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TECHNICAL MANUAL

OPERATION INSTRUCTIONS

RADAR TRAINING SET, AN/MPS-T1(V)

PART NO. 583Z1000M1

GENERAL DYNAMICS
Fort Worth Division

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TABLE OF CONTENTS

Section		Page
LIST OF ILLUSTRATIONS		vi
LIST OF TABLES		xi
INTRODUCTION		xiii
	CHAPTER 1	
	GENERAL INFORMATION	
1-1	Description and Purpose	1-1
1-2	Purpose	1-1
1-3	General Description	1-1
1-8	Description of Equipment	1-1
1-10	Radar Set Control Group	1-1
1-11	Trailer-Mounted Antenna-Receiver-Transmitter Groups	1-1
1-12	Antenna and Antenna Support Semitrailers	1-1
1-13	Leading Particulars	1-50
1-15	Capabilities and Limitations	1-50
1-17	Equipment Supplied	1-54
1-19	Related Technical Manuals	1-146
	CHAPTER 2	
	OPERATION	
2-1	Introduction	2-1
I	CONTROLS AND INDICATORS	
2-3	General	2-1
2-5	Controls and Indicators	2-1
2-7	Interlock Circuits	2-1
II	OPERATING INSTRUCTIONS	
2-15	General	2-117
2-18	Application of Primary Power	2-117
2-20	Air Conditioning Turn On	2-117
2-22	DC Voltage Checks	2-118
2-24	Initial Control Settings	2-118
2-25	Antenna Trailers	2-118
2-26	Radar Control Trailer	2-118
2-27	Transmitter Runup Procedure	2-118
2-28	S- and C-Band Remote Transmitter Runup	2-118
2-28A	S- and C-Band Local Transmitter Runup	2-123
2-29	X-Band Transmitter Runup	2-124
2-29A	X-Band Remote Transmitter Runup	2-125
2-30	L-Band Pulsed Command Transmitter Runup	2-125
2-31	L-Band CW Command Transmitter Runup	2-126
2-32	Radar Set Turnoff Procedure	2-126
2-33	X-Band Trailer Turnoff	2-126
2-37	S- and C-Band Trailer Turnoff	2-127
2-40	Radar Control Trailer Turnoff	2-127
2-43	Computer System Operating Procedure	2-128
2-45	Computer Turn-On	2-128
2-46	Program Loading Procedure	2-128
2-48	Program Tape Rewind Procedure	2-129
2-49	Sense Switch Options	2-129
2-50	Normal Operation	2-129
2-51	Computer System Test Routines	2-130
2-52	General	2-130
2-53	Radar Set Programmed Test Routines	2-130
2-91	Honeywell Diagnostic Routines	2-166
2-94	Continental Operations Range (COR) Video Recorder Instrumentation Operation	2-168
2-96	Typical Operating Procedure	2-169
2-99	S- or C-Band Target Track	2-169
2-100	Guidance Operator	2-169
2-105	Manual Tracker Operations	2-169
2-110	Automatic Position Plotter (APP) Operation	2-169

TABLE OF CONTENTS (Continued)

Section		Page
2-111	X-Band Target Track	2-171
2-112	Guidance Operator	2-171
2-121	Manual Tracker Operations	2-171
2-122	Transponder Reference Track	2-171
2-125	S- or C-Band Radar Reference Track	2-171
2-127	X-Band Radar Reference Track	2-171
III	EMERGENCY OPERATION	
2-129	Introduction	2-171
2-131	Excessive Service Conditions	2-171
2-134	Air Conditioning/Heating	2-173
2-135	Radar Control Trailer	2-173
2-137	Radar Antenna Trailers	2-173
2-138	Interlock Circuits	2-173
	CHAPTER 3	
	THEORY OF OPERATION	
3-1	Introduction	3-1
I	FUNCTIONAL SYSTEMS OPERATION	
3-3	General	3-1
3-9	System Operating Modes	3-1
3-12	S-Band Target Tracking, Transponder Reference System	3-1
3-15	S-Band Target Tracking, C-Band Reference System	3-5
3-18	X-Band Target Track System	3-5
3-19	X-Band Reference Track System	3-5
3-20	S-Band and C-Band Target Simulator Operation	3-5
3-21	Major Equipment Subsystems	3-15
3-23	Transmitter Group	3-15
3-26	S-Band and C-Band Transmitter Systems	3-15
3-33	X-Band Transmitter Systems	3-17
3-36	L-Band CW Command Transmitter	3-17
3-37	Antenna Group	3-18
3-39	S-Band Antenna System	3-18
3-46	C-Band Antenna System	3-19
3-52	X-Band Antenna System	3-21
3-58	Receiver Group	3-21
3-61	Prereceiver System	3-21
3-63	Receiver Select System	3-24
3-64	Main Receiver System	3-24
3-75	Antenna Pedestal Servo Group, AN/MPS-T1(V)1, (V)2 and (V)3	3-27
3-78	Manual Antenna Pedestal Servo System	3-27
3-79	Automatic Antenna Pedestal Servo System	3-30
3-82	Servo Group Instrumentation Outputs	3-30
3-83	Antenna Trailer Encoder	3-30
3-85	Encoder Transducer	3-30
3-87	Control Unit	3-32
3-89	Servo Group Target Simulator Operation	3-32
3-90	Antenna Pedestal Servo Group, AN/MPS-T1(V)4	3-32
3-92	Manual Pedestal Servo Operation	3-32
3-93	Antenna Trailer Encoder	3-32
3-94	Presentation Group	3-34
3-96	Guidance Operator Indicator Group	3-34
3-103	S-Band and C-Band Manual Tracker Displays	3-34
3-106	X-Band Manual Tracker Displays	3-36
3-107	Transponder (Reference) Displays	3-36
3-110	Automatic Position Plotter (APP) Display	3-36
3-111	Tracking Group	3-36
3-116	Range Tracking	3-36
3-126	Angle Tracking	3-40
3-139	Missile Simulation and Scoring Group	3-41
3-148	Missile Simulation Computations	3-43
3-154	Scoring Computations	3-43
3-159	Computer Interface	3-44
3-178	Computer System	3-49

TABLE OF CONTENTS (Continued)

Section		Page
3-179	Miscellaneous Equipment Group	3-49
3-180	Target Simulator	3-49
3-190	Analog Recording System	3-50
3-194	Intercommunication System	3-51
3-197	Radio Communication System	3-51
3-198	Power Supply System	3-51
3-200	Instrumentation System	3-51
II	FUNCTIONAL OPERATION OF ELECTRONICS CIRCUITS	
3-201	Transmitter Group	3-53
3-202	Radar Band Selection	3-53
3-206	S-Band and C-Band Range Timing Generation	3-53
3-246	X-Band Range Timing Generation	3-61
3-247	S-Band and C-Band Transmitters	3-62
3-248	Modulator Trigger Generator	3-62
3-252	Trigger Generator Power Supply	3-62
3-255	Trigger Generator Inhibit Circuits	3-64
3-259	Reverse Power Sensing	3-64
3-260	S-Band and C-Band Modulators	3-64
3-265	Charging Diode	3-65
3-266	Thyratron Switch	3-65
3-267	Pulse Forming Network (PFN)	3-66
3-276	S-Band and C-Band Magnetron Filament Voltage Control	3-68
3-282	S-Band and C-Band Magnetron	3-68
3-293	S-Band and C-Band High Voltage Power Supply	3-71
3-319	S-Band and C-Band Modulator Remote Controls	3-75
3-323	L-Band Pulsed Transmitter	3-75
3-340	L-Band Pulsed Command Transmitter Power Supply	3-82
3-346	Frequency Monitor	3-83
3-348	Transmitter Performance Monitor	3-83
3-366	X-Band Transmitter	3-86
3-368	High Voltage Power Supply	3-86
3-370	X-Band Transmitter Modulator	3-88
3-377	Transmitter	3-89
3-387	Interlocks	3-91
3-396	High Voltage Power Supply	3-94
3-397	Voltage Control	3-94
3-402	Diode Bleeder Assembly	3-94
3-403	Modulator	3-95
3-405	Keyer Tube	3-95
3-406	Keyer Tube Driver Chassis	3-95
3-412	Coupling Assembly	3-96
3-419	Transmitter Operation	3-97
3-421	Control Panel	3-97
3-424	Control Power Supply	3-98
3-427	Relay Assembly	3-98
3-431	Meter Driver Assembly	3-99
3-457	Magnetron Tuning Control	3-103
3-465	L-Band CW Transmitter	3-104
3-467	Transmitter Coder	3-104
3-470	CW Transmitter	3-106
3-494	Antenna Group	3-119
3-496	S-Band Antenna System	3-119
3-499	C-Band Antenna System	3-119
3-501	X-Band Antenna System	3-119
3-504	Antenna Mode Selection	3-122
3-521	S-Band and C-Band Trough Antennas	3-125
3-531	C-Band Dish Antennas	3-129
3-548	L-Band Antenna	3-137
3-549	X-Band Trough Antenna	3-137
3-553	X-Band Dish Illuminator Antenna	3-137
3-560	L-Band Cut Dish Antenna	3-142
3-561	Angle Timing	3-142
3-563	S-Band Angle Timing	3-144
3-577	C-Band Angle Timing	3-149
3-586	X-Band Angle Timing	3-153
3-594	Internal Angle Timing Generation	3-156
3-604	Scan Encoder	3-157
3-612	Scan Encoder	3-157
3-613	Encoder Selection	3-157
3-615	Receiver Group	3-157
3-618	S-Band and C-Band Prereceiver	3-159
3-622	TWT Amplifier	3-159

TABLE OF CONTENTS (Continued)

Section		Page
3-624	Power Divider	3-159
3-625	Target, Transponder, and Down Link Prereceiver Channels	3-159
3-627	Isolator-Filter Network	3-161
3-628	Mixer-IF Preamplifiers	3-161
3-638	Target AFC-Local Oscillator	3-163
3-655	Transponder and Down Link Local Oscillator	3-166
3-657	X-Band Prereceiver	3-166
3-660	X-Band DLJ and Transponder Prereceivers	3-168
3-662	X-Band Target Prereceivers	3-168
3-667	X-Band Target Receiver Local Oscillators	3-168
3-672	Receiver Select Circuit	3-168
3-674	S-Band and C-Band Target Tracking Receivers	3-169
3-678	Logarithmic IF Amplifier	3-169
3-684	Log IF Power Supply	3-173
3-688	Main IF Amplifier	3-173
3-702	Video Selection	3-174
3-712	Boxcar Video Generation	3-175
3-717	Range Gate Generator	3-177
3-723	Gain Control Circuits	3-177
3-728	Manual Gain Control	3-177
3-744	Automatic Gain Control	3-180
3-752	Sensitivity Time Control (STC) Generation	3-180
3-760	Reference Tracking Receiver, S-Band and C-Band	3-182
3-770	X-Band Target Receiver	3-185
3-775	X-Band Acquisition Operation	3-187
3-777	X-Band Track Operation	3-187
3-783	X-Band Receiver Control	3-187
3-785	Range Gate Generator	3-190
3-787	Boxcar and AGC	3-190
3-790	AGC Gating	3-190
3-792	Video Gate and Drivers	3-190
3-795	Video Summing	3-191
3-803	Moving Target Indicator (MTI) System	3-192
3-810	Cancellation System	3-192
3-814	Target Video Cancellation System	3-192
3-829	MTI I Operation Staggered PRF	3-192
3-835	MTI Synchronizer	3-192
3-837	X-Band Synchronizer	3-192
3-839	Trigger Generation MTI Off	3-192
3-845	Trigger Generation MTI On	3-192
3-851	Video Full Wave Rectifier	3-194
3-853	Sample and Hold	3-194
3-854	Delay Line AGC	3-194
3-856	Phase Lock Control	3-195
3-859	Timing Pulse Comparator	3-195
3-863	Delay Line Input	3-196
3-868	Phase Detector	3-196
3-871	Delay Line Output	3-197
3-875	Coherent Oscillator	3-197
3-880	Transponder Receiver	3-197
3-890	Down Link Jammer Receiver	3-203
3-896	Presentation Group	3-203
3-898	B-Scope Sawtooth and Sweep Blanking Generation	3-205
3-901	Angle Sawtooth Generation	3-205
3-906	Range Sawtooth Generation	3-210
3-914	Automatic Position Plotter (APP) Sawtooth and Sweep Blanking Generation	3-210
3-920	Range Sawtooth Generator	3-213
3-921	One-Hertz Oscillator	3-213
3-922	Multiplier	3-213
3-923	Deflection System	3-213
3-925	Horizontal Deflection	3-213
3-927	Vertical Deflection	3-215
3-929	Deflection System Power	3-215
3-930	B-Scope Indicator Video System	3-215
3-941	APP Indicator Video System	3-220
3-944	Cursor Generation	3-220
3-945	Angle Cursor Generation	3-220
3-951	Range Cursor Generation Guidance Operator Indicators	3-223
3-955	Range Cursor Generation Manual Tracker Indicators	3-223

TABLE OF CONTENTS (Continued)

Section		Page
3-956	Range Cursor Generation – APP Indicator	3-225
3-959	Missile Video Generation	3-225
3-960	Cursor Generation Transponder Tracker Indicators	3-225
3-961	High Voltage Power Supply	3-225
3-966	Antenna Pedestal Servo Group	3-227
3-970	Operator Controls	3-227
3-973	Guidance Operator Azimuth Pedestal Controls	3-227
3-981	Guidance Operator Elevation Pedestal Control	3-233
3-991	Manual Tracker Controls – S-Band and C-Band	3-234
3-999	Manual Tracker Controls X-Band	3-234
3-1003	Manual Pedestal Control – X-Band Low Altitude Mode	3-236
3-1004	Command Servos	3-236
3-1020	Pedestal Drive Servos – AN/MPS-T1(V)1, (V)2, and (V)3	3-239
3-1026	Servo Control Unit	3-243
3-1039	DC Amplifiers	3-245
3-1048	Servo Amplifier	3-247
3-1083	Encoder Transducer and Preamplifier	3-258
3-1086	Encoder Control Unit	3-259
3-1106	X-Band Auto Pedestal Operation	3-263
3-1113	Reference Pedestal Control	3-267
3-1117	Pedestal Drive Servos – AN/MPS-T1(V)4	3-267
3-1121	Electromechanical Operation	3-269
3-1124	Pedestal Operating Modes	3-269
3-1130	Servo Control Unit	3-270
3-1143	Power Supply	3-271
3-1166	Silicon Controlled Rectifier (SCR) Power Amplifier	3-274
3-1193	Antenna Trailer Pedestal Encoder	3-282
3-1195	Tracking Group	3-282
3-1197	Range Tracking	3-283
3-1203	Operator Controls Target (S- and C-Band)	3-283
3-1214	Operator Controls – Target (X-Band)	3-289
3-1218	Operator Controls – Reference	3-289
3-1223	Manual Range Tracking	3-291
3-1245	Automatic Range Tracking	3-296
3-1248	Angle Tracking	3-299
3-1251	Operator Controls – Target, S-Band or C-Band	3-299
3-1257	Operator Controls – Target, X-Band	3-299
3-1263	Operator Controls – Transponder	3-301
3-1266	Operator Controls, Reference Track	3-303
3-1268	Manual Angle Tracking – Target Azimuth and Reference	3-303
3-1273	Manual Angle Tracking – Target Elevation	3-305
3-1275	Angle Acquisition – Transponder	3-305
3-1276	Angle Gate Generator	3-305
3-1288	Angle Error Channel	3-311
3-1298	Automatic Angle Tracking	3-316
3-1301	Auto Sensing – Transponder	3-316
3-1307	Cursor Generation – Transponder	3-318
3-1313	Missile Simulation and Scoring Group	3-321
3-1315	Data Transfer	3-321
3-1337	Function Address Decoding	3-330
3-1340	Radar Timing Inputs	3-330
3-1341	Target Range Timing Circuits	3-330
3-1345	Reference Radar Timing Circuits	3-331
3-1348	Input Status Words	3-333
3-1352	Range Conversion	3-333
3-1356	Azimuth and Elevation Angle Conversion	3-334
3-1365	Pedestal Position	3-336
3-1377	Output Status Words	3-340

TABLE OF CONTENTS (Continued)

Section		Page
3-1379	Thumbwheel Inputs	3-341
3-1383	Data Display	3-341
3-1391	Missile Video	3-342
3-1397	Range Calibrate Strobe Generator	3-344
3-1399	Digital-to-Analog Conversion	3-345
3-1406	Missile Guidance Command Generator	3-346
3-1424	Miscellaneous Equipment Groups	3-350
3-1426	Target Simulator	3-350
3-1494	Instrumentation System	3-367

ALPHABETICAL INDEX . . . . . Index 1

LIST OF ILLUSTRATIONS

Number	Title	Page
1-1	Radar Training Set	1-2
1-2	Radar Training Set Functional Block Diagram	1-5
1-3	Radar Control Trailer Components	1-7
1-4	S-Band Antenna Trailer Components	1-21
1-5	C-Band Antenna Trailer Components	1-28
1-6	X-Band Antenna Trailer Components	1-35
1-7	S-Band Antenna Structure Transport Trailer (Unloaded)	1-41
1-8	S-Band Trough Antenna Transport Trailer (Unloaded)	1-42
1-9	C-Band Antenna Structure Transport Trailer (Unloaded)	1-44
1-10	C-Band Trough Antenna Transport Trailer (Unloaded)	1-45
1-11	Dish Antenna Transport Trailer (Unloaded)	1-47
1-12	X-Band Antenna Transport Trailer (Unloaded)	1-49
2-1	Mode Control	2-2
2-2	Guidance Operator Indicators	2-3
2-3	Tracking Control	2-5
2-4	Synchronizer	2-6
2-5	Transponder Receiver	2-8
2-6	Transponder Indicators	2-9
2-7	Tracking Control	1-11
2-8	Transmitter Control, S- and C-Band	2-13
2-9	Power and Frequency Control	2-18
2-10	Receiver Select	2-21
2-11	Power Monitor	2-22
2-12	L-Band Transmitter Control	2-24
2-13	Digital Voltmeter	2-26
2-14	Noise Figure Meter	2-27
2-15	Servo Control	2-30
2-16	Computer Interface	2-32
2-17	Digital Voltmeter Test Panel	2-34
2-18	Transmitter Control, X-Band	2-36
2-19	Intercom	2-40
2-20	Recorder DC Amplifier and Master Power Panel	2-41
2-21	Recorder and Take-Up Reel	2-42
2-22	High Speed Tape Punch	2-46
2-23	Tape Reader	2-47
2-24	Spooler	2-48
2-25	Control Panel	2-49
2-26	Power Distribution Unit	2-52
2-27	S- and C-Band Manual Tracker Azimuth, Range and Elevation Indicators	2-53
2-28	Azimuth Receiver	2-55
2-29	Azimuth Tracking Control	2-56
2-30	Sweep Generator	2-57
2-31	Range Tracking Control	2-58
2-32	Elevation Receiver	2-59
2-33	Elevation Tracking Control	2-60
2-34	Power Distribution Console	2-61
2-35	Down Link Jammer Receiver	2-69
2-36	T1 and T2 Indicators	2-70
2-37	T1 and T2 Tracking Controls	2-71
2-38	Target Simulator	2-72
2-39	Automatic Position Plotter Indicator	2-77
2-40	Common Data Point Assembly	2-79

LIST OF ILLUSTRATIONS (Continued)

Number	Title	Page
2-41	L-Band Pulsed Command Transmitter	2-81
2-42	Elevation and Azimuth Transmitter	2-83
2-43	Prereceiver	2-87
2-44	Power Distribution Panel	2-88
2-45	Azimuth Pedestal Assembly	2-93
2-46	Elevation Pedestal Assembly	2-95
2-47	Antenna Trailer Disconnect Panel	2-97
2-48	Pedestal Interlock Switch Panel	2-98
2-49	L-Band CW Transmitter Control	2-99
2-50	Signal Conditioning	2-102
2-51	Prereceiver	2-103
2-52	X-Band Transmitter Control	2-104
2-53	Power Distribution Panel	2-107
2-54	A.G.C. Format, Punch Format	2-131
2-55	Band, Type Format	2-132
2-56	Target Track Data, Type Format	2-133
2-57	Transponder Track Data, Type Format	2-134
2-58	Missile Status, Type Format	2-135
2-59	Miss Distance, Type Format	2-139
2-60	Truncated Sawtooth Waveform	2-165
2-61	Typical Operating Tasks and Sequences	2-170
3-1	Radar Training Set, Functional Block Diagram	3-2
3-2	S-Band Target Tracking, Transponder Reference System	3-6
3-3	S-Band Target Tracking, C-Band Reference System	3-8
3-4	X-Band Target Track System	3-10
3-5	X-Band Reference Track System	3-12
3-6	S- or C-Band Target Simulator Operation	3-14
3-7	Transmitter Group, Block Diagram	3-16
3-8	S-Band Antenna Group Radiation Envelope	3-18
3-9	C-Band Antenna Group Radiation Envelope	3-20
3-10	X-Band Antenna Group Radiation Envelope	3-22
3-11	Receiver Group Simplified Block Diagram	3-23
3-12	Antenna Pedestal Servo Group System Block Diagram, AN/MPS-T1(V)1, (V)2, and (V)3	3-28
3-13	Servo Group, Manual Pedestal Servo System	3-29
3-14	Servo Group, Automatic Pedestal Servo System	3-31
3-15	Antenna Pedestal Servo Group System Block Diagram AN/MPS-T1(V)4	3-33
3-16	Guidance Operator Display, S- and C-Band Operation	3-35
3-17	Guidance Operator Display, X-Band Acquisition Mode	3-35
3-18	Guidance Operator Display, X-Band Track Mode	3-35
3-19	S- and C-Band Manual Tracker Displays	3-35
3-20	X-Band Manual Tracker Display	3-37
3-21	Transponder Operator Display Transponder Reference	3-37
3-22	APP Display	3-37
3-23	Tracking Group Interconnect Diagram	3-38
3-24	Missile Simulation and Scoring Group, Functional Diagram	3-42
3-25	Missile Simulation Computations, Information Flow Diagram	3-45
3-26	Scoring Computations Information Flow Diagram	3-46
3-27	Computer Interface Block Diagram	3-47
3-28	Continental Operation's Range, Interface Block Diagram	3-52
3-29	Radar Band Selection Simplified Logic Diagram	3-54
3-30	Range Timing Pulse Distribution	3-56
3-31	Range Timing Pulses, Timing Diagram	3-57
3-32	S- and C-Band Range Timing Generation, Simplified Block Diagram	3-59
3-33	Timing Chart, Divide by 12/13 Counter	3-59
3-34	S- and C-Band Transmitter Block Diagram	3-63
3-35	Pulse Forming Network Discharge, Timing Diagram	3-67
3-36	S- and C-Band Waveguide Pressurization Systems	3-70
3-37	Transmitter External Interlocks	3-74

LIST OF ILLUSTRATIONS (Continued)

Number	Title	Page
3-38	C-Band Pedestal L-Band Transmitter Interface Diagram	3-76
3-39	X-Band Pedestal L-Band Transmitter Interface Diagram	3-77
	Block Diagram	3-78
3-41	Height Voltage Control and Interlock	3-80
3-42	S-Band Frequency Monitor, Simplified Functional Diagram	3-84
3-43	X-Band Transmitter Block Diagram	3-87
3-44	X-Band Keyer Tube Driver Chassis Block Diagram	3-90
3-45	X-Band Transmitter Interlock Circuits Functional Diagram	3-92
3-46	L-Band CW Transmitter Interface Diagram	3-105
3-47	X-Band Missile Guidance Timing Diagram	3-105
3-48	L-Band CW Transmitter Block Diagram	3-107
3-49	Cathode-to-Helix Power Supply Block Diagram	3-108
3-50	Filament and Anode Power Supply Block Diagram	3-110
3-51	Collector Power Supply	3-111
3-52	Logic and Protection Diagram	3-113
3-53	L-Band CW Transmitter RF Control	3-115
3-54	Local/Remote Switching	3-117
3-55	S-Band Antenna System Block Diagram	3-118
3-56	C-Band Antenna System Block Diagram	3-120
3-57	X-Band Antenna System Block Diagram	3-121
3-58	S-Band Waveguide Switching Functional Diagram	3-123
3-59	C-Band Waveguide Switch Modes	3-124
3-60	C-Band Antenna Mode Switching Logic	3-124
3-61	Waveguide Switch, Sense Switch Interconnect Diagram	3-126
3-62	Duplexer	3-127
3-63	Trough Antenna	3-128
3-64	Trough Antenna Construction	3-130
3-65	Trough Antenna Scanner and Controls	3-131
3-66	C-Band Dish Scanning Diagram	3-132
3-67	Helical Slot Scanner	3-133
3-68	Dish Scanner Control Simplified Diagram	3-135
3-69	Mode II Scanner Control	3-135
3-70	Mode III Scanner Control (High RPM)	3-135
3-71	RPM Sense Circuit	3-136
3-72	Mode III Scanner Control (Low RPM)	3-138
3-73	Trough Antenna Geometry	3-139
3-74	Trough Scanner Rotation	3-140
3-75	X-Band Trough Scanner Mechanism	3-141
3-76	Cam/Pawl Relationship	3-143
3-77	S-Band Angle Timing Block Diagram	3-145
3-78	AFC Clock Circuit Simplified Diagram	3-146
3-79	AFC Clock Timing Diagram	3-148
3-80	C-Band Angle Timing Block Diagram	3-150
3-81	Dish Scanner Start and End Scan Pulse Generation	3-151
3-82	Dish Scanner Center Scan Pulse Generation	3-152
3-83	X-Band Angle Timing Block Diagram	3-154
3-84	X-Band Trough Antenna Timing Diagram	3-155
3-85	S-/C-Band Receiver Group Simplified Block Diagram	3-160
3-86	Prereceiver Microwave Block Diagram	3-161
3-87	Target and Transponder Prereceiver Block Diagram	3-162
3-88	Target AFC Block Diagram	3-164
3-89	X-Band Prereceiver Block Diagram	3-167
3-90	S- and C-Band Receiver Interfaced	3-170
3-91	S- and C-Band Receiver Block Diagram	3-171
3-92	S-/C-Band Receiver Control Diagram	3-172
3-93	Box Car Video and Automatic Gain Control Generation Timing Diagram	3-176
3-94	Gain Control Circuits Simplified Functional Diagram	3-178

LIST OF ILLUSTRATIONS (Continued)

Number	Title	Page
3-95	Sensitivity Time Control Simplified Functional Diagram	3-181
3-96	Reference Receiver Interface Diagram	3-183
3-97	Reference Receiver Block Diagram	3-184
3-98	X-Band Receiver Interface Diagram	3-186
3-99	X-Band Receiver Block Diagram	3-188
3-100	X-Band Gain Control Select Logic	3-189
3-101	MTI Operation Simplified Block Diagram	3-193
3-102	MTI Cancellation	3-193
3-103	MTI Cancellation System Simplified Block Diagram	3-193
3-104	Delay and Delay Control Simplified Diagram	3-193
3-105	MTI Timing Diagram	3-193
3-106	X-Band Synchronizer Functional Diagram	3-193
3-107	COHO Timing Sequence	3-198
3-108	Transponder Receiver Interface Diagram	3-199
3-109	Transponder Receiver Block Diagram	3-200
3-110	Down Link Jammer Interface Diagram	3-202
3-111	Down Link Jammer Receiver Block Diagram	3-204
3-112	B-Scope Indicator Block Diagram	3-206
3-113	B-Scope S- and C-Band Indicator Switch Generation Block Diagram	3-207
3-114	Range Sweep Generation Timing Diagram	3-211
3-115	APP Sweep Generation Block Diagram	3-212
3-116	Deflection System Functional Diagram	3-214
3-117	Indicator Video System Block Diagram	3-216
3-118	Indicator Video System Block Diagram	3-218
3-119	Video Generation for APP Indicator	3-221
3-120	Azimuth Cursor Generation Logic Diagram	3-222
3-121	Low Altitude Cursor Generation Logic Diagram	3-224
3-122	Low Altitude Cursor Generation Timing Diagram	3-224
3-123	Range Cursor Video APP Indicator	3-226
3-124	Servo Group Simplified Block Diagram	3-228
3-125	Guidance Operator Azimuth Pedestal Control Block Diagram	3-229
3-126	Sector/Search Pedestal Control Diagram	3-230
3-127	Sector Scan Generator Timing Diagram	3-232
3-128	S-/C-Band Manual Tracker Control Block Diagram	3-235
3-129	T1 and T2 Pedestal Control Simplified Diagram	3-237
3-130	Servo-Amplifier Simplified Functional Diagram	3-240
3-131	Pedestal Drive Servo Simplified Functional Diagram	3-241
3-132	Synchro Selection Simplified Functional Diagram	3-242
3-133	Pedestal Interlock Diagram	3-244
3-134	DC Amplifier Simplified Block Diagram	3-246
3-135	Servo Amplifier Timing Diagram	3-248
3-136	Full-Wave Rectifier Operating Modes	3-250
3-137	Crossover Pulse Generator Simplified Diagram	3-252
3-138	SCR Power Amplifier Block Diagram	3-254
3-139	Operational Synchronous Gates Timing Diagram	3-256
3-140	Current Flow Through SCR Bridge	3-257
3-141	Encoder Interface Diagram	3-260
3-142	Encoder Simplified Block Diagram	3-262
3-143	Encoder Timing Diagram	3-264
3-144	X-Band Auto Pedestal Block Diagram	3-265
3-145	Reference Pedestal Handwheel Control Diagram	3-268

LIST OF ILLUSTRATIONS (Continued)

Number	Title	Page
3-146	Power Amplifier Overall Timing	3-276
3-147	Pulse Amplifier Simplified Diagram	3-279
3-148	Current Flow Through SCR Bridge	3-281
3-149	Range Tracking Loops Block Diagram	3-285
3-150	S- and C-Band Target Range Tracking Controls Simplified Diagram	3-286
3-151	X-Band Target Range Tracking Controls Simplified Diagram	3-288
3-152	Operator Control Transponder Range Tracking	3-290
3-153	Range Track Loop Pulse Timing Diagram	3-292
3-154	Target Range Gate Timing Diagram	3-294
3-155	Transponder Range Gates Timing Diagram	3-297
3-156	Angle Track Loop Simplifed Functional Diagram	3-298
3-157	S- and C-Band Operator Control Target	3-298
3-158	Operator Control Target, Low Altitude Mode, S- and C-Band	3-298
3-159	Operator Controls, Target – X-Band	3-300
3-160	Operator Controls, Transponder	3-302
3-161	Operator Controls, Reference Track	3-304
3-162	Angle Gate Generator Clock Control Logic	3-306
3-163	Angle Gate Generator Clock Timing	3-308
3-164	Shift Register Section of Angle Gate Generator	3-309
3-165	Angle Gate Timing for S- and C-Band Normal (Now Low Altitude)	3-310
3-166	S-Band and C-Band Low Altitude Angle Gate Timing	3-310
3-167	X-Band Angle Gate Timing	3-310
3-168	Shift Register Timing	3-312
3-169	Angle Error Channel Block Diagram	3-313
3-170	Angle Error Channel Timing Diagram	3-314
3-171	Boxcar Video Attenuation Network	3-315
3-172	Auto-Sensing (Transponder)	3-317
3-173	Transponder Cursor Generation and Gating	3-319
3-174	Transponder Cursor Generation Timing Diagram	3-320
3-175	Data Transfer to Computer Timing Diagram	3-322
3-176	Computer Interface Block Diagram	3-324
3-177	Data Transfer From Computer Timing Diagram	3-326
3-178	Data Transmitter Receiver Functional Diagram	3-328
3-179	Radar Timing Inputs Timing Diagram	3-332
3-180	Timing Diagram for Pedestal Position Data Transfer	3-338
3-181	Missile Video Presentation	3-343
3-182	Missile Guidance Command Generation	3-344
3-183	X-Band Missile Guidance	3-348
3-184	Target Simulator Interface Diagram	3-351
3-185	Target Angle Control Block Diagram	3-352
3-186	Target Range Control Block Diagram	3-354
3-187	Modulation Generation Block Diagram	3-357
3-188	Range Delay Timing Diagram	3-362
3-189	Range Attenuation Block Diagram	3-364
3-190	Target IF Modulation Block Diagram	3-366
3-191	Instrumentation System Block Diagram	3-368
3-192	Discrete Signal Interface	3-374
3-193	Analog Signal Interface	3-377
3-194	Video Interface	3-378
3-195	Record Range and Angle Sync Signal	3-379
3-196	Timing Diagram for Status Word Input to Computer from Common Data PPoint	3-380
3-197	Control Logic Diagram	3-382
3-198	Timing Diagram for Word Output from Computer to GEIS	3-383

LIST OF TABLES

Number	Title	Page
1-1	Leading Particulars	1-50
1-2	Capabilities and Limitations	1-53
1-3	Equipment Supplied	1-54
	Part I. Radar Set AN/MPS-T1(V)1	1-54
	Part II. Radar Set AN/MPS-T1(V)2	1-77
	Part III. Radar Set AN/MPS-T1(V)3	1-100
	Part IV. Radar Set AN/MPS-T1(V)4	1-123
1-4	Related Technical Manuals	1-146
2-1	Mode Control Controls and Indicators	2-2
2-2	Guidance Operator Indicators Controls and Indicators	2-4
2-3	Tracking Control Controls and Indicators	2-5
2-4	Synchronizer Controls and Indicators	2-6
2-5	Transponder Receiver Controls and Indicators	2-8
2-6	Transponder Indicators Controls and Indicators	2-10
2-7	Tracking Control Controls and Indicators	2-11
2-8	Transmitter Control, S- and C-Band, Controls and Indicators	2-14
2-9	Power and Frequency Control Controls and Indicators	2-19
2-10	Receiver Select Controls and Indicators	2-21
2-11	Power Monitor Controls and Indicators	2-22
2-12	L-Band Transmitter Control Controls and Indicators	2-24
2-13	Digital Voltmeter Controls and Indicators	2-26
2-14	Noise Figure Meter Controls and Indicators	2-27
2-15	Servo Control Unit Controls and Indicators	2-30
2-16	Computer Interface Controls and Indicators	2-33
2-17	Digital Voltmeter Test Panel Controls and Indicators	2-35
2-18	Transmitter Control, X-Band, Controls and Indicators	2-37
2-19	Intercom Controls and Indicators	2-40
2-20	Recorder DC Amplifier and Master Power Panel Controls and Indicators	2-41
2-21	Recorder and Recorder Takeup Reel Controls and Indicators	2-43
2-21A	Recorder Controls and Indicators	2-45
2-22	High Speed Tape Punch Controls and Indicators	2-46
2-23	Tape Reader Controls and Indicators	2-47
2-24	Spooler Controls and Indicators	2-48
2-25	Control Panel Controls and Indicators	2-49
2-26	Power Distribution Unit Controls and Indicators	2-52
2-27	S- and C-Band Manual Tracker Azimuth, Range and Elevation Indicators Controls and Indicators	2-54
2-28	Azimuth Receiver Controls and Indicators	2-55
2-29	Azimuth Tracking Control Controls and Indicators	2-56
2-30	Sweep Generator Controls and Indicators	2-57
2-31	Range Tracking Control Controls and Indicators	2-58
2-32	Elevation Receiver Controls and Indicators	2-59
2-33	Elevation Tracking Control Controls and Indicators	2-60
2-34	Power Distribution Console Controls and Indicators	2-66
2-35	Down Link Jammer Receiver Controls and Indicators	2-69

LIST OF TABLES

Number	Title	Page
2-36	T1 and T2 Indicators	2-70
2-37	T1 and T2 Tracking Controls Controls and Indicators	2-71
2-38	Target Simulator Controls and Indicators	2-73
2-39	Automatic Position Plotter Indicator Controls and Indicators	2-78
2-40	Common Data Point Assembly Controls and Indicators	2-79
2-41	L-Band Pulsed Command Transmitter Controls and Indicators	2-81
2-42	Elevation and Azimuth Transmitter Controls and Indicators	2-84
2-43	Prereceiver Controls and Indicators	2-87
2-44	Power Distribution Panel Controls and Indicators	2-90
2-44A	Signal Conditioning Controls and Indicators	2-92
2-45	Azimuth Pedestal Assembly Controls and Indicators	2-94
2-46	Elevation Pedestal Assembly Controls and Indicators	2-96
2-47	Antenna Trailer Disconnect Panel Controls and Indicators	2-97
2-48	Pedestal Interlock Switch Panel Controls and Indicators	2-98
2-49	L-Band CW Command Transmitter Controls and Indicators	2-100
2-50	Signal Conditioning Controls and Indicators	2-102
2-51	Prereceiver Controls and Indicators	2-103
2-52	X-Band Transmittter Control Controls and Indicators	2-105
2-53	Power Distribution Panel Controls and Indicators	2-107
2-54	Transmitter Access Interlocks	2-109
2-55	Transmitter Protection Interlocks (S- and C-Band Transmitters)	2-110
2-56	Transmitter Protection Interlocks (X-Band Transmitter)	2-111
2-57	Transmitter Protection Interlocks (L-Band Pulsed Command Transmitters)	2-112
2-58	Transmitter Protection Interlocks (L-Band CW Command Transmitter)	2-112
2-59	Transmitter Disable Switches	2-113
2-60	Pedestal Interlocks	2-114
2-61	Pedestal Disable Switches	2-114
2-62	Scanner Disable Switches	2-115
2-63	Initial Control Settings for S- and C-Band Antenna Trailers	2-119
2-64	Initial Control Settings for X-Band Antenna Trailer	2-120
2-65	Initial Control Settings for Radar Control Trailer	2-121
2-66	Multiple Missile Variable Assignments	2-137
2-67	Radar Set Programmed Test Routines	2-144
2-68	Analog-to-Digital Converter Data Inputs	2-147
2-69	Interface Address Assignments	2-148
2-70	Angle Calibration Constants	2-153
2-71	Analog Plot Variables	2-159
2-72	Status Word Bit Assignment	2-163
2-73	Data Word Format	2-167
3-1	System Operating Modes	3-4
3-2	Mixer Preamplifiers-Receiver Connections	3-25
3-3	Scanner Encoder Selection	3-158
3-4	Sweep Function Locations in Display Groups	3-208
3-5	Sawtooth Generation Configurations for Slope Select Circuit Outputs	3-209
3-6	Deflection Power Supplies	3-215

LIST OF TABLES

Number	Title	Page
3-7	Sweep Protection Circuits	3-219
3-8	Tracking Loops Circuit Card Location Chart	3-284
3-9	Radar Mode Angle Gate Generator Clock Selection	3-307
3-10	Pedestal Data Gating Logic	3-339
3-11	Recorder Connector Pin Assignment	3-369
3-12	Ground Equipment Instrumentation Set (GEIS) Connector Pin Assignment	3-377

INTRODUCTION

SCOPE

This publication is the operation instructions manual for Radar Training Set, AN/MPS-T1(V), (General Dynamics Part Number 583Z1000M1) manufactured by General Dynamics, Fort Worth Division, Fort Worth, Texas. In all subsequent references, this equipment will be referred to as the radar set.

This manual contains the instructions which are required by personnel to effectively operate the radar set. The information is arranged in three chapters:

Chapter 1. General Information. Contains general information pertaining to the radar set. This information includes a description of the components; a list of pertinent characteristics of the equipment; a table of the equipment supplied; and a list of referenced technical manuals.

Chapter 2. Operation. Contains information required to operate the set. Controls and indicators are listed and described in Section I. Operating instructions are detailed in Section II. Emergency operation is described in section III.

Chapter 3. Theory of Operation. Contains theory of operation of the radar set. The functional operation of the radar set and its major functional systems are described in Section I. Section II contains a description of the functional operation of the electronic circuits in the radar set. The theory of operation for basic circuits is not discussed in detail in this manual; information related to these circuits may be found in the Technical Manual, Basic Electronics Technology and Testing Practices, T.O. 31-1-141, and other applicable Air Force publications.

APPLICABLE PUBLICATIONS

Applicable publications governing the use of abbreviations, symbols, reference designators and terms used in this technical manual are listed below:

MIL-M-38798	Manuals, Technical: Operation Instructions, Maintenance Instructions, Circuit Diagrams, Alignment Procedures and Installation Planning
MIL-STD-12	Abbreviations for Use on Drawings and in Technical-Type Publications
MIL-STD-15-1	Electrical and Electronic Symbols
ASA-Y32.16-1968	Electrical and Electronic Reference Designations
MIL-STD-806	Graphical Symbols for Logic Diagrams

CHAPTER 1

GENERAL INFORMATION

1-1. DESCRIPTION AND PURPOSE.

1-2. PURPOSE. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

1-3. GENERAL DESCRIPTION.

1-4 thru 1-7. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

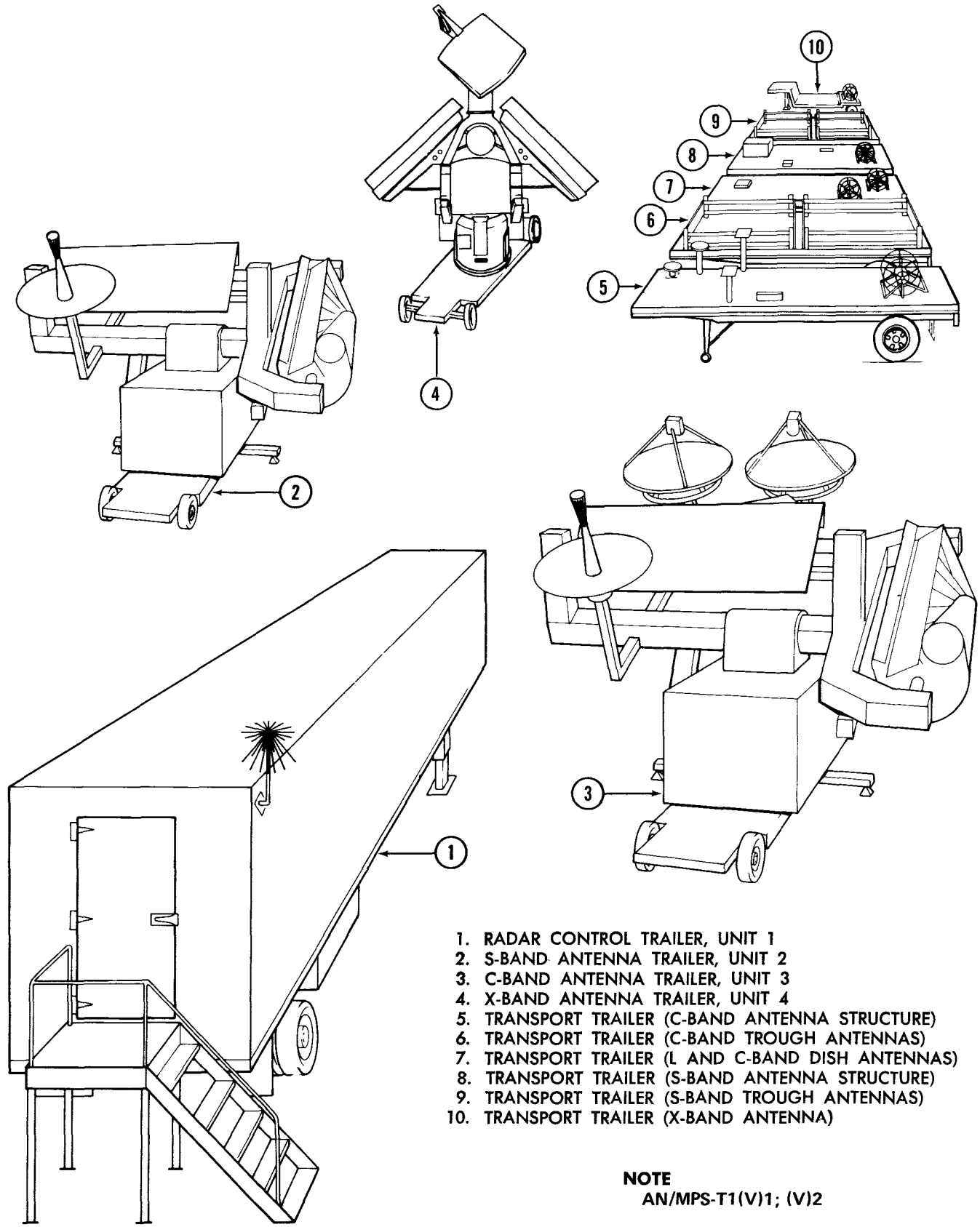
1-8. DESCRIPTION OF EQUIPMENT.

1-9. The radar set consists of a radar set control group, three trailer-mounted antenna-receiver-transmitter groups, and the necessary intercabling for signal and power transfer. In addition, four antenna semitrailers and two antenna support semitrailers are provided to haul the antennas, antenna supporting structure, cables, and MD-4 power equipment from site to site. Figure 1-1 is an illustration of the radar set and figure 1-2 shows an overall functional block diagram. Figures 1-3, 1-4, 1-5, and 1-6 show the equipment within the four active trailers.

1-10. RADAR SET CONTROL GROUP. The radar set control group OK-251/M (figure 1-3) houses the radar operating stations, the computer and associated teletype, the radio and intercommunications equipment, the continental operation range instrumentation, and the air conditioner.

1-11. TRAILER-MOUNTED ANTENNA-RECEIVER-TRANSMITTER GROUPS. The radar set contains three trailer-mounted antenna-receiver-transmitter groups. The S-band trailer-mounted antenna-receiver-transmitter group OY-55/M, OY-55A/M, OY-55B/M and OY-58/M (figure 1-4) provides a mount for S-band azimuth and elevation trough antennas and houses the associated transmitters and prereceivers used for the S-band tracking radar. The C-band trailer-mounted antenna-receiver-transmitter group OY-61/M, OY-56/M, OY-56A/M and OY-59/M (figure 1-5) provides a mount for and houses similar C-band equipment, azimuth and elevation trough antennas, associated transmitters and prereceivers plus azimuth and elevation scanned dish antennas. The X-band trailer-mounted antenna-receiver-transmitter group OY-62/M and OY-60/M (figure 1-6) provides a mount for a trough receiving antenna and a scanned dish transmitting and receiving antenna and houses the associated transmitters and prereceivers used for the X-band tracking radar. All three antenna trailers include L-band antennas and transmitters for transmission of the simulated missile command guidance signals.

1-12. ANTENNA AND ANTENNA SUPPORT SEMITRAILERS. Antenna semitrailers and antenna support semitrailers are provided with the radar set to haul the five dish antennas, five trough antennas, antenna support structure, cable reels, and ancillary equipment from site to site. The physical configuration of the radar set is such that these transport trailers as well as the four radar trailers must be towed by prime movers. Eight configurations (V-847/M through V-494/M) of these semitrailers (transport trailers) are provided. Information for determining the configuration used with a specific variation of a radar set is included in table 1-3. The semitrailers are shown in figures 1-7 through 1-12. The basic trailer (figures 1-7 through 1-11) is the same in all instances; only the support brackets mounted on the trailers are different. The trailer shown in figure 1-12 is a lowbed trailer.



1. RADAR CONTROL TRAILER, UNIT 1
2. S-BAND ANTENNA TRAILER, UNIT 2
3. C-BAND ANTENNA TRAILER, UNIT 3
4. X-BAND ANTENNA TRAILER, UNIT 4
5. TRANSPORT TRAILER (C-BAND ANTENNA STRUCTURE)
6. TRANSPORT TRAILER (C-BAND TROUGH ANTENNAS)
7. TRANSPORT TRAILER (L AND C-BAND DISH ANTENNAS)
8. TRANSPORT TRAILER (S-BAND ANTENNA STRUCTURE)
9. TRANSPORT TRAILER (S-BAND TROUGH ANTENNAS)
10. TRANSPORT TRAILER (X-BAND ANTENNA)

NOTE
AN/MPS-T1(V)1; (V)2

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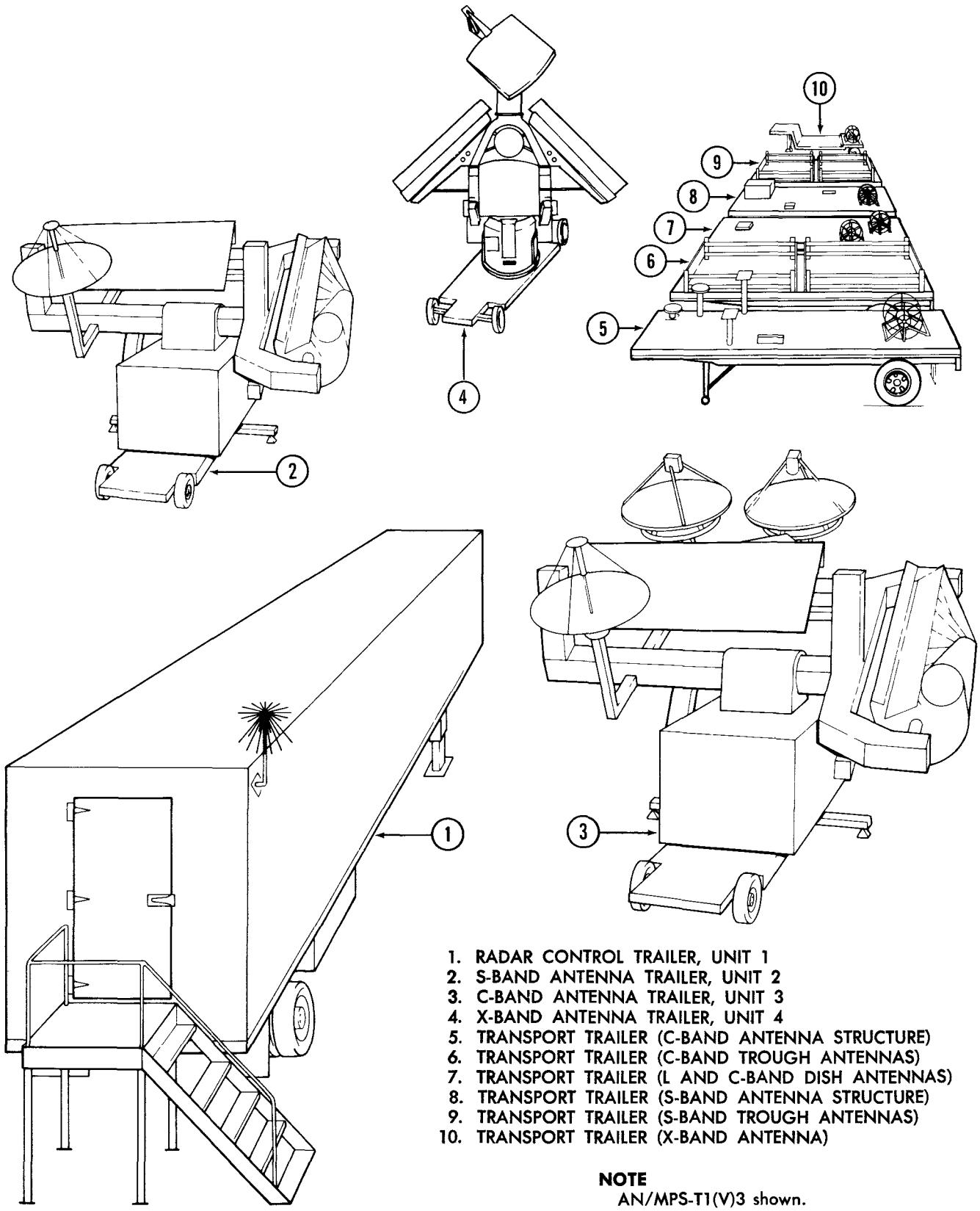
Figure 1-1. Radar Training Set (Sheet 1)



1. RADAR CONTROL TRAILER, UNIT 1
2. S-BAND ANTENNA TRAILER, UNIT 2
3. C-BAND ANTENNA TRAILER, UNIT 3
4. X-BAND ANTENNA TRAILER, UNIT 4
5. TRANSPORT TRAILER (C-BAND ANTENNA STRUCTURE)
6. TRANSPORT TRAILER (C-BAND TROUGH ANTENNAS)
7. TRANSPORT TRAILER (L AND C-BAND DISH ANTENNAS)
8. TRANSPORT TRAILER (S-BAND ANTENNA STRUCTURE)
9. TRANSPORT TRAILER (S-BAND TROUGH ANTENNAS)
10. TRANSPORT TRAILER (X-BAND ANTENNA)

NOTE
AN/MPS-T1(V)3 shown.

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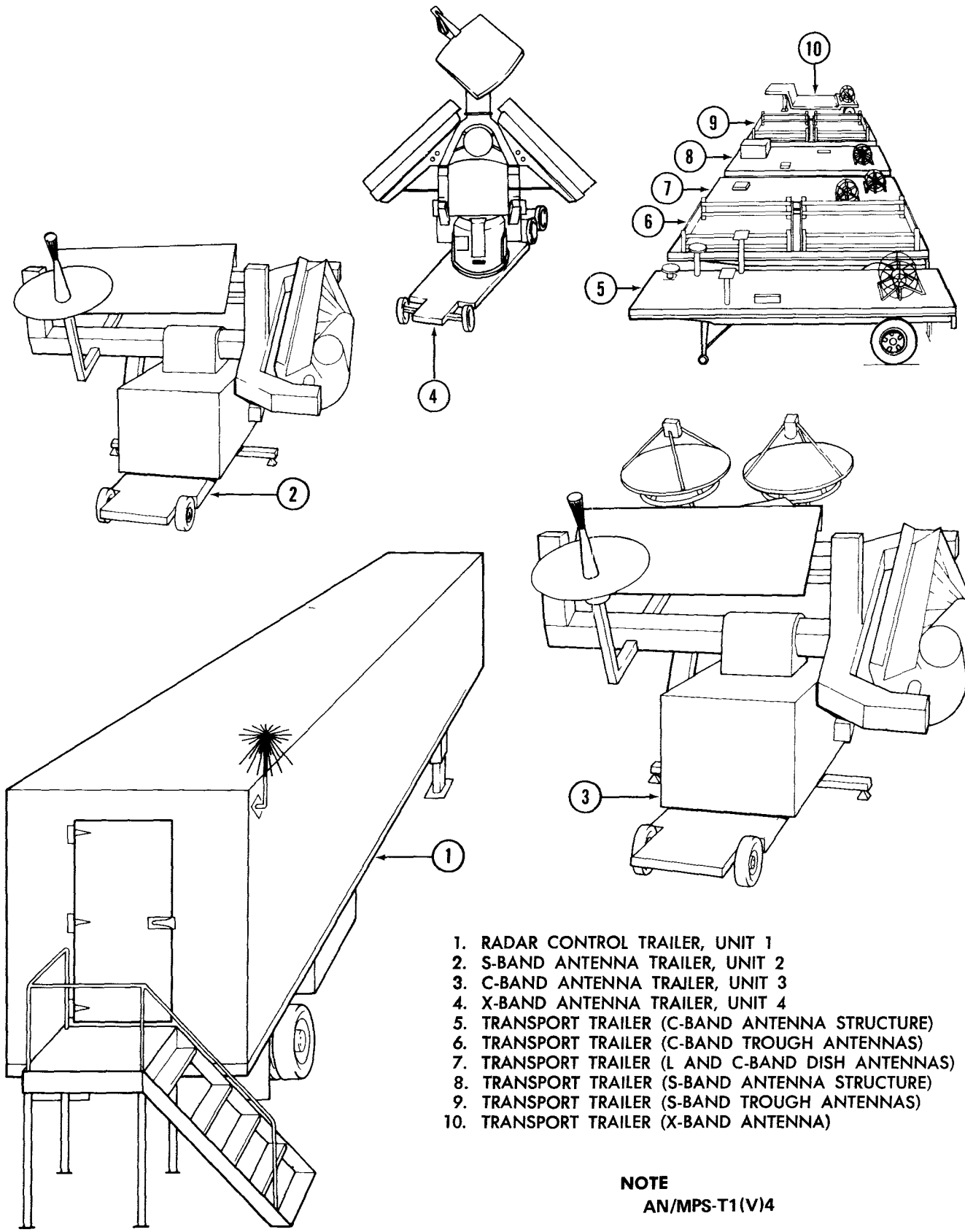
Figure 1-1. Radar Training Set (Sheet 2)



1. RADAR CONTROL TRAILER, UNIT 1
2. S-BAND ANTENNA TRAILER, UNIT 2
3. C-BAND ANTENNA TRAILER, UNIT 3
4. X-BAND ANTENNA TRAILER, UNIT 4
5. TRANSPORT TRAILER (C-BAND ANTENNA STRUCTURE)
6. TRANSPORT TRAILER (C-BAND TROUGH ANTENNAS)
7. TRANSPORT TRAILER (L AND C-BAND DISH ANTENNAS)
8. TRANSPORT TRAILER (S-BAND ANTENNA STRUCTURE)
9. TRANSPORT TRAILER (S-BAND TROUGH ANTENNAS)
10. TRANSPORT TRAILER (X-BAND ANTENNA)

NOTE

AN/MPS-T1(V)4

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Figure 1-1. Radar Training Set (Sheet 3)

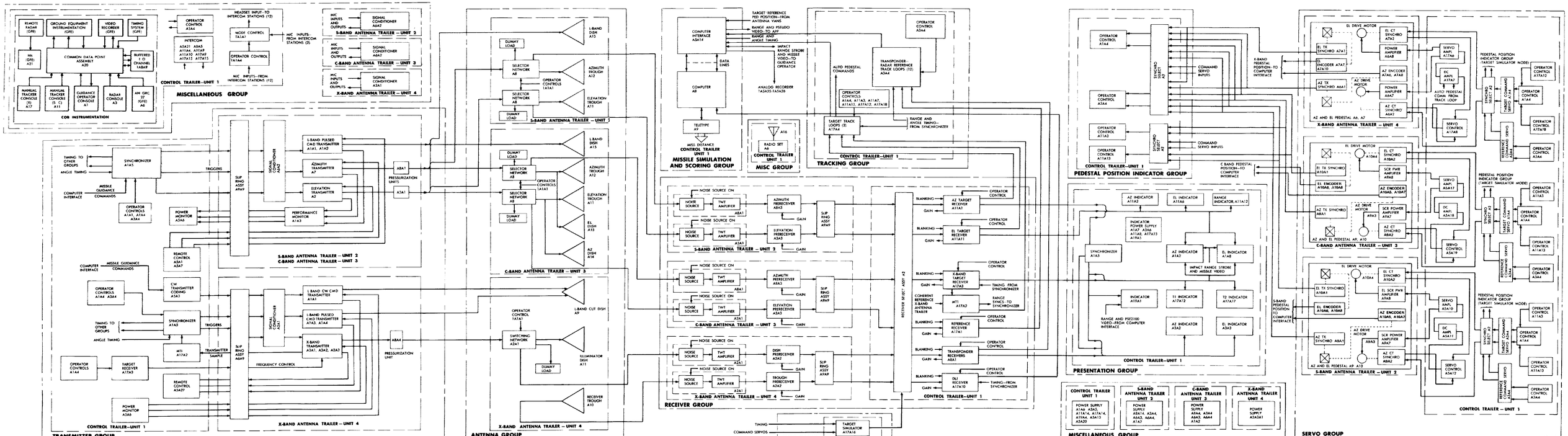


Figure 1-2. Radar Training Set, Functional Block Diagram (Sheet 1)

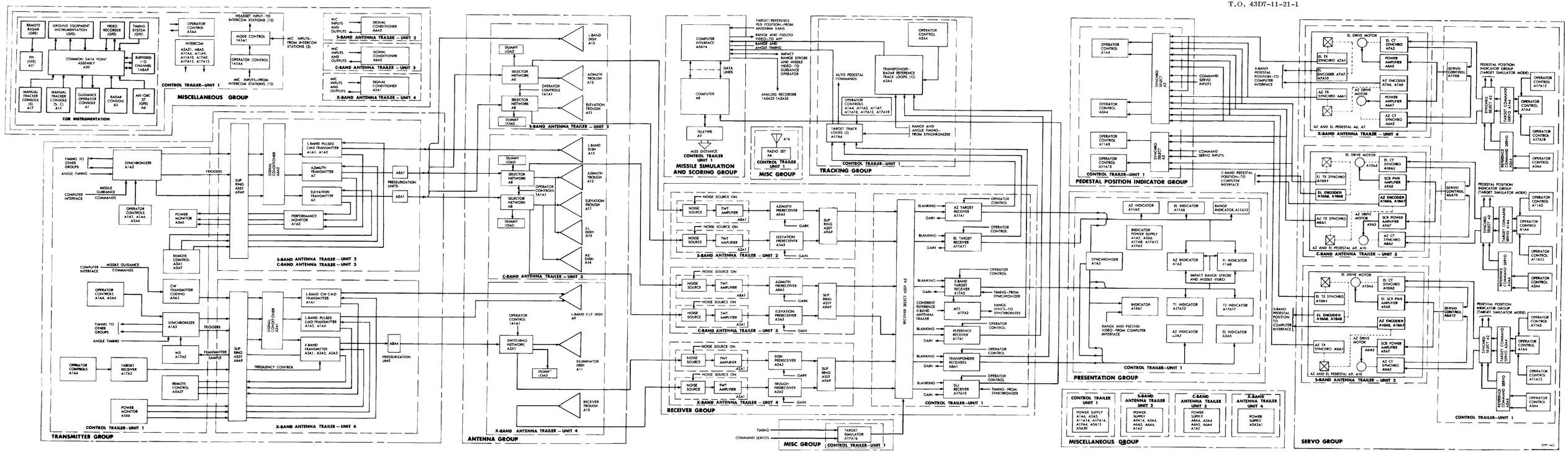
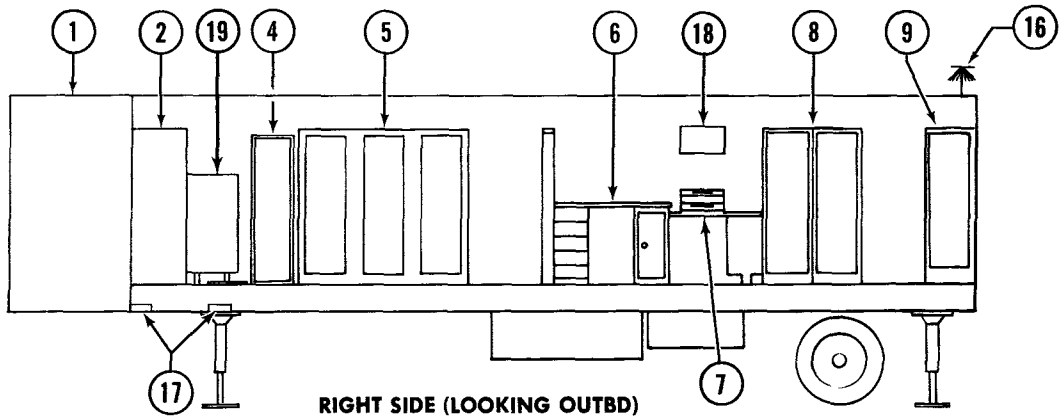
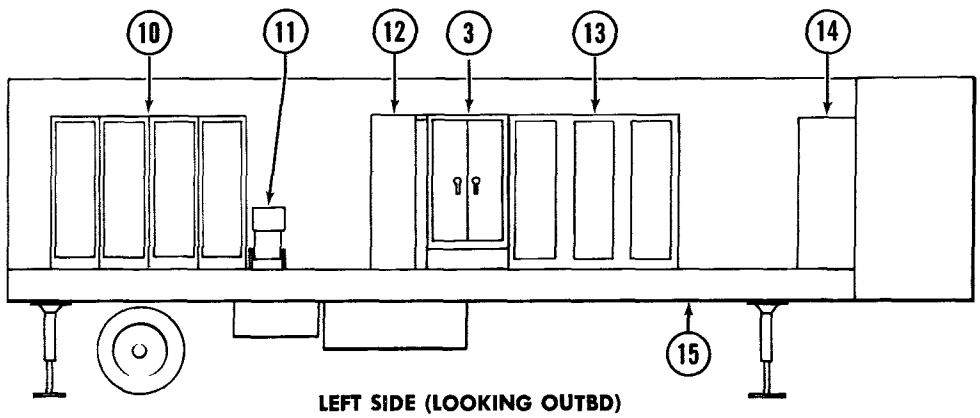
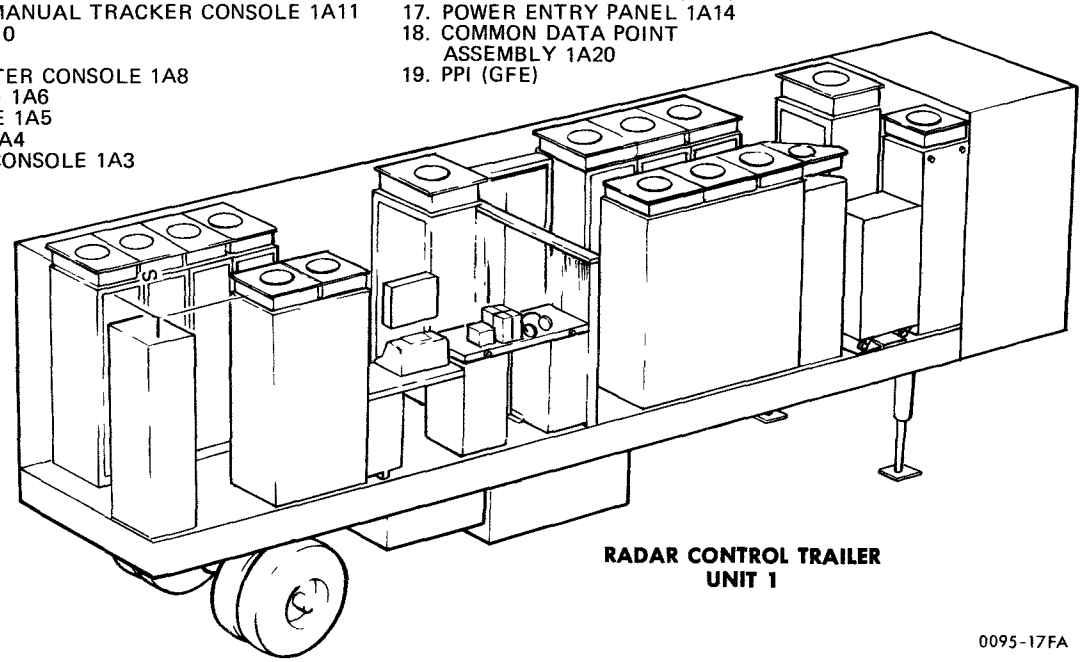


Figure 1-2. Radar Training Set, Functional Block Diagram (Sheet 2)





1. AIR CONDITIONING COMPARTMENT
2. APP CONSOLE 1A19
3. SIGNAL DISTRIBUTION PANEL 1A2
4. POWER DISTRIBUTION CONSOLE 1A12
5. S- AND C-BAND MANUAL TRACKER CONSOLE 1A11
6. WORKBENCH 1A10
7. TELETYPE 1A9
8. DIGITAL COMPUTER CONSOLE 1A8
9. RADIO SET (GFE) 1A6
10. RADAR CONSOLE 1A5
11. OSCILLOSCOPE 1A4
12. TRANSPONDER CONSOLE 1A3
13. X-BAND MANUAL TRACKER CONSOLE 1A17
14. GUIDANCE OPERATOR CONSOLE 1A1
15. VAN SEMITRAILER 1A15
16. RADIO SET ANTENNA (GFE) 1A16
17. POWER ENTRY PANEL 1A14
18. COMMON DATA POINT ASSEMBLY 1A20
19. PPI (GFE)

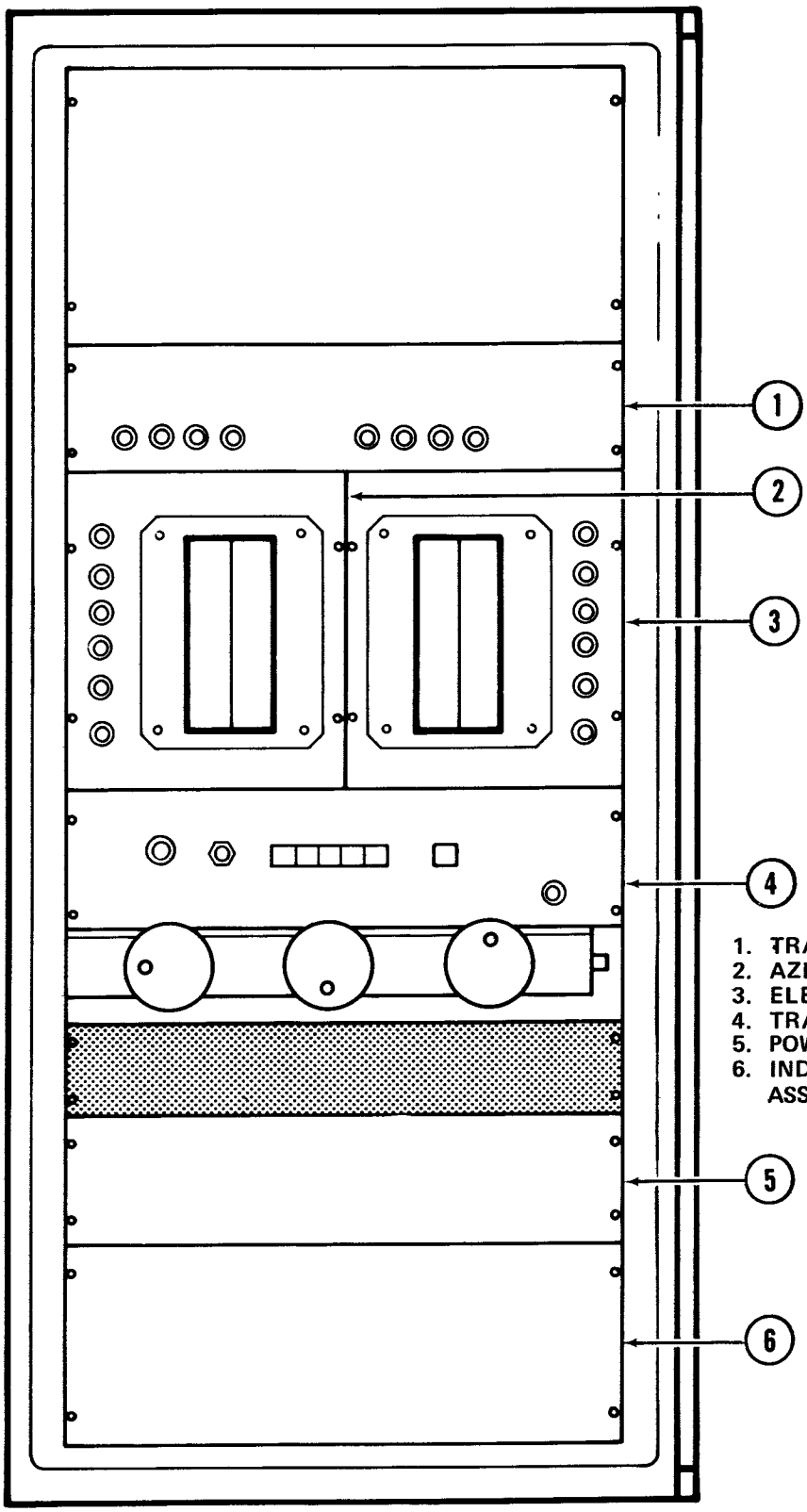


0095-17FA

Figure 1-3. Radar Control Trailer Components (Sheet 1)

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS, RADAR TRAINING SET, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1 FOR FIGURE 1-3 (SHEET 2)

Figure 1-3. Radar Control Trailer Components (Sheet 2)

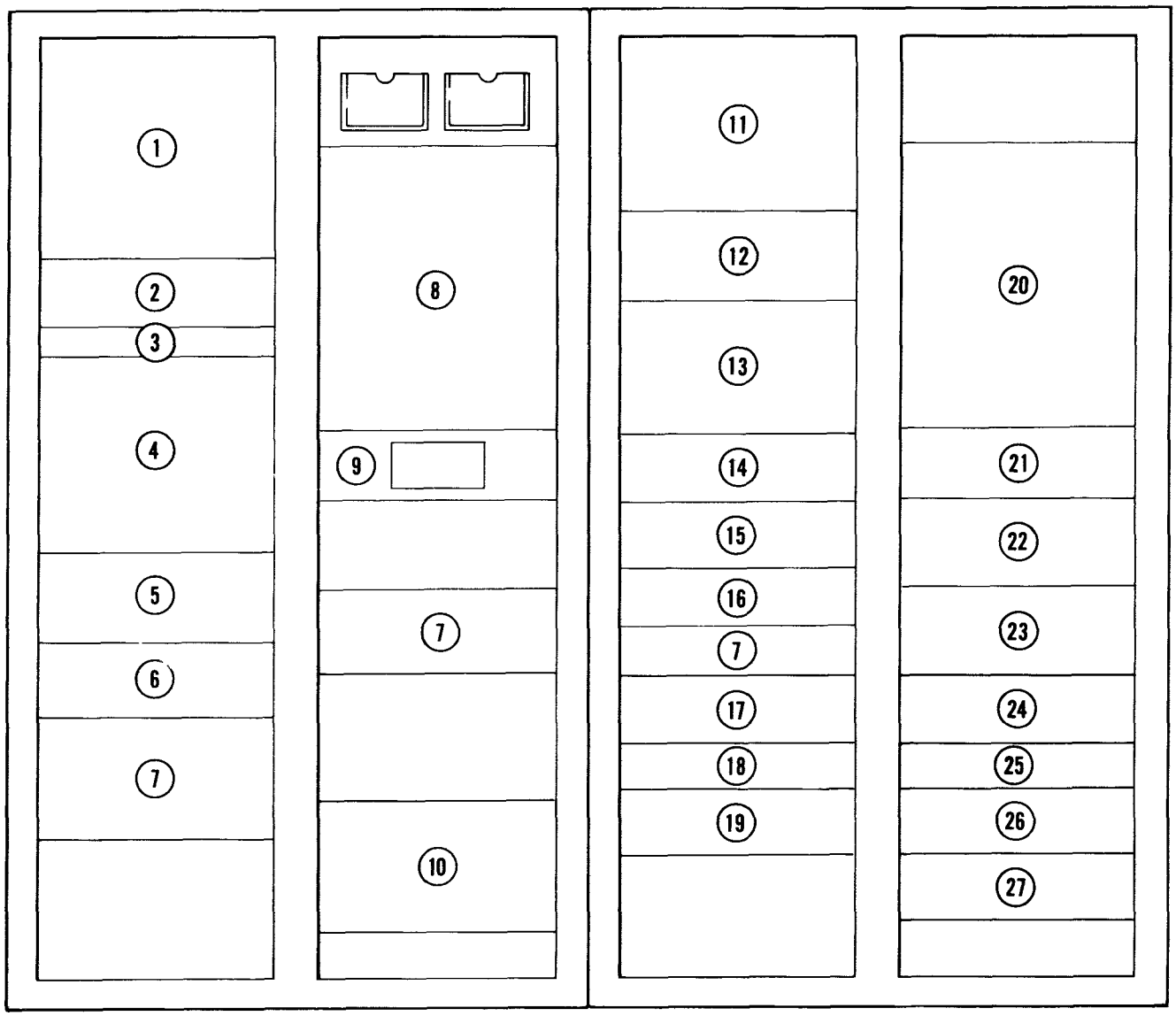


TRANSPONDER CONSOLE 1A3

1. TRANSPONDER RECEIVER 1A3A1
2. AZIMUTH INDICATOR 1A3A2
3. ELEVATION INDICATOR 1A3A3
4. TRACKING CONTROL 1A3A4
5. POWER SUPPLY ASSEMBLY 1A3A5
6. INDICATOR POWER SUPPLY ASSEMBLY 1A3A6

0095-19

Figure 1-3. Radar Control Trailer Components (Sheet 3)



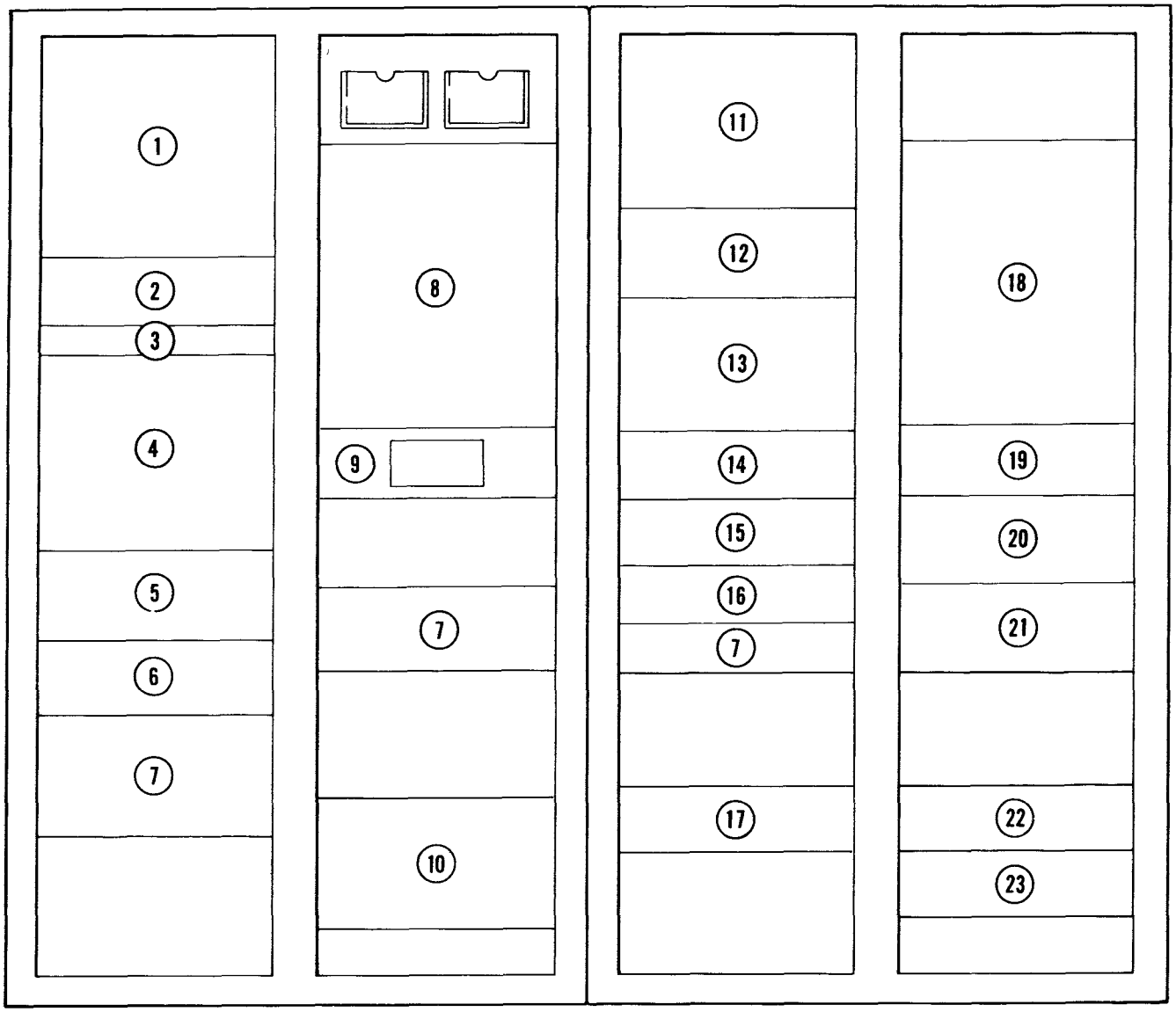
RADAR CONSOLE OJ-343/M
1A5

1. X- AND L-BAND TRANSMITTER CONTROL PANEL 1A5A27
2. RECORDER DC AMPLIFIER 1A5A22
3. RECORDER MASTER POWER 1A5A26
4. RECORDER 1A5A23
5. RECORDER TAKEUP REEL 1A5A25
6. RECORDER INPUT PANEL 1A5A24
7. AIR RETURN
8. S- AND C-BAND TRANSMITTER CONTROL PANEL 1A5A1
9. INTERCOM 1A5A21
10. POWER SUPPLY 1A5A13
11. POWER AND FREQUENCY CONTROL 1A5A2
12. POWER MONITOR 1A5A6
13. L-BAND TRANSMITTER CONTROL PANEL 1A5A7
14. DIGITAL VOLTMETER 1A5A8
15. NOISE FIGURE METER 1A5A9
16. RECEIVER SELECT 1A5A5
17. S-BAND SERVO AMPLIFIER 1A5A10
18. S-BAND DC AMPLIFIER 1A5A11
19. S-BAND SERVO CONTROL 1A5A12
20. COMPUTER INTERFACE 1A5A14
21. TRANSMITTER CODER 1A5A3
22. DVM TEST PANEL 1A5A16
23. SIGNAL TEST PANEL 1A5A15
24. C-BAND SERVO AMPLIFIER 1A5A17
25. C-BAND SERVO AMPLIFIER 1A5A18
26. C-BAND SERVO CONTROL 1A5A19
27. POWER SUPPLY 1A5A20

NOTE
AN/MPS-T1(V)1, (V)2 and (V)3 shown.

0095-20FA

Figure 1-3. Radar Control Trailer Components (Sheet 4)



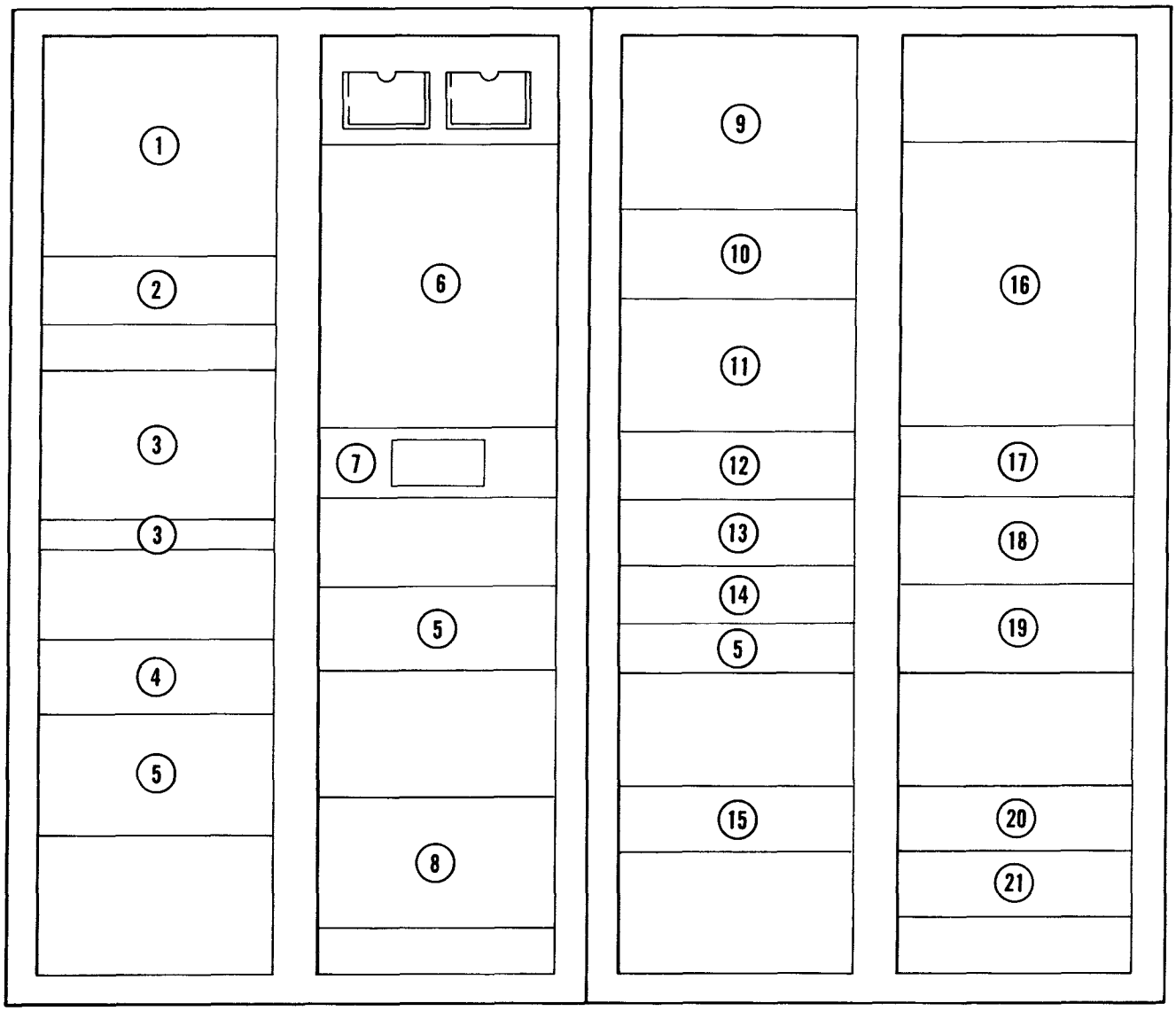
RADAR CONSOLE OJ-370/M
1A5

1. X-BAND AND L-BAND TRANSMITTER CONTROL PANEL 1A5A27
2. RECORDER DC AMPLIFIER 1A5A22
3. RECORDER MASTER POWER 1A5A26
4. RECORDER 1A5A23
5. RECORDER TAKEUP REEL 1A5A25
6. RECORDER INPUT PANEL 1A5A24
7. AIR RETURN
8. S- AND C-BAND TRANSMITTER CONTROL PANEL 1A5A1
9. INTERCOM 1A5A21
10. POWER SUPPLY 1A5A13
11. POWER AND FREQUENCY CONTROL 1A5A2
12. POWER MONITOR 1A5A6
13. L-BAND TRANSMITTER CONTROL PANEL 1A5A7
14. DIGITAL VOLTMETER 1A5A8
15. NOISE FIGURE METER 1A5A9
16. RECEIVER SELECT 1A5A5
17. S-BAND SERVO CONTROL 1A5A12
18. COMPUTER INTERFACE 1A5A14
19. TRANSMITTER CODER 1A5A3
20. DVM TEST PANEL 1A5A16
21. SIGNAL TEST PANEL 1A5A15
22. C-BAND SERVO CONTROL 1A5A19
23. POWER SUPPLY 1A5A20

NOTE
AN/MPS-T1-(V)4 shown.

0095-465

Figure 1-3. Radar Control Trailer Components (Sheet 5)



RADAR CONSOLE OJ-370A/M
1A5

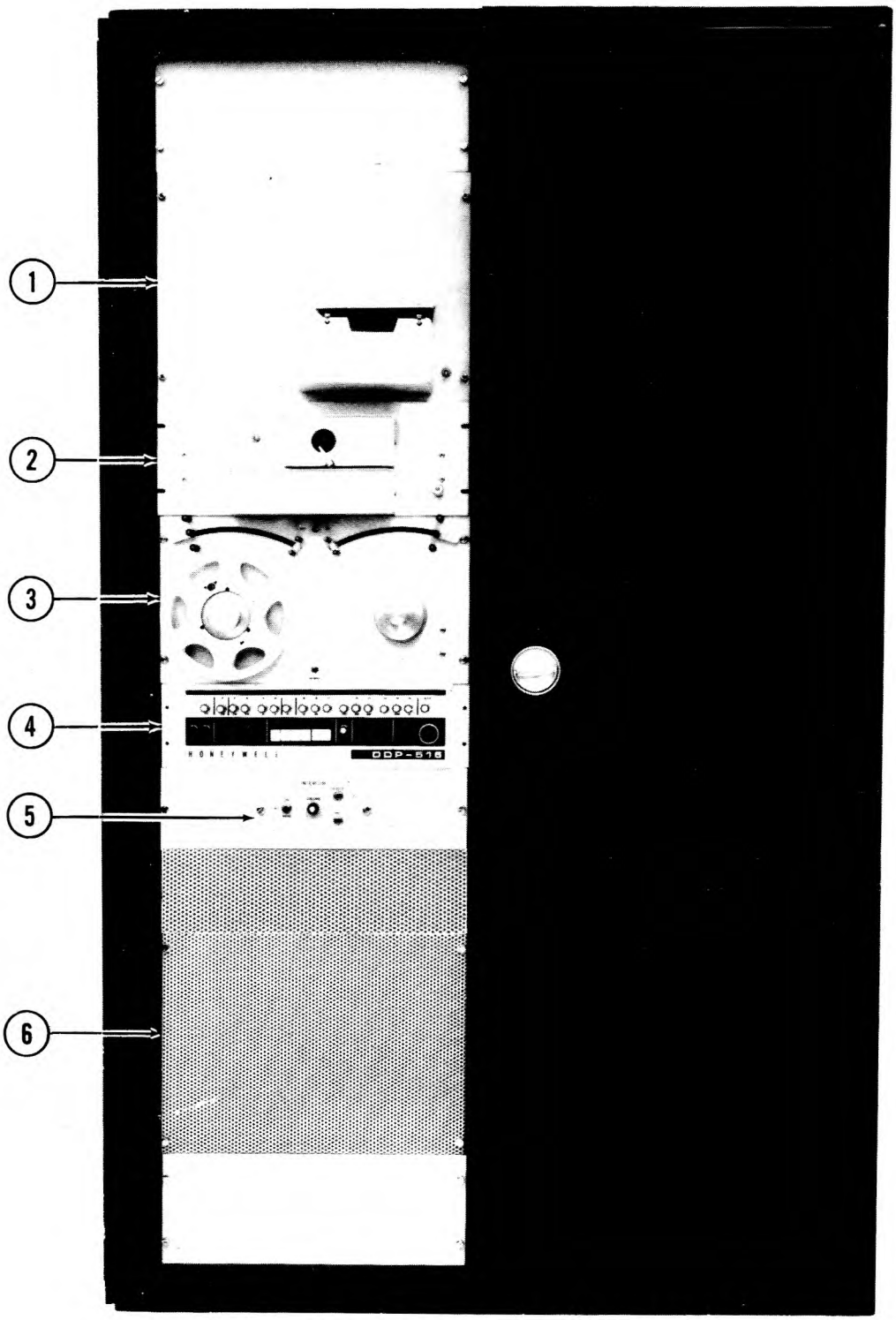
1. X- AND L-BAND TRANSMITTER CONTROL PANEL 1A5A27
2. RECORDER DC AMPLIFIER 1A5A22
3. RECORDER 1A5A23
4. RECORDER INPUT PANEL 1A5A24
5. AIR RETURN
6. S- AND C-BAND TRANSMITTER CONTROL PANEL 1A5A1
7. INTERCOM 1A5A21
8. POWER SUPPLY 1A5A13
9. POWER AND FREQUENCY CONTROL 1A5A2
10. POWER MONITOR 1A5A6
11. L-BAND TRANSMITTER CONTROL PANEL 1A5A7
12. DIGITAL VOLTMETER 1A5A8
13. NOISE FIGURE METER 1A5A9
14. RECEIVER SELECT 1A5A5
15. S-BAND SERVO CONTROL 1A5A12
16. COMPUTER INTERFACE 1A5A14
17. TRANSMITTER CODER 1A5A3
18. DVM TEST PANEL 1A5A16
19. SIGNAL TEST PANEL 1A5A15
20. C-BAND SERVO CONTROL 1A5A19
21. POWER SUPPLY 1A5A20

NOTE

AN/MPS-T1(V)4 shown.

0095-500

Figure 1-3. Radar Control Trailer Components (Sheet 6)



DIGITAL COMPUTER CONSOLE
1A8

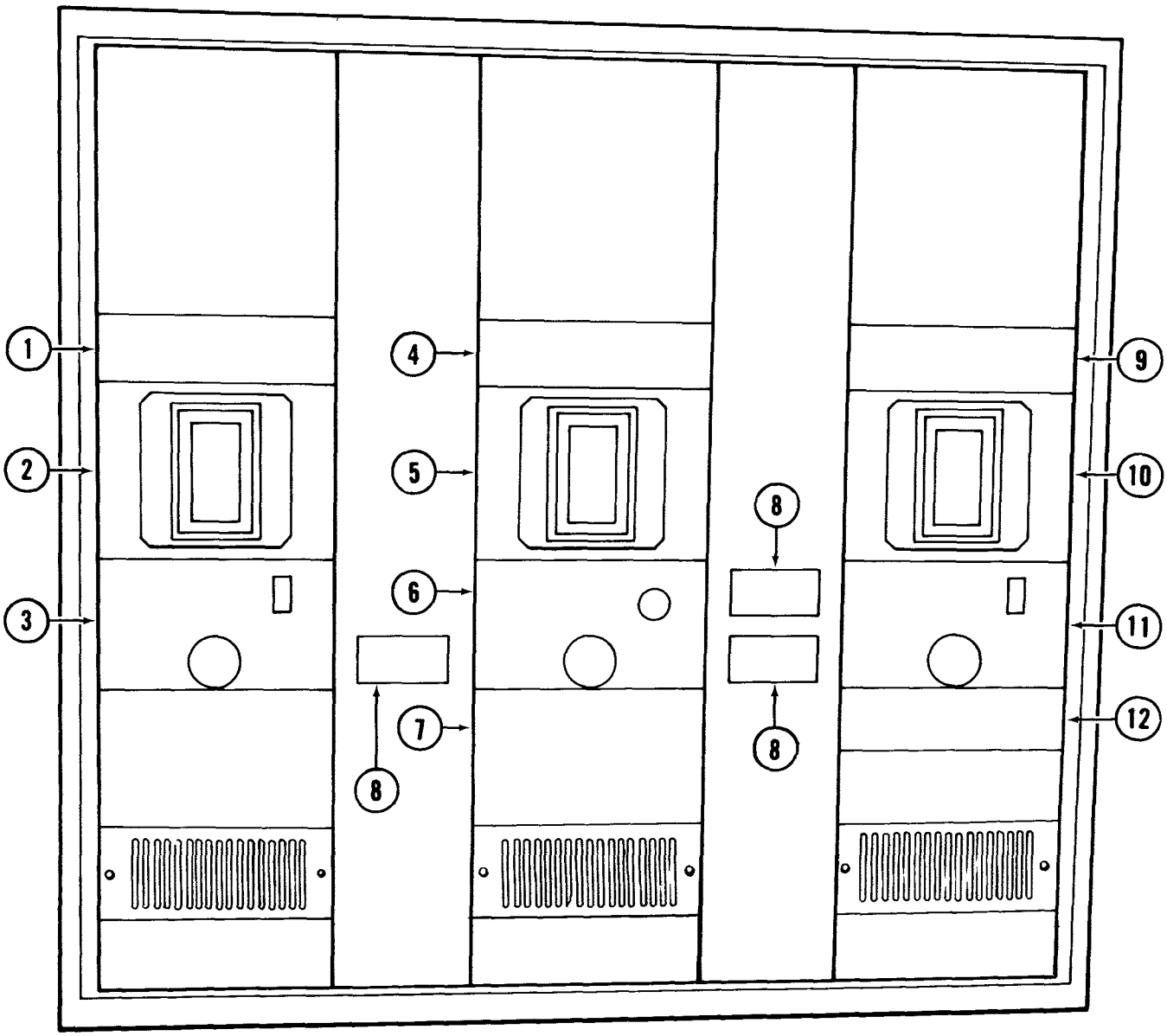
1. HIGH SPEED TAPE PUNCH 1A8A1
2. TAPE READER 1A8A2
3. SPOOLER 1A8A3
4. CONTROL PANEL 1A8A4
5. INTERCOM 1A8A5
6. MULTIVERTER 1A8A6

0095-21A

Figure 1-3. Radar Control Trailer Components (Sheet 7)

0095-265

Figure 1-3. Radar Control Trailer Components (Sheet 8)

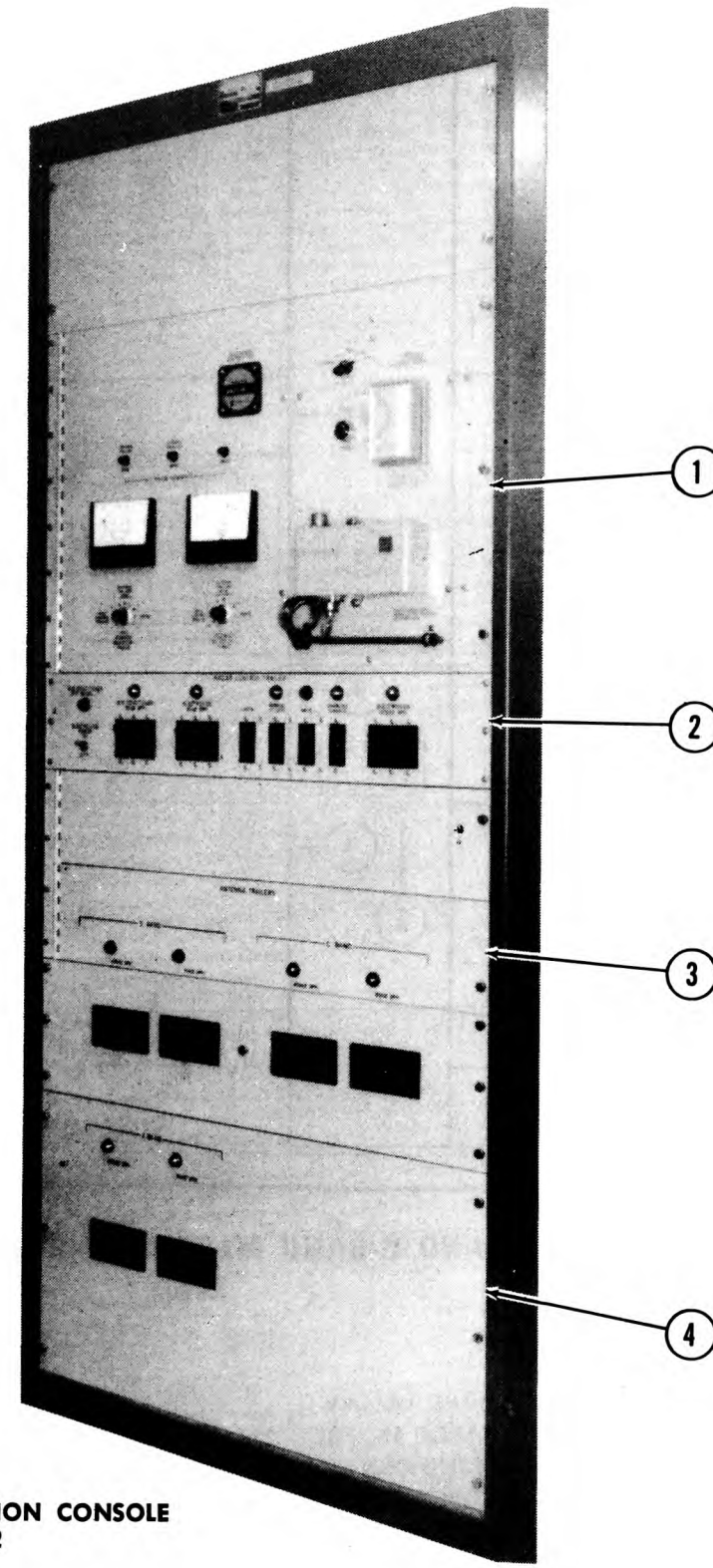


S- AND C-BAND MANUAL TRACKER CONSOLE 1A11

1. AZIMUTH RECEIVER 1A11A1
2. AZIMUTH INDICATOR 1A11A2
3. AZIMUTH TRACKING CONTROL 1A11A3
4. SWEEP GENERATOR 1A11A5
5. RANGE INDICATOR 1A11A6
6. RANGE TRACKING CONTROL 1A11A7
7. INDICATOR POWER SUPPLY 1A11A8
8. INTERCOM 1A11A4, A9, A10
9. ELEVATION RECEIVER 1A11A11
10. ELEVATION INDICATOR 1A11A12
11. ELEVATION TRACKING CONTROL 1A11A13
12. POWER SUPPLY ASSEMBLY 1A11A14

0095-508

Figure 1-3. Radar Control Trailer Components (Sheet 9)

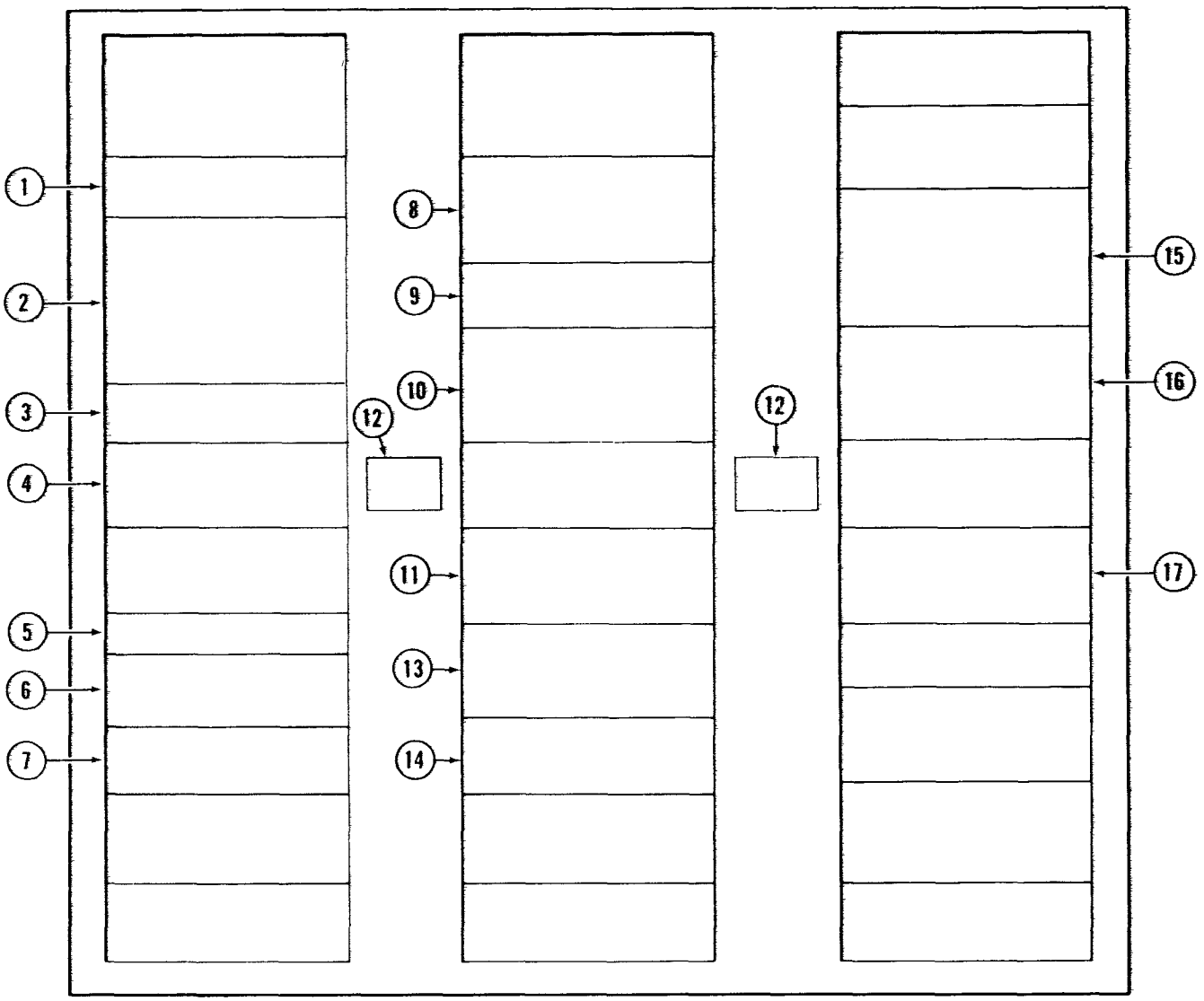


1. AIR CONDITIONER CONTROL PANEL
2. RADAR CONTROL TRAILER POWER PANEL
3. S- AND C-BAND ANTENNA TRAILER POWER PANEL
4. X-BAND ANTENNA TRAILER POWER PANEL

POWER DISTRIBUTION CONSOLE 1A12

0095-23A

Figure 1-3. Radar Control Trailer Components (Sheet 10)



X-BAND MANUAL TRACKER CONSOLE
1A17

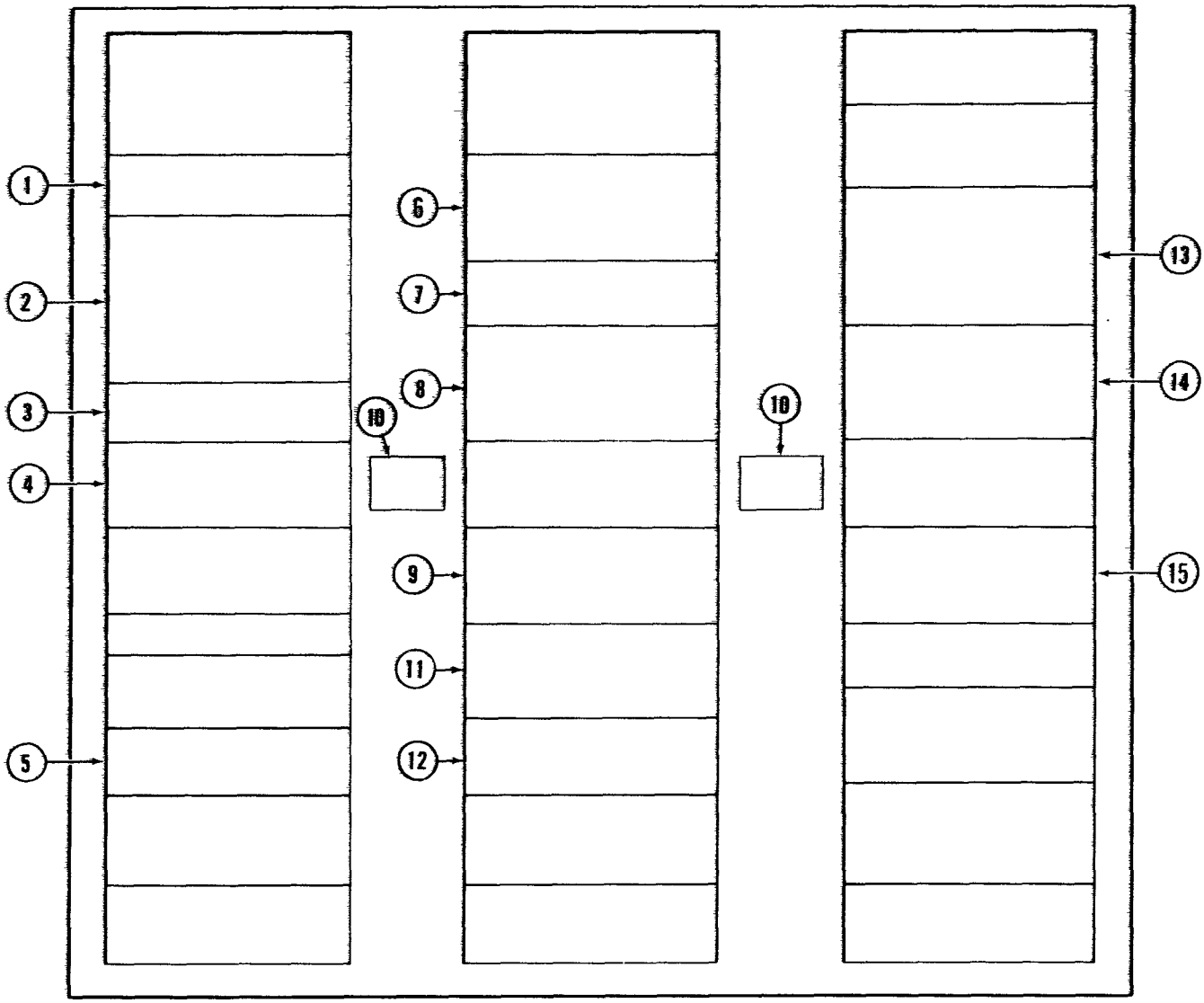
1. REFERENCE RECEIVER 1A17A1
2. MOVING TARGET INDICATOR 1A17A2
3. TARGET RECEIVER 1A17A3
4. TARGET TRACKING 1A17A4
5. X-BAND SERVO AMPLIFIER 1A17A6
6. X-BAND DIRECT DURRENT AMPLIFIER 1A17A7
7. X-BAND SERVO CONTROL 1A17A8
8. REFERENCE PEDESTAL SERVO 1A17A19
9. DOWN LINK JAMMER RECEIVER 1A17A10
10. T1 INDICATOR 1A17A11
11. T1 TRACKING CONTROL 1A17A12
12. INTERCOM 1A17A9, 1A17A15
13. INDICATOR POWER SUPPLY 1A17A13
14. POWER SUPPLY ASSEMBLY 1A17A14
15. TARGET SIMULATOR 1A17A16
16. T2 INDICATOR 1A17A17
17. T2 TRACKING CONTROL 1A17A18

NOTE

AN/MPS-T1 (V)1, (V)2 and (V)3 shown.

0095-24

Figure 1-3. Radar Control Trailer Components (Sheet 11)



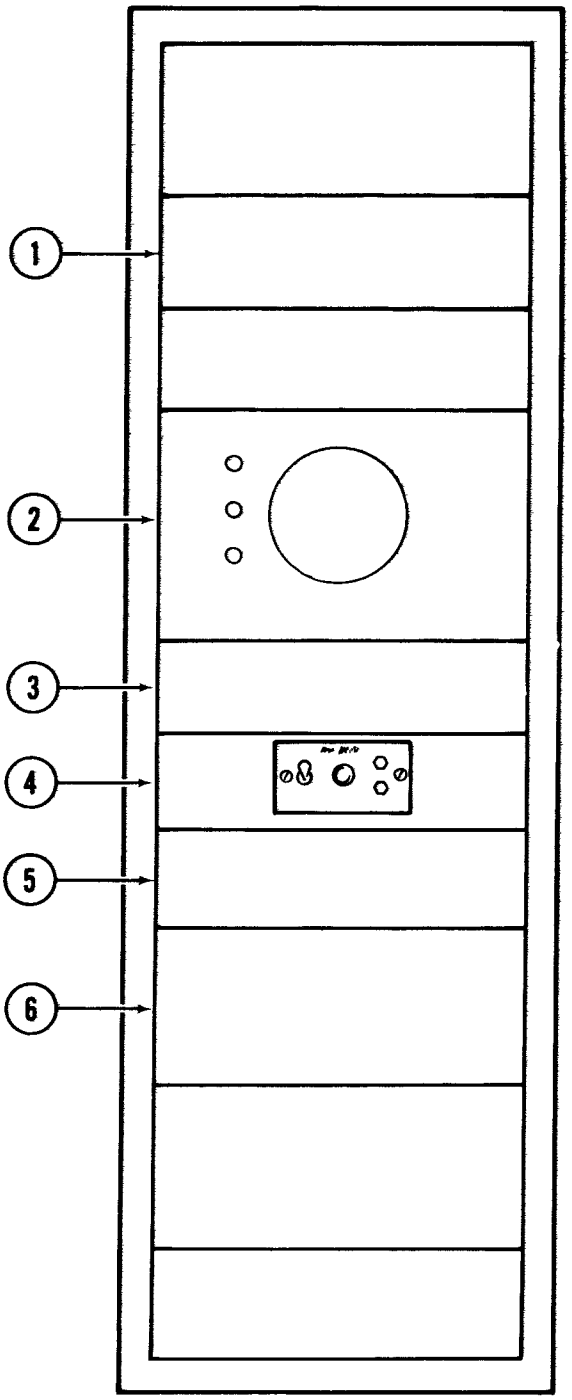
X-BAND MANUAL TRACKER CONSOLE
1A17

1. REFERENCE RECEIVER 1A17A1
2. MOVING TARGET INDICATOR 1A17A2
3. TARGET RECEIVER 1A17A3
4. TARGET TRACKING 1A17A4
5. X-BAND SERVO CONTROL 1A17A8
6. REFERENCE PEDESTAL SERVO 1A17A19
7. DOWN LINK JAMMER RECEIVER 1A17A10
8. T1 INDICATOR 1A17A11
9. T1 TRACKING CONTROL 1A17A12
10. INTERCOM 1A17A9, 1A17A15
11. INDICATOR POWER SUPPLY 1A17A13
12. POWER SUPPLY ASSEMBLY 1A17A14
13. TARGET SIMULATOR 1A17A16
14. T2 INDICATOR 1A17A17
15. T2 TRACKING CONTROL 1A17A18

NOTE
AN/MPS-T1 (V)4 shown.

0095-651

Figure 1-3. Radar Control Trailer Components (Sheet 12)



1. RADIO SET CONTROL (GFE) 1A19A6
2. AUTOMATIC POSITION PLOTTER INDICATOR 1A19A1
3. SWEEP CONTROL 1A19A2
4. INTERCOM 1A19A3
5. POWER SUPPLY 1A19A4
6. INDICATOR POWER SUPPLY 1A19A5

AUTOMATIC POSITION PLOTTER CONSOLE 1A19

0095-25A

Figure 1-3. Radar Control Trailer Components (Sheet 13)

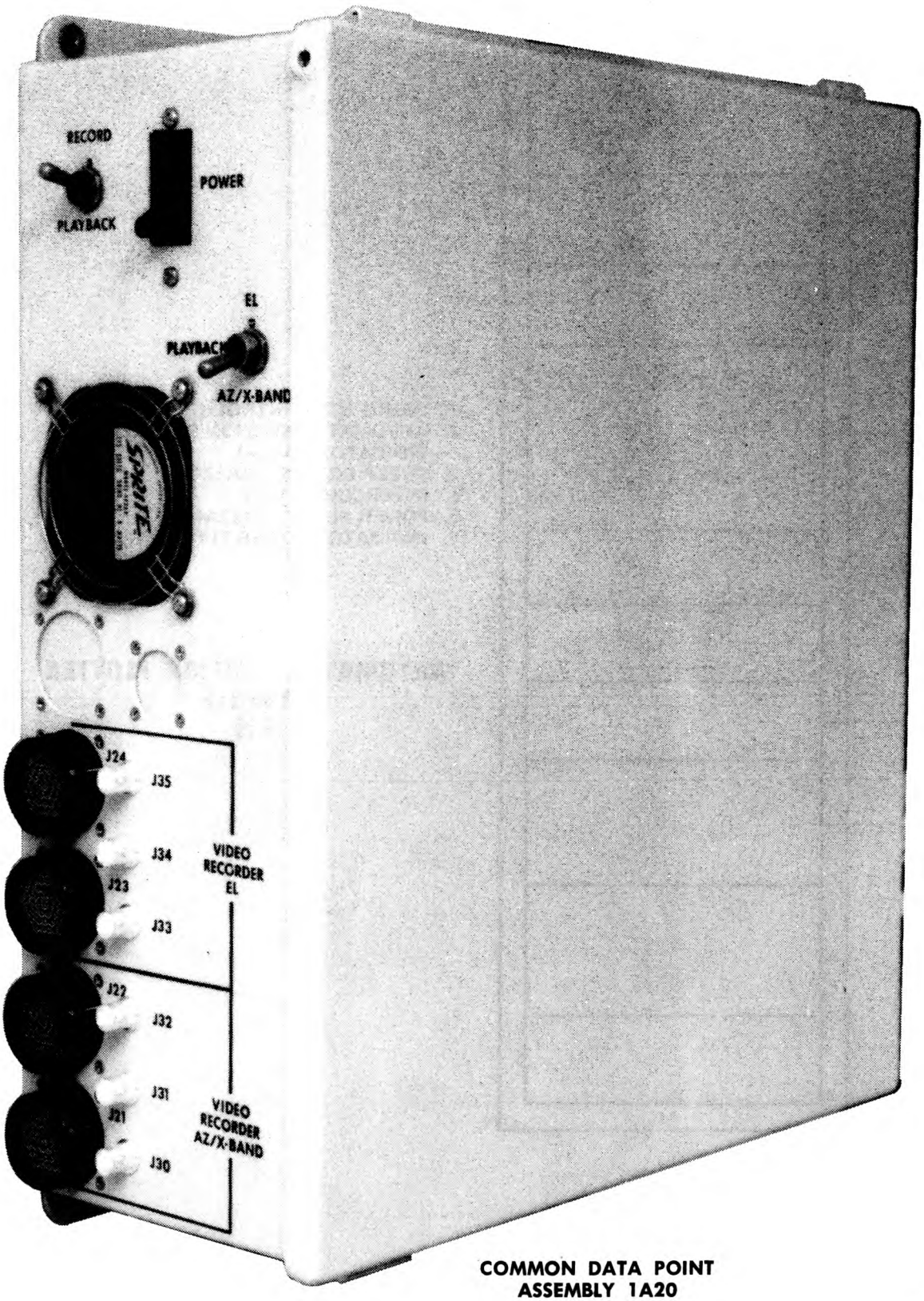
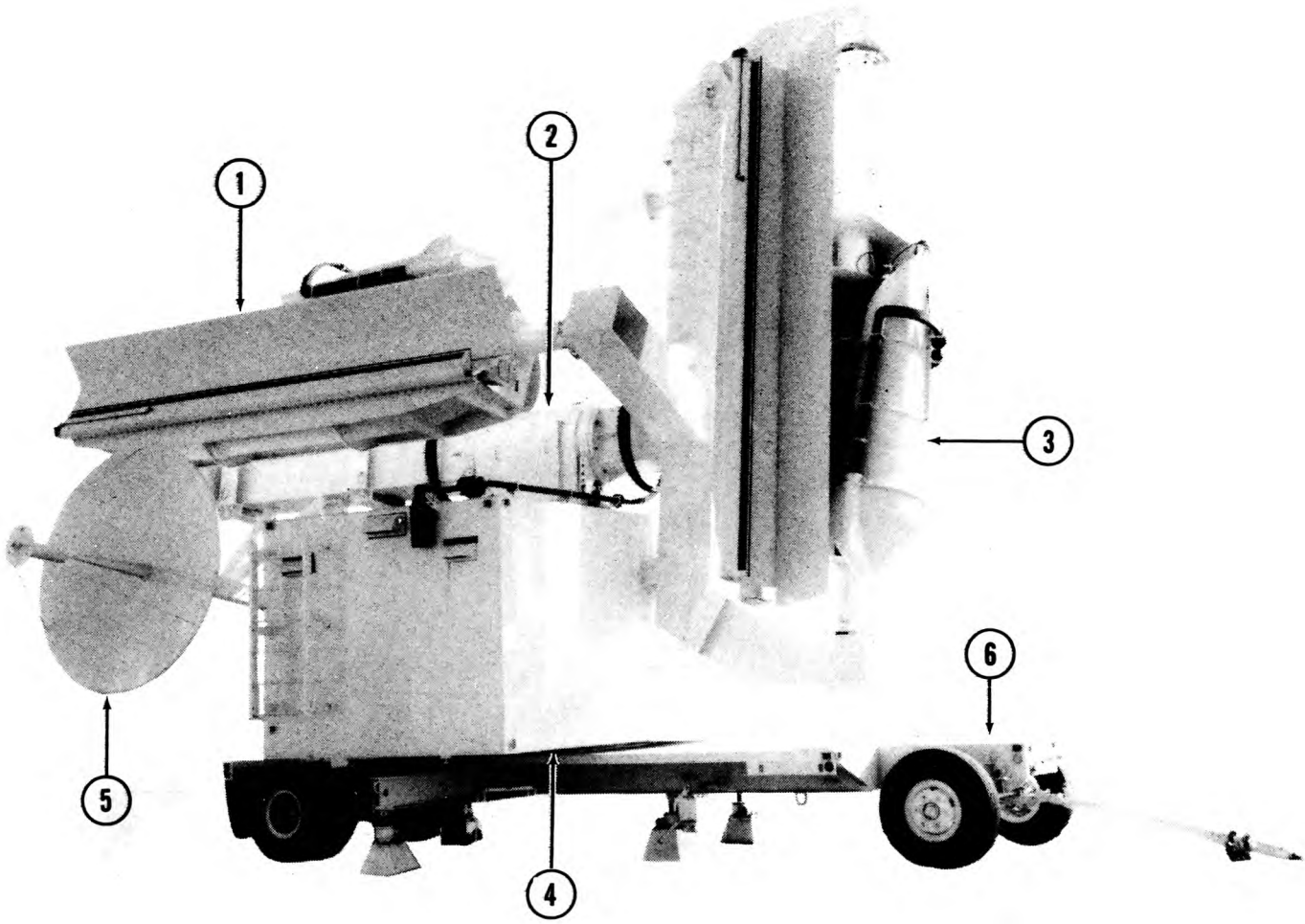


Figure 1-3. Radar Control Trailer Components (Sheet 14)



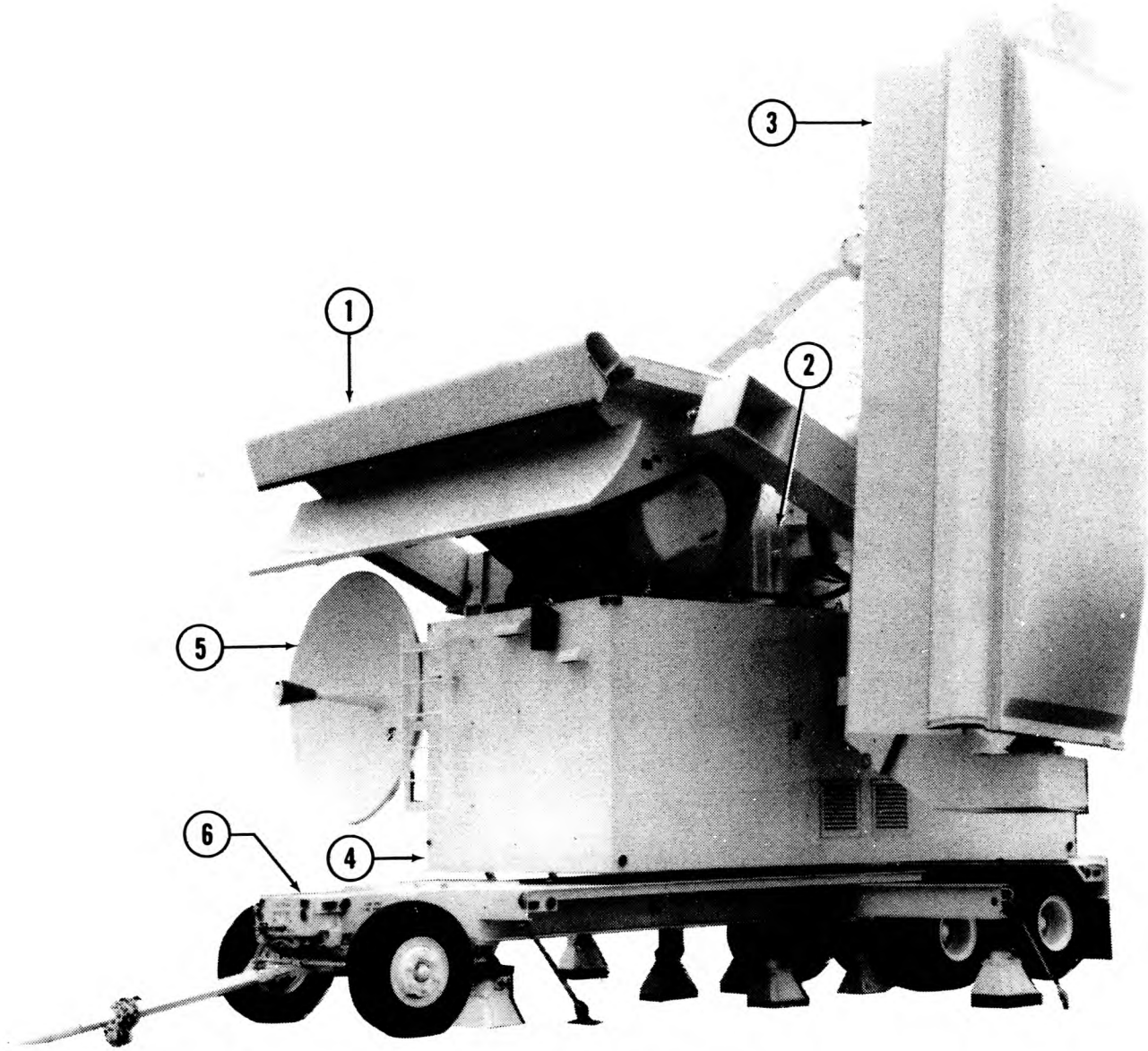
S-BAND ANTENNA TRAILER
UNIT 2

1. AZIMUTH TROUGH ANTENNA 2A12
2. ELEVATION PEDESTAL 2A10
3. ELEVATION TROUGH ANTENNA 2A11
4. ANTENNA TRAILER ASSEMBLY (see sheet 3)
5. L-BAND DISH ANTENNA 2A13
6. MOBILE TRACKER TRAILER

NOTE
AN/MPS-T1(V)3 shown.

0095-26B

Figure 1-4. S-Band Antenna Trailer Components (Sheet 1)



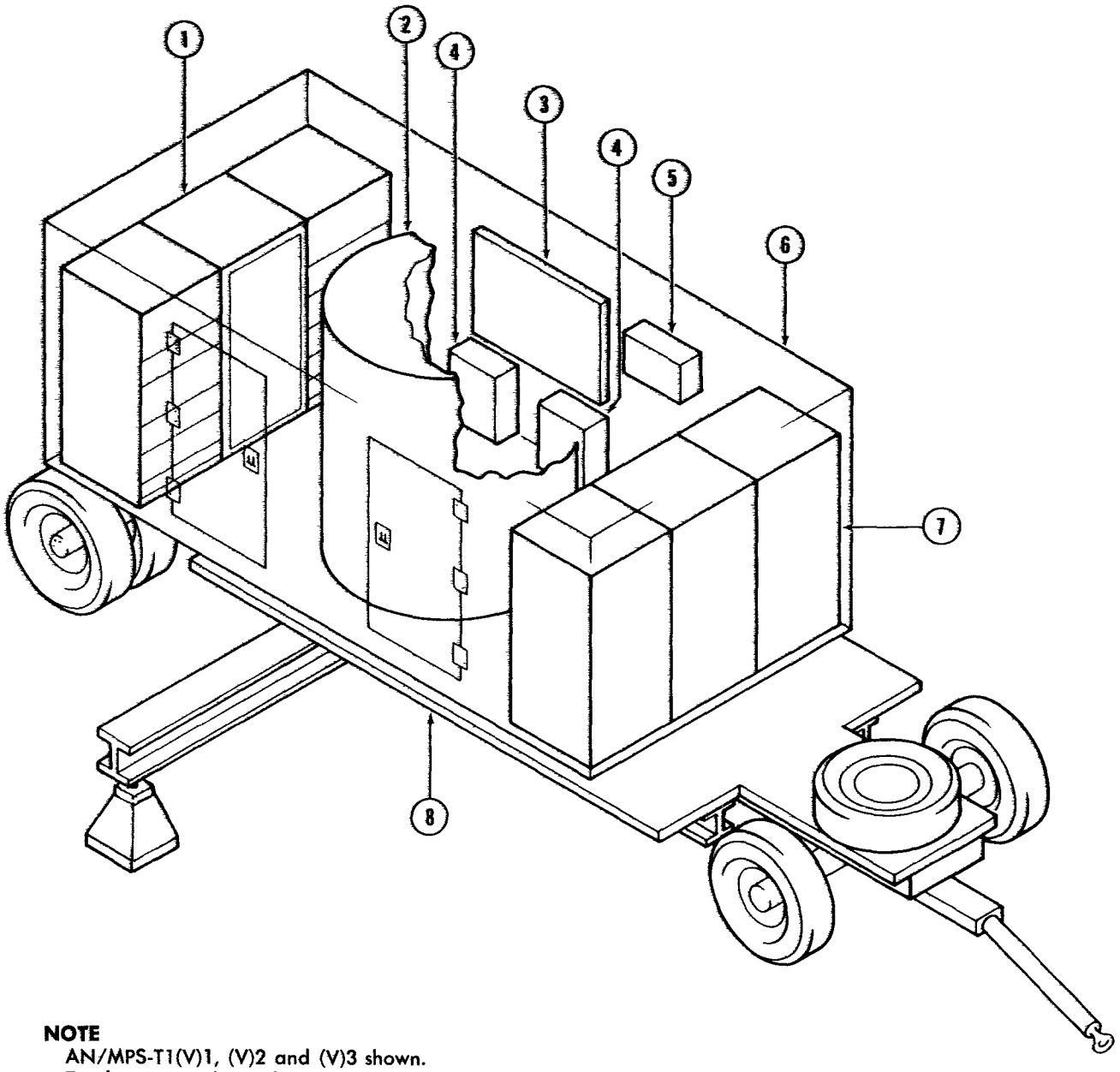
S-BAND ANTENNA TRAILER
UNIT 2

1. AZIMUTH TROUGH ANTENNA 2A12
2. ELEVATION PEDESTAL 2A10
3. ELEVATION TROUGH ANTENNA 2A11
4. ANTENNA TRAILER ASSEMBLY (see sheet 3)
5. L-BAND DISH ANTENNA 2A13
6. MOBILE TRACKER TRAILER

NOTE
AN/MPS-T1-(V)4 shown.

0095-466A

Figure 1-4. S-Band Antenna Trailer Components (Sheet 2)



NOTE
AN/MPS-T1(V)1, (V)2 and (V)3 shown.
Tandem rear axle used on AN/MPS-T1(V)4.

1. AZIMUTH RADAR CONSOLES 2A6, 2A7, 2A8
2. AZIMUTH PEDESTAL 2A9
3. JUNCTION BOX 2A5
4. FAN
5. POWER DISTRIBUTION PANEL 2A4
6. ANTENNA TRAILER ASSEMBLY
7. ELEVATION RADAR CONSOLES 2A1, 2A2, 2A3
8. MOBILE TRACKER TRAILER

0095-27FA

Figure 1-4. S-Band Antenna Trailer Components (Sheet 3)

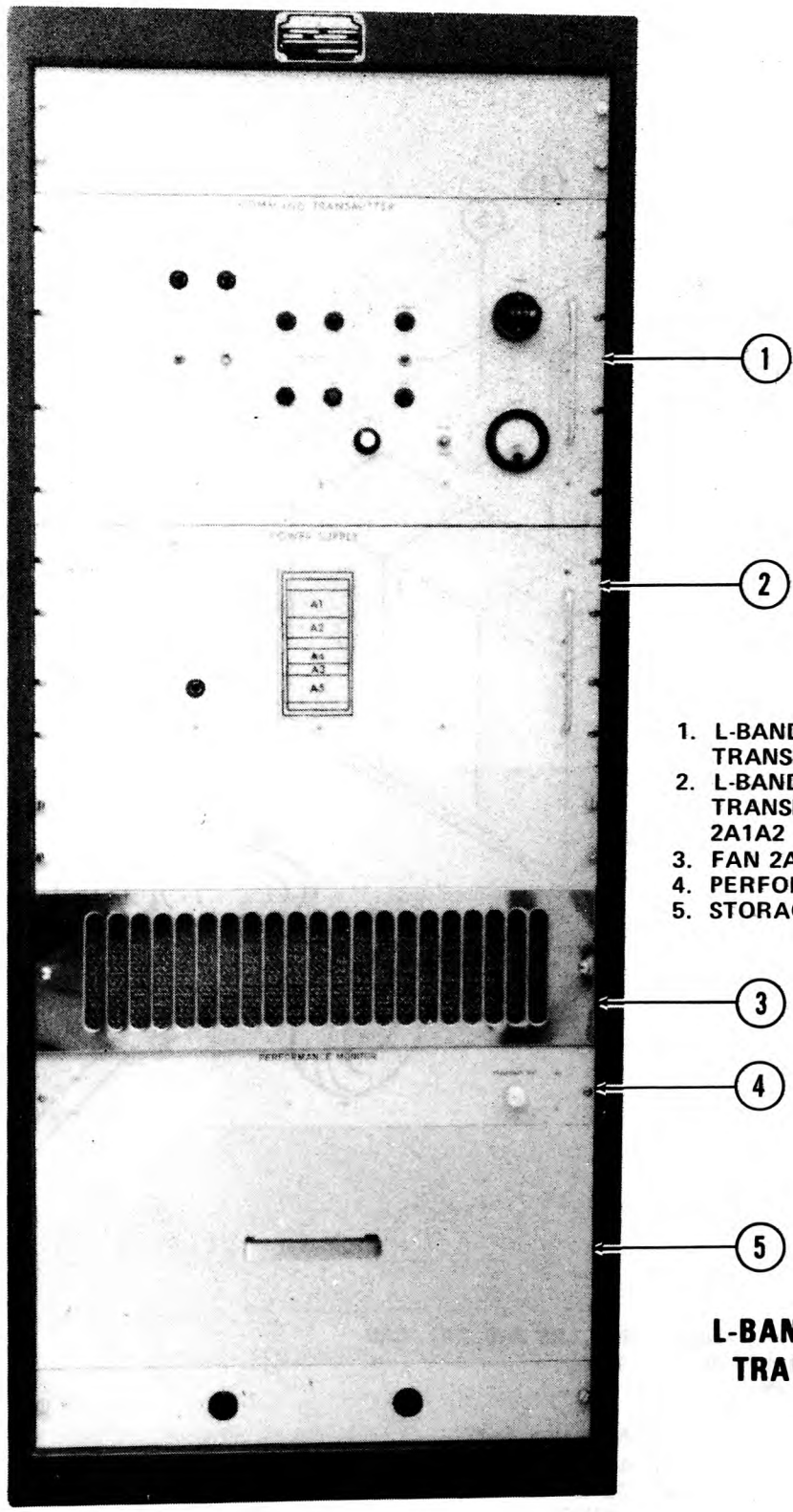
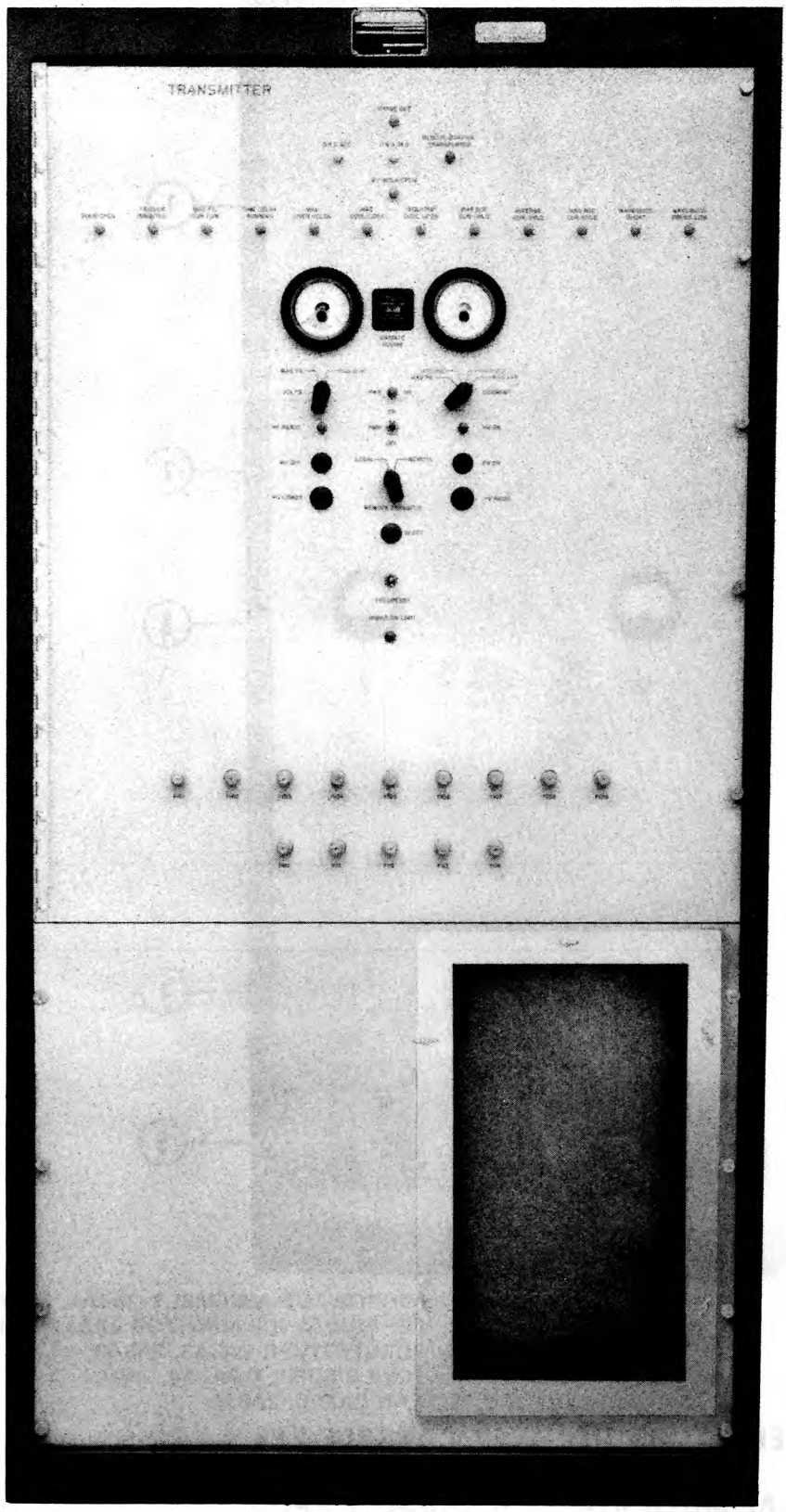


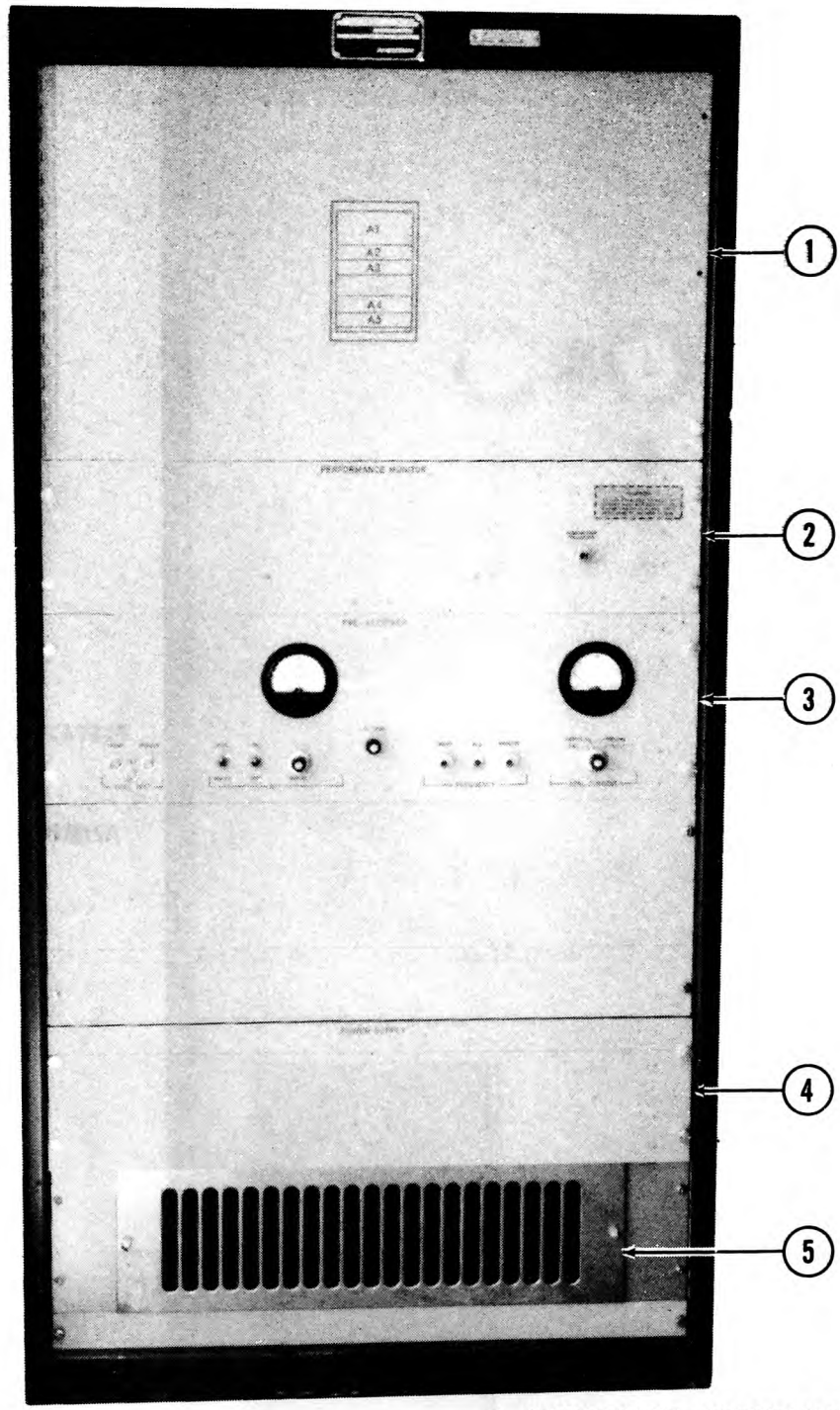
Figure 1-4. S-Band Antenna Trailer Components (Sheet 4)



ELEVATION TRANSMITTER CONSOLE 2A2 AND AZIMUTH TRANSMITTER CONSOLE 2A7

0095-F29

Figure 1-4. S-Band Antenna Trailer Components (Sheet 5)

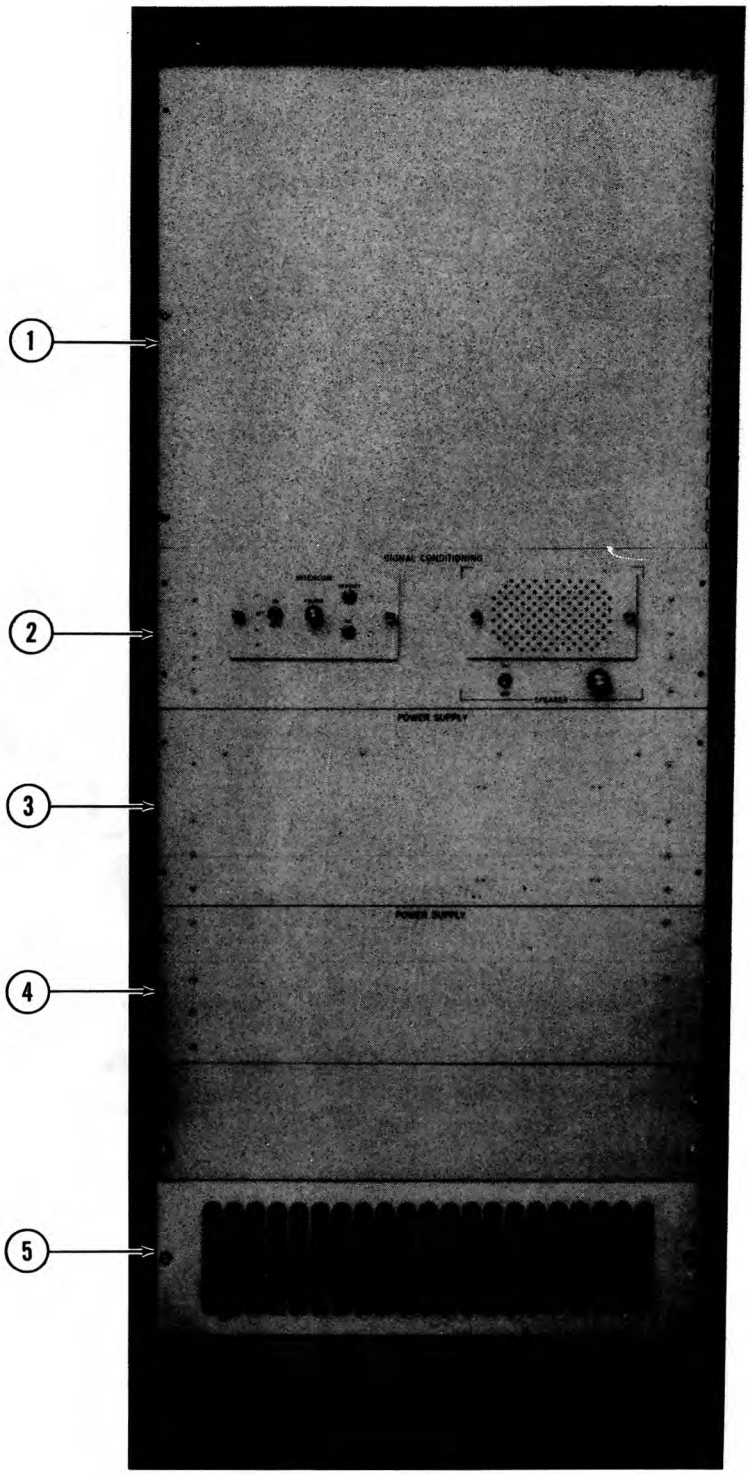


1. MICROWAVE ASSEMBLY 2A3A1, 2A8A1
2. PERFORMANCE MONITOR 2A3A2, 2A8A2
3. PRERECEIVER 2A3A3, 2A8A3
4. POWER SUPPLY 2A3A4, 2A8A4
5. FAN 2A3A5, 2A8A5

ELEVATION RECEIVER CONSOLE 2A3
AND
AZIMUTH RECEIVER CONSOLE 2A8

0095-30A

Figure 1-4. S-Band Antenna Trailer Components (Sheet 6)

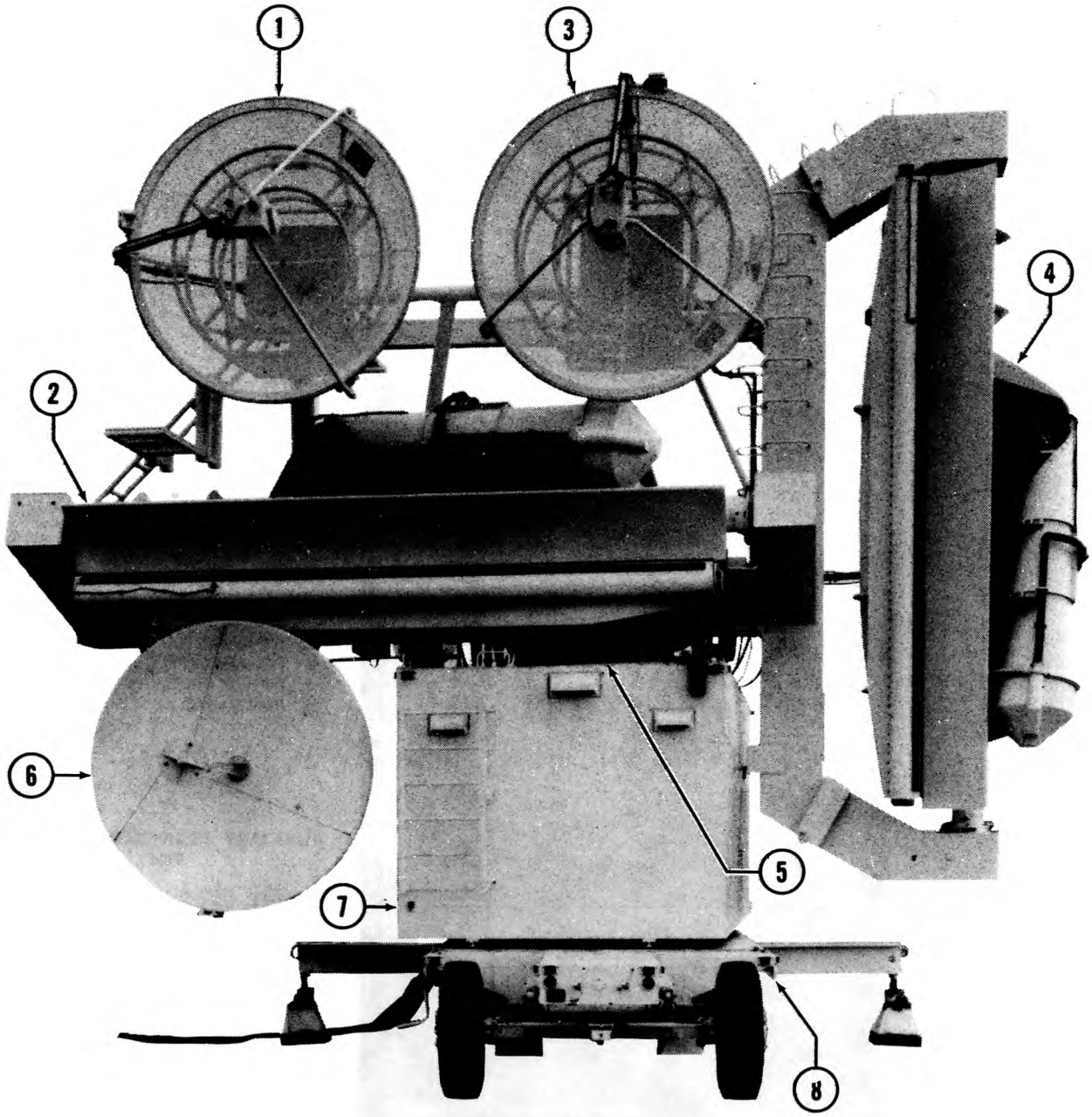


1. WAVEGUIDE AND SCANNER SWITCHING 2A6A1
2. SIGNAL CONDITIONING 2A6A2
3 POWER SUPPLY 2A6A3
4. POWER SUPPLY 2A6A4
5. FAN 2A6A5

AUXILIARY EQUIPMENT CONSOLE 2A6

0095-F31

Figure 1-4. S-Band Antenna Trailer Components (Sheet 7)



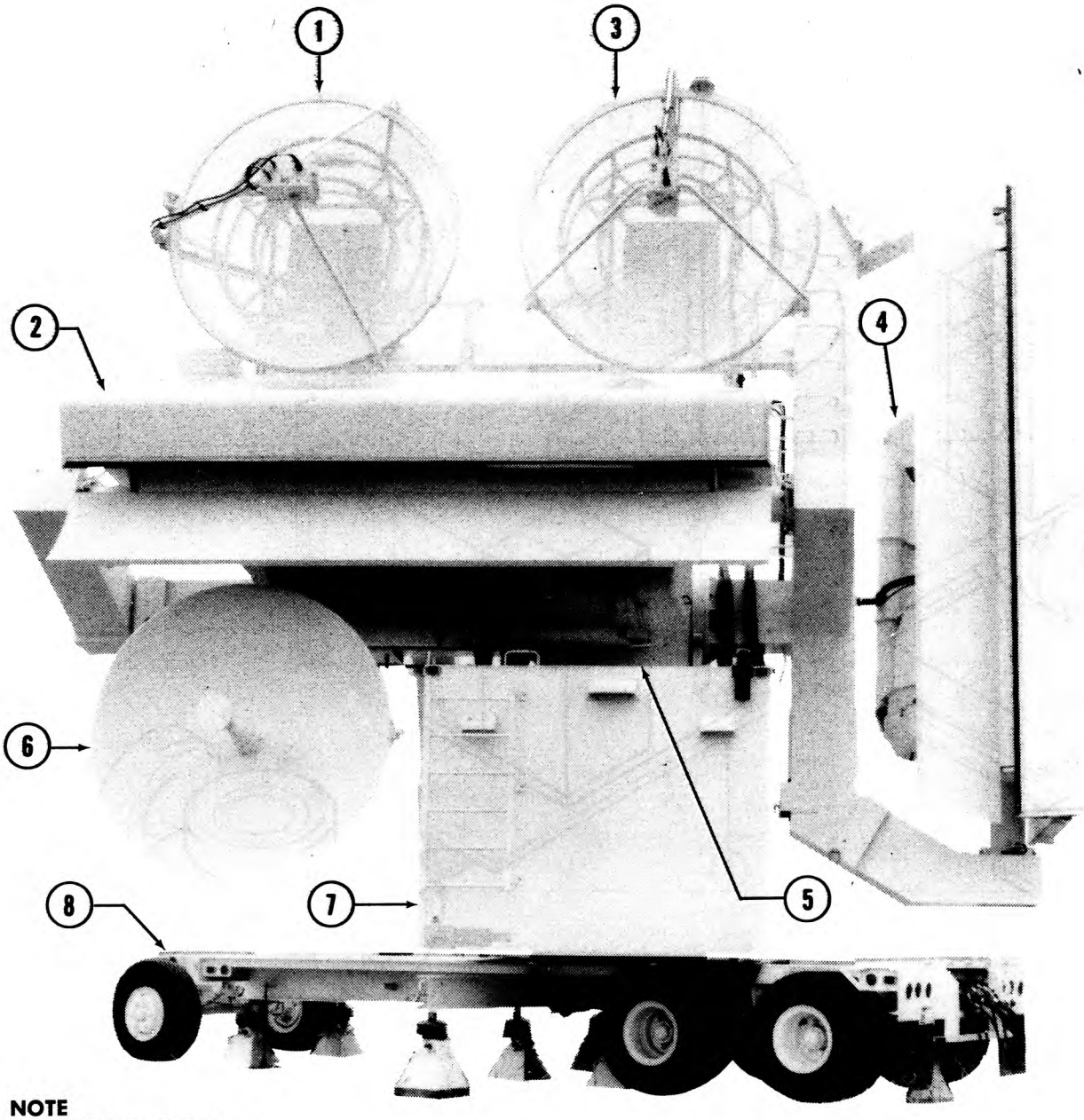
C-BAND ANTENNA TRAILER
UNIT 3

1. AZIMUTH SCANNED DISH ANTENNA 3A14
2. AZIMUTH TROUGH ANTENNA 3A12
3. ELEVATION SCANNED DISH ANTENNA 3A13
4. ELEVATION TROUGH ANTENNA 3A11
5. ELEVATION PEDESTAL 3A10
6. L-BAND DISH ANTENNA 3A15
7. ANTENNA TRAILER ASSEMBLY (see sheet 3)
8. MOBILE TRACKER TRAILER

NOTE
AN/MPS-T1(V 3 shown.

0095-328

Figure 1-5. C-Band Antenna Trailer Components (Sheet 1)



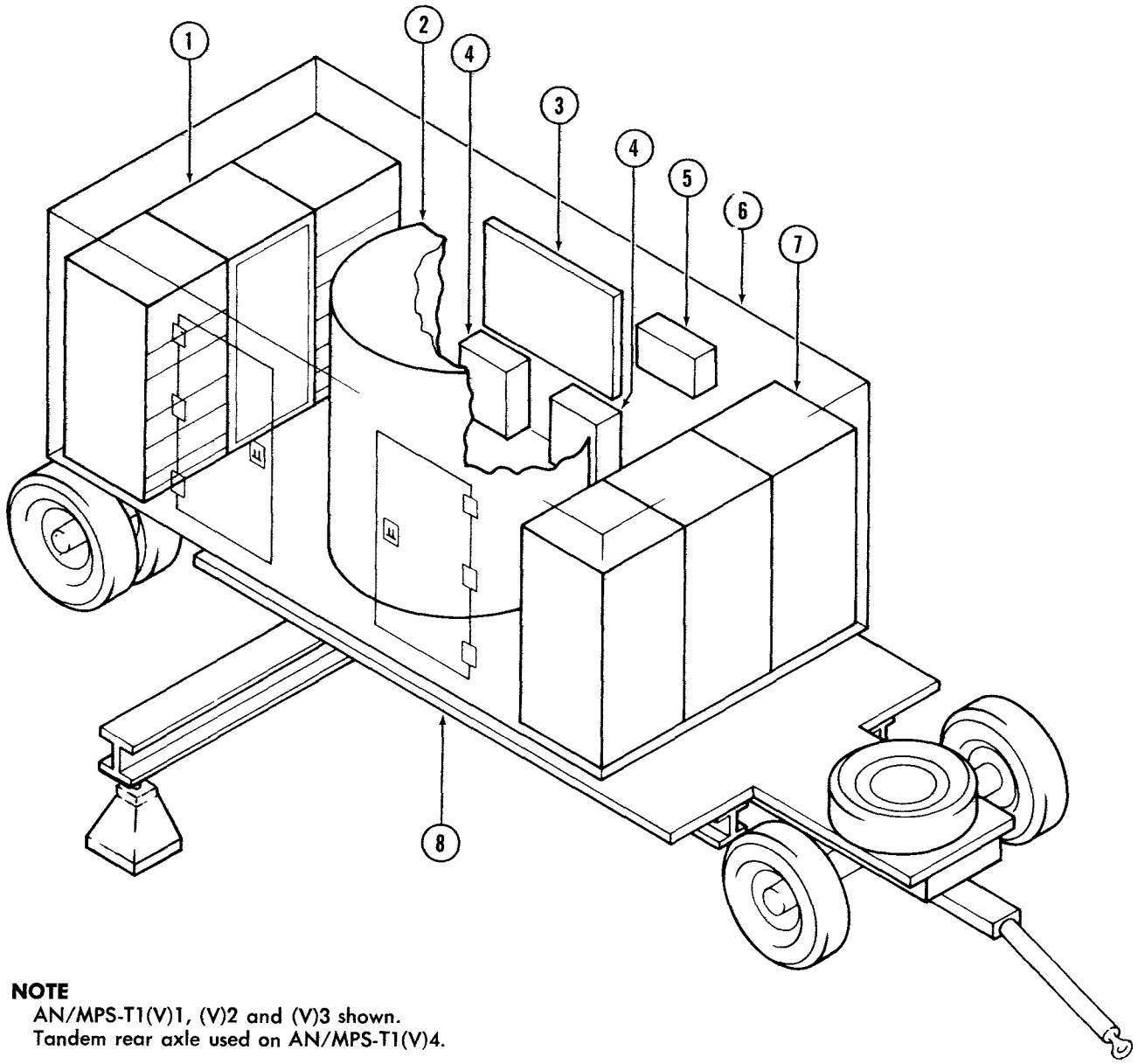
NOTE
AN/MPS-T1-(V)4 shown.

C-BAND ANTENNA TRAILER
UNIT 3

1. AZIMUTH SCANNED DISH ANTENNA 3A14
2. AZIMUTH TROUGH ANTENNA 3A12
3. ELEVATION SCANNED DISH ANTENNA 3A13
4. ELEVATION TROUGH ANTENNA 3A11
5. ELEVATION PEDESTAL 3A10
6. L-BAND DISH ANTENNA 3A15
7. ANTENNA TRAILER ASSEMBLY (see sheet 3)
8. MOBILE TRACKER TRAILER

0095-467A

Figure 1-5. C-Band Antenna Trailer Components (Sheet 2)



NOTE
AN/MPS-T1(V)1, (V)2 and (V)3 shown.
Tandem rear axle used on AN/MPS-T1(V)4.

1. AZIMUTH RADAR CONSOLES 3A6, 3A7, 3A8
2. AZIMUTH PEDESTAL 3A9
3. JUNCTION BOX 3A5
4. FAN
5. POWER DISTRIBUTION PANEL 3A4
6. ANTENNA TRAILER ASSEMBLY
7. ELEVATION RADAR CONSOLES 3A1, 3A2, 3A3
8. MOBILE TRACKER TRAILER

0095-33FB

Figure 1-5. C-Band Antenna Trailer Components (Sheet 3)

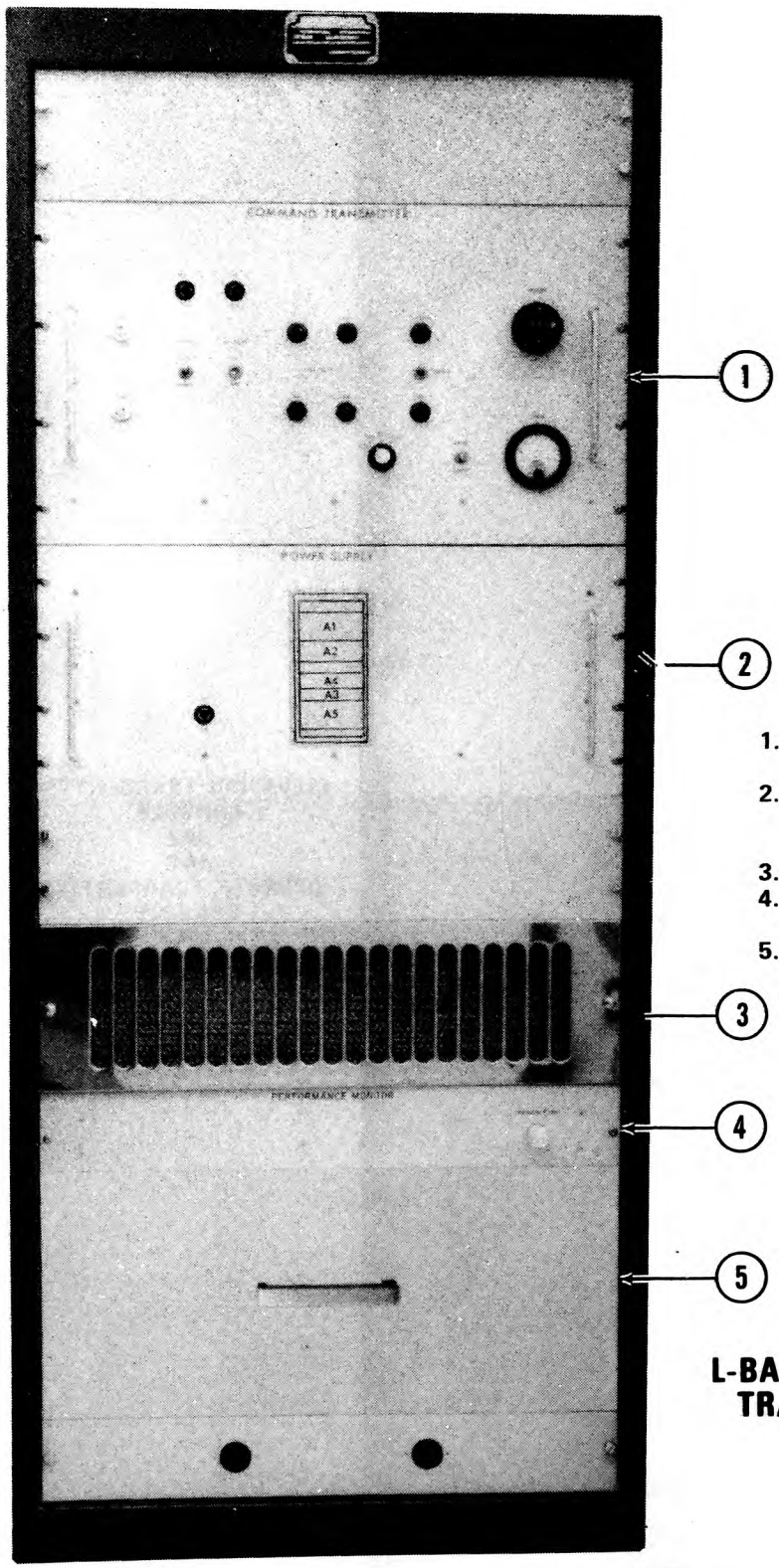
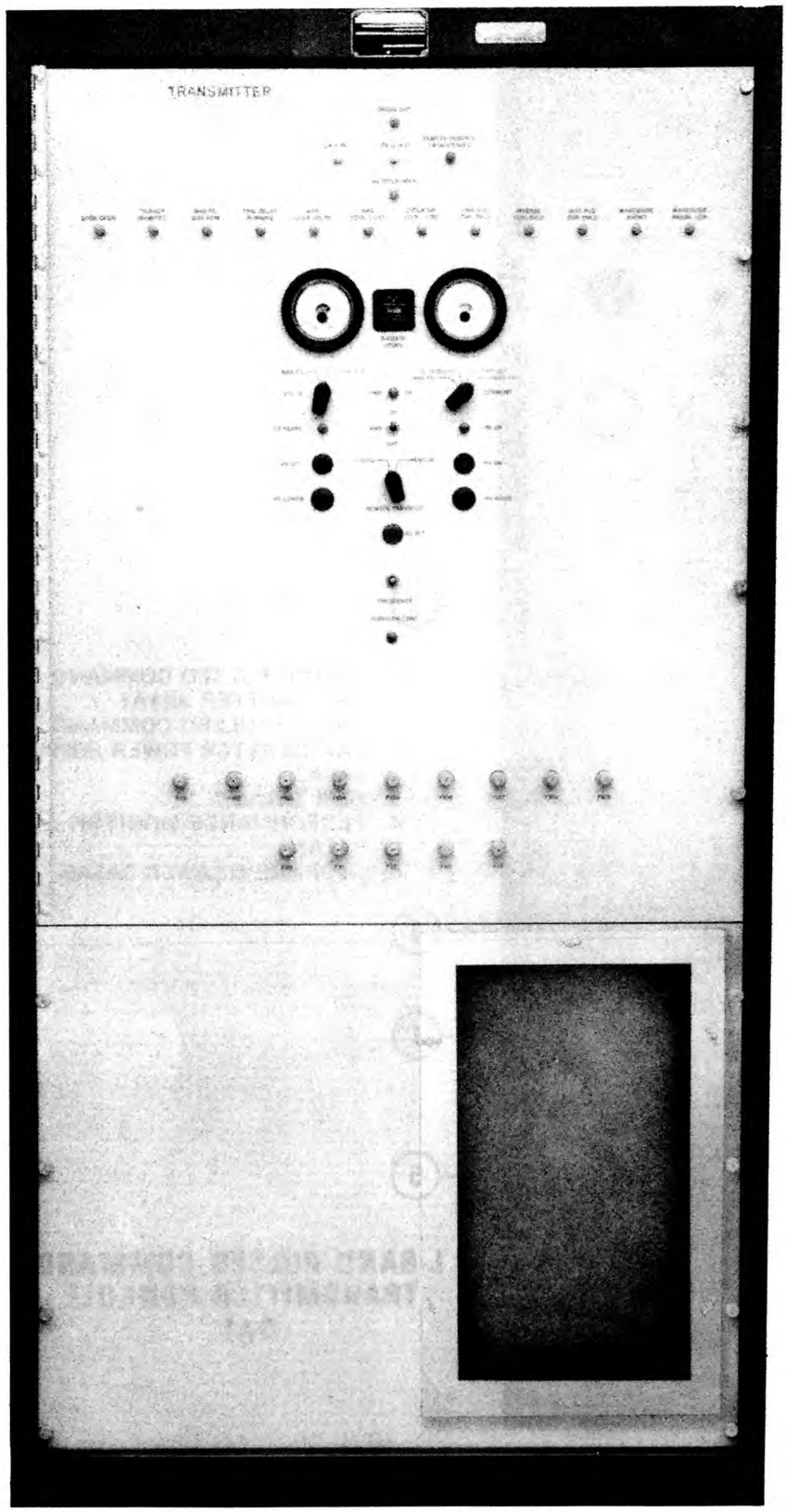


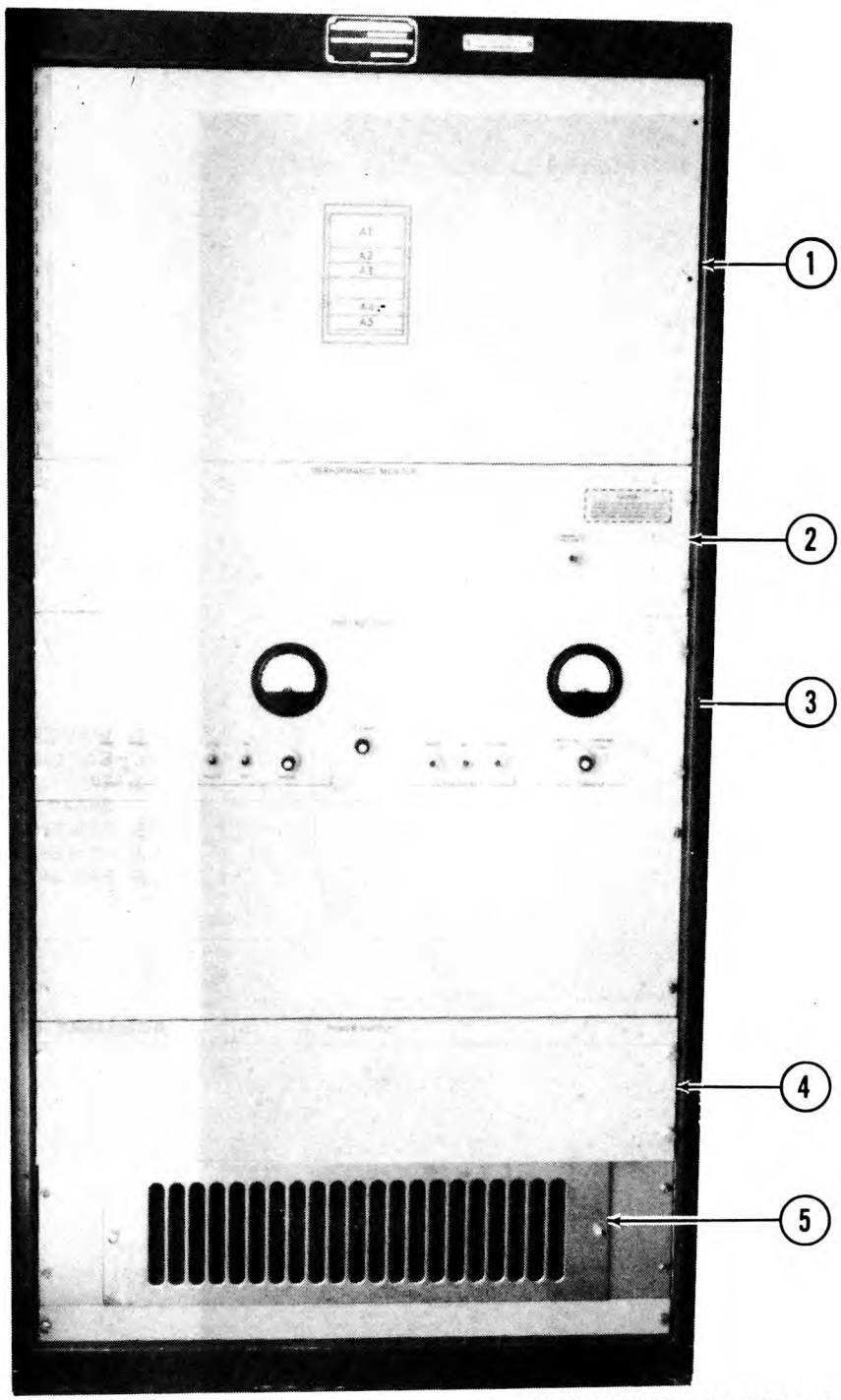
Figure 1-5. C-Band Antenna Trailer Components (Sheet 4)



ELEVATION TRANSMITTER CONSOLE 3A2 AND AZIMUTH TRANSMITTER CONSOLE 3A7

0095-F35

Figure 1-5. C-Band Antenna Trailer Components (Sheet 5)

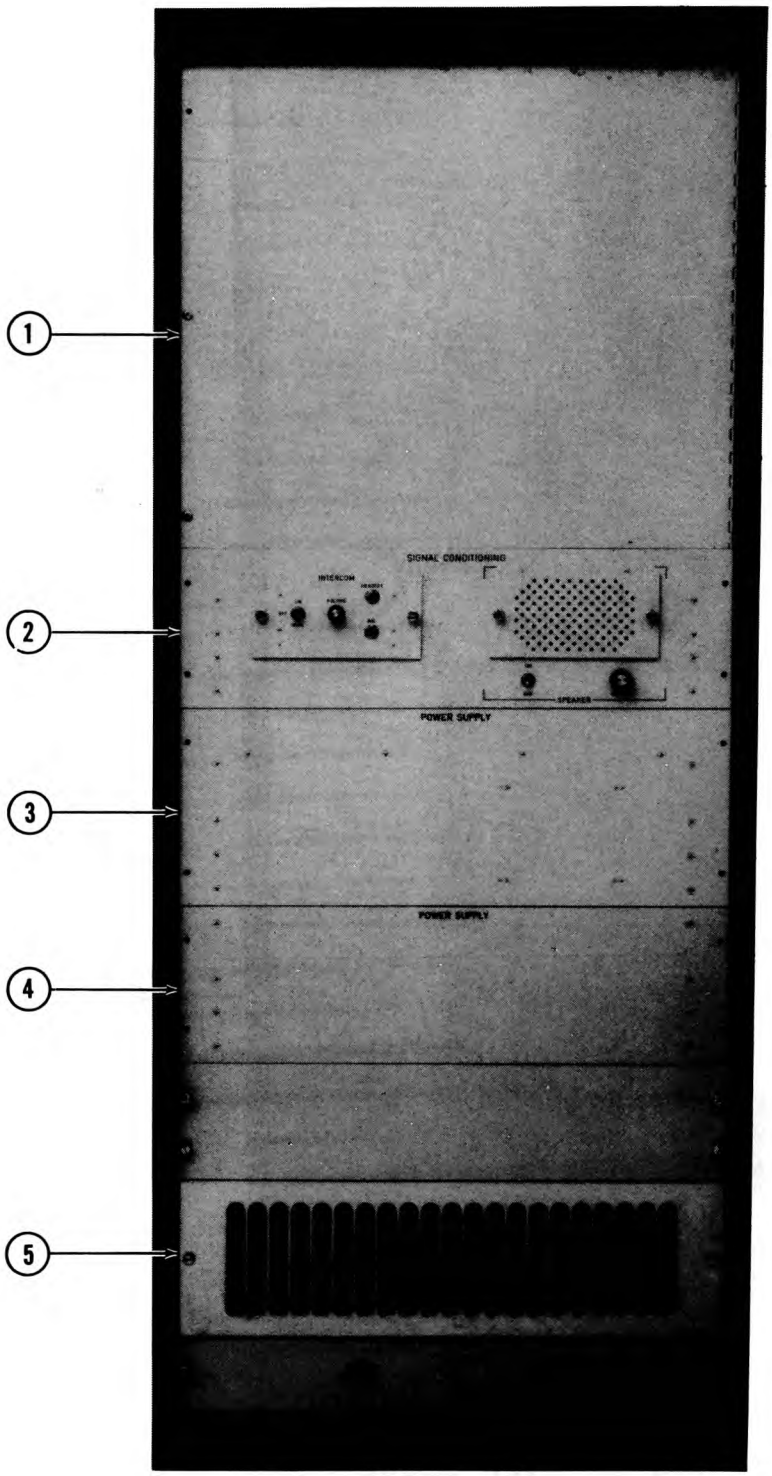


1. MICROWAVE ASSEMBLY 3A3A1, 3A8A1
2. PERFORMANCE MONITOR 3A3A2, 3A8A2
3. PRERECEIVER 3A3A3, 3A8A3
4. POWER SUPPLY 3A3A4, 3A8A4
5. FAN 3A3A5, 3A8A5

ELEVATION RECEIVER CONSOLE 3A3
AND
AZIMUTH RECEIVER CONSOLE 3A8

0095-36A

Figure 1-5. C-Band Antenna Trailer Components (Sheet 6)

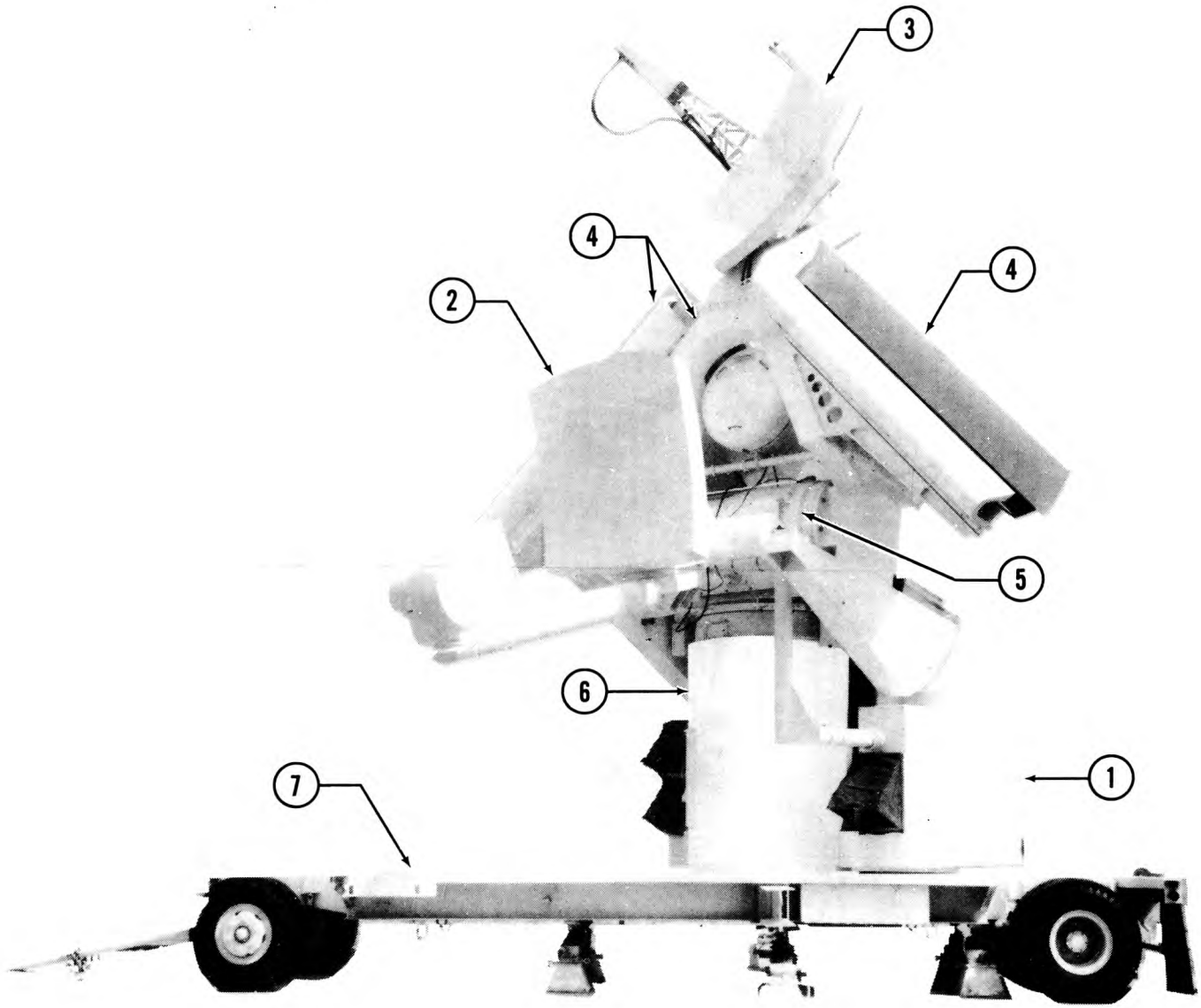


1. WAVEGUIDE AND SCANNER SWITCHING 3A6A1
2. SIGNAL CONDITIONING 3A6A2
3. POWER SUPPLY 3A6A3
4. POWER SUPPLY 3A6A4
5. FAN 3A6A5

AUXILIARY EQUIPMENT CONSOLE 3A6

0095-F37

Figure 1-5. C-Band Antenna Trailer Components (Sheet 7)



X-BAND ANTENNA TRAILER
UNIT 4

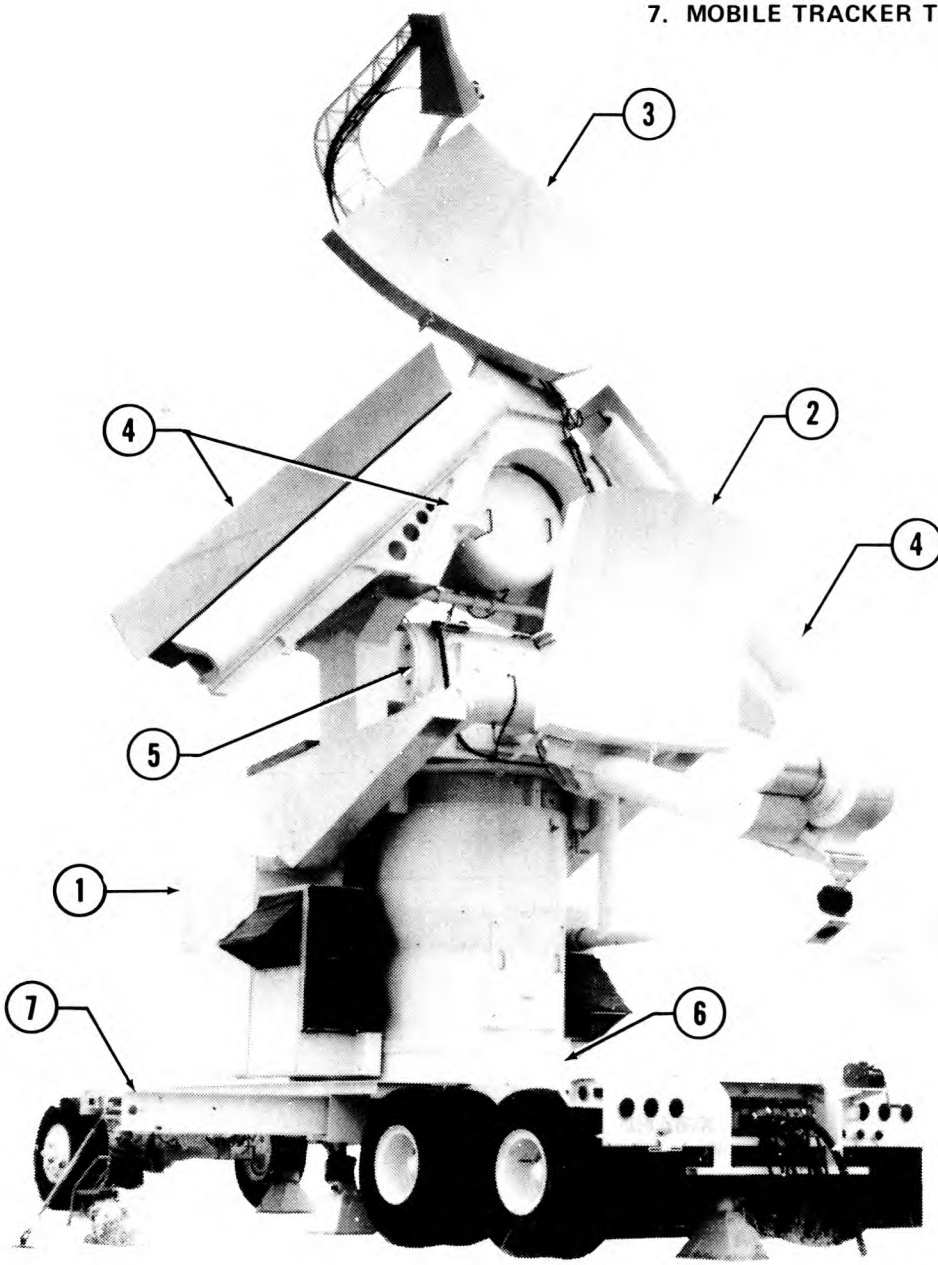
1. RTM ASSEMBLY (see sheet 3)
2. X-BAND ILLUMINATOR ANTENNA 4A11
3. L-BAND CUT DISH COMMAND ANTENNA 4A9
4. X-BAND TROUGH ANTENNA 4A10
5. ELEVATION PEDESTAL 4A7
6. AZIMUTH PEDESTAL 4A6
7. MOBILE TRACKER TRAILER

NOTE
AN/MPS-T1(V)1, (V)2 and (V)3 shown.

0095-388

Figure 1-6. X-Band Antenna Trailer Components (Sheet 1)

1. RTM ASSEMBLY (see sheet 3)
2. X-BAND ILLUMINATOR ANTENNA 4A11
3. L-BAND CUT DISH COMMAND ANTENNA 4A9
4. X-BAND TROUGH ANTENNA 4A10
5. ELEVATION PEDESTAL 4A7
6. AZIMUTH PEDESTAL 4A6
7. MOBILE TRACKER TRAILER

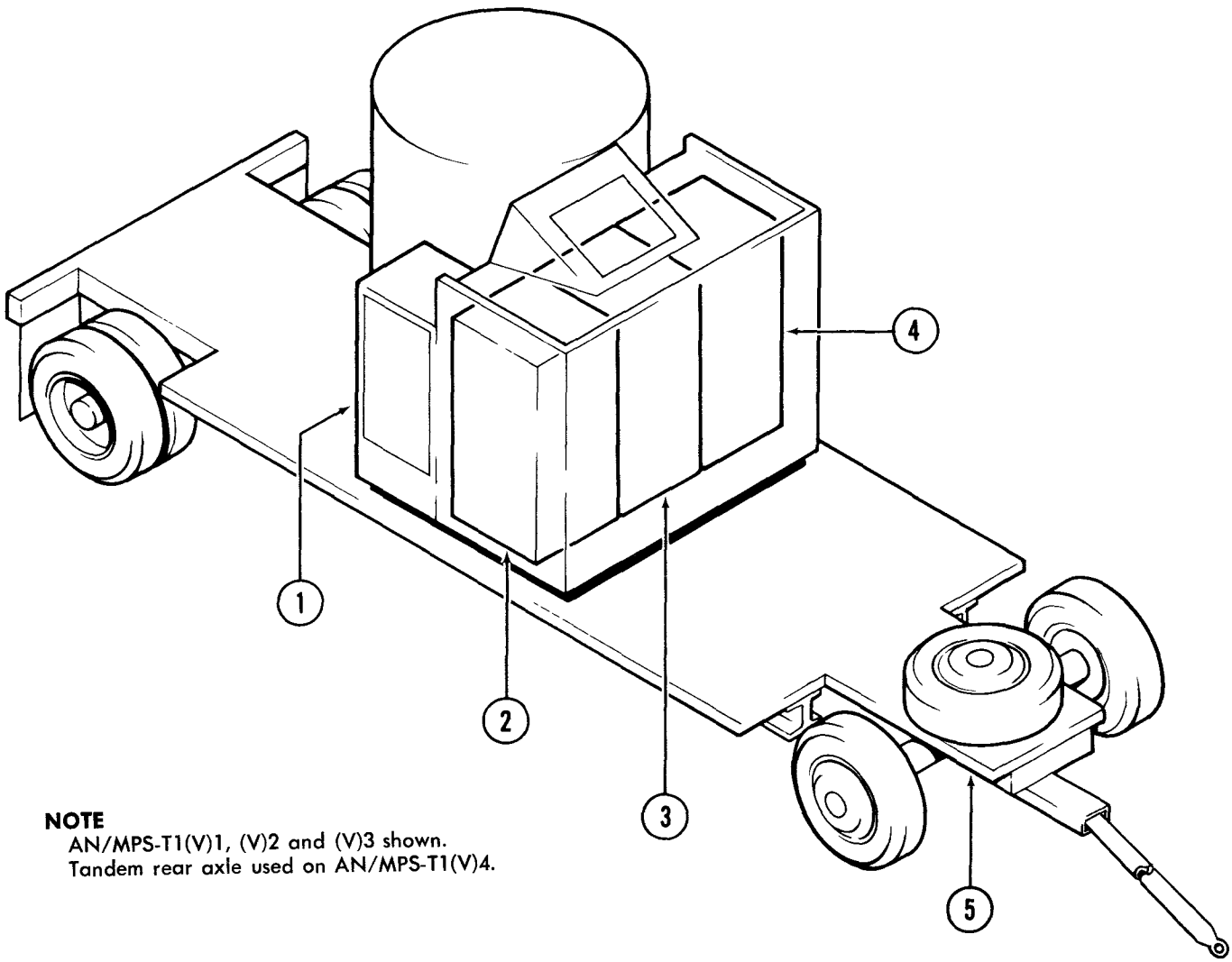


X-BAND ANTENNA TRAILER
UNIT 4

NOTE
AN/MPS-T1-(V)4 shown.

0095-469A

Figure 1-6. X-Band Antenna Trailer Components (Sheet 2)

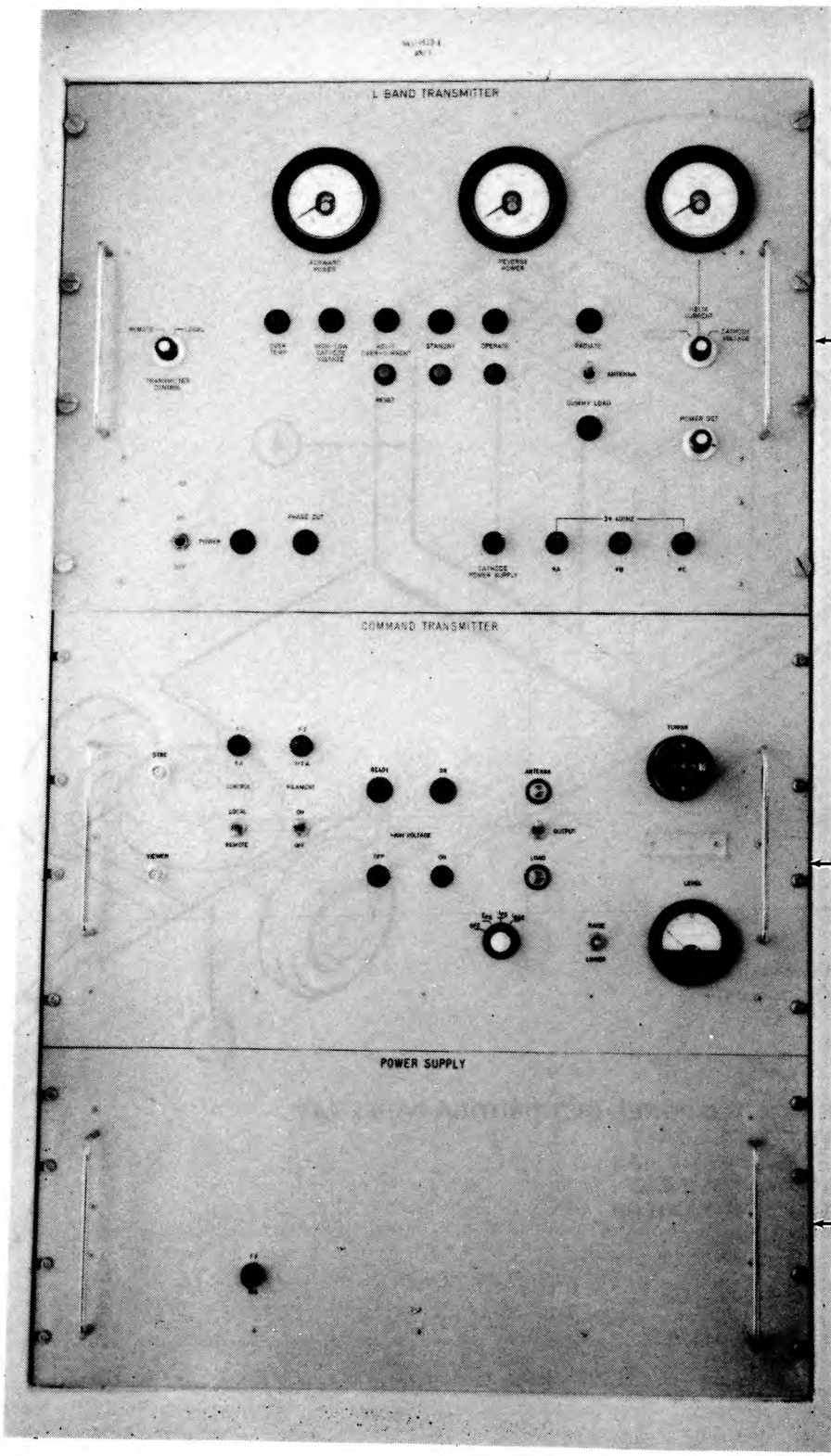


NOTE
AN/MPS-T1(V)1, (V)2 and (V)3 shown.
Tandem rear axle used on AN/MPS-T1(V)4.

1. JUNCTION BOX AND POWER DISTRIBUTION PANEL 4A5
2. LEFT RTM CONSOLE 4A1
3. CENTER RTM CONSOLE 4A3
4. RIGHT RTM CONSOLE 4A3
5. MOBILE TRACKER TRAILER

0095-39B

Figure 1-6. X-Band Antenna Trailer Components (Sheet 3)

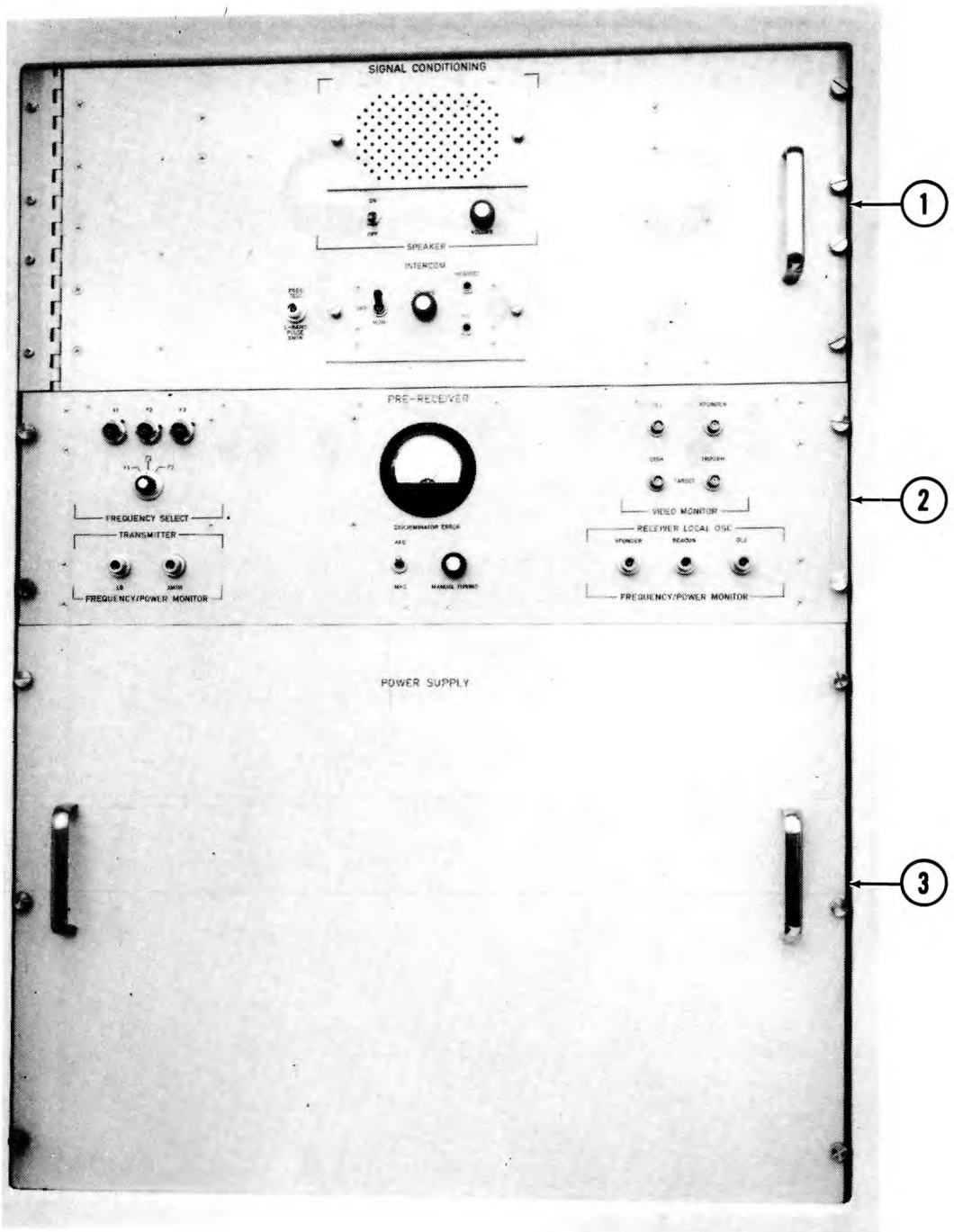


1. L-BAND CW COMMAND TRANSMITTER 4A1A1
2. L-BAND PULSED COMMAND TRANSMITTER 4A1A2
3. L-BAND PULSED COMMAND TRANSMITTER POWER SUPPLY 4A1A3

LEFT RTM CONSOLE 4A1

0095-40A

Figure 1-6. X-Band Antenna Trailer Components (Sheet 4)

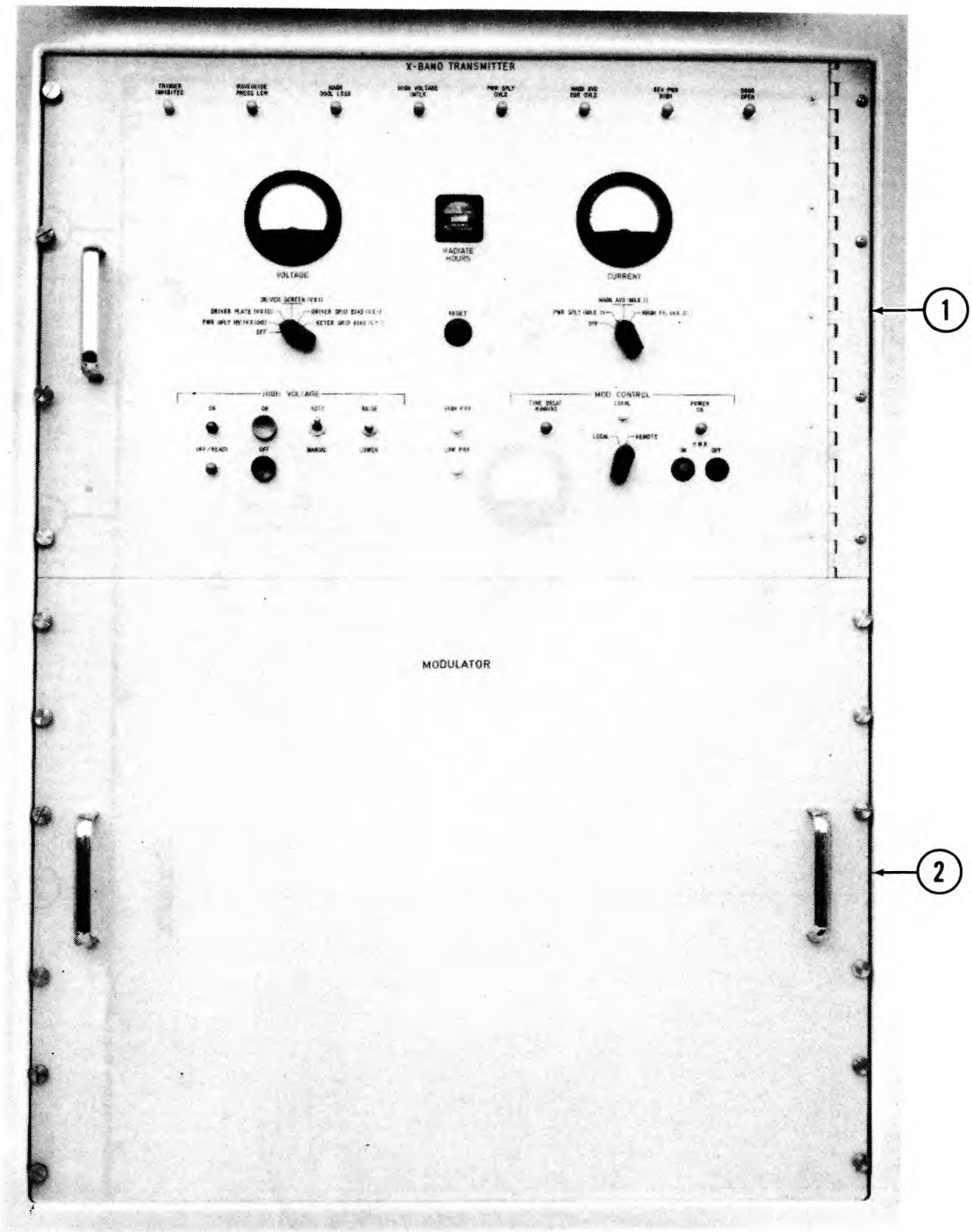


1. MICROWAVE UNIT 4A2A1
2. PRERECEIVER 4A2A2
3. POWER SUPPLY 4A2A3

CENTER RTM CONSOLE 4A2

0095-41

Figure 1-6. X-Band Antenna Trailer Components (Sheet 5)



1. X-BAND TRANSMITTER CONTROL 4A3A1
2. X-BAND TRANSMITTER MODULATOR 4A3A2

RIGHT RTM CONSOLE 4A3

0095-42

Figure 1-6. X-Band Antenna Trailer Components (Sheet 6)

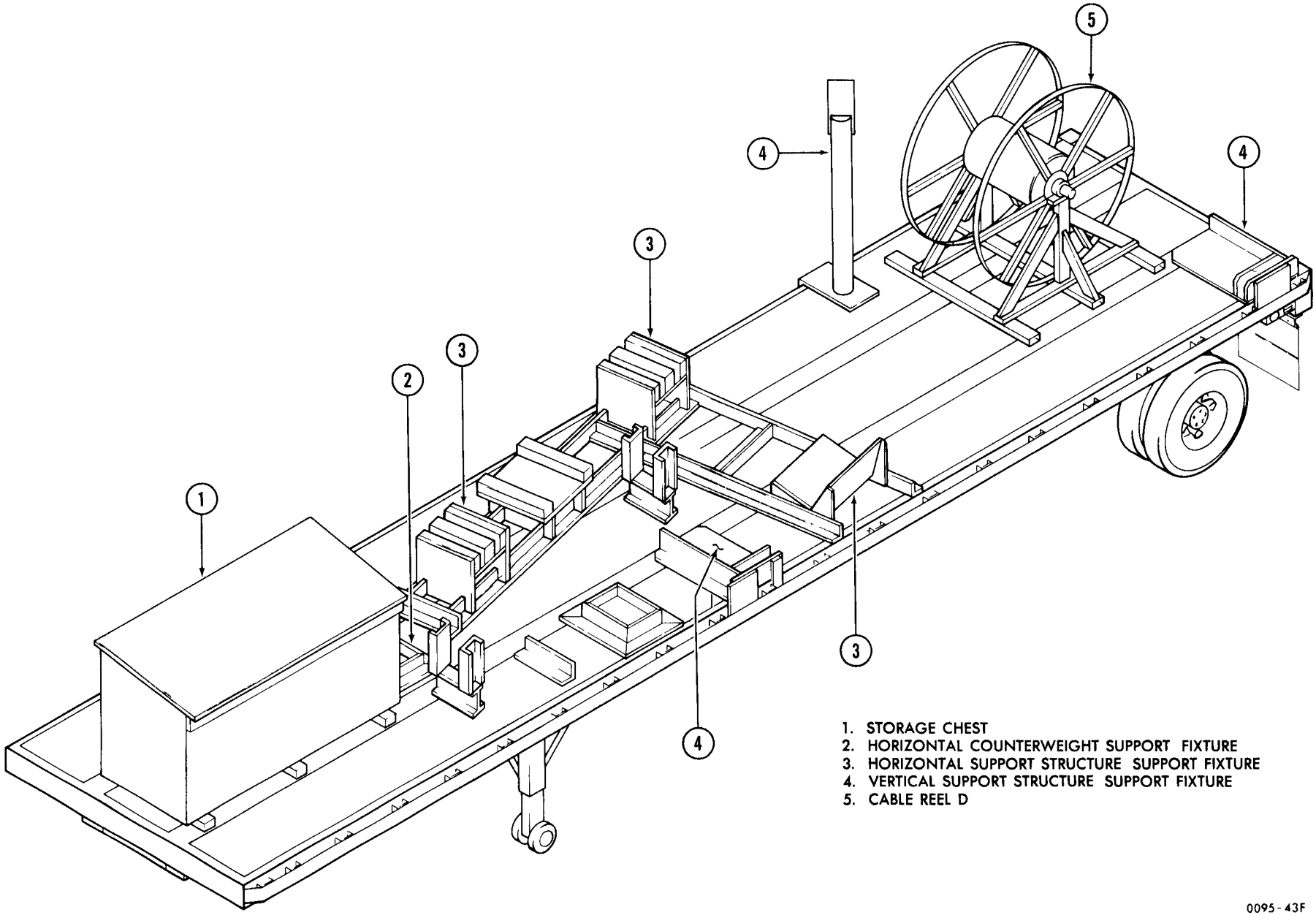


Figure 1-7. S-Band Antenna Structure Transport Trailer (Unloaded)

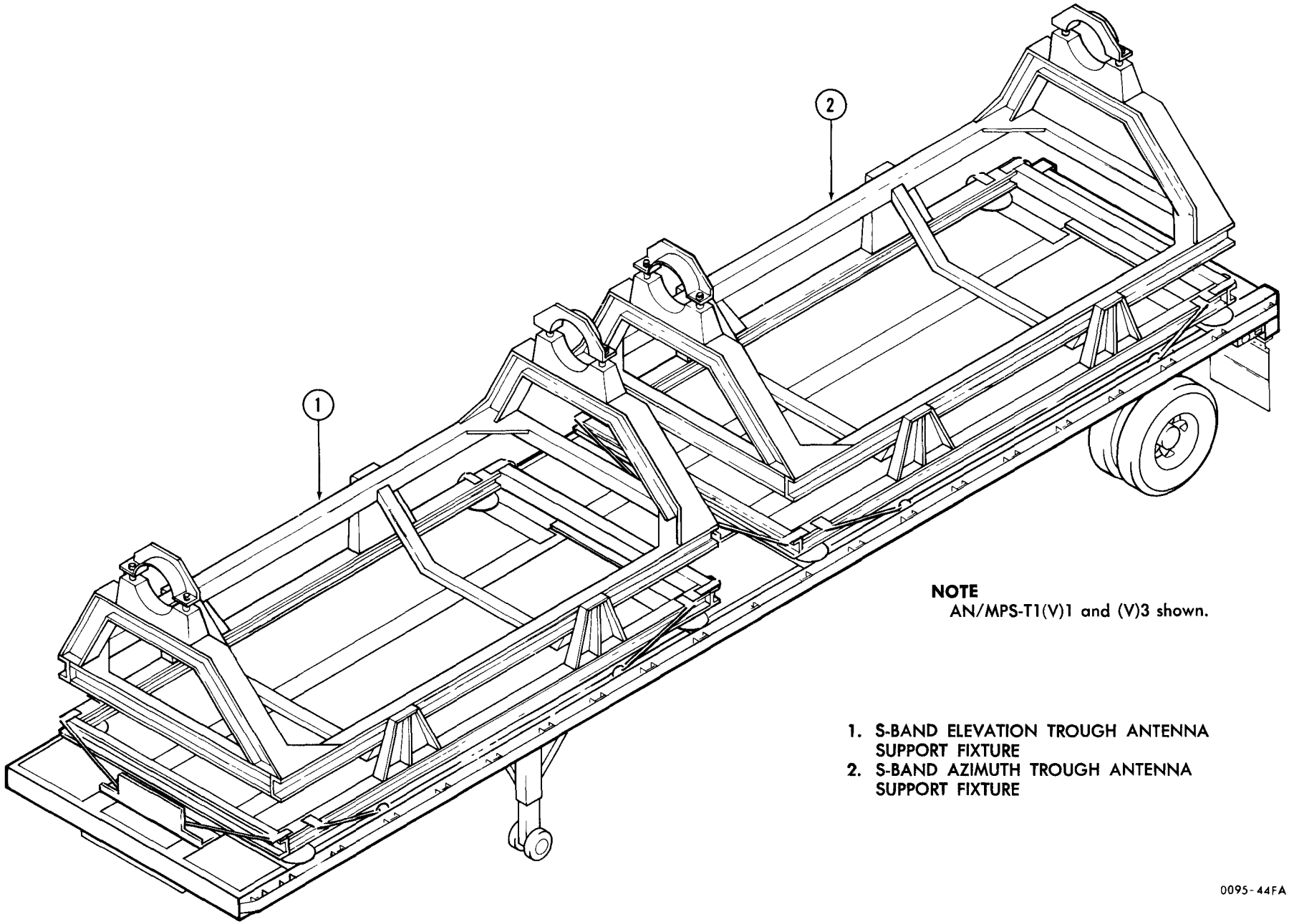


Figure 1-8. S-Band Trough Antenna Transport Trailer (Unloaded) (Sheet 1)

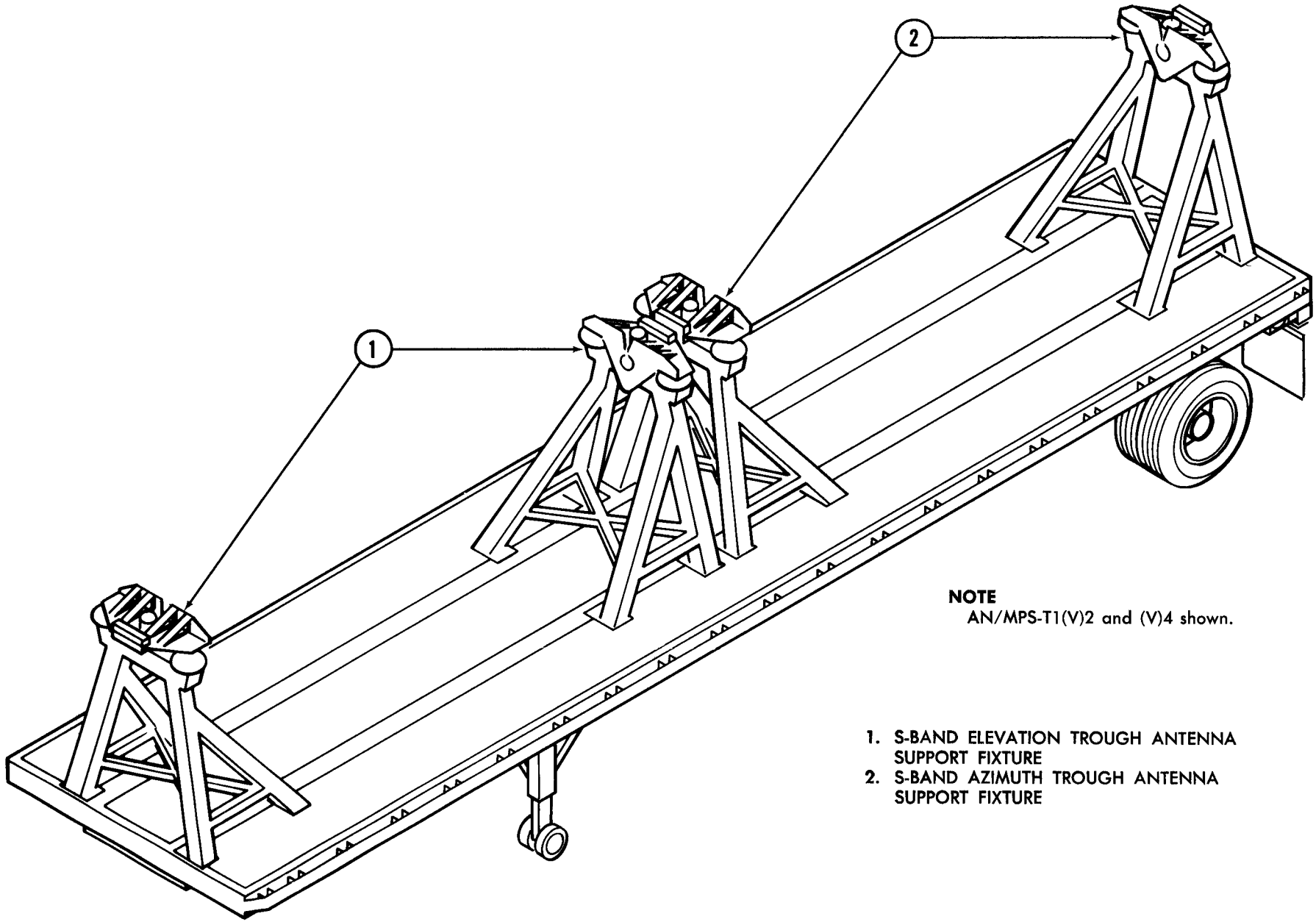


Figure 1-8. S-Band Trough Antenna Transport Trailer (Unloaded) (Sheet 2)

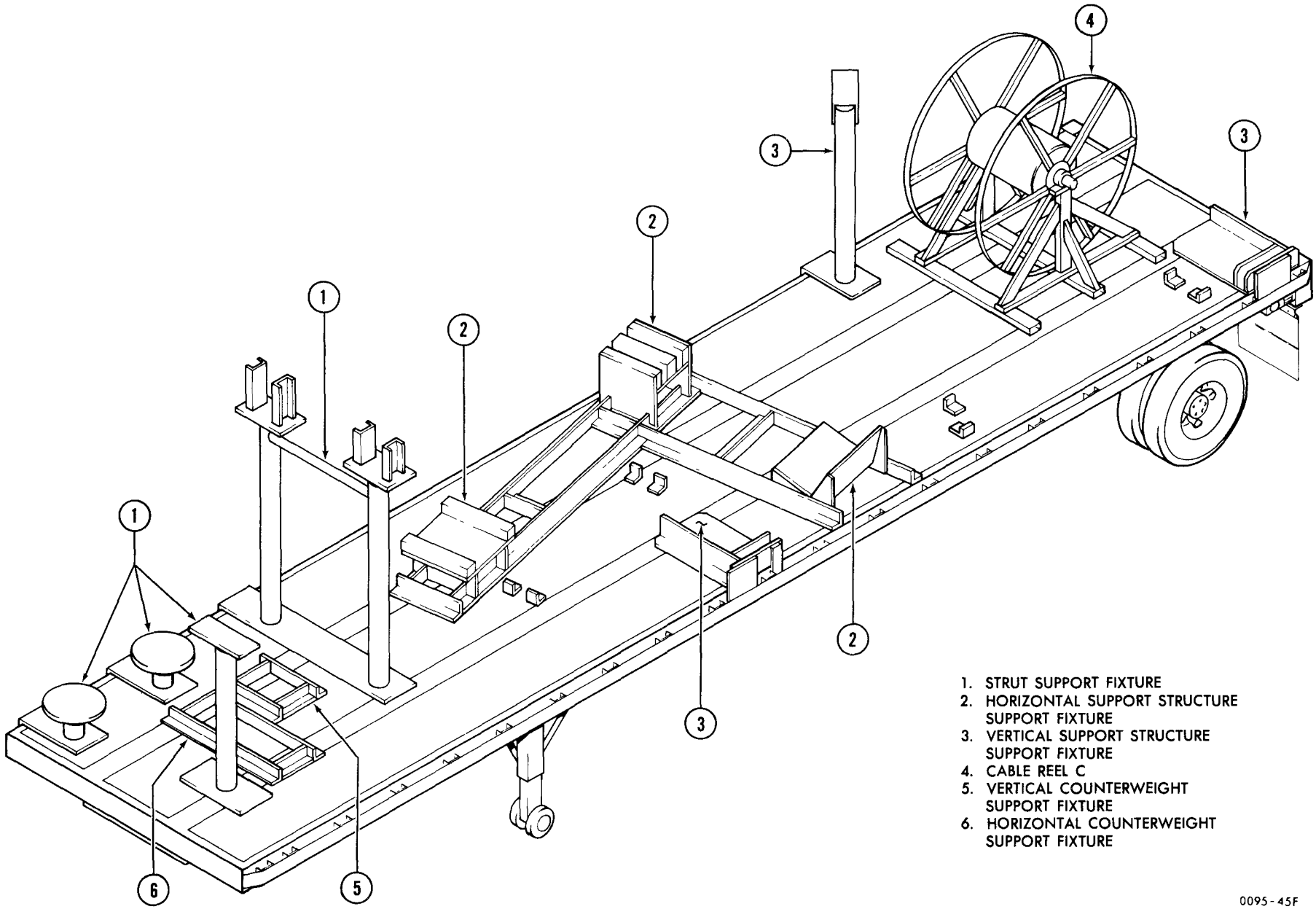
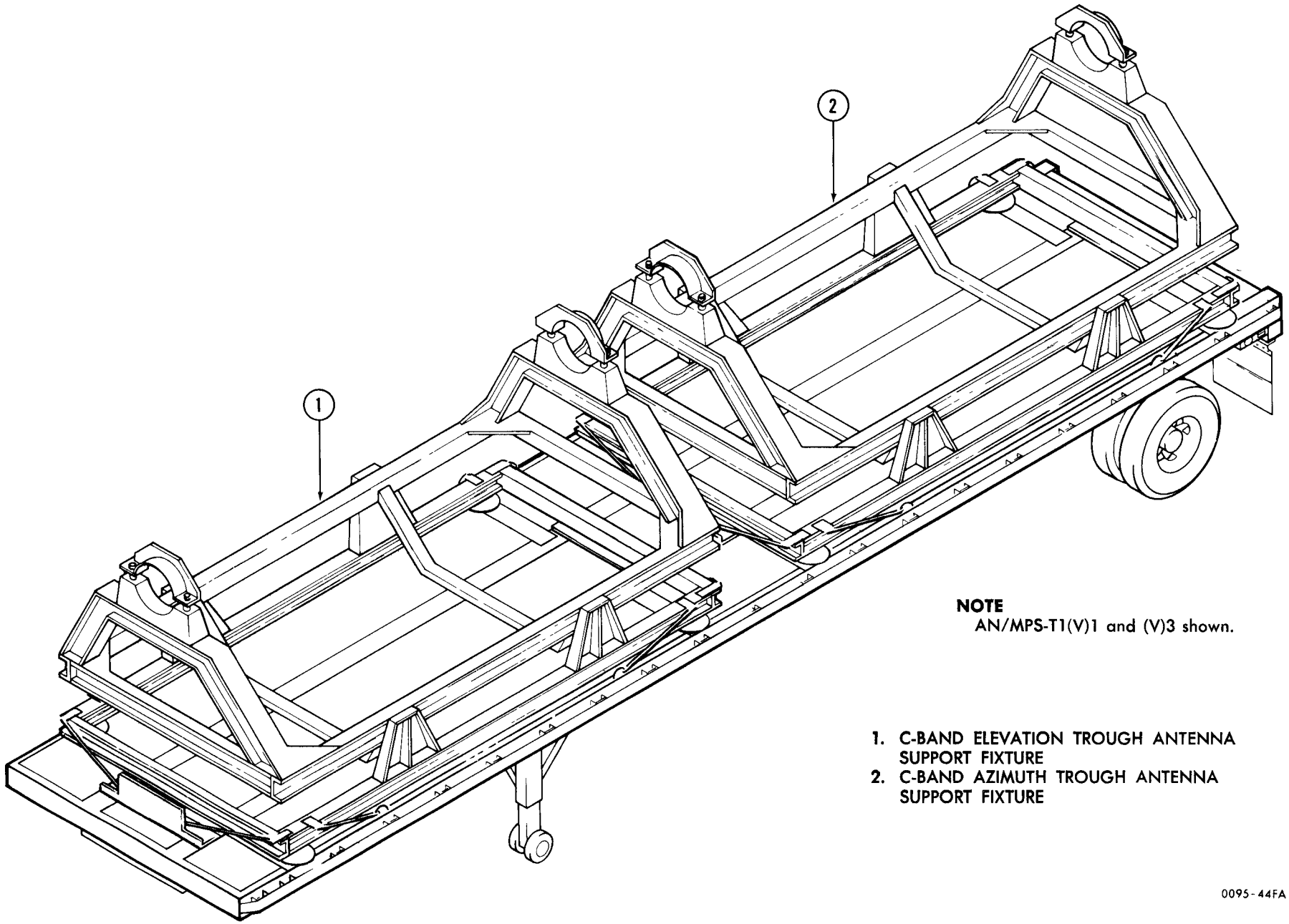


Figure 1-9. C-Band Antenna Structure Transport Trailer (Unloaded)



NOTE
AN/MPS-T1(V)1 and (V)3 shown.

1. C-BAND ELEVATION TROUGH ANTENNA SUPPORT FIXTURE
2. C-BAND AZIMUTH TROUGH ANTENNA SUPPORT FIXTURE

0095-44FA

Figure 1-10. C-Band Trough Antenna Transport Trailer (Unloaded) (Sheet 1)

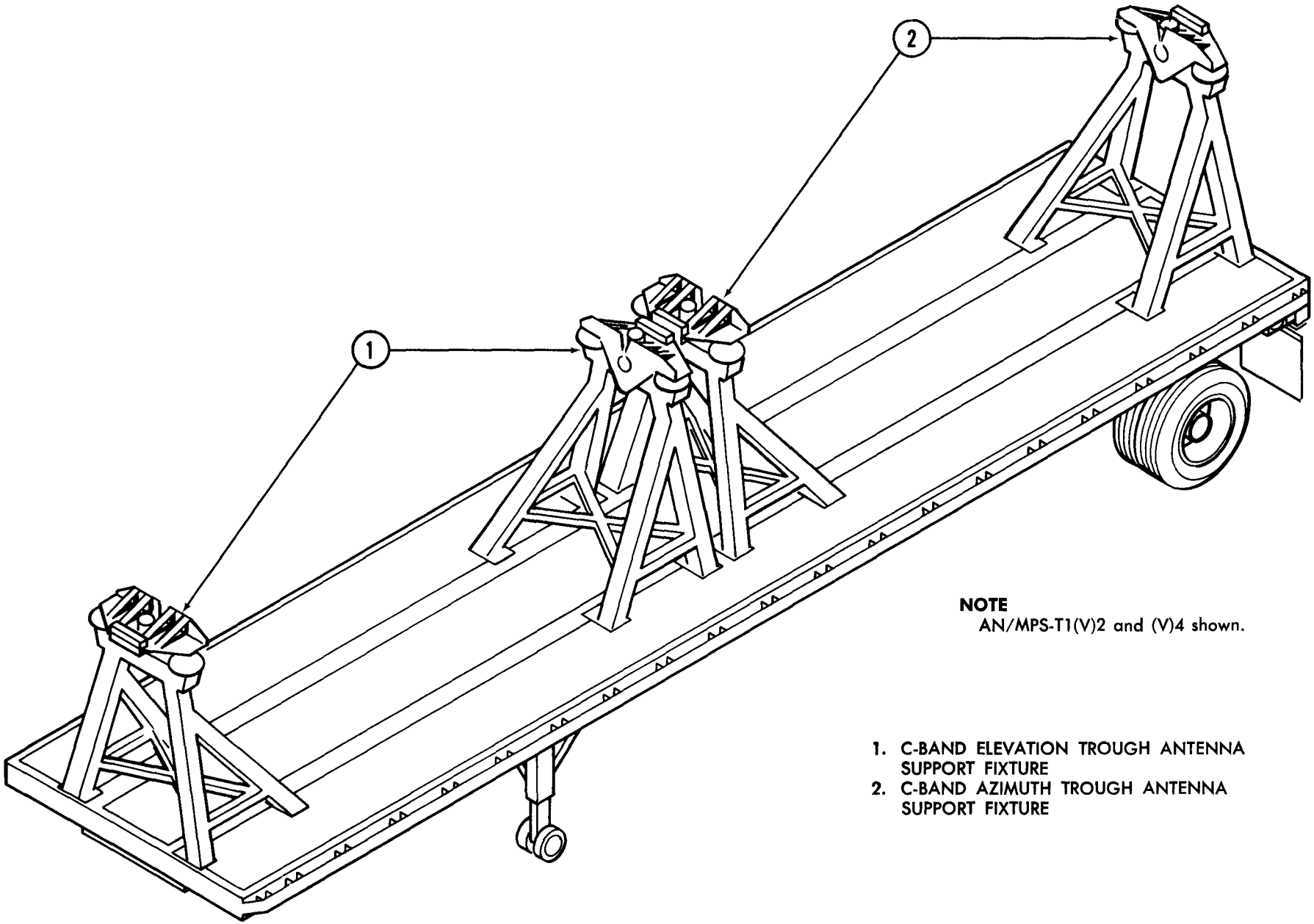


Figure 1-10. C-Band Trough Antenna Transport Trailer (Unloaded) (Sheet 2)

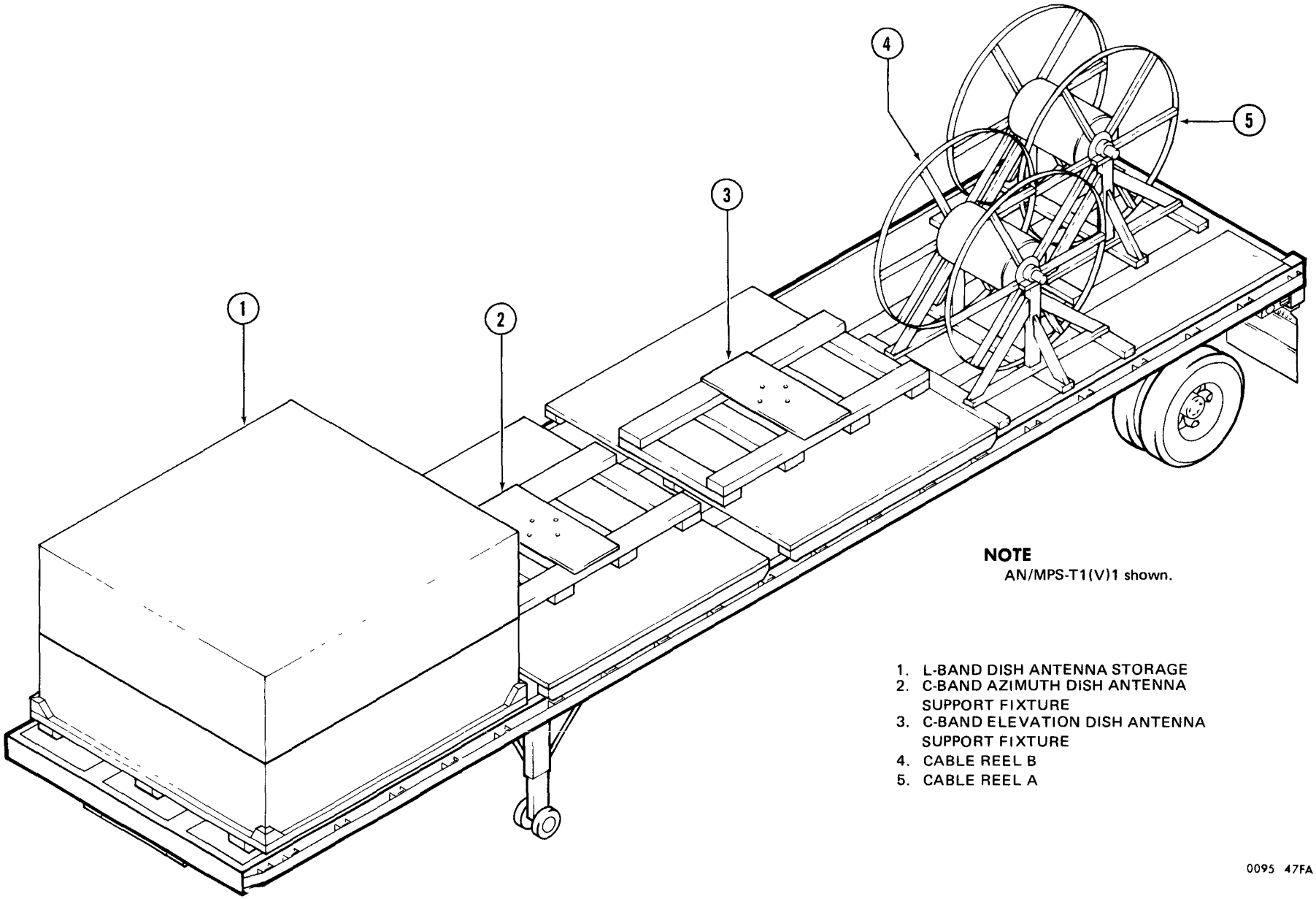
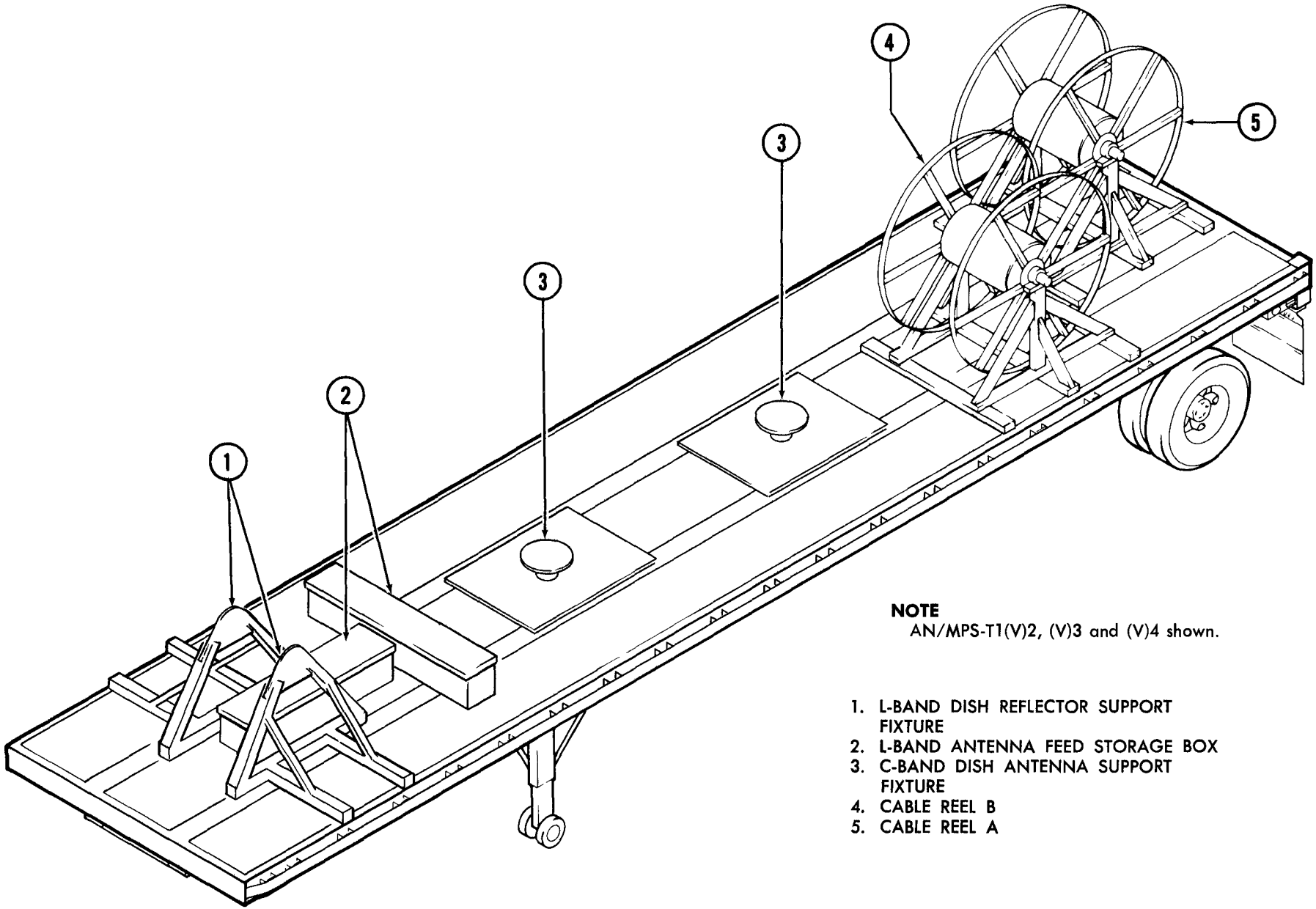


Figure 1-11. Dish Antenna Transport Trailer (Unloaded) (Sheet 1)



NOTE
AN/MPS-T1(V)2, (V)3 and (V)4 shown.

1. L-BAND DISH REFLECTOR SUPPORT FIXTURE
2. L-BAND ANTENNA FEED STORAGE BOX
3. C-BAND DISH ANTENNA SUPPORT FIXTURE
4. CABLE REEL B
5. CABLE REEL A

0095 47A

Figure 1-11. Dish Antenna Transport Trailer (Unloaded) (Sheet 2)

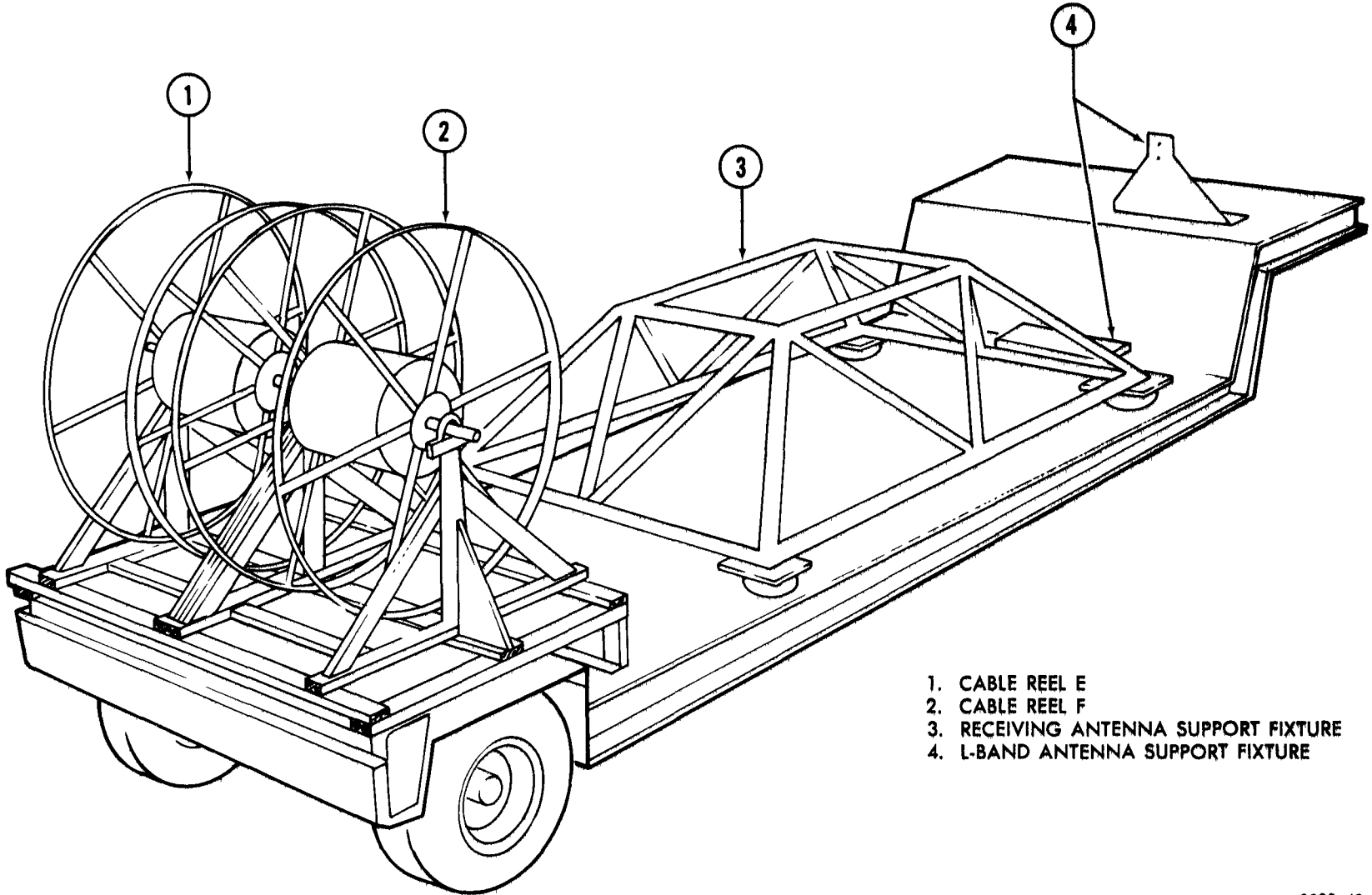


Figure 1-12. X-Band Antenna Transport Trailer (Unloaded)

1-13. LEADING PARTICULARS.

1-14. Leading particulars and logistical data for the radar set are listed or referenced in table 1-1. These data include primary power requirements, transportability, equipment dimensions and weight, waveguide requirements, cabling requirements, storage conditions, and setup times.

1-15. CAPABILITIES AND LIMITATIONS.

1-16. Capabilities and limitations of the radar set are listed in table 1-2. These data include performance characteristics, tracking options, modes of operation, environmental limitations, and ancillary information.

Table 1-1. Leading Particulars

PRIMARY POWER	
Primary Power Sources	1. 60 Hertz, 3-phase, Y-wound commercial or mobile source
	2. 400 Hertz, 3-phase motor-generator (MD-4)
Maximum Power Requirements Radar Set	1. 60 ±3 Hertz, 120/208 ± 5.0/8.6 volts, 3-phase, 4-wire system (three phases and neutral), 150 KW Total
	2. 400 ±20 Hertz, 120/208 ± 5.0/8.6 volts, 3-phase, 4-wire system (three phases and neutral), 52 KW Total
MD-4 Motor Generator	1. Refer to T.O. 35C2-2-31-Series
TRANSPORTABILITY	
Maximum Tow Speeds Radar Control Trailer	50 mph on paved roads
	20 mph on unimproved roads
Antenna Trailers (antennas stored)	40 mph on paved roads
	20 mph on unimproved roads
Antenna Trailers (antennas installed)	Do not tow
Transport Trailers (loaded)	50 mph on paved roads
	20 mph on unimproved roads

Table 1-1. Leading Particulars (Continued)

EQUIPMENT WEIGHT AND DIMENSIONS

Weight - Transport Configuration (Approximate Weight-Pounds)

	AN/MPS-T1(V)1, (V)2 AND (V)3	AN/MPS-T1 (V)4
Radar Control Trailer	26,500	28,000
S-Band Antenna Trailer (antennas and support structure detached)	29,300	31,300
C-Band Antenna Trailer (antennas and support structure detached)	29,200	31,200
X-Band Antenna Trailer (antennas and support structure detached)	33,800	36,100
S-Band Antenna Structure Transport Trailer (loaded)	26,000	26,000
C-Band Antenna Structure Transport Trailer (loaded)	24,900	24,900
S-Band Trough Antenna Transport Trailer (loaded)	14,000	14,000
C-Band Trough Antenna Transport Trailer (loaded)	14,400	14,400
L- and C-Band Dish Antenna Transport Trailer (loaded)	13,000	13,000
X-Band Antenna Transport Trailer (loaded)	19,200	19,200

Weight - Installed Configuration (Approximate - Pounds)

	AN/MPS-T1(V)1, (V)2 AND (V)3	AN/MPS-T1 (V)4
Radar Control Trailer	26,500	28,000
S-Band Antenna Trailer	42,780	44,700
C-Band Antenna Trailer	42,680	44,600
X-Band Antenna Trailer	47,240	49,460

Table 1-1. Leading Particulars (Continued)

	AN/MPS-T1(V)1, (V)2 AND (V)3	AN/MPS-T1 (V)4
Transport Trailers		
Flatbed (unloaded)	7,000	7,000
Lowbed (unloaded)	7,500	7,500
Dimensions - Transport Configuration (Approximate)		
Radar Control Trailer (radio set antenna detached)	40 feet long by 8 feet wide by 13 feet high	
Antenna Trailers (antennas and support structure detached)	26 feet by 8 feet by 13 feet 5 inches	
Transport Trailers		
Flatbed	40 feet by 8 feet by 12 feet (maximum)	
Lowbed	34 feet 2 inches by 8 feet by 12 feet (maximum)	
Dimensions - Installed Configuration (Approximate)		
Radar Control Trailer (radio set antenna installed)	40 feet by 8 feet by 14 feet	
S- and C-Band Antenna Trailers (antennas installed)	26 feet by 35 feet by 30 feet	
X-Band Antenna Trailer	26 feet by 18 feet by 28 feet	
Transport Trailers		
Flatbed	40 feet by 8 feet by 4 feet 5 inches	
Lowbed	34 feet 2 inches by 8 feet by 5 feet	
CABLING REQUIREMENTS	See tables 2-4 and 2-5, T.O. 43D7-11-21-2-1	
WAVEGUIDE REQUIREMENTS	See table 2-6, T.O. 43D7-11-21-2-1	
STORAGE CONDITIONS		
Transport Trailer	Provide 2700 square feet combined minimum covered storage for six transport trailers. Provide 450 square feet for separate/individual trailer storage. (See figures 1-7 through 1-12)	
SETUP TIME:	See table 2-7, T.O. 43D7-11-21-2-1	

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS, RADAR TRAINING SET, AN/MPS-T1(V) T.O. 43D7-11-21-2-1-1 FOR TABLE 1-2

1-17. EQUIPMENT SUPPLIED.

1-18. The items of equipment that comprise the radar set are listed in table 1-3. The four variations of these radar sets are identified by suffixes (V)1 through (V)4 and are shown as Part I through Part IV in table 1-3.

Table 1-3. Equipment Supplied
Part I. Radar Set AN/MPS-T1(V)1

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
Unit 1	Radar Control Trailer	Radar Set Control Group	OK-251/M
1A1	Guidance Operator Console	Console, Target Tracking	OJ-303/M
1A1A1	Mode Control	Control, Transmitter	C-9323/M
1A1A2	Azimuth Indicator	Indicator, Azimuth-Range	IP-1147/M
1A1A3	Elevation Indicator	Indicator, Elevation-Range	IP-1234/M
1A1A4	Tracking Control	Control, Target Tracking	C-9324/M
1A1A5	Synchronizer	Synchronizer, Electrical	SN-479/M
1A1A6	Power Supply Assembly	Power Supply Assembly	PP-6912/M
1A1A7	Indicator Power Supply	Power Supply Assembly	PP-6913/M
1A2	Signal Distribution Panel	Panel, Signal Distribution, Radar	
1A3	Transponder Console	Console, Reference Tracking	OJ-304/M
1A3A1	Transponder Receiver	Receiver, Radar	R-1837/M
1A3A2	Azimuth Indicator	Indicator, Azimuth-Range	IP-1149/M
1A3A3	Elevation Indicator	Indicator, Elevation-Range	IP-1148/M
1A3A4	Tracking Control	Control, Reference Signal	C-9325/M
1A3A5	Power Supply Assembly	Power Supply Assembly	PP-6914/M
1A3A6	Indicator Power Supply	Power Supply Assembly	PP-6915/M
1A4	Oscilloscope	Oscilloscope	
1A5	Radar Console	Console, Radar Set	OJ-343/M

Table 1-3. Equipment Supplied
Part I. Radar Set AN/MPS-T1(V)1 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
1A5A1	S- and C-Band Transmitter Control Panel	Control, Transmitter	C-9713/M
1A5A2	Power and Frequency Control	Control, Frequency Selector-Power	C-9711/M
1A5A3	Transmitter Coder	Coder, Transmitter	KY-809/M
1A5A5	Receiver Select	Selector, Receiver Signal	SA-2026/M
1A5A6	Power Monitor	Monitor, Radio Frequency	ID-1997/M
1A5A7	L-Band Transmitter Control Panel	Control, Transmitter	C-9713/M
1A5A8	Digital Voltmeter	Voltmeter, Digital	ME-473/M
1A5A9	Noise Figure Meter	Radio Interference Field Intensity Meter	IM-232/M
1A5A10	S-Band Servo Amplifier	Amplifier, Electronic Control	AM-6732/M
1A5A11	S-Band DC Amplifier	Amplifier, Direct Current	AM-6733/M
1A5A12	S-Band Servo Control	Control, Antenna	C-9714/M
1A5A13	Power Supply Assembly	Power Supply Assembly	PP-7134/M
1A5A14	Computer Interface	Converter, Analog-to-Digital	CV-3229/M
1A5A15	Signal Test Panel	Panel, Test, Electrical	SB-3798/M
1A5A16	Digital Voltmeter Test Panel	Panel, Test, Electrical	SB-3797/M
1A5A17	C-Band Servo Amplifier	Amplifier, Electronic Control	AM-6732/M
1A5A18	C-Band DC Amplifier	Amplifier, Direct Current	AM-6733/M
1A5A19	C-Band Servo Control	Control, Antenna	C-9714/M
1A5A20	Power Supply Assembly	Power Supply Assembly	PP-7136/M
1A5A21	Intercom	Intercommunication Station	LS-620/M

Table 1-3. Equipment Supplied
Part I. Radar Set AN/MPS-T1(V)1 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
1A5A22	Recorder DC Amplifier	Amplifier Assembly	AM-6731/M
1A5A23	Recorder	Recorder, Coordinate Data	
1A5A24	Recorder Input Panel	Panel, Signal Distribution, Radar	SB-3796/M
1A5A25	Recorder Takeup Reel	Panel, Chart Takeup	
1A5A26	Recorder Master Power Panel	Panel, Power Distribution	
1A5A27	X- and L-Band Transmitter Control Panel	Control, Transmitter	C-9710/M
1A6	Radio Set (GFE)	Radio Set Assembly (GFE)	AN/GRC-27
1A8	Digital Computer Console	Computer-Intercom Station	CP-1236/M
1A8A1	High Speed Tape Punch	Perforator, Tape	
1A8A2	Tape Reader	Reader, Perforated Tape	
1A8A3	Spooler	Handler, Perforated Tape	
1A8A4	Control Panel	Control, Computer	
1A8A5	Intercom	Intercom Station	LS-620/M
1A8A6	Multiverter	Converter, Analog-to-Digital and Digital-to-Analog	
1A8A8	Power Supply	Power Supply Assembly	
1A8A9	Auxiliary Unit	Logic Auxiliary	
1A8A10	Main Power Distribution	Panel, Power Distribution	
1A8A11	Power Supply	Power Supply Assembly	
1A8A12	Main Frame	Logic, Central Processor	
1A8A13	Memory	Core Memory Unit	

Table 1-3. Equipment Supplied
Part I. Radar Set AN/MPS-T1(V)1 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
1A9	Teletype	Teletypewriter	TT-685/M
1A10	Workbench	Work Table	
1A11	S- and C-Band Manual Tracker Console	Console, Target Tracking	OJ-302/M
1A11A1	Azimuth Receiver	Receiver, Radar	R-1835/M
1A11A2	Azimuth Indicator	Indicator, Azimuth-Elevation-Range	IP-1145/M
1A11A3	Azimuth Tracking Control	Control, Antenna	C-9320/M
1A11A4	Azimuth Intercom	Intercom Station	LS-620/M
1A11A5	Sweep Generator	Generator, Sweep	O-1654/M
1A11A6	Range Indicator	Indicator, Azimuth-Elevation-Range	IP-1146/M
1A11A7	Range Tracking Control	Control, Tracking, Range	C-9321/M
1A11A8	Indicator Power Supply	Power Supply Assembly	PP-6910/M
1A11A9	Range Intercom	Intercom Station	LS-620/M
1A11A10	Elevation Intercom	Intercom Station	LS-620/M
1A11A11	Elevation Receiver	Receiver, Radar	R-1836/M
1A11A12	Elevation Indicator	Indicator, Azimuth-Elevation-Range	IP-1145/M
1A11A13	Elevation Tracking Control	Control, Antenna	C-9332/M
1A11A14	Power Supply Assembly	Power Supply Assembly	PP-6911/M
1A12	Power Distribution Console	Switchboard, Power Supply	SB-3799/M
1A14	Power Entry	Power Connector Panel Assembly	
1A15	Van Semitrailer	Semitrailer, Van	

Table 1-3. Equipment Supplied
Part I. Radar Set AN/MPS-T1(V)1 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
1A16	Radio Set Antenna (GFE)	Antenna (GFE)	
1A17	X-Band Manual Tracker Console	Console, Target Tracking	OJ-344/M
1A17A1	Reference Receiver	Receiver, Radar	R-1930/M
1A17A2	Moving Target Indicator	Comparator, Signal	CM-450/M
1A17A3	Target Receiver	Receiver, Radar	R-1931/M
1A17A4	Target Tracking	Tracker, Target	MX-9646/M
1A17A6	X-Band Servo Amplifier	Amplifier, Electronic Control	AM-6732/M
1A17A7	X-Band DC Amplifier	Amplifier, Direct Current	AM-6733/M
1A17A8	X-Band Servo Control	Control, Antenna	C-9714/M
1A17A9	T1 Intercom	Intercom Station	LS-620/M
1A17A10	Down Link Jammer Receiver	Receiver, Radar	R-1932/M
1A17A11	T1 Indicator	Indicator, Azimuth-Elevation-Range	IP-1189/M
1A17A12	T1 Tracking Control	Control, Target Tracking	C-9715/M
1A17A13	Indicator Power Supply	Power Supply	PP-7137/M
1A17A14	Power Supply Assembly	Power Supply Assembly	PP-7138/M
1A17A15	T2 Intercom	Intercom Station	LS-620/M
1A17A16	Target Simulator	Simulator, Radar Target	SM-709/M
1A17A17	T2 Indicator	Indicator, Azimuth-Elevation-Range	IP-1189/M
1A17A18	T2 Tracking Control	Control, Target Tracking	C-9716/M
1A17A19	Reference Pedestal Servo	Programmer, Antenna Position	MX-9647/M

Table 1-3. Equipment Supplied
Part I. Radar Set AN/MPS-T1(V)1 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
1A19	Automatic Position Plotter Console	Console, Target Tracking	OJ-345/M
1A19A1	Automatic Position Plotter Indicator	Indicator, Azimuth-Range	IP-1190/M
1A19A2	Sweep Control	Control, Indicator	C-971/M
1A19A3	Intercom	Intercom System	LS-620/M
1A19A4	Power Supply Assembly	Power Supply Assembly	PP-6911/M
1A19A5	Indicator Power Supply	Power Supply	PP-7137/M
1A19A6	Radio Set Control (GFE)	Radio Set, Control (GFE)	
1A20	Common Data Point Assembly	Control, Indicator	C-9941/M
Unit 2	S-Band Antenna Trailer	Antenna-Receiver-Transmitter Group, Trailer Mounted	OY-55/M
P/O Unit 2	Mobile Tracker Trailer Assembly	Antenna Pedestal-Trailer	OA-8797/M
P/O Unit 2	Mobile Tracker	Antenna Pedestal Group	OA-8798/M
P/O Unit 2	Antenna Trailer	Trailer, Antenna	V-482/M
2A1	L-Band Pulsed Command Transmitter Console	Transmitter Group	OT-83/M
2A1A1	L-Band Pulsed Command Transmitter	Transmitter, Radar	T-1296/M
2A1A2	L-Band Pulsed Command Transmitter Power Supply	Power Supply	PP-7139/M
2A1A3	Performance Monitor	Monitor, Radio Frequency	ID-1999/M
2A1A4	Fan	Fan, Centrifugal	
2A1A5	Storage Drawer	Drawer, Electrical Equipment Cabinet	

Table 1-3. Equipment Supplied
Part I. Radar Set AN/MPS-T1(V)1 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
2A2	Elevation Transmitter Console	Transmitter Group	OT-84/M
P/O 2A2	Control Panel	Control, Transmitter	C-9721/M
P/O 2A2	Trigger Control Assembly	Generator, Pulse	O-1689/M
P/O 2A2	Reverse Power Trip Assembly	Control, Power Supply	C-9722/M
P/O 2A2	Charging Control Assembly	Control, Modulator	C-9720/M
P/O 2A2	Modulator	Modulator, Radar	MD-955/M
P/O 2A2	Thyratron Bias Control	Control Modulator	C-9719/M
P/O 2A2	High Voltage Power Supply	Power Supply Set	OP-99/M
P/O 2A2	Magnetron Filament Control	Control, Magnetron Filament	C-9718/M
P/O 2A2	Current Overload	Relay, Current Overload	RE-1103/M
P/O 2A2	Transformer	Transformer Assembly	TF-573/M
P/O 2A2	Power Supply	Power Supply	PP-7140/M
2A3	Elevation Receiver Console	Receiver Group	OR-159/M
2A3A1	Microwave Assembly	Installation, S-Band Microwave	
2A3A2	Performance Monitor	Monitor, Radio Frequency	ID-2000/M
2A3A3	Prereceiver	Receiver, Radar	R-1933/M
2A3A4	Power Supply Assembly	Power Supply Assembly	PP-7241/M
2A3A5	Fan	Fan, Centrifugal	
2A4	Power Distribution Panel	Panel, Power Distribution	

Table 1-3. Equipment Supplied
Part I. Radar Set AN/MPS-T1(V)1 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
2A5	Junction Box	Junction Box	
2A6	Auxiliary Equipment Console	Console, Auxiliary Equipment	OJ-367/M
2A6A1	Waveguide and Scanner Switching	Relay Assembly	RE-1108/M
2A6A2	Signal Conditioning	Relay Assembly Group	OA-8852/M
2A6A3	Power Supply	Transformer Assembly	TF-580/M
2A6A4	Power Supply Assembly	Power Supply Assembly	PP-7243/M
2A6A5	Fan	Fan, Centrifugal	
2A7	Azimuth Transmitter Console	Transmitter Group	OT-84/M
P/O 2A7	Control Panel	Control, Transmitter	C-9721/M
P/O 2A7	Trigger Control Assembly	Generator, Pulse	O-1689/M
P/O 2A7	Reverse Power Trip Assembly	Control, Power Supply	C-9722/M
P/O 2A7	Charging Control Assembly	Control, Modulator	C-9720/M
P/O 2A7	Modulator	Modulator, Radar	MD-955/M
P/O 2A7	Thyratron Bias Control	Control Modulator	C-9719/M
P/O 2A7	High Voltage Power Supply	Power Supply Set	OP-99/M
P/O 2A7	Magnetron Filament Control	Control, Magnetron Filament	C-9718/M
P/O 2A7	Current Overload	Relay, Current Overload	RE-1103/M
P/O 2A7	Transformer Assembly	Transformer Assembly	TF-573/M
P/O 2A7	Power Supply	Power Supply	PP-7140/M

Table 1-3. Equipment Supplied
Part I. Radar Set AN/MPS-T1(V)1 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
2A8	Azimuth Receiver Console	Receiver Group	OR-159/M
2A8A1	Microwave Assembly	Installation, S-Band Microwave	
2A8A2	Performance Monitor	Monitor, Radio Frequency	ID-2000/M
2A8A3	Prereceiver	Receiver, Radar	R-1933/M
2A8A4	Power Supply Assembly	Power Supply Assembly	PP-7141/M
2A8A5	Fan	Fan, Centrifugal	
2A9	Azimuth Pedestal Assembly	Antenna Pedestal Group	OA-8799/M
2A9A1	Synchro Assembly (TX)	Synchro, Transmitter Assembly	SN-502/M
2A9A2	Synchro Assembly (CT)	Synchro, Control Transformer Assembly	SN-503/M
2A9A3	Drive Unit	Actuator, Electro-Mechanical, Rotary	TG-234/M
2A9A5	Fuse and Circuit Breaker Panel	Panel, Circuit Breaker-Fuse	
2A9A6	Service Outlets		
2A9A7	Azimuth Power Amplifier	Amplifier, Electronic Control	AM-6826/M
2A9A8	Elevation Power Amplifier	Amplifier, Electronic Control	AM-6826/M
2A9A9	Slip Rings	Slip Ring Assembly	
2A9A23	Fan	Fan, Tube Axial	
2A10	Elevation Pedestal Assembly	Antenna Pedestal Group	OA-8800/M
2A10A1	Synchro Assembly (TX)	Synchro, Transmitter Assembly	SN-502/M

Table 1-3. Equipment Supplied
Part I. Radar Set AN/MPS-T1(V)1 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
2A10A2	Synchro Assembly (CT)	Synchro, Control Transformer Assembly	SN-503/M
2A10A3	Limit Switch Assembly	Switch Assembly	
2A10A4	Drive Unit	Actuator, Electro-Mechanical, Rotary	TG-235/M
2A10A5	Azimuth Encoder Control Unit		
2A10A6	Elevation Encoder Control Unit		
2A10A7	Azimuth Transducer		
2A10A8	Elevation Transducer		
2A10A9	Service Outlets		
2A10A10	Elevation Pedestal Disconnect Panel		
2A11	Elevation Trough Antenna	Antenna Group	OE-223/M
2A12	Azimuth Trough Antenna	Antenna Group	OE-224/M
2A13	L-Band Dish Antenna	Antenna	OE-4055/M
2W1	S-Band Trailer Interconnection Cable		
2W2	S-Band Trailer Interconnection Cable		
2W3	S-Band Trailer Interconnection Cable		
2W4	S-Band Trailer Interconnection Cable		
2W5	S-Band Trailer Interconnection Cable		

Table 1-3. Equipment Supplied
Part I. Radar Set AN/MPS-T1(V)1 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
2W6	S-Band Trailer Interconnection Cable		
2W13	S-Band Trailer Interconnection Cable		
2W15	S-Band Trailer Interconnection Cable		
2W16	S-Band Trailer Interconnection Cable		
2W61	S-Band Trough Cable		
2W62	S-Band Trough Cable		
2W63	S-Band Trough Cable		
2W64	S-Band Trough Cable		
2W66	L-Band Coaxial Cable (S-Band)		
2W67	L-Band Coaxial Cable (S-Band)		
2W68	L-Band Coaxial Cable (S-Band)		
Unit 3	C-Band Antenna Trailer	Antenna Receiver-Transmitter Group, Trailer Mounted	OY-61/M
P/O Unit 3	Mobile Tracker Trailer Assembly	Antenna Pedestal-Trailer	OA-8857/M
P/O Unit 3	Mobile Tracker	Antenna Pedestal Group	OA-8853/M
P/O Unit 3	Antenna Trailer	Trailer, Antenna	V-482/M
3A1	L-Band Pulsed Command Transmitter Console	Transmitter Group	OT-83/M
3A1A1	L-Band Pulsed Command Transmitter	Transmitter, Radar	T-1296/M

Table 1-3. Equipment Supplied
Part I. Radar Set AN/MPS-T1(V)1 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
3A1A2	L-Band Pulsed Command Transmitter Power Supply	Power Supply	PP-7139/M
3A1A3	Performance Monitor	Monitor, Radio Frequency	ID-1999/M
3A1A4	Fan	Fan, Centrifugal	
3A1A5	Storage Drawer	Drawer, Electrical Equipment Cabinet	
3A2	Elevation Transmitter Console	Transmitter Group	OT-85/M
P/O 3A2	Control Panel	Control, Transmitter	C-9721/M
P/O 3A2	Trigger Control Assembly	Generator, Pulse	O-1689/M
P/O 3A2	Reverse Power Trip Assembly	Control Power Supply	C-9722/M
P/O 3A2	Charging Control Assembly	Control, Modulator	C-9720/M
P/O 3A2	Modulator	Modulator, Radar	MD-955/M
P/O 3A2	Thyratron Bias Control	Control Modulator	C-9719/M
P/O 3A2	High Voltage Power Supply	Power Supply Set	OP-99/M
P/O 3A2	Magnetron Filament Control	Control, Magnetron Filament	C-9718/M
P/O 3A2	Current Overload	Relay, Current Overload	RE-1103/M
P/O 3A2	Transformer Assembly	Transformer Assembly	TF-573/M
P/O 3A2	Power Supply	Power Supply	PP-7140/M
3A3	Elevation Receiver Console	Receiver Group	OR-171/M
3A3A1	Microwave Assembly	Installation, C-Band Microwave	

Table 1-3. Equipment Supplied
Part I. Radar Set AN/MPS-T1(V)1 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
3A3A2	Performance Monitor	Control - Monitor	C-9942/M
3A3A3	Prereceiver	Receiver, Radar	R-1991/M
3A3A4	Power Supply Assembly	Power Supply Assembly	PP-7141/M
3A3A5	Fan	Fan, Centrifugal	
3A4	Power Distribution Panel	Panel, Power Distribution	
3A5	Junction Box	Junction Box	
3A6	Auxiliary Equipment Console	Console, Auxiliary Equipment	OJ-368/M
3A6A1	Waveguide and Scanner Switching	Relay Assembly Group	OA-8855/M
3A6A2	Signal Conditioning	Relay Assembly Group	OA-8856/M
3A6A3	Power Supply	Power Supply Assembly	PP-7244/M
3A6A4	Power Supply Assembly	Power Supply Assembly	PP-7234/M
3A6A5	Fan	Fan, Centrifugal	
3A7	Azimuth Transmitter Console	Transmitter Group	OT-85/M
P/O 3A7	Control Panel	Control, Transmitter	C-9721/M
P/O 3A7	Trigger Control Assembly	Generator, Pulse	O-1689/M
P/O 3A7	Reverse Power Trip Assembly	Control, Power Supply	C-9722/M
P/O 3A7	Charging Control Assembly	Control, Modulator	C-9720/M
P/O 3A7	Modulator	Modulator, Radar	MD-955/M
P/O 3A7	Thyratron Bias Control	Control Modulator	C-9719/M
P/O 3A7	High Voltage Power Supply	Power Supply Set	OP-99/M

Table 1-3. Equipment Supplied
Part I. Radar Set AN/MPS-T1(V)1 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
P/O 3A7	Magnetron Filament Control	Control, Magnetron Filament	C-9718/M
P/O 3A7	Current Overload	Relay, Current Overload	RE-1103/M
P/O 3A7	Transformer Assembly	Transformer Assembly	TF-573/M
P/O 3A7	Power Supply	Power Supply	PP-7140/M
3A8	Azimuth Receiver Console	Receiver Group	OR-171/M
3A8A1	Microwave Assembly	Installation, C-Band Microwave	
3A8A2	Performance Monitor	Control - Monitor	C-9942/M
3A8A3	Prereceiver	Receiver, Radar	R-1991/M
3A8A4	Power Supply Assembly	Power Supply Assembly	PP-7141/M
3A8A5	Fan	Fan, Centrifugal	
3A9	Azimuth Pedestal	Antenna Pedestal Group	OA-8799/M
3A9A1	Synchro Assembly (TX)	Synchro, Transmitter Assembly	SN-502/M
3A9A2	Synchro Assembly (CT)	Synchro, Control Transformer Assembly	SN-503/M
3A9A3	Drive Unit	Actuator, Electro-Mechanical Rotary	TG-234/M
3A9A5	Circuit Breaker and Fuse Panel	Panel, Circuit Breaker-Fuse	
3A9A6	Service Outlets		
3A9A7	Azimuth Power Amplifier	Amplifier, Electrical Control	AM-6826/M
3A9A8	Elevation Power Amplifier	Amplifier, Electrical Control	AM-6826/M
3A9A9	Slip Rings	Slip Ring Assembly	

Table 1-3. Equipment Supplied
Part I. Radar Set AN/MPS-T1(V)1 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
3A9A23	Fan	Fan, Tube Axial	
3A10	Elevation Pedestal Housing	Antenna Pedestal Group	OA-8800/M
3A10A1	Synchro Assembly (TX)	Synchro, Transmitter Assembly	SN-502/M
3A10A2	Synchro Assembly (CT)	Synchro, Control Transformer Assembly	SN-503/M
3A10A3	Limit Switch Assembly	Switch Assembly	
3A10A4	Drive Unit	Actuator, Electro-Mechanical, Rotary	TG-235/M
3A10A5	Azimuth Encoder Control Unit		
3A10A6	Elevation Encoder Control Unit		
3A10A7	Azimuth Transducer		
3A10A8	Elevation Transducer		
3A10A9	Service Outlets		
3A10A10	Elevation Pedestal Disconnect Panel		
3A11	Elevation Trough Antenna	Antenna Group	OE-226/M
3A12	Azimuth Trough Antenna	Antenna Group	OE-225/M
3A13	Elevation Scanned Dish Antenna	Antenna Group	AS-4054/M
3A14	Azimuth Scanned Dish Antenna	Antenna Group	AS-4053/M
3A15	L-Band Dish Antenna	Antenna Group	AS-4055/M

Table 1-3. Equipment Supplied
Part I. Radar Set AN/MPS-T1(V)1 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE
3W7	C-Band Trailer Interconnection Cable	
3W8	C-Band Trailer Interconnection Cable	
3W9	C-Band Trailer Interconnection Cable	
3W10	C-Band Trailer Interconnection Cable	
3W11	C-Band Trailer Interconnection Cable	
3W12	C-Band Trailer Interconnection Cable	
3W14	C-Band Trailer Interconnection Cable	
3W17	C-Band Trailer Interconnection Cable	
3W18	C-Band Trailer Interconnection Cable	
3W64	C-Band Trough Scanner Cable	
3W65	C-Band Trough Scanner Cable	
3W66	C-Band Trough Scanner Cable	
3W67	C-Band Trough Scanner Cable	
3W68	C-Band Dish Scanner Cable	
3W69	C-Band Dish Scanner Cable	
3W70	C-Band Dish Scanner Cable	

Table 1-3. Equipment Supplied
Part I. Radar Set AN/MPS-T1(V)1 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
3W71	C-Band Dish Scanner Cable		
3W72	C-Band Dish Scanner Cable		
3W73	C-Band Dish Scanner Cable		
3W74	C-Band Dish Scanner Cable		
3W75	C-Band Dish Scanner Cable		
3W77	L-Band Coaxial Cable (C-Band)		
Unit 4	X-Band Antenna Trailer	Antenna-Receiver-Transmitter Group, Trailer Mounted	OY-62/M
P/O Unit 4	Mobile Tracker Trailer Assembly	Antenna Pedestal-Trailer	OA-8851/M
P/O Unit 4	Mobile Tracker	Antenna Pedestal Group	OA-8858/M
P/O Unit 4	Antenna Trailer	Trailer, Antenna	V-482/M
4A1	Left Receiver-Transmitter-Modulator Console	Transmitter Group	T-91/M
4A1A1	L-Band CW Command Transmitter	Transmitter Set, Electrical Guidance	T-1314/M
4A1A2	L-Band Pulsed Command Transmitter	Transmitter, Radar	T-1315/M
4A1A3	L-Band Pulsed Command Transmitter Power Supply	Power Supply	PP-7139/M
4A2	Center Receiver-Transmitter-Modulator Console	Receiver Group	OR-172/M

Table 1-3. Equipment Supplied
Part I. Radar Set AN/MPS-T1(V)1 (Continued)

REF.DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
4A2A1	Microwave Unit	Microwave Assembly, Receiver-Transmitter-Modulator, Center	
4A2A1A5	Signal Conditioning	Relay Assembly Group	OA-8854/M
4A2A2	Prereceiver	Receiver, Radar	R-1992/M
4A2A3	Power Supply Assembly	Power Supply Assembly	PP-7245/M
4A3	Right Receiver-Transmitter-Modulator	Transmitter Group	OT-92/M
4A3A1A1	X-Band Transmitter Control	Control, Transmitter	C-9943/M
4A3A2	X-Band Transmitter Modulator	Modulator, Radar	MD-997/M
4A4	Fan	Fan, Centrifugal	
4A5	Junction Box and Power Distribution Panel	Panel, Power Distribution	
4A6	Azimuth Pedestal	Antenna Pedestal Group	OA-8799/M
4A6A1	Synchro Assembly (TX)	Synchro, Transmitter Assembly	SN-502/M
4A6A2	Synchro Assembly (CT)	Synchro, Control Transformer Assembly	SN-503/M
4A6A3	Drive Unit	Actuator, Electro-Mechanical Rotary	TG-234/M
4A6A5	Fuse and Circuit Breaker Panel	Panel, Power Distribution	
4A6A6	Service Outlets		
4A6A7	Azimuth Power Amplifier	Amplifier, Electronic Control	AM-6826/M
4A6A8	Elevation Power Amplifier	Amplifier, Electronic Control	AM-6826/M

Table 1-3. Equipment Supplied
Part I. Radar Set AN/MPS-T1(V)1 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
4A6A9	Slip Rings	Slip Ring Assembly	
4A6A10	Fan	Fan, Tube Axial	
4A7	Elevation Pedestal	Antenna, Pedestal Group	OA-8800/M
4A7A1	Synchro Assembly (TX)	Synchro, Transmitter Assembly	SN-502/M
4A7A2	Synchro Assembly (CT)	Synchro, Control Transformer Assembly	SN-503/M
4A7A3	Limit Switch Assembly	Switch Assembly	
4A7A4	Drive Unit	Actuator, Electro-Mechanical, Rotary	TG-235/M
4A7A5	Elevation Pedestal Disconnect Panel		
4A7A6	Azimuth Encoder Control Unit		
4A7A7	Elevation Encoder Control Unit		
4A7A8	Azimuth Transducer		
4A7A9	Service Outlets		
4A7A10	Elevation Transducer		
4A8	RTM Housing		
4A9	L-Band Cut Dish Command Antenna	Antenna	AS-4057/M
4A10	X-Band Trough Antenna	Antenna	AS-4058/M
4A11	X-Band Illuminator Antenna	Antenna Group	OE-227/M
4W22	X-Band Trailer Interconnection Cable		

Table 1-3. Equipment Supplied
Part I. Radar Set AN/MPS-T1(V)1 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE
4W23	X-Band Trailer Interconnection Cable	
4W24	X-Band Trailer Interconnection Cable	
4W25	X-Band Trailer Interconnection Cable	
4W26	X-Band Trailer Interconnection Cable	
4W27	X-Band Trailer Interconnection Cable	
4W28	X-Band Trailer Interconnection Cable	
4W29	X-Band Trailer Interconnection Cable	
4W39	X-Band Receiver Scanner Cable	
4W40	X-Band Receiver Scanner Cable	
4W44	L-Band Coaxial Cable (X-Band)	
4W46	L-Band Coaxial Cable (X-Band)	
4W51	L-Band Coaxial Cable (X-Band)	
4W53	L-Band Coaxial Cable (X-Band)	
AP20458-S22	Connector (1P1)	
AP20458-S22-S4	Connector (1P3)	
AP40458-S22	Connector (1P2)	
AT-3B-187-12	C-Band Waveguide	

Table 1-3. Equipment Supplied
Part I. Radar Set AN/MPS-T1(V)1 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE
AT-3B-284-24	S-Band Waveguide	
K-6	Borescope Telescope	
MD4	Motor Generator	
TFT-64-4B-40N	X-Band Waveguide	
TFT-64-4B-50N	X-Band Waveguide	
WCF-2335-4N	Frequency Meter	
WCF-4458-4N	Frequency Meter	
WCF-510-4N	Frequency Meter	
WCF-8211-4N	Frequency Meter	
WCF-912-4N	Frequency Meter	
010-0172-00	Probe	
100A	Pulse Generator	
11414-1C	S- and C-Band Antenna Telescope Elbow	
1200-24	Headset-Microphone	
1859	Sheet Metal Lifter	
200-1	Cart	
583Z2504-1	Extender	
423A	Crystal Detector	
583Z1008	Steel Plate	
583Z3090-1	Grounding Rod	
583Z4004-5	Vertical Support Structure	
583Z4004-801	Vertical Support Structure	
583Z4005-1	Horizontal Support Structure	

Table 1-3. Equipment Supplied
Part I. Radar Set AN/MPS-T1(V)1 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
583Z4005-3	Horizontal Support Structure		
583Z4005-811	Horizontal Arm Extension		
583Z4007-807	Strut		
583Z4008-1	Strut		
583Z4012-1	Lifting Bar		
583Z4012-3	Lifting Cables		
583Z4012-5	Lifting Cables		
583Z4012-801	Lifting Bar		
583Z4014-1	Ladder		
583Z4014-3	Ladder		
583Z4024-801	Vertical Counterweight		
583Z4024-1	Horizontal Counter-weight		
583Z4024-3	Vertical Counterweight		
583Z4024-5	Horizontal Counter-weight		
583Z4284-1	Lifting Bracket		
583Z4600-1	C-Band Antenna Structure Transport Trailer	Antenna Support Semi-trailer	V-489/M
583Z4600-3	C-Band Trough Antenna Transport Trailer	Antenna Semitrailer	V-490/M
583Z4600-5	Dish Antenna Transport Trailer	Antenna Semitrailer	V-491/M
583Z4600-801	S-Band Antenna Structure Transport Trailer	Antenna Support Semi-trailer	V-492/M

Table 1-3. Equipment Supplied
Part I. Radar Set AN/MPS-T1(V)1 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
583Z4600-803	S-Band Trough Antenna Transport Trailer	Antenna Semitrailer	V-493/M
583Z4600-805	X-Band Antenna Transport Trailer	Antenna Semitrailer	V-494/M
583Z5091-1	C-Band Waveguide and Guard Assembly		
583Z5091-3	C-Band Waveguide and Guard Assembly		
583Z5091-5	C-Band Waveguide and Guard Assembly		
583Z5091-801	C-Band Waveguide and Guard Assembly		
583Z5091-803	S-Band Waveguide and Guard Assembly		
583Z5091-805	S-Band Waveguide and Guard Assembly		
590	Extender		
591	Extractor		
608E	Signal Generator		
618C	Signal Generator		
620B	Signal Generator		
8616A	Signal Generator		
95635	Ear Protectors		
5590	Extender		

Table 1-3. Equipment Supplied
Part II. Radar Set AN/MPS-T1(V)2

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
Unit 1	Radar Control Trailer	Radar Set Control Group	OK-251/M
1A1	Guidance Operator Console	Console, Target-Tracking	OJ-303/M
1A1A1	Mode Control	Control, Transmitter	C-9323/M
1A1A2	Azimuth Indicator	Indicator, Azimuth-Range	IP-1147/M
1A1A3	Elevation Indicator	Indicator, Elevation-Range	IP-1234/M
1A1A4	Tracking Control	Control, Target Tracking	C-9324/M
1A1A5	Synchronizer	Synchronizer, Electrical	SN-479/M
1A1A6	Power Supply Assembly	Power Supply Assembly	PP-6912/M
1A1A7	Indicator Power Supply	Power Supply Assembly	PP-6913/M
1A2	Signal Distribution Panel	Panel, Signal Distribution, Radar	
1A3	Transponder Console	Console, Reference Tracking	OJ-304/M
1A3A1	Transponder Receiver	Receiver, Radar	R-1837/M
1A3A2	Azimuth Indicator	Indicator, Azimuth-Range	IP-1149/M
1A3A3	Elevation Indicator	Indicator, Elevation-Range	IP-1148/M
1A3A4	Tracking Control	Control, Reference Signal	C-9325/M
1A3A5	Power Supply Assembly	Power Supply Assembly	PP-6914/M
1A3A6	Indicator Power Supply	Power Supply Assembly	PP-6915/M
1A4	Oscilloscope	Oscilloscope	
1A5	Radar Console	Console, Radar Set	OJ-343/M
1A5A1	S- and C-Band Transmitter Control Panel	Control, Transmitter	C-9713/M

Table 1-3. Equipment Supplied
Part II. Radar Set AN/MPS-T1(V)2 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
1A5A2	Power and Frequency Control	Control, Frequency Selector-Power	C-9711/M
1A5A3	Transmitter Coder	Coder, Transmitter	KY-809/M
1A5A5	Receiver Select	Selector, Receiver Signal	SA-2026/M
1A5A6	Power Monitor	Monitor, Radio Frequency	ID-1997/M
1A5A7	L-Band Transmitter Control Panel	Control, Transmitter	C-9713/M
1A5A8	Digital Voltmeter	Voltmeter, Digital	ME-473/M
1A5A9	Noise Figure Meter	Radio Interference Field Intensity Meter	IM-232/M
1A5A10	S-Band Servo Amplifier	Amplifier, Electronic Control	AM-6732/M
1A5A11	S-Band DC Amplifier	Amplifier, Direct Current	AM-6733/M
1A5A12	S-Band Servo Control	Control, Antenna	C-9714/M
1A5A13	Power Supply Assembly	Power Supply Assembly	PP-7134/M
1A5A14	Computer Interface	Converter, Analog to Digital	CV-3229/M
1A5A15	Signal Test Panel	Panel, Test Electrical	SB-3798/M
1A5A16	Digital Voltmeter Test Panel	Panel, Test Electrical	SB-3797/M
1A5A17	C-Band Servo Amplifier	Amplifier, Electronic Control	AM-6732/M
1A5A18	C-Band DC Amplifier	Amplifier, Direct Current	AM-6733/M
1A5A19	C-Band Servo Control	Control Antenna	C-9714/M
1A5A20	Power Supply Assembly	Power Supply Assembly	PP-7136/M
1A5A21	Intercom	Intercommunication Station	LS-620/M

Table 1-3. Equipment Supplied
Part II. Radar Set AN/MPS-T1(V)2 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
1A5A22	Recorder DC Amplifier	Amplifier Assembly	AM-6731/M
1A5A23	Recorder	Recorder, Coordinate Data	
1A5A24	Recorder Input Panel	Panel, Signal Distribution Radar	SB-3796/M
1A5A25	Recorder Takeup Reel	Panel, Chart Takeup	
1A5A26	Recorder Master Power Panel	Panel, Power Distribution	
1A5A27	X- and L-Band Transmitter Control Panel	Control, Transmitter	C-9710/M
1A6	Radio Set (GFE)	Radio Set Assembly (GFE)	AN/GRC-27
1A8	Digital Computer Console	Computer-Intercom Station	CP-1236/M
1A8A1	High Speed Tape Punch	Perforator, Tape	
1A8A2	Tape Reader	Reader, Perforated Tape	
1A8A3	Spooler	Handler, Perforated Tape	
1A8A4	Control Panel	Control, Computer	
1A8A5	Intercom	Intercom Station	LS-620/M
1A8A6	Multiverter	Converter, Analog-to-Digital and Digital-to-Analog	
1A8A8	Power Supply	Power Supply Assembly	
1A8A9	Auxiliary Unit	Logic Auxiliary	
1A8A10	Main Power Distribution	Panel, Power Distribution	
1A8A11	Power Supply	Power Supply Assembly	
1A8A12	Main Frame	Logic, Central Processor	
1A8A13	Memory	Core Memory Unit	

Table 1-3. Equipment Supplied
Part II. Radar Set AN/MPS-T1(V)2 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
1A9	Teletype	Teletypewriter	TT-685/M
1A10	Workbench	Work Table	
1A11	S- and C-Band Manual Tracker Console	Console, Target-Tracking	OJ-302/M
1A11A1	Azimuth Receiver	Receiver, Radar	R-1835/M
1A11A2	Azimuth Indicator	Indicator, Azimuth-Elevation-Range	IP-1145/M
1A11A3	Azimuth Tracking Control	Control, Antenna	C-9320/M
1A11A4	Azimuth Intercom	Intercom Station	LS-620/M
1A11A5	Sweep Generator	Generator, Sweep	O-1654/M
1A11A6	Range Indicator	Indicator, Azimuth-Elevation Range	IP-1146/M
1A11A7	Range Tracking Control	Control, Tracking, Range	C-9321/M
1A11A8	Indicator Power Supply	Power Supply Assembly	PP-6910/M
1A11A9	Range Intercom	Intercom Station	LS-620/M
1A11A10	Elevation Intercom	Intercom Station	LS-620/M
1A11A11	Elevation Receiver	Receiver, Radar	R-1836/M
1A11A12	Elevation Indicator	Indicator, Azimuth-Elevation-Range	IP-1145/M
1A11A13	Elevation Tracking Control	Control, Antenna	C-9332/M
1A11A14	Power Supply Assembly	Power Supply Assembly	PP-6911/M
1A12	Power Distribution Console	Switchboard, Power Supply	SB-3799/M
1A14	Power Entry	Power Connector Panel Assembly	

Table 1-3. Equipment Supplied
Part II. Radar Set AN/MPS-T1(V)2 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
1A15	Van Semitrailer	Semitrailer, Van	
1A16	Radio Set Antenna (GFE)	Antenna (GFE)	
1A17	X-Band Manual Tracker Console	Console, Target Tracking	OJ-344/M
1A17A1	Reference Receiver	Receiver, Radar	R-1930/M
1A17A2	Moving Target Indicator	Comparator, Signal	CM-450/M
1A17A3	Target Receiver	Receiver, Radar	R-1931/M
1A17A4	Target Tracking	Tracker, Target	MS-9646/M
1A17A6	X-Band Servo Amplifier	Amplifier, Electronic Control	AM-6732/M
1A17A7	X-Band DC Amplifier	Amplifier, Direct Current	AM-6733/M
11A17A8	X-Band Servo Control	Control, Antenna	C-9714/M
11A17A9	T1 Intercom	Intercom Station	LS-620/M
1A17A10	Down Link Jammer Receiver	Receiver, Radar	R-1932/M
1A17A11	T1 Indicator	Indicator, Azimuth-Elevation-Range	IP-1189/M
1A17A12	T1 Tracking Control	Control, Target Tracking	C-9715/M
1A17A13	Indicator Power Supply	Power Supply	PP-7137/M
1A17A14	Power Supply Assembly	Power Supply Assembly	PP-7138/M
1A17A15	T2 Intercom	Intercom Station	LS-620/M
1A17A16	Target Simulator	Simulator, Radar Target	SM-709/M
1A17A17	T2 Indicator	Indicator, Azimuth-Elevation-Range	IP-1189/M
1A17A18	T2 Tracking Control	Control, Target Tracking	C9716/M

Table 1-3. Equipment Supplied
Part II. Radar Set AN/MPS-T1(V)2 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
1A17A19	Reference Pedestal Servo	Programmer, Antenna Position	MX-9647/M
1A19	Automatic Position Plotter Console	Console, Target Tracking	OJ-345/M
1A19A1	Automatic Position Plotter Indicator	Indicator, Azimuth-Range	IP-1190/M
1A19A2	Sweep Control	Control, Indicator	C-971/M
1A19A3	Intercom	Intercom System	LS-620/M
1A19A4	Power Supply Assembly	Power Supply Assembly	PP-6911/M
1A19A5	Indicator Power Supply	Power Supply	PP-7137/M
1A19A6	Radio Set Control (GFE)	Radio Set, Control (GFE)	
1A20	Common Data Point Assembly	Control, Indicator	C-9941/M
Unit 2	S-Band Antenna Trailer	Antenna-Receiver-Transmitter Group, Trailer Mounted	OY-55A/M
P/O Unit 2	Mobile Tracker Assembly	Antenna Pedestal-Trailer	OA-8797/M
P/O Unit 2	Mobile Tracker	Antenna Pedestal Group	OA-8798/M
P/O Unit 2	Antenna Trailer	Trailer, Antenna	V-482/M
2A1	L-Band Pulsed Command Transmitter Console	Transmitter Group	OT-83/M
2A1A1	L-Band Pulsed Command Transmitter	Transmitter, Radar	T-1296/M
2A1A2	L-Band Pulsed Command Transmitter Power Supply	Power Supply	PP-7139/M
2A1A3	Performance Monitor	Monitor, Radio Frequency	ID-1999/M

Table 1-3. Equipment Supplied
Part II. Radar Set AN/MPS-T1(V)2 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
2A1A4	Fan	Fan, Centrifugal	
2A1A5	Storage Drawer	Drawer, Electrical Equipment	
2A2	Elevation Transmitter Console	Transmitter Group	OT-84/M
P/O 2A2	Control Panel	Control, Transmitter	C-9721/M
P/O 2A2	Trigger Control Assembly	Generator, Pulse	O-1689/M
P/O 2A2	Reverse Power Trip Assembly	Control, Power Supply	C-9722/M
P/O 2A2	Charging Control Assembly	Control, Modulator	C-9720/M
P/O 2A2	Modulator	Modulator, Radar	MD-955/M
P/O 2A2	Thyratron Bias Control	Control Modulator	C-9719/M
P/O 2A2	High Voltage Power Supply	Power Supply Set	OP-99/M
P/O 2A2	Magnetron Filament Control	Control, Magnetron Filament	C-9718/M
P/O 2A2	Current Overload	Relay, Current Overload	RE-1103/M
P/O 2A2	Transformer	Transformer Assembly	TF-573/M
P/O 2A2	Power Supply	Power Supply	PP-7140/M
2A3	Elevation Receiver Console	Receiver Group	OR-159/M
2A3A1	Microwave Assembly	Installation, S-Band Microwave	
2A3A2	Performance Monitor	Monitor, Radio Frequency	ID-2000/M
2A3A3	Prereceiver	Receiver, Radar	R-1933/M
2A3A4	Power Supply Assembly	Power Supply Assembly	PP-7241/M

Table 1-3. Equipment Supplied
Part II. Radar Set AN/MPS-T1(V)2 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
2A3A5	Fan	Fan, Centrifugal	
2A4	Power Distribution Panel	Panel, Power Distribution	
2A5	Junction Box	Junction Box	
2A6	Auxiliary Equipment Console	Console, Auxiliary Equipment	OJ-367/M
2A6A1	Waveguide and Scanner Switching	Relay Assembly	RE-1108/M
2A6A2	Signal Conditioning	Relay Assembly Group	OA-8852/M
2A6A3	Power Supply	Transformer Assembly	TF-580/M
2A6A4	Power Supply Assembly	Power Supply Assembly	PP-7243/M
2A6A5	Fan	Fan, Centrifugal	
2A7	Azimuth Transmitter Console	Transmitter Group	OT-84/M
P/O 2A7	Control Panel	Control, Transmitter	C-9721/M
P/O 2A7	Trigger Control Assembly	Generator, Pulse	O-1689/M
P/O 2A7	Reverse Power Trip Assembly	Control, Power Supply	C-9722/M
P/O 2A7	Charging Control Assembly	Control, Modulator	C-9720/M
P/O 2A7	Modulator	Modulator, Radar	MD-955/M
P/O 2A7	Thyratron Bias Control	Control Modulator	C-9719/M
P/O 2A7	High Voltage Power Supply	Power Supply Set	OP-99/M
P/O 2A7	Magnetron Filament Control	Control, Magnetron Filament	C-9718/M

Table 1-3. Equipment Supplied
Part II. Radar Set AN/MPS-T1(V)2 (Continued)

REF.DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
P/O 2A7	Current Overload	Relay, Current Overload	RE-1103/M
P/O 2A7	Transformer Assembly	Transformer Assembly	TF-573/M
P/O 2A7	Power Supply	Power Supply	PP-7140/M
2A8	Azimuth Receiver Console	Receiver Group	OR-159/M
2A8A1	Microwave Assembly	Installation, S-Band Microwave	
2A8A2	Performance Monitor	Monitor, Radio Frequency	ID-2000/M
2A8A3	Prereceiver	Receiver, Radar	R-1933/M
2A8A4	Power Supply Assembly	Power Supply Assembly	PP-7141/M
2A8A5	Fan	Fan, Centrifugal	
2A9	Azimuth Pedestal Assembly	Antenna Pedestal Group	OA-8799/M
2A9A1	Synchro Assembly (TX)	Synchro, Transmitter Assembly	SN-502/M
2A9A2	Synchro Assembly (CT)	Synchro, Control Transformer Assembly	SN-503/M
2A9A3	Drive Unit	Actuator, Electro-Mechanical Rotary	TG-234/M
2A9A5	Fuse and Circuit Breaker Panel	Panel, Circuit Breaker-Fuse	
2A9A6	Service Outlets		
2A9A7	Azimuth Power Amplifier	Amplifier, Electronic Control	AM-6826/M
2A9A8	Elevation Power Amplifier	Amplifier, Electronic Control	AM-6826/M
2A9A9	Slip Rings	Slip Ring Assembly	
2A9A23	Fan	Fan, Tube Axial	

Table 1-3. Equipment Supplied
Part II. Radar Set AN/MPS-T1(V)2 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
2A10	Elevation Pedestal	Antenna Pedestal Group	OA-8800/M
2A10A1	Synchro Assembly (TX)	Synchro, Transmitter Assembly	SN-502/M
2A10A2	Synchro Assembly (CT)	Synchro, Control Transformer Assembly	SN-503/M
2A10A3	Limit Switch Assembly	Switch Assembly	
2A10A4	Drive Unit	Actuator, Electro-Mechanical Rotary	TG-235/M
2A10A5	Azimuth Encoder Control Unit		
2A10A6	Elevation Encoder Control Unit		
2A10A7	Azimuth Transducer		
2A10A8	Elevation Transducer		
2A10A9	Service Outlets		
2A10A10	Elevation Pedestal Disconnect Panel		
2A11	Elevation Trough Antenna	Antenna Group	OE-205/M
2A12	Azimuth Trough Antenna	Antenna Group	OE-206/M
2A13	L-Band Dish Antenna	Antenna	OE-4055/M
2W1	S-Band Trailer Interconnection Cable		
2W2	S-Band Trailer Interconnection Cable		
2W3	S-Band Trailer Interconnection Cable		

Table 1-3. Equipment Supplied
Part II. Radar Set AN/MPS-T1(V)2 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
2W4	S-Band Trailer Interconnection Cable		
2W5	S-Band Trailer Interconnection Cable		
2W6	S-Band Trailer Interconnection Cable		
2W13	S-Band Trailer Interconnection Cable		
2W15	S-Band Trailer Interconnection Cable		
2W16	S-Band Trailer Interconnection Cable		
2W61	S-Band Trough Cable		
2W62	S-Band Trough Cable		
2W63	S-Band Trough Cable		
2W64	S-Band Trough Cable		
2W66	L-Band Coaxial Cable (S-Band)		
2W67	L-Band Coaxial Cable (S-Band)		
2W68	L-Band Coaxial Cable (S-Band)		
Unit 3	C-Band Antenna Trailer	Antenna-Receiver-Transmitter Group, Trailer Mounted	OY-56/M
P/O Unit 3	Mobile Tracker Trailer Assembly	Antenna Pedestal-Trailer	OA-8857/M
P/O Unit 3	Mobile Tracker	Antenna Pedestal Group	OA-8853/M
P/O Unit 3	Antenna Trailer	Trailer, Antenna	V-482/M

Table 1-3. Equipment Supplied
Part II. Radar Set AN/MPS-T1(V)2 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
3A1	L-Band Pulsed Command Transmitter Console	Transmitter Group	OT-83/M
3A1A1	L-Band Pulsed Command Transmitter	Transmitter, Radar	T-1296/M
3A1A2	L-Band Pulsed Command Transmitter Power Supply	Power Supply	PP-7139/M
3A1A3	Performance Monitor	Monitor, Radio Frequency	ID-1999/M
3A1A4	Fan	Fan, Centrifugal	
3A1A5	Storage Drawer	Drawer, Electrical Equipment Cabinet	
3A2	Elevation Transmitter Assembly	Transmitter Group	OT-85/M
P/O 3A2	Control Panel	Control, Transmitter	C-9721/M
P/O 3A2	Trigger Control Assembly	Generator, Pulse	O-1689/M
P/O 3A2	Reverse Power Trip Assembly	Control Power Supply	C-9722/M
P/O 3A2	Charging Control Assembly	Control, Modulator	C-9720/M
P/O 3A2	Modulator	Modulator, Radar	MD-955/M
P/O 3A2	Thyratron Bias Control	Control Modulator	C-9719/M
P/O 3A2	High Voltage Power Supply	Power Supply Set	OP-99/M
P/O 3A2	Magnetron Filament Control	Control, Magnetron Filament	C-9718/M
P/O 3A2	Current Overload	Relay, Current Overload	RE-1103/M
P/O 3A2	Transformer Assembly	Transformer Assembly	TF-573/M
P/O 3A2	Power Supply	Power Supply	PP-7140/M

Table 1-3. Equipment Supplied
Part II. Radar Set AN/MPS-T1(V)2 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
3A3	Elevation Receiver Console	Receiver Group	OR-171/M
3A3A1	Microwave Assembly	Installation, C-Band Microwave	
3A3A2	Performance Monitor	Control - Monitor	C-9942/M
3A3A3	Prereceiver	Receiver, Radar	R-1991/M
3A3A4	Power Supply Assembly	Power Supply Assembly	PP-7141/M
3A3A5	Fan	Fan, Centrifugal	
3A4	Power Distribution Panel	Panel, Power Distribution	
3A5	Junction Box	Junction Box	
3A6	Auxiliary Equipment Console	Console, Auxiliary Equipment	OJ-368/M
3A6A1	Waveguide and Scanner Switching	Relay Assembly Group	OA-8855/M
3A6A2	Signal Conditioning	Relay Assembly Group	OA-8856/M
3A6A3	Power Supply	Power Supply Assembly	PP-7244/M
3A6A4	Power Supply Assembly	Power Supply Assembly	PP-7234/M
3A6A5	Fan	Fan, Centrifugal	
3A7	Azimuth Transmitter Console	Transmitter Group	OT-85/M
P/O 3A7	Control Panel	Control, Transmitter	C-9721/M
P/O 3A7	Trigger Control Assembly	Generator, Pulse	O-1689/M
P/O 3A7	Reverse Power Trip Assembly	Control, Power Supply	C-9722/M
P/O 3A7	Charging Control Assembly	Control, Modulator	C-9720/M

Table 1-3. Equipment Supplied
Part II. Radar Set AN/MPS-T1(V)2 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
P/O 3A7	Modulator	Modulator, Radar	MD-955/M
P/O 3A7	Thyratron Bias Control	Control Modulator	C-9719/M
P/O 3A7	High Voltage Power Supply	Power Supply Set	OP-99/M
P/O 3A7	Magnetron Filament Control	Control, Magnetron Filament	C-9718/M
P/O 3A7	Current Overload	Relay, Current Overload	RE-1103/M
P/O 3A7	Transformer Assembly	Transformer Assembly	TF-573/M
P/O 3A7	Power Supply	Power Supply	PP-7140/M
3A8	Azimuth Receiver Console	Receiver Group	OR-171/M
3A8A1	Microwave Assembly	Installation, C-Band Microwave	
3A8A2	Performance Monitor	Control - Monitor	C-9942/M
3A8A3	Prereceiver	Receiver, Radar	R-1991/M
3A8A4	Power Supply Assembly	Power Supply Assembly	PP-7141/M
3A8A5	Fan	Fan, Centrifugal	
3A9	Azimuth Pedestal	Antenna Pedestal Group	OA-8799/M
3A9A1	Synchro Assembly (TX)	Synchro, Transmitter Assembly	SN-502/M
3A9A2	Synchro Assembly (CT)	Synchro, Control Transformer Assembly	SN-503/M
3A9A3	Drive Unit	Actuator, Electro-Mechanical, Rotary	TG-234/M
3A9A5	Circuit Breaker and Fuse Panel	Panel, Circuit Breaker-Fuse	
3A9A6	Service Outlets		

Table 1-3. Equipment Supplied
Part II. Radar Set AN/MPS-T1(V)2 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
3A9A7	Azimuth Power Amplifier	Amplifier, Electrical Control	AM-6826/M
3A9A8	Elevation Power Amplifier	Amplifier, Electrical Control	AM-6826/M
3A9A9	Slip Rings	Slip Ring Assembly	
3A9A23	Fan	Fan, Tube Axial	
3A10	Elevation Pedestal	Antenna Pedestal Group	OA-8800/M
3A10A1	Synchro Assembly (TX)	Synchro, Transmitter Assembly	SN-502/M
3A10A2	Synchro Assembly (CT)	Synchro, Control Transformer Assembly	SN-503/M
3A10A3	Limit Switch Assembly	Switch Assembly	
3A10A4	Drive Unit	Actuator, Electro-Mechanical, Rotary	TG-235/M
3A10A5	Azimuth Encoder Control Unit		
3A10A6	Elevation Encoder Control Unit		
3A10A7	Azimuth Transducer		
3A10A8	Elevation Transducer		
3A10A9	Service Outlets		
3A10A10	Elevation Pedestal Disconnect Panel		
3A11	Elevation Trough Antenna	Antenna Group	OE-203/M
3A12	Azimuth Trough Antenna	Antenna Group	OE-204/M
3A13	Elevation Scanned Dish Antenna	Antenna Group	AS-4054/M

Table 1-3. Equipment Supplied
Part II. Radar Set AN/MPS-T1(V)2 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
3A14	Azimuth Scanned Dish Antenna	Antenna Group	AS-4053/M
3A15	L-Band Dish Antenna	Antenna Group	AS-4055/M
3W7	C-Band Trailer Interconnection Cable		
3W8	C-Band Trailer Interconnection Cable		
3W9	C-Band Trailer Interconnection Cable		
3W10	C-Band Trailer Interconnection Cable		
3W11	C-Band Trailer Interconnection Cable		
3W12	C-Band Trailer Interconnection Cable		
3W14	C-Band Trailer Interconnection Cable		
3W17	C-Band Trailer Interconnection Cable		
3W18	C-Band Trailer Interconnection Cable		
3W64	C-Band Trough Scanner Cable		
3W65	C-Band Trough Scanner Cable		
3W66	C-Band Trough Scanner Cable		
3W67	C-Band Trough Scanner Cable		
3W68	C-Band Dish Scanner Cable		

Table 1-3. Equipment Supplied
Part II. Radar Set AN/MPS-T1(V)2 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
3W69	C-Band Dish Scanner Cable		
3W70	C-Band Dish Scanner Cable		
3W71	C-Band Dish Scanner Cable		
3W72	C-Band Dish Scanner Cable		
3W73	C-Band Dish Scanner Cable		
3W74	C-Band Dish Scanner Cable		
3W75	C-Band Dish Scanner Cable		
3W77	L-Band Coaxial Cable (C-Band)		
Unit 4	X-Band Antenna Trailer	Antenna-Receiver-Transmitter Group, Trailer Mounted	OY-62/M
P/O Unit 4	Mobile Tracker Trailer Assembly	Antenna Pedestal-Trailer	OA-8851/M
P/O Unit 4	Mobile Tracker	Antenna Pedestal Group	OA-8858/M
P/O Unit 4	Antenna Trailer	Trailer, Antenna	V-482/M
4A1	Left Receiver-Transmitter Modulator Console	Transmitter Group	T-91/M
4A1A1	L-Band CW Command Transmitter	Transmitter Set, Electrical Guidance	T-1314/M
4A1A2	L-Band Pulsed Command Transmitter	Transmitter, Radar	T-1315/M

Table 1-3. Equipment Supplied
Part II. Radar Set AN/MPS-T1(V)2 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
4A1A3	L-Band Pulsed Command Transmitter Power Supply	Power Supply	PP-7139/M
4A2	Center Receiver-Transmitter-Modulator Console	Receiver Group	OR-172/M
4A2A1	Microwave Unit	Microwave Assembly, Receiver-Transmitter-Modulator, Center	
4A2A1A5	Signal Conditioning	Relay Assembly Group	OA-8854/M
4A2A2	Prereceiver	Receiver, Radar	R-1992/M
4A2A3	Power Supply Assembly	Power Supply Assembly	PP-7245/M
4A3	Right Receiver-Transmitter-Modulator Console	Transmitter Group	OT-92/M
4A3A1A1	X-Band Transmitter Control	Control, Transmitter	C-9943/M
4A3A2	X-Band Transmitter Modulator	Modulator, Radar	MD-997/M
4A4	Fan	Fan, Centrifugal	
4A5	Junction Box and Power Distribution Panel	Panel, Power Distribution	
4A6	Azimuth Pedestal	Antenna Pedestal Group	OA-8799/M
4A6A1	Synchro Assembly (TX)	Synchro, Transmitter Assembly	SN-502/M
4A6A2	Synchro Assembly (CT)	Synchro, Control Transformer Assembly	SN-503/M
4A6A3	Drive Unit	Actuator, Electro-Mechanical, Rotary	TG-234/M
4A6A5	Fuse and Circuit Breaker Panel	Panel, Power Distribution	

Table 1-3. Equipment Supplied
Part II. Radar Set AN/MPS-T1(V)2 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
4A6A6	Service Outlets		
4A6A7	Azimuth Power Amplifier	Amplifier, Electronic Control	AM-6826/M
4A6A8	Elevation Power Amplifier	Amplifier, Electronic Control	AM-6826/M
4A6A9	Slip Rings	Slip Ring Assembly	
4A6A10	Fan	Fan, Tube Axial	
4A7	Elevation Pedestal	Antenna, Pedestal Group	OA-8800/M
4A7A1	Synchro Assembly (TX)	Synchro, Transmitter Assembly	SN-502/M
4A7A2	Synchro Assembly (CT)	Synchro, Control Transformer Assembly	SN-503/M
4A7A3	Limit Switch Assembly	Switch Assembly	
4A7A4	Drive Unit	Actuator, Electro-Mechanical, Rotary	TG-235/M
4A7A5	Elevation Pedestal Disconnect Panel		
4A7A6	Azimuth Encoder Control Unit		
4A7A7	Elevation Encoder Control Unit		
4A7A8	Azimuth Transducer		
4A7A9	Service Outlets		
4A7A10	Elevation Transducer		
4A8	RTM Housing		
4A9	L-Band Cut Dish Command Antenna	Antenna	AS-4057/M

Table 1-3. Equipment Supplied
Part II. Radar Set AN/MPS-T1(V)2 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
4A10	X-Band Trough Antenna	Antenna	AS-4058/M
4A11	X-Band Illuminator Antenna	Antenna Group	OE-227/M
4W22	X-Band Trailer Interconnection Cable		
4W23	X-Band Trailer Interconnection Cable		
4W24	X-Band Trailer Interconnection Cable		
4W25	X-Band Trailer Interconnection Cable		
4W26	X-Band Trailer Interconnection Cable		
4W27	X-Band Trailer Interconnection Cable		
4W28	X-Band Trailer Interconnection Cable		
4W29	X-Band Trailer Interconnection Cable		
4W39	X-Band Receiver Scanner Cable		
4W40	X-Band Receiver Scanner Cable		
4W44	L-Band Coaxial Cable (X-Band)		
4W46	L-Band Coaxial Cable (X-Band)		
4W51	L-Band Coaxial Cable (X-Band)		
4W53	L-Band Coaxial Cable (X-Band)		

Table 1-3. Equipment Supplied
Part II. Radar Set AN/MPS-T1(V)2 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE
AP20458-S22	Connector (1P1)	
AP20458-S22-S4	Connector (1P3)	
AP40458-S22	Connector (1P2)	
AT-3B-187-12	C-Band Waveguide	
AT-3B-284-24	S-Band Waveguide	
K-6	Borescope Telescope	
MD4	Motor Generator	
TFT-64-4B-40N	X-Band Waveguide	
TFT-64-4B-50N	X-Band Waveguide	
WCF-2335-4N	Frequency Meter	
WCF-4458-4N	Frequency Meter	
WCF-510-4N	Frequency Meter	
WCF-8211-4N	Frequency Meter	
WCF-912-4N	Frequency Meter	
010-0172-00	Probe	
100A	Pulse Generator	
11414-1C	S- and C-Band Antenna Telescope Elbow	
1200-24	Headset-Microphone	
1859	Sheet Metal Lifter	
200-1	Cart	
583Z2504-1	Extender	
423A	Crystal Detector	

Table 1-3. Equipment Supplied
Part II. Radar Set AN/MPS-T1(V)2 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
583Z1008	Steel Plate		
583Z3090-1	Grounding Rod		
583Z4004-823	Vertical Support Structure		
583Z4004-825	Vertical Support Structure		
583Z4005-817	Horizontal Support Structure		
583Z4005-819	Horizontal Support Structure		
583Z4007-807	Strut		
583Z4008-1	Strut		
583Z4012-3	Lifting Cables		
583Z4012-5	Lifting Cables		
583Z4012-803	Lifting Bar		
583Z4014-3	Ladder		
583Z4014-5	Ladder		
583Z4024-3	Vertical Counterweight		
583Z4024-803	Horizontal Counterweight		
583Z4024-805	Vertical Counterweight		
583Z4024-807	Horizontal Counterweight		
583Z4284-1	Lifting Bracket		
583Z4600-1	C-Band Antenna Structure Transport Trailer	Antenna Support Semitrailer	V-489/M
583Z4600-5	Dish Antenna Transport Trailer	Antenna Semitrailer	V-491/M

Table 1-3. Equipment Supplied
Part II. Radar Set AN/MPS-T1(V)2 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
583Z4600-801	S-Band Antenna Structure Transport Trailer	Antenna Support Semitrailer	V-492/M
583Z4600-805	X-Band Antenna Transport Trailer	Antenna Semitrailer	V-494/M
583Z4600-807	C-Band Trough Antenna Transport Trailer	Antenna Semitrailer	V-487/M
583Z4600-809	S-Band Trough Antenna Transport Trailer	Antenna Semitrailer	V-488/M
583Z5091-1	C-Band Waveguide and Guard Assembly		
583Z5091-3	C-Band Waveguide and Guard Assembly		
583Z5091-5	C-Band Waveguide and Guard Assembly		
583Z5091-801	C-Band Waveguide and Guard Assembly		
583Z5091-803	S-Band Waveguide and Guard Assemblv		
583Z5091-805	S-Band Waveguide and Guard Assembly		
590	Extender		
591	Extractor		
608E	Signal Generator		
618C	Signal Generator		
620B	Signal Generator		
8616A	Signal Generator		
95635	Ear Protectors		
5590	Extender		

Table 1-3. Equipment Supplied
Part III. Radar Set AN/MPS-T1(V)3

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
Unit 1	Radar Control Trailer	Radar Set Control Group	OK-251/M
1A1	Guidance Operator Console	Console, Target Tracking	OJ-303/M
1A1A1	Mode Control	Control, Transmitter	C-9323/M
1A1A2	Azimuth Indicator	Indicator, Azimuth-Range	IP-1147/M
1A1A3	Elevation Indicator	Indicator, Elevation-Range	IP-1234/M
1A1A4	Tracking Control	Control, Target Tracking	C-9324/M
1A1A5	Synchronizer	Synchronizer, Electrical	SN-479/M
1A1A6	Power Supply Assembly	Power Supply Assembly	PP-6912/M
1A1A7	Indicator Power Supply	Power Supply Assembly	PP-6913/M
1A2	Signal Distribution Panel	Panel, Signal Distribution, Radar	
1A3	Transponder Console	Console, Reference Tracking	OJ-304/M
1A3A1	Transponder Receiver	Receiver, Radar	R-1837/M
1A3A2	Azimuth Indicator	Indicator, Azimuth-Range	IP-1149/M
1A3A3	Elevation Indicator	Indicator, Elevation-Range	IP-1148/M
1A3A4	Tracking Control	Control, Reference Signal	C-9325/M
1A3A5	Power Supply Assembly	Power Supply Assembly	PP-6914/M
1A3A6	Indicator Power Supply	Power Supply Assembly	PP-6915/M
1A4	Oscilloscope	Oscilloscope	
1A5	Radar Console	Console, Radar Set	OJ-343/M
1A5A1	S- and C-Band Transmitter Control Panel	Control, Transmitter	C-9713/M
1A5A2	Power and Frequency Control	Control, Frequency Selector-Power	C-9711/M

Table 1-3. Equipment Supplied
Part III. Radar Set AN/MPS-T1(V)3 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
1A5A3	Transmitter Coder	Coder, Transmitter	KY-809/M
1A5A5	Receiver Select	Selector, Receiver Signal	SA-2026/M
1A5A6	Power Monitor	Monitor, Radio Frequency	ID-1997/M
1A5A7	L-Band Transmitter Control Panel	Control, Transmitter	C-9713/M
1A5A8	Digital Voltmeter	Voltmeter, Digital	ME-473/M
1A5A9	Noise Figure Meter	Radio Interference Field Intensity Meter	IM-232/M
1A5A10	S-Band Servo Amplifier	Amplifier, Electronic Control	AM-6732/M
1A5A11	S-Band DC Amplifier	Amplifier, Direct Current	AM-6733/M
1A5A12	S-Band Servo Control	Control, Antenna	C-9714/M
1A5A13	Power Supply Assembly	Power Supply Assembly	PP-7134/M
1A5A14	Computer Interface	Converter, Analog-to-Digital	CV-3229/M
1A5A15	Signal Test Panel	Panel, Test, Electrical	SB-3798/M
1A5A16	Digital Voltmeter Test Panel	Panel, Test, Electrical	SB-3797/M
1A5A17	C-Band Servo Amplifier	Amplifier, Electronic Control	AM-6732/M
1A5A18	C-Band DC Amplifier	Amplifier, Direct Current	AM-6733/M
1A5A19	C-Band Servo Control	Control, Antenna	C-9714/M
1A5A20	Power Supply Assembly	Power Supply Assembly	PP-7136/M
1A5A21	Intercom	Intercommunication Station	LS-620/M
1A5A22	Recorder DC Amplifier	Amplifier Assembly	AM-6731/M
1A5A23	Recorder	Recorder, Coordinate Data	

Table 1-3. Equipment Supplied
Part III. Radar Set AN/MPS-T1(V)3 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
1A5A24	Recorder Input Panel	Panel, Signal Distribution Radar	SB-3796/M
1A5A25	Recorder Takeup Reel	Panel, Chart Takeup	
1A5A26	Recorder Master Power Panel	Panel, Power Distribution	
1A5A27	X- and L-Band Transmitter Control Panel	Control, Transmitter	C-9710/M
1A6	Radio Set (GFE)	Radio Set Assembly (GFE)	AN/GRC-27
1A8	Digital Computer Console	Computer-Intercom Station	CP-1236/M
1A8A1	High Speed Tape Punch	Perforator, Tape	
1A8A2	Tape Reader	Reader, Perforated Tape	
1A8A3	Spooler	Handler, Perforated Tape	
1A8A4	Control Panel	Control, Computer	
1A8A5	Intercom	Intercom Station	LS-620/M
1A8A6	Multiverter	Converter, Analog-to-Digital and Digital-to-Analog	
1A8A8	Power Supply	Power Supply Assembly	
1A8A9	Auxiliary Unit	Logic Auxiliary	
1A8A10	Main Power Distribution	Panel, Power Distribution	
1A8A11	Power Supply	Power Supply Assembly	
1A8A12	Main Frame	Logic, Central Processor	
1A8A13	Memory	Core Memory Unit	
1A9	Teletype	Teletypewriter	TT-685/M
1A10	Workbench	Work Table	

Table 1-3. Equipment Supplied
Part III. Radar Set AN/MPS-T1(V)3 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
1A11	S- and C-Band Manual Tracker Console	Console, Target Tracking	OJ-302/M
1A11A1	Azimuth Receiver	Receiver, Radar	R-1835/M
1A11A2	Azimuth Indicator	Indicator, Azimuth-Elevation-Range	IP-1145/M
1A11A3	Azimuth Tracking Control	Control, Antenna	C-9320/M
1A11A4	Azimuth Intercom	Intercom Station	LS-620/M
1A11A5	Sweep Generator	Generator, Sweep	O-1654/M
1A11A6	Range Indicator	Indicator, Azimuth-Elevation-Range	IP-1146/M
1A11A7	Range Tracking Control	Control, Tracking, Range	C-9321/M
1A11A8	Indicator Power Supply	Power Supply Assembly	PP-6910/M
1A11A9	Range Intercom	Intercom Station	LS-620/M
1A11A10	Elevation Intercom	Intercom Station	LS-620/M
1A11A11	Elevation Receiver	Receiver, Radar	R-1836/M
1A11A12	Elevation Indicator	Indicator, Azimuth-Elevation-Range	IP-1145/M
1A11A13	Elevation Tracking Control	Control, Antenna	C-9332/M
1A11A14	Power Supply Assembly	Power Supply Assembly	PP-6911/M
1A12	Power Distribution Console	Switchboard, Power Supply	SB-3799/M
1A14	Power Entry	Power Connector Panel Assembly	
1A15	Van Semitrailer	Semitrailer, Van	

Table 1-3. Equipment Supplied
Part III. Radar Set AN/MPS-T1(V)3 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
1A16	Radio Set Antenna (GFE)	Antenna (GFE)	
1A17	X-Band Manual Tracker Console	Console, Target Tracking	OJ-344/M
1A17A1	Reference Receiver	Receiver, Radar	R-1930/M
1A17A2	Moving Target Indicator	Comparator, Signal	CM-450/M
1A17A3	Target Receiver	Receiver, Radar	R-1931/M
1A17A4	Target Tracking	Tracker, Target	MX-9646/M
1A17A6	X-Band Servo Amplifier	Amplifier, Electronic Control	AM-6732/M
1A17A7	X-Band DC Amplifier	Amplifier, Direct Current	AM-6733/M
1A17A8	X-Band Servo Control	Control, Antenna	C-9714/M
1A17A9	T1 Intercom	Intercom Station	LS-620/M
1A17A10	Down Link Jammer Receiver	Receiver, Radar	R-1932/M
1A17A11	T1 Indicator	Indicator, Azimuth-Elevation-Range	IP-1189/M
1A17A12	T1 Tracking Control	Control, Target Tracking	C-9715/M
1A17A13	Indicator Power Supply	Power Supply	PP-7137/M
1A17A14	Power Supply Assembly	Power Supply Assembly	PP-7138/M
1A17A15	T2 Intercom	Intercom Station	LS-620/M
1A17A16	Target Simulator	Simulator, Radar Target	SM-709/M
1A17A17	T2 Indicator	Indicator, Azimuth-Elevation-Range	IP-1189/M
1A17A18	T2 Tracking Control	Control, Target Tracking	C-9716/M
1A17A19	Reference Pedestal Servo	Programmer, Antenna Position	MX-9647/M

Table 1-3. Equipment Supplied
Part III. Radar Set AN/MPS-T1(V)3 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
1A19	Automatic Position Plotter Console	Console, Target Tracking	OJ-345/M
1A19A1	Automatic Position Plotter Indicator	Indicator, Azimuth-Range	IP-1190/M
1A19A2	Sweep Control	Control, Indicator	C-971/M
1A19A3	Intercom	Intercom System	LS-620/M
1A19A4	Power Supply Assembly	Power Supply Assembly	PP-6911/M
1A19A5	Indicator Power Supply	Power Supply	PP-7137/M
1A19A6	Radio Set Control (GFE)	Radio Set, Control (GFE)	
1A20	Common Data Point Assembly	Control, Indicator	C-9941/M
Unit 2	S-Band Antenna Trailer	Antenna-Receiver-Transmitter Group, Trailer Mounted	OY-55B/M
P/O Unit 2	Mobile Tracker Trailer Assembly	Antenna Pedestal-Trailer	OA-8797/M
P/O Unit 2	Mobile Tracker	Antenna Pedestal Group	OA-8798/M
P/O Unit 2	Antenna Trailer	Trailer, Antenna	V-482/M
2A1	L-Band Pulsed Command Transmitter Console	Transmitter Group	OT-83/M
2A1A1	L-Band Pulsed Command Transmitter	Transmitter, Radar	T-1296/M
2A1A2	L-Band Pulsed Command Transmitter Power Supply	Power Supply	PP-7139/M
2A1A3	Performance Monitor	Monitor, Radio Frequency	ID-1999/M
2A1A4	Fan	Fan, Centrifugal	

Table 1-3. Equipment Supplied
Part III. Radar Set AN/MPS-T1(V)3 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
2A1A5	Storage Drawer	Drawer, Electrical Equipment	
2A2	Elevation Transmitter Console	Transmitter Group	OT-84/M
P/O 2A2	Control Panel	Control, Transmitter	C-9721/M
P/O 2A2	Trigger Control Assembly	Generator, Pulse	O-1689/M
P/O 2A2	Reverse Power Trip Assembly	Control, Power Supply	C-9722/M
P/O 2A2	Charging Control Assembly	Control, Modulator	C-9720/M
P/O 2A2	Modulator	Modulator, Radar	MD-955/M
P/O 2A2	Thyratron Bias Control	Control Modulator	C-9719/M
P/O 2A2	High Voltage Power Supply	Power Supply Set	OP-99/M
P/O 2A2	Magnetron Filament Control	Control, Magnetron Filament	C-9718/M
P/O 2A2	Current Overload	Relay, Current Overload	RE-1103/M
P/O 2A2	Transformer	Transformer Assembly	TF-573/M
P/O 2A2	Power Supply	Power Supply	PP-7140/M
2A3	Elevation Receiver Console	Receiver Group	OR-159/M
2A3A1	Microwave Assembly	Installation, S-Band Microwave	
2A3A2	Performance Monitor	Monitor, Radio Frequency	ID-2000/M
2A3A3	Prereceiver	Receiver, Radar	R-1933/M
2A3A4	Power Supply Assembly	Power Supply Assembly	PP-7241/M
2A3A5	Fan	Fan, Centrifugal	

Table 1-3. Equipment Supplied
Part III. Radar Set AN/MPS-T1(V)3 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
2A4	Power Distribution Panel	Panel, Power Distribution	
2A5	Junction Box	Junction Box	
2A6	Auxiliary Equipment Console	Console, Auxiliary Equipment	OJ-367/M
2A6A1	Waveguide and Scanner Switching	Relay Assembly	RE-1108/M
2A6A2	Signal Conditioning	Relay Assembly Group	OA-8852/M
2A6A3	Power Supply	Transformer Assembly	TF-580/M
2A6A4	Power Supply Assembly	Power Supply Assembly	PP-7243/M
2A6A5	Fan	Fan, Centrifugal	
2A7	Azimuth Transmitter Console	Transmitter Group	OT-84/M
P/O 2A7	Control Panel	Control, Transmitter	C-9721/M
P/O 2A7	Trigger Control Assembly	Generator, Pulse	O-1689/M
P/O 2A7	Reverse Power Trip Assembly	Control, Power Supply	C-9722/M
P/O 2A7	Charging Control Assembly	Control, Modulator	C-9720/M
P/O 2A7	Modulator	Modulator, Radar	MD-955/M
P/O 2A7	Thyratron Bias Control	Control Modulator	C-9719/M
P/O 2A7	High Voltage Power Supply	Power Supply Set	OP-99/M
P/O 2A7	Magnetron Filament Control	Control, Magnetron	C-9718/M
P/O 2A7	Current Overload	Relay, Current Overload	RE-1103/M

Table 1-3. Equipment Supplied
Part III. Radar Set AN/MPS-T1(V)3 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
P/O 2A7	Transformer Assembly	Transformer Assembly	TF-573/M
P/O 2A7	Power Supply	Power Supply	PP-7140/M
2A8	Azimuth Receiver Console	Receiver Group	OR-159/M
2A8A1	Microwave Assembly	Installation, S-Band Microwave	
2A8A2	Performance Monitor	Monitor, Radio Frequency	ID-2000/M
2A8A3	Prereceiver	Receiver, Radar	R-1933/M
2A8A4	Power Supply Assembly	Power Supply Assembly	PP-7141/M
2A8A5	Fan	Fan, Centrifugal	
2A9	Azimuth Pedestal	Antenna Pedestal Group	OA-8799/M
2A9A1	Synchro Assembly (TX)	Synchro, Transmitter Assembly	SN-502/M
2A9A2	Synchro Assembly (CT)	Synchro, Control Transformer Assembly	SN-503/M
2A9A3	Drive Unit	Actuator, Electro-Mechanical, Rotary	TG-234/M
2A9A5	Fuse and Circuit Breaker Panel	Panel, Circuit Breaker-Fuse	
2A9A6	Service Outlets		
2A9A7	Azimuth Power Amplifier	Amplifier, Electronic Control	AM-6826/M
2A9A8	Elevation Power Amplifier	Amplifier, Electronic Control	AM-6826/M
2A9A9	Slip Rings	Slip Ring Assembly	
2A9A23	Fan	Fan, Tube Axial	

Table 1-3. Equipment Supplied
Part III. Radar Set AN/MPS-T1(V)3 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
2A10	Elevation Pedestal	Antenna Pedestal Group	OA-8800/M
2A10A1	Synchro Assembly (TX)	Synchro, Transmitter Assembly	SN-502/M
2A10A2	Synchro Assembly (CT)	Synchro, Control Transformer Assembly	SN-503/M
2A10A3	Limit Switch Assembly	Switch Assembly	
2A10A4	Drive Unit	Actuator, Electro-Mechanical, Rotary	TG-235/M
2A10A5	Azimuth Encoder Control Unit		
2A10A6	Elevation Encoder Control Unit		
2A10A7	Azimuth Transducer		
2A10A8	Elevation Transducer		
2A10A9	Service Outlets		
2A10A10	Elevation Pedestal Disconnect Panel		
2A11	Elevation Trough Antenna	Antenna Group	OE-223/M
2A12	Azimuth Trough Antenna	Antenna Group	OE-224/M
2A13	L-Band Dish Antenna	Antenna	OE-4056/M
2W1	S-Band Trailer Interconnection Cable		
2W2	S-Band Trailer Interconnection Cable		
2W3	S-Band Trailer Interconnection Cable		

Table 1-3. Equipment Supplied
Part III. Radar Set AN/MPS-T1(V)3 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
2W4	S-Band Trailer Interconnection Cable		
2W5	S-Band Trailer Interconnection Cable		
2W6	S-Band Trailer Interconnection Cable		
2W13	S-Band Trailer Interconnection Cable		
2W15	S-Band Trailer Interconnection Cable		
2W16	S-Band Trailer Interconnection Cable		
2W61	S-Band Trough Scanner Cable		
2W62	S-Band Trough Scanner Cable		
2W63	S-Band Trough Scanner Cable		
2W64	S-Band Trough Scanner Cable		
2W66	L-Band Coaxial Cable (S-Band)		
2W67	L-Band Coaxial Cable (S-Band)		
2W68	L-Band Coaxial Cable (S-Band)		
Unit 3	C-Band Antenna Trailer	Antenna-Receiver-Transmitter Group, Trailer Mounted	OY-56A/M
P/O Unit 3	Mobile Tracker Trailer Assembly	Antenna Pedestal-Trailer	OA-8857/M

Table 1-3. Equipment Supplied
Part III. Radar Set AN/MPS-T1(V)3 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
P/O Unit 3	Mobile Tracker	Antenna Pedestal Group	OA-8853/M
P/O Unit 3	Antenna Trailer	Trailer Antenna	V-482/M
3A1	L-Band Pulsed Command Transmitter Console	Transmitter Group	OT-83/M
3A1A1	L-Band Pulsed Command Transmitter	Transmitter, Radar	T-1296/M
3A1A2	L-Band Pulsed Command Transmitter Power Supply	Power Supply	PP-7139/M
3A1A3	Performance Monitor	Monitor, Radio Frequency	ID-1999/M
3A1A4	Fan	Fan, Centrifugal	
3A1A5	Storage Drawer	Drawer, Electrical Equipment Cabinet	
3A2	Elevation Transmitter Assembly	Transmitter Group	OT-85/M
P/O 3A2	Control Panel	Control, Transmitter	C-9721/M
P/O 3A2	Trigger Control Assembly	Generator, Pulse	O-1689/M
P/O 3A2	Reverse Power Trip Assembly	Control Power Supply	C-9722/M
P/O 3A2	Charging Control Assembly	Control, Modulator	C-9720/M
P/O 3A2	Modulator	Modulator, Radar	MD-955/M
P/O 3A2	Thyratron Bias Control	Control Modulator	C-9719/M
P/O 3A2	High Voltage Power Supply	Power Supply Set	OP-99/M
P/O 3A2	Magnetron Filament Control	Control, Magnetron Filament	C-9718/M

Table 1-3. Equipment Supplied
Part III. Radar Set AN/MPS-T1(V)3 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
P/O 3A2	Current Overload	Relay, Current Overload	RE-1103/M
P/O 3A2	Transformer Assembly	Transformer Assembly	TF-573/M
P/O 3A2	Power Supply	Power Supply	PP-7140/M
3A3	Elevation Receiver Console	Receiver Group	OR-171/M
3A3A1	Microwave Assembly	Installation, C-Band Microwave	
3A3A2	Performance Monitor	Control - Monitor	C-9942/M
3A3A3	Prereceiver	Receiver, Radar	R-1991/M
3A3A4	Power Supply Assembly	Power Supply Assembly	PP-7141/M
3A3A5	Fan	Fan, Centrifugal	
3A4	Power Distribution Panel	Panel, Power Distribution	
3A5	Junction Box	Junction Box	
3A6	Auxiliary Equipment Console	Console, Auxiliary Equipment	OJ-368/M
3A6A1	Waveguide and Scanner Switching	Relay Assembly Group	OA-8855/M
3A6A2	Signal Conditioning	Relay Assembly Group	OA-8856/M
3A6A3	Power Supply	Power Supply Assembly	PP-7244/M
3A6A4	Power Supply Assembly	Power Supply Assembly	PP-7234/M
3A6A5	Fan	Fan, Centrifugal	
3A7	Azimuth Transmitter Console	Transmitter Group	OT-85/M
P/O 3A7	Control Panel	Control, Transmitter	C-9721/M
P/O 3A7	Trigger Control Assembly	Generator, Pulse	O-1689/M

Table 1-3. Equipment Supplied
Part III. Radar Set AN/MPS-T1(V)3 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
P/O 3A7	Reverse Power Trip Assembly	Control, Power Supply	C-9722/M
P/O 3A7	Charging Control Assembly	Control, Modulator	C-9720/M
P/O 3A7	Modulator	Modulator, Radar	MD-955/M
P/O 3A7	Thyratron Bias Control	Control Modulator	C-9719/M
P/O 3A7	High Voltage Power Supply	Power Supply Set	OP-99/M
P/O 3A7	Magnetron Filament Control	Control, Magnetron Filament	C-9718/M
P/O 3A7	Current Overload	Relay, Current Overload	RE-1103/M
P/O 3A7	Transformer Assembly	Transformer Assembly	TF-573/M
P/O 3A7	Power Supply	Power Supply	PP-7140/M
3A8	Azimuth Receiver Console	Receiver Group	OR-171/M
3A8A1	Microwave Assembly	Installation, C-Band Microwave	
3A8A2	Performance Monitor	Control - Monitor	C-9942/M
3A8A3	Prereceiver	Receiver, Radar	R-1991/M
3A8A4	Power Supply Assembly	Power Supply Assembly	PP-7141/M
3A8A5	Fan	Fan, Centrifugal	
3A9	Azimuth Pedestal	Antenna Pedestal Group	OA-8799/M
3A9A1	Synchro Assembly (TX)	Synchro, Transmitter Assembly	SN-502/M
3A9A2	Synchro Assembly (CT)	Synchro, Control Transformer Assembly	SN-503/M
3A9A3	Drive Unit	Actuator, Electro-Mechanical, Rotary	TG-234/M

Table 1-3. Equipment Supplied
Part III. Radar Set AN/MPS-T1(V)3 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
3A9A5	Fuse and Circuit Breaker Panel	Panel, Circuit Breaker-Fuse	
3A9A6	Service Outlets		
3A9A7	Azimuth Power Amplifier	Amplifier, Electrical Control	AM-6826/M
3A9A8	Elevation Power Amplifier	Amplifier, Electrical Control	AM-6826/M
3A9A9	Slip Rings	Slip Ring Assembly	
3A9A23	Fan	Fan, Tube Axial	
3A10	Elevation Pedestal	Antenna Pedestal Group	OA-8800/M
3A10A1	Synchro Assembly (TX)	Synchro, Transmitter Assembly	SN-502/M
3A10A2	Synchro Assembly (CT)	Synchro, Control Transformer Assembly	SN-503/M
3A10A3	Limit Switch Assembly	Switch Assembly	
3A10A4	Drive Unit	Actuator, Electro-Mechanical, Rotary	TG-235/M
3A10A5	Azimuth Encoder Control Unit		
3A10A6	Elevation Encoder Control Unit		
3A10A7	Azimuth Transducer		
3A10A8	Elevation Transducer		
3A10A9	Service Outlets		
3A10A10	Elevation Pedestal Disconnect Panel		
3A11	Elevation Trough Antenna	Antenna Group	OE-226/M
3A12	Azimuth Trough Antenna	Antenna Group	OE-225/M

Table 1-3. Equipment Supplied
Part III. Radar Set AN/MPS-T1(V)3 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
3A13	Elevation Scanned Dish Antenna	Antenna Group	AS-4054/M
3A14	Azimuth Scanned Dish Antenna	Antenna Group	AS-4053/M
3A15	L-Band Dish Antenna	Antenna Group	AS-4056/M
3W7	C-Band Trailer Interconnection Cable		
3W8	C-Band Trailer Interconnection Cable		
3W9	C-Band Trailer Interconnection Cable		
3W10	C-Band Trailer Interconnection Cable		
3W11	C-Band Trailer Interconnection Cable		
3W12	C-Band Trailer Interconnection Cable		
3W14	C-Band Trailer Interconnection Cable		
3W17	C-Band Trailer Interconnection Cable		
3W18	C-Band Trailer Interconnection Cable		
3W64	C-Band Trough Scanner Cable		
3W65	C-Band Trough Scanner Cable		
3W66	C-Band Trough Scanner Cable		
3W67	C-Band Trough Scanner Cable		

Table 1-3. Equipment Supplied
Part III. Radar Set AN/MPS-T1(V)3 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
3W68	C-Band Dish Scanner Cable		
3W69	C-Band Dish Scanner Cable		
3W70	C-Band Dish Scanner Cable		
3W71	C-Band Dish Scanner Cable		
3W72	C-Band Dish Scanner Cable		
3W73	C-Band Dish Scanner Cable		
3W74	C-Band Dish Scanner Cable		
3W75	C-Band Dish Scanner Cable		
3W77	L-Band Coaxial Cable (C-Band)		
Unit 4	X-Band Antenna Trailer	Antenna Receiver-Transmitter Group, Trailer Mounted	OY-62/M
P/O Unit 4	Mobile Tracker Trailer Assembly	Antenna Pedestal-Trailer	OA-8851/M
P/O Unit 4	Mobile Tracker	Antenna Pedestal Group	OA-8858/M
P/O Unit 4	Antenna Trailer	Trailer, Antenna	V-482/M
4A1	Left Receiver-Transmitter-Modulator Console	Transmitter Group	T-91/M
4A1A1	L-Band CW Command Transmitter	Transmitter Set, Electrical Guidance	T-1314/M
4A1A2	L-Band Pulsed Command Transmitter	Transmitter, Radar	T-1315/M

Table 1-3. Equipment Supplied
Part III. Radar Set AN-MPS-T1(V)3 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
4A1A3	L-Band Pulsed Command Transmitter Power Supply	Power Supply	PP-7139/M
4A2	Center Receiver-Transmitter-Modulator Console	Receiver Group	OR-172/M
4A2A1	Microwave Unit	Microwave Assembly, Receiver-Transmitter-Modulator, Center	
4A2A1A5	Signal Conditioning	Relay Assembly Group	OA-8854/M
4A2A2	Prereceiver	Receiver, Radar	R-1992/M
4A2A3	Power Supply Assembly	Power Supply Assembly	PP-7245/M
4A3	Right Receiver-Transmitter-Modulator Console	Transmitter Group	OT-92/M
4A3A1A1	X-Band Transmitter Control	Control, Transmitter	C-9943/M
4A3A2	X-Band Transmitter Modulator	Modulator, Radar	MD-997/M
4A4	Fan	Fan, Centrifugal	
4A5	Junction Box and Power Distribution Panel	Panel, Power Distribution	
4A6	Azimuth Pedestal	Antenna Pedestal Group	OA-8799/M
4A6A1	Synchro Assembly (TX)	Synchro, Transmitter Assembly	SN-502/M
4A6A2	Synchro Assembly (CT)	Synchro, Control Transformer Assembly	SN-503/M
4A6A3	Drive Unit	Actuator, Electro-Mechanical, Rotary	TG-234/M
4A6A5	Fuse and Circuit Breaker Panel	Panel, Power Distribution	

Table 1-3. Equipment Supplied
Part III. Radar Set AN/MPS-T1(V)3 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
4A6A6	Service Outlets		
4A6A7	Azimuth Power Amplifier	Amplifier, Electronic Control	AM-6826/M
4A6A8	Elevation Power Amplifier	Amplifier, Electronic Control	AM-6826/M
4A6A9	Slip Ring	Slip Ring Assembly	
4A6A10	Fan	Fan, Tube Axial	
4A7	Elevation Pedestal	Antenna, Pedestal Group	OA-8800/M
4A7A1	Synchro Assembly (TX)	Synchro, Transmitter Assembly	SN-502/M
4A7A2	Synchro Assembly (CT)	Synchro, Control Transformer Assembly	SN-503/M
4A7A3	Limit Switch Assembly	Switch Assembly	
4A7A4	Drive Unit	Actuator, Electro-Mechanical, Rotary	TG-235/M
4A7A5	Elevation Disconnect Panel		
4A7A6	Azimuth Encoder Control Unit		
4A7A7	Elevation Encoder Control Unit		
4A7A8	Azimuth Transducer		
4A7A9	Service Outlets		
4A7A10	Elevation Transducer		
4A8	RTM Housing		
4A9	L-Band Cut Dish Command Antenna	Antenna	AS-4057/M

Table 1-3. Equipment Supplied
Part III. Radar Set AN/MPS-T1(V)3 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
4A10	X-Band Antenna	Antenna	AS-4058/M
4A11	X-Band Illuminator Antenna	Antenna Group	OE-227/M
4W22	X-Band Trailer Interconnection Cable		
4A23	X-Band Trailer Interconnection Cable		
4W24	X-Band Trailer Interconnection Cable		
4W25	X-Band Trailer Interconnection Cable		
4W26	X-Band Trailer Interconnection Cable		
4W27	X-Band Trailer Interconnection Cable		
4W28	X-Band Trailer Interconnection Cable		
4W29	X-Band Trailer Interconnection Cable		
4W39	X-Band Receiver Scanner Cable		
4W40	X-Band Receiver Scanner Cable		
4W44	L-Band Coaxial Cable (X-Band)		
4W46	L-Band Coaxial Cable (X-Band)		
4W51	L-Band Coaxial Cable (X-Band)		
4W53	L-Band Coaxial Cable (X-Band)		

Table 1-3. Equipment Supplied
Part III. Radar Set AN/MPS-T1(V)3 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE
AP20458-S22	Connector (1P1)	
AP20458-S22-S4	Connector (1P3)	
AP40458-S22	Connector (1P3)	
AT-3B-187-12	C-Band Waveguide	
AT-3B284-24	S-Band Waveguide	
K-6	Borescope Telescope	
MD4	Motor Generator	
TFT-64-4B-40N	X-Band Waveguide	
TFT-64-4B-50N	X-Band Waveguide	
WCF-2335-4N	Frequency Meter	
WCF-4458-4N	Frequency Meter	
WCF-510-4N	Frequency Meter	
WCF-8211-4N	Frequency Meter	
WCF-912-4N	Frequency Meter	
010-0172-00	Probe	
100A	Pulse Generator	
11414-1C	S- and C-Band Antenna Telescope Elbow	
1200-24	Headset-Microphone	
1859	Sheet Metal Lifter	
200-1	Cart	
583Z2504-1	Extender	
423A	Crystal Detector	

Table 1-3. Equipment Supplied
Part III. Radar Set AN/MPS-T1(V)3 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
583Z1008	Steel Plate		
583Z3090-1	Grounding Rod		
583Z4004-831	Vertical Support Structure		
583Z4004-833	Vertical Support Structure		
583Z4005-825	Horizontal Support Structure		
583Z4005-827	Horizontal Support Structure		
583Z4005-811	Horizontal Arm Extension		
583Z4007-807	Strut		
583Z4008-1	Strut		
583Z4012-1	Lifting Bar		
583Z4012-3	Lifting Cables		
583Z4012-5	Lifting Cables		
583Z4014-1	Ladder		
583Z4014-3	Ladder		
583Z4024-801	Vertical Counterweight		
583Z4024-1	Horizontal Counter-weight		
583Z4024-3	Vertical Counterweight		
583Z4024-5	Horizontal Counter-weight		
583Z4284-1	Lifting Bracket		
583Z4600-1	C-Band Antenna Structure Transport Trailer	Antenna Support Semi-Trailer	V-489/M

Table 1-3. Equipment Supplied
Part III. Radar Set AN/MPS-T1(V)3 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
583Z4600-3	C-Band Trough Antenna Transport Trailer	Antenna Semitrailer	V-490/M
583Z4600-5	Dish Antenna Transport Trailer	Antenna Semitrailer	V-491/M
583Z4600-801	S-Band Antenna Structure Transport Trailer	Antenna Support Semitrailer	V-492/M
583Z4600-803	S-Band Trough Antenna Transport Trailer	Antenna Semitrailer	V-493/M
583Z4600-805	X-Band Antenna Transport Trailer	Antenna Semitrailer	V-494/M
583Z5091-1	C-Band Waveguide and Guard Assembly		
583Z5091-3	C-Band Waveguide and Guard Assembly		
583Z5091-5	C-Band Waveguide and Guard Assembly		
583Z5091-801	C-Band Waveguide and Guard Assembly		
583Z5091-803	S-Band Waveguide and Guard Assembly		
583Z5091-805	S-Band Waveguide and Guard Assembly		
590	Extender		
591	Extractor		
608E	Signal Generator		
618C	Signal Generator		
620B	Signal Generator		
8616A	Signal Generator		
95635	Ear Protectors		
5590	Extender		

Table 1-3. Equipment Supplied
Part IV. Radar Set AN/MPS-T1(V)4

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
Unit 1	Radar Control Trailer	Radar Set Control Group	OK-251/M
1A1	Guidance Operator Console	Console, Target Tracking	OJ-303/M
1A1A1	Mode Control	Control, Transmitter	C-9323/M
1A1A2	Azimuth Indicator	Indicator, Azimuth-Range	IP-1147/M
1A1A3	Elevation Indicator	Indicator, Elevation-Range	IP-1234/M
1A1A4	Tracking Control	Control, Target Tracking	C-9324/M
1A1A5	Synchronizer	Synchronizer, Electrical	SN-479/M
1A1A6	Power Supply Assembly	Power Supply Assembly	PP-6912/M
1A1A7	Indicator Power Supply	Power Supply Assembly	PP-6913/M
1A2	Signal Distribution Panel	Panel, Signal Distribution, Radar	
1A3	Transponder Console	Console, Reference Tracking	OJ-304/M
1A3A1	Transponder Receiver	Receiver, Radar	R-1837/M
1A3A2	Azimuth Indicator	Indicator, Azimuth-Range	IP-1149/M
1A3A3	Elevation Indicator	Indicator, Elevation-Range	IP-1148/M
1A3A4	Tracking Control	Control, Reference Signal	C-9325/M
1A3A5	Power Supply Assembly	Power Supply Assembly	PP-6914/M
1A3A6	Indicator Power Supply	Power Supply Assembly	PP-6915/M
1A4	Oscilloscope	Oscilloscope	
1A5	Radar Console	Console, Radar Set	OJ-370/M or OJ-370A/M

Table 1-3. Equipment Supplied
Part IV. Radar Set AN/MPS-T1(V)4 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
1A5A1	S- and C-Band Transmitter Control Panel	Control, Transmitter	C-9713/M
1A5A2	Power and Frequency Control	Control, Frequency Selector-Power	C-9711/M
1A5A3	Transmitter Coder	Coder, Transmitter	KY-809/M
1A5A5	Receiver Select	Selector, Receiver Signal	SA-2026/M
1A5A6	Power Monitor	Monitor, Radio Frequency	ID-1997/M
1A5A7	L-Band Transmitter Control Panel	Control, Transmitter	C-9713/M
1A5A8	Digital Voltmeter	Voltmeter, Digital	ME-473/M
1A5A9	Noise Figure Meter	Radio Interference Field Intensity Meter	IM-232/M
1A5A12	S-Band Servo Control	Control, Antenna	C-9944/M
1A5A13	Power Supply Assembly	Power Supply Assembly	PP-7134/M
1A5A14	Computer Interface	Converter, Analog-to-Digital	CV-3229/M
1A5A15	Signal Test Panel	Panel, Test, Electrical	SB-3798/M
1A5A16	Digital Voltmeter Test Panel	Panel, Test, Electrical	SB-3797/M
1A5A19	C-Band Servo Control	Control, Antenna	C-9944/M
1A5A20	Power Supply Assembly	Power Supply Assembly	PP-7136/M
1A5A21	Intercom	Intercommunication Station	LS-620/M
1A5A22	Recorder DC Amplifier	Amplifier Assembly	AM-6731/M
1A5A23	Recorder	Recorder, Coordinate Data	
1A5A24	Recorder Input Panel	Panel, Signal Distribution Radar	SB-3796/M

Table 1-3. Equipment Supplied
Part IV. Radar Set AN/MPS-T1(V)4 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
1A5A25 (OJ-370/M console only)	Recorder Takeup Reel	Panel, Chart Takeup	
1A5A26 (OJ-370/M console only)	Recorder Master Power Panel	Panel, Power Distribution	
1A5A27	X- and L-Band Transmitter Control Panel	Control, Transmitter	C-9710/M
1A6	Radio Set (GFE)	Radio Set Assembly (GFE)	AN/GRC-27
1A8	Digital Computer Console	Computer-Intercom Station	CP-1236/M
1A8A1	High Speed Tape Punch	Perforator, Tape	
1A8A2	Tape Reader	Reader, Perforated Tape	
1A8A3	Spooler	Handler, Perforated Tape	
1A8A4	Control Panel	Control, Computer	
1A8A5	Intercom	Intercom Station	LS-620/M
1A8A6	Multiverter	Converter, Analog-to-Digital and Digital-to-Analog	
1A8A7	Power Supply	Power Supply Assembly	
1A8A9	Auxiliary Unit	Logic Auxiliary	
1A8A10	Main Power Distribution	Panel, Power Distribution	
1A8A11	Power Supply	Power Supply Assembly	
1A8A12	Main Frame	Logic, Central Processor	
1A8A13	Memory	Core Memory Unit	
1A9	Teletype	Teletypewriter	TT-685/M
1A10	Workbench	Work Table	

Table 1-3. Equipment Supplied
Part IV. Radar Set AN/MPS-T1(V)4 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
1A11	S- and C-Band Manual Tracker Console	Console, Target Tracking	OJ-302/M
1A11A1	Azimuth Receiver	Receiver, Radar	R-1835/M
1A11A2	Azimuth Indicator	Indicator, Azimuth-Elevation Range	IP-1145/M
1A11A3	Azimuth Tracking Control	Control, Antenna	C-9320/M
1A11A4	Azimuth Intercom	Intercom Station	LS-620/M
1A11A5	Sweep Generator	Generator, Sweep	O-1654/M
1A11A6	Range Indicator	Indicator, Azimuth-Elevation Range	IP-1146/M
1A11A7	Range Tracking Control	Control, Tracking, Range	C-9321/M
1A11A8	Indicator Power Supply	Power Supply Assembly	PP-6910/M
1A11A9	Range Intercom	Intercom Station	LS-620/M
1A11A10	Elevation Intercom	Intercom Station	LS-620/M
1A11A11	Elevation Receiver	Receiver, Radar	R-1836/M
1A11A12	Elevation Indicator	Indicator, Azimuth-Elevation-Range	IP-1145/M
1A11A13	Elevation Tracking Control	Control, Antenna	C-9332/M
1A11A14	Power Supply Assembly	Power Supply Assembly	PP-6911/M
1A12	Power Distribution Console	Switchboard, Power Supply	SB-3799/M
1A14	Power Entry	Power Connector Panel Assembly	
1A15	Van Semitrailer	Semitrailer, Van	
1A16	Radio Set Antenna (GFE)	Antenna (GFE)	

Table 1-3. Equipment Supplied
Part IV. Radar Set AN/MPS-T1(V)4 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
1A17	X-Band Manual Tracker Console	Console, Target Tracking	OJ-369/M
1A17A1	Reference Receiver	Receiver, Radar	R-1930/M
1A17A2	Moving Target Indicator	Comparator, Signal	CM-450/M
1A17A3	Target Receiver	Receiver, Radar	R-1931/M
1A17A4	Target Tracking	Tracker, Target	MX-9646/M
1A17A8	X-Band Servo Control	Control, Antenna	C-9944/M
1A17A9	T1 Intercom	Intercom Station	LS-620/M
1A17A10	Down Link Jammer Receiver	Receiver, Radar	R-1932/M
1A17A11	T1 Indicator	Indicator, Azimuth-Elevation Range	IP-1189/M
1A17A12	T1 Tracking Control	Control, Target Tracking	C-9715/M
1A17A13	Indicator Power Supply	Power Supply	PP-7137/M
1A17A14	Power Supply Assembly	Power Supply Assembly	PP-7138/M
1A17A15	T2 Intercom	Intercom Station	LS-620/M
1A17A16	Target Simulator	Simulator, Radar Target	SM-709/M
1A17A17	T2 Indicator	Indicator, Azimuth-Elevation Range	IP-1189/M
1A17A18	T2 Tracking Control	Control, Target Tracking	C-9716/M
1A17A19	Reference Pedestal Servo	Programmer, Antenna Position	MX-9647/M
1A19	Automatic Position Plotter Console	Console, Target Tracking	OJ-345/M
1A19A1	Automatic Position Plotter Indicator	Indicator, Azimuth-Range	IP-1190/M

Table 1-3. Equipment Supplied
Part IV. Radar Set AN/MPS-T1(V)4 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
1A19A2	Sweep Control	Control, Indicator	C-971/M
1A19A3	Intercom	Intercom System	LS-620/M
1A19A4	Power Supply Assembly	Power Supply Assembly	PP-6911/M
1A19A5	Indicator Power Supply	Power Supply	PP-7137/M
1A19A6	Radio Set Control (GFE)	Radio Set, Control (GFE)	
1A20	Common Data Point Assembly	Control, Indicator	C-9941/M
Unit 2	S-Band Antenna Trailer	Antenna-Receiver-Transmitter Group, Trailer Mounted	OY-58/M
P/O Unit 2	Mobile Tracker Trailer Assembly	Antenna Pedestal-Trailer	OA-8859/M
P/O Unit 2	Mobile Tracker	Antenna Pedestal Group	OA-8860/M
P/O Unit 2	Antenna Trailer	Trailer, Antenna	V-486/M
2A1	L-Band Pulsed Command Transmitter Console	Transmitter Group	OT-83/M
2A1A1	L-Band Pulsed Command Transmitter	Transmitter, Radar	T-1296/M
2A1A2	L-Band Pulsed Command Transmitter Power Supply	Power Supply	PP-7139/M
2A1A3	Performance Monitor	Monitor, Radio Frequency	ID-1999/M
2A1A4	Fan	Fan, Centrifugal	
2A1A5	Storage Drawer	Drawer, Electrical Equipment Cabinet	
2A2	Elevation Transmitter Console	Transmitter Group	OT-84/M
P/O 2A2	Control Panel	Control, Transmitter	C-9721/M

Table 1-3. Equipment Supplied
Part IV. Radar Set AN/MPS-T1(V)4 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
P/O 2A2	Trigger Control Assembly	Generator, Pulse	O-1689/M
P/O 2A2	Reverse Power Trip Assembly	Control, Power Supply	C-9722/M
P/O 2A2	Charging Control Assembly	Control, Modulator	C-9720/M
P/O 2A2	Modulator	Modulator, Radar	MD-955/M
P/O 2A2	Thyratron Bias Control	Control Modulator	C-9719/M
P/O 2A2	High Voltage Power Supply	Power Supply Set	OP-99/M
P/O 2A2	Magnetron Filament Control	Control, Magnetron Filament	C-9718/M
P/O 2A2	Current Overload	Relay, Current Overload	RE-1103/M
P/O 2A2	Transformer	Transformer Assembly	TF-573/M
P/O 2A2	Power Supply	Power Supply	PP-7140/M
2A3	Elevation Receiver Console	Receiver Group	OR-159/M
2A3A1	Microwave Assembly	Installation, S-Band Microwave	
2A3A2	Performance Monitor	Monitor, Radio Frequency	ID-2000/M
2A3A3	Prereceiver	Receiver, Radar	R-1933/M
2A3A4	Power Supply Assembly	Power Supply Assembly	PP-7241/M
2A3A5	Fan	Fan, Centrifugal	
2A4	Power Distribution Panel	Panel, Power Distribution	
2A5	Junction Box	Junction Box	
2A6	Auxiliary Equipment Console	Console, Auxiliary Equipment	OJ-367/M

Table 1-3. Equipment Supplied
Part IV. Radar Set AN/MPS-T1(V)4 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
2A6A1	Waveguide and Scanner Switching	Relay Assembly	RE-1108/M
2A6A2	Signal Conditioning	Relay Assembly Group	OA-8852/M
2A6A3	Power Supply	Transformer Assembly	TF-580/M
2A6A4	Power Supply Assembly	Power Supply Assembly	PP-7243/M
2A6A5	Fan	Fan, Centrifugal	
2A7	Azimuth Transmitter Console	Transmitter Group	OT-84/M
P/O 2A7	Control Panel	Control, Transmitter	C-9721/M
P/O 2A7	Trigger Control Assembly	Generator, Pulse	O-1689/M
P/O 2A7	Reverse Power Trip Assembly	Control, Power Supply	C-9722/M
P/O 2A7	Charging Control Assembly	Control, Modulator	C-9720/M
P/O 2A7	Modulator	Modulator, Radar	MD-955/M
P/O 2A7	Thyratron Bias Control	Control Modulator	C-9719/M
P/O 2A7	High Voltage Power Supply	Power Supply Set	OP-99/M
P/O 2A7	Magnetron Filament Control	Control, Magnetron Filament	C-9718/M
P/O 2A7	Current Overload	Relay, Current Overload	RE-1103/M
P/O 2A7	Transformer Assembly	Transformer Assembly	TF-573/M
P/O 2A7	Power Supply	Power Supply	PP-7140/M
2A8	Azimuth Receiver Console	Receiver Group	OR-159/M
2A8A1	Microwave Assembly	Installation, S-Band Microwave	
2A8A2	Performance Monitor	Monitor, Radio Frequency	ID-2000/M

Table 1-3. Equipment Supplied
Part IV. Radar Set AN/MPS-T1(V)4 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
2A8A3	Prereceiver	Receiver, Radar	R-1933/M
2A8A4	Power Supply Assembly	Power Supply Assembly	PP-7141/M
2A8A5	Fan	Fan, Centrifugal	
2A9	Azimuth Pedestal	Antenna Pedestal Group	OA-8866/M
2A9A1	Synchro Assembly (TX	Synchro, Transmitter Assembly	SN-502/M
2A9A2	Synchro Assembly (CT)	Synchro, Control Transformer Assembly	SN-503/M
2A9A3	Drive Unit	Actuator, Electro-Mechanical, Rotary	TG-234/M
2A9A5	Fuse and Circuit Breaker Panel	Panel, Circuit Breaker-Fuse	
2A9A6	Service Outlets		
2A9A7	Azimuth Power Amplifier	Amplifier, Electronic Control	AM-6827/M
2A9A8	Elevation Power Amplifier	Amplifier, Electronic Control	AM-6827/M
2A9A9	Slip Rings	Slip Ring Assembly	
2A9A23	Fan	Fan, Tube Axial	
2A10	Elevation Pedestal	Antenna Pedestal Group	OA-8867/M
2A10A1	Synchro Assembly (TX)	Synchro, Transmitter Assembly	SN-502/M
2A10A2	Synchro Assembly (CT)	Synchro, Control Transformer Assembly	SN-503/M
2A10A3	Limit Switch Assembly	Switch Assembly	
2A10A4	Drive Unit	Actuator, Electro-Mechanical, Rotary	TG-235/M

Table 1-3. Equipment Supplied
Part IV. Radar Set AN/MPS-T1(V)4 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
2A10A5	Azimuth Encoder Control Unit		
2A10A6	Elevation Encoder Control Unit		
2A10A7	Azimuth Transducer		
2A10A8	Elevation Transducer		
2A10A9	Service Outlets		
2A10A10	Elevation Pedestal Disconnect Panel		
2A11	Elevation Trough Antenna	Antenna Group	OE-205/M
2A12	Azimuth Trough Antenna	Antenna Group	OE-206/M
2A13	L-Band Dish Antenna	Antenna	OE-4055/M
2W1	S-Band Trailer Interconnection Cable		
2W2	S-Band Trailer Interconnection Cable		
2W3	S-Band Trailer Interconnection Cable		
2W4	S-Band Trailer Interconnection Cable		
2W5	S-Band Trailer Interconnection Cable		
2W6	S-Band Trailer Interconnection Cable		
2W13	S-Band Trailer Interconnection Cable		
2W15	S-Band Trailer Interconnection Cable		

Table 1-3. Equipment Supplied
Part IV. Radar Set AN/MPS-T1(V)4 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
2W16	S-Band Trailer Interconnection Cable		
2W61	S-Band Trough Scanner Cable		
2W62	S-Band Trough Scanner Cable		
2W63	S-Band Trough Scanner Cable		
2W64	S-Band Trough Scanner Cable		
2W66	L-Band Coaxial Cable (S-Band)		
2W67	L-Band Coaxial Cable (S-Band)		
2W68	L-Band Coaxial Cable (S-Band)		
Unit 3	C-Band Antenna Trailer	Antenna-Receiver-Transmitter Group, Trailer Mounted	OY-59/M
P/O Unit 3	Mobile Tracker Trailer Assembly	Antenna Pedestal-Trailer	OA-8864/M
P/O Unit 3	Mobile Tracker	Antenna Pedestal Group	OA-8865/M
P/O Unit 3	Antenna Trailer	Trailer, Antenna	V-486/M
3A1	L-Band Pulsed Command Transmitter Console	Transmitter Group	OT-83/M
3A1A1	L-Band Pulsed Command Transmitter	Transmitter, Radar	T-1296/M
3A1A2	L-Band Pulsed Command Transmitter Power Supply	Power Supply	PP-7139/M
3A1A3	Performance Monitor	Monitor, Radio Frequency	ID-1999/M

Table 1-3. Equipment Supplied
Part IV. Radar Set AN/MPS-T1(V)4 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
3A1A4	Fan	Fan, Centrifugal	
3A1A5	Storage Drawer	Drawer, Electrical Equipment Cabinet	
3A2	Elevation Transmitter Assembly	Transmitter Group	OT-85/M
P/O 3A2	Control Panel	Control, Transmitter	C-9721/M
P/O 3A2	Trigger Control Assembly	Generator, Pulse	O-1689/M
P/O 3A2	Reverse Power Trip Assembly	Control Power Supply	C-9722/M
P/O 3A2	Charging Control Assembly	Control, Modulator	C-9720/M
P/O 3A2	Modulator	Modulator, Radar	MD-955/M
P/O 3A2	Thyratron Bias Control	Control Modulator	C-9719/M
P/O 3A2	High Voltage Power Supply	Power Supply Set	OP-99/M
P/O 3A2	Magnetron Filament Control	Control, Magnetron Filament	C-9718/M
P/O 3A2	Current Overload	Relay, Current Overload	RE-1103/M
P/O 3A2	Transformer Assembly	Transformer Assembly	TF-573/M
P/O 3A2	Power Supply	Power Supply	PP-7140/M
3A3	Elevation Receiver Console	Receiver Group	OR-171/M
3A3A1	Microwave Assembly	Installation, C-Band Microwave	
3A3A2	Performance Monitor	Control - Monitor	C-9942/M
3A3A3	Prereceiver	Receiver, Radar	R-1991/M
3A3A4	Power Supply Assembly	Power Supply Assembly	PP-7141/M

Table 1-3. Equipment Supplied
Part IV. Radar Set AN/MPS-T1(V)4 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
3A3A5	Fan	Fan, Centrifugal	
3A4	Power Distribution Panel	Panel, Power Distribution	
3A5	Junction Box	Junction Box	
3A6	Auxiliary Equipment Console	Console, Auxiliary Equipment	OJ-368/M
3A6A1	Waveguide and Scanner Switching	Relay Assembly Group	OA-8855/M
3A6A2	Signal Conditioning	Relay Assembly Group	OA-8856/M
3A6A3	Power Supply	Power Supply Assembly	PP-7244/M
3A6A4	Power Supply Assembly	Power Supply Assembly	PP-7234/M
3A6A5	Fan	Fan, Centrifugal	
3A7	Azimuth Transmitter Console	Transmitter Group	OT-85/M
P/O 3A7	Control Panel	Control, Transmitter	C-9721/M
P/O 3A7	Trigger Control Assembly	Generator, Pulse	O-1689/M
P/O 3A7	Reverse Power Trip Assembly	Control, Power Supply	C-9722/M
P/O 3A7	Charging Control Assembly	Control, Modulator	C-9720/M
P/O 3A7	Modulator	Modulator, Radar	MD-955/M
P/O 3A7	Thyratron Bias Control	Control, Modulator	C-9719/M
P/O 3A7	High Voltage Power Supply	Power Supply Set	OP-99/M
P/O 3A7	Magnetron Filament Control	Control, Magnetron Filament	C-9718/M
P/O 3A7	Current Overload	Relay, Current Overload	RE-1103/M
P/O 3A7	Transformer Assembly	Transformer Assembly	TF-573/M

Table 1-3. Equipment Supplied
Part IV. Radar Set AN/MPS-T1(V)4 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
P/O 3A7	Power Supply	Power Supply	PP-7140/M
3A8	Azimuth Receiver Console	Receiver Group	OR-171/M
3A8A1	Microwave Assembly	Installation, C-Band Microwave	
3A8A2	Performance Monitor	Control - Monitor	C-9942/M
3A8A3	Prereceiver	Receiver, Radar	R-1991/M
3A8A4	Power Supply Assembly	Power Supply Assembly	PP-7141/M
3A8A5	Fan	Fan, Centrifugal	
3A9	Azimuth Pedestal	Antenna Pedestal Group	OA-8866/M
3A9A1	Synchro Assembly (TX)	Synchro, Transmitter Assembly	SN-502/M
3A9A2	Synchro Assembly (CT)	Synchro, Control Transformer Assembly	SN-503/M
3A9A3	Drive Unit	Actuator, Electro-Mechanical, Rotary	TG-234/M
3A9A5	Fuse and Circuit Breaker Panel	Panel, Circuit Breaker-Fuse	
3A9A6	Service Outlets		
3A9A7	Azimuth Power Amplifier	Amplifier, Electrical Control	AM-6827/M
3A9A8	Elevation Power Amplifier	Amplifier, Electrical Control	AM-6827/M
3A9A9	Slip Rings	Slip Ring Assembly	
3A9A23	Fan	Fan, Tube Axial	
3A10	Elevation Pedestal	Antenna Pedestal Group	OA-8867/M
3A10A1	Synchro Assembly (TX)	Synchro, Transmitter Assembly	SN-502/M

Table 1-3. Equipment Supplied
Part IV. Radar Set AN/MPS-T1(V)4 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
3A10A2	Synchro Assembly (CT)	Synchro, Control Transformer Assembly	SN-503/M
3A10A3	Limit Switch Assembly	Switch Assembly	
3A10A4	Drive Unit	Actuator, Electro-Mechanical, Rotary	TG-235/M
3A10A5	Azimuth Encoder Control Unit		
3A10A6	Elevation Encoder Control Unit		
3A10A7	Azimuth Transducer		
3A10A8	Elevation Transducer		
3A10A9	Service Outlets		
3A10A10	Elevation Pedestal Disconnect Panel		
3A11	Elevation Trough Antenna	Antenna Group	OE-203/M
3A12	Azimuth Trough Antenna	Antenna Group	OE-204/M
3A13	Elevation Scanned Dish Antenna	Antenna Group	AS-4054/M
3A14	Azimuth Scanned Dish Antenna	Antenna Group	AS-4053/M
3A15	L-Band Dish Antenna	Antenna Group	AS-4055/M
3W7	C-Band Trailer Interconnection Cable		
3W8	C-Band Trailer Interconnection Cable		
3W9	C-Band Trailer Interconnection Cable		

Table 1-3. Equipment Supplied
Part IV. Radar Set AN/MPS-T1(V)4 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE
3W10	C-Band Trailer Interconnection Cable	
3W11	C-Band Trailer Interconnection Cable	
3W12	C-Band Trailer Interconnection Cable	
3W14	C-Band Trailer Interconnection Cable	
3W17	C-Band Trailer Interconnection Cable	
3W18	C-Band Trailer Interconnection Cable	
3W64	C-Band Trough Scanner Cable	
3W65	C-Band Trough Scanner Cable	
3W66	C-Band Trough Scanner Cable	
3W67	C-Band Trough Scanner Cable	
3W68	C-Band Dish Scanner Cable	
3W69	C-Band Dish Scanner Cable	
3W70	C-Band Dish Scanner Cable	
3W71	C-Band Dish Scanner Cable	
3W72	C-Band Dish Scanner Cable	
3W73	C-Band Dish Scanner Cable	

Table 1-3. Equipment Supplied
Part IV. Radar Set AN/MPS-T1(V)4 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
3W74	C-Band Dish Scanner Cable		
3W75	C-Band Dish Scanner Cable		
3W77	C-Band Coaxial Cable (C-Band)		
Unit 4	X-Band Antenna Trailer	Antenna-Receiver-Transmitter Group, Trailer Mounted	OY-60/M
P/O Unit 4	Mobile Tracker Trailer Assembly	Antenna Pedestal-Trailer	OA-8862/M
P/O Unit 4	Mobile Tracker	Antenna Pedestal Group	OA-8861/M
P/O Unit 4	Antenna Trailer	Trailer, Antenna	V-486/M
4A1	Left Receiver-Transmitter-Modulator Console	Transmitter Group	T-91/M
4A1A1	L-Band CW Command Transmitter	Transmitter Set, Electrical Guidance	T-1314/M
4A1A2	L-Band Pulsed Command Transmitter	Transmitter, Radar	T-1315/M
4A1A3	L-Band Pulsed Command Transmitter Power Supply	Power Supply	PP-7139/M
4A2	Center Receiver-Transmitter-Modulator Console	Receiver Group	OR-172/M
4A2A1	Microwave Unit	Microwave Assembly Receiver-Transmitter-Modulator Center	
4A2A1A5	Signal Conditioning	Relay Assembly Group	OA-8854/M
4A2A2	Prereceiver	Receiver, Radar	R-1992/M
4A2A3	Power Supply Assembly	Power Supply Assembly	PP-7245/M

Table 1-3. Equipment Supplied
Part IV. Radar Set AN/MPS-T1(V)4 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
4A3	Right Receiver-Transmitter-Modulator Console	Transmitter Group	OT-92/M
4A3A1A1	X-Band Transmitter Control	Control, Transmitter	C-9943/M
4A3A2	X-Band Transmitter Modulator	Modulator, Radar	MD-997/M
4A4	Fan	Fan, Centrifugal	
4A5	Junction Box and Power Distribution Panel	Panel, Power Distribution	
4A6	Azimuth Pedestal	Antenna Pedestal Group	OA-8866/M
4A6A1	Synchro Assembly (TX)	Synchro, Transmitter Assembly	SN-502/M
4A6A2	Synchro Assembly (CT)	Synchro, Control Transformer Assembly	SN-503/M
4A6A3	Drive Unit	Actuator, Electro-Mechanical, Rotary	TG-234/M
4A6A5	Fuse and Circuit Breaker Panel	Panel, Power Distribution	
4A6A6	Service Outlets		
4A6A7	Azimuth Power Amplifier	Amplifier, Electronic Control	AM-6827/M
4A6A8	Elevation Power Amplifier	Amplifier, Electronic Control	AM-6827/M
4A6A9	Slip Rings	Slip Ring Assembly	
4A6A10	Fan	Fan, Tube Axial	
4A7	Elevation Pedestal	Antenna, Pedestal Group	OA-8863/M
4A7A1	Synchro Assembly (TX)	Synchro, Transmitter Assembly	SN-502/M

Table 1-3. Equipment Supplied
Part IV. Radar Set AN/MPS-T1(V)4 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
4A7A2	Synchro Assembly (CT)	Synchro, Control Transformer Assembly	SN-503/M
4A7A3	Limit Switch Assembly	Switch Assembly	
4A7A4	Drive Unit	Actuator, Electro-Mechanical, Rotary	TG-235/M
4A7A5	Elevation Pedestal Disconnect Panel		
4A7A6	Azimuth Encoder Control Unit		
4A7A7	Elevation Encoder Control Unit		
4A7A8	Azimuth Transducer		
4A7A9	Service Outlets		
4A7A10	Elevation Transducer		
4A8	RTM Housing		
4A9	L-Band Cut Dish Command Antenna	Antenna	AS-4057/M
4A10	X-Band Antenna	Antenna	AS-4058/M
4A11	X-Band Illuminator Antenna	Antenna Group	OE-227/M
4W22	X-Band Trailer Interconnection Cable		
4W23	X-Band Trailer Interconnection Cable		
4W24	X-Band Trailer Interconnection Cable		
4W25	X-Band Trailer Interconnection Cable		

Table 1-3. Equipment Supplied
Part IV. Radar Set AN/MPS-T1(V)4 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE
4W26	X-Band Trailer Interconnection Cable	
4W27	X-Band Trailer Interconnection Cable	
4W28	X-Band Trailer Interconnection Cable	
4W29	X-Band Trailer Interconnection Cable	
4W39	X-Band Receiver Scanner Cable	
4W40	X-Band Receiver Scanner Cable	
4W44	L-Band Coaxial Cable (X-Band)	
4W46	L-Band Coaxial Cable (X-Band)	
4W51	L-Band Coaxial Cable (X-Band)	
4W53	L-Band Coaxial Cable (X-Band)	
AP20458-S22	Connector (1P1)	
AP20458-S22-S4	Connector (1P3)	
AP40458-S22	Connector (1P2)	
AT-3B-187-12	C-Band Waveguide	
AT-3B-284-24	S-Band Waveguide	
K-6	Borescope Telescope	
MD4	Motor Generator	
TFT-64-4B-40N	X-Band Waveguide	

Table 1-3. Equipment Supplied
Part IV. Radar Set AN/MPS-T1(V)4 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE
TFT-64-4B-50N	X-Band Waveguide	
WCF-2335-4N	Frequency Meter	
WCF-4458-4N	Frequency Meter	
WCF-510-4N	Frequency Meter	
WCF-8211-4N	Frequency Meter	
WCF-912-4N	Frequency Meter	
010-0172-00	Probe	
100A	Pulse Generator	
11414-1C	S- and C-Band Antenna Telescope Elbow	
1200-24	Headset-Microphone	
1859	Sheet Metal Lifter	
200-1	Cart	
423A	Crystal Detector	
583Z1008	Steel Plate	
583Z2504-1	Extender	
583Z3090-1	Grounding Rod	
583Z4005-817	Horizontal Support Structure	
583Z4005-819	Horizontal Support Structure	
583Z4004-823	Vertical Support Structure	

Table 1-3. Equipment Supplied
Part IV. Radar Set AN/MPS-T1(V)4 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
583Z4004-825	Vertical Support Structure		
583Z4007-807	Strut		
583Z4008-1	Strut		
583Z4012-3	Lifting Cables		
583Z4012-5	Lifting Cables		
583Z4012-809	Lifting Bar		
583Z4012-807	Lifting Bar		
583Z4012-803	Lifting Bar		
583Z4014-3	Ladder		
583Z4014-5	Ladder		
583Z4024-3	Vertical Counterweight		
583Z4024-803	Vertical Counterweight		
583Z4024-805	Horizontal Counterweight		
583Z4024-807	Horizontal Counterweight		
583Z4284-1	Lifting Bracket		
583Z4600-1	C-Band Antenna Structure Transport Trailer	Antenna Support Semitrailer	V-489/M
583Z4600-5	Dish Antenna Transport Trailer	Antenna Semitrailer	V-491/M
583Z4600-801	S-Band Antenna Structure Transport Trailer	Antenna Support Semitrailer	V-492/M
583Z4600-807	C-Band Trough Antenna Transport Trailer	Antenna Semitrailer	V-487/M

Table 1-3. Equipment Supplied
Part IV. Radar Set AN/MPS-T1(V)4 (Continued)

REF. DESIG. OR PART NUMBER	COMMON NAME	NOMENCLATURE	
583Z4600-805	X-Band Antenna Transport Trailer	Antenna Semitrailer	V-494/M
583Z4600-809	S-Band Trough Antenna Transport Trailer	Antenna Semitrailer	V-488/M
583Z5091-1	C-Band Waveguide and Guard Assembly		
583Z5091-3	C-Band Waveguide and Guard Assembly		
583Z5091-5	C-Band Waveguide and Guard Assembly		
583Z5091-801	C-Band Waveguide and Guard Assembly		
583Z5091-803	S-Band Waveguide and Guard Assembly		
583Z5091-805	S-Band Waveguide and Guard Assembly		
590	Extender		
591	Extractor		
608E	Signal Generator		
618C	Signal Generator		
620B	Signal Generator		
8616A	Signal Generator		
95635	Ear Protectors		
5590	Extender		

1-19. RELATED TECHNICAL MANUALS.

1-20. Related technical manuals are identified in table 1-4.

Table 1-4. Related Technical Manuals

PUBLICATION NUMBER	PUBLICATION TITLE	NOMENCLATURE
TECHNICAL ORDERS		
T.O. 31R2-2GRC27-Series	Ground Radio Electronic Equipment, Type AN/GRC-27 Series	Radio Set
T.O. 31S1-4-48-2	Operating and Maintenance Instructions - Perforated Tape, Handler, Model 4566A, B4566A, 4566ALCR, B4566ALCR, P4566ALCR, Puller, Tape, Type RL-248/AMM-27, P/N 1149213-1 (Digitronics)	Spooler
T.O. 31S1-4-49-1	Operation and Maintenance Instructions - Perforated Tape Reader, Model 2500, Punched Tape Type CV2143/AMM-27 (Digitronics Corp)	Tape Reader
T.O. 31W4-4-116-11	Operation and Maintenance Instructions - High Speed Recorder Set, Bulletin 215B Model BRPE (Teletype)	High Speed Recorder
T.O. 31W4-4-116-14	Illustrated Parts Breakdown - High Speed Recorder Set, Bulletin 1154B Model BRPE (Teletype)	High Speed Recorder
T.O. 31W4-4-283-14	Parts Manual, Model 37 Page Printer Set (KSR-R0) (Teletype Corp)	Teletype Printer
T.O. 31W4-4-283-31	Operations and Installation Instructions, Teletypewriter Set, Keyboard Send Receive (KSR), Switched Network Service, Model 37, Bulletin 317B (Teletype Corp) (Vol I)	Teletype
T.O. 31W4-4-283-32	Maintenance Instruction, Keyboard Send-Receive, Teletypewriter Set for Switched Network Service, Model 37, Bulletin 317B (Teletype Corp) (Vol II)	Teletype

Table 1-4. Related Technical Manuals (Continued)

PUBLICATION NUMBER	PUBLICATION TITLE	NOMENCLATURE
TECHNICAL ORDERS		
T.O. 31W4-4-283-32-1	Supplementary Maintenance Manual, Wiring Data Package (WDP0126), Use with Model KSR37 Console for AN/MPS-T1 (Teletype Corp)	Teletype Wiring
T.O. 31W4-4-283-32-2	Supplementary Maintenance Manual, Wiring Data Package (WDP0191), Use with Model KSR37 Console for AN/MPS-T1 (Teletype Corp)	Teletype Wiring
T.O. 31W4-4-283-103	Wiring Diagram Package (WDP0118) for Models R037, KSR37 and ASR37 (Teletype Corp)	Teletype Wiring
T.O. 31W4-4-291-11	Operation and Maintenance Instructions with IPB, Motor Units, Models MU, SMU and YMU (Teletype Corp)	Teletype Motor
T.O. 33A1-2-169-1	Operation and Service Instructions, Medium Gain Amplifier, Model 8821A (Hewlett-Packard)	Medium Gain Amplifier
T.O. 33A1-5-268-1	Instructions With Parts Breakdown-Modulator, Model 8403 A/Option (Hewlett-Packard)	Modulator
T.O. 33A1-5-330-1	Operation and Maintenance Instructions - Crystal Detector, Model 423A, 8470A (Hewlett-Packard)	Crystal Detector
T.O. 33A1-5-391-1	Microwave Frequency Meters Type WC, WCF, WDB Series (Freq Engineering Lab)	Frequency Meter
T.O. 33A1-7-41-11	Instructions and Parts Breakdown - Precision Attenuators, Models C382A, G382A, H382A, J382A, K382A, K382A, M382A, P382A, R382A, and X382A (Hewlett-Packard)	Variable Attenuator
T.O. 33A1-7-205-1	Operation and Service Instructions With Parts List - Power Meter, Model 432A, 432B, 432A/H03 (Hewlett-Packard)	Power Meter

Table 1-4. Related Technical Manuals (Continued)

PUBLICATION NUMBER	PUBLICATION TITLE	NOMENCLATURE
TECHNICAL ORDERS		
T.O. 33A1-7-248-1	Instruction Manual, GMC Model 5006-1 Noise Measurement System (General Dynamics)	Noise Figure Meter
T.O. 33A1-8-1-141	Operation and Service Instructions With Parts Breakdown - VHF Signal Generator, Model 618C, 620B (Hewlett-Packard)	VHF Signal Generator
T.O. 33A1-8-162-1	Operation and Service Instructions UHF Signal Generator, Model 612A (Hewlett-Packard)	UHF Signal Generator
T.O. 33A1-8-394-1	Operation and Maintenance Instruction with Parts List, Pulse Generator 214A (Hewlett-Packard)	Pulse Generator
T.O. 33A1-8-424-11	Operation and Service Instructions-Signal Generator, Model 8616A (Hewlett-Packard)	Signal Generator
T.O. 33A1-8-510-1	Operation and Service Instructions, Radio Frequency Units, Model 8698A (Hewlett-Packard)	RF Plug-In
T.O. 33A1-8-524-1	Operation and Maintenance Instruction VHF Signal Generator, Model 608E/F (Hewlett-Packard)	VHF Signal Generator
T.O. 33A1-8-561-1	Operation and Service Instructions, Variable Phase Generator, Model 203A (Hewlett-Packard)	Variable Phase
T.O. 33A1-8-625-1	Operation and Maintenance Instructions With Parts List Pulse Generator, Model 100A P/N 37000-690 (Systron-Donner, Datapulse Div)	Pulse Generator
T.O. 33A1-8-773-1	Operation and Service Instructions, Pulse Generator, Model 8005A (Hewlett-Packard)	Pulse Generator
T.O. 33A1-9-47-1	Instructions and Parts Breakdown - Thermistor Mount, Model 478A (Hewlett-Packard)	Thermistor Mount

Table 1-4. Related Technical Manuals (Continued)

PUBLICATION NUMBER	PUBLICATION TITLE	NOMENCLATURE
TECHNICAL ORDERS		
T.O. 33A1-10-76-1	Operating Instructions - Electronic Counter, Model 5245L (Hewlett-Packard)	Counter
T.O. 33A1-12-663-1	Operation and Service Instructions-Digital Voltmeter Model 3440A (Hewlett-Packard)	Digital Voltmeter
T.O. 33A1-12-713-1	Operation and Service Instructions - Automatic Range Selector, Model 3442A (Hewlett-Packard) - General Purpose	Range Selector
T.O. 33A1-12-720-21	Instructions with Parts List - DC Milliammeter, Model 931 (Weston Inst.)	DC Milliammeter
T.O. 33A1-12-774-11	Operation and Service Instructions - DC Multi-Function Unit, Model 3444A (Hewlett-Packard)	DC Multi-Function Unit
T.O. 33A1-12-776-31	Operation and Service Instructions With Parts List - Sweep Oscillator, Model 8690B, H19-8690A/B or 8690A/B, OPH19, H26-8690B, H57-8690B, H52-8690B (Hewlett-Packard)	Sweep Oscillator
T.O. 33A1-12-776-41	Operating and Service Instructions With Parts List - Radio Frequency Units Model 8691A, 8692A, 8693A, 8694A (Hewlett-Packard)	RF Plug-In
T.O. 33A1-12-856-1	Operation and Service Instructions, AD/DC Range Unit, Model 3445A (Hewlett-Packard)	AC/DC Range Unit
T.O. 33A1-12-871-1	Instructions With Parts List - Volt-Ammeter Clamp, Model 749, P/N 25343 (Weston Inst.)	Clip-On Ammeter
T.O. 33A1-12-1017-1	Instruction Manual - High Frequency Voltage Control Generator, Model 142 (Wavetek)	HF VCG Generator

Table 1-4. Related Technical Manuals (Continued)

PUBLICATION NUMBER	PUBLICATION TITLE	NOMENCLATURE
TECHNICAL ORDERS		
T.O. 33A1-12-1043-1	Operators Manual, Model 270 Series 3 (Simpson Electric Company)	Volt-Ohm-Milliammeter
T.O. 33A1-13-336-11	Instruction Manual-Oscilloscope, Type 453/R453 (Above S/N 20,000) (Tektronix)	Oscilloscope
T.O. 33A1-13-355-1	Instructions With Parts Breakdown - Probe Model P6015 (Tektronix)	Oscilloscope Probe
T.O. 33A1-13-428-1	Operation and Service Instructions With Parts List - Thermal Recording System Model 7727A, 7729A (Hewlett-Packard)	Thermal Recorder
T.O. 33A1-13-479-2	Instruction Manual, Oscilloscope Type 465 (Tektronix)	Oscilloscope
T.O. 33AA17-114-1	Operation and Service Instructions, DC Power Supply Model 6209B (Hewlett-Packard)	DC Power Supply
T.O. 33AA6-22-1	Operation and Service Instructions - Decade Resistor Type 1433 (General Radio)	Decade Resistor
T.O. 33D7-12-81-11	Operating and Service Instructions With Parts List - X-Y Recorder, Model 7004B (Hewlett-Packard)	X-Y Recorder
T.O. 33D7-33-76-11	Operation and Service Instructions With Parts List - DC Input Modules, Model 17170A, 17178A (Hewlett-Packard)	DC Coupler
T.O. 33D7-33-103-1	Operating and Service Instructions With Parts List - DC Preamplifier Input Module Model 17171A (Hewlett-Packard)	DC Amplifier
T.O. 33DA11-73-1	Operating and Service Instructions - DC Power Supply P/N 6205B (Hewlett-Packard)	DC Power Supply

Table 1-4. Related Technical Manuals (Continued)

PUBLICATION NUMBER	PUBLICATION TITLE	NOMENCLATURE
TECHNICAL ORDERS		
T.O. 33DA11-74-1	Operating and Service Instructions - Regulated DC Power Supply, Model 6291A (Hewlett-Packard)	Regulated DC Power Supply
T.O. 33DA30-19-1	Operation and Service Instructions, Oscillographic Recorder, Model 7758A/7418A (Hewlett-Packard)	Oscillographic Recorder
T.O. 35C1-2-251-11	Operation and Maintenance Instructions With Parts List - Regulated Power Supplies, Model LM C Package (Lambda Electronics Corp)	Power Supply
T.O. 35C1-2-267-1	Instructions - Regulated Power Supplies, LM-B Package FSN 6130 (Lambda Electronics Corp)	Power Supply
T.O. 35C1-2-267-21	Instruction Manual - Regulated Power Supplies, Model LM-CC Package, (Lambda Electronics Corp)	Power Supply
T.O. 35C1-2-267-31	Instruction Manual - Regulated Power Supplies, Model LM-D Package (Lambda Electronics Corp)	Power Supply
T.O. 35C1-2-267-41	Instruction Manual - Regulated Power Supplies, Model LM-E Package, Units Bearing Serial Number Prefix A (Lambda Electronics Corp)	Power Supply
T.O. 35C2-2-31 Series	Operation and Service Instructions - Motor Generator Skid Mounted Type MD-4	Motor Generator
T.O. 35E9-173-11	Instruction Manual - Model SAC-FS-92S Air Conditioner (General Dynamics)	Air Conditioner
T.O. 36A9-2-46-1	Instruction Manual, Closed Semi-trailer Van, Model A1D209, 101PH40 (General Dynamics)	Control Trailer

Table 1-4. Related Technical Manuals (Continued)

PUBLICATION NUMBER	PUBLICATION TITLE	NOMENCLATURE
TECHNICAL ORDERS		
T.O. 36A9-2-47-1	Instruction Manual, Low-Bed Semitrailer, Model C-10D-J1 (General Dynamics)	Low-Bed Transport Trailer
T.O. 36A9-7-8-1	Instruction Manual, Platform Semitrailer, Model FBL-EP-40S (General Dynamics)	Platform Transport Trailer
T.O. 43D7-11-21-1	Operation Instruction, Radar Training Set, Type AN/MPS-T1(V)	
T.O. 43D7-11-21-2-1	Maintenance Instructions, Radar Training Set, Type AN/MPS-T1(V)	
T.O. 43D7-11-21-2-1-1	Supplementary Maintenance Instructions, Radar Training Set, Type AN/MPS-T1(V)	
T.O. 43D7-11-21-2-2	Maintenance Instructions, Radar Set Control Group, Type OK-251/M	
T.O. 43D7-11-21-2-3	Maintenance Instructions, Trailer-Mounted Antenna-Receiver-Transmitter Group, Types OY-55/M, OY-55A/M, OY-55B/M and OY-58/M	
T.O. 43D7-11-21-2-4	Maintenance Instructions, Trailer-Mounted Antenna-Receiver-Transmitter Group, Types OY-61/M, OY-56/M, OY-56A/M and OY-59/M	
T.O. 43D7-11-21-2-5	Maintenance Instructions, Trailer-Mounted Antenna-Receiver-Transmitter Group, Types OY-62/M and OY-60/M	
T.O. 43D7-11-21-4	Illustrated Parts Breakdown, Radar Training Set, Type AN/MPS-T1(V)	
T.O. 43D7-11-21-6WC-1	Work Cards, Inspection, Lubrication and Maintenance Requirements, Radar Training Set, Type AN/MPS-T1(V)	

CHAPTER 2

OPERATION

2-1. INTRODUCTION.

2-2. This chapter contains the information required to operate the radar set. It contains illustrations of all controls and indicators as well as a description of their functions. Operation information includes initial control settings, startup, operating procedures, shutdown, and a typical operating situation. The chapter is divided into the following sections: Section I Controls and Indicators; Section II Operating Instructions; and Section III Emergency Operation.

SECTION I

CONTROLS AND INDICATORS

2-3. GENERAL.

2-4. This section contains a description of the controls and indicators used to operate the radar set. The controls and indicators are located on the front panels of drawers and assemblies. Interlock circuits are identified and described.

2-5. CONTROLS AND INDICATORS.

2-6. Operator controls and indicator functions illustrated in figures 2-1 through 2-53 are arranged in order by reference designator. Accompanying tables reflect the name, reference designation, and function of each control and indicator.

2-7. INTERLOCK CIRCUITS.

2-8. The following interlock circuits are incorporated to provide personnel safety and equipment protection: transmitter access interlocks, transmitter protection interlocks, transmitter disable switches, pedestal interlocks, pedestal disable switches, and scanner disable switches. The functions of these interlock circuits are identified in tables 2-54 through 2-62.

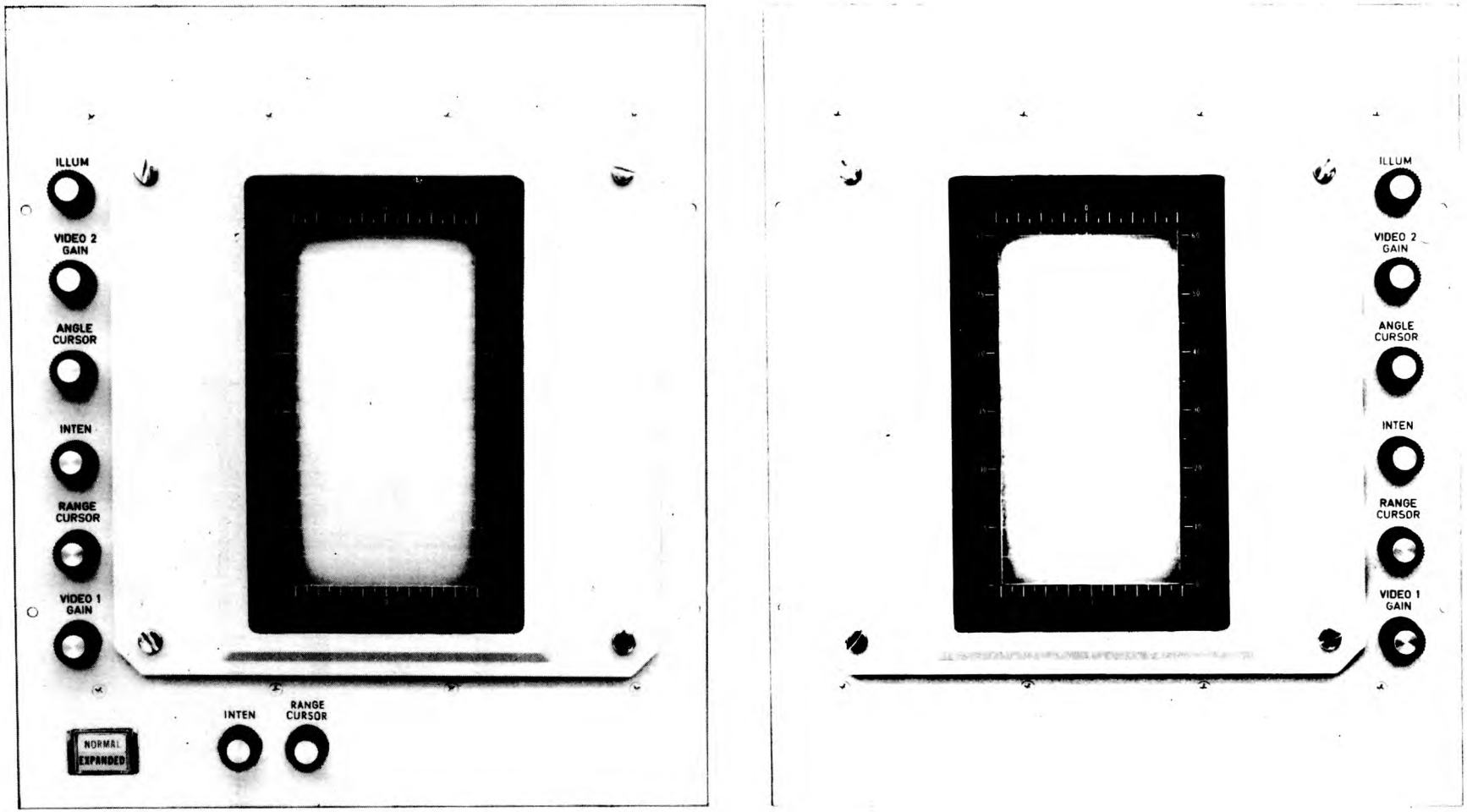
2-9. The transmitter access interlocks consist of three-position, pushbutton switches which actuate when the transmitter front panels are opened. With the panels open, the interlocks may be overridden by pulling the switch plunger out to the fully extended position.

2-10. The transmitter protection interlock circuits consist of high-voltage interlocks, trigger interlocks, and power-on interlocks. These circuits protect the equipment from additional damage in the event of a failure. The interlock circuits can be reset from the local/remote transmitter control panels.

2-11. Transmitter disable switches are provided on the antenna trailer disconnect panels and on the elevation pedestal disconnect panels to allow personnel working on or near the antenna trailers to disable the transmitters and prevent radiation of high power RF energy.

2-12. The pedestal interlock circuits are used to prevent improper operation of the azimuth and elevation pedestals. Interlocks are provided for the stow pins, the handcranks, the manual brake releases, the electrical brake releases, the drive motor blowers, and the upper and lower elevation pedestal limits. These interlock

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS, RADAR TRAINING SET AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1 FOR TABLE 2-1 AND FIGURE 2-1



AZIMUTH INDICATOR 1A1A2

ELEVATION INDICATOR 1A1A3

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Figure 2-2. Guidance Operator Indicators 1A1A2, 1A1A3

circuits, when activated, remove the drive signals from the pedestals.

2-13. In addition to the pedestal interlocks, pedestal disable switches are provided to allow personnel working on or near the antenna trailers to disable the pedestal drive circuits. These disable switches are located on the front of the antenna trailers on the trailer disconnect panels and on the elevation pedestal disconnect panels.

2-14. Scanner disable switches are located on the antenna trailer disconnect panels and on the elevation pedestal disconnect panels. These disable switches are used to prevent application of scanner motor power during maintenance of the scanner assemblies.

Table 2-2. Guidance Operator Indicators 1A1A2, 1A1A3 Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR		FUNCTION
	AZIMUTH 1A1A2	ELEVATION 1A1A3	
ILLUM Control	R33	R33	Controls intensity of angle and range overlay scale lighting
VIDEO 2 GAIN Control	R29	R29	Controls gain of missile video
ANGLE CURSOR Control	R35	R35	Controls intensity of cursor
INTEN Control	R32	R32	Controls raster intensity in normal range operation
RANGE CURSOR Control	R30	R30	Controls intensity of range cursor in normal range operation
VIDEO 1 GAIN Control	R31	R31	Controls gain of target video and playback video from recorder
NORMAL/EXPANDED Switch	S2	None	Selects either normal or expanded range operation
INTEN Control	R36	None	Controls raster intensity in expanded range operation
RANGE CURSOR Control	R34	None	Controls intensity of range cursor in expanded range operation

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS RADAR TRAINING SET, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1 FOR TABLE 2-3 AND FIGURE 2-3

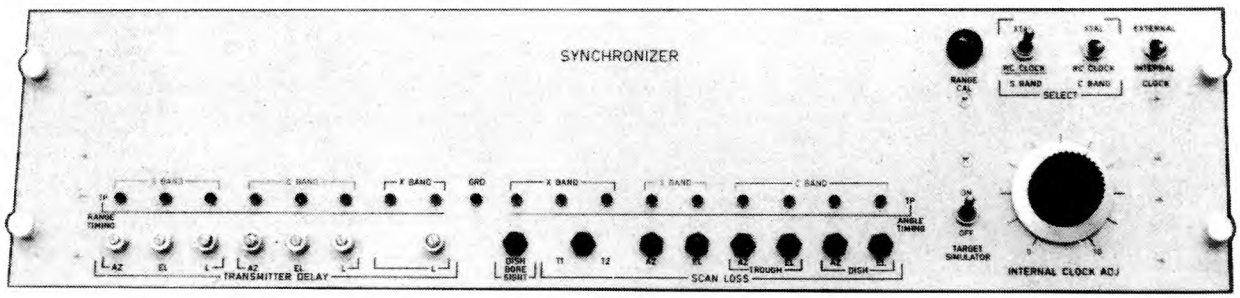

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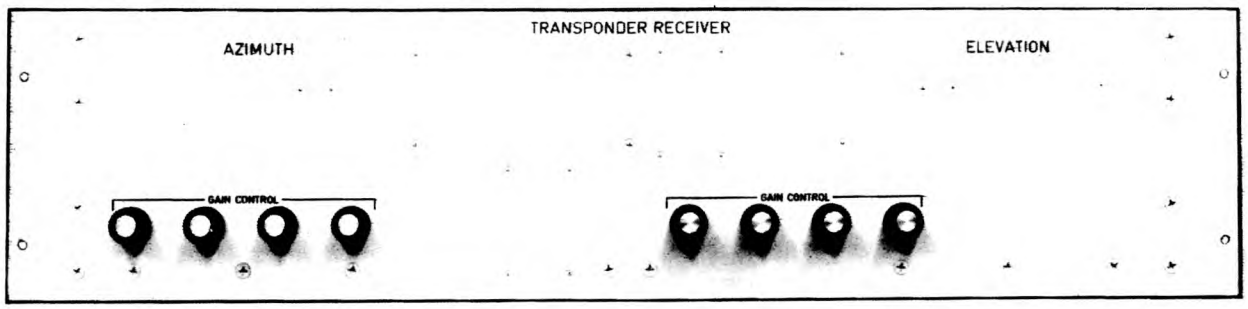
Figure 2-4. Synchronizer 1A1A5

Table 2-4. Synchronizer 1A1A5 Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
TRANSMITTER DELAY Potentiometer		Adjusts trigger delay for indicated transmitter
AZ	R1	
EL	R2	
L	R3	
AZ	R4	
EL	R5	
L	R6	
L	R9	
DISH BORESIGHT Indicator	DS8	Lights when illuminator antenna does not return to boresight position when track mode is selected in X-band radar

Table 2-4. Synchronizer 1A1A5 Controls and Indicators (Continued)

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
SCAN LOSS Indicators (Red)		Indicates abnormal operation of antenna scan rate
TROUGH (T1, T2)	DS7	
AZ	DS1	
EL	DS2	
AZ TROUGH	DS3	
EL TROUGH	DS4	
AZ DISH	DS5	
EL DISH	DS6	
TARGET SIMULATOR ON/OFF Switch	S1	Connects simulated target inputs from target simulator 1A17A16 to receiver groups in place of signals derived from antennas
RANGE CAL Switch	S2	Causes 20-mile range calibrate strobe to appear on guidance operators indicators
CLOCK INTERNAL/ EXTERNAL Switch	S3	When INTERNAL is selected, selected internal clock provides system inputs. EXTERNAL connects an external clock to the system
SELECT		
S-BAND XTAL/RC CLOCK Switch	S4	Connects selected clock to S-band radar
C-BAND XTAL/RC CLOCK Switch	S5	Connects selected clock to C-band radar
INTERNAL CLOCK ADJ Switch	S6	Adjusts rate of selected internal clock

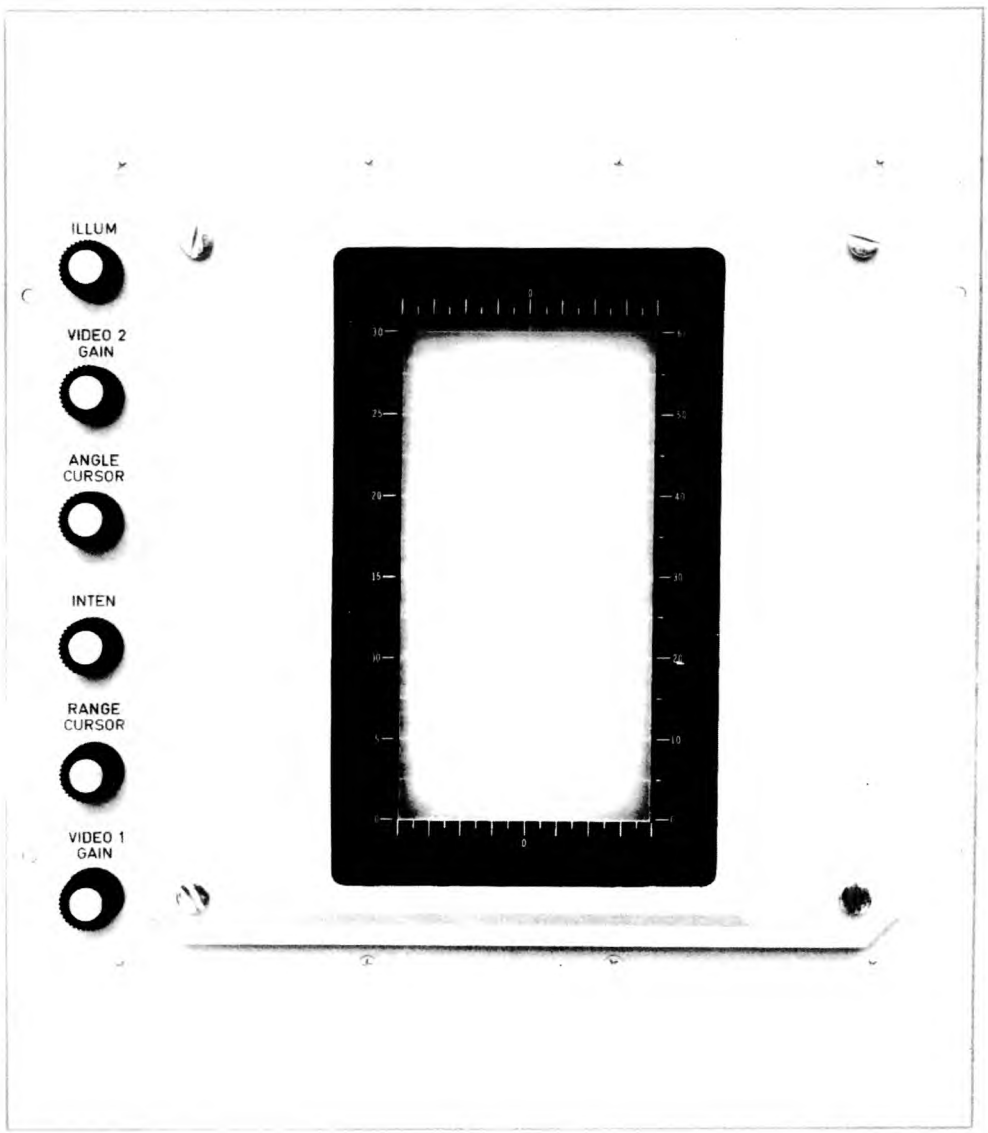


0095-103

Figure 2-5. Transponder Receiver 1A3A1

Table 2-5. Transponder Receiver 1A3A1 Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
AZIMUTH GAIN CONTROL 1	R1	Controls gain of transponder 1 azimuth receiver
AZIMUTH GAIN CONTROL 2	R2	Controls gain of transponder 2 azimuth receiver
AZIMUTH GAIN CONTROL 3	R3	Controls gain of transponder 3 azimuth receiver
AZIMUTH GAIN CONTROL 4	R4	Controls gain of transponder 4 azimuth receiver
ELEVATION GAIN CONTROL 1	R6	Controls gain of transponder 1 elevation receiver
ELEVATION GAIN CONTROL 2	R7	Controls gain of transponder 2 elevation receiver
ELEVATION GAIN CONTROL 3	R8	Controls gain of transponder 3 elevation receiver
ELEVATION GAIN CONTROL 4	R9	Controls gain of transponder 4 elevation receiver



AZIMUTH INDICATOR 1A3A2*

***Elevation Indicator 1A3A3 identical except controls are on right side**

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Figure 2-6. Transponder Indicators 1A3A2, 1A3A3

Table 2-6. Transponder Indicators 1A3A2, 1A3A3 Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
ILLUM Control	R33	Controls intensity of overlay scale lighting
VIDEO 2 GAIN Control	R29	Controls gain of transponder video
ANGLE CURSOR Control	R35	Controls intensity of angle cursor
INTEN Control	R32	Controls raster intensity
RANGE CURSOR Control	R30	Controls intensity of range cursor
VIDEO 1 GAIN Control	R31	Controls gain of target video

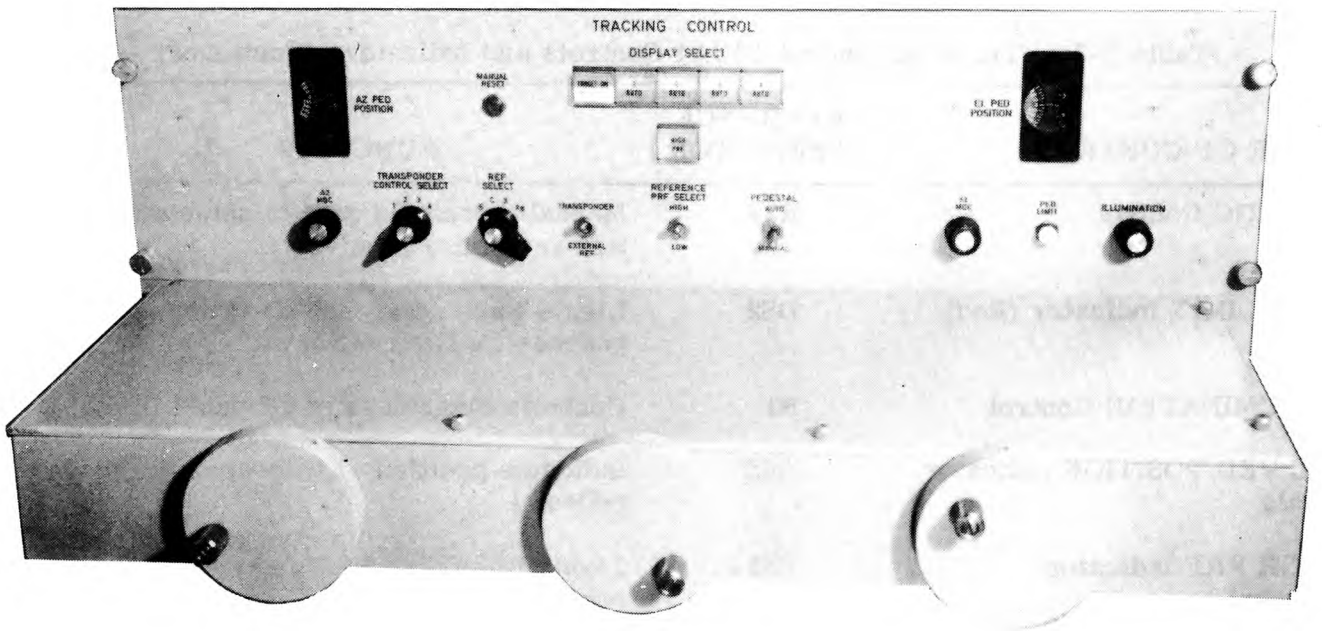

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Figure 2-7. Tracking Control 1A3A4

Table 2-7. Tracking Control 1A3A4 Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
AZ PED POSITION Indicator Dials	A64	Indicates position of reference azimuth pedestal
AZ MGC Control	R22	Manually controls gain of selected azimuth reference receiver
TRANSPONDER CONTROL SELECT Switch	S1	Selects any one of four transponder tracking loops
REF SELECT Switch	S12	Selects any one of three reference track receivers, i.e., S-, C- and X-band as well as X-band beacon receiver
TRANSPONDER/EXTERNAL REF Switch	S13	Selects transponder or radar reference tracking function
MANUAL RESET Control	S5	Overrides auto track and returns selected tracking loops to manual control
REFERENCE PRF SELECT HIGH/LOW Switch	S14	Selects either high or low PRF when S-13 is in EXTERNAL REF position
PEDESTAL AUTO/MANUAL Switch	S15	Selects either automatic or manual control of X-band azimuth and elevation pedestals in X-band reference operation

Table 2-7. Tracking Control 1A3A4 Controls and Indicators (Continued)

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
EL MGC Control	R23	Manually controls gain of selected elevation reference receiver
PED LIMIT Indicator (Red)	DS2	Lights when reference elevation pedestal reaches its limit of travel
ILLUMINATION Control	R1	Controls brightness of all panel lights
EL PED POSITION Indicator Dials	A65	Indicates position of reference elevation pedestal
HIGH PRF Indicator (Green)	DS1	Lights when high PRF is selected during target tracking
TARGET ON-TARGET OFF	S10	Enables display of target video on B-scopes in transponder track
1-AUTO Indicator Switch	S6	Selects and displays transponder 1 video and indicates automatic angle-range tracking
2-AUTO Indicator Switch	S7	Same as 1-AUTO, except for transponder 2
3-AUTO Indicator Switch	S8	Same as 1-AUTO, except for transponder 3
4-AUTO Indicator Switch	S9	Same as 1-AUTO, except for transponder 4
AZIMUTH Handwheel	-	Initiates transponder auto azimuth track, S- and C-band reference auto azimuth track, X-band reference auto angle track, and X-band beacon auto angle in the out position; controls transponder cursors in azimuth, in the in position; controls azimuth pedestal during reference track
RANGE Handwheel	-	Initiates auto range track in the out position
ELEVATION Handwheel	-	Initiates transponder auto elevation track, S- and C-band reference elevation auto track, and reference X-band track in the out position

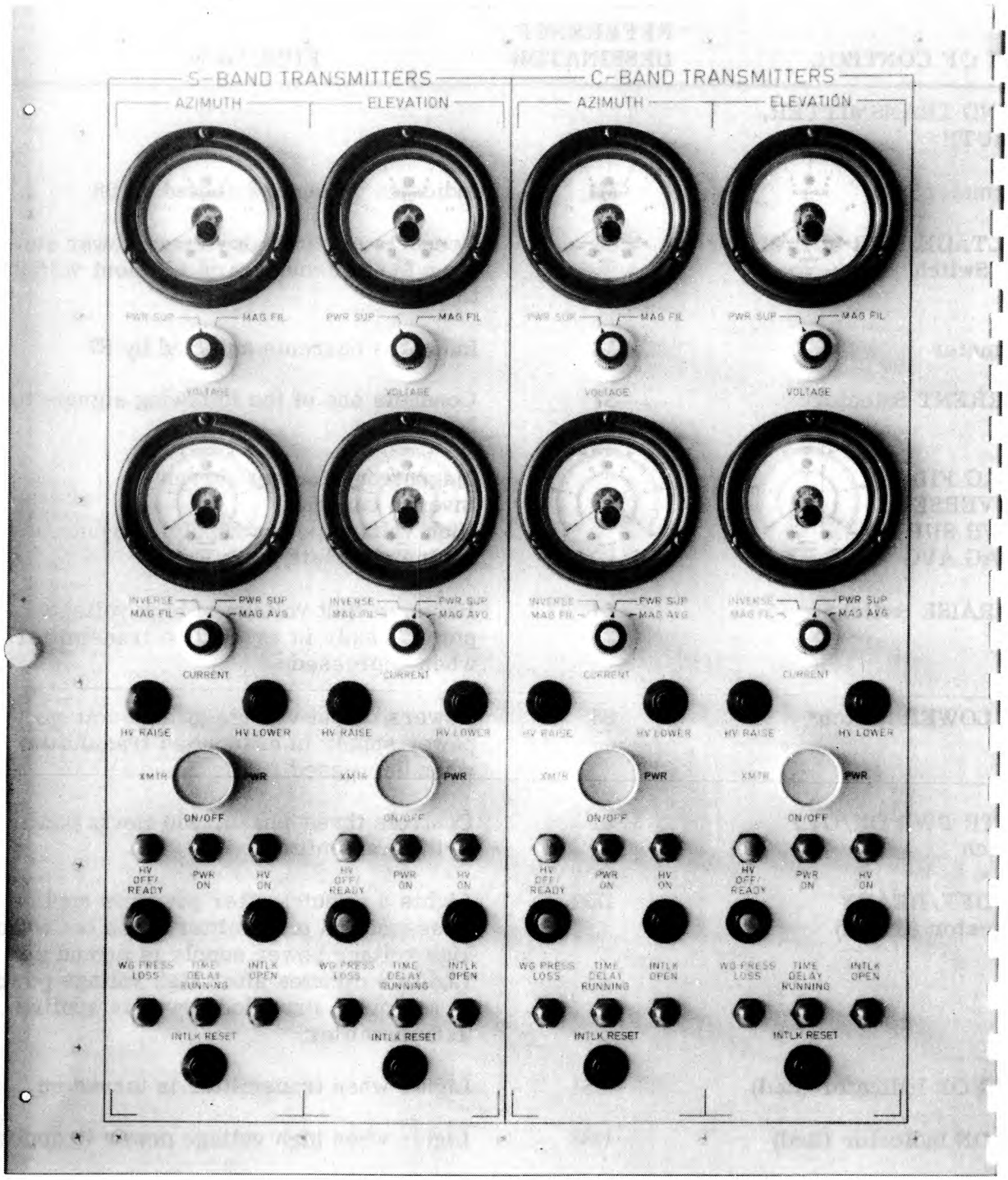

Figure 2-8. Transmitter Control, S- and C-Band 1A5A1

Table 2-8. Transmitter Control, S- and C-Band 1A5A1 Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
S-BAND TRANSMITTER, AZIMUTH		
Voltmeter	M1	Indicates voltages selected by S8
VOLTAGE PWR SUP/MAG FIL Switch	S8	Connects either high voltage power supply output or magnetron filament voltage to M1
Ammeter	M2	Indicates currents selected by S7
CURRENT Selector	S7	Connects one of the following signals to M2:
MAG FIL		Magnetron filament current
INVERSE		Inverse current
PWR SUP		High voltage power supply current
MAG AVG		Magnetron plate current
HV RAISE Switch*	S4	Raises output voltage of high voltage power supply in associated transmitter when depressed
HV LOWER Switch*	S5	Lowers output voltage at high voltage power supply in associated transmitter when depressed
XMTR PWR ON/OFF Switch	S1	Controls three-phase, 400 Hertz power to the transmitter
HV OFF/READY Indicator (Green)	DS2	Lights 8 minutes after power is applied to associated transmitter; goes out when high voltage power supply is turned on. Lights 8 minutes after high voltage power is removed, provided power is applied to transmitter
PWR ON Indicator (Red)	DS1	Lights when transmitter is turned on
HV ON Indicator (Red)	DS3	Lights when high voltage power is applied
HV OFF Switch*	S3	Removes high voltage power

*Effective only when REMOTE TRANSFER switch on associated transmitter is positioned to REMOTE.
**Same controls and indicators as S-BAND AZIMUTH TRANSMITTER except as noted.

Table 2-8. Transmitter Control, S- and C-Band 1A5A1 Controls and Indicators (Continued)

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
HV ON Switch*	S2	Applies high voltage power provided DS2 is on
WG PRESS LOSS Indicator (Red)	DS4	Lights when waveguide pressurization is inadequate
TIME DELAY RUNNING Indicator (Green)	DS5	Lights when transmitter is turned on; then goes out after 8-minute time delay
INTLK OPEN Indicator (Red)	DS6	Lights when one or more of the interlock devices in interlock circuit is open. Normally goes out at end of 8-minute time delay; re-lights when S3 (or HV OFF switch on associated transmitter) is actuated, or when an interlock is opened
INTLK RESET Switch*	S6	Resets latching relays in transmitter interlock circuits
S-BAND TRANSMITTER, ELEVATION**		Performs functions listed for S-BAND AZIMUTH TRANSMITTER
Voltmeter	M3	(S16 selects the input)
VOLTAGE Selector	S16	(Readout is on M3)
Ammeter	M4	(S15 selects the input)
CURRENT Selector Switch	S15	(Readout is on M4)
HV RAISE Switch*	S12	
HV LOWER Switch*	S13	
XMTR PWR Switch*	S9	
HV OFF/READY Indicator (Green)	DS8	
PWR ON Indicator (Red)	DS7	
HV ON Indicator (Red)	DS9	
HV OFF Switch*	S11	

*Effective only when REMOTE TRANSFER switch on associated transmitter is positioned to REMOTE.
**Same controls and indicators as S-BAND AZIMUTH TRANSMITTER except as noted.

Table 2-8. Transmitter Control, S- and C-Band 1A5A1 Controls and Indicators (Continued)

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
HV ON Switch*	S10	(Functions only if DS8 is on)
WG PRESS LOSS Indicator (Red)	DS10	
TIME DELAY RUNNING Indicator (Green)	DS11	
INTLK OPEN Indicator (Red)	DS12	
INTLK RESET Switch*	S14	
C-BAND TRANSMITTER, Azimuth**		Performs functions listed for S-Band AZIMUTH TRANSMITTER
Voltmeter	M5	(S24 selects the input)
VOLTAGE Selector Switch	S24	(Readout is on M5)
Ammeter	M6	(S23 selects the input)
CURRENT Selector Switch	S23	(Readout is on M6)
HV RAISE Switch*	S20	
HV LOWER Switch*	S21	
XMTR PWR Switch*	S17	
HV OFF/READY Indicator (Green)	DS14	
PWR ON Indicator (Red)	DS13	
HV ON Indicator (Red)	DS15	
HV OFF Switch*	S19	
HV ON Switch*	S18	(Functions only if DS14 is on)
WG PRESS LOSS Indicator (Red)	DS16	

*Effective only when REMOTE TRANSFER switch on associated transmitter is positioned to REMOTE.

**Same controls and indicators as S-BAND AZIMUTH TRANSMITTER except as noted.

Table 2-8. Transmitter Control, S- and C-Band 1A5A1 Controls and Indicators (Continued)

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
TIME DELAY RUNNING Indicator (Green)	DS17	
INTLK OPEN Indicator (Red)	DS18	
INTLK RESET Switch*	S22	
C-BAND TRANSMITTER, ELEVATION**		Performs functions listed for S-BAND AZIMUTH TRANSMITTER
Voltmeter	M7	(S32 selects the input)
VOLTAGE Selector Switch	S32	(Readout is on M7)
Ammeter	M8	(S31 selects the input)
CURRENT Selector Switch	S31	(Readout is on M8)
HV RAISE Switch*	S28	
HV LOWER Switch*	S29	
XMTR PWR Switch*	S25	
HV OFF/READY Indicator (Green)	DS20	
PWR ON Indicator (Red)	DS19	
HV ON Indicator (Red)	DS21	
HV OFF Switch*	S27	
HV ON Switch*	S26	(Functions only if DS20 is on)
WG PRESS LOSS Indicator (Red)	DS22	
TIME DELAY RUNNING Indicator (Green)	DS23	
INTLK OPEN Indicator (Red)	DS24	
INTLK RESET Switch*	S30	

*Effective only when REMOTE TRANSFER switch on associated transmitter is positioned to REMOTE.

**Same controls and indicators as S-BAND AZIMUTH TRANSMITTER except as noted.

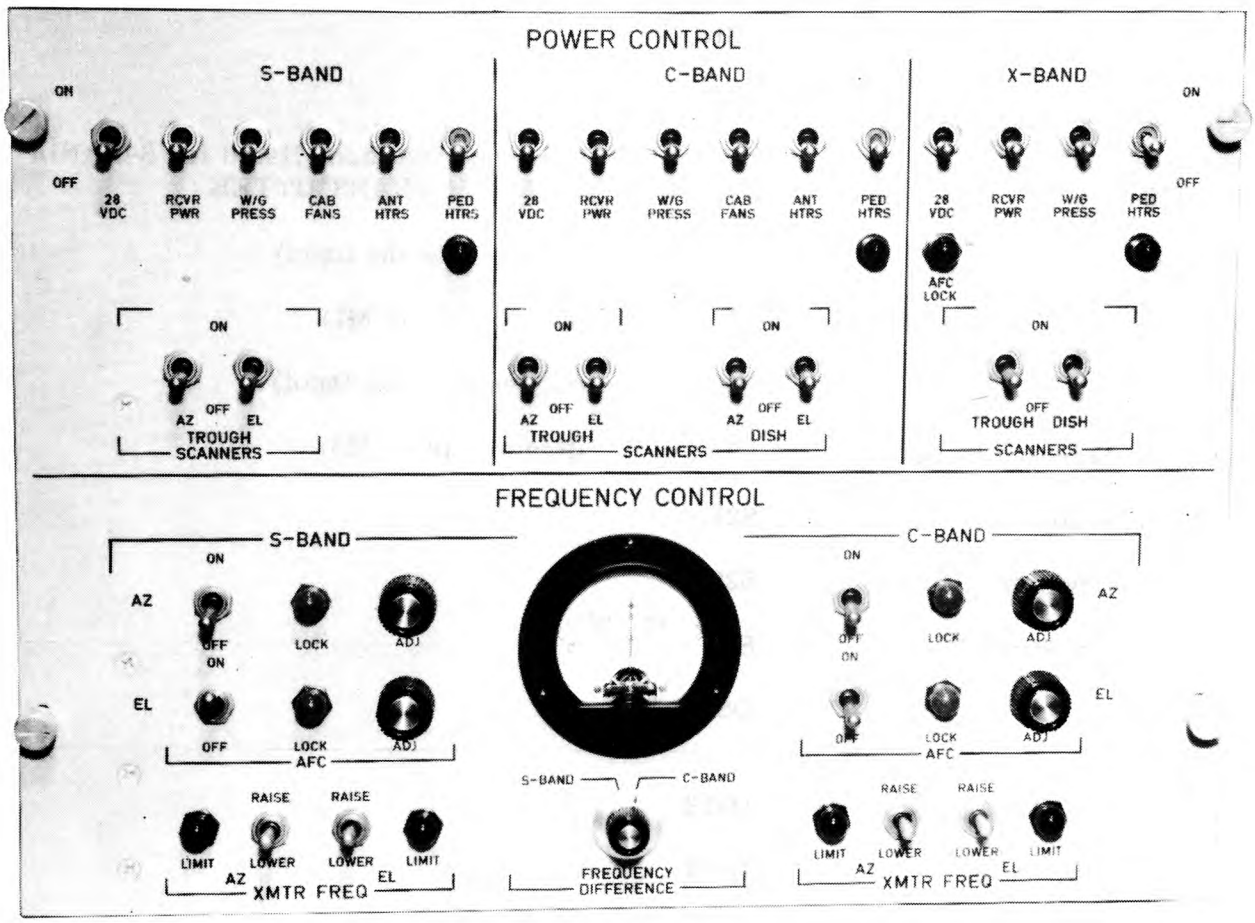

Figure 2-9. Power and Frequency Control 1A5A2

Table 2-9. Power and Frequency Control 1A5A2 Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR		FUNCTION
28 VDC ON/OFF Switches	(S) (C) (X)	S1 S9 S28	Apply 115 VAC power to and remove power from the 28 volt power supplies in associated radar trailers.
RCVR PWR ON/OFF Switches	(S) (C) (X)	S2 S10 S29	Apply 115 VAC to and remove power from the regulated power supplies in associated radar trailers
W/G PRESS ON/OFF Switches	(S) (C) (X)	S3 S11 S30	Apply power to and remove power from waveguide pressurization pump
CAB FANS ON/OFF Switches	(S) (C)	S4 S12	Apply power to and remove power from selected receiver blowers
ANT HTRS ON/OFF Switches	(S) (C)	S5 S13	Apply power to and remove power from selected antenna heaters
PED HTRS ON/OFF Switches	(S) (C) (X)	S6 S14 S33	Apply power to and remove power from selected antenna pedestal heaters
SCANNERS TROUGH ON/OFF Switches			Apply power to and remove power from selected trough antenna scanners
AZ	(S) (C)	S7 S15	
EL	(S) (C)	S8 S16	
TROUGH	(X)	S31	
SCANNERS DISH ON/OFF Switches			Apply power to and remove power from C-band and X-band dish antenna scanners
AZ	(C)	S17	
EL	(C)	S18	
DISH	(X)	S32	
PED HTRS Indicators (Red)	(S) (C) (X)	DS9 DS10 DS11	Light when power is applied to pedestal heaters
AFC LOCK Indicator (Green)	(X)	DS12	Lights when X-band AFC loop has accomplished frequency lock
FREQUENCY DIFFERENCE			
Meter	M1		Displays frequency difference between AZ and EL transmitters for selected band

Table 2-9. Power and Frequency Control 1A5A2
Controls and Indicators (Continued)

NAME OF CONTROL		REFERENCE DESIGNATOR	FUNCTION
S-BAND/C-BAND Selector Switch		S27	Selects band to be displayed on meter
AFC			
OFF/ON Switch*			Receiver system automatic frequency control off/on switch
S-BAND	AZ	S19	
	EL	S20	
C-BAND	AZ	S23	
	EL	S24	
LOCK Indicator (Green)			When lighted, indicates frequency control is locked in
S-BAND	AZ	DS1	
	EL	DS2	
C-BAND	AZ	DS5	
	EL	DS6	
ADJ Control*			Manually adjusts automatic frequency control circuits when AFC is off
S-BAND	AZ	R1	
	EL	R2	
C-BAND	AZ	R3	
	EL	R4	
XMTR FREQUENCY			
LIMIT Indicator (Red)*			When lighted, indicates respective radar transmitter is adjusted to upper or lower frequency limit
S-BAND	AZ	DS3	
	EL	DS4	
C-BAND	AZ	DS7	
	EL	DS8	
RAISE/LOWER Switch*			Raises or lowers frequency of respective radar transmitter within operating limits
S-BAND	AZ	S21	
	EL	S22	
C-BAND	AZ	S25	
	EL	S26	

*Effective only when REMOTE/LOCAL switch on associated prereceiver is positioned to REMOTE.

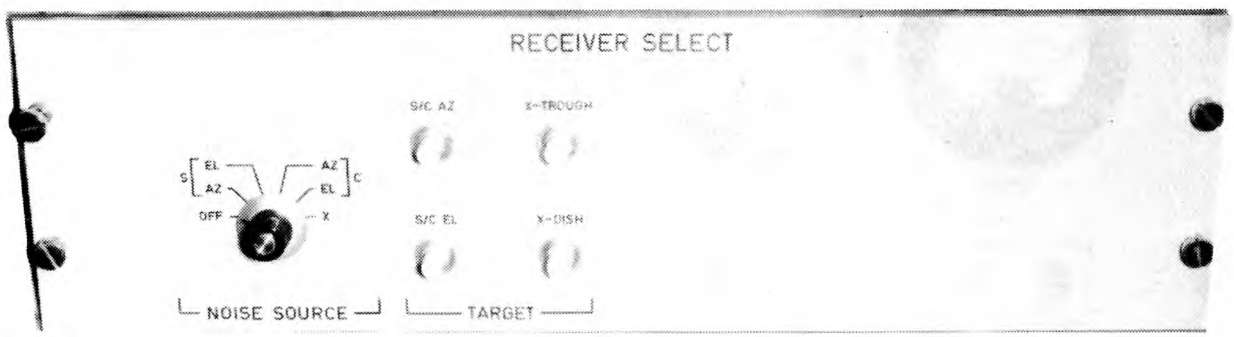

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Figure 2-10. Receiver Select 1A5A5

Table 2-10. Receiver Select 1A5A5 Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
NOISE SOURCE Switch	S1	Selects receiver whose noise figure is to be measured by means of noise figure meter 1A5A9

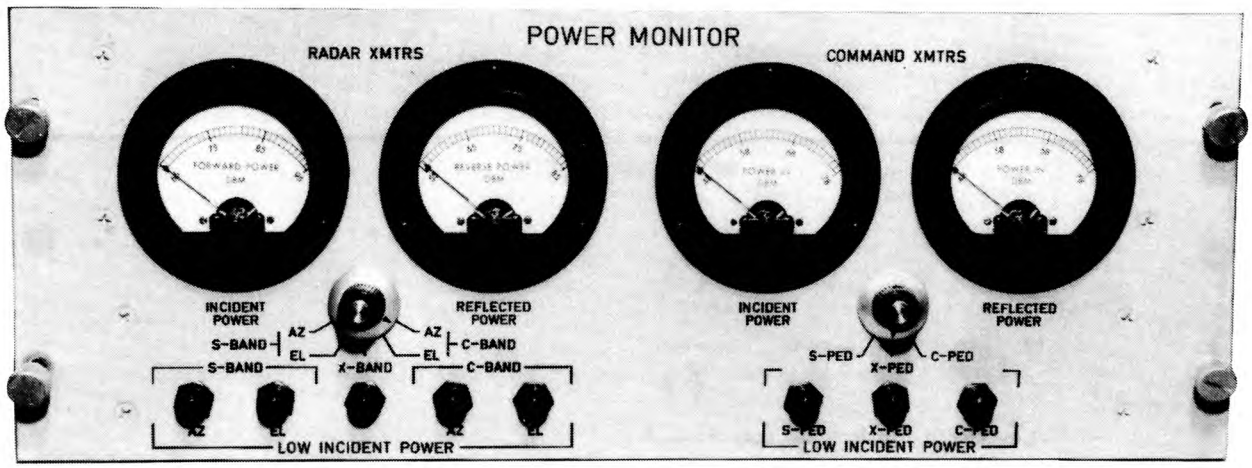

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Figure 2-11. Power Monitor 1A5A6

Table 2-11. Power Monitor 1A5A6 Controls and Indicators

NAME OF CONTROL		REFERENCE DESIGNATOR	FUNCTION
RADARS XMTRS			
INCIDENT POWER Meter		M1	Displays incident power of selected radar transmitter
REFLECTED POWER Meter		M2	Displays reflected power of selected radar transmitter
Transmitter Select Switch		S1	Selects radar transmitter displayed on power meters
LOW INCIDENT POWER Indicators (Red)			Light when respective transmitter incident power drops below predetermined level
S-BAND	AZ	DS1	
	EL	DS2	
C-BAND	AZ	DS4	
	EL	DS3	
X-BAND		DS7	

Table 2-9. Power and Frequency Control 1A5A2
Controls and Indicators (Continued)

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
COMMAND XMTRS		
INCIDENT POWER Meter	M3	Displays incident power of selected command transmitter
REFLECTED POWER Meter	M4	Displays reflected power of selected command transmitter
Transmitter Select Switch	S2	Selects command transmitter to be displayed on power meters
LOW INCIDENT POWER Indicators (Red)		Light when respective command transmitter incident power drops below predetermined level
S-PED	DS5	
C-PED	DS6	
X-PED	DS8	

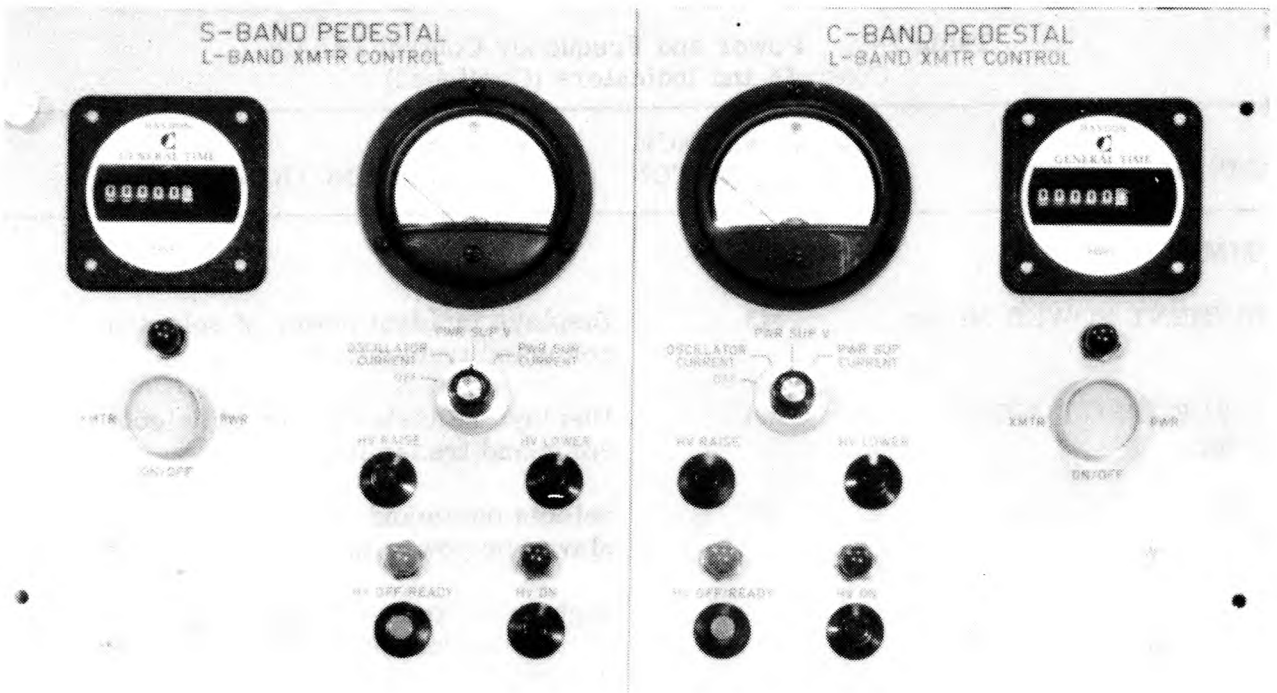

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Figure 2-12. L-Band Transmitter Control 1A5A7

Table 2-12. L-Band Transmitter Control 1A5A7 Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR		FUNCTION
Meter Selector Switch	(S) (C)	S6 S12	Selects one of three functions for microammeter
OSCILLATOR CURRENT			Selects current of cavity oscillator
PWR SUP V			Selects output voltage of high voltage power supply
PWR SUP CURRENT			Selects current of high voltage power supply
HV RAISE*	(S) (C)	S4 S10	Raises output voltage of high voltage power supply
HV LOWER*	(S) (C)	S5 S11	Lowers output voltage of high voltage power supply
Microammeter	(S) (C)	M1 M3	Measures voltage or current as selected by S6 or S12 as applicable

Table 2-12. L-Band Transmitter Control 1A5A7
Controls and Indicators (Continued)

NAME OF CONTROL	REFERENCE DESIGNATOR		FUNCTION
HV OFF/READY			
Indicator (Green)	(S) (C)	DS3 DS6	Indicates that high voltage may be applied; lights 4 minutes after XMTR PWR has been turned on
Switch*	(S) (C)	S3 S9	Momentary switch; removes high voltage
HV ON			
Indicator (Red)	(S) (C)	DS2 DS5	Indicates high voltage is on
Switch*	(S) (C)	S2 S8	Momentary switch; applies high voltage; effective only when HV OFF/READY indicator is lighted
HOURS Meter	(S) (C)	M2 M4	Indicates transmitter running time
XMTR PWR			Controls application of 120 VAC and +28 VDC to transmitter; also applies transmitter filament voltage when control switch on L-band transmitter front panel is in REMOTE position
ON/OFF* Switch	(S) (C)	S1 S7	
Indicator (Green)	(S) (C)	DS1 DS4	Indicates power is applied to the transmitter

*This control is effective only when the LOCAL/REMOTE switch on the associated transmitter is in the REMOTE position.

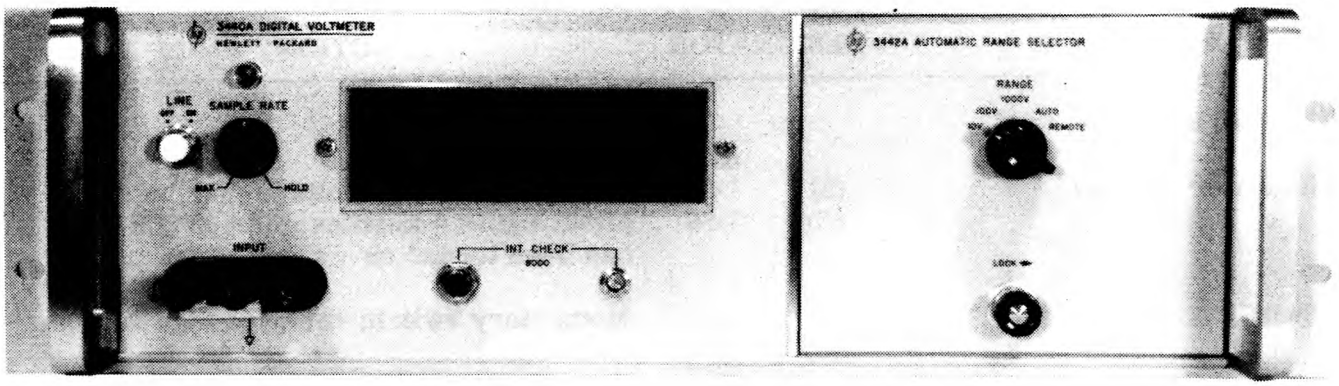

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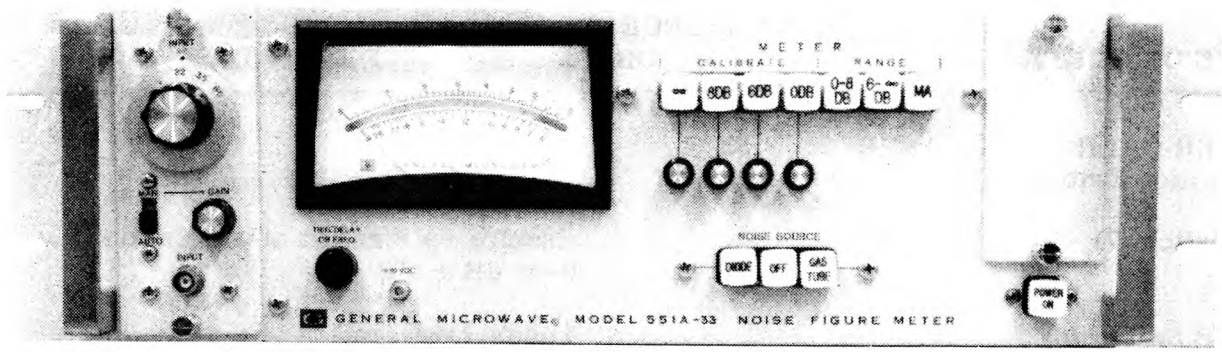
Figure 2-13. Digital Voltmeter 1A5A8

Table 2-13. Digital Voltmeter 1A5A8 Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
LINE ON/OFF Switch	S2	Applies primary power
Indicator (Red)	DS8	Flashes at sampling rate
INT CHECK		
Switch	S3	Applies -8.000 volts to input circuits for calibration
Screwdriver Adjust	R60	Adjusts readout to -8.000 volts when S3 is depressed
RANGE Switch	S1	Selects full scale input; controls decimal point and mode indicator
LOCK		Locks plug-in unit in place
Readout Display and Mode Indicator		Indicates voltage value, polarity, and instrument measurement units (V, MV, or OVERRANGE)
SAMPLE RATE Control	R6	Adjusts voltmeter sample rate. Stops sampling when placed in the HOLD position



0095-112A

Figure 2-14. Noise Figure Meter 1A5A9

Table 2-14. Noise Figure Meter 1A5A9 Controls and Indicators

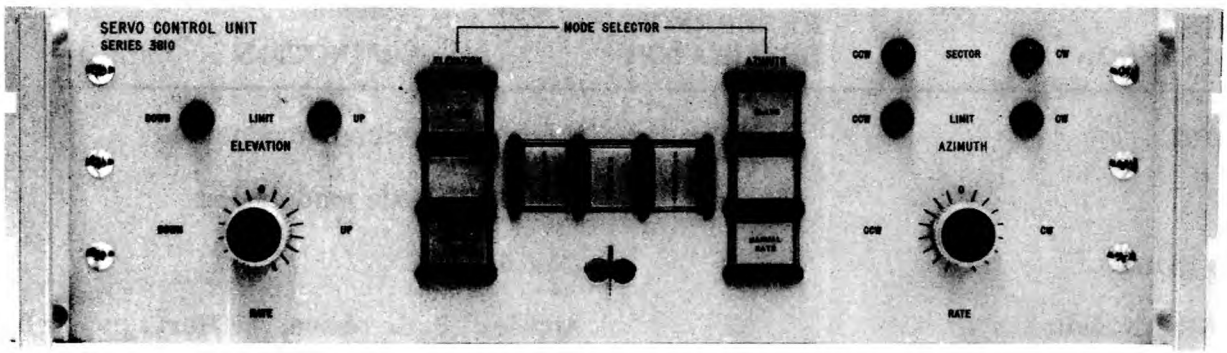
NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
INPUT-MC Switch	S301	Selects 22, 35, or 60 MHz input frequency
MAN/AUTO Switch	S302	Selects manual or automatic AGC in IF amplifier
GAIN Control	R329	Permits adjustment of amplifier gain in manual mode
Noise Figure-dB Meter	M1	Indicates noise figure of receiver being tested
TRIG DELAY OR FREQ Control	S11	Permits external adjustment of square wave frequency to eliminate undesired beating effects or lock-up with line frequency harmonics or signal modulation components

Table 2-14. Noise Figure Meter 1A5A9 Controls and Indicators (Continued)

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
METER CALIBRATE-RANGE 7-Position Switch	S3	
∞ Switch (7)		Enables calibration of ∞ point on the 6-∞ dB scale
8 DB Switch (6)		Enables calibration of 8 dB point on 0-8 dB scale
6 DB Switch (5)		Enables calibration of 6 dB point on 6-∞ dB scale
0 DB Switch (4)		Enables calibration of 0 dB point on 0-8 dB scale
0-8 DB Switch (3)		Selects 0-8 dB scale for noise figure measurements
6 -∞ DB Switch (2)		Selects 6-∞ dB scale for noise figure measurements
METER CALIBRATE-RANGE Switch Indicators		
6-∞ DB Indicator	DS2	Lights when the 6-∞ dB scale has been chosen
0-8 DB Indicator	DS3	Lights when the 0-8 dB scale has been chosen
0 DB Indicator	DS4	Lights when 0 dB point on the 0-8 dB scale is being calibrated
6 DB Indicator	DS5	Lights when the 6 dB point on the 6-∞ dB scale is being calibrated
8 DB Indicator	DS6	Lights when the 8 dB point on the 0-8 dB scale is being calibrated
∞ Indicator	DS7	Lights when the ∞ point on the 6-∞ dB scale is being calibrated
NOISE SOURCE Switch	S2	

Table 2-14. Noise Figure Meter 1A5A9 Controls and Indicators (Continued)

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
DIODE		Turns on the diode modulation
OFF		Turns off diode modulation
GAS TUBE		(Not used)
POWER ON Switch	S1	Applies single phase, 60 Hertz power to the noise figure meter
METER CALIBRATE		
Gain Controls		
∞ Gain Control	R7	Permits calibration of ∞ dB point on the 6 - ∞ dB scale
8 dB Gain Control	R8	Permits calibration of 8 dB point on the 0 - 8 dB scale
6 dB Gain Control	R9	Permits calibration of 6 dB point on the 6 - ∞ dB scale
0 dB Gain Control	R10	Permits calibration of 0 dB point on the 0 - 8 dB scale



0095-113

Figure 2-15. Servo Control Unit 1A5A12, 1A5A19, 1A17A8

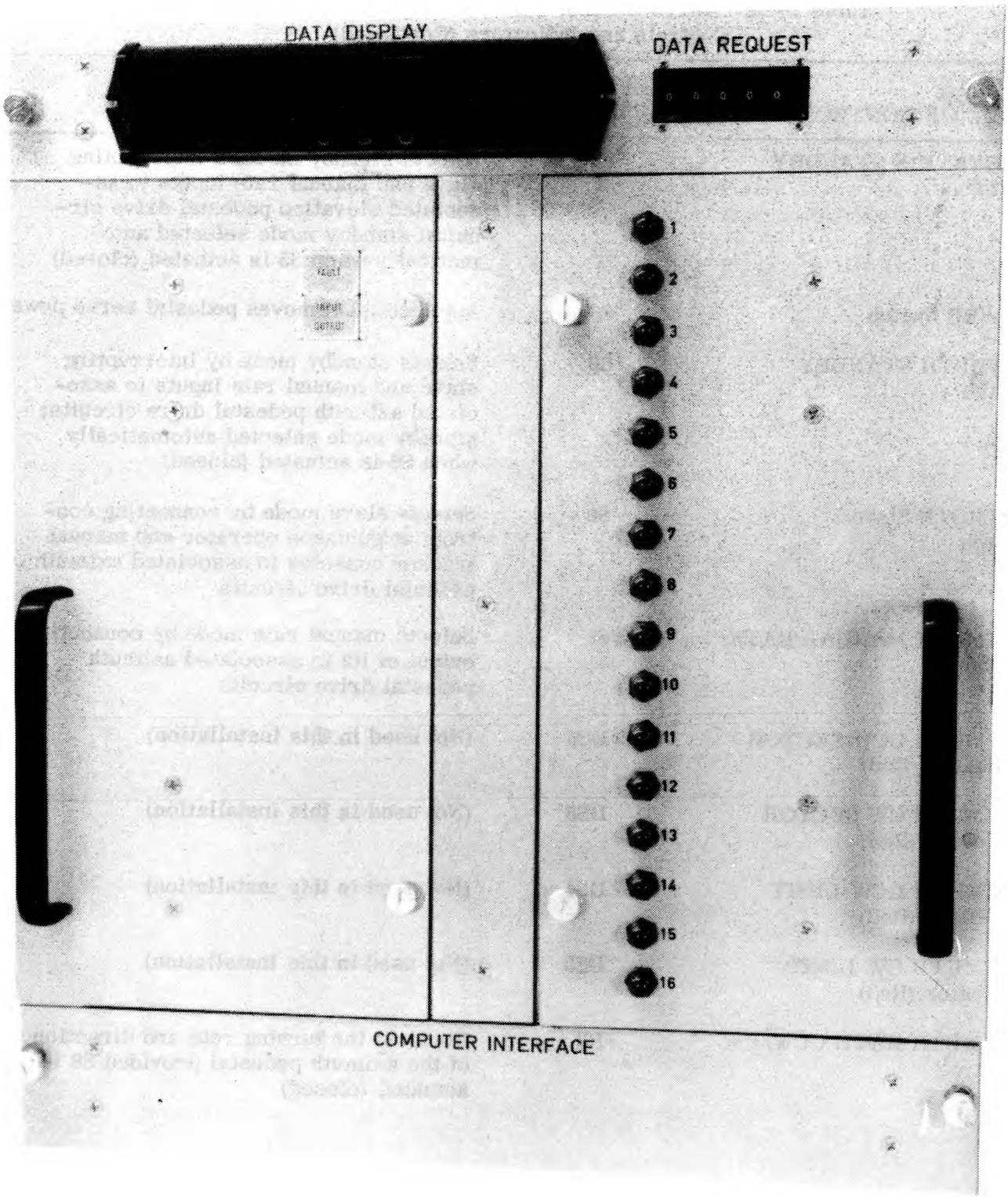
Table 2-15. Servo Control Unit 1A5A12, 1A5A19, 1A17A8 Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
ELEVATION DOWN LIMIT Indicator (Red)	DS2*	Lights when down limit (+5.5 degrees) of elevation pedestal travel is reached
ELEVATION UP LIMIT Indicator (Red)	DS1*	Lights when up limit (+85 degrees) of elevation pedestal travel is reached
ELEVATION RATE CCW/CW Control	R1	Controls turning rate and direction of elevation pedestal, provided S3 is actuated (closed)
ELEVATION SLAVE	S1	Selects slave mode by connecting controls at guidance operator and manual tracker consoles to associated elevation pedestal drive circuits
ELEVATION MANUAL RATE Switch	S3	Selects manual rate mode by connecting output of R1 to associated elevation pedestal drive circuits

*If both DS1 and DS2 are on, one or more of the pedestal interlocks are open.

Table 2-15. Servo Control Unit 1A5A12, 1A5A19, 1A17A8 Controls and Indicators (Continued)

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
ELEVATION STANDBY Switch	S4	Selects standby mode of interrupting slave and manual rate inputs to associated elevation pedestal drive circuits; standby mode selected automatically when S5 is actuated (closed)
POWER Switch	S5	Applies and removes pedestal servo power
AZIMUTH STANDBY Switch	S9	Selects standby mode by interrupting slave and manual rate inputs to associated azimuth pedestal drive circuits; standby mode selected automatically when S5 is actuated (closed)
AZIMUTH Slave Switch	S6	Selects slave mode by connecting controls at guidance operator and manual tracker consoles to associated azimuth pedestal drive circuits
AZIMUTH MANUAL RATE Switch	S8	Selects manual rate mode by connecting output of R2 to associated azimuth pedestal drive circuits
AZIMUTH CCW SECTOR Indicator (Red)	DS6	(Not used in this installation)
AZIMUTH CW SECTOR Indicator (Red)	DS5	(Not used in this installation)
AZIMUTH CCW LIMIT Indicator (Red)	DS4	(Not used in this installation)
AZIMUTH CW LIMIT Indicator (Red)	DS3	(Not used in this installation)
AZIMUTH RATE CCW/CW Control	R2	Controls the turning rate and direction of the azimuth pedestal provided S8 is actuated (closed)

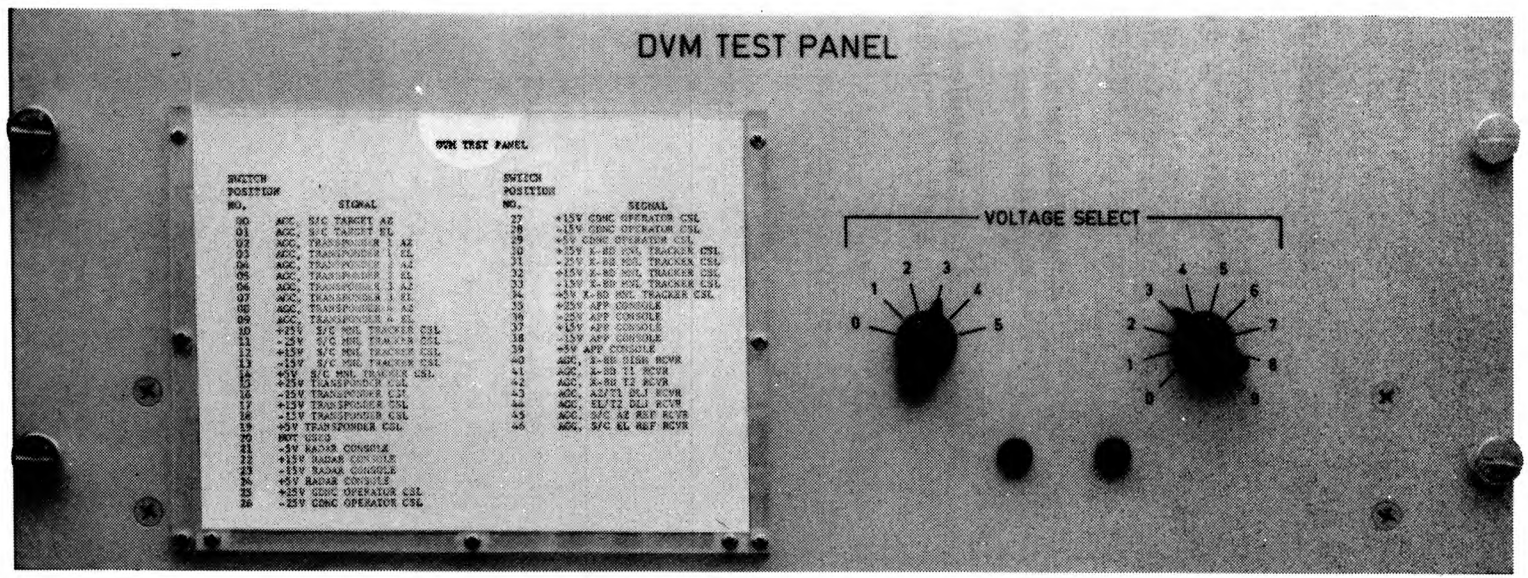


0095-114A

Figure 2-16. Computer Interface 1A5A14

Table 2-16. Computer Interface 1A5A14
Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
DATA REQUEST Switches	S1 thru S5	Thumbwheel switches. Adjust to memory location of data word to be displayed on DATA DISPLAY nixie tubes and on indicator lights DS1 through DS16
DATA DISPLAY Indicators (Amber)	V1 thru V9	Display numerical data in memory location selected by switches
Indicators (Green)	DS1 thru DS16	Light to display data in location selected by DATA REQUEST
FAULT Indicator (Red)	DS17	Lights to indicate data not being transferred between computer and interface
INPUT/OUTPUT Indicator (Green)	DS18	Lights to indicate direction of last data transfer in relation to computer

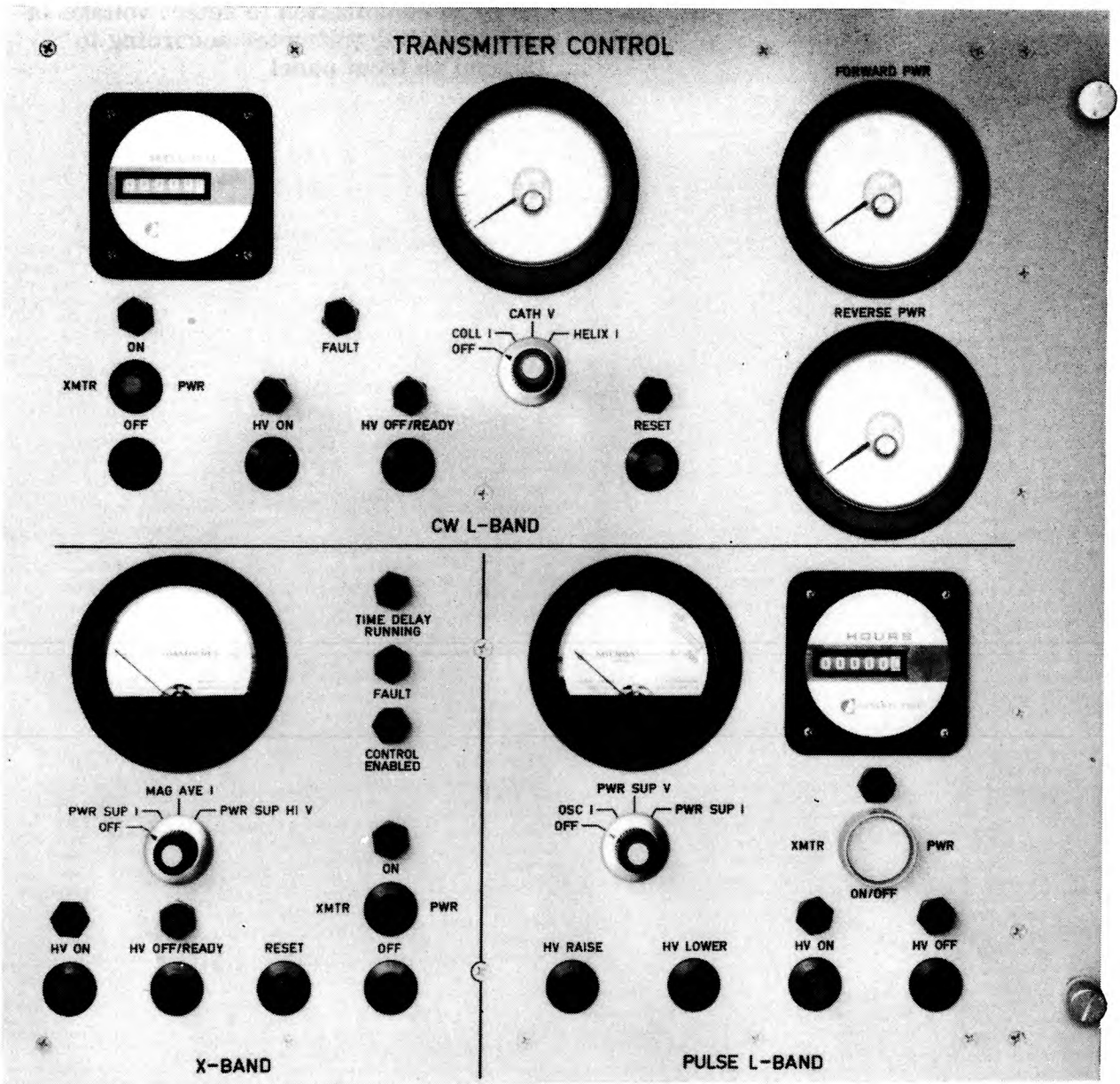


0095-115A

Figure 2-17. Digital Voltmeter Test Panel 1A5A16

Table 2-17. Digital Voltmeter Test Panel 1A5A16 Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
VOLTAGE SELECT Switches	S1, S2	Used in combination to select voltage input to digital voltmeter according to legend on front panel



0095-259

Figure 2-18. Transmitter Control, X-Band, 1A5A27

Table 2-18. Transmitter Control, X-Band, 1A5A27, Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
CW L-BAND TRANSMITTER		
RUNNING TIME Indicator	M3	Indicates length of time power applied to CW transmitter
XMTR PWR ON Indicator (Red)	DS4	Lights when 60 Hertz power is applied to L-band transmitter
XMTR PWR ON Switch*	S7	Applies 60 Hertz power to L-band CW transmitter
XMTR PWR OFF Switch*	S8	Removes 60 Hertz power from L-band CW transmitter
HV ON Indicator (Red)	DS5	Lights when high voltage is applied to CW transmitter output tube
HV ON Switch*	S9	Applies high voltage to CW transmitter output tube
FAULT Indicator (Red)	DS14	Lights when some fault appears in CW transmitter
HV OFF/READY Indicator (Green)	DS7	Lights when high voltage power supply is in ready state
HV OFF/READY Switch*	S10	Removes 60 Hertz power from L-band CW transmitter high voltage power supply
OFF/COLL I/CATH V/HELIX I		
Meter	M4	Indicates transmitter tube collector current, helix current, and cathode voltage
Switch	S12	Selects voltage or current to be measured on M4
RESET Indicator (Red)*	DS6	Lights when overload circuit has been reset

*This control effective only when LOCAL/REMOTE switch or associated transmitter is positioned to REMOTE.

Table 2-18. Transmitter Control, X-Band, 1A5A27, Controls and Indicators (Continued)

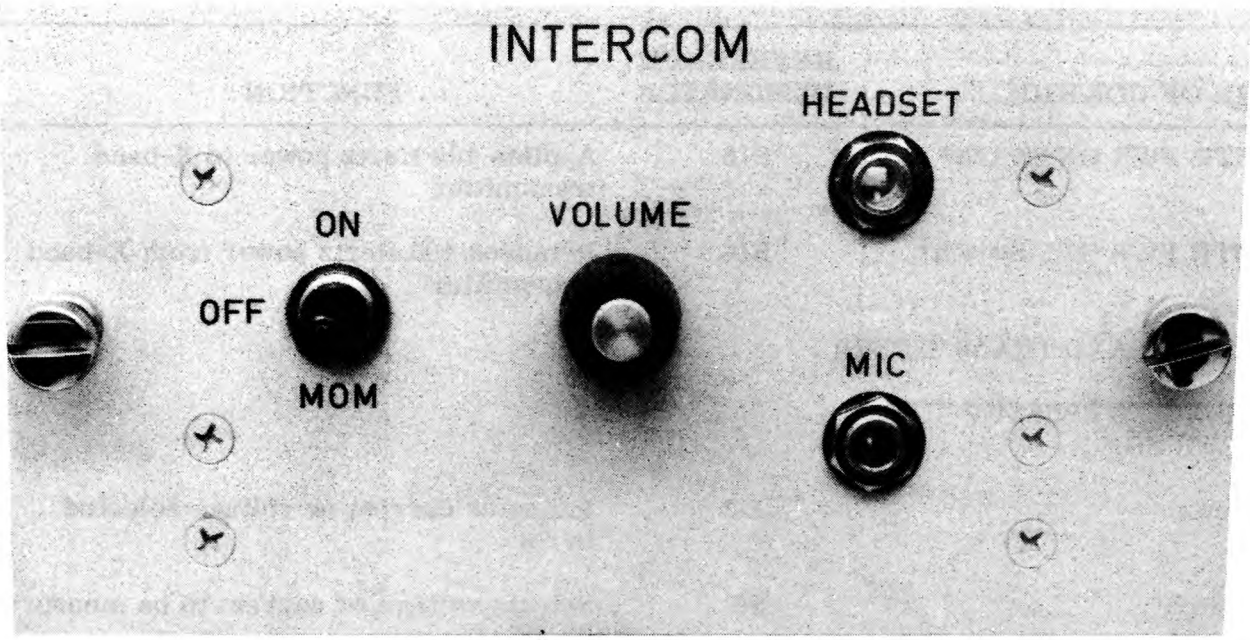
NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
RESET Switch*	S11	Resets overload protection circuitry after overload condition has been cleared
FORWARD PWR Meter	M5	Indicates transmitter output power
REVERSE PWR Meter	M6	Indicates reflected power due to transmission line VSWR
X-BAND TRANSMITTER		
OFF/PWR SUP I/MAG AVE I/PWR SUP HI V		
Meter	M7	Indicates transmitter tube average current, power supply current, and power supply high voltage
Switch	S17	Selects voltage or current to be measured on M7
HV ON Indicator (Red)	DS8	Lights when high voltage is applied to X-band magnetron
HV ON Switch*	S13	Applies high voltage to X-band magnetron
HV OFF/READY Indicator (Green)	DS9	Lights when high voltage power supply is in ready state
HV OFF/READY Switch*	S14	Removes high voltage from S-band magnetron
RESET Switch*	S18	Resets overload protection circuitry after overload condition has been cleared
TIME DELAY RUNNING Indicator (Green)	DS11	Lights during warmup period and goes out when high voltage is applied
FAULT Indicator (Red)	DS12	Lights when some fault appears in X-band transmitter
CONTROL ENABLED Indicator (Green)	DS13	Lights when control is transferred to remote transmitter control panel
XMTR PWR ON Indicator (Red)	DS10	Lights when 400 Hertz power is applied to X-band transmitter

*This control effective only when LOCAL/REMOTE switch on associated transmitter is positioned to REMOTE.

Table 2-18. Transmitter Control, X-Band, 1A5A27, Controls and Indicators (Continued)

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
XMTR PWR ON Switch*	S15	Applies 400 Hertz power to X-band transmitter
XMTR PWR OFF Switch*	S16	Removes 400 Hertz power from X-band transmitter
PULSE L-BAND TRANSMITTER		
OFF/OSC I/PWR SUP V/PWR SUP I		
Meter	M2	Indicates current or voltage selected by S6
Switch	S6	Selects voltage or current to be measured by M2
HV RAISE Switch*	S4	Increases amplitude of high voltage applied to pulse L-band transmitter output tube
HV LOWER Switch*	S5	Decreases amplitude of high voltage
RUNNING TIME Indicator	M1	Indicates time power applied to L-band pulse transmitter
XMTR POWER ON/OFF Indicator (Red)	DS1	Lights when 60 Hertz power has been applied to L-band pulse transmitter
XMTR PWR ON/OFF Switch*	S1	Applies 60 Hertz power to L-band pulse transmitter
HV ON Indicator (Red)	DS2	Lights when high voltage is applied to L-band pulse transmitter
HV ON Switch*	S2	Applies high voltage to pulse L-band transmitter output tube
HV OFF Indicator (Green)	DS3	Indicates that high voltage may be turned on; lights 4 minutes after XMTR PWR has been turned on
HV OFF Switch*	S3	Removes high voltage from pulse L-band transmitter output tube

*This control effective only when LOCAL/REMOTE switch on associated transmitter is positioned to REMOTE.

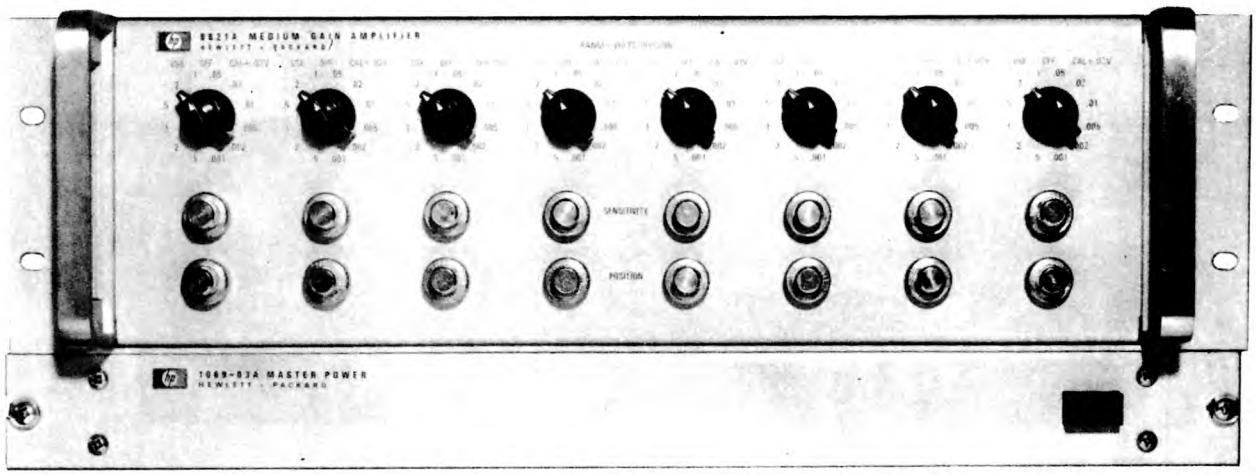


0095-116

Figure 2-19. Intercom 1A5A21, 1A8A5, 1A11A4, 1A11A9, 1A11A10, 1A17A9, 1A17A15, 1A19A3, 2A6A2A14, 3A6A2A14 and P/O 1A1A4, 1A3A4 and 4A2A1A5

Table 2-19. Intercom 1A5A21, 1A8A5, 1A11A4, 1A11A9, 1A11A10, 1A17A9, 1A17A15, 1A19A3, 2A6A2A14, 3A6A2A14 and P/O 1A1A4, 1A3A4, and 4A2A1A5 Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
INTERCOM OFF/ON/MOM Switch	S1	Connects headset into communications network
VOLUME Control	R1	Controls earphone volume



NOTE:

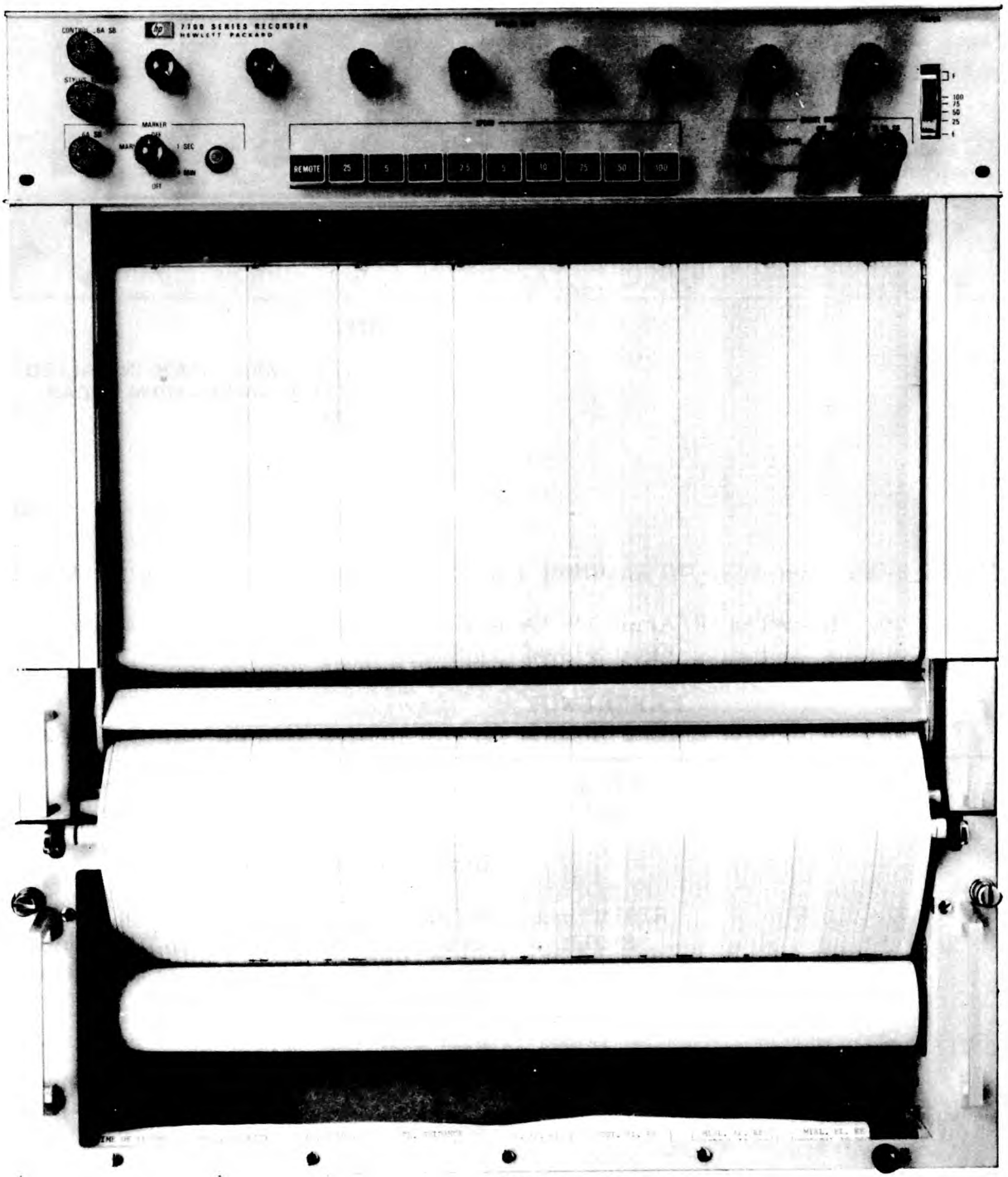
MASTER POWER 1A5A26 INSTALLED IN OJ-343/M AND OJ-370/M RADAR SET CONSOLES.

0095-117

Figure 2-20. Recorder DC Amplifier 1A5A22 and Master Power Panel 1A5A26

Table 2-20. Recorder DC Amplifier 1A5A22 and Master Power Panel 1A5A26 Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
RANGE-VOLTS/DIVISION Switches (Outer)	S101A thru S801A	Enable the selection of 12 recording sensitivities for each of 8 recording channels when the amplifier is calibrated to normal gain
USE-OFF-CAL + 0.02V Switches (Inner)	S101B thru S801B	Permits individual amplifier channels to be turned off, to receive inputs or to be calibrated with a built-in calibration voltage
SENSITIVITY Control	R100	Sets amplifier channel gain
POSITION Control	R101	Adjusts stylus baseline to position that represents zero input
MASTER POWER Switch	S1	Controls power to recording system
		NOTE Master Power Panel 1A5A26 installed in OJ-343/M and OJ-370/M radar set consoles.



NOTE:

RECORDER 1A5A23 AND TAKEUP REEL 1A5A25 INSTALLED IN OJ-343/M AND OJ-370/M RADAR SET CONSOLES.

0095-118

Figure 2-21. Recorder 1A5A23 and Recorder Take-up Reel 1A5A25

Table 2-21. Recorder 1A5A23 and Recorder Takeup Reel 1A5A25 Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
STYLUS HEAT Controls	R101 thru R108	Control stylus heat of each channel
MARKER Switch	S101	Generates AC marking trace or mark at 1 second or 1 minute intervals or upon command
MARKER Indicator	I101	Lights while mark is being made
SPEED Switches	S103	Used to select chart speeds at 0.25 to 100mm/sec
CHART DRIVE - MM/SEC Indicator (Red)	I102	Lights when chart drive is switched to MM/SEC position
CHART DRIVE - MM/MIN Indicator (Yellow)	I103	Lights when chart drive is switched to MM/MIN position (inoperative)
CHART DRIVE Switch	S102	Used to select chart drive motor and turns chart drive on or off. (MM/MIN position inoperative)

NOTE

RECORDER 1A5A23 and Take-Up Reel 1A5A25 installed in OJ-343/M and OJ-370/M radar set consoles

TO BE SUPPLIED AT LATER DATE

NOTE

RECORDER 1A5A23 INSTALLED IN OJ-370A/M RADAR SET CONSOLE.

Figure 2-21A. Recorder 1A5A23

Table 2-21A. Recorder 1A5A23 Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION

TO BE SUPPLIED AT A LATER DATE

NOTE

RECORDER 1A5A23 INSTALLED IN OJ-370A/M RADAR SET CONSOLE

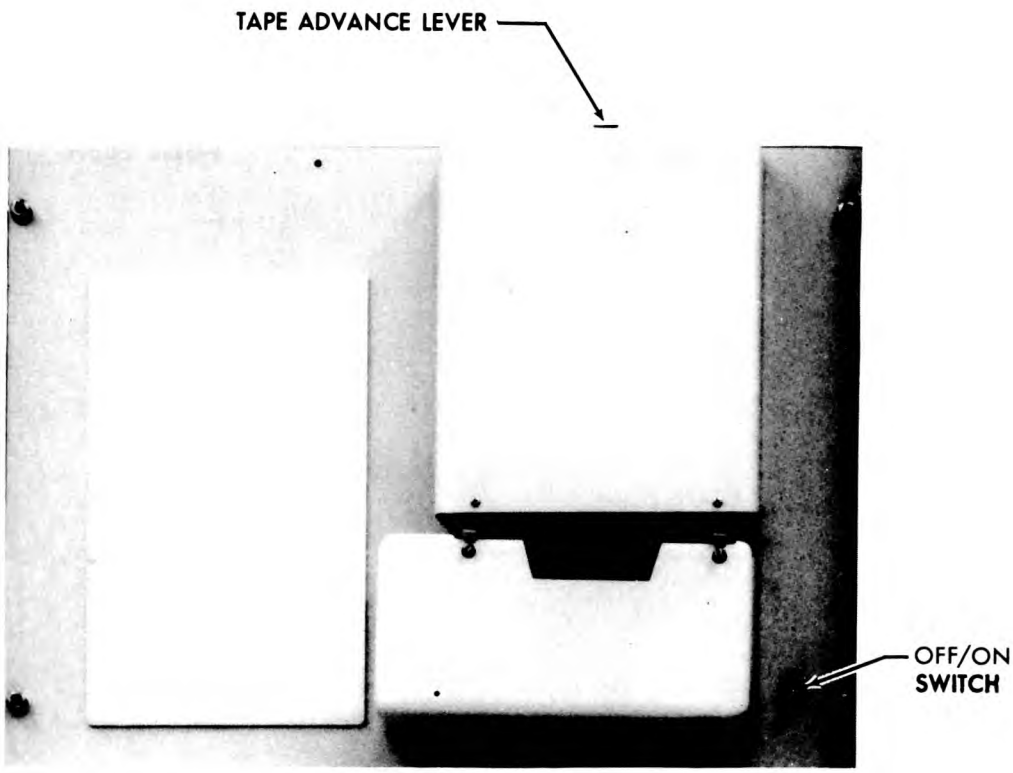
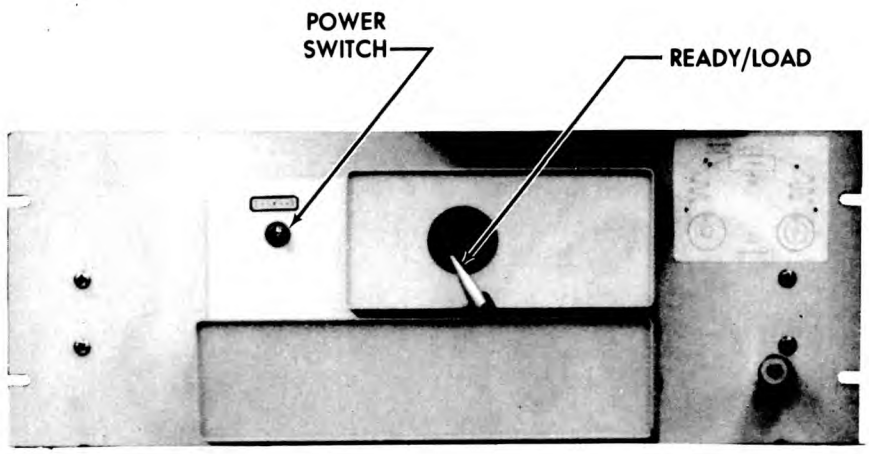


Figure 2-22. High Speed Tape Punch 1A8A1

Table 2-22. High Speed Tape Punch 1A8A1 Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
OFF/ON Switch	D2Z1F	Controls application of power to tape punch
TAPE ADVANCE Lever		Advances tape through the punch



0095-121

Figure 2-23. Tape Reader 1A8A2

Table 2-23. Tape Reader 1A8A2 Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
POWER ON/OFF Switch	S1	Controls application of power to tape reader
Ready/Load Switch	S2	Deenergize reader punch roller and brake solenoids to permit loading or changing of tape without removing AC power

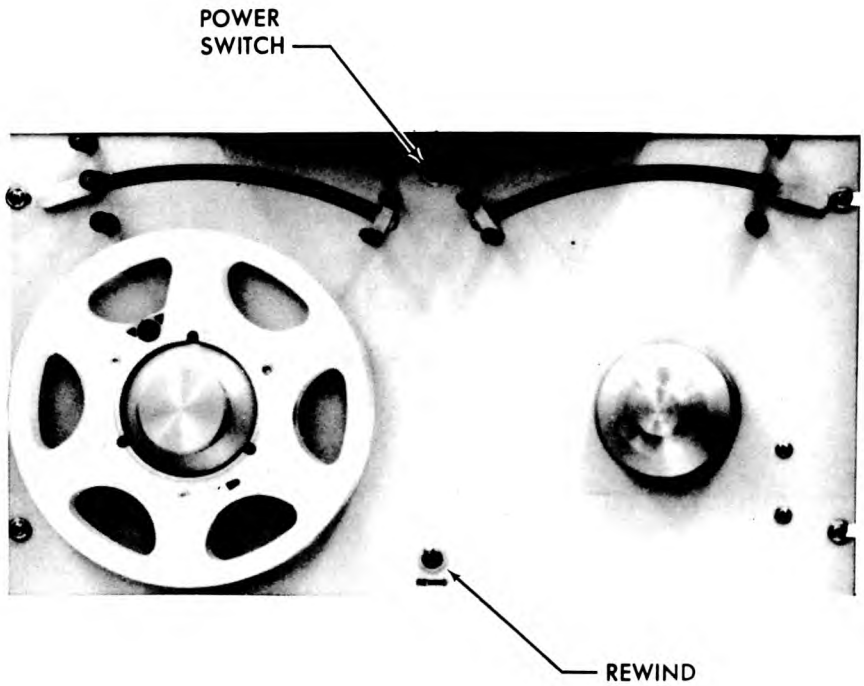
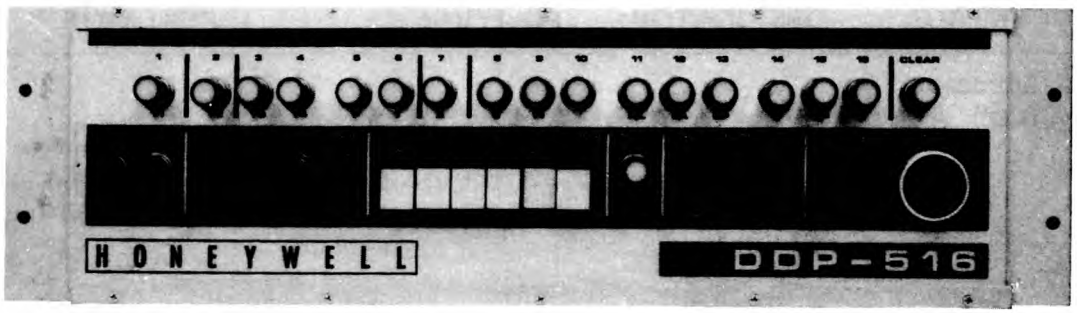


Figure 2-24. Spooler 1A8A3

Table 2-24. Spooler 1A8A3 Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
POWER ON/OFF Switch		Controls application of power to tape spooler
REWIND Switch		Initiates rewind of tape



0095-123

Figure 2-25. Control Panel 1A8A4

Table 2-25. Control Panel 1A8A4 Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR	POSITION	FUNCTION
Indicator Switches 1 through 16* (Clear)	Z1X1B, Z1X1D thru Z1X1H, Z1X1J thru Z1X1L, Z1X1N, Z1X1P thru Z1X1U		Display contents of selected register and allow operator to alter contents of certain selected registers. A binary ONE is indicated when indicator lights
CLEAR Indicator Switch (Clear)	Z1X1A		Clears selected display register (A, B, P/Y, or M only
POWER ON Indicator Switch (Red)	Z1X2V		Applies power to main frame and lights when power is applied
POWER OFF Indicator Switch (Green)	Z1X2U		Removes power from main frame

*Bits 1 through 4 (T1 through T4) signify timing level, 1 through 4; bits 5, 6 and 7 (F, I and A) represent the fetch, indirect and execute cycles; bit 8 (c) is the C-bit; bit 9 (P1) signifies permit interrupt; bit 13 (DP) indicates double precision; bits 10 and 14 are unassigned; bits 11, 12, 15 and 16 are unused.

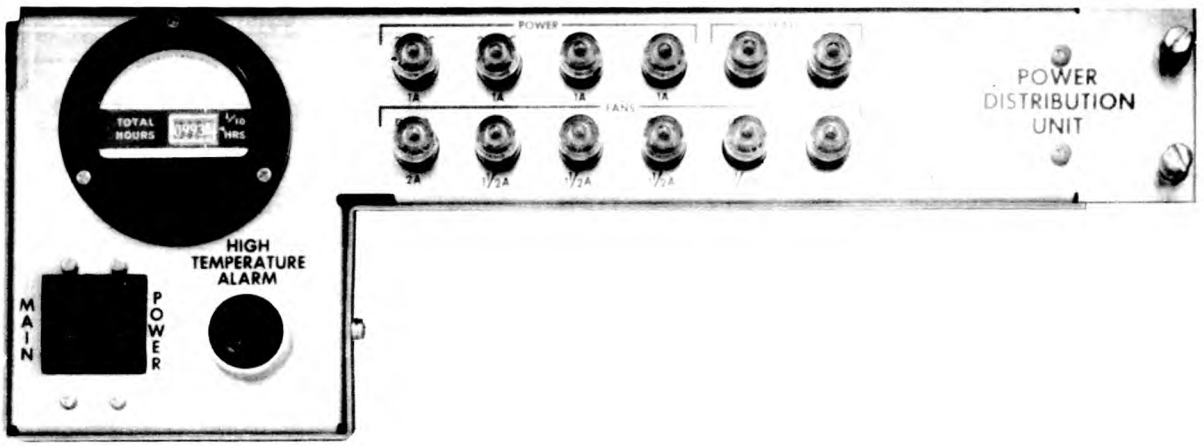
Table 2-25. Control Panel 1A8A4 Controls and Indicators (Continued)

NAME OF CONTROL	REFERENCE DESIGNATOR	POSITION	FUNCTION
REGISTER Indicator Switches (Clear)			
X	Z1X2P		Displays contents of index register; data can be entered into register X by means of location 000008
A	Z1X2N		Displays and permits alteration of contents of register A
B	Z1X2M		Displays and permits alteration of contents of register B
OP	Z1X2L		Displays state of key flip-flops in the system
P/Y	Z1X2K		Displays and permits alterations of contents of P and Y registers. (Registers P and Y contain the same address when the computer is in the memory access (MA) mode. Register P contains an address which is one higher than that contained in register Y when the computer is in the single instruction (SI) or run modes)
M	Z1X2J		Displays and permits alterations of contents and register M
MSTR CLEAR, INDICATORS Switch (Clear)	Z1X2H		Clears registers A, B, P, Y and M; sets all timing to that state existing following a halt; initializes standard peripheral devices and options. Clears data lines from interface.
START INDICATOR Switch (Green)	Z1X2A		Starts machine in all modes; indicator lights when machine in run mode
SENSE Switches			Enables change in course of a program via switch interrogation during program operation; uses depend on mode of operation. (Reference paragraphs 2-49 and 2-50.) Switches set in up position and reset in down position
1	Z1X2T		
2	Z1X2S		
3	Z1X2R		
4	Z1X2Q		

Table 2-25. Control Panel 1A8A4 Controls and Indicators (Continued)

NAME OF CONTROL	REFERENCE DESIGNATOR	POSITION	FUNCTION
PFI/PFH Switch (Power Fail Interrupt/Power Fail Halt)	Z1X2G	PFI	Enables machine to interrupt program when power fails
		PFH	Allows machine to halt when power fails
STORE/FETCH Switch	Z1X2F	STORE	Enables data to be written into memory when computer is in MA mode
		FETCH	Enables data to be read out of memory when computer is in MA mode
P/P+1 Switch	Z1X2E	P	Enables access to specific memory location when computer is in MA mode
MA/SI/RUN Switch**	Z1X2C	MA (Memory) Access Mode)	Enables data to be written into or read from a location in memory and disables protection for location 1-178
		SI (Single Instruction Mode)	Enables step-by-step execution of a program and control panel switches
		RUN (Run Mode)	Enables normal operating mode

**Switch shall be in SI or MA to enable master clear, data clear, or manual insertion of data into the registers.

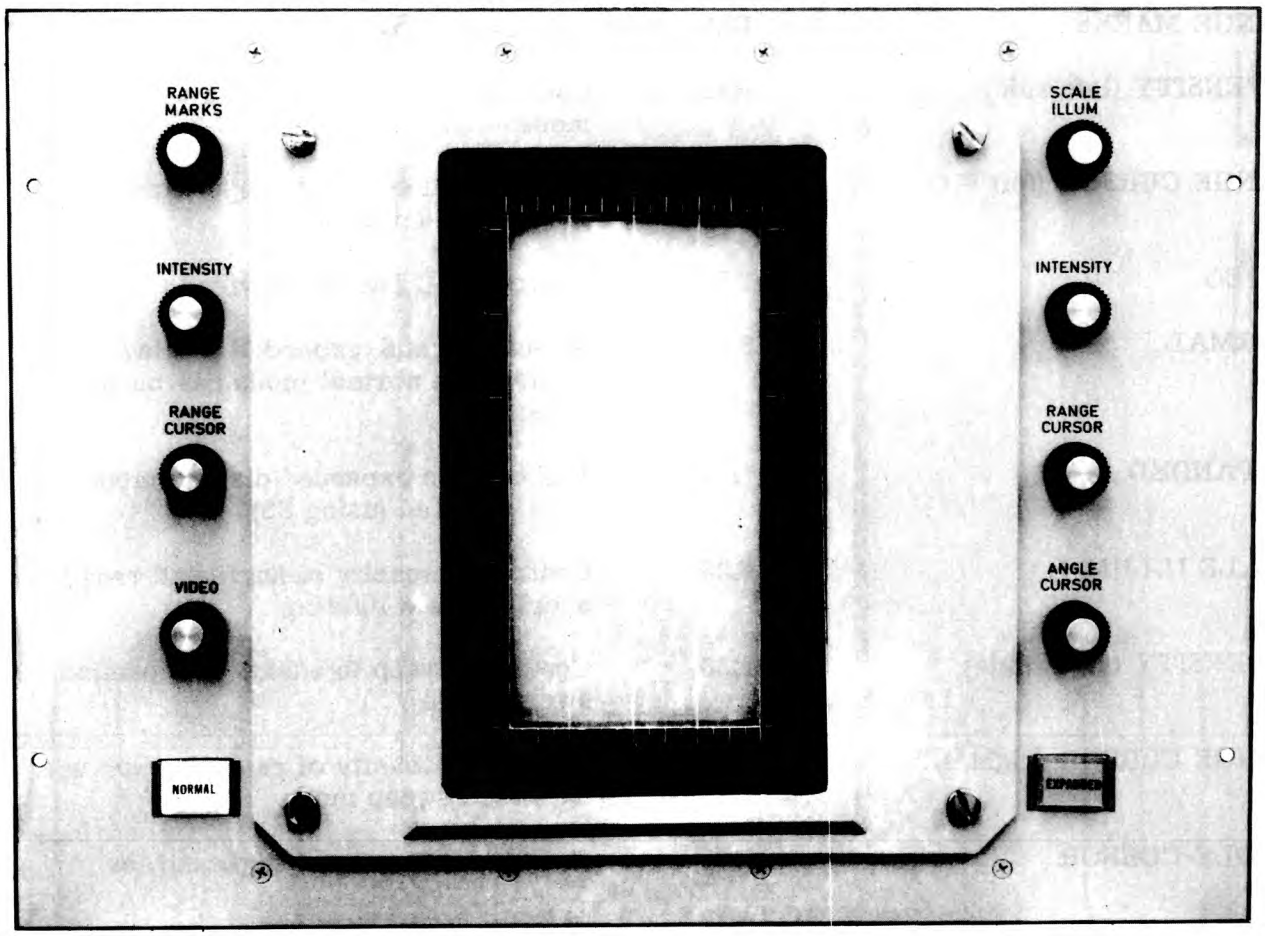


0095-124

Figure 2-26. Power Distribution Unit 1A8A10

Table 2-26. Power Distribution Unit 1A8A10 Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
MAIN POWER Circuit Breaker	A25F1	Applies primary power to computer System
HIGH TEMPERATURE ALARM Horn		Sounds overtemperature warning
TOTAL HOURS Meter	A25A3	Reflects total operating hours of system

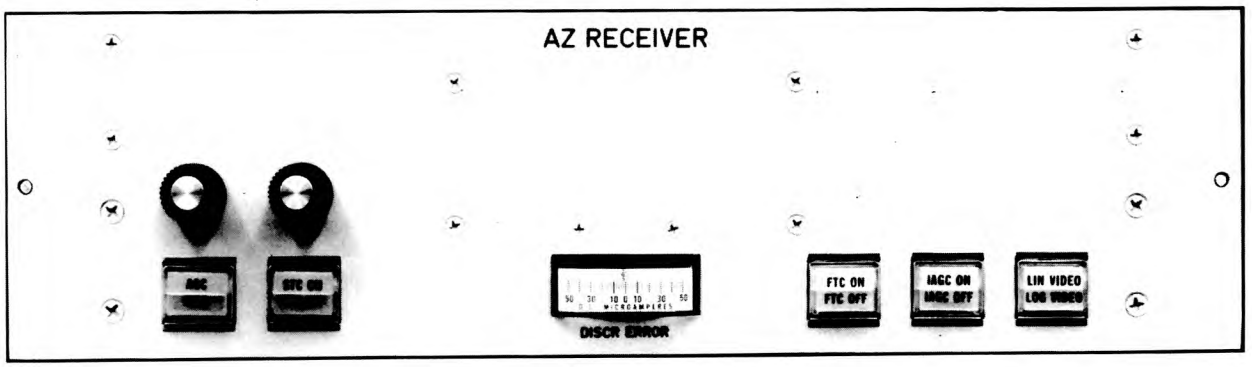


0095-125

Figure 2-27. S- and C-Band Manual Tracker Azimuth 1A11A2, Range 1A11A6 and Elevation 1A11A12 Indicators

Table 2-27. S- and C-Band Manual Tracker Azimuth 1A11A2, Range 1A11A6 and Elevation 1A11A12 Indicators Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
RANGE MARKS	R29	Not used
INTENSITY (left side)	R32	Controls sweep intensity in normal sweep mode
RANGE CURSOR (left side)	R30	Controls intensity of range cursor in normal sweep mode
VIDEO	R31	Controls gain of target video
NORMAL	S3	Selects normal/expanded display mode; lights when normal mode has been selected
EXPANDED	DS1	Lights when expanded display mode has been selected (using S3)
SCALE ILLUM	R33	Controls intensity of angle and range overlay scale lighting
INTENSITY (right side)	R36	Controls sweep intensity in expanded sweep mode
RANGE CURSOR (right side)	R34	Controls intensity of range cursor in expanded sweep mode
ANGLE CURSOR	R35	Controls intensity of angle cursor



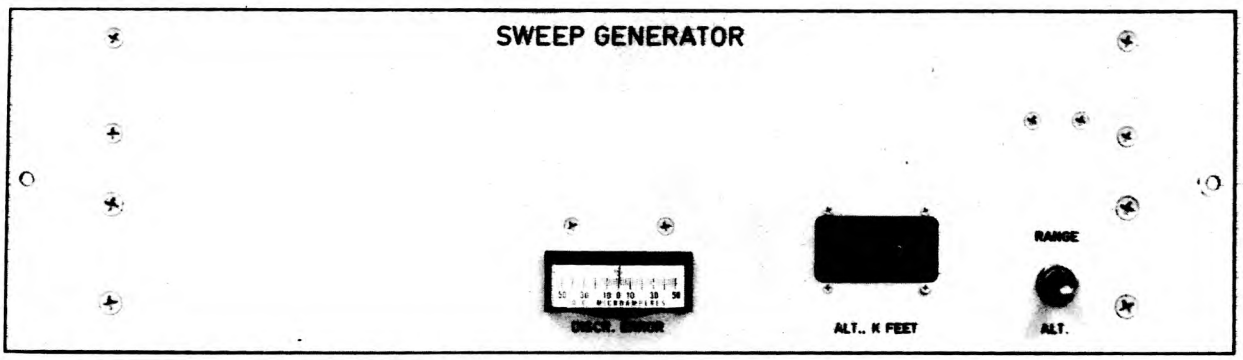
0095-126

Figure 2-28. Azimuth Receiver 1A11A1

Table 2-28. Azimuth Receiver 1A11A1 Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
Manual Gain Control (above AGC/MGC Switch)	R1	Adjusts manual gain when manual gain is selected on S3
AGC/MGC Switch	S3	Selects either automatic or manual gain control
Manual STC Control (above STC switch)	R2	Adjusts sensitivity time control when S5 is ON
STC ON/STC OFF Switch	S5	Selects sensitivity time control
DISCR ERROR Meter	M1	Indicates discriminator error of selected azimuth angle track loop
FTC ON/FTC OFF Switch	S4	Selects fast time constant
IAGC ON/IAGC OFF Switch	S1	Selects instantaneous automatic gain control
LIN VIDEO/LOG VIDEO	S2	Selects either linear or logarithmic video for input to presentation group

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS, RADAR TRAINING SET AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1 FOR TABLE 2-29 AND FIGURE 2-29



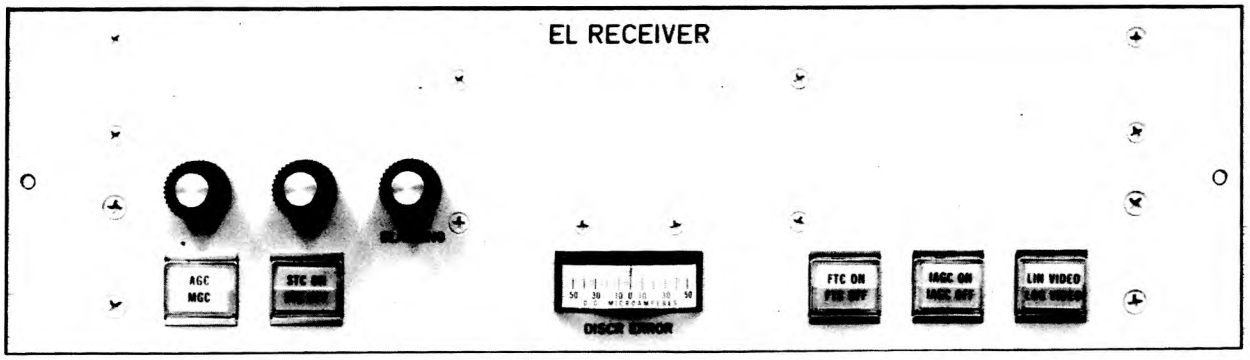
0095-128

Figure 2-30. Sweep Generator 1A11A5

Table 2-30. Sweep Generator 1A11A5 Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
DISCR. ERROR Meter	M1	Indicates discriminator error in target range track loop
ALT., K. FEET Thumbwheel Switches	S2, S3 and S4	Supplies target altitude to computer when S1 is in ALT position
RANGE/ALT. Switch	S1	Selects source of target range information to computer: i.e., target range calculated from ALT., K. FEET switches and elevation angle of pedestal (S1 in ALT position), or tracked range calculated from target range track loop (S1 in RANGE position)

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS, RADAR TRAINING SET, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1 FOR TABLE 2-31 AND FIGURE 2-31.



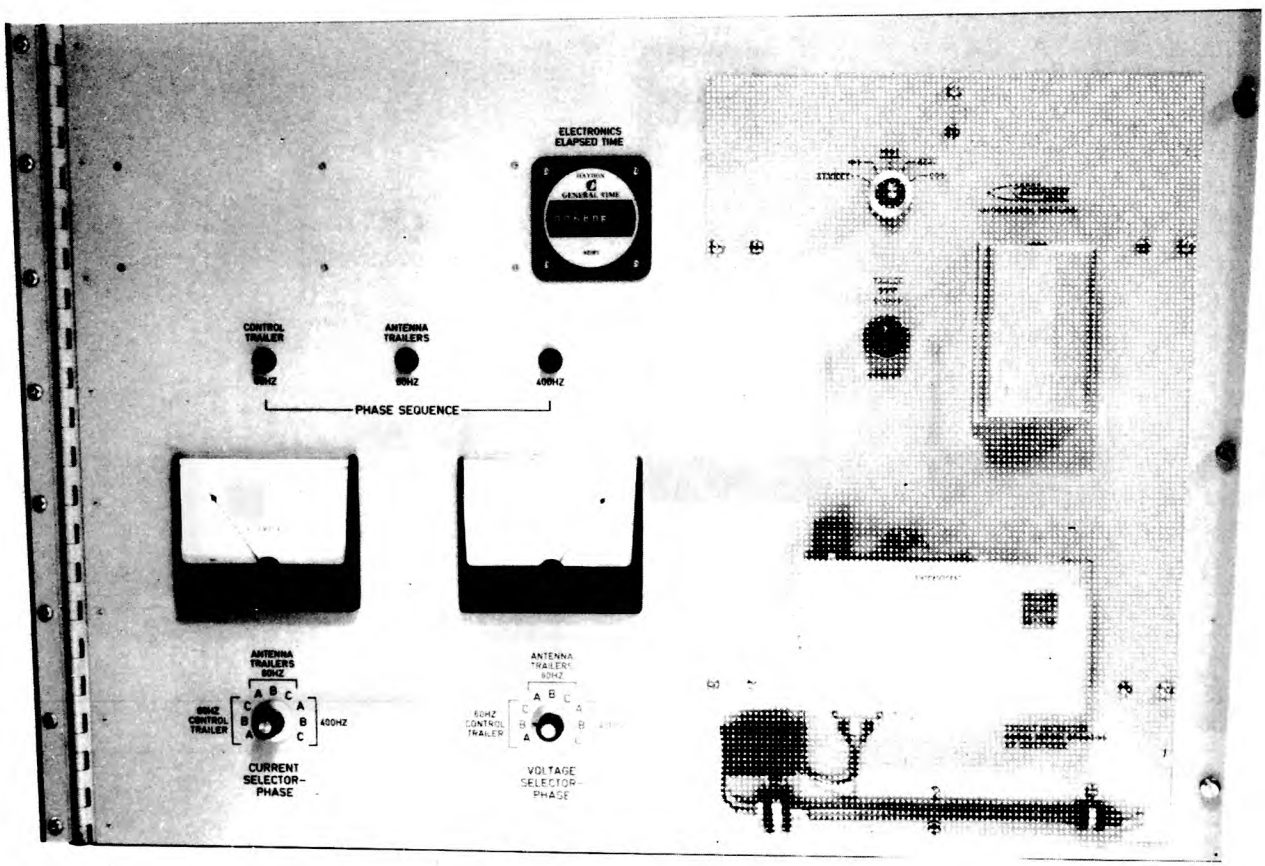
0095-130

Figure 2-32. Elevation Receiver 1A11A11

Table 2-32. Elevation Receiver 1A11A11
Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
Manual Gain Control (above AGC/MGC Switch)	R1	Adjusts manual gain when manual gain is selected on S3
AGC/MGC Switch	S3	Selects either automatic or manual gain control
Manual STC Control (above STC Switch)	R2	Adjusts sensitivity time control when S5 is ON
STC ON/STC OFF	S5	Selects sensitivity time control
BLANKING Control	R3	Adjusts blanking of receiver group
DISCR ERROR Meter	M1	Indicates discriminator error of target angle track loop
FTC ON/FTC OFF Switch	S4	Selects fast time constant
IAGC ON/IAGC OFF Switch	S1	Selects instantaneous automatic gain control
LIN VIDEO/LOG VIDEO	S2	Selects either linear or logarithmic video for input to presentation group

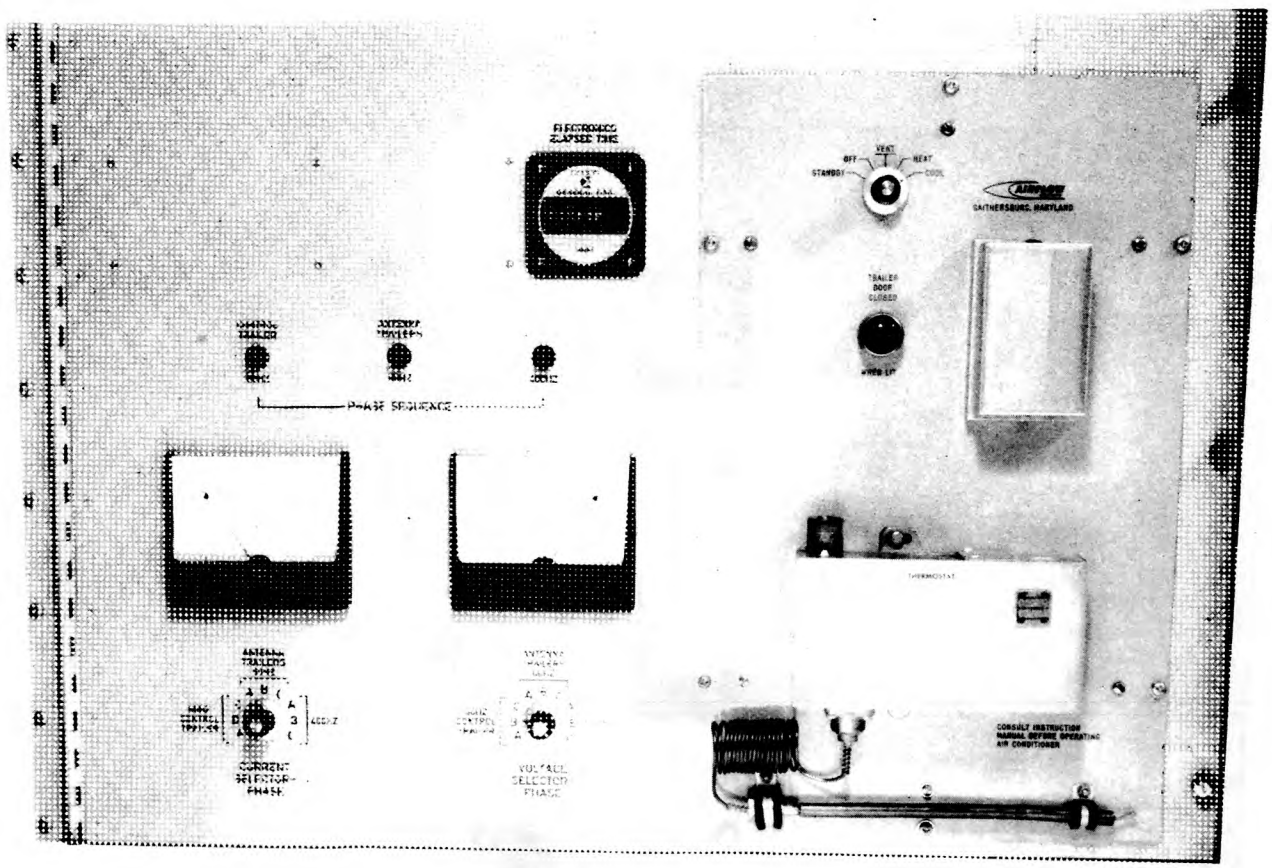
SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS, RADAR TRAINING SET AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1 FOR TABLE 2-33 AND FIGURE 2-33



INPUT POWER MONITOR

0095-132

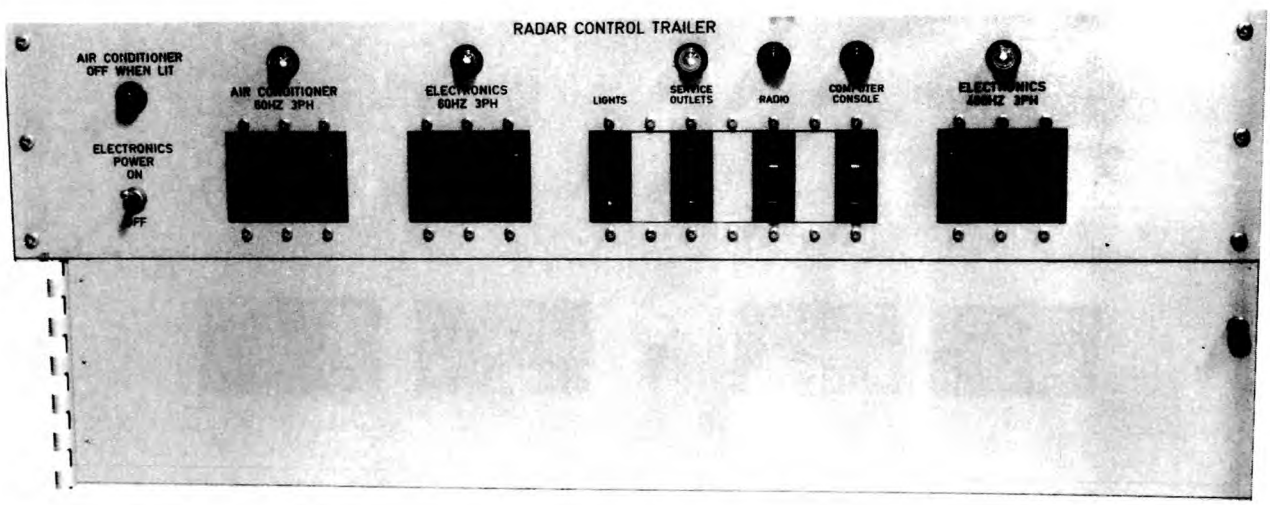
Figure 2-34. Power Distribution Console 1A12 (Sheet 1)



AIR CONDITIONER CONTROL PANEL

0095-138

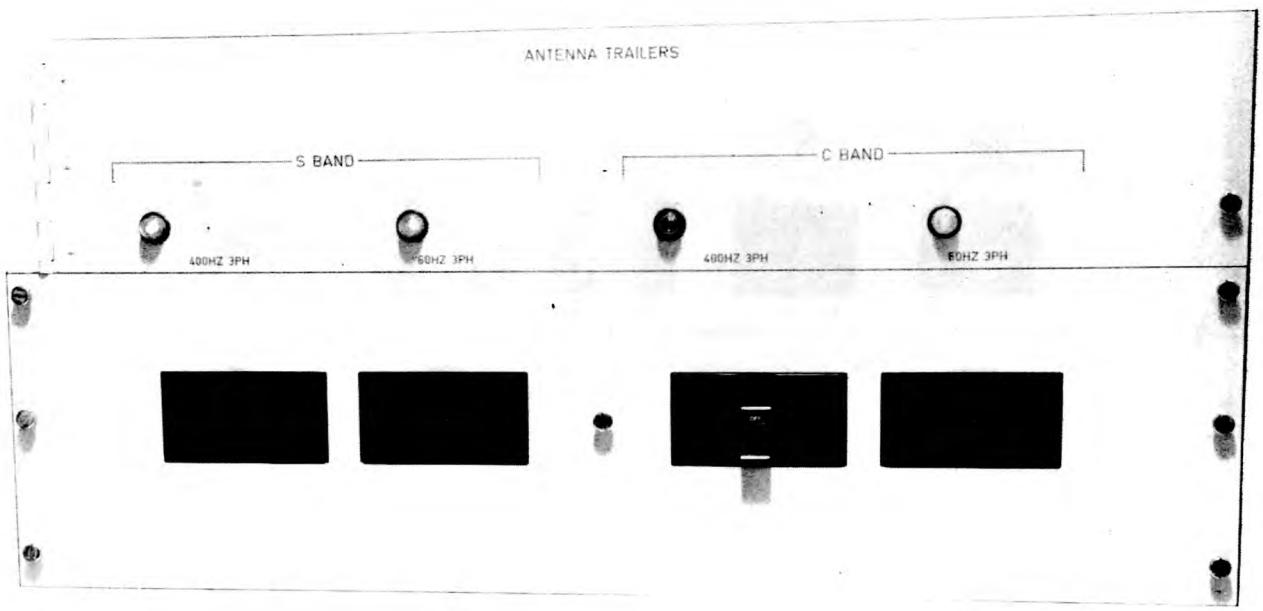
Figure 2-34. Power Distribution Console 1A12 (Sheet 2)



RADAR CONTROL TRAILER PANEL

0095-134

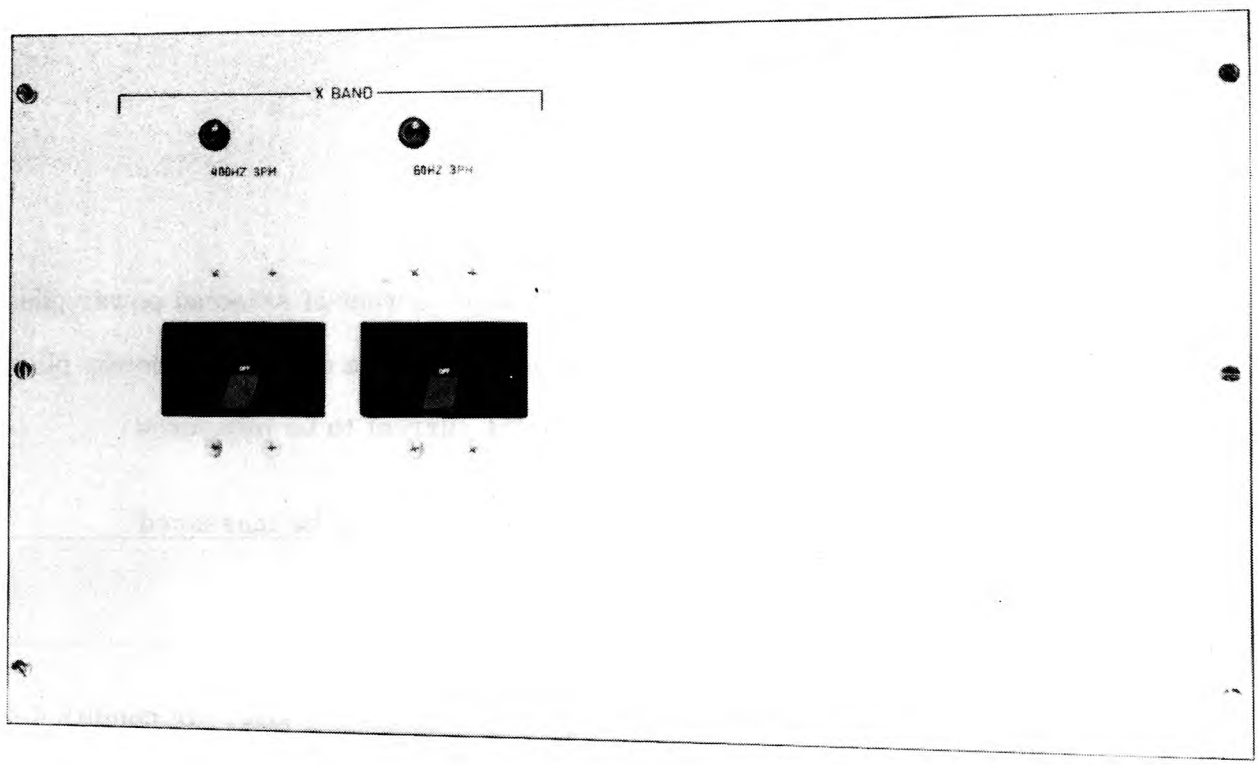
Figure 2-34. Power Distribution Console 1A12 (Sheet 3)



S- AND C-BAND ANTENNA TRAILER POWER PANEL

0095-135

Figure 2-34. Power Distribution Console 1A12 (Sheet 4)



X-BAND ANTENNA TRAILER POWER PANEL

0095-136

Figure 2-34. Power Distribution Console 1A12 (Sheet 5)

Table 2-34. Power Distribution Console 1A12
Controls and Indicators

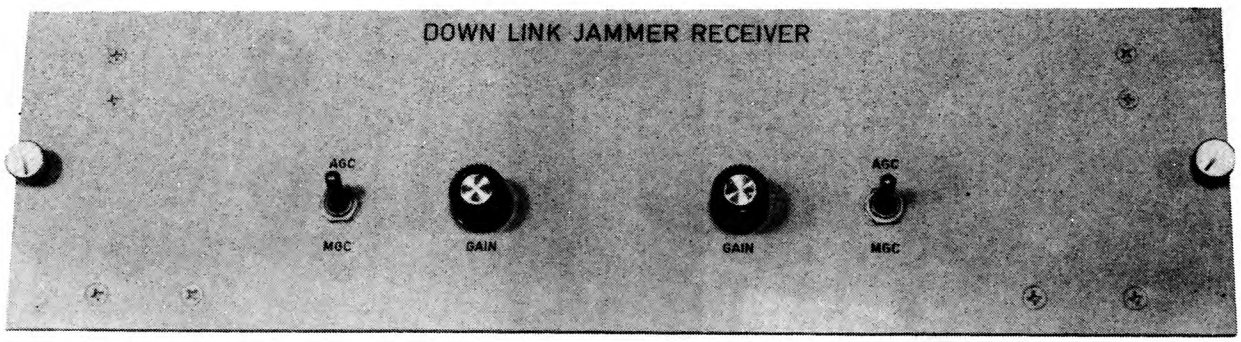
NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
INPUT POWER MONITOR		
ELECTRONICS ELAPSED TIME Meter	M3	Records operating time of radar set
PHASE SEQUENCE Indicator (Red)		Lights to indicate improper phase sequence of respective input power
CONTROL TRAILER 60HZ	DS12	
ANTENNA TRAILERS		
60HZ	DS13	
400HZ	DS14	
AC AMPERES Meter	M2	Indicates current of selected power phase
AC VOLTS Meter	M1	Indicates voltage of selected power phase
CURRENT SELECTOR-PHASE Switch	S3	Selects current to be measured
VOLTAGE SELECTOR-PHASE Switch	S2	Selects voltage to be measured
AIR CONDITIONER CONTROL Selector Switch	S5	Selects desired mode
TRAILER DOOR CLOSED WHEN LIT Indicator (Red)	DS1	Lights to indicate trailer air conditioner doors are closed
Humidistat Control	S7	Adjusts humidity
THERMOSTAT Control	S6	Adjusts temperature
RADAR CONTROL TRAILER POWER PANEL		
AIR CONDITIONER OFF WHEN LIT Indicator (Red)	DS11	Lights when air conditioning unit is off
ELECTRONICS POWER Switch	S1	Switches power (400 and 60 Hertz) to electronic equipment in the radar control trailer

Table 2-34. Power Distribution Console 1A12
Controls and Indicators (Continued)

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
AIR CONDITIONER 60HZ 3PH Circuit Breaker	CB3	Applies 60 Hertz, 3-phase power to air conditioner
Indicator (Amber)	DS3	Lights when CB3 is on
ELECTRONICS 60HZ 3PH Circuit Breaker	CB1	Applies 60 Hertz, 3-phase power to radar control trailer electronics
Indicator (Amber)	DS1	Lights when CB1 is on
LIGHTS Circuit Breaker	CB11	Applies power for radar control trailer lighting
SERVICE OUTLETS Circuit Breaker	CB2	Applies power for radar control trailer service outlets
Indicator (Amber)	DS2	Lights when CB2 is on
RADIO Circuit Breaker	CB9	Applies power to communications equipment
Indicator (Amber)	DS9	Lights when CB9 is on
COMPUTER CONSOLE Circuit Breaker	CB10	Applies power for computer console
Indicator (Amber)	DS10	Lights when CB10 is on
ELECTRONICS 400HZ 3PH Circuit Breaker	CB6	Applies 400 Hertz, 3-phase power to radar control trailer electronics
Indicator (Amber)	DS6	Lights when CB6 is on
S- AND C-BAND ANTENNA TRAILER POWER Indicator (Amber)		Lights to indicate corresponding power is applied

Table 2-34. Power Distribution Console 1A12
Controls and Indicators (Continued)

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
S-BAND		
400HZ 3PH	DS8	
60HZ 3PH	DS5	
C-BAND		
400HZ 3PH	DS7	
60HZ 3PH	DS4	
Circuit Breakers		Applies corresponding power to S-band and C-band antenna trailer electronics
S-BAND		
400HZ 3PH	CB8	
60HZ 3PH	CB5	
C-BAND		
400HZ 3PH	CB7	
60HZ 3PH	CB4	
X-BAND ANTENNA TRAILER POWER PANEL		
Indicator (Amber)		
400HZ 3PH	DS15	Lights to indicate that 400 Hertz power is applied to X-band antenna trailer
60HZ 3PH	DS16	Lights to indicate that 60 Hertz power is applied to X-band antenna trailer
Circuit Breakers		
400 HZ 3PH	CB12	Applies 400 Hertz 3-phase input power to X-band antenna trailer
60HZ 3PH	CB13	Applies 60 Hertz 3-phase input power to X-band antenna trailer

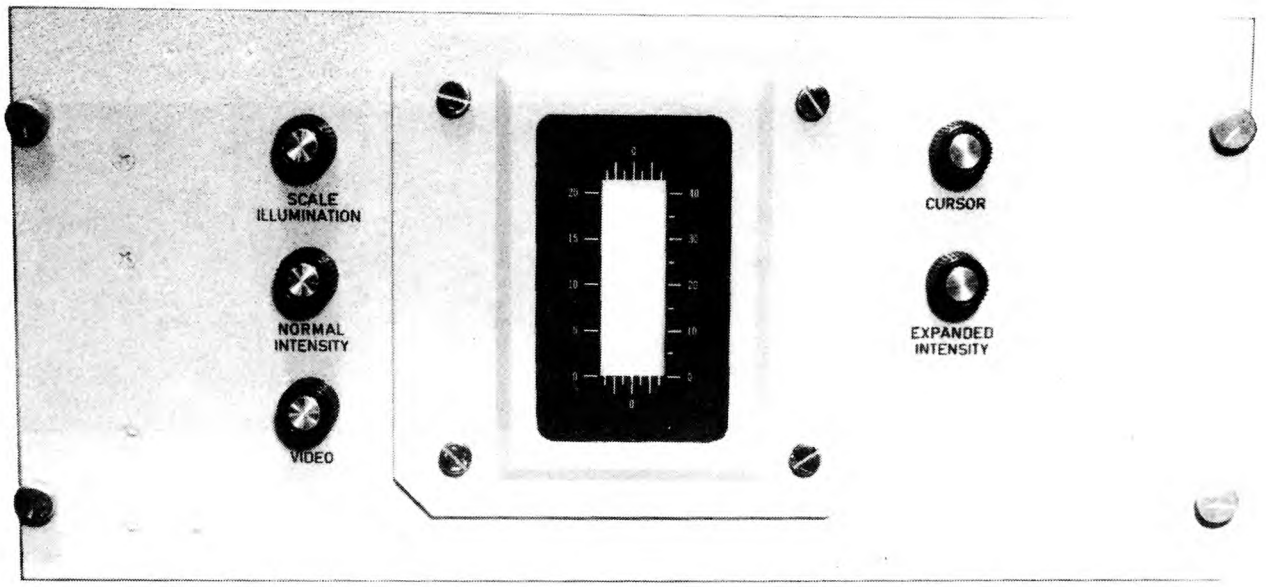


0095-137

Figure 2-35. Down Link Jammer Receiver 1A17A10

Table 2-35. Down Link Jammer Receiver 1A17A10 Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
AGC/MGC Switch (To left of observer)	S2	Enables selection of automatic or manual gain control of selected azimuth/T1 down link jammer radar receiver
GAIN Control (To left of observer)	R2	Controls manual gain level of selected azimuth/T1 video when AGC/MGC Switch (S2) is in MGC position
AGC/MGC Switch (To right of observer)	S1	Enables selection of either automatic or manual gain control of elevation/T2 down link jammer radar receiver
GAIN Control (To right of observer)	R1	Controls manual gain level of selected elevation/T2 video when AGC/MGC switch (S1) is in MGC position



0095-138

Figure 2-36. T1 and T2 Indicators 1A17A11, 1A17A17

Table 2-36. T1 and T2 Indicators 1A17A11 and 1A17A17

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
SCALE ILLUMINATION Control	R29	Controls intensity of angle and range overlay scale lighting
NORMAL INTENSITY Control	R30	Controls raster intensity during normal operation of B-scope
VIDEO Control	R43	Controls gain of T1 or T2 video
CURSOR Control	R31	Controls intensity of angle cursors
EXPANDED INTENSITY Control	R32	Controls raster intensity during expanded range operation of B-scope

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS, RADAR TRAINING SET, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1 FOR TABLE 2-37 AND FIGURE 2-37

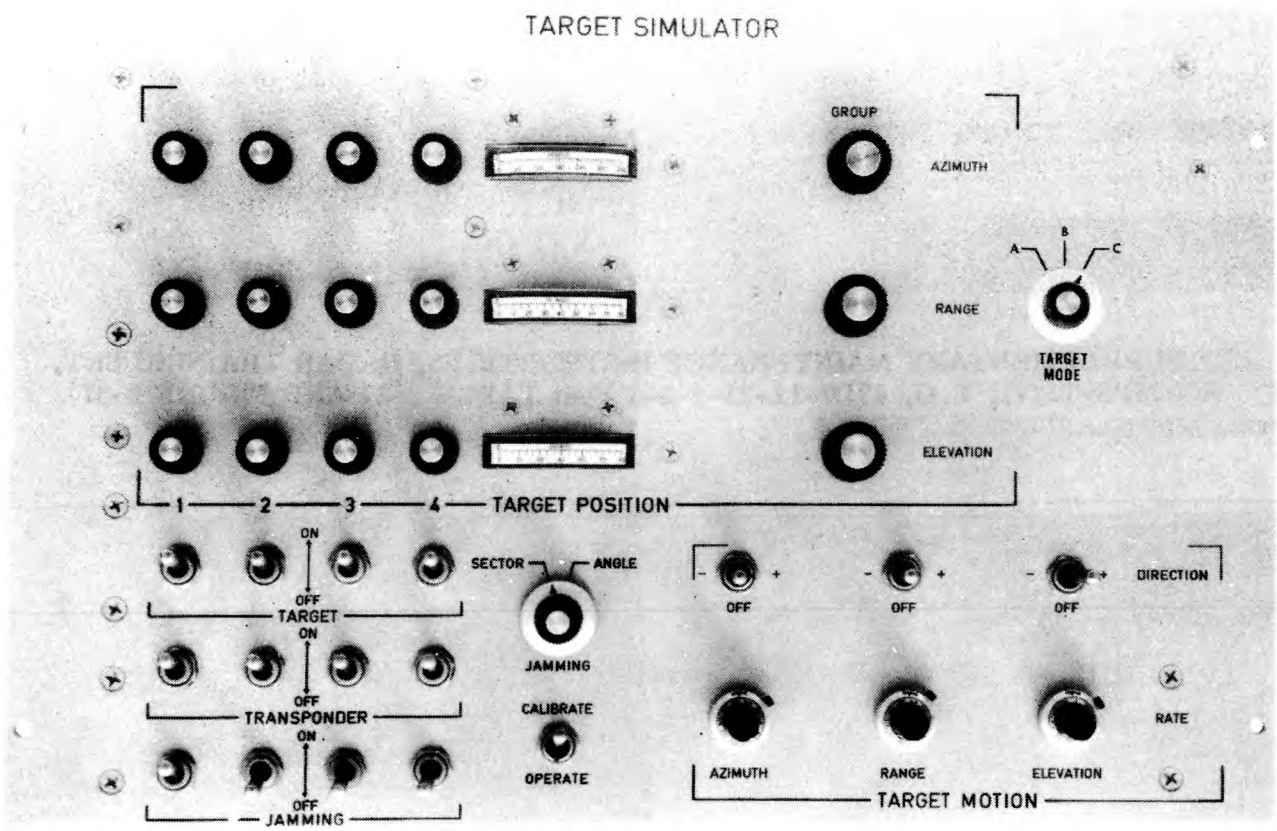


Figure 2-38. Target Simulator 1Á17A16

Table 2-38. Target Simulator 1A17A16
Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
TARGET POSITION		
AZIMUTH		
1 Control	R1	Varies azimuth position of simulated target No. 1 from position selected using R13
2 Control	R2	Varies azimuth position of simulated target No. 2 from position selected using R13
3 Control	R3	Varies azimuth position of simulated target No. 3 from position selected using R13
4 Control	R4	Varies azimuth position of simulated target No. 4 from position selected using R13
Meter	M1	Shows simulated target group azimuth position
GROUP Control	R13	Adjusts azimuth position for group of four simulated targets
RANGE		
1 Control	R5	Varies range position of simulated target No. 1 from position selected using R14
2 Control	R6	Varies range position of simulated target No. 2 from position selected using R14
3 Control	R7	Varies range position of simulated target No. 3 from position selected using R14
4 Control	R8	Varies range position of simulated target No. 4 from position selected using R14
Meter	M2	Shows simulated target group range position
GROUP Control	R14	Selects range position for group of four simulated targets

Table 2-38. Target Simulator 1A17A16
Controls and Indicators (Continued)

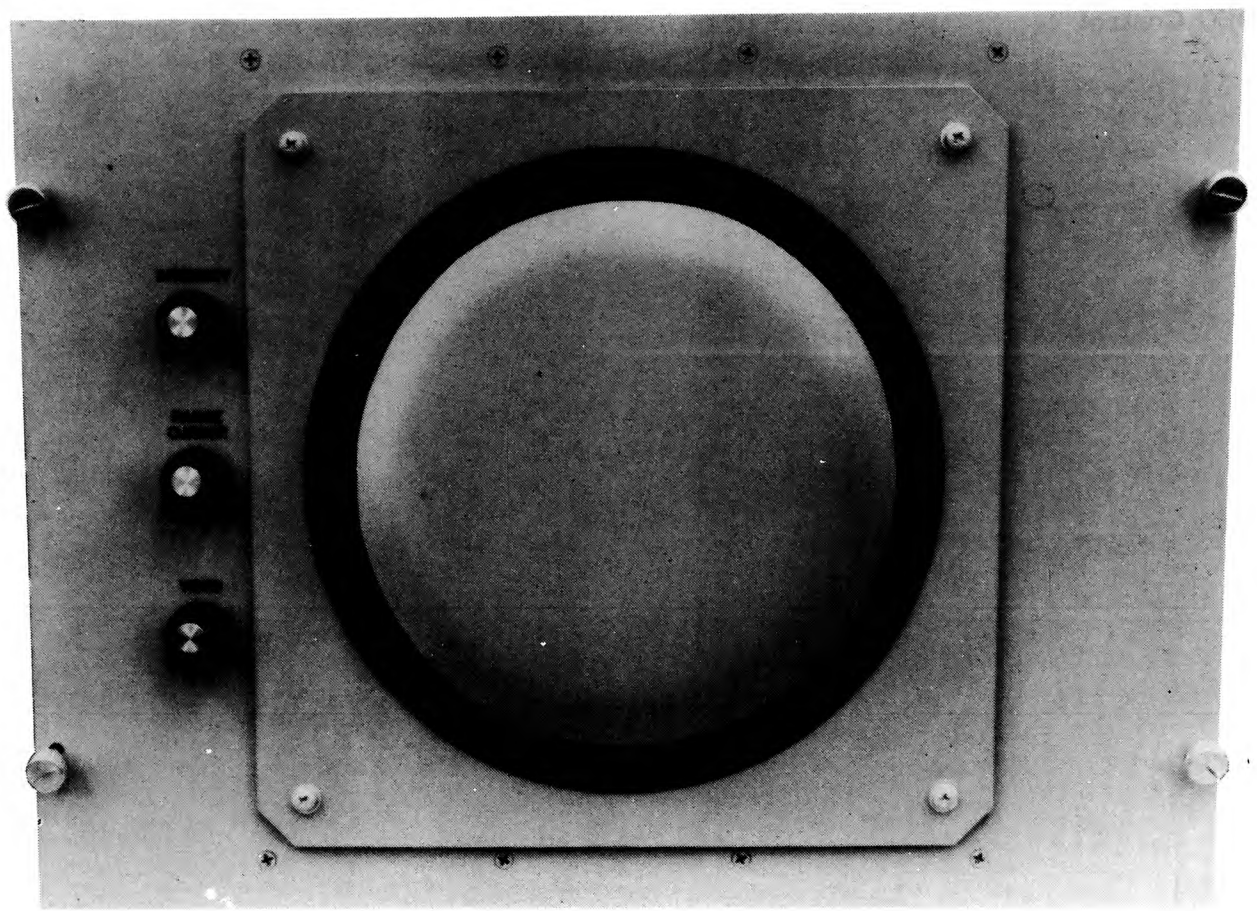
NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
ELEVATION		
1 Control	R9	Varies elevation position of simulated target Number 1 from position selected using R15
2 Control	R10	Varies elevation position of simulated target Number 2 from position selected using R15
3 Control	R11	Varies elevation position of simulated target Number 3 from position selected using R15
4 Control	R12	Varies elevation position of simulated target Number 4 from position selected using R15
Meter	M3	Shows simulated target group elevation position
GROUP Control	R15	Controls elevation position for group of four simulated targets
TARGET ON/OFF		
1 Switch	S1	Controls simulated IF which is fed to the azimuth and elevation receivers to provide signals representing target No. 1 to the IF strips
2 Switch	S2	Controls simulated IF which is fed to the azimuth and elevation receivers to provide signals representing target No. 2 to the IF strips
3 Switch	S3	Controls simulated IF which is fed to the azimuth and elevation receivers to provide signals representing target No. 3 to the IF strips
4 Switch	S4	Controls simulated IF which is fed to the azimuth and elevation receivers to provide signals representing target No. 4 to the IF strips

Table 2-38. Target Simulator 1A17A16
Controls and Indicators (Continued)

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
TRANSPONDER ON/OFF		
1 Switch	S5	Controls simulated IF which is fed to the transponder tracking console to represent target No. 1 in the IF strips
2 Switch	S6	Controls simulated IF which is fed to the transponder tracking console to represent transponder No. 2 in the IF strips
3 Switch	S7	Controls simulated IF which is fed to the transponder tracking console to represent transponder No. 3 in the IF strips
4 Switch	S8	Controls simulated IF which is fed to the transponder tracking console to represent transponder No. 4 in the IF strips
JAMMING ON/OFF		
1 Switch	S9	Controls simulated electronic countermeasures which are directed against radar from target No. 1
2 Switch	S10	Controls simulated electronic countermeasures which are directed against the radar from target No. 2
3 Switch	S11	Controls simulated electronic countermeasures which are directed against the radar from target No. 3
4 Switch	S12	Controls simulated electronic countermeasures which are directed against the radar from target No. 4
JAMMING/SECTOR/ ANGLE-Switch	S14	Selects either sector- or angle-type jamming
CALIBRATE/OPERATE Switch	S13	In CALIBRATE position, feeds IF signals of target No. 1 and four transponder IF signals from transponder No. 1 channel into respective IF strips of the radar; in OPERATE position, enables normal operation

Table 2-38. Target Simulator 1A17A16
Controls and Indicators (Continued)

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
TARGET MOTION		
DIRECTION		
AZIMUTH-/OFF/+ Switch	S15	Selects direction (- for counterclockwise, OFF for no change, and + for clockwise) for rate of change in azimuth angle position (selected using R16)
RANGE-/OFF/+ Switch	S16	Selects direction (- to decrease range, OFF for no change, and + to increase range) for the rate of change in range of target group (selected using R17)
ELEVATION-/OFF/+ Switch	S17	Selects the direction (- to decrease elevation angle, OFF for no change, and + to increase elevation angle) for rate of change in elevation angle position (selected using R18)
RATE		
AZIMUTH Control	R16	Selects rate at which azimuth angle position of target group is changed
RANGE Control	R17	Selects rate at which range position of target group is changed
ELEVATION Control	R18	Selects rate at which elevation angle position of target group is changed
TARGET MODE Switch	S21	Selects one of three target modes to obtain differing false target arrangements of motion

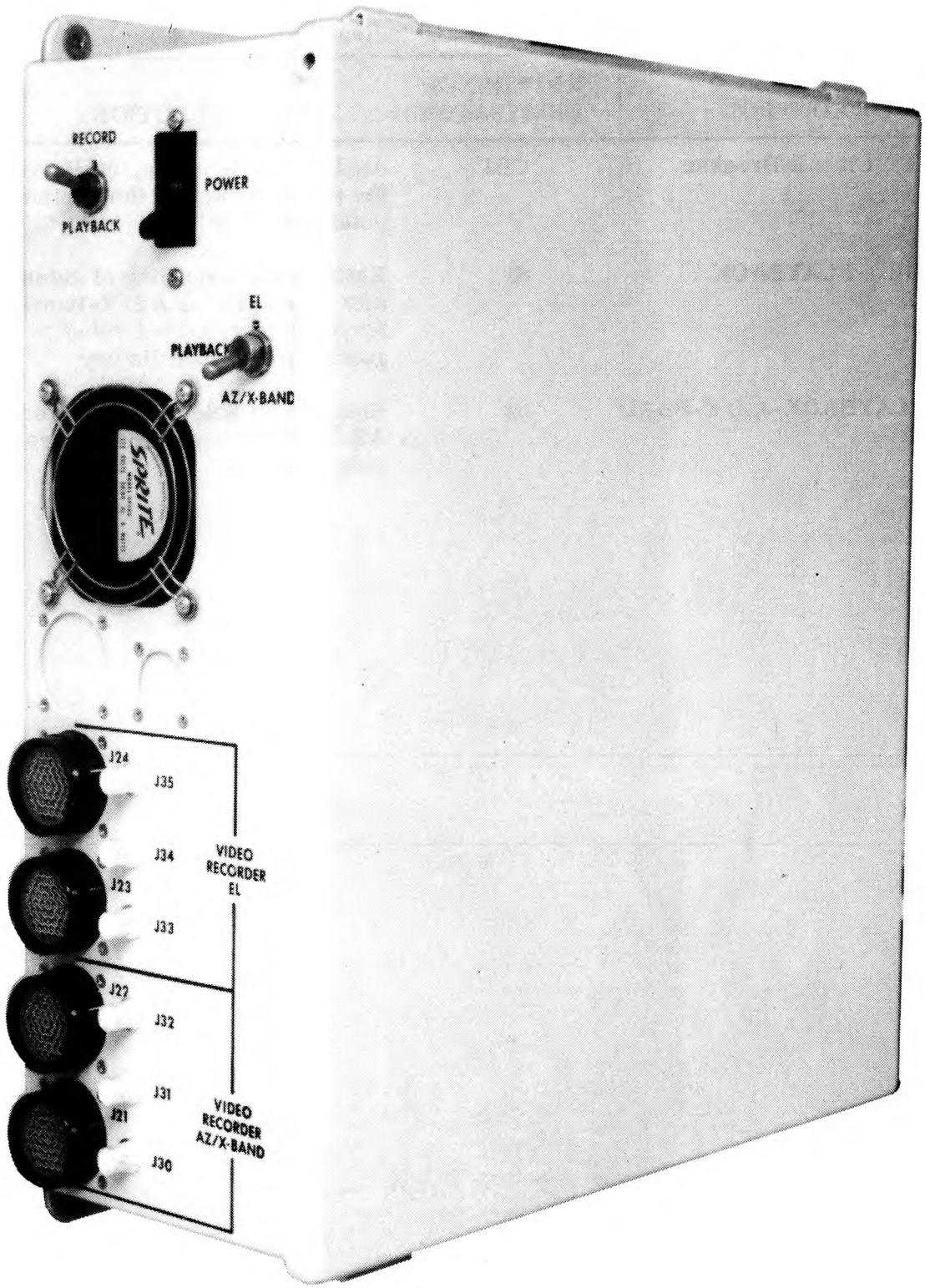


0095-141

Figure 2-39. Automatic Position Plotter Indicator 1A19A1

Table 2-39. Automatic Position Plotter Indicator 1A19A1 Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
INTENSITY Control	R32	Controls raster intensity of PPI
RANGE CURSOR Control	R29	Controls intensity of range cursors
VIDEO Control	R31	Controls amplitude of video input to video amplifier 1A19A1A4

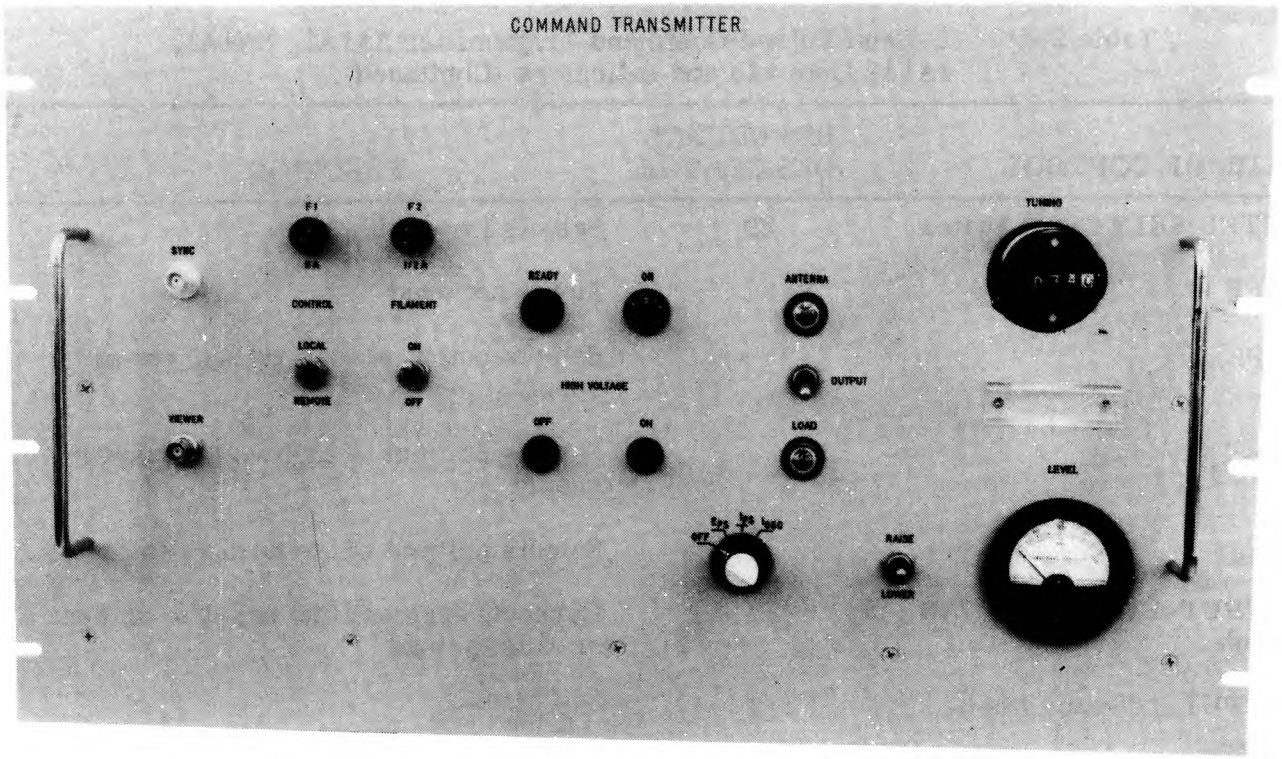


0095-499

Figure 2-40. Common Data Point Assembly 1A20

Table 2-40. Common Data Point Assembly 1A20
Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
POWER Circuit Breaker	CB1	Applies single phase, 60 Hertz power to the power supply in the common data point assembly
RECORD-PLAYBACK Switch	S1	Enables the recording of guidance operator video (EL or AZ/X-Band) or the playback of recorded video on the guidance operator display
EL-PLAYBACK-AZ/X-BAND Switch	S2	Enables the selection of either EL or AZ/X-Band video for the purpose of video playback



0095-142

Figure 2-41. L-Band Pulsed Command Transmitter 2A1A1, 3A1A1, 4A1A2

Table 2-41. L-Band Pulsed Command Transmitter 2A1A1, 3A1A1, 4A1A2 Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
CONTROL LOCAL/REMOTE Switch	S3	In local position, permits control at command transmitter panel; in remote position, transfers control to L-band transmitter control panel 1A5A7 (S- and C-Ped) or X-band transmitter control panel 1A5A27 (X-band Ped)
FILAMENT ON/OFF Switch	S2	Controls 120 volts, 60 Hertz power to filaments, blowers, and time delay circuits
HIGH VOLTAGE Indicators		
READY (Green)	DS1	Indicates protective time delays have elapsed; lights 4 minutes after FILAMENT switch is turned on
ON (Red)	DS2	Indicates high voltage on
HIGH VOLTAGE Switches		Momentary switches
OFF	S5	Removes high voltage
ON	S6	Applies high voltage

Table 2-41. L-Band Pulsed Command Transmitter 2A1A1, 3A1A1, 4A1A2 Controls and Indicators (Continued)

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
METER SELECTOR Switch	S9	Selects meter display
OFF		Meter not used
E_{PS}		Selects output of high voltage power supply
I_{PS}		Selects current of high voltage power supply
I_{OSC}		Selects current of cavity oscillator
OUTPUT ANTENNA/LOAD Switch	S1	Connects transmitter output to antenna or dummy load
OUTPUT Indicator (Red)		
ANTENNA	DS3	Lights to indicate transmitter connected to antenna
LOAD	DS4	Lights to indicate transmitter connected to dummy load
RAISE/LOWER Switch	S4	Adjusts voltage of high voltage power supply
TUNING Dial	Z1	Tunes cavity oscillator
LEVEL Meter	M1	Measures voltage or current selected by S9

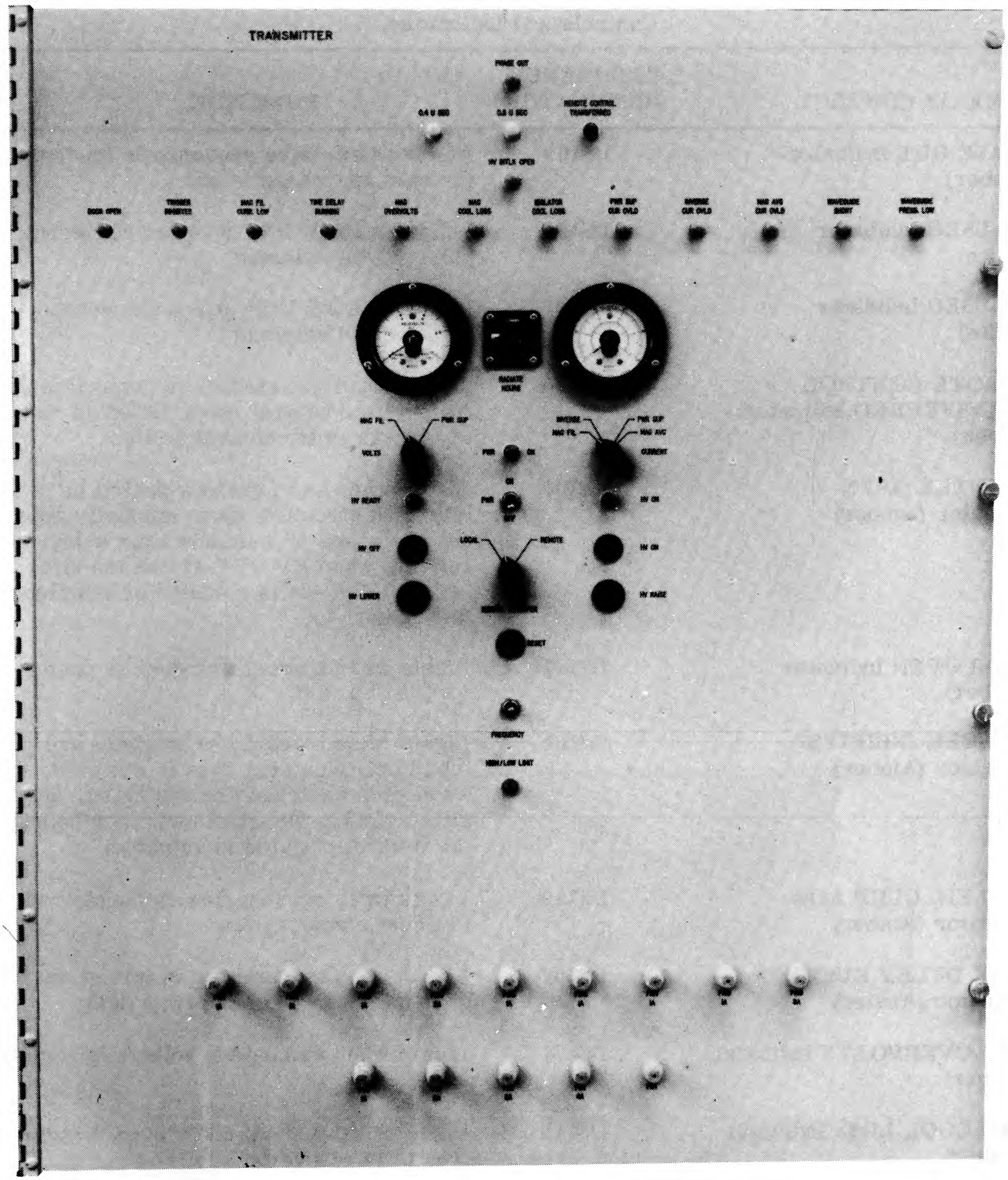


Figure 2-42. Elevation and Azimuth Transmitter 2A2, 2A7, 3A2, 3A7

Table 2-42. Elevation and Azimuth Transmitter 2A2, 2A7, 3A2, 3A7 Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
PHASE OUT Indicator (Amber)	DS109	Lights when phase sequence is incorrect or when any phase is out
0.4 USEC Indicator (White)	DS102	Indicates HIGH PRF (0.4 microsecond pulse width) selected
0.8 USEC Indicator (White)	DS101	Indicates LOW PRF (0.8 microsecond pulse width) selected
REMOTE CONTROL TRANSFERRED Indicator (Green)	DS120	Lights when transmitter is controlled at transmitter control panel 1A5A1 of radar console in radar control trailer
HV INTLK OPEN Indicator (Amber)	DS108	Lights when any interlock device in interlock circuit is open; normally goes out at the end of 8-minute time delay; relights when HV OFF switch (on this panel or 1A5A1) is actuated or interlock is opened
DOOR OPEN Indicator (Amber)	DS111	Lights when transmitter door is open
TRIGGER INHIBITED Indicator (Amber)	DS103	Lights when transmitter triggers are inhibited (when scan loss is detected, waveguide switches are switching, or either XMTR DISABLE switch on pedestal disconnect panel is actuated)
MAG FIL CURR LOW Indicator (Amber)	DS110	Lights when current flow in magnetron filament circuit is low
TIME DELAY RUNNING Indicator (Amber)	DS107	Lights when transmitter is turned on; goes out after 8-minute time delay
MAG OVERVOLTS Indicator (Amber)	DS117	Lights when magnetron voltage is excessive
MAG COOL LOSS Indicator (Amber)	DS112	Lights when cooling air across magnetron is inadequate
ISOLATOR COOL LOSS Indicator (Amber)	DS113	Lights when cooling air across isolator is inadequate
PWR SUP CUR OVLD Indicator (Amber)	DS114	Lights during current overload of high voltage power supply

Table 2-42. Elevation and Azimuth Transmitter 2A2, 2A7, 3A2, 3A7 Controls and Indicators (Continued)

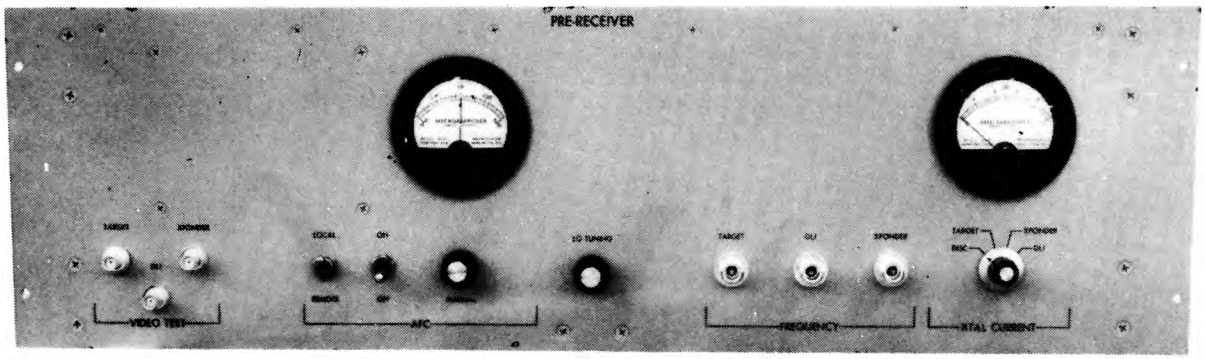
NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
INVERSE CUR OVLD Indicator (Amber)	DS115	Lights when transmitter inverse current is excessive
MAG AVG CUR OVLD Indicator (Amber)	DS116	Lights when average current through magnetron is excessive
WAVEGUIDE SHORT Indicator (Amber)	DS118	Lights when reflected power is excessive
WAVEGUIDE PRESS LOW Indicator (Amber)	DS119	Lights when air pressure in waveguide is inadequate
VOLTS Meter (Kilovolts)	M102	Indicates voltage in selected circuit
VOLTS MAG FIL/PWR SUP Selector Switch	S102	Connects either high voltage power supply output or magnetron filament voltage to M102
HV READY Indicator (Green)	DS105	Lights 8 minutes after power is applied to transmitter; goes out when high voltage power supply is removed
HV OFF Switch*	S106	Removes high voltage power supply in transmitter
HV LOWER Switch*	S108	Lowers output voltage of high voltage power supply
RADIATE HOURS Meter	M103	Indicates total operating hours of high voltage power supply
PWR ON Indicator (Green)	DS104	Lights when S104 is positioned to ON
PWR ON/OFF Switch*	S104	Applies 3-phase, 400 Hertz power to transmitter
REMOTE TRANSFER Switch	S103	Selects control point for transmitter
LOCAL		Selects transmitter front panel
REMOTE		Selects transmitter control panel 1A5A1 at radar console in radar control trailer

*These switches are effective only when S103 is positioned to LOCAL.

Table 2-42. Elevation and Azimuth Transmitter 2A2, 2A7, 3A2, 3A7 Controls and Indicators (Continued)

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
RESET Switch*	S109	Resets latching relays in transmitter interlock circuits
FREQUENCY Switch*	S118	Controls magnetron frequency tuner drive motor; in up position, increases frequency; in down position, decreases frequency
FREQUENCY HIGH/LOW LIMIT Indicator (Red)	DS121	Lights when either high or low frequency limit is reached
CURRENT Meter (Milliamps DC)	M101	Indicates average current in selected circuit
CURRENT Selector Switch	S101	Connects one of following circuits to M101:
MAG FIL		Magnetron filament
INVERSE		Inverse current
PWR SUP		High voltage power supply
MAG AVG		Magnetron plate
HV ON Indicator (Red)	DS106	Lights when the high voltage power supply is applied
HV ON Switch*	S105	Applies high voltage power
HV RAISE Switch*	S107	Raises output voltage of high voltage power supply

*These switches are effective only when S103 is positioned to LOCAL.

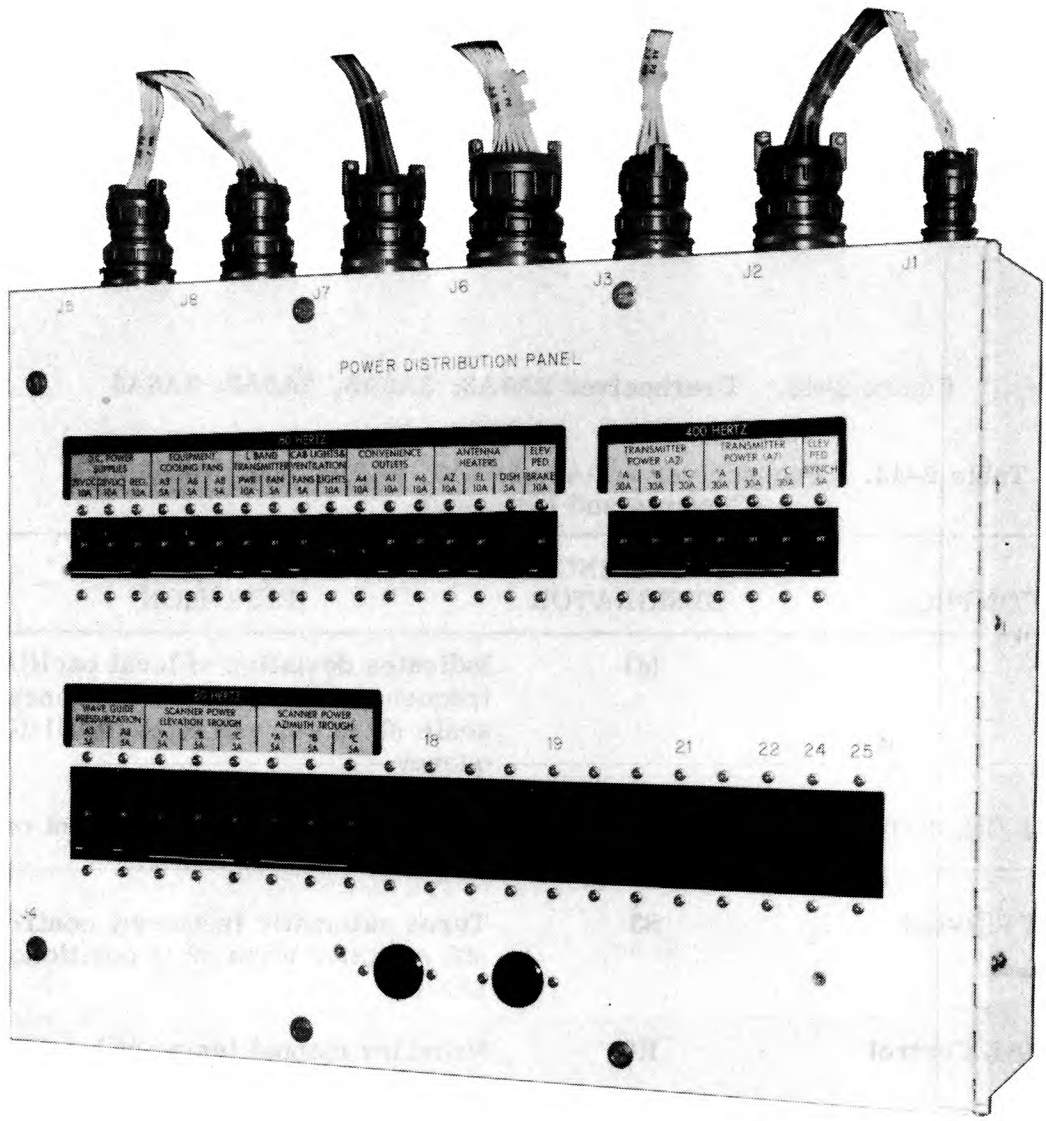


0095-144

Figure 2-43. Prereceiver 2A3A3, 3A3A3, 2A8A3, 3A8A3

Table 2-43. Prereceiver 2A3A3, 3A3A3, 2A8A3, and 3A8A3 Controls and Indicators

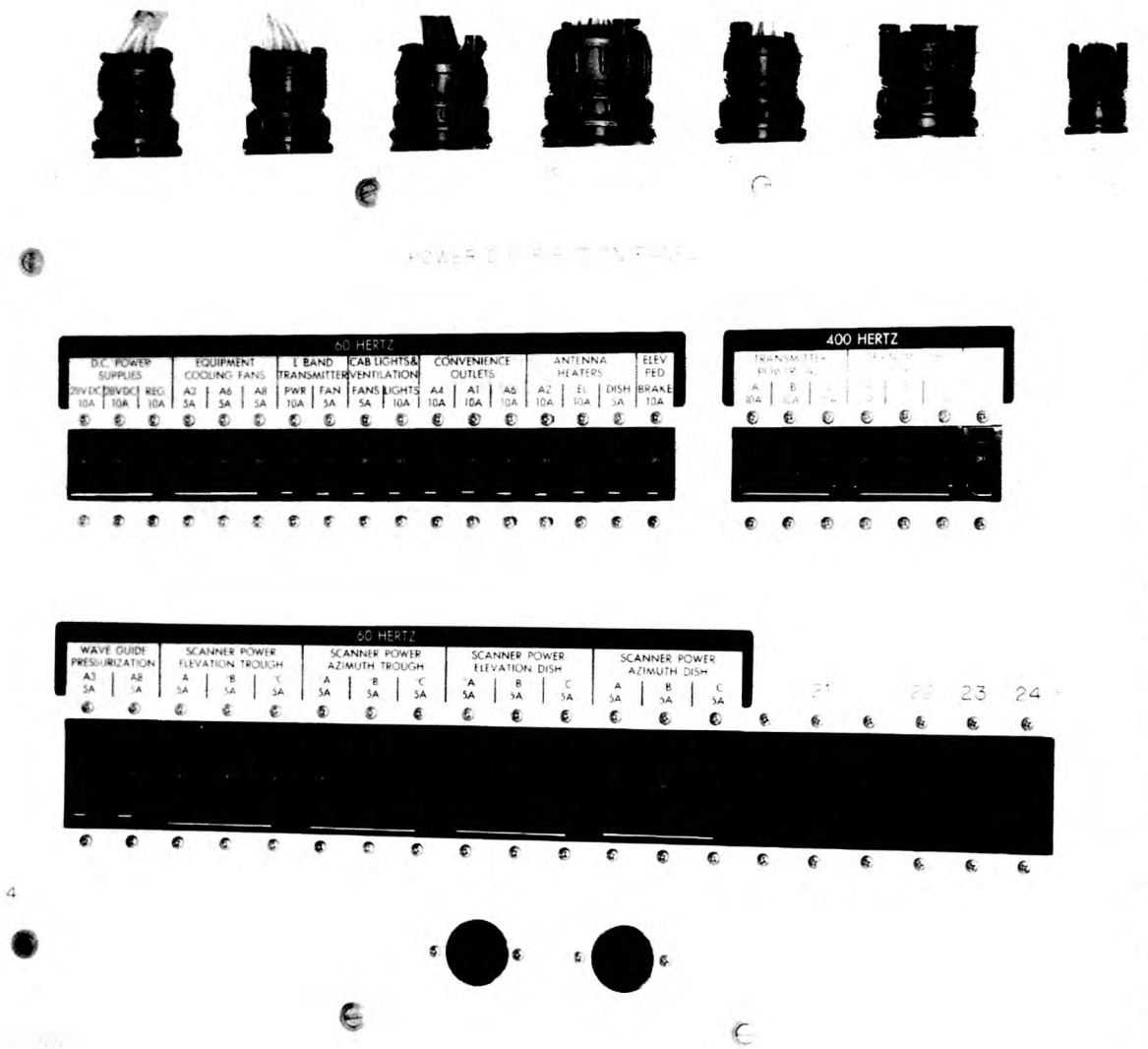
NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
AFC Meter	M1	Indicates deviation of local oscillator frequency from correct frequency; center scale (0) is correct local oscillator frequency
AFC LOCAL/REMOTE Switch	S2	Selects local or remote control of automatic frequency control
AFC ON/OFF Switch	S3	Turns automatic frequency control on or off; effective when S2 is positioned to LOCAL
AFC MANUAL Control	R6	Provides manual tuning of local oscillator; effective when S2 is positioned to LOCAL and S3 is positioned to OFF
LO TUNING Control	Y2	Provides mechanical tuning of local oscillator
XTAL CURRENT Meter	M2	Indicates crystal current of selected mixer crystals
XTAL CURRENT Selector Switch	S1	Selects crystal current for display on M2:
DISC		AFC discriminator mixer
TARGET		Target receiver mixer
XPONDER		Transponder receiver mixer
DLJ		Down link jammer mixer



2A4 PANEL

0095-338

Figure 2-44. Power Distribution Panel (Sheet 1)



3A4 PANEL

0095-145

Figure 2-44. Power Distribution Panel (Sheet 2)

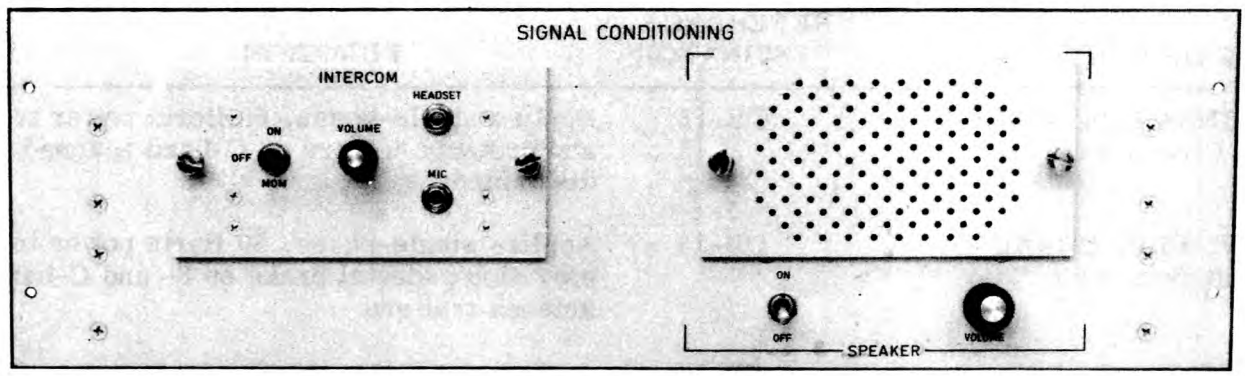
Table 2-44. Power Distribution Panel 2A4, 3A4 Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
60 HERTZ DC POWER SUPPLIES Circuit Breaker		
28 VDC, 28 VDC, REG	CB-1	Applies single-phase, 60 Hertz power to and protects unregulated and regulated +28 VDC power supplies in S- and C-band antenna trailers
EQUIPMENT COOLING FANS Circuit Breaker		
A3, A6, and A8	CB-2	Applies single-phase, 60 Hertz power to and protects cooling fans in consoles A3, A6, and A8 in S- and C-band antenna trailers
L-BAND TRANSMITTER PWR Circuit Breaker	CB-3	Applies single-phase, 60 Hertz power to and protects L-band transmitter in S- and C-band antenna trailers
L-BAND TRANSMITTER FAN Circuit Breaker	CB-4	Applies single-phase, 60 Hertz power to and protects cooling fan in L-band transmitter in S- and C-band antenna trailers
VENTILATION FANS Circuit Breaker	CB-5	Applies single-phase, 60 Hertz power to and protects ventilating fans in S- and C-band antenna trailers
CAB LIGHTS Circuit Breaker	CB-6	Applies single-phase, 60 Hertz power to and protects cab lights in S- and C-band antenna trailers
CONVENIENCE OUTLETS A4 Circuit Breaker	CB-7	Applies single-phase, 60 Hertz power to service outlet on consoles 2A4 and 3A4
CONVENIENCE OUTLETS A1 Circuit Breaker	CB-8	Applies single-phase, 60 Hertz power to service outlet on consoles 2A1 and 3A1
CONVENIENCE OUTLETS A6 Circuit Breaker	CB-9	Applies single-phase, 60 Hertz power to service outlet on the consoles 2A6 and 3A3
ANTENNA HEATERS AZ Circuit Breaker	CB-10	Applies single-phase, 60 Hertz power to and protects azimuth trough scanner antenna heaters on S- and C-band antenna trailers
ANTENNA HEATERS EL Circuit Breaker	CB-11	Applies single-phase, 60 Hertz power to and protects elevation trough scanner antenna heaters on S- and C-band antenna trailers

Table 2-44. Power Distribution Panel 2A4, 3A4 Controls and Indicators (Continued)

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
ANTENNA HEATERS DISH Circuit Breaker*	CB-12	Applies single-phase, 60 Hertz power to and protects heaters on C-band scanned dish antennas
ELEV. PED. BRAKE Circuit Breaker	CB-13	Applies single-phase, 60 Hertz power to elevation pedestal brake on S- and C-band antenna trailers
TRANSMITTER POWER (A2) Circuit Breaker	CB-14	Applies 3-phase, 400 Hertz power to elevation radar transmitter in S- and C-band antenna trailers
TRANSMITTER POWER (A7) Circuit Breaker	CB-15	Applies 3-phase, 400 Hertz power to azimuth radar transmitter in S- and C-band antenna trailers
ELEV. PED. SYNCH Circuit Breaker	CB-16	(Not used)
60 HERTZ WAVEGUIDE PRESSURIZATION A3 Circuit Breaker	CB-17	Applies single-phase, 60 Hertz power to pressure pump in consoles 2A3 and 3A3
WAVEGUIDE PRESSURIZATION A8 Circuit Breaker	CB-18	Applies single-phase, 60 Hertz power to pressure pump in consoles 2A8 and 3A8
SCANNER POWER ELEVATION TROUGH Circuit Breaker	CB-19	Applies 3-phase, 60 Hertz power to scanners of S- and C-band elevation trough antennas
SCANNER POWER AZIMUTH TROUGH Circuit Breaker	CB-20	Applies 3-phase, 60 Hertz power to scanners of S- and C-band azimuth trough antennas
SCANNER POWER ELEVATION DISH Circuit Breaker*	CB-21	Applies 3-phase, 60 Hertz power to scanners in elevation dish antenna
SCANNER POWER AZIMUTH DISH Circuit Breaker*	CB-22	Applies 3-phase, 60 Hertz power to scanner in azimuth dish antenna

*CB-12, 21, and 22 not included in panel 2A4

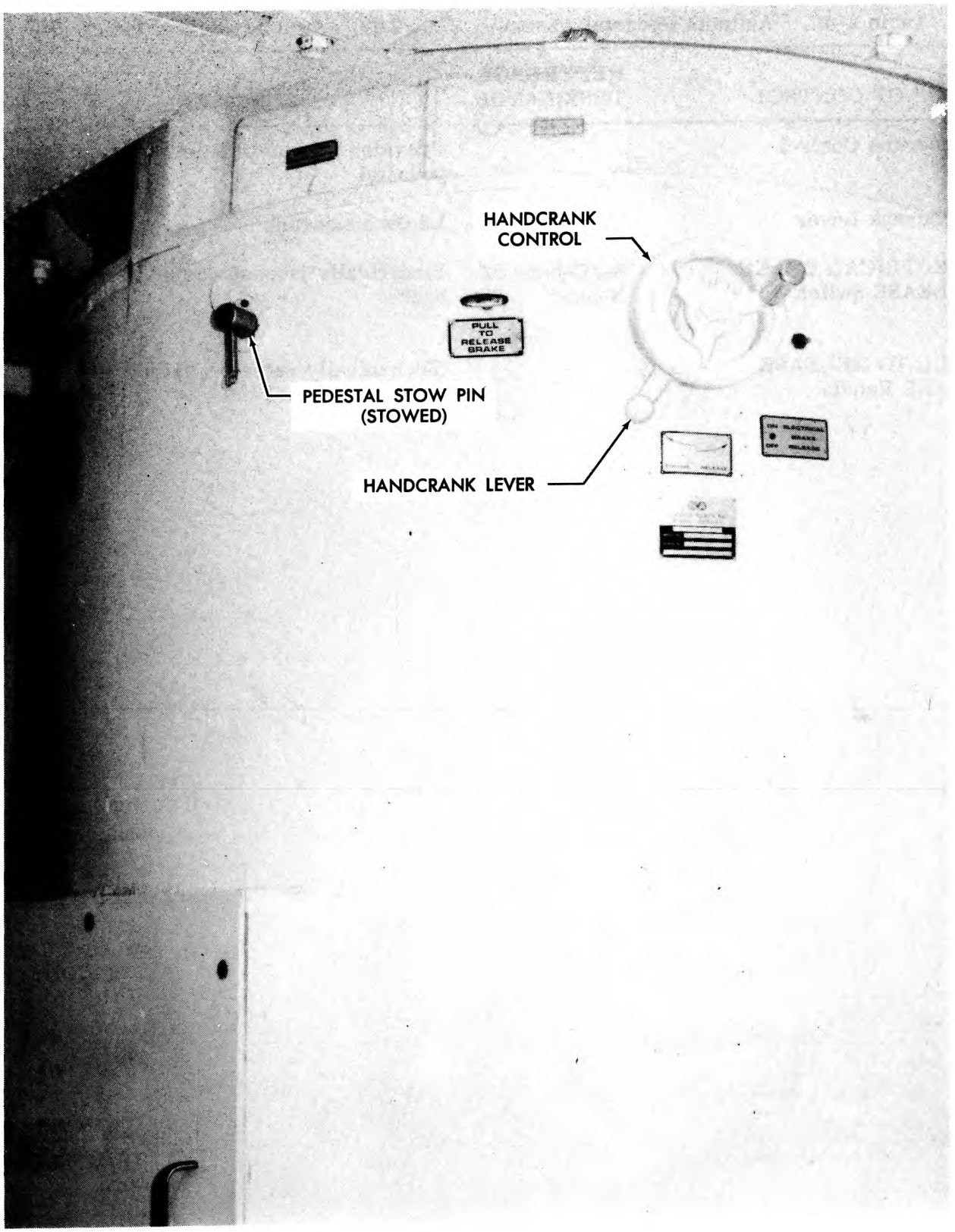


0095-654

Figure 2-44A. Signal Conditioning 2A6A2, 3A6A2

Table 2-44A. Signal Conditioning 2A6A2, 3A6A2 Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
SPEAKER ON/OFF Switch	S1	Connects speaker to intercommunication system
SPEAKER VOLUME Control	R5	Controls speaker volume
INTERCOM ON/OFF/ MOM Switch	A14S1	Connects headset to intercommunication system
INTERCOM VOLUME Control	A14R1	Controls earphone volume

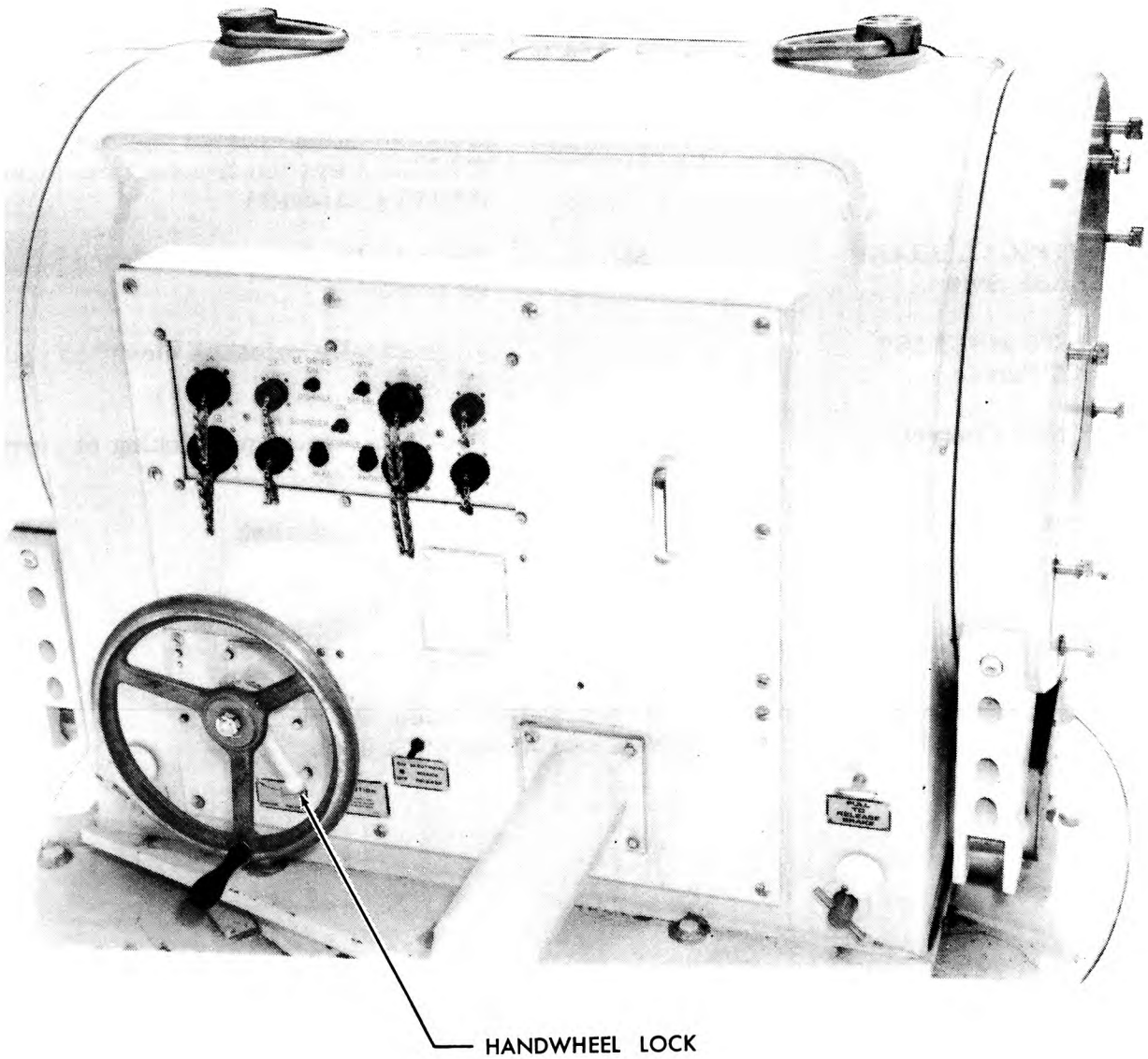


104501-146A

Figure 2-45. Azimuth Pedestal Assembly 2A9, 3A9, 4A6

Table 2-45. Azimuth Pedestal Assembly 2A9, 3A9, 4A6 Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
Handcrank Control	-	Provides manual positioning of azimuth pedestal
Handcrank Lever	-	Locks handcrank
ELECTRICAL BRAKE RELEASE Switch	S-/C-band S2 X-band S3	Electrically releases azimuth pedestal brake
PULL TO RELEASE BRAKE Handle	-	Mechanically releases azimuth pedestal brake



NOTE

C-Band pedestal disconnect panel shown.

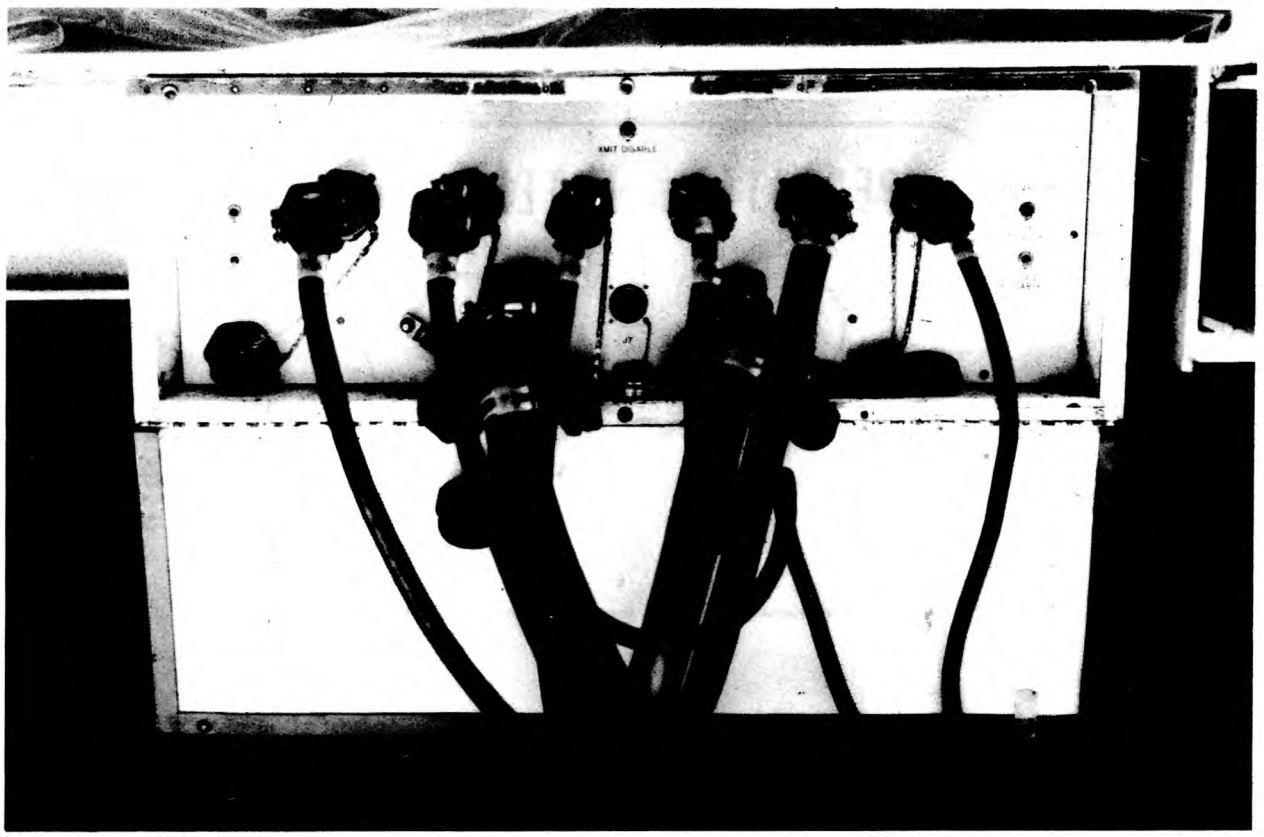
0095-147A

Figure 2-46. Elevation Pedestal Assembly 2A10, 3A10, 4A7

Table 2-46. Elevation Pedestal Assembly 2A10, 3A10, 4A7 Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
*EL DRIVE ON/DISABLE Switch	S1	Applies power to or removes power from elevation pedestal servo system
*XMTR ON/DISABLE Switch	S2	Applies power to or removes power from elevation transmitter
*SCANNER Switch	S3	Applies power to or removes power from elevation scanner motors (also disables elevation transmitter through interlock circuits)
ELECTRICAL BRAKE RELEASE Switch	S4	Electrically releases elevation pedestal brake
PULL TO RELEASE BRAKE Handle	-	Mechanically releases elevation pedestal brake
Handcrank Control	-	Provides manual positioning of elevation pedestal
Handcrank Lever	-	Engages handcrank

*Switches are located on the A10 Pedestal Disconnect Panel on the S- and C-Band Elevation Pedestal Assemblies only.

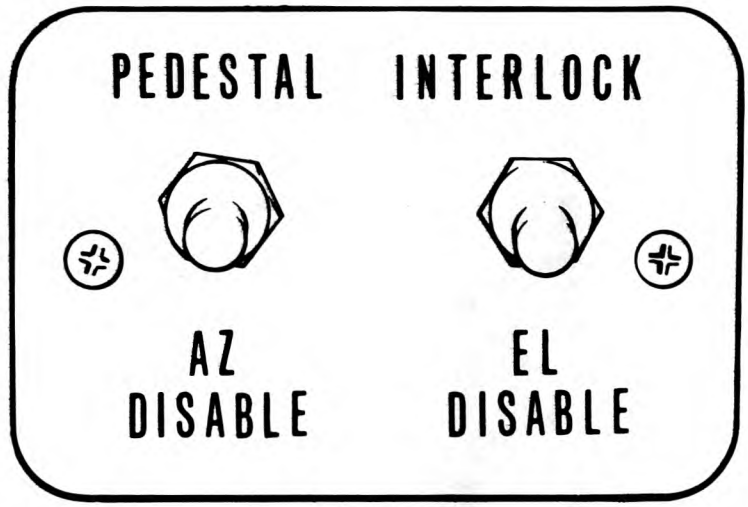


0095-148

Figure 2-47. Antenna Trailer Disconnect Panel

Table 2-47. Antenna Trailer Disconnect Panel Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
AZIMUTH		
PED DISABLE Switch	S1	Disables azimuth pedestal servo system
SCAN DISABLE Switch	S4	Disables azimuth antenna scan motors
XMIT DISABLE Switch	S5	Disables azimuth, elevation, and L-band transmitters
ELEVATION		
PED DISABLE Switch	S2	Disables elevation pedestal servo system
SCAN DISABLE Switch	S3	Disables elevation antenna scan motors

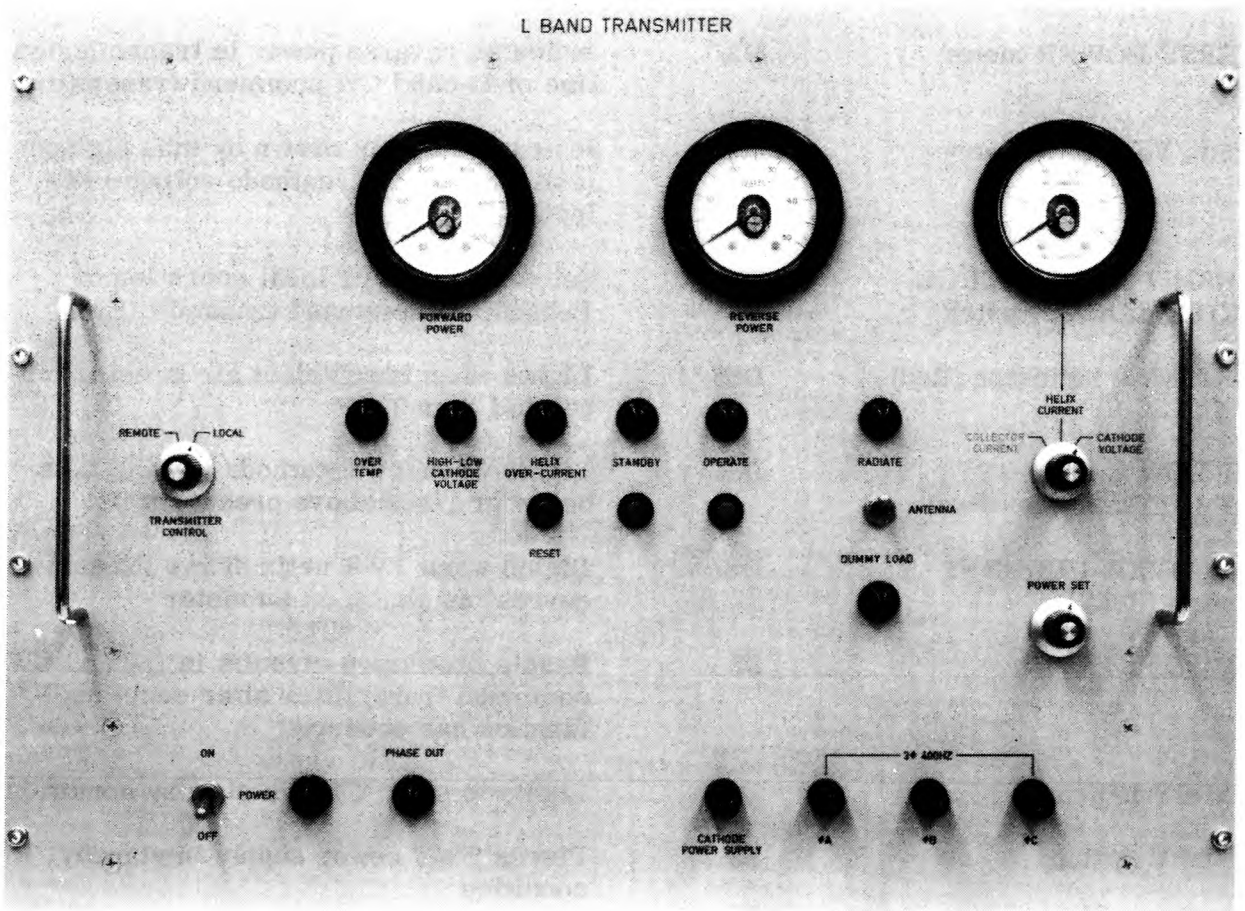


0095-149

Figure 2-48. Pedestal Interlock Switch Panel

Table 2-48. Pedestal Interlock Switch Panel Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
PEDESTAL INTERLOCK		
AZ DISABLE Switch	S2	Disables azimuth pedestal servo system
EL DISABLE Switch	S1	Disables elevation pedestal servo system



0095-150

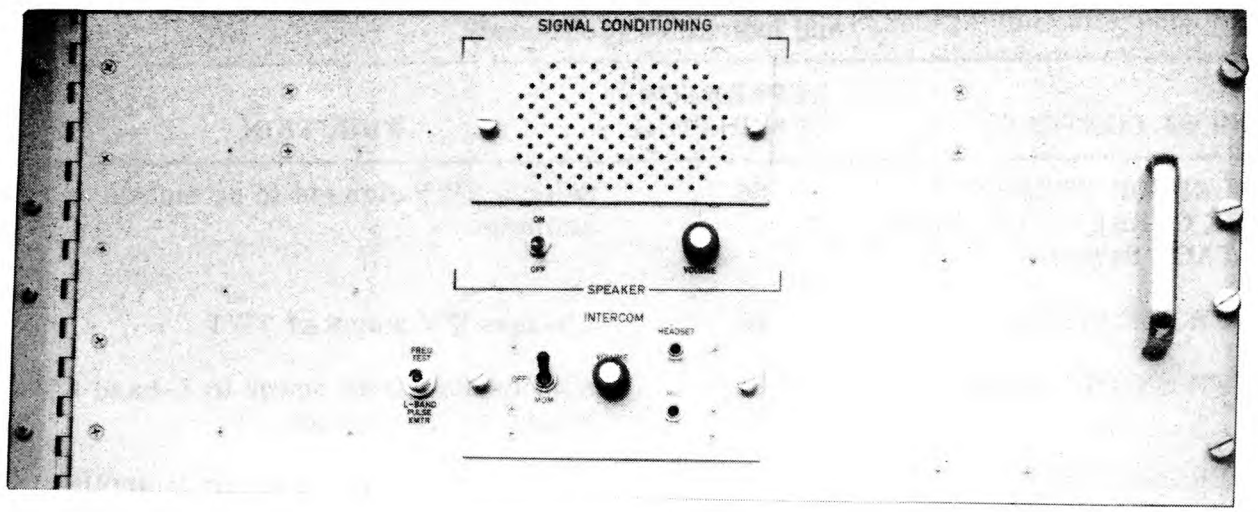
Figure 2-49. L-Band CW Command Transmitter 4A1A1

Table 2-49. L-Band CW Command Transmitter 4A1A1 Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
FORWARD POWER Meter	M1	Indicates forward power being transmitted by TWT
REVERSE POWER Meter	M2	Indicates reverse power in transmission line of L-band CW command transmitter
Current/Voltage Meter	M3	Indicates current drawn by tube element (collector, helix, cathode voltage) selected by S6
TRANSMITTER CONTROL REMOTE/LOCAL Switch	S2	Selects remote or local operation of L-band CW command transmitter
OVER TEMP Indicator (Red)	DS5	Lights when insufficient air is being circulated over TWT
HIGH-LOW CATHODE VOLTAGE Indicator (Red)	DS6	Lights when TWT cathode voltage falls below or rises above preset limits
HELIX OVER-CURRENT Indicator (Red)	DS7	Lights when TWT helix draws excessive current as shown on ammeter
RESET Switch	S7	Resets protective circuits in L-band CW command transmitter after some malfunction has occurred
STANDBY Indicator (Green)	DS2	Lights to show TWT in standby condition
STANDBY Switch	S3	Places TWT power supply in standby condition
OPERATE Indicator (Red)	DS3	Lights when TWT is transmitting CW power
OPERATE Switch	S4	Places high voltage on cathode of TWT to begin operation
RADIATE Indicator (Green)	DS8	Lights when TWT is feeding L-band cut-dish antenna
ANTENNA RADIATE/DUMMY LOAD Switch	S8	Enables termination of TWT in antenna or dummy load
DUMMY LOAD Indicator (Green)	DS9	Lights when TWT is terminated in dummy load

Table 2-49. L-Band CW Command Transmitter 4A1A1 Controls and Indicators (Continued)

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
COLLECTOR CURRENT/ HELIX CURRENT/CATHODE VOLTAGE Switch	S6	Selects TWT element to be measured by ammeter
POWER SET Control	R1	Changes CW output of TWT
POWER ON/OFF Switch	S1	Applies 400 Hertz power to L-band CW command transmitter
POWER Indicator (Green)	DS1	Lights when primary power is applied to L-band CW command transmitter
PHASE OUT Indicator (Red)	DS4	Lights when phase sequence is incorrect or when any phase is out



0095-151

Figure 2-50. Signal Conditioning 4A2A1A5

Table 2-50. Signal Conditioning 4A2A1A5 Controls and Indicators

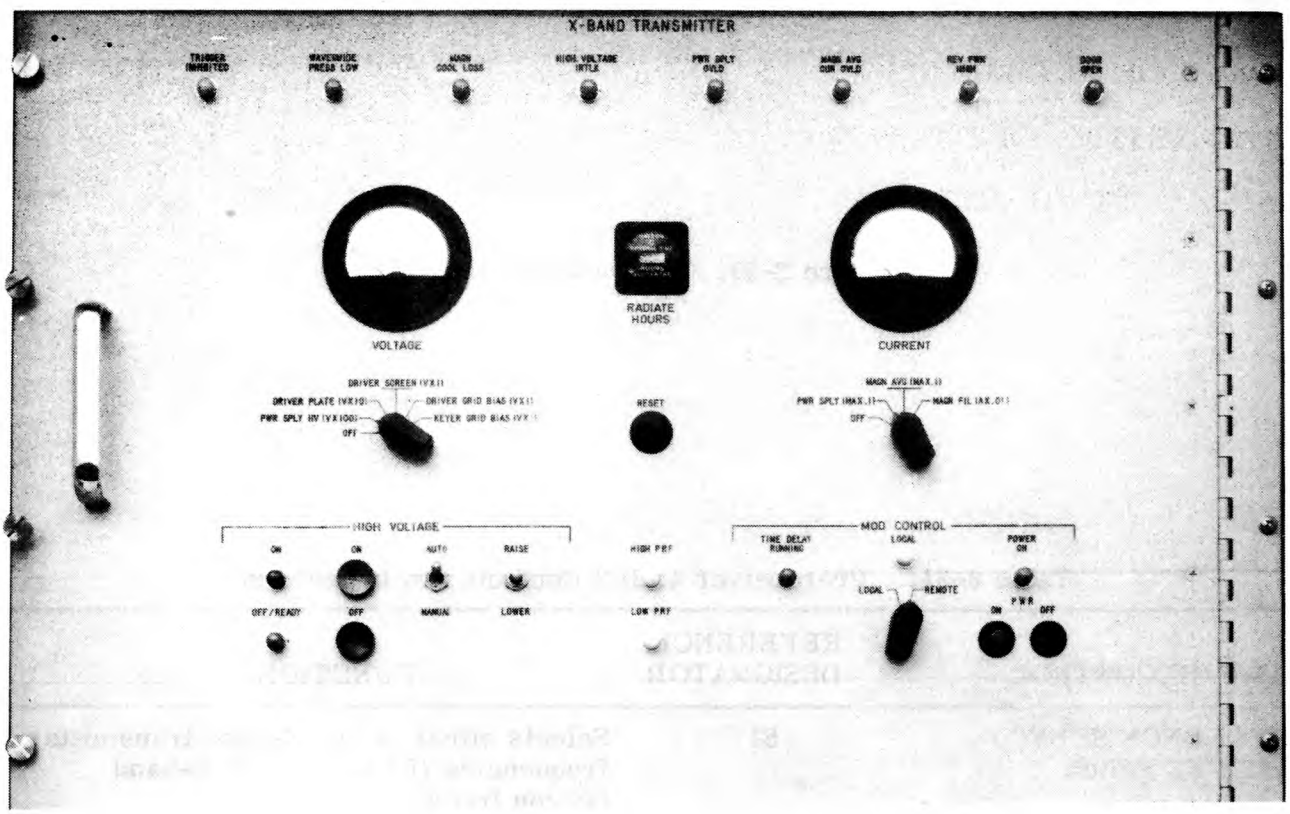
NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
SPEAKER ON/OFF Switch	S2	Connects speaker to intercommunication system
SPEAKER VOLUME Control	R3	Controls speaker volume
INTERCOM ON-OFF-MOM Switch	S1	Connects headset to intercommunication system
INTERCOM VOLUME Control	R1	Controls earphone volume

0095-152

Figure 2-51. Prereceiver 4A2A2

Table 2-51. Prereceiver 4A2A2 Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
FREQUENCY SELECT F1/F2/F3 Switch	S1	Selects either of two X-band transmitter frequencies (F1 and F2) or X-band beacon frequency (F3)
TRANSMITTER FREQUENCY SELECT		
F1 Control	R4	Adjusts F1 X-band transmitter frequency
F2 Control	R3	Adjusts F2 X-band transmitter frequency
F3 Control	R2	Adjusts F3 X-band beacon frequency
DISCRIMINATOR ERROR Indicator	M1	Indicates discriminator error of X-band target angle track loop
AFC/MFC Switch	S2	Selects either automatic or manual frequency control



0095-153

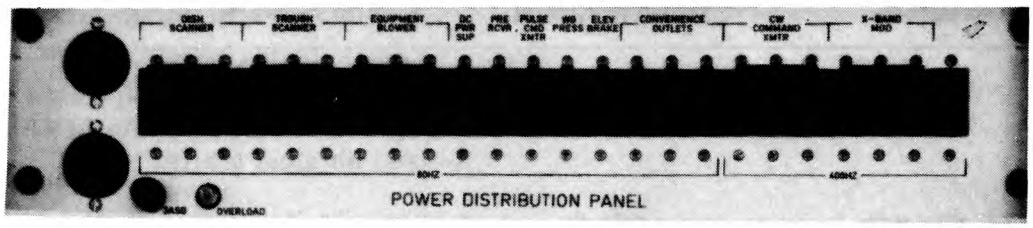
Figure 2-52. X-Band Transmitter Control 4A3A1A1

Table 2-52. X-Band Transmitter Control 4A3A1A1 Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
TRIGGER INHIBITED Indicator (Amber)	DS1	Lights when transmitter triggers are inhibited (scan loss is detected, waveguide switches malfunction, or XMTR DISABLE switches on the pedestal disconnect panel are actuated)
WAVEGUIDE PRESS LOW Indicator (Amber)	DS2	Lights when air pressure in antenna waveguides drops below preset limit
MAGN COOL LOSS Indicator (Amber)	DS3	Lights when cooling air across magnetron is inadequate
HIGH VOLTAGE INTLK Indicator (Amber)	DS4	Lights when any interlock device in the interlock circuit (see table 2-55) is open
PWR SPLY OVLD Indicator (Amber)	DS5	Lights when current overload circuit in high voltage power supply detects excessive current flow
MAGN AVG CUR OVLD Indicator (Amber)	DS6	Lights when average current being drawn by the magnetron becomes excessive
REV PWR HIGH Indicator (Amber)	DS7	Lights when transmitter reverse power becomes excessive
DOOR OPEN Indicator (Amber)	DS8	Lights when hinged front panel of transmitter is opened
VOLTAGE Meter	M1	Indicates voltage in circuit selected by S9
VOLTAGE Meter Select Switch (OFF/PWR SPLY HV/DRIVER PLATE/DRIVER SCREEN/DRIVER GRID BIAS/ KEYER GRID BIAS)	S9	Selects circuit for which voltage is to be measured using M1
RADIATE HOURS Meter	M3	Indicates operating hours of magnetron
CURRENT Meter	M2	Indicates current being drawn by circuit selected by S10
CURRENT Meter Select Switch (OFF/PWR SPLY/ MAGN AVG/MAGN FIL)	S10	Selects circuit for which current is to be measured using M2
RESET Switch	S3	Resets latching relays in transmitter interlock circuits

Table 2-52. X-Band Transmitter Control 4A3A1A1 Controls and Indicators (Continued)

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
HIGH VOLTAGE ON Indicator (Red)	DS9	Lights when S7 is positioned to ON
HIGH VOLTAGE OFF/ READY Indicator (Green)	DS10	Lights 8-minutes after power is applied to the transmitter; goes out when S7 is positioned to ON
HIGH VOLTAGE ON Switch	S7	Applies high voltage power
HIGH VOLTAGE OFF Switch	S8	Removes high voltage power
HIGH VOLTAGE AUTO/ MANUAL Switch	S6	Selects automatic or manual control of high voltage
RAISE/LOWER Switch	S5	Raises or lowers output voltage of high voltage power supply when S6 is in MANUAL position
HIGH PRF Indicator	DS11	Lights when magnetron is being pulsed by high PRF
LOW PRF Indicator	DS12	Lights when magnetron is being pulsed by low PRF
MOD CONTROL TIME DELAY RUNNING Indicator (Green)	DS13	Lights during modulator power supply time delay
MOD CONTROL LOCAL Indicator (Amber)	DS14	Lights when S4 is in LOCAL position
MOD CONTROL LOCAL/ REMOTE Switch	S4	Selects local or remote control of modulator
MOD CONTROL POWER ON Indicator (Green)	DS15	Lights when power is applied to modulator
MOD CONTROL PWR ON Switch	S1	Applies power to modulator
MOD CONTROL PWR OFF Switch	S2	Removes power from modulator



0095-154

Figure 2-53. Power Distribution Panel (P/O 4A5A1)

Table 2-53. Power Distribution Panel (P/O 4A5A1) Controls and Indicators

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
DISH SCANNER Circuit Breaker	CB-1	Applies 3-phase, 60 Hertz power to scanner on X-band cut dish antenna
TROUGH SCANNER Circuit Breaker	CB-2	Applies 3-phase, 60 Hertz power to trough scanner on X-band receiver antenna
EQUIPMENT BLOWER Circuit Breaker	CB-3	Applies 3-phase, 60 Hertz power to cooling fans in consoles 4A1, 4A2, and 4A3
DC PWR SUP Circuit Breaker	CB-4	Applies single-phase, 60 Hertz power to DC power supply in X-band radar
PRE RCVR Circuit Breaker	CB-5	Applies single-phase, 60 Hertz power to prereceivers in X-band radar
PULSE CMD XMTR Circuit Breaker	CB-6	Applies single-phase, 60 Hertz power to pulsed command transmitter

Table 2-53. Power Distribution Panel (P/O 4A5A1)
Controls and Indicators (Continued)

NAME OF CONTROL	REFERENCE DESIGNATOR	FUNCTION
WG PRESS Circuit Breaker	CB-7	Applies single-phase, 60 Hertz power to waveguide pressure pump in 4A8 area of X-band antenna trailer
ELEV BRAKE Circuit Breaker	CB-8	Applies single-phase, 60 Hertz power to elevation pedestal brake in X-band antenna trailer
CONVENIENCE OUTLETS	CB-9 CB-10 CB-11	Apply single-phase, 60 Hertz power to service outlets on power distribution panel and receiver-transmitter modulator consoles
CW COMMAND XMTR Circuit Breaker	CB-12	Applies 3-phase, 60 Hertz power to CW command transmitter
X-BAND MOD Circuit Breaker	CB-13	Applies 3-phase, 400 Hertz power to X-band transmitter and modulator
OVERLOAD Indicator	DS1	Lights when overload exists in dish scanner relay circuit

Table 2-54. Transmitter Access Interlocks

INTERLOCK/LOCATION	FUNCTION
S-Band Elevation Transmitter Control Panel (2A2S112)	Removes primary power from high voltage power supply when control panel door is open
S-Band Elevation Transmitter High Voltage Power Supply Access Panel (2A2S113)	Removes primary power from high voltage power supply when access panel is removed
S-Band Azimuth Transmitter Control Panel (2A7S112)	Removes primary power from high voltage power supply when control panel door is open
S-Band Azimuth Transmitter High Voltage Power Supply Access Panel (2A7S113)	Removes primary power from high voltage power supply when access panel is removed
C-Band Elevation Transmitter Control Panel (3A2S112)	Removes primary power from high voltage power supply when control panel door is open
C-Band Elevation Transmitter High Voltage Power Supply Access Panel (3A2S113)	Removes primary power from high voltage power supply when access panel is removed
C-Band Azimuth Transmitter Control Panel (3A7S112)	Removes primary power from high voltage power supply when control panel door is open
C-Band Azimuth Transmitter High Voltage Power Supply Access Panel (3A7S113)	Removes primary power from high voltage power supply when access panel is removed
S-Ped L-Band Transmitter Chassis (2A1S1)	Shuts off high voltage when L-band pulsed command transmitter chassis 2A1A1 is pulled out
S-Ped L-Band High Voltage Power Supply Chassis (2A1S2)	Shuts off high voltage when power supply chassis 2A1A2 is pulled out
C-Ped L-Band Transmitter Chassis (3A1S1)	Shuts off high voltage when L-band pulsed command transmitter chassis 3A1A1 is pulled out
C-Ped L-Band High Voltage Power Supply Chassis (3A1S2)	Shuts off high voltage when power supply chassis 3A1A2 is pulled out
X-Ped L-Band Pulsed Transmitter Chassis (4A1S1)	Shuts off high voltage when L-band pulsed command transmitter chassis 4A1A2 is pulled out

Table 2-54. Transmitter Access Interlocks (Continued)

INTERLOCK/LOCATION	FUNCTION
X-Ped L-Band High Voltage Power Supply Chassis (4A1S2)	Shuts off high voltage when power supply chassis 4A1A3 is pulled out
CW L-Band Transmitter Chassis (4A1S3)	Removes primary power from CW L-Band transmitter (4A1A1) when chassis is pulled out
X-Band Transmitter Panel (4A3A1S1)	Removes primary power from X-band transmitter when panel 4A3A1 is open
X-Band Modulator Panel (4A3A2S1)	Removes primary power from X-band modulator when panel 4A3A1 is open
X-Band High Voltage Power Supply Chassis (4A2A3S1)	Removes primary power from X-band high voltage power supply when chassis 4A2A3 is pulled out

Table 2-55. Transmitter Protection Interlocks (S- and C-Band Transmitters)

INTERLOCK NOMENCLATURE	FUNCTION
PHASE OUT	Prevents application of primary power to equipment in the event of phase loss or phase reversal
TIME DELAY RUNNING	Prevents application of high voltage until magnetron has warmed up
MAGNETRON FILAMENT CURRENT LOW	Prevents application of high voltage when magnetron standby filament current is below safe operating level
MAGNETRON COOLING LOSS	Removes or prevents application of high voltage when magnetron cooling air flow is insufficient
ISOLATOR COOLING LOSS	Removes or prevents application of high voltage when isolator cooling air is insufficient
WAVEGUIDE PRESSURE LOSS	Removes or prevents application of high voltage when waveguide pressure is below magnetron operating limit
POWER SUPPLY CURRENT OVERLOAD	Removes high voltage when power supply current is excessive

Table 2-55. Transmitter Protection Interlocks (S- and C-Band Transmitters) (Continued)

INTERLOCK/LOCATION	FUNCTION
INVERSE CURRENT OVERLOAD	Removes high voltage when inverse current is excessive
MAGNETRON AVERAGE CURRENT OVERLOAD	Removes high voltage when magnetron average current is excessive
MAGNETRON OVER VOLTAGE	Turns off high voltage when magnetron is over voltage
WAVEGUIDE SHORT	Turns off high voltage when excessive reverse power occurs at magnetron output port
TRIGGER INHIBIT (System Fault)	Removes transmitter trigger in event of a waveguide switch fault or when transmitter disable switch is thrown

Table 2-56. Transmitter Protection Interlocks (X-Band Transmitter)

INTERLOCK NOMENCLATURE	FUNCTION
KEYER TUBE AIR FLOW LOSS	Removes or prevents application of primary power to transmitter
TIME DELAY RUNNING	Prevents application of high voltage until magnetron has warmed up
WAVEGUIDE PRESS LOW	Removes or prevents application of high voltage when waveguide pressure is below magnetron operating limit
MAGNETRON COOLING LOSS	Removes or prevents application of high voltage when magnetron cooling air is insufficient
MAGNETRON FILAMENT CURRENT LOW	Removes or prevents application of high voltage when magnetron filament current is below safe operating level
DRIVER BIAS VOLTAGE LOW	Removes or prevents application of high voltage when driver tube bias voltage is below operating limit

Table 2-56. Transmitter Protection Interlocks (X-Band Transmitter) (Continued)

INTERLOCK NOMENCLATURE	FUNCTION
KEYER BIAS VOLTAGE LOW	Removes or prevents application of high voltage when keyer tube bias is below operating limit
POWER SUPPLY CURRENT OVERLOAD	Removes or prevents application of high voltage when high voltage power supply current is excessive
DRIVER PLATE VOLTAGE LOW	Inhibits transmitter trigger when driver plate voltage is below operating limit
HIGH VOLTAGE POWER SUPPLY LOW	Inhibits triggers when high voltage is below minimum operating level
MAGNETRON AVERAGE CURRENT OVERLOAD	Inhibits triggers when magnetron average current is too high
REVERSE POWER HIGH	Inhibits triggers when reverse power is too high
WAVEGUIDE SWITCH	Inhibits triggers during waveguide switch operation and in the event of waveguide switch failure

Table 2-57. Transmitter Protection Interlocks (L-Band Pulsed Command Transmitters)

INTERLOCK NOMENCLATURE	FUNCTION
POWER SUPPLY VOLTAGE LOW	Inhibits transmitter triggers when high voltage is below operating limit
COAX RELAY	Inhibits triggers while switching between antenna and load
POWER SUPPLY CURRENT OVERLOAD	Removes high voltage when high voltage power supply current is excessive

Table 2-58. Transmitter Protection Interlocks (L-Band CW Command Transmitter)

INTERLOCK NOMENCLATURE	FUNCTION
PHASE OUT SENSE	Prevents application of 3-phase primary power to equipment in the event of phase loss or phase reversal

Table 2-58. Transmitter Protection Interlocks (L-Band CW Command Transmitter) (Continued)

INTERLOCK NOMENCLATURE	FUNCTION
TIME DELAY	Prevents application of cathode and collector voltages until TWT has warmed up
CATHODE HIGH/LOW	Prevents application of cathode and collector voltages when cathode voltage is not within TWT limits
HELIX OVER CURRENT	Removes cathode and collector voltages when helix current is excessive
TWT OVER TEMPERATURE	Removes cathode and collector voltages when TWT temperature is above safe operating point
RF MODULATION	Switches to dummy load and biases PIN modulator off if there is no modulation signal
COAX RELAY	Switches the PIN modulator off while switching between antenna and load

Table 2-59. Transmitter Disable Switches

INTERLOCK/LOCATION	FUNCTION
S-Band Trailer Disconnect Panel (2S5)	Inhibits azimuth and elevation transmitter triggers and removes or prevents application of L-band transmitter high voltage
S-Band Elevation Pedestal Disconnect Panel (2A10A10S2)	Inhibits the azimuth and elevation transmitter triggers and removes or prevents application of L-band transmitter high voltage
C-Band Trailer Disconnect Panel (3S5)	Inhibits azimuth and elevation transmitter triggers and removes or prevents application of L-band transmitter high voltage
C-Band Elevation Pedestal Disconnect Panel (3A10A10S2)	Inhibits azimuth and elevation transmitter triggers and removes or prevents application of L-band transmitter high voltage
X-Band Trailer Disconnect Panel (4S5)	Removes or prevents application of high voltages for X-band, L-band pulsed command and L-band CW command transmitters

Table 2-60. Pedestal Interlocks

INTERLOCK NOMENCLATURE	FUNCTION
Stow Pin(s) (two stow pins for elevation)	Disables pedestal drive circuit if stow pins are not in operating location
Handcrank	Disables pedestal drive if handwheel is not fully disengaged; disables electrical brake release if handwheel is not fully engaged
Manual Brake Release	Disables pedestal drive circuit when pulled out
Drive Motor Blower	Disables pedestal drive circuit when drive motor cooling air flow is insufficient for operation

Table 2-61. Pedestal Disable Switches

INTERLOCK/LOCATION	FUNCTION
S-Band Trailer Interlock Panel Azimuth Pedestal Disable (2S1)	Disables azimuth pedestal drive circuit
S-Band Trailer Interlock Panel Elevation Pedestal Disable (2S2)	Disables elevation pedestal drive circuit
S-Band Trailer Disconnect Panel Azimuth Pedestal Disable (2S2)	Disables azimuth pedestal drive circuit
S-Band Trailer Disconnect Panel Elevation Pedestal Disable (2S1)	Disables elevation pedestal drive circuit
S-Band Elevation Pedestal Disconnect Panel Elevation Pedestal Disable (2A10A10S1)	Disables elevation pedestal drive circuit
C-Band Trailer Interlock Panel Azimuth Pedestal Disable (3S1)	Disables azimuth pedestal drive circuit
C-Band Trailer Interlock Panel Elevation Pedestal Disable (3S2)	Disables elevation pedestal drive circuit
C-Band Trailer Disconnect Panel Azimuth Pedestal Disable (3S2)	Disables azimuth pedestal drive circuit
C-Band Trailer Disconnect Panel Elevation Pedestal Disable (3S1)	Disables elevation pedestal drive circuit

Table 2-61. Pedestal Disable Switches (Continued)

INTERLOCK NOMENCLATURE	FUNCTION
C-Band Elevation Pedestal Disconnect Panel Elevation Pedestal Disable (3A10A10S1)	Disables elevation pedestal drive circuit
X-Band Trailer Interlock Panel Azimuth Pedestal Disable (4S1)	Disables azimuth pedestal drive circuit
X-Band Trailer Interlock Panel Elevation Pedestal Disable (4S2)	Disables elevation pedestal drive circuit
X-Band Trailer Disconnect Panel Azimuth Pedestal Disable (4S2)	Disables azimuth pedestal drive circuit
X-Band Trailer Disconnect Panel Elevation Pedestal Disable (4S1)	Disables elevation pedestal drive circuit

Table 2-62. Scanner Disable Switches

INTERLOCK/LOCATION	FUNCTION
S-Band Trailer Disconnect Panel Azimuth Scanner Disable (2S4)	Removes scanner motor power from azimuth scanner
S-Band Trailer Disconnect Panel Elevation Scanner Disable (2S3)	Removes scanner motor power from elevation scanner
S-Band Elevation Pedestal Disconnect Panel Scanner Disable (2A10A10S3)	Removes scanner motor power from azimuth and elevation scanners
C-Band Trailer Disconnect Panel Azimuth Scanner Disable (3S4)	Removes scanner motor power from azimuth trough and dish scanners
C-Band Trailer Disconnect Panel Elevation Scanner Disable (3S3)	Removes scanner motor power from elevation trough and dish scanners
C-Band Elevation Pedestal Disconnect Panel Scanner Disable (3A10A10S3)	Removes scanner motor power from azimuth and elevation trough and dish scanners
X-Band Trailer Disconnect Panel Scanner Disable (4S3)	Removes scanner motor power from trough and dish scanners

SECTION II

OPERATING INSTRUCTIONS

2-15. GENERAL.

2-16. The instructions required to operate the radar set are detailed in this section. These procedures cover initial control settings, runup procedures, daily functional tests, and a typical operating situation.

NOTE

If icing conditions are expected, the antenna heater switches on power distribution panels 2A4 and/or 3A4 and on power and frequency control 1A5A2 should be positioned to ON at all times. Otherwise, position all panel controls to OFF.

2-17. Primary power shall be applied, air conditioners shall be operating, and waveguide pressurization shall be checked before any of the radar set equipment is operated.

2-18. APPLICATION OF PRIMARY POWER.

2-19. Apply primary power to the radar set as described below:

a. Determine that all circuit breakers on power distribution console 1A12 and power distribution panels 2A4, 3A4, and 4A5 and all switches on power control 1A5A2 are positioned to off.

b. PHASE SEQUENCE indicators on power distribution console 1A12 should not be lighted. (A lighted PHASE SEQUENCE indicator indicates that phases are crossed or that a phase and neutral are crossed. Proper phase relation shall exist before the next step can be taken.)

c. Using VOLTAGE SELECTOR-PHASE switch and AC VOLTS meter on input power monitor panel of power distribution console 1A12, monitor the six 60-Hertz phase voltages and the three 400-Hertz phase voltages. Voltages should be 120 ± 5 volts. If required, correct primary voltages.

d. On power distribution console 1A12, position RADAR CONTROL TRAILER LIGHTS, SERVICE OUTLETS, and RADIO circuit breakers to ON.

2-20. AIR CONDITIONING TURN ON.

CAUTION

Prior to initial turn-on or after shutdown period of more than 48 hours, do not operate in the COOL mode for at least 4 hours after the AIR CONDITIONER circuit breaker is positioned to ON. This time interval is required to permit compressor crankcase heaters to perform their function.

2-21. Turn on the air conditioning system in the radar control trailer in the following manner:

a. Open doors of the air conditioning compartment on forward end of radar control trailer. Note that TRAILER DOOR CLOSED WHEN LIT indicator on air conditioner control panel of power distribution console 1A12 is not lighted.

b. Position the RADAR CONTROL TRAILER AIR CONDITIONER 60Hz 3PH circuit breakers on power distribution console 1A12 to ON.

c. Position the selector switch on air conditioner control panel to COOL or HEAT and the THERMOSTAT and humidistat for desired temperature and humidity.

CAUTION

Wait at least one-half hour after air conditioner is turned on before applying electrical power to the electronics.

2-22. DC VOLTAGE CHECKS.

2-23. Apply power to the electronics in all trailers and check the output of direct current power supplies as follows:

a. Position RADAR CONTROL TRAILER ELECTRONICS 60HZ 3PH, ELECTRONICS 400HZ 3PH, and COMPUTER CONSOLE circuit breakers on power distribution console 1A12 to ON.

b. Position ANTENNA TRAILERS S-BAND, C-BAND, and X-BAND 400HZ 3PH and 60HZ 3PH circuit breakers on power distribution console 1A12 to ON.

c. Position RADAR CONTROL TRAILER ELECTRONICS POWER switch on power distribution console 1A12 to ON.

d. Apply power to digital voltmeter 1A5A8. Refer to the applicable technical manual listed in table 1-4, as required.

e. At DVM test panel 1A5A16, use selectors on panel and digital voltmeter 1A5A8 to measure output of direct current power supplies listed on the front panel index card. (See figure 2-17.)

2-24. INITIAL CONTROL SETTINGS.

WARNING

Before setting antenna trailer controls initially, determine that the PEDESTAL INTERLOCK AZ and EL DISABLE switches located at the front (towing end) of the antenna trailers are positioned to DISABLE. (See figure 2-48.)

2-25. ANTENNA TRAILERS. Initial control settings for the S- and C-band antennas trailers are given in table 2-63. Initial settings for the X-band antenna trailer are given in table 2-64.

2-26. RADAR CONTROL TRAILER. Initial control settings for the radar control trailer are given in table 2-65.

CAUTION

SCANNER switches on power and frequency control 1A5A2 shall be positioned to OFF when not in use in order to conserve service life of the rotary joints.

2-27. TRANSMITTER RUNUP PROCEDURE.

2-28. S-AND C-BAND REMOTE TRANSMITTER RUNUP. A single procedure is applicable for turning on all azimuth and elevation transmitters (2A2, 3A2, 2A7 and 3A7) remotely in the S- and C-band radar sets. This procedure is detailed below:

CAUTION

Do not attempt to run up S- or C-band radars until the procedures in paragraphs 2-18 through 2-25 and the settings in table 2-63 have been completed.

a. Adjust the manually controlled exhaust baffles above azimuth and elevation transmitters as required to maintain an operating temperature inside the cab between -32 and +52° Centigrade. Equipment air should be exhausted inside the trailer during cold weather conditions.

b. At transmitter control panel 1A5A1, position CURRENT selector switch and VOLTAGE selector switch to MAG FIL.

Table 2-63. Initial Control Settings for S- and C-Band Antenna Trailers

NAME OF CONTROL	LOCATION	POSITION
S-BAND TRAILER		
TRANSMITTER POWER 2A2 and 2A7 Circuit Breakers	2A4	ON
CAB LIGHTS and VENTILATION FANS Circuit Breakers	2A4	ON
DC POWER SUPPLIES Circuit Breaker	2A4	ON
SCANNER POWER AZ and EL TROUGH Circuit Breakers	2A4	ON
EQUIPMENT COOLING FANS Circuit Breaker	2A4	ON
WAVEGUIDE PRESSURIZATION 2A3 and 2A8 Circuit Breaker	2A4	ON
ANTENNA HEATERS Circuit Breakers	2A4	OFF unless icing conditions expected*
REMOTE TRANSFER Switch	2A2, 2A7	REMOTE
L-BAND TRANSMITTER PWR and FAN Circuit Breakers	2A4	ON
CONTROL LOCAL/REMOTE Switch	2A1A1	REMOTE
OUTPUT ANTENNA/LOAD Switch	2A1A1	ANT
TUNING Control	2A1A1	As Required
OFF-E_{PS}-I_{PS}-I_{OSC} Switch	2A1A1	OFF
C-BAND TRAILER		
TRANSMITTER POWER 3A2 and 3A7 Circuit Breakers	3A4	ON
CAB LIGHTS AND VENTILATION FANS Circuit Breakers	3A4	ON
DC POWER SUPPLIES Circuit Breakers	3A4	ON
SCANNER POWER AZ and EL TROUGH Circuit Breaker	3A4	ON
EQUIPMENT COOLING FANS Circuit Breaker	3A4	ON
WAVEGUIDE PRESSURIZATION 3A3 and 3A8 Circuit Breakers	3A4	ON

*Antenna heaters are provided on radar set AN/MPS-T1(V)1.

Table 2-63. Initial Control Settings for S- and C-Band Antenna Trailers (Continued)

NAME OF CONTROL	LOCATION	POSITION
C-BAND TRAILER (CONTINUED)		
ANTENNA HEATERS Circuit Breakers	3A4	OFF unless icing conditions expected*
SCANNER POWER AZ and EL DISH Circuit Breakers	3A4	ON
REMOTE TRANSFER Switch	3A2, 3A7	REMOTE
L-BAND TRANSMITTER and FAN Circuit Breakers	3A4	ON
CONTROL LOCAL/REMOTE Switch	3A1A1	REMOTE
OUTPUT ANTENNA/LOAD	3A1A1	ANT
TUNING Control	3A1A1	As required
OFF-E_{PS}-I_{PS}-I_{OSC} Switch	3A1A1	OFF

*Antenna heaters are provided on radar set AN/MPS-T1(V)1.

Table 2-64. Initial Control Settings for X-Band Antenna Trailer

NAME OF CONTROL	LOCATION	POSITION
X-BAND MOD Circuit Breaker	4A5	ON
EQUIPMENT BLOWER Circuit Breaker	4A5	ON
DC PWR SUP Circuit Breaker	4A5	ON
PRE RECVR Circuit Breaker	4A5	ON
W/G PRESS Circuit Breaker	4A5	ON
TROUGH SCANNER Circuit Breaker	4A5	ON
DISH SCANNER Circuit Breaker	4A5	ON
CONTROL LOCAL/REMOTE Switch (L-Band pulsed command)	4A1A2	REMOTE
OUTPUT ANTENNA/LOAD (L-Band pulsed command)	4A1A2	ANT
TUNING Control (L-Band pulsed command)	4A1A2	As required

Table 2-64. Initial Control Settings for X-Band Antenna Trailer (Continued)

NAME OF CONTROL	LOCATION	POSITION
OFF-E_{PS}-I_{PS}-I_{OSC} Switch (L-Band pulsed command)	4A1A2	OFF
TRANSMITTER CONTROL (L-Band CW command)	4A1A1	REMOTE
ANTENNA RADIATE/DUMMY LOAD Switch (L-Band CW command)	4A1A1	RADIATE
MOD CONTROL LOCAL/REMOTE Switch (X-Band)	4A3A1	LOCAL
CW COMMAND XMTR Circuit Breaker	4A5	ON
CONVENIENCE OUTLET Circuit Breaker	4A5	ON
PULSE CMD XMTR Circuit Breaker	4A5	ON
ELEV BRAKE Circuit Breaker	4A5	ON
HIGH VOLTAGE AUTO-MANUAL Switch	4A3A1	AUTO
VOLTAGE Switch	4A3A1	OFF
CURRENT Switch	4A3A1	OFF
AFT-MFC Switch	4A2A2	AFC

Table 2-65. Initial Control Settings for Radar Control Trailer

NAME OF CONTROL	LOCATION	POSITION
28 VDC Switches	1A5A2	ON
RECVR PWR Switches	1A5A2	ON
WG PRESS Switches	1A5A2	ON
CAB FANS	1A5A2	ON
ANT HTRS Switches	1A5A2	As required
PED HTRS Switches	1A5A2	As required
MODE SELECTOR Switches	1A1A1	MODE I
XMTR CONTROL AZ and EL Switches (S- and C-Band)	1A1A1	ON
XMTR CONTROL Switch (X-Band)	1A1A1	ON

Table 2-65. Initial Control Settings for Radar Control Trailer (Continued)

NAME OF CONTROL	LOCATION	POSITION
XMTR CONTROL ANTENNA/LOAD Switches	1A1A1	LOAD
CMD XMTR ON-OFF Switch	1A1A1	ON
CMD XMTR ANTENNA/LOAD Switches	1A1A1	LOAD
HIGH PRF/LOW PRF Switch	1A1A4	HIGH PRF
REFERENCE PRF SELECT HIGH-LOW Switch	1A3A4	HIGH
LAUNCH 1, 2 and 3 Switches	1A1A4	Lower half of switch is not lighted

NOTE

Computer shall be positioned to on and in normal operation. Refer to paragraphs 2-45 and 2-50.

CAUTION

Scanner switches on panel 1A5A2 shall be positioned to OFF when not in use in order to conserve service life of rotary joints.

TROUGH SCANNERS AZ and EL Switches (S- and C-Band)	1A5A2	ON
DISH SCANNERS AZ and EL Switches (C-Band)	1A5A2	ON
TROUGH AND DISH SCANNERS Switches (X-Band)	1A5A2	ON
CW XMTR PWR ON Switch	1A5A27	ON
PULSE XMTR PWR ON Switch	1A5A27	ON

c. Depress XMTR PWR ON/OFF switch to apply power. The following panel indicators will light: PWR ON, WG PRESS LOSS, TIME DELAY RUNNING, and INTLK OPEN. Also, CURRENT meter and VOLTAGE meter should indicate correct magnetron filament readings for the transmitter selected.

NOTE

The required current and voltage for each transmitter is listed on a placard on the panel above transmitter control 1A5A1.

d. Depress INTLK RESET switch. WG PRESS LOSS indicator should go out if there is sufficient waveguide pressure.

e. After an 8-minute time delay, TIME DELAY RUNNING indicator and INTLK OPEN indicator should go out.

f. HV OFF/READY indicator should be lighted.

g. Depress HV ON switch. This actuates high voltage power supply in selected transmitter. HV OFF/READY indicator should go out, indicating proper sequencing of actuating circuit. HV ON indicator should light.

h. Position selector switch to INVERSE; position VOLTAGE selector switch to CURRENT PWR SUP.

i. Momentarily depress HV RAISE switch and observe CURRENT and VOLTAGE meters. Continue depressing HV RAISE switch until power supply voltage reaches 3 kilovolts. Note that inverse current rises rapidly at first and then the rate of rise decreases with increasing power supply voltage.

j. Depress HV LOWER switch until voltage begins to decrease to ensure proper operation of high voltage lower circuit.

CAUTION

At no time should magnetron average current exceed 68 milliamperes. Damage to magnetron or associated equipment may result.

k. Position CURRENT selector switch to MAG AVG. Depress HV RAISE switch and hold until magnetron average current reaches the proper value (as shown on the placard) for the selected transmitter. Ensure that high voltage has not exceeded 5.6 kilovolts.

CAUTION

Monitor transmitter control panel meter reading to ensure that maximum reflected power is not exceeded. Reflected power shall be at least 12dB less than incident power.

2-28A. S- AND C-BAND LOCAL Transmitter RUNUP. A single procedure is applicable for running up all azimuth and elevation transmitters (2A2, 3A2, 2A7 and 3A7) locally in the S- and C-band antenna trailers. This procedure is detailed below:

CAUTION

Do not attempt to run up S- or C-band transmitters until the procedures in paragraphs 2-18 through 2-25 and the settings in table 2-63 have been completed.

a. Adjust the manually controlled exhaust baffles above the azimuth and elevation transmitters as required to maintain the operating temperature inside the cab between -32 and +52 degrees centigrade. Equipment air should be exhausted inside the trailer during cold weather conditions.

b. At the transmitter control panel (2A2, 3A2, 2A7 or 3A7) position REMOTE TRANSFER LOCAL/REMOTE switch S103 to LOCAL.

c. Position both CURRENT switch S101 and VOLTS switch S102 to MAG FIL.

d. Position PWR ON/OFF switch S104 to ON. Current and voltage meter should indicate the required readings for the transmitter selected after approximately 8 minutes, TIME DELAY RUNNING indicator DS107 should extinguish and HV READY indicator DS105 should light.

e. Press HV ON switch S105. HV ON indicator DS106 should illuminate.

f. Position VOLTS selector switch S102 to PWR SUP and CURRENT switch to MAG AVG. Press and hold HV RAISE switch S107 while monitoring meters until required MAG AVG reading is indicated on CURRENT meter. (Required reading is listed on a placard on the panel above transmitter control 1A5A1). Press RESET switch S109 and any remaining fault lamps should extinguish.

2-29. X-BAND TRANSMITTER RUNUP. The X-band transmitter is activated locally by the following procedure:

CAUTION

Do not attempt to run up the X-band radar until the procedures in paragraphs 2-18 through 2-26 and settings in table 2-64 have been completed.

a. At transmitter control panel 4A3A1A1, position CURRENT selector switch to MAGN FIL [AX. 01].

b. Depress MOD CONTROL PWR ON switch. The following panel indicators will light: POWER ON, WAVEGUIDE PRESS LOW, MOD CONTROL TIME DELAY RUNNING, and HIGH VOLTAGE INTLK. The CURRENT meter should indicate the required reading.

NOTE

The required current for the transmitter is listed on a placard on the front panel.

c. Depress RESET switch. WAVEGUIDE PRESS LOW indicator should go out.

d. After an 8-minute time delay, MOD CONTROL TIME DELAY RUNNING indicator should go out.

e. HIGH VOLTAGE OFF/READY indicator should light.

f. Position HIGH VOLTAGE AUTO/MANUAL switch to MANUAL, and depress HIGH VOLTAGE ON switch. This activates the high voltage power supply. HIGH VOLTAGE OFF/READY indicator should go out, indicating proper sequencing of actuating circuits. HIGH VOLTAGE ON indicator should then light.

g. Position VOLTAGE selector switch to PWR SPLY HV [VX100]; position CURRENT selector switch to PWR SPLY [MAX. 1].

h. Position HIGH VOLTAGE RAISE/LOWER switch to RAISE and observe meters. Increase high voltage until it reaches 15 kilovolts.

i. Position HIGH VOLTAGE RAISE/LOWER switch to LOWER and determine that voltage decreases.

CAUTION

The magnetron average current should not exceed 30 milliamperes at any time. Damage to the magnetron and associated equipment can result if this value is exceeded.

j. Position CURRENT selector switch to MAGN AVG [MAX .1]. By use of HIGH VOLTAGE RAISE/LOWER switch, adjust high voltage to approximately 24 kilovolts and depress RESET switch. Continue raising high voltage until magnetron average current equals the value shown on front panel placard. The high voltage applied to the magnetron should not exceed 28 kilovolts as indicated on VOLTAGE meter.

k. At transmitter control 1A5A27, depress XMTR PWR ON switch; depress HV ON switch.

l. Position MOD CONTROL LOCAL/REMOTE switch on the X-band transmitter control 4A3A1A1 to REMOTE. Control of X-band transmitter is now transferred to control panel 1A5A27.

NOTE

If the X-BAND FAULT indicator on the X-band transmitter control 1A5A27 (remote) lights during X-band operation, some fault has developed and an automatic shutdown will have occurred. Examine the fault indicators at the top of the X-band transmitter control 4A3A1A1 to determine the condition that caused the shutdown. After correcting the fault, depress the RESET switch on the X-band transmitter control 4A3A1A1 and reperform the runup procedure.

2-29A. X-BAND REMOTE TRANSMITTER RUNUP. The X-band transmitter is activated remotely by the following procedure:

a. At the transmitter control 4A3A1A1, position the MOD CONTROL LOCAL/REMOTE switch to REMOTE at the transmitter control 1A5A27, position the XMTR PWR ON-OFF switch to ON.

b. The FAULT indicator DS12 and the TIME DELAY RUNNING indicator DS11 should light.

c. After approximately 8 minutes, the TIME DELAY RUNNING indicator DS11 will go out.

d. Depress the RESET switch S18. If waveguide pressure is adequate and interlock are closed, the FAULT indicator DS12 will go out; the CONTROL ENABLED indicator DS13 will light; and the HV OFF/READY indicator DS9 will light.

e. Depress HV/ON switch S13. Observe that power supply voltage, power supply current and magnetron average current are in accordance with the values shown for X-band on the placard on the panel above transmitter control 1A5A1.

2-30. L-BAND PULSED COMMAND TRANSMITTER RUNUP. The same procedure is used to turn on any one of the three L-band pulsed command transmitters (2A1A1, 3A1A1, and 4A1A2). This procedure is detailed below.

CAUTION

Do not attempt to run up an L-band pulsed command transmitter until the procedures in paragraphs 2-16 through 2-26 and the settings in tables 2-63, 2-64, and 2-65 have been completed.

a. At appropriate transmitter control panel (1A5A7 or 1A5A27), determine that XMTR PWR ON/OFF switch is depressed for XMTR PWR ON. The XMTR PWR indicator should light.

b. Select PWR SUP V (PWR SUP HI V, X-band) at the meter select switch.

c. After a 5-minute delay period, HV OFF/READY (HV OFF, X-band) indicator should light.

d. Depress HV ON switch. HV OFF/READY (HV OFF, X-band) indicator should remain lighted and HV ON indicator should light.

e. Momentarily depress both HV RAISE and HV LOWER switches and note that voltage indicated on panel meter increases or decreases accordingly.

f. Adjust high voltage with the appropriate switch until panel meter indicates 8 kilovolts.

CAUTION

Observe power monitor meter reading to ensure that maximum inverse power is not exceeded.

2-31. L-BAND CW COMMAND TRANSMITTER RUNUP. The L-band CW command transmitter 4A1A1 is activated by completing the following steps:

CAUTION

Do not attempt to run up the L-band CW command transmitter until the procedures in paragraphs 2-18 through 2-26 and the settings in tables 2-63, 2-64, and 2-65 have been completed.

a. At transmitter control 1A5A27, determine that XMTR PWR ON switch is depressed for XMTR PWR ON and that XMTR PWR ON indicator is lighted.

b. Select CATH V on meter selector switch on CW L-BAND section of the control panel 1A5A27.

c. After a 5-minute time delay, HV OFF/READY indicator will light.

d. Depress HV ON switch. HV OFF/READY indicator should go out and HV ON indicator should light.

e. Check panel meters for required current, voltage and power readings as shown on placard on the panel.

CAUTION

The FAULT indicator lights during transmitter operation to indicate that a fault has developed in the transmitter and an automatic shutdown will occur. Examine the fault lights on the panel of the L-band CW command transmitter 4A1A1 to determine the condition that caused the shutdown. After correcting the fault, depress the RESET switch and reperform the runup procedure.

2-32. RADAR SET TURNOFF PROCEDURE.

2-33. X-BAND TRAILER TURNOFF. L-band CW command transmitter 4A1A1 rundown is detailed below:

a. Depress HV OFF switch on X-band transmitter control 1A5A27.

b. Depress XMTR PWR OFF switch on X-band transmitter control 1A5A27.

2-34. L-Band Pulsed Command Transmitter 4A1A2 Rundown. The same procedure is used to turn off any one of the three L-band pulsed command transmitters 2A1A1, 3A1A1, and 4A1A2.

a. Use the RAISE/LOWER switch to lower high voltage to zero.

b. Depress HIGH VOLTAGE OFF switch.

c. Depress XMTR PWR ON/OFF switch on applicable transmitter control panel (1A5A7, 1A5A27).

2-35. X-Band Transmitter 4A3A1A1 Rundown. Proceed as follows:

a. Position MOD CONTROL LOCAL/REMOTE switch to LOCAL.

b. Depress HIGH VOLTAGE OFF switch, wait for HIGH VOLTAGE OFF/READY indicator to light.

c. Depress MOD CONTROL PWR OFF switch.

2-36. Power Distribution Panel (P/O 4A5A1) Turnoff. Proceed as follows:

a. Position DISH SCANNER circuit breaker to OFF.

b. Position TROUGH SCANNER circuit breaker to OFF.

c. Position WG PRESS circuit breaker to OFF.

d. Position X-BAND MOD circuit breaker to OFF.

e. Position EQUIPMENT BLOWER circuit breaker to OFF.

f. Position PRE RCVR circuit breaker to OFF.

g. Position DC PWR SUP circuit breaker to OFF.

2-37. S- and C-BAND TRAILERS TURNOFF. L-band pulsed command transmitters 2A1A1 and 3A1A1 rundown use the same rundown procedure as for the L-band pulsed command transmitter 4A1A2 in the X-band trailer turnoff procedure.

2-38. S- and C-Band Transmitter Rundown. A single procedure is applicable for turning off all azimuth and elevation transmitters 2A2, 3A2, 2A7, and 3A7.

a. On transmitter front panel, position REMOTE TRANSFER switch to LOCAL.

b. Depress HV LOWER switch to lower high voltage to zero.

c. Depress HV OFF switch; HV READY indicator will light.

d. Position PWR ON/OFF switch to OFF.

2-39. Power Distribution Panel 2A4 or 3A4. Proceed as follows:

a. Position 60 HERTZ SCANNER POWER AZIMUTH and ELEVATION TROUGH circuit breakers to OFF.

b. On power distribution panel 3A4, position SCANNER POWER AZIMUTH and ELEVATION DISH circuit breakers to OFF.

c. Position 60 HERTZ WAVE GUIDE PRESSURIZATION A3 and A8 circuit breakers to OFF.

d. Position 400 HERTZ TRANSMITTER POWER A2 and A7 circuit breakers to OFF.

e. Position 60 HERTZ ANTENNA HEATERS circuit breakers to OFF.

f. Position 60 HERTZ L-BAND TRANSMITTER PWR and FAN circuit breakers to OFF.

g. Position 60 HERTZ EQUIPMENT COOLING FANS circuit breakers to OFF.

h. Position 60 HERTZ DC POWER SUPPLIES circuit breakers to OFF.

i. Position 60 HERTZ CAB LIGHTS & VENTILLATION FANS and LIGHTS circuit breakers to OFF.

2-40. RADAR CONTROL TRAILER TURNOFF. The computer is turned off by positioning switches as follows:

a. Position POWER ON/OFF switch on paper tape reader 1A8A2 to OFF.

b. Position OFF/ON switch on high speed tape punch 1A8A1 to OFF.

c. Position MA/SI/RUN switch on control panel 1A8A4 to SI.

d. Depress POWER OFF switch on control panel 1A8A4.

2-41. Radar Console 1A5. Position all power switches on the radar console 1A5 to OFF. Position the switches on the mode control 1A1A1 as follows:

a. Position XMTR CONTROL C-BAND AZ ON/OFF and EL ON/OFF switches to OFF; position XMTR CONTROL S-BAND AZ ON/OFF and EL ON/OFF switches to OFF.

b. Position XMTR CONTROL X-BAND ON/OFF switch to OFF.

c. Position CMD XMTR X-PEDESTAL, C-PEDESTAL and S-PEDESTAL ON/OFF switches to OFF.

d. Position PEDESTAL POWER S, C and X ON/OFF switches to OFF.

e. Position all OPERATOR SELECT ON/OFF switches to OFF.

2-42. Power Distribution Console 1A12. Proceed as follows:

a. Position RADAR CONTROL TRAILER ELECTRONICS POWER ON/OFF switch to OFF.

b. Position ANTENNA TRAILERS S-BAND, C-BAND, and X-BAND 400HZ 3 PH and 60HZ 3PH circuit breakers to OFF.

c. Position RADAR CONTROL TRAILER ELECTRONICS 60HZ 3PH circuit breakers to OFF; position RADAR CONTROL TRAILER COMPUTER CONSOLE circuit breaker to OFF.

d. Position selector switch 1A12S5 on air conditioner control panel to STANDBY; wait for compressor to shut off, and then position selector switch 1A12S5 to OFF.

e. Position RADAR CONTROL TRAILER AIR CONDITIONER 60HZ 3PH circuit breakers to OFF.

f. Position RADAR CONTROL TRAILER LIGHTS, SERVICE OUTLETS, and RADIO circuit breakers to OFF.

2-43. COMPUTER SYSTEM OPERATING PROCEDURE.

2-44. The following paragraphs contain the information required to operate the DDP-516R computer.

2-45. COMPUTER TURN-ON. The computer is turned on by positioning the COMPUTER CONSOLE circuit breaker 1A12CB10 to ON and by positioning switches on the control panel 1A8A4 as follows:

a. Depress POWER ON switch.

b. Position PFH/PFI switch to PFH.

c. Position STORE/FETCH switch to FETCH.

d. Position P/P+1 switch to P.

e. Position MA/SI/RUN switch to SI.

f. Position OFF/ON switch on the high speed tape punch 1A8A1 to OFF.

g. Position POWER ON/OFF switch on the tape reader 1A8A2 to ON.

h. If program system tape has already been loaded and memory has not been destroyed, proceed to paragraph 2-49, SENSE SWITCH OPTIONS. If it is necessary to load the program into computer, proceed to paragraph 2-46, PROGRAM LOADING PROCEDURE.

2-46. PROGRAM LOADING PROCEDURE. The program is loaded into the computer by positioning switches on control panel 1A8A4 as follows:

a. Thread punched paper tape through tape reader 1A8A2. (Refer to decal on front panel of tape reader.)

b. Depress REGISTER P/Y switch.

c. Position the four SENSE switches to reset (down).

d. Set data register to '1 by depressing switch No. 16 on data register. (Apostrophe indicates octal rather than decimal number.)

e. Position the POWER ON/OFF switch on spooler 1A8A3 to ON.

f. Position MA/SI/RUN switch to RUN.

g. Depress START switch.

2-47. The tape should now begin to load. The entire tape should feed through the tape reader. The reader should stop when it reaches the end of the tape. The program is now in memory. Failure to stop at the end of the tape, failure to start loading, or a stop in the middle of the tape indicates a fault condition. If any of the above conditions occur, check the KEY-IN loader.

If the KEY-IN loader is found to be correct, check for dust or lint in the area of the photocell of the tape reader 1A8A2. A spare system tape should also be tried to determine if the system tape is worn or torn.

2-48. PROGRAM TAPE REWIND PROCEDURE. To rewind the punched paper tape, depress and hold the REWIND switch on the spooler 1A8A3 and tape will rewind on the left spool. Release REWIND switch at end of tape.

CAUTION

Tape must be kept on extension fingers during rewind.

2-49. SENSE SWITCH OPTIONS. The four SENSE switches on the computer front panel are used to control various program options. These SENSE switches should be reset prior to loading a program. The SENSE switches reflect different options applicable to the specific program being executed. During normal operation (execution of the main program), the SENSE switches have the following meanings:

SENSE Switch 1	Reset	High speed tape punch not used
	Set	High speed tape punch ON
SENSE Switch 2	Reset	Status data not typed on teletype
	Set	Status data typed out on teletype
SENSE Switch 3	Reset	Normal program operation
	Set	Operator input for annotating the data produced by the high speed tape punch
SENSE Switch 4	Reset	Perform normal missile calibration
	Set	Execute test routine.

2-50. NORMAL OPERATION. Normal operation of the main computer program (missile simulation and scoring) is accomplished by performing the following steps:

a. Position SENSE switch 4 to reset (down).

b. Position SENSE switches 1, 2, and 3 in accordance with needs regarding the use of high speed tape punch, the typing of status data, and the annotation of test data. (Refer to settings described in paragraph 2-49.)

c. Depress REGISTER P/Y switch. Set data register to 1000_8 by depressing switch No. 7 on data register.

d. Position MA/SI/RUN switch to RUN.

e. Depress START switch.

f. The computer will now type out TIME-HOUR? on the teletype.

g. Type in the current time in hours only and strike carriage return key. For example, if the time is 10:30, type in 10 and return carriage.

h. The computer will type out MIN?

i. Type in the current time in minutes. In the above example, operator would type in 30 and return carriage.

j. The computer will type our SEC?

k. Type in the current time in seconds. Zero may be entered by striking the carriage return key.

l. If it is desirable to annotate paper tape and typewriter (SENSE switch 3 to set (up), the computer will type out **. The operator should then type in appropriate

annotation data such as run number, aircraft type, etc. When last line of annotation data has been typed in, position SENSE switch 3 to reset (down) and strike return carriage.

m. If it is desirable to punch tape (SENSE switch 1 to set), paper tape punch will punch status data as events occur (refer to step 1) and AGC voltage at 5-second intervals. (See figure 2-54.)

n. If it is desirable to type status data (SENSE switch 2 to set), the computer will type frequency band, target track, and transponder track data when switch is set initially and each time a condition changes. (See figures 2-54 through 2-57.) Missile status data will be recorded at the time of launch, abort and end-of-flight. (See figure 2-58.) At the time of simulated missile impact, the miss-distance from the missile to each transponder or to the reference track is calculated and printed out in the format shown in figure 2-59.

o. While computer is performing normal missile calculation, specific memory locations may be examined by operator. This is accomplished by making use of the DATA REQUEST thumbwheels on computer interface 1A5A14. The requested data is then displayed on the Nixie tubes of the DATA DISPLAY. A list of missile variables that may be displayed is shown in table 2-66. The variables are listed alphabetically by the mnemonics used to identify the variables in the computer program.

2-51. COMPUTER SYSTEM TEST ROUTINES.

2-52. GENERAL. The Honeywell diagnostic routines and the radar set programmed test routines are used to check operation of the computer system. These routines may be used to determine proper operation of the computer main frame. The radar set programmed test routines are used to determine proper operation of the input/output system and the missile guidance program. They may also be used for adjustment of certain parameters in the radar system.

2-53. RADAR SET PROGRAMMED TEST ROUTINES. The radar set programmed test routines are contained in the main system program tape and the radar test program tape. The main system program tape contains test numbers 5, 6, 7, 11, 12 and 13 and the radar test program tape contains test numbers 1, 2, 3, 4, 10, 11, 12, and 15. In order to execute the desired test routine, the applicable tape must first be loaded as described previously. The program is initiated by performing the following steps:

a. Position SENSE switch 4 to set (up).

b. Depress REGISTER P switch.

c. Set the data register to '1000 (by depressing switch No. 7).

d. Position MA/SI/RUN switch to RUN.

e. Depress START switch.

f. The computer will type out TEST No. ?

g. Position SENSE switches 1, 2, and 3 as required for the program to be executed. (Refer to Test Instructions, Paragraph 2-55.)

h. Type in the number of the test program followed by a carriage return.

2-54. The computer program will now proceed with the requested test. The real time clock is not serviced while executing the test routines. Therefore, it is necessary to enter a new starting time after completion of the test routine. Test 0 is a "dummy" test to allow return to the main program after execution of test programs contained in the main system program. To reenter the main program, position SENSE switch 4 to reset down and type in 0 when the computer requests a new test number at completion of a test routine. To reenter the main program after execution of test programs on the radar test program tape, the main system program must be loaded into the computer as previously described.

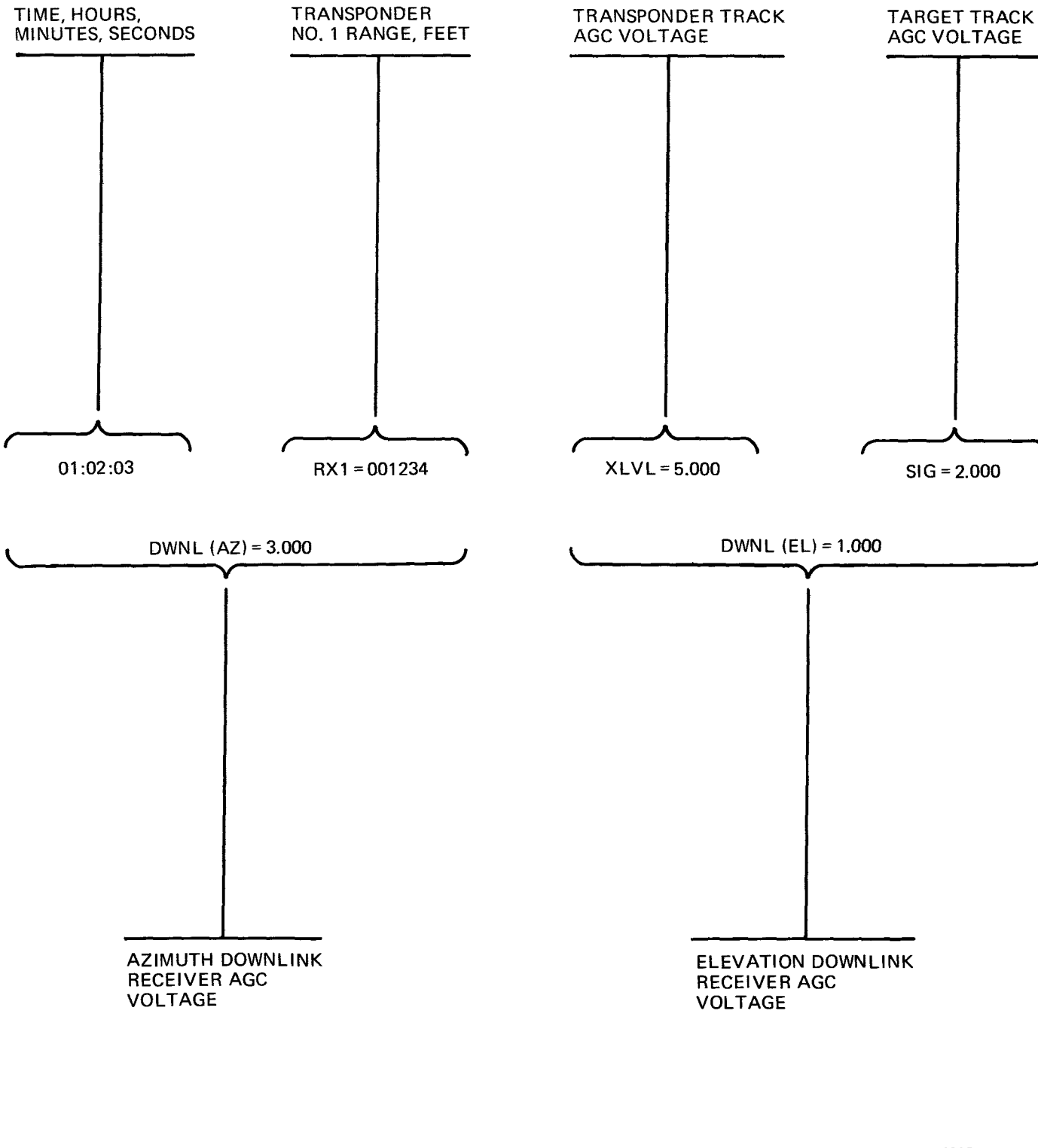


Figure 2-54. A. G. C. Format, Punch Format

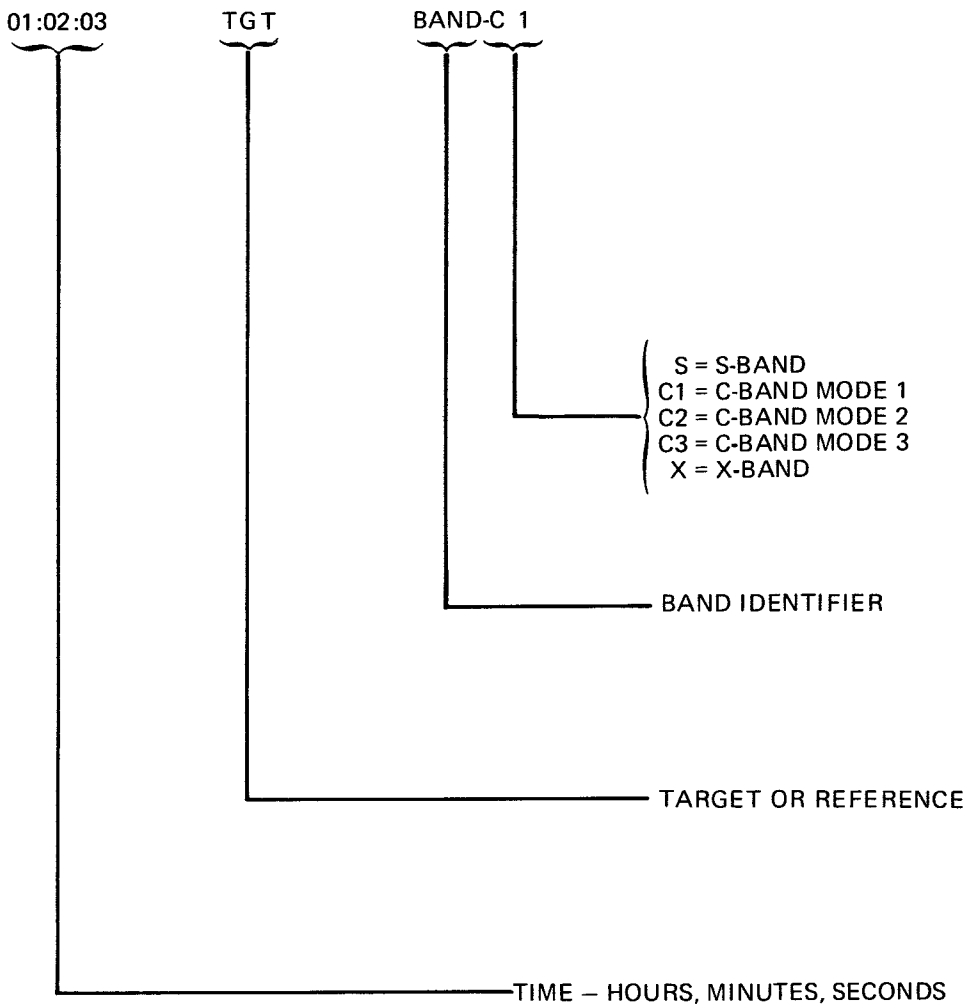


Figure 2-55. Band Type Format

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS, RADAR TRAINING SET, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1 FOR FIGURE 2-56

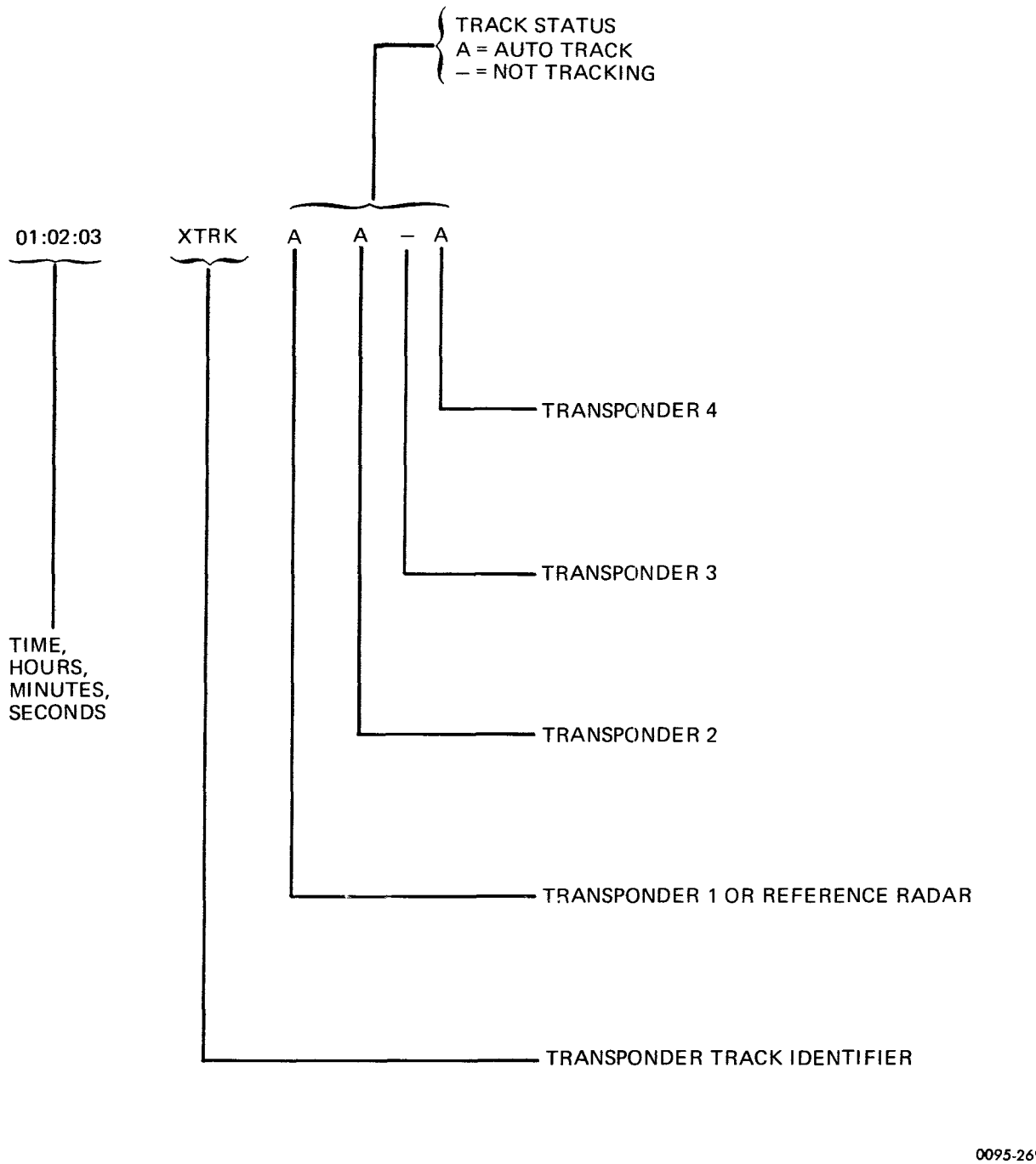


Figure 2-57. Transponder Track Data, Type Format

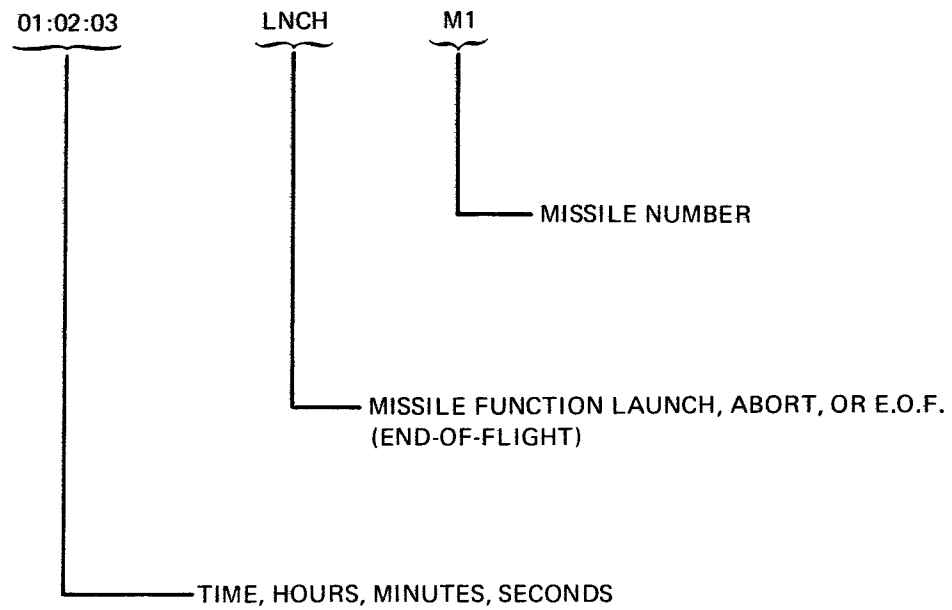


Figure 2-58. Missile Status, Type Format

2-55. Test Instructions. The test routines contained in the radar set main computer program and test program are described below. Required positioning of SENSE switches to execute the tests is also described. The tests are listed in table 2-67.

2-56. Test 1. Test 1 is used to read punched paper tape on the tape reader 1A8A2. The data which is read is typed out on the teletype. This program is used to ascertain that the high speed tape punch 1A8A1 has punched out all data required during a run. The program may also be used to make additional copies of data typed out during execution of the main program. Test 1 will continue to loop as long as SENSE switch 4 is positioned to set (up). When SENSE switch 4 is positioned to reset, the computer will again request a new test number.

2-57. SENSE switch 4 must normally be positioned to reset on the "trailer" of the punched paper tape. If the paper tape runs completely through the reader, recovery of the program must be accomplished by restarting the program. In order to restart the program, depress the REGISTER P switch and then depress switch No. 7 on the data register.

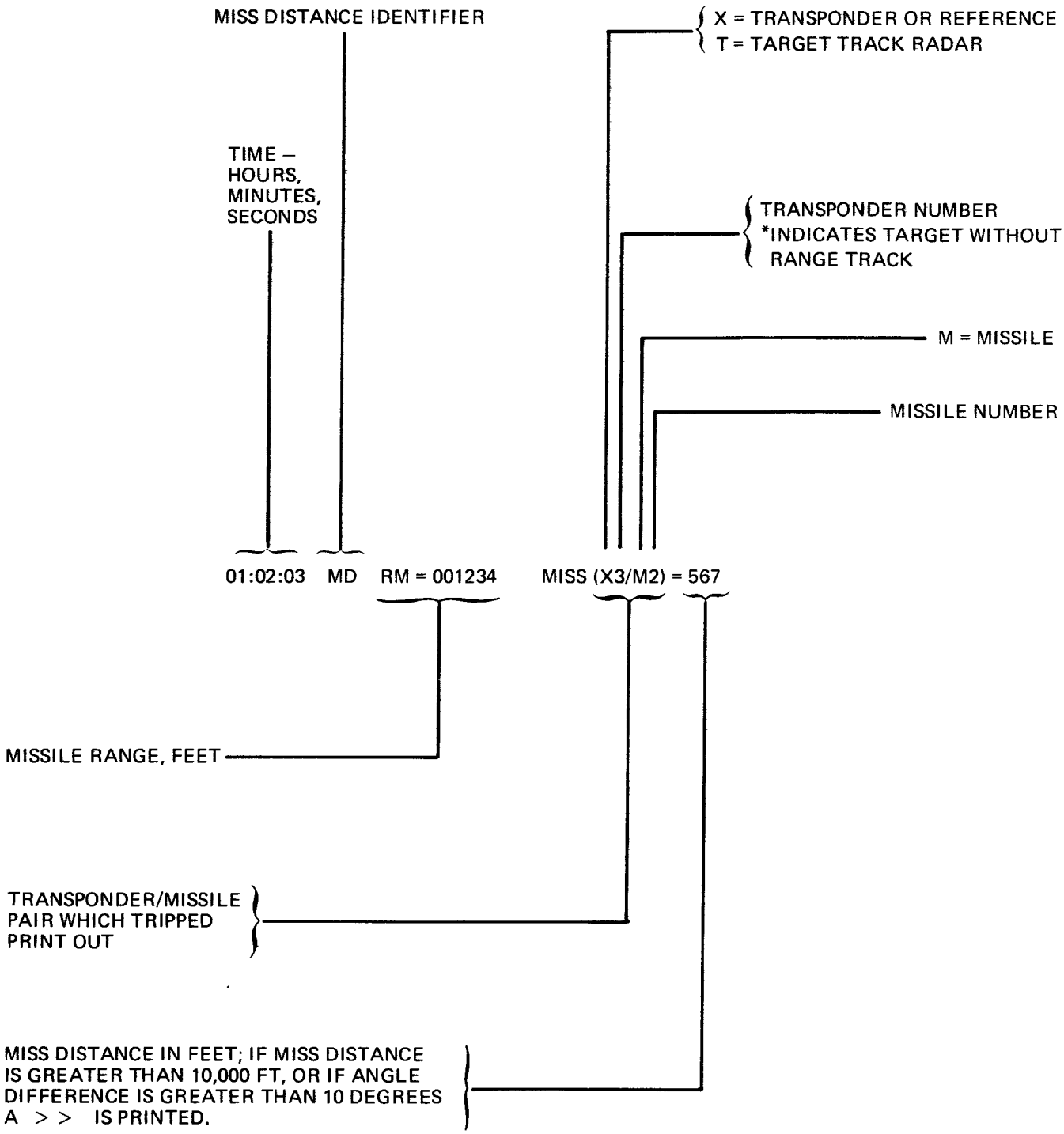


Figure 2-59. Miss Distance, Type Format

Table 2-66. Multiple Missile Variable Assignments

MNEMONIC	MEMORY LOC	SYMBOL	NAME	UNITS
ALPP	'1171, '1172, '1173	αp	Pitch Angle of Attack	rdn
ALPY	'1174, '1175, '1176	α_y	Yaw Angle of Attach	rdn
AQ	'1351, '1352, '1353	A(Q)	Autopilot Gain (Guid. 1 & 3)	
AY	'1344, '1345, '1346	a_y	Lateral Acceleration	ft/sec^2
AZ	'1341, '1342, '1343	a_z	Normal Acceleration	ft/sec^2
A11	'1041, '1042, '1043	a_{11}	Direction Cosine	
A12	'1044, '1045, '1046	a_{12}	Direction Cosine	
A12	'1051, '1052, '1053	a_{13}	Direction Cosine	
A21	'1054, '1055, '1056	a_{21}	Direction Cosine	
A22	'1061, '1062, '1063	a_{22}	Direction Cosine	
A23	'1064, '1065, '1066	a_{23}	Direction Cosine	
A31	'1071, '1072, '1073	a_{31}	Direction Cosine	

Table 2-66. Multiple Missile Variable Assignments (Continued)

MNEMONIC	MEMORY LOC	SYMBOL	NAME	UNITS
A32	'1074, '1075, '1076	a_{32}	Direction Cosine	
A33	'1101, '1102, '1103	a_{33}	Direction Cosine	
BM	'1142, '1144, '1146	βM	Missile Azimuth Angle (Double Precision)	deg
BPDT	'1274	$\dot{\beta}P$	Pedestal Azimuth Angle Rate Handwheel	deg/sec
BPED (DP)	'1406	βP_T	Pedestal Azimuth Angle (Target) (DP)	deg
BPDR	'1456	βP_R	Pedestal Azimuth Angle (Ref) (DP)	deg
BPTD	'1275	$\dot{\beta}P_T$	Total Pedestal Azimuth Rate	deg
BRT	'3143	βRT	Target Azimuth Relative to Pedestal	deg
BRX1	'3145		Transponder Azimuth	deg
BRX2	'3146		Relative to Window	
BRX3	'3147			
BRX4	'3150			
BT	'1402 (DP)	βT	Tracked Target Azimuth Angle	deg
BTDT	'1047	$\dot{\beta}T$	Tracket Target Azimuth Rate	rdn/sec
BX1	'1462		Transponder Azimuth	deg
BX2	'1464			
BX3	'1466			
BX4	'1522			

Table 2-66. Multiple Missile Variable Assignments (Continued)

MNEMONIC	MEMORY LOC	SYMBOL	NAME	UNITS
CAD	'1221, '1222, '1223	C_{A_δ}	Axial Force due to Fin Deflection	$1/rdn^2$
CAϕ	'1224, '1225, '1226	C_{A_ϕ}	Power On Axial Force	
CG	'1271, '1272, '1273	CG(t)	Center of Gravity Aft of Reference Point (GDA)	feet
CM	'1214, '1215 '1216	C_m (M, δ, α)	Pitch Moment Coefficient	
CN	'1211, '1212, '1213	C_n (M, δ, α)	Yaw Moment Coefficient	
CNN	'1201, '1202, '1203	C_N (M, δ, α)	Normal Force Coefficient	
CYY	'1204, '1205, '1206	C_Y (M, δ, α)	Lateral Force Coefficient	
DELP	'1311, '1312, '1313	δ_P	Pitch Control Surface Deflection	rdn
DELT	'1007	ΔT	Iteration Time	sec
DELY	'1314, '1315, '1316	δ_y	Yaw Control Surface Deflection	rdn
DWNL	'1473, '1474		Down Link Jam Sig Level (AZ), (EL)	volts
EM	'1132, '1134, '1136	ϵ_M	Missile Elevation Angle (Double Precision)	deg
EPDT	'1276	$\dot{\epsilon}_P$	Pedestal Elevation Angle Rate (Handwheel)	deg/sec
EPED	'1452	ϵ_{R_t}	Pedestal Elevation Angle (Tft) (DP)	deg

Table 2-66. Multiple Missile Variable Assignments (Continued)

MNEMONIC	MEMORY LOC	SYMBOL	NAME	UNITS
EPDR	'1454	ϵP_r	Pedestal Elevation Angle (Ref) (DP)	deg
EPTD	'1277	$\dot{\epsilon}_{PT}$	Total Pedestal Elevation Rate	deg/sec
ERT	'3144	ϵ_{RT}	Target Elevation Relative to Pedestal	deg
ERX1 ERX2 ERX3 ERX4	'3151, '3152, '3153, '3154	ϵ_{Rx}	Transponder Elevation Relative to Pedestal	deg
ET	'1404 (DP)	ϵ_T	Tracked Target Elevation Angle	deg
ETDT	'1057	$\dot{\epsilon}_T$	Tracked Target Elevation Rate	rdn/sec
EX1 EX2 EX3 EX4	'1524, '1526, '1512, '1514		Transponder Elevation Angle	deg
FQ	'1231, '1232, '1233	$f_{(q)}$	Dynamic Pressure Function	
HMSL	'1151, '1152, '1153	h_m (1000)	Height of Missile (= $-Z_M$)	Kilo feet
HTGT	'1431	h_{tl}	Target Altitude	Kilo feet
HTP	'1157	h_t	Target Sight Set on Thumbwheel Switches	Kilo feet
IYY	'1261, '1262, '1263	I_{yy}	Moment of Inertia	Slug-ft^2
K1	'1324, '1325, '1326	K_1	Yaw Command Signal	FT
K2	'1321, '1322, '1323	K_2	Pitch Command Signal	Ft

Table 2-66. Multiple Missile Variable Assignments (Continued)

MNEMONIC	MEMORY LOC	SYMBOL	NAME	UNITS
LMDA	'1104, '1105, '1106	λ	Atmospheric Pressure Ratio	
LPRM	'1266		Number of Idle Cycles	10's μsec
MACH	'1161, '1162, '1163	M	Mach Number	
MASS	'1251, '1252, '1253	m	Mass	Slugs
MCOR	'1261, '1262		Angle Correction in Manual Track	
NIXA	'1254,		BCD Nixie Display - 1st BCD GROUP	
NIXB	'1255,		BCD Nixie Display - 2nd BCD Group	
NIXC	'1256,		Decimal Place and Sign Address	
NIXD	'1257			
NRM	'1334		Number of Missiles (-)	
PC1	'1006	$1-\epsilon^{\Delta t/.013}$	Time Constant Function (Autopilot)	Units
QC	'1424, '1425, '1426	$\bar{q}_c$	Dynamic Pressure Corrected	lb/ft^2
QR	'1111, '1112, '1113	q	Pitch Angular Rate	rdn/sec
RM	'1122, '1124, '1126	R_M	Missile Stant Range (Double Precision)	Ft
RMAX	'1441	R_{max}	Max. Plot Board Range	Ft
RMI	'1121	R_i	Predicted Impact Range	Ft

Table 2-66. Multiple Missile Variable Assignments (Continued)

MNEMONIC	MEMORY LOC	SYMBOL	NAME	UNITS
RMIN	'1442	R_{min}	Min. Plot Board Range	Ft
ROFF	'1501	R_{off}	Target Offset Range	Ft
RR	'1114, '1115, '1116	r	Yaw Angular Rate	rdn/sec
RT	'1412 (DP)	R_t	Tracked Target Slant Range	Ft
RTG	'1443	R_{tg}	Target Ground Range	Ft
RX1 RX2 RX3 RX4	'1502, '1504, '1506, '1414		Transponder Range	Ft
SIG	'1472		Received Signal	Volts
STW			Status Words - See Status Word Table 2-72	
TFØ	'1241	t_o	Initial Time of Flight	Sec
TF	'1242, '1244, '1246	t	Time of Flight	Sec
TREM	'1267		Time Remaining	10's of ms
TSL	'1154, '1155, '1156	T_{SL}	Sea Level Thrust (Function 10)	Thousands of Pounds
U	'1012 '1014, '1016	u	Missile Linear Velocity (Double Precision)	ft/sec
V	'1022, '1024, '1026	v	Missile Linear Velocity along y_b axis (Double Precision)	ft/sec
VSND	'1301, '1302, '1303	v_s	Speed of Sound	ft/sec

Table 2-66. Multiple Missile Variable Assignments (Continued)

MNEMONIC	MEMORY LOC	SYMBOL	NAME	UNITS
VT	'1361, '1362, '1363	V	Total Missile Velocity	ft/sec
VTGT	'1021		Target Radial Velocity	ft/sec
W	'1032, '1034, '1036	w	Missile Linear Velocity in Z_b direction (Double Precision)	ft/sec
XLVL	'1471		Transponder #1 Signal Level	volts
XTPB	'1546		X Component of Target Plot Board	
YTPB	• '1547		Y Component of Target Plot Board	

Table 2-67. Radar Set Programmed Test Routines

TEST NO.	PURPOSE	SENSE SW1		SENSE SW2		SENSE SW3		SENSE SW4		NOTES
		RESET	SET	RESET	SET	RESET	SET	RESET	SET	
*0	Main Program	Punch OFF	Punch ON	No Type status	Type status data	Operate	Annotate paper tape and type-writer	Operate	Execute test program	
*1	Read Paper Tape and Type							Quit	Continue	
*2	Analog Input (A/D) Test			Type results	Loop without typing	Continu-ous loop	Loop once, press start to repeat	Quit	Continue	
*3	Input from Radar Interface			Loop	Request new chan-nel num-ber	Inter-rupt OFF	Inter-rupt ON	Quit	Continue	Data in B Register type subchannel on TTY
*4	Output to Radar Interface			Loop	Enter new data			Quit	Continue	Set data into B Register
5	Print Calibration Constants on Teletype									Enter Start and Stop Loca-tion from TTY
6	Assign Plot Variables									See ANOUTX listing
7	Computer-Only Flight					Operate	Reset target (momen-tary)	Quit	Continue	Set status word in A; type in var-iables; GO

Table 2-67. Radar Set Programmed Test Routines (Continued)

TEST NO.	PURPOSE	SENSE SW1		SENSE SW2		SENSE SW3		SENSE SW4		NOTES
		RESET	SET	RESET	SET	RESET	SET	RESET	SET	
*10	D/A Converter Test					Sawtooth out	Zero volts out	Quit	Continue	
**11	Calibrate Radar Constants	Loop	Enter new address		Increment		Decrement	Quit	Continue	
**12	Punch New Program Tape	Punch complete program	Enter memory locations					Quit	Continue	
13	Enter Parallax Data							Quit	Continue	
*15	Check Data Transfer to GEIS	Bit transfer to GEIS	Word transfer to GEIS		Interchange Odd and even words transferred to GEIS			Quit	Continue	

*These tests are not contained in the main system program.
**These tests are contained in both the main system program and the radar test program.

2-58. Test 2. Test 2 is used to enter data from the analog-to-digital (A/D) converter into the computer. The A/D input voltages may be printed out on the teletype in groups of 16, corresponding to the 16 channels available on the A/D converter. Inputs to the A/D converter are listed in table 2-68.

2-59. SENSE switch 2 governs the typing of the input data. With SENSE switch 2 positioned to reset, normal typeout occurs. With SENSE switch 2 positioned to set, the input data is not typed, and the program loops continuously. This mode may be used to exercise the analog-to-digital converter for troubleshooting purposes.

2-60. SENSE switch 3 determines the number of conversion sets to be performed. If SENSE switch 3 is positioned to reset, the system continuously converts. If SENSE switch 3 is positioned to set, the conversion is commanded, the typewriter prints the results, and the computer stops. Another cycle of conversion and printout can be initiated by depressing the START switch.

2-61. SENSE switch 4 determines whether execution of the current program is to continue or be discontinued. If SENSE switch 4 is positioned to set, the current program continues to be executed. If SENSE switch 4 is positioned to reset, the program requests the next test to be executed.

2-62. Test 3. Test 3 is used to enter data from the computer interface. When the routine is entered, the computer types out CHANNEL NR/. At this point the operator must type in the interface address which is to be entered, followed by a "carriage return". For a list of computer interface address assignments, refer to table 2-69. The program will cause data to be transferred from the computer interface to the computer. The input data may be displayed on the B data register by depressing the REGISTER B switch. In the case of interface channels which enter more than one word at a time (e.g., pedestal encoders), the operator must select the series of words to be displayed by entering the word number on the teletype while the program is running. SENSE switch operation is described in the following paragraphs.

2-63. SENSE switch 2 determines whether or not the same channel number is to be interrogated continuously. If SENSE switch 2 is positioned to reset, the same channel will be interrogated on a continuous basis. If SENSE switch 2 is positioned to set, the computer will request a new channel number. SENSE switch 2 may be operated before the program is executed or during program execution. SENSE switch 3 determines whether the interrupt system is to be used. The interrupt system is used only for range inputs. SENSE switch 3 must be positioned to set if the selected channel contains range data. SENSE switch 4 determines whether or not execution of the test in progress will continue. If SENSE switch 4 is positioned to set, the current program continues to be executed. If SENSE switch 4 is positioned to reset, the program requests the next test to be executed.

2-64. Test 4. Test 4 is used to supply one channel of data to the computer interface. When the test is entered, the computer types out LOAD "B" W/DATA. The operator must position MA/SI/RUN switch to SI, then load the OUTPUT data word which is to be entered into the B register by depressing the REGISTER B switch and manually loading the register by means of data register switches 1 through 16. After loading the B register with data, position MA/SI/RUN switch to RUN then depress START switch. The computer will type out CHAN NR ?. Type in desired channel number selector from table 2-69. The computer will then route the output data word to the computer interface.

2-65. SENSE switch 2 determines whether the output data which is entered is

to be entered on a continuous repetitive basis or whether new data must be entered. If SENSE switch 2 is positioned to reset, the computer continuously routes the same data to the computer interface. If SENSE switch 2 is positioned to set, the operator may request a new channel number and enter new data. Sense switch 3 determines whether or not the interrupt system is to be used.

2-66. SENSE switch 4 determines whether or not execution of the current program is to continue. If SENSE switch 4 is positioned to set, the current program continues to be executed. If SENSE switch 4 is positioned to reset, the program requests the next test which is to be executed.

2-67. Test 5. Test 5 is used to print out specified memory locations. It is useful for making a printed record of radar calibration constants. (Refer to table 2-70.) When test 5 is entered, the operator must then type in the beginning and end address of the area of memory to be typed out. SENSE switch positioning is not applicable to this subroutine.

Table 2-68. Analog-to-Digital Converter Data Inputs

LIST OF INPUTS					
CHANNEL	VARIABLE	LIST OF INPUTS	INPUT SCALE	THUMBWHEEL SETTING	DISPLAYED UNITS
'0	'Ep	Pedestal Elevation Rate (Handwheel Output)	-1°/sec/V	1276	deg/sec
'1	'Bp	Pedestal Azimuth Rate (Handwheel Output)	-2°/sec/V	1274	deg/sec
'2					
'3					
'4	XLVL	Transponder #1 AGC	10 V Max	1471	volts
'5	SIG	Target Track AGC	10 V Max	1471	volts
'6	DWNL (AZ)	Down Link AGC	10 V Max	1473	volts
'7	DWNL (EL)	Down Link AGC	10 V Max	1474	volts

Table 2-69. Interface Address Assignments

INTERFACE ADDRESS	ASSIGNMENT	THUMBWHEEL SETTING	DISPLAYED UNITS	TO/FROM COMPUTER	WORD FORMAT
'1	Status Word 1	1371	Bits	T	Pedestal Position is sent in the following sequence: Tgt Az MSB, Tgt AZ LSB, Tgt El MSB, Tgt El LSB, Ref Az MSB, Ref Az LSB, Ref El MSB, Ref El LSB, where MSB is the 16-bit most significant bit and LSB is the least significant bit.
'2	Pedestal Position	See Note 1	Degrees	T	
'3	Max Misl Rng (APB)	1441		F*	
'4	Status Word 2	1372	Bits	F	
'5	Min Misl Rng (APB)	1442		F*	
					16 bit words - Each bit represents a discrete variable. For bit assignments, see status word assignments sheets.
'6	Status Word 3	1373	Bits	T	
'7	Status Word 4	1374	Bits	T	
'10	Status Word 5	1375	Bits	F	
'11	APP Tgt Rng	1443	Feet		
'12	Analog Output		Binary	F	Bits 1-12 data; Bits 13-16 Channel #
'13	Target Range	1412	Feet	T	16 Bit Word. Range is represented by the binary count of a 20 MHz clock. The 16 bit word is treated as all-positive.
'14	Transponder 1 Range	1502	Feet	T	
'15	Transponder 2 Range	1504	Feet	T	
'16	Transponder 3 Range	1506	Feet	T	
'17	Transponder 4 Range	1414	Feet	T	
	*Same as '13				

Table 2-69. Interface Address Assignments (Continued)

INTERFACE ADDRESS	ASSIGNMENT	THUMBWHEEL SETTING	DISPLAYED UNITS	TO/FROM COMPUTER	WORD FORMAT
'20	Target Az Re Window	3143	Degrees	T	
'21	Transponder 1 Az Re Window	3145	Degrees	T	
'22	Transponder 2 Az Re Window	3146	Degrees	T	
'23	Transponder 3 Az Re Window	3147	Degrees	T	16 Bit Word. The first bit is the sign bit. The word represents the count produced by the antenna incremental encoder. Center-of-scan is nominally represented by 0.
'24	Transponder 4 Az Re Window	3150	Degrees	T	
'25	Target El Re Window	3144	Degrees	T	
'26	Transponder 1 El Re Window	3151	Degrees	T	
'27	Transponder 2 El Re Window	3152	Degrees	T	
'30	Transponder 3 El Re Window	3153	Degrees	T	
'31	Transponder 4 El Re Window	3154	Degrees	T	
'32	Thumbwheel			T	15 Bit Word (bits 2 through 16) representing 5 octal digits which have been set into the thumbwheel switches.

Table 2-69. Interface Address Assignments (Continued)

INTERFACE ADDRESS	ASSIGNMENT	THUMBWHEEL SETTING	DISPLAYED UNITS	TO/FROM COMPUTER	WORD FORMAT
'33	Missile Impact Range	1121	Feet	F	Same as '13.
'34	Missile 1 Range	1122	Feet	F	
'35	Missile 1 Az	1142	Degrees	F	Same as '20.
'36	Missile 1 El	1132	Degrees	F	
'37	Nixie A		--	F	2 16-Bit Words representing the first and second group of four Nixie tubes; four BCD digits are represented in each 16-bit word.
'40	Nixie B		--	F	
'41	Nixie C		--	F	Bits 1 through 4 represent the sign; $(7)_{BCD}$ is plus; $(4)_{BCD}$ is minus; Bits 13 through 16 define the decimal point as the number of places to the right of the first Nixie tube.
'42	Azimuth Command Servo	Note 1	Degrees	T	16 Bit Word representing encoder output. The data is in gray code.
'43	Elevation Command Servo	Note 1	Degrees	T	

Table 2-69. Interface Address Assignments (Continued)

INTERFACE ADDRESS	ASSIGNMENT	THUMBWHEEL SETTING	DISPLAYED UNITS	TO/FROM COMPUTER	WORD FORMAT
'44	Missile I Guidance		--	F	16 Bit Word; Bits 4 through 9 are for K_1; Bits 11 through 16 are for K_2. K_1 and K_2 are unsigned binary numbers ranging from $(7)_{10}$ to $(57)_{10}$ to represent flipper deflection; $(32)_{10}$ is the nominal neutral position of the flippers.
'45	Missile II Guidance		--	F	
'46	Missile III Guidance		--	F	
'47	Target Alt for Impact	1157	Kilofeet	T	Bits 1 through 12 represent 3 BCD digits which are set into the impact range computer.
'50	Missile 2 Range	1124	Feet	F	
'51	Missile 2 Az	1144	Degrees	F	Same as '20 and '13.
'52	Missile 2 El	1134	Degrees	F	
'53	Missile 3 Range	1126	Feet	F	
'54	Missile 3 Az	1146	Degrees	F	
'55	Missile 3 El	1136	Degrees	F	

NOTE

T = "To Computer," i.e., computer input

F = "From Computer," i.e., computer output

Table 2-69. Interface Address Assignments (Continued)

INTERFACE ADDRESS	ASSIGNMENT	THUMBWHEEL SETTING	DISPLAYED UNITS	TO/FROM COMPUTER	WORD FORMAT

NOTE

When in normal track mode, pedestal azimuth and elevation angles may be read out as shown below:

	Pedestal	Total Angle
Target Azimuth	1406	1402
Reference Azimuth	1456	1462
Target Elevation	1452	1404
Reference Elevation	1454	1524

If target and reference system make use of the same tracking pedestal, identical readings should be obtained in 1406 and 1456 and in 1452 and 1454.

When in target simulator mode, the angles read above are the command servo encoder output angles.

Table 2-70. Angle Calibration Constants

DESCRIPTION OF CALIBRATION CONSTANT	MEMORY LOCATION	AFFECTED PARAMETER	AFFECTED PARAMETER LOCATION
S-Band Pedestal Azimuth Encoder Zero	3006 (103006*)	Pedestal Azimuth	1406
C-Band Pedestal Azimuth Encoder Zero	3010 (103010*)	Pedestal Azimuth	1406
X-Band Pedestal Azimuth Encoder Zero	3012 (103012*)	Pedestal Azimuth	1406
S-Band Pedestal Elevation Encoder Zero	3014 (103014*)	Pedestal Elevation	1452
C-Band Pedestal Elevation Encoder Zero	3016 (103016*)	Pedestal Elevation	1452
X-Band Pedestal Elevation Encoder Zero	3020 (103020*)	Pedestal Elevation	1452
S-Band Azimuth Scan Encoder Scale Factor	3022	Target Azimuth	1402
C-Band Mode I Azimuth Scan Encoder Scale Factor	3023	Target Azimuth	1402
C-Band Mode II Azimuth Scan Encoder Scale Factor	3024	Target Azimuth	1402
C-Band Mode III Azimuth Scan Encoder Scale Factor	3025	Target Azimuth	1402
X-Band T1 Scan Encoder Scale Factor	3026	T1 Angle	3143
S-Band Elevation Scan Encoder Scale Factor	3027	Target Elevation	1404
C-Band Mode I Elevation Scan Encoder Scale Factor	3030	Target Elevation	1404
C-Band Mode II Elevation Scan Encoder Scale Factor	3031	Target Elevation	1404
C-Band Mode III Elevation Scan Encoder Scale Factor	3032	Target Elevation	1404
X-Band T2 Scan Encoder Scale Factor	3033	T2 Angle	3144

Table 2-70. Angle Calibration Constants (Continued)

DESCRIPTION OF CALIBRATION CONSTANT	MEMORY LOCATION	AFFECTED PARAMETER	AFFECTED PARAMETER LOCATION
S-Band Azimuth Scan Encoder Zero	3034	Target Azimuth	1402
C-Band Mode I Azimuth Scan Encoder Zero	3032	Target Azimuth	1402
C-Band Mode II Azimuth Scan Encoder Zero	3042	Target Azimuth	1402
C-Band Mode III Azimuth Scan Encoder Zero	3045	Target Azimuth	1402
X-Band T1 Scan Encoder Zero	3050	T1 Angle	3143
S-Band Elevation Scan Encoder Zero	3053	Target Elevation	1404
C-Band Mode I Elevation Scan Encoder Zero	3056	Target Elevation	1404
C-Band Mode II Elevation Scan Encoder Zero	3061	Target Elevation	1404
C-Band Mode III Elevation Scan Encoder Zero	3064	Target Elevation	1404
X-Band T2 Scan Encoder Zero	3067	T2 Angle	3144
S-Band Low PRF AZ Auto Track Boxcar Delay Comp	3035	Target Azimuth	1402
S-Band High PRF AZ Auto Track Boxcar Delay Comp	3036	Target Azimuth	1402
C-Band Mode I Low PRF AZ Auto Track Boxcar Delay Comp	3040	Target Azimuth	1402
C-Band Mode I High PRF AZ Auto Track Boxcar Delay Comp	3041	Target Azimuth	1402
C-Band Mode II Low PRF AZ Auto Track Boxcar Delay Comp	3043	Target Azimuth	1402

Table 2-70. Angle Calibration Constants (Continued)

DESCRIPTION OF CALIBRATION CONSTANT	MEMORY LOCATION	AFFECTED PARAMETER	AFFECTED PARAMETER LOCATION
C-Band Mode II High PRF AZ Auto Track Boxcar Delay Comp	3044	Target Azimuth	1402
C-Band Mode III Low PRF AZ Auto Track Boxcar Delay Comp	3046	Target Azimuth	1402
C-Band Mode III High PRF AZ Auto Track Boxcar Delay Comp	3047	Target Azimuth	1402
X-Band T1 Low PRF Auto Track Boxcar Delay Comp	3051	T1 Angle	3143
X-Band T1 High PRF Auto Track Boxcar Delay Comp	3052	T1 Angle	3143
S-Band Low PRF EL Auto Track Boxcar Comp	3054	Target Elevation	1404
S-Band High PRF EL Auto Track Boxcar Comp	3055	Target Elevation	1404
C-Band Mode I Low PRF EL Auto Track Boxcar Comp	3057	Target Elevation	1404
C-Band Mode I High PRF EL Track Boxcar Comp	3060	Target Elevation	1404
C-Band Mode II Low PRF EL Auto Track Boxcar Comp	3062	Target Elevation	1404
C-Band Mode II High PRF EL Auto Track Boxcar Comp	3063	Target Elevation	1404
C-Band Mode III Low PRF EL Auto Track Boxcar Comp	3065	Target Elevation	1404
C-Band Mode III High PRF EL Auto Track Boxcar Comp	3066	Target Elevation	1404
X-Band Low PRF, T2 Scan Auto Track Boxcar Comp	3070	T2 Angle	3144
X-Band High PRF, T2 Scan Auto Track Boxcar Comp	3071	T2 Angle	3144

Table 2-70. Angle Calibration Constants (Continued)

DESCRIPTION OF CALIBRATION CONSTANT	MEMORY LOCATION	AFFECTED PARAMETER	AFFECTED PARAMETER LOCATION
S-Band Elevation Pedestal Deflection at 0-Degree	3107	Pedestal Elevation	1452
S-Band Elevation Pedestal Deflection at 22.5-Degrees	3110	Pedestal Elevation	1452
S-Band Elevation Pedestal Deflection at 45-Degrees	3111	Pedestal Elevation	1452
S-Band Elevation Pedestal Deflection at 67.5-Degrees	3112	Pedestal Elevation	1452
C-Band Elevation Pedestal Deflection at 0-Degree	3114	Pedestal Elevation	1452
C-Band Elevation Pedestal Deflection at 22.5-Degrees	3115	Pedestal Elevation	1452
C-Band Elevation Pedestal Deflection at 45-Degrees	3116	Pedestal Elevation	1452
C-Band Elevation Pedestal Deflection at 67.5-Degrees	3117	Pedestal Elevation	1452
X-Band Elevation Pedestal Deflection at 0-Degree	3121	Pedestal Elevation	1452
X-Band Elevation Pedestal Deflection at 22.5-Degrees	3122	Pedestal Elevation	1452
X-Band Elevation Pedestal Deflection at 45-Degrees	3123	Pedestal Elevation	1452
X-Band Elevation Pedestal Deflection at 67.5-Degrees	3124	Pedestal Elevation	1452
X-Band MTI Delay TA1, MTI 1	3137	Target AZ/EL	1402-4
X-Band MTI Delay TA2, MTI 1	3140	Target AZ/EL	1402-4
X-Band MTI Delay TA1, MTI 2	3141	Target AZ/EL	1402-4
X-Band MTI Delay TA2, MTI 2	3142	Target AZ/EL	1402-4

Table 2-70. Angle Calibration Constants (Continued)

DESCRIPTION OF CALIBRATION CONSTANT	MEMORY LOCATION	AFFECTED PARAMETER	AFFECTED PARAMETER LOCATION
S-Band Low PRF Ref AZ Bias	3072	Ref AZ	1462
S-Band High PRF Ref AZ Bias	3073	Ref AZ	1462
C-Band Low PRF Ref AZ Bias	3074	Ref AZ	1462
C-Band High PRF Ref AZ Bias	3075	Ref AZ	1462
X-Band Low PRF Ref T1 Bias	3076	Ref AZ/EL	1462/1524
X-Band High PRF Ref T1 Bias	3077	Ref AZ/EL	1462/1524
S-Band Low PRF Ref EL Bias	3100	Ref EL	1524
S-Band High PRF Ref EL Bias	3101	Ref EL	1524
C-Band Low PRF Ref EL Bias	3102	Ref EL	1524
C-Band High PRF Ref EL Bias	3103	Ref EL	1524
X-Band Low PRF Ref T2 Bias	3104	Ref AZ/EL	1462/1524
X-Band High PRF Ref T2 Bias	3105	Ref AZ/EL	1462/1524
AZ Missile Cursor Bias S-Band	3125	Cursor Display	
AZ Missile Cursor Bias C-Band Mode I	3126	Cursor Display	
AZ Missile Cursor Bias C-Band Mode II	3127	Cursor Display	
AZ Missile Cursor Bias C-Band Mode III	3130	Cursor Display	
T1 Missile Cursor Bias X-Band	3131	Cursor Display	
EL Missile Cursor Bias S-Band	3132	Cursor Display	
EL Missile Cursor Bias C-Band Mode I	3133	Cursor Display	

Table 2-70. Angle Calibration Constants (Continued)

DESCRIPTION OF CALIBRATION CONSTANT	MEMORY LOCATION	AFFECTED PARAMETER	AFFECTED PARAMETER LOCATION
EL Missile Cursor Bias C-Band Mode II	3134	Cursor Display	
EL Missile Cursor Bias C-Band Mode III	3135	Cursor Display	
T2 Missile Cursor Bias X-Band	3136	Cursor Display	

2-68. Test 6. Test 6 is used to assign analog outputs to the strip chart recorder. The data requested for each channel determines the type of processing that subroutine ANOUTX must perform. ANOUTX can process up to 11 variables. The data to be supplied to the digital-to-analog converter in ANOUTX is determined by the following formula:

$$\text{OUTPUT DATA} = \frac{[(A - B) * C \quad D]}{E}$$

where

A, B, C, = Addresses of variables in core memory

D = A specified left shift command

E = Fraction of full scale at which the variable is to be supplied

If B, C, and D are not required, a zero must be entered and the equation reduces to

$$\text{OUTPUT DATA} = \frac{A}{E}$$

Several of the most commonly plotted variables are identified in table 2-71 along with precalculated values of the teletype entry data for these variables.

2-69. When test 6 is entered, the computer will request the following inputs in this order: CHAN, A, B, C, D, and E. The operator must then type in the required data as a request is made by the typewriter. When all data for a particular variable has been entered and the carriage returned, the ANOUTX subroutine will process the data and supply the selected variable to the selected channel of the strip chart recorder. When the processing is complete for a parameter, the computer will print out CHAN and the next assignment can be made.

Table 2-71. Analog Plot Variables

RANGE DIFFERENCES

Variable	A	B	C	D
Target-to-Xpndr 1	1412	1502	0	5
Target-to-Xpndr 2	1412	1504	0	5
Target-to-Xpndr 3	1412	1506	0	5
Target-to-Xpndr 4	1412	1414	0	5

E	Full-Scale D/A Output
0.611	10,000 Ft
0.305	5,000 Ft
0.122	2,000 Ft
0.0611	1,000 Ft
0.0305	500 Ft
0.0122	200 Ft

Line-of-Sight Distances

Variable	A	B	C	D
Missile 1-to-Target Az Deviation	1142	1402	1122	5
Missile 1-to-Target El Deviation	1132	1404	1122	5
Missile 2-to-Target Az Deviation	1144	1402	1124	5
Missile 2-to-Target El Deviation	1134	1404	1124	5
Missile 3-to-Target Az Deviation	1146	1402	1126	5
Missile 3-to-Target El Deviation	1136	1404	1126	5
Missile 1-to-Xpndr 1* Az Deviation	1142	1462	1122	5
Missile 1-to-Xpndr 1* El Deviation	1132	1524	1122	5
Missile 2-to-Xpndr 1* Az Deviation	1144	1462	1124	5
Missile 2-to-Xpndr 1* El Deviation	1134	1524	1124	5
Missile 3-to-Xpndr 1* Az Deviation	1146	1462	1126	5
Missile 3-to-Xpndr 1* El Deviation	1136	1524	1126	5
Target-to-Xpndr 1 Az Deviation	1402	1462	1502	5
Target-to-Xpndr 1 El Deviation	1404	1524	1502	5
Target-to-Xpndr 2 Az Deviation	1402	1464	1504	5
Target-to-Xpndr 2 El Deviation	1409	1526	1504	5
Target-to-Xpndr 3 Az Deviation	1402	1466	1506	5
Target-to-Xpndr 3 El Deviation	1404	1512	1506	5
Target-to-Xpndr 4 Az Deviation	1402	1522	1414	5
Target-to-Xpndr 4 El Deviation	1404	1514	1414	5

*Note: Xpndr 1 and Reference are identical

E	Full-Scale D/A Output
0.00194	100 Ft
0.00389	200 Ft
0.00972	500 Ft
0.0194	1,000 Ft
0.0389	2,000 Ft
0.1942	10,000 Ft

Table 2-71. Analog Plot Variables (Continued)

Angle Differences

Variable	A	B	C	D
Target-to-Xpndr 1 (Ref) AZ	1402	1462	0	5
Target-to-Xpndr 1 (Ref) El	1404	1524	0	5
Target-to-Xpndr 2 Az	1402	1464	0	5
Target-to-Xpndr 2 El	1404	1526	0	5
Target-to-Xpndr 3 Az	1402	1466	0	5
Target-to-Xpndr 3 El	1404	1512	0	5
Target-to-Xpndr 4 Az	1402	1522	0	5
Target-to-Xpndr 4 El	1404	1514	0	5

E	Full-Scale D/A Output
0.889	5 degrees
0.445	2.5 degrees
0.178	1 degree
0.0889	0.5 degree
0.0445	0.25 degree
0.0178	0.1 degree

Ranges

Variable	A	B	C	D
Target Range	1412	0	0	0
Transponder 1 Range	1502	0	0	0
Transponder 2 Range	1504	0	0	0
Transponder 3 Range	1506	0	0	0
Transponder 4 Range	1414	0	0	0
Missile 1 Range	1122	0	0	0
Missile 2 Range	1124	0	0	0
Missile 3 Range	1126	0	0	0

E	Full-Scale D/A
0.953	500,000 Ft
0.477	250,000 Ft
0.1905	100,000 Ft
0.0953	50,000 Ft
0.572	50 MI
0.286	25 MI
0.1144	10 MI

Table 2-71. Analog Plot Variables (Continued)

Angles Relative To Boresight

Variable	A	B	C	D
Target Azimuth Re Window	3122	0	0	0
Target Elevation Re Window	3123	0	0	0
Transponder 1 (Ref) Az Re Window	3124	0	0	0
Transponder 1 (Ref) El Re Window	3130	0	0	0
Transponder 2 (Ref) Az Re Window	3125	0	0	0
Transponder 2 (Ref) El Re Window	3131	0	0	0
Transponder 3 (Ref) Az Re Window	3126	0	0	0
Transponder 3 (Ref) El Re Window	3132	0	0	0
Transponder 4 (Ref) Az Re Window	3127	0	0	0
Transponder 4 (Ref) El Re Window	3133	0	0	0

E	Full-Scale D/A
0.782	25 degrees
0.313	10 degrees
0.156	5 degrees
0.0782	2.5 degrees
0.0313	1 degree
0.0156	0.5 degree

2-70. If a variable that does not appear in table 2-71 must be recorded, the values required by ANOUTX for the assignment shall be derived. The procedure is shown in the following three examples:

a. Suppose that the operator desires to record time-of-flight of missile 1 on D/A channel 1 at 100 seconds equals full scale. Proceed as follows:

1. Determine the address of the variable from table 2-66; A becomes 1242. Since no other variables are involved and a left shift command is not required, B, C and D are zero.

2. Determine the fraction of full scale by taking the ratio of desired plot full scale to the maximum value the variable may have in the computer. In this example

$$E = \frac{100 \text{ sec (desired plot scale)}}{128 \text{ sec (computer max value)}} = 0.782.$$

Therefore, the following entries are made on the teletype after sense switch 4 has been set:

```
TEST NR? 6
CHAN 1
A = 1242
B = 0
C = 0
D = 0
E = 0.782
```

b. Suppose the operator desires to record the azimuth angle difference between target track and transponder track so that full scale is 1 degree. Proceed as follows:

1. Determine the address of target azimuth and reference (transponder) azimuth; these are 1402 and 1462; therefore, A = 1402 and B = 1462.

2. The variable table shows that the computer maximum value is 180 degrees; the desired plot scale is 1 degree. Dividing as before (1/180 = 0.0056), the E factor becomes a very small number. However, better accuracy can be obtained by shifting the results of the A-B subtraction to the left. By shifting the result of the A-B subtraction 5 places to the left, the value of the variable is increased by 2^5; therefore, the single scale becomes $\frac{180}{2^5} = \frac{180}{32} = 5.63$.

Now the E-factor can be computed as follows:

$$E = \frac{1 \text{ degree (desired plot scale)}}{5.63 \text{ (computer maximum value)}} = 0.178$$

The entries on the teletype would therefore be:

```
TEST NR? 6
A = 1402
B = 1462
C = 0
D = 5
E = 0.178
```

No exact rule can be given as to when the left-shift instruction (D) should be used. However, if the E-factor is significantly less than 0.05, some loss of accuracy will result.

c. Suppose the operator desires to record the line-of-sight difference distance between missile 1 and target angle in azimuth, i.e., to determine the distance (in feet) between the target line-of-sight and missile angle. In this case, the desired value may be obtained by multiplying the angle difference (in radians) by the missile range. Target azimuth, missile azimuth, and missile range memory locations are determined from the table of variables (table 2-71).

```
A = 1142
B = 1102
C = 1122
```

1. Calculate the scale factors. After the (A-B) * C calculation has been done, the computer maximum value is the product of the maximum values of the angle (in radians) and range. Therefore, the maximum value of the function is

$$\pi * 2^{19} = \pi * 524,288 = 1,650,000 \text{ feet.}$$

The variable is to be plotted at a maximum scale of 10,000 feet. Since the ratio is large, the left-shift operation is again used. If a left-shift of 6 is used, the computer maximum value is

$$\frac{1,650,000}{2^6} \quad \frac{1,650,000}{64} = 25,800;$$

the E-value is then

$$\frac{10,000}{25,800} = 0.389.$$

The complete teletype entry would be

```
TEST NR? 6
CHAN? 3
A = 1142
B = 1402
C = 1122
D = 6
E = 0.389
```

2-71. Test 7. Test 7 is a closed loop test of the missile simulation equations. It may be used to "fly" a target internally to the computer. No input/output operations are performed unless specifically requested in the case of analog plotting.

2-72. When the test is entered, the computer will type out the message: SET STW3 BITS IN A REGISTER. Status word 3 determines the operating mode of the program. At the time this message is printed, the A register will contain information which will cause the computer to execute the program in radar mode I, C-band, using lead guidance. If these parameters are satisfactory, the operator may simply depress the START switch. If it is desired to operate in some other mode, the A register bit configuration for that mode may be determined from the status word assignment list given in table 2-72. In any case, after the correct bit pattern has been set

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS, RADAR TRAINING SET, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1 FOR TABLE 2-72

into the A register, the operator must depress the START switch. The computer will next type out SET A = 1 IF ANALOG OUT RQD. If it is desired to make an analog record of the computer run, the operator must enter a 1 into the A register and depress the START switch. If an analog record is not required, the operator may simply depress the START switch. The program will now loop and the computer will print out miss distance.

2-73. SENSE switch 3 must be momentarily positioned to set, then returned to reset. This will cause the computer to type out INPUT PARAMETER ?. The operator may then enter any of the following:

HTGT	Target altitude in thousands of feet
RTG (SP)	Initial target ground range in thousands of feet
HDNG	Target heading in degrees
VT (SP)(SP)	Target Speed in feet per second
BT (SP)(SP)	Initial target azimuth angle in degrees

2-74. The mnemonic must always consist of four characters or enough spaces to occupy a four-character field. In any case, if the four letter designation of the variable has been entered, the computer will type out an equal sign. The operator may then enter the value of the variables he wishes to enter. He may alter any or all of the variables in any sequence. After the last variable has been entered, the operator should type in GO. The program will then execute the closed-loop missile system equations.

2-75. Within several seconds, the computer should type out a missile launch message (example: LAUNCH NR 1). When the missile impacts, a miss distance message should be printed out. These printouts should be sufficient to verify the operational readiness of the computer guidance and missile equations. If it is desired to repeat the run, the operator may momentarily position SENSE switch 3 to set. The operator may then type in new parameter data or he may simply type in GO to repeat the previous run.

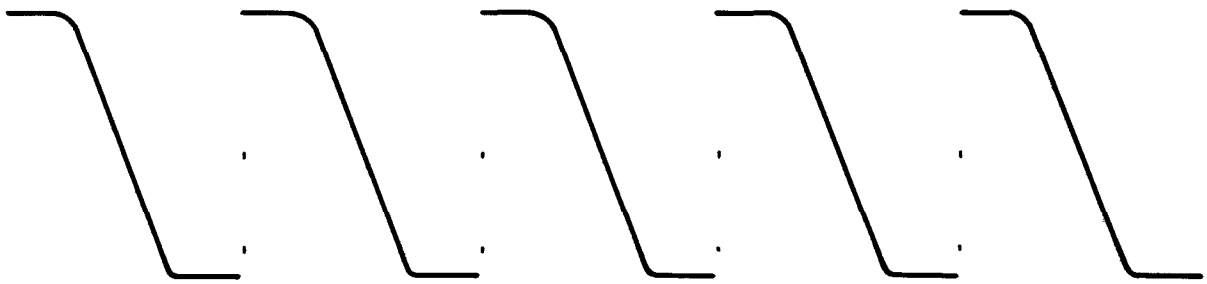
2-76. SENSE switch 4 determines whether or not execution of the current program is to continue. If SENSE switch 4 is positioned to set, the current program continues to be executed. If SENSE switch 4 is positioned to reset, the program requests the next test to be executed.

2-77. Test 10. Test 10 is used to verify operation of the digital-to-analog converter. It supplies a truncated sawtooth waveform (figure 2-60) to each of the 16 analog output channels. This output voltage may be used by the strip-chart recorder. Operation of the recording system is completely verified if the sawtooth voltage is reproduced on the recording.

2-78. SENSE switch 3 may be used to cause zero output voltage so that the recorder may be zeroed. If SENSE switch 3 is positioned to reset, normal sawtooth outputs will be supplied. If SENSE switch 3 is positioned to set, zero output will be supplied.

2-79. SENSE switch 4 determines whether or not execution of the current program is to continued. If SENSE switch 4 is positioned to set, the current program continues to be executed. If SENSE switch 4 is positioned to reset, the program requests the next test to be executed.

2-80. Test 11. Test 11 is used to vary radar calibration constants in memory (table 2-71). The subroutine recognizes two types of addresses: a 6-digit number which represents a double-precision constant (e.g., pedestal azimuth encoder zero) and a 4-digit single-precision variable (e.g., scan encoder scale factor). The use of this test subroutine is illustrated in the following example. The parameter to be varied is the S-band pedestal azimuth encoder zero. As shown in



0095-240

Figure 2-60. Truncated Sawtooth Waveform

table 2-71, this parameter involves a 6-digit, double-precision constant. When test 11 has been called up, this parameter can be requested by adjusting the DATA REQUEST thumbwheels on computer interface 1A5A14 to 1406. The S-band radar must then be operated and positioned so that the calibration target is centered on the azimuth display. SENSE switch 1 must be set and the number 103006 can be entered on the teletype. When the carriage has been returned, the pedestal azimuth angle will appear on the DATA DISPLAY Nixie tubes on the computer interface 1A5A14. The operator must position SENSE switch 1 to reset if the operation is to continue with this variable. SENSE switches 2 and 3 are used to increment or decrement the displayed number to produce the desired pedestal azimuth angle.

2-81. SENSE switch 1 must be positioned to set to request a new memory location from the teletype. To continue operation with the variable that was requested last, position SENSE switch 1 to reset.

2-82. The subroutine examines the position of SENSE switch 2 to determine if incrementation is required. To increase the value of the selected variable, SENSE switch 2 must be positioned to set. An input/output is also performed to update the Nixie tubes and the computer interface. If no increase in the value of the variable is required, SENSE switch 2 should be positioned to reset.

2-83. The subroutine also examines the position of SENSE switch 3 to determine if decrementation of the selected variable is required. To decrease the value of the variable, SENSE switch 3 must be positioned to set. If no decrease in the variable is required, SENSE switch 3 should be positioned to reset.

2-84. SENSE switch 4 determines whether or not test 11 will continue. If SENSE switch 4 is positioned to set, test 11 subroutine continues to be executed. If SENSE switch 4 is positioned to reset, the

program requests the next test subroutine to be executed.

2-85. Test 12. Test 12 is used to punch a paper tape of the program stored in memory. The operator may select a specific area of the program (e.g., the calibration constants from '3000 to '3123) or select all of the core memory used for programming ('60 to '35777). If the latter selection is made, the new tape will contain the complete program in the same form as the tape originally furnished. If a portion of core memory is to be examined, the operator can type in the first and last memory locations of any area of the program and this portion will be punched out.

2-86. SENSE switch 1 is used to determine the amount of core memory which will be punched on tape. If the switch is positioned to set before entry, the operator can type in the beginning and end memory location which he wants to punch out. If the switch is positioned to reset, the subroutine automatically punches out all of the core memory used for programming.

2-87. SENSE switch 4 determines whether the tape punching will continue or stop. If SENSE switch 4 is positioned to set, the subroutine will continue to punch the selected tape. If the switch is positioned to reset, the program will request the next test to be executed.

2-88. Test 13. Test 13 is used to enter parallax information into the computer program. These parallax data are defined in T.O. 43D7-11-21-2-1, Chapter 2. When this test has been called up, the teletype will consecutively print out the following requests for data and the operator must type in the parallax data upon request:

PARALLAX

S TO C

AZIMUTH	Type Entry (deg)
RANGE	Type Entry (feet)
ELEVATION	Type Entry (deg)

C TO X

AZIMUTH	Type Entry (deg)
RANGE	Type Entry (feet)
ELEVATION	Type Entry (deg)

X TO S

AZIMUTH	Type Entry (deg)
RANGE	Type Entry (feet)
ELEVATION	Type Entry (deg)

2-89. Test 15. This test is used to ascertain that all data words are being transferred to the ground equipment instrumentation set (GEIS) in the proper sequence. The GEIS should be able to check the data content of each word to ascertain if proper sequencing is taking place. When SENSE switch 1 is positioned to set, test 15 transfers 32 words to the GEIS. The content of each word is the word number. Thus, the first data word transferred is a "1", the second word transferred is a "2", etc.

2-90. When SENSE switch 1 is positioned to reset, test 15 tests if all bits in each word are being transferred. The first word transferred contains a single "one". The second word transferred contains all "ones" except for a single "zero". Thirty-two words are transferred with all odd words like word 1 and all even words like word 2. With each block transmission, the single "one", or the single "zero" is rotated 1 place to the right. By positioning SENSE switch 2 to set, the even and odd words are interchanged. The GEIS should be capable of monitoring the moving digits for proper sequence. A visual check of transferred data should accomplish the test. The data word format being transferred to the GEIS when using the main system program is contained in table 2-73.

2-91. HONEYWELL DIAGNOSTIC ROUTINES. Program tapes are provided for diagnostic testing of the computer main frane and installed optionals. The tapes are loaded into the computer in the same general manner as the main program. Loading of any of these diagnostic tapes

Table 2-73. Data Word Format

WORD NR.	ASSIGNMENT
1	Status Word 1
2	Status Word 3
3	Status Word 4
4	Status Word 5
5	Status Word 6
6	Status Word 7
7	Status Word 8
8	Maximum missile impact range
9	Minimum missile impact range
10	Predicted missile impact range
11	Target range
12	Transponder 1/reference range
13	Transponder 2 range
14	Transponder 3 range
15	Transponder 4 range
16	Target Azimuth
17	Transponder 1/reference azimuth
18	Transponder 2 azimuth
19	Transponder 3 azimuth
20	Transponder 4 azimuth
21	Target elevation
22	Transponder 1/reference elevation
23	Transponder 2 elevation
24	Transponder 3 elevation
25	Transponder 4 elevation
26	ASCII teletype data
27	ASCII teletype data
28	ASCII teletype data
29	Not assigned
30	Not assigned
31	Not assigned
32	Not assigned

into the computer destroys the main system program. When the diagnostic testing is completed, it will be necessary to reload the computer with the main program before returning to normal operation. The following program tapes are provided:

PROGRAM NO.	PURPOSE
X16-CCT3	Tests marginal packs and noise interference in the computer
X16-11T1	High-speed arithmetic option test
X16-CMT1	Core memory test
X16-PFT2	Power failure test
X16-TWT1	Teletype unit test
X16-RPT2	High-speed tape punch/ tape reader test
X16-RTC1	Real time clock test

The use of test X16-RTC1 is described below.

2-92. The purpose of test routine X16-RTC1 is to test the real time clock. The test is performed as follows:

a. Load the program.

b. In location '1207, enter "174370".

c. Depress MSTR CLEAR and enter 1000 into the P-register.

d. Depress START switch and wait for end message.

2-93. Printouts will be made on the teletype. The program may be restarted after any halt by depressing the START switch. Error messages are printed out as follows:

ER1 Interrupt did not occur with RTC increment time.

ER2 Interrupt not caused by RTC.

ER3 Interrupt occurred in less than RTC increment time.

ER4 RTC is running too fast.

ER5 RTC is running too slow.

ER6 Interrupt did not reset by OCP '20.

ER7 Clock failed to increment '61.

2-94. CONTINENTAL OPERATIONS RANGE (COR) VIDEO RECORDER INSTRUMENTATION OPERATION. To record and playback azimuth, elevation or X-band discrete and video signals, use the following procedure.

a. Position POWER ON/OFF switch on common data point assembly 1A20 to ON.

b. To record azimuth or X-band signals, position RECORD/PLAYBACK switch on common data point assembly 1A20 to RECORD.

c. To playback azimuth or X-band signals on guidance operators indicators:

1. Position RECORD/PLAYBACK switch to PLAYBACK.

2. Position PLAYBACK switch on common data point assembly 1A20 to AZ/X-BAND.

d. To record elevation signals:

1. Position RECORD/PLAYBACK switch to RECORD.

2. Connect recorder to VIDEO RECORDER EL connectors on common data point assembly 1A20.

e. To playback elevation signals on guidance operators elevation indicator:

1. Position RECORD/PLAYBACK switch to PLAYBACK.

2. Position PLAYBACK switch to EL.

2-95. Continental Operations Range (COR) Ground Equipment Instrument Set (GEIS) Operation. To provide instrumentation output to the GEIS, connect the GEIS to the common data point assembly (connector 1A20J5) and position the common data point assembly POWER ON/OFF switch to ON.

2-96. TYPICAL OPERATING PROCEDURE.

2-97. Typical operating procedures are outlined for the radar set operating in the following modes: S- or C-Band Target Track, X-Band Target Track, Transponder Reference Track, S- or C-Band Radar Reference Track, and X-Band Radar Reference Track. The S- and C-band tracking operations are identical with the exception of C-Band Modes II and III; therefore, the procedures for the two operations are described simultaneously with only the exceptions noted.

NOTE

Operators shall become thoroughly familiar with their functions before participating in a training mission.

2-98 through 2-104 and figure 2-61. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

2-105. MANUAL TRACKER OPERATIONS. Instructions for manually or automatically tracking a target by use of the controls and indicators on the manual tracker console 1A11 are detailed below.

2-106. Indicator Adjustments. The manual tracker operators should adjust their indicators as described below:

a. Select NORMAL sweep.

b. Adjust normal sweep INTENSITY for a raster that is just barely visible in the operating ambient light conditions.

c. Adjust normal RANGE CURSOR for a distinct horizontal trace.

d. Select EXPANDED sweep.

e. Adjust expanded sweep INTENSITY for a raster that is just barely visible in the operating ambient light conditions.

f. Adjust expanded RANGE CURSOR so that the two horizontal traces are visible.

g. Adjust the ANGLE CURSOR control for a visible vertical trace.

h. Set VIDEO control at maximum.

i. Select NORMAL or EXPANDED sweep mode as desired.

NOTE

Normally better tracking conditions will exist when the indicators are used in the expanded mode.

2-107 through 2-109. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

2-110. AUTOMATIC POSITION PLOTTER (APP) OPERATION. The information required from the APP display during a scoring mission is the maximum and minimum ranges at which missiles can be launched at the target being tracked. Synthetic video is received from the computer interface and displayed on the APP indicator. The display is synchronized in range to the radar set, but its angular scan is asynchronous. The video display includes maximum and minimum missile launch range cursors and a predicted impact range cursor for the initial missile launched. The minimum and maximum range cursors are displayed as continuous range rings. The impact cursor is a dashed line. Synthetic target video is also displayed. The APP display thus indicates the following information to the guidance operator:

a. Maximum range at which missiles can be launched

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS, RADAR TRAINING SET AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1 FOR FIGURE 2-61

b. Minimum ranges at which missiles should not be launched due to radar and missile limitations

c. Target azimuth and range position

d. Instantaneous impact range.

2-111 through 2-116. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

2-117. Low Altitude Operation. If the target is below the elevation pedestal lower limit, the following procedure should be used for target tracking:

a. If the target is below pedestal limit prior to acquisition, align radar as close as possible to target and transfer control to manual trackers.

b. Check to see that target is near both T1 and T2 angle cursors so that when electronic angle track is selected tracking gates will acquire the target.

c. Select low altitude operation by pulling elevation handwheel out.

NOTE

In this mode of operation, the azimuth pedestal is controlled automatically by the T2 tracking loop and the T1 tracking loop is in the automatic electronic track mode. If the target flies above the 1-degree pedestal limit, the T1 operator controls the elevation pedestal.

d. Low altitude operation is terminated by pushing in elevation handwheel. If AUTO/MAN PEDESTAL switch is in MAN position, control will be transferred to manual trackers at this time.

2-118 through 2-128. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

SECTION III

EMERGENCY OPERATION

2-129. INTRODUCTION.

2-130. Instructions for operating the radar set during emergency conditions are detailed in this section. Emergency conditions include abnormal service conditions, (table 1-2), air conditioner malfunction, and radar set catastropic failures and performance degradation.

2-131. EXCESSIVE SERVICE CONDITIONS.

2-132. The radar set has been designed to operate from 60 Hertz and 400 Hertz, 3-phase, 4-wire primary power source of 120/208±12/21 volts. An emergency condition exists if the line-to-neutral voltage exceeds 132 volts or drops below 108 volts. In this emergency, primary power should be removed from the radar control trailer by positioning the RADAR CONTROL TRAILER ELECTRONICS 60HZ 3PH and 400HZ 3PH circuit breakers to OFF, and from the radar antenna trailers by positioning the six ANTENNA TRAILERS S-BAND, C-BAND and X-BAND circuit breakers to OFF. These circuit breakers are located on the power distribution console 1A12.

2-133. The radar set can operate without reduced efficiency in winds up to 30 knots with an ice load of up to 0.5 inch radial thickness and up to 60 knots without an ice load. An emergency condition exists if these limits are exceeded. In this event, the set should not be operated. In the non-operating condition, the radar antenna trailers can withstand winds up to 80 knots with or without the use of tiedowns. However, if winds are predicted to exceed 80 knots, an emergency exists and the antennas, support structure, counter-weights, struts, ladders, flexible waveguides and cables shall be removed and placed on their respective transport trailers as described in section II, Chapter 3. The transport trailers should be placed in the most protected location available. Using a standard of 48 hours for 6 men to dismantle and store the equipment, the site shall have 48 to 72 hours notification of predicted winds in excess of 80 knots to adequately protect the equipment.

2-134. AIR CONDITIONING/HEATING.

2-135. RADAR CONTROL TRAILER. The air conditioner/heater in the radar control trailer is designed to maintain a comfortable temperature, i.e., 70 to 75°F, in the personnel area during outside ambient temperatures of between -32° to +52°C (-26° to +126°F).

NOTE

All console panels should be installed; prior to operation of the radar control trailer, the trailer rear door (personnel entry) should be closed, and the forward doors (air conditioner access) must be open. The red TRAILER DOOR CLOSED WHEN LIT indicator on the power distribution panel 1A12 lights when the front doors are closed during operation of the set.

2-136. If the temperature differential between the operator area and the outside ambient temperature exceeds 30°F, a malfunction may have occurred in the air conditioner system. In this emergency condition, remove primary power from the radar set and consult the operation and maintenance manual on the air conditioner unit.

2-137. RADAR ANTENNA TRAILERS. The radar antenna trailers are operated from a remote location (i.e., radar control trailer); therefore, a controlled environment for operators is not provided.

Equipment in the two radar antenna trailers has been designed to withstand wide variations in ambient temperatures and does not require either refrigerated or heated inside air. Instead, each trailer makes use of built-in fans to circulate outside air through the equipment. Each equipment console, as well as the pedestal, contains a fan. Fan motors start when power is applied to the individual equipment. Inside air is exhausted through manually controlled baffles which are located over the azimuth transmitter console (2A2, 3A2) and the elevation transmitter console (2A7, 3A7). In moderate and hot weather conditions, these baffles should be open (air exhausted to the outside). During periods of maintenance in cold weather, it may be desirable to retain the warm air inside the antenna trailer. In this case, the baffles should be closed.

2-138. INTERLOCK CIRCUITS.

2-139. The system interlocks and their functions are listed in tables 2-54 through 2-62.

2-140. System circuit breakers and their functions are listed in tables 2-34, 2-44, and 2-53.

CHAPTER 3

THEORY OF OPERATION

3-1. INTRODUCTION.

3-2. This chapter contains the information required to understand the function of the radar set, the function of major equipment groups, and the operation of circuits contained within these major equipment groups. The information is divided into three sections: Section I covers the functions and principles of operation of each major equipment group; Section II contains the detailed descriptions of the electronic circuits used to implement the functions described in Section I; Section III (omitted from this manual) is reserved for discussion of the functional operation of mechanical assemblies. In order to understand the information presented in this section, frequent reference should be made to diagrams contained in chapter 6 of T.O.s 43D7-11-21-2-2, 43D7-11-21-2-3, 43D7-11-21-2-4 and 43D7-11-21-2-5.

SECTION I

FUNCTIONAL SYSTEMS OPERATION

3-3. GENERAL.

3-4. The radar set, AN/MPS-T1(V), (figure 3-1) is a track-while-scan (TWS) radar system that may be operated in either S-Band, C-Band, or X-Band. Because a TWS radar system utilizes a scanning antenna during the tracking mode, the radar set is not limited to tracking a target at the single-line-of-sight of the antenna as are other types of radars. A TWS radar can track one or more targets, at once, including those with radiating transponders, as long as they are scanned by the antenna. A TWS radar also permits surveillance of the area being tracked for other targets. This capability is limited only by the gain control settings of the receiver systems.

3-5 through 3-8. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-9. SYSTEM OPERATING MODES.

3-10. The radar operators may select one of three target tracking radar frequency bands and one of several modes of system operation to obtain true target position. (Refer to table 3-1.) Operation of the radar set in some typical combinations is described in subsequent paragraphs. The following modes are addressed:

a. S-Band target tracking, transponder reference system

b. S-Band target tracking, C-band reference system

c. X-band target track system

d. X-band reference track system

e. S-Band or C-band target simulator operation.

3-11. Other modes of system operation are discussed as variations of these five basic modes. System mode is selected by use of switches at the guidance operator console 1A1 and the transponder console 1A3.

3-12. S-BAND TARGET TRACKING, TRANSPONDER REFERENCE SYSTEM. Target tracking and transponder reference system modes may be selected by the

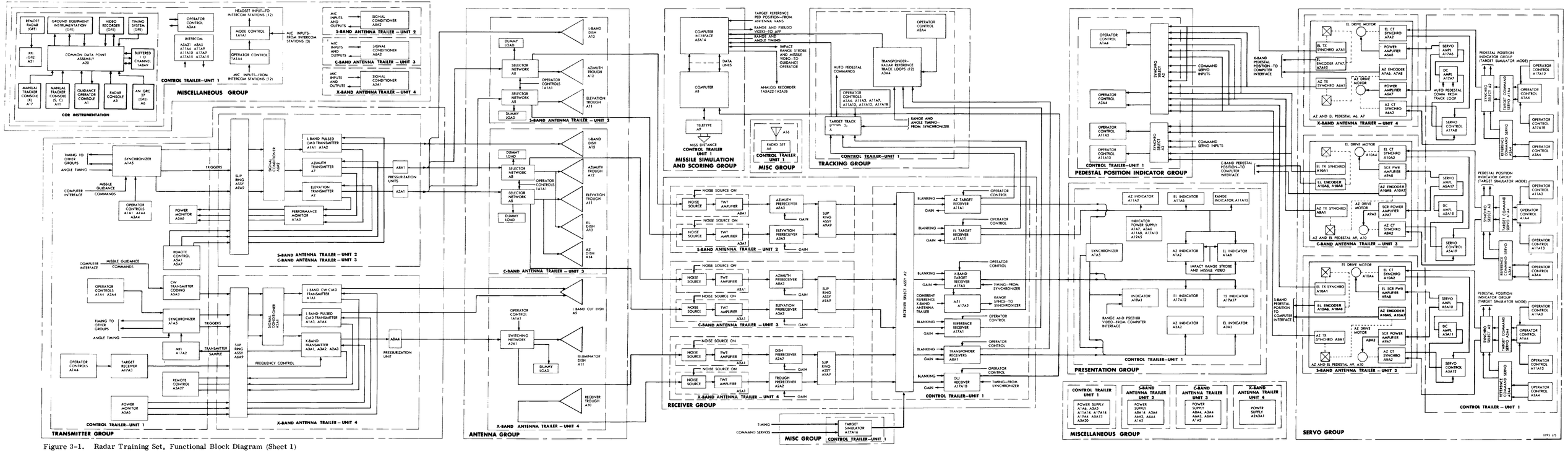


Figure 3-1. Radar Training Set, Functional Block Diagram (Sheet 1)

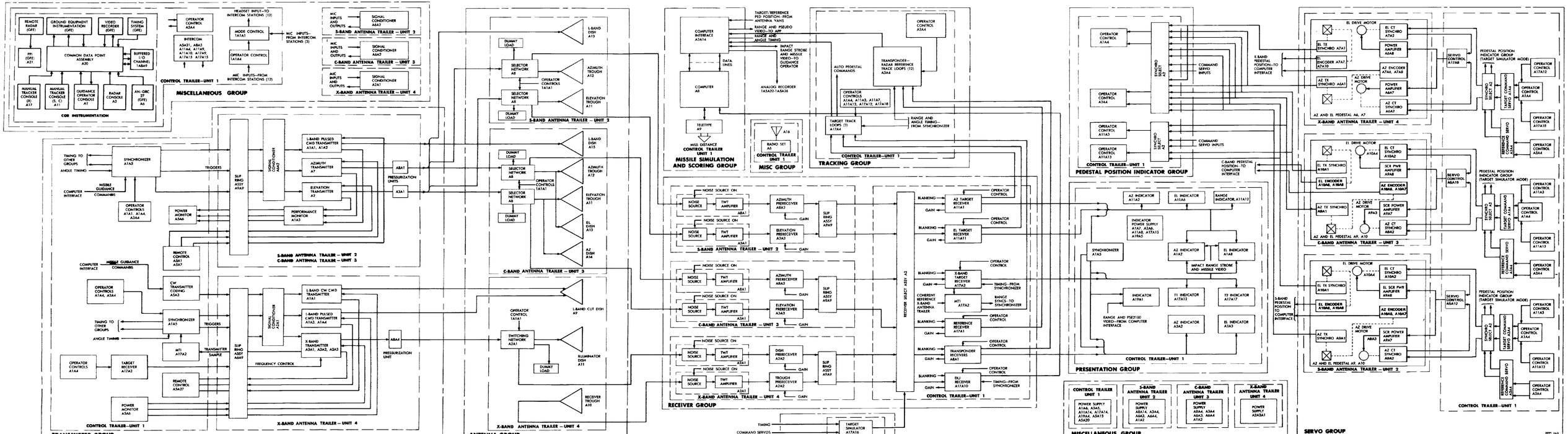


Figure 3-2. Radar Training Set, Functional Block Diagram (Sheet 2)

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS, RADAR TRAINING SET, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1 FOR TABLE 3-1

operator for S-band, C-band or X-band. A block diagram of the S-band mode is provided in figure 3-2. In this mode, the target skin track returns are routed through the receiver select circuitry, the receiver, and the target track loops. The target position within the antenna scan is furnished to the computer interface by the track loops in the form of guidance pulses. This position within the scan is combined with the pedestal position information received by the computer interface from the antenna pedestal so that the tracked target position is known by the computer in earth coordinates. When the missile is launched by the operator, it is guided to intercept this tracked target.

3-13. The reference (true-target position) information is obtained in this system by interrogating a transponder that is carried aboard the target aircraft, tracking the transponder return, and furnishing the tracked position of the transponder within the scan to the computer interface. The transponder system is capable of tracking up to four transponder returns simultaneously so that up to 12 guidance pulses (azimuth, elevation, and range guidance pulses for each of the four transponders) may be furnished to the computer. This reference information is used only for the scoring function.

3-14. When the simulated missiles within the computer fly through the tracked range of the target and the tracked range of each of the transponders, the miss-distance of the missiles to the target and transponders is computed.

3-15. S-BAND TARGET TRACKING, C-BAND REFERENCE SYSTEM. The mode of operation in which one frequency band is used for target tracking and a different frequency band is used for reference tracking can be selected in any combination of the S-band, C-band, and X-band radar systems. The system, as illustrated in figure 3-3, combines S-band target tracking and C-band reference system.

3-16. Tracking of the target and guidance of the missile is accomplished by use of the target tracking system described previously in paragraph 3-12.

3-17. The selected reference system skin-tracks the target with one of the radar systems (plus its associated transmitters, antennas, receivers, and tracking loops) which is not being used for target tracking. This tracked position, along with pedestal position information from the reference pedestal, is relayed to the digital computer in the form of guidance pulses. The reference system is limited to tracking a single target, i. e., the target tracked by the target tracking operators; and, in order to be effective, the system must not be jammed with electronic countermeasures equipment.

3-18. X-BAND TARGET TRACK SYSTEM. When the X-band radar is selected as the target track system, the equipment illustrated in figure 3-4 is substituted for the equipment of the target track systems shown in figures 3-2 and 3-3. System operation, missile flight, and scoring are as described previously.

3-19. X-BAND REFERENCE TRACK SYSTEM. The X-band reference track system shown in figure 3-5 can be used in conjunction with either the S-band or C-band target track system, as described previously; in this case, it would be substituted for the reference track system shown in figure 3-3. The general operation, information flow, and scoring is as previously described for the skin track reference system.

3-20. S-BAND AND C-BAND TARGET SIMULATOR OPERATION. Substitution of the target simulator for the radar system equipment makes it possible to perform maintenance, alignment, and various training tasks on the radar set without operating the transmitters, antennas, and antenna pedestals. The target simulator provides intermediate frequency (IF) signals to the receivers and provides controlled moving targets so that the operator controls, displays, tracking, and scoring can be checked. Figure 3-6 depicts this

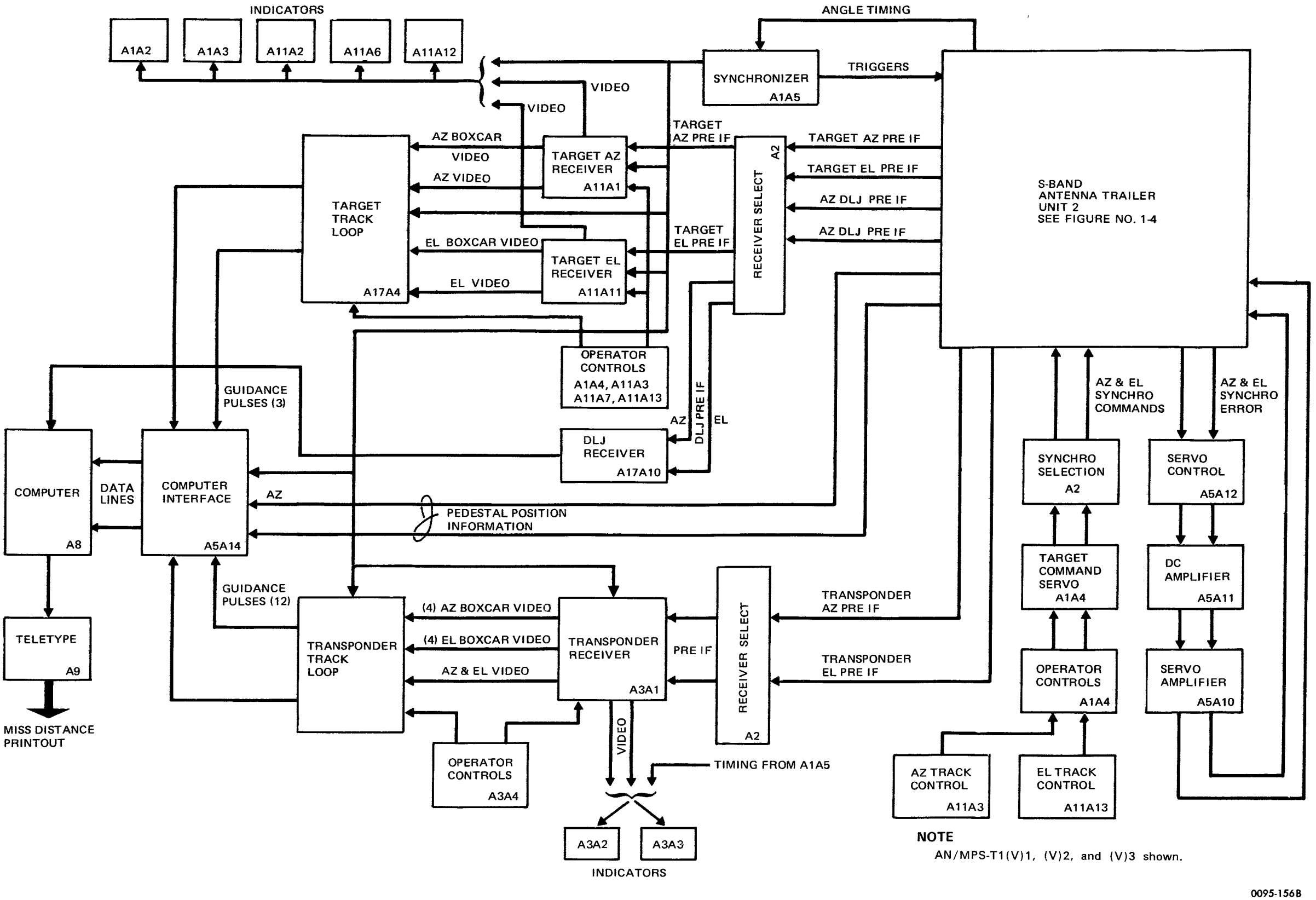


Figure 3-2. S-Band Target Tracking, Transponder Reference System (Sheet 1)

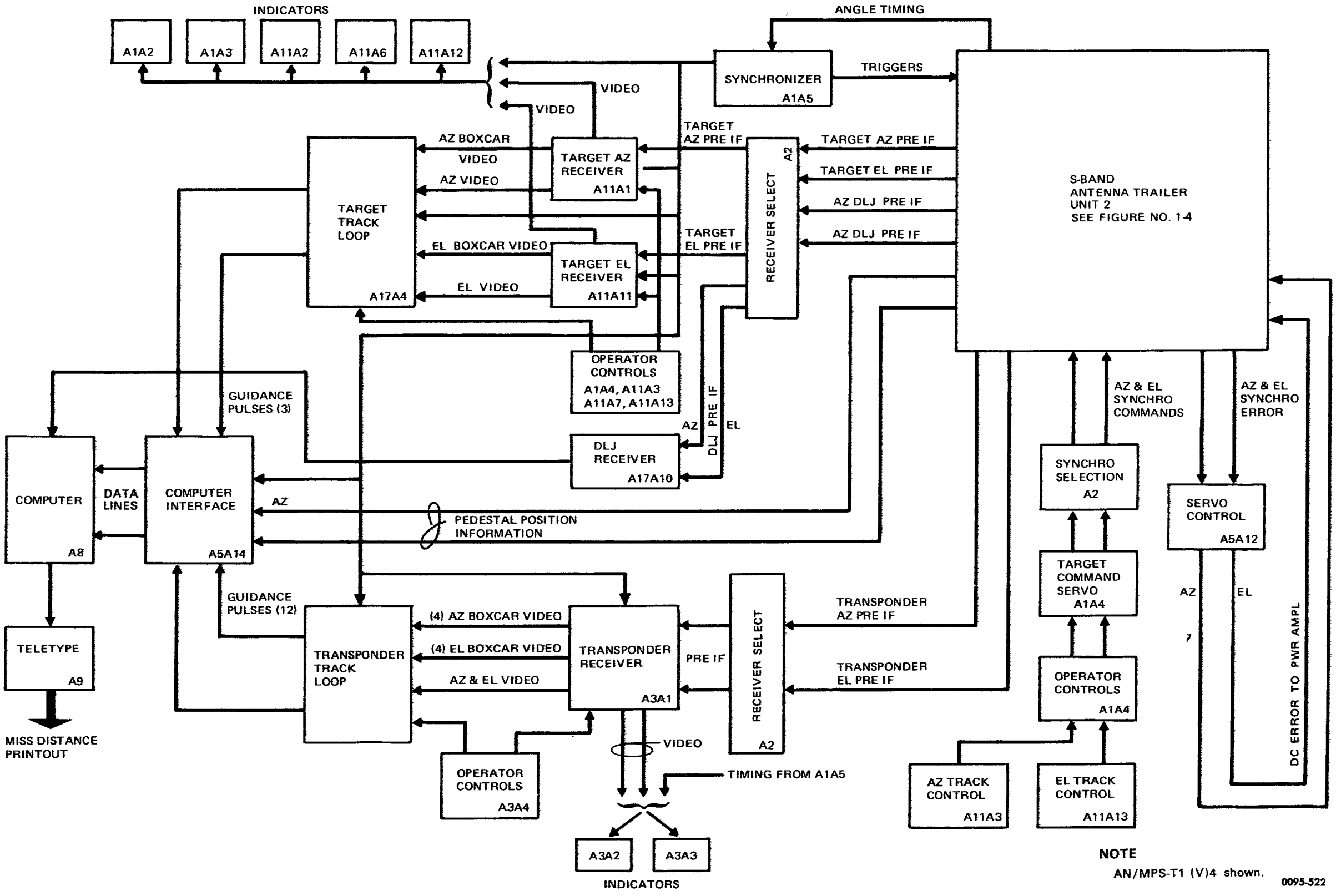


Figure 3-2. S-Band Target Tracking, Transponder Reference System (Sheet 2)

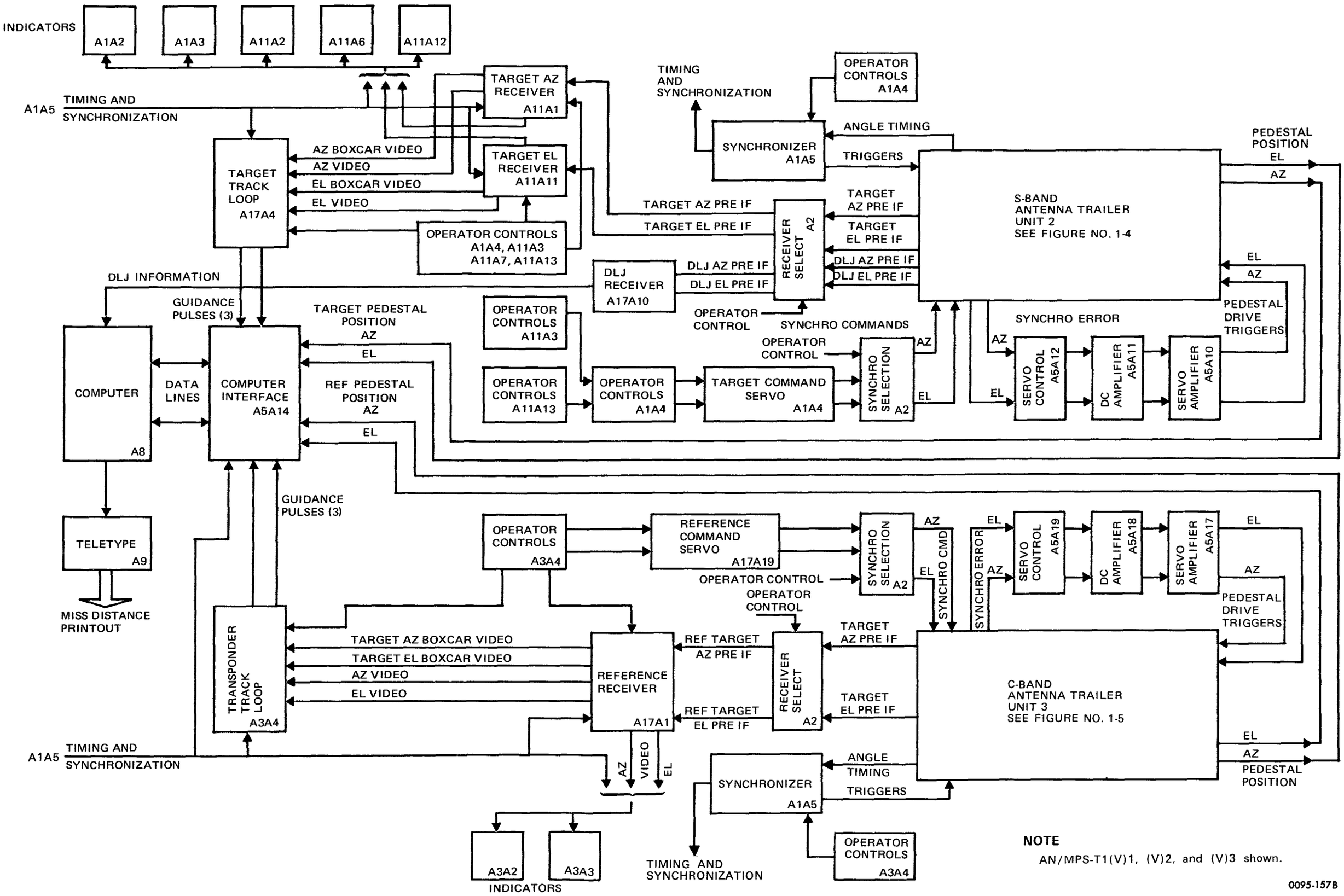


Figure 3-3. S-Band Target Tracking, C-Band Reference System (Sheet 1)

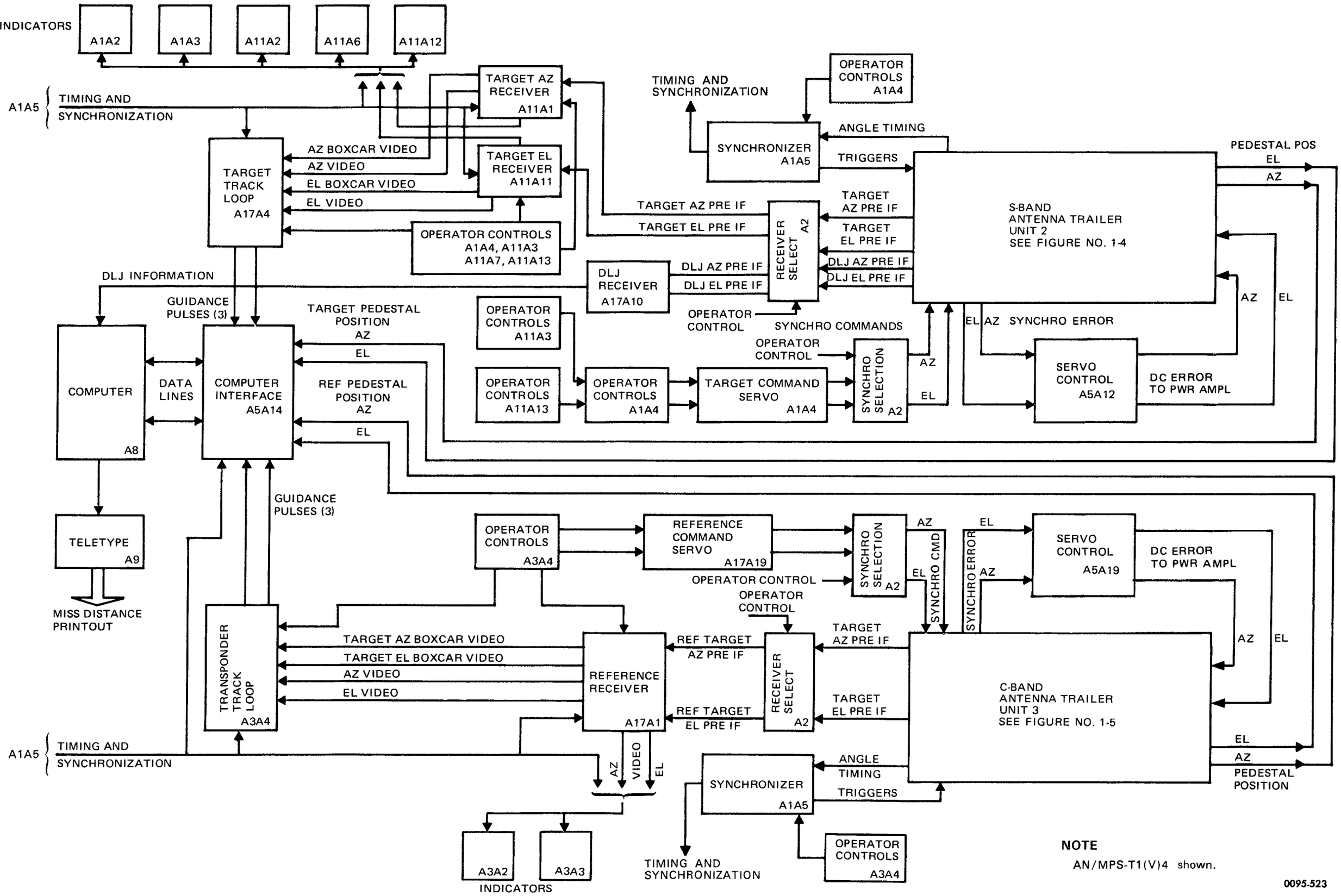


Figure 3-3. S-Band Target Tracking, C-Band Reference System (Sheet 2)

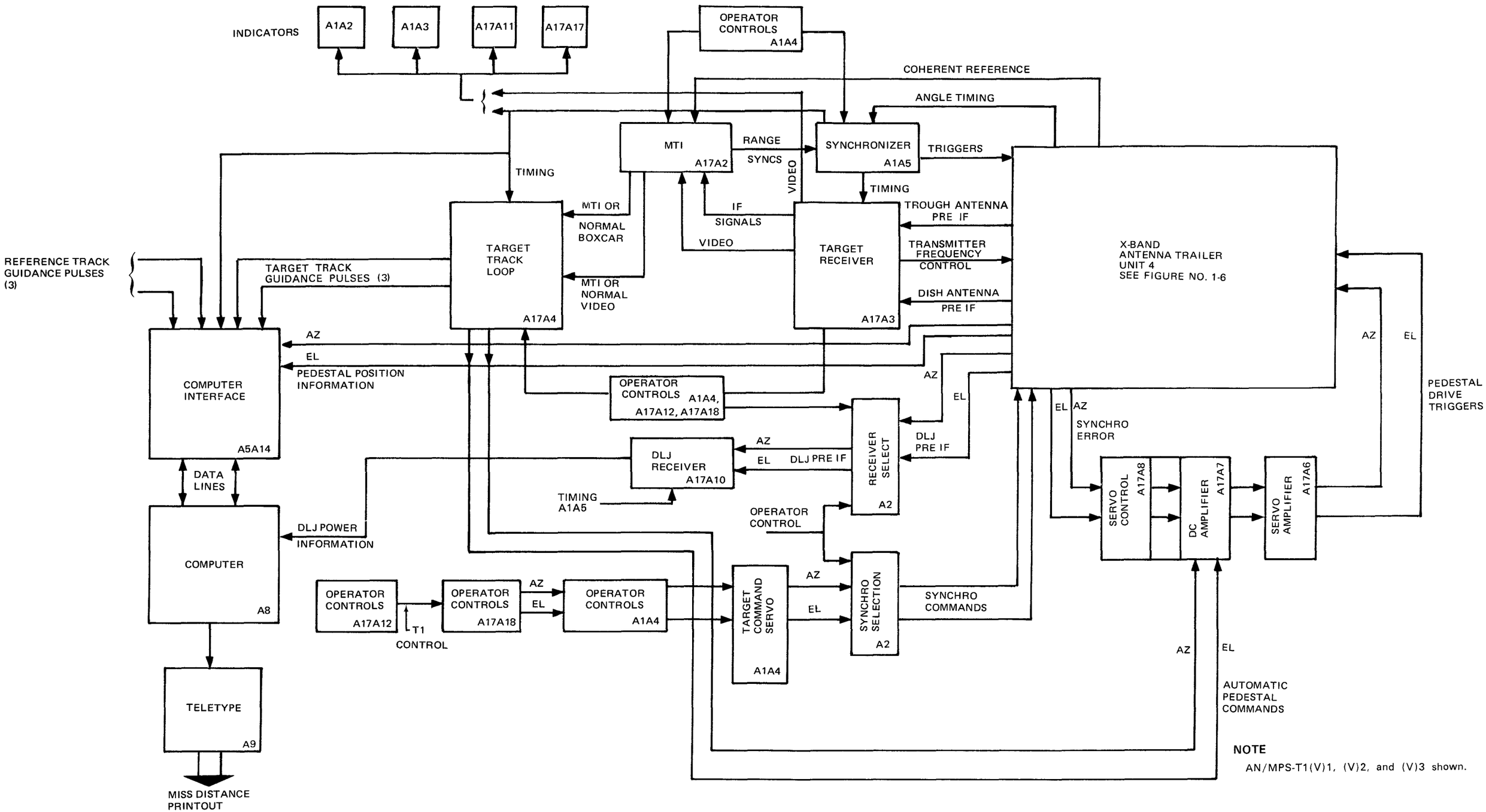


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Figure 3-4. X-Band Target Tracking System (Sheet 1)

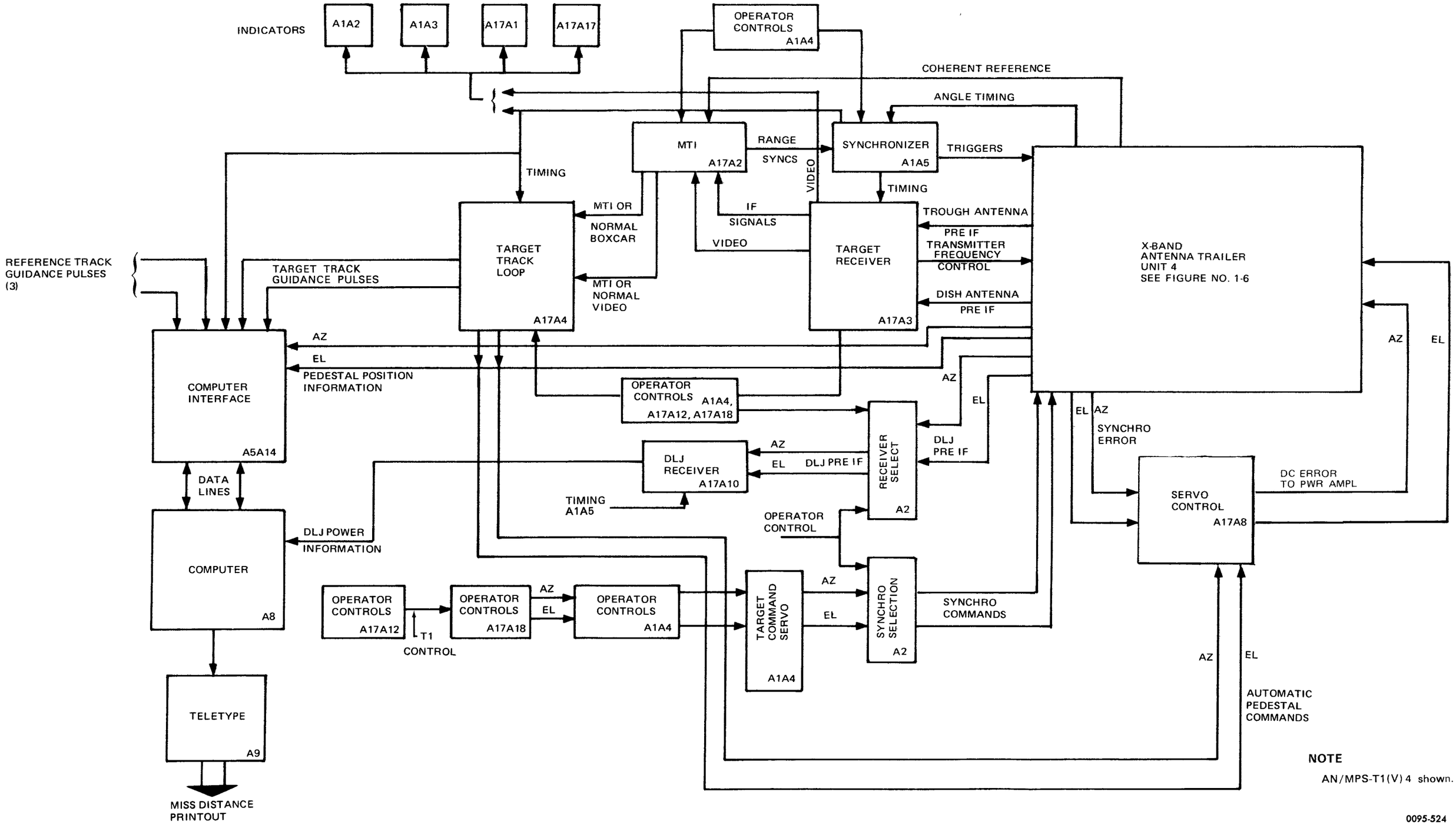


Figure 3-4. X-Band Target Tracking System (Sheet 2)

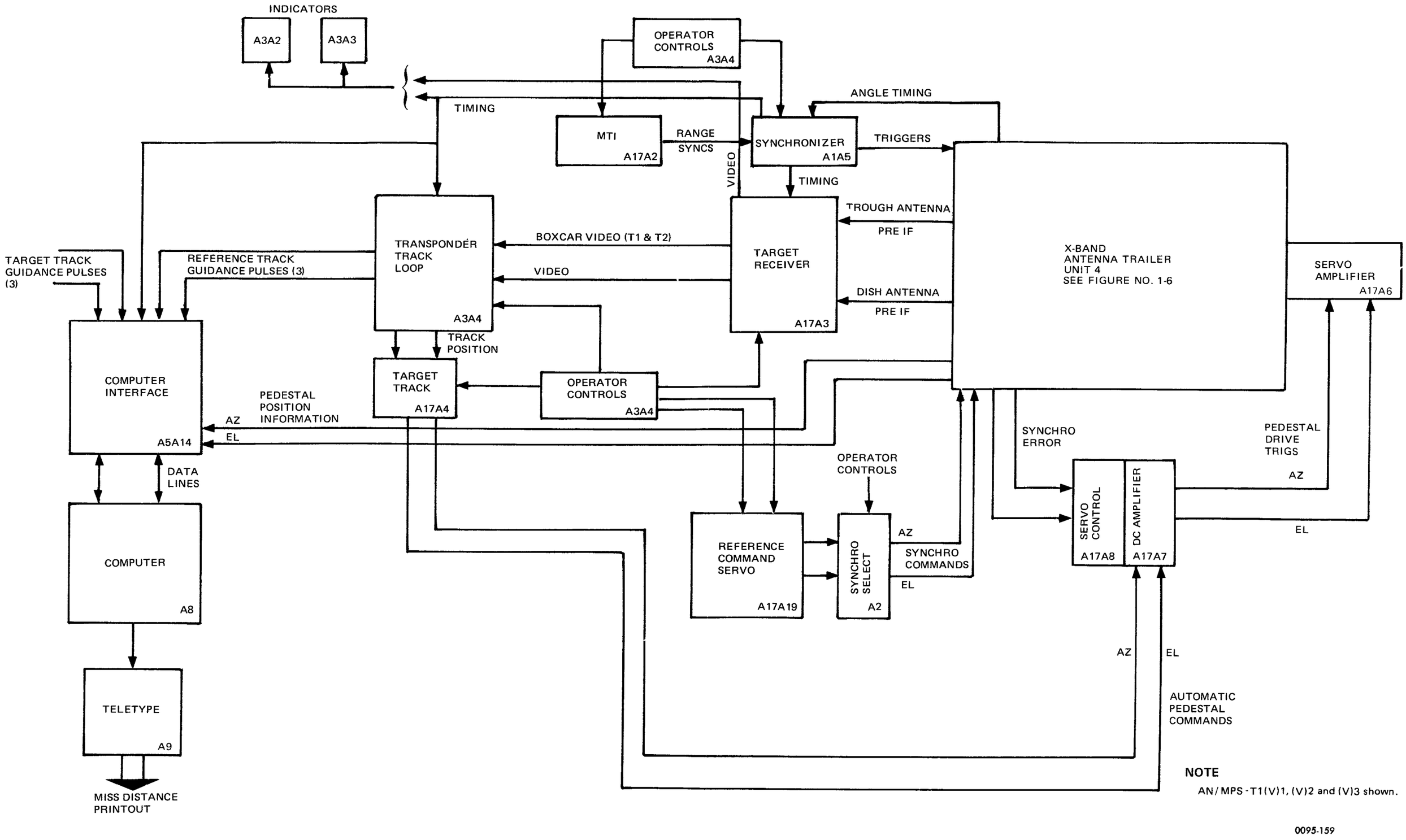


Figure 3-5. X-Band Reference Tracking System (Sheet 1)

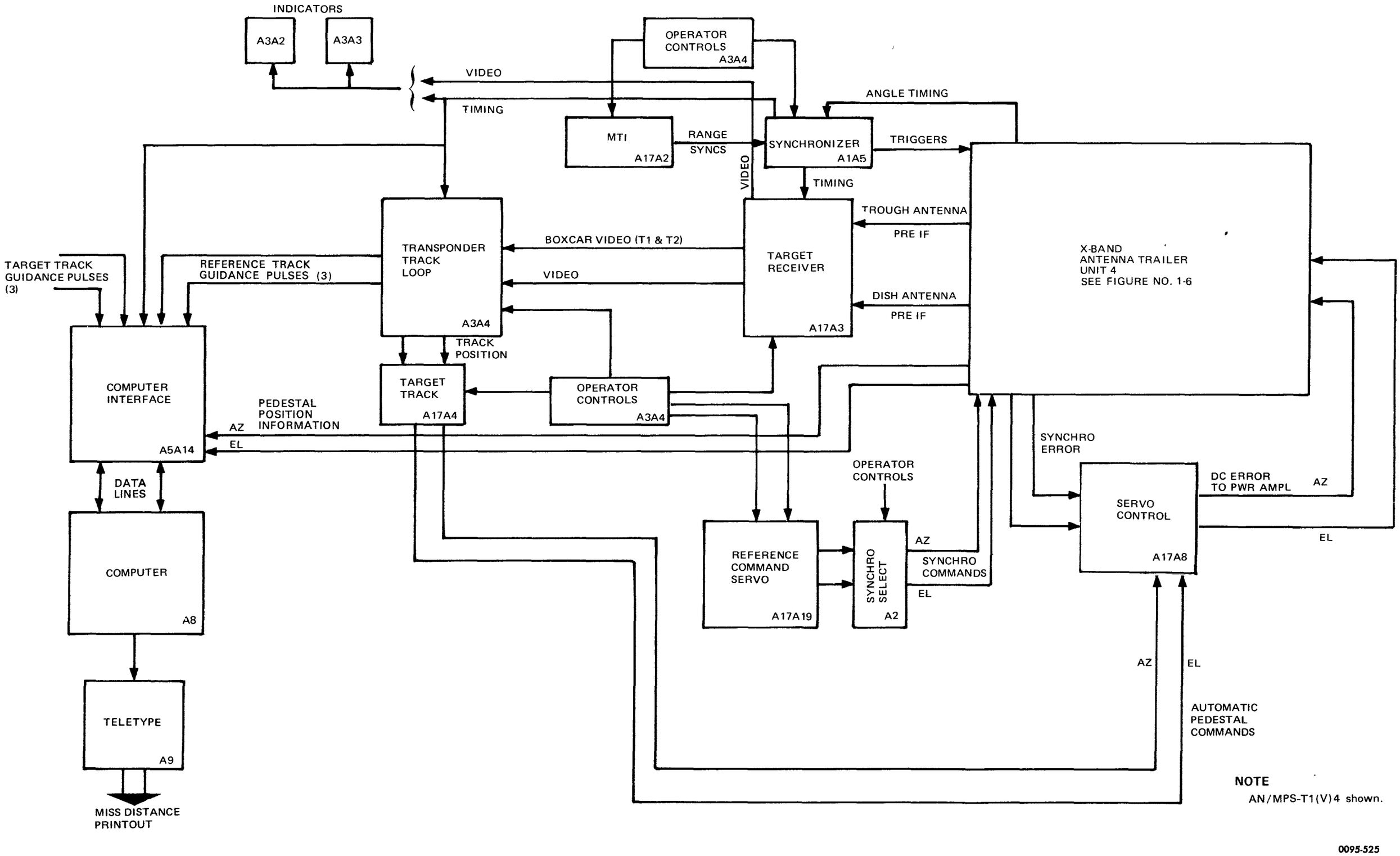


Figure 3-5. X-Band Reference Tracking System (Sheet 2)

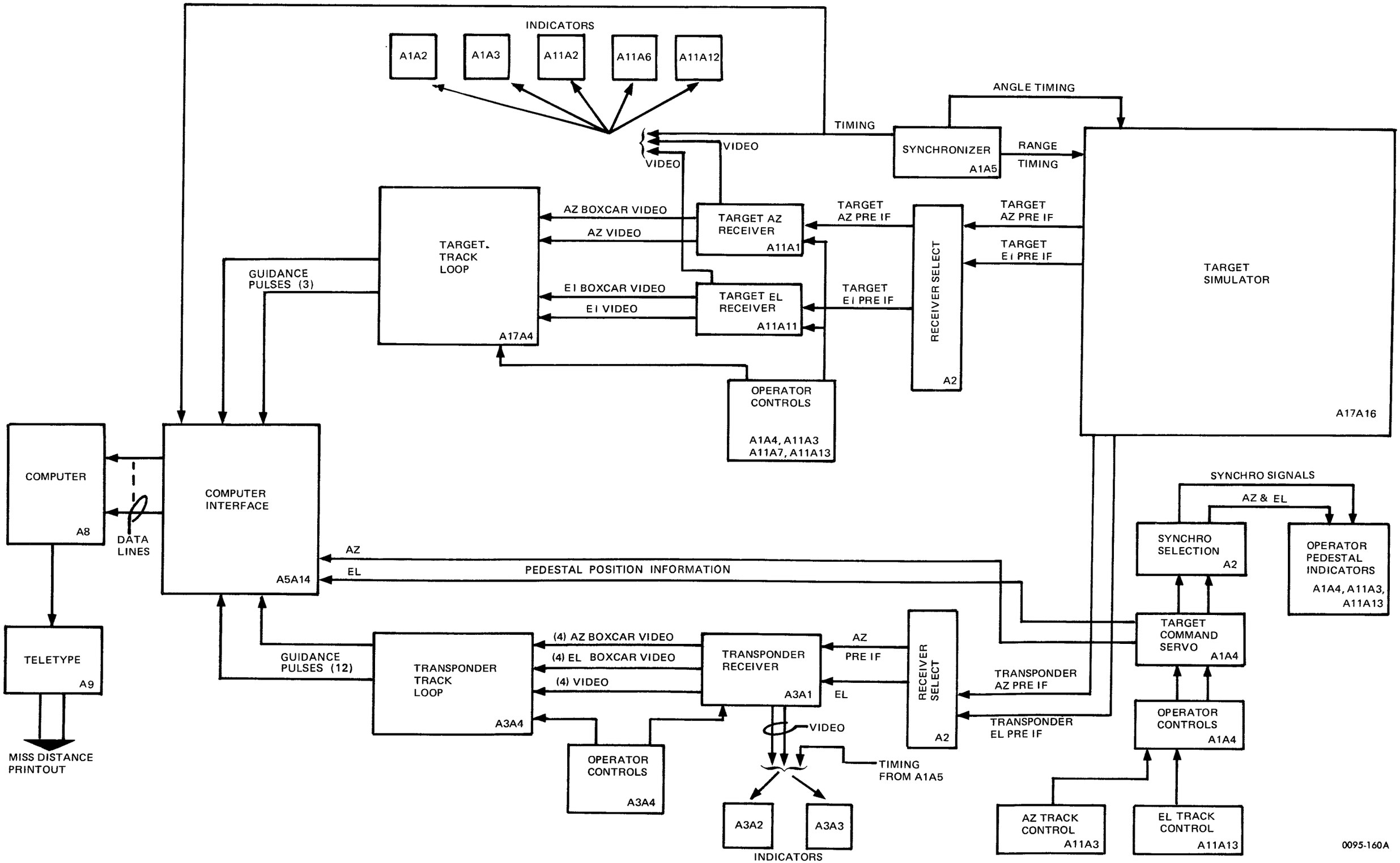


Figure 3-6. S- or C-Band Target Simulator Operation

system mode for the transponder reference case. Most maintenance, control trailer alignment, and operator training can be accomplished in this mode.

3-21. MAJOR EQUIPMENT SUBSYSTEMS.

3-22. Descriptions of the major equipment subsystems of the radar set are grouped by major functions as indicated below:

a. Transmitter group

b. Antenna group

c. Receiver group

d. Antenna pedestal servo group

e. Presentation group

f. Pedestal position readout group

g. Tracking group

h. Missile simulation and scoring group

i. Miscellaneous equipment, composed of the following:

1. Target simulator

2. Analog recording system

3. Intercommunication system

4. Radio communication system

5. Power supply system

6. Continental operations range (COR) instrumentation system.

3-23 through 3-24 and figure 3-7. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T. O. 43D7-11-21-2-1-1.

3-25. The transmitters used for the external reference system are controlled through use of the reference operator tracking controls 1A3A4. Otherwise, selection of the pulse repetition frequency (PRF) of the transmitters is controlled by means of the guidance operator tracking controls 1A1A4. When the airborne transponder reference system is in use, control of PRF is vested in the guidance operator.

3-26. S-BAND AND C-BAND TRANSMITTER SYSTEMS. The S- and C-band transmitters are dual pulse forming network (PFN) line-type modulators and utilize coaxial magnetrons for generation of the high power RF pulses. Ferrite load isolators isolate the magnetrons from loading effects due to variations in antenna-load impedance matching and improve the voltage standing wave ratio (VSWR) of the transmission lines. The isolators thus improve RF spectrum distribution and stabilize magnetron operation.

3-27. The S-band azimuth and elevation transmitters are normally operated at frequencies 60 megahertz (MHz) apart with the elevation transmitter tuned to the higher frequency. The C-band transmitters are normally operated at frequencies 100 MHz apart with the elevation transmitter tuned to the higher frequency.

3-28. Transmitter triggers for the S- and C-band units and their associated L-band transmitters are generated in the synchronizer, which also provides the timing and synchronization signals for the other functional groups of the radar set. Missile guidance command signals generated in the computer interface unit and controlled by the digital computer are summed with the L-band transmitter trigger in the synchronizer. These transmitter triggers are routed through the slipring assembly to the signal conditioner where they are converted from differential signals to single-ended signals for application to the modulator trigger circuits in the transmitter assemblies. Provisions are incorporated in the synchronizer so that the transmitted RF pulses from the azimuth and elevation transmitters and associated guidance transmitter may be correctly aligned.

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTION RADAR TRAINING SET AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1 FOR FIGURE 3-7

3-29. A bidirectional coupler, located in each waveguide transmission line, is used to sample the incident (forward) and reflected (reverse) power of the transmitted RF energy. Incident and reflected power from the coupler is applied to the performance monitor where a direct current signal is generated to drive the forward and reverse power meters in the remote power monitor. A sample of the forward power from the bidirectional coupler is also routed to the automatic frequency control (AFC) circuits in the receiver group.

3-30. L-Band Transmitters. The L-band transmitters are medium-power cavity oscillator transmitters which generate the RF pulses that trigger the airborne transponder and convey missile command guidance information. These transmitters operate in conjunction with, and are synchronized with, the respective S-band and C-band transmitters.

3-31. Transmitter Controls. Local and remote controls allow the transmitters to be turned on and adjusted, and allow the critical voltages and currents to be monitored for proper operation at the transmitter as well as in the radar control trailer. An additional meter in the control trailer indicates the RF frequency difference of the azimuth and elevation transmitters in S-band or C-band.

3-32. Waveguide Pressurization. Waveguide pressurization is provided in the S-, C- and X-band waveguide sections in order to improve the power handling capability of the magnetron and waveguide runs. The compressed and dried air from the compressor system keeps the magnetron output window and waveguide sections free of dust and moisture.

3-33. X-BAND TRANSMITTER SYSTEMS. The X-band transmitter is a hard-tube modulator and employs a driver tube to provide the magnetron pulse so that the pulse shape and frequency characteristics of the output may be closely controlled. Control of the pulse and frequency provides the RF stability required for the moving target indicator (MTI) system. A sample of the RF energy from the transmitter is converted to an IF signal and furnished to the MTI circuits for use as a coherent oscillator (COHO) reference.

3-34. The magnetron employed in the system is tunable and can be switched between two operating frequencies by the guidance operator or by automatic frequency selection circuits in the X-band target receiver. Load isolators, bidirectional couplers, and waveguide pressurization systems are employed as described in paragraphs 3-29 through 3-32 on the S-band and C-band transmitters.

3-35. Transmitter trigger pulses for the X-band tracking transmitter originate in the MTI assembly where they are generated and controlled by the delay line in the MTI canceller. This common delay line for the generation of triggers and for video cancellation yields a trigger stability commensurate with the cancellation system requirements. These triggers and the L-band pulsed command transmitter triggers are routed to the synchronizer which generates the differential triggers for the X-band modulator and the timing and synchronization for other functional groups of the radar set. The transmitter PRF is controlled from guidance operator tracking control 1A1A4 when the X-band system is the target tracking system and from reference operator tracking control 1A3A4 when used as the external reference system. These transmitter triggers are routed through the X-band trailer slipring assembly to the signal conditioner where the single-ended trigger pulses are generated for application to the X-band modulator.

3-36. L-BAND CW COMMAND TRANSMITTER. The L-band continuous wave (CW) command transmitter is a medium power transmitter that transmits the missile guidance information associated with the X-band missile. In this missile system the guidance information is conveyed by modulating the carrier signal

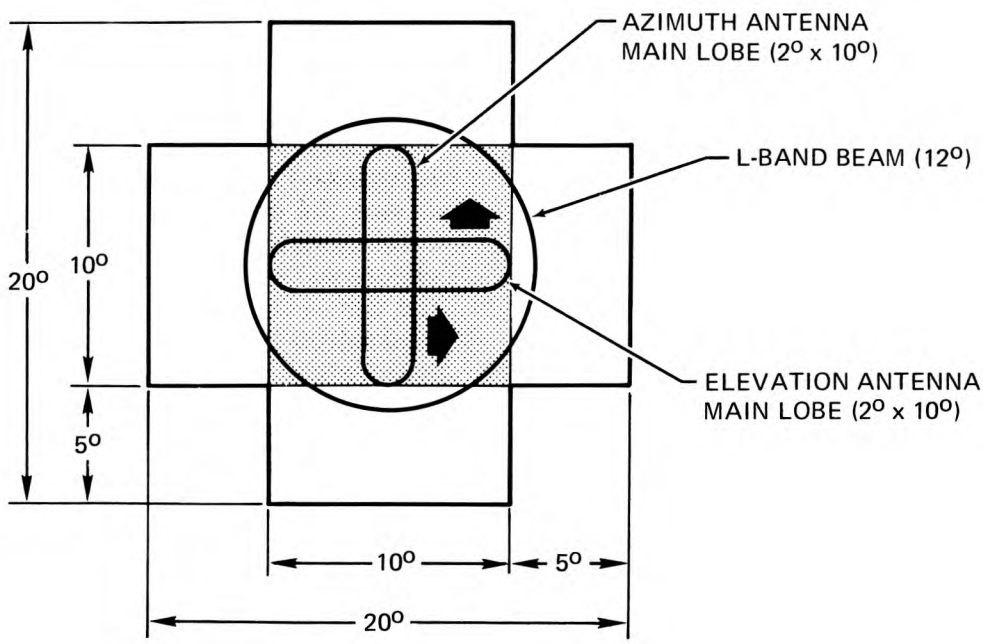
with discrete modulating frequencies and controlling the time that the modulating signals are applied. The modulating signals are controlled by missile guidance information from the digital computer.

3-37. ANTENNA GROUP.

3-38. The antenna group consists of separate S-band, C-band, and X-band antenna systems. Each antenna system receives high-power RF pulses from the associated transmitters, routes the pulses to the antennas, and provides the radiation and scan patterns for target illumination and transponder interrogation. Reflected energy from the targets and the transponder reply pulses are received by the antenna systems and routed to the receivers which are selected by the operators to control the system operating mode. Angle-timing pulses for synchronization of other functional groups in the radar set originate in the antenna group. These synchronizing pulses are also selected and routed according to the system operating mode.

3-39. S-BAND ANTENNA SYSTEM. The S-band antenna system (figure 1-4) is composed of three antennas installed on the S-band antenna trailer: azimuth trough antenna 2A12, elevation trough antenna 2A11, and L-band transponder interrogation and command guidance dish antenna 2A13. These antennas provide the electromagnetic radiation envelope shown in figure 3-8.

3-40. The azimuth trough antenna provides a radiation pattern of 2 degrees in the scanned (azimuth) plane and 10 degrees in the unscanned (elevation) plane. The pattern is scanned 20 degrees unidirectionally in the azimuth plane in a clockwise direction. It is used for both transmitting and receiving. The elevation trough



NOTE

Arrows (➧) indicate direction of scan.

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Figure 3-8. S-Band Antenna Group Radiation Envelope

antenna provides a radiation pattern of 2 degrees in the scanned (elevation) plane and 10 degrees in the unscanned (azimuth) plane. This pattern is scanned 20 degrees unidirectionally in the elevation plane in an upward direction. It is also used for both transmitting and receiving. The radiation is polarized normal to the scanned plane in each case. The L-band dish antenna provides a 12-degree circularly polarized beam.

3-41. The two trough antennas and the L-band dish antenna are mounted on an antenna support structure and boresighted to a common point to produce the overlapping lobe structure (dual scanned window) of the trough antennas and the L-band radiated antenna pattern shown in figure 3-8.

3-42. Antenna Scanning. In each trough antenna section (azimuth or elevation), RF energy is routed through the duplexer and waveguide switch to the trough antenna scanner assembly. The RF energy is routed through a rotating joint in the scanner assembly to a feed horn that is mounted on a circular fly-wheel and is rotated at a 16-Hertz (Hz) rate. Radio frequency energy from the feed horn is directed into a parallel plate structure where it is focused and directed to the output feed opening and reflected by the reflector.

3-43. The 20-degree unidirectional scan of the beam is obtained by the interrelationship of the 360-degree feed horn rotation and the mechanical curvature of the parallel plate structure and mirror assembly.

3-44. Reflected RF energy is picked up by each antenna and follows a return path similar to that of the transmitted RF. However, at the duplexer, reflected RF energy is diverted to the receiver group. Waveguide switches and dummy loads allow the transmitter output to be switched from the antennas to the dummy loads.

3-45. Magnetic pickup units located on the antenna generate pulses as the scanner rotates. Pulses are produced at the start of scan, end of scan, and center of scan (boresight) for angle synchronization purposes. An automatic frequency control (AFC) clock regulates the pulse train as the scanner rotates to provide a time base for determining the position of the antenna beam angle within the scan.

3-46. C-BAND ANTENNA SYSTEM. The C-band antenna system (figure 1-5) is composed of five antennas installed on the C-band antenna trailer: azimuth and elevation trough antennas 3A12 and 3A11 similar to those in the S-band antenna system, azimuth and elevation scanned dish antennas 3A14 and 3A13, and L-band transponder interrogation and command guidance dish antenna 3A15. These five antennas are mounted on the antenna support structure and are boresighted to a common point. These antennas provide the electromagnetic radiation envelope for the operating modes of the C-band radar (figure 3-9).

3-47 through 3-49. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-50. Antenna Scanning. In the C-band system, two different antenna scanning devices are used: one for the trough antennas and one for the dish antennas. The scanners used with the C-band trough antennas are identical to those used with the S-band trough antennas except for frequency characteristics.

3-51. The dish scanning is accomplished by a helical slot scanner mechanism at the focal point of the dish antenna. The RF energy from the transmitter is passed through a waveguide section to the rotating cylinder containing a helical slot. The RF is passed through the open waveguide end formed by the alignment of the feed waveguide section and the helical slot. Rotation of the cylinder at a 16-Hz rate results in a sawtooth scan at the 16-Hz rate. The 8-degree unidirectional scan during the 360-degree helix rotation is obtained by the relationship of the length and the

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS, RADAR TRAINING SET, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1 FOR FIGURE 3-9

pitch of the helical slot. Angle timing signals in each antenna scanner provide angle synchronization of other groups of the radar set with the angle scan of the antennas.

3-52. X-BAND ANTENNA SYSTEM. The X-band antenna system (figure 1-6) is composed of three antennas mounted on the X-band antenna trailer pedestal: X-band illuminator antenna 4A11, dual-scanning trough antenna 4A10, and L-band transponder interrogation and missile command guidance cut dish antenna 4A9. These antennas are mounted and boresighted on a common antenna support structure to produce the radiation envelope shown in figure 3-10.

3-53. Acquisition Mode. When the system is operating in the acquisition mode, the illuminator antenna scans from bottom to top at a 25-Hz rate and is used for both the transmitting and receiving functions. The dual-scanning trough antenna that provides the T1 and T2 scans (figure 3-10) continues to scan but the outputs from the antenna are not used by the system.

3-54. Track Mode. When the operator selects the track mode, the illuminator antenna stops at a boresight position (center of its scan) which is at the 4-degree and 11-degree points of the T1 and T2 scans shown in figure 3-10. This boresight position of the illuminator antenna is referred to as the antenna system directrix. The illuminator antenna is used for the transmitting function and the dual-trough antenna for the receiving function to provide a LORO system capability.

3-55. Antenna Scanning, Illuminator Antenna. The illuminator antenna is an offset-fed, cut dish scanning antenna that utilizes an organ pipe scanner to produce the required unidirectional sawtooth scan.

3-56. Antenna Scanning, Dual Trough Antenna. The dual trough antenna utilizes a parallel-plate construction similar to the S- and C-band antennas. However, both parallel plate structures (T1 and T2) utilize a common rotating feed horn mechanism; hence, the T1 and T2 scans are generated sequentially during each rotation of the feed horn. This antenna is used only for a receiving antenna and only during the track mode of the X-band radar.

3-57. L-Band Guidance Antenna. The L-band guidance antenna is a horn-fed, offset-fed cut dish that is used to transmit the pulsed interrogation signals and the CW guidance signals associated with the X-band radar system.

3-58. RECEIVER GROUP.

3-59. The receiver group consists of the receiver channels that process the received signals for the target tracking function, the reference skin tracking function, the transponder reference function, and the down link jammer (DLJ) power measurement function.

3-60. A simplified block diagram of the receiver group, showing the interconnection of the various units and the function and usage of the receiver assemblies, is presented in figure 3-11.

3-61. PRERECEIVER SYSTEM. Each of the antenna trailers (S-, C-, and X-band) contains traveling wave tube (TWT) amplifiers which amplify the RF signals received from the antenna group; preselector filters which separate the signals into the target, transponder, and DLJ channels; and mixer-IF amplifier units which convert the RF signals to an intermediate frequency and amplify them before routing them through the slipring assembly to the control trailer. In addition to these units, local oscillators are provided for each channel and the automatic frequency control unit associated with the target channels. Each prereceiver system also contains an RF noise source that, when energized and selected, allows noise figure measurement for each prereceiver system. The noise figure meter and selection panel are located in the radar console in the control trailer. Each preamplifier receives gain control signals from the associated main receiver in the control trailer.

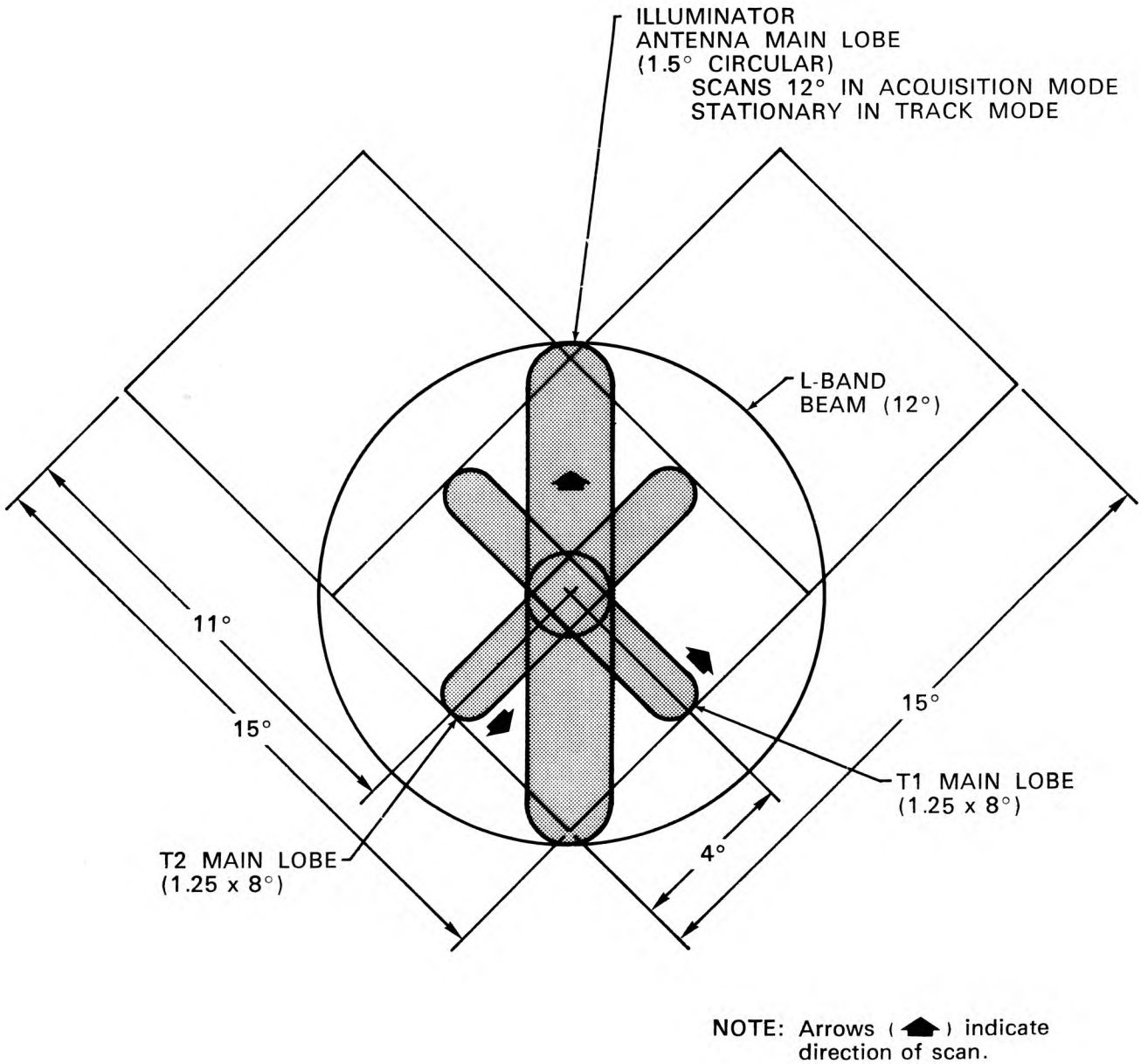


Figure 3-10. X-Band Antenna Group Radiation Envelope

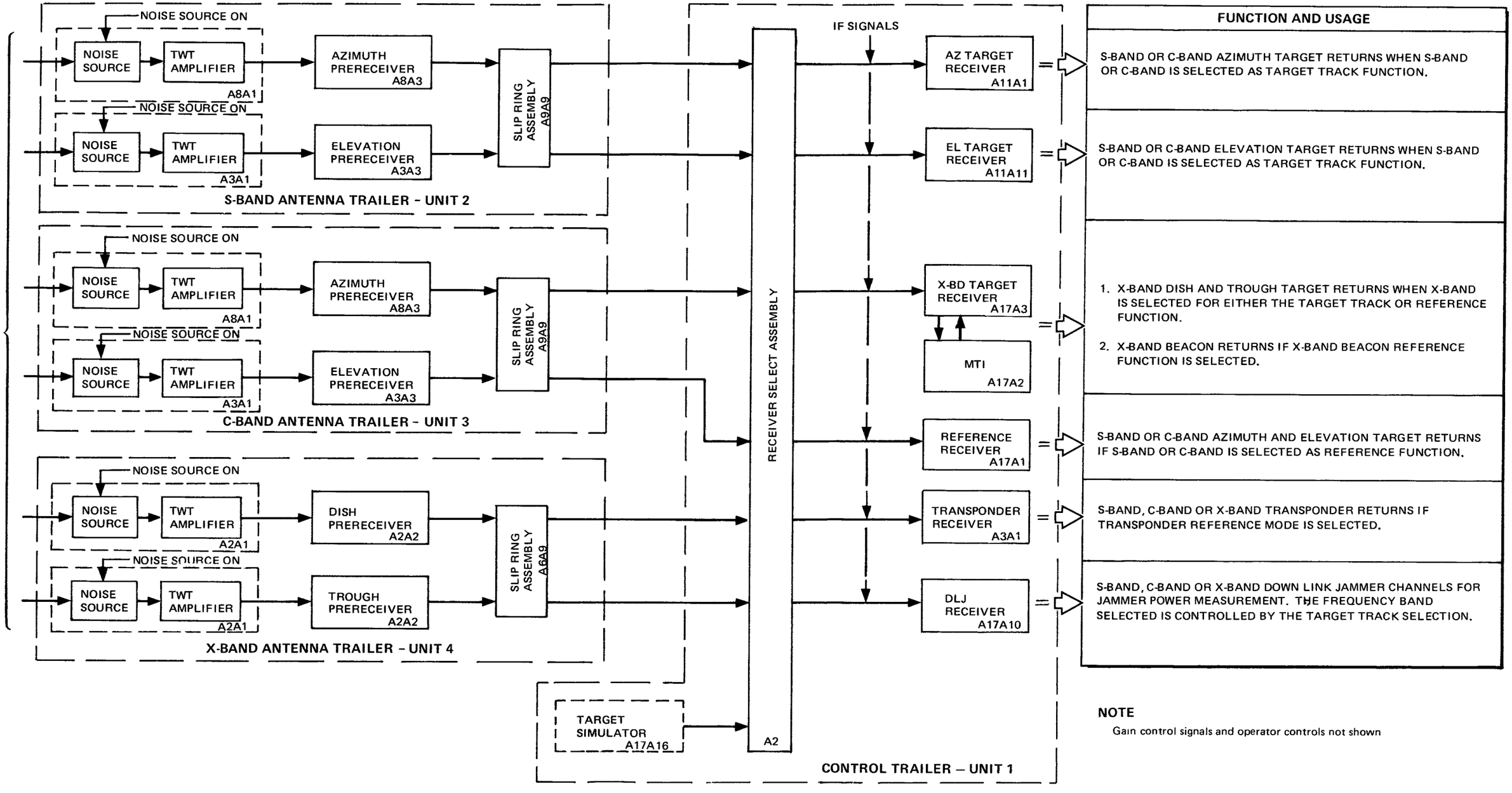


Figure 3-11. Receiver Group Simplified Block Diagram

3-62. The S- and C-band prereceivers contain separate azimuth and elevation units which differ only in operating frequencies. The X-band prereceiver contains trough and dish units that process the radio frequency from the trough and dish antennas and perform the functions described for the target, transponder, and DLJ channels.

3-63. RECEIVER SELECT SYSTEM. The receiver select system selects either the outputs from the prereceivers or the IF output from the target simulator according to the system operating mode selected by the radar operators and applies the selected signals to the receivers according to the system needs. A list of the connections between the mixer preamplifiers and the receiver chassis is shown in table 3-2. Reference to table 3-1 will shown the allowable combination of target track and reference track selection.

3-64. MAIN RECEIVER SYSTEM. The main receiver system includes the S- and C-band azimuth and elevation target receivers, X-band target receiver, reference receiver, transponder receiver, and down link jammer (DLJ) receiver.

3-65. S-Band and C-Band Target Receivers. The azimuth and elevation S- and C-band receivers are used to process the target returns and supply inputs to the target tracking system and presentation system when either the S- or C-band radar has been selected as the primary target tracking system.

3-66. Azimuth receiver 1A11A1 and elevation receiver 1A11A11 are similar. Each contains linear and logarithmic IF amplifiers, which amplify the signals received from the receiver select circuits. The amplified signals are detected and thus provide video signals for the target range track loop, presentation group, and the boxcar video generation circuits. Each receiver contains boxcar video generation circuits and gain control circuits. The gain control options include manual gain control (MGC), automatic gain control (AGC), instantaneous automatic gain control (IAGC), and sensitivity time control (STC). During transmitter main bang, blanking signals are also used to reduce the gain of the receiver system.

3-67. X-Band Target Receiver. When the X-band radar has been selected as the primary target tracking system, the X-band target receiver is used in conjunction with target tracking loops 1A17A4, guidance operator indicators 1A1A2 and 1A1A3, and X-band manual tracker indicators 1A17A11 and 1A17A17. When X-band skin tracking or X-band beacon tracking has been selected as the reference system, the receiver is used with reference track loops 1A3A4 and reference tracking indicators 1A3A2 and 1A3A3.

3-68. The X-band target receiver contains two linear IF amplifiers which amplify the signal inputs received from the X-band pre-IF amplifiers associated with the illuminator and trough antennas and provide detected video output. The input to these amplifiers originates at either the illuminator (dish antenna) or the trough antenna pre-IF amplifier and is controlled by operator selection of the acquisition or track mode of the X-band system. Each channel contains boxcar video generation circuits and gain control circuits. The gain control options that are selectable by the operator are the same as those for the S- and C-band receivers: MGC, AGC, IAGC, and STC.

3-69. Additional circuits in this receiver monitor the level of jamming noise received. If automatic frequency control is selected and the target signal-to noise power exceeds a set ratio, a signal is applied to the X-band transmitter. This signal will cause the transmitter to tune to the other of its two preset frequencies.

3-70 through 3-71. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-72. Reference Receiver. The reference receiver (1A17A1) is used to process signals from the S- or C-band target pre-IF

Table 3-2. Mixer Pre Amplifiers - Receiver Connection

System Mode	Mixer Pre-Amp Ref Des	Main Receiver Location									
		S-Band Target Track	C-Band Target Track	X-Band Target Track	S-Band Ref Track	C-Band Ref Track	X-Band Ref Track	S-Band Xponder Track	C-Band Xponder Track	X-Band Xponder Track	X-Band Beacon Track
S-Band Az Target	2A8A3A2	1A11A1			1A17A1						
S-Band El Target	2A3A3A2	1A11A11			1A17A1						
S-Band Az Transponder	2A8A3A4							1A3A1			
S-Band El Transponder	2A3A3A4							1A3A1			
S-Band Az DLJ	2A8A3A3	1A17A10									
S-Band El DLJ	2A3A3A3	1A17A10									
C-Band Az Target	3A8A3A2		1A11A1			1A17A1					
C-Band El Target	3A3A3A2		1A11A11			1A17A1					
C-Band Az Transponder	3A8A3A4								1A3A1		
C-Band El Transponder	3A3A3A4								1A3A1		
C-Band Az DLJ	3A8A3A3		1A17A10								

Table 3-2. Mixer Pre Amplifiers - Receiver Connections (Continued)

System Mode	Mixer Pre-Amp Ref Des	Main Receiver Location									
		S-Band Target Track	C-Band Target Track	X-Band Target Track	S-Band Ref Track	C-Band Ref Track	X-Band Ref Track	S-Band Xponder Track	C-Band Xponder Track	X-Band Xponder Track	X-Band Beacon Track
C-Band El DLJ	3A3A3A3		1A17A10								
X-Band Dish Antenna Target	4A2A2A11			1A17A3			1A17A1				
X-Band Trough Antenna Target	4A2A2A10			1A17A3			1A17A1				
X-Band Transponder	4A2A2A9									1A3A1	
X-Band DLJ	4A2A2A8			1A17A10							
X-Band Beacon	4A2A2A10 4A2A2A11										1A17A3

amplifiers when the S- or C-band system has been selected as the skin tracking reference system. Azimuth and elevation sections of the receiver are identical and contain linear IF amplifiers, boxcar video generators, gain control circuits, and video drivers. The outputs of the receiver (video and boxcar video) are routed to reference track loops 1A3A4 and reference tracking indicators 1A3A2 and 1A3A3. MGC and AGC options are available to the reference operator.

3-73. Transponder Receiver. Transponder receiver 1A3A1 consists of separate azimuth and elevation channels. The signals received from the receiver select circuits are divided by four-way power dividers. Each of the divider outputs is routed to a separate section of the four azimuth and four elevation transponder receiver sections. In each section, IF signals are amplified, video is detected for the range-tracking loop and the presentation group, and boxcar video is developed for the angle-track loop and the AGC circuits. The video used in the range-track loops is obtained from the elevation sections only. AGC and MGC voltages for each of the eight receiver sections are developed within the receiver.

3-74. Down Link Jammer (DLJ) Receiver. The DLJ receiver processes signals from the DLJ preamplifiers (in the antenna trailer) selected for the target tracking function. These signals are received through the azimuth and elevation antennas of the S- and C-band systems or the trough antennas of the X-band system. Separate channels amplify and detect the signals received at the down link channel frequency. The detected video output is used to develop a gain voltage in an AGC mode so that the gain voltage produced can be furnished to the computer system as a function of the received signal strength (power) at the missile down link (reply) frequency. The antenna trailers contain input ports which permit connection of a signal generator so that the gain voltage output can be calibrated with a known power level input.

3-75. ANTENNA PEDESTAL SERVO GROUP, AN/MPS-T1(V)1, (V)2 and (V)3.

3-76. The antenna pedestal servo group positions the antenna systems as commanded by various operator control inputs. When selection of the system operating mode is made, the various servo drive systems are automatically connected to the correct operator control system. The antenna system to be used for the target tracking or reference tracking functions can then be selected.

3-77. The S- and C-band antenna pedestal servo systems operate only in a manual mode in which the antenna pedestal systems are positioned according to operator position controls. The X-band antenna pedestal servo system operates in either a manual mode (pedestal positioned as in S- or C-band) or an automatic mode. The X-band automatic mode operates such that the error signals developed in the electronic angle tracking loops position the antenna system. The X-band illuminator antenna points to the tracked target and target returns are at a point in the T1 and T2 scans corresponding to the antenna system directrix.

3-78. MANUAL ANTENNA PEDESTAL SERVO SYSTEM. In the servo system manual mode, the antennas and pedestals are positioned according to operator inputs (figure 3-12 and 3-13). The operator control inputs originate in the guidance operator console, S- and C-band manual tracker console, X-band manual tracker console, or the transponder (reference) operator console, depending on the system mode selected. Guidance operator console controls provide position commands to the pedestal while manual tracking controls on the remaining consoles (S- and C-band manual tracker, transponder operator, and X-band manual tracker consoles) provide both rate and position pedestal commands. The operator control input causes the synchro in the command servo to turn, and the resultant stator command signals induce an AC error signal on the rotor of the follow-up synchro in the associated antenna

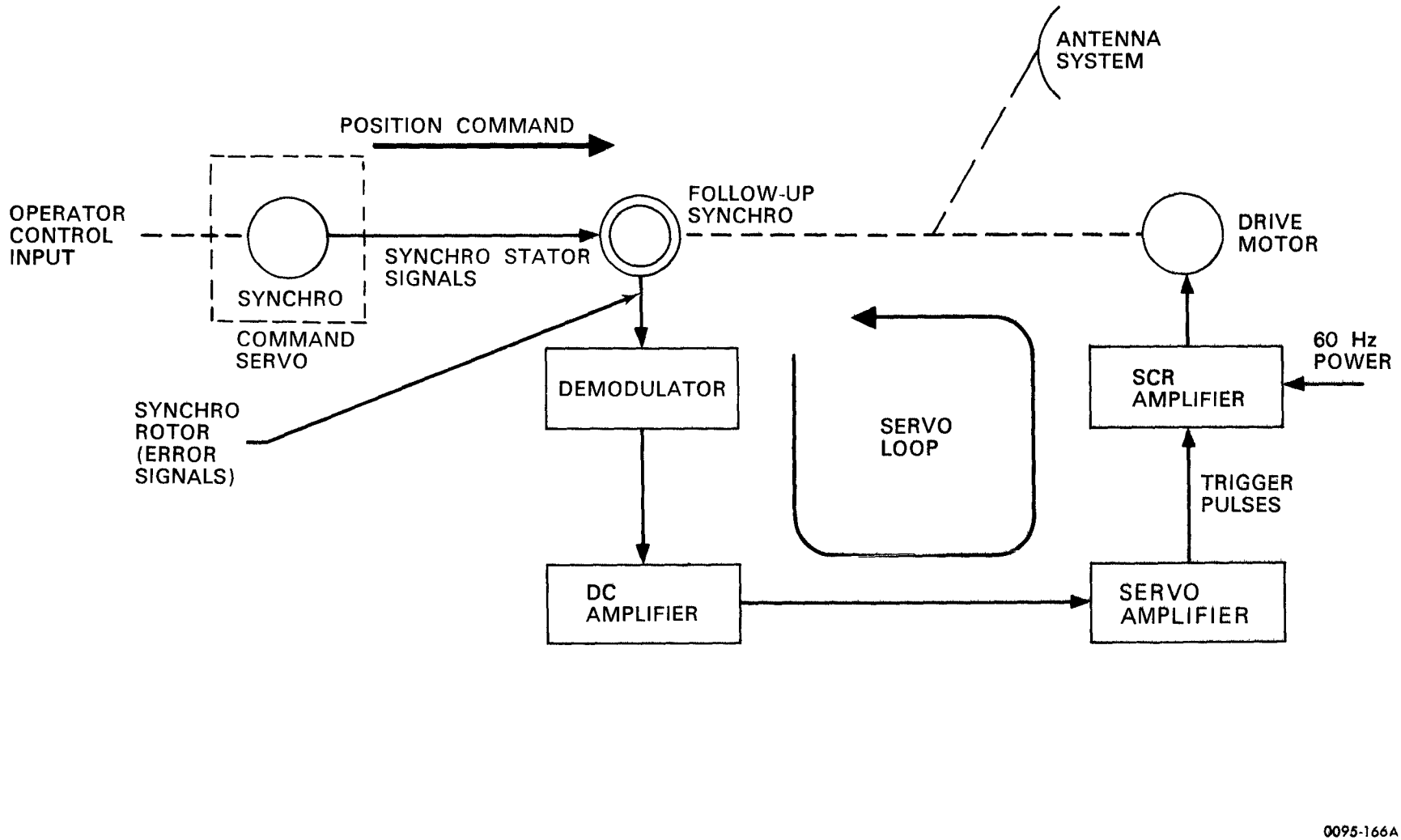
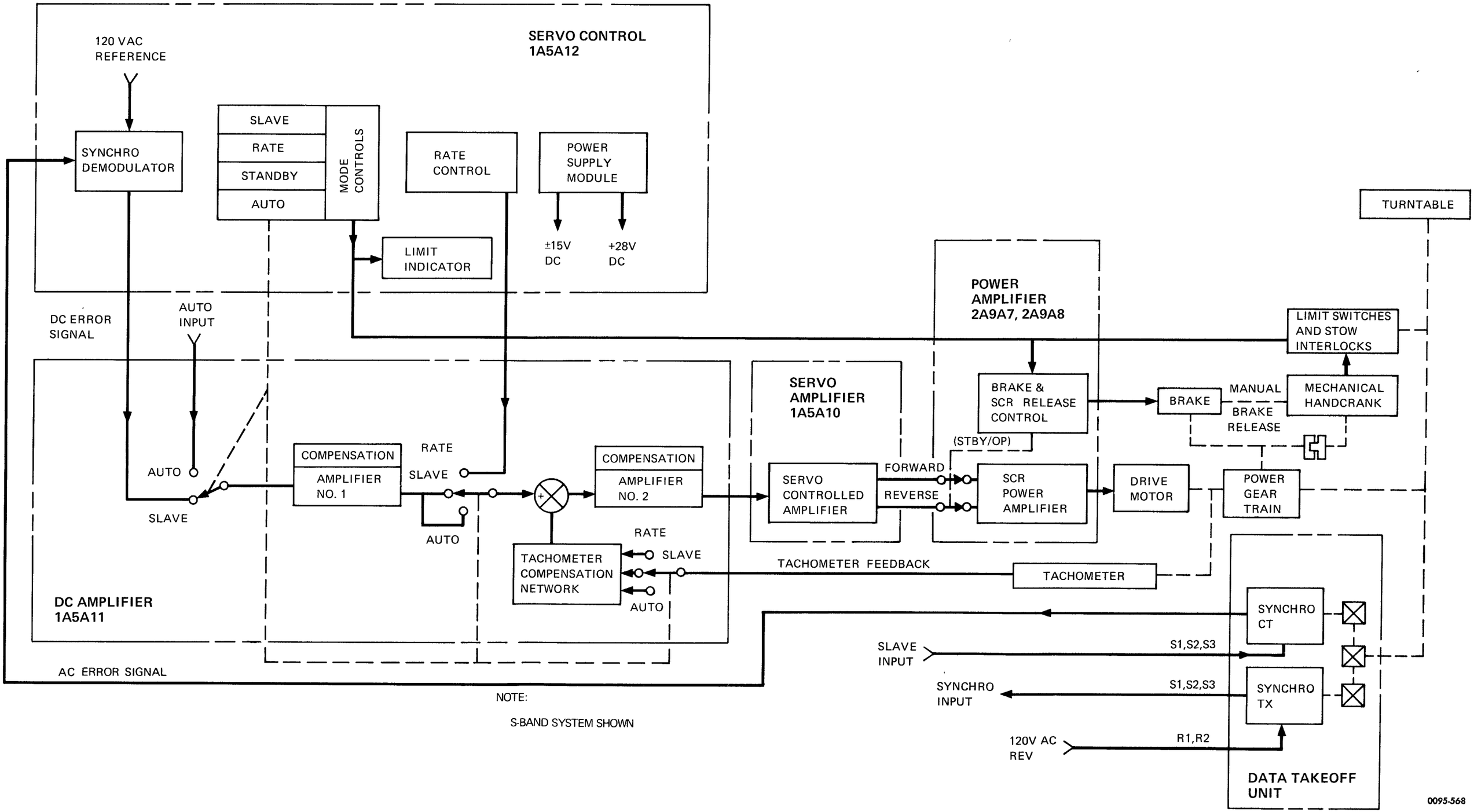


Figure 3-12. Servo Group, Manual Pedestal Servo System



NOTE:

S-BAND SYSTEM SHOWN

Figure 3-13. Antenna Pedestal Servo Group System Block Diagram

trailer. The synchro demodulator circuits in the control trailer servo control unit converts the AC synchro error signal from the rotor of the antenna trailer follow-up synchro (CT) into a positive or negative DC error signal, which determines direction of motor rotation. The error signal is amplified in the DC amplifier and then routed to the servo amplifier unit where trigger pulses are developed. These trigger pulses trigger the silicon controlled rectifier (SCR) power amplifier bridge circuit during a portion of the 60 Hz power cycle (determined by the amount of error) to provide pedestal motor drive current. A tachometer attached to the motor shaft provides a feedback signal which enhances overall loop stabilization. This servo loop action drives the antenna pedestal to the position selected by the operator control input. The power amplifier brake release control routes 115 VAC to the brake system to prevent the brake from being engaged during normal operation.

3-79. AUTOMATIC ANTENNA PEDESTAL SERVO SYSTEM. The automatic antenna pedestal servo system ensures that the illuminator antenna points to the tracked target (figure 3-14). The automatic mode is available only for the X-band antenna servo system.

3-80. During automatic pedestal operation, the auto positioning error signal is derived from the automatic tracking loops and routed directly to the DC amplifier unit. The DC amplifier produces an error voltage that is a measure of the misalignment of the target aircraft and the antenna system directrix. The direct current amplifier processes the error voltage signal, the servo amplifier trigger generator produces the trigger pulses, and the SCR amplifier develops the required motor drive currents to maintain antenna alignment with the target.

3-81. When the system is operated in the automatic pedestal mode, the manual mode command synchro is utilized as a follow-up synchro. This feature ensures synchro alignment which prevents a pedestal transient condition when the system is switched from automatic to manual pedestal mode.

3-82. SERVO GROUP INSTRUMENTATION OUTPUTS. An encoder, provided for both the azimuth and elevation axes, develops and supplies digital pedestal position information to the digital computer for use in the missile guidance and scoring functions of the missile simulation and scoring group.

3-83. ANTENNA TRAILER ENCODER. Two encoders are used in each antenna trailer; one each for the azimuth and elevation axis.

3-84. The electronic encoder includes a transducer unit, which consists of two resolvers, and a control unit, which consists of pulse converters, up/down counters, timing circuitry, parallel/serial register, and an ambiguity elimination stage. It is configured to accurately convert the analog angular positions of the antenna pedestal into a digital format for processing in the computer.

3-85. ENCODER TRANSDUCER 2A10A7, A8, 3A10A7, A8, 4A7A8, A10. A two-speed resolver transducer is used to provide the angular input for the electronic encoding sybsystem. The one-cycle resolver provides the coarse angular data and makes one electrical cycle per revolution of the input angle. The fine track, or high-resolution angular data, is provided by the 256-cycle resolver, which makes 256 electrical cycles per revolution of the input shaft.

3-86. Each electrical cycle of both resolvers is divided into 512 increments by the pulse converter in the control unit. The output from the coarse resolver is used to determine in which of the 256 time cycles the input angle is represented. The first eight bits of the coarse resolver output are used as the eight most significant bits of the output angle. The bits of the fine track (256 cycle) resolver provide the exact position within the particular cycle of the 256:1 resolver, and are directly utilized as

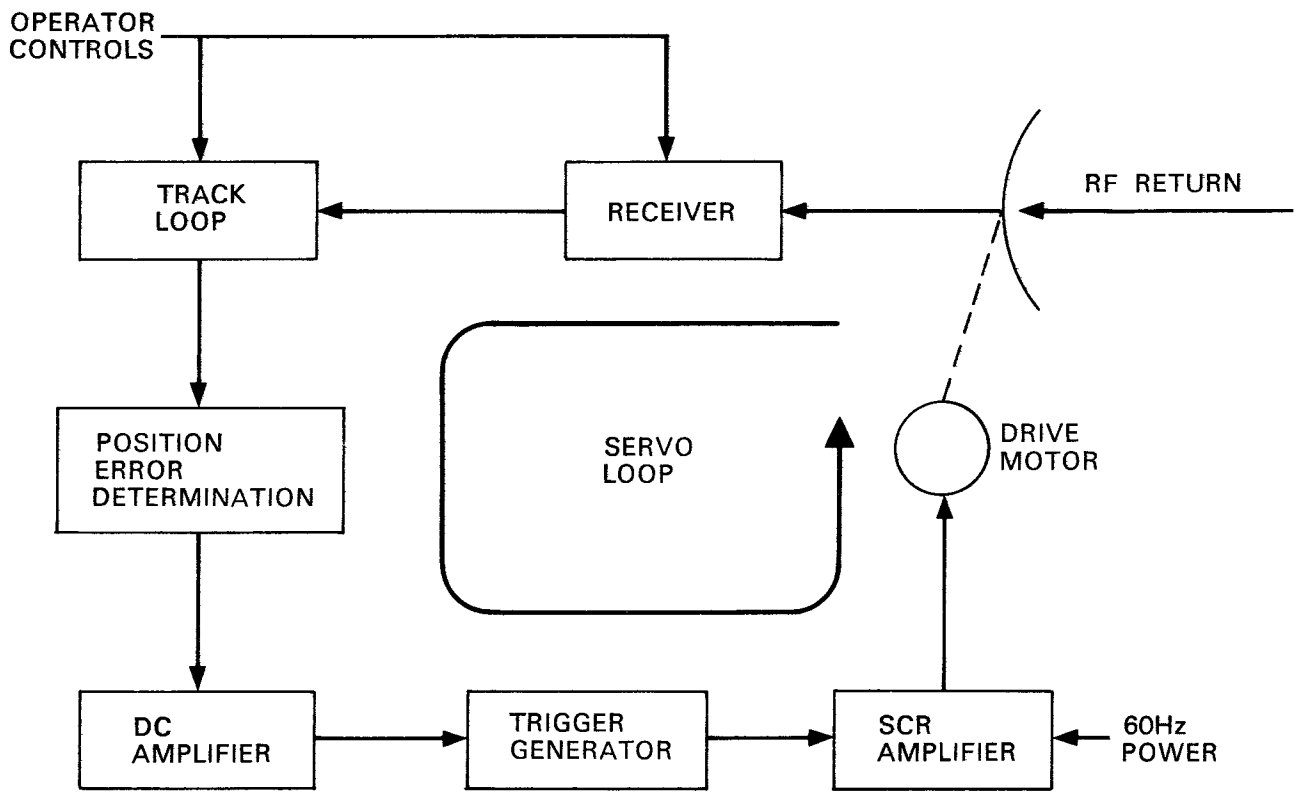


Figure 3-14. Servo Group, Automatic Pedestal Servo System

the least significant bits of the natural binary number.

3-87. CONTROL UNIT 2A10A5, A6; 3A10A5, A6; 4A7A6, A7. Pulse converters in the control unit are essentially sine/cosine generators which supply input signals to the resolver. Up/Down counters operate for both fine and coarse channels until the error between the assumed angle and the actual pedestal angle is nulled. Digital information from the counters is transferred to the output register periodically. Timing circuitry controls the transfer of data to the output register and from the output register to the computer.

3-88. The antenna pedestal synchro transmitter units provide inputs to the operator station pedestal position indicators to display pedestal pointing angles for the target tracking and reference tracking operators.

3-89. SERVO GROUP TARGET SIMULATOR OPERATION. Operation of the target simulator permits control trailer maintenance and operator training and does not require that the high-power transmitters, antennas, and pedestals be in operation. During target simulator operation, the operator command servos provide electrical inputs to drive the pedestal position synchros. A potentiometer, mechanically connected to the command servo, provides pedestal position reference information to the target simulator. The command servo encoder supplies pedestal position information to the digital computer which allows the operator controls to function normally, and the operator displays and control functions to give simulated video indications without ground clutter effect on the displays.

3-90. ANTENNA PEDESTAL SERVO GROUP, AN/MPS-T1(V)4.

3-91. The simplified theory of operation for the antenna pedestal servo group for the AN/MPS-T1(V)1, (V)2, and (V)3 is essentially the same as the antenna pedestal servo group for the AN/MPS-T1(V)4, except for the manner in which the error signals from the pedestal are processed through the control trailer and then routed to the pedestal for motor drive control. (Refer to general theory for the AN/MPS-T1(V)1, (V)2 and (V)3.) Manual pedestal servo operation for the AN/MPS-T1(V)4 is described in the following paragraphs. Figure 3-15 is a simplified block diagram for this configuration. The dashed lines indicate the physical grouping of the elements in the major electronic chassis. The mode-selector switches are shown in the slave mode. Signal channels for only one axis of rotation are shown. The azimuth and elevation are very similar and can be operated independently.

3-92. MANUAL PEDESTAL SERVO OPERATION. The major difference between the AN/MPS-T1(V)1, (V)2, and (V)3 and the AN/MPS-T1(V)4 is the manner in which the AC error signal is processed and routed from the control transformer (CT) rotor through to the drive motor. For the AN/MPS-T1(V)4, the synchro demodulator circuits of the servo control unit demodulate the AC error signal from the rotor of the antenna trailer follow-up synchro (CT). This DC error signal is then routed to the relay chassis (for remote mode control) where it is switched and then fed to the position loop amplifier. The position loop amplifier amplifies the DC error signal and routes it to the rate loop amplifier. The rate loop amplifier amplifies and integrates the algebraic sum of the DC error signal from the position loop amplifier and the feedback signal from the tachometer compensation network. The resultant output is then fed to the pulse generator. The pulse generator develops trigger pulses which are routed to the SCR power amplifier through the forward trigger or reverse trigger signal lines (depending upon the polarity of the drive signal). The pulse amplifier card amplifies these pulses and couples them through the pulse transformer card to the SCR bridge. The sequence of these pulses determine the direction of rotation of the drive motor.

3-93. ANTENNA TRAILER ENCODER. Two encoders are used in each antenna trailer; one each for the azimuth and elevation axis. The encoders are identical to

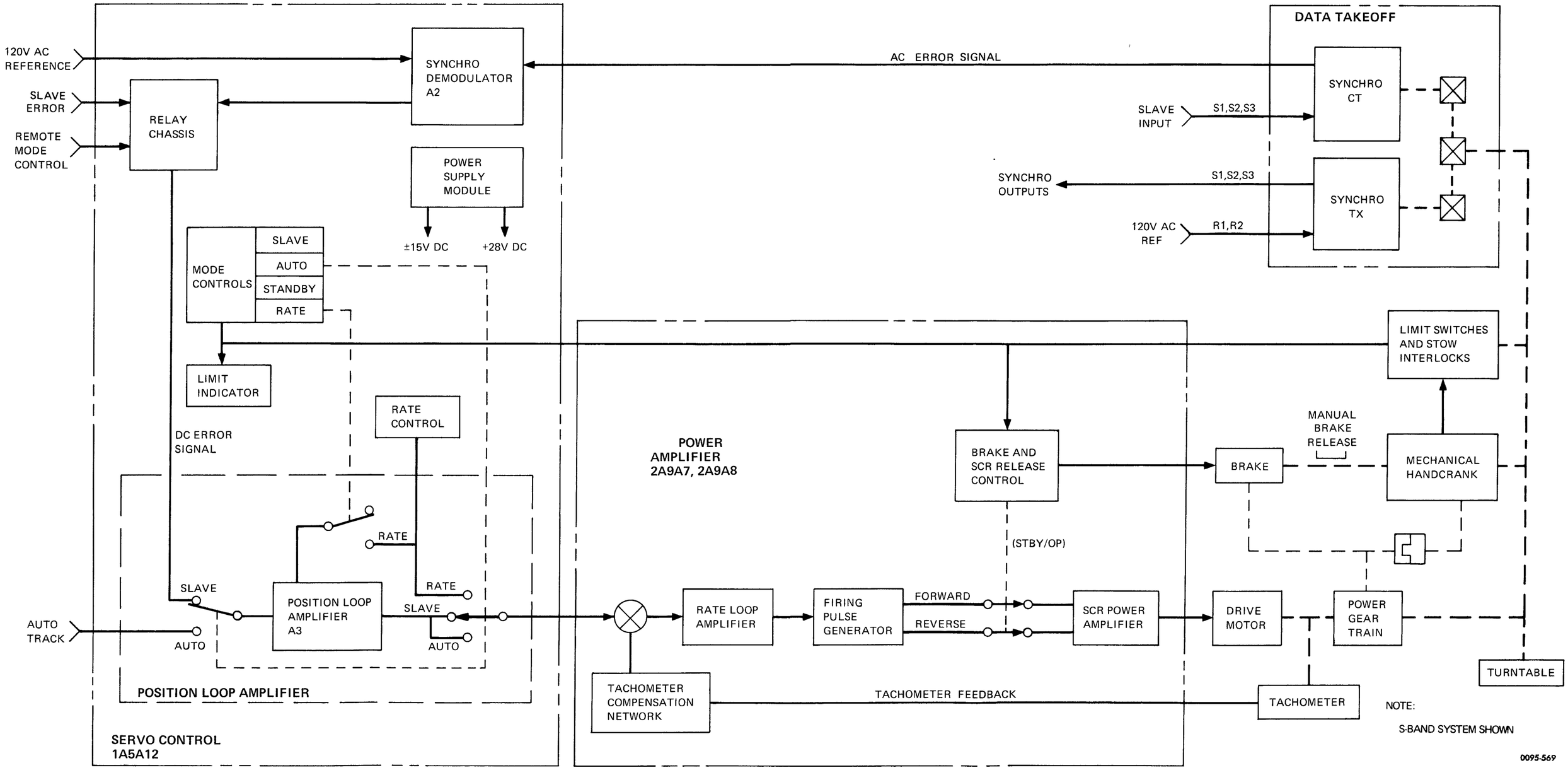


Figure 3-15. Antenna Pedestal Servo Group Block Diagram

the ones supplied for the AN/MPS-T1(V)1, (V)2, and (V)3. Simplified theory of operation is provided in that section.

3-94. PRESENTATION GROUP.

3-95. The radar presentation group provides a visual display of targets received by the tracking radar and reference radar systems. The target and reference video displayed on the indicators is derived by the receiver group from the signals received from the S-band, C-band, or X-band antenna systems or from the target simulator, as selected by the operators. The cursors and the strobes required for the tracking and calibration functions are also displayed. The presentation group is divided into five display groups: guidance operator, S- and C-band manual tracker operators, X-band manual tracker operators, reference (transponder) operator, and the APP operator. With the exception of the APP display, all displays within the system are B-scope displays that are synchronized to radar main bang and display range on the vertical axis and synchronized to an antenna scan to display angle on the horizontal axis.

3-96. GUIDANCE OPERATOR INDICATOR GROUP. The guidance operator indicator group consists of two B-scope indicators 1A1A2 and 1A1A3. The indicators display the target video signals from the antenna-receiver system of the selected target tracking radar.

3-97 and figure 3-16. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T. O. 43D7-11-21-2-1-1.

3-98. In the low-altitude mode of operation, the angle cursor on the elevation indicator consists of two vertical lines. The vertical lines indicate the beginning of the elevation early angle tracking gate and the end of the elevation late angle tracking gate.

3-99. X-Band Guidance Operator Displays. The appearance and use of the displays for X-band system operation differ for the acquisition mode and the track mode of the X-band target track system.

3-100 and figure 3-17. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T. O. 43D7-11-21-2-1-1.

3-101. When the X-band system is in the track mode, the displays operate as T1 and T2 scan displays as shown in figure 3-18. One indicator operates as a T1-range display and the other as a T2-range display. The guidance operator can select the display which is to be presented on the left indicator. This display has an expanded range sweep capability.

3-102. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T. O. 43D7-11-21-2-1-1.

3-103. S-BAND AND C-BAND MANUAL TRACKER DISPLAYS. The S- and C-band manual tracker displays consist of three B-type displays as shown in figure 3-19. The indicator on the left is an azimuth-range display for the azimuth manual tracker operator, the center indicator is the display for the range manual tracker (utilized as an azimuth-range or an elevation-range display at operator discretion), and the indicator on the right is an elevation-range display for the elevation manual track operator.

3-104. In addition to the target video, the following visual marks are displayed on these indicators: the range cursors (two horizontal strobes, separated in range, and centered around the center of the range-tracking gates), angle cursors, and boresight cursors (which are identical to those described for the guidance operator displays).

3-105. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T. O. 43D7-11-21-2-1-1.

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS RADAR TRAINING SET, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1 FOR FIGURES 3-16 THROUGH 3-19

3-106 and figure 3-20. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-107. TRANSPONDER (REFERENCE) DISPLAYS. The transponder display group consists of two B-scope displays. The information displayed on these units depends upon the reference system selected. If the S-, C-, or X-band skin-track reference system is selected, the displays will be identical to those described for the guidance operator display group (paragraphs 3-97, 3-99) except that there is no expanded range display option.

3-108. When a transponder reference system is chosen, the displays will be azimuth range and elevation range for the S- and C-band transponder reference system and T1 scan range and T2 scan range for the X-band transponder reference system.

3-109 through 3-110 and figures 3-21 and 3-22. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-111. TRACKING GROUP.

3-112. The tracking group consists of two separate systems: the target tracking system and the transponder or reference tracking system. The target tracking system enables range, azimuth, and elevation tracking of the skin-echo returns from a target aircraft. The transponder or reference tracking system contains four sets of tracking loops which enable range, azimuth, and elevation tracking of reply signals. The reply signals originate from four transponders installed aboard aircraft or the tracking of a single reference target depending on the system mode selected. The tracked position of the target (and transponders) or reference target (in range, azimuth, and elevation) is furnished to the missile simulation and scoring system in the form of guidance pulses. These pulses show the position of the center of the associated tracking gates.

3-113. The target position information is the position information from which missile guidance commands are generated. In addition, the miss distance of the missile to this tracked target is computed when the missile range is equal to the tracked target range.

3-114. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-115. Because of the angle scanning of the antennas past the target to be tracked, the video signal used for automatic range tracking must be angle-gated during the angle of interest in a scanning radar. This angle-gating is necessary in order to exclude targets that may occur at the same range as the target to be tracked but at different angular positions. Similarly, the video signals used for angle tracking must be range-gated at the range of interest. A simplified diagram of the target tracking system and its relationship to other subsystems is shown in figure 3-23.

3-116. RANGE TRACKING. The range tracking loops provide tracked range information of the target or reference target for the missile simulation and scoring system. This information is in the form of a guidance pulse that indicates the position of the tracked target in time. All range track loops are similar and provide automatic range track capability, when selected, as well as a manual capability that is used for manual tracking or acquisition of the target or transponder in range.

3-117. Target Range Tracking - Manual, S-Band and C-Band. A visual presentation of target video for tracking and acquisition purposes is provided on the two guidance operator displays and the three manual tracker displays. A range cursor in the form of a single horizontal strobe is displayed on the guidance operator scope to indicate the position of the range tracking gates. This range gate position is displayed on the manual tracker indicators in the form of two horizontal strobes. During acquisition and manual tracking, the range

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS RADAR TRAINING SET, AN/MPS-T1(V), T. O. 43D7-11-21-2-1-1 FOR FIGURES 3-20 THROUGH 3-22

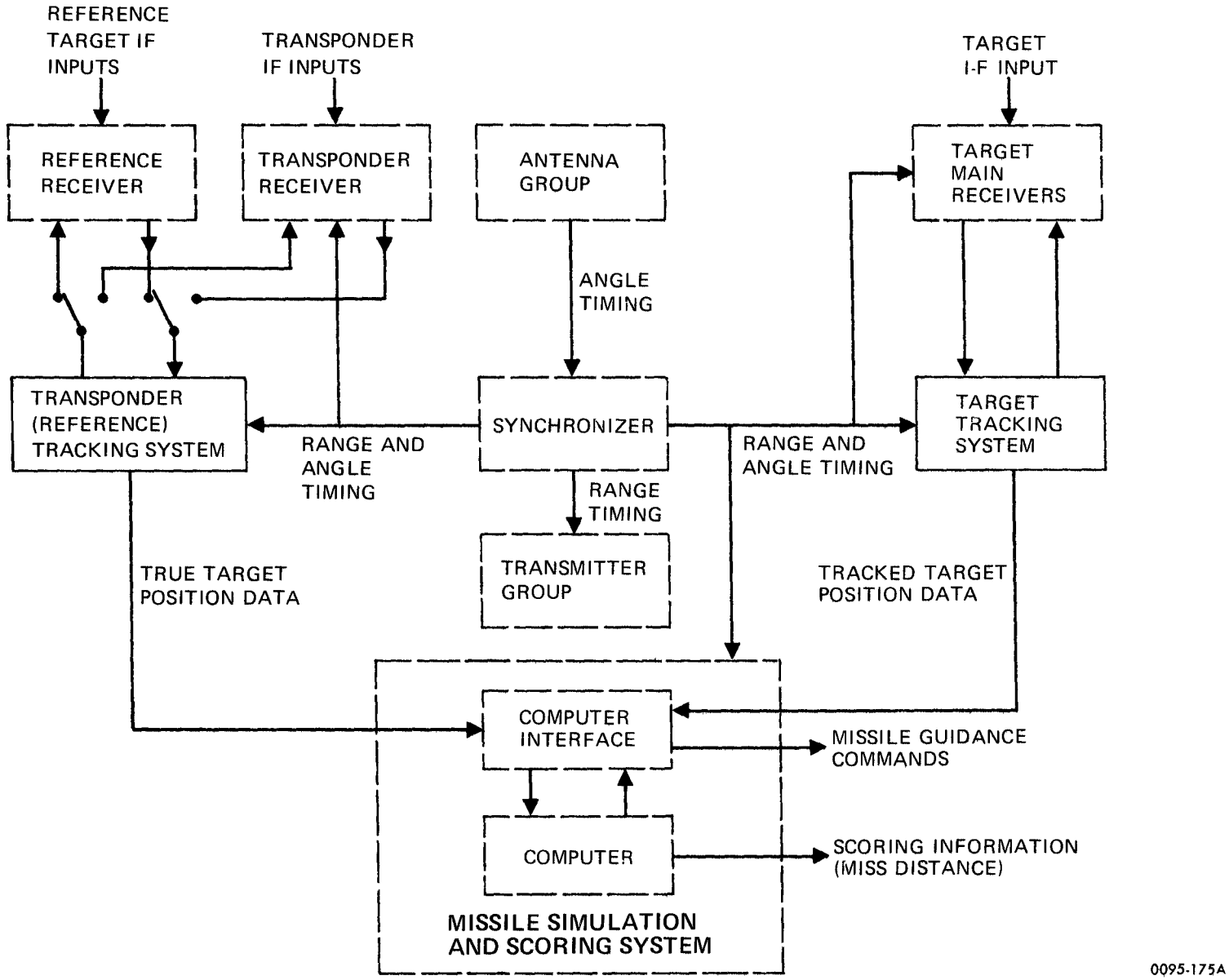


Figure 3-23. Tracking Group Interconnect Diagram

gates and cursors are controlled by an operator to maintain alignment of target and cursors.

3-118. Range acquisition is accomplished by the guidance operator when his range handwheel (P/O 1A1A4) is pushed in. In this condition, the handwheel provides position control of the range tracking gates and cursors.

3-119. Manual range tracking can be accomplished by the range manual tracker operator when control has been transferred by the guidance operator (handwheel pulled out). This manual control is accomplished by rotating the range handwheel (P/O 1A11A7) which provides a combination of position control and rate control of the range tracking gates and cursors. A slew capability to allow rapid alignment of the range cursors and target video is provided by the SLEW IN and SLEW OUT switches.

3-120. Target Range Tracking - Manual, X-Band. Manual range tracking in this system mode is accomplished only by the guidance operator. The operator may select either rate or position control of the range gates. When rate control is selected, the operator handwheel will cause the range tracking gates to move at a constant velocity.

3-121. Reference Range Tracking. When a system operating mode is selected, simultaneous and automatic selection of a reference system occurs. (Refer to paragraph 3-10.) The reference system is used to track skin track returns from one of the antenna-receiver systems, returns from an X-band beacon, or returns from airborne transponders. Regardless of the system operating mode selected, manual tracking is used only to align the video returns and the range tracking gates so that the transistion to automatic tracking may be made successfully.

3-122. During radar reference mode operation, manual tracking is accomplished when the reference operator aligns the range cursors (range tracking gates) and the video returns.

3-123. During transponder reference tracking mode operation, manual tracking is accomplished when the transponder operator aligns the transponder cursor with the transponder video return so that the bottom of the cursor is aligned in range with the tracked video return. The transponder cursor is a vertical strobe that shows the position of the angle tracking gates by its horizontal position on the display and starts in the range dimension at the first video return from the transponder. The cursor terminates in range at the time of the second reply pulse which is the position of the range tracking gates. The position of the cursor and tracking gates for the transponder track loop that has been selected by the transponder CONTROL SELECT switch 1A3A4S1 is controlled by the transponder operator handwheel.

3-124. Automatic Range Tracking. The automatic tracking function is similar for all range track loops. During automatic tracking operations, the operator control inputs are disconnected from the range tracking loops and the tracking gates automatically track the video returns in range. The target to be tracked must be aligned with the angle cursor before automatic range track can begin since the video used in range tracking is angle-gated by a signal derived from the angle track loops.

3-125. Automatic range tracking is selected by the range manual tracker operator for S- or C-band target tracking, by the guidance operator for X-band target tracking, and by the transponder (reference) operator for the transponder (reference) track loops. A discriminator error signal that is generated in the range error channel provides a measure of the amplitude and direction of misalignment of the video and range tracking gates. When automatic track is selected, this discriminator error is fed to the input of the range track loop in lieu of the operator control signals to correct the position of the track gates in relation to the target and reduce the discriminator error to zero. This automatically maintains the alignment of video and range cursors.

3-126. ANGLE TRACKING. Each angle track loop provides tracked angle information for the missile simulation and scoring system in the form of a guidance pulse that indicates the tracked position of the tracking target or reference target within the antenna scan window. By utilizing the guidance pulse and the incremental encoder output from the receiving antenna scanner assembly and the pedestal position information, the angular position of the tracked targets can be computed in degrees.

3-127. All angle track loops are similar and provide an automatic angle track capability when selected by the operator. In the manual mode, the track loops provide outputs which are used in manual tracking or in the acquisition of the tracking target or reference target.

3-128. Target Angle Tracking - Manual, S-Band and C-Band. Target video is displayed on the guidance operator and the S- and C-band manual tracker operator displays for manual tracking and acquisition purposes. The azimuth angle track loop and the normal mode (not low altitude) elevation track loop are preset to a condition so that the tracking gates, angle cursors, and guidance pulses occur at the center of the antenna scan window. The operator then adjusts the pedestal position until the target to be tracked appears centered under the angle cursor. (The antenna position is changed by the control of the pedestal servos until the target is at the center of the antenna scan.) The target is then manually tracked by maintaining alignment between the cursor and video return.

3-129. The low altitude mode of the elevation track loop allows manual tracking of a target that is at an elevation angle below the lower limit of the elevation pedestal. The low altitude mode releases the track loop from the preset condition of the normal manual mode. During the low altitude mode operation, the position of the cursors, tracking gates, and guidance pulse may be controlled by the guidance operator or by the manual tracker operator elevation handwheels.

3-130. Target Acquisition and Manual Tracking - X-Band. During acquisition, returns from the scanning illuminator antenna are processed through the X-band target receiver and displayed on the guidance operator indicators (as described in the previous discussion of the presentation group). The operator then centers the target return under the angle cursor by rotating his elevation handwheel and maximizes the amplitude of the return by use of his azimuth handwheel. When this has been accomplished, the operator may switch to the track mode. As a result, the returns from the T1 and T2 scans of the dual trough antenna and the directrix cursors are displayed on the guidance operator and X-band manual tracker displays. The manual tracker operators can then rotate their handwheels to maintain alignment between the video returns and the directrix.

3-131. Transponder (Reference) Angle Tracking - Acquisition. When operating in a radar reference system mode, the reference pedestals are controlled by transponder operator handwheels; thus the operator can align the target returns and cursors for S-band, C-band, or X-band as described above to allow the successful transition to automatic tracking. Manual tracking for other than acquisition purposes is not a valid mode for the transponder operator.

3-132. During transponder tracking system mode operation, transponder video is displayed on the transponder displays. The operator handwheel controls are connected to the set of transponder track loops selected by the transponder CONTROL SELECT switch. As a result, the operator may control the position of the display cursors and angle tracking gates associated with the selected tracking loop. The operator aligns the cursor (in angle) with the transponder video return to be tracked and then momentarily pulls the handwheel outward to switch the associated loop to the automatic track mode.

3-133. Automatic Electronic Angle Tracking. Automatic electronic angle

tracking is accomplished similarly for all track loops of the target tracking and reference tracking radars. The target or transponder must first be automatically tracked in range before it can be automatically tracked in angle. During automatic electronic angle tracking, the alignment of the target and angle gates and cursors is maintained automatically, but the operator must move the pedestal to keep the target at the correct position in the antenna scan.

3-134. Automatic tracking is selected for the target tracking loops by the guidance operator and, depending on the system mode of operation, either the S-/C-band manual tracker operators or the X-band manual tracker operators. When automatic electronic track has been selected, a discriminator error signal that is developed in the angle error channel is used to correct the position of the track gates and cursors relative to the target. The target loops will remain in the automatic mode until the manual mode has been selected by the operators.

3-135. When a radar reference system has been selected, the transponder (reference) operator selects automatic or manual tracking and then moves the pedestal to maintain the target at the correct position in the antenna scan.

3-136. If the transponder track mode is selected, automatic electronic track is initiated in the transponder track loops by momentarily pulling out the azimuth and elevation handwheels (P/O 1A3A4). When automatic angle track has been selected and the handwheel has been released, the tracking loop is held in automatic track by electronic circuitry that senses that a valid transponder reply is being tracked. During automatic track, the transponder operator monitors the function of the track loops by observing the scope displays. This automatic track mode may be overridden by the operator by depressing the MANUAL RESET switch (P/O 1A3A4).

3-137. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-138. Automatic Pedestal Angle Tracking. An automatic pedestal angle tracking mode is incorporated in the X-band target and reference tracking system. This mode can be selected by either the guidance operator or the reference operator depending on the system operating mode selected. When this mode has been selected, the tracking loop circuits furnish a signal to the servo group which then keeps the antenna system pointed at the target being tracked. Operation of this circuit is described in the discussion of the servo group (paragraphs 3-75 and 3-93).

3-139. MISSILE SIMULATION AND SCORING GROUP.

3-140. The missile simulation and scoring group (figure 3-24) is composed of a computer interface which transforms radar information into a form acceptable to the digital computer, and computer information into a form acceptable to the radar; and a digital computer that performs missile simulation and scoring computations, and controls the transfer of data to and from the computer interface. The digital computer utilizes peripheral equipment such as a teletype, a paper tape reader, a paper tape punch, and an analog-to-digital converter in addition to the computer interface for input and output data tasks.

3-141. The missile simulation and scoring group performs two main functions: missile simulation - guiding the missile to impact with the tracked target; and scoring - calculating the miss distance of the missile to the tracked target and reference target or targets.

3-142. Missile simulation circuitry receives target position information the target tracking system and guides a simulated missile, programmed within the digital computer, to impact with the target. Scoring circuits compute the miss distance of the missile to the tracked target and the tracked reference targets to provide a measure of the effectiveness of aircraft maneuvers and electronic countermeasures.

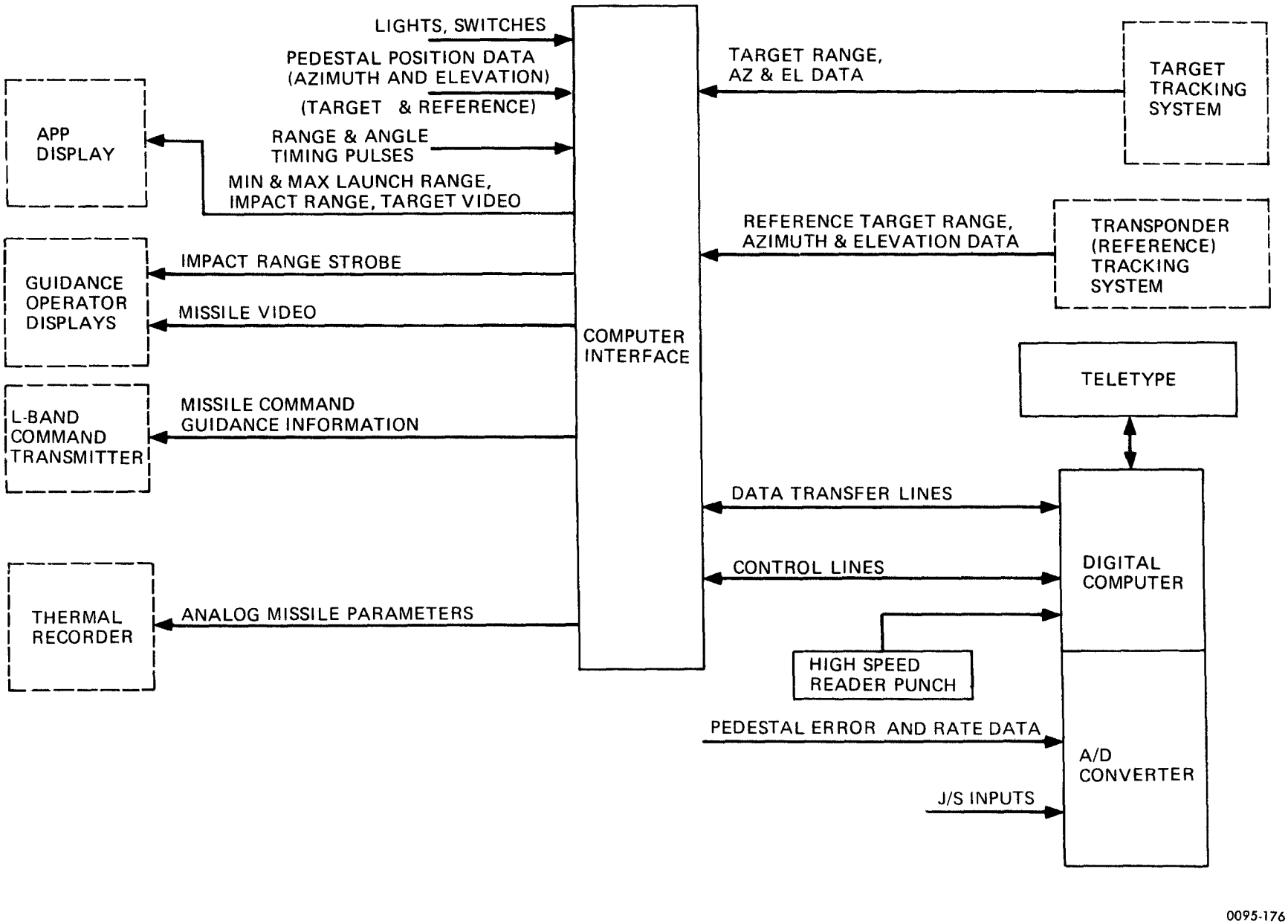


Figure 3-24. Missile Simulation and Scoring Group, Functional Diagram

3-143. The missile simulation circuitry utilizes the tracked target position information from the target tracking system along with the pedestal and antenna scanner position information from the pedestal servo and antenna groups to determine the target position so that it may launch and guide missiles to intercept the tracked target. Missile launch is commanded by the guidance operator. Missile command guidance information from the computer is translated into the proper format for transmission by the L-band transmitter (associated with the target tracking pedestal) so that the aircraft RF environment is a complete simulation of the RF environment from an operational SAM radar site. Missile video information for presentation on the guidance operator displays is generated in the computer interface from the computer information. Minimum and maximum permissible launch ranges for the target being tracked are generated. These ranges are then displayed with the predicted impact range and target video on the automatic point plotter to aid the operator in determining the correct launch times.

3-144. The scoring circuits utilize the tracked position of the target and reference target or transponder reference to compute the miss distance of the missile to the tracked target and reference target(s) at the time the range of the missile is equal to the range of the tracked target or reference target.

3-145. A program tape supplied with the radar set is read by the paper tape reader and fed into the computer to store the program in the computer memory. This program includes all instructions required by the computer to perform the missile simulation and scoring computations. Several test routines, which may be used to test various circuits of the computer/interface system, are included on the program tape.

3-146. Information such as run number and time are entered into the computer via the teletype. Miss distance output and status information are typed out by the teletype for a permanent record of the miss distance computations.

3-147. The analog-to-digital (A/D) converter receives analog information from groups within the radar set and converts it to digital information for use by the computer. The A/D converter is controlled by the computer program.

3-148. MISSILE SIMULATION COMPUTATIONS. The information flow of the various computer subroutines for the missile simulation function is shown schematically in figure 3-25. The diagram reflects the major subroutines used for computations.

3-149. The input-output subroutine provides communication link control with the computer interface and transfers data from the radar to the computer when requested by the computer program. This subroutine transfers the tracked azimuth and elevation target position to the guidance subroutine; it also transfers the launch command, guidance mode, and radar band selection to succeeding subroutines. Missile position relative to the earth is received from the kinematics subroutine, transformed into the missile position relative to the antenna scan by utilizing the pedestal position information received from the radar, and transferred to the guidance subroutine.

3-150 through 3-153. See Supplementary Maintenance Instructions, Radar Training Set AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-154. SCORING COMPUTATIONS. The information flow of the various computer subroutines for the scoring function is shown schematically in figure 3-26. The diagram reflects the major subroutines used for computations.

3-155. The input-output subroutine provides communications link control with the computer interface and transfers data from the radar to the computer when requested by the computer program. Information used in the scoring function consists of the tracked azimuth, elevation, and range position of the transponders.

3-156. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-157. The miss distance of the missile to the target (when target range is equal to missile range) is obtained by solving the equation

$$\text{miss distance} = \sqrt{\Delta Az^2 + \Delta El^2}$$

where

ΔAz is the difference in the tracked target azimuth angle and the missile azimuth angle

ΔEl is the difference in the elevation angles, when the difference in ranges is equal to zero.

3-158. When tracked target range or transponder range does not equal missile range, the miss distance to tracked targets or transponders is obtained by solving the equation:

$$\text{miss distance} = \sqrt{(R_M \Delta Az)^2 + (R_M \Delta El)^2 + \Delta R^2}$$

where

R is the difference in the missile and target ranges

R_M is missile range

Other variables are as described above.

The results of these miss distance calculations are typed out on the teletype for a permanent record of the miss distances.

3-159. COMPUTER INTERFACE. The computer interface translates the radar signals into a form which is acceptable to the computer, and the computer signals into a form which is acceptable to the radar. The radar signals are in the form of timing pulses, direct-current voltages, shaft positions, switch positions, etc. The computer signals are in the form of 16-bit digital words. Therefore, all data transfer to and from the computer is in the form of 16-bit digital words. The computer interface translates the 16-bit computer words to radar signals or radar signals to 16-bit computer words. A block diagram of the computer interface is shown in figure 3-27.

3-160. Computer Interface Control. Transfer of data to and from the computer is controlled by the computer interface control, in conjunction with the function addesss decoding section. Signal carriers between the computer and computer interface consist of 16 data lines and 6 control lines. The 16 data lines carry the data and the computer uses the 6 control lines to control data transfer. The computer uses the SEND and REC OCP (output control pulse) to place the computer interface in the send or receive mode. The CHRDY (channel ready) indicates that the computer is ready to send or receive data. The DROPN (drop in) indicates that the interface is ready to send or receive data, and is the only signal controlled at the computer interface. The ADD (address) OCP tells the interface that the next data transfer will be a function address. The MSTCL (master clear), which is tied to the MASTER CLEAR switch on the computer control panel, resets the computer interface to standby.

3-161. When data is to be transferred, the computer sends the REC OCP, which places the computer interface in the receive mode, and the ADD OCP, which tells the computer interface that the next data will be an address. The computer then puts the address on bits 11 through 16 of the data lines and sends CHRDY, which lets the interface know that the address is on line. The interface control then sends DROPN back to the computer and generates a function strobe which is sent to the function address decoding circuits. When the address is received from the computer, the decoding circuits decode the strobe to the addressed function strobe. The selected function strobe is routed to enable the addressed function. A list of the functions contained in the interface along with their assigned addresses is presented in table 2-69, chapter 2.

3-162. After the addressed function is enabled, the computer sends the SEND or REC OCP depending upon the direction of the data transfer. If the addressed function is to send data to the computer, SEND OCP is generated, and the computer sends CHRDY. When the selected function places its data on the 16 send lines, an OUTPUT GATE ENABLE is generated and sent to the interface control. When the interface control receives the OUTPUT GATE ENABLE from the selected function and CHRDY from the computer, it sends DROPN back to the computer, indicating

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS, RADAR TRAINING SET, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1 FOR FIGURE 3-25

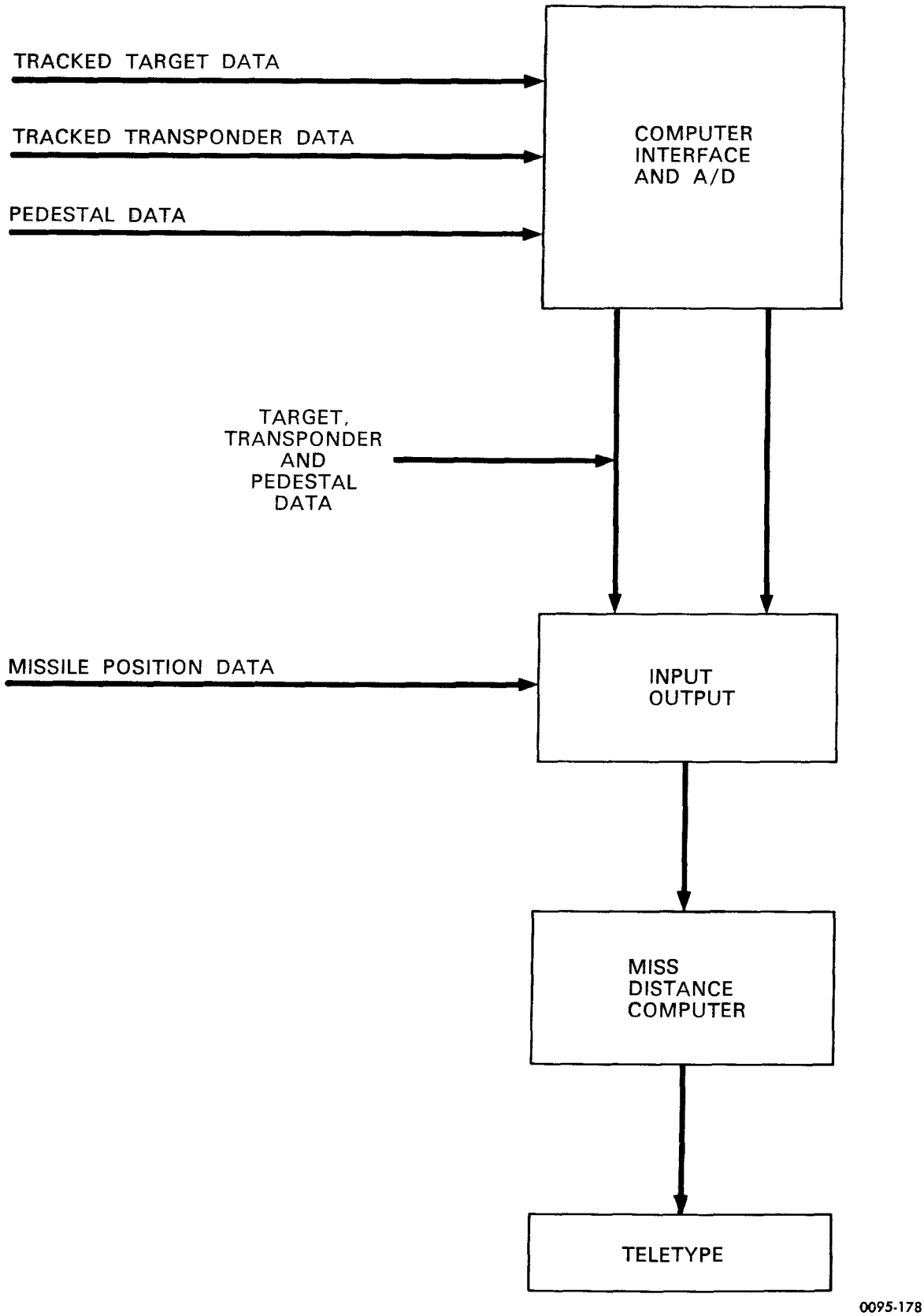


Figure 3-26. Scoring Computations Information Flow Diagram

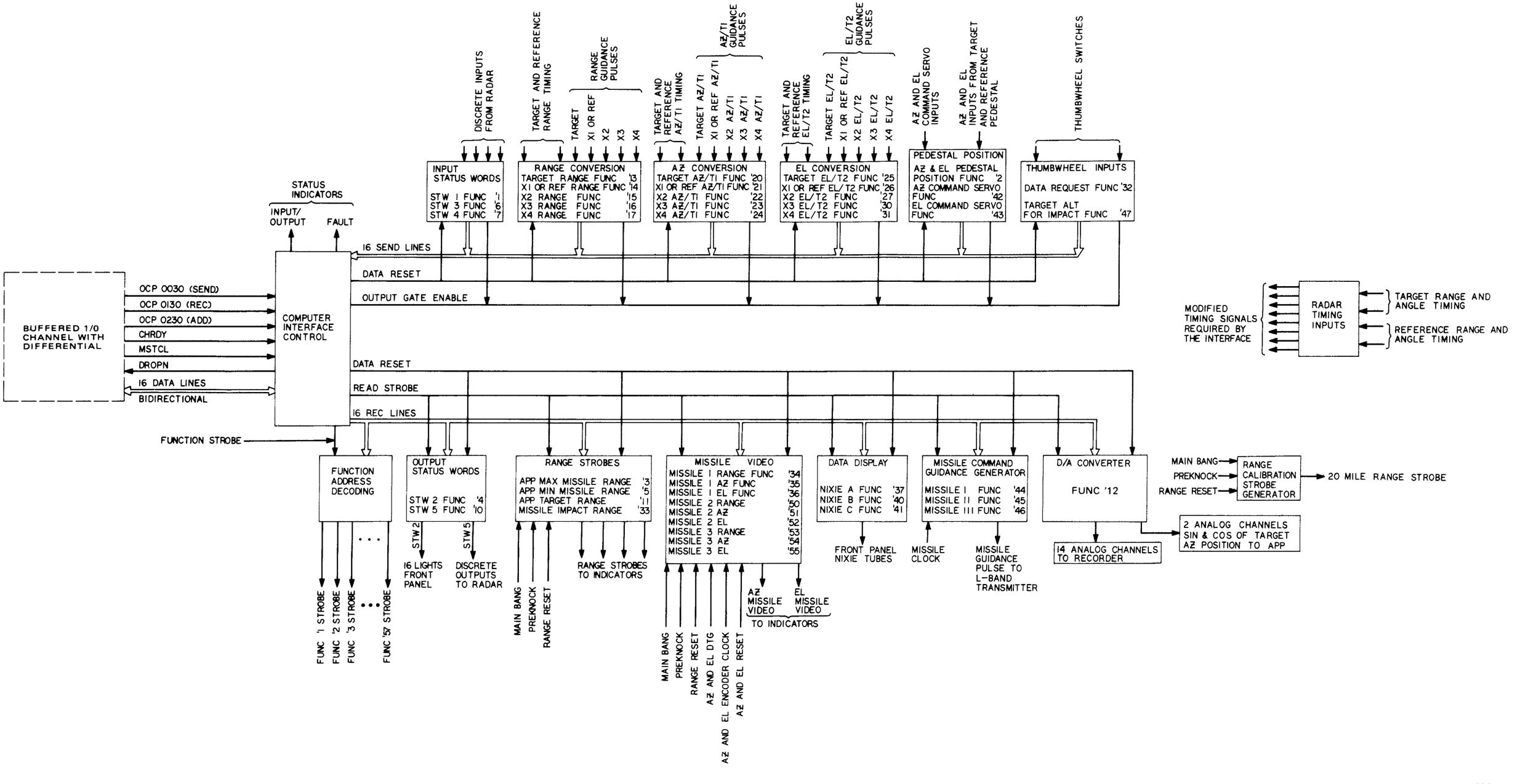


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Figure 3-27. Computer Interface Block Diagram

that the data is ready to be sent to the computer. When the data transfer is complete, DATA RESET is generated by the interface control to reset all of the computer interface functions to standby.

3-163. If the function addressed by the computer is to receive data from the computer, then REC OCP and CHRDY are sent by the computer. The interface control sends DROPN back to the computer and generates a READ STROBE which sends the data on the 16 receive lines into the selected function. After the data is transferred to the function, DATA RESET is generated.

3-164. Input Status Words. Discrete signals from the radar are fed into one of the three input status words. These inputs are controlled by various switches in the radar. The state of a particular switch is assigned to a bit in one of the 16-bit status words and read by the computer when the status word is addressed. The bit assignments for the status words 1, 3, and 4 are shown in table 2-72, chapter 2.

3-165. Range Conversion. The range conversion section of the interface transfers the tracked slant range of the target and/or reference return signals to the computer. This is accomplished by starting a 16-bit counter at main bang sync and clocking the counter to 20 MHz. When the guidance pulse is received from the track loop, the counter is stopped, and the contents of the counter are transferred to the computer upon request. The computer can then calculate the tracked range in feet. The tracked ranges that can be selected for display on the Nixie tubes consist of the ranges to the target and four transponders. If reference tracking is used, it is selected at the transponder 1 address.

3-166. Azimuth and Elevation Conversion. The azimuth and elevation conversion section converts the tracked angular position within the antenna scan to a digital word. This tracked position is obtained for the target, four transponders, and the reference tracker. Conversion is accomplished by starting a 16-bit counter at the trailing edge of the selected antenna deadtime gate (beginning of scan) and clocking the counter with the incremental encoder output from the associated receiving antenna scanner assembly. The counter is stopped by the guidance pulse from the angle track loop, and the contents of the counter are sent to the computer. From this information, the computer can calculate the tracked angular position within the antenna scan.

3-167. Pedestal Position. The pedestal position section of the computer interface transfers position information to the computer: the azimuth and elevation pedestal position information from the target and reference pedestal, and the azimuth and elevation command servo information. The azimuth and elevation pedestal positions are transferred when the computer selects address '2 (apostrophe indicates octal number) in the interface. This is the only case in which more than one data word is transferred to the computer with one address. When the computer selects address '2, the interface transfers the target azimuth pedestal position data serially from the pedestal. This serial information is converted to a parallel 17-bit word. This 17-bit word is transferred to the computer in two 16-bit words. When the first word is transferred, an OUTPUT GATE ENABLE is generated, and the interface control sends DROPN. The second word is then transferred and again DROPN is sent to the computer indicating that the second word is on line. The interface then transfers the serial target elevation pedestal position from the pedestal, converts it to a parallel 17-bit word, and transfers this word to the computer as two 16-bit words. The azimuth and elevation information is transferred from the reference pedestal in the same manner. Therefore, when the computer selects address '2, the interface sends eight 16-bit words to the computer.

3-168. Transfer of the azimuth and elevation command servo information is accomplished when the output of the 16-bit encoder in the azimuth or elevation command servo assembly is sent to the computer. Separate addresses are assigned for the azimuth information and elevation information.

3-169. Thumbwheel Inputs. The thumbwheel input section of the computer interface transfers the output of thumbwheels

into the computer. The data is derived from the data request thumbwheels on the front of the interface drawer and the target altitude thumbwheels located at the range manual tracking station.

3-170. Output Status Words. The output status word section transfers the discrete outputs from the computer to various indicators in the radar system when commanded by the computer. These outputs are transferred by use of status words 2 and 5. Status word 2 is tied to the 16 computer interface front panel lights which display the contents of any selected computer word. The bits of status word 5 are assigned to missile outputs. (See table 2-72, chapter 2.)

3-171. Range Strobes. Range strobes displayed on the indicators are generated by reversing the procedure used in the range conversion section. In this case, the computer loads a 16-bit word into a 16-bit counter, which represents the range delay required for the strobe. The counter is started at main bang sync and clocked by a 20 MHz clock. When the counter reaches the value read in by the computer, it generates a pulse. This pulse is delayed from main bang sync by the time delay that is transferred into the counter by the computer. These delayed pulses are then sent to the indicators.

3-172. Missile Video. The missile video section generates missile-simulation video for display on the guidance operator indicators. The range of the missile (simulated) is generated in the same manner as the range strobes. The position of the missile (AZ and EL) in the scan plane is generated by reversing the procedure used in the azimuth and elevation conversion section. The computer loads a 16-bit word which represents the missile position into a computer; the counter starts at the end of the dead time gate and counts the encoder pulses until the value read in by the computer is reached. The range pulses are angle-gated at this angular position and are then sent to the indicators.

3-173. Data Display. The data display section takes information from the computer and displays this information on Nixie tubes located on the front panel of the interface drawer. Three 16-bit words are required to drive the Nixie display. The first 16-bit word defines the first four digits of the display; the second word defines the last four digits of the display; and the third word positions the decimal point and defines plus and minus for the display.

3-174. Missile Command Guidance Generator. The missile command guidance generator takes missile guidance commands from the computer in the form of 16-bit words and transforms this data into coded command pulses. Command guidance pulses are generated for all missiles and sent to trigger the associated L-band transmitter.

3-175. D/A Converter. The digital-to-analog (D/A) converter receives digital information from the computer and converts it to analog signals that are routed to the analog recorder and APP display. The signals sent to the recorder are used for testing and instrumentation. The two signals sent to the APP are the sine and cosine of the target azimuth position.

3-176. Radar Timing Inputs. The radar timing inputs section receives the target and reference timing signals and converts them to the modified timing signals required for the computer interface.

3-177. Range Calibration Strobe Generator. The range calibration strobe generator section uses a 20 MHz clock and a counter to generate a 20-mile range strobe. This strobe is used to calibrate the indicators of the radar in range.

3-178. COMPUTER SYSTEM. The computer used to perform the missile simulation and scoring computations is a standard commercial digital computer. Peripheral equipment that is part of the computer system includes a teletype, a paper tape reader, a paper tape punch, and an analog-to-digital converter. The operation of each piece of peripheral equipment is described in a separate manual. (See table 1-6, Volumn I.)

3-179. MISCELLANEOUS EQUIPMENT GROUP.

3-180. TARGET SIMULATOR. Target simulator 1A17A16 generates IF signals to

represent signals received through the antennas and processed by the prereceivers during normal system operation. The signals simulate target and transponder returns and jamming signals associated with the target.

3-181. Use of the target simulator allows operator training in the search, acquisition, tracking, and scoring functions of the radar system without operation of the transmitters, pedestal servos, and antenna scanning portions of the radar. The target simulator also allows accomplishment of many maintenance and troubleshooting tasks without use of the antennas and antenna cab equipment.

3-182. The target simulator is provided with range and angle synchronization pulses and a pedestal position voltage so that the generated targets and their motions can be synchronized with other radar subsystems.

3-183. The pedestal drive servos may be deactivated during operation of the target simulator so that the antenna cabs do not rotate; however, the pedestal position input to the target simulator is generated in the pedestal command servo assembly so that system operation is the same as system operation using the transmitters, antennas, and pedestal systems.

3-184. The target simulator can generate four targets and their associated transponders plus simulated jamming signals from the targets. Separate on-off controls permit selection of these targets, transponders, and jamming signals. Front panel controls allow the operator to set the initial conditions of the position of the target group and adjust the position of each individual target relative to the group. Transponder returns are generated at the same angle as their associated target and delayed in time to simulate the airborne transponders used during actual operation.

3-185. Simple target motion is simulated and the rate of change of range, azimuth, and elevation of the formation is adjustable by individual rate controls in the three coordinates. Front panel switches allow selection of either a plus or minus rate so that the target course simulates an inbound run or an outbound run with the azimuth direction set so that the formation flies with an offset in the clockwise or counterclockwise direction.

3-186. An additional control permits selection of a target movement mode in which one target of the four that may be generated flies "through" the target group formation.

3-187. Because of the discontinuity exhibited on the one-turn pedestal position potentiometer in the guidance operator command servo assembly, the azimuth group position and rate must be selected so that the target course does not cross this discontinuity. The discontinuity of the potentiometer is oriented at zero degrees.

3-188. Generation of transponder signals is similar to that of target signals and is accomplished by modulating a 60 MHz signal with simulated antenna patterns and range sync pulses. The antenna patterns and range sync pulse position is controlled by the target position and rate controls and the timing syncs and pedestal position information received from the radar set.

3-189. The modulated IF signals are attenuated as a function of range to approximate the range attenuation of target and transponder returns.

3-190. ANALOG RECORDING SYSTEM. The analog recording system provides the capability for recording analog signals from the radar set. Also, when it is operated in conjunction with the digital-to-analog (D/A) function in the missile simulation and scoring group, the analog recording system records, in analog form, the digital information (from the computer system) relating to missile simulation and scoring functions.

3-191. Eight channels may be selected to record target range, azimuth, and elevation discriminator errors of the target tracking loops and the eight analog outputs of the D/A converters. Selection is effected through a recorder input patch panel. The eight channels selected are patched to the recorder input jacks on the patch panel.

3-192. The analog recording system will record eight channels simultaneously on a

direct-writing thermal recorder equipped with a vertical chart table. Preamplifiers in the system amplify, isolate, and otherwise condition the signals and feed them to driver amplifiers that position the recorder writing arms. The variables are then recorded on plastic-coated, heat-sensitive chart paper by heated styli at the tips of the writing arms. An event marker channel is provided in the recorder for recording timing marks on the chart border.

3-193. A complete description of the recorder and its principles of operation can be found in the manuals listed in table 1-4.

3-194. INTERCOMMUNICATION SYSTEM. An intercommunication system enables communication between operators of the radar set. The master controls are located at the mode control (1A1A1) in the guidance operator console and are used to effect station selection.

3-195. In addition to an intercommunication station P/O 1A1A4 at the guidance operator console, similar stations consisting of microphone on-off switches, volume control, and headset jacks are provided at the following locations:

a. X-Band manual tracker console (T1) 1A17A9

b. X-Band manual tracker console (T2) 1A17A15

c. S- and C-Band manual tracker console (Azimuth) 1A11A4

d. S- and C-Band manual tracker console (Range) 1A11A9

e. S- and C-Band manual tracker console (Elevation) 1A11A10

f. Transponder console P/O 1A3A4

g. APP console 1A19A3

h. Radar console 1A5A21

i. Computer console 1A8A5

j. S-band antenna trailer P/O 2A6A2

k. C-band antenna trailer P/O 3A6A2

l. X-band antenna trailer P/O 4A2A1A5.

3-196. Loudspeakers are connected to the intercommunications network at the guidance operator console and the S-band, C-band, and X-band antenna trailers.

3-197. RADIO COMMUNICATION SYSTEM. During an exercise, the radio set installed in the control trailer allows two-way radio communications with the aircraft or with a remote site. A complete description of the radio and its principles of operation can be found in the technical manuals listed in table 1-4.

3-198. POWER SUPPLY SYSTEM. The radar set requires 60 Hz and 400 Hz power for operation. This power is provided through the power entry panel 1A14 and distributed to the various components of the radar set through power distribution console 1A12. Circuit breakers on the power distribution console control the power routed to the various equipment in the control trailer; the air conditioner; the lighting circuits; and the S-band, C-band, and X-band antenna trailers.

3-199. Direct current for the various consoles within the radar set is generated in each console. The output voltage of the direct current power supplies can be monitored by the digital voltmeter (DVM) located in radar console 1A5. Relay power (unregulated +28 volts) is generated in the control trailer and each antenna trailer and distributed within the trailer to the equipment hardware. Detailed information pertaining to the power supplies in the radar set can be found in the Lambda technical manuals cited in table 1-6, chapter 1.

3-200. INSTRUMENTATION SYSTEM. The instrumentation system provides radar signals at a common data point to be used by government-furnished equipment to record discrete and digital radar signals, raw radar video, and audio from the radar intercom and the AN/GRC-27 radio. All connections for the government-furnished equipment are located on the common data point assembly (1A20). (See figure 3-28.) A provision is included to play back the recorded radar video on the guidance operator console display.

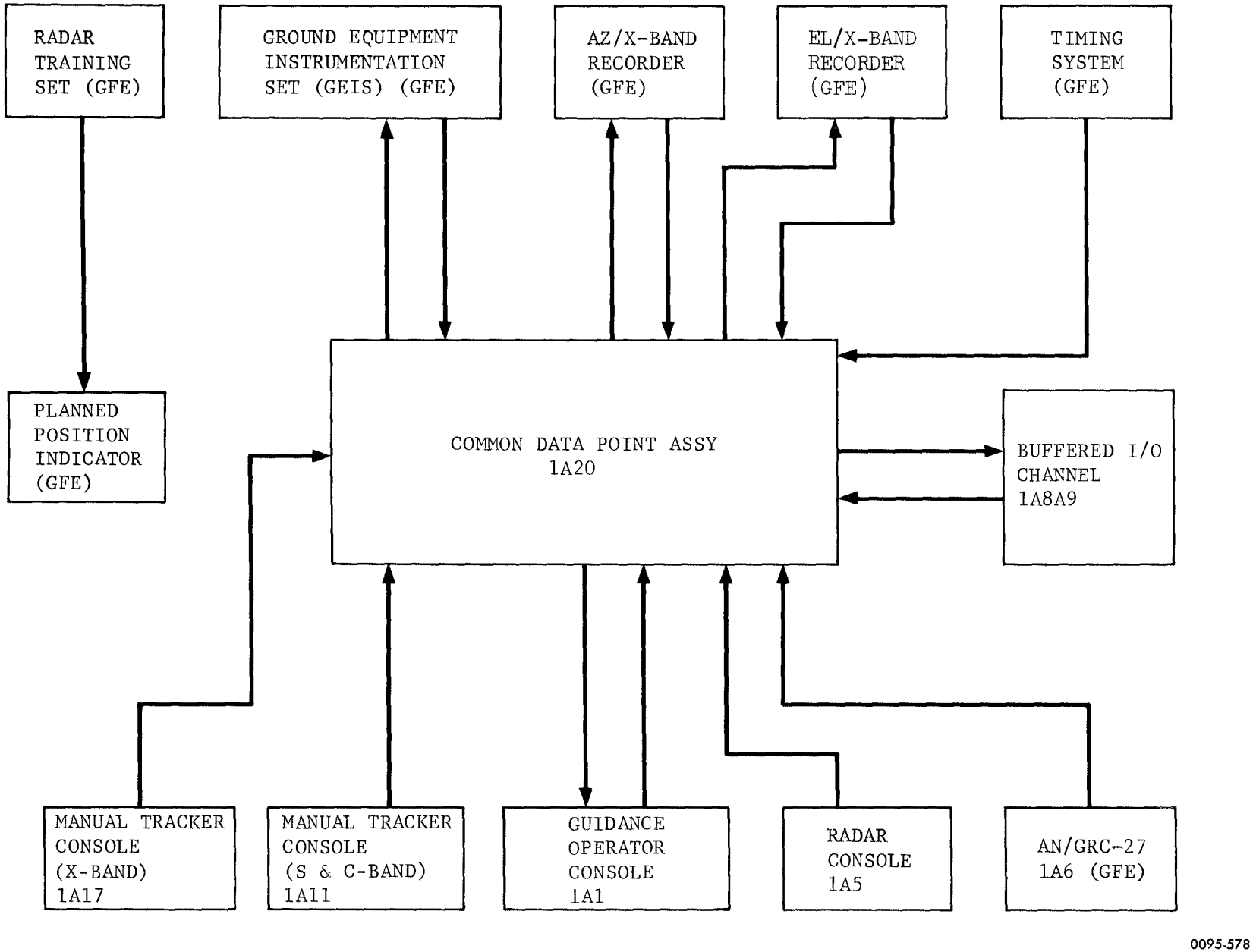


Figure 3-28. Continental Operations Range, Interface Block Diagram

SECTION II

FUNCTIONAL OPERATION
OF ELECTRONICS CIRCUITS

3-201. TRANSMITTER GROUP.

3-202. RADAR BAND SELECTION. The circuits required to select the target tracking radar and the reference tracking radar are located in transponder tracking control 1A3A4 and in mode control 1A1A1 as shown in figure 3-29. The circuit is designed such that when the band (S, C, or X) is selected for reference tracking that same band cannot be selected by the guidance operator for target tracking.

3-203. If TRANSPONDER/EXTERNAL REF switch 1A3A4S13 is in the TRANSPONDER position, the reference select lines to mode control 1A1A1 are at a logic low. This allows the guidance operator to select any one of the three bands for target tracking by momentarily depressing the appropriate band select switch (S33, S34, or S35). The target tracking band is determined by the states of the two latch circuits (gates 6 and 7 and gates 8 and 9 of A5). When power is first applied, the system is forced to C-band Mode I operation by the circuit consisting of resistor R4, capacitor C1 and gate A1-3. Initially the voltage charge on capacitor C1 is zero. When power is applied, capacitor C1 begins to charge at a rate set by network R4-C1. Since the initial input to gate A1-3 is zero volts, the gate output is at a logic high and relay K3 is deenergized. At some point in the charge time of capacitor C1, the output of gate A1-3 will change to a logic low and relay K3 will energize. This delay holds the normally closed contacts of the C-band select switch at ground for a short period of time after power is applied. This logic low is inverted twice and applied to gates A5-7 and A5-8 (latch circuits), forcing their outputs to a logic high. The three inputs to gates A5-6 and A5-9 are then logic highs, which causes their outputs to go to logic lows, which, in turn, holds the outputs of gates A5-7 and A5-8 at logic highs.

3-204. If the S-BAND select switch S35 is depressed, a logic low is applied to gates A5-6 and A5-9 which causes the latch circuits to change state so that the S-band (+) signal goes to a logic high and the C-band signal goes to a low. When the X-BAND select switch S33 is depressed, both latch circuits are reset and the outputs of gates A5-7 and A5-9 go to logic high. Combined in NAND gate A1-4, as shown in figure 3-29, they generate the X-band (-) signal.

3-205. When one of the radars is selected for reference tracking, its reference select line is switched to +5 volts through switches 1A3A4S13D and 1A3A4S12. This removes ground from the normally open contacts of the target select switches and prevents this radar from being selected as a target tracking radar by the guidance operator. Gates A11-2, -4, and -6 are used to reselect the target radar if it is the same as that selected for reference tracking.

3-206. S-BAND AND C-BAND RANGE TIMING GENERATION. The trigger

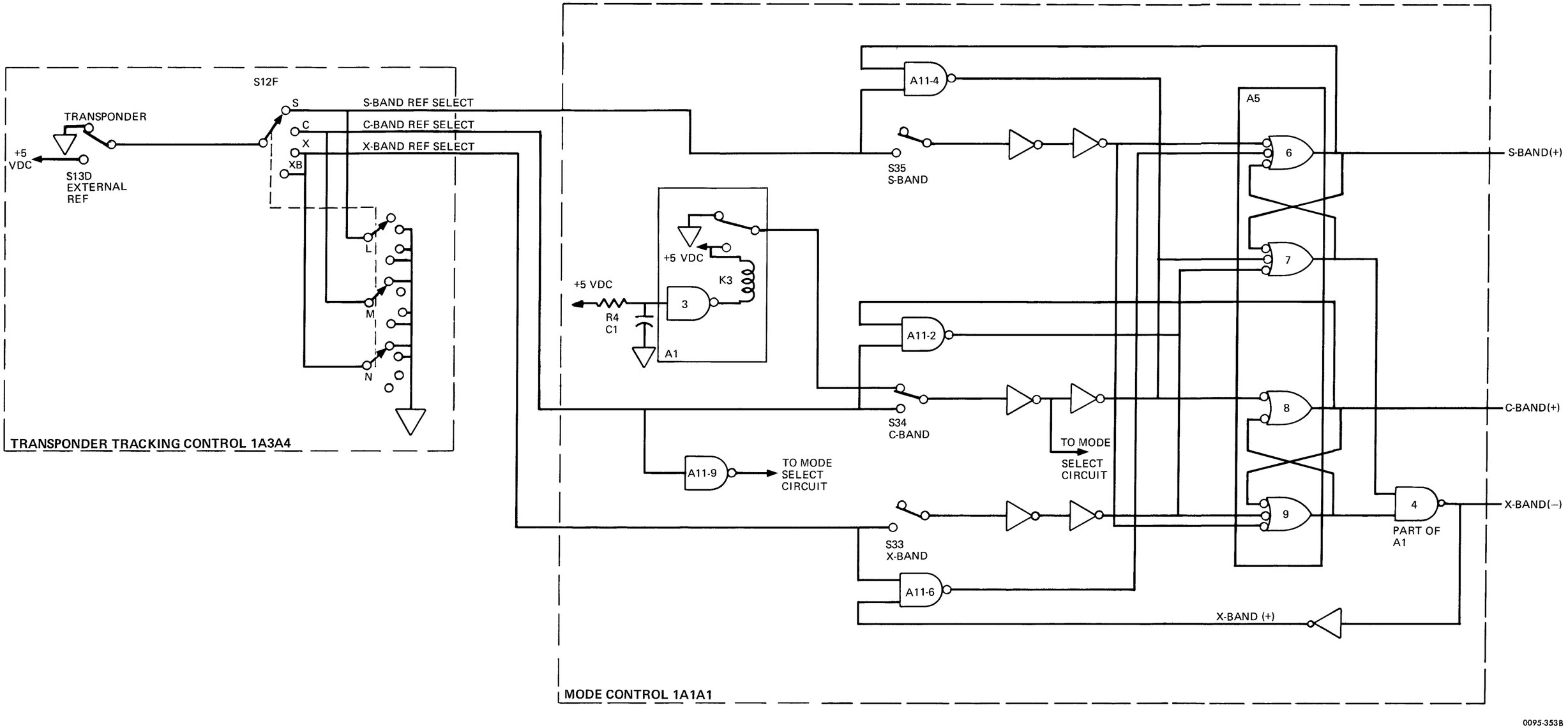


Figure 3-29. Radar Band Selection Simplified Logic Diagram

pulses for the azimuth and elevation S- and C-band transmitters (2A2, 2A7, 3A2, 3A7) and the interrogation pulses for the L-band transmitter (2A1A1, 3A1A1) associated with the S-band and C-band systems are generated within synchronizer assembly 1A1A5. Missile guidance pulses for the L-band transmitters are generated in computer interface 1A5A14 and are summed with the interrogation pulse in the synchronizer before being routed to the L-band transmitter.

3-207. Range synchronization pulses for other groups in the radar set are selected from the S-band, C-band, or X-band timing generators depending on the band selected for the tracking radar function by the guidance operator at mode control 1A1A1.

3-208. Range synchronization pulses for the radar groups associated with the reference track mode are also selected from these timing generators to agree with the external reference selected by the reference operator at tracking control 1A3A4.

3-209. Distribution of the range synchronization pulses and the time relationship of these pulses are depicted in figure 3-30 and 3-31.

3-210. Generation of range timing pulses in synchronizer 1A1A5 is accomplished similarly for both the S- and C-band transmitter systems (figure 3-31). The master timing clock from which the pulses are derived is selected by the guidance operator from an external clock input, a resistor-capacitor coupled multivibrator (RC clock), or a crystal clock by means of control switches.

3-211 through 3-212. See Supplementary Maintenance Instruction, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-213. The clock delay circuit is enabled by the selected high or low PRF sync pulses. When enabled, this circuit counts the pulses of the selected clock and generates the range blanking pulse, which is one crystal clock period, and the indicator range blanking pulse, which is three crystal clock periods. The reset and preknock pulses are generated to coincide with the beginning and end of the indicator range blanking pulse.

3-214. The reset, preknock, range blanking, and indicator range blanking pulses are routed to select circuits where pulses appropriate to the system being used are selected and routed to other groups of the radar set for synchronization.

3-215. The preknock pulse from the clock delay circuit is used to develop transmitter trigger pulses. The preknock pulse is delayed in three separate pulse delay circuits that allow adjustment of the relative timing of the transmitter main bangs. The output of each delay circuit is routed to a single-shot where the delayed trigger and interrogation pulses are generated.

3-216. The delayed trigger pulses are routed to the blanking circuits where they are blanked by the dead-time gate of the associated antenna scanner, by the transmitter ON/OFF switch, and by a scan loss condition of the associated antenna scanner. After blanking, these pulses are transformed into differential signals, routed to the antenna trailers, and converted back to single-ended signals by the line receivers. Upon receipt of a waveguide switch blanking signal from the antenna group, the trigger driver circuit blanks the triggers and generates a 10-volt trigger pulse that is routed to the modulator.

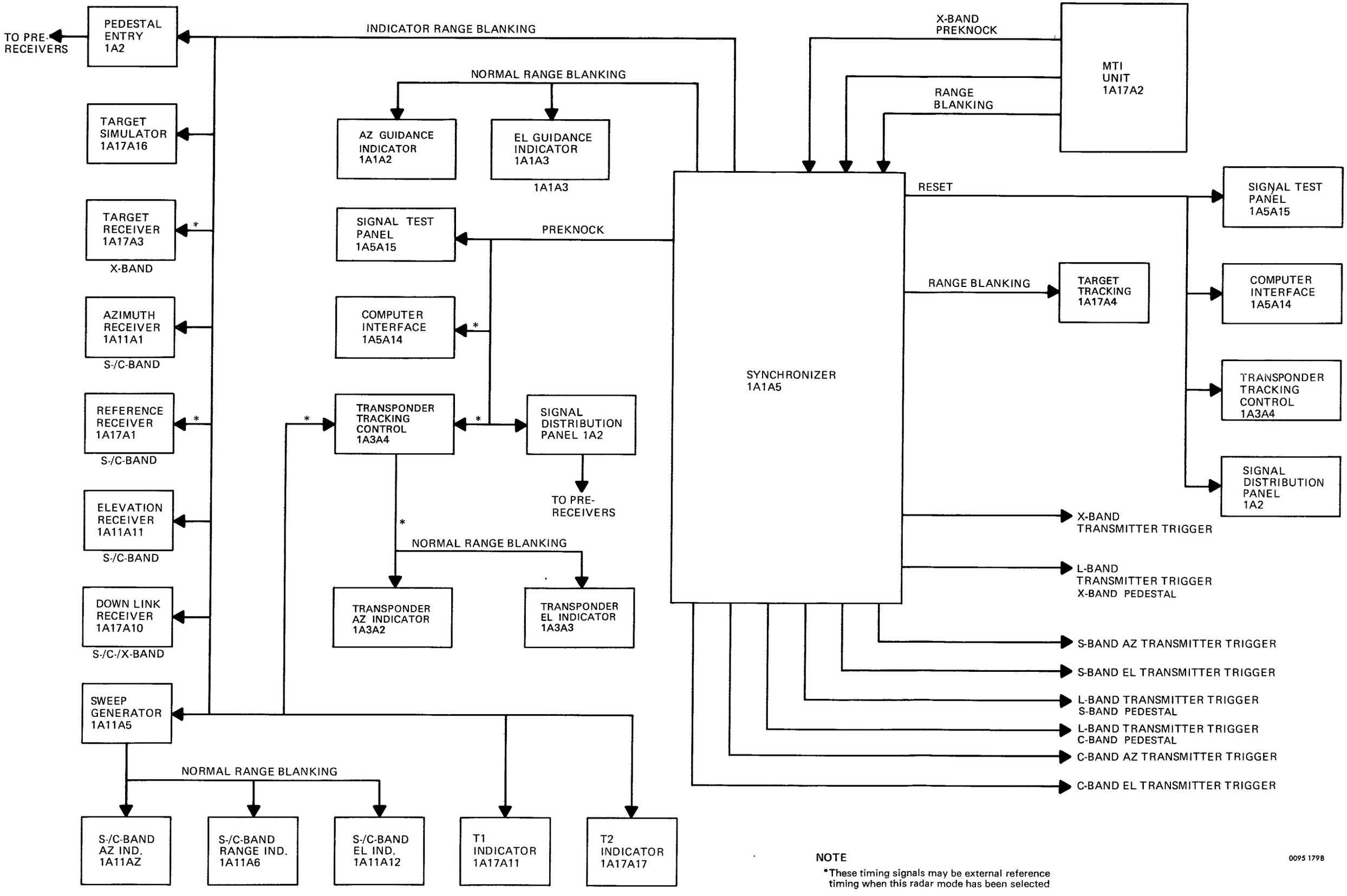


Figure 3-30. Range Timing Pulse Distribution

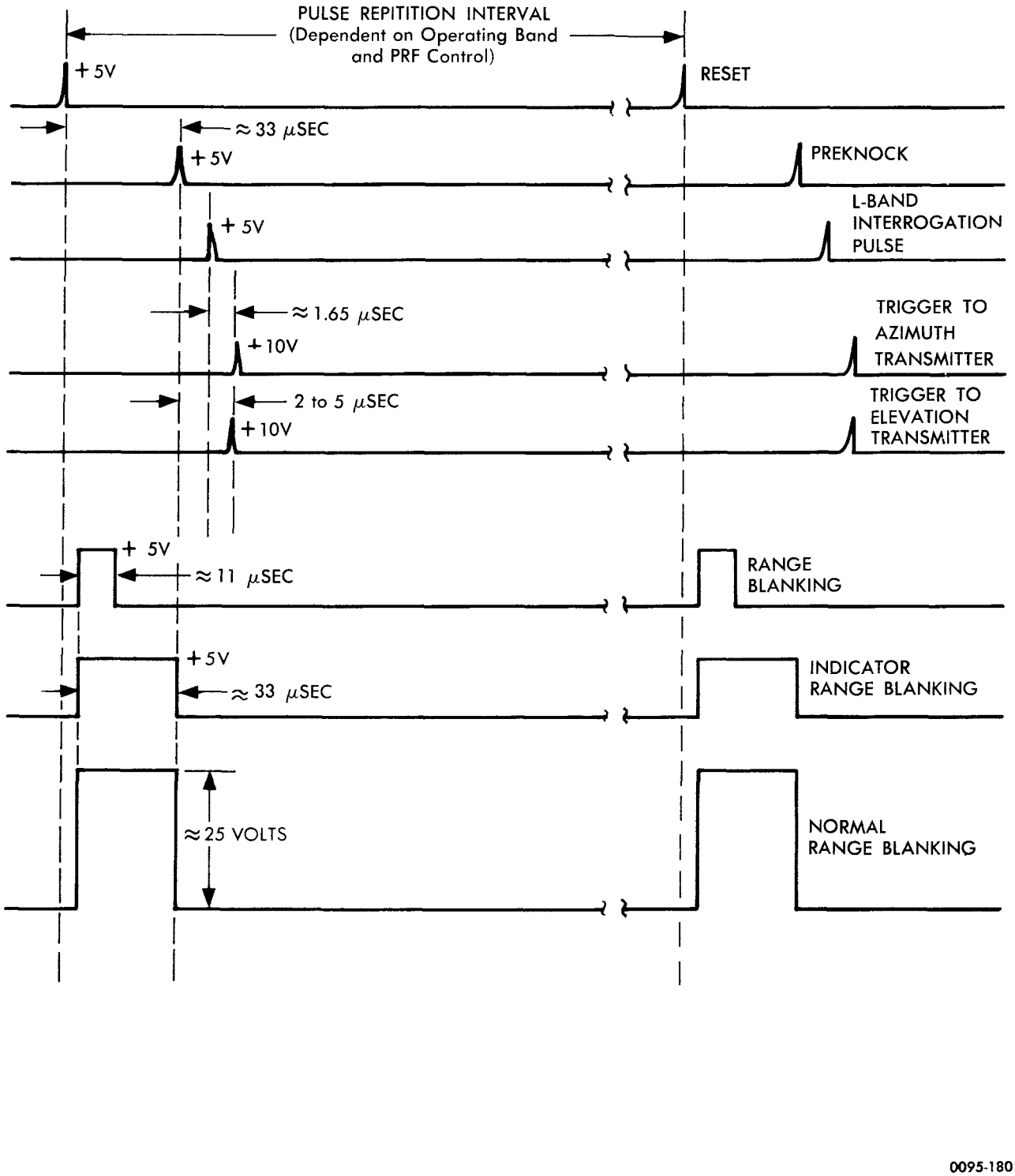


Figure 3-31. Range Timing Pulses, Timing Diagram

3-217. The trigger pulse from the L-band transmitter delay circuit is routed to a single-shot that sets the interrogation pulse width. This interrogation pulse is summed with missile command pulses from the missile simulation and scoring system for the L-band system associated with the selected tracking radar. This summed output is transformed into a single-ended signal by the line receiver. A trigger driver circuit provides the +5 volt trigger pulses to the L-band transmitter.

3-218. Clock Select Circuits. Clock select circuits in the synchronizer permit selection of an external sync, an RC clock A1A5, or a crystal clock A1A1, A1A3 as the input for the counters.

3-219. The external sync input, which is linked to connector 1A1J3, must be a 0 to +5 volt pulse or square wave with a repetition rate of 80 to 90 kilohertz in order to generate proper synchronization pulses and trigger pulse outputs from the synchronizer.

3-220. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-221. Crystal clocks A1A1 and A1A3 provide a stable frequency of 90 kilohertz and 88.32 kilohertz for the S- and C-band timing sources, respectively. Each clock contains a crystal-controlled oscillator and a squaring circuit.

3-222. Selection of the clock inputs to the counter is controlled by the INTERNAL/EXTERNAL switch S3, S-BAND RC CLOCK/XTAL switch S4, and C-BAND RC CLOCK/XTAL switch S5. These switches are used in conjunction with signal select circuits A1A6, which consists of a pair of 2-input NAND gates whose outputs are wire-OR'ed as shown in figure 3-32 to select the clock. The RC CLOCK/XTAL switch must be in the RC CLOCK position before the external sync input is connected.

3-223 through 3-226 and figure 3-33. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-227. Since the counter has been preset to 4, it must count 12 times to reach the full count of 16. At this time, single-shot A1A15-2 is triggered again and flip-flop A1A9-5 is toggled to its opposite state ("0" output to logic 0 and "1" output to logic 1). Thus, the positive pulse from the one-shot is gated through NAND gate A1A14-2 to set flip-flops A1A9-1 and -2 and clear flip-flop A1A9-3. Flip-flop A1A9-4 is cleared by the negative pulse at the "0" output of the single-shot so that the counter is preset to a count of 3 and therefore must count 13 times to reach the full count of 16 when it is again reset to the count of 4.

3-228. The "1" output from flip-flop A1A9-4 is gated through gate A1A14-6 when HIGH PRF has been selected by the HIGH/LOW PRF switch (1A1A4S11). When HIGH PRF has been selected, the signal input is at +5 volts.

3-229. When LOW PRF is selected, the high PRF signal line is at ground which clears flip-flop A1A9-5. Since the clear (C) input overrides the trigger (T) input, the flip-flop remains in this condition during low PRF operation. As was shown above, this presets the counter to a count of 4 so that the counter divides by 12 only. The output of flip-flop A1A9-4 toggles flip-flop A1A9-6 for a further division by 2. This output is gated through gate A1A14-7 by the PRF signal that has been inverted in gate A1A14-3 to provide a positive input to the output gate.

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS, RADAR TRAINING SET, AN/MPS-T1(V), T. O. 43D7-11-21-2-1-1 FOR FIGURES 3-32 AND 3-33

3-230. The high and low PRF counter outputs at the outputs of gates A1A14-6 and -7 are wire-OR'ed to provide the C-band timing signal.

3-231. The C-band timing signal triggers the 3-count delay circuit from which the reset, preknock, range blanking, and indicator range blanking pulses are derived.

3-232. Range Pulse Delay Circuits. The delay circuits gate through the crystal clock pulses that follow the timing pulse at the counter output to provide the 11-microsecond range blanking pulse and the 33-microsecond indicator range blanking pulse. The reset pulse is generated at the beginning of the range blanking pulse, and the preknock pulse from which the transmitter trigger pulses are generated occurs at the end of the indicator range blanking pulse.

3-233. Because the delay circuits for both S- and C-band operation are similar, the description of the S-band delay circuits presented herein is also applicable to the C-band operation. The S-band timing signal from the counter output toggles flip-flop A1A11-1 to its "1" state. This state is transferred to flip-flop A1A11-2 when the S-band crystal clock goes from logic 1 to logic 0. When this occurs, single-shot A1A10-1 fires and sets flip-flop A1A11-3, -4, and -5. The next negative S-band crystal clock transition toggles flip-flop A1A11-3. The output of this flip-flop is the range blanking pulse, which has a pulse width of one cycle of the S-band crystal clock (11 microseconds). The second transition of the crystal clock toggles flip-flop A1A11-4, and the third transition toggles flip-flop A1A11-5. The "1" output of flip-flop A1A11-5 is the indicator range blanking pulse, which has a pulse width of 3 cycles of the crystal clock (33 microseconds). The range blanking pulse and indicator range blanking outputs from the S- and C-band units are routed to signal select circuits where they are selected for radar synchronization according to the frequency band selected for the radar set tracking mode.

3-234. The indicator range blanking pulse from gate A1A14-8 is wire-OR'ed with the C- and X-band indicator range blanking at gates A1A14-9 and A1A13-3, respectively. The resulting logic 0 pulse is routed to single-shots A1A10-3 and -4. Single-shot A1A10-3 generates a 1-microsecond pulse range reset at the leading edge of the input pulse; and single-shot A1A10-4 generates a 1-microsecond pulse preknock at the trailing edge of the input pulse. The reset and preknock pulses along with the range blanking and indicator range blanking effect the synchronization of the other groups within the radar set.

3-235. The adjustable delays for the azimuth and elevation transmitter triggers and the associated L-band interrogation pulse allow the main bang of the azimuth and elevation transmitters to be aligned after a delay from the associated L-band interrogation pulse. This adjustment capability is provided through front panel operator adjustments R1, R2, R4, and R5 (TRANSMITTER DELAY for the S-band and C-band (AZ, EL) and L-band).

3-236. The negative transition of the output pulse from the trigger delay single-shots A2A22-1, -3 and A2A23-1, -3 triggers additional single-shots A2A22-2, -4 and A2A23-2, -4 that set the width of the transmitter trigger pulses. The single-shots that establish trigger pulse width are set to produce 1-microsecond pulses for the azimuth and elevation S- and C-band modulators. The width of the interrogation pulse for the L-band transmitters is set by single-shots A2A20-1 and A2A20-2 for the S- and C-band pedestals. The L-band interrogation pulse for the X-band pedestal is delayed and fixed in width by single-shots A2A21-2 and A2A20-3. The single-shots for S- and C-band operation are set by potentiometers R3 and R6, respectively, to produce 0.5-microsecond interrogation

pulses. Width of the X-band pedestal L-band interrogation pulse is set by potentiometer R9.

3-237. Regulated Power. A separate regulated power supply is used to improve the time stability of the delay single-shots. Regulator assembly A2A24 provides three +6-volt outputs which supply the delay single-shots and their timing resistors. The power supply regulator consists of an integrated circuit module that contains a voltage reference and error sensing amplifiers that adjust the voltage outputs.

3-238. S-Band Trigger Blanking Circuits. The blanking circuits for the S-band azimuth and elevation transmitter triggers are identical. The transmitter trigger pulses are blanked when the S-BAND AZ and EL XMTR ON/OFF switches 1A1A1S4 and 1A1A1S5 are positioned to OFF, when the associated antenna dead-time gate is received from the antenna group, and when a scan-loss condition exists. (The associated antenna scanner is not scanning or is not at full scan speed.) The scan-loss signal is received from the antenna group.

3-239. The azimuth transmitter pulses are gated through gate A1A18-1 when the enabling inputs are all at logic 1 resulting in a negative trigger at the gate output. The enabling input at pin 7 is high when switch 1A1A1S4 is in the ON position; pin 6 is high when the antenna is scanning as sensed by the scan loss circuit; pin 5 is high in the absence of the antenna dead-time gate due to the inversion of the positive dead time gate by NAND gate A1A17-7.

3-240 through 3-241. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-242. L-Band Transmitter Trigger Summing. The missile command guidance pulses from the missile simulation and scoring group are summed with the L-band interrogation pulses for the system selected as the radar tracking system (i.e., if S-band has been selected as the tracking radar frequency, the command pulses are summed with the interrogation pulse for the L-band transmitter in the S-band antenna trailer).

3-243. The command pulses are gated through gates A2A9-1 or -2 by the S- and C-band select signals from S-BAND and C-BAND switches 1A1A1S35 and 1A1A1S34. These outputs are summed with the interrogation pulses or OR gates A2A9-3 or -4. The summed output is passed by gates A2A9-5 or -6 if the transmitter control lines are positive. These transmitter control lines are controlled by the pedestal CMD XMTR ON/OFF switches (1A1A1S10 and 1A1A1S12).

3-244. The interrogation pulses are routed from the outputs of gates A2A9-7 and -8 to signal test panel 1A5A15 for test purposes.

3-245. Modulator Trigger Circuits. The modulator triggers are derived by transforming the outputs of the L-band trigger summing network and the azimuth and elevation trigger blanking circuits into differential signals that are routed to signal conditioner A6A2 in the antenna trailer through the slip ring assembly. These differential signals are transformed back to single-ended signals by the line receivers. The line receiver output is routed to the trigger driver circuits where the modulator trigger is generated. The modulator trigger signals for the azimuth and elevation transmitters are blanked with a signal that is present when the waveguide switches are transferring.

3-246. X-BAND RANGE TIMING GENERATION. Trigger pulses for X-band transmitter 4A3A1 and associated L-band pulse command transmitter 4A1A2 are generated in MTI unit 1A17A2 and routed through synchronizer 1A1A5 before being routed to the antenna. The theory of operation for the generation of these X-band trigger pulses is covered in the discussion of the X-band synchronizer (paragraph 3-837, T.O. 43D7-11-21-2-1-1. The X-band transmitter triggers generated in the MTI unit and the associated L-band

transmitter triggers are transformed into differential signals that are routed to the X-band receiver-transmitter-modulator (RTM) assembly through the slipring assembly where they are transformed back into single-ended logic signals. These trigger pulses are not blanked during the rotation of the X-band transmitter antenna regardless of the operating mode.

3-247. S-BAND AND C-BAND TRANSMITTERS 2A2 AND 2A7. (See figure 3-34.)

3-248. MODULATOR TRIGGER GENERATOR. The S-Band and C-Band transmitters are similar; the S-Band transmitter will be described. The trigger generator (A2A1) accepts the modulator trigger pulses from the trigger drivers and generates the high power pulses needed to activate the thyratron switch. Blanking provisions in the trigger generator remove the thyratron trigger pulses when the PRF controlled relays in the modulator are operating.

3-249. In the normal condition (triggers not inhibited), the trigger pulses are received from the trigger driver and routed through J203 where they are differentiated by capacitor C8 and resistor R11. The negative pulse resulting from differentiation is removed by diode CR9. The positive pulse is coupled through diode CR10 to the base of transistor Q2 to start the blocking oscillator action. The pulse from this blocking oscillator is coupled to the base of emitter follower Q3 by the third winding on the blocking oscillator transformer T4. The pulse at the emitter of Q3 is coupled through diode CR12 which is forward biased because of the positive power supply voltage that runs through resistor R15 when the triggers are not inhibited. This pulse is differentiated by capacitor C11 and resistor R16 and the negative pulse is clipped by diode CR14 to produce a positive pulse at the emitter of Q4. This positive pulse is routed through diode CR29 and through the normally closed contacts of relay K204 and energized relay K201 to the gate circuit of the silicon controlled rectifier SCR201.

3-250. The pulse for the thyratron is developed with pulse forming networks (PFN) N201 and N202 which are charged from a positive power supply voltage and discharged by the SCR when a trigger is received from emitter follower Q4.

3-251. When the dual pulse forming networks N201 and N202 are charged to the positive power supply voltage, a positive gate pulse is applied to the gate of the SCR, and the SCR is turned on. This action effectively grounds the input of network N201 through the conducting diode CR223 and SCR201. This short circuit discharges the pulse forming networks N201 and N202, providing a step voltage of two times the power supply voltage.

3-252. TRIGGER GENERATOR POWER SUPPLY. The power supply voltages for trigger generator A201 are generated in the circuits composed of T201 and T203 and associated components. The 120-volt, 400 Hertz input to the power supplies is received from terminals 1 and 2 of terminal board TB201 when power is applied to the modulator.

3-253. The positive charging voltage for the PFN is developed in the supply consisting of the transformer T201, a full wave bridge rectifier CR201-CR202-CR203-CR204, a choke L201, and filter capacitor and bleeder resistor C201 and R230. During the charge cycle of the PFN, current from the power supply is furnished through resistors R201 and R231. During the discharge cycle when rectifier SCR201 is triggered, diode CR223 is forward biased causing the emitter of transistor Q201 to be positive with respect to its base thus cutting off the charging current from the power supply.

3-254. The positive and negative supply voltages for the remainder of the trigger generator are developed by transformer T203 and associated circuits. The negative supply contains a half-wave rectifier assembly consisting of CR205 and CR206 and resistor-capacitor filter R205-C203-R206-C204-R232, and supplies the negative bias required for the SCR. The

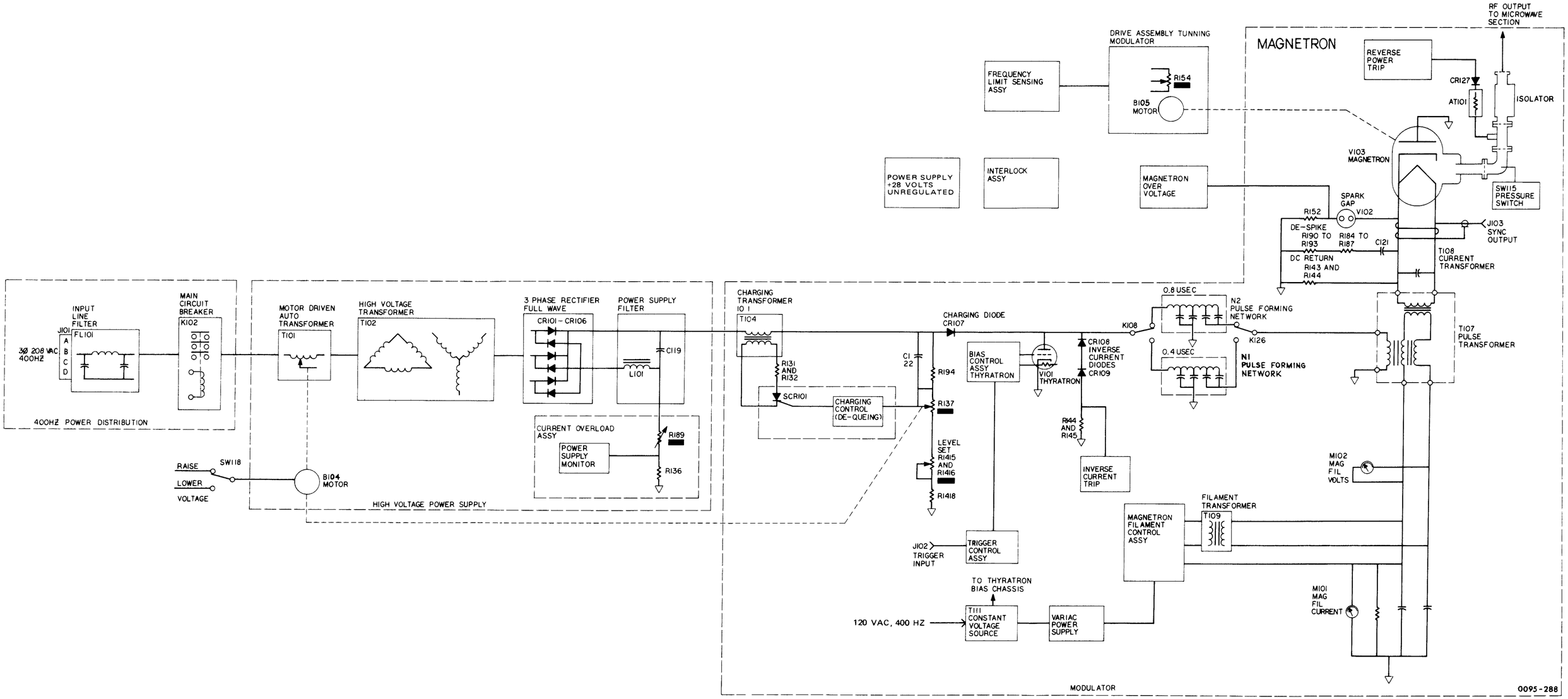


Figure 3-34. S- and C-Band Transmitter Block Diagram

positive voltages are developed by the half-wave rectifier assembly consisting of diodes CR207 and CR208 and a capacitor-resistor filter C206-R207-C207. The positive output voltage that can be monitored at test point TP1 is regulated to approximately 22 volts by reference diode VR201.

3-255. TRIGGER GENERATOR INHIBIT CIRCUITS. The inhibit circuits blank the triggers to the thyrathron switch when the reverse power of the microwave system is above an allowable threshold and the PRF controlled relays in the modulator are operating.

3-256. When a change of PRF is selected by the HIGH/LOW PRF switch 1A1A4S11, relay K203 is energized, and a positive voltage is applied to one or the other of the pulse differentiating circuits at the base of transistor Q10 in the trigger generator A201. The positive pulse on the emitter of emitter-follower Q10 triggers the single-shot composed of transistors Q7 and Q9. The duration of the single-shot output pulse is set by RC network C14-R25 and is approximately 35 milliseconds. During the single-shot action, transistor Q7 is turned on, its collector is at ground, and the emitter-follower Q6 is at ground potential for the time delay. The length of the single shot pulse can be monitored at test point TP2. This ground pulse is coupled through diode CR16 to diode CR12 in the trigger generator. Diode CR12 is thus back-triggered and the pulse from transistor Q3 in the trigger generator is not received by transistor Q4. The rectifier SCR201 trigger pulses and consequently the thyrathron trigger pulses are thus inhibited.

3-257. An additional set of contacts on relay K203 applies power to the coils of relays K108 and K126 when LOW PRF has been selected. When energized, relays K108 and K126 select the low PRF pulse forming network N2. When the relays are deenergized, pulse forming network N1 is selected. Indicators DS101 and DS102 are lighted for low and high PRF operation, respectively.

3-258. When the reverse power sensed in the microwave system is below allowable limits, a positive 20-volt signal is received from the reverse power trip circuits. Receipt of this signal turns on transmitter Q5 allowing the thyratron to be triggered. When the reverse power is above allowable limits, Q5 is turned off due to the ground signal on its base, diode CR15 is therefore forward biased, and the triggers to the emitter follower Q4 in the trigger generator are inhibited.

3-259. REVERSE POWER SENSING. The reverse power trip circuit A501 contains a flip-flop circuit made up of transistors Q7 and Q8. Normally, transistor Q8 is conducting; therefore, transistor Q9 is turned off and transistor Q10 is conducting. The output of transistor Q10 is an enabling signal which is sent to the trigger generator. When excess reverse power is received, a signal at terminal A501-A causes flip-flop Q7-Q8 to change state through Q1, Q2, Q3, and multivibrator Q4-Q5-Q6. When the state of flip-flop Q7-Q8 is changed, +20 volts enabling transistor Q10 is turned off and the +20-volt enabling signal is removed. Operating the reset switch (2A2S109, 2A7S109, 3A2S109, 3A7S109) energizes relay K2 which, in turn, resets flip-flop Q7-Q8 to the normal state with Q8 conducting. The sensitivity of the circuit can be adjusted by using potentiometer R9 to vary the level of the pulse voltage to the base of transistor Q4.

3-260. S-BAND AND C-BAND MODLATORS. The S- and C-band modulators (figure 3-34) consists basically of charging transformer T104, a charging control A300, a charging diode CR107, a thyratron switch tube V101, reverse current diodes CR108 and CR109, pulse forming networks N1 and N2, vacuum relays K108 and K126, and a pulse transformer T107. When triggered by the trigger generator, the modulator produces a high voltage negative pulse on the magnetron cathode, which pulses the magnetron to generate the high power RF transmitter pulse. The modulator produces different pulse widths on the magnetron cathode for high and low PRF

operation of the radar set. This is accomplished by selecting the desired pulse forming network in the modulator. Relays K108 and K126 which select the pulse forming network are controlled by signals received from relay K203 in the trigger generator.

3-261. During the interval between trigger pulses, the DC voltage from one modulator power supply (approximately 5000 VDC) is applied through the primary of charging transformer T104 and charging diode CR107 to charge either the high PRF or low PRF pulse forming network N1 or N2. When the selected network is charged, diode CR107 is back biased, keeping the pulse forming network charged to a voltage approximately twice that of the power supply voltage input. The pulse forming network not selected for use in the modulator is charged through resistor R198. The trigger pulse from the trigger generator fires thyratron V10, which discharges the pulse forming network. The discharge of the network produces a high voltage pulse which is applied to the pulse transformer. The pulse transformer output pulses the magnetron producing the high power RF pulse.

3-262. Charging Inductor-Charging Control. The charging current for the pulse forming network flows from ground through the pulse transformer T107, the pulse forming network N1 or N2, the charging diode CR107, and the charging inductance (the primary of T104) to the modulator power supply. The inductance of the primary of transformer T104 resonates with the capacitance of the pulse forming network to give a network resonate charging period of approximately 350 microseconds for network N1 and a resonate charging period of approximately 470 microseconds for network N2. The maximum voltage level of the charge on the pulse forming network is determined by the charging control circuit.

3-263. A compensated voltage divided composed of resistors R194-1 through R194-20, R137, R197, and R138 and their parallel compensating capacitors measures the instantaneous value of the charging voltage at the output side of the primary of transformer T104. Either potentiometer R1415 or R1416 is connected in parallel to resistor R138 to vary the voltage divider for high and low PRF operation, respectively. A sample of the charging voltage from the arm of potentiometer R137 is routed to the charging control circuit.

3-264. When the voltage at the arm of R137 exceeds 27 volts, transistor Q303 begins to conduct, thereby turning off transistor Q304 and driving transistor Q305 into conduction; the potential at J301, which is applied to the gate of the SCR, is raised to +10 volts, thus firing SCR101. This action shorts the secondary of the charging transformer T104 through resistor R131, greatly reducing the Q of the primary. Consequently, the voltage raise at the primary that is due to the resonance with the PFN is stopped. The charging diode CR107 is back biased and the PFN is charged to the voltage that it had attained at the time the SCR was fired. Thus, the PFN charging voltage is regulated.

3-265. CHARGING DIODE. During the charging time of the PFN, the charging diode CR107 conducts. The charging control circuit fires and shorts the secondary of charging transformer T104, thus collapsing the field about the charging primary inductance of transformer T104. The charging diode CR107 stops conducting and is reverse biased. This prevents the PFN set from discharging back through the high voltage power supply.

3-266. THYRATRON SWITCH. The charge on the PFN remains at a constant level until the next trigger pulse is applied to the thyratron. This pulse is received from the trigger generator. Thyratron V10 is normally grid biased off by the negative 50-volt bias on its grid. As thyratron V10 is driven into ionization by the trigger pulse, the anode drops to approximately the same potential as the cathode, switching the PFN input to ground.

3-267. PULSE FORMING NETWORK (PFN). The pulse forming network serves the double purpose of storing energy and of shaping the output waveform. In operation, it is quite similar to an artificial transmission line in that it furnishes a steady output voltage for a length of time depending on the line "length."

3-268. The discharge cycle takes place as follows (figure 3-35): At a time t = T, the pulse forming network in use is charged to a potential of approximately twice the power supply voltage (Eps). The exact potential on the network is set by the charge control circuit. The thyratron is in the high impedance nonconducting state.

3-269. At time t = 0, the trigger pulse is applied to the grid of the thyratron, which switches to the low impedance conducting state. The thyratron discharges the first half of the network only. This half is, in effect, a short-circuited transmission line.

3-270. At time t = $\frac{1}{2}$T, the negative traveling wave of amplitude 2 Eps, has traversed to the far end of the first half of the network without change of phase. Since the second half of the network is in series with the pulse transformer primary, the terminating impedance of the first half appears as an open circuit. This causes the wave front to travel back down the first half towards the thyratron with a phase reversal. This causes the first half section to suddenly reverse its potential from approximately +2 Eps to approximately -2 Eps. The result is that both sections of the network are suddenly connected in series across the pulse transformer primary. The total exciting voltage around the circuit is approximately 4 Eps (the summation of the -2E potential at E1 and the +2E potential at E2), and, if matched conditions exist between the PFN and the pulse transformer (the reflected primary load impedance of the pulse transformer is equal to the sum of the impedance of both network sections), a voltage pulse of approximately 2 Eps appears across the pulse transformer primary.

3-271. At time t = T, the negative inverse voltage across the first half of the network appears across the thyratron cutting off the thyratron; forward conduction ceases and recovery begins.

3-272. At time t = 3/2T, the discharge of both sections of the network is completed and the pulse output ceases.

3-273. Inverse Current Limiting. If a mismatch between the PFN and pulse transformer occurs during the discharge cycle, a charge will be placed on the PFN of opposite polarity to the normal charge. This charge cannot be dissipated by the thyratron because of its polarity. If the charge is not removed, the peak voltage stored in the PFN will increase with each cycle. The inverse charge is limited by diodes CR108 and CR109 and resistors R144 through R147 in parallel to the thyratron. The voltage dropped across R147 is measured by the metering circuit for a measure of the inverse current. Protection against internal magnetron arcing due to load shorts is provided by the inverse current trip circuitry initiated by relay K105.

3-274. Pulse transformer T107 has a turn ratio of approximately 4.25:1, which matches the impedance of the PFN to the input impedance of the magnetron. This step-up allows development of a magnetron pulse of approximately 40 kilovolts from a PFN charge of approximately 10 kilovolts. The pulse transformer also contains the step-down filament transformer for the magnetron filaments.

3-275. Magnetron Filament Voltage. A programmed level of 400 Hertz power from the secondary winding of transformer T109 in the filament voltage control unit is connected to the low side of the two secondaries of pulse transformer T107. The primary of transformer T110 in series with one of the power leads senses the filament current for the low filament current interlock circuit. A separate filament transformer, within the pulse transformer, is connected to the two secondary windings and isolates the magnetron filaments.

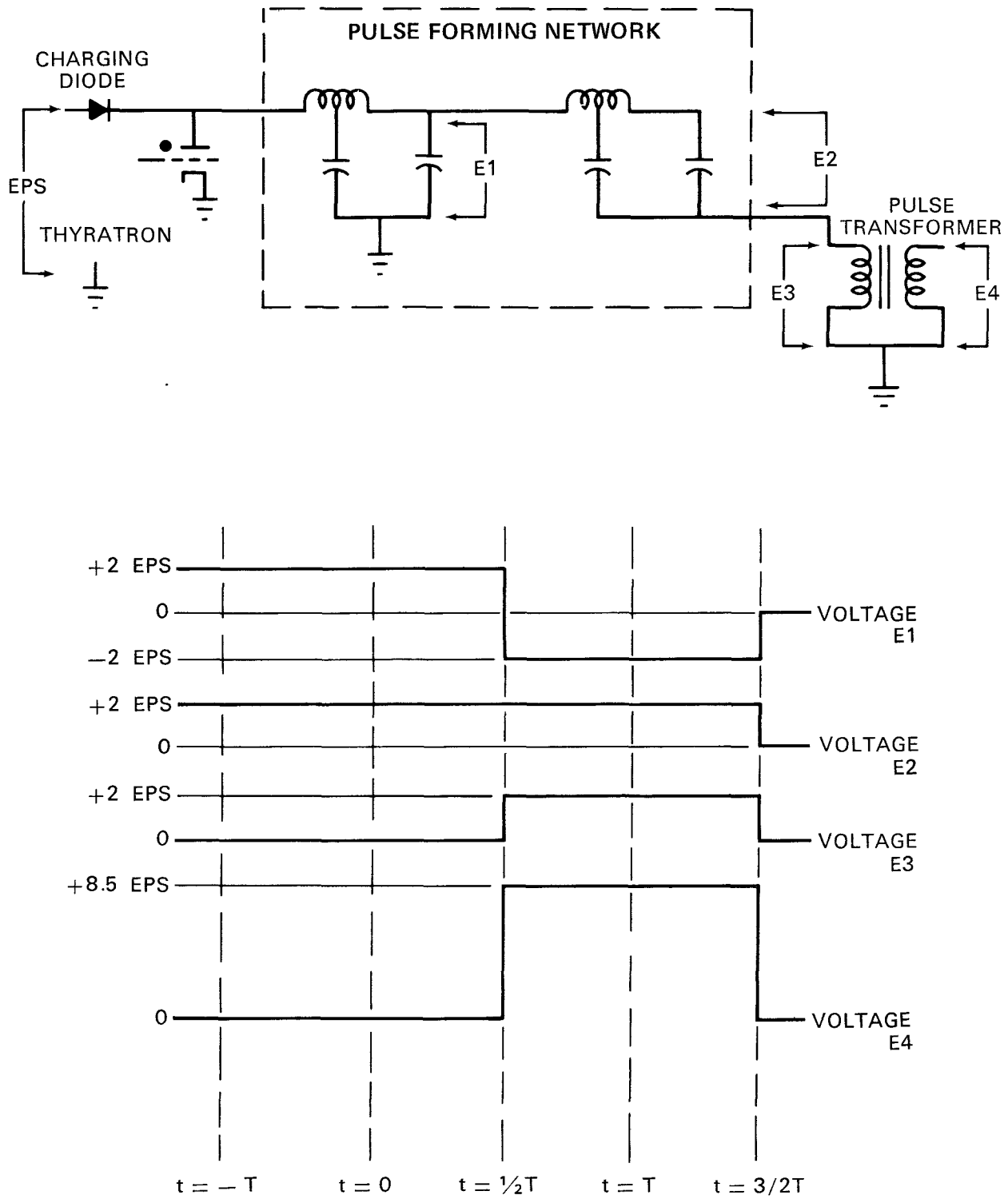


Figure 3-35. Pulse Forming Network Discharge, Timing Diagram

3-276. S-BAND AND C-BAND MAGNETRON FILAMENT VOLTAGE CONTROL. The filament voltage supplied to the magnetron is controlled by control circuit A400 so that the filament voltage is lowered in discrete steps as the average anode current of the magnetron increases. The electron back-bombardment heats the magnetron cathode so that less filament voltage is required to maintain the required cathode temperature at higher values of anode current.

3-277. The magnetron average current received through connector J401 is filtered by choke L401 and capacitors C3 and C5 and routed to one input of comparators U1, U2, U3, and U4. The second input of the comparators is received from the precision resistor chain, composed of resistors R1 through R6, which is tied between ground and a positive voltage regulated by reference diode VR1.

3-278. Considering the case where magnetron average current is low, the input to filament transformer T109 is connected directly across the 400 Hertz power line through the normally closed contacts of relays K401, K402, K403, and K404.

3-279. When magnetron average current is increased until comparator U1 changes state, the comparator output turns on transistor Q1, and relay K8 is energized. In turn relay K404 is energized and the filament transformer is connected across variable transformer T405 which results in a lower filament voltage. An additional contact of relay K404 connects potentiometer R426 to accomplish the scaling of the magnetron filament voltage meter.

3-280. As magnetron average current is further increased, comparators U2, U3 and U4 change state. Relays K7, K6, and K5 and relays K403, K402, and K401 energize to select the variable transformers T404, T403, and T402, thereby lowering the filament voltage input. In each case, a different scaling potentiometer is connected in a filament voltage metering circuit.

3-281. The generation of positive and negative power supply voltages for the comparator and relay circuitry is accomplished in a similar manner. The positive supply voltage is obtained by using transformer T401 and full wave rectifiers CR1 and CR2. The output of the rectifiers is filtered by capacitor C1 and applied to the collector of the series regulating transistor Q5 through the limiting resistor R20. Reference diode VR2 establishes the base drive voltage of the transistor to regulate the output across load resistor R19 to +6 volts.

3-282. S-BAND AND C-BAND MAGNETRON. The S- and C-band magnetron is a coaxial magnetron. It produces high power RF pulses when its cathode is triggered by a high voltage negative pulse from the pulse transformer. The anode of the magnetron is grounded and the large negative pulse on its cathode causes electrons to leave the cathode and establish RF oscillations in the resonant cavities. This energy is coupled through the coaxial section to the waveguide flange at the magnetron output.

3-283. Magnetron Tuning. Tuning of the magnetron frequency can be accomplished from either local or remote positions. Frequency control is accomplished by controlling tuning motor B105 which drives the frequency control shaft of the magnetron through a slip clutch. Potentiometer R154, geared to the magnetron tuning shaft, is used to sense the upper and lower limits of magnetron tuning and to provide the delta frequency circuit with an input which provides a remote indication of the difference of the azimuth and elevation transmitter frequencies.

3-284. Local control of frequency by the actuation of the momentary RAISE-LOWER FREQUENCY switch (S118) energizes relay K1402 or K1403 in magnetron frequency control circuit A1401 so that the motor drive voltage is connected to accomplish either clockwise or counterclockwise rotation of the magnetron frequency control shaft. Potentiometer R154 receives plus

and minus 15-volt excitation from the signal conditioning chassis and is geared to the magnetron tuning shaft so that the potentiometer turns approximately 10 turns for the entire travel of the magnetron tuning shaft.

3-285. The arm of potentiometer R154 is routed through a voltage divider consisting of resistors R1414 and R1413 to an input on comparators U1401 and U1402. The other input for the comparators is taken from voltage dividers that are connected from a plus and minus power supply voltage. The potentiometers in these dividers (R1404 and R1405) allow adjustment of this comparison voltage. If the magnetron is tuned until the voltage at the arm of potentiometer R154 is equal to the comparison voltage, one of the comparators will fire, turning on transistor Q1401 through diode CR1406 or CR1407. This energizes relay K1401 which lights the FREQUENCY LIMIT indicator (DS121). Simultaneously, the slip clutch installed between tuning motor B105 and the magnetron slips, because of mechanical stops on the tuning shaft within the magnetron. The mechanical stops prevent the shaft from being overdriven.

3-286. Isolator. The ferrite load isolator isolates the magnetron from excessive power reflection that is due to high VSWR. High VSWR may be caused by the rotary joint, scanner motion, or waveguide fault.

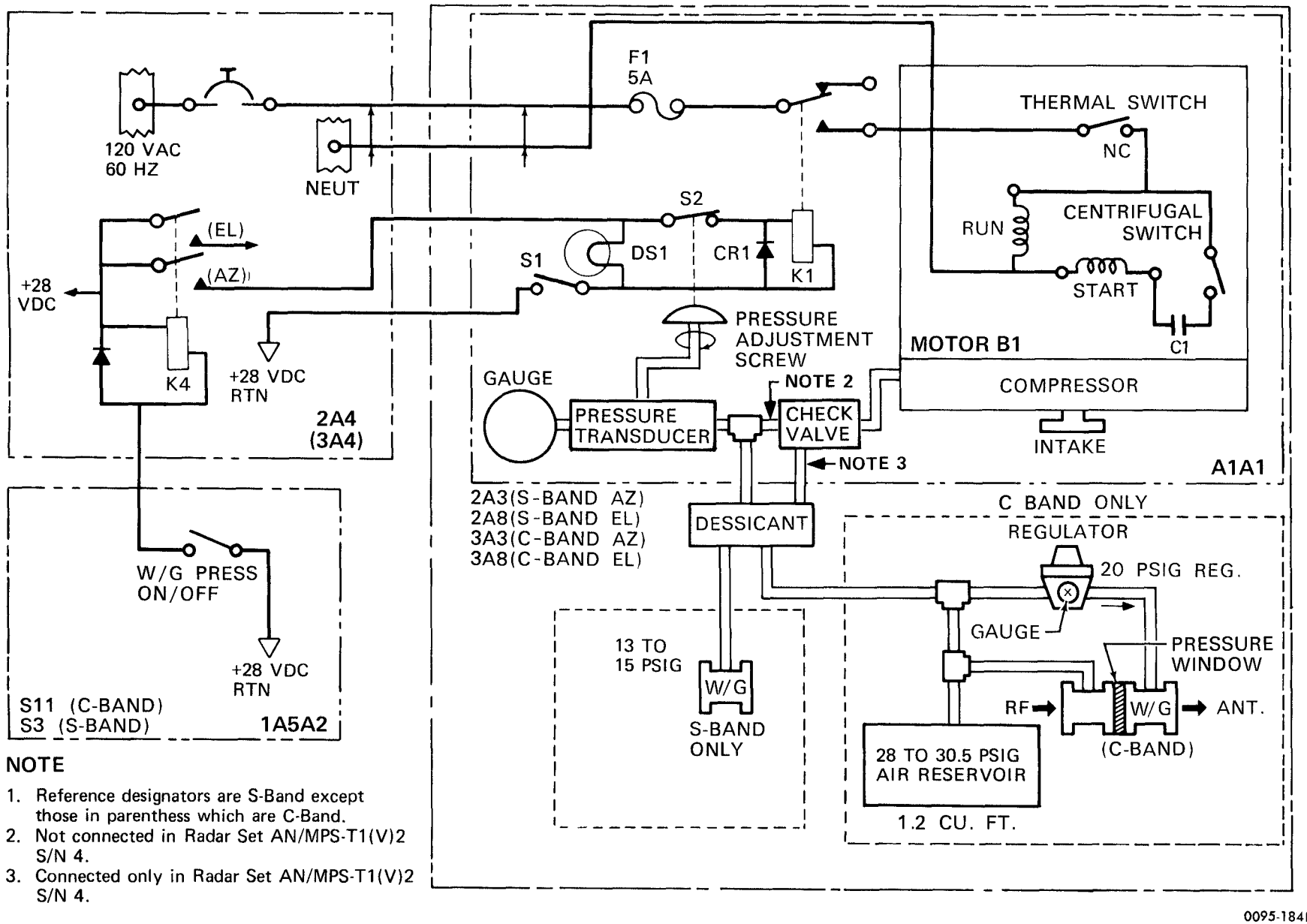
3-287. The isolator, which consists of an internal ferrite slab with a permanent magnet attached to the exterior of the unit, acts as a unidirectional coupler by offering 0.4 dB attenuation in the forward direction and 20 dB attenuation in the reverse direction for the S-band isolator and 10 dB attenuation in the reverse direction for the C-band unit.

3-288. Bidirectional Coupler. The RF energy from the magnetron passes through the bidirectional coupler to the waveguide sections of the antenna group. The bidirectional coupler samples the incident (forward) power and the reflected (reverse) power for transmitter and antenna group performance monitoring and furnishes a sample of the transmitter RF signal to the AFC circuits in the receiver group.

3-289. The attenuation at each port is 50 dB and the directivity between ports is 25 dB. Therefore, if +90 dBm of power enters the coupler in the forward direction, then the amount of power seen at the forward port is +40 dBm and the power seen at the reverse port due to the forward power is +15 dBm. The opposite is true for reverse power.

3-290. Waveguide Pressurization. The waveguide pressurization system provides positive dry air pressurization of the waveguide system to increase the power handling capability of the system, to prevent corrosion or moisture forming in the waveguide, and to provide the necessary pressure to interface with the magnetron output window (figure 3-36). The system consists of a remote ON/OFF switch; a remote controlled relay; a compressor assembly; a desiccant bottle; and, in the C-band system, an air reservoir, a pressure regulator, and pressure window.

3-291. When the remote W/G PRESS ON/OFF switch 1A5A2S3 or 1A5A2S11 at the remote power and frequency control panel is positioned to ON, relay K4 in the power distribution panel 2A4 or 3A4 is energized and +28 VDC is applied to the compressor assembly control circuit. If the ON/OFF switch S1 in compressor assembly A1A1 of the receiver (2A3, 2A8, 3A3, 3A8) is positioned to ON, relay K1 energizes and applies 120-volt, 60 Hertz power to motor B1. This motor drives the centrifugal air compressor unit to provide the pressurized air output. A check valve is used to prevent leakage of pressurized air through the compressor. An adjustable pressure transducer and an associated switch S2 allows the pressure maintained in the waveguide lines to be adjusted. A relief valve protects the compressor from overpressure due to the blockage of the air



NOTE

1. Reference designators are S-Band except those in parenthess which are C-Band.
2. Not connected in Radar Set AN/MPS-T1(V)2 S/N 4.
3. Connected only in Radar Set AN/MPS-T1(V)2 S/N 4.

Figure 3-36. S- and C-Band Waveguide Pressurization System

line. The desiccant bottle collects the moisture from the compressed air to prevent corrosion and moisture from forming in the waveguide. The combination of the air reservoir, regulator, and pressure window in the C-band unit enables the air pressure on the magnetron output window to be maintained at approximately 30 psig and the antenna waveguide sections to be maintained at a pressure of 20 psig.

3-292. The hysteresis of the pressure transducer and switch S2 in the compressor assembly causes the compressor to turn on when the pressure is below 13 psig for S-band (28 psig for C-band) and to shut off at 15 psig for S-band (30.5 psig for C-band) when the pressure transducer is properly adjusted.

3-293. S-BAND AND C-BAND HIGH VOLTAGE POWER SUPPLY. The modulator power supply provides the high voltage required for charging the pulse forming network and the low voltages required to operate the control circuits and distribute the 400-Hertz line voltages to the various units of the modulator. Local and remote controls are provided for the modulator and power supply control functions. The circuitry will be described with the REMOTE CONTROL TRANSFER switch on the transmitter in the LOCAL position.

3-294. The 400 Hertz, 3-phase power input lines are routed to the modulator through connector P101 and through line filter FL101. These line filters reduce the conducted interferences between the modulator and other equipment in the radar set. Surge suppressors SU101, SU102, and SU103 protect the equipment against possible power line surges. Circuit breaker CB101 controls the 400-Hertz power to the modulator and modulator power supply. Relay K101, connected to each phase of the line voltage, detects the absence of a phase or an excessive imbalance of the phase voltages. If a phase voltage is missing or there is an imbalance, relay K101 is deenergized. This causes relay K111 to energize which removes the +28 volt control voltage. High voltage relay K103 and main contactor relay K102 are deenergized and PHASE OUT indicator DS109 lights.

3-295. The +28 volt power supply furnishes the voltage for relay control in the modulator power supply and modulator. The three phases of the input voltage are connected to the +28 volt power supply through fuses F101, F102, and F103. Each of the three transformers in the power supply is connected from one of the input phases to the 400-Hertz neutral line to provide a 3-phase, Y-connected transformer. Rectifier diodes at each secondary provide rectification of the secondary voltage which is filtered by network R601-R603-C601-C602. Resistor R602 provides a load to the power supply output which is routed to the control switches, relays, and indicators in the modulator and modulator power supply unit.

3-296. The input power is connected to the remainder of the system when the PWR ON/OFF switch S104 is positioned to ON and power is applied to the coil of main contactor K102. BLOWERS circuit breaker CB103 applies power to the cooling fans for the modulator cabinet, magnetron cooling, and isolator cooling.

3-297. Variable transformer T101 supplies the line voltage to the high voltage power supply and is controlled by motor B104 and the H.V. RAISE and H.V. LOWER switches S107 and S108. When the H.V. ON switch S105 is depressed, a +28 volt signal is connected through the normally closed contacts of limit switch S111A, the normally open contacts of the 8-minute time delay relay K124, and the normally closed contacts of relays K112 through K121 to the coils of relays K125, K103, K130, K131, and K132. This ensures that the variable transformer T101 is at the lower limit (S111); the time delay (K124) after the main power has been applied has elapsed; and none of the high voltage interlock circuits (K112 through K121) have been energized.

3-298. When the H.V. RAISE switch S107 is depressed, the H.V. RAISE relay K122 is energized and a 120-volt, 400

Hertz signal from phase C of the input power is fed through fuse F105, through the normally open contacts of relay K125, and through the interconnected contacts of high voltage raise and lower relays K122 and K123. The signal continues through the upper and lower high voltage limit switches S110 and S111 to variable transformer drive motor B104 to increase the line voltage at its output. When the upper high voltage limit has been reached, switch S110 opens, thus removing the motor drive. When the H. V. LOWER switch is depressed, relay K123 is energized and relay K122 is deenergized, thereby changing the connections to motor B104 and lowering the high voltage. If one of the high voltage interlocks is energized or if the H. V. OFF switch S106 is depressed when the high voltage is not at the lower limit, relay K125 is deenergized and the line voltage is fed to motor B104 through the normally closed contacts of K125. If the high voltage is lost for any reason, transformer T101 is always driven to its lower limit by motor B104.

3-299. The output of transformer T101 is fed through the H. V. PWR INPUT circuit breaker CB102 and through the closed contacts of K103 to high voltage power transformer T102. The power transformer has a delta-connected primary and a Y-connected secondary. The transformer output is rectified in a full wave bridge by diodes CR101 through CR106 and is filtered by the choke input filter which consists of inductor L101 and capacitor C119.

3-300. Safety relay K130, which is deenergized when any of the equipment interlocks are activated, connects resistor R188 across the filter capacitor C119 to discharge the high voltage charge at the same time the previously described interlock circuits are lowering the variable transformer T101 by means of the drive motor.

3-301. A bleeder resistor composed of resistors R102, R103, and R104 provides a load resistance to the high voltage filter circuit.

3-302. A resistor divider circuit and current sensing resistors provide inputs to the metering circuit so that the power supply output voltage and current may be monitored. A resistor divider composed of R106 through R130, R133, and R134 connected across the high voltage output provides a 5-megohm load to the power supply output. The meter and its parallel shunt resistor are connected in parallel to resistor R133 when the voltmeter selector switch S102 is in the PWR SUP position. The metering circuit resistances provide a scale on the meter face of 10 kilovolts full scale when reading the high voltage. Power supply current is monitored by connecting meter M101 in parallel with resistor R136, which is in the ground side of the power supply output. The metering circuit resistors provide a full-scale deflection of the meter for 2 amperes of high voltage power supply current.

3-303. Safety and Interlock Circuits. Various interlock circuits provide for removal of the high voltage output of the power supply in the event of abnormal conditions that may constitute a personnel safety hazard or may cause equipment failures.

3-304. Relays K112 through K121 are latching relays and each is connected to a different fault-sensing circuit. When a fault is detected, the relays are latched and may be reset when the fault has been corrected by use of the RESET switch S109. A fault indicator is provided for each fault relay to indicate the cause of the high voltage loss. Activation of any fault relay opens the 28 volt control line to the high voltage contactor K103 to remove the high voltage. When any fault relay is actuated, relay K110 is energized and the H. V. INTERLOCK OPEN indicator DS108 is lighted. When correct conditions are sensed and the time delay cycle is complete, relay K110 is deenergized and H. V. READY indicator DS106 is lighted.

3-305. Improper phase voltage, i.e, an absent phase voltage or phase voltage imbalance, deenergizes relay K101 which

lights indicator DS109 and removes the control voltage from relays K102 and K103.

3-306. The low magnetron filament current circuit ensures that the magnetron filament preheating is being accomplished at the correct value of filament current. The primary of transformer T110 is connected in series with the magnetron filament leads and develops the voltage across the secondary winding, which is proportional to magnetron filament current. This secondary voltage is rectified and filtered by diodes CR123 through CR126 and capacitor C137. Reference diode VR103 or VR VR104 drops part of the voltage developed. The remainder of the voltage across the coil of relay K109 energizes this relay. If relay K109 is deenergized (the filament current is low), a 28-volt control signal is routed through the normally open contacts of relay K125 which energizes relay K112 which removes the high voltage and lights indicator DS110. Since the circuit only senses the filament voltage during the preheat cycle, the circuit is inoperable once the high voltage has been applied and relays K103 and K125 are energized.

3-307. The door interlock open circuit is energized when either the rear panel or front door is open. Interlock switch S112 and S113 energizes relay K113, lights indicator DS111, and deenergizes K103.

3-308. Loss of magnetron cooling air due to a blower failure or airflow obstruction causes the operation of the airflow switch (S115). Operation of this switch energizes relay K114 and lights indicator DS112.

3-309. Loss of isolator cooling air due to a blower failure or airflow obstruction energizes the airflow switch S116. Operation of this switch energizes relay K115 and lights indicator DS113.

3-310. The power supply current overload circuit is energized by excessive power supply current. Relays K104 and K116 are energized successively as described previously. When relay K116 is energized, indicator DS114 lights.

3-311. Inverse current overload energizes an interlock in the event of excessive modulator inverse current. Excessive inverse current through diodes CR108 and CR109 and resistors R144 through R147 at the plate of the thyratron causes successive operation of relays K105 and K117, lights indicator DS115, and removes the high voltage. The inverse current is sensed by the voltage dropped across potentiometer R146, which acts in parallel to the coil of relay K105 and allows adjustment of the value of inverse current that will energize relay K105.

3-312. Magnetron average current is sensed by the voltage dropped across potentiometer R149, which is in the ground side of magnetron pulse transformer T107. When excessive voltage is dropped across R149, which can be adjusted for proper trip level, relay K106 is energized and, in turn, energized relay K118 and lights indicator DS116.

3-313. An excessive voltage at the magnetron cathode will fire the spark gap tube V102 and cause current to flow through resistor R152 and potentiometer R153. Relay K107 acting in parallel with resistor R153 will energize when excessive voltage is present and will energize relay K119 and light indicator DS117.

3-314. In the event of a waveguide short, a pickup loop within directional coupler DC110 is used to sense reverse power caused by the short. When the pulsed signal is detected, it is amplified and stretched in the reverse power trip unit by the operation of transistors Q1, Q2, and Q3. This stretched signal operates the Schmitt trigger (Q4 and Q5) at the signal level preset by potentiometer R9. When the Schmitt trigger fires, the flip-flop (Q7 and Q8) is operated and relay K1 is energized. Operation of the flip-flop causes the trigger to be inhibited as described in the modulator trigger generator section. When relay K1 is energized, it energizes K120 and lights the waveguide short indicator DS118. The flip-flop is reset and pulse stretching capacitors C3 and C4 are discharged by relay K2 when energized by the RESET switch.

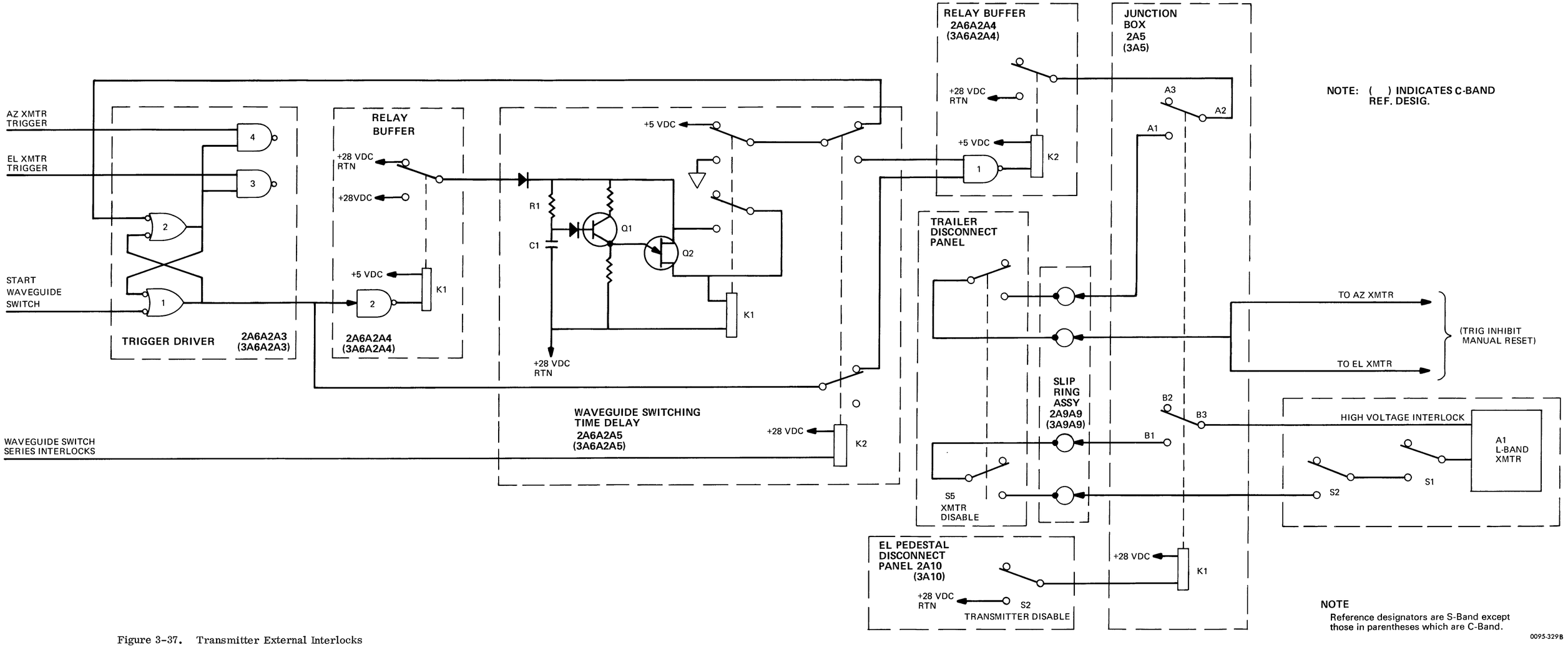


Figure 3-37. Transmitter External Interlocks

3-315. In the event of low waveguide pressure, the waveguide air pressure switch S117 is closed, thus energizing relay K121 and lighting indicator DS119.

3-316. A magnetron cathode warm-up time delay relay K124 ensures that 8 minutes have elapsed after the magnetron filament has been energized and that it is drawing proper warm-up current. The time delay of this relay is set by the charging time of capacitor C136. The energizing voltage for the coil is routed from the magnetron current sense relay K109 so that proper magnetron warm-up current must exist before starting the time delay. Until the time delay energizes, indicator DS107 is lighted and the control line to the high voltage relay K103 is open.

3-317. Three safety relays, with coils parallel to the coil of the high voltage relay K103, short out the high voltages stored in the modulator when high voltage is deenergized for any reason. Relay K130 shorts out filter capacitor C119 in the high voltage power supply and relays K131 and K132 short out pulse forming networks N1 and N2, respectively.

3-318. The high voltage power supply line input is decreased when high voltage relay K103 is deenergized for any reason. Relay K125, whose coil is in parallel with the coil of relay K103, routes a voltage to the variable transformer control motor B104 to decrease the input voltage to the power supply when relay K103 is deenergized.

3-319. S-BAND AND C-BAND MODULATOR REMOTE CONTROLS. When the REMOTE CONTROL TRANSFER switch S103 on the modulator front panel is positioned to REMOTE, remote control of the modulator and modulator power supply can be effected by means of controls located on the transmitter control panel 1A5A1. Additional remote functions are controlled from power and frequency control panel 1A5A2.

3-320. Controls on the transmitter control panel provide remote control of each of the S-band azimuth and elevation and C-band azimuth and elevation modulators simultaneously.

3-321. The remote controls are duplicates of those described for the local control function. Indicators on the transmitter control panel light when the time delay is running, when high voltage is energized, when high voltage is deenergized, when high voltage interlock is open, when power is applied, and when the waveguide pressure is low. The metering circuits include scaling circuits so that the remote meters may be calibrated.

3-322. Transmitter external interlock switches (figure 3-37) are provided to disable the transmitters and ensure protection of personnel who are working on or near the pedestal.

3-323. L-BAND PULSED TRANSMITTER. The L-band pulsed command transmitters 2A1A1, 3A1A1, 4A1A2 in the S-, C-, and X-band transmitter groups are electrically identical. An interface block diagram of the pedestal is shown in figure 3-38. The S-band pedestal L-band transmitter interface block diagram is identical to that of the C-band pedestal. An interface block diagram of the X-band pedestal is shown in figure 3-39.

3-324. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-325. Command guidance pulses for the S- and C-band pedestal L-band transmitters are controlled by the computer. Generated in computer interface chassis 1A5A14, the command guidance pulses are routed to synchronizer chassis 1A1A5. The C PEDESTAL CMD XMTR ON/OFF switch S12 on mode control 1A1A1 provides an enabling signal for gate 1A1A5-6. When this gate is enabled, guidance pulses are routed through line driver 1A1A5A2A6 to line receiver A1 in the signal conditioning chassis 2A6A2, 3A6A2. The pulses are routed through the trigger driver A2 in the

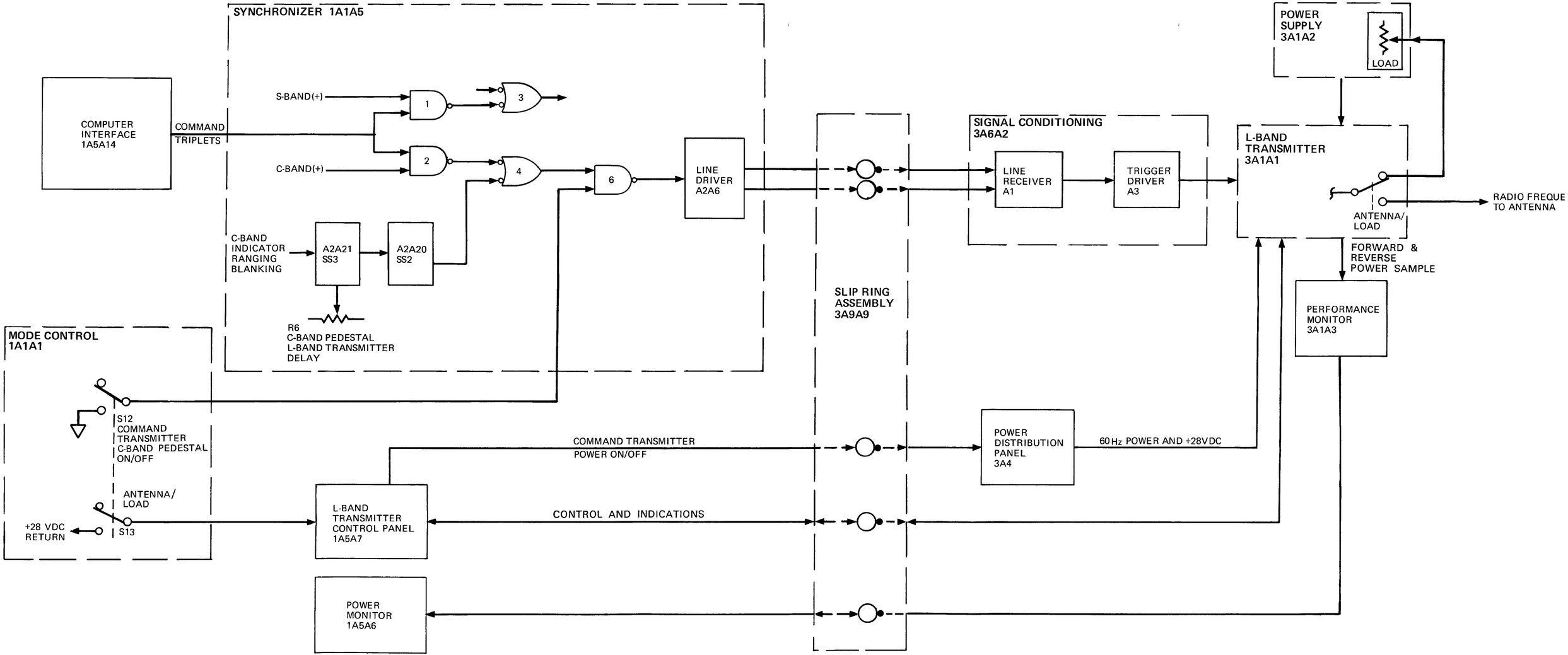


Figure 3-38. C-Band Pedestal L-Band Transmitter Interface Diagram

signal conditioning chassis and then applied to the L-band pulsed command transmitters. The ANTENNA/LOAD switch S13 on mode control chassis 1A1A1 (operating in conjunction with switch S12) controls a relay in the L-band transmitter control panel 1A5A7 which in turn controls the application of 120 VAC to the coax relay in the L-band transmitter. The coax relay is used to route the RF pulses to the antenna or to a dummy load in the power supply.

3-326. In a manner similar to that described in the previous paragraph, interrogation pulses are applied to the X-band pedestal L-band transmitter. The interrogation pulses originate in MTI chassis 1A17A2 and are applied to a gate in synchronizer 1A1A5. The gate is enabled by a signal from the X-BAND PEDESTAL CMD XMTR ON/OFF switch S31 (located on mode control 1A1A1) and the interrogation pulses are routed through the line driver 1A1A5A2A7 to the line receiver A4 in the signal conditioning unit 4A2A5. The pulses are then routed through the trigger driver A6 in the signal conditioning unit 4A2A5 and applied to the L-band transmitter.

3-327. The input trigger pulses are amplified successively by a trigger generator and a hard-tube modulator (figure 3-40), which reproduce the width and spacing of the input triggers rather than using them for synchronization to generate an independent pulse. The output of the hard-tube modulator provides high voltage pulses to the cathode of a cavity oscillator. The RF output of the cavity oscillator is routed to a coaxial switch that is controlled by the L-band transmitter control panel 1A5A7 and applied to the C-band antenna or dummy load.

3-328. Provision is made to operate the L-band transmitter either at the transmitter (local control) or at the control trailer (remote control). The L-band transmitter cannot be activated unless the remote XMTR PWER ON/OFF switch on L-band transmitter control panel 1A5A7 is positioned to ON. Control of the transmitter cannot be exercised from the control trailer unless the CONTROL LOCAL/REMOTE switch S3 on the L-band pulsed command transmitter is positioned to REMOTE.

3-329. A high voltage interlock circuits, shown in figure 3-41, is provided for the protection of personnel and equipment. The local/remote relays K1 and K2 are deenergized when CONTROL LOCAL/REMOTE switch S3 is positioned to LOCAL and the high voltage on relay K4 is deenergized. In order to energize relay K4, a path must be provided from the +28 VDC to the 28 VDC return. With relays K1 and K2 deenergized, +28 VDC is applied through the coil of relay K4 to terminal A2 of relay K4 and to terminals D2 and D3 of local/remote relay K1. The voltage is now presented at the local HIGH VOLTAGE ON switch S6 (on the L-band pulsed command transmitter) which, when momentarily depressed, passes the voltage through terminals C3 and C2 of local remote relay K2 to the current overload protection relay K7 and external interlocks of the applicable command transmitter. The voltage is now applied to the terminals of time delay relay K6 which prohibits application of high voltage without the presence of bias voltage. The voltage path is now complete to the 28 VDC return. When CONTROL LOCAL/REMOTE switch S3 is positioned to REMOTE, relays K1 and K2 are energized, control is transferred to panel 1A5A7, and interlock is accomplished through the remote HV (DS2) ON and HV OFF/READY (DS3) switches. When relay K4 is energized by momentarily depressing the local or remote high voltage on switch, the relay remains energized by a hold down ground applied through contacts K4-A1, -A2 and the applicable local or remote high voltage off switch (S5 local, S3 remote). When the high voltage off switch is depressed, the 28-VDC path opens and relay K4 deenergizes.

3-330. Trigger Generator. The trigger generator is triggered by positive 5-volt pulses of either 0.5 microsecond duration for interrogation or 1.0-microsecond duration for command guidance. (The X-band pedestal L-band is triggered by a 0.5-microsecond pulse only.) The pulses

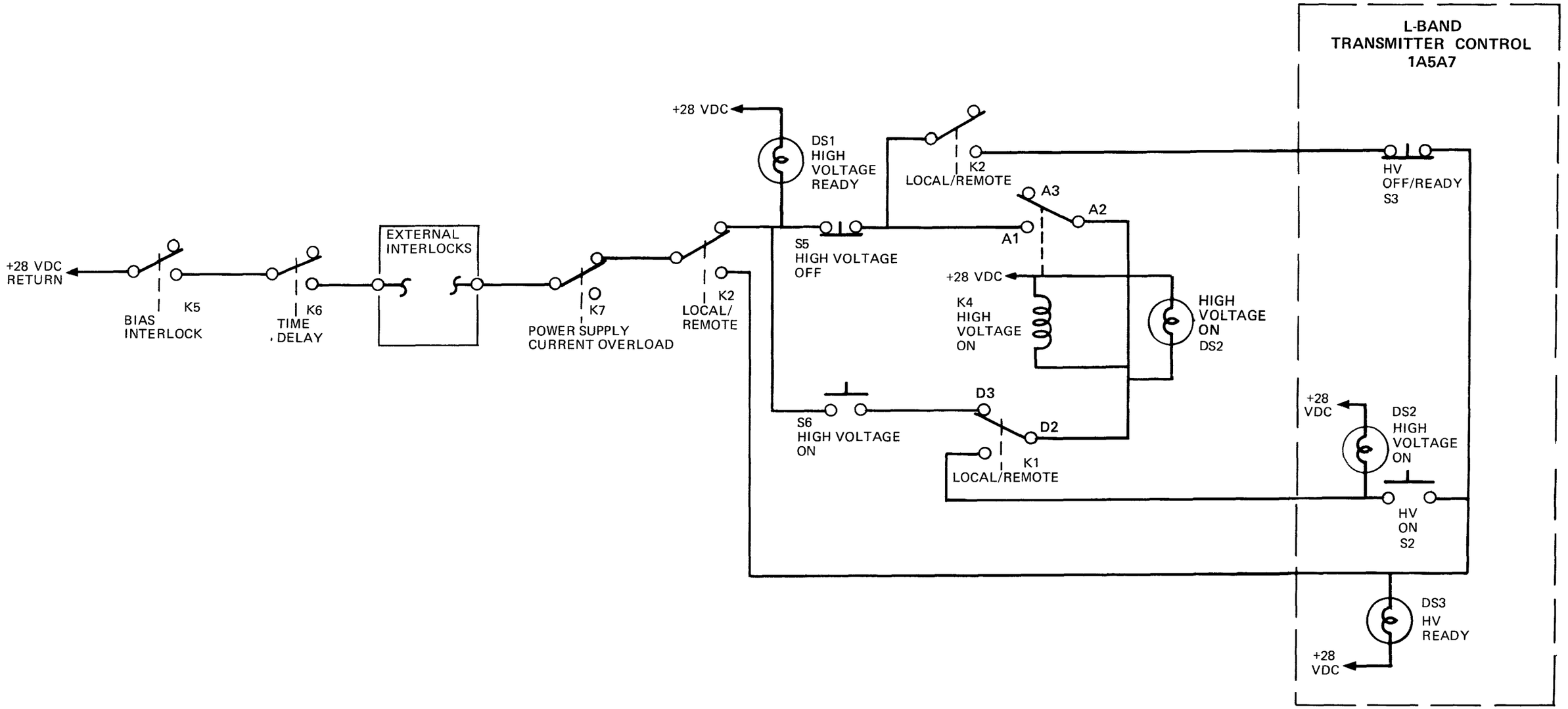


Figure 3-41. High Voltage Control and Interlock

is started. This pulse is coupled through capacitor C5 to transistor Q2. Capacitor C7 charges from the +24 volt line through resistor R7 until the firing point of transistor Q2 is reached. The firing of transistor Q2 is aided by the negative pulse through capacitor C5 which lowers the firing point of transistor Q2 when the pulse is present. When transistor Q2 fires, the pulse from resistor R6 is applied to the gate of the silicon controlled rectifier which fires and energizes time delay relay K6. When relay K6 is energized, the power is removed from the time delay circuit Q1, Q2 and the cabinet interlock circuit through the relay is completed. The 26-volt alternating current is available from the same transformer secondary winding.

3-344. High Voltage Generation. When the high voltage is energized by the local or remote high voltage on switches, relay K4 is energized and the 60 Hertz line voltage is supplied to the input of the motor driven variable transformer MT1. The motor is controlled by the RAISE/LOWER switch S4 when the transmitter is under local control. Operation of the RAISE/LOWER switch varies the output of the variable transformer which is fed to the input of the high voltage transformer T2.

3-345. The +8 kilovolt DC power is developed by the voltage doubler circuit consisting of diodes CR12 and CR13 and capacitors C8 and C9. A portion of the output voltage from the voltage divider, consisting of resistors R15 and R17 is fed through inductor L1 and coax switch S10 to provide the enable signal to the trigger generator. The +8 kilovolt output is supplied through resistor K14 to the parallel connected modulator tubes V1 and V2 and storage capacitor C13.

3-346. FREQUENCY MONITOR. The frequency monitor circuits provide a means of remotely monitoring the frequency difference of the azimuth and elevation transmitters in the S- or C-band transmitter systems. The frequency difference is displayed on a meter on the power and frequency control unit 1A5A2. The frequency difference S-BAND/C-BAND switch 1A5A2S27 allows selection of the transmitter system to supply inputs to the meter circuit (figure 3-42).

3-347. The potentiometer R154 in the S-band EL modulator has +15 volts at the CW terminal and -15 volts at the CCW terminal. The S-band AZ modulator has -15 volts at the CW terminal and +15 volts at the CCW terminal of the potentiometer. The wiper of R154 potentiometer is mechanically connected to the tuning shafts so that the voltage on the wiper is a function of the transmitter frequency. This voltage is routed to the delta frequency card 2A6A2A9 in the signal conditioning chassis 2A6A2. The AZ and EL frequency voltages are applied to isolation amplifiers Z1 and Z2. The output of the isolation amplifiers are summed at the input of a differential amplifier Z3, and the output is the voltage difference of the wiper arms and hence the frequency difference of the transmitters. This output is routed through the slipring assembly to the meter panel where it is displayed when S-band monitoring is selected by switch S27. Since the S- and C-band modulators are identical, C-band operation is the same.

3-348. TRANSMITTER PERFORMANCE MONITOR. A performance monitor system is provided for each of the six transmitters within the radar set. The performance monitor system receives a sample of the forward and reverse signals from the bidirectional couplers in the transmitters and produces direct current signals that are a function of incident (forward) and reflected (reverse) power in the transmitting system. This allows a continuous monitoring of the voltage standing wave ratio (VSWR) and transmitted power of the transmitter system.

3-349. A dual peak detector in each performance monitor receives the sample of incident and reflected power and generates the direct current output voltages. The six dual peak detectors are all electrically identical but not interchangeable among the operating bands (S-band, C-band, and L-band) without recalibration. The azimuth

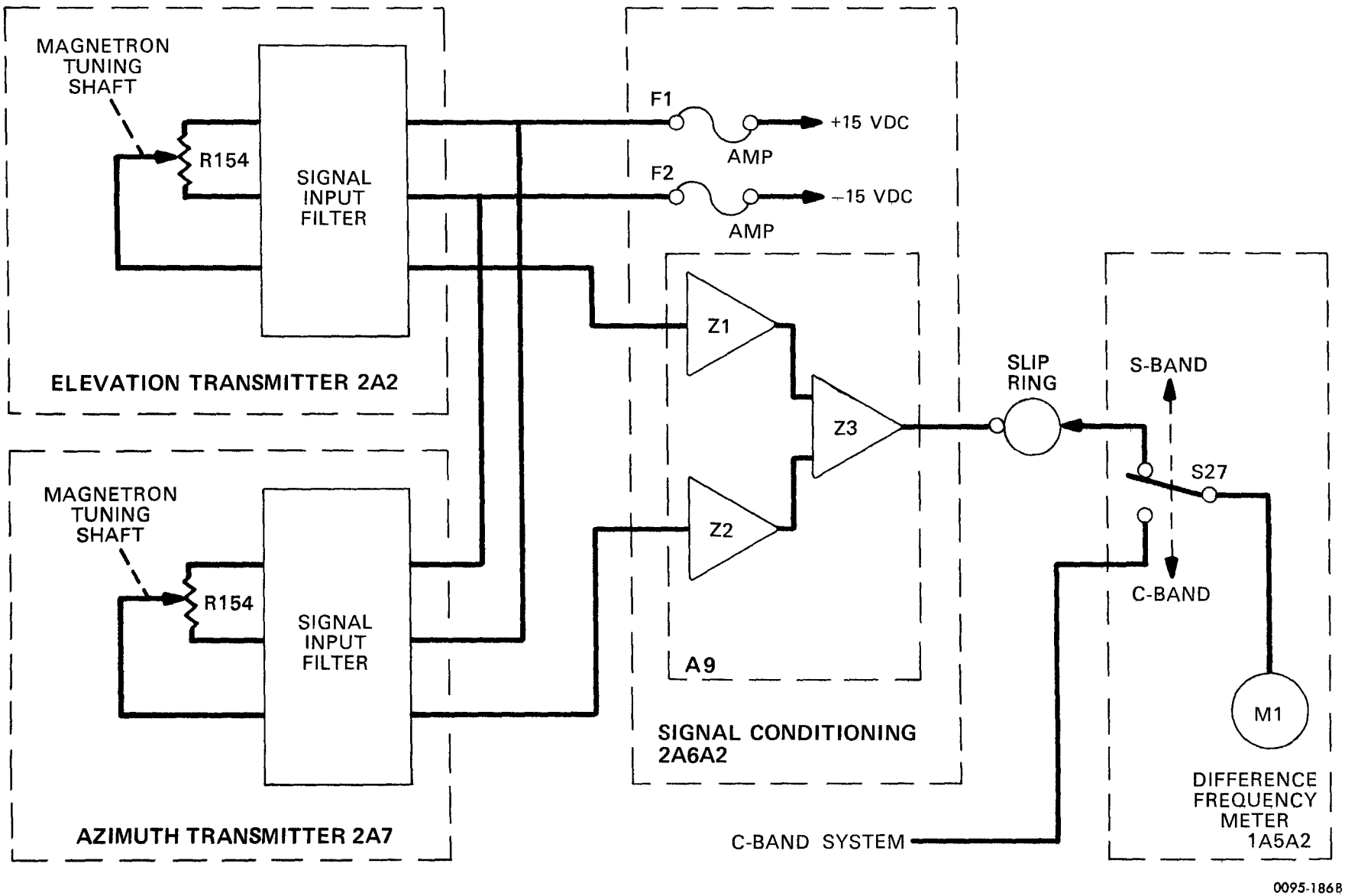


Figure 3-42. S-Band Frequency Monitor, Simplified Functional Diagram

and elevation dual peak detectors and the two L-band dual peak detectors are interchangeable within their respective bands without recalibration.

3-350. Dual Peak Detector. The dual peak detector receives a sample of the forward and reverse power, detects the signals to derive a video pulse, samples the video pulse and, during the interpulse period, stores the direct current level derived from sampled pulse in the sample and hold circuit. The direct current signal is then converted with an amplifier that has a logarithmic gain characteristic so that the output signal is a direct current voltage that represents the input power level in decibels referenced to 1 milliwatt.

3-351. The detected signal derived from the incident pulse is used to develop the sampling pulse used in the sample and hold circuit. A filter network is used to decouple the direct current voltages used in the dual peak detector. Development of the forward and reverse direct current signals is identical and the forward power channel is described below.

3-352. RF Detector. The RF pulse that is received is detected by diode CR1 which yields a negative video pulse that is routed to the sample pulse driver and video detection and sampling circuits.

3-353. Sample Pulse Driver. The negative video pulse from the diode detector CR1 is applied to the base of transistor Q1 in the differential amplifier. The base of transistor Q2, the other half of the differential amplifier, is returned to ground. Transistor Q3 provides a constant current source for the differential amplifier stages. The output of the differential amplifier is coupled by emitter follower Q4 and amplifier Q5 to develop a trigger pulse that triggers single-shot Z1.

3-354. The output on pin 8 of single-shot Z1 is a positive 0.1 microsecond pulse which is capacitive-coupled to the bases of complimentary amplifier stages Q6 and Q7. The pulse deactivates amplifier Q6 and activates amplifier Q7. This causes the level of the driver output pulse to go from +14 volts to -14 volts during the period of the 0.1 microsecond pulse.

3-355. Single-shot Z2 is triggered by a pulse taken from pin 6 of a single-shot Z1 every time Z1 fires. The period of single-shot Z2 is long so that during normal operation single-shot Z2 never times out. If the triggers cease (due to the absence of the detected pulse at the input) for a time greater than the delay of single-shot Z2, Z2 will time out and generate a positive pulse that is coupled back to single-shot Z1.

3-356. Since the sample pulse for the peak detector is generated from the detected incident (forward) RF pulse, the system would tend to hold the output of the dual peak detector at the level corresponding to the last detected pulse. Therefore, when the forward pulses are lost for a period of time greater than normal for the radar set, single-shot Z1 is triggered by the pulse generated in single-shot Z2, which resets the drives circuit. During normal operation, the triggers will be lost for a period of time corresponding to the antenna scanner flyback time (13 milliseconds); so, the time period of single-shot Z2 is set longer than this time period.

3-357. Video Detection and Sampling. During the period of the sample pulse received from the sample pulse driver, the video detection and sampling circuit samples the video pulse from the RF detector and holds this direct current level during the sample pulse interpulse period. A temperature compensation circuit compensates for the temperature characteristics of the RF detector.

3-358. The detected video pulse is applied to differential amplifier Q1 whose combined collector current is set by the constant current stage Q2. The other input of the differential amplifier is derived in the temperature compensation loop of the circuit.

3-359. The output of the differential amplifier is amplified by amplifier Q3 and coupled by a Darlington connected emitter follower (Q4, Q5) to the analog gate Q6. Capacitor C6 in the Darlington emitter follower stretches the video pulse.

3-360. The analog gate Q6 is driven into conduction by the negative input sample pulse from the sample pulse driver. When the gate is turned on, the video pulse charges capacitor C8. Voltage follower Z1 and gate Q6 both have high impedances when the gate is turned off, thus preventing the discharge of capacitor C8 during the interpulse period. The output of voltage follower Z1 is a direct current level corresponding to the peak level of the video input.

3-361. The direct current level output is routed to amplifier Z2 to set the operating point of the second half of the differential input amplifier. Diode CR3 in this circuit has the same temperature characteristics as the RF detector diode and thus corrects for the temperature coefficient by biasing the differential amplifier as a function of video peak level and temperature.

3-362. Log and Scaling Amplifier. The log and scaling amplifier receives the direct current level from the video sampling circuit and processes it through an amplifier that has a logarithmic gain characteristic. The log output is scaled and offset to provide an output with a known slope and scale for the meter scaling function.

3-363. Amplifier Z1 utilizes the logarithmic relationship of voltage and current inherent in the first half of transistor Q1 to achieve an amplifier with a logarithmic gain characteristic. Potentiometer R3 allows adjustment of the bias to amplifier Z1 so that the amplifier will operate over the usable dynamic range of the feedback transistor Q1. The second half of transistor Q1 is used in a diode configuration to couple the signal to amplifier Z2. Amplifier Z2 is used as a buffer for the signal from amplifier Z1 and due to thermistor R18 compensates the circuit for temperature variation.

3-364. Amplifier Z3 scales the output voltage. Potentiometer R11 adjusts the gain of the stage so the output voltage will have a scale of 3 dB per volt. Potentiometer R14 allows adjustment of the biasing point of amplifier Z3.

3-365. Filter Network. The direct current filter network within the dual peak detector assembly filters the plus and minus 15 volt power supply voltages used in the remainder of the circuits. The filter networks consist of simple inductor-capacitor filters.

3-366. X-BAND TRANSMITTER.

3-367. The X-band transmitter assembly generates the high power X-band radio frequency pulses and consists of three physically separate parts: power supply, modulator, and transmitter. This assembly is illustrated in the functional block diagram of figure 3-43.

3-368. HIGH VOLTAGE POWER SUPPLY. The high voltage power supply 4A2A3 receives 3-phase, 400 Hz power at the voltage control circuits assembly. During normal operation (with no high voltage interlocks), the primary high voltage contactor is energized through the HV ON switch and all high voltage interlock relay contacts, only when the motor driven autotransformer is in the lower position. This action applies 3-phase power to the motor controlled autotransformer and its outputs are directly connected to the input terminals of the high voltage transformer T1. The stepped-up output of transformer T1 is connected to the full wave 3-phase diode bridge assembly. The rectified output is connected to an L-section filter assembly that also contains the power supply current and voltage sampling resistors as well as the keyer plate load resistor. These sampling signals are routed to amplifier and control circuits located in X-band meter driver 4A3A1A4 and are used for meter indication of power supply operation. In addition, the voltage sample is the controlling parameter to the regulating circuit located in meter driver 4A3A1A4 that drives the variac in the direction

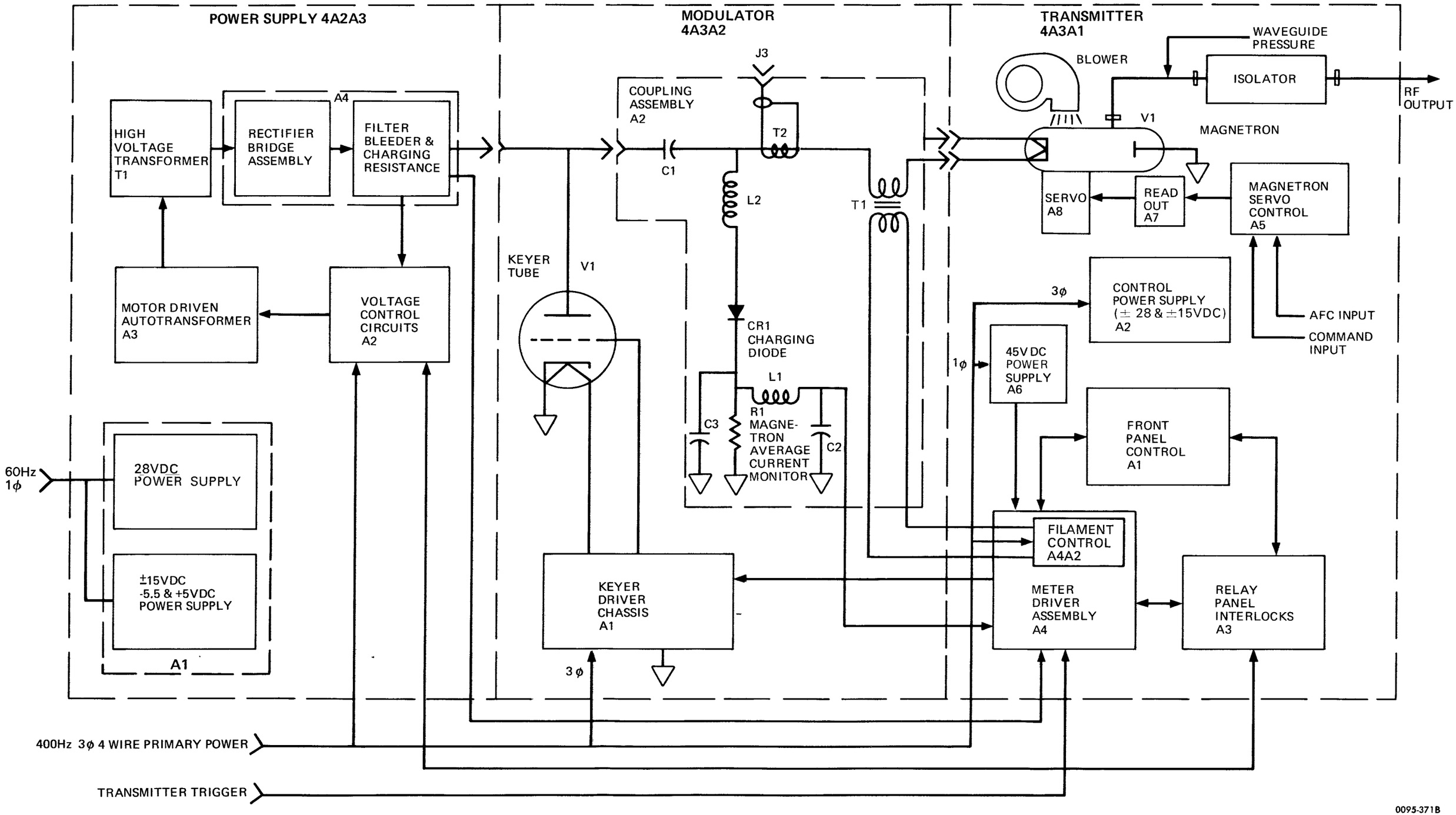


Figure 3-43. X-Band Transmitter Block Diagram

necessary to maintain the high voltage output at a constant level. This regulating action will hold the direct current voltage at a fixed level even with load variation or line voltage variations. The regulation is performed automatically upon activation of the high voltage power supply or is selectable by manual control from control panel 4A3A1A1. Depressing the high voltage off switch disables the high voltage power supply and automatically returns the variac to its lower position. Filtering of the supply is accomplished by a choke input filter. Nominal operating voltage of the supply is about 29,000 volts. Maximum supply current is 100 milliamperes. Direct current output voltage is routed to the modulation section through a connector located in the side wall.

3-369. This power supply section also contains several low voltage direct current power supplies that are required by other circuits in the X-band system, but are not directly necessary for operation of the X-band transmitter.

3-370. X-BAND TRANSMITTER MODULATOR. X-band transmitter modulator 4A3A2 is required to generate a voltage pulse of the proper level and shape to drive the high power magnetron. The modulator is of a hard-tube design. Its basic functional components are a coupling capacitor, a charging network, a keyer tube, a magnetron filament voltage control, a pulse current transformer, and a driver chassis.

3-371. Coupling Assembly. Under normal operating conditions, coupling capacitor 4A3A2A2C1 is charged to the high voltage power supply level through the charging network CR1-L2-R1 while the keyer tube V1 is biased off by the keyer bias supply located in the driver chassis. During the pulse period, keyer tube V1 is conducting and capacitor C1 partially discharges through the magnetron. The charging diode and current monitor circuit are reverse biased during this period. The power supply current is limited by a 10K charging resistor mounted in the bleeder resistor assembly 4A2A3A4. This limitation results in the application of a negative voltage level to the cathode of the magnetron which causes it to oscillate. This level is removed when keyer tube conduction ceases and the power supply is allowed to restore the keyer plate voltage to its original value. The charge drawn from the coupling capacitor is restored through the charging diode and current monitor. The voltage change across capacitor C1 is not more than 100 volts during normal pulse operation.

3-372. Pulse current to the magnetron can be monitored at connector 4A3A2J3 and the average charge current, indicated as magnetron average current, is monitored through resistor 4A3A2A2R1 and capacitor 4A3A2A2C3. Average charge current is indicated on both the remote and local meter panels and is used in the magnetron average current trip-out circuits to protect the magnetron against average current overload. Magnetron average charge current is also used to alter the magnetron filament voltage as a function of average power delivered by the magnetron. This capability improves performance and extends the operating life of the magnetron. The magnetron filament control includes a printed circuit card 4A3A1A4A2, control relays, and variable autotransformer located in high voltage power supply 4A2A3. There are three discrete steps in filament voltage operation: warmup and standby, low PRF, and high PRF. Control panel indicators display the mode of operation as LOW PRF or HIGH PRF; when neither indicator is lighted, a standby condition is indicated.

3-373. Keyer Tube Driver Chassis. The keyer tube driver chassis 4A3A2A1 is functionally located between the pulse generator 4A3A1A4A9 and the keyer tube. (See figure 3-43.) Its primary function is to "drive" the grid of the keyer tube; thus the name keyer tube driver chassis. The driver chassis also supplies some important transmitter operating parameters to the monitoring circuits located in 4A3A1A4. The driver chassis interfaces with other parts of the transmitter through connectors so that it can be easily removed

from the modulator section. A block diagram of this driver chassis is provided in figure 3-44.

3-374. The driver chassis consists of a tetrode driver tube, complete with control grid and screen grid bias supplies, a filament supply, and high voltage plate supply. The driver tube requires both an input and output coupling transformer. The trigger input is received from the trigger generator printed circuit card 4A3A1A4A9. Grid bias and filament power for the keyer tube are obtained from the driver chassis. All bias supplies are regulated and are voltage monitored for proper level in the meter driver assembly 4A3A1A4. With the exception of the driver plate and screen supplies, all voltages are present any time transmitter primary power is applied, as indicated by the control panel POWER ON indicator. The driver plate and screen supplies are energized during the time that high voltage is applied, as indicated by the H.V. ON indicator on the control panel. Driver plate voltage is derived from a 3-phase transformer-diode subassembly.

3-375. Pulse operation of the driver chassis cannot be accomplished unless all high voltage-related interlocks are clear. When all monitored parameters (i.e., high voltage, waveguide pressure, etc.) reach their proper level, a trigger pulse will be transmitted to J3, which is transformer-coupled to the grid of the driver tube V1 (4CX1000A). The grid drive protection circuit prevents grid damage of driver tube V1 and transformer coupled to the grid of the keyer tube.

3-376. The pulse-shaping circuit ensures proper rate of voltage rise of the input pulse to the keyer tube grid. The driver chassis blower B1 ensures proper cooling airflow within the driver chassis and across the cooling fins of driver tube V1 even when the assembly is operated on an external flat surface.

3-377. TRANSMITTER. Transmitter section 4A3A1 of the X-band transmitter system contains the magnetron and blower, tuning control, control power supply, and all interlock control and indication circuits.

3-378. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-379. Magnetron Tuning Control. Frequency tuning is accomplished by a position-velocity feedback servo system 4A3A1A5 which receives command and AFC follow-up signals generated in the prereceiver chassis. Separate command signals may be selected at the control trailer guidance operators console or at the X-band prereceiver front panel. Each command corresponds to a specific frequency to which the transmitter is to be tuned. AFC follow-up originates in the X-band prereceiver AFC printed circuit card 4A2A2A5. Automatic frequency control occurs each time the magnetron oscillates to prevent the magnetron-to-local oscillator difference frequency from drifting out of the receiver IF bandwidth.

3-380. Control Power Supply. Control power supply 4A3A1A2 contains the components required to generate control and logic voltages for the circuits, relays, and indicators of the X-band transmitter system. The unit houses a +28 VDC power supply for use in the relays and indicator lamps and a 15 VDC regulated supply for use in the logic and interlock circuits. A regulated -45 VDC supply 4A3A1A6 supplies power to the pulse generator card housed in meter driver assembly 4A3A1A4.

3-381. Control Panel. Control panel 4A3A1A1 contains all pertinent operator controls and indicators required to operate the X-band transmitter in its normal operating mode. It is the primary control point for all transmitter operation, and transmitter control can be transferred to or from the remote control panel at this location only. Controls include MOD CONTROL PWR ON/OFF, HIGH VOLTAGE ON/OFF, MOD CONTROL LOCAL/REMOTE, and high voltage level control

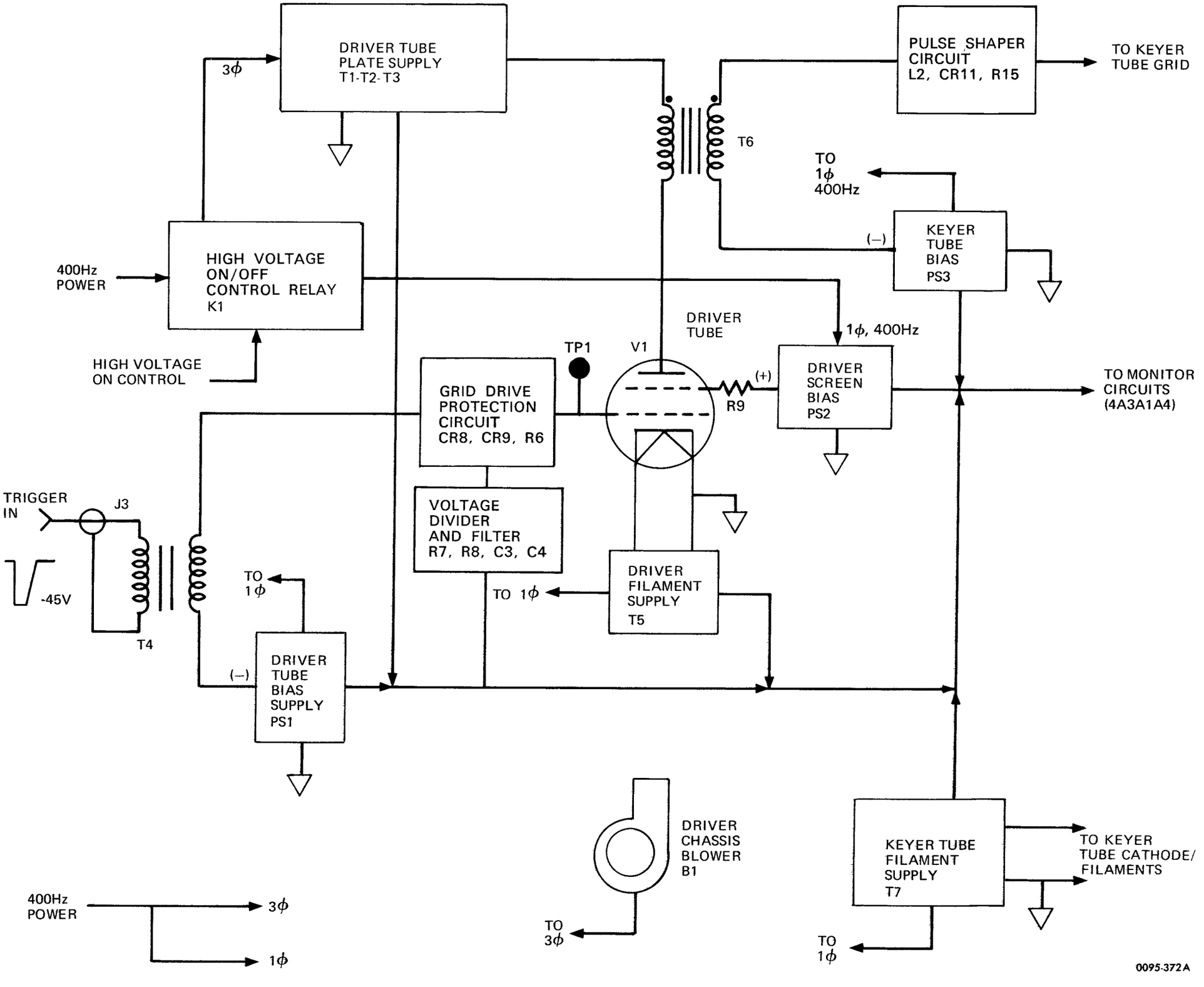


Figure 3-44. X-Band Keyer Tube Driver Chassis Block Diagram

HIGH VOLTAGE AUTO/MANUAL. Indicators include selectable voltage and current meters which are used to monitor all primary electrical parameters. Status indicators continuously display the status of all primary interlock circuits: high voltage interlocks, trigger inhibit indicators, and transmitter control interlocks.

3-382. Relay Panel Interlocks. All primary interlock and disable relays are contained in assembly 4A3A1A3 which is interfaced with the rest of the transmitter system through terminal boards, providing ready access for troubleshooting and replacement of relays. In general, the interlock relays are controlled by circuits not contained on the relay panel.

3-383. Meter Driver Assembly. With only one exception (the ±15 VDC regulator), the meter driver assembly 4A3A1A4 contains all printed circuit cards directly required by the transmitter for proper operation. Included in this assembly are meter amplifier and driver circuits, voltage/current sense interlock circuits, trigger generator circuits, high voltage regulator circuits, and monitor circuits. These are all contained in printed circuit card configuration in a small easily accessible enclosed container that interfaces with the rest of the transmitter system through connectors.

3-384. From the standpoint of proper transmitter operation, this assembly is perhaps the most important subassembly in the X-band transmitter system because, in addition to driving the meters, the meter driver assembly permits all important operating parameters to be constantly monitored and compared to normal expected operating levels. Should a parameter drop below an acceptable level, an immediate and automatic reduction in power eleminates or at least reduces the likelihood of damage to expensive or long lead items or components. The interlock circuits are divided into three basic areas: those that prevent the transmitter from being activated (power on interlock); those that prevent activation or operation of the high voltage circuits (high voltage interlock); and those that prevent proper operation of the trigger circuits (trigger inhibit).

3-385. Magnetron Isolator and Blower. The magnetron blower 4A3A1B1 is used to reduce the amount of magnetron temperature rise above ambient while the magnetron is operating at full rated power. Outside air is forced from the RTM blowers up into the modulator section 4A3A2 to cool the components of that section. Here it is drawn up through the modulator section and directed through the cooling fins of the magnetron structure by the magnetron blower. A small quantity of air is directed on the motor housing of the servo tuning motor. This blower ensures sufficient cooling air for these components even at high ambient conditions.

3-386. The isolator 4A3A1AT1 protects or "isolates" the magnetron from excessive magnetron (source) to antenna (load) mismatch. The isolation of hard-to-drive loads helps the magnetron operate in a more stable mode and improves overall performance. It also affords good protection against waveguide short conditions which could damage the magnetron.

3-387. INTERLOCKS. The interlock circuits of the X-band system protect many expensive long lead time items against damage due to improper operation as a result of component failure or malfunction. These circuits are used to monitor many types of circuits at various physical locations and the types of circuits involved are varied in their tasks.

3-388. The interlock circuits X-band transmitter functional diagram (figure 3-45) is an electrical equivalent wiring diagram of the interlock circuits in simple form. The components shown in the interlock diagram are grouped and referenced as a function of their location, e.g., the modulator section is referenced as 4A3A2, which designates its physical location. Primary component parts within that section are indicated and referenced by function name. All components are segregated and referenced with respect to their location with

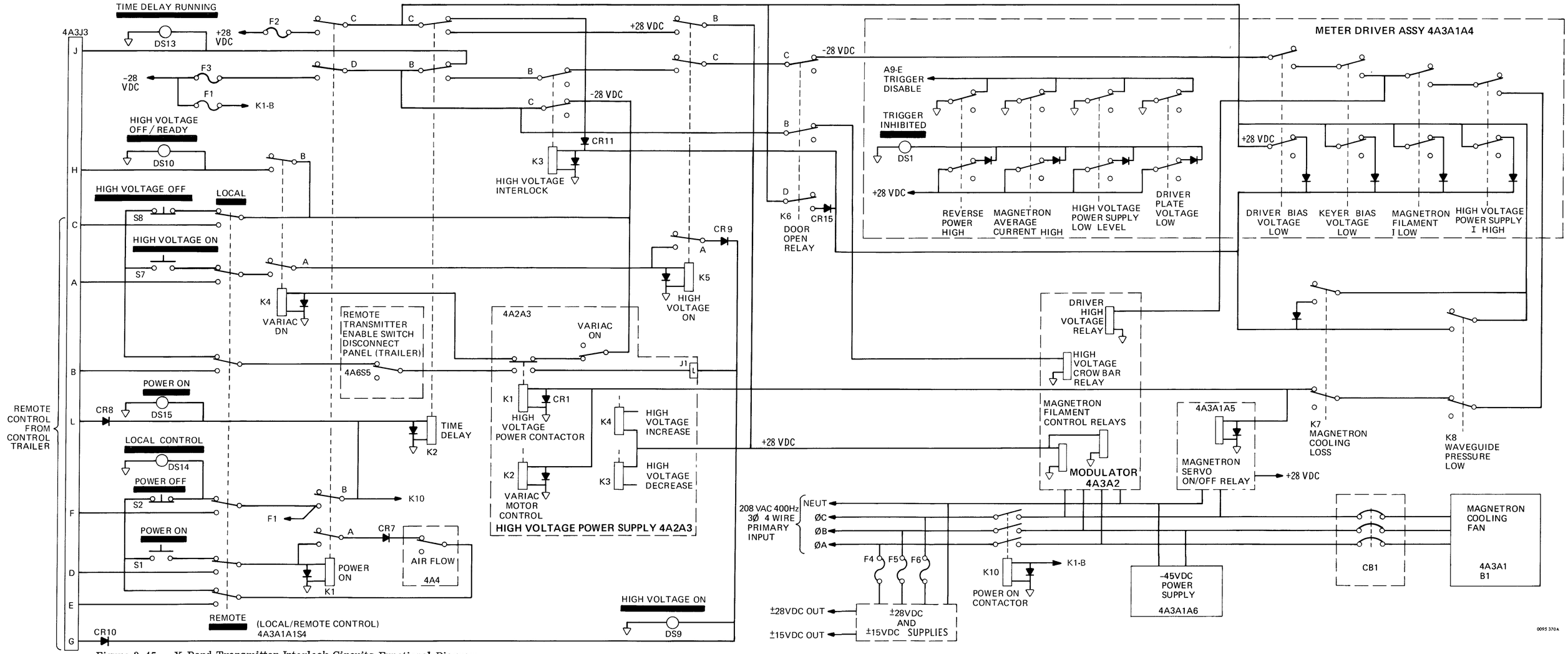


Figure 3-45. X-Band Transmitter Interlock Circuits Functional Diagram

two exceptions: operator controls and indicators. These components, shown at the extreme left on the diagram, are located on the X-band transmitter control 4A3A1A1 and their remote counterpart is referenced. Otherwise, all other components are physically located on the relay panel 4A3A1A3.

3-389. Conventional descriptions of switches, relay contacts, and indicators are used; a relay or indicator name describes the condition required to energize it. Under normal operation, power on relay K1 will be energized any time transmitter primary power is on; indicator DS15 indicates this status when lighted. The only exception to this practice includes the relays shown in the meter driver assembly 4A3A1A4. Without exception, these relays are energized until the condition referencing that relay by name exists, at which time the relay is deenergized and remains so until a manual reset is made. An example is the relay referenced "mag average current high." Under normal operations, it will be energized; when the maximum allowed magnetron average current is reached, it will deenergize, disabling the pulse generator circuit and lighting the front panel indicator DS1 (trigger inhibited). This condition remains until manually reset.

3-390. As noted previously, the interlock circuits fall into one of three basic areas. The first area concerns power-on circuits. With 3-phase power applied to the transmitter system, ±28VDC control power will be generated by control power supply 4A3A1A2. To apply transmitter power MOD CONTROL PWR ON switch S1 is depressed and relay K1 is energized. This state will remain if cab airflow is sufficient to close the airflow switch in assembly 4A4. Relay K1 controls the operation of the power on contactor K10, which controls primary alternating current power to all transmitter subassemblies. Relay K1 also routes ±28 volts to the time delay relay and other interlock circuits. Until the power-on circuits are activated, ±15 VDC is not present.

3-391. The second area of interlock protection concerns the high voltage interlock. After successful operation of the power-on circuits, relay K2 will begin its time delay. This delay of 8-minutes duration allows the filaments of the driver tube, the keyer tube, and the magnetron to heat the tube cathodes and the glass-to-metal seals to normal operating temperature before pulse operation begins. During this delay, the other interlock conditions will be indicated at the remote and local front panel locations.

3-392. At the end of the time delay, the high voltage power contactor K1 in high voltage power supply 4A2A3 can be energized through the HIGH VOLTAGE ON switch 4A3A1A1S7 and a series of closed interlock circuits only when the automatic transformer is in its lower position. The high voltage circuits will remain energized as long as the XMIT DISABLE switch on the antenna trailer disconnect panel is closed and no other high voltage interlocks are opened.

3-393. When one of the high voltage interlock conditions exist, the corresponding relay will open the series of interlock circuits holding relay 4A2A3K1 energized and causing the high voltage to drop out. As the level of high voltage drops, two trigger inhibits will occur: one from the high voltage power supply and one from the driver plate supply. As a result, the pulse generator will be inhibited and further transmitter pulse operation will cease. The high voltage circuits cannot be energized until the AUTOTRANSFORMER reaches its lower position, and the trigger inhibit cannot be corrected until high voltage is applied and the proper operating level is reached. Activation of high voltage interlock will invariably result in a trigger condition.

3-394. The third area of interlock protection involves trigger inhibition. Trigger inhibit interlocks are located in the meter driver assembly 4A3A1A4 and must normally be energized for pulse operation. In the event an interlock condition occurs, the appropriate relay will deenergize, disable

the pulse generator 4A3A1A4A9, and light the front panel trigger inhibited indicator 4A3A1A4DS1. No other interlock will occur; only the pulse generator will be inhibited.

3-395. All interlocks can be reset to the operating state by depressing a RESET switch located on the local or remote control panel. This switch is interlocked to function only from the control panel selected by the REMOTE/LOCAL switch.

3-396. HIGH VOLTAGE POWER SUPPLY.

3-397. VOLTAGE CONTROL. The voltage control circuits are located in assembly 4A2A3A2. This assembly receives 400 Hz, 3-phase power at contacts K1-A1, K1-B1, and K1-C1 of the high voltage power contactor K1. Contactor K1 and variac motor control relay K2 will be energized as long as -28 volt power is present at J1 pin L which occurs any time that high voltage is applied, as shown on the interlock circuits diagram (figure 3-45).

3-398. Relay K1 supplies 3-phase power to the Y-connected motor driven variac. Relay K2 connects the control motor to raise/lower relays K3 and K4. When relay K4 is energized, phase C voltage appears across the control motor A3B1 driving the variac in the direction which increases the voltage applied to the high voltage power transformer. The inverse results are obtained when relay K3 is energized.

3-399. These relays are designed so that the motor cannot coast past the desired position after the relay supplying control power is deenergized. This feature is achieved by charging capacitor C3 from the -28 volt supply through a set of contacts of the energized relay K3 or K4. When the energized relay is allowed to deenergize, capacitor C3 will discharge through the coils of the motor. The discharge current through the motor windings will cause the motor to brake to a stop, because of the resultant force between the direct current generated magnetic field and the motor residual magnetic field. This action occurs each time either relay K3 or relay K4 is sequenced. The operation of relays K3 and K4 is controlled by a voltage comparator circuit which programs the appropriate relay required to maintain the high voltage level at a preset value. The result is a line and load power-supply regulator that allows more effective regulation.

3-400. Relay K2 controls the application of phase C power through relays K3 and K4 to the variac motor and applies phase C power to the motor, causing it to lower the voltage to the primary of the power transformer A3T1. This will continue until the down limit switch A3SW111, that is mounted on the variac and controlled by a cam mounted on the variac shaft, opens. When this switch is opened, the power to the motor is removed and the motor will coast to a stop. The second set of contacts of A3SW111 is used to indicate that the lower limit of the variac has been reached. This switch is part of the interlock circuits and is shown in the interlock block diagram. Switch A3SW110 is used to prevent the motor from driving the variac past an upper limit, thus preventing excessive voltage rise in the event of a relay or circuit failure.

3-401. Transformer 4A2A3T1 is a 3-phase, Y-Y step-up power transformer. The three high voltage output leads are connected to the diode assembly through high voltage connectors.

3-402. DIODE BLEEDER ASSEMBLY. Diode bleeder assembly 4A2A3A4 contains six high voltage diodes (which are connected in a 3-phase full wave configuration) and a series resistor bleeder. Resistors R2 through R21 are used to compare a 3-megohm bleeder resistor for the high voltage filter capacitor 4A2A3C1. Resistors R22 and R23 are used to monitor the voltage and current level respectively. The diode assembly is returned to ground through filter inductor 4A2A3A2L1 and current monitor resistor 4A2A3A4R23. The voltage across resistor R23 is a direct function of the total current delivered to the load (bleeder plus modulator current).

Resistor 4A2A3A4R22 comprises a voltage divider network with the 3-megohm bleeder. The voltage across resistor R22 is directly related to the high voltage output. Power supply voltage and current are filtered by capacitors 4A2A3A2C2 and 4A2A3A2C1 respectively, and monitored by printed circuit cards in the meter driver assembly 4A3A1A4.

3-403. MODULATOR.

3-404. The X-band modulator shown in figure 3-43 consists of the keyer tube 4A3A2 V1, the keyer tube driver chassis A1, the coupling assembly A2, line fuses, and filters.

3-405. KEYER TUBE. Keyer tube 4A3A2 V1 is a directly-heated high power triode capable of delivering 2.5-megawatt peak power pulses. It is mounted in its own insulating socket since its plate voltage is setting at the high voltage power supply potential. It receives its 6-volt, 60-ampere filament power from a transformer mounted on the keyer driver chassis A1. Control grid bias and driver are also generated in the driver chassis. The anode, cathode, and grid are all forced-air cooled by a specially directed airflow from the cab blower compartment 4A4. Anode voltage is received from the high voltage power supply through a 10K charging resistor 4A2A3A4R1 and the interconnecting high voltage connector mounted in the sidewall of the modulator box.

3-406. KEYER TUBE DRIVER CHASSIS. The keyer driver chassis 4A3A2A1 is a subassembly of the modulator section which is required to bias and drive the keyer tube. Functional components of the X-band driver chassis are shown in figure 3-44. The primary component of this chassis is the keyer driver tube V1 which is a 1000-watt ceramic tetrode that derives its required electrode bias and power from the other components contained in the driver chassis.

3-407. Driver Tube Control Grid Bias. Control grid bias is supplied by the regulated driver tube bias supply PS1 through the secondary of pulse transformer T4. Input triggers from the pulse generator card located in the meter driver assembly are superimposed on this bias level and are connected to the control grid of the driver tube V1. Special clamping diode CR9 and de-ringing diode CR8 prevent excessive grid drive. Resistor R6 provides secondary matching for transformer T4. Resistor dividers R7 and R8 provide a low voltage monitor level proportional to the bias potential. This voltage is used as an input to interlock and meter circuits located in the meter driver assembly 4A3A1A4. Bypass and filtering of these voltages are obtained from capacitors C3 and C4. Test point 4A3A2A1/TP1 provides a scope monitoring point directly at the grid of tube V1.

3-408. Keyer Tube Grid Bias. The keyer also receives its bias voltage from the regulated keyer tube bias supply PS3 through the secondary of pulse transformer T6. Pulse shaping is provided by network L2-CR11-R15. Transformer T6 provides plate-to-grid coupling between the driver plate and keyer grid. Voltage monitoring and bypass are provided for this supply in the same manner as for the driver grid supply.

3-409. Driver Screen Supply. The driver tube screen voltage is supplied by regulated driver screen bias supply PS2 through current limiting resistor R9. Bypass and monitoring are accomplished in the same manner as those described for the two control grid bias supplies. Additional bypass is provided by a capacitor formed by the physical construction of the mounting socket for driver tube V1. This capacitor prevents oscillation and voltage jitter of the screen supply. Direct monitoring of the screen grid is provided through test point 4A3A2A1/TP2. This grid supply is the only one of the three that is positive with respect to ground and then only when high voltage is applied since it receives primary power only when the high voltage on/off control relay K1 is energized.

3-410. Driver Plate Supply. The supply voltage for the plate of driver tube V1 is generated by a separate 3-phase unregulated supply. Component parts include transformers T1, T2, and T3; diodes CR1 through CR6; filter inductor L1; filter capacitor C1; and bleeder and monitor resistors R1 through R5. The power transformers are connected in a Y-delta set-up configuration which is rectified by a 3-phase full-wave diode assembly and filtered by inductor L1 and filter capacitor C1. Inductor L1 is connected to the ground side of the supply to allow a lower isolation voltage requirement for inductor L1. Bleeder resistors R1 through R5 provide a discharge path for capacitor C1 minimum allowed current flow through inductor L1 for proper filtering and voltage monitoring of the plate voltage. Normal operating output of this supply is about 3000 VDC. A proportional part of this voltage appears across monitor resistor R5. This supply is active only while the high voltage circuit of the transmitter is energized as shown in figure 3-45.

3-411. Filament Supplies. The filament power for the driver tube V1 is supplied by transformer T5. The filament power for the keyer tube 4A3A2V1 is supplied by transformer T7. Both transformers are located on the driver chassis and receive their power from single phase 400 Hertz. Voltage monitoring is provided for each filament transformer. The monitored parameter outputs are indicated with a voltage level that corresponds to a nominal operating level so that they provide a useful reference for troubleshooting.

3-412. COUPLING ASSEMBLY.

3-413. The coupling assembly 4A3A2A2 is located within the enclosed modulator section. Its functional location is between the keyer tube (switch) and magnetron (load). The components of this assembly are mounted on an insulating fiber glass structure with an aluminum base containing Teflon insert sliding guides to facilitate installation. When inserted, one side of the coupling capacitor automatically mates to the keyer tube anode. One multi-pin connector, one magnetron socket connector, and one BNC connector comprise the electrical interface between this unit and the modulator and magnetron.

3-414. Circuit Operation. The primary functional components of the coupling assembly and their relationship to other modulator/transmitter components are shown in figure 3-43. Its functional circuits include the coupling capacitor, a charging path for that capacitor, a magnetron filament transformer, and a filament voltage control circuit. One side of coupling capacitor C1 is connected to the grounded side of the high voltage power supply through the charging circuit L1-CR1-R1, so that capacitor C1 is normally charged to the power supply voltage level. When the keyer tube V1 is fired, the positive side of capacitor C1 will be returned to ground so that charging diode CR1 is reversed biased. With the anode of the magnetron grounded and diode CR1 reverse biased, magnetron 4A3A1V1 will conduct. This action causes the magnetron to oscillate at the resonant frequency of its tuned cavity until the keyer tube is deactivated, thereby causing magnetron current and oscillation to cease. The energy taken from capacitor C1 is restored through the charging circuit, since diode CR1 is now forward biased.

3-415. Capacitor C2 is charged through inductor L1 from the voltage developed across resistor R1 during the charging period of capacitor C1. This voltage level corresponds to the average current required to charge capacitor C1. Inductor L2 prevents damage from excessive peak currents through the junction capacitance of diode CR1 during the reverse biased pulse period. The peak magnetron current can be monitored by current transformer T2. Normal peak magnetron current is 27 amperes, which corresponds to a 2.7 volt output of transformer T2 into a high impedance load such as that for an oscilloscope. This current is accessible at BNC connector 4A3A1J3 directly in front of the magnetron. The transformer provides a

convenient indication of the current delivered to the load. Magnetron peak current and pulse current shape are important parameters which can be determined through the use of transformer T2.

3-416. Magnetron Filament Voltage Control. Measurement of magnetron average current is used as a means of determining the average power delivered by the magnetron and therefore the filament voltage. Operating filament voltage levels are determined by the magnetron manufacturer as a function of the average power.

3-417. The circuits used to control the filament voltage are located in the meter driver assembly 4A3A1A4. The output of card 4A3A1A4A2 controls relays K2 and K3. These relays remove the full line voltage applied to the primary of the filament transformer T1 and supply a lower voltage which is adjustable by transformers T3 or T4. Relay K3 is energized during low PRF operation of the transmitter applying the output of autotransformer T4 to the primary of transformer T1. In a similar manner, relay K2 is used with transformer T3 during high PRF operation of the transmitter. During standby, full-line voltage is applied to the filament transformer.

3-418. The proper PRF operating mode is indicated on the front panel and can be used to determine proper operation of the filament programmer. As the magnetron filament demands more current, the primary of the filament transformer will supply more current. This increased current flow develops an increased voltage drop across resistor R2. This voltage is impressed upon the primary winding of transformer TB1T1 whose secondary is routed to the magnetron filament current monitor 4A3A1A4A3 where it is rectified, monitored, and amplified as the parameter "magnetron filament current." If the magnetron filament opens, an interlock condition will occur from the resulting decrease in the monitored parameter. Operation of the filament programming circuits is indicated by a corresponding decrease in the magnetron filament current as displayed on meter 4A3A1A1M2. Relay K1 is a high voltage personnel safety relay. When deenergized, it will short one side of capacitor C1 to ground any time power is removed or a transmitter door is opened. This feature ensures proper discharge of capacitor C1 in the event the front panel door is removed. Interlock switches can be defeated for observation and testing, but this override defeats their intended purpose which is personnel safety.

3-419. TRANSMITTER OPERATION.

3-420. The transmitter of the X-band transmitter assembly contains subassemblies that are functionally divided into a group of control circuits. (See figure 3-43.)

3-421. CONTROL PANEL A1. Control panel 4A3A1A1 contains all controls required to operate the X-band transmitter system. Indicators DS1 through DS15 reflect the operating status of the transmitter at all times. These indicators carry functional names that describe the condition which causes the indicator to light. For example, the high voltage interlock indicator light when any condition that prevents activation of the high voltage circuits exists. The interlock functional diagram for the X-band transmitter (figure 3-45) can be used to determine which condition or parameter is causing the high voltage interlock. Other indicators may also offer help. For example, a magnetron cooling loss condition could cause indicators DS3, DS4, and DS1 to light. By indicator analysis, therefore, the operation can determine that the trigger was inhibited by a loss of high voltage and that the high voltage interlock was caused by a reduction of cooling airflow around the magnetron. Finally, inspection of the magnetron blower and air duct would reveal the reason the transmitter ceased operations.

3-422. Other controls include a MOD CONTROL LOCAL/REMOTE switch S4 with indicator DS14. This switch transfers control of the transmitter operation between the X-band transmitter (local) front

panel and a remotely located control panel. Power and high voltage is provided through switches S1, S2, S7 and S8 respectively. The high voltage level is controlled by HIGH VOLTAGE AUTO/MANUAL switch S6 and HIGH VOLTAGE RAISE/LOWER switch S5. In the high voltage automatic mode of operation, switch S5 is disabled.

3-423. Selection of voltage and current meters is provided by rotary selector switches S9 and S10. Meter M3 indicates the approximate total radiate time (in hours) of the transmitter. This meter receives power from the high voltage on circuit and indicates true high voltage on time. It also provides a reasonably accurate indication of radiate hours, since the high voltage must be applied during radiate time.

3-424. CONTROL POWER SUPPLY 4A3A1A2. Control power supply 4A3A1A2 provides all 28-VDC and 15-VDC regulated power required for the X-band transmitter system. The unit interfaces with the rest of the transmitter through a single terminal board TB1. As described in subsequent paragraphs, one part of the unit supplies ±28 VDC to all relay and indicators and the second supplies ±15 VDC regulated power to all printed circuit cards.

3-425. 28-VDC Power Supply. The 28-volt power supply consists of 3 transformers T1, T2, T3, 12 diodes CR1 through CR12, 2 filter chokes L1, L2, 2 filter capacitors C1, C2, and 2 bleeder resistors R1, R2 which are connected in a 3-phase full wave, transformer center tapped configuration. The three primary Y-connected power transformers receive 3-phase, 400 Hertz power through terminal board TB1. The stepped-down secondary voltages are combined in a full wave 3-phase, center tapped rectifier assembly which provides a 2400 Hertz ripple frequency. The center tapped secondaries allow 100 percent utilization of the transformers while developing both a positive and a negative reference 28 VDC supply. Filtering of each supply is accomplished by an inductance input filter. Inductors L1 and L2 are swinging inductors and therefore provide better filtering and regulation of changes in load current. Capacitors C1 and C2 allow the supply to possess a low-source impedance. Resistors R1 and R2 provide discharge paths for each filter capacitor and minimum inductor current for best overall regulation. This supply not only provides power for control relays and indicators, but also provides input power for the ±15 VDC power supply located in the same subassembly.

3-426. ±15VDC Power Supply. The ±15 VDC power supply is provided by a regulator printed circuit card A1 and two transsistors Q1, Q2, which receive ±28 VDC from the relay and indicator power supply discussed previously. This power is received through relay contacts K1C2 and D2 located on the relay panel 4A3A1A3. The power supply board A1 regulates this ±28 VDC to ±15 VDC by controlling the base drive on the pass transistors Q1 and Q2. Operation of the regulator printed circuit card is the same as that described for assemblies 2A3A4, 3A3A4, 2A8A4, or 3A8A4 of the S- and C-band prereceiver power supply. Pass transistors Q1 and Q2 allow the printed circuit card to supply a higher load current. Voltage transient filtering of the ±15 VDC supply a higher load current. Voltage transient filtering of the ±15 VDC supply is provided by capacitors C3 and C4. Bleeder resistors R3 and R4 ensure proper discharge of the filter capacitors.

3-427. RELAY ASSEMBLY. Relay assembly 4A3A1A3 consists of one power on/off relay K10, one time delay relay K2, five single coil relays K1, K2, K3, K4, and K5, and three dual coil magnetic latching relays K6, K7, and K8. The interconnection of these relays and the terminal board is illustrated in the interlock circuits functional diagram (figure 3-45). Relays K6, K7, and K8 have two coils that are constructed to exhibit a memory feature. The contacts of these relays will remain in the position resulting when the last coil was energized. There is no spring return or "normal" position as found in most common relays, but there is a "set" and a "reset" position.

3-428. The "X" coil of these relays is energized when an interlock condition is encountered and the relay is transferred or "set", the interlock relay K3 is energized, and further magnetron pulse operation is terminated. This set position will remain, even if the "X" coil is deenergized, since the relay is magnetically latched in that position. The "Y" coils is then connected to a "reset bus" through the closed contacts of reset relay K9 when the front panel (local or remote) RESET switch is depressed.

3-429. The power on/off relay K10 applies 3-phase power to circuits in the transmitter system after the appropriate (local or remote) power on switch is depressed. Operation of time delay relay K2 allows its normally open contacts to close approximately 8 minutes after power is applied to the relay coil. Other single-coil relays on this assembly operate functionally as shown in figure 3-45.

3-430. Diodes located across the coils provide a shunt load for noise spikes produced by the coil when it is deenergized. This reduces the likelihood of other sensitive circuits being adversely affected by the voltage noise spikes. Other diodes provide an isolation between unlike circuits that control or operate a common circuit, e.g., diodes CR11, CR12, CR13 and CR14 provide isolation to interlock relay K3. Capacitors connected across the "Y" or reset coils of latching relays K6, K7, and K8 provide a more positive reset action of those coils. Terminal boards provide a convenient test point for electrical checkout and troubleshooting.

3-431. METER DRIVER ASSEMBLY. In addition to the meter drivers, meter-driver assembly 4A3A1A4 contains all (except printed circuit boards 4A3A1A2A1) directly required to operate the X-band transmitter system. Hence, the central printed circuit board location is a desirable feature during checkout, adjustment, or troubleshooting.

3-432. The meter driver assembly contains nine printed circuit cards of six different types. The assembly interfaces with the rest of the transmitter through four connectors: connectors J1 and J2 provide most of the interface for signal and power; connectors J3 and J4 are trigger interface connectors.

3-433. Voltage Current Sense. The voltage current sense printed circuit boards A4, A5, and A6 contain three identical latching voltage comparators. Each latching comparator is composed of three basic functional groups. The primary component is an integrated circuit voltage comparator Z1 which requires a reference input and a monitored signal input. The second component is relay K1 which is connected in a special latching circuit. Proper operation of the transmitter requires that this relay remain energized and this will occur only when the relay coil is good; transistor Q1 is conducting as a result of base bias current provided from the zenered +5 volt through R6 and R7; and pin 7 of comparator Z1 is not at ground.

3-434. Voltage comparator Z1 is an integrated circuit that functions as a single-pole, single-throw switch which provides two possible states between pins 1 and 7: (1) if pin 1 is open to pin 7, forward base bias current will be supplied to transistor Q1 causing the effective collector-to-emitter resistance to decrease; (2) if pin 1 is closed to pin 7, forward base bias current will be shunted to ground and collector-to-emitter resistance will increase.

3-435. State 1 or state 2 is determined by the relative voltages appearing at the comparator input pins 2 and 3. If the voltage at pin 2 is more positive than the voltage at pin 3, then an open circuit between pin 7 and pin 1 will result. The other independent state results in a short between pins 7 and 1. The term "more positive" as opposed to "positive" is used to describe the operation of comparator Z1 for positive inputs as well as negative inputs.

3-436. Jumpers at the comparator allow the circuit to operate in the event of any one of four possible fault conditions: when a positive monitored voltage becomes less

positive than a safe positive reference voltage; when a negative monitored voltage becomes more negative than a safe negative reference voltage.

3-437. Relay K1 is energized when +28 volts is applied at pin C, causing current to flow through diode CR2 to the coil of relay K1 and through transistor Q1 to ground. Transistor Q1 conducts as a result of base current supplied through R6 and R7. Relay K1 will continue to be energized by the 28-volt supply through diode CR2 after the voltage is removed from the reset bus. This condition is the normal operating state and is maintained until comparator Z1 shunts transistor Q1 base current to ground, allowing relay K1 to deenergize and remain so until reset. In the deenergized state, relay K1 will open an interlock circuit causing properly sequenced shutdown of the transmitter. (See figure 3-45.)

3-438. Since so many parameters of differing characteristics are monitored, this printed circuit board is assembled in three different configurations which reflect the wiring details of the indicated jumpers. The jumper wire details are described in a table for each type of circuit. Test points for both reference and monitored inputs, as well as transistor collector level, have been provided to aid in troubleshooting.

3-439. Meter Driver Printed Circuit Board. The meter driver printed circuit boards A7 and A8 contain four identical integrated circuit operational amplifiers. Each circuit provides a high enough input impedance to prevent monitor circuit loading and a low enough output impedance to properly drive one or more meters, and each circuit can be connected as in inverting or noninverting amplifier.

3-440. Operational amplifier Z1 provides sufficient power gain to operate a low impedance load without loading a high impedance source. In addition, amplifier Z1 provides an inverting gain to a voltage applied to pin E of the printed circuit card or a noninverting gain to a voltage applied to pin D. The amount of gain provided by this amplifier is a function of the input resistors R1, R4, R5, and R6, and feedback resistors R2 and R3. Resistor R2 provides an adjustment of the gain factor required to properly calibrate the meter readings. Test point TP1 provides a monitoring point to test for proper operation of this amplifier circuit. In order to simplify the meter switching circuits, the output polarity of the amplifier is always positive, regardless of input polarity. This is accomplished by applying either the inverting or noninverting inputs. Capacitor C1 provides amplifier frequency compensation. Capacitors C5 and C6 provide ±15 VDC filtering.

3-441. High Voltage Regulator. The voltage drop across A4R22 interfaces with the rest of the transmitter at A2J1-B. This voltage is applied as an input to the voltage regulator board at pins 1 and A and is monitored at TP1. The control output of this card is used to operate the high voltage increase relay K4 and high voltage decrease relay K3 in the high voltage power supply. If transistor Q2 is forward biased, the increased current flow through relay K4 will cause its contacts to transfer and allow the 400 Hertz power applied to motor B1 to turn the variac shaft in the direction resulting in an increased voltage level of the high voltage power supply. Base bias current for transistor Q2 is supplied by amplifier Z2 through resistor R7. The bias circuit for transistor Q1 is electrically identical.

3-442. Operational amplifiers Z1 and Z2 are connected in an open loop configuration with only a small amount of alternating current feedback from capacitors C6 and C2 for amplifiers Z2 and Z1, respectively. The high direct current gain resulting from this configuration provides only two possible output voltage levels for each amplifier: positive saturation and negative saturation. The positive saturation output level of each amplifier provides forward emitter-base bias for the corresponding transistor; the negative saturation level removes forward bias and turns the corresponding transistor off. Diodes CR1 and CR2 prevent damage of the emitter base junction during reverse bias conditions.

3-443. Two inputs are required by each amplifier to properly regulate the supply: a reference voltage and a sample of a monitored voltage corresponding to the true power supply voltage. The monitored voltage sample, which is applied to both amplifiers, is provided by the voltage drop across the power supply sampling resistor 4A2A3A4R22. Separate reference voltages, required by each amplifier, are established on the regulator card and provided by resistors R1, R2, R3, and R6. Reference voltage of amplifier Z1 is always less than or equal to the reference voltage for amplifier Z2. The difference between these levels is provided by adjusting potentiometer R2. The absolute level of both references is adjusted by R1. One amplifier Z2 is connected as an inverting amplifier and the other amplifier Z1 as a noninverting amplifier.

3-444. During normal operation, the regulator card is connected to the high voltage control relays so that the voltage at test point TP1 is always between the two reference voltages of the amplifier. For example, if the power supply voltage is greater than a desired upper level, the voltage developed across sampling resistor R22 in the high voltage power supply will be greater than normal. This voltage is routed to the high voltage regulator printed circuit card 4A3A1A4A1 and applied to the inputs of both amplifiers. Since the input is greater than normal, the output of amplifier Z2 will be negative so that transistor Q2 remains off. The output of amplifier Z1 will be positive since the input applied to the noninverting input is positive and greater than the reference applied to the inverting input of Z1. This positive output supplies base bias current to transistor Q1 driving it to emitter-collector saturation resistance. This causes an increase in current flow through the coil of the high voltage decrease relay K3, causing it to energize and apply power to the autotransformer drive motor B1. The motor will rotate the shaft of the variac, and reduce input voltage to the power transformer, thus causing the high voltage level to decrease. The voltage will continue to decrease until the voltage across monitoring resistor R22 falls below the voltage threshold of pin 2 of amplifier Z1.

3-445. A similar operation occurs when the voltage falls below an acceptable level except that amplifier Z2 will cause transistor Q2 to energize the high voltage increase relay K4. Resistor R1 will adjust the effective regulated level and resistor R2 will adjust the minimum regulated difference. Test points are provided at the collector of each relay driver transistor. Power supply decoupling is provided by capacitors C7, C8, and C9.

3-446. Magnetron Filament Current Monitor. Printed circuit board A3 is required to convert the 400 Hertz output of the magnetron filament current monitor-transformer 4A3A2A2TB1T1 to a direct current voltage. This direct current is used to indicate the amount of current required by the magnetron filament and also monitored as an interlock parameter to terminate transmitter operation in the event the filament opens or the filament transformer fails. Operation of the circuit is simple and straightforward.

3-447. The 400 Hertz input at pins U and W is rectified by diode bridge CR1 through CR4 and filtered by capacitor C1 and resistor R3. Resistor R4 is the effective load of this supply since the outputs of pins D and E are connected to the input of the operational amplifiers. The direct current output voltage level is proportional to the magnetron filament current. Test points are provided for troubleshooting purposes.

3-448. Magnetron Filament Control. The primary function of magnetron filament control circuit A2 is to adjust the magnetron filament voltage as a function of the average RF power generated by the magnetron. Proper operation of this circuit helps to ensure a long operating lifetime for the magnetron. Since magnetron voltage-current characteristics are similar to zener diode voltage current characteristics, magnetron average current varies directly with the average RF power generated by the magnetron. The magnitude of the magnetron average current inversely controls the magnetron filament voltage.

3-449. The printed circuit board contains a circuit that is similar in appearance to the high voltage regulator, but it utilizes components in the voltage current sense circuit. The input for this circuit is a voltage proportional to magnetron average current. Normally, this input voltage will correspond to one of three transmitting modes: 0 volts for standby; less than 3.3 volts for low PRF; and less than 5.7 volts but more than 3.75 volts for high PRF. Actual operating trip points are adjusted by potentiometers R11 and R12. During the standby mode, comparators Z1 and Z2 shunt bias current for transistors Q1 and Q2 preventing collector current flow and keeping filament control relays 4A3A2A2K2 and K3 deenergized so that full primary voltage is applied to the magnetron-filament transformer T1 from the 120-volt 400 Hz power line.

3-450. When the magnetron operates at a low PRF, the corresponding voltage input to comparator Z1 is greater than the reference input set by potentiometer R11 and the output of amplifier Z1 allows base current to flow in transistor Q1. With transistor Q1 conducting, a ground path is provided for relay 4A3A2A2K2. This relay is thus energized and the further reduced output voltage of autotransformer T4 is applied to the primary of the magnetron filament transformer T1. Power (28 VDC) to light the low PRF indicator is routed through relay contact 4A3A2A2K3-B1.

3-451. When the magnetron operates at a high PRF, the corresponding voltage input comparator Z2 is greater than the reference input set by potentiometer R12 and the output of comparator Z2 allows base current to flow in transistor Q2. With transistor Q2 conducting, a ground path is provided for relay 4A3A2A2K2. This relay is thus energized and the further reduced output voltage of autotransformer T3 is applied to the primary of the magnetron filament transformer T1. Autotransformer T4 is thus removed from the primary of transformer T1, the LOW PRF indicator goes out, and the HIGH PRF indicator lights. Power (28 VDC) to light the high PRF indicator is routed through relay contact 4A3A2A2K2B1.

3-452. Base bias current for transistor Q1 and Q2 is supplied from zener diode CR1 and the +15 VDC supply. Test points are provided in both the input and output circuits of the magnetron filament control board.

3-453. Pulse Generator. The pulse generator printed circuit board A9 receives a trigger pulse from the trigger generator circuit and generates a pulse having the correct parameters to properly drive the driver tube V1 of the keyer driver chassis. Examination of the X-band transmitter block diagram (figure 3-43), the X-band driver chassis block diagram (figure 3-44), and the interlock circuits functional diagram (figure 3-45) would prove helpful in understanding the pulse generator circuit board.

3-454. The functional components of the schematic include a +5 volt regulator VR1, gated single-shot Z1, inverting amplifier Q1, complementary amplifiers Q2 and Q3, and driver stages Q4 and Q5. An input pulse trigger logic level pulse having a duration of 1 microsecond is received from the trigger driver card in the signal conditioning section by single-shot Z1. Single-shot Z1 produces a negative going 5-volt pulse having a duration of approximately 0.5 microsecond only when it is not disabled. This negative going pulse, monitored at test point 4A3A1A4A9/TP1, inhibits normally conducting transistor Q1 and causes its collector voltage to approach +15 volts through resistors R6 and R7. This waveform is monitored at test point 4A3A1A4A9/TP2 and directly coupled to the complementary emitter amplifier Q2-Q3. The time required for this pulse to reach its maximum voltage is determined by resistor R7 and the shunt capacitance of the base junctions of transistors Q2 and Q3. The pulse appearing at the output of this complementary amplifier will start at 0 volts, increase to almost +15 volts for a period of about 0.5 microsecond, then be driven by transistor Q3 back to 0 volts. This pulse is capacitively coupled to the driver transistors Q4 and Q5. The emitter of transistor Q4 is returned to the -45 volt supply and the emitter of transistor Q5 is returned to ground.

3-455. During the positive transition input, transistor Q4 is forward biased and causes the pulse output to approach -45 volts. The input pulse to transistor Q5 is differentiated by network C10-CR5-R22 to ground and transistor Q5 is turned off. When the input pulses to transistors Q4 and Q5 fall to ground, transistor Q4 is turned off and the charge on capacitor C10 drives transistor Q5 into conduction, forces the output back to ground and thereby damping the oscillations of transformer 4A3A2A1T4. This active drive to -45 volts and back to ground ensures a faithful reproduction of the input pulse at driver stages Q4 and Q5.

3-456. The output of the pulse generator is routed to the driver chassis 4A3A2A1 where it is transformer-coupled to the grid of the driver tube. Decoupling of the ±15 volt power input is accomplished by network L1-L2-C1-C2, while capacitor C6 decouples the -45 volt supply input.

3-457. MAGNETRON TUNING CONTROL.

3-458. A proper tuning relationship between the receiver and the transmitter must be maintained in any type of radar system. This relationship is usually maintained by an automatic frequency control (AFC) circuit. In addition, the X-band transmitter/receiver must exhibit a rapid tuning characteristic capable of operation anywhere in the tuning range of the magnetron. All of this must be accomplished by a circuit possessing the accuracy and stability required by the moving target indicator (MTI) processor.

3-459. The AFC is usually accomplished in one of two basic ways: by using a fixed-tuned magnetron and adjusting the local oscillator frequency to maintain a difference between local oscillator and transmitter that is numerically equal to the intermediate frequency; or by using a fixed tuned local oscillator and adjusting the transmitter frequency to maintain an IF difference. Since the X-band transmitter must operate at several different frequencies, both the transmitter and local oscillator must be rapidly tuned. For this reason, a modification of the second method is used for X-band operation.

3-460. Selection of a receiver local oscillator is made from one of several oscillators tuned to various frequencies within the X-band. The magnetron is tuned to a frequency that is 35 megahertz from the selected local oscillator. At each transmitter RF pulse, a discriminator generates a signal corresponding to the error between the true IF and the desired IF of 35 megahertz. This error signal is analyzed by the AFC circuits and a correction voltage is sent to the magnetron tuning control, causing the magnetron to tune to a frequency that decreases the original error.

3-461. As indicated in the transmitter block diagram (figure 3-43), the magnetron tuning circuits include a magnetron servo control assembly 4A3A1A5, a readout assembly 4A3A1A7, and a magnetron-mounted servo assembly 4A3A1A8. The magnetron servo control includes a control relay and transformer, a 12-volt zener supply, and a servo amplifier. The readout assembly contains circuits needed to properly position the tuning mechanism of the magnetron mounted components. The magnetron mounted servo assembly, contains a drive motor, M; tachometer feedback generator, G; and a position feedback resolver, R.

3-462. The output of the tach generator is used to limit the maximum rotating velocity of the motor by reducing the gain of the motor drive amplifier shown on the servo amplifier. The resolver is used as a position indicator and generates an error signal that is a function of the command tuner position and the actual tuner position. This position error signal is developed through the use of a 100 kilohertz oscillator and a synchronous detector. Output of this circuit is amplified and applied as a negative feedback input to the first summing amplifier of the servo amplifier assembly. The two other inputs include a command voltage and the AFC discriminator followup voltage. These inputs may operate the tuning assembly anywhere

between plus and minus 5 volts as shown in the following example.

3-463. Assume the transmitter is properly operating at a frequency of f1 and the command input voltage is at +1.5 VDC with the discriminator input less than 0.05 VDC. Normally this input is so close to 0 volts that is is barely detectable. The voltage at test point 4A3A1A5/TP1 of the servo control assembly will be equal to the algebraic sum of the voltage at test points TPS and TPC but different in sign. Therefore the algebraic sum of all inputs to the summing amplifier of the servo amplifier will be zero. This establishes a steady-state output for the motor drive amplifier causing the motor to remain at rest. Now assume the command voltage changes to -2.00 volts corresponding to a new desired frequency of f2. The resulting imbalance condition of the summing amplifier causes the motor drive amplifier to drive the servo motor. The amplitude of the error determines the amount of drive and the polarity of the error voltage (negative in this case) determines the rotation direction of the motor shaft. The motor accelerates to a maximum rotational velocity determined by the tach feedback voltage generated by the tachometer G. The motor continues driving until the detected resolver output at test point TP1 is equal in amplitude but opposite in polarity to the algebraic sum of the discriminator input and command input. In this case the voltage at test point TP1, will be +2.00 volts with a command input voltage of -2.00 VDC. At the next transmitter pulse, the frequency discriminator and AFC circuits will update any error by altering the discriminator input to the servo control assembly. This entire process can be accomplished in approximately 20 milliseconds.

3-464. The readout assembly is matched to the characteristics of the magnetron mounted components. In the event of the failure or replacement of one, the other should also be replaced with a matched counterpart to ensure rapid and reliable servo operation. The components in the servo control assembly are all interchangeable with like components. Relay K1 controls the power inputs to the servo amplifier and the readout assembly. It is energized with the high voltage circuits as shown in figure 3-45. Capacitor C1 prevents loading of the 28 VDC supply when the servo motor is driven. Zener diode CR2 and resistor R1 established a -12 VDC level required by the servo amplifier.

3-465 and 3-466 and figures 3-46 and 3-47. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-467. TRANSMITTER CODER. Transmitter coder 1A5A3 generates the four frequency pair modulation signals which are used to amplitude modulate the L-band CW transmitter RF signals. The transmitter coder consists of four oscillator boards A1 through A4 and a summer and driver board A5.

3-468. Oscillator. The oscillator boards each contain the two oscillators required for a frequency pair. The input to the oscillator is the flipper command signal from the computer interface. When the signal is high, transistor Q1 is off and -15 volts is routed to the base of transistor Q2 and to the gate of transistor Q4 which begins to conduct. With -15 volts on its base, transistor Q2 is off and +15 volts is routed to the gate of transistor Q3 and transistor Q3 ceases to conduct. In this condition, the output of oscillator Z1 is inhibited and the output of oscillator Z2 is connected to filter amplifier Z3. When the frequency command goes low, transistor Q1 turns on and supplies +5 volts to the gate of transistor Q4 and through resistor R5 to the base of transistor Q2. Transistor Q2 turns on and switches -15 volts to the gate of transistor Q3. Transistor Q3 is driven into conduction, transistor Q4 ceases to conduct, and the input to filter amplifier Z3 is from oscillator Z1. Potentiometers R9 and R24 are used to set the oscillator frequencies and potentiometers R12 and R27 are used to set the signal amplitudes. The outputs of the oscillator boards are routed to the summer and driver board A5.

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS, RADAR TRAINING SET, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1 FOR FIGURES 3-46 AND 3-47

3-469. Summer and Driver. Summer and driver board combines the four frequency pair modulation signals in summing amplifier Z1. The output of amplifier Z1 is routed through relay K1 to the driver transistors Q1 through A4. Relay K1 is used to inhibit the modulation signal unless target X-band is selected and a missile is launched. The output of the summer and driver circuit is routed to the L-band CW transmitter 4A1A1 in the X-band pedestal.

3-470 and figure 3-48. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-471. The RF source A1 is a mechanically tuned transistor oscillator with +30 dBm minimum (1 watt) output power. It is tunable from 1.0 to 1.15 gigahertz and the operating voltage is -28 VDC at 160 ma. The RF input level to the TWT is controlled by the AM PIN modulator, which attenuates the signal from the source in direct proportion to the modulation command applied to the log converter. The modulated RF is then amplified by the TWT by approximately 30 db (1000 times). The RF output of the TWT is composed of the fundamental frequency and the second harmonic of the fundamental. The second harmonic is attenuated by the low-pass filter and is dissipated in the circulator and load prior to the filter. The RF output is applied to the antenna switch through the bidirectional coupler DC1 where a sample is taken approximately 42 db down in the forward direction and 30 db down in the reverse direction. These RF samples are then detected and applied to the linearizer network A12, where they are scaled to the forward and reverse power meters. The RF is applied to the antenna or the dummy load depending on the position of the radiate/dummy load relay which is controlled by the RADIATE/DUMMY LOAD switch on the front panel and the amplitude of the modulation input to the transmitter. If there is no modulation input, the RF is inhibited at the PIN modulator and the radiate/dummy load relay remains in dummy load regardless of the position of the RADIATE/DUMMY LOAD select switch. When modulation is applied, the transmitter output is switched to the antenna through contacts of relay K4.

3-472. The cathode-to-helix power supply is a regulated direct-current-to-direct-current coverter capable of delivering up to 100 milliamperes of current to the helix for proper focusing of the TWT beam. This supply has low ripple, is well regulated, and is adjustable to allow for tube requirement variations. The basic blocks of this supply, shown in figure 3-49, include a regulator circuit, a self-starting magnetic multivibrator, a set-up torroid transformer, a full-wave bridge rectifier, high voltage relay, and high voltage bleeder.

3-473. The function of this supply is the conversion of a regulated direct current voltage to a high-level regulated direct current voltage. Regulated B+ is applied through transistors A6Q7, Q8, and Q9 to the center tap of the feedback transformer A6T1 and to the power transformer A5T1, turning on either transistors A6Q1 or Q2. Transistors Q1 and Q2, feedback transformer A6T1, and power transformer A5T1 make up the magnetic multivibrator. Switching is determined by saturation of the feedback transformer and nonsaturation of the power transformer. The transistor that is conducting is pulled out of saturation by the decrease of base current which occurs when the torroidal transformer saturates. As the core reaches saturation, the increasing magnetizing current causes an additional voltage drop across feedback resistor A6R3. Thus, the primary of the saturated transformer has less voltage drop across it, effecting the decrease in secondary or basedrive voltage. The feedback transformer A6T1 also supplies the drive signals to the filament power supply which is discussed below.

3-474. The high voltage power supply oscillator operates at approximately 1.5 kilohertz. A square wave is produced in the "A" winding of transformer A6T1 which is included in the "B" winding and stepped up by a ratio of 80 to 1. This high

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS, RADAR TRAINING SET, AN/MPS-T1(V), T. O. 43D7-11-21-2-1-1 FOR FIGURE 3-48

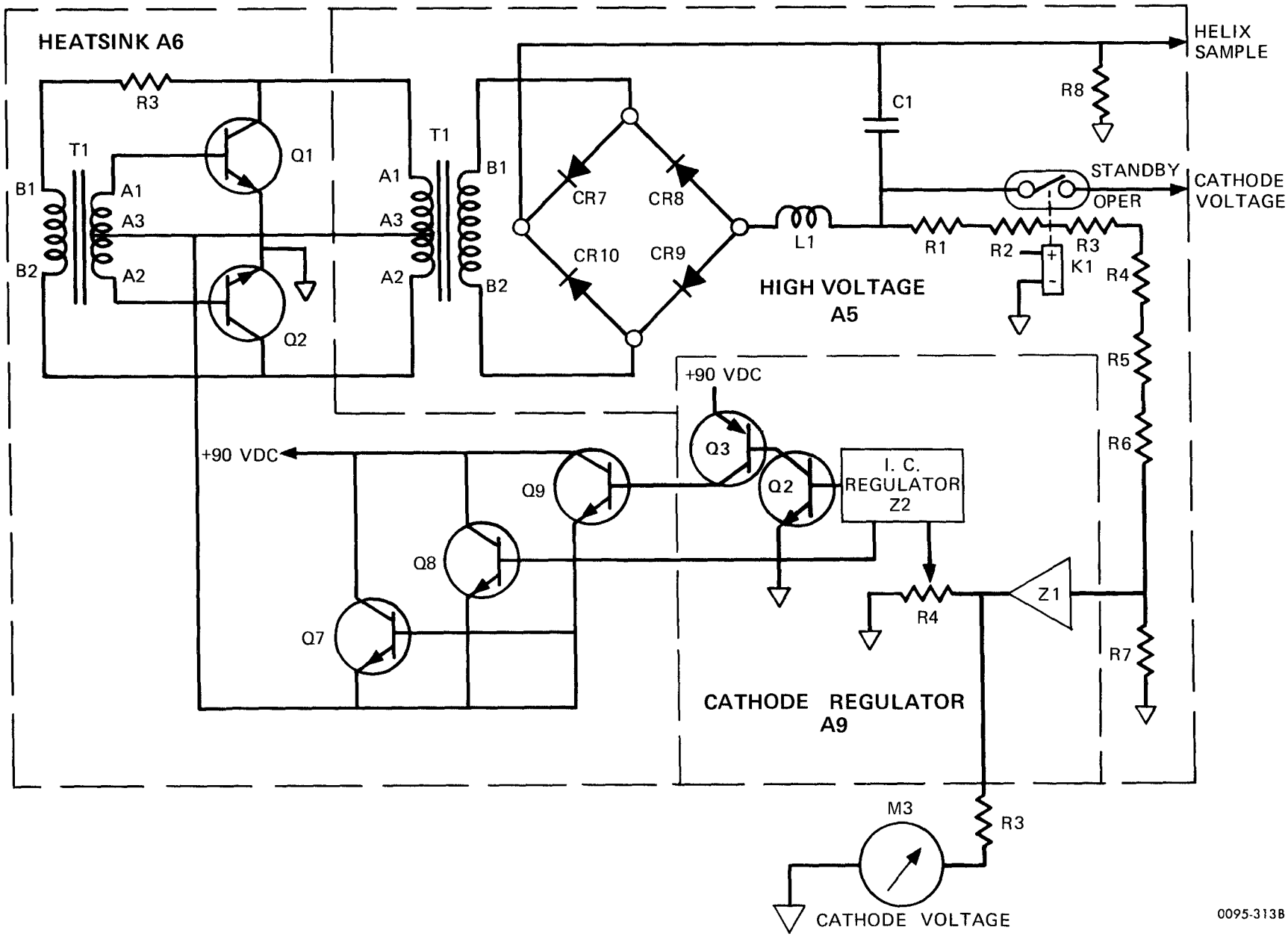


Figure 3-49. Cathode-to-Helix Power Supply Block Diagram

voltage square wave is rectified and filtered and switched to the cathode in the operate mode. A sample of the high voltage is fed by the 300:1 bleeder to the cathode regulator circuit on high voltage regulator circuit board A9. This sample is applied to the base of transistor Q1, a buffer amplifier which isolates the regulator from the high voltage circuit. The sample is inverted by amplifier Z1, a unity gain operational amplifier, and fed to the regulator Z2 through the cathode voltage adjust potentiometer R4. The output of the regulator Z2 is applied to the bases of transisters Q2 and Q3 in cathode regulator 4A1A1A9. Transistors Q2 and Q3 make up a level converter amplifier which extends the voltage range of the voltage regulator to provide control of the B+ to transistors Q1 and Q2, the cathode multivibrator in heat sink 4A1A1A6. The level converter amplifier output is applied to pass transistors Q7 and Q8 through the emitter follower Q9. The pass transistors, in combination with the level converter, allow the voltage regulator to control the amplitude of the cathode multivibrator and thus effect regulation of the cathode power supply voltage.

3-475. Another sample of the high voltage is fed to the metering circuits for an indication of helix current. The supply is floated 10 ohms above ground, and the current through this 10-ohm resistor A5R8 is sensed and metered for helix current indication and protection.

3-476. The filament supply shown in figure 3-50 is a regulated direct-current-to-alternating-current converter capable of delivering up to 4 amps at 6.3 VAC to the filament of the TWT and is adjustable to allow for tube requirement variations. The anode supply is a rectified direct current voltage obtained from the filament transformer.

3-477. The basic blocks of the filament and anode supply include a regulator, a driven magnetic multivibrator, a transformer with a stepdown winding for the filaments and a step-up winding for the anode, and a rectifier for the direct current anode voltage. This supply is driven by the self-starting multivibrator of the cathode supply. The "C" winding shown on the block diagram is part of transformer A6T1 in the cathode supply, and the alternate saturating of this transformer induces a voltage in the "C" winding which alternately turns transistors A6Q3 and Q4 on and off. The square loop core of transformer A5T2 is driven at the same frequency as the cathode multivibrator. This produces a square wave in the "B" and "C" winding of transformer A5T2. The square wave of the "C" winding is fed directly to the TWT heater and the square wave of the "B" winding is rectified and applied to a voltage divider where it is adjusted and applied directly to the anode. The amplitude of the square wave is directly proportional to the level of the regulated B+ voltage supplied by the filament regulator.

3-478. The filament regulator (Z3) is located on the high voltage regulator board (A9). Network Z3 is a regulator that supplies regulated B+ voltage to the filament and anode multivibrator. The output of regulator Z3 is adjusted by potentiometer R16 which determines the amplitude of the filament square wave and drives the pass transistor A6Q10 to deliver the current required by the filament multivibrator. Regulated B+ voltage is measured at test point A9/TP2 and is one-half the square wave amplitude measured at the filament multivibrator test point A6/TP2. When the filament voltage has been set, the anode voltage can be adjusted by potentiometer A5R10.

3-479. The collector power supply A4, shown in figure 3-51, is an unregulated nominal 3 kilovolt power supply capable of delivering to the TWT collector a maximum of 500 milliamperes required for beam current in the tube. This supply is not adjustable as the depressed collector mode does not require the collector to have any control function on the operation of the TWT. The collector voltage is routed through the cathode supply and applied to the TWT at the same time as the cathode voltage.

3-480. The basic clocks of the collector supply A4 include a 3-phase, 115-volt, 400

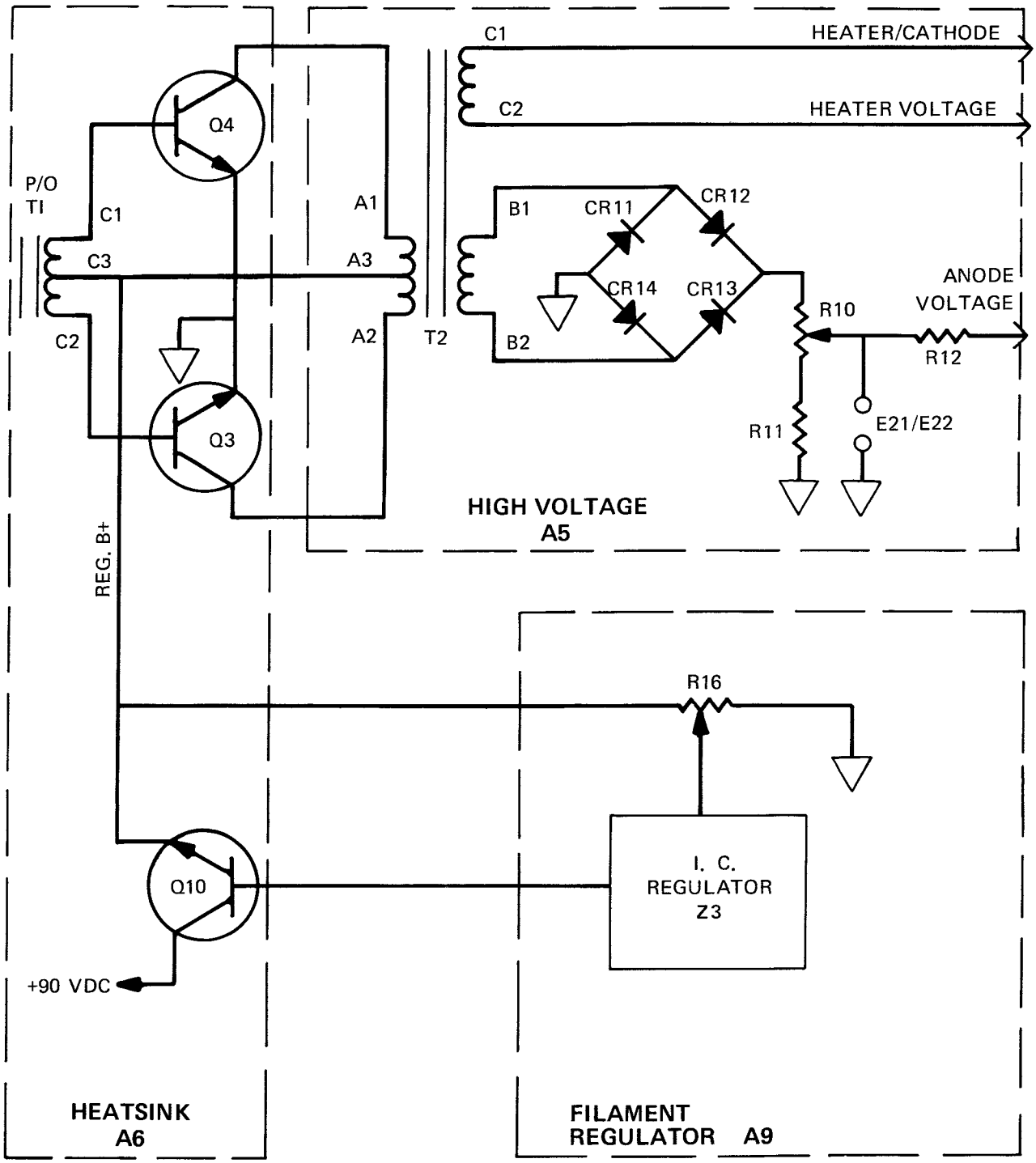


Figure 3-50. Filament and Anode Supply Block Diagram

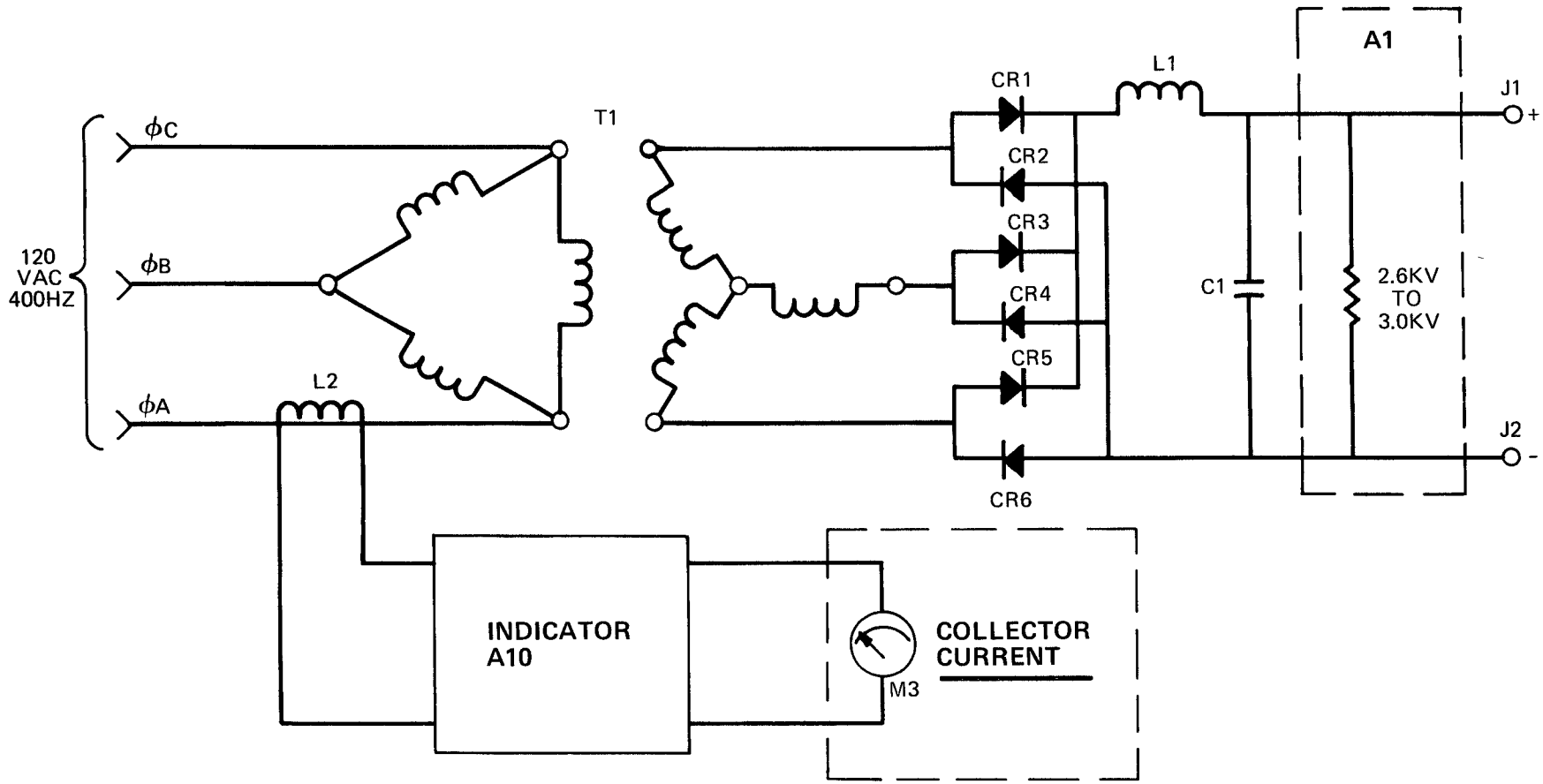


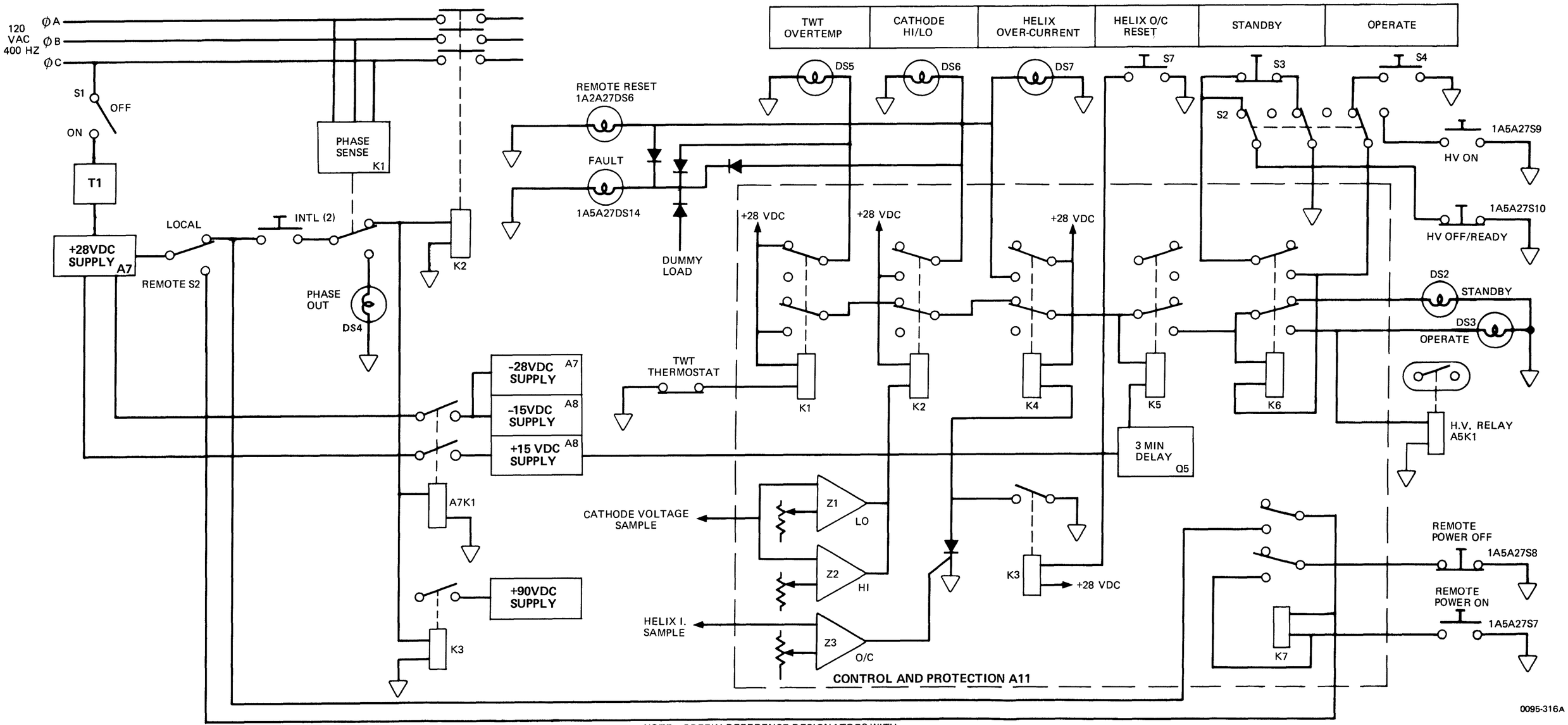
Figure 3-51. Collector Power Supply

Hertz delta-to-Y step-up power transformer T1, a full-wave bridge rectifier CR1-CR6, and LC-type filter L1, C1, a high voltage bleeder assembly A1, and a current transformer L2 from which collector current is sensed and metered.

3-481. The negative side of the collector power supply is connected to the cathode power supply through terminal A5P1-B and is switched to the TWT cathode by use of the cathode power supply HIGH VOLTAGE switch. The positive side of the collector power supply is connected directly to the TWT collector through junction box A14. Because it is not convenient to measure collector current directly, current transformer L2 is used in one primary power lead to monitor primary current. This current is scaled to read the collector power supply direct current.

3-482. When the main power switch S1 is activated, the +28 power supply is energized, and power is applied through the LOCAL/REMOTE switch S2; the drawer interlocks; and the phase sense relay to energize relays K2, K3, and A7K1. The logic and protection of the L-band CW transmitter are illustrated in figure 3-52. Relay K2 controls the 3-phase primary power to the transmitter and relay K3 controls the +90 VDC unregulated B+ voltage. Relay A7K1 controls the -28 VDC supply, the -15 VDC supply and the +15 VDC supply. When the +15 volt supply is energized, the 3-minute time delay circuit A11Q5 through Q9 begins the delay sequence, and the 3-phase, 115-volt power is applied to the cathode supply, and the high voltages are applied to the high voltage relay A5K1. At the end of the 3-minute delay, relay A11K5 is energized; and, if there is no TWT overtemperature condition, the cathode supply is within limits, and if there are no indications of helix excessive current, +28 volt power is applied through relay K1 energized, relay K2 deenergized, relay K4 deenergized, relay K5 energized, and relay K6 deenergized to light the standby light. This indicates that all control functions have been accomplished and all protection circuits are within their preset limits. When the operate switch is depressed, relay A11K6 is energized and latched; the operator indicator is lighted; the high voltage relay A5K1 is energized; and high voltage is applied to the TWT. If the standby switch is depressed, relay A11K6 is deenergized thereby lighting the standby indicator and deenergizing relay A5K1 which removes high voltage from the TWT.

3-483. The TWT overtemp circuit is controlled by a thermal relay inside the TWT which is normally closed and keeps relay A11K1 energized unless the TWT overheats causing the thermal relay to open and deenergize relay A11K1. When this happens, the 28-volt power is removed from the standby and operate indicators and is switched to the TWT overtemp and fault indicators. Relay A5K1 is deenergized so that high voltage is removed from the TWT. The transmitter will not return to the standby mode until the TWT cools and the thermal relay closes. The cathode high/low protection circuit is controlled by a pair of adjustable comparators Z1 and Z2 on the control and protection circuit board A11. The comparators sense a cathode overvoltage or undervoltage and take the transmitter to a cathode high/low condition, which removes all high voltage from the TWT until the cathode voltage is within the present minimum/maximum voltages recommended for the TWT. A sample of the cathode high voltage is fed from the high voltage regulator circuit board A9 to the cathode low comparator A11Z1 and the cathode high comparator A11Z2. The negative sample (nominally -8 VDC) is applied to the noninverting input of the cathode low comparator which also has a negative reference level (set by resistor R2) applied to the inverting input. The negative sample holds the comparator output negative so that transistor Q1 does not turn on. If the sample falls below the reference level, the output of comparator Z1 will switch to a positive DC level and turn on transistor Q1, which in turn energizes relay K2. The 28-volt power is removed from the standby and operate indicators and is switched to the cathode high/low and fault indicators. The transmitter will not return to the standby condition until the cathode voltage goes above the reference level.



NOTE: PREFIX REFERENCE DESIGNATORS WITH 4A1A1 UNLESS OTHERWISE SHOWN.

Figure 3-52. Logic and Protection Diagram

3-484. The negative sample is also applied to the inverting input of the cathode high comparator Z2 which has a negative reference level, set by potentiometer R4, applied to the noninverting input higher than the sample. The larger reference voltage holds the comparator output negative so that transistor Q1 will not turn on. If the sample voltage exceeds the reference level, the output of comparator Z2 will switch to a positive DC level and turn on transistor Q1, which in turn energizes relay K2. The transmitter is switched to cathode high/low and will not return to standby until the cathode voltage drops below the reference level. These functions prevent application of an erroneous voltage to the cathode which could damage the TWT.

3-485. The operation of the helix overcurrent comparator A11Z3 is similar to that for the cathode high/low comparators which are described above. Current flow through the 10 ohm current monitor resistor A5R8, in the cathode power supply, provides a positive voltage, which is proportional to helix current. This voltage is applied to the noninverting input of comparator Z3 which has a positive reference level (set with potentiometer R7) applied to the noninverting input. This level is equal to the voltage developed across resistor A5R8 if the helix current reaches the maximum recommended for the TWT. If the helix current sample exceeds the preset maximum level, the output of comparator Z3 switches to positive and triggers the SCR Q2 into conduction, which turns on transistors Q3 and Q4 and energizes relay K4. The 28-volt power is removed from the standby and operate indicators and routed to the helix overcurrent indicator. Relay A5K1 is deenergized, which removes high voltage from the TWT. In order to enable the transmitter, the helix overcurrent reset switch (S7) must be depressed to supply a ground to energize relay A11K2. Relay K3 switches a ground to the anode of the SCR Q2 to extinguish it. As a result, transistors Q3 and Q4 are turned off, relay K4 is deenergized, and the transmitter is returned to standby. The helix overcurrent circuit protects the TWT from cathode arcing and excessive helix current due to defocusing of the TWT.

3-486. RF Control. The RF input to the TWT is controlled by an AM pin modulator A2 which attenuates the RF signal level from the RF source. The attenuation is controlled by the log converter circuit A13 which varies the bias on the PIN modulator in direct proportion to the various input. There are four inputs to the log converter: modulation, RF off, power set, and blanking. An RF control diagram is shown in figure 3-53.

3-487. The modulation input is applied to the log converter A13 and to the indicator A10 simultaneously. At the log converter, the 16 VPP AC modulation is converted to an adjustable logarithmic function to meet the bias requirements of the PIN modulator and to produce the desired modulation of the RF signal. The modulation is fed to the line receiver Z1.

3-488. At the log converter, the 16 VPP AC modulation is applied to noise cancellation amplifier A13Z1 where the input can be measured at test point TP1. This linear input is fed through the level adjust potentiometer R9 to an antilog function generator Z2, transistor Q1, and buffer amplifier Z3. The log gain is adjusted at potentiometer R9 and a break point inserted from resistor R18. Other signals to control the PIN modulator are summed and applied to the PIN to meet the bias requirements of the PIN modulator and produce the desired modulation of the RF signal. At the indicator A10, the modulation input is detected and used to enable the radiate/dummy load relay K4 and the PIN modulator. When no modulation signal is present, the comparator A10Z1 holds relay A10K1 in an energized position thus keeping relay K4 energized in the dummy load position. Also, a signal is sent to the log converter which keeps the PIN modulator at maximum attenuation. This RF off command can be overcome by the power set control in local operation only for unmodulated CW operation. The blanking input is applied through the linearizer to the log converter by the RADIATE/DUMMY LOAD

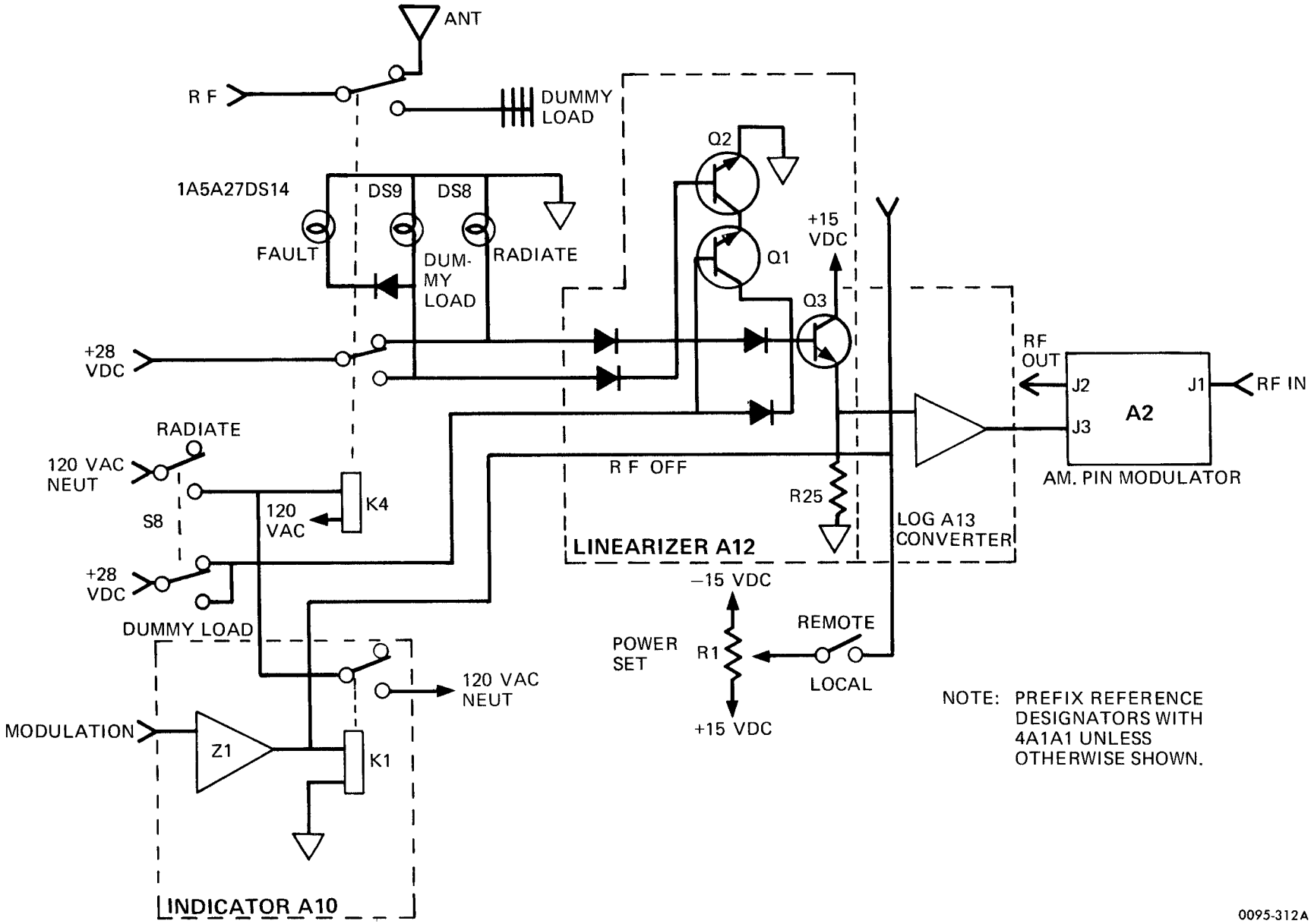


Figure 3-53. L-Band CW Transmitter RF Control

switch to deactivate the PIN modulator during the time it takes relay K4 to switch the RF output of the TWT from the antenna to the dummy load.

3-489. Before the RADIATE/DUMMY LOAD switch (S8) is actuated, +28 volt power is applied from switch S2 and relay K4 to the bases of transistors A12Q1 and A12Q2. Transistors A12Q1 and A12Q2 are driven into conduction to ground the base of transistor A12Q3 so that it remains inhibited. The inhibited condition of transistor Q3 holds the blanking output at 0 volts, which has no effect on the log converter or the PIN modulator. When switch S2 is switched, the +28 volt supply is removed from the base of transistor Q1. Transistor Q1 is turned off allowing transistor Q3 to turn on. As a result, a positive DC blanking input is applied to the log converter which causes the PIN modulator to attenuate the RF. When S2 switching is complete, +28 volt power is again applied to the base of transistor Q1 which keeps it from turning on, but +28 volts is applied to relay K4. As relay K4 starts to energize, it removes +28 volts from the base of transistor Q2, which deenergizes transistor Q2 and allows transistor Q3 to remain energized and hold the attenuation in the PIN modulator until relay K4 has finished switching the output. When relay K4 energizes, it again applies +28 volts to the base of transistor Q2; transistor Q2 turns on; transistor Q3 turns off, and the blanking output is returned to zero volts. This circuit protects the TWT from operating into an open circuit with RF applied and protects the antenna switch from switching high RF power levels.

3-490. The RF samples taken from the bidirectional coupler discussed previously are detected by the forward and reverse power crystal detectors CR1 and CR2. The resultant negative DC levels from each are fed to the scaling amplifiers Z1 and Z2 on the linearizer network A12. Each negative voltage is applied to the inverting inputs to produce a positive output needed for proper deflection of the meters. Potentiometers R4 and R14 are used to adjust the 0 meter reading when no RF is applied. Potentiometers R10 and R20 are used for break point adjustments to linearize or "straighten out" the log characteristics of the crystal detector outputs before they are applied to the linear milliampere meters that are used to indicate forward and reverse power. The outputs of the linearizer network are fed to the indicator circuits on circuit board A10. Potentiometers R1 and R2 are used to limit the current through the power meters and to scale the top end reading of power.

3-491. The LOCAL/REMOTE switch S2 shown in figure 3-54, is located on the transmitter front panel and allows local operation for initial setup and test functions. The power set control R1 controls the attenuation of the PIN modulator in local position only. It is switched out when the transmitter is remotely controlled; then the modulation input has complete control of the RF.

3-492. The low level DC power requirements consist of +90 volts unregulated, ± 28 volts regulated, and ±15 volts regulated. The 115 VAC supply is applied to the primary of transformer T1. The secondary of transformer T1 has three outputs; two 35 VAC outputs and a 66 VAC output. The 66 VAC output is applied through relay K3, which is energized by the phase sense relay, to the full wave bridge Z1 where it is rectified and filtered to +90 VDC unregulated. Both of the 35 VAC outputs are fed to the ±28 volts regulated circuit board A7, where they are rectified to positive DC Z1 and negative DC Z2. The positive DC is applied directly to the +28 volts regulator Z3, the pass transistor Q1, and the current driver A6Q5 on the heat sink assembly. The +28 volts is adjustable with potentiometer A7R5. The positive DC is also switched through transistor A7Q1 to the +15 volts supply A8, where it is applied to the regulator Z1, the pass transistor Q1 and the current driver A6Q6 on the heat sink assembly. Both the +28 VDC and +15 VDC are fed from the heat sink assembly back to their regulators where they are current limited and can be monitored at test point A7/TP1 and A8/TP1, respectively.

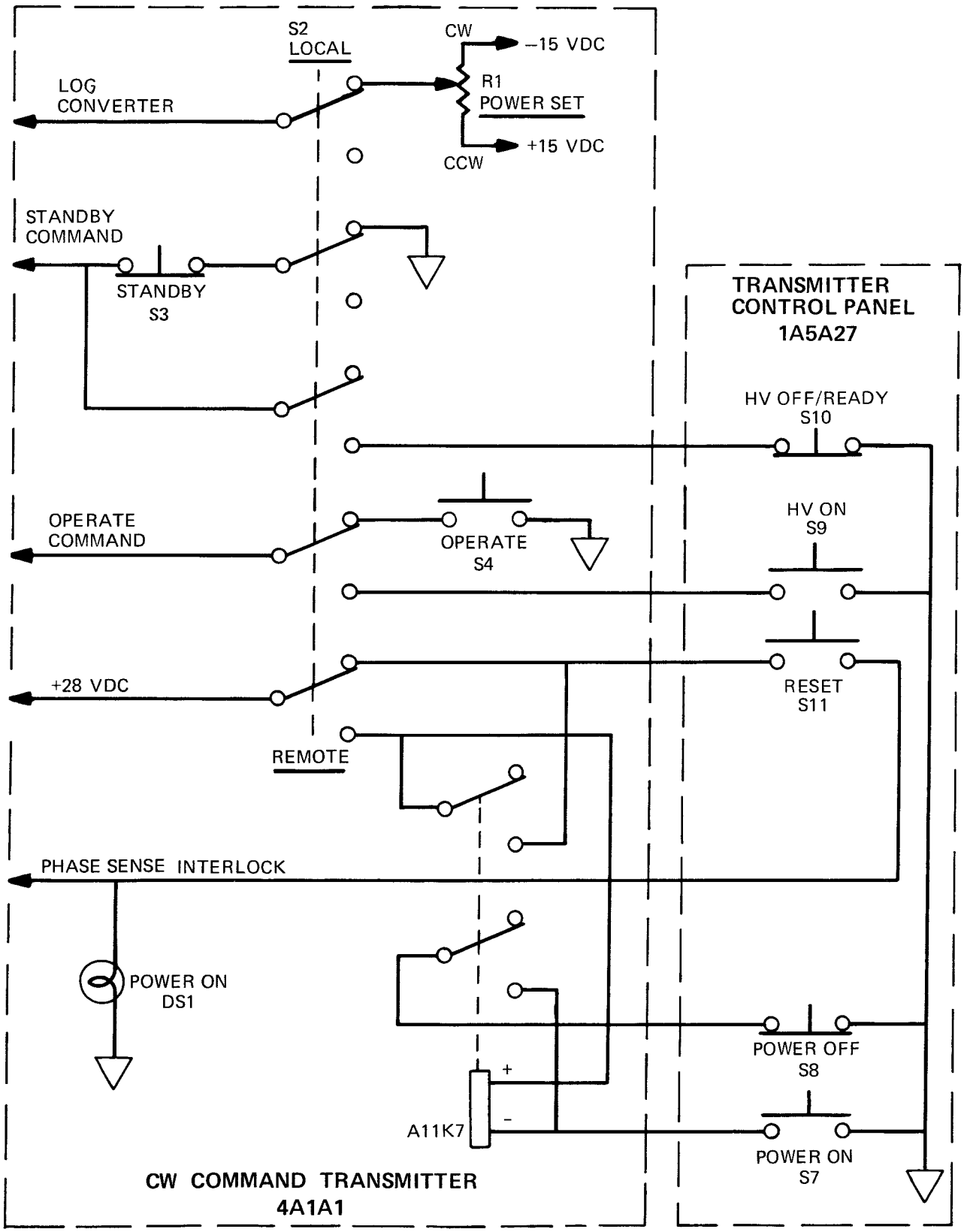


Figure 3-54. Local/Remote Switching

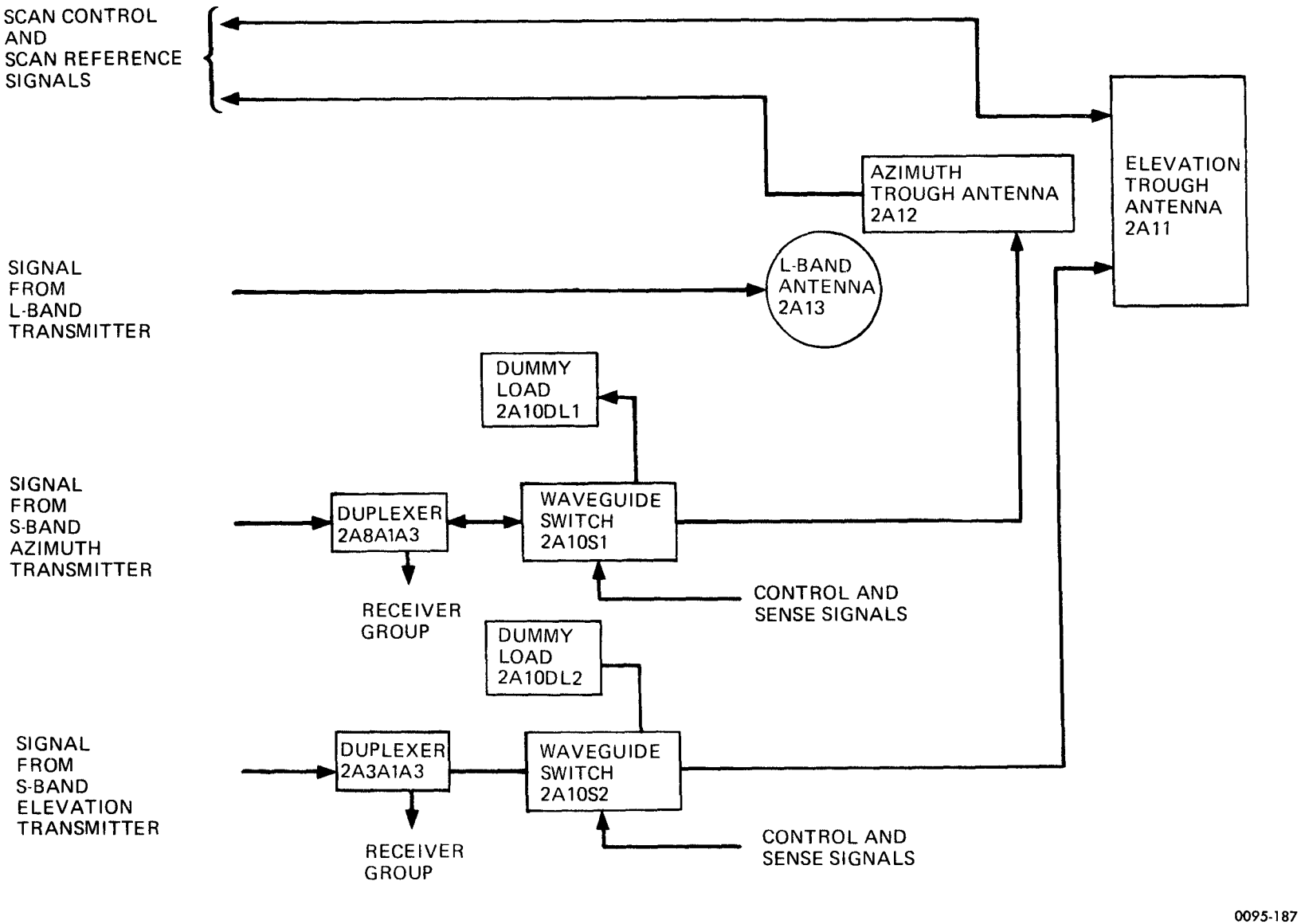


Figure 3-55. S-Band Antenna System Block Diagram

3-493. The negative DC level from regulator A7Z1 is switched by relay K1 to the -28 volts regulator and the -15 VDC is applied to the regulators, pass transistors, and current drivers on assemblies A7 and A8. The -28 volts supply is adjustable with potentiometer A7R9 and can be monitored at test point A7/TP2. The -15 volts supply is adjustable with potentiometer A8R9 and can be monitored at test point A8/TP2.

3-494. ANTENNA GROUP.

3-495. The antenna group includes the S-band, C-band, and X-band antenna systems. Each system is capable of independent operation and each is installed on separate pedestal gimbal systems.

3-496. S-BAND ANTENNA SYSTEM. The S-band antenna system includes the S-band azimuth and elevation trough antennas 2A12, 2A11, duplexers, waveguide switches, dummy loads, and the L-band command (dish) antenna 2A13. (See figure 3-55.) The three antennas are boresighted to a common point to provide the antenna scan patterns shown in figure 3-8. Boresight is accomplished through use of the mechanical support structure with mechanical adjustments.

4-497. The S-band high power RF pulses are received from the associated transmitter and routed through the duplexer to the waveguide switch where they are routed to either the dummy load or the S-band trough antenna. The position of the waveguide switch is controlled by the guidance operator. When the switch is in the antenna position, the RF signals received by the antenna are routed through the waveguide switch to the duplexer where the signal is routed through the TR portion of the duplexer to the input of the receiver group.

3-498. The output signals from the L-band transmitter are routed to the L-band dish antenna.

3-499. C-BAND ANTENNA SYSTEM. The C-band antenna system consists of the C-band azimuth and elevation trough antennas 3A12, 3A11, C-band azimuth and elevation dish antennas 3A14, 3A13, and L-band command (dish) antenna 3A15, a waveguide switch network to allow antenna and dummy load selection, duplexers, and dummy loads. (See figure 3-56.) Boresighting of the five antennas is effected to a common point to provide the antenna scan patterns shown in figure 3-9. Boresighting is accomplished through use of the mechanical support structure.

3-500. The C-band high power RF pulses are received from the associated transmitter and routed through the waveguide switch network to the antenna selected as the transmitting antenna or to the dummy load. Received signals from the selected receiving antenna are routed through the waveguide switch network to the receiver input.

3-501. X-BAND ANTENNA SYSTEM. The X-band antenna system consists of the dual scanned X-band trough antenna 4A10, the X-band illuminator (dish) antenna 4A11, an L-band command (cut dish) antenna 4A9, a system duplexer, waveguide switch, and dummy loads. (See figure 3-57.) Boresighting of the antenna system is effected to a common point to provide the antenna scan coverage shown in figure 3-10. Boresighting is accomplished through use of the mechanical support structure of the antenna system.

3-502. The RF pulses received from the X-band transmitter are routed through the duplexer and the waveguide switch to either the dummy load or the illuminator antenna. Received RF signals from both the illuminator and the trough antenna are routed to the prereceiver in the RTM enclosure mounted on the antenna trailer.

3-503. Control signals provide the commands to the dish and trough antennas to provide the proper scans. Timing and reference pulses from these two antennas are used to synchronize units in the control trailer, such as the operator displays, receivers, and tracking loops, when an X-band mode of operation has been selected by the radar operators.

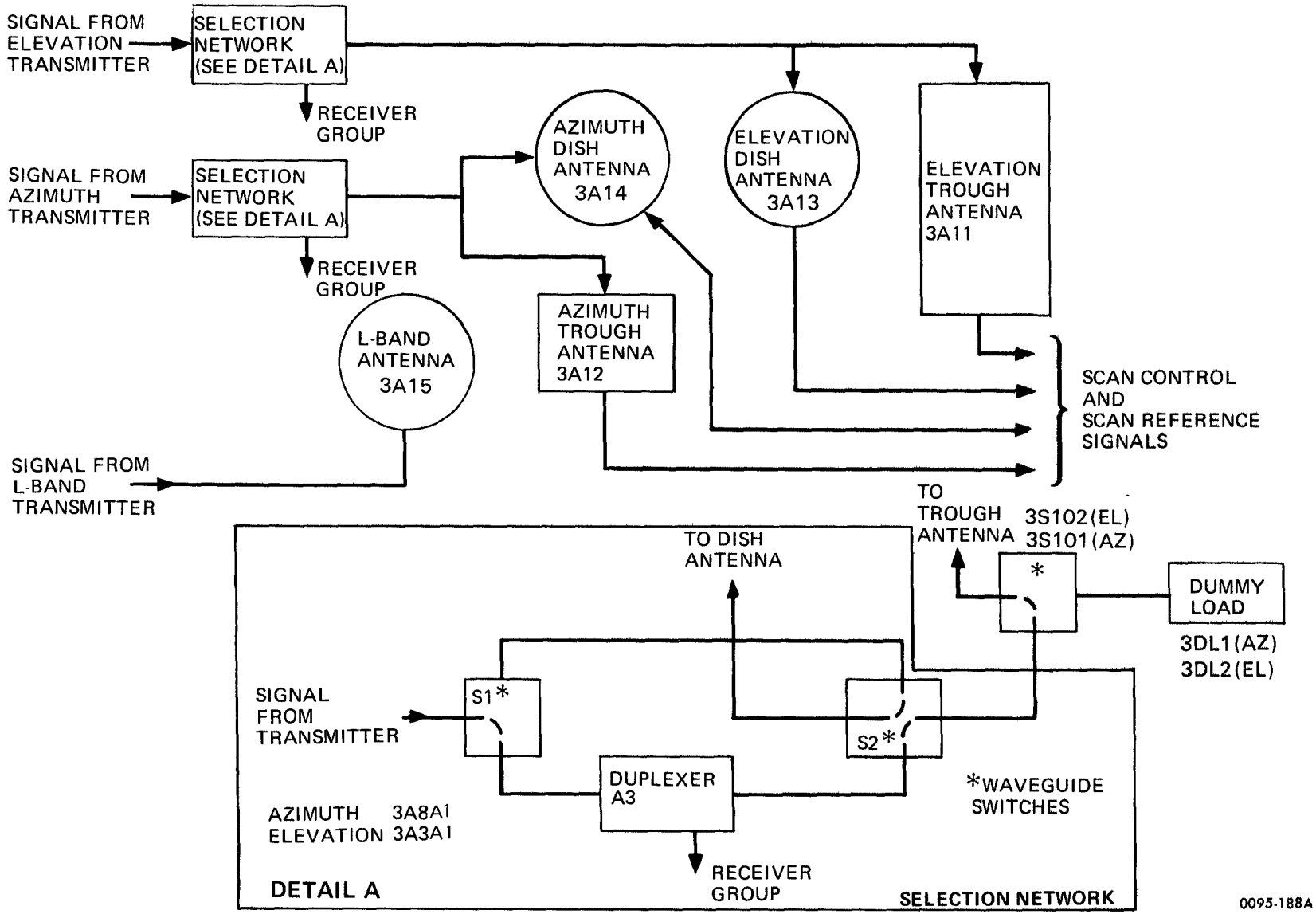


Figure 3-56. C-Band Antenna System Block Diagram

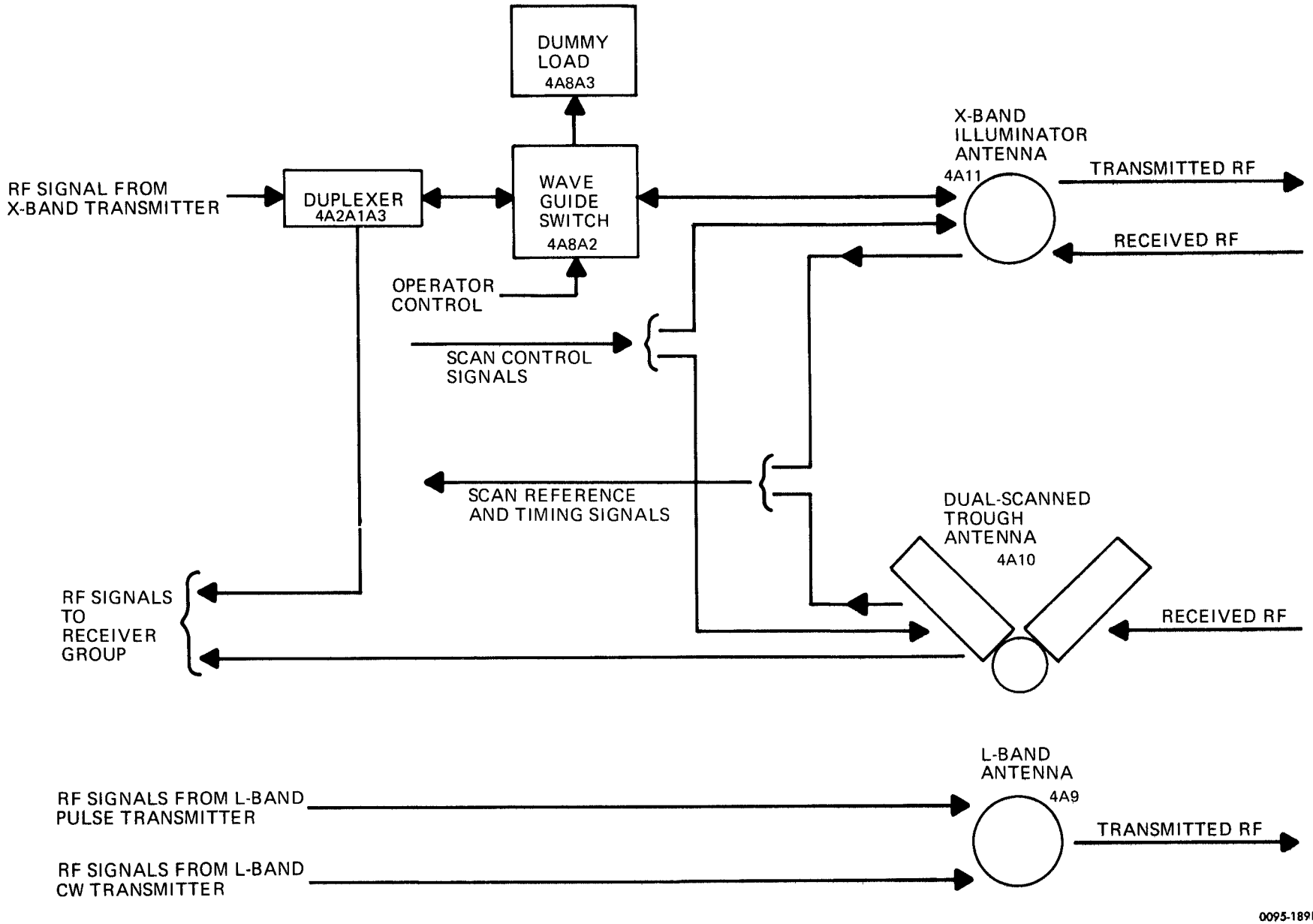


Figure 3-71. RPM Sense Circuit

3-504. ANTENNA MODE SELECTION. Waveguide switch networks allow the guidance operator to select the operating mode of the S-band, C-band, and X-band antenna systems at the mode control 1A1A1.

3-505. S-band Waveguide Switching. The S-band waveguide switches are controlled by the ANTENNA/LOAD switch 1A1A1S6. When the LOAD position is selected, both waveguide switches are positioned so that the RF energy is routed to the dummy loads. The transmitter triggers are blanked during waveguide switching to protect the magnetron from the effects of the high VSWR at its output when the switches are positioning. (See figure 3-58.)

3-506. When switch S6 is actuated (to initiate waveguide switching), a pulse is developed by a single-shot A6-2 in the mode control unit 1A1A1 and routed through a gate A2A10-7 where the pulse is inverted and applied to the line driver A2A8-2 in the synchronizer unit 1A1A5. The line driver output is routed to the S-band signal conditioning unit 2A6A2 along with a control trailer common signal. The control trailer common signal is a DC voltage derived from the +5 volt power line by voltage divider R21-R22.

3-507. The line receiver accepts the line driver output and the data common (control trailer common signal) and generates a pulse corresponding to the line receiver input pulse. Because of the common mode rejection of the line receiver, noise signals picked up by the two long input lines from the control trailer are cancelled in the line receiver. The pulse output of the line receiver sets an R-S flip-flop from which the logic 0 output is sent to the transmitter group to blank the azimuth and elevation transmitter triggers during the transfer time of the waveguide switches. The logic 1 output of the flip-flop is routed to a relay buffer where it energizes a relay to apply a +28 volt signal to the waveguide switch time delay circuit. The +28 volt input initiates a time delay in the waveguide switch time delay circuit. At the end of the time delay, a relay in the circuit is energized for use in the waveguide switch sensing circuits.

3-508. The +28 volt signal input charges capacitor C1 through resistor R1. The charge voltage on capacitor C1 is coupled through the emitter follower stage Q1 to the emitter of unijunction transistor Q2. When the charge equals the firing point of the unijunction transistor, Q2 fires, capacitor C1 discharges, and relay K1 is energized. Holding contacts on relay K1 hold the relay in the energized state. When relay K1 is deenergized, a +5 volt signal is connected through the deenergized contacts of relays K1 and K2 to inhibit the transmitter triggers.

3-509. Sense switches in the waveguide switch assemblies close when the waveguide switches are closed and open when the waveguide switches are actuated. When both waveguide switches are closed, a 28 volt return signal is routed serially through the waveguide switch sense switches, energizing relay K2 on the waveguide switch time delay assembly. If at this time relay K1 has been energized by transistor Q2, a ground signal is routed through relays K1 and K2 to reset the RS flip-flop, reapply the transmitter triggers, and remove the 28 volts from the waveguide switch time delay circuit. Should the waveguide switch sense switches remain open after the time delay set by transistor Q2, the transmitter triggers are inhibited by the signal derived from the relay buffer (2A6A2A4-2).

3-510 through 3-512 and figures 3-59 and 3-60. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-513. When a mode change is made by actuating switch S14, S15, or S16, or when a change between antenna and dummy load is made by actuating switch S9, a pulse is generated by a single-shot SS-1 or SS-3 in the mode control chassis 1A1A1. These pulses are summed in OR gate A3-4 to form the C-band start waveguide switching pulse. This pulse is routed from the mode control chassis to a line driver in the synchronizer chassis 1A1A5 where it is sent along with a data common signal to the waveguide switch blanking circuit in

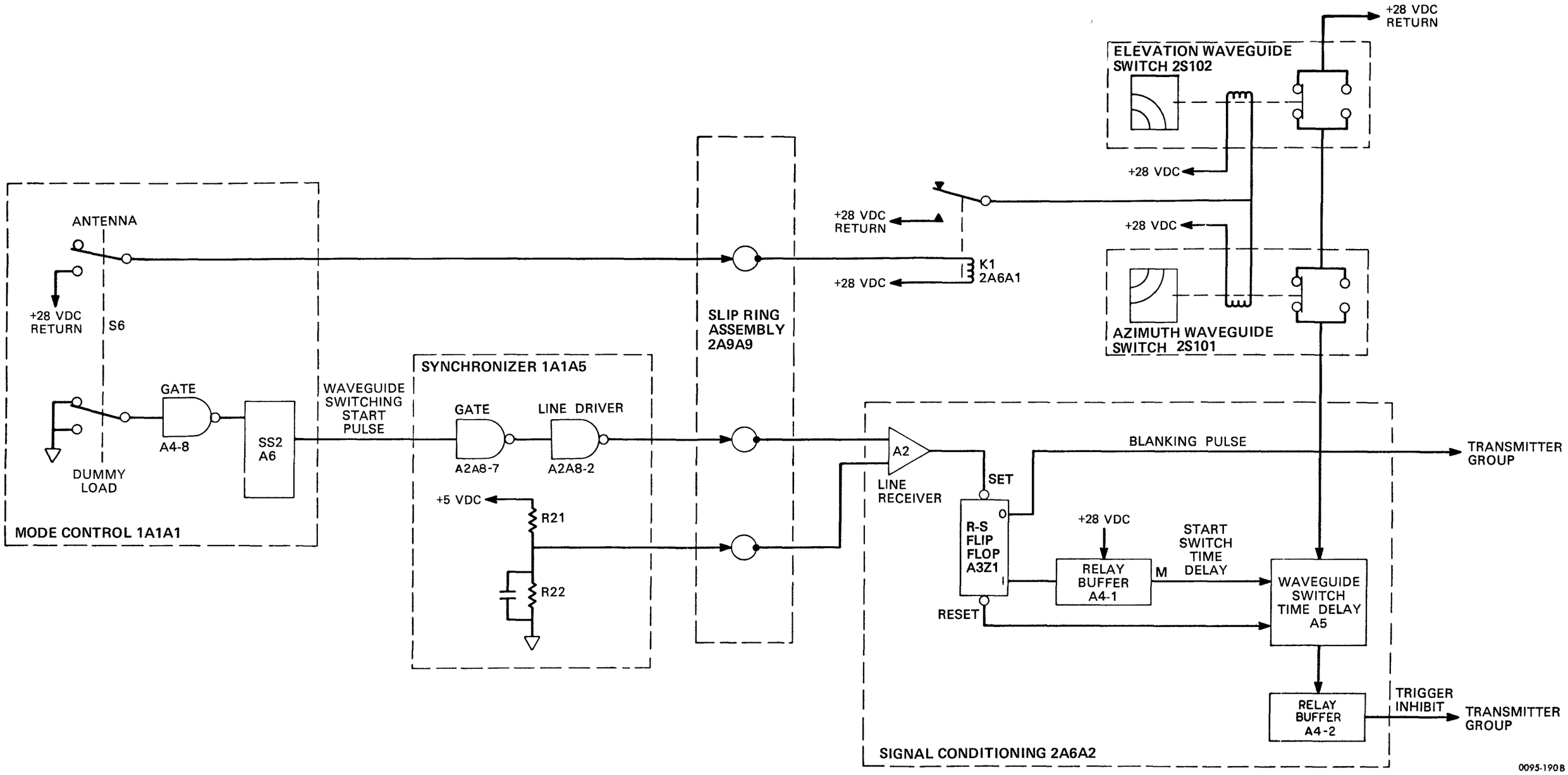


Figure 3-58. S-Band Waveguide Switching Functional Diagram

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS, RADAR TRAINING SET AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1 FOR FIGURES 3-59 AND 3-60

the C-band antenna cab. The data common signal is the same signal as that described for S-band waveguide switching and is provided by the voltage divider which consists of resistors R21 and R22.

3-514. The circuits in the signal conditioner 3A6A2 that blank the transmitter triggers are the same as those described for the S-band signal conditioner 2A6A2. The waveguide sense switches that close when the waveguide switches are in position are series-connected to furnish the waveguide switch series interlock signal (figure 3-61).

3-515. X-Band Waveguide Switching. The X-band waveguide switch is controlled by the ANTENNA/LOAD switch 1A1A1S32 to direct the RF pulses from the transmitter to the dish antenna or the dummy load. Circuits in the synchronizer 1A1A5 inhibit the transmitter triggers so that the transmitter will not fire during the time the waveguide switch is operating.

3-516. Duplexer. The duplexer conducts the transmitted RF energy to the antenna and also conducts the received RF energy from the antenna to the receiving group. In this way, it acts as an electronic switch. The duplexer prevents the transmitted RF energy from entering the receiver and prevents the received RF energy from entering the transmitter port and being attenuated because of this division of power.

3-517. The duplexer is a quartz cylinder-type branched duplexer that consists of an anti-transmit-receive (ATR) device and a transmit-receive (TR) and pre-TR device that are constructed within waveguide sections (figure 3-62). The center of each cylinder is filled with a gas that is ionized by the high power transmitter RF pulse.

3-518. When a high power RF pulse from the transmitter is applied to the duplexer, the pulse ionizes the gas within the six quartz cylinders. Ionization of the gas creates short circuits at the input windows to the cylinders. Ionization of the gas in the pre-TR quartz cylinders reduces the power to the TR to levels which are easily handled by the glass-kovar window in the TR tube. The need for keep-alive voltages in the TR is eliminated by the use of a radio-active keep-alive source that injects priming electrons into the TR discharge gaps. This lowers the power required to ionize the gas within the pre-TR, and the TR prevents the transmitter energy from entering the receiver.

3-519. The received signal from the antenna is not of sufficient power to cause ionization of the gas in the quartz cylinders. The low power received signal is passed to the pre-TR where half of the power passes into the receiver and the other half passes to the ATR. The ATR quartz cylinders reflect this power and, because of the one-fourth wavelength spacing from the pre-TR, the reflected power is passed through the pre-TR and TR to the receiver. The second set of ATR cylinders, spaced at one-half wavelength from the first set, increases the bandwidth of the duplexer.

3-520. Dummy Load. The dummy loads allow operation of the transmitters without radiating through the antenna. When the dummy load is selected, the transmitter energy is terminated in the high-power resistive dummy load and the receiver input is disconnected from the antenna.

3-521. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-522. The scanning trough antenna is made up of two closely spaced large parallel surfaces. These surfaces are shaped so that, when used in conjunction with a focusing objective, they form a narrow beam of RF energy in the scanned plane of the antenna that can be scanned by a rotary motion of a feed horn. Because of mechanical construction and shaping of the parallel plate surfaces and the feed horn, the antenna beam scans in a sawtooth fashion. The wide dimension of the beam in the unscanned plane is determined by the reflector characteristics.

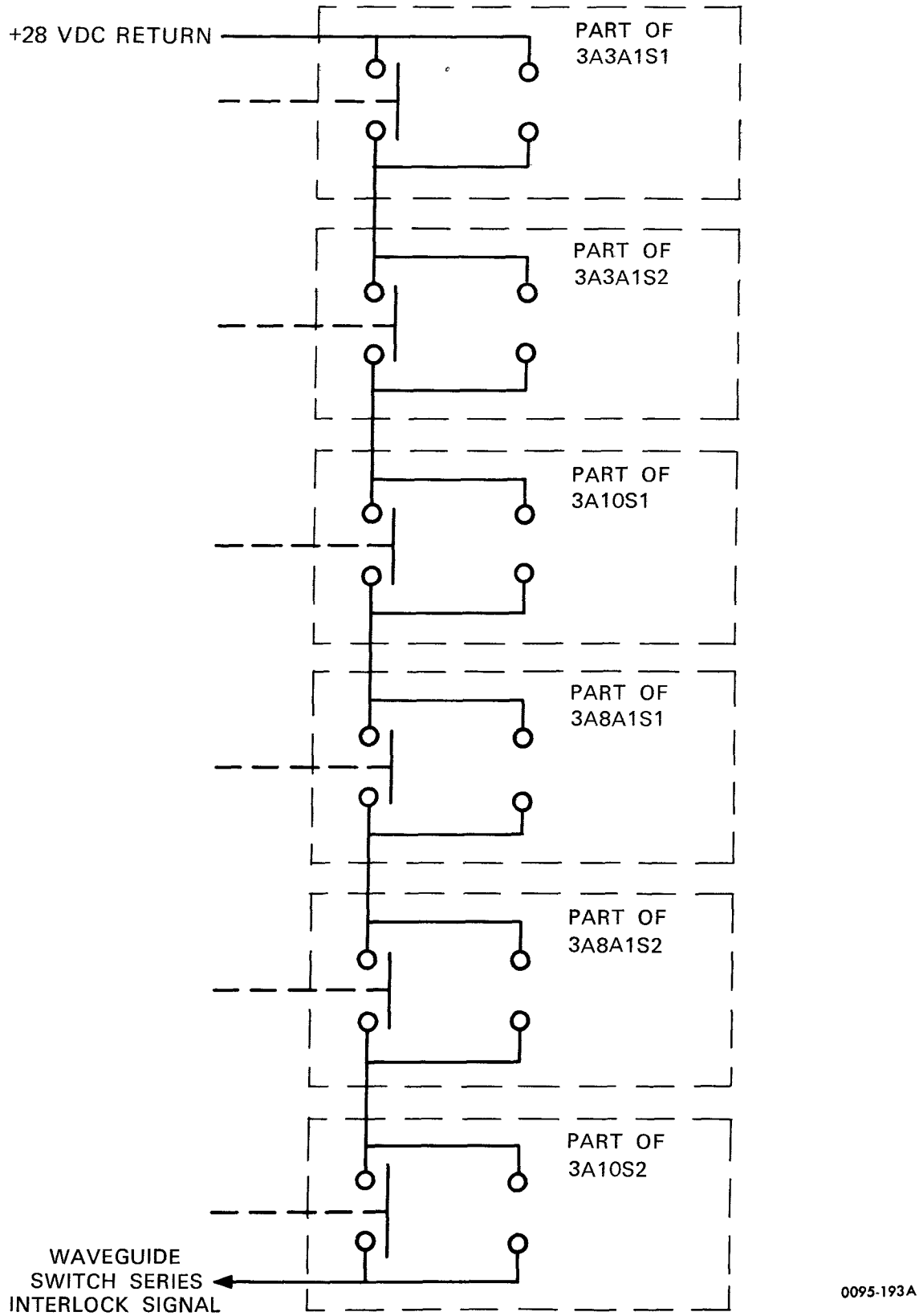


Figure 3-61. Waveguide Switch, Sense Switch Interconnect Diagram

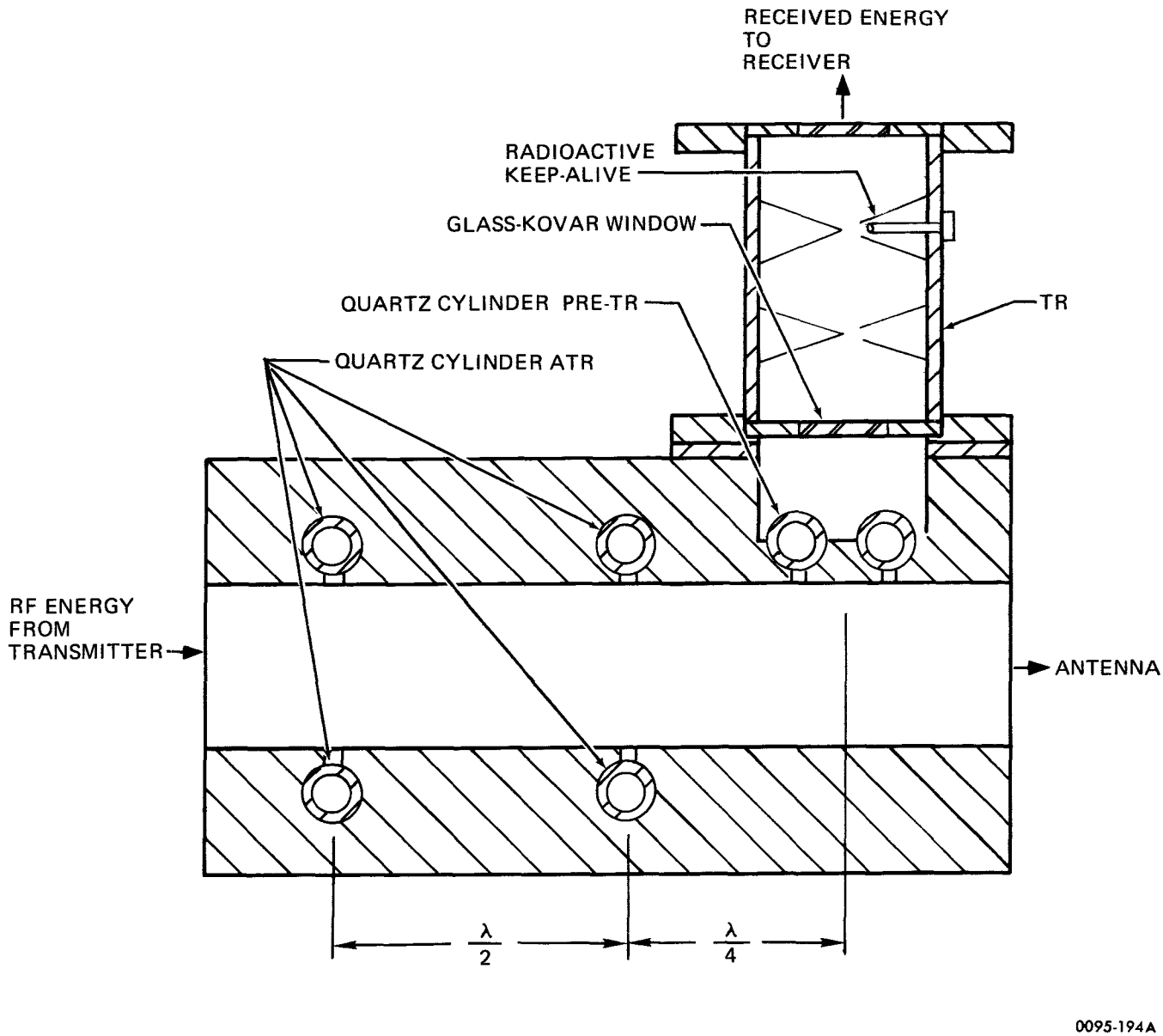


Figure 3-62. Duplexer

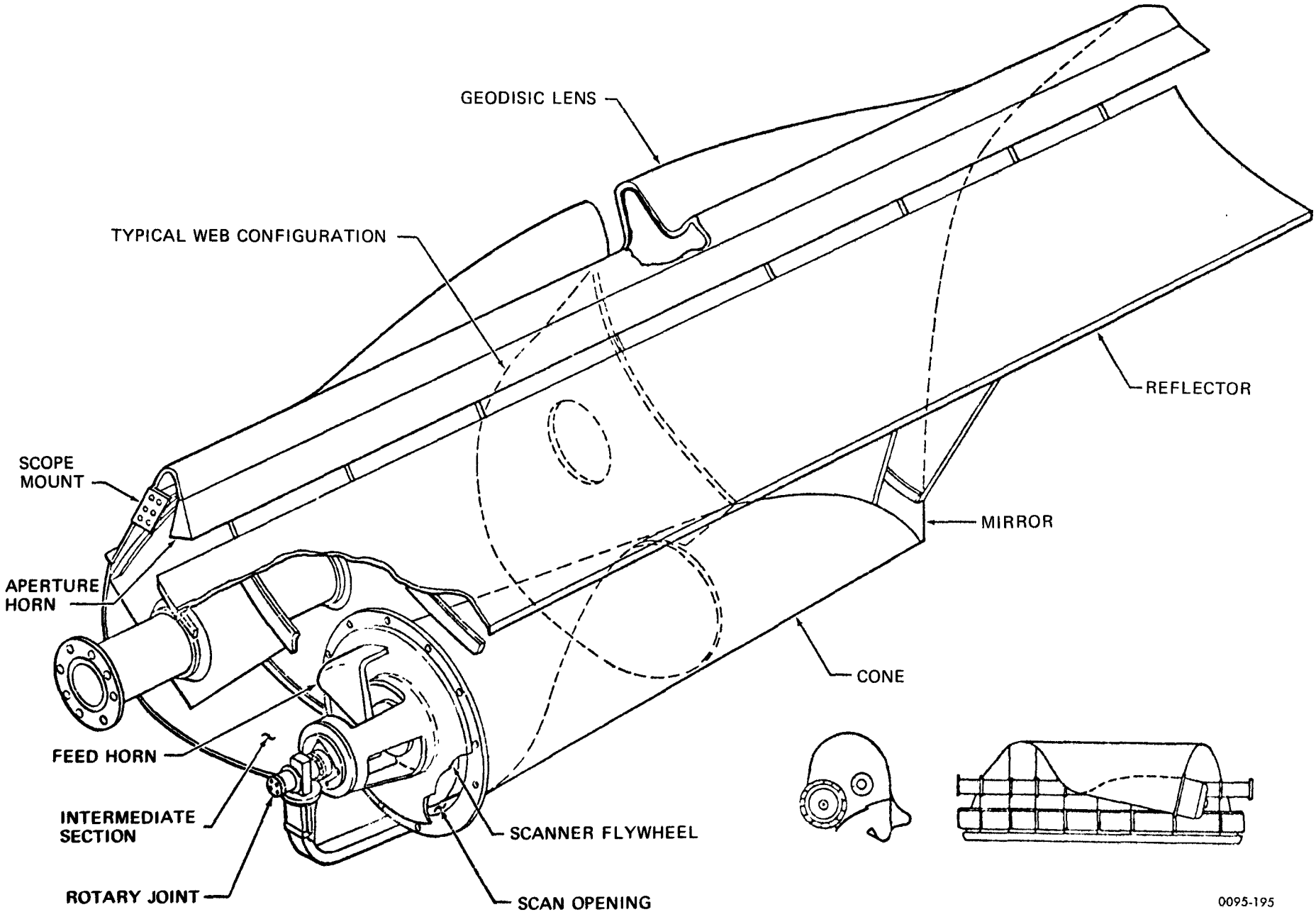


Figure 3-63. Trough Antenna

3-523. The RF energy from the transmitter is passed through the rotary joint (figure 3-63) to the rotating feed horn which directs the RF energy into the scan opening of the parallel plate structure (the annular ring formed by the rolling of the parallel plate structure). The RF energy propagates in the space between the parallel plates in the cone section and is reflected by a mirror (reflector) at the surface that is formed when the parallel plate structure is folded.

3-524. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-525. Antenna Contruction. The folding of the parallel plate structure to form the mirror surface and the rolling of the structure to form the cone is illustrated in figure 3-64. The two-dimensional geometry of the illustration demonstrates the general optics of the antenna. Detail A reflects the basic mean plane geometry of an antenna in which motion of a feed horn along the focal arc (scan face) produces beam scanning. With the feed end of the parallel plate structure folded, and with a reflecting mirror inserted (detail B), the feed horn positions and focal arc are reflected to the A, B, and C positions shown at left; the optics of the system are as before except that right and left are interchanged. In detail C, the feed end of the parallel plate section is rolled into a cone in which the height is equal to the focal length. This makes the two lines from the ends of the scan opening (positions A and C) to the apex of the cone coincident, and the scan opening becomes a planar annular ring. A simple rotary motion of the feed horn causes the beam to be scanned in a linear sawtooth fashion. A dead time zone occurs as the feed horn passes the point on the scan opening where the two sides of the cone are joined, which corresponds to the flyback of the sawtooth scan. As shown in detail C, a clockwise rotation of the feed horn produces a left-to-right direction of scan at the antenna face.

3-526. Scanner Assembly. The scanner assembly provides the feed horn motion required to scan the antenna beam and provides angle-timing signals referenced to this feed motion to obtain angle synchronization of other groups in the radar set.

3-527. The transmitted energy is passed through an RF rotary joint which includes a pressure block that terminates the pressurized portion of the waveguide assembly to the feed horn.

3-528. The scan driver motor receives its drive voltages from a contactor that is remotely controlled from the radar control trailer (figure 3-65). Scan disable switches on the antenna trailer allow the scan drive to be inhibited so that maintenance on the units may be safely performed.

3-529. Magnetic pickup devices located around the scanner face are used to generate the three required angle-timing signals for each of the S- and C-band trough antennas. These signals are start scan (end dead-time), center scan (boresight sync), and end scan (start dead-time). The outputs from the magnetic pickups are routed to the scanner pulse generator assemblies for processing and then to the signal conditioning chassis.

3-530. Antenna Deicing. The trough antennas are equipped with 1000 watt heaters at the radiating feed aperture. The heaters are turned on at the remote power and frequency control panel (1A5A2) and are controlled automatically by a thermostat mounted on the antenna near the feed aperture.

3-531 through 3-533. Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-534. If the antenna feed is moved as shown in figure 3-66 from a through b, to c, and back to a, in a sawtooth manner, then the antenna beam is scanned from A through B, to C, and back to A, in a sawtooth scan. The helical slot scanner shown in figure 3-67 provides the necessary feed motion described above by rotating a cylindrical mask containing the helical slot

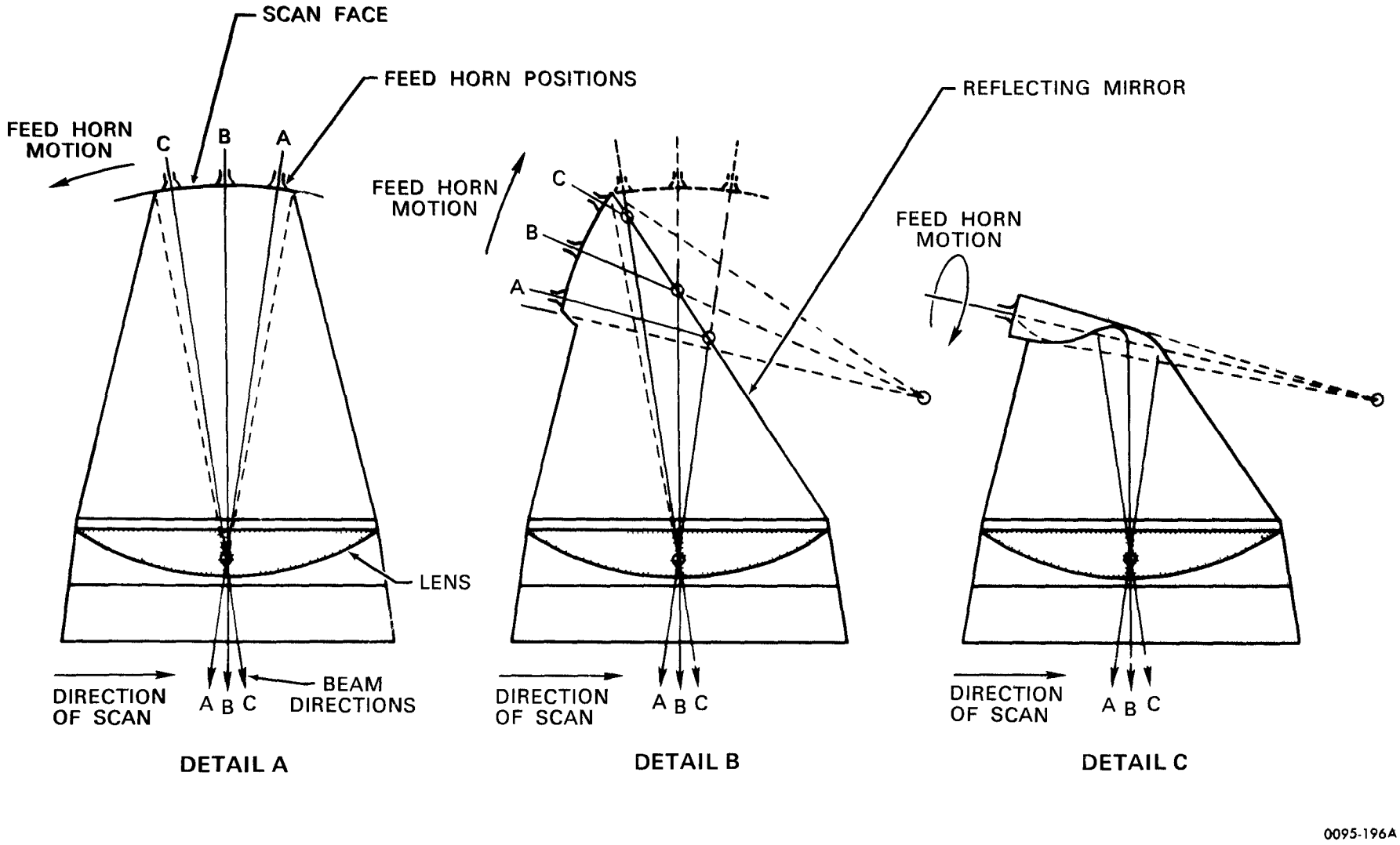


Figure 3-64. Trough Antenna Construction

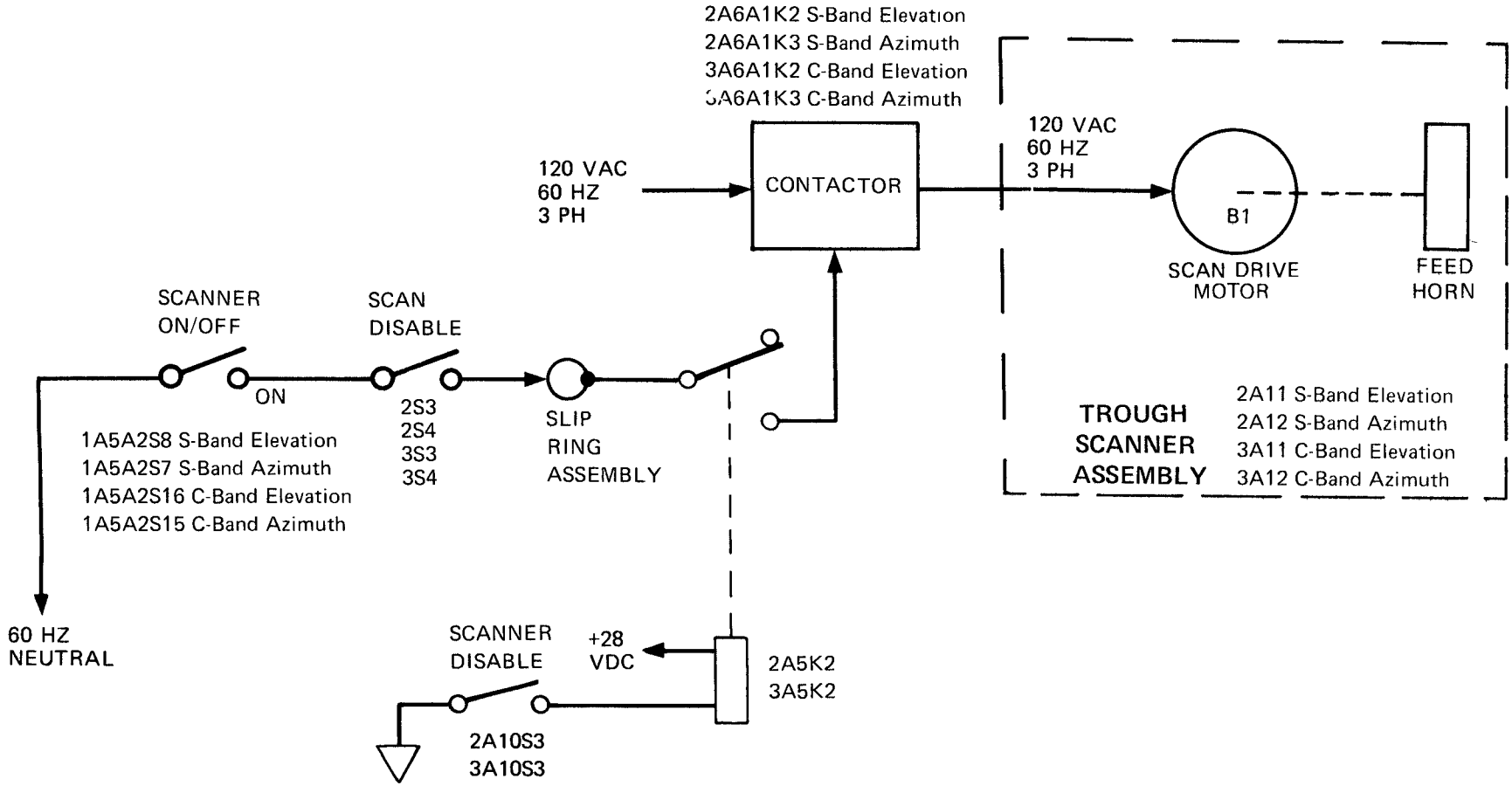


Figure 3-65. Trough Antenna Scanner and Controls

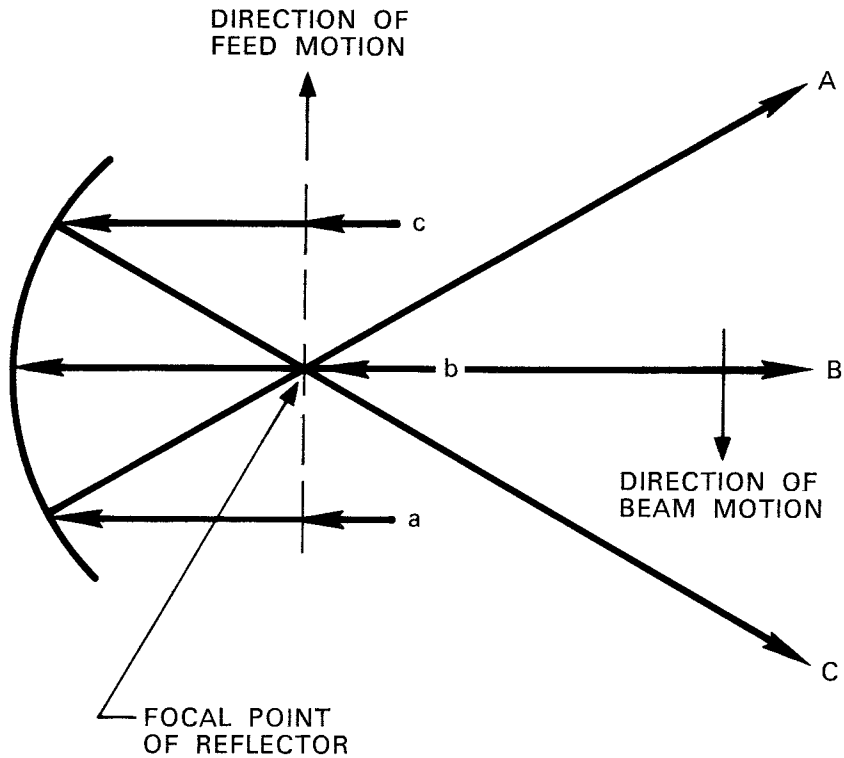


Figure 3-66. C-Band Dish Scanning Diagram

across on open waveguide. The slot exposes the portion of the open-sided waveguide directly aligned with it and permits radiation at the corresponding portion of the scan. As the outer cylinder is rotated about its axis, the radiating portion moves uniformly in the scan plane and, because of the discontinuity of the helical slot, the antenna beam is accordingly scanned in a sawtooth scan. The waveguide, crosshatched in figure 3-67, is slotted at the current null point on the walls perpendicular to the E-field inside the guide and on both sides of the rotating outer cylinder. Chokes are provided at the side wall opening and along both sides of the slot to enable mechanical motion at these surfaces free from electrical conductivity disturbance. Thus, between the input end and the slot opening, the conductive walls of the cylinder act as the walls of the waveguide and propagation down the line is normal. At the slot opening, the waveguide wall is missing and radiation occurs. Beyond the slot opening, the cylinder again forms a wall for the waveguide and a short-circuiting fin prevents any energy propagation beyond the slot opening. This short circuiting fin is located at a null point in the slot and is maintained a nominal quarter wavelength beyond the effective center of the slot opening. This is accomplished by rigidly attaching this cylindrical fin to the outer cylinder and shaping the helical edge the same as the helical slot in the outer cylinder. The wedge-shaped waveguide sections outside the scanning cylinder function to control the feed illumination in the nonscan plane. Illumination is fixed in the scan plane by the slot width.

3-535. The scanner, drive mechanism, data pickoffs, and stop mechanism are all contained in a single box-shaped housing. The semicylindrical front portion contains the scanner itself; the rear rectangular portion houses the drive mechanism and other components. The scanning cylinder is driven at both ends by toothed timing belts. The scan start, center, and stop pulses are provided by a photoelectric system.

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS, RADAR TRAINING SET, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1 FOR FIGURE 3-67

3-536. An incremental encoder 3A13A1, 3A14A1 is provided in the dish scanner assembly to sense the scan speed of the antenna. The output of the encoder is a pulse train of 10,000 pulses per revolution and when the scanner is rotating at its normal rate of 16 Hertz, the encoder output pulse rate is 160 kilohertz.

3-537. Photocell amplifier V1 receives a light beam from the lamp that is modulated by the shaft driven mask and produces a sine wave output of 5000 cycles per revolution. This output is amplified by a two-stage amplifier, amplifier Q1 and Darlington-connected emitter follower Q2, in which gain is controlled by feedback resistor R4. The output of the emitter follower is capacitively coupled (C7) to the input of a Schmitt trigger Z2. The operational amplifier functions as a Schmitt trigger by virtue of the feedback from the junction of resistors R12 and R13 at the output to the noninverting input (pin 1) of the operational amplifier. When the input voltage on the inverting input (pin 2) is positive, the output voltage goes to a value equal to the minus power supply voltage at the maximum slew rate of the device because of the positive feedback from the output to the noninverting input. When the input at pin 2 goes to negative, the output switches to a positive voltage at the slew rate of the device.

3-538. The output of the Schmitt is fed to the doubling circuit consisting of gates Z1A and Z1B, and transistors Q3 and Q4. Gates Z1A and Z1B provide complementary signal inputs to the transistor amplifiers. These complementary inputs are differentiated by networks C11-R15 and C12-R16 to produce at the amplifier outputs a series of pulses. These pulses occur at the negative transition of the output voltage of Schmitt trigger Z2 for amplifier Q4 and at the positive transition of the output voltage of Schmitt trigger Z2 for amplifier Q3. The outputs of these two amplifiers are summed by gate Z1C and routed to the driver amplifier Q5 which drives the output lines of the encoder.

3-539. A 3-phase AC induction motor drives the feed mechanism and the incremental encoder. A solenoid roller assembly provides a mechanical stop. The entire assembly is pressurized and a fiber glass radome is provided over the scan aperture. The radome is deiced by heating elements embedded in the radiating aperture walls. The heaters are turned on at the remote power and frequency control panel 1A5A2S13 and are controlled automatically by thermostats S2 and S3 located in the scanner assembly.

3-540 through 3-542 and figures 3-68, 3-69, and 3-70. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-543. The RPM sense circuit, shown in figure 3-71, is used to sense an RPM threshold of approximately 1.5 revolutions per second. The circuit consists of a one-half of the scan loss detector 3A6A2A19, an RS flip-flop on the 2-input NAND card 3A6A2A20, one circuit of the relay buffer 3A6A2A4, and relay 3A6A 2K3.

3-544. When the mode of operation is changed, the start waveguide switching pulse generated in the mode control chassis 1A1A1 and routed to the signal conditioning chassis 3A6A2 sets the output of the RS flip-flop at a logic low, which inhibits the RPM sense circuit from giving a low RPM indication until the flip-flop is reset by an incremental encoder pulse from the scanner. This prevents the RPM sense circuit from giving a low RPM indication because of an encoder failure.

3-545. The scan loss detector 3A6A2A19 is used to sense the RPM threshold. The encoder pulse train output from the scanner is routed to a single-shot Z5 through an inverter Z4. The period of the single-shot is approximately 3.0 microseconds. The output of the single shot is inverted and amplified by transistor Q2. Since the pulse width of the positive pulse as the collector of transistor Q2 is constant for all pulse repetition intervals below 3.0

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS, RADAR TRAINING SET, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1 FOR FIGURES 3-68, 3-69, AND 3-70

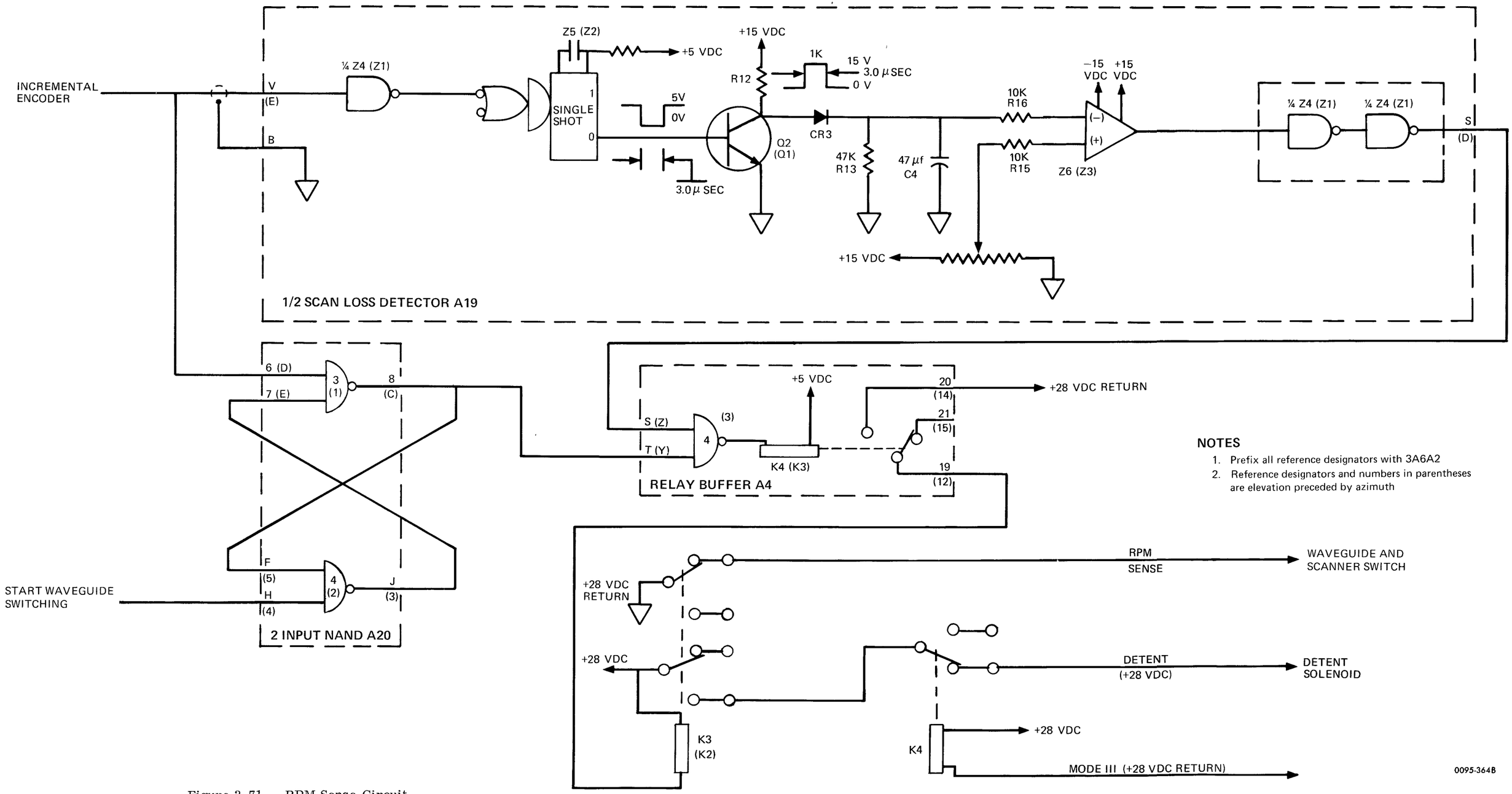


Figure 3-71. RPM Sense Circuit

microseconds, the average DC value of the signal is directly proportional to the RPM of the scanner. The 47 kilohm resistor and the 0.47 microfarad capacitor make up a filter to extract the DC average voltage from the signal at the collector of transistor Q2. As the scanner slows down, the voltage across the 0.47 microfarad capacitor decreases. The operational amplifier Z6 is used as a comparator and when the inverting input (-) is more positive than the noninverting input (+), the output is a logic low. When the noninverting input is more positive, the output is a logic high. Therefore, because of the two inversions, the output of the comparator Z6, and the scan loss detector 3A6A2A19, is at a logic low when the voltage across the capacitor is more positive than the voltage on the wiper of the potentiometer. When the revolutions per minute decrease to the point where the voltage across the capacitor is less than the voltage on the wiper of the potentiometer, the output of the scan loss detector is a logic high. Therefore, the potentiometer is used to set the threshold level of the RPM sense circuit. The output of the scan loss detector 3A6A2A19 is routed to the relay buffer 3A6A2A4.

3-546 through 3-547 and figure 3-72. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-548. L-BAND ANTENNA. The L-band antenna 2A15, 3A15, which is boresighted on the common boresight of the scanning antennas and is used to radiate the L-band transmitter outputs, forms a 12-degree circularly polarized beam. The antenna feed is a helix which is formed of copper tubing and held in place with a low-loss plastic foam. The feed line is constructed of standard 1-5/8-inch diameter solid coaxial transmission line and incorporates an impedance matching transformer to match the antenna to the line. The feed line also provides mechanical support of the feed.

3-549. X-BAND TROUGH ANTENNA. The X-band trough antenna consists of a scanning mechanism which sequentially scans two parallel plate structure antenna sections that form the T1 and T2 scans of the radar. Operation of this antenna is similar to that of the S- and C-band trough antennas described previously. Its geodesic lens is one-half section of a Luneberg lens. A ray path through the parallel plate region is shown in figure 3-73. This view shows one of the trough sections after the mirror reflecting surfaces have been installed and before the feed section has been rolled into its final one-half circle configuration.

3-550 through 3-552 and figure 3-74. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-553. X-BAND DISH ILLUMINATOR ANTENNA. The X-band dish illuminator antenna (4A11) provides the vertical scan required of the transmitted energy during the acquisition mode of the radar and provides the stationary transmitted beam during the track mode of the radar system.

3-554. The antenna assembly consists of a cut paraboloid reflector, a scanning feed, drive mechanism, and logic circuitry to control the scanner drive. The antenna radiates a vertically polarized 1.5-degree pencil beam that is scanned unidirectionally through a 12-degree vertical sector at a 25-Hertz rate.

3-555. When the X-band system is switched from acquisition to track mode, the antenna scan slows down and stops at boresight to provide the steady transmit beam. The scanner mechanism is illustrated in figure 3-75. In order to perform vertical scan, the feed horn located in the center of the scanner remains fixed while the cylinder containing the four septum regions rotates. As the cylinder rotates, the effective radiating aperture at the scanner output moves so that when the beam is reflected from the parabolic surface a unidirectional scan is obtained. During the period between scans, the feed radiates both at the top and the bottom.

3-556. Scanner timing sync generators mounted on the antenna provide pulses at

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS, RADAR TRAINING SET AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1 FOR FIGURE 3-72

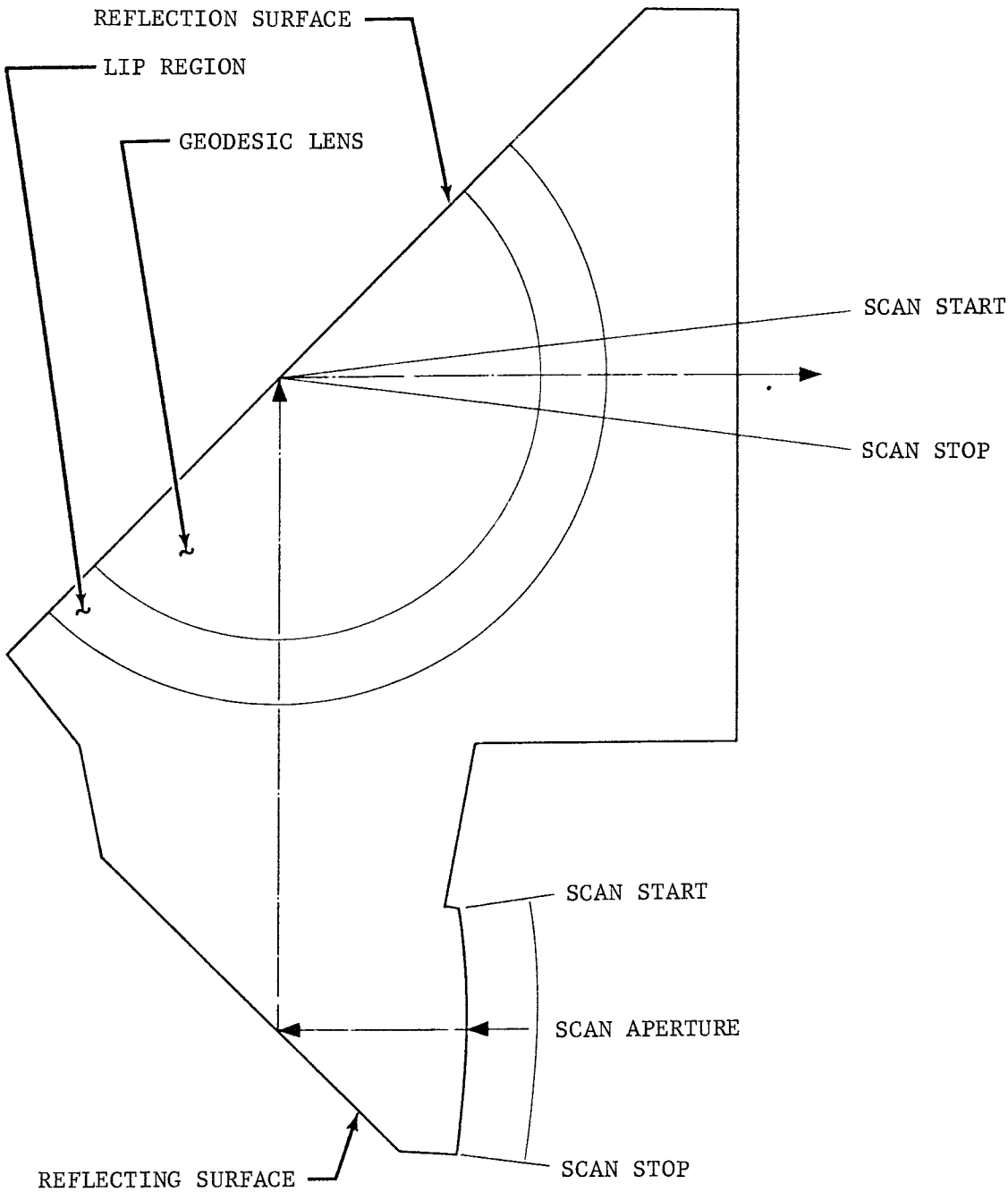


Figure 3-73. Trough Antenna Geometry

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS, RADAR TRAINING SET AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1 FOR FIGURE 3-47

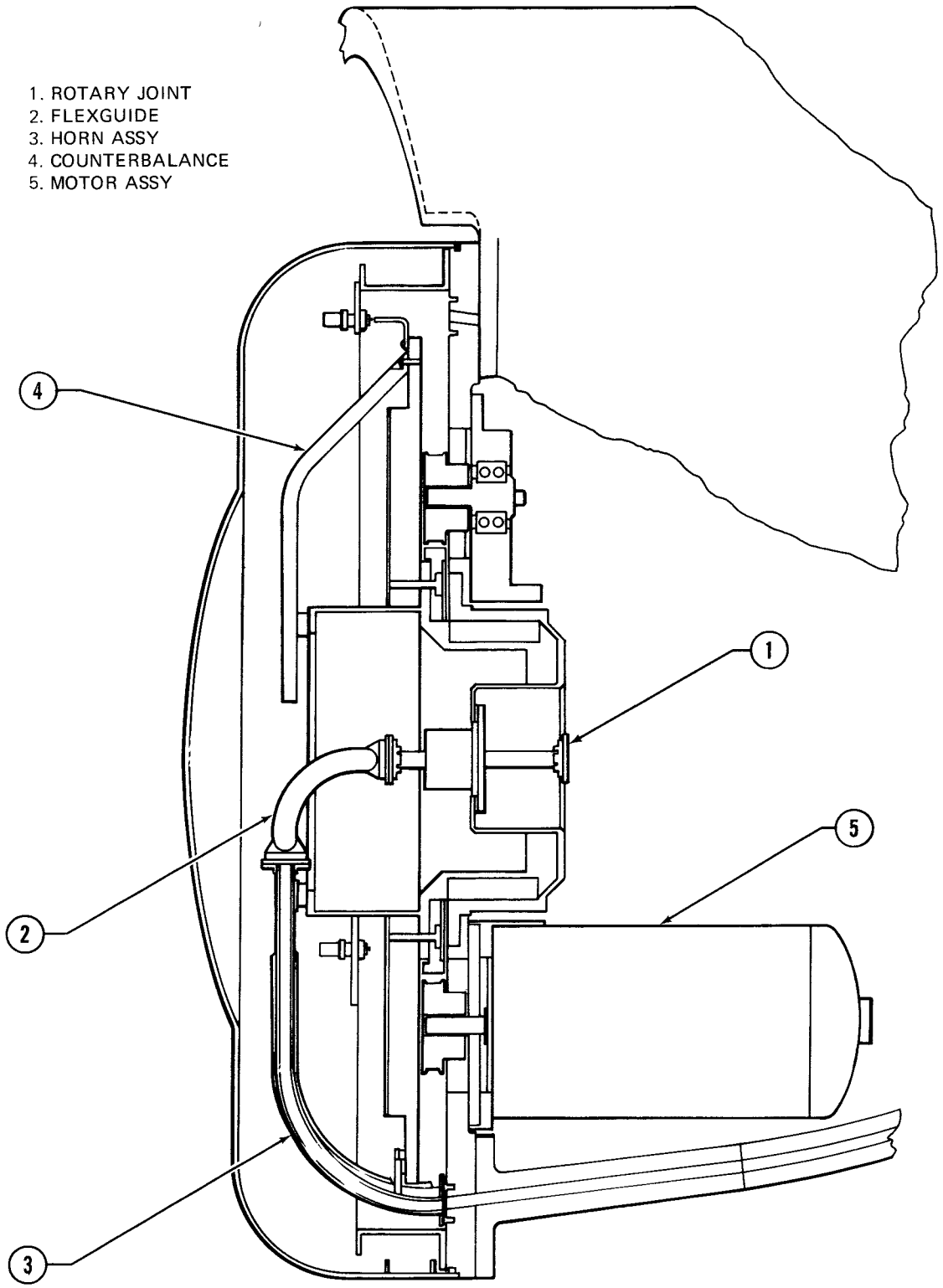


Figure 3-75. X-Band Trough Scanner Mechanism

the beginning of the scan (the first fully formed beam) and at the end of the scan (last fully formed beam). These pulses are used to provide indicator sweeps and to synchronize the receiver systems for system timing. A pulse generated at the center of the scan provides the synchronizing pulse to develop a boresight sync for the indicator cursor when operating in the acquisition mode.

3-557. Scanner Drive and Control. The scanner drive unit is enabled by the X-band acquisition mode of operation which is selected by pushing in the azimuth handwheel at the guidance operator console. When the X-band reference tracking mode is selected, the scanner drive unit is controlled by the reference operator elevation handwheel. This selection provides a 28-volt return signal through the scanner disable switch 4A11S3 to energize relay 4A5A1K5. When the relay energizes, 115-volt power is applied through the normally open contacts of relay 4A5A1K5, through the normally open contacts of relay 4A11K3, to the "forward" contactor 4A11K2 which applies 3-phase, 60 Hertz power to the motor.

3-558. When the track mode is selected by pulling out either the guidance operator azimuth handwheel or reference operator elevation handwheel (depending on radar mode selection), a dish stop command is generated. This command signal energizes relay 4A5A1K6, removes the start command which deenergizes relay 4A11K3 and the forward contactor 4A11K2, and energizes the "reverse" contactor 4A11K1. With contactor 4A11K1 energized, the phase of the power to the motor is changed to provide a braking action to the motor. Simultaneously, power is applied through contactor 4A11K3 to an electromechanical brake.

3-559. Scanner Indexing Mechanism. The indexing mechanism illustrated in figure 3-76 controls the operation of the indexing solenoid and pawl, which ensures that the antenna scanner stops at its boresight position when the X-band radar track mode is selected. View A illustrates the position of the pawl when the solenoid is deenergized during the acquisition mode when the scanner is running in the "forward" direction. When track or boresight is selected (the motor is reversed and the brake is applied), the solenoid is energized as shown in View B. The arm of the pawl is pulled against the cam until the pawl strikes the step on the face of the cam (as shown in View C) and subsequently the scanner is stopped at the boresight position. At this time, the reverse drive voltages to the motor are removed. When the acquisition mode is selected, the solenoid deenergizes as shown in view A and the scanner again turns in the forward direction.

3-560. L-BAND CUT DISH ANTENNA. The L-band cut dish antenna 4A9 is a horn-fed antenna that is used to radiate both the pulsed L-band interrogation signals and the L-band CW missile guidance commands. Signals from these two transmitters are fed into and mixed in the horn feed.

3-561. ANGLE TIMING. The radar set is synchronized in angle to timing pulses that are generated in the antenna scanners when the radar set is operating in the normal mode (target simulator off). During operation of the target simulator, timing pulses that are generated within the radar control trailer are substituted for the antenna scanner timing signals.

3-562. The target tracking mode of the radar set is determined by selector switches at the guidance operator console which control the timing signal selection for the units involved in target tracking. Additionally, selection of an external reference function determines the timing signals for the units of the radar used for reference tracking. This target track and reference track mode selection affects all of the major groups within the radar set and performs the functions enumerated below:

a. Switches control of pedestals between the guidance operator and reference operator consoles

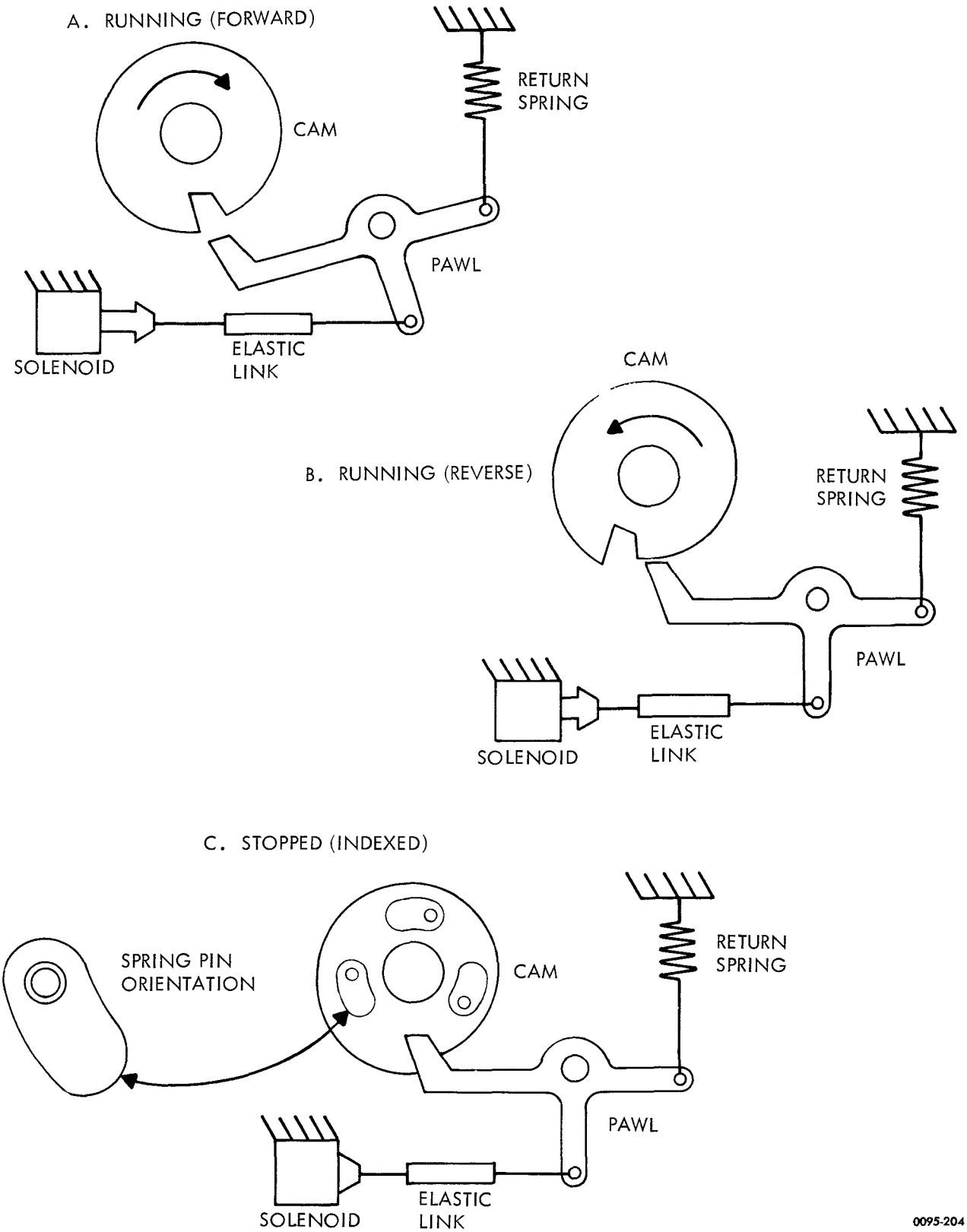


Figure 3-76. Cam/Pawl Relationship

b. Selects angle timing signals from selected target tracking pedestal to synchronize the target receiver(s) and select(s) signals from reference pedestal to synchronize the reference receiver(s)

c. Switches IF outputs from selected pedestals to correct tracking and reference receivers

d. Selects proper tracking gate widths in range and angle tracking circuits for target and reference track function.

e. Selects inputs for the presentation group sweep generation circuits for target track and reference track

f. Routes tracking information from target and reference range and angle track circuits to missile simulation and scoring system

g. Selects and reads pedestal position of target and reference tracking pedestals into missile simulation and scoring system in proper sequence as commanded by the computer

h. Connects follow-up instrumentation synchros in servo dial assemblies for target tracking and reference operators to correct pedestal synchros. When operating in target simulator mode, timing pulses are generated within the synchronizer 1A1A5 and the servo repeaters are connected directly to the command servo transmitters (reference tracking mode is not simulated).

3-563. S-BAND ANGLE TIMING. The generation and distribution of angle timing for S-band operation are shown in figure 3-77. Magnetic pickups are used to generate the start scan, end scan, and center scan pulses. The outputs of the magnetic pickups are routed to comparators on the scanner pulse generator board A1 in the scanner pulse generator assembly 2A11A1 and 2A12A1. The comparators Z1, Z3, and Z5 "square up" the pickup output signals and apply them to single-shots Z2, Z4, and Z6, which are used to set the timing pulse pulsewidth. The outputs of the single-shots are routed to the line driver A3.

3-564. The line drive operation is the same as that used in the transmitter trigger circuits. The outputs of the line driver are routed to line receiver A10 in the signal conditioning chassis (2A6A2). The outputs of the line receiver consist of +5 volt pulses. The start scan and end scan timing pulses are then routed to the dead-time gate generator A12. The boresight sync (center scan) pulses are routed to the line driver A13.

3-565. Dead-Time Gate Generator A12. The start and stop dead-time sync pulses from the line receiver are applied to the dead-time gate generator where they set and reset an RS flip-flop that is formed by interconnected NAND gates. An RS flip-flop changes state when one of the inputs goes to zero volts and holds that state until the other input goes to zero volts.

3-566. When the output of the start dead-time pulse from the line receiver goes to +5 volts, the pin 4 input of comparator Z1 in the dead-time gate generator goes to zero volts because of the inversion of the NAND gate. As a result, pin 6 of comparator Z1 goes to +5 volts regardless of the level on pin 5. The plus level on pin 9 and the plus level on pin 10, which are due to the inversion of the zero input on pin 13, cause pin 8 to go to zero. This state is maintained until the signal at pin 13 goes to +5 volts. When this occurs, the level on pin 10 goes to zero volts, and pin 8 goes to +5 volts, causing pin 6 to go to zero volts and holding the pin 8 output at the plus level.

3-567. The output at pin 8 is the inverted dead-time gate (i.e., the output is at ground during the dead-time gate and at +5 volts for the quiescent state) and is routed to the line driver A13. The noninverted dead-time gates are routed to the AFC clock circuits.

3-568. AFC Clock A17, A19. The AFC clock circuit is used to generate a high frequency (approximately 160 kilohertz)

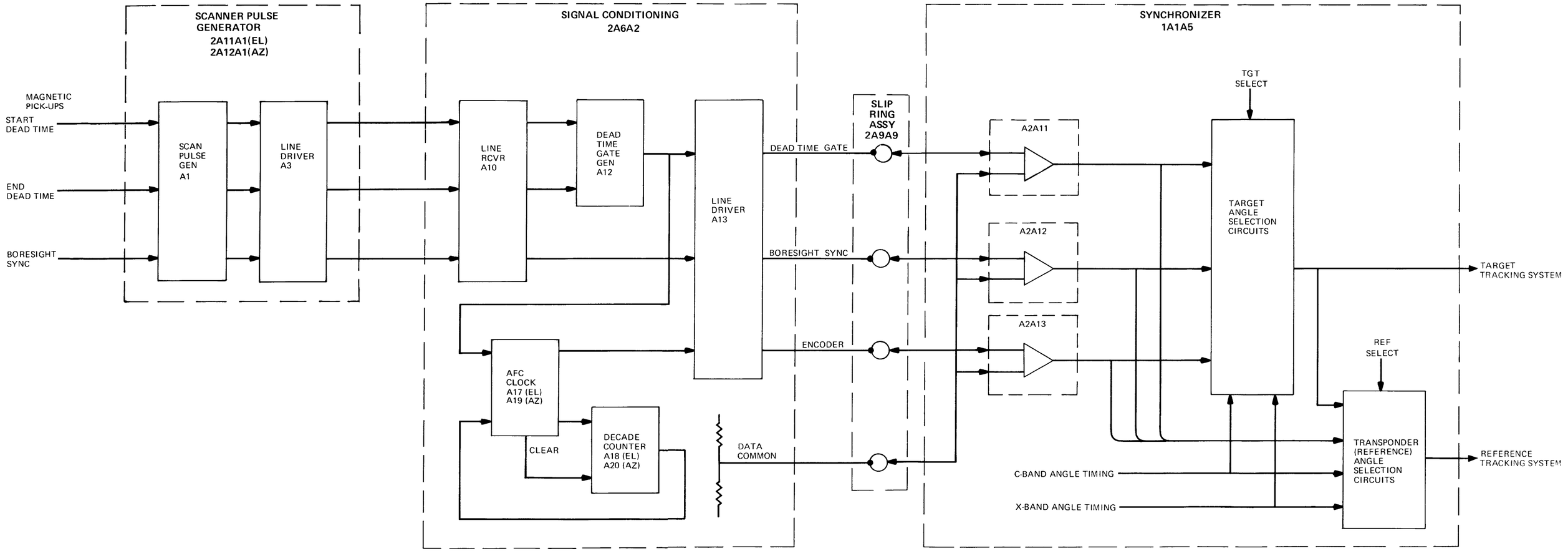


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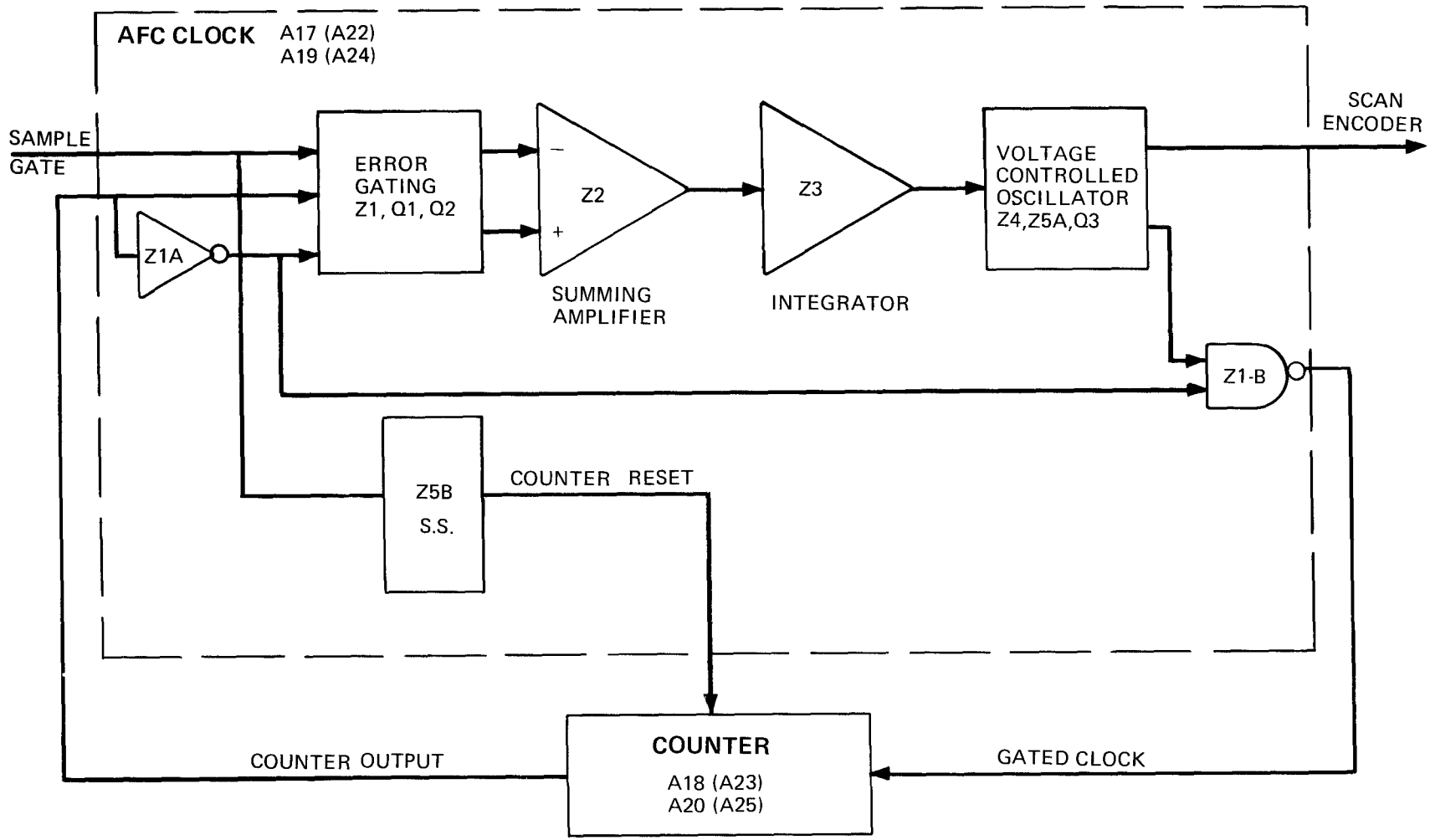
Figure 3-77. S-Band Angle Timing Block Diagram



NOTE

Reference designators are S-Band except those in parentheses which are C-Band

0095-365C

Figure 3-78. AFC Clock Circuit Simplified Diagram

clock signal whose frequency is directly proportional to scanner speed. The AFC clock output is used to sense the scanner speed for trigger blanking and to determine the antenna beam position at any instant during the angle scan. The AFC clock circuit (shown in figure 3-78) consists of an error gating section Z1-Q1-Q2, a summing amplifier Z2, an integrator Z3, a voltage controlled oscillator Z4-Z5A-Q3, an external decade counter, and a counter reset single-shot Z5B.

3-569. The sample gate (scanner dead time gate) is routed to the error gating circuit along with the counter output. (See timing diagram, figure 3-79.) At the end of the sample gate period, single-shot Z5B is triggered to provide a counter reset pulse. At the end of the counter reset, the decade counter begins counting. This is a four-stage decade counter connected in series so that the counter output will go to a logic high when the clock pulses reach 8000 after counter reset. The counter output is inverted by amplifier Z1A and routed to gate Z1B along with the clock signal so that when the counter reaches 8000 the clock is gated off until the next counter reset sets the clock output low.

3-570. If the 8000 count occurs as shown in the timing diagram, the collectors of transistors Q1 and Q2 will alternately go to +5 volts as shown. The collectors of transistors Q1 and Q2 are connected to the inverting and noninverting inputs of amplifier Z2. The resultant output of amplifier Z2 is used to drive the integrator Z3. The output of integrator Z3 is routed to the voltage controlled oscillator. The oscillator is designed so that as the output of integrator Z3 goes more negative, the oscillator frequency will increase.

3-571. The AFC clock circuit stabilizes at the point where integrator Z3 returns to the same output level after the sample gate as it had before the sample gate. If the scanner speed decreases, the sample gate and counter output will combine so that transistor Q1 is positive for a longer period than transistor Q2 and the result is that the output of integrator Z3 is more positive after the sample period, and, therefore, the clock frequency decreases.

3-572. The voltage controlled oscillator consists of single-shot Z4, transistor Q3, and single-shot Z5A. Single-shots Z4 and Z5A are interconnected so that each triggers on the trailing edge of the other's output to produce a free-running multivibrator. The period of single-shot Z5A is fixed at approximately 1.0 microsecond. Transistor Q3 is connected in the RC pulsewidth determining circuit of single-shot Z4 and acts as a voltage controlled resistor. As the voltage on the base of transistor Q3 goes negative, the resistance of transistor Q3 decreases, making the period of single-shot Z4 shorter, which in turn increases the frequency of the clock. Potentiometer R12 is used to set the operating level of integrator Z3. As the wiper of potentiometer R12 is moved toward +5 volts, the output of integrator Z3 must go more negative to maintain a consistent clock frequency. The output of integrator Z3 is nominally set to -5 volts.

3-573. Line Driver. The dead-time gate from the dead-time gate generator, and the AFC clock output are applied to the line driver to provide the driving capability for driving the signal lines to the radar control trailer.

3-574. Line Receiver. The line receiver receives the dead-time gate and scan encoder signals and a data common signal from the antenna trailer circuits. The data common signal is a +2.5 volt signal that is generated from a power supply voltage generator within the antenna trailer.

3-575. Utilization of the logic level signal and the data common signal as inputs to the differential line receiver provides noise immunity to extraneous interference picked up on the cables between trailers, since the interference is applied to both the data line and common line and effectively removed by the common mode rejection afforded by a differential line receiver. Also any difference in power

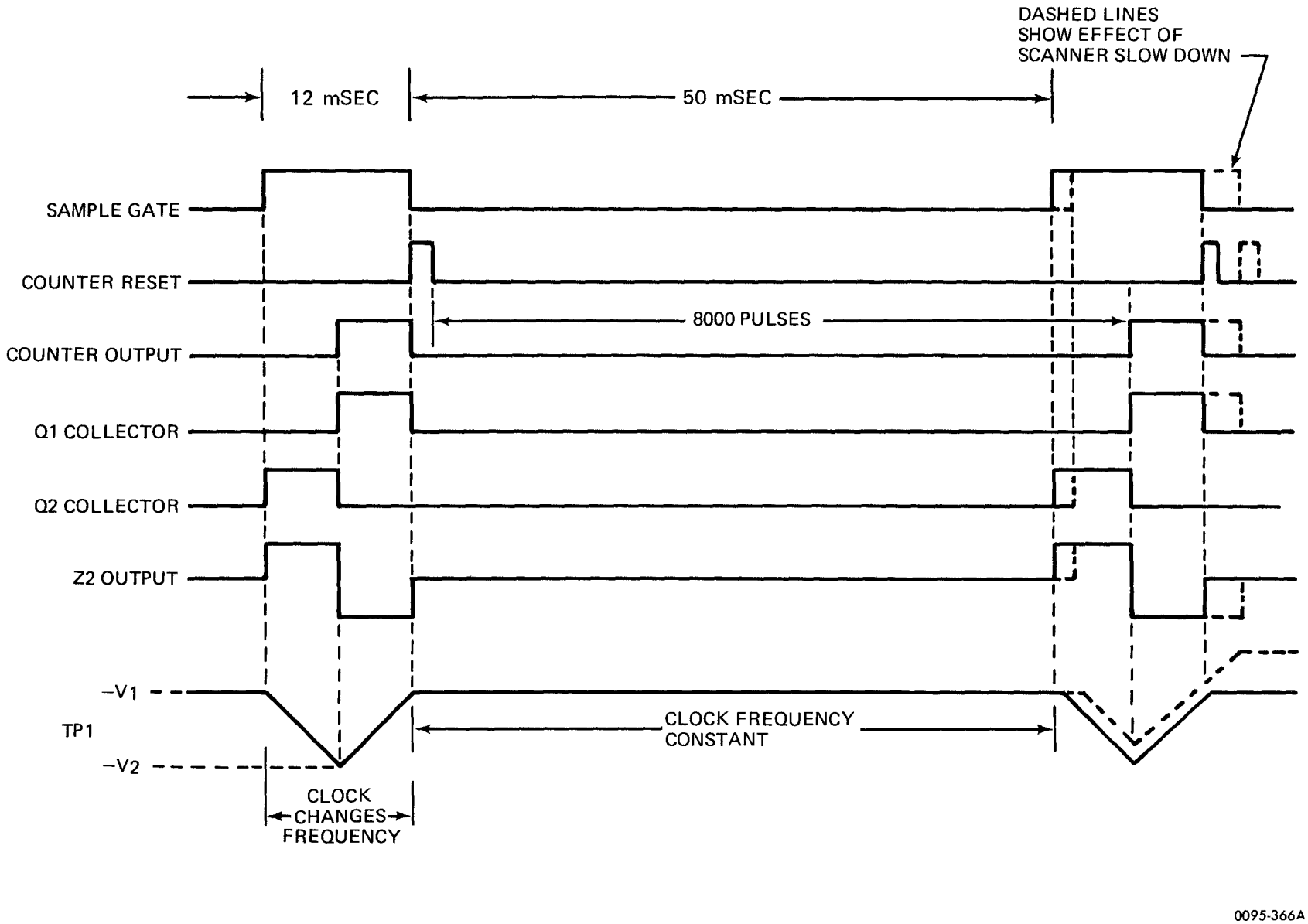


Figure 3-79. AFC Clock Timing Diagram

supply level or power supply ripple between trailers is rejected since both inputs to the differential receiver are generated from the power supplies in the antenna trailer.

3-576. The S-band angle timing signals are then routed to the angle timing selection circuits in the synchronizer 1A1A5.

3-577. C-BAND ANGLE TIMING. The C-band angle timing circuits are used to generate the antenna scan synchronization signals for use during C-band target and/or reference track operation and consists of both trough and dish timing circuits as shown in figure 3-80. The trough antenna timing is similar to the S-band antenna timing and consists of magnetic pickups used to sense scanner position, scanner pulse generators 3A11A1 or 3A12A1 to condition the magnetic pickup outputs, a line receiver A10, a dead time gate generator A12, and a line driver A13.

3-578. The AFC clock circuits A24 and A25, or A22 and A23, operate in the same manner as those used in S-band operation; however, the inputs and outputs are switched through gates on gate assembly A20 as a function of mode selection. In the first and third modes of operation, the sample gate is the trough dead-time gate and the clock output is routed through the line driver A13. In the second mode of operation, the dish dead-time gate is used for the sample gate and the clock output is routed to the line driver A18.

3-579. C-Band Dish Scanner Timing Signals. A fiber/optics bundle, mounted on the scan cylinder, is used to conduct light from a lamp to the scan start, center, and stop photoelectric pickups. As the scan cylinder is rotated, the fiber optics bundle conducts light to each of the photoelectric pickups in turn.

3-580. The photoelectric pickup circuit for the start and end scan signals consists of a voltage divider and an emitter-follower stage as shown in figure 3-81. As light from the fiber optics bundle passes by the photoelectric device, its resistance decreases causing a corresponding decrease in the voltage on the base of the emitter-follower stage. The emitter follower is used to isolate the output of the photoelectric pickup. The negative-going pulse output of the emitter follower is capacitively coupled to a pulse shaping circuit.

3-581. The pulse shaping circuit for the start and end scan pulses consists of a Schmidt trigger stage and an emitter-follower driver stage. The pulse is applied to the base of the first transistor in the Schmidt trigger stage. With no pulse present, this transistor is turned off and the second transistor turned on. When the pulse is applied, the first transistor turns on and in turn inhibits the second transistor. The resultant waveform at the collector of the second transistor is a negative going pulse. The zener diode in the collector circuit of the second amplifier stage limits the positive swing of the collector voltage that is applied to the base of the output transistor. The output-emitter follower stage is used to drive the -5 volt pulse over 75-ohm coax to the signal conditioning chassis 3A6A2 in the antenna trailer.

3-582. The center scan pulse is generated with two photoelectric pickups as shown in figure 3-82: one for the leading edge and one for the trailing edge of the pulse. The two photoelectric pickups are mounted a fixed distance from each other and this distance sets the pulse width of the center scan pulse.

3-583. The photoelectric pickup circuits and pulse-shaping circuits are the same as the scan start and scan stop circuits with the exception that there are no zener diodes in the collector circuits of the second amplifier stages. Instead the two pulses are differentiated by RC differentiators and are routed to an RS flip-flop. The leading edge pulse sets the flip-flop output to -5.5 VDC and the trailing edge pulse resets the flip-flop output to 0 VDC. The output of the flip-flop is applied to the

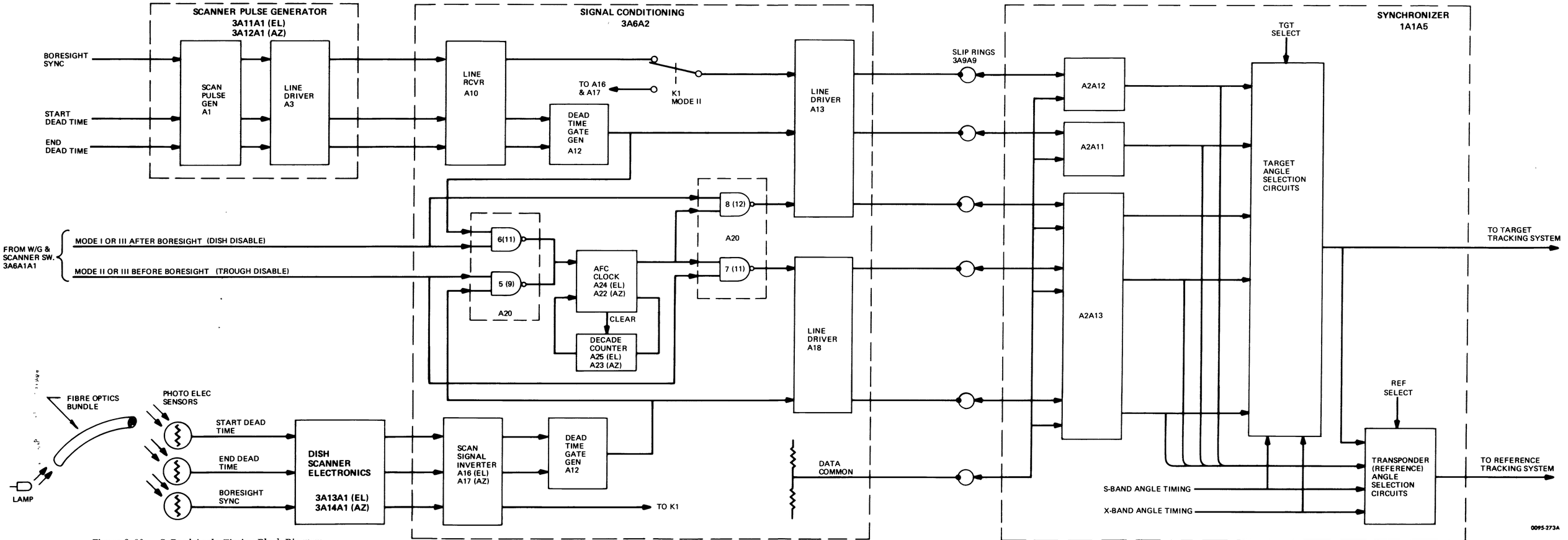


Figure 3-80. C-Band Angle Timing Block Diagram

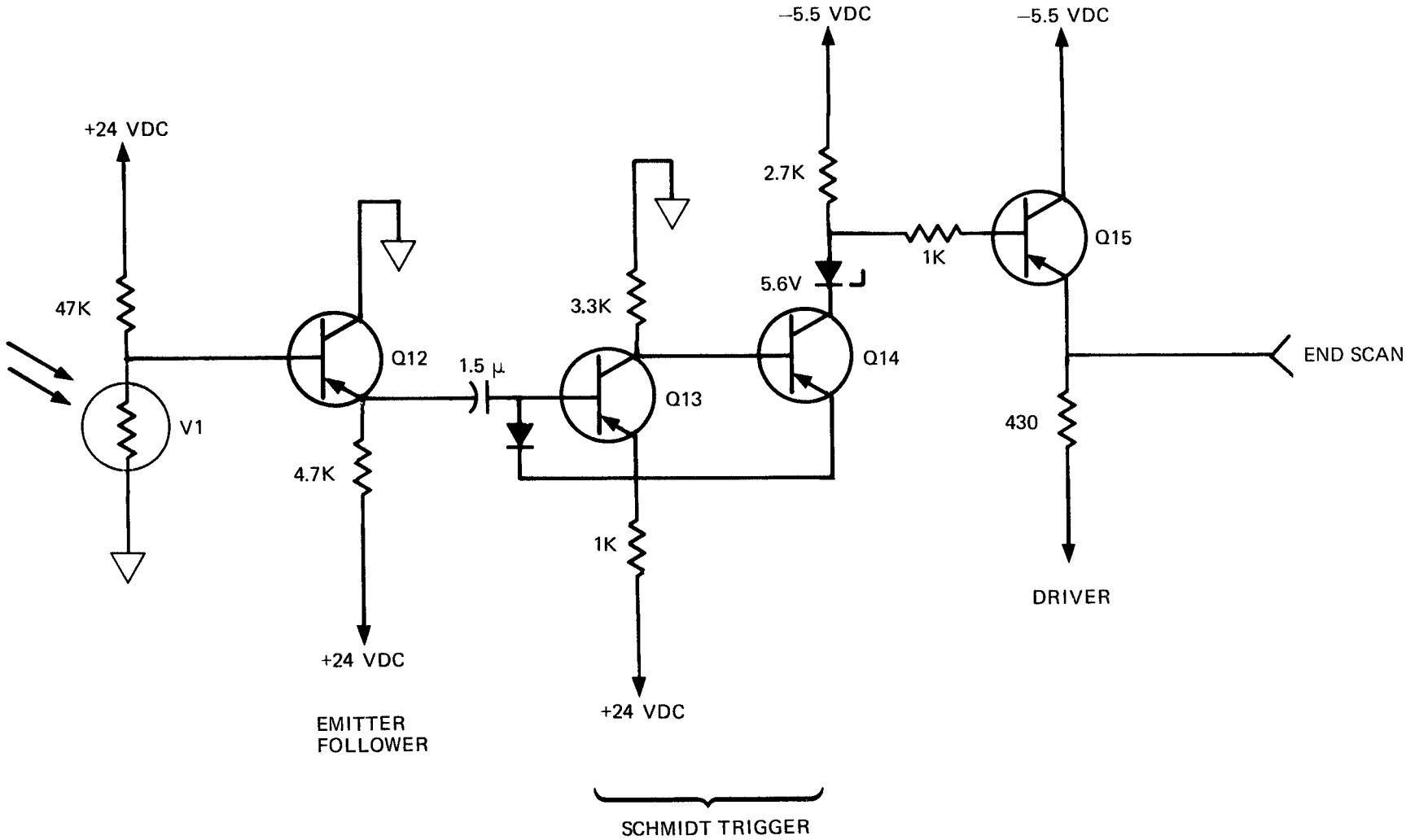


Figure 3-81. Dish Scanner Start and End Scan Pulse Generation

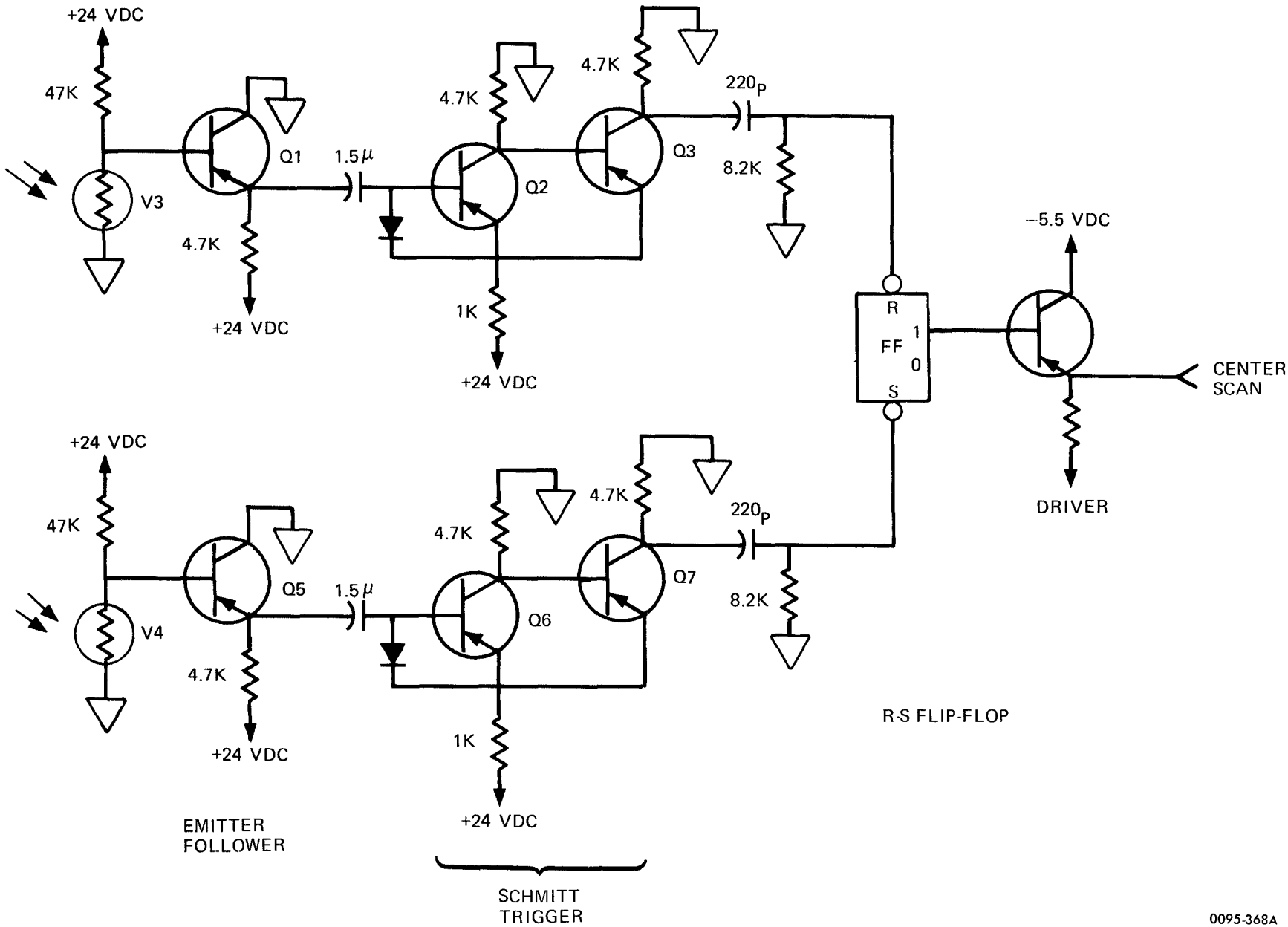


Figure 3-82. Dish Scanner Center Scan Pulse Generation

base of the emitter-follower driver stage that is used to drive the center scan pulse over 75-ohm coax to the signal conditioning chassis 3A6A2 in the antenna trailer.

3-584. Scan Signal Inverter. The dish scanner timing signals are buffered by scan signal inverters. The pulses are applied to the base circuit of amplifiers Q1, Q2 and Q3. Resistors R1, R5, and R9 terminate the input cable in its characteristic impedance to minimize reflections. The pulse received is a -5 volt pulse referenced to a zero volt level. When the input pulse is at -5 volts, diodes CR1 through CR4 are forward-biased and, due to their forward voltage drop, provide a minus voltage at the junction of diodes CR2, CR6 and CR7 that is sufficient to reverse bias diode CR7 which turns off transistor Q1 providing an output level of +5 volts. When the input is at ground, the function of diodes CR2, CR6 and CR7 is positive causing CR7 to be forward-biased and turning on transistor Q1 to provide an output level of zero volts. The start and end scan outputs are routed to the dead-time gate generator and the center scan (boresight sync) signal is routed to relay K1 where it is switched with the trough center scan signal as a function of operating mode.

3-585. The C-band angle timing signals are then routed through the line receiver in the synchronizer to the angle timing selection circuits.

3-586. X-BAND ANGLE TIMING. The X-band angle timing circuits consist of the T1 and T2 trough antenna timing circuit and the illuminator (dish) antenna timing circuits as shown in figure 3-83. The T1 and T2 timing signals are generated by magnetic pickups located around the scanner face and consist of start scan, end scan, predirectrix, and directrix. The magnetic pickup outputs are processed by the scanner pulse generator 4A10A2 in the same manner as the S-band scanner timing signals.

3-587. The T1 and T2 start and end scan pulses are routed to the dead-time gate generator A8 to generate the T1 and T2 dead-time gates as shown in figure 3-84. In addition, the T2 end scan and the T1 start scan are routed to one of the dead-time gate generator circuits to form the AFC clock sample gate.

3-588. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-589. Illuminator Scanner Timing. The illuminator scanner timing is provided by an optical encoder (Rotaswitch Pulser) which is used to generate the indicator timing signals for the X-band acquisition mode of operation. These signals are start scan, center scan, and end scan.

3-590. The encoder shaft is mechanically coupled to the scanning mechanism and, as the scanner rotates, an opaque disk with three transparent spots also rotates at the same rate. There are three identical photocell sensing circuits in the encoder and, as the dish makes one revolution, each circuit generates a -5 volt pulse corresponding to that scanner position. Each circuit consists of a lamp/photocell pair, a Schmidt trigger stage and an output driver transistor. As the transparent spot on the disk passes between the lamp and the photocell, the photocell resistance decreases, generating a positive-going pulse at the input of the Schmidt trigger. This causes the input transistor to cut off and the output transistor of the Schmidt trigger to conduct, generating a positive-going pulse on its collector. This pulse is inverted by the driver transistor to generate the -5 volt pulse.

3-591. The three timing pulses are fixed in relation to each other since they are generated by the rotation of the disk. A magnetic pickup is mounted in the scanner to permit mechanical alignment of the encoder and scanner. This is done by rotating the case of the encoder (while the scanner is running) until the leading edge of the center scan pulse is aligned to the zero-crossing of the magnetic pickup signal.

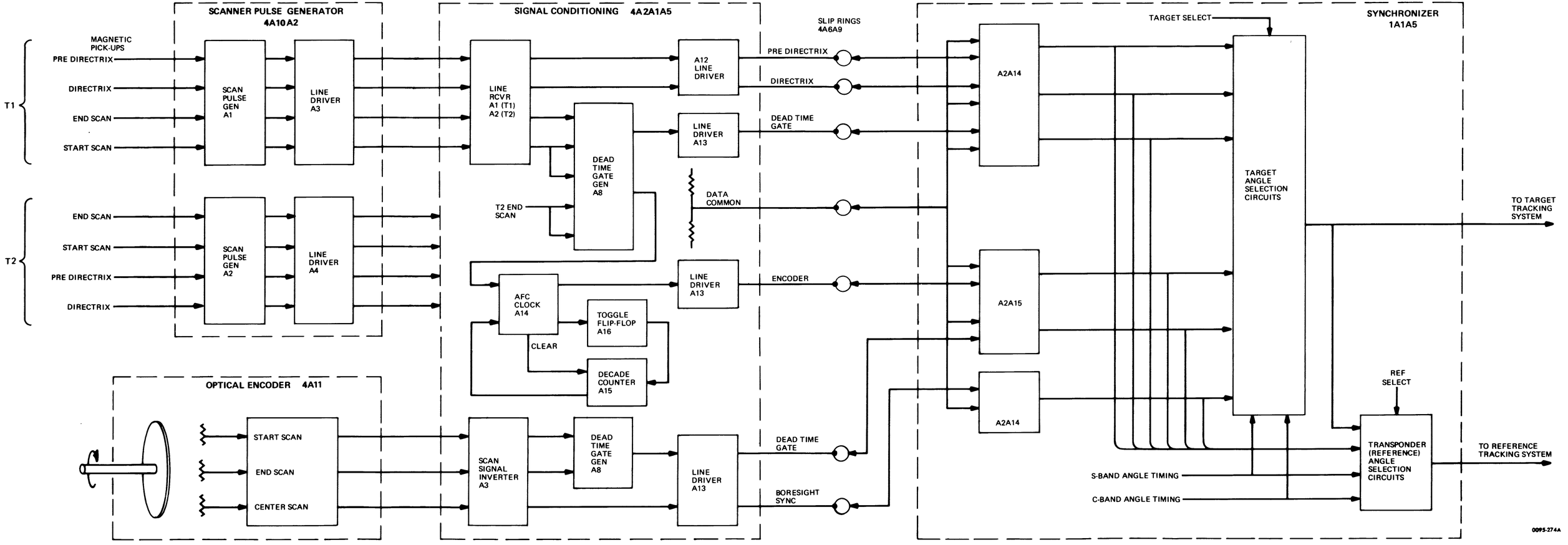


Figure 3-83. X-Band Angle Timing Block Diagram

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS, RADAR TRAINING SET, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1 FOR FIGURE 3-84

3-592. The encoder output signals are routed to a scan signal inverter 4A2A5A3 in the signal conditioning chassis. The start and end scan pulses are routed to the dead-time gate generator A8 to generate the dish dead-time gate.

3-593. The X-band antenna timing signals are routed through line receivers A12 and A13 to the angle timing selection circuits in the synchronizer 1A1A5.

3-594. INTERNAL ANGLE TIMING GENERATION. In order to achieve angle synchronization of the radar set during operation of the target simulator, simulated dead-time gates for the target track systems are generated within the synchronizer assembly in lieu of the dead-time gates derived from the antenna scanner pulse outputs.

3-595. The simulated dead-time gates and the simulated predirectrix pulses for X-band operation are generated in the synchronizer 1A1A5. The predirectrix pulses simulate those pulses generated by the X-band trough antenna that occur at the 2.2-degree point of the T1 scan and the 9.2-degree point in the T2 scan and are used to provide synchronizing pulses to the X-band receiver system.

3-596. The simulated pulses are generated by two sets of RC clocks, angle counters, and decoding logic. Angle counter 1 and its associated clock and decoding logic generate the simulated T1 and T2 predirectrix, the azimuth dead-time gate for S- and C-band operation and the T1 and T2 dead-time gates for X-band operation. Angle counter 2 and its associated circuits generate the simulated elevation dead-time gate and, when X-band has been selected, a simulated X-band acquisition dead-time gate.

3-597 through 3-600. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-601. Dead-Time Gate Selection. The dead-time gates from the simulated dead-time gate generator and the dead-time gates generated from the antenna scanner pulses are routed to the selection logic in the synchronizer 1A1A5 where the correct dead-time gate is selected. This process results in the selection of either the simulated gates or those gates developed from the antenna scanner pulses along with the gates from the correct antenna system (S-, C- or X-band) for the target tracking system. Correct gates are also selected for the reference track system according to the modes selected by the reference operator at the tracking control 1A3A4 and the target track (guidance) operator at the mode control 1A1A1.

3-602. Dead-time gate selection for a typical operation (target simulator off, target tracking with X-band, and using C-band as the reference track system) is accomplished as follows. The X-band pulses for the target track system, T1 dead-time gate and T2 dead-time gate, are gated through NAND gates A1A23-5 and A1A23-7 since the simulator select (-) line is at +5 volt (target simulator is not selected) and is OR'd with the output of NAND gates A1A23-6 and A1A23-8 to gates A1A16-11 and A1A16-12 to provide the synchronization inputs for the X-band receiver and T1 and T2 indicator sweep circuits. The dead-time gate output of gates A1A23-9 and A1A23-10 are passed through gates A1A22-5 and A1A22-7 since the X-band (+) input is at +5 volts (X-band has been selected), and through gates A1A24-9 and A1A24-10 to provide sweep synchronization for the guidance operator indicators. The dead-time gates passed by gates A1A22-1 and A1A22-3 and A1A24-5 and A1A24-7 provide the T1 and T2 reset pulses to synchronize the target tracking loops.

3-603. Selection of the C-band dead-time gates for the reference track system is accomplished as described for the C-band Mode I case. In order to select these gates, the reference operator selects EXTERNAL REFERENCE and C-band at the reference track chassis 1A3A4. This will cause the reference select (+) line to go to +5 volts and the reference C-band (+) line to go to +5 volts. This will pass the azimuth trough dead-time gate through gates A1A22-12,

A1A47-4, A1A46-9, A1A41-8 in series. The elevation trough dead-time gate passes through A1A47-6, A1A47-8, A1A46-10, and A1A41-9 in series. This provides synchronization to the reference operator indicator sweep circuits and the reference receivers. The signals at the outputs of gates A1A47-4 and A1A47-8 are also changed to 1.5 millisecond pulses by single-shots A1A49-3 and A1A49-4 which are used to provide the azimuth reset and elevation reset pulses to synchronize the reference tracking circuits.

3-604. SCAN ENCODER. The scan encoder output from the antenna scan synchronized AFC clock is used to sense the scan speed of the antennas and is also used by the missile simulation and scoring group to determine the antenna beam position at any point in the antenna scan. The scan encoder outputs from the AFC clocks are routed to line drivers in the signal conditioning unit 2A6A2, 3A6A2, or 4A2A1A5, in the antenna trailers. The line driver outputs along with a data common line are routed through the slipring assembly to the radar control trailer where a differential receiver reconstructs the encoder signals as described previously for the antenna dead-time gates. The scan encoder outputs from the line receiver are routed to the scan loss detection circuits and the scan encoder selection circuits.

3-605. Scan Loss Detection. The scan-loss detection circuits determine an abnormal scan speed of the antenna scanners and, if an abnormal condition exists, light a scan loss indicator on the synchronizer 1A1A5 and blank the triggers for the transmitters associated with the antenna scanner. An abnormal condition for the trough antenna scanners is sensed when the scan speed is below one-half of the normal scan speed.

3-606. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-607. Scan Loss Detector. The scan loss detector receives the pulse train from the line receiver, generates 1-microsecond pulses when triggered by this pulse train, amplifies the pulses, and develops a DC voltage level that is a function of the pulse rate. This DC voltage level is compared to a threshold level and, when the level is below the threshold (the scan rate is slower than normal), a scan loss signal is generated.

3-608. The input pulses are inverted in a section of gate Z1 whose output triggers single-shot Z2 which generates a 1-microsecond pulse when triggered. The zero volt output on pin 6 of the single-shot turns off amplifier stage Q1 during the 1-microsecond interval causing its collector voltage to go to +15 volts. This DC level forward biases diode CR1 and establishes a charge on capacitor C2. Diode CR1 is reverse biased during the interval between pulses so that the discharged path for capacitor C2 is through resistor R3. Successive pulses charge capacitor C2 to higher levels if the pulse rate is high enough to compensate for the discharge through resistor R3.

3-609 through 3-613 and table 3-3. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-614. It should be noted that if the target simulator is in use (switch is on) the signal selected is the simulated encoder signal from the RC clock A1A37 for S- and C-band and RC clock A1A39 for X-band.

3-615. RECEIVER GROUP.

3-616. The receiver group consists of the receivers used to process the target returns for the target tracking function, the target returns for the reference tracking function, the transponder returns for transponder reference tracking function, and the returns from airborne jammers for jammer power measurements. In addition, during target simulator mode operation, the selected target track receiver and the transponder receiver are used to process IF signals from the target simulator in lieu of the signals from the

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS, RADAR TRAINING SET, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1 FOR TABLE 3-3

antennas and prereceiver systems. Signal flow and function of the various receiver assemblies are illustrated in figure 3-85.

3-617. The receiver group consists of S-band, C-band and X-band prereceiver units which are located in the antenna trailers, and the target receiver units, transponder receiver unit, and down link jammer receiver unit which are located in the control trailer.

3-618. S-BAND AND C-BAND PRERECEIVER.

3-619. The S-band and C-band prereceivers 2A3, 2A8, 3A3, and 3A8 are similar. Each prereceiver consists of two channels: one for azimuth and one for elevation. Each channel contains an RF amplifier and separate prereceiver sections for target, transponder, and down link jammer returns. Since the azimuth and elevation channels in each prereceiver system are identical (except for operating frequencies), the following description will cover only the S-band azimuth prereceiver channel (see figure 3-86). Differences between the channels will be noted when applicable.

3-620. The received RF energy from the azimuth receiving antenna is routed through the waveguide switches and duplexer of the antenna group and applied to the input of the S-band prereceiver. This RF energy is routed through the main line of the noise-source directional coupler to the input of traveling wave tube (TWT) amplifier 2A8A1AR1.

3-621. The nose-source directional coupler assembly consists of a diode noise source that produces a wide-band RF noise signal and is triggered by the receiver performance monitoring system for noise figure measurements. The noise source output is coupled to the TWT input through the coupled arm of the directional coupler A2.

3-622. TWT AMPLIFIER. The TWT amplifier is a broad bandwidth RF amplifier which amplifies the target and transponder RF signals. Due to its RF gain, this TWT amplifier is the primary determining element of the receiver system noise figure. The TWT amplifier makes use of the distributed interaction between an electron beam and a traveling wave to amplify the RF signal input. The RF input is applied to the helix within the TWT, setting up a traveling wave in the helix. Interaction between the wave in the helix and the intermodulation of the electron beam due to the helix signal, amplifies the signal through the TWT. The output of the TWT amplifier is taken from the output connection on the helix. A gain control signal is applied to the grid of the TWT to reduce the gain of the amplifier. This positive gain control voltage consists of a pulse that reduces the gain during the transmitter main bang and a sensitivity time control (STC) voltage that changes the gain of the TWT as a function of time to reduce the effects of ground clutter on the system.

3-623. The sealed TWT package contains a solid-state power supply that generates voltages required for TWT.

3-624. POWER DIVIDER. The TWT amplifier output is routed to a hybrid coupler 2A8A3HY2 that is used as a power divider. The power divider splits the RF power and routes one-half of the power to HY3 which divides the signal between the down link jammer prereceiver and transponder prereceiver.

3-625. TARGET, TRANSPONDER, AND DOWN LINK PRERECEIVER CHANNELS.

3-626. Since the target, transponder, and down link prereceiver channels (figure 3-87) are similar, they will be described concurrently. The signal input from the power divider is filtered to separate the target and transponder RF signals, then converted to an IF signal and amplified. This amplified IF signal is routed through the slip rings to the receiver select circuits in the control trailer.

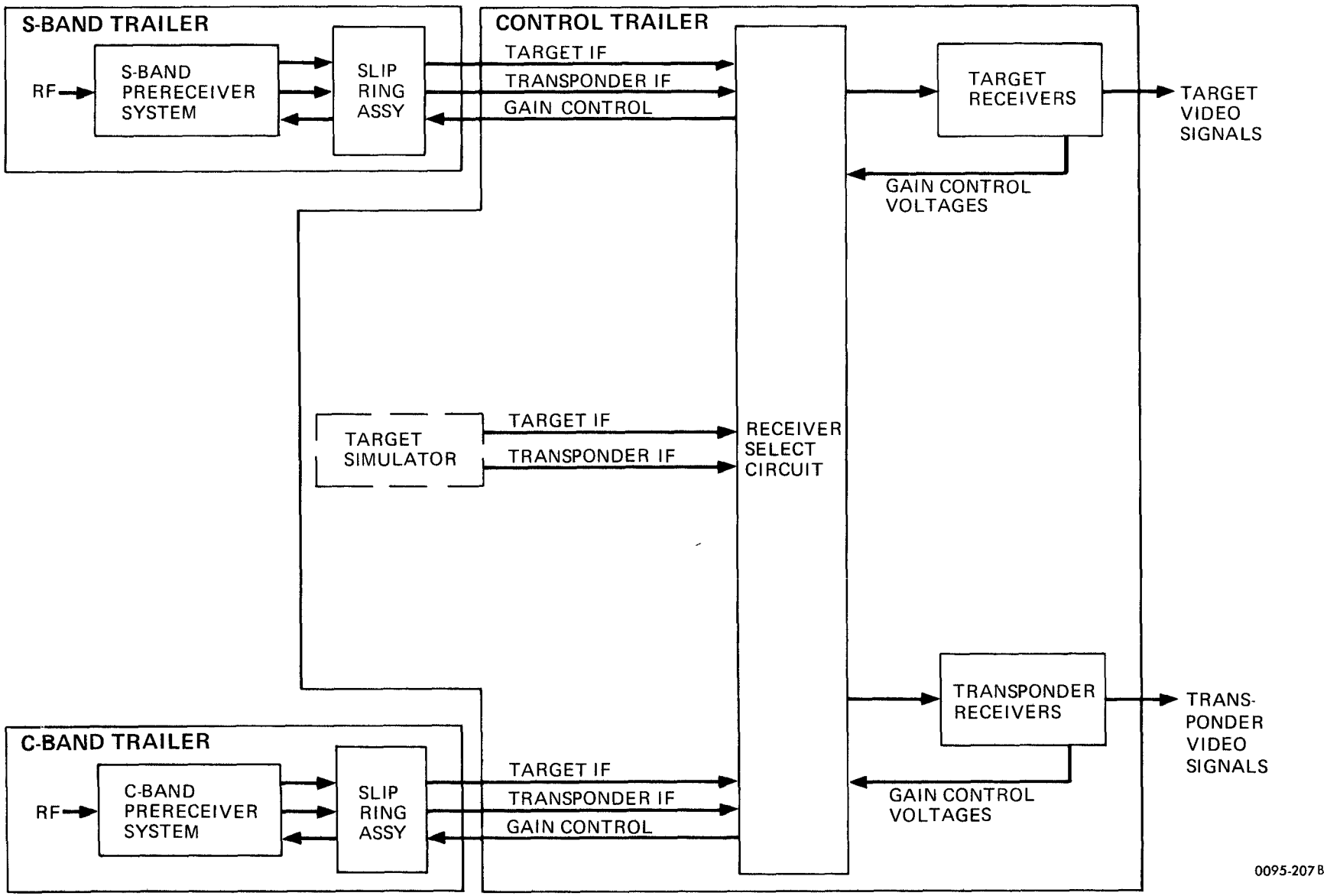


Figure 3-85. S/C Band Receiver Group Simplified Block Diagram

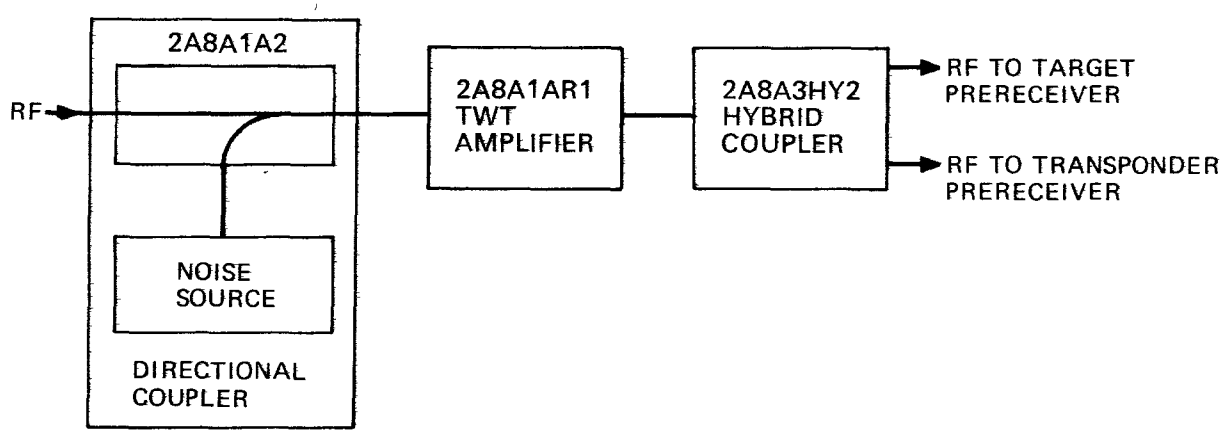


Figure 3-86. Prereceiver Microwave Block Diagram

3-627. ISOLATOR-FILTER NETWORK. The RF energy from the power divider is applied to isolator-filter networks in the transponder and target prereceivers. These filter networks FL1, FL2 and FL3 are bandpass filters which are tuned so that the target or transponder returns are separated and passed to their respective mixer-preamplifiers. Isolators AT4 and AT5 in conjunction with bandpass filter FL1 comprise the filter network for the target RF signals. Filter FL1 has a manual tuning capability to allow adjustment of the filter to the operating frequency of the associated transmitter. Isolators AT11 and AT12 along with bandpass filter FL3, which is fixed-tuned to the transponder transmitter frequency, comprise the filter network for the transponder RF signals, while isolators AT3 and AT6 and fixed-tuned filter FL2 is the down link filter network. The bandpass filters reflect all signals outside the filter bandpass and the isolators absorb the reflected signals.

3-628. MIXER-IF PREAMPLIFIERS. The mixer-IF preamplifier units A2, A3 and A4 convert the input RF signal to an amplified IF signal and route this IF signal through the sliprings to the receiver select circuits in the control trailer. A gain control voltage is generated in the gain control circuits of the associated main receiver assembly and routed through the receiver select circuits to the preamplifier to control the IF signal gain of the unit.

3-629. Target Mixer Preamplifier. The target mixer-preamplifier units A2 used in the S-band prereceiver systems are identical to those used in the C-band prereceiver systems except for the operating frequencies of the mixer stages.

3-630. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

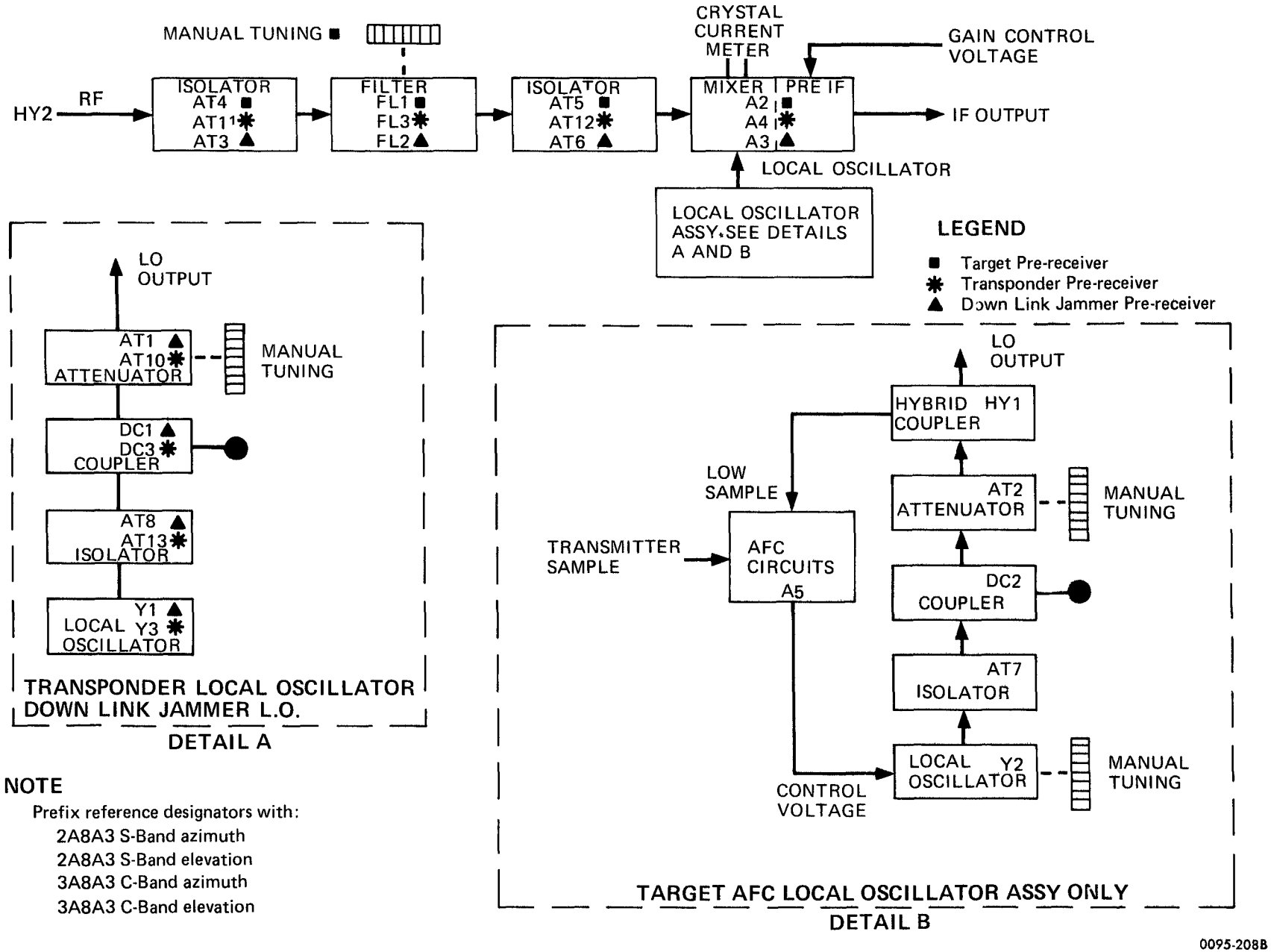


Figure 3-87. Target and Transponder Prereceiver Block Diagram

3-631. The IF preamplifier consists of four capacitance-coupled transistor amplifiers and associated gain control networks.

3-632. Gain control of the amplifier is accomplished by applying a negative voltage to terminal P3-6 of the amplifier. This negative voltage causes a current to flow through diodes CR1, CR2, CR3, and CR4 at the base of transistor Q2. The current can be adjusted by potentiometer R7. The magnitude of the current through potentiometer R7 and diodes CR1 through CR4 to ground is a function of the gain voltage applied. This current varies the effective resistance of the path to ground through diodes CR1 and CR2 and capacitor C15 since the resistance of a forward biased diode is a function of the current through the diode. Therefore, as the gain control voltage increases in the negative direction, the current through the diodes is increased, and the resistance of the diodes is decreased, changing the voltage divider which consists of resistor R6 and the diode path resistances.

3-633. Gain control at the base of transistor Q3 operates in a similar manner except that application of gain control at this point is delayed until the negative gain voltage has exceeded the breakdown voltage of reference diode CR9. Additional control of gain is provided by the IF gain potentiometer R12 by allowing the unbypassed emitter resistance to be increased, thereby reducing the effective base-emitter drive and reducing the gain of the stage.

3-634. After attenuation by the gain control networks, the IF signal is applied to the IF amplifier Q3 which drives the IF bandpass network. The IF bandpass network is a 3-pole, R-L-C filter network consisting of variable RF inductors L11, L13, L15, and L16, capacitors C22, C24, C27, C31, and C33, and resistors R21, R22, and R29. The bandpass network sets the center frequency and bandpass characteristics of the IF amplifier. After the signal passes through the bandpass network it is capacitor coupled (C33) to transistor Q4.

3-635 through 3-639 and figure 3-88. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-640. The AFC circuitry may be operated in the manual mode or the automatic mode. For example, the manual or automatic mode is selected in the S-band radar set by the AFC/ON/OFF switch A8A3S3 or A3A3S3 when the LOCAL/REMOTE switch (A8A3S2, A3A3S2) is in the LOCAL position. When the LOCAL/REMOTE switch is in the REMOTE position, the manual or automatic mode is selected by the AFC ON/OFF switch S19, S20, S23, or S24, on the power and frequency control panel 1A5A2 in the radar control trailer. Manual control of the local oscillator frequency is accomplished by the AFC MANUAL control A3A3R6 or the ADJ control 1A5A2R1, R2, R3, or R4 for the local and remote positions of the LOCAL/REMOTE switch respectively.

3-641. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-642. Automatic Mode. During the automatic mode of operation, a sample of the transmitter frequency routed from the transmitter group, is frequency compared in the mixer stage of the mixer-AFC discriminator unit A3A3A1 or A8A3A1. The output of the mixer stage, which is the sum and difference of the two sampled frequencies, is applied through a filter network to an IF amplifier. The amplifier output signal is applied to the trigger amplifier and the discriminator. The trigger amplifier produces positive trigger pulses which synchronize the AFC circuits to the transmitter. The discriminator produces error signals that are processed by the AFC circuits to generate the local oscillator tuning voltage.

3-643. The output of the mixer is routed to a filter network that passes the sum frequency to ground and couples the difference frequency to the three stage RC coupled IF amplifier. The third stage Q3 operates as a limited IF amplifier due to

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS, RADAR TRAINING SET AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1 FOR FIGURE 3-88

the hot-carrier diodes CR4 and CR5 connected across inductor L3. The output of this stage is amplified by transistor amplifier Q4 that supplies the inputs to the trigger amplifier and discriminator circuits.

3-644. The trigger amplifier circuits consist of a video detector stage Q7 and emitter follower Q8. The IF signal is detected by the base-collector junction of stage Q7. Emitter follower Q8 supplies a sample of the detected signal to the AFC circuits for synchronization with the transmitter.

3-645. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-646. The automatic frequency control (AFC) circuit 3A3A3A5, 3A8A3A5 converts the error signal from the discriminator unit or the manual tuning voltage into a DC voltage level used for tuning the target local oscillator, controls the remote AFC LOCK indicators, and supplies the drive signal to the AFC meter circuit.

3-647. The trigger pulse from the trigger amplifier is applied to pin 2 of comparator Z1 in the AFC unit. A reference voltage level, which is adjusted by potentiometer R3, is applied to pin 3 of comparator Z1. When the voltage level of the trigger pulse is equal to or exceeds the reference voltage level, comparator Z1 produces a positive voltage step at its output. This voltage step triggers single-shots Z2 and Z5. The trailing edge of the output pulse from single-shot Z2 then triggers single-shot Z3. The delay introduced by single-shot Z2 (adjustable by potentiometer R9) allows the video pulse from the discriminator unit to rise to near its maximum amplitude before gate transistor Q2 is turned on to sample the discriminator error signal. The output pulse of single-shot Z3 turns on transistor Q1 which applies -15 volts to the gate terminal of transistor Q2. This turns on transistor Q2 and allows the video pulse at the source terminal to pass through and charge capacitor C6. Before the video pulse begins to drop off, the pulse output from single-shot Z3 is terminated, transistor Q1 is turned off and +15 volts is applied to the gate terminal of transistor Q2. The length of the pulse produced by single-shot Z3 is set by potentiometer R10. This turns off transistor Q2 which leaves capacitor C6 charged to the peak voltage of the video pulse. Operational amplifier Z4 and transistor Q2 both offer high impedance discharge paths to the voltage stored by capacitor C6.

3-648. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-649. In the automatic frequency control mode, relay K2 is deenergized connecting amplifier/integrator Z7 as an integrator and connecting the error signal from the output of amplifier Z6 to the input of amplifier/integrator Z7. An error voltage at the input will cause the output of amplifier/integrator Z7 to integrate from its initial value changing the target local oscillator tuning voltage to correct the frequency output of the local oscillator. Correction of the local oscillator frequency control voltage occurs each time the transmitter fires.

3-650. Single-shot Z5, which is triggered simultaneously with Z2, produces a pulse whose time duration is greater than the angle dead-time gate generated in the antenna system. Therefore, each time the transmitter fires single-shot Z5 is retriggered and the output at pin 6 will remain low during normal operation. If the trigger pulse is lost for a period of time greater than the normal pulse duration of single-shot Z5, it will time out and pin 6 will go to a logic high (plus 5 volts). This will place a forward bias on diode CR3, charging capacitor C8, and turning on transistor Q3 which energizes relays K1 and K2. When relay K1 is energized, the remote AFC LOCK indicator DS1, DS2, DS5 or DS6 in the radar control trailer (power and frequency control 1A5A2) goes out to indicate loss of AFC lock. Relay K2 opens the automatic AFC loop by removing the output of amplifier Z6 from the input of amplifier Z7. If the trigger pulse input is

regained by normal loop operation or by adjustment of the manual AFC control voltage, the loop will automatically close and lock at the correct frequency.

3-651. Target Local Oscillator. The target local oscillator (Y2) is a cavity tuned transistor oscillator that can be mechanically tuned and voltage tuned. Mechanical tuning is accomplished by the adjustment of a stub within the cavity and allows the oscillator to be tuned throughout the frequency band of the associated transmitter. Voltage tuning is accomplished by varying the capacitance of a varactor diode that is in the resonating cavity and changes the frequency characteristics of the cavity.

3-652. The oscillator is a self-starting continuous wave oscillator that consists of a resonant cavity, transistor amplifier/oscillator, and feedback components. The feedback signal to the transistor oscillator is provided by capacitor C3 and inductor L2 and the resonant cavity.

3-653. The output signal in the S-band local oscillator is provided by a loop coupler in the oscillator cavity that couples the signal to the output connector.

3-654. The output signal in the C-band local oscillator is provided by a loop coupler in the oscillator cavity that couples energy to the frequency doubler cavity and circuit consisting of capacitors C4 and C5 and varactor diode CR4. Coupling of the output signal to the output connector is accomplished by a loop inserted into the cavity of the frequency doubler circuit.

3-655. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-656. The crystal-controlled transistor oscillator composed of crystal Y1 and transistor Q1 generates the stable frequency source that is multiplied to yield the oscillator output frequency. Driver transistors Q2 and Q3, operated in parallel and driven by transformer T1, drive a filter network composed of inductors L4 and L5 and capacitors C17 through C23. The filter network is tuned to a harmonic of the crystal oscillator frequency and suppresses the fundamental frequency. The output of the first multiplier filter is coupled to a driver stage composed of transistors Q4 and Q5 by RF inductor L6 and transformer T2. The driver stages drive the second tuned harmonic filter. The second harmonic filter composed of RF inductors L8 and L9 and capacitors C32 through C36 is tuned to a harmonic of the input frequency received from transistors Q4 and Q5 and the fundamental frequency is suppressed. The output of the second harmonic filter is capacitor coupled (capacitor C37) to the output driver transistor stages. The output stages composed of transistors Q6 and Q7 are common emitter amplifiers and are tuned to the output frequency by inductors L11 and L13 and capacitors C40 and C41. The output of the driver stages is coupled by a loop into a cavity filter through a matching filter composed of capacitors C46 and C47. The cavity filter whose inputs and outputs are both loop coupled is a mechanical tuned resonant cavity and includes a mechanical comb filter to increase the output frequency stability of the oscillator.

3-657. X-BAND PRERECEIVER 4A2A2.

3-658. The X-band prereceiver system receives RF signals from the trough and dish antennas, amplifies the RF signals, converts them to intermediate frequency signals and amplifies these IF signals, which are then routed through the slip-ring assembly to the receivers in the control trailer. Additional circuits provide the automatic frequency control signals for tuning the magnetron to the correct frequency. A block diagram of the prereceiver is shown in figure 3-89.

3-659. The RF signals received by the trough antenna are routed through directional coupler 4A2A1A1 to the traveling wave tube amplifier 4A2A1AR2. Control voltages to the TWT amplifier apply sensitivity time control characteristics to the TWT amplifier gain. The directional

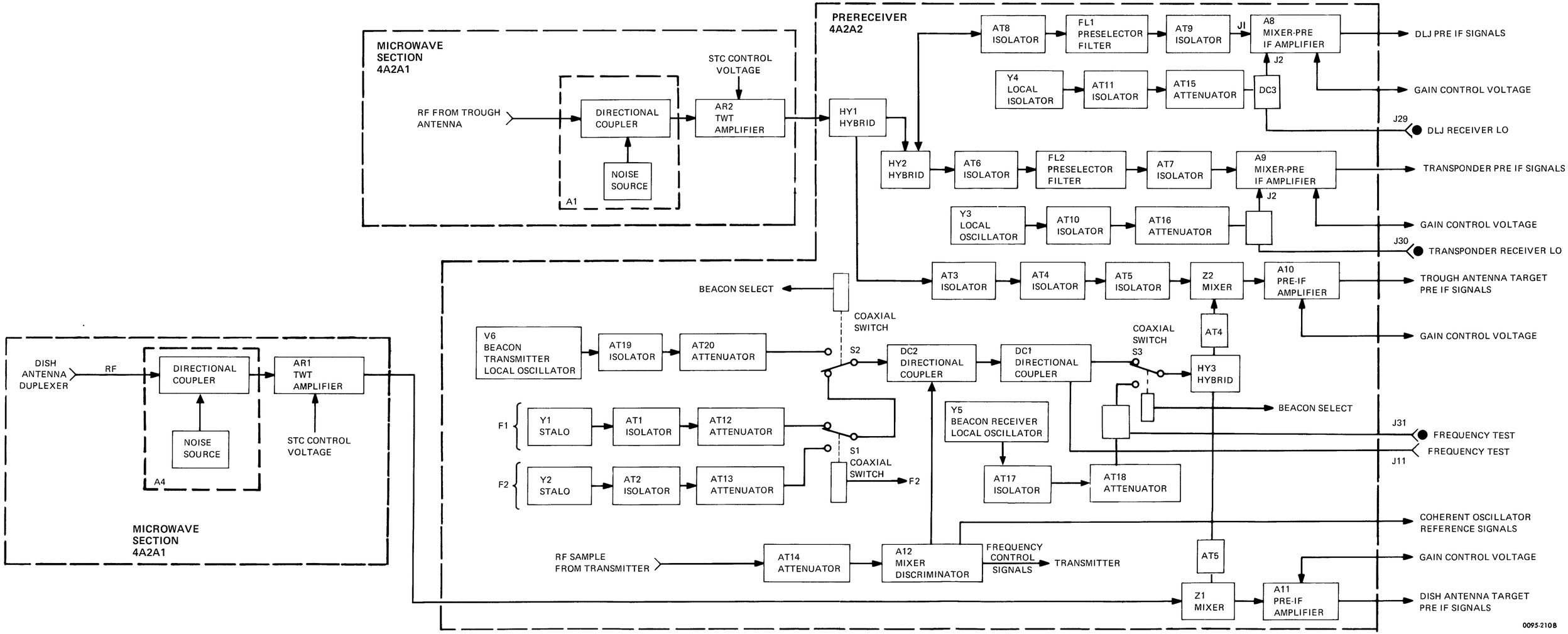


Figure 3-89. X-Band Prereceiver Block Diagram

coupler and its integral noise source provide the means to inject noise into the receiver system for noise figure measurements. The RF signals that are amplified in the TWT are split by hybrid power dividers (HY1 and HY2) into three paths in prereceiver 4A2A2 for the down link jammer receiver, the transponder receiver, and the target receivers.

3-660 through 3-661. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-662. X-BAND TARGET PRERECEIVER.

3-663. The X-band target prereceiver consists of two channels which process the RF returns from the trough antenna and the dish antenna.

3-664. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-665. Mixer Z2 and its equivalent in the dish receiver channel, Mixer Z1, are image rejection mixers. These mixers, because of their internal construction, provide approximately 20 d_B rejection to the image RF frequencies. Because of this rejection, a separate preselector filter is not required in the target receiver channels. This configuration, which eliminates the use of preselector filters, is necessary because of the fast tuning or frequency switching capabilities of the X-band transmitter system.

3-666. The RF signals received by the dish antenna are processed in a similar chain consisting of a noise-source directional doupler, TWT amplifier, mixer, and pre-IF amplifier.

3-667. X-BAND TARGET RECEIVER LOCAL OSCILLATORS.

3-668. The local oscillator system for the target skin tracking functions consists of stable local oscillators (STALO) Y1 and Y2, their associated isolators and attenuators and coaxial switch S1. As the frequency of the associated X-band transmitter is switched between frequencies 1 and 2, the STALO Y1 and Y2 are selected to obtain the correct local oscillator frequency for signal conversion and for the transmitter AFC functions. This selected STALO signal is routed through coaxial switches S1 and S2, directional couplers DC1 and DC2, coaxial switch S3, and hybrid coupler HY3 to the mixers in the trough and dish target channels.

3-669. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-670. During operation in the X-band beacon track mode, the beacon transmitter local oscillator Y6 is connected through coaxial switch S2 and coupler DC2 to the mixer discriminator. This will tune the transmitter to the correct frequency to trigger the aircraft beacon. The receiver local oscillator output in this mode, Y5, is routed through coaxial switch S3 and coupler HY3 and mixers Z1 and Z2.

3-671. The circuitry of units within this prereceiver is similar to that described for the S-band and C-band prereceivers except for the image rejection mixers noted previously.

3-672. RECEIVER SELECT CIRCUIT.

3-673. The receiver select circuit 1A5A5 connects the outputs of the S-band, C-band, or X-band prereceiver channels, or the target simulator outputs to the correct main receiver units. Gain control voltages generated in the main receiver units are connected to the prereceiver channels selected as the input to the main receivers. The prereceiver channels not in use receive a fixed negative control voltage to reduce their gain. The selection relays that perform these functions are located in the signal distribution assembly 1A2 and are controlled from the target operating band selection switches 1A1A1S33, S34, S35, the reference operating band selection switch 1A3A4S12, and the TARGET SIM ON/OFF switch 1A1A5S1.

3-674. S-BAND AND C-BAND TARGET TRACKING RECEIVERS.

3-675. The target tracking receiver systems for S-band and C-band consist of separate azimuth and elevation receiver units 1A11A1 and 1A11A11. The receiver units amplify the IF signals received from the receiver select circuit, detect the video information, and generate boxcar video for use in the gain control circuits and angle tracking loops. Gain control circuits controlled by the guidance operator or manual tracker operators generate the gain control voltages for the main IF amplifiers in these units and for the pre-IF amplifiers in the antenna cab prereceiver channels. Video driver circuits provide the line driving capability required for the video outputs to the range tracking loop and operator displays. The receiver interface for the IF input and the video output selection circuits is diagrammed in figure 3-90.

3-676. The azimuth and elevation receivers are nearly identical with some additional circuitry required in the elevation receiver for the low altitude tracking function. The receiver block diagram is shown in figure 3-91. The receiver control circuits are shown in figure 3-92.

3-677. The selected S- or C-band pre-IF signal is routed to the A3 power divider where it is split and routed to the logarithmic IF amplifier A2 and the linear IF amplifier A1.

3-678. LOGARITHMIC IF AMPLIFIER. The logarithmic IF amplifier A2 amplifies the target IF signals from the power divider A3 and provides a video output derived from these signals that can be displayed on the operator displays (when selected by the LIN/LOG select switch 1A11A1S2 or 1A11A11S2). The video output level of this amplifier is a logarithmic function of the input power level.

3-679. The amplifier is a seven stage RC coupled transistor amplifier. Each stage of the amplifier is also connected to a transistor detector. The outputs of the seven detector stages are summed to provide the log video output. Potentiometers in each detector stage set the bias level for the detector determining the video level from each stage supplied to the video summing function. This allows calibration to ensure that the video output is a log function of input power.

3-680. Capacitors C1 through C5 and C53 and inductors L1 and L2 constitute a filter network that determines the center frequency and bandpass characteristics of the amplifier and matches the impedance of the input line to the first IF amplifier Q1A.

3-681. The first half of dual transistors Q1 through Q4 and Q6 through Q8 are capacitor-coupled to provide a seven stage RC-coupled IF amplifier. The bias supply voltage for these transistors is set by constant current regulator transistor Q9.

3-682. The second half of dual transistors Q1 through Q4 and Q6 through Q8 are used as video detectors which, due to the interconnection of their collectors, sum the video signals detected by each stage at the input to the video output stages. The IF signal from the emitter of the first IF amplifier Q1A is coupled to the emitter of the detector transistor A1B by coupler R5-C8. The bias supply voltage for detector transistor Q1B is set by the voltage divider composed of resistors R6 and R7 and determines the threshold of the detector. The detected video on the collector is summed at the emitter of transistor Q5 with the detected video outputs of the second, third, and fourth video detector stages. Transistor Q5 serves as a threshold circuit and delays the summing of the detected outputs of transistors Q1 through Q4 with the output of transistors Q6 through Q8 until the base-emitter junction of transistor Q5 has been forward biased. This ensures that the detected output from the first four stages is not summed (at the output) with the video detected by the last three detectors until the input IF power to the amplifier has increased to the threshold level set by the base emitter bias of transistor Q5.

SIGNAL DISTRIBUTION 1A2
S-BAND PRE IF
C-BAND PRE IF
K16 S-BAND REF
K10 C-BAND
K9 NOISE FIG SELECT
K8 SIMULATOR SELECT
K7 C-BAND REF
K6 X-BAND
PRE IF
TARGET SIMULATOR 1A17A16
1A11A3 (1A11A13) MANUAL TRACKER CONTROLS
GUIDANCE OPERATOR CONTROLS 1A1A4
TRANSFER 1A1A4
ANGLE GATES 1A17A4
DEAD TIME GATES 1A1A5
HI PRF SELECT 1A1A4
IND RANGE BLNK 1A1A5
RANGE TRACK SYNC 1A17A4
AZIMUTH RECEIVER 1A11A1 (1A11A11)
P6
P7
P8
P9
P10
P11
SIGNAL DISTRIBUTION 1A2
A1 (A2) POWER DIVIDER
S-BAND TEST VIDEO 2A8A3 (2A3A3)
C-BAND TEST VIDEO 3A8A3 (3A3A3)
S-BAND TARGET PRE-IF GAIN 2A8A3 (2A3A3)
C-BAND TARGET PRE-IF GAIN 3A8A3 (3A3A3)
−15 VDC
K13 C-BAND
C-BAND STC 3A8A2 (3A3A2)
K4 S-BAND REF
K3 C-BAND REF
S-BAND STC 2A8A2 (2A3A2)
1A1 GUIDANCE OPERATOR CONSOLE
TARGET VIDEO
A2 (A3) INDICATOR
K2 X-BAND
K1 TARGET OFF
TARGET VIDEO
1A11A2 (1A11A12) INDICATOR
1A11A5 SWEEP GENERATOR
TARGET VIDEO
TARGET VIDEO
1A11A6 RANGE INDICATOR
K1 EL SELECT
1A17A4 TARGET TRACKING
TARGET VIDEO
TARGET VIDEO
K5 EL SELECT
BOXCAR VIDEO
K1 X-BAND
TO SIGNAL TEST PANEL
GAIN VOLTAGE
TO DVM
TRANSPONDER CONSOLE 1A3
TARGET VIDEO
A2 (A3) INDICATOR
K1 X-BAND
K2 TARGET VIDEO SELECT

NOTE

Reference designators are azimuth except those in parentheses which are elevation

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Figure 3-90. C-Band Receiver Interface

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS, RADAR TRAINING SET, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1 FOR FIGURE 3-91

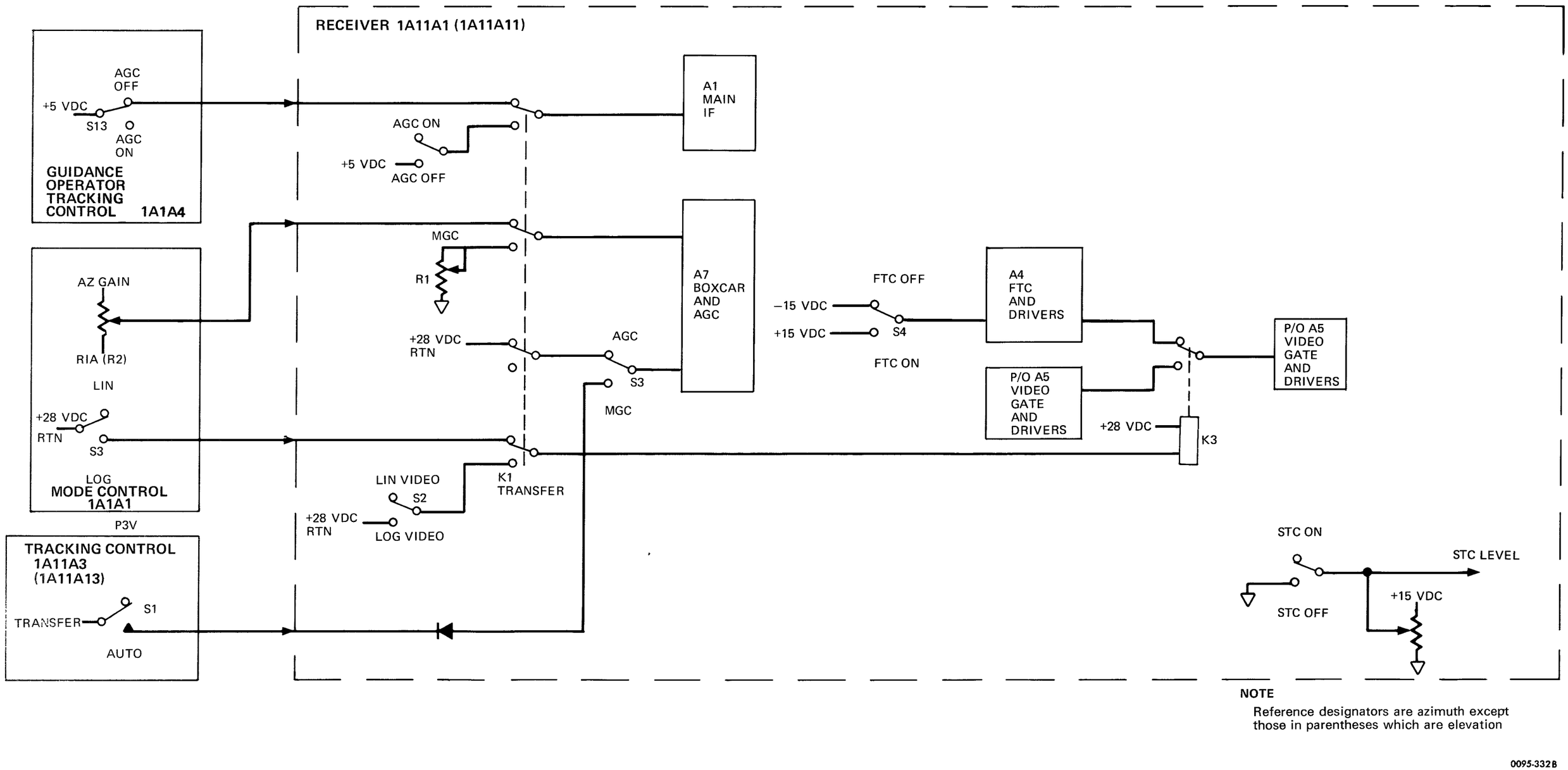


Figure 3-92. S-/C-Band Receiver Control Diagram

3-683. The summed output of the detector stages at the collector of transistor Q5 is applied to the base of the video amplifier output stage Q11. A variable bias current set by the output offset potentiometer R63 and amplifier Q10 allows the baseline of the direct-coupled video circuits to be set to zero at the output of transistor Q11. The video gain potentiometer R68 adjusts the signal level at the output connector J4.

3-684. LOG IF POWER SUPPLY. The log IF power supply A11 provides the +12 volt and -12 volt power sources required by the logarithmic IF amplifier.

3-685. Each of the power supply voltages is generaged by an integrated circuit that contains an internal voltage reference, an error amplifier, and a series regulator. The +12 volt and -12 volt supplies are similar in operation.

3-686. The -25 volt regulated supply voltage from the console power supply assembly 1A5A14 is the input to the -12 volt power supply. This voltage is passed through a regulator amplifier in the integrated circuit to the output pin (Rs) of the integrated circuit and through the resistance path (R10, R7, R8, and R9) to ground. Potentiometer R8 allows adjustment of the output voltage around the desired 12 volt operating point. The voltage at the arm of potentiometer R8 is coupled through resistor R6 to the feedback input (FB) of the integrated circuit. This feedback voltage is compared by the internal error amplifier to the internal voltage reference to derive a correction voltage. This correction voltage is applied to the series regulator to increase or decrease its series resistance, thereby correcting the output voltage and holding it to the value set by potentiometer R8 regardless of load variations.

3-687. Internal current limiting provides protection against shorts at the output of the integrated circuits. Feedback from the output through resistor R10 to the RS input of the integrated circuit limits the output current capability. Internal constant current sources supply the voltage requirements of the integrated circuit.

3-688. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-689. Gain control of the amplifier is provided by the gain control circuits and may be either AGC or MGC. An additional type of gain control, instantaneous automatic gain control (IAGC), is provided by circuits within the amplifier assembly and is selected by the manual tracker operator.

3-690. The amplifier contains a bandwidth selection circuit that changes the bandwidth of the amplifier and is controlled by the system PRF control.

3-691. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-692. The first three stages of amplification are provided by transistors Q1, Q2, and Q4 and associated circuitry and are conventional RC coupled amplifiers. Gain control of these stages is accomplished by a diode network voltage divider as described for the preamplifiers. The gain control voltage (MGC or AGC) is applied to emitter follower Q3 which provides the bias voltage for the diode networks.

3-693. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-694. The output of each bandpass filter network is capacitance coupled to the base of the fourth IF amplifier stage Q5. GAIN potentiometer R36, in the emitter circuit of amplifier stage Q5, regulates the gain of this stage by controlling the value of the unbypassed emitter resistor. The fifth and sixth IF amplifier stages Q6 and Q7 are standard RC coupled IF amplifiers. A sample of the IF from the collector of amplifier stage Q6 is routed to connector J6 for use in the receiver performance monitoring system. A gain control signal at the base of amplifier stage Q6 is furnished by the IAGC circuitry.

3-695. The signal at the collector of IF amplifier Q7 is detected by diode CR26 in

the filter-detector network. This detected signal is coupled through a low pass filter C75-C77-L38 to the base of transistor Q8 in the differential amplifier output stage.

3-696. Normal Video Output. The video output stages consist of differential amplifier Q8 - Q9, amplifier Q10, and emitter follower Q11. The output signal at the emitter of transistor Q11 is fed back through resistor R83 to the base of transistor Q9 in the differential amplifier and provides negative feedback to the gain of the video output stages. Video zero potentiometer R76 adjusts the DC operating level of the differential amplifier.

3-697. Range Gated Video Generation. The range gated video output is provided by the circuitry of transistors Q15 through Q22 and is identical with the ungated video channel (normal video output) described above except for the gating circuitry and a video gain potentiometer R94 that allows adjustment of the gain of the circuit.

3-698. Range gating is accomplished by the transformer coupled diode bridge consisting of transformers T1 and T2; diodes CR27, CR28, CR31, and CR32 and potentiometer R67; and the gate control circuit Q16 - Q17. A zero volt input on the gate input connector J3 enables the gate circuit and passes the IF through the diode bridge to the base circuit of amplifier Q18.

3-699. The IF signal on the primary of transformer T1 is coupled to the secondary by transformer action. When an "ON" gate voltage (zero volt) is applied to connector J3, the gate transistors Q16 and Q17 are turned off and their collectors are at a plus voltage, forward biasing diodes CR27, CR28, CR31, and CR32. The IF signal then passes through the diode bridge, is applied to the primary of transformer T2 (terminals 3 and 6), and coupled to the secondary of transformer T2. When an "OFF" gate voltage (plus 5 volts) is applied to connector J3, transistors Q16 and Q17 are turned on, their collectors are at ground and the bridge diodes are reverse biased, cutting off the path for the IF signal. Potentiometer R67 balances the bridge by compensating for unequal diode "ON" resistances.

3-700. IAGC Generation. Instantaneous automatic gain control (IAGC) reduces the amplitude of the returned signal for targets of longer than normal width and therefore suppresses ground clutter returns. The IAGC voltage is generated from a detected video signal.

3-701. Detector diode CR25 produces a video pulse that is applied to the differential amplifier Q13 and Q14. The application of the video pulse to the base of transistor Q14 is delayed approximately 1 microsecond by the charging of capacitor C59 to the value of the base bias voltage of transistor Q14 so that a signal on the collector is not developed unless the video pulses are longer than this delay. The video amplifier stages Q12, Q13, and Q14 are similar to the video output stages previously described. The output of amplifier Q12 is the IAGC voltage which is applied to the gain control circuit at the base of IF amplifier Q6 and is fed back to the base of transistor Q13 in the differential amplifier to control the gain of the circuit. A positive voltage on pin 2 of connector J2 activates the IAGC function to turn on transistor Q13. The IAGC threshold, the minimum video level at which IAGC is developed, is adjusted by potentiometer R66 (IAGC threshold), which applies a variable reverse bias to detector diode CR25.

3-702. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-703. The ungated video output at connector J4 of the linear IF amplifier is routed to a gate and driver circuit A6 which provides a gating capability for the video and includes line drivers for the video which is routed to the target range track loop and to the display video circuitry.

3-704. Video Gate and Driver. The video gate Q3 provides an external blanking capability for the video supplied to the

range track loop and operator displays. A +5 volt signal or gate applied at the blanking gate input turns on transistors Q1 and Q2. With transistors Q1 and Q2 conducting, a 15 volt signal is applied at the gate of transistor Q3 to open the gate. A ground signal or an open connection on the blanking gate input applies a -15 volt signal to the gate of transistor Q3 to close the gate and the video input is connected to emitter followers Q4 and Q5. There is no connection to the gate input (the gate is closed) in the radar set. This feature is provided for possible future use only.

3-705. Emitter followers Q4 and Q5 drive the video lines to the range track loop and display video circuit respectively. Biasing of the emitter follower circuitry is accomplished by diode networks so that the base line DC level at the emitter follower output will be zero for emitter follower Q4 and approximately +0.7 volt for emitter follower Q5. The output level of emitter follower Q5 is raised from zero to compensate for the base-emitter junction voltage of the next stage (transistor Q2 in the FTC circuitry).

3-706. The biasing circuit for emitter follower Q4 consists of diodes CR1, CR2, and CR3, and resistor R9. The +15 volt supply at resistor R9 forward biases diodes CR2 and CR3. Each of these diodes drops approximately 0.7 volt; therefore the junction CR1 - CR2 is at +1.4 volts. Diode CR1 is forward biased by this voltage producing a 0.7 volt bias at the base of emitter follower Q4 due to the voltage drop across diode CR1. The emitter signal at transistor Q4 is the base voltage minus the 0.7 volt base-emitter diode drop so that the video output at the emitter has a 0 volt baseline. Similar biasing of emitter follower Q5 sets a +0.7 volt baseline at the emitter of transistor Q5.

3-707. Video gating circuits for the log video output of amplifier A2 provide similar gating capability and drive the test video and display video lines. The test video signals are routed to the antenna trailers for use in system alignment and calibration.

3-708 through 3-709. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-710. Lin/Log Video Selection. Selection of linear or logarithmic video for the operator displays is controlled by the guidance operator or the manual tracker operator. When the guidance operator angle handwheel is pushed in, relay K1 is deenergized and video is selected by lin/log switch 1A1A1S3 for both azimuth and elevation receivers simultaneously. When the handwheel is pulled out, relay K1 in each target receiver is energized and selection control is transferred to the receiver front panel lin/log switch S2.

3-711. The selected video signal is routed to emitter follower line drivers Q3, Q4, Q5, and Q6 which provide signals for the guidance operator, manual track operator, and transponder operator displays.

3-712. BOXCAR VIDEO GENERATION. Boxcar video for use in the angle track loops and the receiver AGC function is generated by the boxcar and AGC circuit (A7) in the receiver chassis. This circuit generates boxcar video by sampling the returned video signal at the time of the range tracking gates and holding this sampled video level until the next range track time when the sampled video level is updated (figure 3-93).

3-713. The gated video received from the main IF amplifier is gated again by transistor gate Q1 and peak detected by the network composed of diodes CR4 and CR5 and capacitors C9 and C3. The peak video level is stored on capacitor C3 of this network.

3-714. Transistor gate Q1 is an analog gate that is turned on (passes signals) when a negative voltage is applied to the gate terminal and is turned off when a positive voltage is applied.

3-715. The voltage on capacitor C3 is discharged by the range dump gate which turns on transistor Q11 and discharges

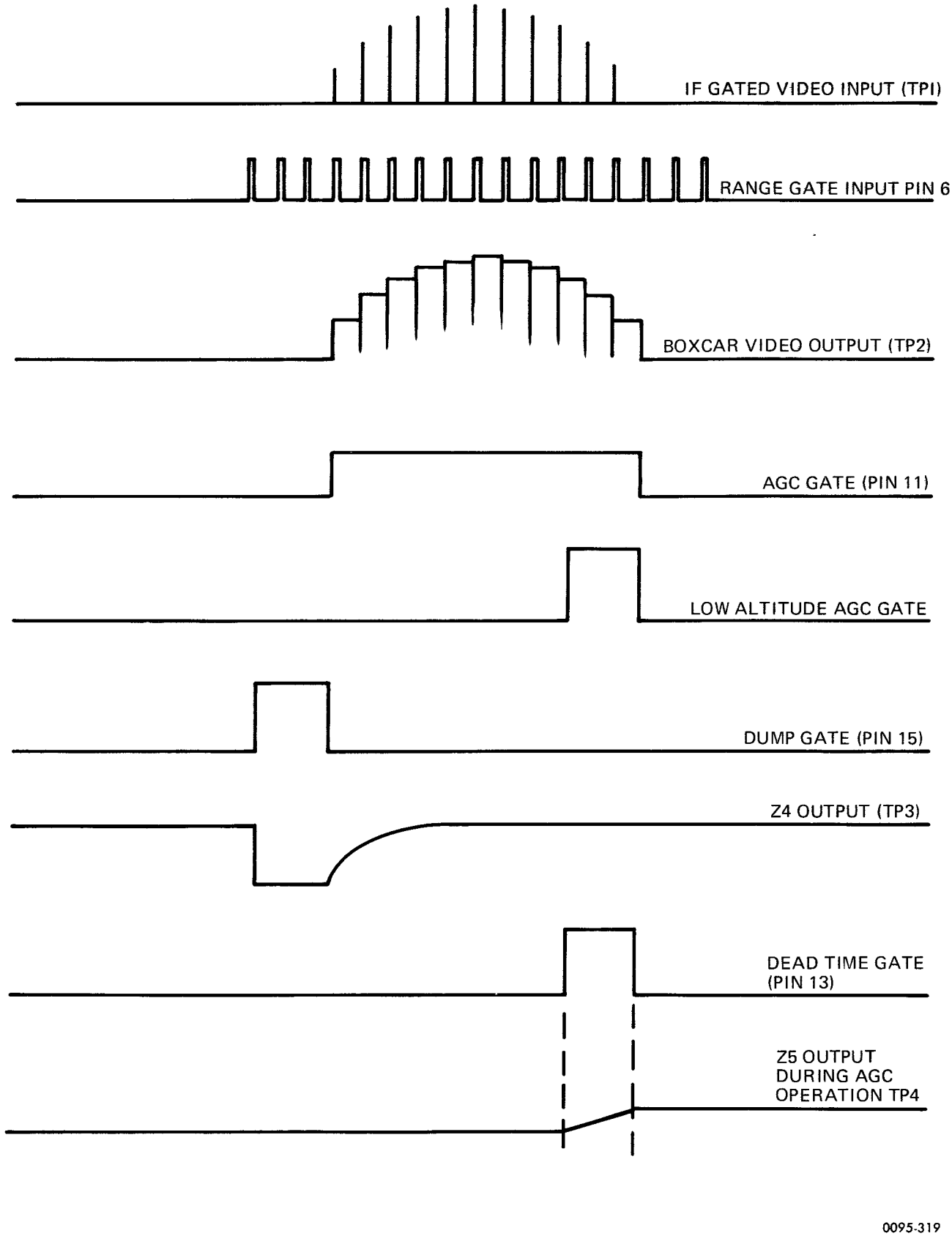


Figure 3-93. Boxcar Video and Automatic Gain Control Generation-Timing Diagram

capacitor C3 just prior to the time the range gate is applied to gate Q1. The boxcar voltage is buffered by voltage follower Z1.

3-716. Voltage follower Z1 is an impedance matching device which presents a high input impedance to the voltage charge on capacitor C3 and a low output driving impedance. The boxcar video at the output from voltage follower Z1 is routed to amplifier Z2, which provides the boxcar video for the angle tracking loop. The voltage gain of amplifier Z2 is adjustable by potentiometer R19 (the gain adjust potentiometer) in the feedback circuit.

3-717. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-718. During normal operation, separate range gates are provided for high and low PRF operation of the radar to allow individual adjustment of the range gate width in each PRF.

3-719 through 3-720. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-721. The normal range gate is selected by the high PRF signal at pin 1A11A1A8-W and logic gates Z7 and Z8. When high PRF is selected, the high PRF gate is gated through to pin 6 of NAND gate Z7. The inverted high PRF signal gates the low PRF gate to pin 8 of NAND gate Z7 when low PRF is selected.

3-722. Since the normal range gates are gated by the system PRF selection and are inhibited when TOJ is selected, only one of the gates is present at the pin 1, 2, and 4 inputs of NOR gate Z8 and at the output of the circuit. This boxcar range gate output is inverted to provide the zero volt range gate required for the IF range gate input.

3-723. GAIN CONTROL CIRCUITS.

3-724. The gain control functions provided for the target receiver systems include manual gain control (MGC) and automatic gain control (AGC) and the pre-IF amplifiers and main IF amplifier. Crossover circuits are provided so that for low amplitude signals the gain control voltage is applied to the main IF amplifier only and, as the input signals increase past a threshold level, the gain voltage is also applied to the pre-IF amplifier. This crossover of gain voltage application yields the maximum dynamic range possible from the overall receiver system (figure 3-94).

3-725. Generation of the manual gain control voltage is controlled by the guidance operator or manual tracker operators. The operating station that controls the MGC function is selected by the transfer switch on the guidance operator azimuth and elevation handwheel control.

3-726. Blanking signals are applied to the pre-IF amplifier and TWT amplifier to reduce the system gain during transmitter main bang. An additional blanking signal in the elevation receiver reduces the gain of the pre-IF amplifier for low elevation angles during low-altitude tracking. An operator control adjusts the duration of this low-altitude blanking signal.

3-727. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-728. MANUAL GAIN CONTROL. The operating station that controls the target receiver system gain voltage in the MGC mode is selected by the transfer switch on the guidance operator angle handwheel. Because the azimuth and elevation gain control circuits are similar, only azimuth gain control is described here; however, differences between the two are noted.

3-729. When the handwheel is pushed in, the handwheel actuated switch 1A1A4S18 is open and relay 1A11A1K1 is deenergized. This connects the MGC control 1A1A1R1 at the guidance operator station to the MGC input (pin 1A11A1A7-17) of the AGC integrator/amplifier 1A11A1A7Z5. The MGC control is connected as a rheostat and is connected to the junction of resistors R31

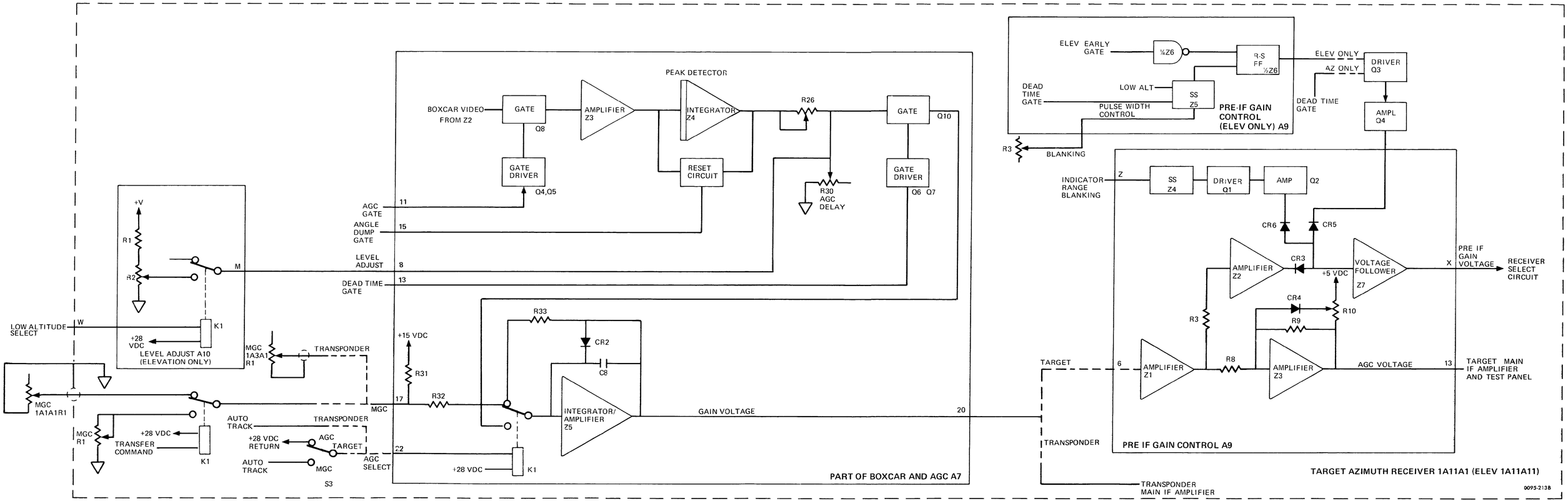


Figure 3-94. Gain Control Circuits Simplified Functional Diagram

and R32 at the input of amplifier Z5 in the gain control circuit. Varying the gain control varies the voltage at the amplifier input resistor R32 due to the voltage divider composed of resistor R31 and the gain control potentiometer 1A1A1R1.

3-730. When relay 1A11A11K1 is deenergized, the summing junction of amplifier Z5 is connected to the junction of the feedback and input resistors. Varying the MGC control varies the output of amplifier Z5 which operates as an inverting amplifier. The integrating capacitor C8 is charged by this MGC voltage output so that when the AGC mode is selected there is no blossoming of the displays or large level changes of the receiver video.

3-731. The gain voltage from amplifier Z5 is routed to the pre-IF gain control circuit (1A11A1A9), which includes the gain control crossover circuits and the blanking circuits for the pre-IF amplifiers.

3-732. The gain voltage is inverted in amplifier Z1 and applied to the main IF amplifier gain voltage circuit, consisting of amplifier Z3, and the pre-IF amplifier gain voltage circuit, consisting of amplifier Z2, voltage follower Z7, and the associated blanking circuits.

3-733. The positive gain voltage from the output of amplifier Z1 is routed through input resistor R8 to amplifier Z3 in the main IF gain voltage path. Amplifier Z3 is an inverting limited amplifier and its negative output voltage is routed to the main IF gain voltage input and the digital voltmeter test panel (1A5A16). Potentiometer R10 and diode CR4 in the feedback provide a variable limit on the output of amplifier Z3. The output of amplifier Z3 can go negative until the wiper of potentiometer R10 goes to -0.7 volt at which time diode CR4 is forward biased, thereby bypassing feedback resistor R9 with an additional current path. This limits the output to a negative voltage adjustable by potentiometer R10.

3-734. Operation of the remainder of the gain control cross-over circuit includes the delay of the application of gain voltage to the pre-IF amplifier until the boxcar video exceeds a threshold value.

3-735. The delay in generation of pre-IF gain voltage is accomplished by an input voltage to amplifier Z2 that is set by voltage divider R5 - R6. The output of amplifier Z1 must exceed this threshold before the output of amplifier Z2 can go negative. Diode CR2 prevents the output of amplifier Z2 from going to a positive voltage when the output of amplifier Z1 is below the threshold. The output voltage of amplifier Z2 will start at zero volts when the threshold condition is overcome and becomes negative as the output of amplifier Z1 increases past the threshold level.

3-736. Voltage follower Z7 is a noninverting voltage follower which drives the pre-IF gain line that is routed through the receiver select circuits to the selected pre-IF amplifier.

3-737. Blanking of the pre-IF amplifiers (reducing the gain of the amplifiers) is accomplished by pulling the input of voltage follower Z7 to a negative voltage during the blanking time. Diode CR3 is reverse biased during the blanking time to prevent the blanking pulse from pulling the output of amplifier Z2 to the blanking pulse level.

3-738. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-739. The indicator range blanking pulse from the range timing portion of the transmitter group sets single shot Z4 which generates a positive output pulse on pin Z4-8. The pulse width is set by resistor R11 and capacitor C8 so that the output pulse does not reset until after transmitter main bang. Common base amplifier Q1 acts as a buffer between single-shot Z4 and amplifier Q2. Amplifier Q2 is turned on by the output pulse from single-shot Z4 causing its collector to go towards -15 volts, forward biasing diode CR6 and applying the blanking pulse to the input of voltage follower Z7.

3-740. Dead-time blanking for the azimuth receiver is accomplished by routing the dead-time gate at pin A9-E to the emitter of common base amplifier Q3 through resistor R16. Amplifier Q4 and diode CR5 couple the negative blanking signal to voltage follower Z7.

3-741 through 3-743. Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-744. AUTOMATIC GAIN CONTROL. The automatic gain control voltage is developed from the boxcar video that is coincident with the angle tracking gates of the associated tracking loop. The gain voltage developed is that voltage required to maintain a constant peak value of boxcar video regardless of variations of received RF signal strength due to target cross-section variations or variation of the RF signal strength due to the range of the target. A timing diagram of signals used during generation of the AGC voltage is shown in figure 3-93.

3-745. The AGC gate received from the angle tracking loop is applied to gate driver Q4 - Q5 which turns on analog gate Q8. With analog gate Q8 turned on, the boxcar video is applied to amplifier Z3. The AGC gate spans the period from the beginning of the early angle tracking gate to the end of the late angle tracking gate. This ensures that only the boxcar video from the target being angle tracked is used for developing the AGC.

3-746. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-747. The angle gated boxcar video from analog gate Q8 is inverted in amplifier Z3 and routed to peak detector Z4. This peak detector is reset by the dump pulse developed in the associated angle tracking loop. This dump pulse, which immediately precedes the early angle track gate, turns on transistor Q9 and discharges the integrating capacitor C6 through the saturation resistance of transistor Q9. The integrator stage Z4 operates as a peak detector due to the action of diode CR1 and feedback resistor R25. As the boxcar video output of amplifier Z3 is going negative, diode CR1 is forward biased and amplifier Z3 acts as an inverting voltage follower with resistor R23 as the input resistor and resistor R25 as the feedback resistor. The charge on integrating capacitor C6 follows the boxcar voltage input. When the boxcar video passes the peak level and starts toward ground, diode CR1 is back biased by the charge on capacitor C6, removing the voltage input from amplifier Z3, and the stage acts as an integrator with its input disconnected. Therefore, the peak negative level of the boxcar is stored until it is reset by the next dump pulse and updated.

3-748. If AGC has been selected at the AGC/MGC switch 1A11A1S3 when the manual tracker has control of the receiver or when the manual tracker has selected automatic angle tracking with the AUTO switch 1A11A3S1, even though the AGC/MGC switch is in the MGC position, relay 1A11A1K1 is energized.

3-749. When relay K1 is energized, the output of the integrator Z4 is gated into the AGC integrator Z5 during the antenna flyback time (dead-time) by gate Q10 and its associated driver. This ensures that the gain voltage is not changed during the antenna scan, thus preventing variations in the video levels during the scan.

3-750. The response time of the AGC integrator is determined by resistor network R26 - R27 and the integrating capacitor C8 and is adjusted by potentiometer R26. The adjustment of potentiometer R30 (AGC delay) determines the minimum value of boxcar video that can develop AGC voltage.

3-751 through 3-757 and figure 3-95. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-758. The positive transmitter trigger pulse is applied through a differentiating and clamping network consisting of capacitor C6, diode CR9, and resistor R19. The

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS, RADAR TRAINING SET, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1 FOR FIGURE 3-95

transmitter trigger pulse is differentiated and clamped to +24 volts in this network. When the trailing edge of the transmitter trigger pulse falls to ground, the differentiated pulse triggers flip-flop Z1 whose output at pin 8 then goes high. Transistor Q9 is turned off by the high output of flip-flop Z1 when the voltage output of drivers Q5 and Q6 begins to fall toward zero. The voltage will continue to drop until the voltage at the junction of diode CR3 and capacitor C3 equals the voltage across resistor R12. Further decrease in voltage at this point will allow current from the constant current source for the ramp generator (transistor Q4, resistor R5, and diode CR1) to charge capacitor C3. Therefore, as the voltage output drops, it will follow the charging curve of capacitor C3. This curve will be linear because capacitor C3 is charged through a constant current source. The output voltage will continue to follow the charging curve of capacitor C3 until it reaches zero volts. The output will remain at zero volts until the next pulse sequence is initiated. Current from the constant current source Q4-CR1-R5-R20 is connected to ground through diodes CR2 and CR3, which ensures that the output voltage remains near the ground potential between triggers. The slope of the linear ramp voltage may be changed by adjusting potentiometer R20. By changing the setting of potentiometer R20, the constant current supplied from transistor Q4 is changed. This causes capacitor C3 to charge at a different rate, thereby changing the slope of the ramp.

3-759. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-760. REFERENCE TRACKING RECEIVER, S-BAND AND C-BAND (1A17A1).

3-761. The reference tracking receiver, which is divided into similar azimuth and elevation channels, processes the S- or C-band pre-IF signals from the receiver select circuits when either S- or C-band has been selected for reference tracking. The receiver amplifies the IF signals, detects video information, and generates boxcar video for use in the gain control circuits and angle-tracking loops. Gain control circuits controlled by the transponder operator generate the gain control voltages for the reference receiver main IF amplifiers and for the pre-IF amplifiers in the antenna cabs. Video driver circuits provide the line driving capability required for the video outputs to the reference operator displays.

3-762. Signal interface for the reference tracking receiver is shown in figure 3-96. The S-band pre-IF signal is routed to the reference receiver through energized contacts of relay 1A2K16 and deenergized contacts of relay 1A2K7 when S-band reference is selected. The C-band pre-IF signal is routed through energized contacts of relays 1A2K7 and 1A2K17 when C-band reference is selected. The MGC voltage for the receiver is provided by the MGC control on the transponder tracking control 1A3A4. The reference azimuth and elevation autotrack inputs are provided through switches on the transponder tracking control 1A3A4 handwheels. Additional inputs to the reference receiver are the reference angle gates and reference range track sync pulses from the transponder tracking control 1A3A4 and reference dead-time gates and reference range blanking pulses from the synchronizer (1A1A5).

3-763. Reference boxcar video from the reference receiver is routed to the transponder tracking control 1A3A4 for use in the Number 1 angle track loops. Reference range track video is routed to the transponder tracking control 1A3A4 through deenergized contacts of relay 1A2K25 and energized contacts of relay 1A3K5 for use in the Number 1 range track loop when either S- or C-band reference is selected. Reference azimuth and elevation video is routed to the transponder indicators 1A3A2 and 1A3A3 through deenergized contacts of relay 1A3K3 and energized contacts of relay 1A3K4 when either S- or C-band reference is selected. Reference pre-IF gain voltage is routed to either the S- or C-band prereceiver through closed contacts of relays 1A2K4 or 1A2K3 when either S- or C-band reference is selected.

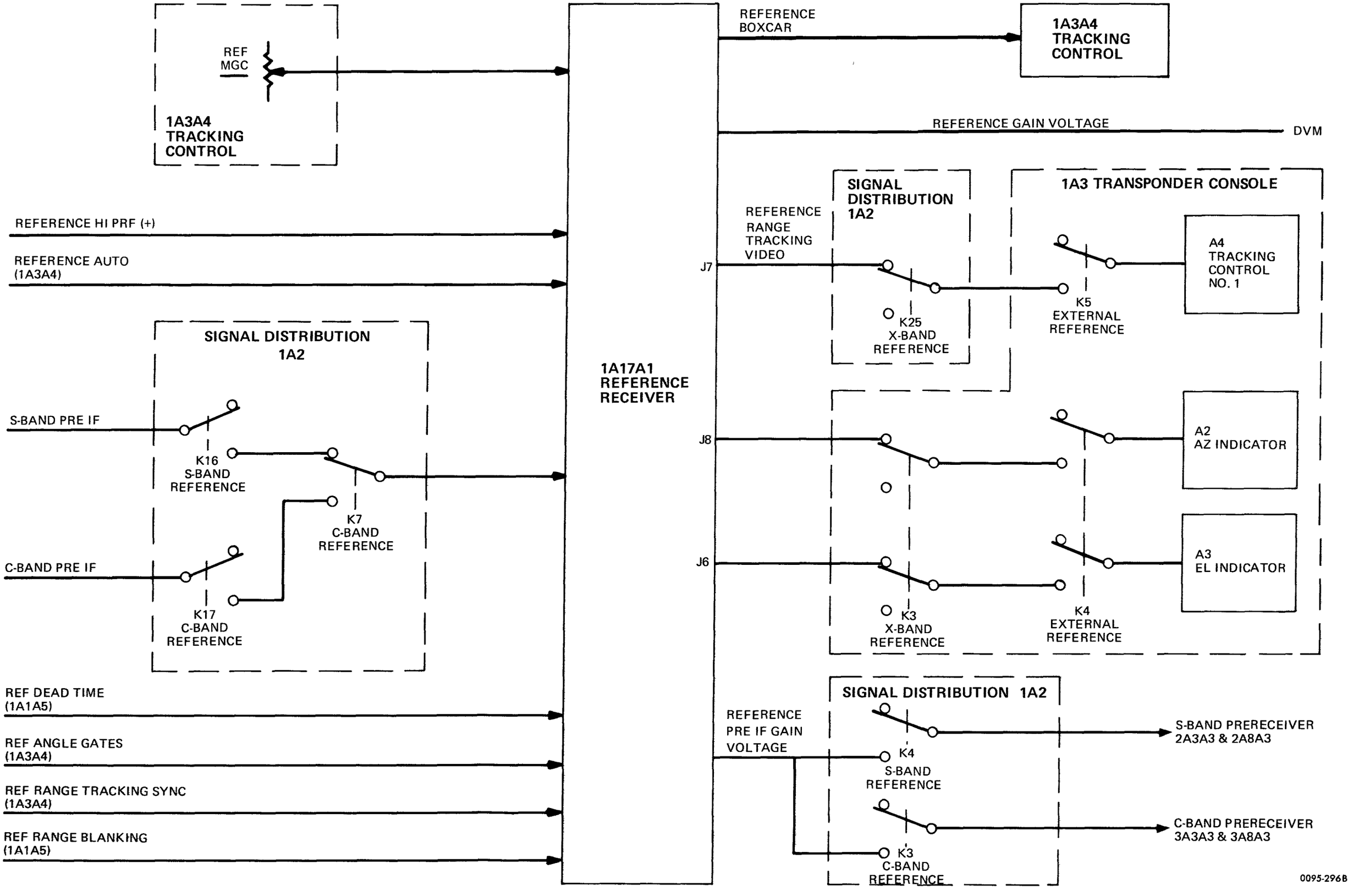


Figure 3-96. Reference Receiver Interface Diagram

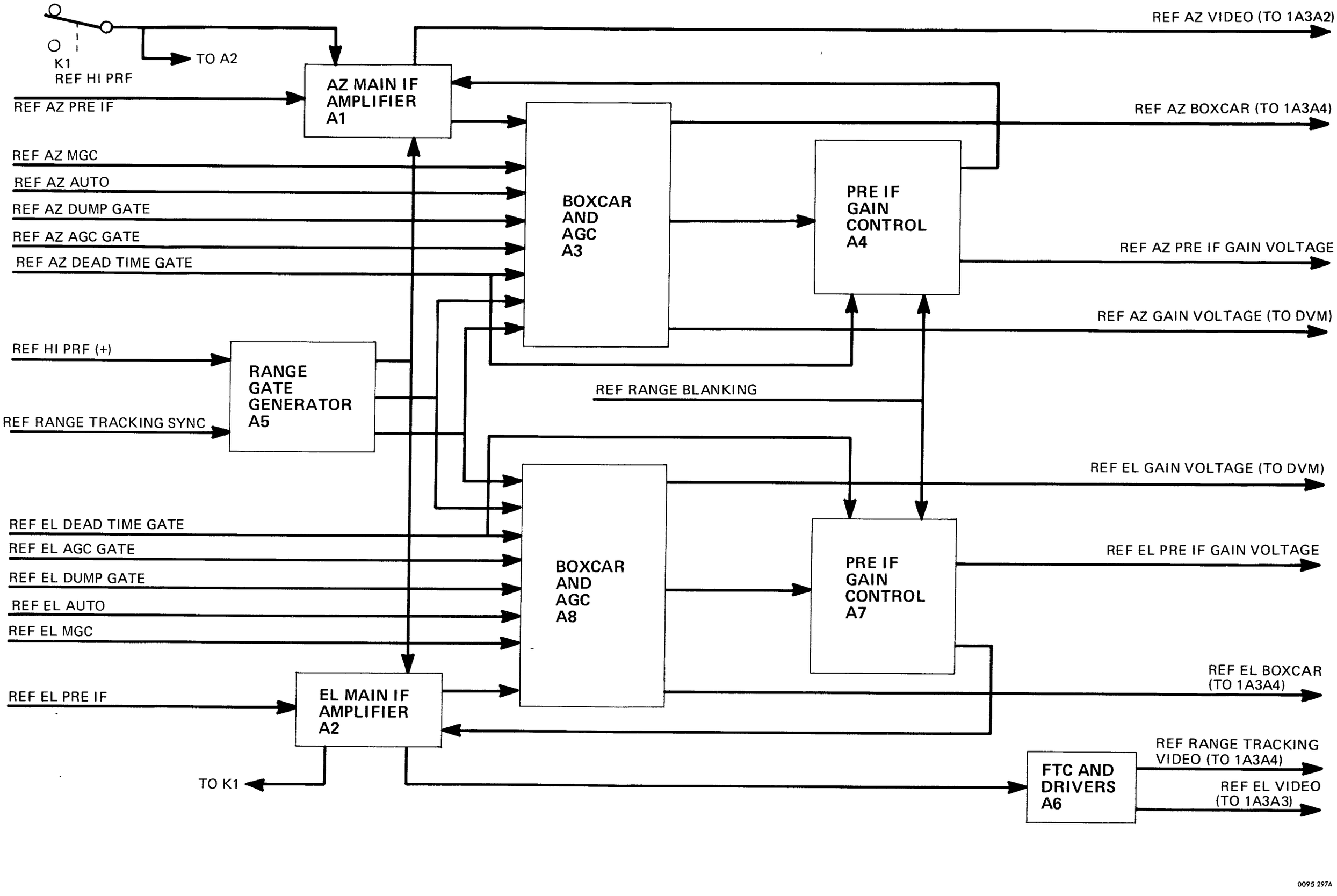


Figure 3-97. Reference Receiver Block Diagram

3-764. A block diagram showing signal flow in the reference receiver is provided by figure 3-97. Operation of the reference receiver is similar to that of azimuth receiver 1A11A1 and elevation receiver 1A11A11. General differences in operation of the reference receiver will be specified in the following discussion. Since the azimuth and elevation channels of the reference receiver are almost identical, signal flow description for only the azimuth channel is provided.

3-765. The selected S- or C-band pre-IF signal is routed to the main IF amplifier A1 where it is amplified and detected in order to produce ungated reference azimuth video for display on azimuth indicator 1A3A2 and range gated video for boxcar and AGC circuits in circuit boards A3 and A4. Operation of the main IF amplifier is the same as for receivers 1A11A1 and 1A11A11 except that bandwidth selection is controlled by the REFERENCE HIGH/LOW PRF SELECT switch on the transponder tracking control 1A3A4 and the IAGC circuit is biased off by application of a constant +5 volt DC signal.

3-766. Range gate generator A5 receives a reference range track synchronization pulse and reference high PRF command when high PRF has been selected. The range gate generator provides the range gate pulse for the main IF and the range dump and boxcar range gates for boxcar and AGC circuits. Range gate generation in the reference receiver is the same as in receivers 1A11A1 and 1A11A11 during normal mode operation.

3-767. From the gated video and range gate inputs, the boxcar circuits of circuit board A3 develop a reference azimuth boxcar signal for the reference angle track loop and a boxcar video signal for utilization by the gain control circuits.

3-768. In addition to the boxcar video input, the gain control circuits of circuit boards A3 and A4 receive MGC from the AZ MGC control on the transponder tracking control 1A3A4 and reference azimuth auto track, reference azimuth dump, reference range blanking, and azimuth deadtime gate inputs. The gain control circuits provide an automatic gain control signal to main IF amplifier A1 and to the selected S- and C-band prereceiver in the antenna cab. The gain control circuits also provide a reference azimuth gain voltage output for monitoring by the digital voltmeter A5A16. There is no provision for low altitude tracking in the reference receiver. During reference tracking operation, STC voltage for the prereceiver is a constant level from a preset voltage source in the transponder tracking control; it is routed to the selected prereceiver by relay switching in the pedestal entry panel 1A2.

3-769. The only difference between the azimuth and elevation channels of the reference receiver is that in elevation, ungated video from the elevation main IF amplifier A2 is routed to the FTC and drivers card A6 where it is split in order to provide the additional reference range track video signal for the reference range track loop as well as the reference elevation video signal for the transponder operator elevation indicator.

3-770. X-BAND TARGET RECEIVER 1A17A3.

3-771. The X-band target receiver is used to process the X-band dish and trough returns during X-band target tracking, X-band reference tracking, or X-band beacon tracking operation. The X-band receiver interface diagram is shown in figure 3-98. The dish and trough prereceiver outputs are routed through the deenergized contacts of the noise figure select relay 1A2K5 to the simulator select relay 1A2K18. When the target simulator is off, these signals are routed to the X-band target receiver. If X-band target tracking is selected and the target simulator is on, the target simulator outputs are routed through the energized contacts of relay 1A2K6, through the energized contacts of relay 1A2K18, to the X-band receiver.

3-772. The target and reference range and angle timing signals from the respective track loops are routed to gates assembly A9 in the reference receiver 1A17A1

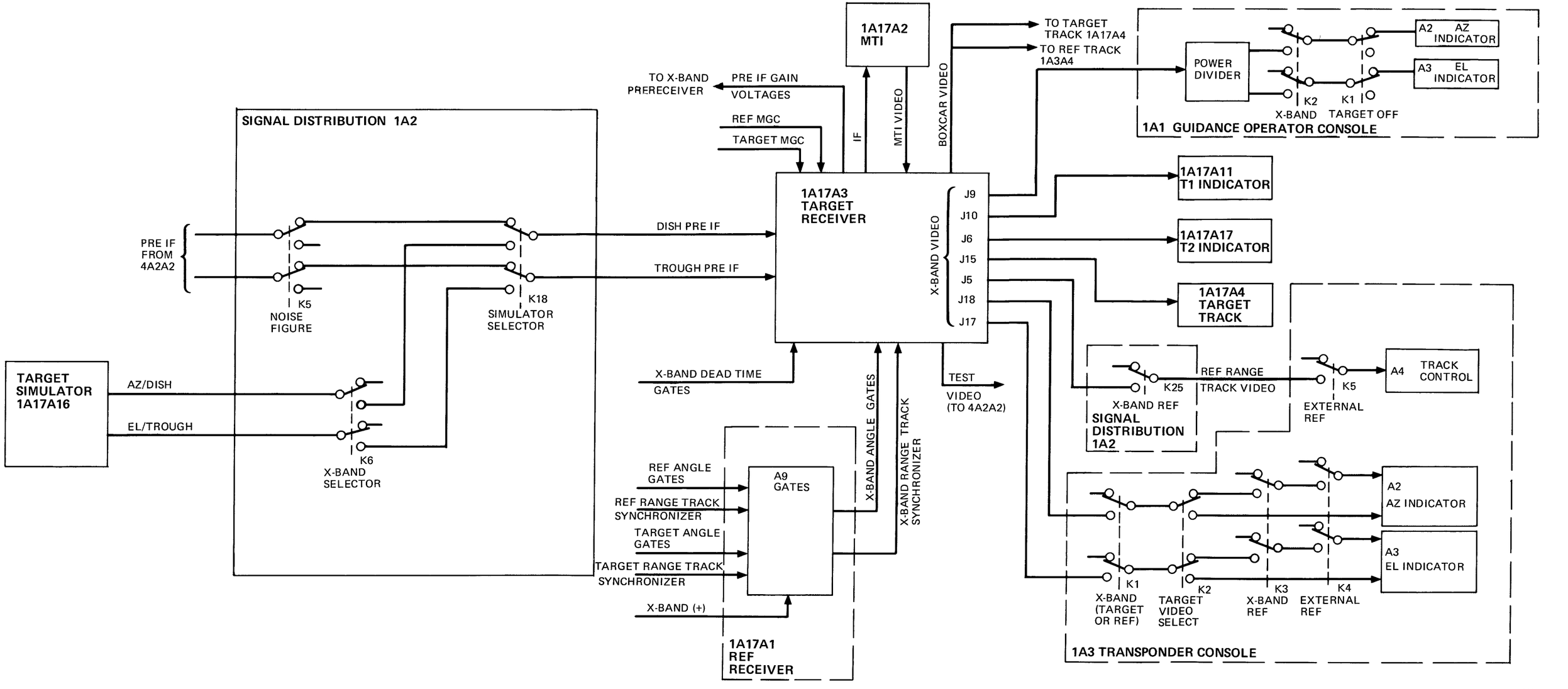


Figure 3-98. X-Band Receiver Interface Diagram

where they are selected as a function of X-band target track and routed to the X-band target receiver.

3-773. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-774. The video outputs from the X-band target receiver are routed to the guidance operator displays 1A1A2 and 1A1A3, the T1 and T2 manual tracker displays 1A17A11 and 1A17A17, the transponder operator displays 1A3A2 and 1A3A3, the target tracking chassis 1A17A4, and the transponder tracking control 1A3A4. In addition, trough and dish test video signals are routed to the X-band prereceiver 4A2A2. Boxcar video signals are routed to the target tracking chassis 1A17A4 and the transponder tracking control 1A3A4 for use in the angle-track loops.

3-775 and figure 3-99. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-776. During X-band acquisition, the dish receiver gain voltage is routed from the gain control select logic through boxcar and AGC card A9 to the deenergized contacts of relay K2. The pre-IF gain control card A6 is used to provide the delayed AGC voltage to the dish prereceiver and the trough main IF amplifier during X-band acquisition.

3-777. X-BAND TRACK OPERATION. In X-band track operation, relay K1 is energized and the dish and trough prereceiver signals are routed to their respective main IF amplifiers A1 and A2. The trough and dish main IF amplifiers (A1 and A2) are similar and are also similar to the S- and C-band main IF amplifiers with the exceptions that the dish IF amplifier does not have an IF range gate circuit and neither has bandwidth selection circuits. The IAGC function for the trough and dish IF amplifiers is controlled by the guidance operator (switch 1A1A4S13).

3-778. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-779. The ungated video output from the trough IF amplifier is routed to video gate and driver circuit A12 and then to the video summing board (A14). A second output from video gate and driver A12 is routed to the X-band prereceiver and to the frequency control circuit A13. The video summing board combines the gated trough and dish video signals. The combined video is then routed to relays K3 and K4 for selection and distribution.

3-780. The gated video output from the trough IF amplifier is routed to the boxcar and AGC circuits A7 and A9. Boxcar and AGC circuit board A9 is used to develop the T1 gain control voltage, while circuit board A7 is used to develop the T2 gain voltage and the T1 and T2 boxcar video signals for use in the angle-track loops.

3-781. The T1 and T2 gain voltages are routed to the AGC gating circuit A8 where they are sequentially gated as a function of the trough scanner position. The output of the AGC gating circuit is routed through relay K2 to the pre-IF gain control board A6. The outputs of pre-IF gain control circuit A6 are routed to the trough main IF amplifier and pre-IF amplifier.

3-782. During X-band track operation, the dish gain control voltage is developed by boxcar and AGC circuit A4. The output of circuit A4 is routed to the pre-IF gain control circuit A5. The outputs of gain control circuit A5 are routed to the dish main IF amplifier and through relay K2 to the dish pre-IF amplifier.

3-783. X-BAND RECEIVER CONTROL. The X-band receiver gain control selection logic is shown in figure 3-100. When X-band is selected as the target tracking system, the guidance operator controls the receiver gain during acquisition with the AZ GAIN control located on the mode control 1A1A1. When control is transferred to the T1 and T2 manual trackers, they control their respective portions of the trough

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS, RADAR TRAINING SET AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1 FOR FIGURE 3-99

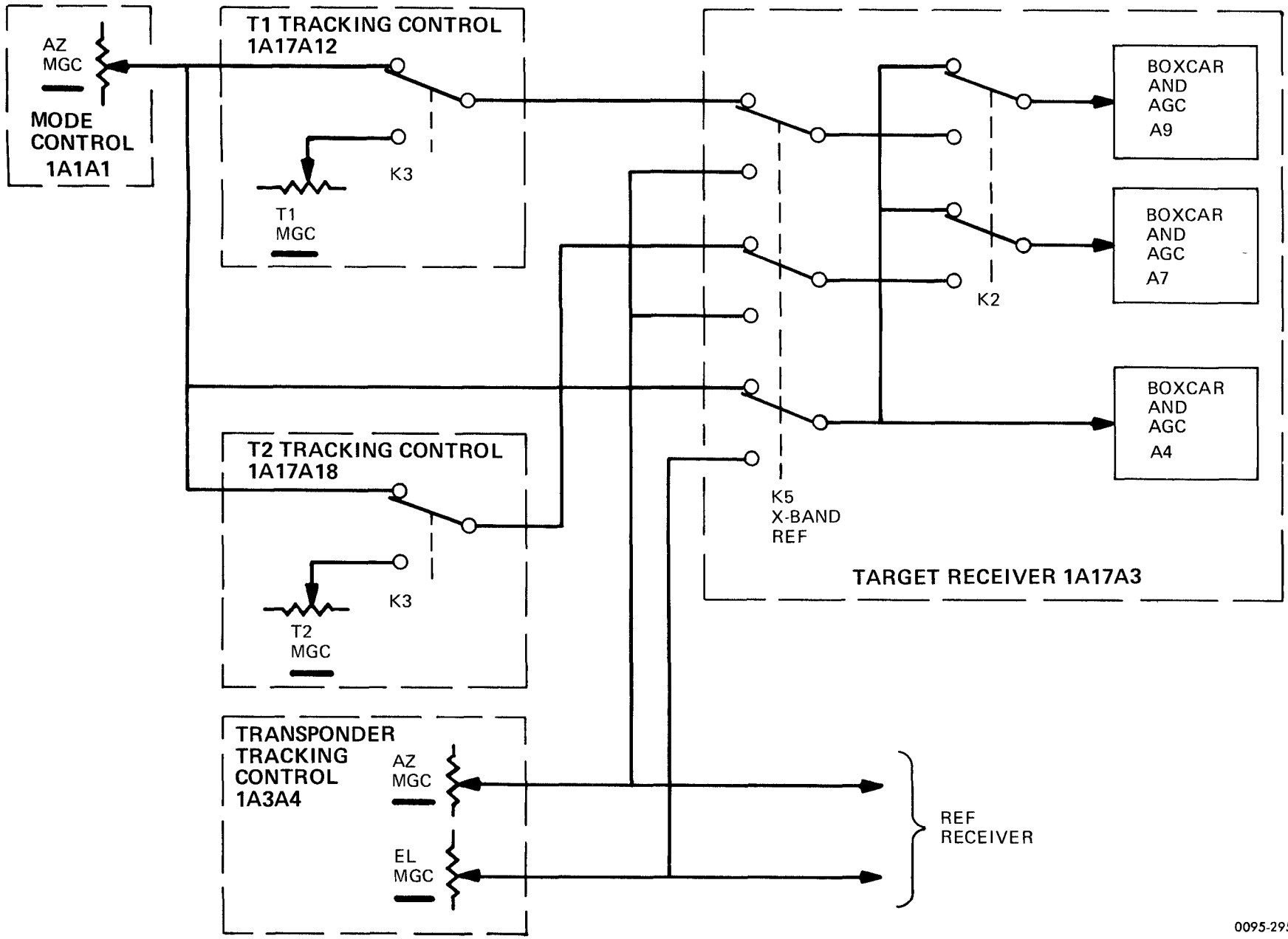


Figure 3-100. X-Band Gain Control Select Logic

gain signal and the guidance operator retains control of the dish receiver gain.

3-784. During X-band reference track operation, the transponder operator controls the trough and dish receivers.

3-785 through 3-786. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-787. BOXCAR AND AGC A4, A7, A9, and A17. Boxcar and AGC circuits A7 and A9 operate in the same manner as the S- and C-band circuits. The gated video is applied to the analog gate Q1. Gate Q1 is turned on by the range gate applied to the gate driver circuit Q2 - Q3. Diode CR4, resistor R6, and capacitor C9 stretch the video pulse which is peak detected by diode CR5 and capacitor C3; i.e., capacitor C3 charges to the peak value of the video pulse and holds that level until the next range dump pulse. Diode CR5 prevents capacitor C3 from discharging until transistor Q11 is turned on. Voltage follower Z1 and noninverting amplifier Z2 are used to set the amplitude of the boxcar video. Since both trough video signals are present at the input, both T1 and T2 boxcar signals will be present at the output. However, since the input to amplifier Z3 is gated by the appropriate AGC gate, only the correct (T1 or T2) boxcar signal will be applied to the boxcar peak detector Z4. The MGC/AGC amplifier/integrator Z5 operates in the same manner as for S- and C-band.

3-788. Boxcar and AGC circuit A4 is used to develop the dish gain voltage during X-band track operation. The circuit operates the same as circuits A7 and A9 with the exception that there is no angle gating to be done; therefore, there is no boxcar gating circuit or peak detector. (During the track mode, the dish scanner is stopped and, therefore, the dish video does not have amplitude modulation due to antenna scan.) The dish boxcar video is essentially a constant amplitude and, therefore, the input to the AGC integrator Z5 is not gated.

3-789. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-790. AGC GATING. The AGC gating circuit is used to sequentially select either the T1 or the T2 receiver gain voltage as a function of trough scanner position. The gain selection circuits consist of analog gates Q3 and Q6, and gate drivers Q1 - Q2 and Q4 - Q5. The gain voltages from the T1 and T2 boxcar and AGC circuits are applied to the analog gates. During the T1 scan time, gate Q3 is turned on and the T1 gain voltage is switched to the noninverting input of amplifier Z4. During the T2 scan time the T2 gain voltage is selected by analog gate Q6. The T1 and T2 dead-time gates are combined in NAND gate Z1C to produce a blanking signal when neither T1 nor T2 antenna is being scanned. This blanking signal is inverted by gate Z1B to produce a +5 volt pulse during the nonscan periods and is applied to the inverting input of amplifier Z4. The output of amplifier Z4 is then routed to relay K2 where it is selected during X-band track and routed to the pre-IF gain control circuit A6.

3-791. An additional logic circuit consisting of gates Z2 and Z3D is used to generate the video gating signals for use by the video gate and drivers A11 and A12. During X-band acquisition, the X-band ACQ (+) signal is inverted by gate Z2D and forces a high output at gate Z2B and a low output at gate Z2C. In X-band track operation the expanded dead-time gates are combined in gate Z2B to produce positive pulses during the 3.8 degree sectors centered on the T1 and T2 cursors. This signal is routed to the trough video gate and driver A12, and the inverted signal is routed to the dish video gate and driver A11.

3-792. VIDEO GATE AND DRIVERS A11 AND A12. The video gate and driver circuits are used to gate the trough and dish video signals. The circuit consists of the analog gate Q3, the gate driver circuit Z1 - Q1 - Q2, and video drivers Q4 and Q5. During X-band acquisition, the display

select logic on the AGC gating board is such that a logic high level is applied to pin 11 of video gate and driver A12 and a low level is applied to pin 11 of video gate and driver A11. With TOJ off (logic low) the output of gate Z1 (pin 8) is then low on circuit A12 and high on circuit A11. Transistor Q1 inverts this logic signal and applies it to the base of transistor Q2. With a high output from gate Z1, the collector of transistor Q1 is slightly less than +15 volts. This turns on transistor Q2, which applies +15 volts to the gates of transistor Q3. With +15 volts on the gates of transistor Q3, transistor Q3 ceases to conduct and no video passes.

3-793. When the output of gate Z1 is low, transistor Q1 is not conducting and +15 volts is applied to the base of transistor Q2. Transistor Q2, therefore, ceases to conduct and -15 volts is applied to the gates of transistor Q3. Transistor Q3 is turned on and the video is gated through to drivers Q4 and Q5. During X-band track operation, the video select signals contain the combined expanded dead-time gates so that the video gate and driver A12 is turned on during the 3.8 degree sectors centered on the T1 and T2 cursors, and the video gate and driver A11 is turned on during the remainder of the trough scan.

3-794. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-795. VIDEO SUMMING (A14). The video summing board used to combine the gated dish and trough video signals consists of emitter followers Q1 through Q4 and driver Q5. The emitter followers provide isolation of the video lines and their outputs are connected together and capacitively coupled to the base of driver Q5. Diodes CR2 and CR3 are used to provide a small DC bias to minimize video loss through driver Q5.

3-796. Frequency Control (A13). The frequency control assembly is used to select one of two preset transmitter frequencies either manually or automatically as determined by the guidance operator. In the manual mode, with F1 selected, the auto frequency (+) signal is a logic low, which forces a logic high output at gate Z6C. The output of gate Z6A is then a logic low, which forces a logic high output at gate Z6B. The outputs of gate Z6A and Z6B are routed to the direct set and direct clear inputs of toggle flip-flop Z9. This forces a logic high output at pin 1 of flip-flop Z9. The output of flip-flop Z9 is routed through isolation transistor Q10 to driver Q11. Driver Q11 is then turned on and relay K1 is energized removing the 28 volt return from the F2 control line.

3-797. When F2 is selected, the output of gate Z6A goes to a logic high and the output of gate Z6B goes to a logic low, which forces a logic low output at pin 1 of flip-flop Z9. This turns off driver Q11 and thus deenergizes K1, which connects the 28 volt return to the F2 control line.

3-798. During the auto frequency mode, if T1 is not autotracking, the transmitter is forced to F2. If auto frequency is selected and T1 is autotracking, the output of gate Z6C is a logic low, which forces the outputs of gates Z6A and Z6B to a logic high, thus enabling the toggle action of flip-flop Z9. During the auto frequency mode, the remainder of the frequency control circuit is used to sample and compare the video signal in the range gate with the video signal which is at a fixed range plus a threshold value. If the difference between these signals becomes too small, the frequency is changed.

3-799. The range gate sampling circuit consists of the gate driver Z1 - Q1 - Q2, the analog gate Q3, the peak detector CR2 - C7, the reset circuit Z2 - Q4, and voltage follower Z4. The range gate is gated by the T1 and T2 AGC gates in gates Z1A and Z1B. The outputs of gates Z1A and Z1B are combined in gate Z1C to produce positive range gate pulses during the T1 and T2 AGC gate periods. These pulses are used to turn on analog gate Q3 and gate the video into the peak detector circuit. The peak detector circuit is reset at every angle sweep by the T1 and T2

dump gates. Thus the output of the peak detector resembles the peak detected box-car waveform. Voltage follower Z4 buffers the output of the peak detector. Filter network R7-C8 filters the output of Z4 to reduce the effects of the angle dump gate reset.

3-800. The fixed range sampling circuit is similar to the range gate sampling with the exception that single-shots Z3A and Z3B are used to generate the fixed range rate. At the end of the indicator range blanking period, single-shot Z3A is triggered for 200 microseconds. After single-shot Z3A times out, single-shot Z3B is triggered to provide a 1-microsecond range gate. This gate is applied to gate driver Q7 - Q8 and turns on analog gate Q6 to sample the video. The peak detector CR3 - C10 is reset at every angle sweep by transistor Q5 and the output of voltage follower Z5 is filtered by network R14 - C11.

3-801. The outputs of voltage followers Z4 and Z5 are routed to differential amplifier Z7 which is used as a differential comparator. In normal operation, the output of voltage follower Z4 is greater than the output of voltage follower Z5 plus the threshold set by potentiometer R17, and thus the output of amplifier Z7 is a logic low. When the output of voltage follower Z5 increases (due to a signal such as a jamming noise strobe) so that the output plus the threshold voltage exceeds the output of voltage follower Z4, the output of amplifier Z7 changes to a logic high level. This change in level triggers single-shot Z8 which in turn causes single-shot Z9 to change state on the leading edge of the output pulse from single-shot Z8. The period of the output pulse of single-shot Z8 is also routed back to its input to prevent single-shot Z8 from being retriggered during its pulse period. If the change in frequency causes the noise amplitude to decrease, the output of amplifier Z7 is low and the transmitter will stay at the new frequency until the noise again exceeds the range gate video.

3-802. If the noise at the new frequency still exceeds the video, the output of amplifier Z7 will remain a logic high and single-shot Z8 will retrigger itself at the end of the 1.5 second period, thus causing the frequency to reverse to the original state. This cycle will continue at 1.5 second intervals until a "clear" frequency is formed.

3-803 through 3-844 and figures 3-101 through 3-106. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-845. TRIGGER GENERATION - MTI ON.

3-846. When the MTI system is in use, a stable transmitter trigger must be provided and the pulse repetition interval of the trigger pulses must be equal to the delay of the delay line in order to effectively cancel stationary targets. In order to produce this equality, the PRI of the trigger pulses is generated by the use of the delay line itself as explained in the following paragraphs.

3-847. Assume that target return video pulses are not sent to the delay line. When a single pulse is generated by the synchronizer, single-shot Z2 is triggered in the timing pulse comparator A21 which develops the detected reference pulse. This reference pulse is injected into the delay line DL1 through switch Z1 in the delay line input A22. This pulse propagates through the delay line, is detected in the delay line output A24, and amplified through amplifier A16. The pulse from amplifier A16 produces another pulse at the output of comparator Z1. In this manner, trigger pulses are continuously generated by the continuous loop in the delay line circuitry.

3-848. The output from single-shot Z1 is also instrumental in generating sample strobes (DL1 and DL2) when applied to gates Z6B and Z6D in conjunction with gating pulses and delay select signals. These strobes are used to sample the delayed video and the AFC video to develop the gain control for the IF amplifiers and the VCXO frequency control, respectively.

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS, RADAR TRAINING SET, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1 FOR FIGURES 3-101 THROUGH 3-106

3-849. The sample strobes, in conjunction with the sample and hold circuit, sample the delay video and use the sampled level to control the two gain voltage integrators. This gain control for the IF amplifiers holds the reference pulse in the IF amplifiers at a constant level and hence holds a constant gain through the delay line IF amplifier loop.

3-850. Frequency control of the VCXOs is generated by sampling the level of the AFC video with sample and hold circuits and controlling integrators that supply the VCXO frequency control voltage. The output of the AFC video mixer is zero when the phase lock loop is phase locked because of the 90-degree phase shift at the input to the mixer. When phase lock is lost, video will not be detected and none will be amplified by the delayed video amplifier A26, and the sample strobes DL1 and DL2 will not be generated. Single-shots Z4 and Z5 are built so that their period is greater than two radar PRIs (the normal period of their input pulses is equal to two radar PRIs), so that, when phase lock is lost, these single-shots time out and two pulse absence signals are generated. These signals cause the VCXO frequency control to go into a search mode to find the correct frequency. When the search mode causes the VCXOs to tune through the correct frequency, video will again be detected, the pulse absence signals will not be generated, and the VCXO control will again be in the track mode.

3-851. VIDEO FULL WAVE RECTIFIER. The full wave rectifier A15 receives bipolar video at pin D and converts it to unipolar positive video. Field effect transistors Q1 and Q2 are biased in their quiescent state just beyond cutoff. With transistors Q1 and Q2 off, zero volts is presented to operational amplifier Z1 at both the inverting and noninverting inputs. If a positive voltage is applied to pin D, transistor Q1 begins to conduct, operating as a source follower, and presents the voltage at pin D to the noninverting input of amplifier Z1. When a negative voltage appears at pin D, transistor Q2 is driven into conduction and, acting as a source follower, presents the pin D negative voltage to the inverting input of amplifier Z1. The gain of amplifier Z1 from either input, inverting or noninverting, is equal to one. Therefore, when a positive voltage is at pin D, it is passed by transistor Q1 to amplifier Z1 and to the output of amplifier Z1 as a positive voltage. When a negative voltage appears at pin D, it is passed through transistor Q2 to amplifier Z1 and then inverted to a positive voltage.

3-852. The unipolar video output of amplifier Z1 is applied to a complementary emitter follower driver circuit (Q3 - Q4) with a gain of one. Driver circuit Q5 - Q6 is identical to circuit Q3 - Q4.

3-853. SAMPLE AND HOLD. The sample and hold card A18 is composed of four identical sample and hold channels. Only one (channel Z1-Z2-Q1-Q2-Q3) will be described. The function of the circuit is to sample the voltage at pin F when commanded by a strobe at pin J. The sampled voltage is held until the sample at pin J commands another sample update. When the sample strobe is present (a logic low) the output of gate Z1 goes to a logic high, turning on both transistors Q1 and Q2. When transistor Q2 turns on, -15 volts is applied to gates G1 and G2 of FET transistor Q3 causing the resistance between the sources and drains to become small. When this occurs, the capacitor C4 charges to the voltage level at pin F. The impedance of voltage follower Z2 is very high so that capacitor C4 is not discharged. When the sample strobe is removed, a logic high is present at gate Z1; this causes a logic low at the emitter of transistor Q1 and both transistors Q1 and Q2 cease conduction. When transistor Q2 is off, +15 volts is applied to gates G1 and G2 of transistor Q3, causing the source-to-drain resistance to become very high. The voltage on capacitor C4 is then held until the next sample update.

3-854. DELAY LINE AGC. The delay line AGC assembly A19 samples the detected reference pulse and generates gain

control voltages for the IF amplifiers so that the loop gain is held constant. The delay line AGC card is composed of two identical channels; therefore, only one will be discussed. One channel is composed of operational amplifiers Z1 and Z3, integrator Z2, and associated components.

3-855. The sampled voltage, the level of which changes at the rate of MTI PRF, is applied to pin H. Amplifier Z1 buffers the signal at pin H and applies it, inverted, to integrator Z2, which is essentially a low pass filter, smoothing the waveform. The resultant output of integrator Z2 is buffered by noninverting amplifier Z3. Amplifier Z2 inverts the signal again, scales it, and routes the signal out as the VCXO-1 control voltage. At the summing junction of amplifier Z6, a DC bias voltage is summed with the control signal. Diodes CR2 through CR5 limit the maximum negative swing to four diode drops and diode CR6 limits the positive output voltage swing to one diode voltage drop. The resistive network comprised of resistors R11 through R14 provides the output voltage bias required by the delay line AGC.

3-856. PHASE LOCK CONTROL. The purpose of the phase lock control A20, is to generate frequency control voltages for the VCXOs. The board can be separated into two similar parts, one for VCXO-1 and for VCXO-2. Because of this similarity, only that part of the circuit related to the VCXO-1 control will be discussed.

3-857. The AFC control signal is routed through pin H to integrating amplifier Z5, where it is inverted and integrated and applied to summing amplifier Z6. The DC bias differs for the MTI mode selected and is selected by relay K1 and controlled by MTI-1/OFF at pin 11 of delay line AGC A19.

3-858. When the DL2 pulse absence signal is not present at pin J, the circuit operation is as described above. A logic low at pin J disables NAND gates Z3 and causes a logic low to be applied to the summing inputs of integrator Z5. When the DL2 pulse absence signal is present at pin J as a logic high, NAND gates Z3A and Z3B are enabled. Single-shots Z1 and Z2 are connected to form a square wave oscillator with a period of 0.8 second. The outputs of single-shots Z1 and Z2 alternately apply logic highs to gates Z3A and Z3B. When the DL2 pulse absence signal enables these gates, the result is that the square wave is applied to integrator Z5. If it is assumed that there is a logic high at pin 11 of gate Z3, there will then be a logic low at pin 8. The logic high will cause integrator Z5 to sweep negative. The logic high then returns to a logic low and the resultant logic high at pin 8 is applied to the noninverting input of the integrator. The integrator will then sweep positive. The output of integrator Z5 is then routed out through amplifier Z6 as a swept VCXO-1 control voltage. This will continue until the DL2 pulse absence signal disappears.

3-859. TIMING PULSE COMPARATOR. The timing pulse comparator A21 basically has two functions. The reference pulse is detected and sample strobes are then generated and routed to the sample and hold card. If a reference pulse is not detected after a predetermined delay line period (DL1 and DL2), pulse absence signals are generated and routed to the phase lock card, eventually resulting in a frequency search mode.

3-860. Delay line video is applied to pin X and routed to comparator Z1. Since the reference pulse video is much larger in amplitude than normal target video, the reference pulse may be detected by simply setting a threshold at comparator Z1. When the threshold (set by potentiometer R5) is crossed, a logic level output is applied to single-shot Z2. In order to reduce the possibility of misfires the single-shot is enabled by "REF PULSE SEARCH GATE" at pin Y. The gate generated is of only a few microseconds duration and is centered about the nominal time the reference pulse should appear.

3-861. The output of single-shot Z2 is routed through pin T to the delay line. Single-shot Z3 is triggered by comparator

Z1 and fires single-shot Z4 or Z5 depending on the delay selected. Delay selection is controlled by "DELAY SELECT" at pin F. Single-shots Z4 and Z5 are missing pulse detectors and as such are retriggerable single-shots. The single-shot time is several milliseconds and the time period is restarted each time a trigger pulse is received from single-shot Z3. If no reference pulse is detected, no trigger pulse appears and single-shot Z4 or Z5, or both, time out. The outputs are OR'ed together at gate Z7 and are also routed out as delay line (DL1 and DL2) pulse absence signals to the phase lock control.

3-862. In the event that a reference pulse (which is routed to reset the synchronizer) is not detected, a range timing pulse will appear at pin 18, which is OR'ed with the reference pulse at single-shot Z2 and applied to reset the synchronizer.

3-863. DELAY LINE INPUT. The delay line input assembly A22 converts bipolar video into modulated IF, which is then injected into the delay line.

3-864. Bipolar video is brought in through connector J2 to analog (video) gate A2Z2, which is closed except during the reference pulse gate. When the reference pulse gate signal is present at pin E4, it is inverted by gate A2Z1 and applied to gate A2Z2. The gate signal enables the main bang sync signal (REF PULSE) at connector A22J1 to pass through gate A2Z2. The gate is only a few microseconds wide and occurs at the system PRI determined by the synchronizer and delay line. The output of gate A2Z2 (bipolar video or reference pulses) is applied to mixer A3A1 where it modulates the LO (Local Oscillator) signal at pin L of the mixer. The output of mixer A3A1 is routed to the delay line (connector J4).

3-865. The local oscillator signal selected for routing to mixer A3Q1 is determined by DELAY SELECT at pin A22J1-9. The outputs of local oscillators Y1 and Y2 are routed through power dividers A3Z3 and A3Z4 respectively and then to analog gate switches A3S1 and A3S2. If the delay select signal is a logic high, DELAY SELECT is then inverted by gate A2Z1 and applied to analog gate driver A3A1 - A3Q2 - A3Q3 and associated components. The logic low from gate A2Z1 turns off transistor A3Q1 and transistor A3Q2. With transistor A3Q2 turned off, a positive voltage is applied to emitter follower A3Q3 and switch A3S1. Gate switch A3S1 closed and the output of VCXO Y1 is applied to mixer A3A1. Simultaneously, the logic high DELAY SELECT is routed to an identical driver A3Q4 - A3Q5 - A3Q6 without being inverted. The logic high causes transistor A3Q4 to conduct, raising the voltage at the base of transistor A3Q5 and, thereby, causing it to conduct. The resulting negative voltage is buffered by emitter follower A3Q6 and applied to gate switch A3S2. Switch A3S2 is therefore opened to disconnect VCXO Y2 from mixer A3A1.

3-866. The outputs of power dividers A3Z3 and Z3Z4 are also routed to analog gates A3S3 and A3S4, which are controlled by gate drivers A3Q7 - A3Q8 - A3Q9 and A3Q10 - A3Q11 - A3Q12 respectively, identical to those controlling analog gates A3S1 and A3S2. The control is such that if the output of VCXO Y1 is gated to mixer A3A1, then the output of VCXO Y2 is gated through switch A3S3 to connector J3. If the output of VCXO Y2 is gated to mixer A3A1, then the output of VCXO Y1 is gated through switch A3S4 to connector J3.

3-867. Local oscillators Y1 and Y2 are voltage controlled crystal oscillators VCXO-1 and VCXO-2. Voltage control for both oscillators is identical. The VCXO-1 control voltage is applied to pin A22J1-11 and routed to amplifier A3Z1 which scales, smoothes, and limits the voltage output. The output of amplifier A3Z1 is then applied to local oscillator Y2 (VCXO-2) as the control voltage.

3-868. PHASE DETECTOR. The output of the phase detector A23 is a DC voltage proportional to the phase difference of the receiver IF and the coherent oscillator (COHO). Since the phase difference is constantly changing, the output is varying and

is called bipolar video. The IF inputs are routed from the dish receiver and from the trough receiver. The two signals are alternately selected and gated for application to the phase detector.

3-869. The AGC Gate signal (pin A3E8) is inverted by gate A3Z2 and applied to analog gate switch drivers A3Q2 - A3Q4 - A3Q6. The gate signal is inverted again by gate A3Z2 before it is applied to switch drivers A3Q1 - A3Q3 - A3Q5, so that the outputs of the two drivers are opposite in polarity. The analog gate driver outputs are applied to analog gate switches A3S1 and A3S2. If a logic high is present at pin A3E8 at the AGC gate, then a negative voltage will be applied to switch A3S2 thereby opening the switch. A positive voltage will be applied to analog switch A3S1 thereby closing the switch. In this way the dish or trough IF is gated to the phase detector (mixer) A3A1.

3-870. At phase detector A3A1, the selected IF and the COHO signal, from pin A3E13, combine to produce bipolar video. The video output at pin A3E15 is a DC level proportional to the phase difference between the IF and the COHO signal. Since the phase relationship is varying, the phase detector output level will vary in the same manner.

3-871. DELAY LINE OUTPUT. The purpose of the delay line output card A24 is to demodulate the delay line IF, thus generating bipolar video and AFC video. The AFC video output is applied to the local oscillators to change, or regulate, the frequency. Ideally, if the phase of the delay line IF is changed by 90 degrees and then demodulated by the same local oscillator which was used to modulate the signal, the resultant will be zero. As delay line characteristics vary, the resultant will not equal zero. This voltage is then applied to the VCXO local oscillator to change the frequency until the demodulated AFC video is again zero.

3-872. Depending on the delay selected, IF (delayed RF) will be gated in from pin A3E10 or A3E12. Delay select is present at pin A3E8 in the form of a logic high or a logic low. It is inverted by gate A3Z2 and applied to identical analog gate drivers A3Q1 - A3Q3 - A3Q5 and A3Q2 - A3Q4 - A3Q6. With a logic high at pin A3E8, a negative voltage is presented at analog gate switch A3S1, thereby opening the switch, and a positive voltage is presented at switch A3S2, thereby closing that switch.

3-873. The IF is gated through switches A3S1 or A3S2 to power divider Z3 where the signal is then split and routed to mixers A3A1 and A3A2. The local oscillator signal at pin A3E7 is split by power divider A3Z1 and routed to mixer A3A1 and to transformer A3T1. Transformer A3T1 shifts the local oscillator signal in phase by 90 degrees and applies it to mixer A3A2. The output of mixer A3A2 is a DC level proportional to the phase difference of the two signals at mixer input pins A3A2-L and A3A1-R. If the phase difference is 90 degrees, the output will be zero.

3-874. At mixer A3A1, the delay line IF and the unshifted local oscillator signal combine to produce the demodulated bipolar video at pin A3E15.

3-875 through 3-879 and figure 3-107. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-880. TRANSPONDER RECEIVER 1A3A1.

3-881. The transponder receiver contains four identical azimuth and elevation channels; one channel for each of the four transponder tracking loops. The interface diagram for the transponder receiver is shown in figure 3-108. The IF input to the receiver comes from the target tracking pedestal or from the target simulator as selected by the guidance operator. The outputs from the receiver consist of azimuth and elevation video for display, elevation video for range tracking, and azimuth and elevation boxcar video for angle

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS, RADAR TRAINING SET, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1 FOR FIGURE 3-107

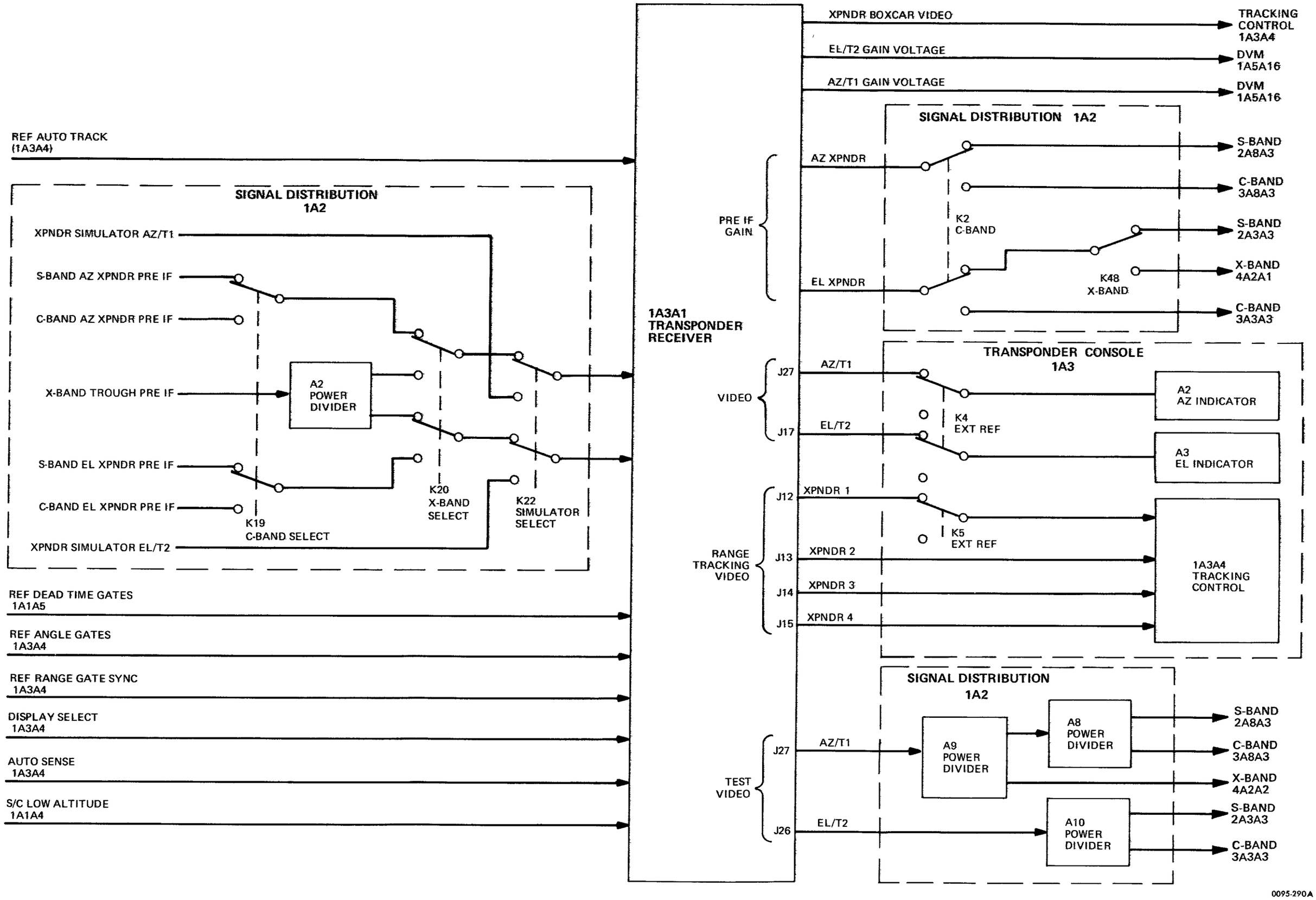


Figure 3-108. Transponder Receiver Interface Diagram

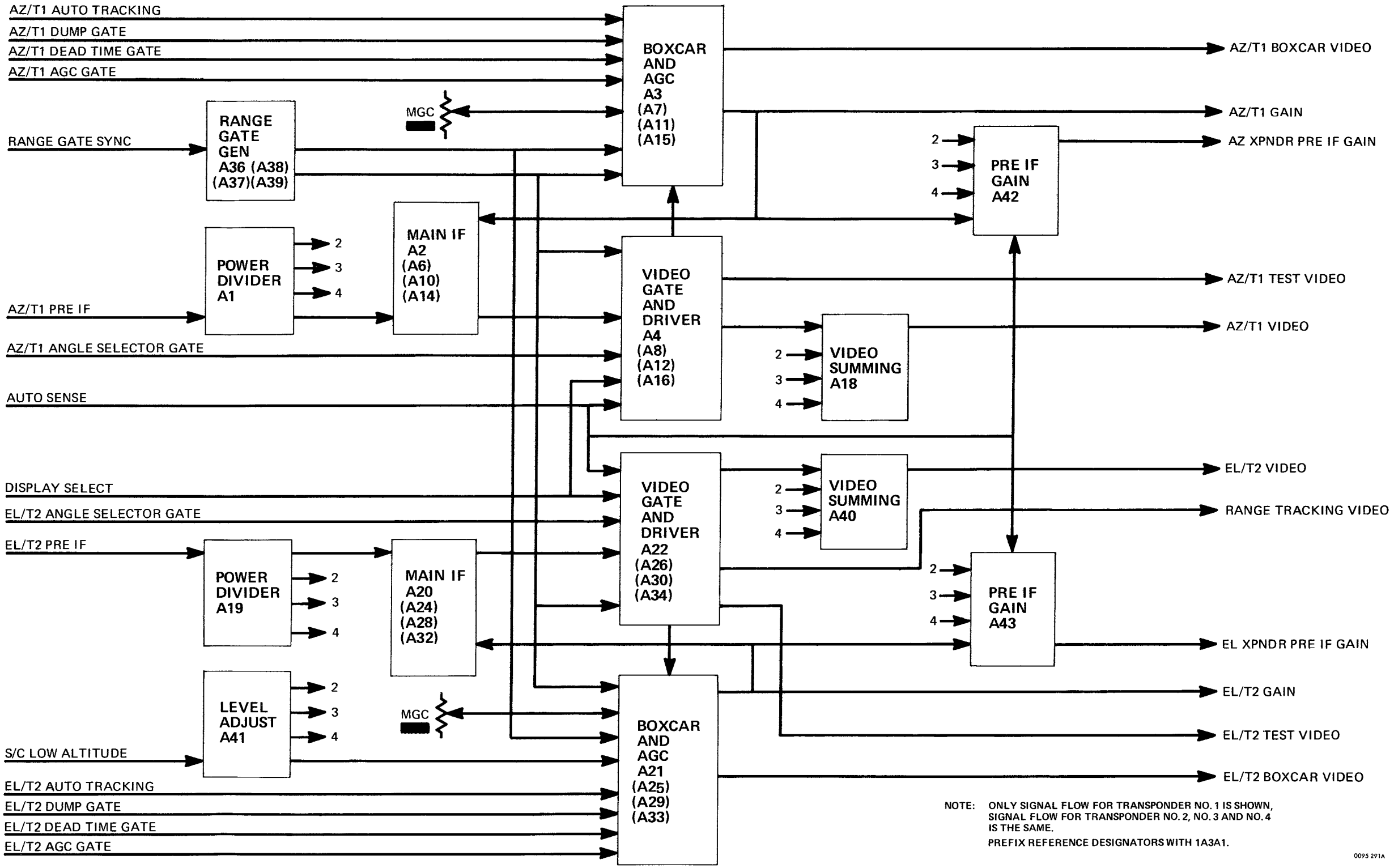


Figure 3-109. Transponder Receiver Block Diagram

tracking. The angle and range timing signals for each of the four channels come from the respective track loops located in the transponder tracking control 1A3A4.

3-882. The block diagram of the transponder No. 1 channel is shown in figure 3-109. The remaining three channels are identical and their respective reference designators are shown in sequential order. In addition to the four channels being identical, it will also be noted that the azimuth and elevation portions of each channel are similar with the exception of the level adjust card used during elevation low altitude.

3-883. The selected IF input signal is routed to a four-way power divider where it is split and routed to each of the four main IF amplifiers. The main IF amplifiers are similar to the S-/C-band main IF amplifiers except that bandwidth switching and the IAGC circuit are not available in the transponder receiver. In addition, these main IF amplifiers are tuned to 60 megahertz. Video outputs of the IF amplifiers are routed to video gate and driver boards.

3-884. Video Gate and Driver. The video gate and drivers (A4, A22) are used to provide ungated video to the boxcar and AGC assemblies and, in the case of elevation, to the range track loops. The video gate and driver also provides a gated video output for display. This gated video is controlled by the logic of gate Z1 which drives the gate driver circuit Q1 - Q2. The display select line is controlled from the transponder tracking control 1A3A4. When the channel display is not selected, pin 11 of the card is at a logic low which forces a logic high output from gate Z1C. This turns on transistor Q1 which reduces the voltage at the base of transistor Q2. Transistor Q2 turns on and +15 volts is applied to the gates of transistor Q3. With +15 volts applied to its gates, transistor Q3 ceases to conduct to prevent video from passing to driver Q5. When the display is selected and auto sense is low (i.e., azimuth, elevation and range are not in autotrack) the output of gate Z1C is at a logic low and transistor Q1 turns off. With transistor Q1 turned off, +15 volts is applied to the base of transistor Q2 and it ceases to conduct. As a result, -15 volts is applied to the gates of transistor Q3. Transistor Q3 turns on and passes the video to gate driver Q5.

3-885. When the auto sense line goes to a logic high, the video is gated by the output of gate Z1A which is a combination of the angle and range gates. Thus, only the video within the range gate and centered on the angle cursor is gated through for display.

3-886. The display video (i.e., gated) outputs from the video gate and drivers are routed to the video summing boards A18 and A40. These video summing boards are the same as those used in the X-band target receiver 1A17A3 and are used in the transponder receiver to combine the gated transponder video signal for display.

3-887. An ungated video output from the video gate and drivers is routed to the boxcar and AGC circuits. The boxcar and AGC circuits operation is the same as for the S-/C-band target receiver. The boxcar video output is routed to the transponder tracking control 1A3A4. The gain voltage outputs are routed to the main IF amplifiers and to the pre-IF gain control circuits A42 and A43.

3-888. Pre-IF Gain Control A42 and A43. The pre-IF gain control circuits used in the transponder receiver combine the gain voltages of the channels that are autotracking and provide an average gain voltage output to the transponder prereceiver. The pre-IF gain control circuit consists of four analog gates and gate drivers, a voltage follower Z1, and an amplifier Z2. The gain voltages from the boxcar and AGC circuits are routed to the analog gates. When autotrack is selected for a track loop, the associated gate is turned on and the gain voltage is gated through to the follower. The resistor network R4-R8-R12-R16 acts as an averaging network so that, when more than one transponder is being autotracked, the pre-IF gain voltage is con-

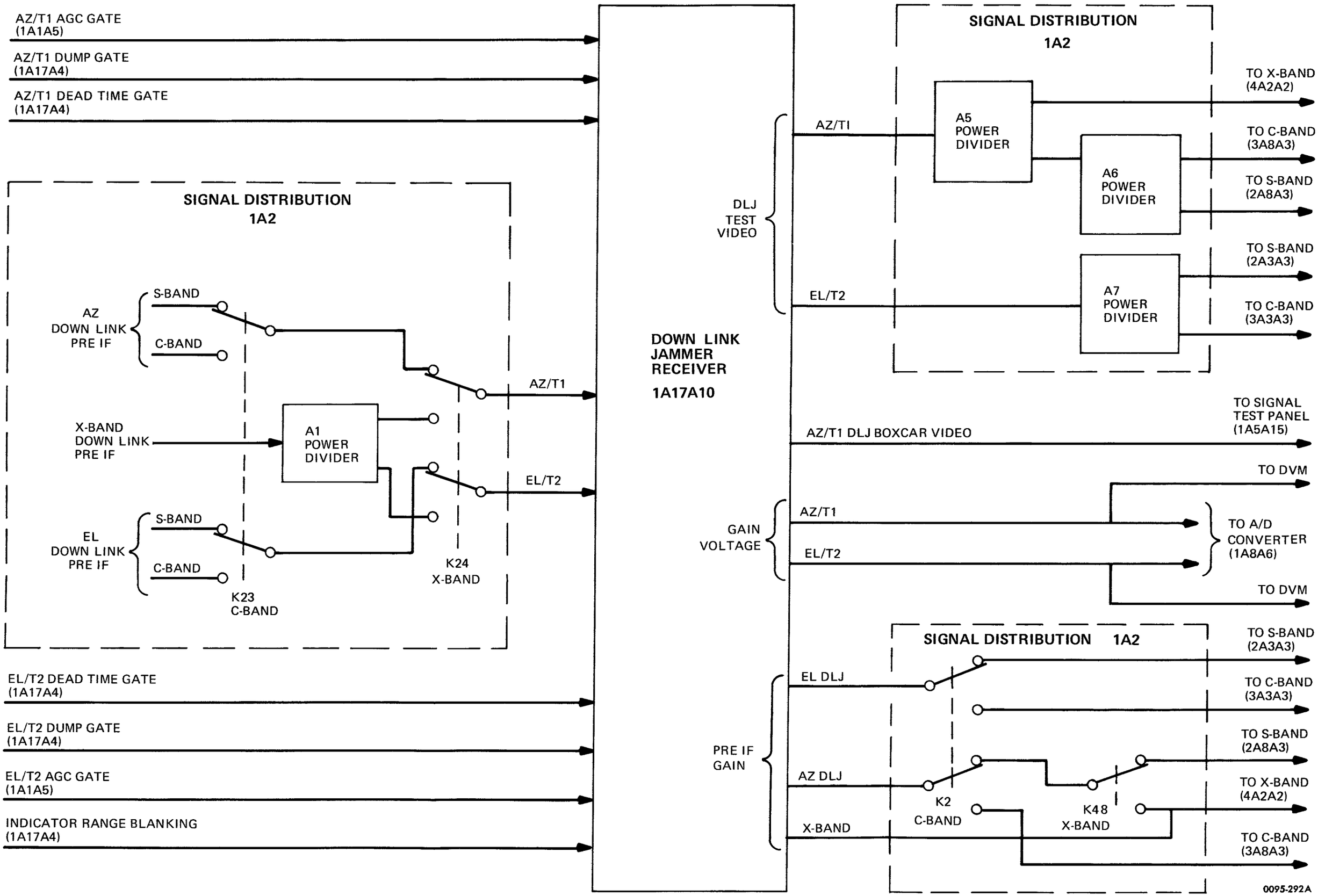


Figure 3-110. Downlink Jammer Interface Diagram

trolled by the average value required for each transponder receiver channel. When only one transponder is autotracking, that gain voltage is gated through to voltage follower Z1. When transponders 1 and 2 are autotracking, then gates Q3 and Q6 are enabled. Since each gain voltage is driven from a low impedance source (i.e., the AGC integrator) that source appears as essentially ground to the other signal(s). Therefore, the voltage at voltage follower Z1, due to transponder 1 gain voltage, is half of what it would be if transponder 2 was not autotracking, and the voltage at voltage follower Z1, due to transponder 2, is also half of what it would be. If three transponders were being autotracked, each would contribute one-third of its normal gain voltage, and, if four were being tracked each would contribute one-fourth.

3-889. Amplifier Z2 is a noninverting amplifier. Diode, CR1, prevents the output from going positive and the voltage divider R17 - R18 provides the transponder AGC delay. The output of the pre-IF gain control is routed to the transponder pre-IF amplifier in the selected target tracking pedestal.

3-890. DOWN LINK JAMMER RECEIVER (1A17A10).

3-891. The down link jammer receiver is used to process the output of the down link jammer prereceiver from the selected target tracking pedestal. The down link jammer receiver interface diagram is shown in figure 3-110. The selected prereceiver IF signal is routed to the receiver where it is processed to provide a measurement of down link jammer power. The receiver outputs consist of test video which is routed to the antenna trailers through the power dividers in the signal distribution panel, boxcar video which is routed to the scope test panel, prereceiver gain voltage which is routed to the selected antenna trailer, and receiver gain voltage which is routed to the digital voltmeter and to the computer through the analog-to-digital converter. This gain voltage, when compared to a calibration chart of gain voltage versus RF input power, can be used as a measurement of received jammer power. (Normal operation is with the AGC/MGC switches in the AGC position.)

3-892. The down link jammer receiver block diagram is shown in figure 3-111. The pre-IF signal is routed to the IF amplifiers A1 and A2. The IF amplifiers are similar to the S-/C-band target IF amplifiers except that bandwidth switching is not incorporated. The IF amplifiers provide an ungated video output for test and a gated output which is routed to the boxcar and AGC circuits. The IF range gate, as well as the range dump gate and video range gate for the boxcar circuit, is generated at a fixed range by the range gate generator A5. The synchronizing pulse for the range gate generator is target indicator range blanking.

3-893. The boxcar and AGC circuits receive angle gates from the target track loops and generate boxcar video from the video in the fixed range gate. The down link jammer AGC voltage is developed from the jamming video centered on the angle cursor. The gain voltage from AGC integrator A8Z5 is routed to the pre-IF gain control A7 and the AGC gating circuit board A6. The gain voltage from boxcar and AGC circuit board A3 is routed to AGC gating circuit board A6 and relay K2. In X-band operation, relay K2 routes the output of the AGC gating circuit board as the input to the pre-IF gain control A4.

3-894. The AGC gating circuit board performs the same function as in the X-band target receiver 1A17A3; that is, it sequentially selects the gain voltages from AGC circuit board A3 and AGC integrator A8Z5 as a function of the trough scanner position to provide the correct pre-IF gain voltage to the trough prereceiver.

3-895. The pre-IF gain control circuits are identical to those used in the X-band receiver and are used to provide outputs to the main and pre-IF amplifiers.

3-896. PRESENTATION GROUP.

3-897. The implementation of each of the nine B-scope displays 1A1A2, 1A1A3, 1A3A2, 1A3A3, 1A11A2, 1A11A6,

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS, RADAR TRAINING SET AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1 FOR FIGURE 3-111

1A11A11, 1A17A12, 1A17A17, and their associated sweep generation circuits is essentially the same. (See figure 3-112.) The implementation of the APP display 1A19A1 is similar to that of the B-scope. The functional grouping of these circuits as described in the following paragraphs is: sawtooth and sweep blanking generation, deflection system, video system, cursor generation, and high voltage power supplies.

3-898. B-SCOPE SAWTOOTH AND SWEEP BLANKING GENERATION.

3-899. The horizontal angle sweep for the B-scope indicators is synchronized to the angle dead-time gate while the vertical range sweep is synchronized to the main-bang of the transmitter which is used for the tracking function. The angle dead-time gate is selected in the angle timing portion of the synchronizer 1A1A5 and originates in the antenna which is used for the receiving function. When the target simulator is in use, this gate is internally generated in the synchronizer. The expanded range sawtooth is synchronized by a prerange track sync pulse received from the target range tracking loop and is timed so that the sweep brackets the range track gates. The sweep and blanking generation is similar for all operator display groups as shown in figure 3-113. The expanded range sweep is provided only for the indicators in the manual tracker display group and the guidance operator left hand indicator. The location of the units used for the sweep functions for the various display groups is shown in table 3-4. The selection of either azimuth or elevation sawtooth and blanking is provided for the range manual tracker display and is controlled by the AZIMUTH SELECT and ELEVATION SELECT switches 1A11A7S3 and S4.

3-900. Sweep blanking signals are generated during the time the angle and range sweeps are in the reset condition to blank the cathode ray tube (CRT) raster during the sweep retrace.

3-901. ANGLE SAWTOOTH GENERATION. Sawtooth waveforms which are used as the input to the horizontal sweep (scan) input of the displays are generated in the angle sawtooth generator. Selection circuits provide for adjustment of the sawtooth slope for the different radar operating modes to ensure that the amplitude of the sawtooth and, hence, the width of the horizontal sweep display does not vary between operating modes. The angle sawtooth waveforms are reset by the angle dead-time gate received from the angle timing portion of the synchronizer 1A1A5.

3-902 and table 3-5. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-903. Angle Sawtooth Generator. The angle sawtooth generator consists of an integrator, reset circuit, gating circuit, and level converters. The Slope 1 and Slope 2 inputs are decoded in the gating circuit which drives the base circuits of the level converters. When the base drive to a level converter is a logic high (+5 volts), the level converter is turned off causing its collector to go to a negative voltage. This negative voltage is connected to the summing junction of the integrator causing an increase of current to the summing junction and hence a high integration rate of the integrator.

3-904. When both slope inputs are low, all level converters are turned on and the integrator input resistor is resistor R1. When the mode signal input is changed, one of the outputs of gating circuit Z3 goes to the logic high state which turns off its level converter and adds a parallel resistance path to resistor R1.

3-905. The reset circuit consists of inverter drivers and the integrator reset transistor Q4. The dead-time gate input produces a positive gate on the base of integrator reset Q4. Transistor Q4 saturates and discharges the integrating capacitor through the saturation resistance of the

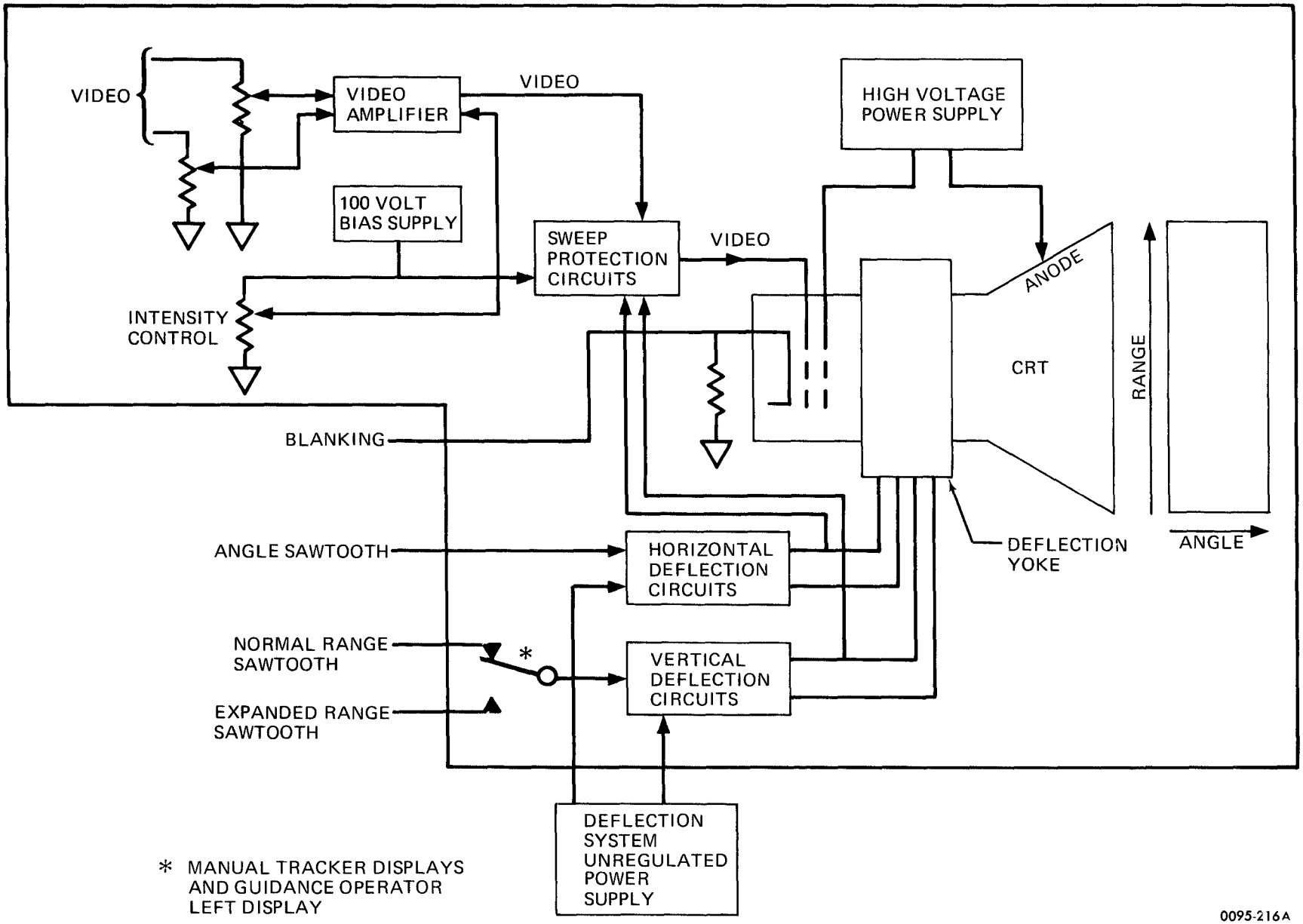


Figure 3-112. B-Scope Indicator Block Diagram

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS, RADAR TRAINING SET, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-2 FOR FIGURE 3-113.

Table 3-4. Sweep Function Locations in Display Groups

Display Group	Angle Sawtooth Generator	Normal Range Sawtooth Generator	Slope Select and Blanking Circuits	Expanded Range Sawtooth Generator
Guidance Operator Display Group				
Azimuth T1 Indicator A1A2	A1A5A2A33	A1A5A2A31	A1A5A2A29	A1A5A2A27
Elevation T2 Indicator A1A3	A1A5A2A35	A1A5A2A31	A1A5A2A29	None
X-Band Acquisition A1A2, A1A3	A1A5A2A37	A1A5A2A31	None	A1A5A2A27
Manual Tracker Display Group S- and C-Band				
Azimuth Indicator A11A2	A11A5A3	A11A5A1	A11A5A2	A11A5A5
Range Indicator A11A6	A11A5A3 or A11A5A4	A11A5A1	A11A5A2	A11A5A5
Elevation Indicator A11A12	A11A5A4	A11A5A1	A11A5A2	A11A5A5
Transponder Operator Display Group				
Azimuth T1 Indicator A3A2	A3A4A57	A3A4A56	A3A4A59	None
Elevation T2 Indicator A3A3	A3A4A58	A3A4A56	A3A4A59	None
X-Band Acquisition A3A2, A3A3	A3A4A66	A3A4A56	None	None
Manual Tracker Display Group X-Band				
T1 Indicator A17A11	A17A11A7	A17A11A5	A17A11A6	A17A11A8
T2 Indicator A17A17	A17A17A7	A17A17A5	A17A17A6	A17A17A8
Automatic Position Plotter Display				
APP Indicator A19A1	None	A19A2A1	A19A2A2	None

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS, RADAR TRAINING SET, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1 FOR TABLE 3-5.

transistor and holds the integrator reset Q4 for the duration of the dead-time gate. At the end of the dead-time gate, transistor Q4 is turned off which allows capacitor C2 to charge due to the integration; thus the next angle sawtooth is generated.

3-906. RANGE SAWTOOTH GENERATION. Range Sawtooth generation is performed by either the normal range sawtooth generator or the expanded range sawtooth generator.

3-907. Normal Range Sawtooth Generator. The normal range sawtooth generator produces the range sawtooth used as the input to the vertical (range on the B-scope) deflection circuitry in the indicators when operating in the normal range sweep mode.

3-908. The timing diagram of the range sweep generation is shown in figure 3-114. The indicator range blanking pulse, generated in the range timing portion of the transmitter group, is received from the synchronizer and can be monitored at test point TP1. The indicator range blanking pulse starts at range reset time and stops at preknock time. This assembly operates in the same manner as the angle sawtooth generator previously described.

3-909. The Slope 1 input is connected to the high PRF select line from the range timing section of the transmitter group. The Slope 2 input is wired to X-band (+) select. Therefore, when high PRF is selected, +5 volts is applied to the Slope 1 input, level converter Q3 is selected, and the resistance network R12-R13 is connected to the summing junction of integrator Z4. When low PRF is selected (the Slope 1 input is at ground), the resistance network R8-R9 is connected to the summing junction of integrator Z4 by level converter Q2. Level converter Q1 remains in conduction at all times in the range sawtooth generator.

3-910 and 3-911. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-912. The sync pulse input is inverted by a section of gate Z3 and used to trigger single-shot Z2. The duration of the single-shot output pulse is determined by network R2-R3-C7 and is adjusted for 40 microseconds by potentiometer R2. This output pulse is inverted by another section of gate Z3 and is used to turn off reset transistor Q1 allowing the integrator to operate during the pulse period. The integrator is reset during the inter-pulse period.

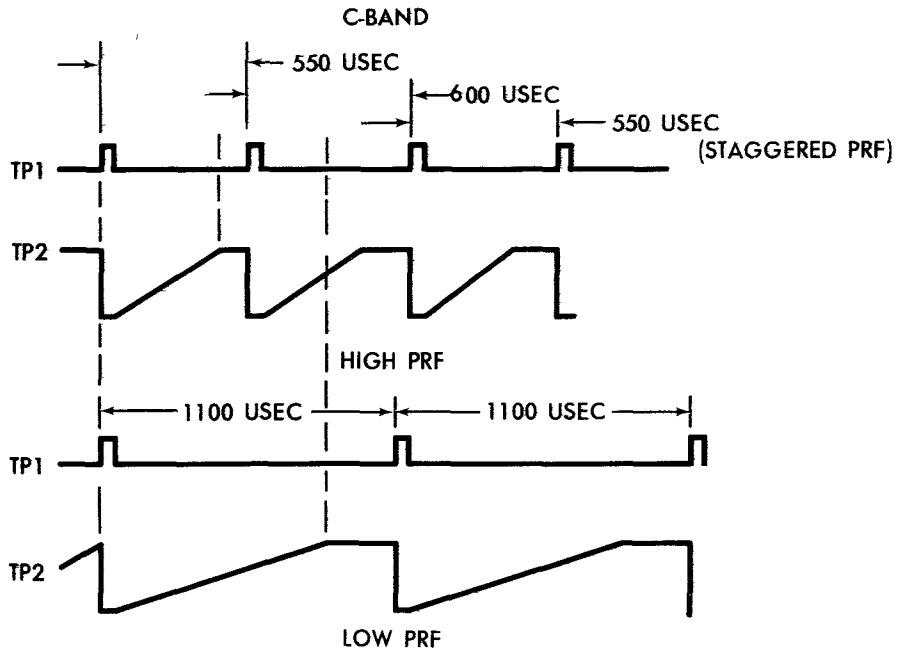
3-913. The zero output of single-shot Z2 is inverted by a section of gate Z3, amplified by emitter follower Q2 for use as the range sweep retrace blanking pulse for the indicators. Emitter followers Q3, Q4 and Q5 provide the driving capability for the +25-volt blanking pulses sent to the three manual tracker indicators.

3-914. AUTOMATIC POSITION PLOTTER (APP) SAWTOOTH AND SWEEP BLANKING GENERATION.

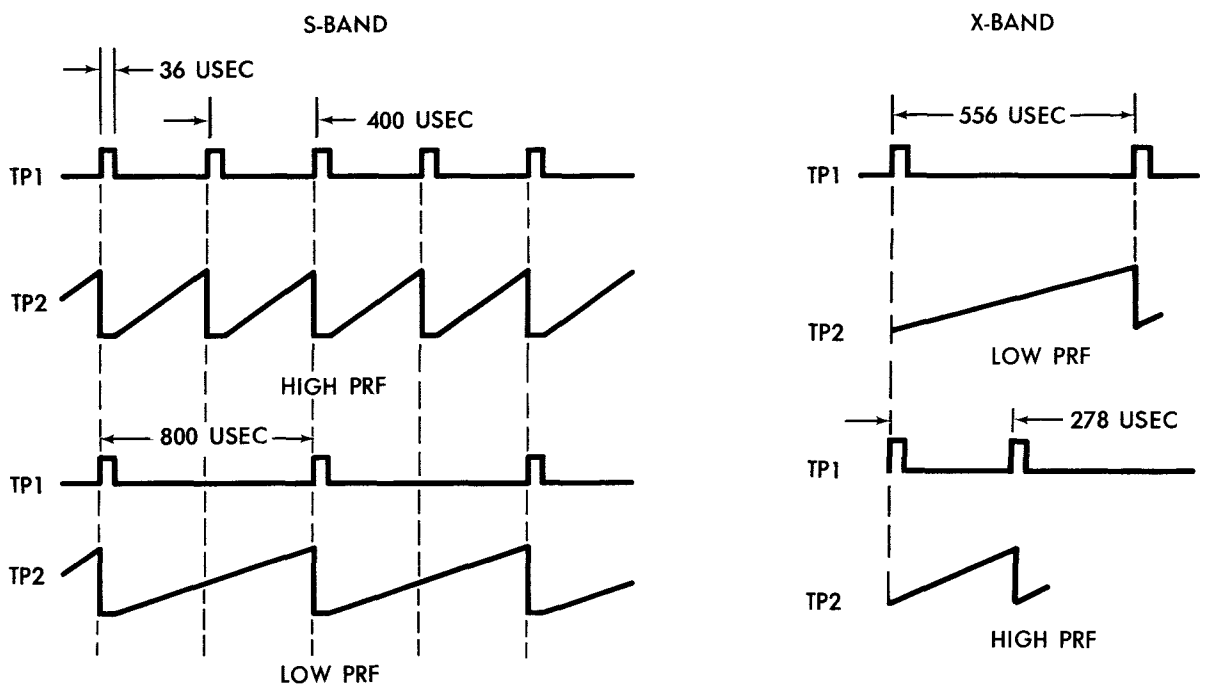
3-915. The range sweeps for the APP indicators are synchronized to the main bang of the transmitter being used for tracking. The angle sweep is asynchronous with the tracking radar.

3-916. Sweep blanking signals are generated during the time the range sweeps are in the reset condition to blank the CRT raster during the sweep retrace.

3-917. The vertical and horizontal sweeps are generated as shown in figure 3-115. One-Hertz oscillator, A5, has two outputs: a sine wave and a wave shifted in phase by 90 degrees. The instantaneous value of each waveform represents the sine and cosine of an angle. Over one period of the waveform, the angle varies from zero degrees to 360 degrees. When applied to the indicator, the magnitude of the two waveforms (which must be equal) determine the distance from the indicator center at which the sweep occurs. For this reason, the two waveforms are then multiplied in multiplier A4 by the output of range sawtooth generator A1. Because the sawtooth



C-BAND



S-BAND **X-BAND**

0095-4B

Figure 3-114. Range Sweep Generation Timing Diagram

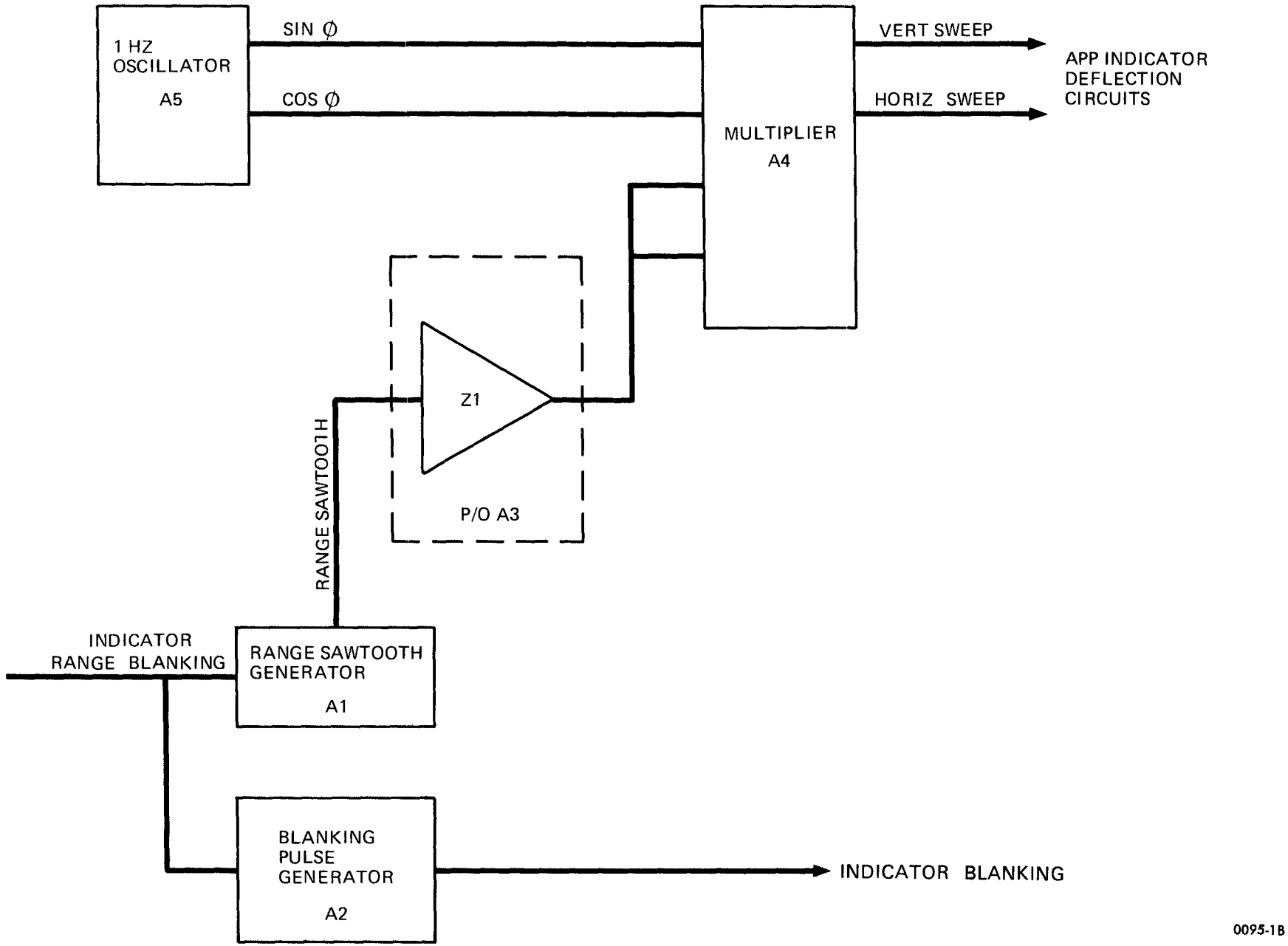


Figure 3-115. APP Sweep Generation Block Diagram

begins at zero, increases, and resets to zero, the indicator sweep will begin at the indicator display center and range out toward the periphery of the display. The sawtooth then resets and the sweep returns to the display center. If the time required for the sawtooth to reach its maximum value and reset is very small compared to that required to sweep 360 degrees, the sweep will appear to be a straight line which moves in a circle. During the reset time, the indicator is blanked to prevent the sweep retrace from being displayed.

3-918. The indicator range blanking pulse starts and resets the range sawtooth generator A1. The range sawtooth is routed through a gain scaling amplifier on the operational amplifier A3 and then to the multiplier A4. The multiplier actually multiplies the range sawtooth by the sine and cosine waveforms as well as a scaling constant. The resulting two outputs are two sawtooth waveforms, varying in amplitude in coincidence with the amplitudes of the cosine and sine waveforms. These are the vertical and horizontal sweeps for the APP indicator, respectively.

3-919. The indicator blanking pulse is simply the indicator range blanking pulse converted to a +25-volt level.

3-920. RANGE SAWTOOTH GENERATOR. The range sawtooth generator A1 operates in the same manner as the angle sawtooth generator described for the B-scope. (Refer to paragraph 3-901.)

3-921. ONE-HERTZ OSCILLATOR A5. An oscillator, consisting of amplifiers Z1, Z2, and Z3, is self-sustaining and generates the sine and cosine waves that appear at pins H and J, respectively. When power is applied to the circuits, a sine wave appears at the output of amplifier Z1. This waveform is integrated in amplifier Z2 into a cosine wave which is shifted slightly in phase in amplifier Z3. The cosine wave output of Z3 is integrated in amplifier Z1 to produce a sine wave and the cycle is completed. The sine wave output of amplifier Z1 and the cosine wave output of amplifier Z2 are then buffered and amplified in amplifiers Z4 and Z5, respectively.

3-922. MULTIPLIER. The multiplier A6 contains two identical, separate channels composed of multiplier Z1 and amplifier Z2 in one channel, and multiplier Z3 and amplifier Z4 in the other. Operation of only one multipler-amplifier network Z1-Z2 will be described. Signals are routed into pins 9 and 10 of multiplier Z1 where they are multiplied together and then amplified by amplifier Z2. The gain of amplifier Z2 is controlled by resistor R10. Potentiometers R6 and R7 provide for the adjustment of the pin H and F input offset voltage. Potentiometer R8 provides for the adjustment of the output offset voltage.

3-923. DEFLECTION SYSTEM.

3-924. The deflection system, consisting of similar horizontal and vertical channels, deflects the beam on the cathode ray tube and is controlled by the sweep inputs received from the sawtooth generators. See figure 3-116. Each channel operates as a push-pull amplifier and utilizes a two-section deflection yoke. The B-scopes utilize compound transistor stages only in the vertical circuit. The APP utilizes compound transistors in both the vertical and horizontal circuits. Because operation of both indicators is very similar, only the B-scope will be discussed.

3-925. HORIZONTAL DEFLECTION. The angle (or horizontal) sawtooth input is scaled by GAIN potentiometer, R26, and applied to one section of the differential amplifier stage Q1. A DC voltage from POSITION potentiometer R19 is applied to the other section of amplifier stage Q1 and controls the position of the raster in the horizontal plane. Differential action of amplifier stage Q1 is achieved by the common emitter load resistor R5. The outputs at the collectors of dual transistor Q1 are applied to push-pull amplifier stages Q2 - Q4, and driver amplifiers Q3-Q5. The push-pull amplifier outputs are then applied to driver amplifiers Q1 and Q2 that are

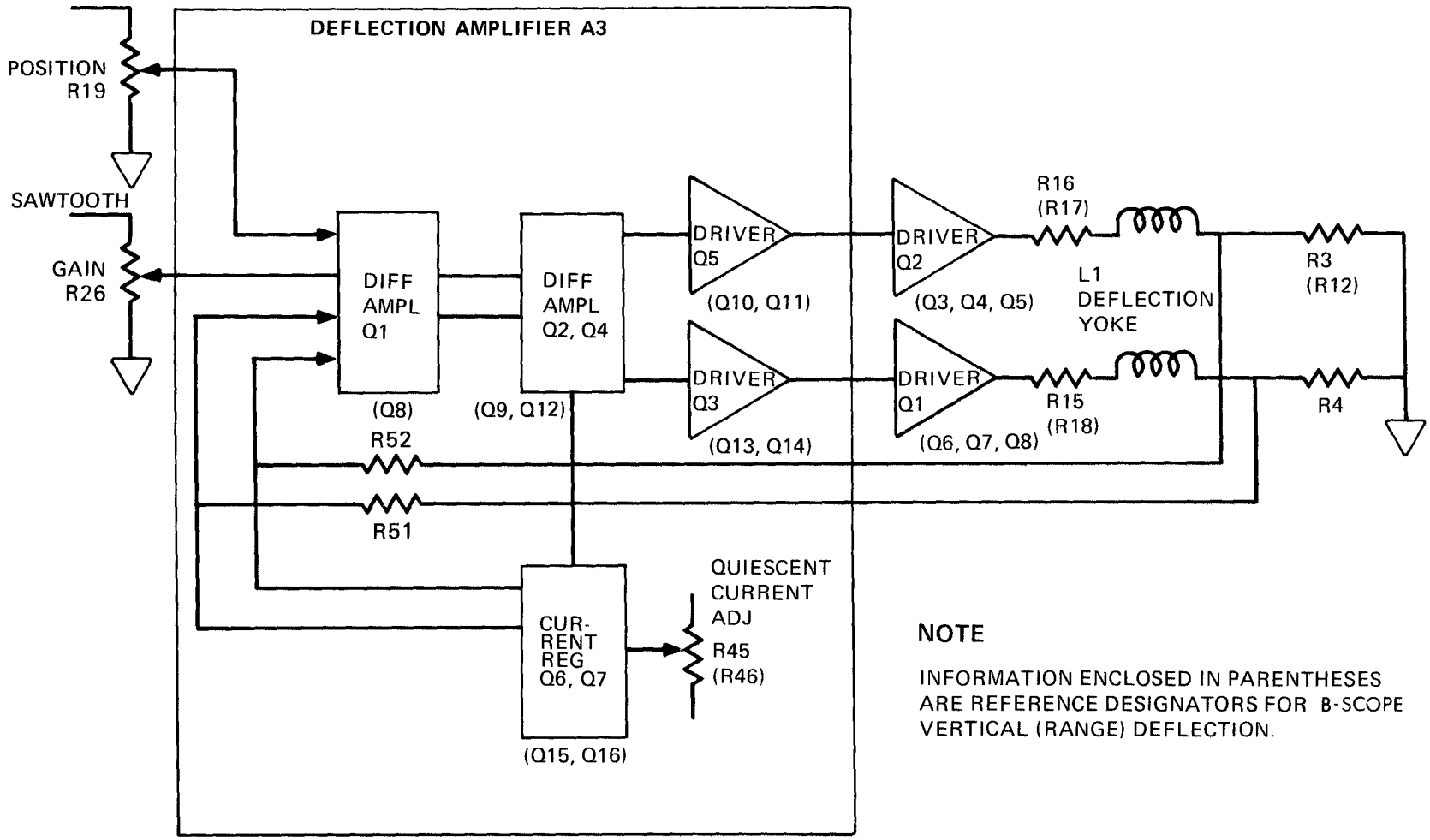


Figure 3-116. Deflection System Functional Diagram

located on the indicator chassis. The deflection yoke is the collector load for the driver stages which provide the deflection current for the yoke. An output derived from the collector of amplifier Q2 is routed to the sweep protection circuit for sweep loss detection.

3-926. The current through each half of the deflection yoke is sensed by resistors R3 and R4. Voltages proportional to these currents obtained from resistors R3 and R4 are applied to the inputs of transistor Q1 in the deflection amplifier to stabilize the loop and reduce distortion. These feedback voltages are also summed and applied to one input of the differential amplifier composed of transistors Q6 and Q7. The other input to the amplifier is obtained from the QUIESCENT CURRENT ADJ potentiometer R45. This differential amplifier controls the average current flow through the yoke by comparing the two inputs and controlling the emitter voltage of push-pull stage Q2-Q4 so that the yoke current is the desired average value.

3-927. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-928. The vertical channels of all indicators utilize compound transistor stages for the push-pull amplifier and driver amplifier stages to provide the high current requirements of the vertical channel. An output derived from the collector of transistor Q8 is routed to the sweep protection circuitry for sweep loss detection.

3-929. DEFLECTION SYSTEM POWER. An unregulated 35-volt power supply for each display is used to furnish the high current requirements of the deflection system. The location of these supplies for the indicators in the radar set is shown in table 3-6.

3-930. B-SCOPE INDICATOR VIDEO SYSTEM. The indicator video system contains the circuits that control the beam current of the CRT so that the raster intensity may be varied and the video and cursors may be displayed as Z-axis modulation of the CRT. The video system for all

Table 3-6. Deflection Power Supplies

	Power Supply Location
Guidance Operator Azimuth Indicator (1A1A2)	1A1A7A1
Guidance Operator Elevation Indicator (1A1A3)	1A1A7A2
Manual Tracker Azimuth Indicator (1A11A2)	1A11A8A1
Manual Tracker - T1 Indicator (X-Band) (1A17A11)	1A17A13A1
Manual Tracker Range Indicator (1A11A6)	1A11A8A2
Manual Tracker Elevation Indicator (1A11A12)	1A11A8A3
Manual Tracker - T2 Indicator (X-Band) (1A17A17)	1A17A13A1
Transponder Azimuth Indicator (1A3A2)	1A3A6A1
Transponder Elevation Indicator (1A3A3)	1A3A6A2
APP Indicator (1A19A1)	1A19A5

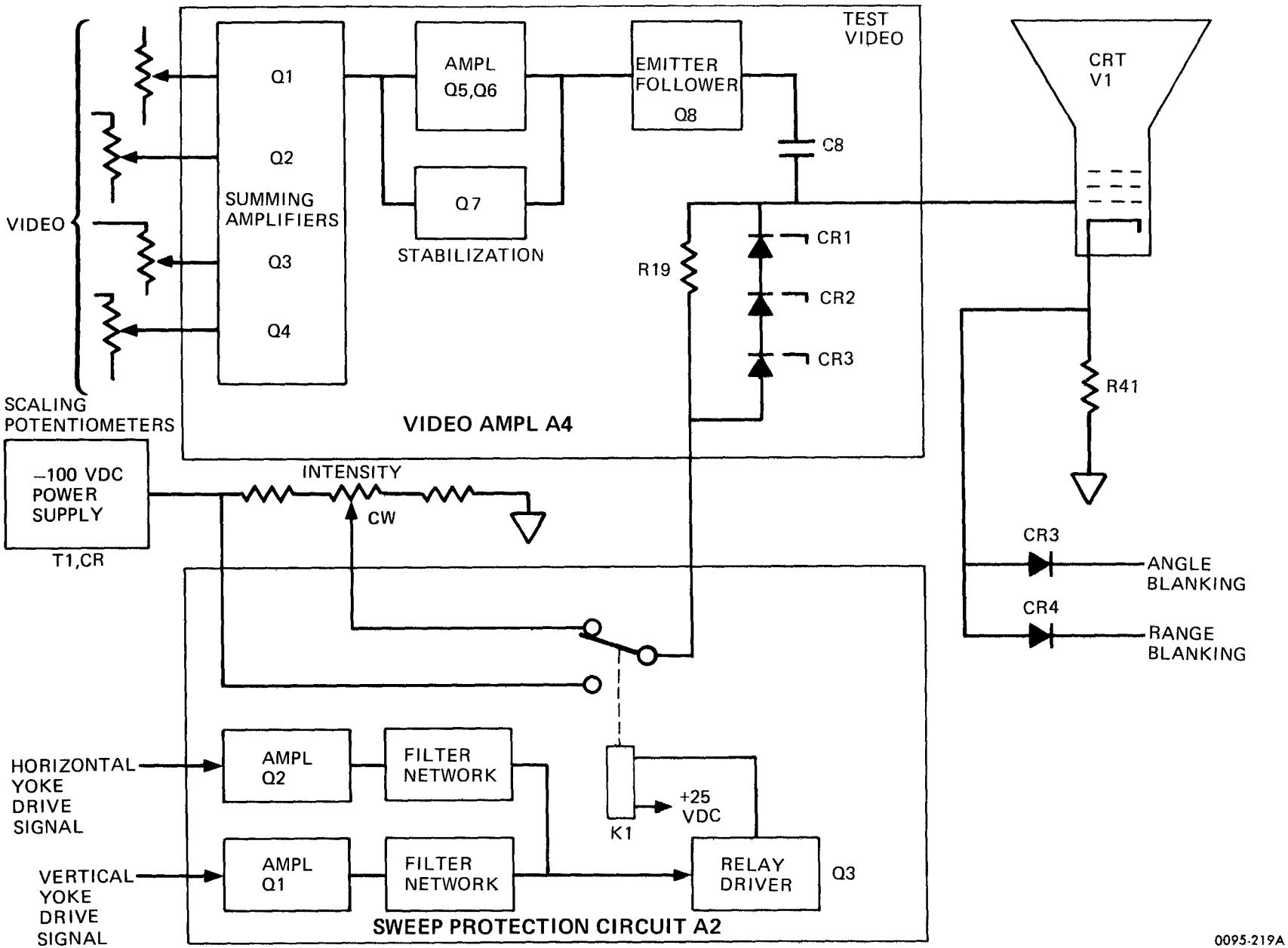


Figure 3-117. Indicator Video System Block Diagram Except 1A1A2 and 1A1A3

indicators is similar except as follows: the manual tracker azimuth indicator 1A11A2 shown in figure 3-117 and described below is representative of all indicators except the 1A1A2 and 1A1A3 indicators; the video amplifier in both the guidance operator indicators 1A1A2 and 1A1A3 differ from the other indicators as shown in figure 3-118 and they are described in the subsequent paragraph.

3-931. Manual Tracker Azimuth Indicator. The level of each video or cursor input is adjusted individually by front panel controls on the indicator to adjust the intensity of the video presentation. These video signals are then routed to the video amplifier assembly A4 and in all but the guidance operator indicators are summed by virtue of the emitter resistor of summing amplifiers Q1, Q2, Q3, and Q4. This summed signal is applied to the direct coupled amplifier consisting of transistors Q5 and Q6. Transistor Q7 provides bias stabilization for amplifier Q5-Q6. The output from the collector of transistor Q6 is buffered by emitter follower Q8 and summed with the raster intensity level test by the operator INTENSITY control and applied to the control grid of the CRT. Diodes CR1 through CR3 form a clipper or limiting network to limit the maximum positive video level that can be applied to the CRT. This summation of the intensity and video levels allows independent control of video and raster intensity.

3-932. In both guidance operator indicators 1A1A2 and 1A1A3, the level of each video or cursor input is adjusted individually by front panel controls on the indicator to adjust the intensity of the video presentation. These signals are then routed to the video amplifier assembly A4 and are summed by the summing amplifier U1. The summed signal is routed to driver amplifier U2 and to summing amplifier U3 when relay K1 is deenergized. The output of U2 is routed to common data point assembly 1A20 where it may be recorded by government furnished recorders. The output of U3 is summed with the raster intensity level set by the operator intensity control and applied to the control grid of the CRT. Diode CR9 forms a limiting network to limit the maximum positive video level that can be applied to the CRT. This summation of the intensity and video level allows independent control of video and raster intensity. Recorded video may be played back on the guidance operator indicators when relay K1 is energized. Video from the recorder rather than from U1 is then applied to the input of summing amplifier U3. The playback video level can be adjusted by the front panel VIDEO GAIN control.

3-933. The negative bias supply voltage for the intensity controls is developed in the power supply consisting of transformer T1, diodes CR5 and CR6, resistors R39 and R40, and capacitors C3 and C4. This negative voltage is routed to the intensity control and the control output is routed through the normally closed contacts of relay K1 in the sweep protection circuit to the summing resistor of the video amplifier.

3-934. The sweep protection assembly A2 senses the loss of yoke drive signals in the deflection circuitry and, when loss of drive is sensed, connects the negative bias supply voltage through the normally open contacts of relay K1 to the video amplifier. This negative voltage reduces the intensity level on the CRT to prevent burning of the CRT phosphor when sweep drive is lost. Two types of sweep protection boards are described below. The locations of these circuits in the radar set are listed in table 3-7.

3-935. Sweep Protection Circuit. The vertical yoke drive signal is obtained from the collector of emitter follower Q8 and applied to the base of amplifier Q1 in sweep protection circuit A2. The output of amplifier Q1 is applied to a filter network C2-CR1-R4. With the sweep voltage present, a negative voltage is developed at the junction of capacitor C2 and diode CR2. This action places a forward bias on diode CR2, a reverse bias on diode CR3, and allows capacitor C3 to charge through resistor R5 and potentiometer R12. Potentiometer R12

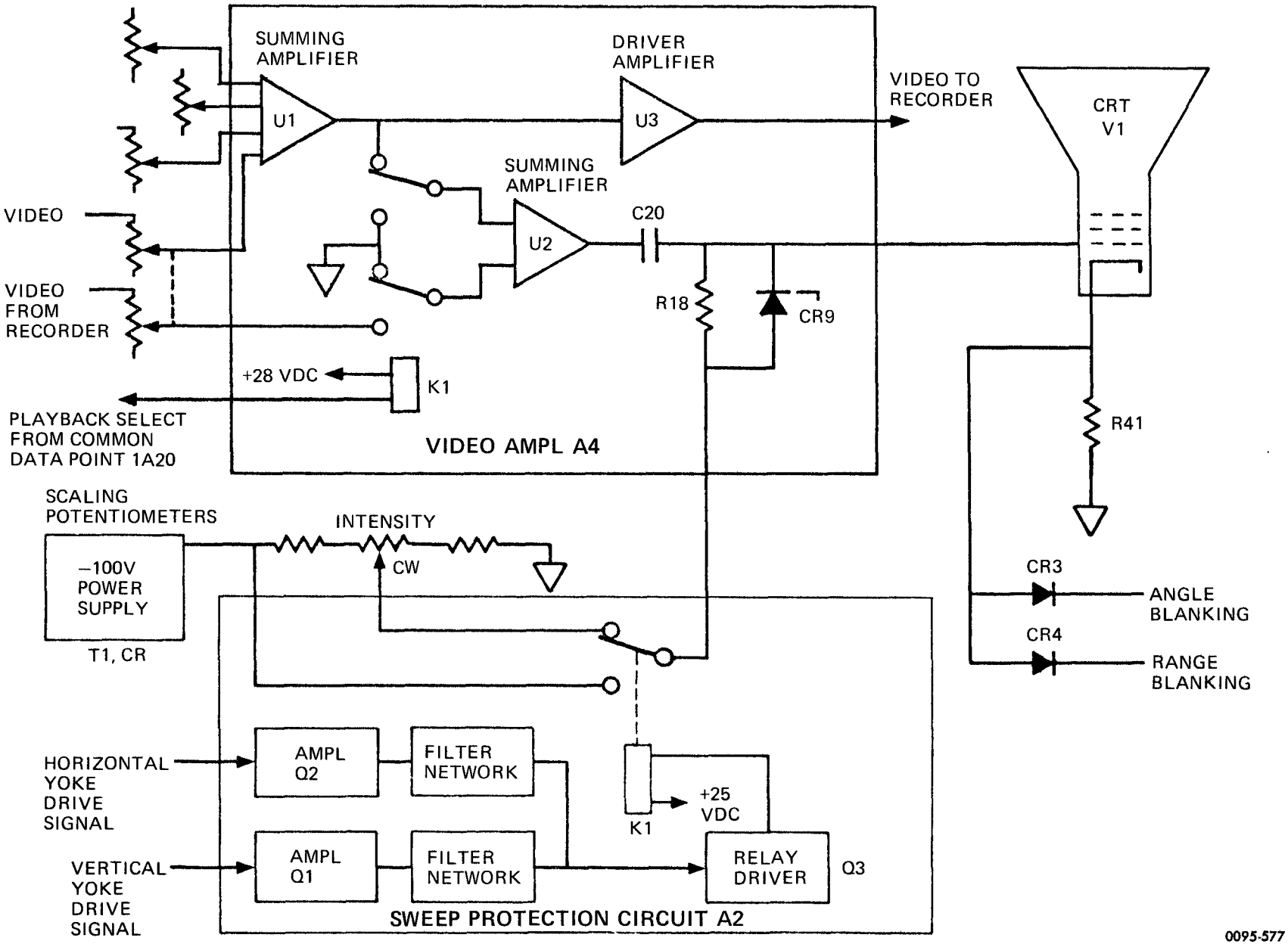


Figure 3-118. Indicator Video System Block Diagram for 1A1A2 and 1A1A3

Table 3-7. Sweep Protection Circuits

	Sweep Protection Circuit Location
Guidance Operator Azimuth Indicator (1A1A2)	1A1A2A2
Guidance Operator Elevation Indicator (1A1A3)	1A1A3A2
Manual Tracker Azimuth Indicator (1A11A2)	1A11A2A2
Manual Tracker Range Indicator (1A11A6)	1A11A6A2
Manual Tracker Elevation Indicator (1A11A12)	1A11A12A2
Manual Tracker - T1 Indicator (1A17A11)	1A17A11A2
Manual Tracker - T2 Indicator (1A17A17)	1A17A17A2
Transponder Azimuth Indicator (1A3A2)	1A3A2A2
Transponder Elevation Indicator (1A3A3)	1A3A3A2
APP Indicator (1A19A1)	1A19A1A2

is used to adjust the charging rate of capacitor C3. Diode CR1 limits the positive excursion of the voltage coupled through C2. Similar action occurs in the horizontal section of the sweep protection network when the horizontal sweep is present. With diodes CR3 and CR6 reverse biased, transistor Q3 is held at cutoff and sweep protection relay K1 is deenergized.

3-936. When the vertical sweep voltage fails or is cut off, the negative voltage at the junction of capacitor C2 and diode CR2 is removed. Capacitor C3 then charges and places a forward bias on diode CR3 which, in turn, applied a positive voltage at the base of transistor Q3. Transistor Q3 is driven into conduction and energizes relay K1. The negative bias voltage is then applied to the cathode ray tube grid. This negative bias deactivates the cathode ray tube. Potentiometers R11 and R12 allow adjustment of the time required to sense sweep loss.

3-937. APP Sweep Loss Protection Circuit. The vertical and horizontal yoke drives are applied to the sweep loss detection card. The vertical and horizontal circuits are similar; therefore, only the vertical circuit will be discussed. The yoke drive is applied to an absolute value amplifier, comprised of operational amplifier Z1 and Z2, which converts the input signal to one polarity. The rectified signal is then routed to summing amplifier and integrator Z5. The output of integrator Z5 is essentially the time average of the input. If a sweep is present, the output of integrator Z5 is a positive DC level which is then applied to pin 2 of comparator Z6. If greater than the reference at pin 3, the output will be at zero and transistor Q1 will be off. Relay K1 will then be deenergized and the CRT intensity is controlled by the front panel intensity control.

3-938. When the sweep fails, or is cut off, the output of integrator Z5 will fall below the reference voltage of comparator Z6, forcing the output of comparator Z6 into a logic high state. Transistor switch Q1 is then turned on, energizing relay K1, closing the contacts and connecting the

negative bias supply to the CRT intensity. As the sweep voltage is returned to the input, relay K1 will again deenergize.

3-939. Blanking of the sweep retrace is accomplished by summing the blanking voltages generated by the sweep generation circuitry and applying them to the cathode of the CRT. The summation of these signals is accomplished by the OR circuit composed of diodes CR3 and CR4, and resistor R41. Presence of either blanking signal increases the voltage on the cathode thereby decreasing the grid drive voltage on the CRT and cutting off the CRT beam.

3-940. Difference in the video system for the manual tracker displays are provided to allow the adjustment of raster intensity and range cursor intensity independently for the normal and expanded sweep mode. Relay circuits controlled by the NORMAL and EXPANDED switches select the outputs from these controls and also switch the range blanking voltage routed to the CRT cathode.

3-941. APP INDICATOR VIDEO SYSTEM.

3-942. Range and angle data is supplied to the APP circuitry from the systems computer. (See figure 3-119.) Since the angle sweep is generated within the APP circuitry, range pulses are provided with each range sweep. Circuits common to the APP compare the actual position angle of the indicator sweep with the target angle information from the computer. When both angles are the same, the range pulses from the computer are gated into the target video circuits of the APP indicator.

3-943. The operation of the video generation circuits is based on the relationship sine ϕ cos θ - cos ϕ sin θ = sin(ϕ-θ), where ϕ is the APP instantaneous display angle and θ is the target angle. The sin θ and cos θ are buffered by amplifiers in the amplifier A3 and applied to the two multipliers in multiplier A6, along with sin ϕ and cos ϕ. The outputs of the multipliers are -sin ϕ cos θ and -cos ϕ sin θ which are applied to the inverting and noninverting inputs of summing amplifier Z5 in operational amplifier A3. The output of amplifier Z5 is then sin (ϕ - θ). When the two angles are equal, sin (ϕ - θ) = sin (0) = 0. A zero output will also appear if (ϕ - θ) equals 180 degrees, which means that a zero will appear at the output of amplifier Z5 twice for each complete indicator display revolution. When ϕ and θ are equal (ϕ - θ = 0) the output of amplifier Z5 goes from a negative value to a positive value. Zero-crossing detector Z6 senses the zero crossing and produces a logic level high output, which fires single-shot Z1A. When sin (ϕ-θ) = 0 the angles are not equal (ϕ-θ = 180), the output of amplifier Z5 approaches zero from a positive value, causing the output of zero crossing detector Z6 to become a logic low level, which has no effect on single-shot Z1A, since it is triggered only by a positive going pulse. The output of single-shot Z1A, when triggered by a positive going pulse, then becomes a logic high, which enables NAND gate Z3A. When NAND gate Z3A is enabled, target range video from the systems computer is gated out to the APP indicator video circuits.

3-944. CURSOR GENERATION.

3-945. ANGLE CURSOR GENERATION. The azimuth and elevation angle cursors for the guidance operator displays 1A1A2 and 1A1A3, and the manual tracker displays 1A3A2, 1A3A3, 1A11A2, 1A11A6, 1A11A12, 1A17A11, and 1A17A17, are generated in the synchronizer 1A1A5. Generation of the azimuth and elevation cursor are functionally identical except for the elevation low altitude mode in which two elevation cursors are generated.

3-946. Each angle cursor consists of one brightened raster line and is generated such that the next raster line after the cursor sync is the line brightened on the display. A logic diagram of the azimuth tracking and boresight cursor generation is shown in figure 3-120.

3-947. The azimuth tracking cursor sync pulse is generated in the azimuth angle tracking loop and is time coincident with the azimuth-angle guidance pulse. The

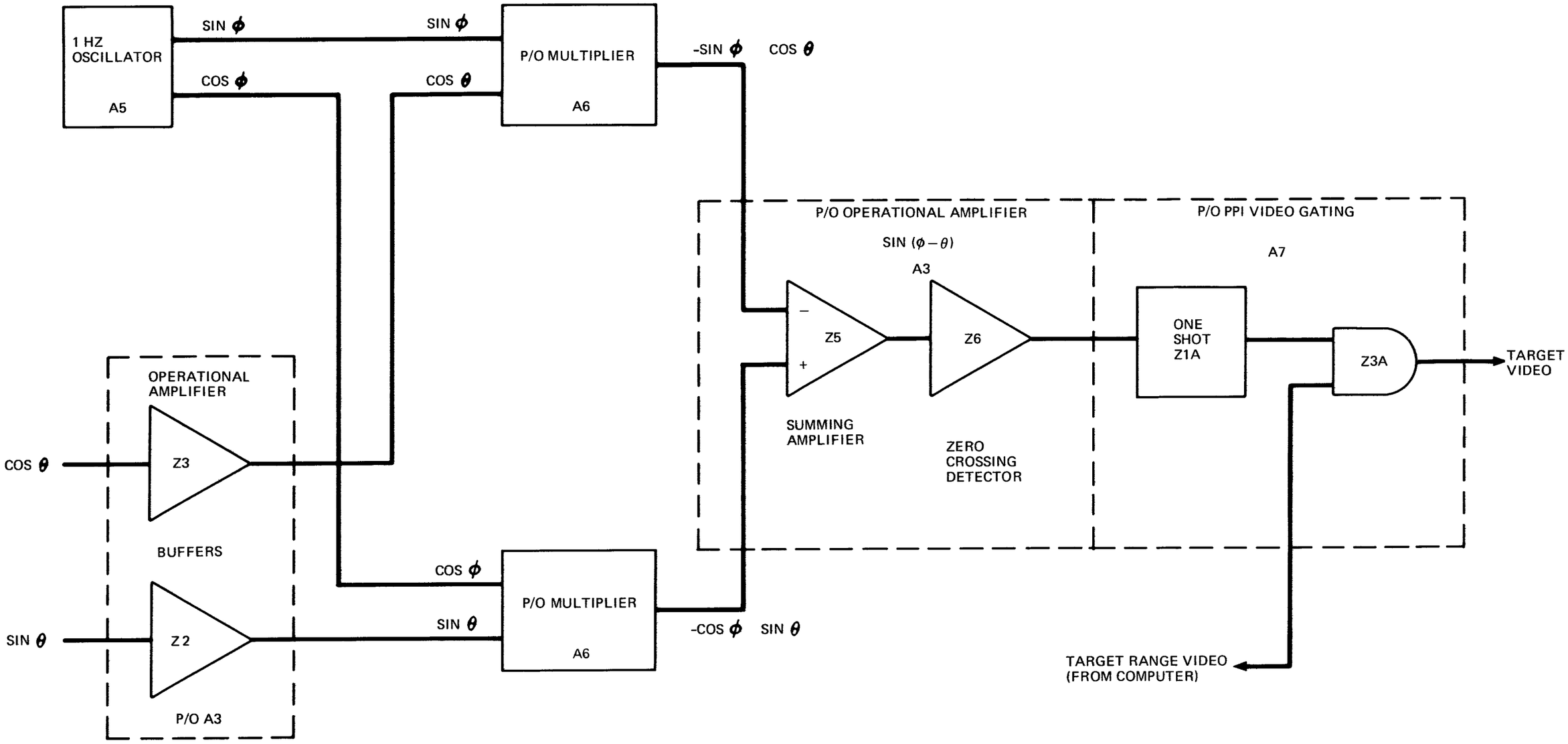


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Figure 3-119. Video Generation for APP Indicator

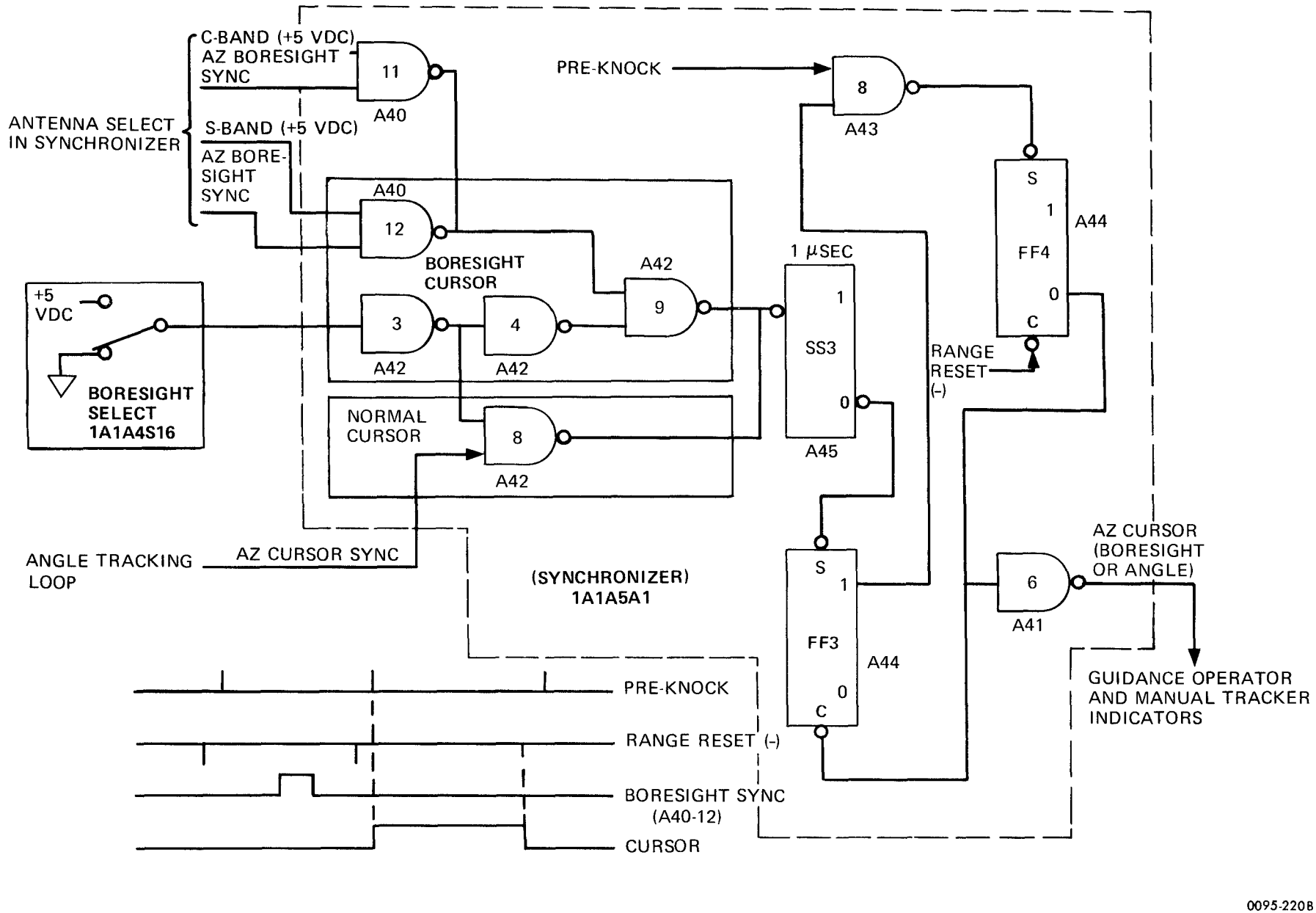


Figure 3-120. Azimuth Cursor Generation Logic Diagram

cursor sync is applied to gate A1A42-8. The other input is a logic high when the BORESIGHT SELECT switch 1A1A4S16 is not depressed. Hence, when the boresight cursor is not selected, the azimuth cursor sync pulse is inverted in gate A1A42-8 and sets single-shot A1A45-3. Single-shot A1A45-3 produces a 1-microsecond delay and, at the end of the delay, sets flip-flop A1A44-3. The 1 output of flip-flop A1A44-3 enables gate A1A43-8 and the next pre-knock pulse from the range timing circuits sets flip-flop A1A44-4. The zero output of flip-flop A1A44-4 is inverted by gate A1A41-6 and becomes the azimuth angle cursor. The zero output of flip-flop A1A44-4 also resets flip-flop A1A44-3. The next range reset pulse resets flip-flop A1A44-4 which ends the azimuth angle cursor.

3-948. When the boresight cursor is selected by depressing the BORESIGHT SELECT switch 1A1A4S16, the logic 1 (+5 volts) signal applied to the input of gate A1A42-3 is inverted twice (by gates A1A42-3 and A1A42-4) and finally applied to gate A1A42-9. The second input to gate A1A42-9 is a logic high during the azimuth boresight sync pulse and when S-band operation has been selected. When both inputs to gate A1A42-9 are logic highs, the output triggers single-shot A1A45-3. From this point on, generation of the boresight cursor is identical to the angle cursor described above.

3-949 through 3-950 and figures 3-121 and 3-122. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-951. RANGE CURSOR GENERATION - GUIDANCE OPERATOR INDICATORS. Three horizontal cursors may be displayed on the guidance operator indicators 1A1A2 and 1A1A3. The range cursor, its position corresponding to the position of the range tracking gate, is displayed continuously. The range calibrate strobe, which appears at a range of 20 nautical miles, may be displayed by positioning the RANGE CAL switch 1A1A5S2 to ON. The missile impact range strobe may be displayed, at the option of the operator, by positioning the three position (AZ, OFF, EL) IMPACT POINT DISPLAY switch 1A1A4S14 to either AZ or EL. This strobe indicates the range at which the missile would intercept the target if the missile were launched at the time of observation.

3-952. When RANGE CAL switch 1A1A5S2 is positioned to OFF, gate A2A26-11 is enabled. The guidance operator range track sync from the target tracking loop is inverted by gate A1A26-11 and the positive going trailing edge triggers single-shot A2A19-3. The 1-microsecond zero output of single-shot A2A19-3 is passed through NOR gates A2A26-8 and A2A26-9 to produce the range cursor for the azimuth and elevation displays. When the RANGE CAL switch S2 is positioned to ON, gate A2A26-12 is enabled. Gate A2A26-12 will then pass the range calibrate strobe pulse which will trigger single-shot A2A19-3 to generate the range calibrate strobe.

3-953. The missile impact range strobe may be displayed on either the azimuth or the elevation indicators. When azimuth display is selected, the input to gate A2A26-1 is a logic low. The output of gate A2A26-1 is a logic high and gate A2A26-4 is enabled. The missile impact pulse is then inverted by gate A2A26-4 and applied to the input of gate A2A26-8. When elevation display is selected, the input of gate A2A26-2 is a logic low. The output of gate A2A26-2 is a logic high and enables gate A2A26-5 which inverts the missile impact pulse and applies it to the input of gate A2A26-9.

3-954. The output signal of gate A2A26-8 is either the range cursor or the range calibrate strobe and the azimuth missile impact strobe when it has been selected. The output signal of gate A2A26-9 is the corresponding elevation range strobes.

3-955. RANGE CURSOR GENERATION - MANUAL TRACKER INDICATORS. The description of the range cursor generation for the manual tracker indicators can be found in paragraph 3-1196, entitled Cursor Generation - Transponder.

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS, RADAR TRAINING SET AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1 FOR FIGURE 3-121 AND 3-122

3-956. RANGE CURSOR GENERATION - APP INDICATOR. Three range cursors are displayed on APP indicator display 1A19A1. These cursors are maximum range, minimum range, and instantaneous impact range. The minimum and maximum range cursors are displayed as solid rings while the impact range cursor is displayed as a ring composed of dashes. The range cursor information is generated by computer 1A8 and appears as a range pulse for each range sweep. If each pulse is painted on the display, a circle, or ring will be formed. If the pulses are alternately gated on and off, the circle will appear with dashes. The cursor video is processed through the APP indicator video circuits in the same manner as the target video.

3-957. Figure 3-123 depicts signal flow of the APP cursor generation. The minimum and maximum range cursor video pulses are inverted by NAND-gates A7Z4A and A7Z4D, then OR'ed together at OR-gate A7Z4B. NAND-gate A7Z5C inverts the resulting video and applies it to OR-gate A7Z5B, where it is then routed to the APP indicator video circuits. The impact range dashed circle is generated by alternately enabling and disabling NAND-gate A7Z3C, and routing the resulting signal through OR-gate A7Z5B to the APP indicator video circuits.

3-958. A clock comprised of single-shots A7Z2A and A7Z2B generates the chopping pulses for NAND-gate A7Z3C to produce the impact range dashed ring. In order to keep the ring stationary in angle, the clock is synchronized with each revolution of the display sweep. The sine output of the one-Hertz oscillator A5 is routed to zero crossing detector A3Z4. When the sweep angle is zero, a positive going pulse output of detector A3Z4 is obtained, triggering single-shot A7Z1B. The output of single-shot A7Z1B stops the clock and restarts it, ensuring that, with respect to the angle sweep, the dashes of the impact ring will appear in the same position with each sweep.

3-959. MISSILE VIDEO GENERATION. For a description of simulated missile video generation, see the description of the missile simulation and scoring group.

3-960. CURSOR GENERATION TRANSPONDER TRACKER INDICATORS. For a description of transponder cursor generation, see the description of the tracking group.

3-961. HIGH VOLTAGE POWER SUPPLY.

3-962. The indicator power supply A1 provides the 12-kilovolt anode voltage, 1.9-kilovolt focus voltage, and 300-volt grid voltage required for operation of the cathode ray tube. Power supplies A11A1 and A17A1 function identically with minor circuit changes which reduce the output voltage levels. The high voltage power supply is an oscillator type power supply with a voltage doubler circuit.

3-963. The voltage regulator and Darlington emitter follower Q2 - Q3 supply a regulated +9-volt (nominal) input voltage to the oscillator. The oscillator, consisting of transformer T1, capacitors C2 and C4, resistor R2, and transistor Q1, oscillates at a frequency of approximately 150 kilohertz. The voltage supplied to the oscillator is set by potentiometer R1, which adjusts the feedback to the voltage regulator and establishes the oscillator input voltage and hence the output voltage of the power supply. A sample of the oscillator frequency is taken from a winding of the transformer to supply the positive feedback required for oscillation.

3-964. The voltage doubler network on the secondary of transformer T1 consists of diodes CR1 and CR2, and capacitors C5 and C10. The voltage doubler configuration delivers a DC voltage that is approximately twice the peak amplitude of the alternating voltage at the junction of diodes CR1 and CR2. Voltage doubling is accomplished by charging capacitors C5 and C10 on alternate half cycles to the peak voltage of the transformer secondary. The polarity of the voltages on the capacitors is such that the DC voltages add, thereby doubling the voltage output.

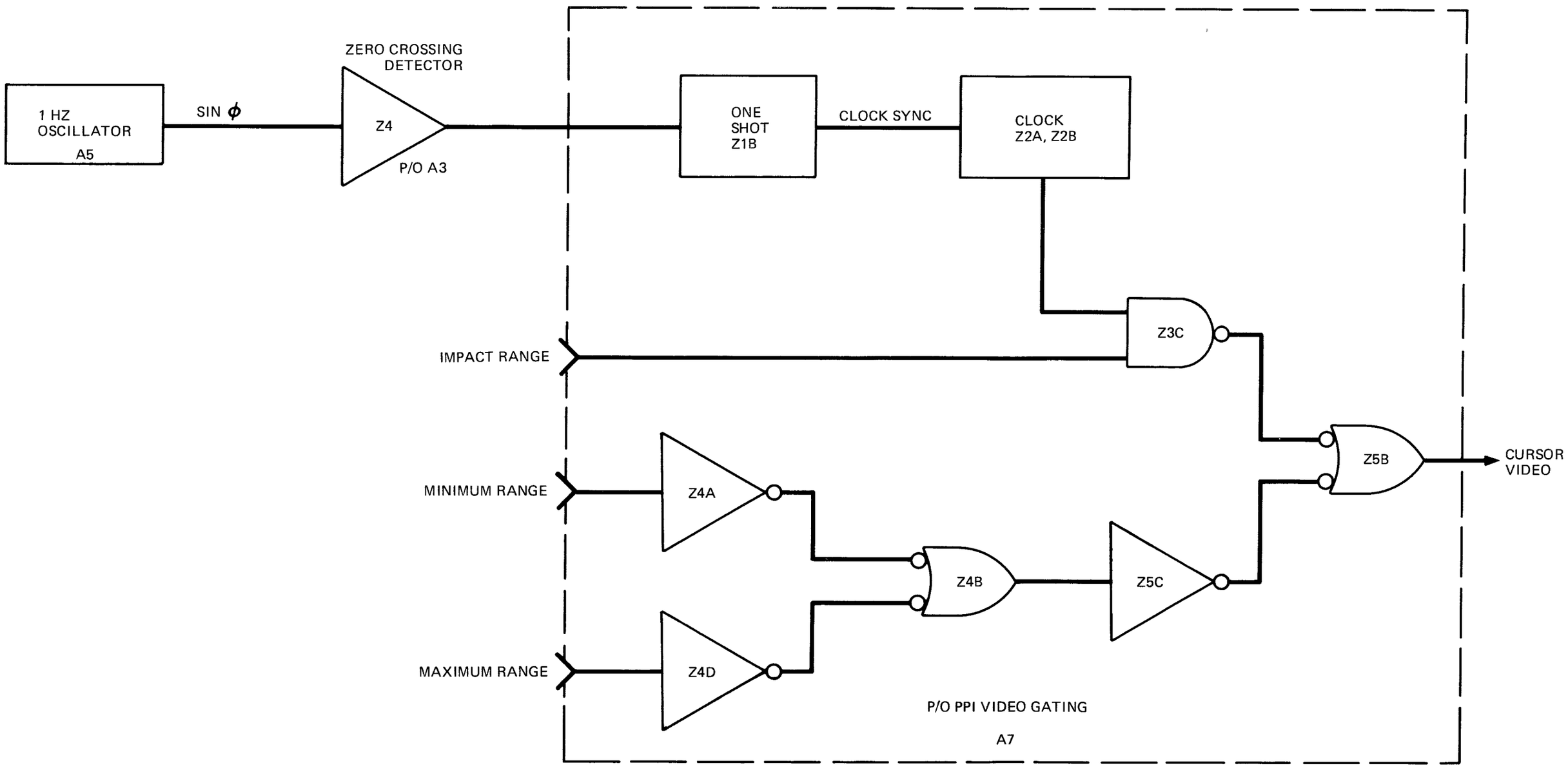


Figure 3-123. Range Cursor Video APP Indicator

3-965. Resistors R3 through R24 form a voltage divider network for the focus and grid voltages and a bleeder path for the anode voltage. The focus voltage is adjustable from 1.4 to 1.9 kilovolts by potentiometer R21. The nominal 300-volt DC grid voltage is obtained from the junction of resistors R23 and R24 and is available for test purposes at test point TP1.

3-966. ANTENNA PEDESTAL SERVO GROUP.

3-967. The antenna pedestal servo group consists of the S-band, C-band, and X-band Pedestal drive servo systems and operator selection and control circuits as shown in the block diagram of figure 3-124. Operator selection and control circuits located in the control trailer are functionally identical for all systems. Detailed theory of operation for these circuits is provided in the following paragraphs. The electromechanical pedestal servo drive systems for AN/MPS-T1(V)1, (V)2, and (V)3, however, differ from the pedestal servo drive systems for AN/MPS-T1(V)4. Detailed theory of operation for the two pedestal drive servo system configurations are provided in separate sections following the discussion of operator selection and control circuits.

3-968. The pedestals may be slaved together and controlled by the target tracking system (the guidance operator and manual trackers) or one of the pedestals may be selected for radar reference track and is then controlled by the transponder operator.

3-969. An automatic pedestal mode is provided for the pedestal servo system associated with the X-band radar system and may be selected by the operator at tracking controls 1A1A4 or 1A3A4 (figure 3-125). During this automatic mode, drive signals to the pedestal servo are derived from the target or reference track loops to automatically maintain the pedestal and antenna alignment with the target being tracked.

3-970. OPERATOR CONTROLS. Operator controls to turn the target track pedestal on or off and to select the slave mode or the rate mode for maintenance are located in the mode control unit 1A1A1 and in the servo control units 1A5A12, 1A5A19 and 1A17A8 (figure 3-125). Controls on tracking control 1A1A4 position the selected pedestal(s) during the acquisition mode of the radar. A sector or search scan capability in azimuth may also be selected by the guidance operator at tracking control 1A1A4.

3-971. Manual pedestal controls for tracking the target in S-band or C-band are located in the azimuth and elevation manual tracking controls 1A11A3, 1A11A13 (figure 3-124); for tracking the target in X-band the controls are located in the T1 and T2 tracking control units 1A17A12 and 1A17A18.

3-972. The selected radar reference pedestal is controlled from the transponder tracking control 1A3A4 through the reference pedestal servo 1A17A19.

3-973. GUIDANCE OPERATOR AZIMUTH PEDESTAL CONTROLS. The guidance operator controls the azimuth pedestal position by manually rotating the azimuth handwheel on the tracking control 1A1A4 (figure 3-125). Clockwise rotation of the handwheel causes clockwise rotation of the pedestal. Rotation of the handwheel controls the rotor position of the command synchro in the command servo assembly which provides the position command for the pedestal drive servo loop to control the antenna position.

3-974. When the azimuth handwheel is pushed in, it is mechanically coupled to the command synchro B5 in the azimuth command servo gearbox 1A1A4A37 by the brake/clutch B2 which is energized by the 28-volt return signal coupled through the deenergized contacts of relay K7. Relay K2 is deenergized when the handwheel is pushed in causing +28 volts to be applied through current limiting resistor R35 and the normally closed contacts of relay K2 to the reference winding of the command servo motor B1. The resultant DC current in the reference winding generates a small holding torque on the motor which prevents

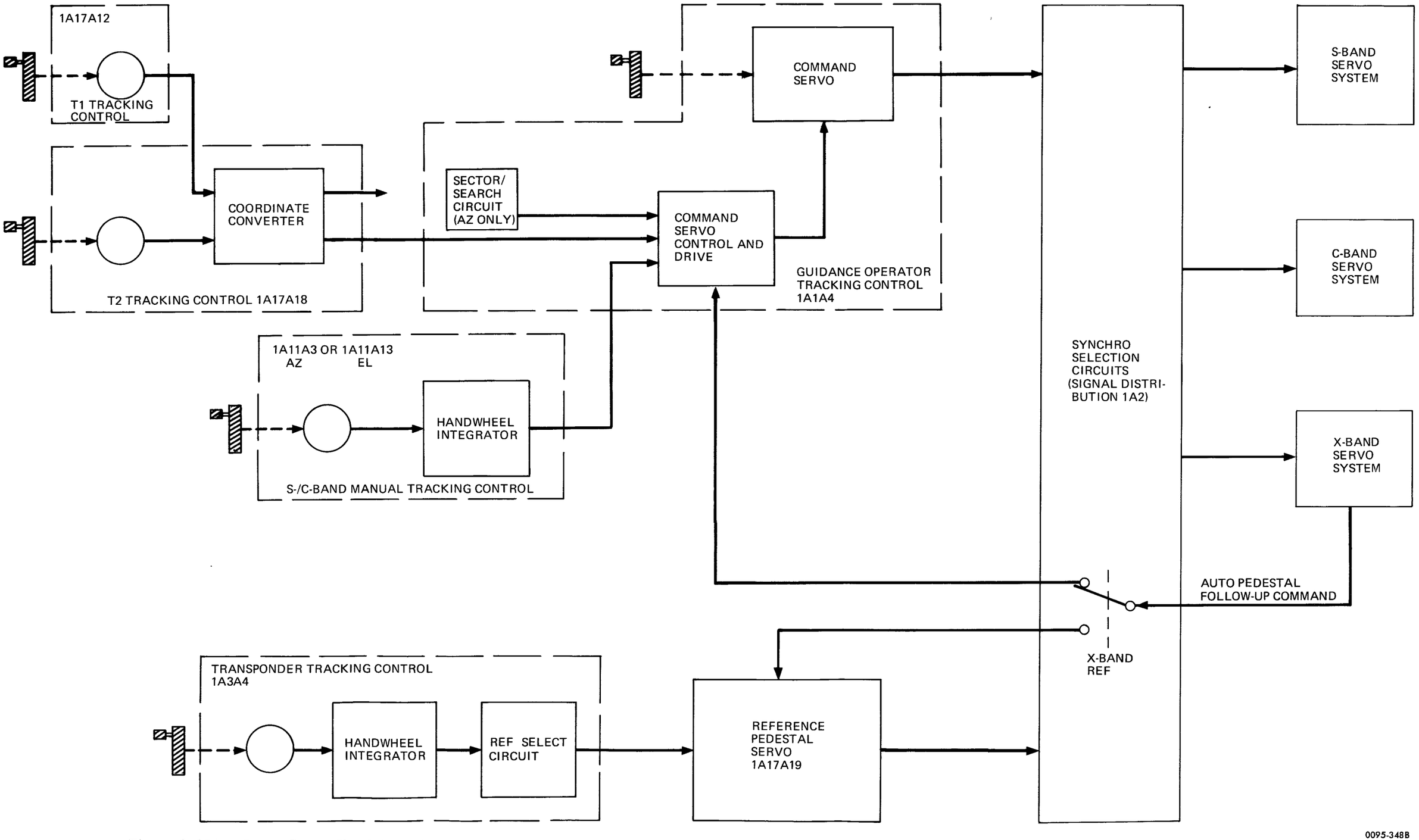


Figure 3-124. Servo Group Simplified Block Diagram

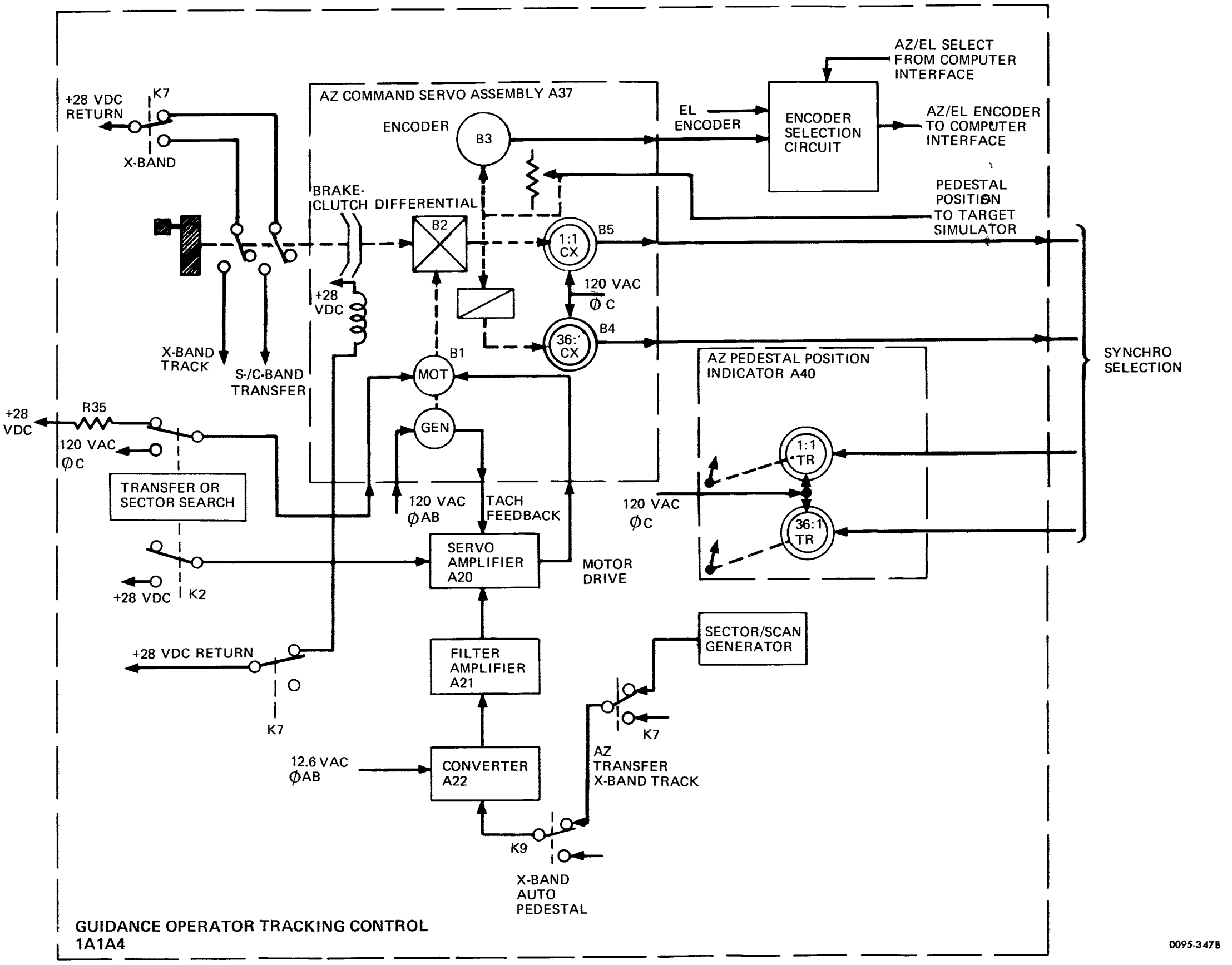


Figure 3-125. Guidance Operator Azimuth Control Block Diagram

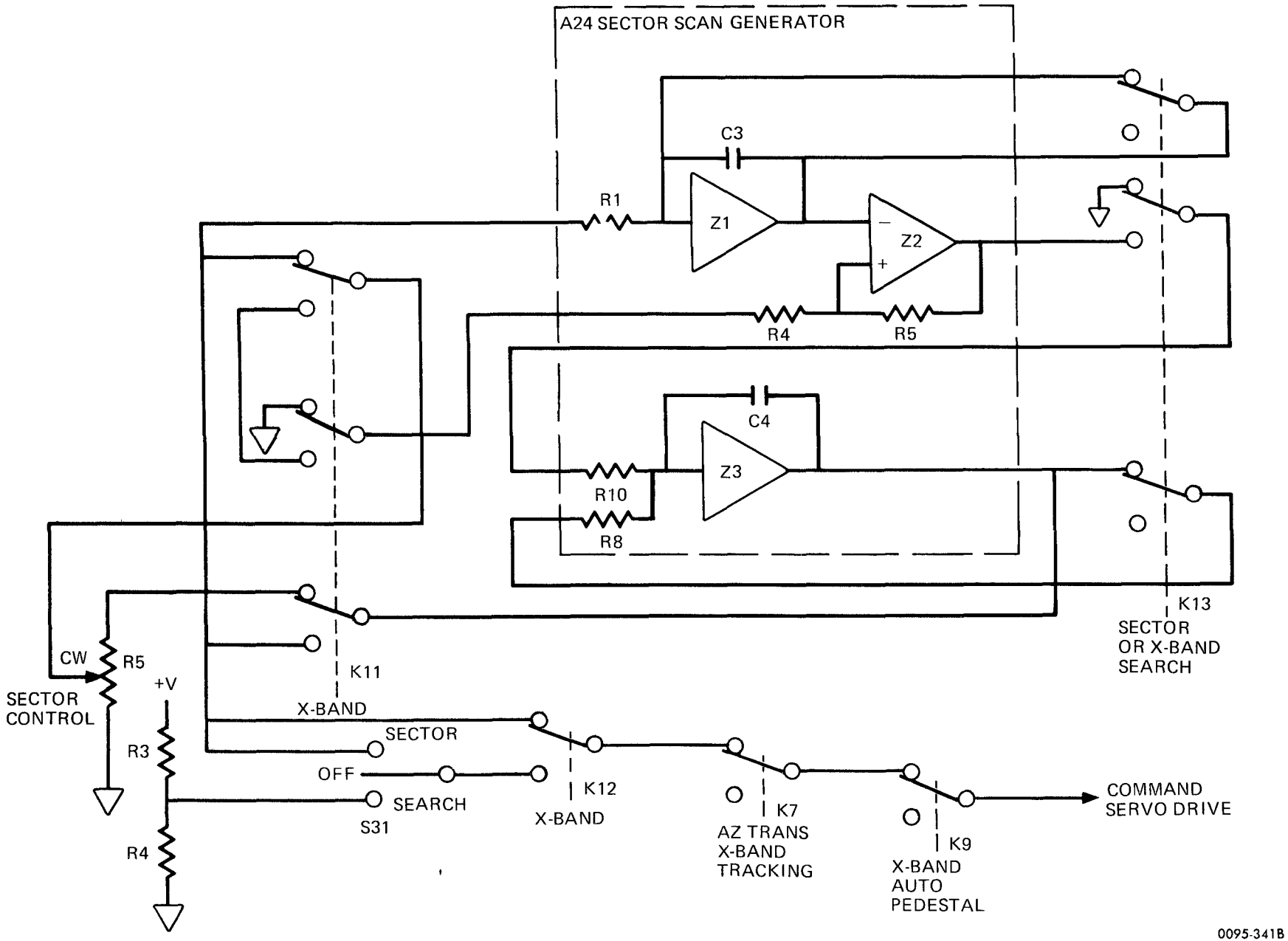


Figure 3-126. Sector/Search Pedestal Control Diagram

the motor shaft from turning through the differential gear when the handwheel is rotated.

3-975. If sector scan or search operation has been selected by the SECTOR/SEARCH switch S31, relay K2 is energized through the contacts of relay K13. This applies 400 Hz power to the motor reference windings and +28 volt power to the servo amplifier and the center tap of the motor control winding. The control of the center of the sector scanned by the sector scan circuits is controlled by the operator handwheel and brake/clutch B2 in the sector scan mode.

3-976. Sector/Search Pedestal Control. The sector/search pedestal control circuit shown in figure 3-126 is used to generate the S-/C-band sector scan control signal and the X-band sector scan and search control signals. During S-/C-band operation, the azimuth pedestal is scanned through a 40-degree sector at a variable rate controlled by the SECTOR CONTROL potentiometer R5. In X-band operation, the sector scan rate is constant and the sector width is varied by use of potentiometer R5. There is also a search mode of operation in X-band during which the pedestal rotates in a clockwise direction at a fixed rate.

3-977. S-/C-Band Sector Scan (see figure 3-126). When sector scan is selected (switch S31) during S-/C-band operation, relay K13 is energized which in turn energizes relay K2 and applies +28 volts to the servo amplifier and removes the short from capacitor C3 on the sector scan generator A24. When sector scan is selected, the output of the comparator A24Z2 is either +15 volts or -15 volts. (See the sector scan generator timing diagram, figure 3-127.) For analysis of the sector scan generator A24, the output of comparator A24Z2 will be assumed to be at +15 volts. The output of comparator A24Z2 is applied through the normally open contacts of relay K13 to integrator A24Z3. Integrator A24Z3 integrates linearly to -15 volts and remains at -15 volts until comparator A24Z2 changes state. The output of integrator A24Z3 is routed through the normally closed contacts of relay K11 to the SECTOR CONTROL potentiometer R5. The voltage at the arm of potentiometer R5 is routed through normally closed contacts of relay K11 to the input of integrator A24Z1 and to the command servo drive circuit through the deenergized contacts of relays K12, K7, and K9. Integrator A24Z1 begins integrating towards a positive voltage at a rate determined by network A24R1 - A24C3 and the voltage from the SECTOR CONTROL potentiometer R5. When the output of integrator A24Z1 reaches approximately 0.2 volts, which is set by the output of comparator A24Z2 through the voltage divider network A24R4 - A24R5, comparator A24Z2 changes state and its output goes to -15 volts. Integrator A24Z3 then begins integrating towards a +15 volt level. Thus the output of integrator A24Z3 is trapezoidal waveform (figure 3-127). If the sector control is turned counterclockwise, the integration rate of integrator A24Z1 decreases and therefore takes a longer period of time to reach the 0.2 volt triggering level of comparator A24Z2 (shown by dashed lines in figure 3-127). Since the drive voltage to the command servo is also reduced, the pedestal drives at a reduced rate. The combination of reduced rate and a longer time interval to complete a sector scan cycle results in a constant sector width of approximately 40 degrees. When the SECTOR SCAN switch S31 is positioned to OFF, integrator A24Z1 is reset by the short across capacitor A24C3. Relay K13 is deenergized and grounds the input to integrator A24Z3 and resets the integrator by discharging capacitor A24C4 through resistor A24R8. Hence, the sector scan will slow down and stop due to the discharging of capacitor A24C4.

3-978. X-Band Sector/Search. During X-band operation the sector scan generator A24 functions in a manner similar to S-/C-band operation, the exception being that the SECTOR CONTROL potentiometer R5 is used to set the threshold at which comparator A24Z2 changes state, and the output of integrator A24Z3 is routed through the normally open contacts of relay K11 to the input of integrator A24Z1 and through sector switch S31 to relay K12. Since the command servo drive signal is

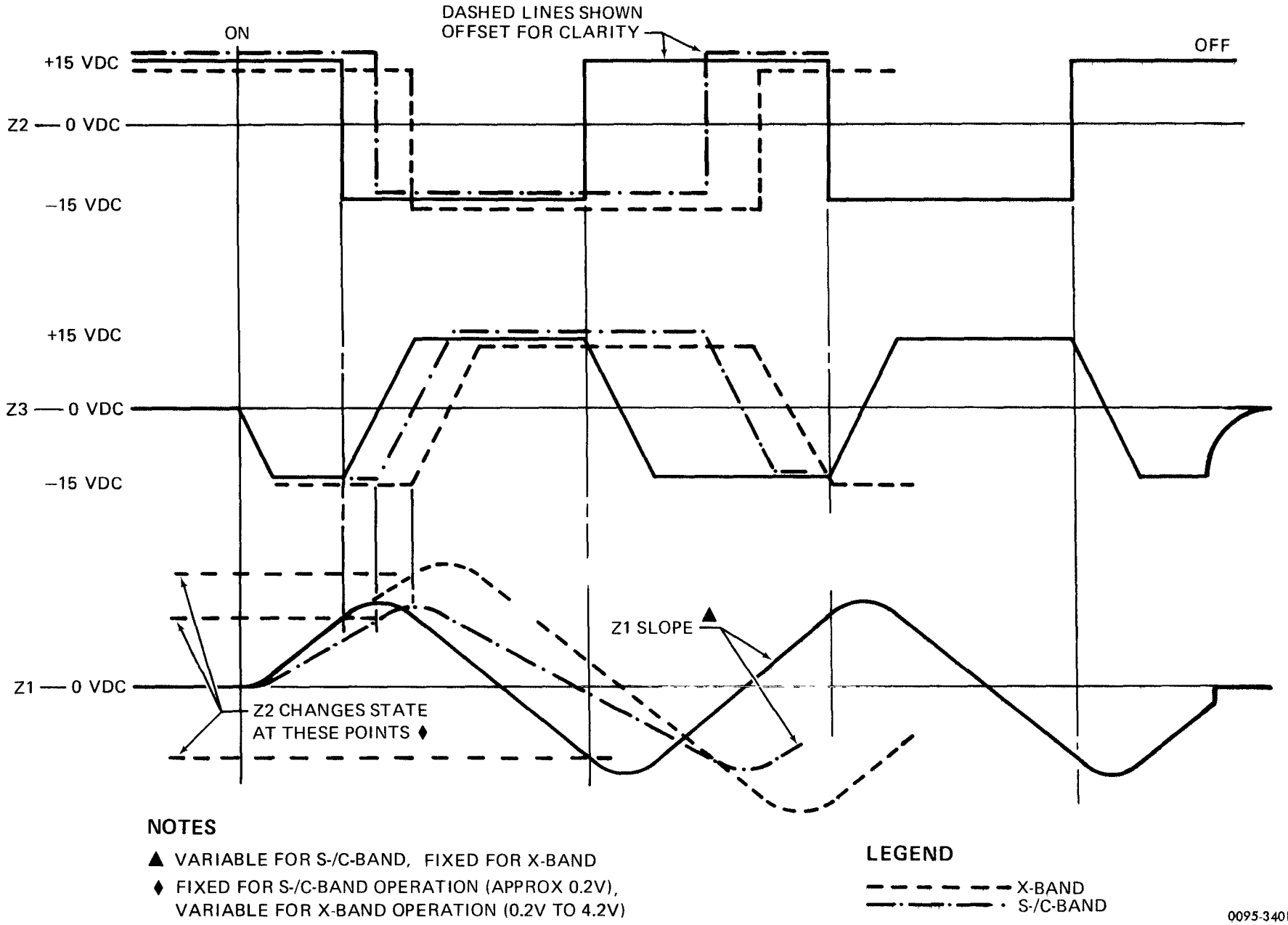


Figure 3-127. Sector Scan Generator Timing Diagram

not attenuated as in S-/C-band operation, the pedestal sectors at a constant rate. The SECTOR CONTROL potentiometer R5 is connected through the contacts of relay K11 to the voltage divider network A24R4 - A24R5. The voltage across resistor A24R5 increases the time required for integrator A24Z1 to reach the threshold. This combination of constant amplitude drive signal and variable sector scan interval produces the required variable sector width.

3-979. During X-band operation, the guidance operator can also select the search mode of azimuth pedestal control. In this mode, a positive DC voltage of approximately 10 volts from the junction of resistors R3 and R4 is connected through switch S31 to the command servo drive circuit. This causes the pedestal to rotate in a clockwise direction at a constant rate.

3-980. The output of the sector/search control is routed to the converter A22 where it is modulated by a 400-Hertz signal. The output of the converter is routed through a filter amplifier A21 to the servo amplifier A20. The servo amplifier provides the control signal to the command servo drive motor.

3-981 through 3-983. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T. O. 43D7-11-21-2-1-1.

3-984. Pedestal Control Transfer - S-Band and C-Band. Transfer of pedestal control to the manual tracker operators in S-band or C-band is accomplished when the guidance operator pulls his azimuth and elevation handwheels outward.

3-985. When the guidance operator azimuth handwheel is pulled out, switch S30 is closed and completes the 28-volt return circuit to energize relays K2 and K7 and generate the transfer signal. These relays deenergize the brake/clutch in the command servo assembly and apply power to the command servo motor and servo amplifier.

3-986. When the guidance operator elevation handwheel is pulled out, switch S32 is closed. A 28-volt return path is connected to relay K4 and the elevation transfer signal. This applies power to the command servo motor unless the low altitude relay K5 is energized. It also deenergizes the brake/clutch in the elevation command servo.

3-987. Pedestal Control Transfer - X-Band. Transfer of the pedestal control from the acquisition mode may be accomplished in two different modes depending on whether the guidance operator desires to go immediately to the automatic pedestal mode (the pedestal controlled by the angle tracking circuits) or whether he desires to go to manual pedestal control through the T1 and T2 manual tracker operators.

3-988. To select the automatic pedestal mode, the guidance operator selects the AUTO position of the TRACK SELECT switch S29 and pulls the azimuth handwheel outward. This connects the outputs of the automatic pedestal circuit in the target tracking unit 1A17A4 to the automatic pedestal control input of the DC amplifier 1A17A7 for the X-band pedestal. When this automatic mode is selected, the azimuth and elevation command servos in the guidance operator console are connected as follow-up servo and, therefore, follow pedestal motion. This ensures that when the system is switched from automatic pedestal mode, the command servo and pedestal will be aligned and the pedestal will not drive to a new position.

3-989. The guidance operator may also select the low altitude mode of the X-band elevation pedestal by pulling his elevation handwheel outward. This causes the X-band elevation pedestal to automatically depress to a +1.0 degree elevation angle.

3-990. To select manual pedestal control of the X-band pedestal by the T1 and T2 manual trackers, the guidance operator selects the MANUAL position of the TRACK SELECT switch S29 and pulls the

azimuth handwheel outward. This connects the outputs of the T1 and T2 tracking controls 1A17A12 and 1A17A18 to the command servos.

3-991. MANUAL TRACKER CONTROLS - S-BAND AND C-BAND. Operator controls located on the manual tracker azimuth and elevation tracking control units 1A11A3 and 1A11A13 provide control of the azimuth and elevation pedestal positions respectively when control has been transferred by the guidance operator and S-band or C-band target tracking has been selected (figure 3-128).

3-992. Azimuth Manual Tracker Controls. The azimuth manual tracker operator controls the azimuth pedestal position by rotating the handwheel or by depressing slew switches S4 and S5. When the guidance operator handwheel is pulled outward, the BEGIN MANUAL TRACK indicator DS1 lights. The manual tracker accepts pedestal control signals when the switches S1, S2 or S3 are depressed. Depressing any switch deenergizes relay K6 which removes the short on the integrating capacitor C3.

3-993. Rotation of the handwheel causes a combination of pedestal position control and a rate of pedestal position change (i. e., one turn of the handwheel will cause an initial displacement of the pedestal position and will also cause a rate of change of pedestal position that will remain until the handwheel is rotated again).

3-994. Rotation of the handwheel generates a DC voltage at the output of the DC tachometer A2B1. The amplitude of the DC voltage is equal to the rate of rotation and the polarity of the DC voltage depends upon the direction of rotation. This DC voltage is fed through resistor A1R7 to the summing junction of amplifier A1Z2 and causes a DC voltage at the output of amplifier A1Z2. The tachometer output voltage is also fed to the input resistor A1R1 of integrator A1Z1. The integrator then integrates this voltage and applies it to amplifier A1Z2 through input resistor A1R4 to generate a rate of change of the pedestal position voltage. The output of the DC tachometer is also routed to the guidance operator tracking control where it is scaled and routed to the angle track loops as a feed forward command to reduce the effects of pedestal motion on the track loops.

3-995. Slew switches S4 and S5 connect either a positive or negative DC voltage to the slew speed adjust potentiometer R9. The voltage on the arm of potentiometer R9 is integrated by the RC integrator composed of resistor R11 and capacitors C1 and C2 and fed through resistor A1R8 to amplifier A1Z2. The slew switches provide a displacement control of the pedestal position without interrupting the rate voltage generated by integrator A1Z1.

3-996. The output of amplifier A1Z2 is routed to the modulator in the command servo where it controls the motor-generator to position the command synchro and hence the position of the pedestal.

3-997. The output of integrator A1Z1, pedestal rate command, is indicated on the RATE meter M1. Potentiometer R14 and resistor R13 scale the input voltage to the meter movement. The output of the integrator is also fed to scaling potentiometers in the missile simulation and scoring group.

3-998. Elevation Manual Tracker Controls. Operation of the elevation manual tracker pedestal controls is similar to the azimuth manual tracker controls. An additional reset circuit for the integrating capacitor A1C3 of integrator A1Z1 holds the integrator reset when low altitude tracking has been selected and when automatic track has been selected. These two conditions are met with the LOW ALT switch S6 and relay K3 energized.

3-999. MANUAL TRACKER CONTROLS - X-BAND. Operator controls located at 1A17A12 and 1A17A18 provide control of the azimuth and elevation pedestal position when manual control has been selected by the guidance operator, control has been transferred, and X-Band has been selected.

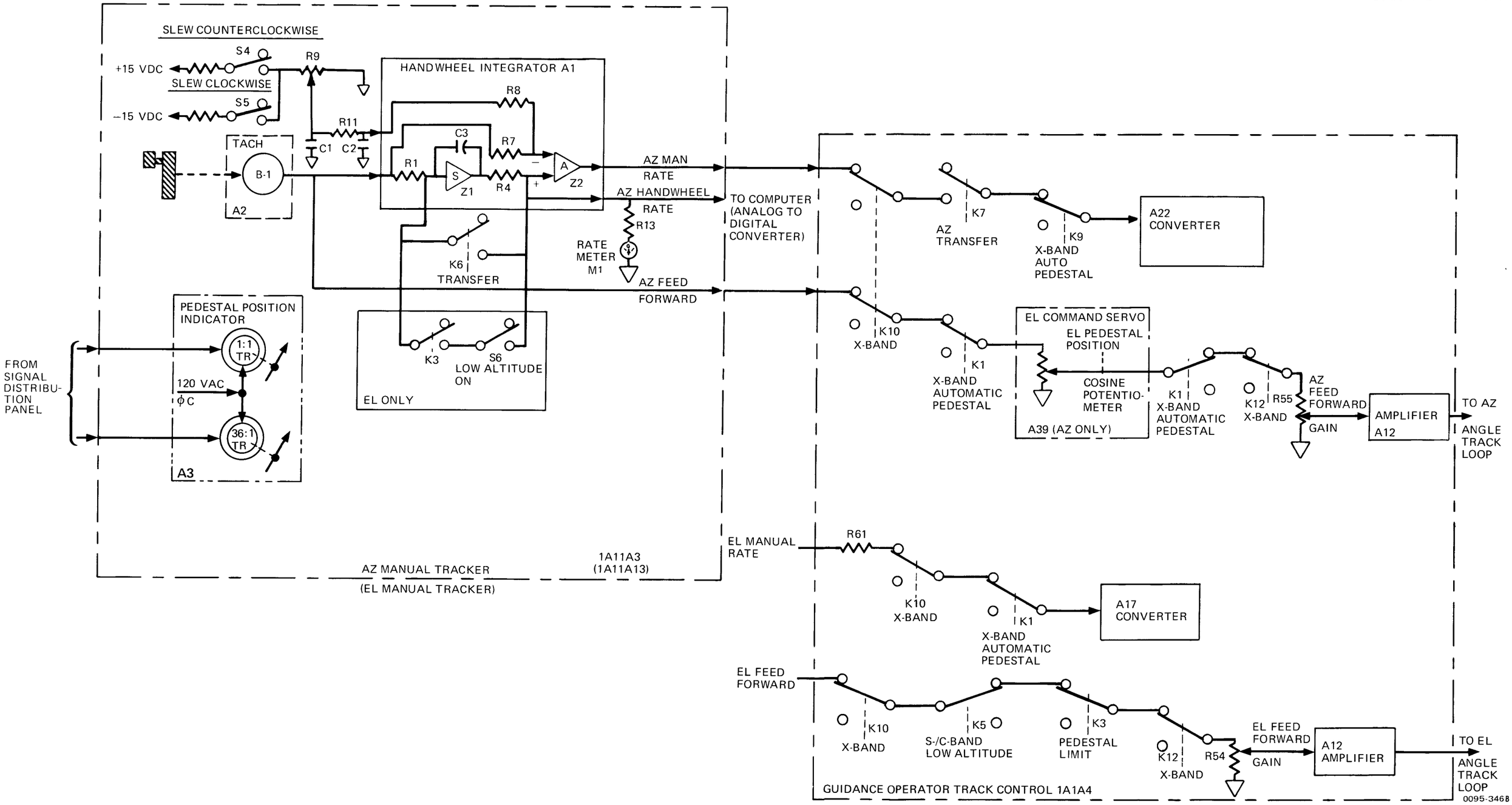


Figure 3-128. S-/C-Band Manual Tracker Control Block Diagram

3-1000. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T. O. 43D7-11-21-2-1-1.

3-1001. In the same manner, a clockwise rotation of the T2 handwheel will cause equal clockwise movement of the azimuth pedestal and down movement of the elevation pedestal.

3-1002. In the normal mode, the outputs of the T1 and T2 tachometers are buffered by operational amplifiers, A2Z2 and A2Z1 respectively, figure 3-129. The outputs of amplifier A2Z2 and A2Z1 are summed in phase at the input to amplifier A2Z3 (both go to the inverting input of the amplifier) to provide the azimuth control signal. The outputs of amplifier A2Z2 and A2Z1 are summed out of phase at the input to amplifier A2Z4 (T1 goes to the inverting input and T2 goes to the noninverting input of the amplifier) to provide the elevation control signal.

3-1003. MANUAL PEDESTAL CONTROL - X-BAND LOW ALTITUDE MODE. The low altitude mode does not provide both azimuth and elevation pedestal movement from each operator handwheel. The elevation pedestal is controlled only by the T1 operator and only if the tracked target angle is greater than 1 degree. If the tracked target angle is less than 1 degree (this signal is generated in target tracking assembly, 1A17A4), relay K6 is de-energized and relay K5 is energized. This disconnects tachometer A1 from coordinate converter A2 and the output of the converter. If the tracked target angle goes above one degree, relay K6 is automatically energized and relay K5 is de-energized, and the T1 handwheel controls the elevation pedestal through amplifiers A2Z2 and A2Z4. The azimuth pedestal is controlled automatically by the T2 track loop.

3-1004. COMMAND SERVOS. The azimuth and elevation command servos provide a drive servo between the operator pedestal control inputs and pedestal drive servo. The command servos drive the motors of command synchros which apply position commands to follow-up synchros located in the pedestal drive servo in response to operator controlled inputs. The control inputs may be either a handwheel or a DC drive in the command servo assembly.

3-1005. Additional outputs are provided for the target simulator and the pedestal indicator assemblies when the target simulator is in use. The command pedestal position in a digital form is generated for the missile simulation and scoring group.

3-1006. There are two similar command servo assemblies A37, A39 located in the guidance operator tracking control unit 1A1A4. Each assembly consists of a gear train that is driven by the guidance operator handwheel or an integral servo motor B1 that positions the output data devices. These output devices consist of synchros that command the pedestal drive servos B4 and B5, a digital encoder B3, and a potentiometer R1A. The encoder furnishes pedestal position to the missile simulation and scoring group. The potentiometer furnishes pedestal position information to the target simulator.

3-1007. Additional devices on the elevation command servo assembly include a potentiometer R1B that scales the azimuth feed forward voltage for the tracking group as a function of the secant of the elevation angle. Mechanical limits are provided to limit the travel of the command servo.

3-1008. Elevation Command Servo 1A1A4A39. When the brake/clutch B2 is energized, the output gear train is driven by the guidance operator handwheel through the brake/clutch assembly, the differential gear and the slip clutch. When the brake/clutch is de-energized, the output gear train is driven by servo motor B1 through the differential gear and the slip clutch.

3-1009. Synchro B5, the 1:1 synchro transmitter, provides the position commands to the 1:1 follow up synchro in the pedestal drive servo. Potentiometer R1 and the upper and lower limit switches S2 and S3 are geared at 1:1 to synchro B5.

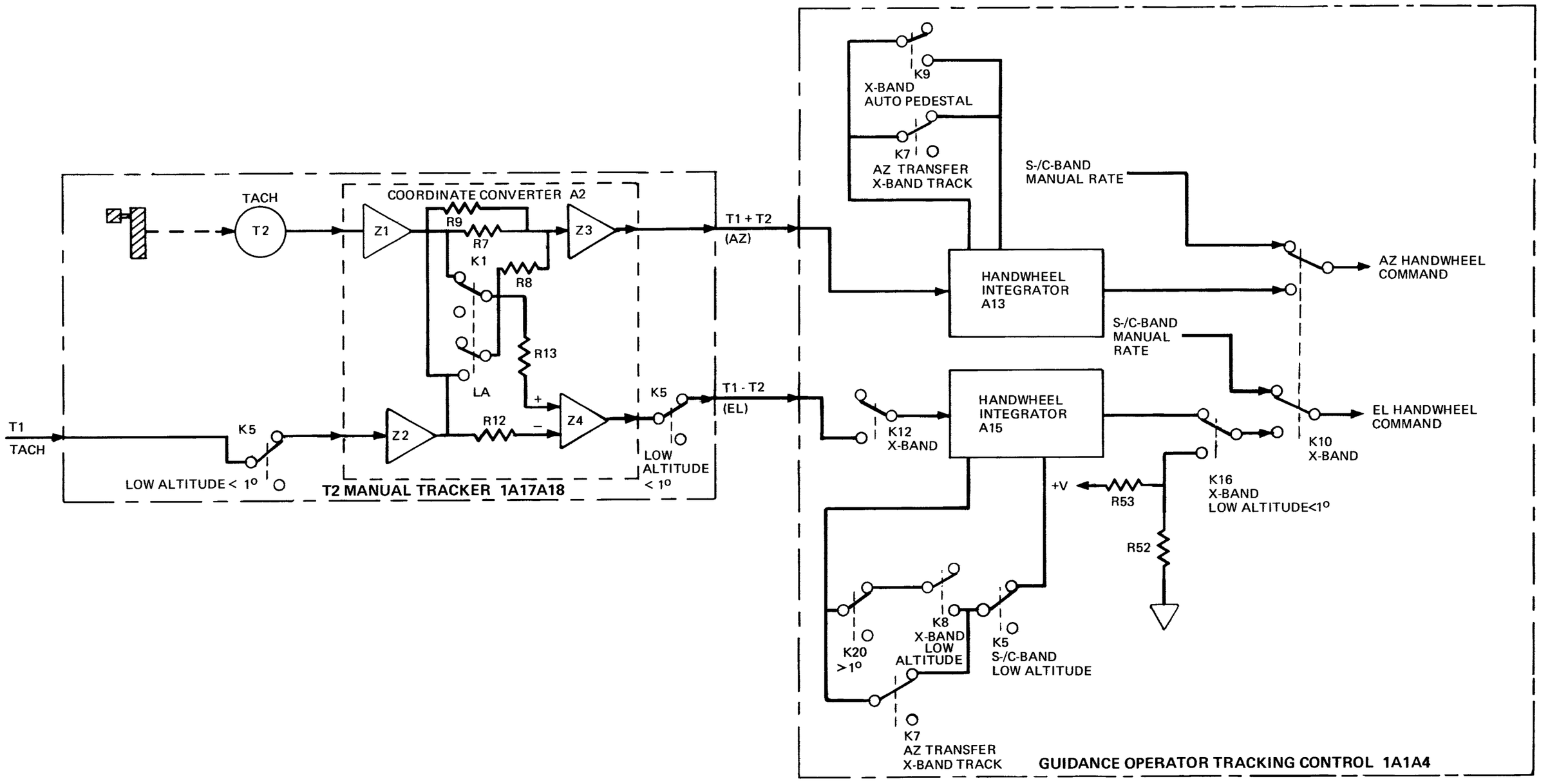


Figure 3-129. T1 and T2 Pedestal Control Simplified Diagram

Synchro B4, the 36:1 synchro transmitter, is geared at 36:1 to synchro B5. The digital encoder, B3, is geared at 64:1 to synchro B5 so that it turns 64 turns during one turn of synchro B5. The digital encoder is so constructed that it must turn 64 turns to reach full count on its output.

3-1010. Azimuth Command Servo 1A1A4A37. The azimuth command servo assembly is similar to the elevation command servo assembly and provides the azimuth data. The azimuth assembly does not include the limits described previously and does not include the potentiometer section R1B.

3-1011. Command Servo Motor Drive. During sector scan operation of the azimuth pedestal and during manual tracker control of the azimuth or elevation pedestal, the command servo gearbox is driven by servo motor B1 in response to operator-controlled inputs. Since azimuth and elevation command servo motor drives are similar, only the azimuth motor drive will be described in the following paragraphs.

3-1012. The azimuth drive signal from the sector scan generator A24 or the pedestal control voltage from the manual tracker operator control circuits is routed through relay K7 to the converter A22, which changes the DC input into an AC signal. This AC signal is filtered in filter amplifier A21 to remove frequency components other than the desired 400-Hz frequency and routed to servo amplifier A20. The servo amplifier and its companion power amplifier Q1-Q2 provides the required motor drive voltage. A tachometer which is mounted integrally with the servo motor, generates an AC feedback signal that is routed to the servo amplifier to stabilize the motor drive.

3-1013. The feed forward signal from the azimuth manual tracker is scaled to the elevation command servo A39 as a function of the secant of the elevation angle. The feed forward signal is also scaled by the rate adjust potentiometer and buffered by an operational amplifier.

3-1014. Converter 1A1A4A17, A22. The converter contains a modulator current which changes the DC pedestal command signals from the sector scan generator A24 or the manual tracker operator control circuits into a square wave signal with a 400-Hz rate. The DC manual rate signal input is attenuated in the modulator by voltage divider R6-R7. Gate drivers Q2 and Q3 convert the 400-Hertz input signal to a square wave which alternately turns chopper gate Q4 on and off to alternately ground and pass the signal input. The resultant chopper output at test point TP4 is a square wave referenced to ground. Its polarity and amplitude represents the direction and amount of command pedestal movement. Except for gain, the modulators in the azimuth and elevation converters are identical. The voltage at the junction of resistors R6 and R7 for the elevation modulator is one-half that for the azimuth modulator when the input voltages are equal to accomplish the elevation drive gain reduction.

3-1015. In the azimuth system, the feed forward signal is scaled by potentiometer R1B in the elevation command servo A39 to scale the azimuth feed forward signal for the azimuth tracking loops as a function of the secant of the elevation pedestal angle. This scaled voltage is routed to the azimuth rate adjust potentiometer R55 and then buffered by amplifier 1A1A4A12Z1. The amplifier output is the feed forward signal to the azimuth angle tracking loops.

3-1016. The elevation feed forward signal from the elevation demodulator is scaled by the elevation rate adjust potentiometer R54. The signal is then buffered by amplifier 1A1A4A12Z2 to derive the elevation feed forward signal for the elevation angle tracking loops.

3-1017. Filter 1A1A4A18, A21. The filter assembly converts the 400-Hz square wave generated by the converter into a 400-Hz sine wave for the servo amplifier input. The square wave input is routed through emitter follower Q1 which drives the filter-amplifier. The filter amplifier consists of operational amplifier Z1 and

the frequency and bandwidth determining components, capacitors C2 and C3 and resistors R4 through R8. The operational amplifier and associated components form a multiple feedback bandpass filter which has a center frequency or 400-Hz.

3-1018. Servo Amplifier 1A1A4A19, A20. The servo amplifier receives the 400-Hz signal from the filter, amplifies this signal and drives push-pull outputs to drive the associated power amplifier. The power amplifier supplies the drive voltage to the servo motor B1 in the command servo assembly. Since the servo amplifier, and the associated power amplifier (transistors Q1 and Q2 and related components) operate in combination to furnish the motor drive power they are described as one functional unit (figure 3-130).

3-1019. The servo amplifier receives the 400-Hz rate command signal from the filter and the 400-Hz feedback signal from the tachometer portion of servo motor B1. These inputs are amplified successively by amplifiers Z1 and Z2. Filter networks C2-C3-R6 and C5-C6-R9-R10 serve as filters and phase shifters so that the motor drive voltage derived at the output is at a 90-degree phase relationship with the reference (excitation) voltage applied to the servo motor. Transformer T1 provides the push-pull outputs to drive the power amplifier stages Q1 and Q2. The power supply voltage for the power amplifier stage is routed through relay K2 (K1 in elevation) as described in the operator controls. The load for the output power stage is the split winding of the servo motor B1.

3-1020. PEDESTAL DRIVE SERVOS - AN/MPS-T1(V)1, (V)2 and (V)3.

3-1021. The pedestal drive servos position the S-, C-, and X-band antenna pedestal systems in azimuth and elevation in response to the position of the synchros in the command servo assemblies. Operation of the azimuth and elevation drive servos (figure 3-131) of the S-, C- and X-band systems are identical except that the setting of the elevation limit switches for the X-band system differs from the settings for the S- and C-band systems. Also, the X-band system is capable of automatic pedestal operation while the S- and C-band systems are not. Since these identities and similarities exist, only the S-band pedestal azimuth drive servo system is described in detail. Any exceptions or references to the elevation channel are noted in the test.

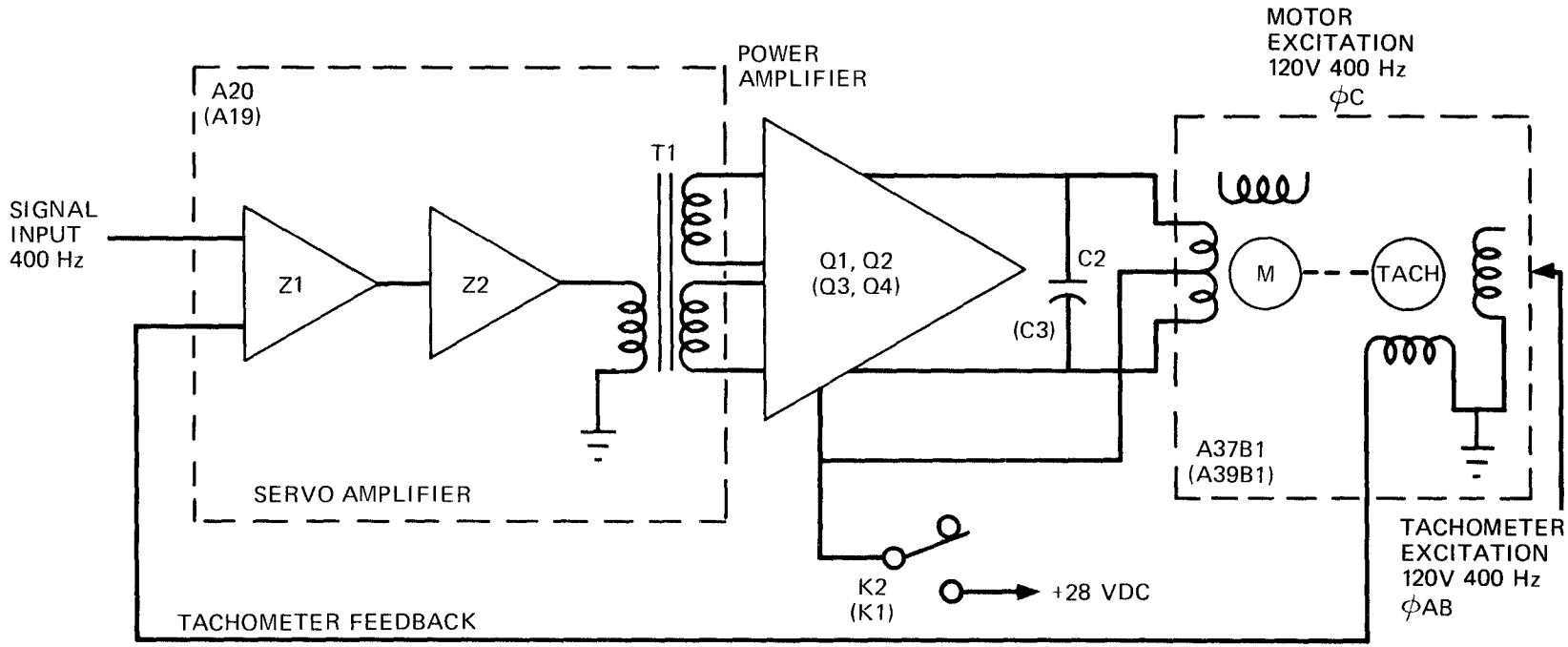
CAUTION

Differences in the pedestal servo equipment prevent the direct interchange of antenna trailers between AN/MPS-T1(V)1, (V)2, and (V)3 and AN/MPS-T1(V)4. Interchange shall be accomplished in accordance with special instructions provided in Servo Interchange Instructions for AN/MPS-T1(V)1, (V)2, and (V)3 and AN/MPS-T1(V)4.

3-1022. The stators of the pedestal follow-up synchro, which is geared to the pedestal drive gear mechanism, are connected to the stators of the command synchro (figure 3-132). A signal developed on the rotor of the follow-up synchro is the pedestal positioning error signal. This error signal is routed to the servo control unit to produce a DC error signal that is amplified in the DC amplifier. The amplified DC error signal is then routed to the servo amplifier where gate triggers are generated. These triggers gate on the power amplifier to produce a DC voltage of proper polarity so that the drive unit motor is driven in a direction that will position the pedestal and follow-up synchro to the command position. A tachometer in the drive unit produces a voltage that is fed to the DC amplifier for stabilization of the pedestal drive servo.

3-1023. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-1024. Synchro transmitters geared to the pedestal drive gear mechanism drive pedestal position indicators in the control trailer to indicate pedestal angles. The



NOTES

1. PREFIX REFERENCE DESIGNATORS WITH 1A1A4.
2. ELEVATION SERVO AMPLIFIER REFERENCE DESIGNATORS ARE IN PARENTHESIS.

0095-226A

Figure 3-130. Servo-Amplifier Simplified Functional Diagram

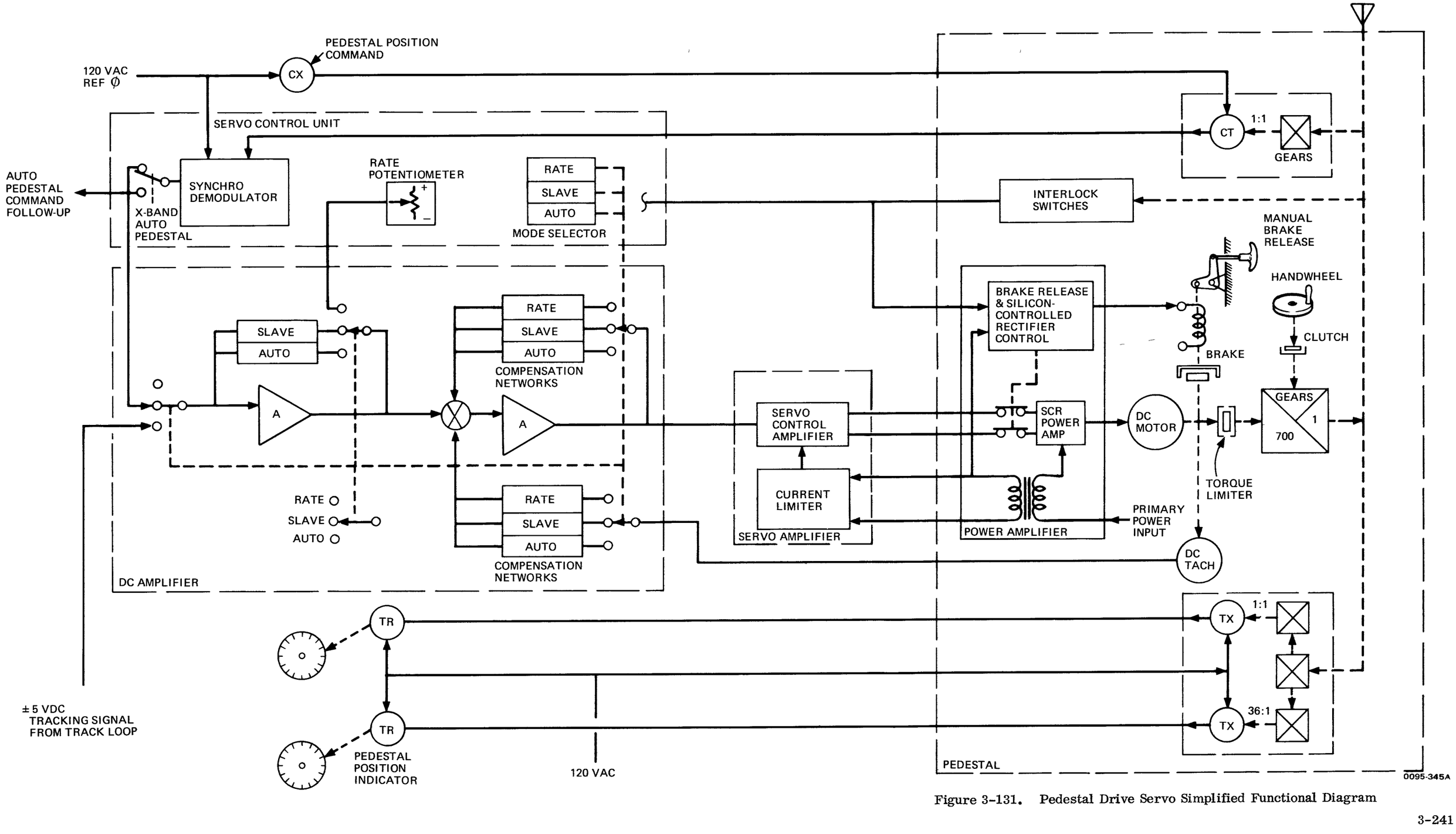


Figure 3-131. Pedestal Drive Servo Simplified Functional Diagram

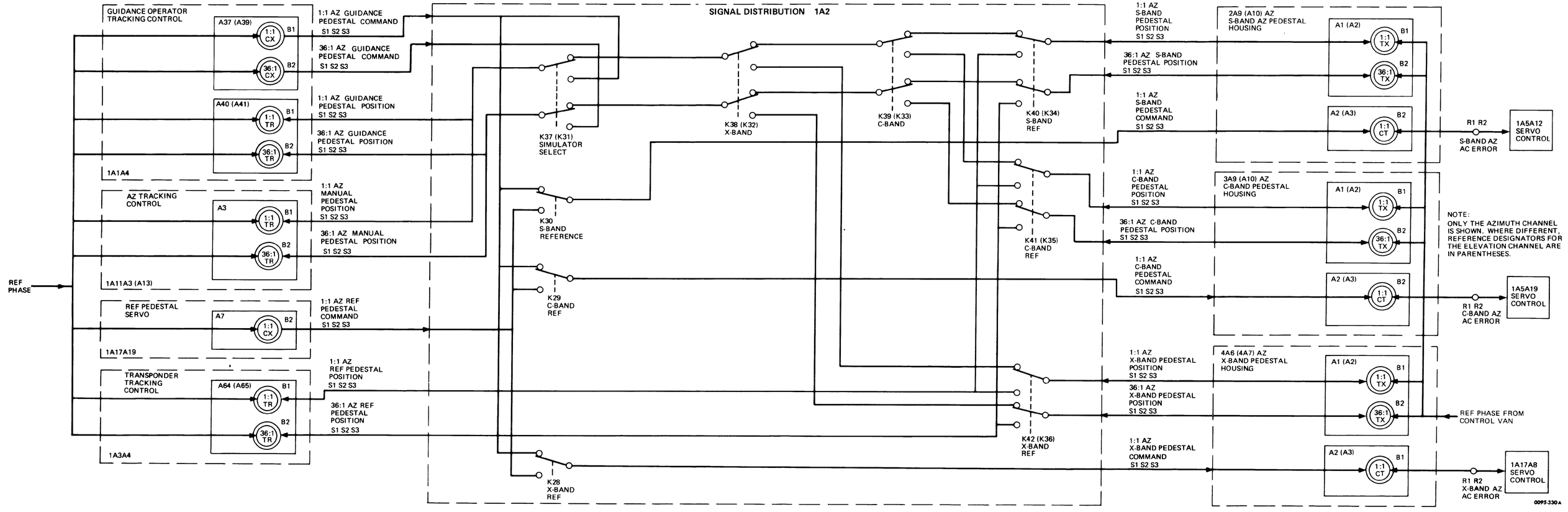


Figure 3-132. Synchro Selection Simplified Functional Diagram

input to the pedestal position indicators is connected to the pedestal selected for the tracking radar function and/or the reference tracking radar function.

3-1025. Followup Synchro. The followup synchro generates on its rotor an error signal that is an indication of the misalignment of the pedestal with position of the command synchro. The error voltage magnitude is a measure of the degree of misalignment and the phase of the error voltage indicates the direction of misalignment.

3-1026. SERVO CONTROL UNIT 1A5A12, 1A5A19, AND 1A17A8. The servo control unit contains demodulators to convert the synchro error signal to a DC error signal, power supplies to furnish the required DC power and control circuits to select the mode of operation of the drive servo. Also included are indicators to indicate that the elevation pedestal is at a limit or that one of the pedestal interlock switches is in the "safe" position. The elevation pedestal interlocks are shown in figure 3-133.

3-1027. Demodulators 1A5A12A2, 1A5A19A2, 1A17A8A2. The demodulator section consists of full wave sampling demodulator bridges and twin-T filters. The output of the filters is a DC error signal which is routed to the DC amplifiers in the pedestal drive servo loops.

3-1028. The azimuth and elevation demodulator channels are identical, therefore, only the azimuth channel is described. The 120-volt, 60 Hz voltage applied to transformer T4 serves as the azimuth demodulator reference signal and is in phase with the power applied to the command synchro 1A1A4A37B1. The synchro error signal from the followup synchro rotor is applied to transformer T3.

3-1029. If the error signal and the reference signal are in phase (T4-6 and T3-8 same polarity), as the AC reference at T4-6 starts positive capacitor C6, which was charged during the previous negative half cycle, discharges through resistor R9. The full wave bridge consisting of diodes CR7 through CR10 is reverse biased and cannot conduct. As the reference voltage increases to its peak positive voltage at T4-6, T4-7 increases to its peak negative voltage. Therefore, the full wave bridge consisting of diodes CR3 through CR6 conducts, charging capacitor C5. Current flow through the full wave bridge (CR3 through CR6) charges capacitor C7 such that the voltage at TP2 is negative.

3-1030. As the AC reference voltage at T4-6 starts negative capacitor C5, which was charged during the previous positive half cycle discharges through resistor R8. The full wave bridge consisting of diode CR3 through CR6 is reverse biased and cannot conduct. As the reference voltage increases to its peak negative value at T4-6, T4-7 increases to its peak positive voltage. Therefore, the full wave bridge consisting of diodes CR7 through CR10 conducts, charging capacitor C6. Current flow through the full wave bridge (CR7 through CR10) charges capacitor C8 such that the voltage at TP2 is also negative. Therefore the DC voltage appearing at the output (TP2) is equal to the combined voltages on C7 and C8. If the error voltage and the reference voltage are out of phase, action similar to that described above takes place, but charges of opposite polarities are placed on capacitors C7 and C8. Consequently the DC voltage at TP2 is positive.

3-1031. The full wave sampling demodulator bridge therefore compares the synchro error signal with the reference signal and produces a DC voltage at its output. The polarity of the DC voltage depends on the phase of the input signal and the magnitude depends on the amplitude of the input signal.

3-1032. The twin tee filter, consisting of resistors R12 through R14 and capacitors C9 through C11, remove unwanted ripple frequency components.

3-1033. Power Supply 1A5A12A1, 1A5A19A1, and 1A17A8A1. The power supply in the servo control unit provides unregulated +28 volt power for lamp and relay circuits in the servo control unit and

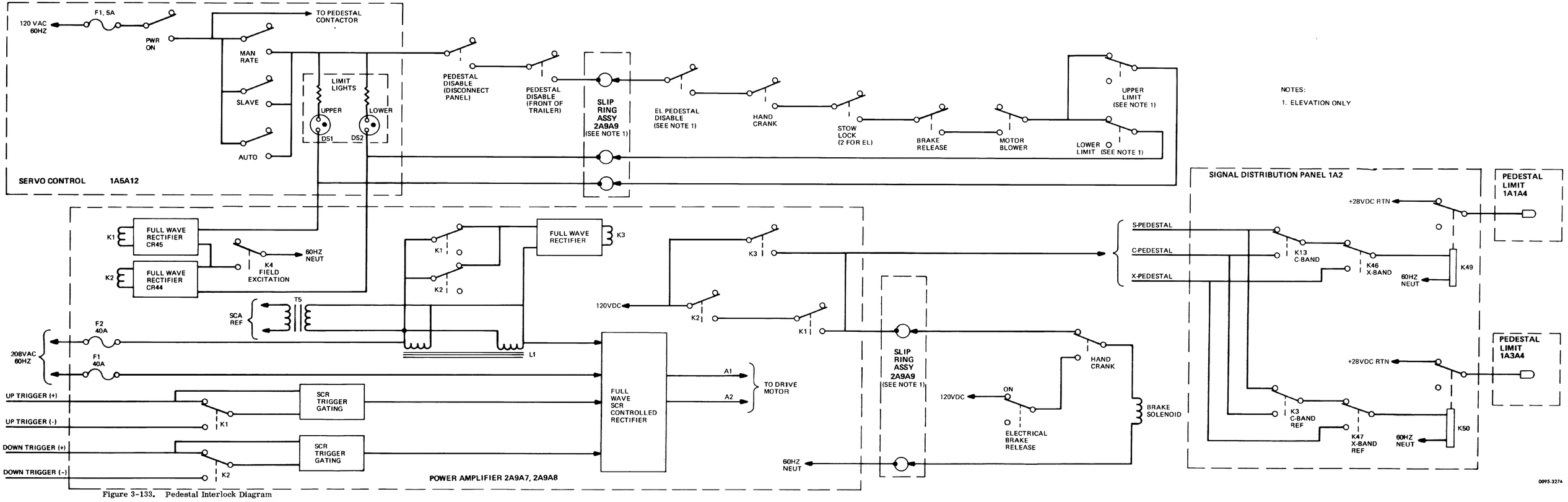


Figure 3-133. Pedestal Interlock Diagram

the DC amplifier unit. The power supply also provides regulated +15 volt and -15 volt power for the servo control unit and the DC amplifier unit.

3-1034. Unregulated +28 volt power is generated in the supply consisting of transformer T1 and full-wave bridge rectifier CR16. Fuse F3 protects the supply from excessive loads.

3-1035. The source of unregulated power for the +15 volt and -15 volt regulated supplies is furnished by transformer T2, a full-wave rectifier circuit consisting of diodes CR1 through CR4 and filter capacitors C1 and C2.

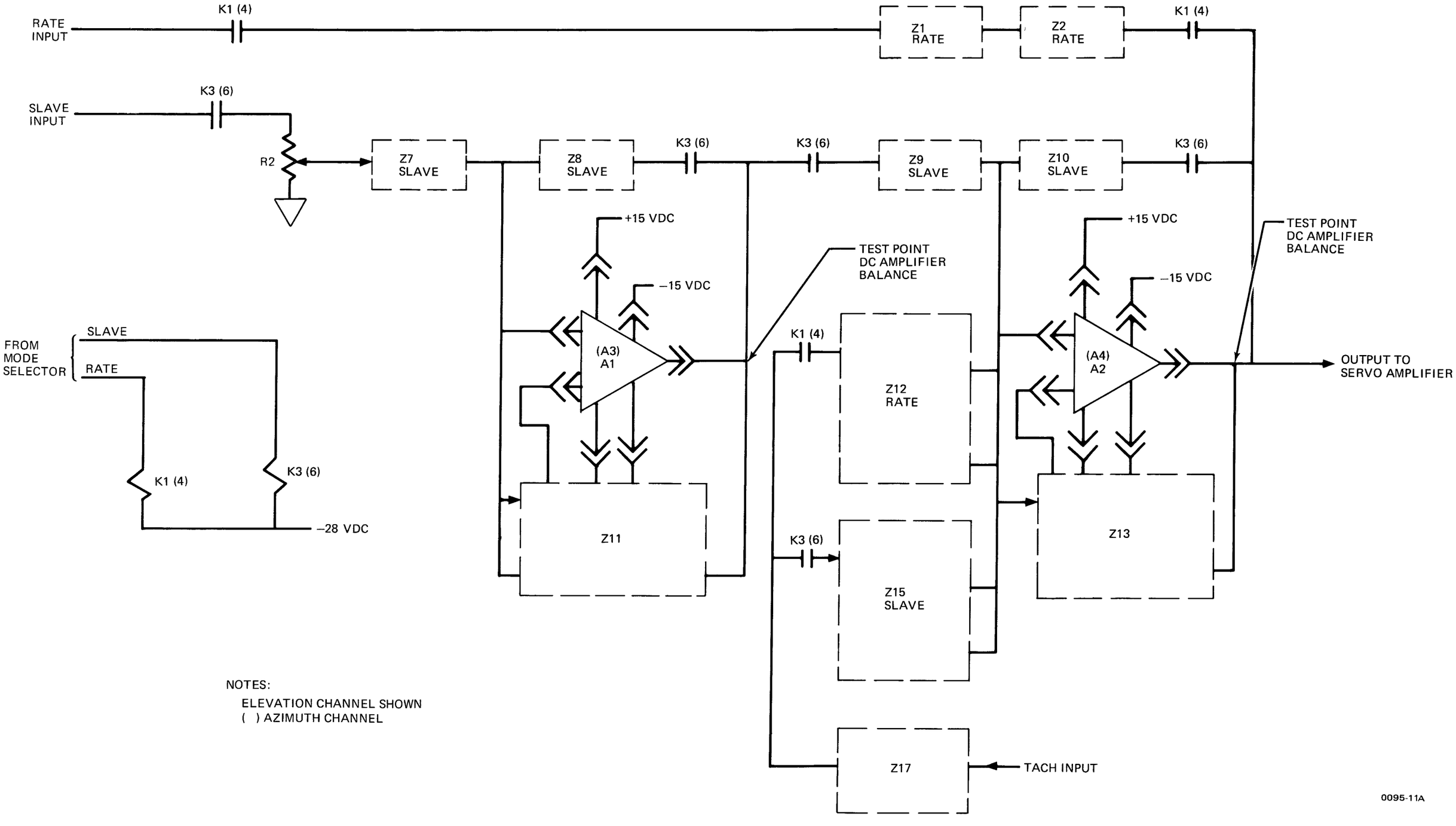
3-1036. The +15 volt supply consists essentially of series transistor Q3, reference diode CR8, and comparator amplifier Q7. The emitter of amplifier Q7 is fixed at approximately +6 volts by diode CR8. The base of amplifier Q7 monitors the supply output voltage through a sampling divider network (R13-R14-R15), to which it is connected by forward-biased diode CR10. The divider resistance ratio is provided by potentiometer R14 to set the output voltage to 15 volts. Any variance of the output voltage from its operating value produces a change in the base-to-emitter voltage of amplifier Q7. This error signal is amplified and applied to the base of transistor Q4, changing the voltage drop across transistor Q3 so that it opposes the output voltage change and limits it to an insignificant magnitude.

3-1037. Transistors Q3 and Q4 are arranged in a compound complementary emitter-follower connection. Together they function as if they constituted a single high-gain power transistor of NPN (rather than PNP) configuration with its collector connected to the rectifier circuit, its emitter to the load, and its base to the collector of transistor Q7. The circuit consisting of transistor Q1, diodes CR9 and CR10, and resistor R1 and R4 delivers a constant load current of about 1 ma to the collector of amplifier Q7 and the base of transistor Q4, independent of rectifier output voltage fluctuations. The emitter of transistor Q1 must follow its base; therefore, the voltage drop across resistor R4 must nearly equal a fixed drop of approximately 1 volt across diodes CR9 and CR10. This condition results in a collector current of approximately 1 ma. Capacitors C5 and C3 control the frequency-response characteristic of the comparator amplifier to ensure closed-loop stability. Diode CR9 protects the base-emitter junction of amplifier Q7 from excessive reverse-bias transients during on-off switching of the supply. During power supply operation, the diode is reverse biased and has no effect. Diode CR10, which is forward biased by current through resistor R10, provides compensation for thermal changes in the base-to-emitter potential characteristic of amplifier Q7.

3-1038. The -15 volt supply is similar in principle to the +15 volt supply, but certain differences result from its opposite polarity. The raw DC voltages (20 to 29V) provided by the full-wave rectifier are negative with respect to ground. Transistors Q5 and Q6 are arranged in the ordinary compound emitter-follower connection; that is, both are PNP. The reference voltage is obtained from the resistive divider R17-R18-R19 connected between the +15 volt and -15 volt outputs.

3-1039. DC AMPLIFIER 1A5A11, 1A5A18, AND 1A17A7. Operation of the azimuth and elevation DC amplifier channels are identical. Therefore, the elevation channel only is discussed. The DC amplifier unit amplifies the signals from the servo control unit, sums them with the tachometer feedback signals from the pedestal drive unit, and then applies the output signal to a servo amplifier 1A5A10 (see figure 3-134).

3-1040. The DC amplifier unit may be operated in any of three modes: slave, manual rate, or auto. (Automatic mode for X-band only.) During normal operation, the elevation slave mode is selected by the ELEVATION SLAVE switch S1 on servo control unit 1A5A12 or by momentarily positioning the S-band PEDESTAL



NOTES:

ELEVATION CHANNEL SHOWN
( ) AZIMUTH CHANNEL

Figure 3-134. DC Amplifier Simplified Block Diagram

POWER switches 1A1A1S1 to the ON position. In this mode, the elevation pedestal servo system is a closed loop and is driven by the error signal from the followup synchros on the antenna pedestal. Operation in the elevation manual rate mode may be selected by momentarily depressing the ELEVATION MANUAL RATE switch S3 on servo control unit 1A5A12. When the elevation manual rate mode is used for checkout of the elevation pedestal system, the speed and direction of the elevation pedestal is controlled by the RATE control potentiometer R1 on unit 1A5A12. The X-band servo system can be controlled automatically by the track loops when selected by the guidance operator.

3-1041. During operation in the elevation slave mode, the slave input from the servo control unit is coupled through the normally open contacts of relay K3 to the gain potentiometer R2 and applied to the input network of amplifier A1. The input network and feedback network of amplifier A1 determine the complex frequency characteristics of the amplifier stage. The input network consisting of resistors R19 and R20 and capacitors C2 and C4 provides a lead function to the stage. The feedback network which is an integrator network is composed of resistors R22, R26 and capacitors C5 and C6. The amplifier feedback network limits the velocity of the pedestal due to the back-to-back reference diodes CR12 and CR13 which limit the output voltage of the stage. Relay K7 connects resistors R24 and R27 across the feedback network discharging the integrator when the unit is in standby.

3-1042. A balance control for the integrator is provided by the balance switch S1 to allow adjustment of the integrator balance with the potentiometer that is integral to amplifier A1.

3-1043. The output of the first integrator stage is applied through the input lag network consisting of inductors L1 and L2 and resistor R29 and through the normally open contacts of relay K3 to input resistor R30. During operation in the manual rate mode, when relay K1 is energized and relay K3 is deenergized, the output from the RATE potentiometer is applied through relay K1 to the input network (resistor R31) to the summing junction of amplifier A2.

3-1044. The feedback network for amplifier A2 in the slave mode is the network that is selected by relay K3. This feedback network is composed of potentiometer R7, resistor R38, and capacitor C13 to provide an integrator function to amplifier stage A2. The feedback network for the manual rate mode is selected by relay K1. The manual rate mode network is composed of potentiometer R3, resistor R38, and capacitor C13.

3-1045. The limiting circuit and balance circuit for this stage is identical to that described for amplifier A1.

3-1046. The feedback signal from the tachometer in the pedestal drive unit is filtered by the network composed of resistors R37 and R36 and capacitors C11 and C12 and applied through relays K1 or K3 to an input resistor R32. This tachometer feedback signal provides stabilization of the pedestal drive loop.

3-1047. The DC output voltage of stage A2 is applied to the input of the associated pedestal servo amplifier.

3-1048. SERVO AMPLIFIER 1A5A10, 1A5A17, AND 1A17A6. The servo amplifier receives the DC error signals from the DC amplifier and provides pulse trains that are used to control the power output of the SCR power amplifier (figure 3-135). Current limiter circuits clamp the error signal during overload conditions to limit the power command from the SCR power amplifiers.

3-1049. Current Limiter 1A5A10A3, 1A5A17A3, AND 1A17A6A3. The current limiter senses and limits the average DC current supplied to the pedestal drive motors by the SCR power amplifier. Both azimuth and elevation circuits are incorporated in the subassembly and are the same. The azimuth circuit will be described.

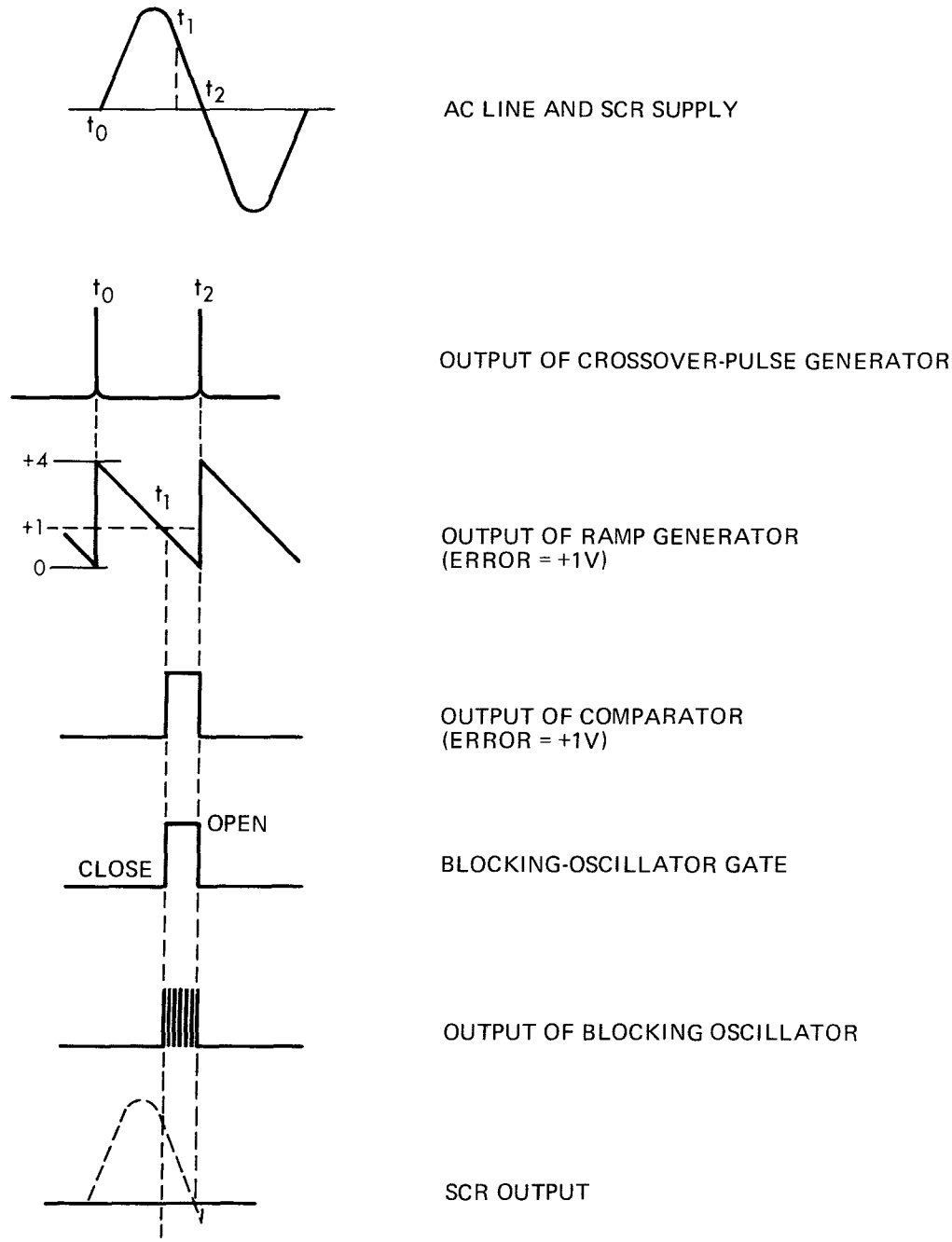


Figure 3-135. Servo Amplifier Timing Diagram

3-1050. An alternating voltage proportional to the rate of change of the AC source current is derived from the secondary of a sampling transformer in the power amplifier. This voltage is applied to a bootstrap integrator with an output consisting of alternating voltage having the same waveform as the source current. This alternating voltage is then applied to a full wave rectifier. The output of the rectifier consists of unidirectional current pulses having the same waveform as the load current. The positive current pulses are applied to a large capacitor whose negative charge keeps a phase splitter at cutoff.

3-1051. As the amplitude of the current pulses increases to a value which corresponds to an increase in load current, the charge on the capacitor is decreased to the preset current limit and the phase splitter is allowed to conduct. The collector and emitter voltages of the phase splitter are resistively coupled to two complementary clamp circuits. When the phase splitter conducts, the two transistors in the clamp circuits are forward biased; and one or the other (depending on polarity) clamps the DC error voltage near ground potential, thus reducing the SCR firing angle and limiting the load current.

3-1052. Integrator. The operation of the integrator is identical for both the azimuth and elevation circuits. Therefore, operation of the azimuth circuit only is discussed. Transistors Q11 and Q12 and associated components are arranged in a bootstrap integrator circuit. Applied to this circuit is an alternating voltage proportional to the rate of change of the AC source current. This voltage is obtained from the secondary of transformer 2A9A7T5, the primary of which is connected across a choke 2A9A7L1 in series with the AC supply line in the power amplifier. Transistors Q11 and Q12 are arranged in a complementary-pair emitter-follower circuit having a gain of +1. The amplifier output, at the junction of the two emitters, is, therefore, equal to the integral of the input signal.

3-1053. Full-Wave Rectifier. The integrator output is applied to a full-wave rectifier circuit consisting of diode CR7 and CR8, transistor Q13 and associated components. This circuit produces DC current pulses from an AC voltage input (A of figure 3-13).

3-1054. When the input voltage swings positive, diode CR8 conducts and diode CR7 is reverse biased. The circuit is now arranged as a common-emitter amplifier with emitter degeneration and a 2:1 voltage divider drive in the base circuit (B of figure 3-136). When the input voltage swings negative, diode CR7 conducts and diode CR8 is reverse biased. The base of transistor Q13 is clamped to the negative supply, and the circuit is arranged in a common-base connected amplifier circuit having essentially unity current gain (C of figure 3-136).

3-1055. Limit Level Stages. The output of the full-wave rectifier at transistor Q13, which acts as a constant current source, tends to charge capacitor C10 negatively, in proportion to the signal feed back from the motor current sensor in the pedestal. The limit level transistor Q14 acts as a constant current source to charge capacitor C10 positively at a rate set by current limit control resistor R34. If the pedestal drive motor current is below the desired limit, the current input from transistor Q14 will exceed that from transistor Q13, and the charge on capacitor C10 will stabilize at a voltage set by the clamper transistor Q15, which can be adjusted from about -4 to -0.5 volts by the attack time control potentiometer R36. The threshold bias of the limit signal amplifier Q15 is fixed at about -4.2 volts by resistor R37. If the motor current increases beyond the desired limit, the rate of current flow from transistor Q13 will exceed that from transistor Q14, and capacitor C10 will start to charge in a negative direction toward the threshold of the transistor Q16 at a rate determined by the overload excess.

3-1056. A large current overload will cause capacitor C10 to charge rapidly to the conduction point of transistor Q16, and

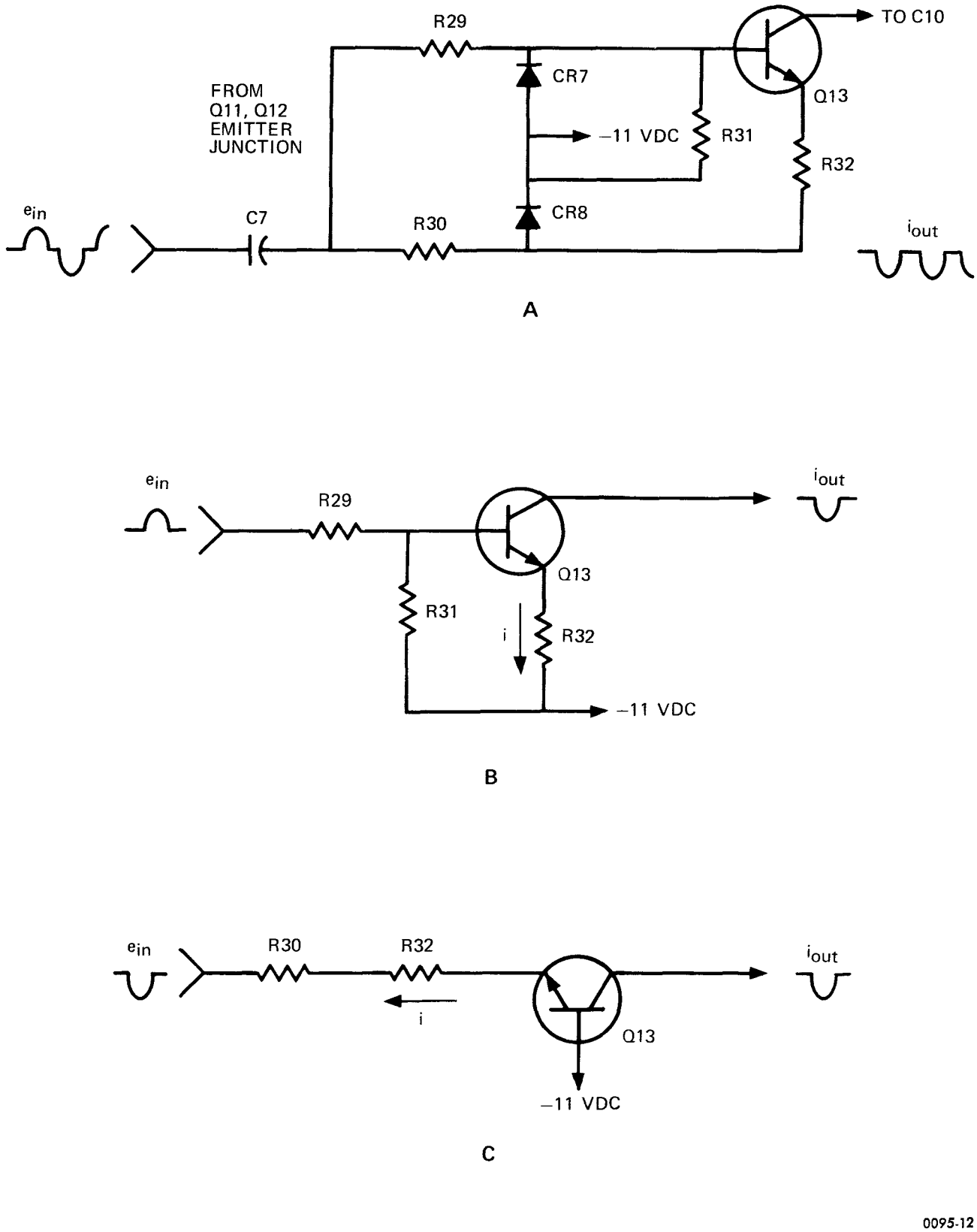


Figure 3-136. Full Wave Rectifier Operating Modes

a signal proportional to the excess current will be applied to the servo error voltage clamp stages for the required limit action. A small current overload will require a longer period for charging capacitor C10; and the signal passed by transistor Q16, when it does conduct, will also be less. Limit level control R34 sets the rate of current flow of transistor Q14 versus transistor Q13 and, therefore, the point at which the feedback signal from the motor current will cause transistor Q13 to predominate and start the charge of capacitor C10 in a negative direction. The voltage from which capacitor C10 starts to charge is set by the attack time control R36, which allows a small, adjustable delay time before a given overload signal starts limit action.

3-1057. The limit level signal passed by transistor Q16 is amplified by transistor Q17 and applied to the clamping circuit Q20-CR12, which limits the positive servo error. The output of transistor Q17 also feeds the inverter amplifier Q18, which applies the limiting signal to the clamping circuit Q19-CR11 to limit negative servo error signals. With no limit-level signal input to transistors Q19 and Q20, the clamp voltage on the servo error signal is approximately -11 volts and +11 volts respectively, well beyond the ±4 volt limits of the error signal. Diodes CR9 and CR10, at the input to transistors Q19 and Q20, prevent the clamping of the respective servo error signals beyond the zero or ground potential.

3-1058. Servo Control Amplifier 1A5A10A1, 1A5A17A1, 1A17A6A1, Azimuth. The servo control amplifier includes a ramp generator card 1A5A10A1A1 consisting of a crossover pulse generator and ramp generator, and a comparator and blocking oscillator card 1A5A10A1A2. Azimuth channel operation is identical to elevation servo control amplifier 1A5A10A2. Therefore, only azimuth channel operation is discussed in the following paragraphs.

3-1059. Crossover Pulse Generator (Part of cards 1A5A10A1A1, 1A5A17A1A1, 1A17A6A1A1). Transistors Q1 and Q2 and associated circuitry (figure 3-137) produce a pulse at each crossover of the applied AC voltage. The AC voltage from the secondary of transformer 1A5A10A1 -T1 is applied between the junction of resistor R1 with resistor R2 and the junction of the anode of diode CR2 with the cathode of diode CR4. During one half cycle of the AC line voltage, transistor Q1 is forward biased and base current flows as shown in A of figure 3-137. Collector current flows through resistor R3 and pulls the collector of transistor Q1 down from its positive supply voltage.

3-1060. At the end of the half cycle (near crossover), the applied AC voltage is no longer of sufficient amplitude to cause base current to flow, and the collector voltage rises toward +11 volts. After crossover (at the start of the next half cycle), both transistor Q1 and transistor Q2 are forward biased, and base current flows as shown in B of figure 3-137. Collector current again flows through resistor R3 and pulls down the collector of transistor Q1. Thus collector current flows through resistor A1R3 at all times except during the period near the AC line-voltage crossover. Since a crossover occurs twice each cycle of the line voltage, 120-Hz pulses are generated coincident with crossover.

3-1061. Ramp Generator (Part of 1A5A10A1A1, 1A5A17A1A1, 1A17A6A1A1). A Miller ramp generator is formed by inverting amplifier Q6, emitter follower Q7, integrating capacitor C2, and integrating resistors R1 and R9. Transistors Q3 and Q4 reset the circuit at AC line crossover; transistor Q5 provides an additional ramp output of inverted polarity.

3-1062. During the ramp interval, clamp Q4 is held off by current through transistor Q3. Current through resistor R1 and R9 tends to cause conduction of transistor Q6, drawing its collector positive. This collector-voltage rise is duplicated at the emitter of transistor Q7 and is applied to capacitor C2. The negative-feedback connection between capacitor C2 and the base

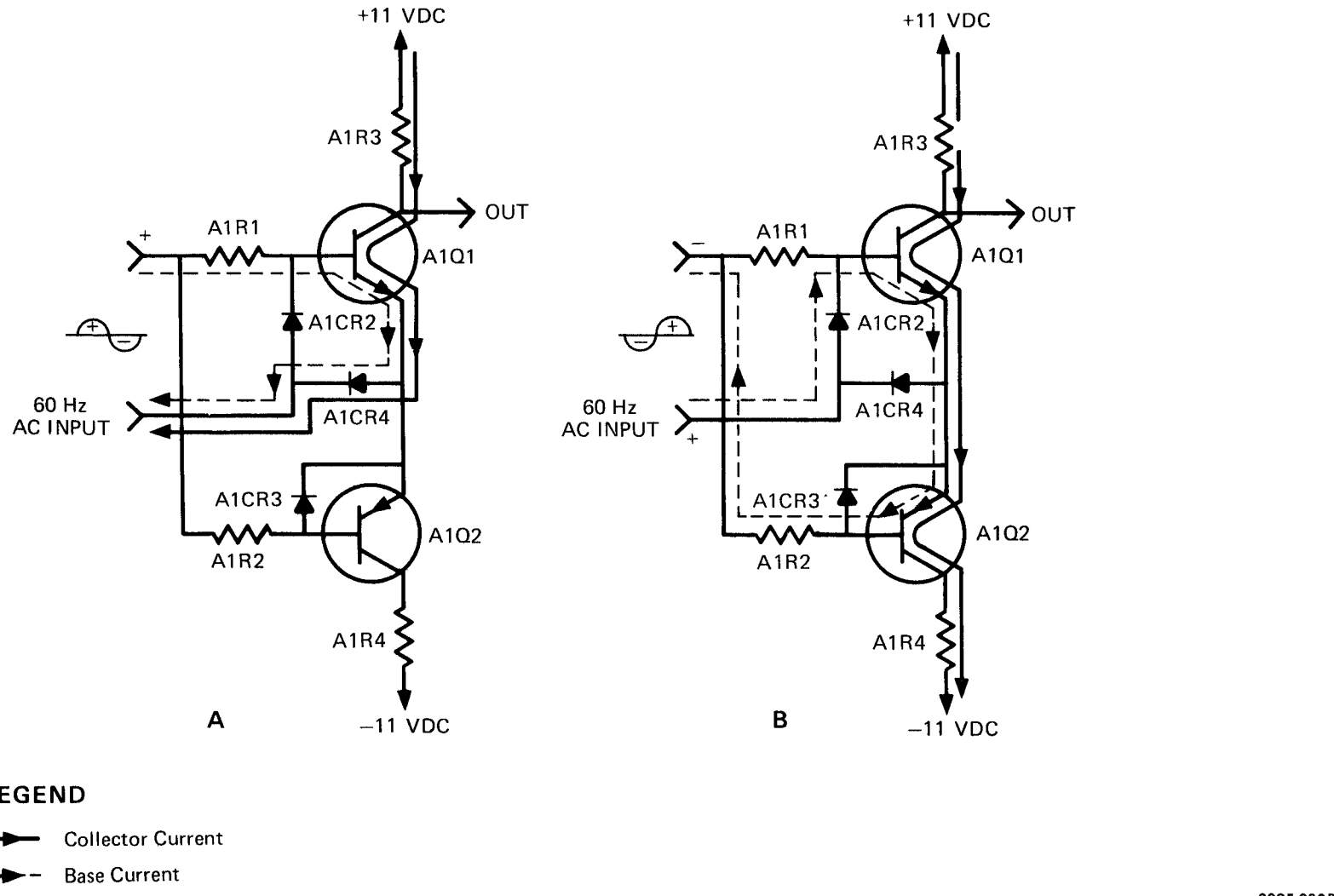


Figure 3-137. Crossover Pulse Generator Simplified Diagram

of transistor Q6 limits the rate of rise of collector voltage, since current through the capacitor directs current through resistors R1 and R9 from the base of transistor Q6 and limits conduction in transistor Q6. The collector is then permitted to rise only at the rate at which the diverted current can charge capacitor C2. The voltage across the capacitor therefore increases linearly with time. A positive-going ramp output is taken from the collector of transistor Q6. The current through transistor Q6 also flows through common-base amplifier Q5 and collector resistor R7, where a negative-going duplicate of the ramp is developed.

3-1063. A crossover pulse cuts off transistor Q3, allowing transistor Q4 to conduct heavily and clamp the base of transistor Q6 and one terminal of capacitor C2 to ground. With transistor Q6 cut off, its collector decreases to the negative supply potential, drawing the emitter of transistor Q7 and the other terminal of capacitor C2 with it. Transistor Q7 provides the heavy current required to recharge capacitor C2 rapidly; the current is limited to a safe magnitude by resistor R8. Upon termination of the crossover pulse, transistor Q4 cuts off, and the ramp begins again.

3-1064. The two ramps are applied to a resistive network (R13 through R18, R2 and R3) which determines the amplitude (slope) and DC levels of the ramps. The setting of potentiometer R2 determines the amplitude (slope of the ramps); potentiometer R3 is used to adjust their DC levels.

3-1065. Comparator Circuits (Part of cards 1A5A10A1A2, 1A5A17A1A2, 1A17A6A1A2). Each channel contains two comparator circuits - one for reverse signal (positive-going ramp) and one for the forward signal (negative-going ramp). The comparators are identical except for complementary transistors. Two inputs are provided to each comparator circuit - the ramp generator output and the DC error voltage received from the DC amplifier.

3-1066. The negative-going ramp is applied to the base of transistor Q1, and the DC error signal is applied to the base of transistor Q2. These transistors, transistor Q5, and associated components constitute the comparator, which operates on the negative-going ramp. The DC error voltage applied to transistor Q2 must be positive for this comparator to operate.

3-1067. Assume that the ramp voltage is decreasing at time t_0. Collector current from transistor Q1, Flowing through resistor R2, holds transistor Q2 at cutoff. As the ramp voltage decreases, the bias on the base of transistor Q2 decreases and transistor Q2 will eventually become forward biased (at time t_1, when the ramp voltage is slightly less than the DC error voltage). When transistor Q2 is forward biased and conducts, the drop in collector voltage (taken across resistor R1) is applied as forward bias to transistor Q5 and transistor Q5 conducts. The output of the comparator, a positive gate taken across resistor R6, is applied to the blocking oscillator gate Q7. Diodes CR1 and CR2 apply approximately 1-volt reverse bias to the base-emitter junction of transistor Q5 to hold transistor Q5 at cutoff before transistor Q2 conducts.

3-1068. Blocking Oscillator Gate and Blocking Oscillator (Part of cards 1A5A10A1A2, 1A5A17A1A2, 1A17A6A1A2). The blocking oscillator gate (forward) consists of transistor Q7, diode CR5, and the secondary winding of transformer T1. Before coincidence (transistor Q5 at cutoff), transistor Q7 is reverse biased and cut off by the forward voltage drop across diode CR5. The positive output gate from the comparator overcomes this bias, and transistor Q7 conducts. With transistor Q7 conducting, pin 5 of transformer T1 is effectively placed at ground potential, thus providing a ground return for the secondary winding of transformer T1 and allowing regenerative blocking action of transmitter Q9 to occur. The blocking oscillator free-runs while the gate is open; pulses appearing across the tertiary winding of transformer T1 (pins 1 and 2) are transmitted to the gate circuit of the appropriate SCRs in the power amplifier.

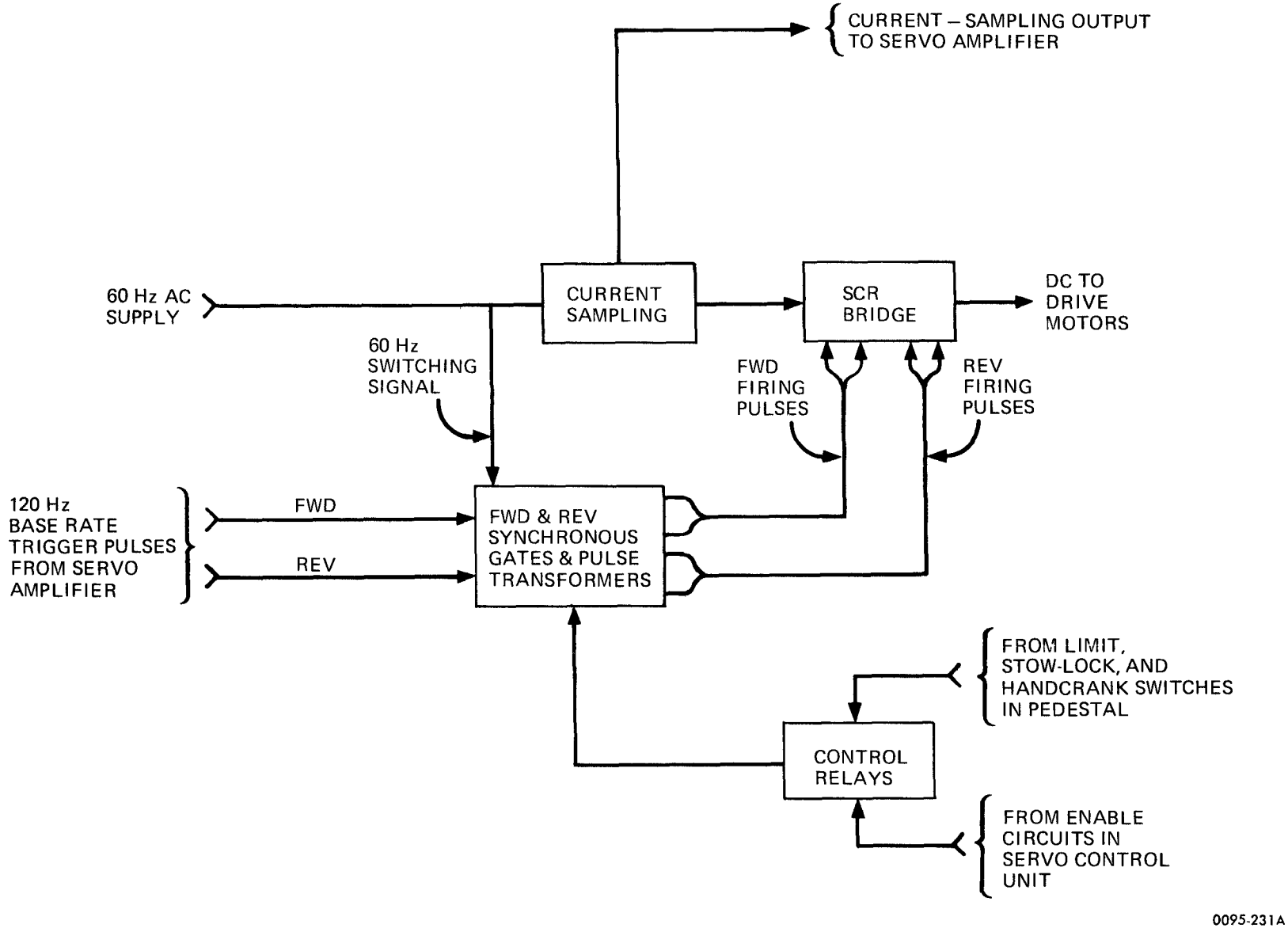


Figure 3-138. SCR Power Amplifier Block Diagram

3-1069. The comparator, blocking oscillator, and gate described above control the forward (clockwise for the azimuth pedestal or down for the elevation pedestal) motion of the pedestal axes and function when the input error voltage at pin 8 of connector J3 is positive. The reverse direction (negative error voltage) is controlled by the circuitry comprising transistors Q3, Q4, Q6, Q8, and Q10, which form the other comparator, blocking oscillator, and gate.

3-1070. Silicon Controlled Rectifier (SCR) Power Amplifier 2A9A7, 3A9A7, and 4A6A7, Azimuth. Identical SCR power amplifiers are provided to supply the DC drive voltages to the pedestal drive motors in the azimuth and elevation axes. The power amplifiers receive the 60-Hz power line voltages and the trigger pulses generated in the associated servo controlled amplifier. The power amplifiers then generate the DC drive voltages for the pedestal drive motors and the current sampling waveform for the servo control amplifiers. Control relays actuated from circuits in the control trailer and pedestal disable switches on the antenna trailer control the operation of the unit (figure 3-138).

3-1071. The unit is basically a full wave, bidirectional SCR bridge which controls the speed and direction of rotation of the DC motor. Other circuits included in the unit are firing circuits for the SCR's, a brake-control circuit, and a pedestal travel limit circuit. Filtering and shielding to reduce radio frequency interference (RFI) are also included.

3-1072. Operation of the circuits used in the forward motor direction is identical with operation of circuits used in the reverse direction. Only the reverse direction is discussed here. In every instance, an analogous reference can be made for the forward direction. Since the same is true for the azimuth and elevation channels, the elevation channel is discussed.

3-1073. Triggering and Synchronous-Gate Circuits. Reverse triggers (a series of pulses that cause the pedestal axis to move up) are generated in the servo amplifier and applied to a synchronous-gate circuit consisting of transistors Q1 and Q2 and associated components. A 60-Hz sinusoidal switching signal from the secondary of transformer T6 is also applied to the gate circuit (figure 3-139).

3-1074. The 120-Hz trigger pulses are fed alternately to pulse transformers T3 and T4 by the switching action of the synchronous gate. During the positive half-cycle of the voltage across the primary of transformer T6, pulses are applied through transistor Q1 and diode CR3 to transformer T4. During the negative half cycle, the pulses appear on transformer T3. Thus only the SCR intended to conduct during a particular half cycle of the line voltage can be triggered, and out-of-phase "firing" of an SCR which is forward biased by the drive motor back-emf is prevented.

3-1075. SCR-Bridge Circuit. The upper and lower corners of the bridge, as shown in figure 3-140, are connected across the 120-volt AC line; the motor armatures are connected between the right and left corners of the bridge. The current path through the bridge, and consequently the polarity of the voltage applied to the load, is a function of the relative polarity of the AC lines and which SCR's are fired by pulse transformers T1, T2, T3, and T4. The average magnitude of the DC current is controlled by the time relationship between the AC line voltage and the SCR-firing pulses.

3-1076. The operation of an SCR is similar to that of a gas-filled thyratron. When the SCR is forward biased, that is, when its anode is at a positive potential with respect to its cathode, it will normally not conduct unless its gate electrode is made positive with respect to the cathode. Once the SCR has been brought into conduction, conduction continues until the SCR becomes reverse biased, regardless of the signal on the gate electrode. It is a function of the firing pulses to turn the SCR on at the appropriate time. Usually only the first pulse in the pulse train is effective. If the pulse train turns the SCR on, the SCR is insensitive to the voltage on the gate electrode.

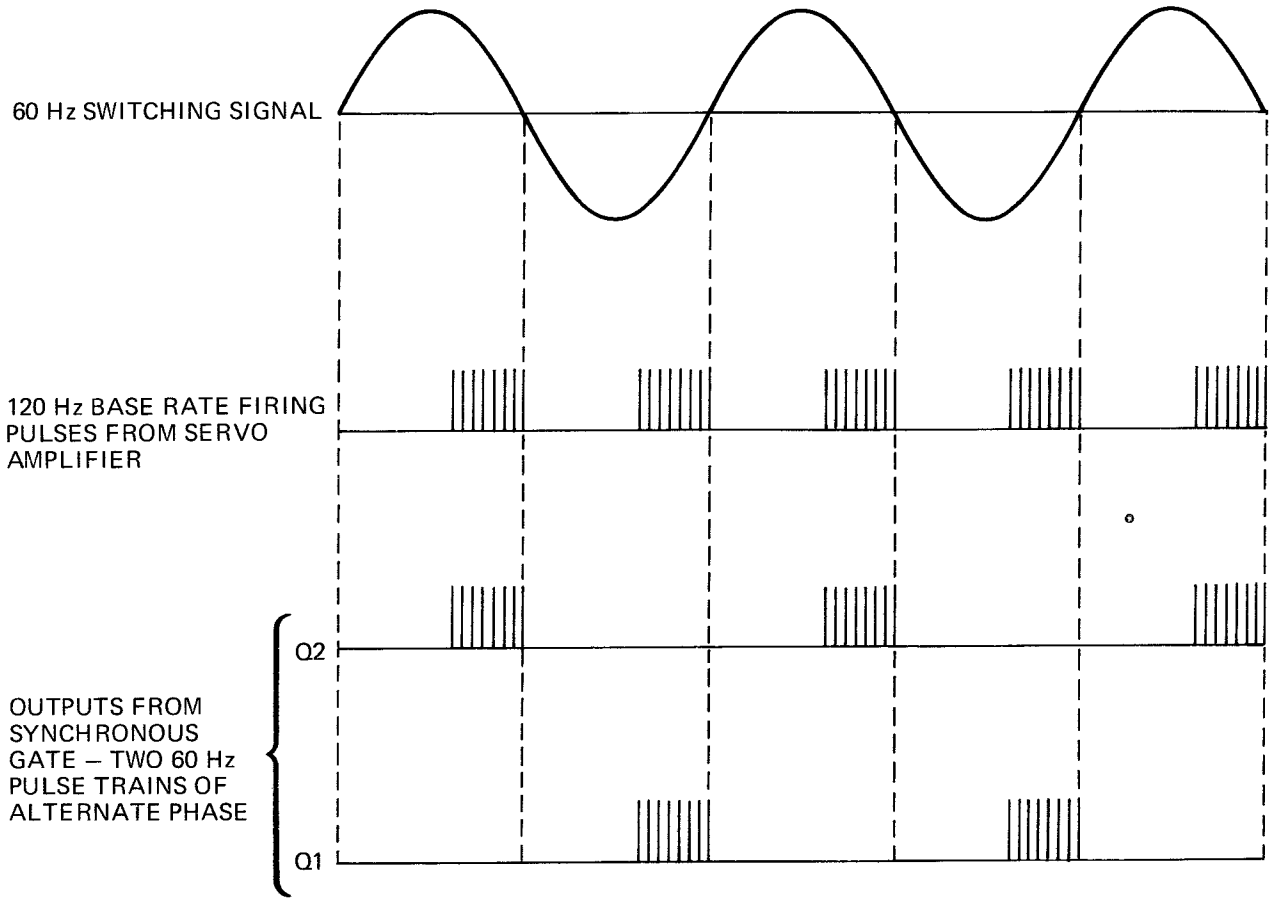


Figure 3-139. Operational Synchronous Gates Timing Diagram

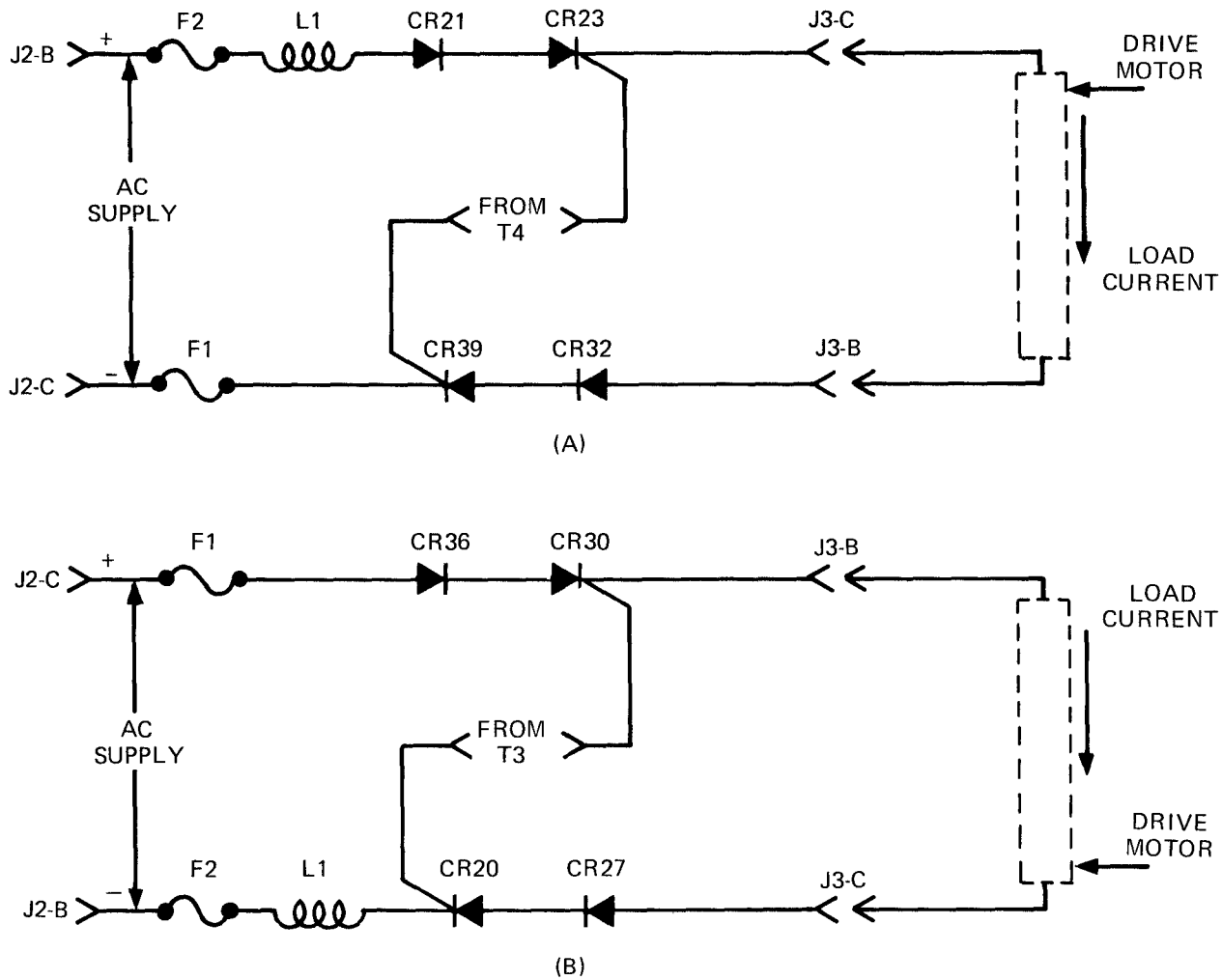


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Figure 3-140. Current Flow Through SCR Bridge

However, the train of pulses is generated to ensure that the SCR is fired at every half cycle, although it might be reverse biased by back-emf from the motor at the moment the first firing pulse occurs. When the first pulse in the pulse train occurs, relative to the line voltage, the power output from the SCR's is determined. For example, if this first pulse occurs when the SCR is forward biased, but is approximately 10 degrees from crossover of the line voltage, a small amount of power will be delivered, because the SCR will be cut off at the crossover. If, however, the first pulse occurs near the peak of the applied line voltage, the SCR will be allowed to conduct for approximately 90 degrees, and a larger quantity of power will be delivered by the SCR's. The largest amount of power which can be delivered occurs when the first pulse of the pulse train occurs at the start of a given half cycle, allowing the SCR to conduct for the full half cycle.

3-1077. During the positive half cycle of the AC supply (pin B of J2 positive) current flow is as shown in A of figure 3-140 for the reverse direction of rotation. During the negative half cycle, current flow as shown in B of figure 3-140.

3-1078. The diodes connected between the gate and cathode electronics of the SCR's (diodes CR17, etc.) clip the trigger-pulse overshoot caused by the inductance of the pulse transformers. The diodes connected in parallel-inverse with the SCR's (diodes CR21, etc) are arranged to prevent inverse-voltage damage to the SCR's.

3-1079. Inductor L1, in conjunction with the AC line resistance, limits the current drawn through the SCR's to a value within their current rating. Transformer T5, whose primary is connected in parallel with inductor L1, provides an input to current-limiting circuits in the servo amplifier. These circuits process the DC error signal so that the load current is limited. Resistor R22 and capacitor C16 reduce RFI.

3-1080. Limit-Control Relay Circuits. Rectifiers CR12, CR13, CR14, and CR15 form a full-wave bridge rectifier which supplies about 120 volts DC to the field of the drive motor. Diodes CR9, CR10, and CR16 are suppressors for protection of the rectifiers. The coil of relay K4 is connected across the field supply output, and its contacts will open the main interlocks when field voltage is lost.

3-1081. Reverse and forward relay (K1 and K2) circuits are provided to disable the SCR's when the system is in standby or when any pedestal interlocks are opened. In the event of power failure, the relay circuits are fail-safe, disabling the drive and applying the pedestal brakes when de-energized. The relay K3 circuit allows the pedestal to be reversed out of a limit switch interlock when reverse pulses are applied to the gate circuit.

3-1082. RF Shielding. Since some RF noise is generated when the SCR's are turned on, the SCR's are enclosed in a shielded chamber of the power amplifier. The AC lines entering this section of the power amplifier pass through RFI filters FL1, FL2, and FL3 to suppress any radiation from the lines. All other circuits which enter the chamber, pass through feed-through capacitors for RFI suppression. The motor leads connecting the motor to the power amplifier are enclosed in a completely shielded cable; the shield is bonded to the connector at each end.

3-1083. ENCODER TRANSDUCER AND PREAMPLIFIER. The transducer coarse (one-speed) data is sensed by resolver B1. Pulse-width modulated signals representing the sine and cosine of the assumed angle are applied to connector pins L and M, and H and J, respectively. If an error between the actual and assumed positions exists, an AC error signal will be present on connector pins X and Y. The relative phase of the error indicates the direction of the error, and its magnitude is proportional to the sine of the error.

3-1084. Fine track position information is detected by inductosyn B2, which is electrically equivalent to a 256-pole pair resolver. The inductosyn is excited on

connector pins A and B, and D and E. Pins G, V, and W are tie points only. Error output voltage is applied to terminals E4 and E5 of preamplifier A1. This is a high-gain, AC-coupled amplifier that conditions the inductosyn output for transmission to the control unit.

3-1085. Each electrical cycle of both resolvers is divided into 512 increments by the pulse converter in the control unit. The output from the coarse resolver is used to determine in which of the 256 fine cycles the input angle is represented. The first eight bits of the coarse resolver output are used as the eight most significant bits of the output angle. The bits of the fine track (256 cycle) resolver provide the exact position within the particular cycle of the 256:1 resolver, and are directly utilized as the least significant bits of the natural binary number.

3-1086. ENCODER CONTROL UNIT. The pulse converters (in the control unit) for the coarse and fine tracks are identical. Each supplies two signals pulse-width modulated to the stator leads of its resolver. The pulse widths are proportional to the sine and cosine of an assumed resolver angle. If the assumed angle is not equal to the actual angular position of the resolver, an error signal will exist on the rotor leads. A servo loop changes the assumed angle until it is coincident with the actual angle. The interface between the encoder transducer and the encoder control unit is depicted in figure 3-141.

3-1087. At startup or initialization, the outputs to the resolver are sin 0^{o} and cos 0^{o}. The pulse converter begins to increment the value of the sine and cosine functions in steps of 1/512 part of the resolver electrical cycle. For each increment of value of the sine and cosine function, a pulse is fed into the up/down counter. This incrementing continues until the sine and cosine of the input angle are reached and the error (rotor) signal reaches null. Since each pulse represents 1/512 electrical cycle, the accumulated count in the up/down counter represents the binary-coded angle with a least significant bit representing 1/512 shaft revolution.

3-1088. As the input shaft angle goes up or down, the pulse converter generates a number of pulses corresponding to the angle traveled and is counted either up or down depending on the direction of rotation from the initial angle. The maximum count rate for normal tracking is 80,000 counts per second.

3-1089. Both the coarse (one-cycle) and the fine (256-cycle) resolvers and their associated pulse converters and counters operate in identical fashion. The coarse data determines angular position within one revolution of the input shaft to a nine-bit accuracy. The fine data determines angular position, within one of its 256 cycles per revolution of the input shaft, to a nine-bit accuracy.

3-1090. Since the fine data resolver makes 256 (2^{8}) electrical cycles per revolution of the input shaft and each of the 256 cycles is broken into 2^{9} quanta the overall resolution of the system is $2^{8} \times 2^{9}$, or seventeen bits. Since there are nine bits in both coarse and fine data tracks, and the system resolution is seventeen bits, there is a one-bit overlap between the coarse and fine data tracks.

3-1091. In a perfect system, due to the overlap of fine and coarse data, the ninth bit in both data counters always changes at the same time and is always equal. However, due to the errors in the one-cycle resolver and the accuracy to which the one-cycle and 256-cycle resolvers can be zeroed with respect to each other, this overlapping bit is not always the same. This presents an ambiguity problem in determining which of the overlapping bits are correct. A special circuit for ambiguity elimination is included to resolve this problem.

3-1092. The basic timing of the encoder system is set up by the pulse converters, which have an actual resolution of 2048 (2^{11}) counts per electrical cycle. When the pulse converters and counters are initialized, they are reset to zero and a large error signal exists on the resolver rotor leads. The pulse converter produces error correcting (incrementing) pulses at a

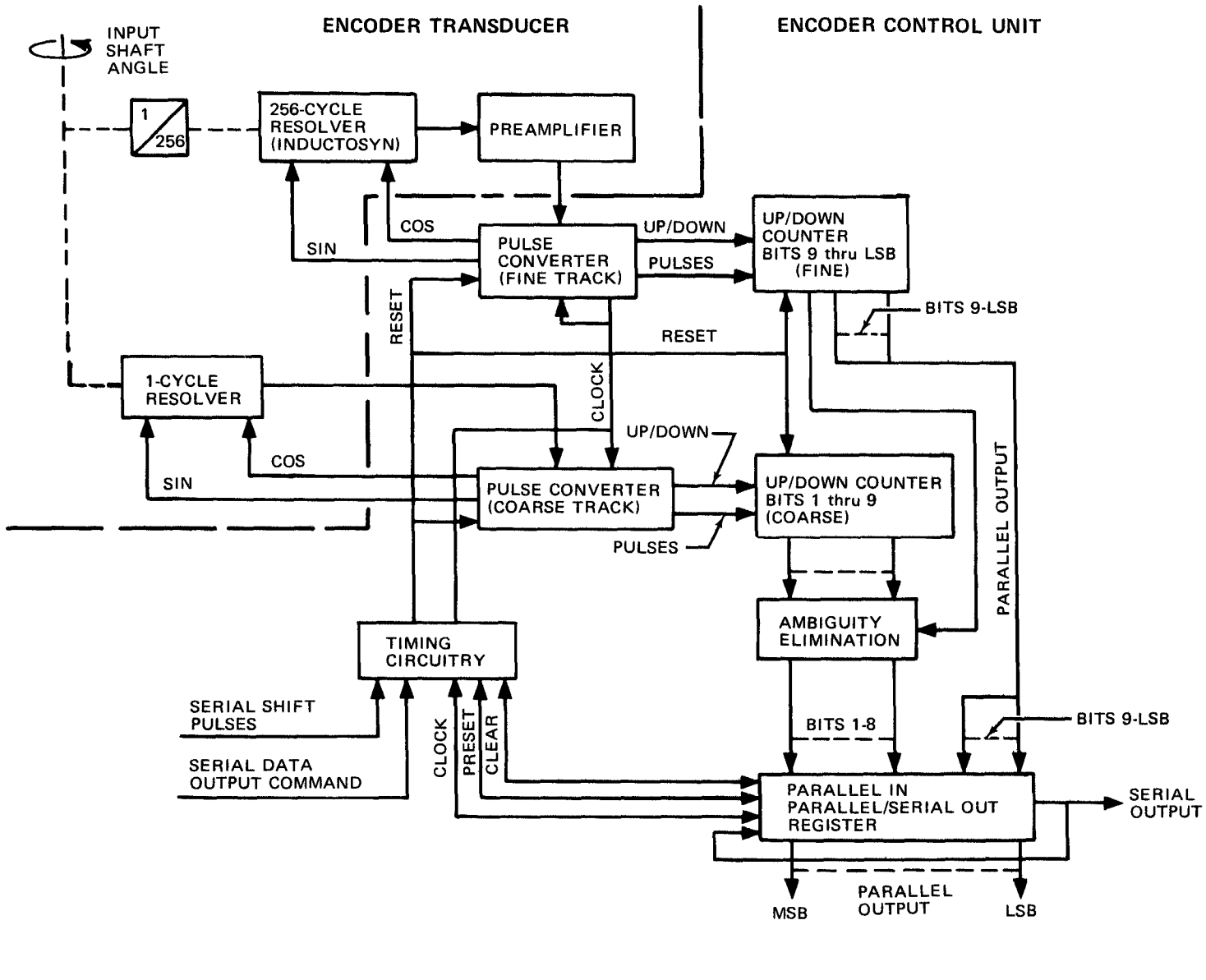


Figure 3-141. Encoder Interface Diagram

maximum rate of 400 KHz. As the position error is nulled out, the pulse rate drops to 500 Hz.

3-1093. An absolute-position readout characteristic exists for the resolver encoder system because the electronic circuitry maintains the current position of the encoder shaft at any instant by counting pulses that represent movement or displacement that has occurred since the last initialization. However, it must be emphasized that initialization does produce an absolute position indication for the resolver encoder system, since a 1:1 coarse track and 256:1 fine track two-speed resolver is used. Also, initialization may be commanded at any time, or periodically at some suitable predetermined rate. The initialization time for the worst case situation is approximately 9.6 ms. After the initialization, the updating of the angular data continues automatically and almost instantaneously. The output data is inhibited only 400 ns out of each 2.5us to update the output data.

3-1094. For the serial output encoder system, initialization is commanded at the same time that angle data is commanded so that initialization can be automatically proceeding at the same time that the previously commanded angle data is being shifted out.

3-1095. The power supply regulator supplies +5 volts and ±15 volts to the encoder. Integrated-circuit regulator U1 provides the 5 volts output, with an external pass transistor providing current boost. Transistor Q2 provides current limiting, and is normally turned off until the current exceeds about 6.5 A. Transistor Q1 is a current driver in the overvoltage crowbar circuit. If the output voltage exceeds about 5.7 volts, transistor Q1 drives current into the gate of a chassis-mounted SCR. The SCR then fires, shorting out the power supply and blowing the fuse.

3-1096. Regulator U3 provides +15 volts regulation and U2 provides -15 volts regulation. Both supplies contain electronic current limiting and utilize chassis-mounted pass transistors.

3-1097. The filter board in the electronics assembly contains low-pass filtering for both the fine and coarse tracks, balancing circuits, and a preamplifier for the coarse-track AC error.

3-1098. Encoder. The fine and coarse track sections of the encoder operate identically. However, the source of the resolver error signal for the fine track section differs from that for the coarse track section. The coarse track signal is supplied by a 1:1 resolver and the fine track signal by a 256 cycle resolver. The fine and coarse track data are combined in the output register to provide the complete output data angle, with the eight most significant bits derived from the coarse track and the remaining bits derived from the fine track. The following discussion and reference designations are for the fine track circuits. Operation of the coarse track is identical.

3-1099. The basic timing signals for the logic circuitry are produced by a multiphase clock generator U21 - U22 - U23 - U24. This circuit produces four signals (C_T, C_{DC1}, C_{DC2} and C_{DC3}) used for clocking and gating functions in the logic circuitry. (See figure 3-142.) The timing diagram shows the time relationship of the clock pulses and other key signals in the logic circuitry. The multiphase clock generator is driven by a 10-MHz crystal clock from the pulse converter board A2.

3-1100. The pulse converter board is essentially a sine/cosine generator with an output value which can be linearly incremented. The control signal for incrementing the output value is the error signal from the resolver, and the output value is stepped until the error signal is nulled.

3-1101. When the pulse converter is reset, the output value is set to zero and the sine and cosine of zero degrees is generated. The error signal from the resolver is sensed and the generator is incremented until the error signal is nulled. For each increment of the output value, a pulse is produced on pin A2A-8 and is counted by a binary up/down counter U28 - U29 - U30.

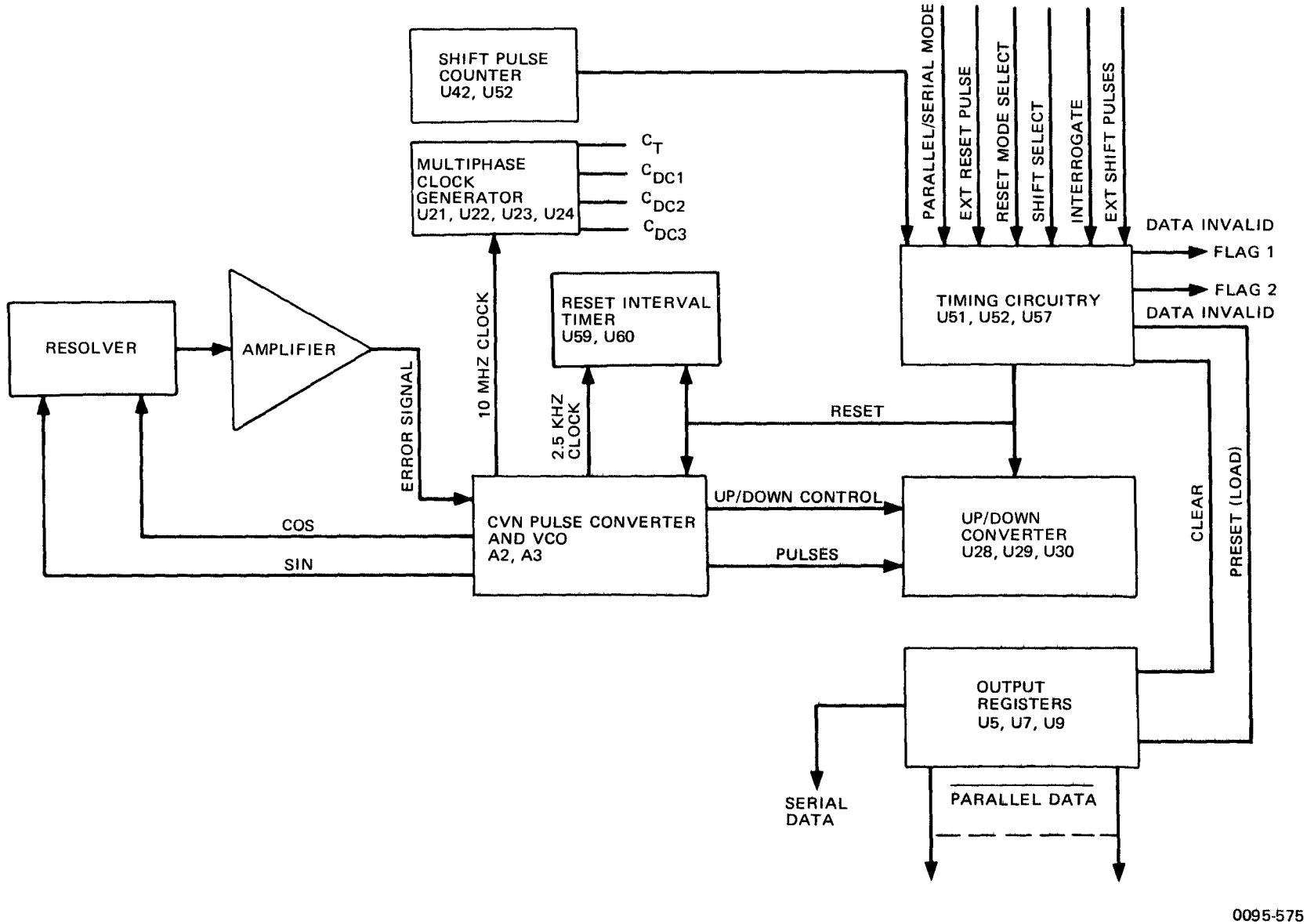


Figure 3-142. Encoder Simplified Block Diagram

The direction of count is determined by the pulse converter on pin A2A-M, which controls the binary counters. The counters accumulate the increments of the output value, and when the error signal from the resolver is nulled, the accumulated count represents the resolver angle. As the transducer rotates, the sine/cosine generator is incremented up or down to maintain a nulled error signal, and the up/down counters accumulate the resultant angular change.

3-1102. The timing circuitry provides the control of the pulse converter, interfaces the external control signals, and controls the output data register for the various modes of operation.

3-1103. The output data register A7U5 - U7 - U9 stores the transducer shaft angle that was present when the last interrogate pulse was received (pin J3-f). When a new interrogate pulse is received, flip-flop A7U51B is clocked to a logic 1. (See timing diagram, figure 3-143.) This flip-flop synchronizes the asynchronous interrogate pulse with the synchronous logic circuitry. When the next C_T pulse occurs, flip-flop A7U52A is clocked to the logic 1 state, which in turn clocks flip-flop A7U51A to the logic 1 state. Data invalid flag 1 (pins J3-m and A7-11) goes to a logic high, indicating that the parallel data in the output register is no longer valid. The same indication is present on data invalid flag 2 (pins J3-p and A7-20).

3-1104. The output data register is cleared with a reset pulse (pin A7U46-8) coincident with C_{DC1}. The present shaft angle stored in the up/down counters is preset into the output register by a pulse (pin A7U24-12) coincident with C_{DC2}. The new angular data is now present at the parallel outputs. If it is desired that the encoder be reset after each interrogate pulse (pin J3-j connected to pin J3-h), a reset pulse to the pulse converter and binary up/down counters is generated by gate A7U46-6. This pulse also initializes the reset interval time, which is composed of binary counters A7U59 and A7U60. The timer is a five-bit binary counter, driven by a 2.5-KHz clock, which stops counting after 24 counts. This produces a 9.6 millisecond pulse (pin A7U47-10) which holds data invalid flag 2 at a logic high until after the pulse converter has nulled the angular error. Interrogate pulses received while resetting are not acted on immediately, but stored by flip-flop A7U51B until after the resetting is complete and data invalid flag 2 returns to a logic 0.

3-1105. The above description applies to the parallel mode of operation (pin J3-n connected to pin J3-h). Operation in the serial mode (pin J3-n connected to pin J3-B) is identical except for the following items. Coincident with the clearing of the output registers, the five-bit binary shift pulse counter (A7U42 and A7U52B) is reset to zero. After the data is preset into the output registers, the data is shifted in a circulation loop and the serial data is picked off from pin A7U3-15 and shifted out least significant bit first. Shifting continues until the binary counter reaches seventeen, and the shift pulses are no longer gated in. After shifting is complete, the data invalid flag 1 returns to logic 0 indicating that the parallel data is valid.

3-1106. X-BAND AUTO PEDESTAL OPERATION. During X-band target or reference track operation, the X-band azimuth and elevation pedestals may be positioned automatically by error signals from the angle track loops (figure 3-144). In the auto pedestal mode of operation, the T1 and T2 tracked angle position and discriminator error signals are processed by the auto pedestal command circuit board 1A17A4A1 to produce the azimuth and elevation error signals. These signals are routed directly to the DC amplifier 1A17A7 where they are processed in a manner similar to the slave error. The error signals cause the pedestal to move in a direction to reduce the error to 0 volts.

3-1107. As the pedestal moves in response to the tracking signals, an AC error signal is induced in the 1:1 synchro control transformer (CT) located in the pedestal. This error results when the pedestal has moved and the command

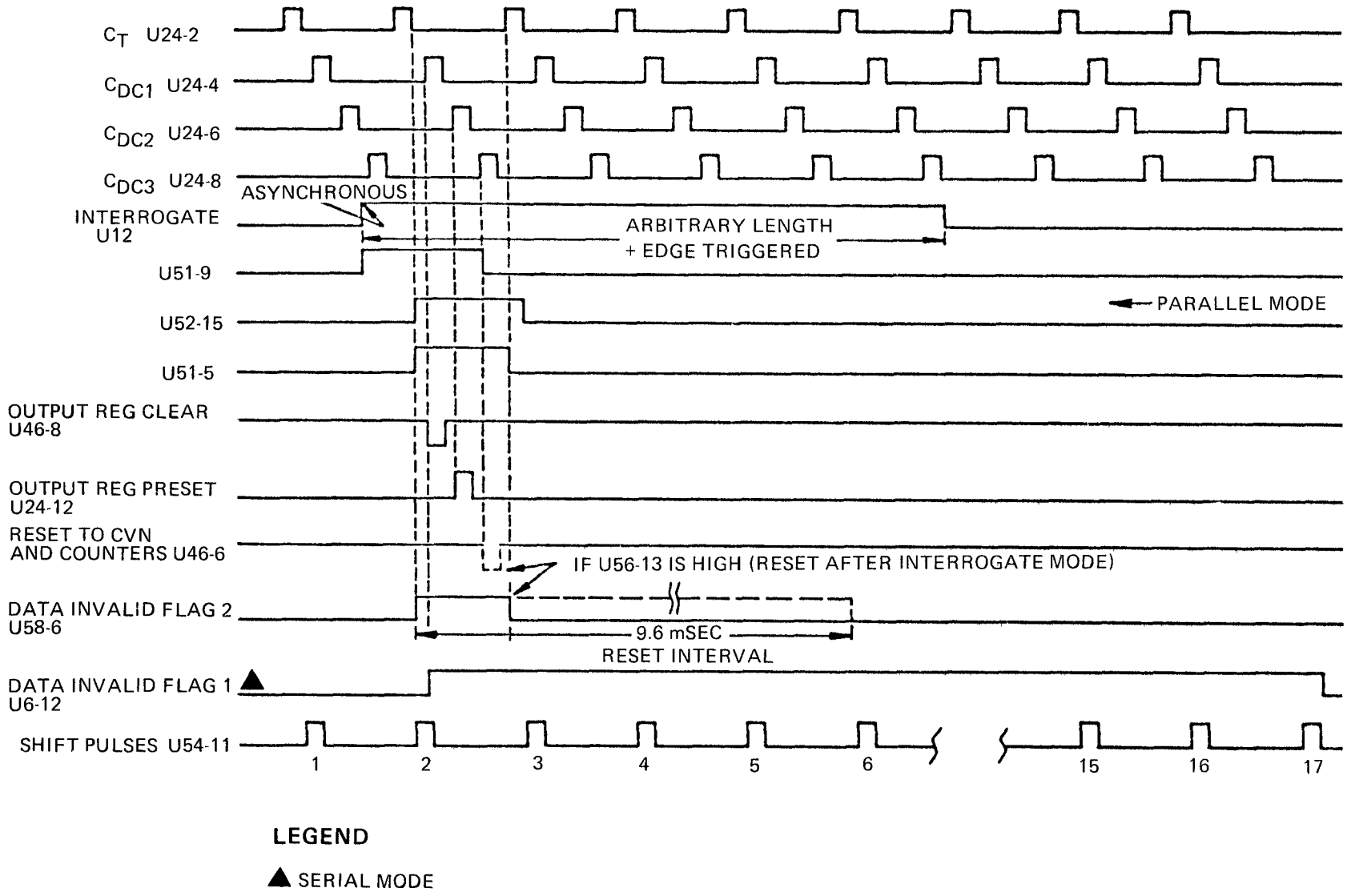


Figure 3-143. Encoder Timing Diagram

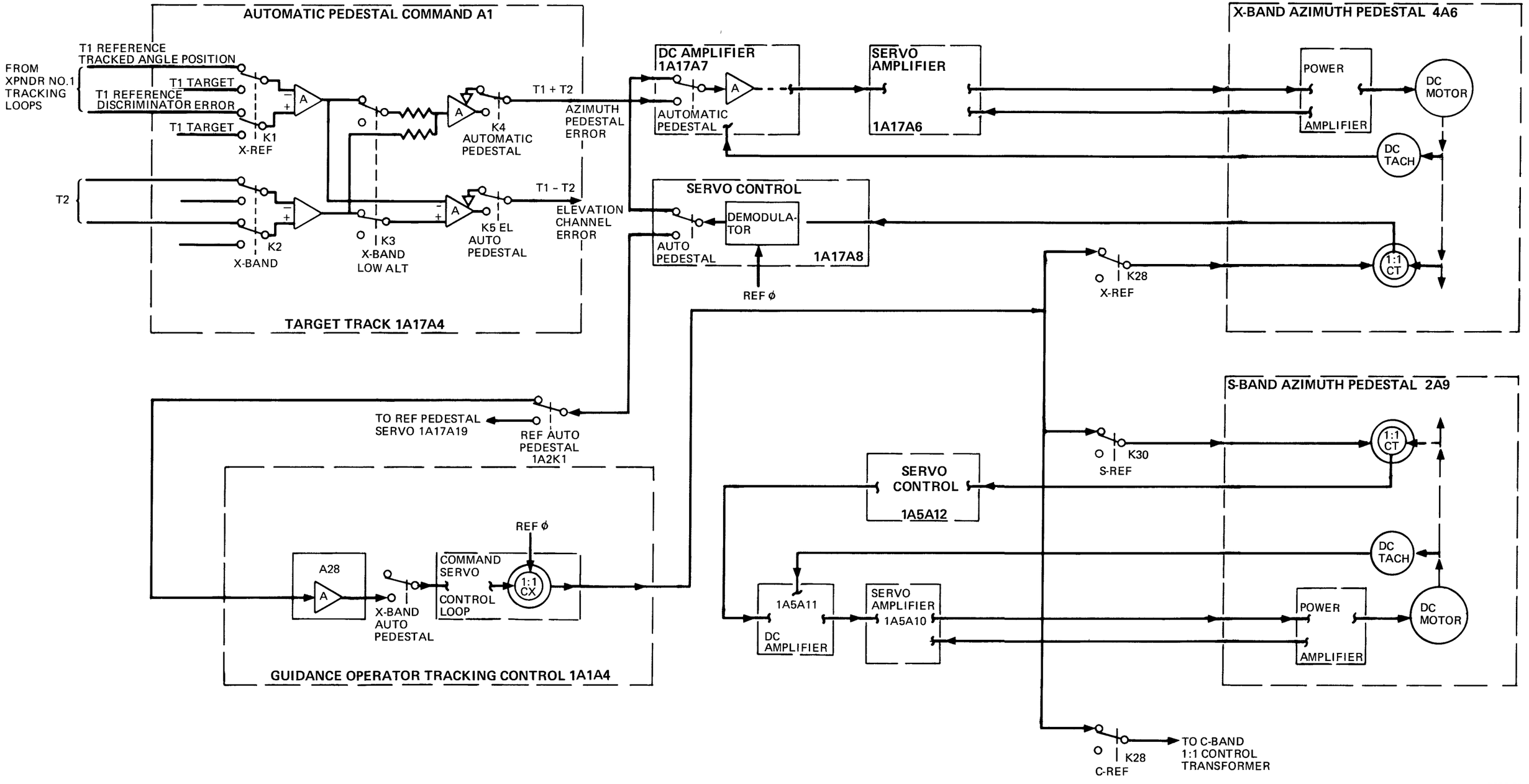


Figure 3-144. X-Band Auto Pedestal Block

servo has not moved. The error is routed to the servo control unit 1A17A8 where it is demodulated to produce a DC error signal. This DC error is then switched to either the guidance operator tracking control 1A1A4 or the reference command servos 1A17A19 where it is used to drive the command servo in follow-up so that, when the auto pedestal mode is terminated, the pedestal does not return to the position at which the auto track mode was entered, which would be the case if there were no follow-up drive to the command servo.

3-1108. During X-band target track auto pedestal operation, the S-band and/or C-band pedestals may be slaved to the X-band pedestal motion. This is accomplished through the fact that when the guidance operator command servo is driven in follow-up, its 1:1 synchro command transformer (CX) induces an error in the S-band and/or C-band pedestal control transformers (CT's). These error signals then drive the respective pedestal to follow the command servo which is driven by the X-band pedestal.

3-1109. Auto Pedestal Command 1A17A4A1. The auto pedestal command circuit is used to process either the target or reference T1 and T2 angle error signals to produce the azimuth and elevation error signals. During X-band auto pedestal operation either target or reference track) the angle track loops are used to electronically track the target to keep the cursor positioned on the target. As the target moves in angle, it creates a discriminator error (refer to tracking group) and this discriminator error is integrated to change the tracked angle position in the window. As the tracked angle position moves away from the boresight (i.e. directive), an error signal is generated which causes the pedestal to move in such a direction that the target returns to the center of the window.

3-1110. Relays K1 and K2 are used to select either the reference track error signals or the target track error signals as inputs to amplifiers Z1 and Z2. Potentiometers R6 and R15 are used to scale the amplitude of the tracked angle position error signals. Potentiometers R2 and R11 are used to adjust the point in the windows at which the pedestal will track the target. A small amount of discriminator error is summed with the tracked angle position error as a feed-forward signal to improve the automatic pedestal tracking response. The outputs of amplifiers Z1 and Z2 are routed through relay K3 to summing amplifiers Z3 and Z4. Amplifiers Z3 and Z4 are used to combine the T1 and T2 tracking errors such that they produce the required azimuth and elevation drive signals. Amplifier Z3 adds the T1 and T2 signals in phase and amplifier Z4 adds the signals out of phase. Amplifiers Z5, Z6 and Z9 are used as buffers and also to provide the correct polarity of drive signal.

3-1111. During X-band low altitude operation, the elevation pedestal is controlled by the T1 operator and the azimuth pedestal is controlled automatically by the T2 tracking loop circuits. Relay K3 is energized in X-band low altitude which removes the T1 inputs from the azimuth circuit and the T2 inputs from the elevation circuit.

3-1112. Voltage comparator Z7 is used to sense when the target is above 1-degree elevation during low altitude operation. Since the T2 tracking error is used to position the azimuth pedestal only, when the target goes below 1 degree all of the tracking error will be in the T1 plane. This will cause the output of amplifier Z4 to be negative and the output of voltage comparator Z7 to be high. As the target elevation angle increases, the output of amplifier Z4 will go positive until it crosses the threshold value set by resistor R34. At this point, the output of comparator Z7 will go low and the output of amplifier Z8A will go high if a missile has not been launched. When amplifier Z8A goes high, transistor Q1 turns on, then transistor Q2 turns on and switches ground to pin v of the card. The presence of this low altitude (greater than 1 degree) then allows the T1 manual tracker to control the elevation pedestal.

3-1113. REFERENCE PEDESTAL CONTROL. If the external reference mode has been selected by the transponder INTERNAL REFERENCE switch 1A3A4S13 and the reference radar band is selected by the REF SELECT switch 1A3A4S12, the control of the selected radar pedestal is accomplished by the reference radar operator at tracking control 1A3A4 as shown in figure 3-145. These operator handwheels and associated tachometers, along with the reference pedestal command servos in chassis 1A17A19 provide the pedestal servo drive commands. This circuitry within units 1A3A4 and 1A17A19 operate as described for the primary target tracking pedestal servo system except that several control options do not exist.

3-1114. Since the reference operator controls the pedestal for both acquisition and track modes, no "handing off" of the controls to other operators is necessary and the switches actuated by the in/out movement of the handwheels is used for another function. (See tracking group.) The command servo package, 1A17A19 utilizes only the motor drive input to the command servo so that the direct drive handwheel input is omitted and the gearbox is simplified because of this.

3-1115. An additional simplification of the handwheel controls is made possible by the elimination of the X-band low altitude tracking mode.

3-1116. When the X-band reference system has been selected, an automatic pedestal mode of control is provided in addition to the operator control.

3-1117. PEDESTAL DRIVE SERVOS - AN/MPS-T1(V)4.

3-1118. The pedestal drive servos position the S-band, C-band, and X-band antenna pedestal systems in both azimuth and elevation axis in response to the position of the synchros in the command servo assemblies. Operation of azimuth and elevation drive servos of the S-Band, C-Band and X-Band are identical except that the setting for the elevation limit switches for the X-band system differs from the settings for the S- and C-band systems. Also the X-band system is capable of automatic pedestal operation, while the S- and C-band systems are not. Since these similarities exist, only the S-band pedestal drive servo system is described.

CAUTION

Differences in the pedestal servo equipment prevent the direct interchange of antenna trailers between systems AN/MPS-T1(V)1, (V)2, and (V) 3 and systems AN/MPS-T1(V)4. Interchange shall be accomplished in accordance with special instructions provided in Servo Interchange Instructions for Systems AN/MPS-T1(V)1, (V)2, and (V)3 and AN/MPS-T1(V)4, Chapter V, T. O. 43D7-11-21-2-2.

3-1119. The stators of the pedestal follow-up synchro are connected to the stators of the command synchro (figure 3-132). The follow-up synchro is geared to the pedestal drive gear mechanism. A signal, developed on the rotor of the follow-up synchro, represents the positioning error of the pedestal. The error signal is routed to the servo control unit to produce a DC error that is amplified in the position loop amplifier. This amplified DC error signal is routed to the SCR power amplifier unit where gate triggers are generated. These triggers gate the required current through the SCR bridge to drive the pedestal drive motor in a direction to align the pedestal and follow-up synchro to the commanded position.

3-1120. Synchro transmitters geared to the pedestal drive gear mechanism drive pedestal position indicators in the control trailer to indicate pedestal angles. The input to the pedestal position indicators is connected to the pedestal selected for the target and/or reference tracking radar function.

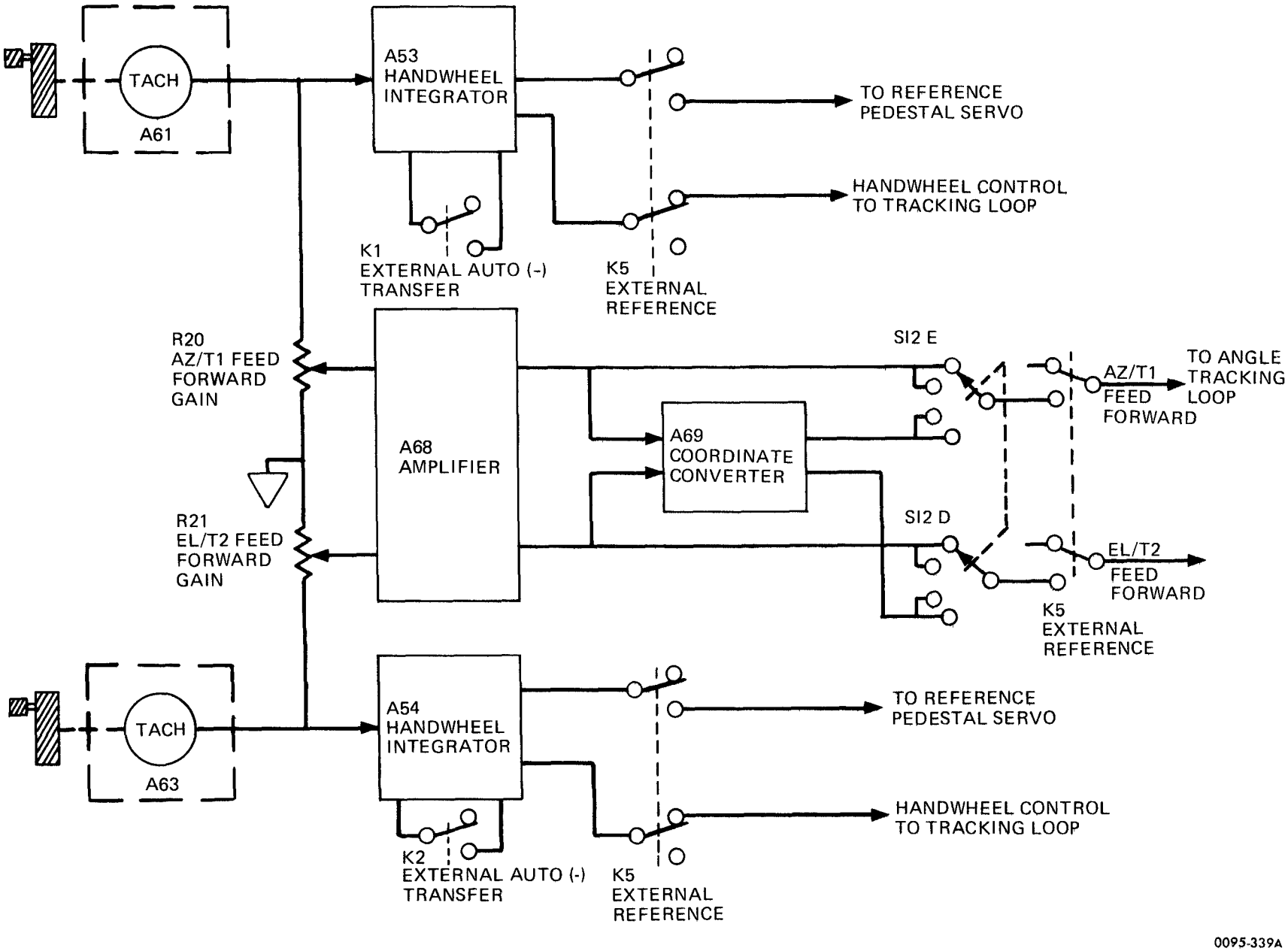


Figure 3-145. Reference Pedestal Handwheel Control Diagram

3-1121. Electromechanical Operation. An electromechanical brake is attached to the shaft of each drive motor. For fail-safe operation, the brakes are applied by a spring-loaded mechanism and released when electrically energized. The brakes are automatically applied under the following conditions: when the power is off; when the standby mode is selected; when a limit switch is actuated (in elevation axis only); or when the stow pin is not in its storage receptacle. When a stow pin is removed from its storage receptacle, interlock switches deenergize the equipment.

3-1122. When the pedestal is rotated to the end of its limit in the elevation axis, a limit switch (upper or lower) prevents further rotation in that direction and the proper LIMIT indicator lights. Automatic back-out circuits release the brakes and energize the equipment when the controls are operated to drive the pedestal away from the actuated limit switch.

3-1123. Data takeoff units are connected to the output gear of each axis by means of antibacklash gears. The data takeoff units contain synchro control transformers (CTs) and synchro transmitters (TXs). The TX rotors are energized by the 120 VAC reference phase. The TX stator outputs are connected to the pedestal position indicators in the control trailer tracking consoles.

3-1124. PEDESTAL OPERATING MODES. The various pedestal operating modes are discussed in the following paragraphs.

3-1125. Auto-Track Mode. In the auto-track mode, (X-band only) a DC error signal from the track loops is fed directly into the servo control unit position loop amplifier. The auto-track error signal is proportional to the antenna position error. In passing through the position loop amplifier, the auto-track error signal is processed by the auto-track compensation networks. The position loop amplifier output to the SCR power amplifier is the error correction signal which causes the pedestal to drive in a direction to reduce the position error and DC error voltage to zero. The DC tachometer feedback signal is introduced into the rate loop amplifier in the SCR power amplifier (from its compensation network) at a level which provides smooth operation of the pedestal in the auto-track mode.

3-1126. Slave Mode. In the slave mode, the CT stators in the pedestal are connected to the command transmitters (CX) in the guidance operator console (1A1A4). If the pointing angle of the pedestal is not equal to the remote command source, there is a corresponding angular error between the synchro shafts and a proportional AC output error voltage from the CT rotors. The AC error signal is applied to the demodulator circuit. This circuit also has as a reference input (the same 120 VAC that energizes the CX in the guidance operator console) thus permitting synchronous demodulation of the AC error signal. The magnitude of the detected DC output is proportional to the magnitude of the error, and its polarity corresponds to the direction of the error. The DC error signal from the demodulator is routed to the relay chassis where the signal is applied to the position loop amplifier.

3-1127. The signal is stabilized with respect to gain and bandwidth in the slave mode compensation network of the position loop amplifier. The slave DC error signal is amplified in amplifiers U2 and U1 and is then routed to the SCR power amplifier as the actuating error signal. The actuating error signal drives the pedestal in a direction to make the pointing angles the same, the synchro-shaft positions coincide, and the AC error signals reach a null. As the guidance operator handwheel is rotated, the pedestal follows in a manner which continuously minimizes the AC error signal and keeps the pointing angles the same.

3-1128. Manual Rate Mode. In the manual rate mode, the manual rate signal is switched through to the position loop amplifier, amplified in amplifier U1, then routed to the rate loop amplifier. The

manual rate signal is a positive or negative DC voltage from a potentiometer 1A5A12R1, R2, operated by the manual rate control. At the summing junction in the rate loop amplifier, this voltage is combined with a tachometer feedback voltage to become an actuating error signal. This signal is applied to the rate loop amplifier and motor drive circuitry which causes the pedestal to rotate at a speed determined by the potentiometer voltage setting. The polarity of the voltage determines the direction of rotation.

3-1129. Standby Mode. When the STANDBY mode switch is actuated, control signals to the power amplifiers are disabled, and the brakes are applied to the selected axis shaft. When the POWER switch is actuated, the control system will reset itself to the standby mode and will be ready for selection of the desired operating mode. Modes can be switched directly while the equipment is in operation, without returning to STANDBY.

3-1130. SERVO CONTROL UNIT 1A5A12, 1A5A19, AND 1A17A8. The azimuth channel controls are described in the following paragraphs. The elevation channel controls are similar and existing differences are noted.

3-1131. The servo control unit contains the front panel controls (POWER and MODE SELECTOR switches, LIMIT and SECTOR indicators, and manual RATE controls), a demodulator to convert the synchro error signal to a DC error signal, a position loop amplifier to amplify this signal, a power supply to furnish the required DC power, and relay chassis (control circuits) to select the mode of operation of the drive servo. In the elevation channel only, the servo control unit utilizes circuitry to indicate that the elevation pedestal is at a limit or that one of the pedestal interlock switches is in the safe position (figure 3-15).

3-1132. Servo Control Unit Controls. The servo control unit controls are explained in the following paragraphs.

3-1133. POWER Switch. POWER switch S5 connects 120 VAC, 60-Hz power to the DC power supply and to other circuits requiring AC voltage. When the DC power supply is energized, the POWER and STANDBY switch-indicators will light. These switch sections of the switch-indicators are connected directly to the +28 VDC bus at the power supply. The +15 VDC and -15 VDC power supplies are also energized when AC power is applied.

3-1134. MODE SELECTOR Switches. Each MODE SELECTOR switch consists of a four-pole switch assembly.

3-1135. Poles A and B and the STANDBY switch are arranged in a latching circuit. This arrangement provides automatic cancellation or release of any mode when another mode is selected. When a selector switch is depressed, 28 VDC is applied (through the relay chassis) across the holding coil for that particular selector. The holding circuit is interrupted for all other holding coils. When activated, the STANDBY switch opens the holding circuit to all mode selectors resulting in return to standby.

3-1136. Pole C of each selector forms an "OR" circuit which energizes the enable circuit with 120 VAC when the MODE SELECTOR switch is activated. The enable circuit is connected to a series connection of pedestal interlocks and limit switches. If all interlocks are closed when the enable circuit is energized, relays in the SCR power amplifier are energized, placing the system in an operational condition. When an interlock switch is open, one or both LIMIT indicators light.

3-1137. Pole D is energized by +28 VDC. When the MODE SELECTOR switch is activated, the +28 VDC is applied to a relay in the position loop DC amplifier. This relay interconnects the appropriate signal input and compensation networks with the system.

3-1138. Relay Chassis. Contacts of relays in the relay chassis 1A5A12A4,

1A5A19A4, or 1A17A8A4, are connected to terminals of the mode selector switches to permit remote mode selection. The following modes can be remotely selected: standby (both axes); slave (both axes); mixed (one axis in slave, the other in auto-track); and auto-track (both axes).

3-1139. The voltage for the enable circuit, position loop amplifier relay actuation, and mode indication is supplied through the relay chassis. The REMOTE MODE switch controls the coils of relays in the relay chassis and configures the relays as required to energize the enable circuit, to light the mode indicators and to energize the appropriate relays in the position loop amplifier chassis.

NOTE

The front panel switches should not be activated when the system is remotely controlled.

3-1140. LIMIT Indicators. This paragraph describes operation for the elevation channel. The neon LIMIT indicators are connected in parallel with the pedestal interlocks and the appropriate limit switches in the enable circuit. When all interlocks and limit switches are closed, the indicators are shunted and therefore not lighted. When a limit switch opens, 120 VAC is applied across an indicator and relay (in the SCR power amplifier). The indicator, having a much higher impedance than the relay, is lighted while the relay remains deenergized. With an interlock switch open, both indicators and relays are connected to 120 VAC and therefore both indicators are lighted.

3-1141. SECTOR Indicators. One side of the SECTOR indicators is connected to 120 VAC in the control unit. The other side of one of the indicators is connected to AC neutral by the sector switch in the pedestal and is thus lighted. The SECTOR switch transfers the neutral connection from one indicator to the other as the azimuth axis passes zero degrees.

3-1142. Manual RATE Control. The manual RATE control provides input for the system in the manual rate mode. The control is a potentiometer excited by the plus or minus 15 VDC in the DC power supply. The potentiometer is linear resulting in a linear-speed versus shaft-rotation relationship. The potentiometer is grounded through a center tap for balanced speed on either side of zero position. The signal is taken from the wiper of the potentiometer and routed to the position loop amplifier unit.

3-1143. POWER SUPPLY 1A5A12A1, 1A5A19A1, or 1A17A8A1. The servo control unit contains three DC voltage supplies; +28 VDC, 1 ampere, unregulated; +15 VDC, 0.4 ampere, 1% regulation; and -15 VDC, 0.4 ampere, 1% regulation. These power supplies are described in the following paragraphs.

3-1144. Positive 28 VDC Supply. The +28 VDC power supply is a full-wave bridge rectifier connected across the secondary of T1, supplying unfiltered and unregulated voltage for operation of DC lamps, relays, etc., as required by the system.

3-1145. Positive 15 VDC Supply. The +15 VDC power supply is a full-wave rectifier circuit, consisting of transformer T2, diodes CR1 thru CR4 and capacitor C1, which developes a raw potential of 20 VDC to 29 VDC (varies with line and load changes). The regulator is a conventional degenerative feedback circuit consisting essentially of series transistors Q3, voltage-reference diode CR8, and comparator amplifier Q7. The emitter of amplifier Q7 is fixed at approximately +6 VDC by diode CR8. The base of amplifier Q7 monitors the supply output voltage through a sampling divider network R13 - R14 - R15, to which it is connected by forward-biased diode CR10. The divider resistance ratio is set by resistor R14 so that the output voltage is +15 VDC. Any departure of the output voltage from its normal value produces a change in the base-to-emitter voltage of amplifier Q7.

This error signal is amplified and applied to the base of transistor Q4, changing the voltage drop across transistor Q3 so that it opposes the output voltage change and limits it to insignificant magnitude.

3-1146. Transistors Q3 and Q4 are arranged in a compound complementary emitter-follower connection. Together they function as if they constituted a single high-gain power transistor of NPN (rather than PNP) configuration with its collector connected to the rectifier circuit, its emitter to the load, and its base to the collector of transistor Q4. The circuit consisting of transistor Q1, diodes CR5, CR6, CR15, and resistors R1 and R4 delivers a constant load current of about 1 ma to the collector of amplifiers Q7 and the base of transistor Q4, independent of rectifier output voltage fluctuations. The emitter of transistor Q1 must follow its base. The voltage drop across resistor R1 must merely equal a fixed drop of approximately 1V across diodes CR5, CR6 and CR15. This condition forces a collector current of approximately 1 ma.

3-1147. Capacitors C3 and C5 control the frequency-response characteristic of the comparator amplifier to ensure closed-loop stability. Diode CR9 protects the base emitter junction of amplifier Q7 from excessive reverse-bias transients during on-off switching of the supply. In normal operation, diode CR9 is reverse-biased and has no effect. Diode CR10, which is forward-biased by current through resistor R10, provides compensation for thermal changes in the base-to-emitter potential characteristic of amplifier Q7.

3-1148. Negative 15 VDC Supply. The negative 15 VDC power supply is similar in principle to the +15 VDC power supply, but certain differences result from its opposite polarity. The raw DC voltages (20 VDC to 29 VDC) provided by full-wave rectifiers CR1 through CR4, transformer T2 and capacitor C2 are negative with respect to ground. Transistors Q5 and Q6 are arranged in the ordinary compound emitter-follower connection. (Both transistors are PNP.) The reference voltage is obtained from the output of the +15 VDC supply.

3-1149. Demodulator 1A5A12A2, 1A5A19A2, or 1A17A8A2. The demodulator module is a two-channel unit (azimuth and elevation channels are identical) with each channel consisting of a full-wave sampling demodulator bridge and a twin-tee filter.

3-1150. In the SLAVE MODE, the system is driven by an AC error signal generated by a remote 1:1 synchro command transmitter (CX) connected to the pedestal control transformer (CT). If the command synchro and the pedestal synchro are not in the same relative position, an AC CT rotor error signal is generated and fed directly to the full-wave sampling demodulator bridge. The CT error signal is converted to a DC error signal which is used to drive the pedestal to the command position.

3-1151. The demodulator is operated similar to a sampling switch. For demodulator operation, the 120 VAC supplied through T4 serves as the reference signal and is synchronized with the command synchro transmitter. The CT error signal is coupled to the demodulator circuit by transformer T3.

3-1152. When the error signal and the reference signal are in phase (T4-6 and T3-8 same polarity), as the AC reference voltage at T4-6 starts positive capacitor C6 which was charged during the previous negative half cycle, discharges through resistor R9. The full wave bridge consisting of diodes CR7 through CR10 is reverse biased and cannot conduct. As the reference voltage increases to its' peak positive voltage at T4-6, T4-7 increases to its peak negative voltage. Therefore, the full-wave bridge consisting of diodes CR3 through CR6 conducts charging capacitor C5. Current flow through the full wave bridge (CR3 through CR6) charges capacitor C7 such that the voltage at TP2 is negative.

3-1153. As the AC reference voltage at T4-6 starts negative capacitor C5, which was charged during the previous positive half cycle discharges through resistor R8. The full wave bridge consisting of diodes CR3 through CR6 is reverse biased and cannot conduct. As the reference voltage increases to its peaks negative value at T4-6, T4-7 increases to its peak positive voltage. Therefore, the full wave bridge consisting of diodes CR7 through CR10 conducts, charging capacitor C6. Current flow through the full wave bridge (CR7 through CR10) charges capacitor C8 such that the voltage at TP2 is also negative. Therefore the DC voltage appearing at the output (TP2) is equal to the combined voltages on C7 and C8. If the error voltage and the reference voltage are out of phase, action similar to that described above takes place, but charges of opposite polarities are placed on capacitors C7 and C8. Consequently the DC voltage at TP2 is positive.

3-1154. The full-wave sampling demodulator bridge therefore compares the synchro error signal with the reference signal and produces a bipolar DC voltage at its output, the polarity of which depends upon the phase of the input signal. The magnitude of the voltage depends upon the amplitude of the input signal. The twin-tee filter at the output of the demodulator is used to eliminate unwanted ripple-frequency components.

3-1155. Position Loop Amplifier 1A5A12A3, 1A5A19A3, or 1A17A8A3. The azimuth and elevation circuits of the position loop amplifier are similar. Each circuit consists basically of a pair of integrated circuit operational amplifiers, compensation networks, and mode selection relays. The compensation networks are connected to the amplifiers by the mode selection relays, and determine the gain/phase response of the position loop amplifier.

3-1156. When the system is being operated in the slave and auto-track modes, amplifier A2U2 is used. The compensating circuits used for the auto-track mode are identical to the slave mode compensating circuits but are switched separately to allow for modification of the circuits when closing the auto-track loop. The auto-track loop is used in X-band operation only.

3-1157. The first stage compensating network employed in the auto-track mode consists of resistors R3 and R4 and capacitors C2 and C3. The second stage compensating network consists of resistors R5 and R6 and capacitors C8 and C9.

3-1158. The first stage slave mode compensating network consists of resistors R7 and R8, and capacitors C4 and C5. The second stage slave mode compensating network consists of resistors R9 and R10, and capacitor C10 and C11. The gain of operational amplifier A2U2 is determined by the ratio of the impedance of the second stage network to the first stage compensating network.

3-1159. Another network consisting of diodes CR1, CR2, CR3, CR4, and resistor R17 provides output limiting, which, in conjunction with tachometer networks, limits the pedestal rotation rate. This network also includes a feature used in zeroing the amplifier by utilization of balance potentiometer R6 for azimuth (R3 for elevation).

3-1160. Amplifier A2U1 used in all modes is configured as a unity-gain, noninverting amplifier providing a buffer between the position loop amplifier circuits and the cabling which connects to the rate loop amplifier in the SCR power amplifier. A resistor scaling network consisting of resistors R1 and R2 matches the maximum rate input signal to the maximum output signal of amplifier A2U2.

3-1161. Operation of the position loop amplifier is initiated when one of the three mode switches (MANUAL RATE, AUTO-TRACK, or SLAVE) is positioned to on. For purpose of this discussion, only modes of operation in the azimuth axis will be used. The circuitry of the elevation axis is similar.

3-1162. When the AUTO-TRACK switch is positioned to on, 28 VDC is routed from the switch through position loop amplifier subchassis connector A3J2-2 to the coil of relay K5, energizing the relay. The auto-track input signal applied through connector A3J2-16 appears at the contacts of relay K5. When relay K5 is energized, this input signal is applied to the auto-track adjustable gain potentiometer R4. From the gain potentiometer wiper, the adjusted input is routed through connector A2J2 to the first stage compensating network. From the first stage compensating network, the signal is applied to the second stage network, and also to the input of amplifier A2U2. The output of amplifier A2U2, DC level proportional in amplitude to the amplifier input signal, passes through the limiter network to test point TP10 where it may be used as a test signal. This output signal also is routed to XA2-A through relay K5 to the input of amplifier A2U1. The output signal of amplifier A2U1 connects to XA2-9 then is routed through A3J2-18 and the position loop amplifier subchassis connector J1-5 to the pedestal.

3-1163. During slave mode operation, the SLAVE switch is positioned to on which applies 28 VDC to the coil of relay K6, thus energizing the relay. When relay K6 is energized, the slave mode input signal is routed through relay K6 to adjustable gain potentiometer R5. From the wiper of potentiometer R5, the signal is applied to the first stage compensating network. From the first stage compensating network, the signal is applied to the second stage compensating network and the input of amplifier A2U2. The output of amplifier A2U2 is routed to test point TP10, and through relay K6 to the input of amplifier A2U1. The output of amplifier A2U1 is routed to the pedestal as a servo command signal.

3-1164. During manual rate operation, the MANUAL RATE switch is positioned to on, applying 28 VDC to relay K4, thus energizing the relay. The AZ RATE input signal is routed through relay K4 to the resistor scaling network. The output from the resistor scaling network is routed through relay K4 to the input of amplifier A2U1. The output signal of amplifier A2U1 is routed through connector J1 to the pedestal.

3-1165. A tachometer, attached to the shaft of the motor on each axis, generates a DC voltage proportional to the pedestal rotation speed. The tachometer signal is fed to the rate loop amplifier. The use of a feedback voltage proportional to the drive motor rotation speed allows the control system to reduce or increase the actuating error in order to counteract antenna momentum and stabilize against varying external loads.

3-1166. SILICON CONTROLLED RECTIFIER (SCR) POWER AMPLIFIER (2A9A7, 3A9A7, and 4A6A7). Identical SCR power amplifiers and associated circuits, located in the antenna azimuth pedestal, supply the DC drive voltages to the pedestal drive motors in the azimuth and elevation axes. The SCR power amplifiers utilize the 60-Hz power line voltages and the trigger pulses generated in the pulse generator A4.

3-1167. The SCR power amplifier includes a full wave bidirectional SCR bridge and associated circuitry which controls the speed and direction of rotation of the DC drive motor. The rate loop amplifier receives the DC command signal and DC tachometer loop feedback signal which are summed to produce an error command signal. The error command signal is fed to the current limiter where the input DC command signal is limited to a maximum value. The resultant signal is fed to the pulse generator where it is converted into a train of 120-Hz pulses synchronized to the AC line voltage frequency at each zero crossing. Two pulse amplifier cards, one for forward pulses and one for reverse pulses, amplify the outputs from the pulse generator and drive the gates of the SCRs. Coupling to the SCRs is accomplished by the pulse transformer card to provide common mode isolation. These pulses are used to gate current through the SCR bridge during a portion of the power cycle. The duration of gating determines the

equivalent DC current passed to the motor. Other circuits include a power supply, a brake-control circuit, a pedestal travel limit circuit, and filtering and shielding to reduce RFI. The Power Amplifier Timing diagram is shown in figure 3-146.

3-1168. Rate loop amplifier 2A9A7A2, 3A9A7A2, and 4A6A7A2 consists of operational amplifiers U1, U2, U3, and associated circuitry. Amplifier U1 and resistors R1, R2, and R3 form an inverting unity-gain amplifier to isolate the input command signal from the power amplifier circuitry. Amplifier U2 and associated circuitry differentially couples the tachometer signal to the rate amplifier. The compensation networks are utilized to frequency-compensate the tachometer and DC command signals. Operational amplifier U3 is used to sum the tachometer and DC command signals to produce a compensated DC. This DC error signal is clamped in the current limiter and fed to the pulse generator. Diodes CR1 through CR4 limit the output swing of amplifier U3 to ± 10 volts.

3-1169. Current Limiter (2A9A7A3, 3A9A7A3, or 4A6A7A3). The current limiter card A3 will be discussed in two parts. A discussion of those circuits associated with the tachometer sensing clamp will be presented, followed by a discussion of those circuits associated with the current sensing clamp.

3-1170. Tach Sensing Clamp. The tachometer-sensing clamp is comprised of amplifiers U5 through U8 and associated circuitry. The tachometer input is coupled through a differential amplifier composed of operational amplifier U5 and associated resistors R23 through R26.

3-1171. The sensitivity of the output to command-mode voltage of either input (tachometer-sensing clamp or current-sensing clamp) with respect to ground is minimized by using one percent resistors to ensure close tracking of the resistor values. The output of amplifier U5 is then proportional to the tachometer voltage and attenuated by a factor of 10/64. Resistors R29 through R33 set the clamp voltage for the tachometer-sensing clamp when the tachometer voltage is zero. The positive clamp voltage is set at the junction of resistors R31 and R32, and the negative clamp voltage is set at the junction of resistors R32 and R33. For zero tachometer voltage, these voltages are symmetrical at or near zero volts. The value of these voltages is set by potentiometer R32 to clamp the DC command signal. Resistor R27 and potentiometer R28 couple the tachometer signal into the clamp to modify the positive and negative clamp voltages according to the motor speed. As the motor speed increases, the tachometer voltage increases the clamp value to allow a large command to overcome the back emf of the motor. The clamp voltage in the reverse direction is decreased to counteract back emf dump. Potentiometer R28 adjusts the tachometer sensitivity so that a constant current limit is maintained over the specified speed range of the motor.

3-1172. Operational amplifiers U6 and U7, with diodes CR7 and CR8, buffer the tachometer-clamp network from the DC error signal and provide sharp clamping. Resistor R34 limits the current absorbed by the clamp to approximately 1 milliampere, and isolates the DC error signal from the clamp circuit. Operational amplifier U8 and associated resistors R35 through R37 provide a buffer between the pulse generator card and the current limit card. Also, amplifier U8 limits the maximum voltage to the pulse generator card to approximately +6.8 volts, which matches the ramp height at the pulse generator card.

3-1173. Current Sensing Clamp. Current sensing is derived by transformer T2 located in the SCR bridge section of the power amplifier (2A9A7, 3A9A7, and 4A6A7). The primary winding of transformer T2 monitors the voltage across AC line inductor L1. The voltage across the secondary winding of transformer T2 is a scaled replica of the voltage across inductor L1. The voltage across the secondary winding, as well as the voltage across inductor L1, is proportional to the rate of change of the current in the SCR

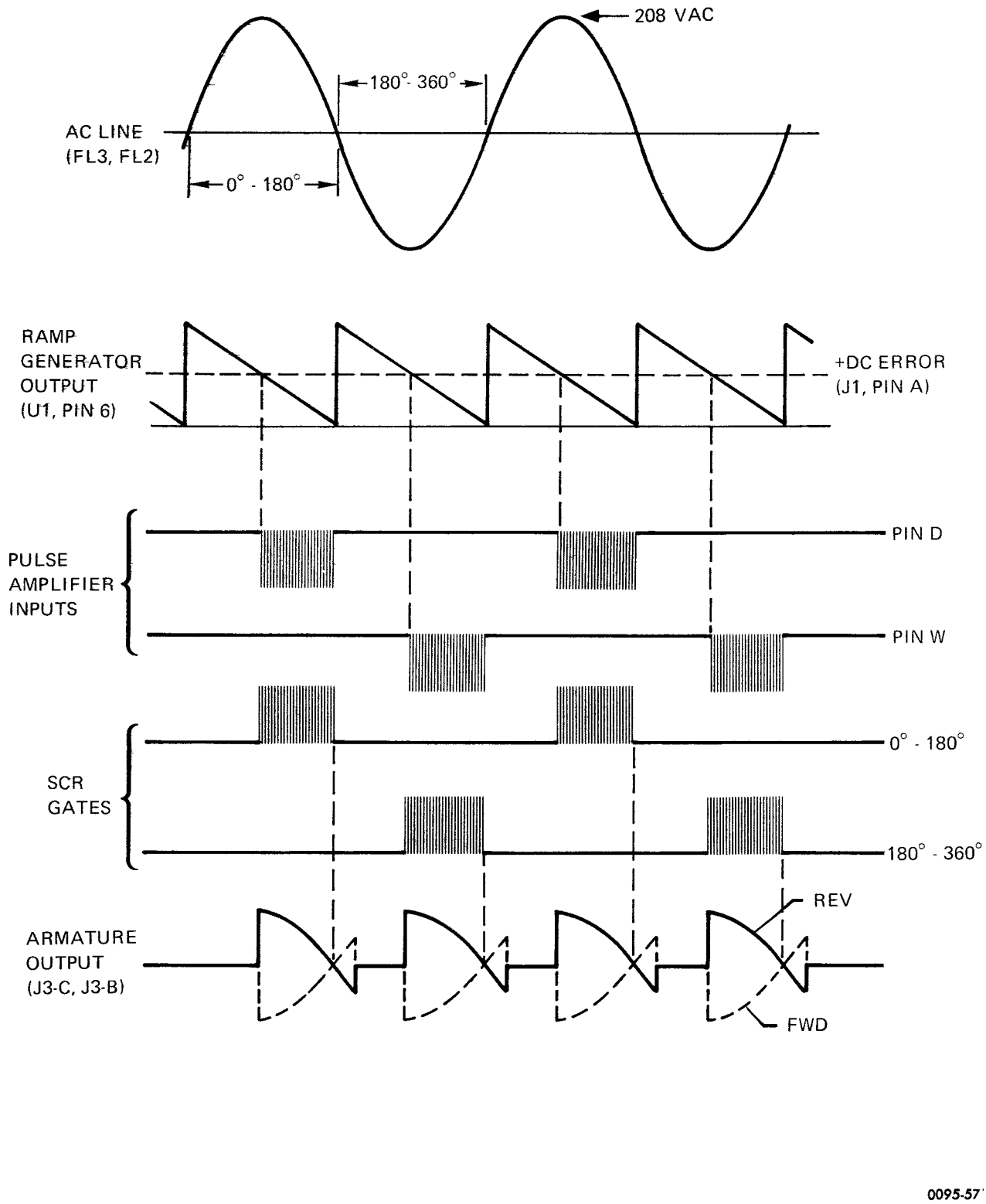


Figure 3-146. Power Amplifier Overall Timing

bridge and hence the current in the motor armature.

3-1174. The voltage across the secondary winding of transformer T2 drives integrating amplifier U1 on the current limiter card (2A9A7A3, 3A9A7A3, or 4A6A7A3). Resistors R1 and R2 convert the secondary voltage into a proportional current. Capacitor C1 provides a DC block for the amplifier bias current and minimizes amplifier offset. Capacitor C2 integrates the incoming AC signal current to provide an output voltage that resembles the current flowing in the AC line inductor (2A9A7L1).

3-1175. Resistor R4 prevents amplifier drift and holds the average value of the output to zero volts. Amplifier U2 and associated circuitry take the absolute value of the output voltage from amplifier U1. During positive swings of amplifier U1, operational amplifier U2 inverts the output from amplifier U1 and amplifies the signal by a factor of two. This signal is then added back to the output of amplifier U1 through resistors R8 and R9.

3-1176. The net current flow into amplifier U3 is proportional to the absolute value of the waveform at the output of amplifier U1 and resembles the armature current delivered to the motor. Operational amplifier U3 and associated circuitry set the current limit threshold. When the armature current is less than the current limit value, the output of amplifier U3 remains at approximately -6 volts. Resistors R11 and R12, diodes CR2 and CR3, and transistor Q1 act as a clamp to hold the amplifier at this negative potential. The value of the clamping current is determined by resistor R11 and potentiometer R12. When the average value of the input from amplifiers U1 and U2 exceeds the current set by resistors R11 and R12, diode CR3 and transistor Q1 become back biased, and operational amplifier U3 integrates the difference current through capacitors C3 and C4. The integration begins at -6 volts and integrates positively toward amplifier saturation. The circuits connected to the output of operational amplifier U3 are designed to be disabled while the output of amplifier U3 is negative. The duration prior to zero crossing determines the current limiter attack time and is adjustable through potentiometer R13. Potentiometer R13 sets the initial value of amplifier U3 between -1.5 volts and -6.5 volts.

3-1177. Operational amplifier U4, associated resistors R15 and R17, and zener diode CR4 invert the output of U3 to provide the positive side of the DC error signal clamp. Diode CR4 clamps the output of amplifier U4 to +0.6 volts while amplifier U3 is negative, and limits the output to -10 volts to keep amplifier U4 out of saturation. The purpose of potentiometer R18 is to adjust the gain of the current limiter loop by setting the amount of feedback flowing back into amplifier U4. Resistors R19 and R20 provide an output for the positive clamp.

3-1178. Operational amplifier U9 provides the negative signal clamp by inverting the output from amplifier U4 and driving resistors R39 and R40. Diodes CR5 and CR6 connect the signal clamp into the DC error signal. If the current limit value is exceeded by the armature current, both the positive and negative clamps collapse toward zero volts until the DC error signal drops to a value that produces armature current just equal to the current limit setting.

3-1179. Unity gain inverting amplifier U10 supplies the +10 volts and -10 volts necessary for the operation of other current limiter card circuitry. The +15 volts is fed to amplifier U10 which inverts this voltage and provides an output by dropping resistor R43. Resistor R44 and diode CR10 maintain the positive output at +10 volts.

3-1180. Pulse Generator 2A9A7A4, 3A9A7A4, or 4A6A7A4. The pulse generator card receives the DC command signal and produces pulses to gate the SCRs in the SCR bridge. All components are on plug-in card A4. Operational amplifier U1 and associated circuitry generate a ramp synchronized to the AC line frequency. Transistors Q1, Q2, and Q3 make up the

synchronizing circuit. Base drive for transistors Q1 and Q2 is derived from the secondary winding of the power-supply transformer (2A9A7T1) and is delivered through base resistors R1 and R4. Transistors Q1 and Q2 are driven to saturation during alternate half cycles of the ac line; however, at each zero crossing, Q1 and Q2 are both in the OFF state, allowing transistor Q3 to be driven into saturation. During saturation, Q3 resets integrating amplifier U1 to +7 volts through coupling resistor R9. Immediately after zero crossing, Q3 turns OFF due to saturation of either Q1 or Q2. Resistors R8 and R9 then integrate capacitor C1 towards zero. Amplifier U2 and associated circuitry regulate the integration rate so that amplifier U1 is reset to +7 volts (due to the next zero crossing) just before amplifier U1 integrates past zero volts. Resistors R5, R7, and R10 with diode CR3 and capacitor C2 set the ramp height by monitoring the magnitude of the AC line. Differential comparators U3 and U4 compare the magnitude of the DC error signal with the magnitude of the ramp voltage. Voltage comparator U3 produces an output of +5 volts when the DC error signal is more positive than the ramp voltage.

3-1181. Current comparator U4 produces a +5 volt output when the DC error voltage is more negative than the ramp generator voltage is positive. Resistors R15 and R16, and resistors R17 and R18 are input-comparison resistors for the positive and negative comparators, respectively. Resistors R20 and R21 are 5-volt pull-up resistors for the comparators. Transistors Q5, Q6, and Q7 and associated circuitry form a synchronous pulse generator. The circuit is configured basically as a relaxation oscillator with capacitor C9 discharging through R29 to produce pulses at a repetitive rate of 4 KHz. Resistor R28 with a 15 VDC input recharges capacitor C9 after each discharge. Transistors Q6 and Q7 act as a unijunction transistor with a peak voltage of +5 volts as determined by R30. Transistor Q5 and resistor R25 disable the oscillator by holding the base of transistor Q7 at ground potential. The oscillator is gated into operation through diodes CR6 and CR7 when either comparator is at +5 volts.

3-1182. Operational amplifier U5 and associated circuitry detect the phase of the AC line by comparing the polarity of one side of the power-supply transformer (2A9A7T1) against signal ground. The output of the detector is at the junction of diodes CR9 and CR10 and swings between +5 volts and -0.6 volt depending on the phase of the AC line. Three-input NAND gates U6 and U7 are used to logically connect the differential comparators, phase detector, and pulse generator stages to determine the proper firing order for the SCRs.

3-1183. Pulse Amplifier Card 2A9A7A5, A6; 3A9A7A5, A6; or 4A6A7A5, A6. Each pulse amplifier card (figure 3-147), A6 for forward direction and A5 for reverse direction, contains two identical amplifier circuits, one for each output from the pulse generator card. Only one circuit will be discussed, the other operates in an identical fashion.

3-1184. The amplifier receives gated pulses from the pulse generator card. Resistor R3 couples the negative-swinging pulse into the base of inverting and preamplifier transistor Q1. Resistor R1 provides bias to transistor Q1 holding it off during positive pulse swings. Diode CR1 clamps the input to a maximum of 5.6 volts at the input of transistor Q1. Capacitor C1 filters stray pulses from the amplifier to prevent false SCR triggering. Resistor R5 provides base bias for transistor Q1 to ensure a saturated condition. Resistor R7 supplies base drive to the output power transistor Q3. Resistor R11 is a collector pullup resistor to bring the collector to +15 volts during the interval between pulses.

3-1185. Diode CR3 suppresses inductive ringing and fly-back spikes that occur during off transitions of transistor Q3. The output from the amplifier is from the collector of transistor Q3. This output swings from approximately -15 volts to +15 volts

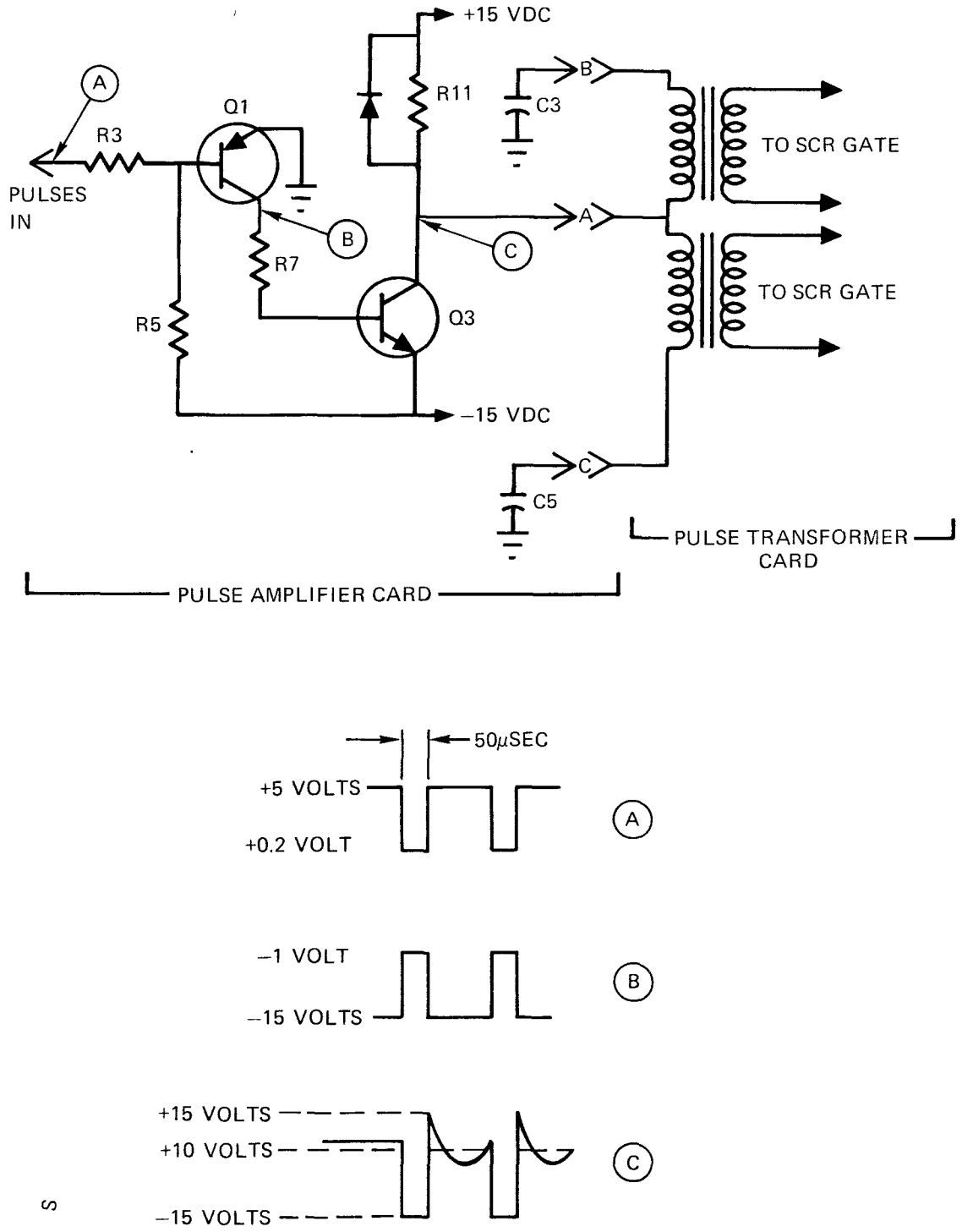


Figure 3-147. Pulse Amplifier Simplified Diagram

when unloaded. The output drives the primary winding of two pulse transformers for gating the SCRs during one half-cycle of the AC line. During the opposite half-cycle of the AC line, an identical pulse amplifier provides gating as commanded by the pulse generator card. Return from the pulse transformer is through DC block capacitors C3 and C5, one from each pulse transformer.

3-1186. Pulse Transformer Card 2A9A7A7, 3A9A7A7, and 4A6A7A7. The pulse transformer card isolates the output from the pulse amplifier card from the SCR bridge. This card contains eight identical circuits - one for each SCR. The primary of the pulse transformer is driven from the pulse amplifier cards while the secondary is connected between the SCR gates and SCR controls.

3-1187. SCR Bridge 2A9A7, 3A9A7, or 4A6A7. The SCR bridge consists of SCR/diode modules U1 through U4, resistors R1 and R2, and capacitors C19 and C20. Two sides of the bridge are connected directly to the AC line while the other two sides are connected to the motor armature. The SCR modules themselves are composed of two SCRs and two diodes arranged to give bidirectional conduction. For example, if terminal AC1 is positive relative to terminal AC2, the SCR module will conduct when gate G2 is triggered. Conversely, if terminal AC2 is positive relative to terminal AC1, the module will conduct in the opposite direction when gate G1 is triggered. For one direction of rotation, the triggering logic is arranged so that gates U4G2 and U1G1 are triggered together during a positive half-cycle of the AC line and gates U3G2 and U2G1 are triggered together for the negative half-cycle to produce a positive voltage at connector J3B relative to connector J3C. (See figure 3-148.) The opposite sets of gates are triggered to produce a negative voltage at connector J3B relative to connector J3C. Resistor/capacitor networks R1-C19 and R2-C20 filter switching transients produced by the SCRs. Inductor L1 filters the armature current to improve the ratio of rms current to average current. The AC drop across inductor L1 is used as the armature-current sensing signal.

3-1188. Field Supply 2A9A7, 3A9A7, or 4A6A7. The field supply voltage is derived from phase B of the AC line and neutral. The AC line supplies 120 VAC through feedthrough capacitor C1 to the primary (pin 2) of field supply transformer T3. Pin 4 transformer of T3 is connected through line filter FL1 back to neutral. This places 120 VAC across field supply transformer T3. The secondary of transformer T3 is connected in series with the 120 VAC line to boost the field supply voltage to 135 VAC before being applied to a rectifier. The boosted voltage is applied to rectifier module CR7. The rectified output voltage of approximately 130 VDC is applied to pins J3-A and J3-D for the field supply voltage. Transient-suppression diode CR8 protects the field-supply circuit from inductive spikes produced by the motor field winding. Fuse F3 protects the field circuit and disables the low-lever power supply in the event of field-circuit failure. The field supply is rated for 130 VDC at 2 amperes continuous.

3-1189. Backout Circuitry 2A9A7, 3A9A7, or 4A6A7. The backout circuits allow the power amplifier to drive the motor out of a limit without enabling the amplifier that would allow travel in the direction further against the limit. Basically the backout circuitry disables the amplifier for the limit direction and applies the brakes. However, if a command in the opposite direction is received, the amplifier releases the brakes and applies backout current to the motor. Once out of a limit, the amplifier reverts to normal operation. Operationally, the backout circuit consists of relay K3, rectifier module CR5, and associated circuitry.

3-1190. The following describes the sequence of events, assuming a limit has been encountered. Assume that the forward direction limit is reached. The forward direction limit switch would remove voltage from relay K2, disconnecting the output of pulse generator card A4 from the input of forward pulse amplifier A6. The

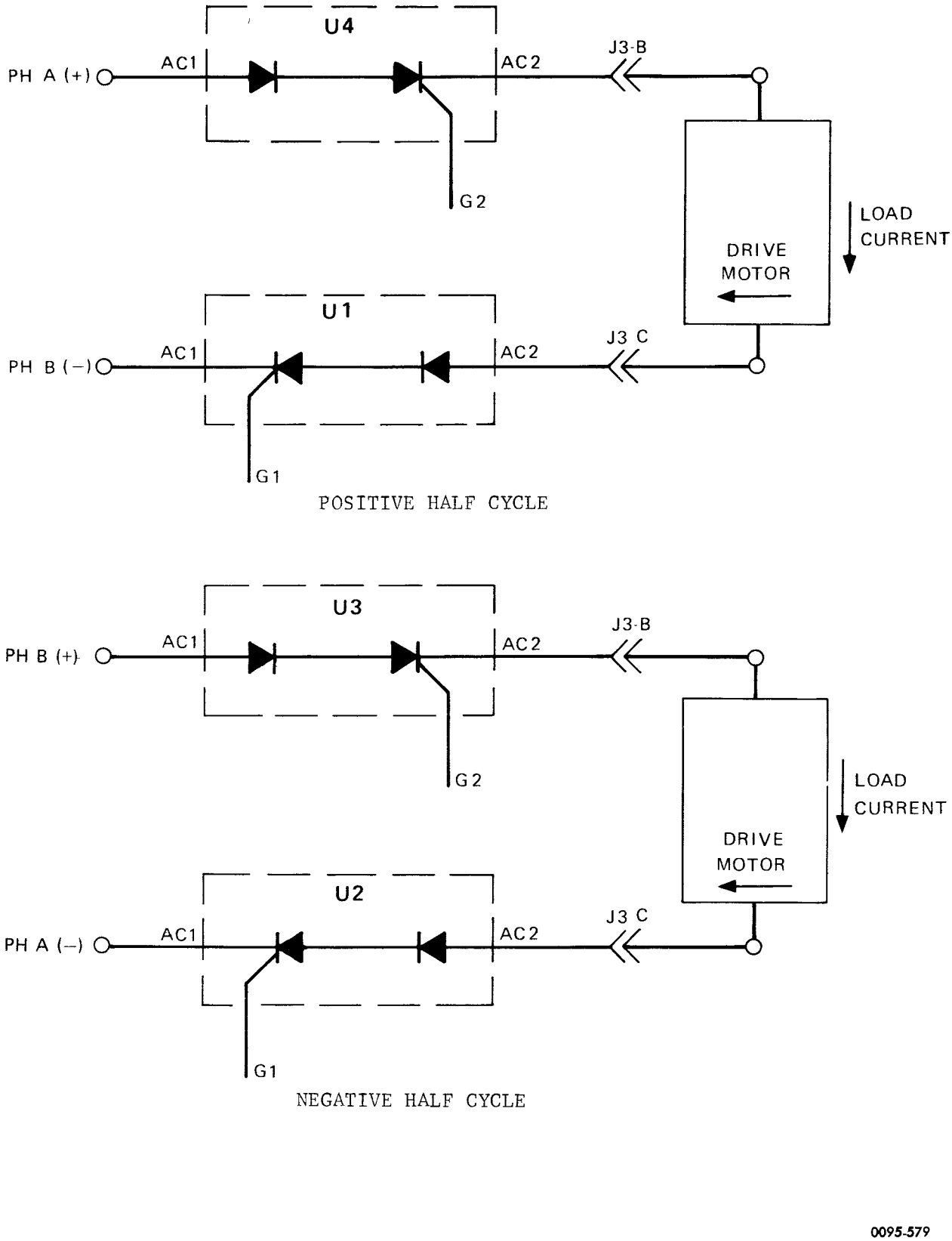


Figure 3-148. Current Flow Through SCR Bridge

forward gating pulses would then be disabled. Also, brake relay K4 would be deenergized, thus applying the brake. Addition of a greater negative command voltage would not cause the amplifier to drive the motor since the forward drive channel is disabled. However, if the polarity of the command is changed (+ command), the SCRs would be triggered from the reverse pulse amplifier because relay K1 is energized. Current would flow in the motor to produce backout torque. Also, current would flow in filter inductor L1. The voltage produced across inductor L1 is sensed by rectifier bridge CR5 through normally closed contacts of relay K2. This voltage is rectified by diode CR5 and supplied to the coil of relay K3. When the DC voltage across relay K3 exceeds 24 volts, relay K3 energizes and places 120 VAC across brake relay K4. The brake then releases allowing the system to back out of the forward limit. Once out of the forward limit, relay K2 is again energized reconnecting the forward command pulses and disconnecting relay K3 from inductor L1. The process is identical when entering the reverse limit with the exception that relay K2 becomes deenergized causing the reverse direction to be disabled.

3-1191. Input power, 120 VAC, is applied across the primary winding of transformer T1 (azimuth power amplifier 2A9A7, 3A9A7, and 4A6A7). The applied voltage is stepped down to 48 volts through the secondary winding, and routed to power supply A1 and to the pulse generator A4. Transformer T1 also is center tapped to supply the required power to the filter and regulator circuits of power supply A1.

3-1192. Power supply 2A9A7A1, 3A9A7A1, and 4A6A7A1, consists of plug-in card A1. Voltage from the secondary winding of transformer T1 is applied to the bridge rectifier CR1 to supply a full-wave rectified voltage. Capacitors C1 and C2 filter the rectified voltage to remove ripple. Capacitor C1 supplies negative voltage to the collector of the negative supply transistor while C2 provides positive voltage for the collector of the positive supply pass transistor. Resistors R1 and R3 provide both base current and zener current for diodes CR1, CR2, and transistors Q1 and Q2. The diodes and transistors are located externally to power supply A1 on the main frame of azimuth power amplifier 2A9A7, 3A9A7, 4A6A7. Zener diodes CR1 and CR2 set the base potential of transistors Q1 and Q2 to +16 volts and -16 volts, respectively. The power supply output of approximately +15 and -15 volts is from the emitters of transistors Q1 and Q2. Resistors R2 and R4 along with transistors Q1 and Q2 (on card A1) provide current-limiting to approximately 1 ampere at the output of each power supply. Resistors R5, R6, and capacitor C3 act as a decoupling network for the -15 volts supplied to the pulse-amplifier card. This decoupling prevents intermittent pulses from distorting the power supply voltages applied to other circuits.

3-1193. ANTENNA TRAILER PEDESTAL ENCODER. Two encoders are utilized for each antenna trailer, one each for the azimuth and elevation axis. The encoder employed in system AN/MPS-T1(V)4 is identical to the encoder supplied for systems AN/MPS-T1(V)1, AN/MPS-T1(V)2, and AN/MPS-T1(V)3. Detailed theory of operation for the encoder is provided in PEDESTAL DRIVE SERVOS (Systems AN/MPS-T1(V)1, AN/MPS-T1(V)2, and AN/MPS-T1(V)3, paragraph 3-1020.

3-1194. X-band auto pedestal, auto pedestal command, and reference pedestal control operation for system AN/MPS-T1(V)4 is identical to that of systems AN/MPS-T1(V)1, AN/MPS-T1(V)2, and AN/MPS-T1(V)3. Detailed theory of operation is provided in X-Band Auto Pedestal Operation, paragraph 3-1106.

3-1195. TRACKING GROUP.

3-1196. The tracking group contains range, azimuth, and elevation tracking loops for the target tracking system and reference tracking system. The reference tracking system includes four sets of tracking loops that are used for tracking four transponders simultaneously when the

transponder reference tracking system is selected. One of the four sets of tracking loops is used when the skin track or beacon track reference system is selected. Location of circuit board assemblies used in the tracking group is shown in table 3-8.

3-1197. RANGE TRACKING.

3-1198. Each of the five range tracking loops is similar in design and provides a manual mode for acquisition or manual tracking of the target and an automatic mode to automatically range track the target or reference pulses (figure 3-149).

3-1199. Inputs from the operator control circuits control the position of the range gates and cursors in the acquisition and manual modes by controlling the tracked range integrator. The range track integrator output is a DC voltage representing the range command.

3-1200. Synchronization of the range gates and cursors with the transmitter pulse is accomplished by a sawtooth generator and a comparator. The sawtooth generator produces a ramp that is synchronized with the transmitter trigger. In the comparator, this sawtooth is compared to the range track integrator output to produce a synchronization pulse that represents the tracked range. This synchronization pulse starts a timing sequence in the range gate generator which produces the range tracking gates and triggers for the range cursor circuits.

3-1201. The range error channel compares the position of the tracking gates and the video replies and generates a range error signal (discriminator error). This error signal is a voltage that shows the direction and magnitude of the misalignment of the tracking gates and video.

3-1202. When automatic range track is selected, the operator control inputs are removed from the range tracked integrator and the range error signal is connected. The range error signal then automatically maintains the gate and video alignment.

3-1203. OPERATOR CONTROLS TARGET (S- AND C-BAND). The target range track loop operates in the manual mode when target acquisition is effected by the guidance operator and when manual tracking of the target is accomplished by the range manual tracker operator. The operator that controls the range track loop is selected by the guidance operator (figure 3-150).

3-1204. Automatic range track can be selected by the range manual tracker operator when he has control of the range loop. In addition, this operator may select either azimuth or elevation video for application to the range error channel of the range track loop. These selection switches located on range tracking control 1A11A7 also select the sweep, video, and cursors for the range manual tracker display to provide either a range-azimuth display or a range-elevation display. (Refer to presentation group.)

3-1205. Guidance Operator Control. During acquisition of the target in range, the range gates and cursors are controlled from the guidance operator console. The handwheel at the guidance operator console provides a cursor position control. The handwheel is connected througn a geartrain to a DC tachometer. The tachometer output is routed through the normally closed contacts of relays 1A1A4K10 and K6 and the normally closed contacts of relay 1A17A4A6K1 to the input of the tracked range integrator. The polarity of the tachometer output voltage is dependent on the direction of rotation of the handwheel. The magnitude of the tachometer output voltage is proportional to the rate at which the handwheel is turned. The output of the tracked-range integrator is the integral of the voltage at its input.

3-1206. Control Transfer. Control of the range tracking loop is transferred to the range manual tracker operator when the guidance operator range handwheel is pulled outward momentarily. The transfer switch 1A1A4S19 is actuated by a cam on the handwheel shaft when the handwheel is pulled outward. When the transfer switch

Table 3-8. Tracking Loops Circuit Card Location Chart

	ANGLE GATE GEN	ANGLE ERROR DISC	ANGLE ERROR AMPLI-FIER	ANGLE TRACK INTE-GRATOR	RANGE ERROR DISC AND INTE-GRATOR	TARGET RANGE GATE GENERATOR	TRANSPONDER RANGE GATE GENERATOR	AUTO SENSE	CURSOR GATING
TARGET TRACK LOOPS	Chassis 1A17A4								
AZ	A9	A10	A11	A12					
EL	A2	A3	A4	A5					
RANGE					A6	A7			
TRANS-PONDER TRACK LOOPS	Chassis 1A3A4								
No. 1 AZ	A9	A10	A11	A12				A25	A26
No. 1 EL	A2	A3	A4	A5				A25	A52
No. 1 RG					A6		A7	A25	A26 and A52
No. 2 AZ	A21	A22	A23	A24				A25	A26
No. 2 EL	A14	A15	A16	A17				A25	A52
No. 2 RG					A18		A19	A25	A26 and A52
No. 3 AZ	A35	A36	A37	A38				A51	A26
No. 3 EL	A28	A29	A30	A31				A51	A52
No. 3 RG					A32		A33	A51	A26 and A52
No. 4 AZ	A47	A48	A49	A50				A51	A26
No. 4 EL	A40	A41	A42	A43				A51	A52
No. 4 RG					A44		A45	A51	A26 and A52

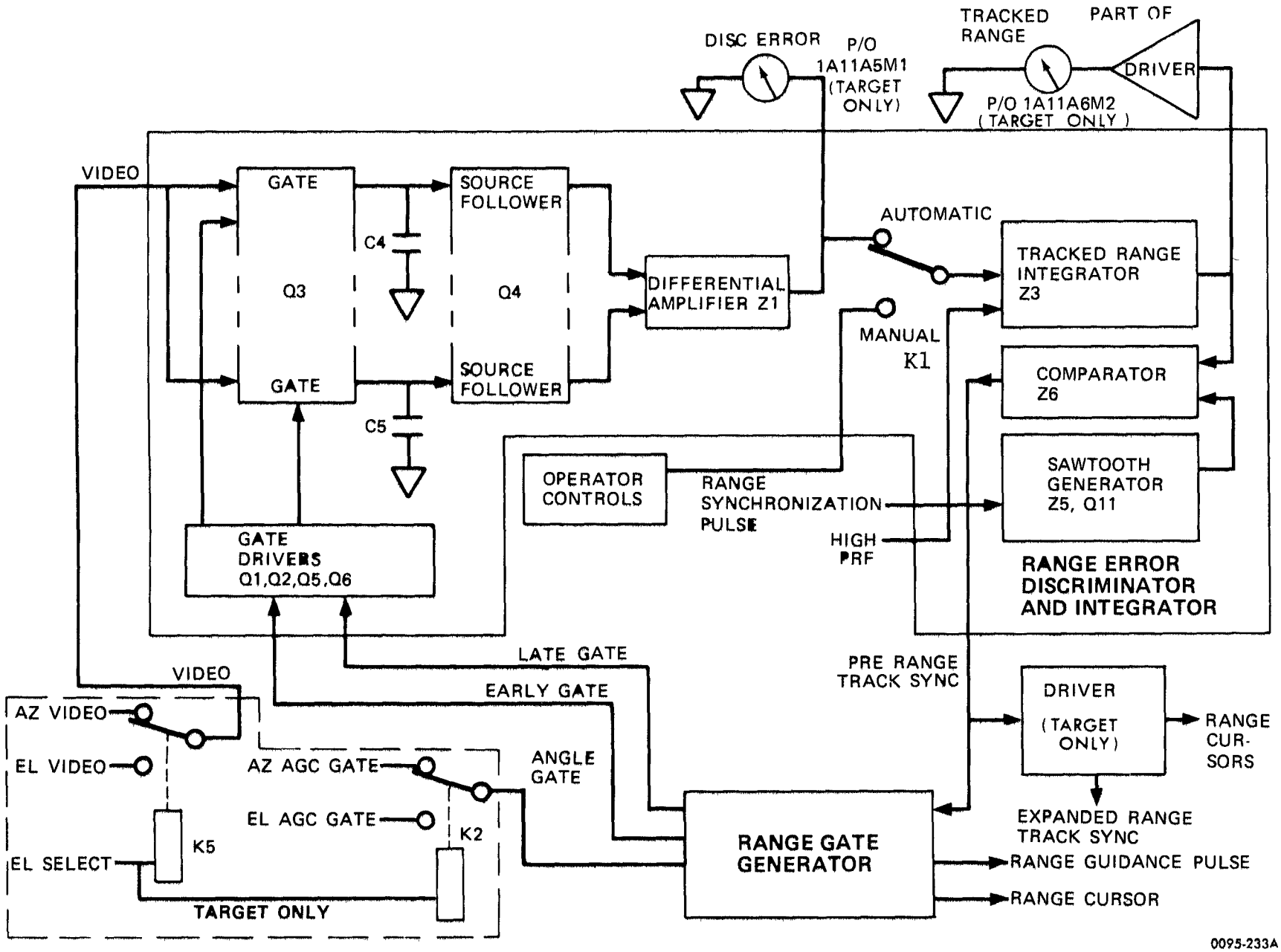


Figure 3-149. Range Tracking Loops Block Diagram

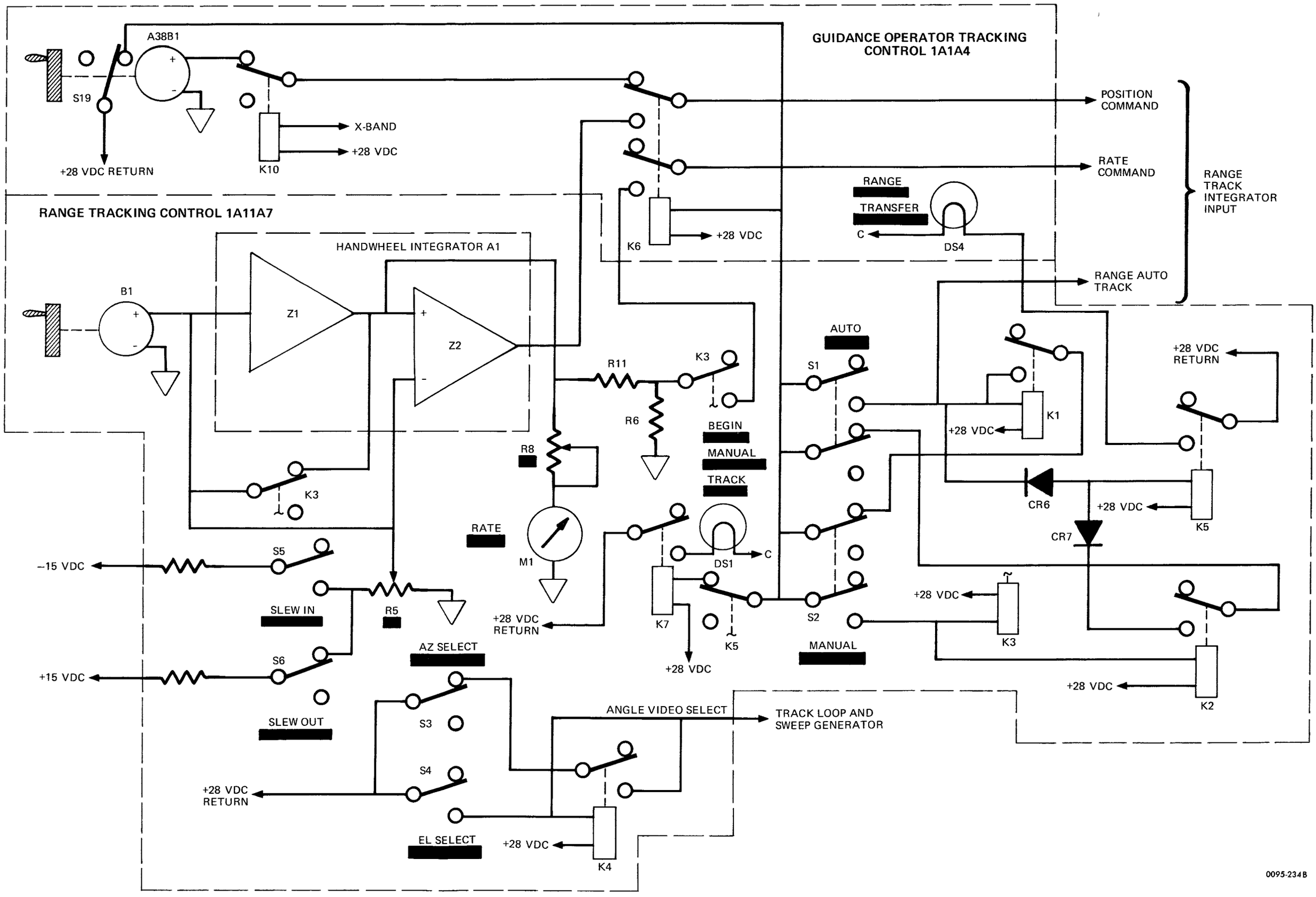


Figure 3-150. S- and C-Band Target Range Tracking Controls Simplified Diagram

is actuated, relay 1A1A4K6 is energized and the guidance operator control input is removed from the tracked range integrator. At the same time, position and rate control circuits of the range manual tracker operator are connected through the normally open contacts of relay 1A1A4K6. In addition, the BEGIN MANUAL TRACK indicator 1A11A7DS1 is lighted. Depressing the MANUAL switch 1A11A7S2 or AUTO switch 1A11A7S1 completes the control transfer.

3-1207. Manual Tracker Control. The manual tracker handwheel provides a combination of position and rate control of the range gates and cursors. In addition, slew switches provide a means of controlling the position of the gates. Depressing either switch S1 or S2 energizes relay K5 and deenergizes relay K7 in unit 1A11A7. Operation of relays K5 and K7 causes the BEGIN MANUAL TRACK indicator to go out and the RANGE TRANSFER indicator at guidance operator console to light. Relays 1A11A7K2 and K3 are latched when the MANUAL switch 1A11A7S2 is depressed and maintain control in the manual mode when switch S2 is released. Similarly, relay 1A11A7K1 is latched when the AUTO switch 1A11A7S1 is depressed and maintains control in the automatic mode when switch S1 is released. Relay 1A11A7K3 opens the reset contacts around the handwheel integrator feedback capacitor allowing its output voltage to change with handwheel rotation, thus the integrator is connected to the input of the tracked range integrator to provide the handwheel rate control. The voltage divider 1A11A7R11 and R6 scales the rate input to the tracked range integrator.

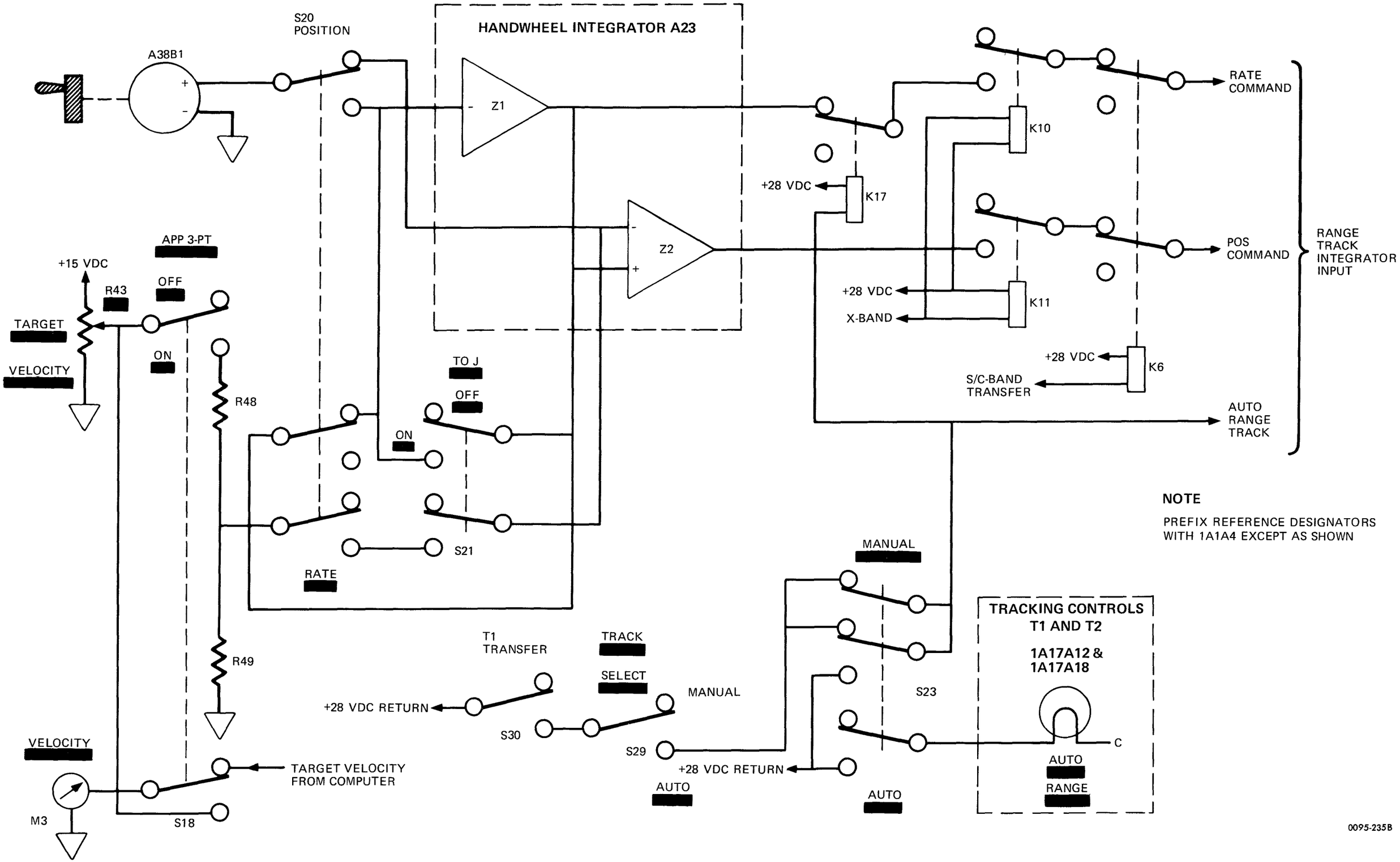
3-1208. When control has been transferred by the guidance operator and accepted by the manual tracker operator by depressing the MANUAL switch, the range manual tracker handwheel provides a combination of position and rate control of the cursor movement. Before the transfer has been accepted, the handwheel provides only position control since relay 1A11A7K3 holds the handwheel integrator in its reset condition.

3-1209. Rate control of the range gates and cursors is provided by routing the output of the DC tachometer through the handwheel integrator 1A11A7A1Z1. The number of turns and the rate at which the handwheel is rotated determine the time duration and amplitude of the DC voltage applied to the handwheel integrator. The polarity of the output voltage is determined by the direction of rotation of the handwheel.

3-1210. The handwheel integrator output, the rate control voltage, is the integral of the input voltage. This rate voltage is routed through normally open contacts of relay 1A11A7K3 to the tracked range integrator and causes the output of tracked range integrator 1A17A4A6Z3 to move at a rate proportional to the DC voltage input. The output voltage of the handwheel integrator is indicated on rate meter 1A11A7M1. Potentiometer 1A11A7R8 adjusts the rate meter for full-scale deflection when the maximum output from the integrator is applied to the meter circuit.

3-1211. Position control of the range gates and cursors is provided by routing the output of the handwheel controlled DC tachometer to the input of amplifier 1A11A7Z2 where it is summed with the slew switch voltages.

3-1212. Since the SLEW IN and SLEW OUT switch voltages are summed with the handwheel position control voltage at the input of 1A11A7Z2 and the rate control voltage is routed separately to the tracked range integrator, these voltages provide the operator with a "catch up" capability so that the cursor and target video display may be aligned in range without disturbing the handwheel rate setting. When the slew switch is released, the tracked range integrator will continue to integrate at the rate set in by the operator handwheel. The combined slew and position voltage, and the rate voltage are both present at the input of the tracked-range integrator. Therefore, the tracked range integrator output voltage provides a combined position and rate control for cursor movement.



NOTE

PREFIX REFERENCE DESIGNATORS WITH 1A1A4 EXCEPT AS SHOWN

0095-235B

Figure 3-151. X-Band Target Range Tracking Controls Simplified Diagram

3-1213. Selection of azimuth or elevation video for range tracking and display functions is controlled by the AZ SELECT and EL SELECT switches 1A11A7S3 and S4. When switch 1A11A7S4 is depressed, relay 1A11A7K4 is energized and remains energized through the normally closed contact of 1A11A7S3. With relay 1A11A7K4 energized, a 28-volt return signal is routed to the target range track loop 1A17A4 so that the target elevation video is selected at the input for the range error channel. The return signal is also routed to sweep generator chassis 1A11A5 to enable selection of the signals for the indicator display. When switch S3 is depressed, relay 1A11A7K4 is deenergized, and the 28-volt return signal is removed. As a result, the target azimuth video is connected to the range error channel and the indicator display is changed. When the AUTO switch S1 is depressed, relays 1A11A7K2 and K3 are deenergized and relay 1A11A7K1 is energized. Relay K3 resets integrator 1A11A7Z1 and disconnect its output from the tracked range integrator. Relay K1 furnishes an automatic range command (a 28-volt return signal) to the range track loop to remove the control voltage input to the tracked range integrator. Hence, in the AUTO mode, all of the control inputs to the tracked range integrator are disabled.

3-1214. OPERATOR CONTROLS - TARGET (X-BAND). During X-band operation, the guidance operator has complete control of the range acquisition and tracking functions. During range acquisition or manual tracking, the operator may select either position or rate control of the range cursor and tracking gates by using switch 1A1A4S20. When automatically tracking range, the operator controls are disconnected from the range track loop. Cursor and video alignment is then maintained as described previously. A simplified schematic diagram of the operator control functions for X-band target range tracking is shown in figure 3-151.

3-1215. During acquisition, the cursor movement is controlled by rotating the range handwheel. Rotation of the handwheel drives the DC tachometer A38B1. The tachometer output voltage is routed through the POSITION/RATE switch to the input of the handwheel integrator 1A1A4A23. If POSITION is selected at switch 1A1A4S20, the tachometer voltage is inverted by 1A1A4A23Z2 and routed through relays 1A1A4K11 and K6 to the input of the range tracked integrator providing position control of the range cursor. Relays 1A1A4K10 and K11 are energized and relay 1A1A4K6 is deenergized during X-band operation. If rate input is selected at switch 1A1A4S20, the tachometer voltage is integrated by 1A1A4A23Z1 and routed through relays 1A1A4K17, K10, and K6 to the input of the tracked range integrator providing rate control of the range cursor. Hence, the operator may select either position or rate control of the cursor.

3-1216. Automatic Tracking. When the operator has aligned the range cursor with the target video, he may select range automatic track by two methods: by positioning RANGE AUTO/RANGE switch 1A1A4S23 to AUTO or by pulling out the azimuth handwheel if the TRACK SELECT AUTO/MANUAL switch 1A1A4S29 is in AUTO. In either case, a 28-volt return signal is routed to the range track loop and relay 1A1A4K17 to disconnect all operator inputs from the range tracked integrator. When automatic range track is selected at 1A1A4S23, the AUTO RANGE switch S1 indicator on both the T1 and T2 tracking controls 1A17A12 and 1A17A18 lights. When range tracking the target automatically, the velocity of the target calculated by the computer is displayed on the velocity meter 1A1A4M3.

3-1217. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), Manual T.O. 43D7-11-21-2-1-1.

3-1218. OPERATOR CONTROLS - REFERENCE. Manual control of the reference range track loops for acquisition purposes is accomplished by rotating the range handwheel on the tracking control 1A3A4 (figure 3-152). The range track

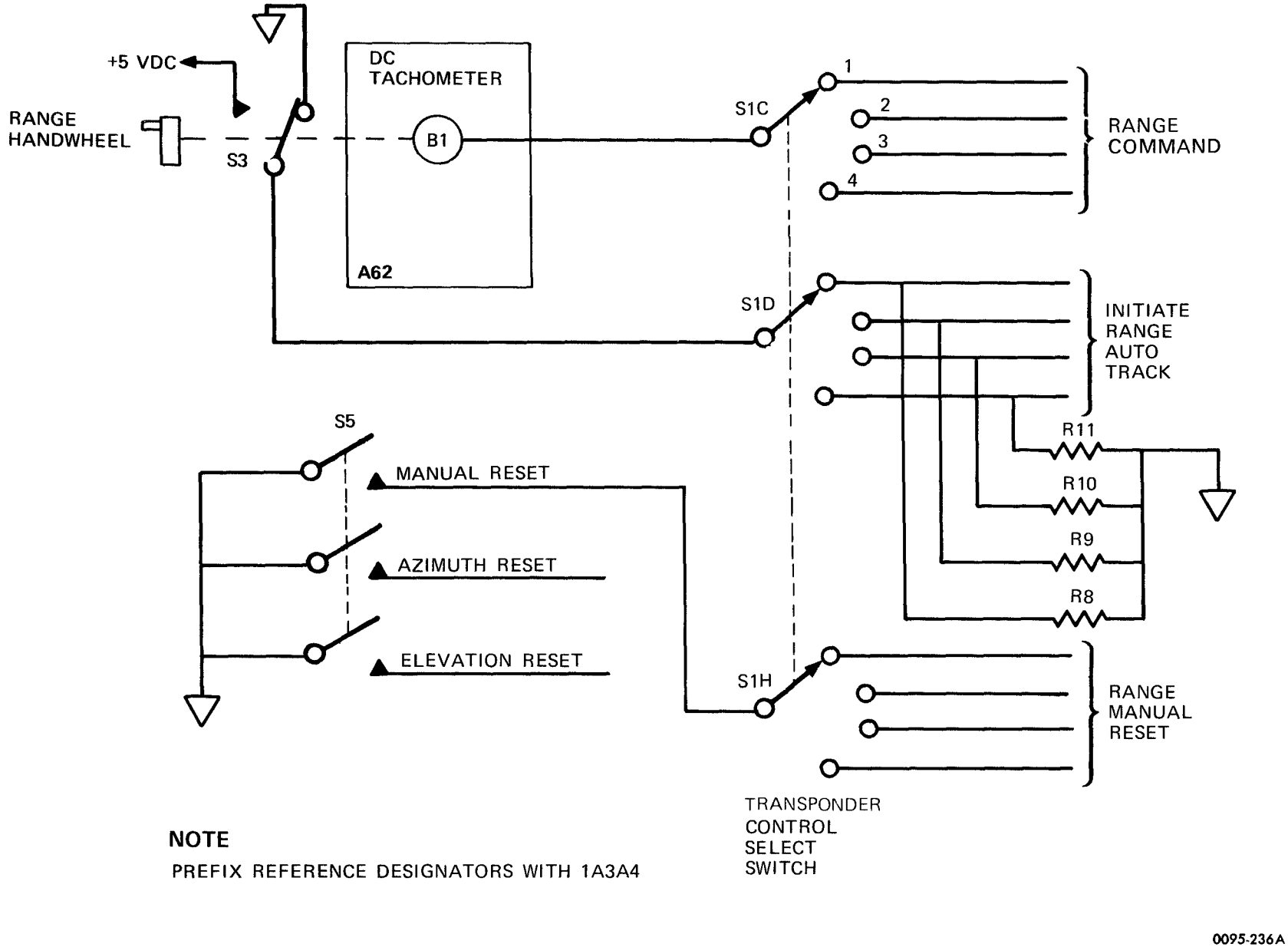


Figure 3-152. Operator Control Transponder Range Tracking

loops and the operator controls are located in the same unit. One of three reference track modes may be selected: transponder reference, beacon reference, or skin-track reference. Four transponders may be tracked simultaneously but only one beacon or target may be tracked when beacon or skin-track reference is selected. The transponder control select switch S1 is used to select one of the four transponder reference track loops for control in range and angle and to determine the routing of the handwheel controlled tachometer outputs, automatic track commands, reset commands and other tracking loop control functions. Position 1 on the switch is selected when beacon or skin-track reference is used.

3-1219. The automatic track mode is initiated by the transponder operator by momentarily pulling the range handwheel outward. Electronic circuits hold the track loops in automatic track until manually reset by the operator. (Refer to auto sensing discussion.)

3-1220. The range handwheel is connected through a geartrain to a DC tachometer. Rotation of the handwheel-tachometer generates DC voltage on the tachometer output that is routed through the CONTROL SELECT switch (S1C) to the input of the tracked range integrator. This provides position control of the range gates and cursor by the rotation of the handwheel.

3-1221. Switch S3 is actuated by pulling the range handwheel outward to initiate the range automatic track mode. This provides a +5 volt signal (initiate range auto track) that is routed through switch S1D to the automatic sensing circuits (A25). Resistors R8 through R11 hold the initiate automatic track lines near ground when the handwheel is in the normal position.

3-1222. The tracking loops that have been selected by the transponder CONTROL SWITCH switch S1 may be reset to the manual condition by depressing the MANUAL RESET switch S5. This causes a ground signal to be routed through the CONTROL SELECT switch (S1H to the automatic sensing circuit to override the automatic command holding circuit.

3-1223. MANUAL RANGE TRACKING. The range tracking loops are synchronized to the transmitter triggers by a range blanking pulse (figure 3-153). This range blanking pulse, generated in the range timing portion of the transmitter group, resets the range sawtooth generator used for range track timing. The sawtooth output voltage is compared to a DC voltage level from the tracked range integrator. When the sawtooth voltage is equal to the integrator output voltage, the prerange track sync pulse is generated. The prerange track sync pulse starts a timing sequence in the range gate generator. The pulses and gates produced in the range gate generator are the early and late range tracking gates, range cursor, range guidance pulse, blanking gate, and range track sync pulse.

3-1224. Range Error Discriminator and Integrator. A sawtooth generator, located in the target range error discriminator and integrator, consists of an integrator Z5 and associated circuitry. In the absence of the range blanking signal, integrator Z5 integrates linearly until the sawtooth voltage equals the tracked range voltage. Voltage comparator Z6 then changes state and its output resets flip-flop Z7 which disables the gate driver Q15 - Q16 and the analog gate Q17. The output of the sawtooth generator is then a constant level until the range blanking pulse sets flip-flop Z7 and resets the integrator. When flip-flop Z7 is set, it enables the gate driver and analog gate. Transistor Q11 is energized during the range blanking time, discharging the integrating capacitor C6. After range blanking, the integrator begins to integrate again repeating the cycle. The resultant waveform at the output of Z5 is a truncated sawtooth with an amplitude equal in voltage to the tracked range voltage at the output of Z3.

3-1225. Position control of the range gates and cursors is accomplished by routing the operator control voltage through the normally closed contact of

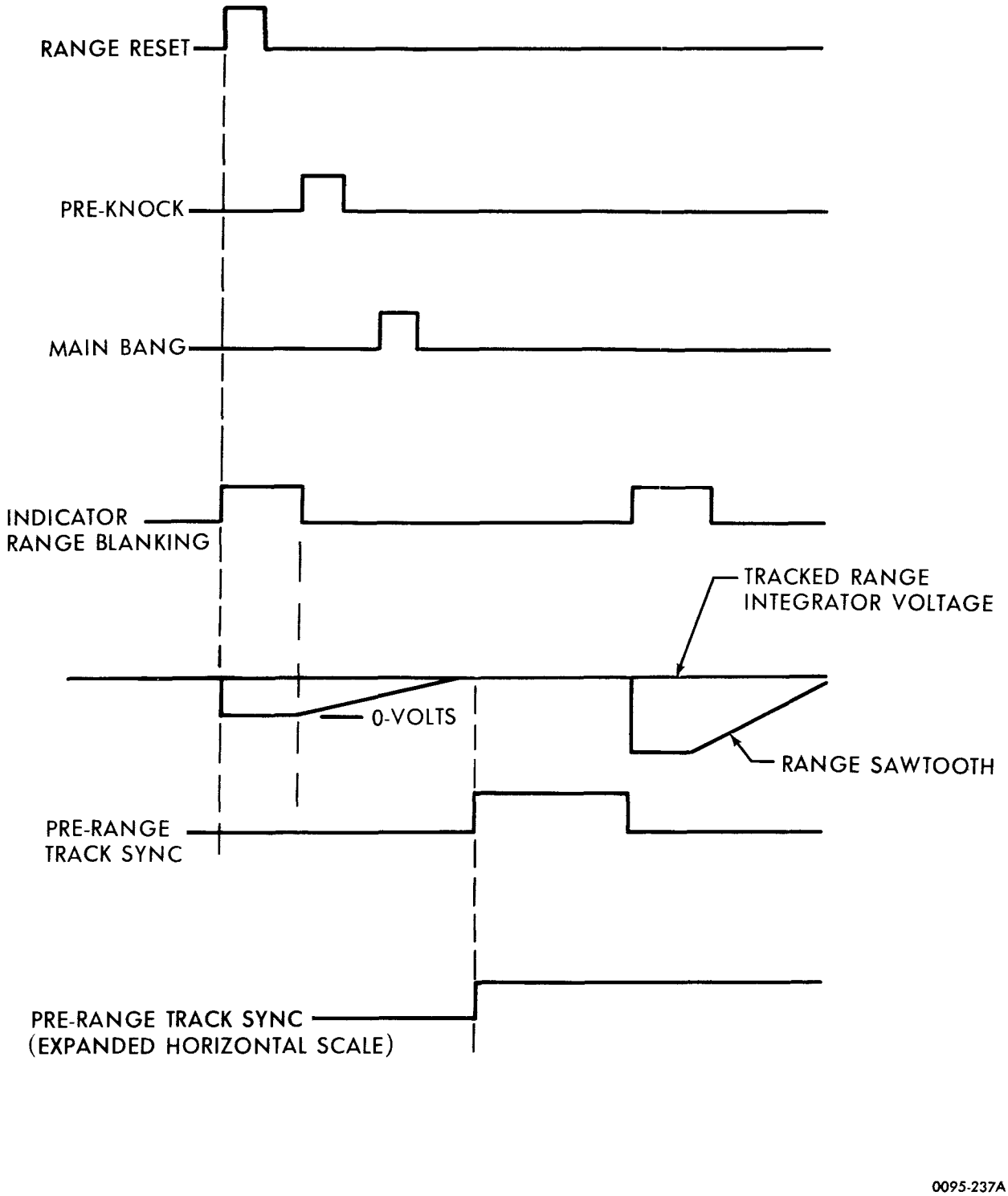


Figure 3-153. Range Track Loop Pulse Timing Diagram

relay K1 and resistor R30 to the summing junction of the tracked range integrator Z3. The control voltage for the target range loop originates at the guidance operator handwheel tachometer or the manual tracker operator handwheel tachometer and slew switches. The control voltage for the transponder range track loops originates at the transponder operator handwheel tachometer.

3-1226. Rate control of the range gate and cursor position in the target range track loop is accomplished by routing the integrated handwheel tachometer output from the range manual tracking unit 1A11A7 through network R24 - C14, R28 - R27, Z2 to the integrator Z3. Capacitor C14 is charged to a voltage proportional to the handwheel developed rate voltage. The charge on capacitor C14 is routed through voltage follower Z2 and provides an initial rate voltage for integrator Z3 when the AUTO switch is depressed. Therefore, if the rate of movement of the range gate and cursor is matched to the rate of movement of the target video before depressing of the AUTO switch, the discriminator error developed when auto track is selected will be minimized resulting in a smooth transition from manual to auto track.

3-1227. Application of either the position or rate control inputs to integrator Z3 results in a change to the tracked range voltage. The maximum output voltage level of integrator Z3 is limited so that its output level will never be greater than the output of sawtooth generator Z5. This ensures that the voltage step (prerange track sync) output from voltage comparator Z6 will be generated during each pulse repetition interval.

3-1228. In the low PRF mode, the maximum output voltage of integrator Z3 is limited by reference diode CR1. When the maximum voltage level is reached, diode CR1 breaks down, holding the integrator output voltage to the breakdown voltage of the diode. In the high PRF S- or C-band mode, diode CR2, voltage divider R39 - R40, transistor Q12, and inverter Z4B limit the maximum output voltage of integrator Z3. When HIGH PRF has been selected, transistor Q12 is turned off and a positive voltage is at the junction of resistors R39 and R40. This voltage increases as the integrator output voltage increases until it becomes approximately plus 0.7 volt. At this time, diode CR2 is forward-biased providing an input to the integrator and the output of integrator Z3 is limited. Similarly, voltage divider R41 - R42, diode CR3, transistor Q13, and inverter Z4A limit the output voltage of integrator Z3 in the X-band high PRF mode. In the X-band low PRF mode, voltage divider R43 - R44, transistor Q14, diode CR4, and inverter Z4C limit the output voltage of integrator Z3. The output of the range track integrator Z3 in the target range track loop is routed to driver amplifier Z1 on the driver card 1A17A4A13. Amplifier Z1 scales and biases the range tracked voltage which is routed to the RANGE TRACKED meter M2 on the manual tracker range tracking unit 1A11A6.

3-1229. The tracked range voltage and the sawtooth voltage are processed by comparator Z6 which produces a 5-volt positive voltage step (prerange track sync) when the sawtooth voltage is equal to the tracked range voltage. The voltage step triggers the range tracking gate generator which generates the gates, pulses, and syncs required for range tracking. The comparator output also triggers a single-shot Z2 on the driver card 1A17A4A13 which produces the expanded range track sync pulse. The expanded range track sync pulse is routed to sweep generator 1A11A5 where it triggers the expanded range sweep for the manual tracker displays. (Refer to presentation group.)

3-1230. Range Gate Generator - Target. The target range gate generator produces the gates and synchronizing pulses used in the target range track loop, target receivers, missile simulation and scoring group, and the presentation group. These are the early and late range tracking gates, range guidance pulse, range blanking gate, and the range cursor sync pulses. For a timing diagram of these signals, see figure 3-154.

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS, RADAR TRAINING SET AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1 FOR FIGURE 3-154.

3-1231. The gate generator circuits delay the generation of the track gates and cursors relative to the sync input so that the expanded display mode of the manual tracker and guidance operator indicators can be provided with the range gate position in the center of the expanded sweep. Additional delay circuitry ensures that the center of the range track gates (the guidance pulse position) is at a constant delay from the synchronizing pulse input for both high and low PRF operation of the S- or C-band radar.

3-1232. The prerange track sync pulse is delayed by single-shot Z1A during S- and C-band operation and by single-shot Z16A during X-band operation before the range gates are generated so that the range gates and cursors will be centered on the displays during expanded range.

3-1233. The delay circuit consisting of single-shots Z2B, Z3A, and Z3B generates the delay before the early gate, the split gate, and the late gate, respectively, for the high PRF S- and C-band mode. Each of these single-shots is triggered from the trailing edge of the preceding stage output. Single-shots Z2A, Z4A, and Z4B generate the corresponding pulses for the low PRF S- and C-band mode. A delay to ensure that the center of the track gates is at the same delay time from the sync input for both radar PRFs is provided by single-shots Z2A and Z2B.

3-1234. The high PRF single input on PIN X, which is at +5 volts when HIGH PRF is selected, enables the single-shots that generate the high PRF tracking gates. When LOW PRF is selected, single-shots Z2B, Z3A, and Z3B are disabled and single-shots Z2A, Z4A, and Z4B are enabled. When X-band operation is selected, single-shots Z2, Z3, and Z4 are disabled and single-shots Z1B and Z5 are enabled. Single-shot Z5A generates the X-band early gate and single-shot Z5B the late gate. The gates widths are the same for both high and low PRF during X-band operation. In S- and C-band, the early and late range gates are angle-gated at the output by gates Z9C and Z10C. During X-band operation, the early and late gates are not angle gated. The range track sync pulse is generated by single-shot Z6A and occurs 17 microseconds after prerange track sync in S- and C-band and 10 microseconds after prerange track sync in X-band. The range track sync pulse is routed to the guidance operator console for cursor generation and to the receivers for range gate generation.

3-1235. The range guidance pulse is the same length as the late tracking rate and is produced from the late tracking gates by a NOR circuit. The guidance pulse appears at PIN 6 of NOR gate Z12A. The leading edge of this pulse is used in the missile simulation and scoring system to indicate the tracked target range position. The blanking gate at PIN Y of the range gate generator is a pulse that equals the combined early and late gates used in the range tracking loop.

3-1236. The delay time between the termination of the initial delay pulse (the output of single-shot Z1A) and the first range cursor is set by single-shot Z6B. At the trailing edge of the pulse generated by single-shot Z6B, single-shot Z7B is triggered and produces the first range cursor. The time between range cursor is set by single-shot Z7A which triggers single-shot Z7B for the second range cursor. The duration of the range cursor is set by the delay time of single-shot Z7B. The range cursor output of single-shot Z7B is routed through amplifier Z14B to the driver card 1A17A4A13 where it is amplified by transistors Q1 and Q2. The amplified output from transistor Q2 drives three emitter followers Q3, Q4 and Q5 which provide the range cursors for the three manual tracker indicators.

3-1237. Range Gate Generator - Transponder. The four transponder range gate generators receive the prerange track sync signal from the comparator and generate the early and late tracking gates used in the range error channel, the range guidance pulse used in the missile simulation and scoring group, the range cursor

used in the generation of the display cursors, and the range gate used in the transponder receivers.

3-1238 and figure 3-155. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-1239. Voltage regulator Z7 provides a regulated voltage supply for differential amplifiers Z1 and ensures the stable delay required by single-shot Z1A for accurate transponder range tracking.

3-1240. Range Error Channel. The range error channel, which is part of the range error discriminator and integrator, produces a discriminator error signal (range track error) that is a voltage representative of the amount and direction of misalignment of the video input and the range tracking gates.

3-1241. The video input tor the target range error channel is selected from the azimuth or elevation target receiver by the range manual tracker operator control switches and relay K5 in target tracking unit 1A11A4. The video for the transponder range track loops is always provided by the associated transponder elevation channel.

3-1242. The video input is applied to the dual analog gate transistor Q3. The angle-gated early and late range gates are routed to gate drivers Q5-Q6, and Q1-Q2. The outputs of these gate drivers enable the two halves of gate transistor Q3 so that the video occurring during the duration of the gate passes through transistor Q3. The video gated by transistor Q3 is stored on capacitors C5 and C4. Transistor Q3 along with capacitors C5, and C4 from two sample-and-hold circuits. The dual source follower Q4 presents a high impedance to the storage capacitors preventing them from discharging during the period between successive range gates.

3-1243. The two outputs of source follower Q4 are applied to the inverting and noninverting inputs of differential amplifier Z1. Potentiometer R13 provides a DC balance adjustment to amplifier Z1 so that the output will be zero when no video is present at the input of the range error channel. The polarity of the range error channel output at the output of amplifier Z2 is such that a positive discriminator error voltage indicates that the tracking gates are early with respect to the video and a negative error voltage indicates that the tracking gates are late with respect to the video.

3-1244. The discriminator error is routed through resistor R20 to a normally open contact of relay K1. The output of the differential amplifier Z1 in the target track loop is indicated on discriminator error meter 1A11A5M1 at the range manual tracker station. The discriminator error voltage is scaled by the voltage divider consisting of resistors R20, R21, and R22 when transistor Q9 is turned on. Transistor Q9 is turned on when X-band is selected. Transistor Q10 is turned on when S- or C-band is selected. The discriminator error voltage is then scaled by resistors R20, R23, and R24.

3-1245. AUTOMATIC RANGE TRACKING. When automatic range tracking is selected by the operator controlling the range track function, the operator inputs are removed from the tracked range integrator by relay K1 in the range error discriminator and integrator assembly. In addition, relay K1 connects the discriminator error from the range error channel through the voltage follower Z2 to the input of tracked range integrator Z3 which operates as previously described for the manual tracking mode of operation. The network consisting of resistors R27, R28, R29, and capacitor C14 is a velocity memory network which ensures stable closed loop operation.

3-1246. The delay circuit, composed of transistors Q6 and Q7 on driver 1A17A4A13, energizes relay K2 in the range error discriminator and integrator 3.3 seconds after automatic track has been selected. Relay K2 removes resistor R26 from the range error discriminator and integrator input path thus reducing the

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS, RADAR TRAINING SET, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1 FOR FIGURE 3-155.

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS, RADAR TRAINING SET AN/MPS-T1(V), T.O. 43D7-11-21-1-1 FOR FIGURES 3-156 THROUGH 3-158.

response of the range track loop 3.3 seconds after initiation of automatic track.

3-1247. Continued closed-loop operation of the range error channel, integrator, sawtooth generator, comparator, and gate circuits maintains the alignment of the video and the range track gates to track the target in range.

3-1248. ANGLE TRACKING.

3-1249. Similar angle tracking loops for the target and reference tracking functions produce the angle tracking gates, cursors and guidance pulses during the acquisition, manual tracking, and automatic tracking modes of operation. The automatic track mode provides automatic tracking of the target with the angle track gates as long as the target remains within the scanned window of the antenna.

3-1250. Functionally, the angle track loops operate similarly to the range track loop previously described. The track loop is synchronized by a pulse derived from the associated antenna scan (dead-time gate). The tracked angle integrator output is compated to a sawtooth synchronized to the antenna scan to produce a pulse. This pulse starts the angle gate generator timing sequence that produces the tracking gates, guidance pulse, and cursor synchronizing pulses. (See figure 3-156.) In the automatic mode, a discriminator error signal is developed to change the output level of the tracked angle integrator. This in turn changes the position of the comparator output pulse (angle premark) and maintains the alignment between the boxcar video and the angle tracking gates.

3-1251 through 3-1253 and figures 3-157 and 3-158. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-1254. The change in the azimuth pedestal position as it relates to the change in the target position within the scanned antenna window increases proportionally by the secant of the target elevation angle. Therefore, the azimuth feed forward required to minimize the azimuth tracking error introduced by the manual tracker azimuth pedestal position command is proportional to the cosine of the target elevation angle.

3-1255. The elevation feed forward voltage is directly proportional to the elevation manual tracker pedestal position command (tachometer output). The feed forward voltage changes the tracked angle position within the scanned antenna window by approximately the same amount as the apparent change in the target position due to the pedestal position command. Therefore, the feed forward voltage minimizes the discriminator error voltage (angle tracking error) developed by pedestal commands from the manual tracker.

3-1256. When the elevation manual tracker operator selects the low altitude tracking mode (LOW ALT ON), the handwheel controlled tachometer and slew switches are used to position the elevation tracking gates and cursors. The output of integrator Z1 is the integral of the tachometer output voltage when LOW ALT ON and MANUAL have been selected by the operator. The integrator output is summed with the slew inputs from SLEW UP and SLEW DOWN switches S5 and S4 by summing amplifier Z2. The output of amplifier Z2 is applied to the elevation angle track integrator through the normally open contacts of relay K1 and the normally closed contacts of relay K5 in the target tracking chassis 1A5A4. Integrator Z1 is reset when the LOW ALT ON and AUTO functions are both selected. Therefore, when the MANUAL switch is depressed after the system has been automatically tracking in the low altitude mode, the cursor will return to the center of the indicator.

3-1257. OPERATOR CONTROLS - TARGET, X-BAND. The control signals which implement automatic tracking mode for the X-band target tracking functions are derived from the T1 and T2 manual tracker operator controls or from the guidance operator controls (figure 3-159).

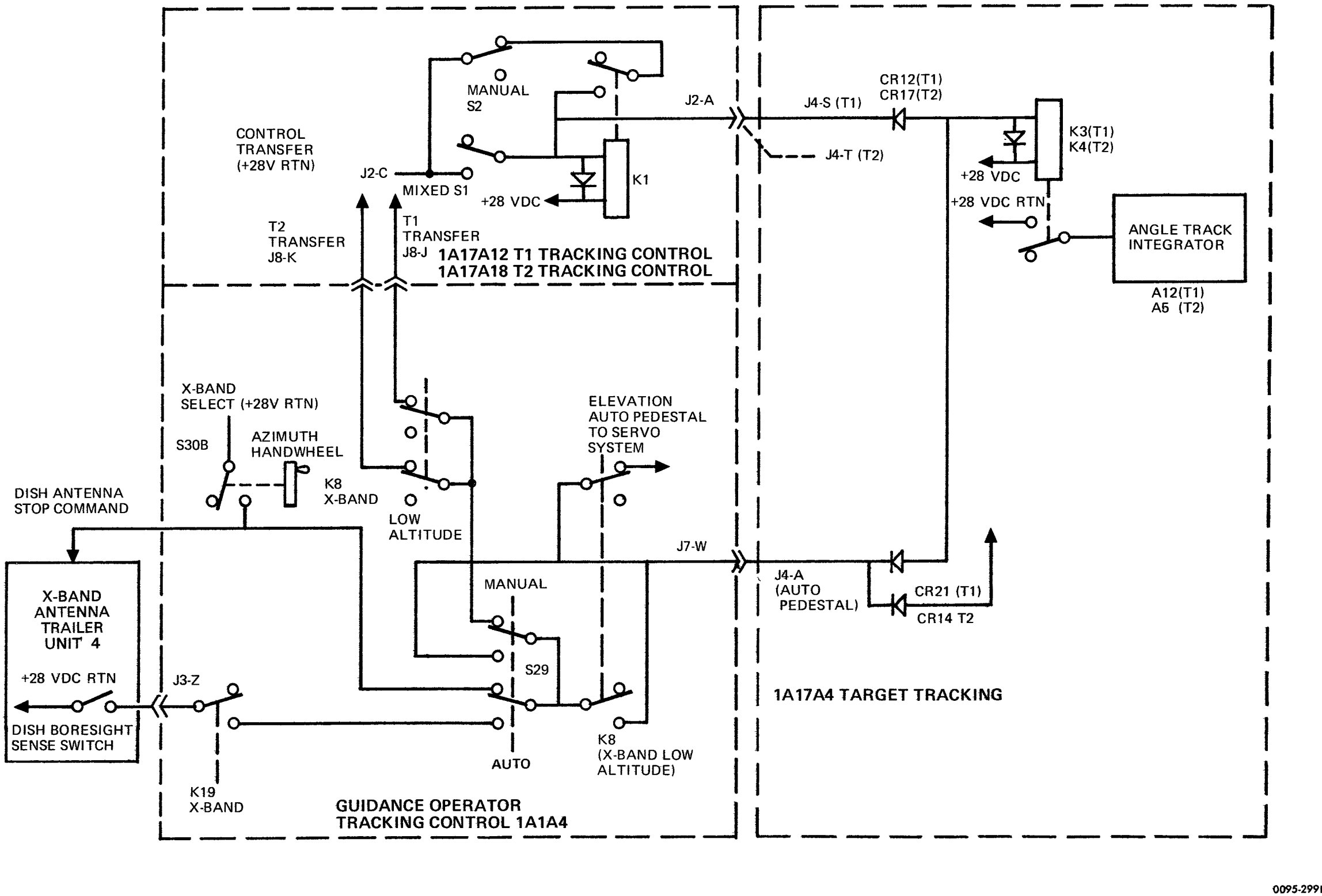


Figure 3-159. Operator Controls, Target X-Band

3-1258. If control has been transferred to the manual tracker operator, a 28-volt return signal is present on terminal J2-C. When the manual tracker operator depresses the MIXED switch S1 to select automatic electronic track, relay K1 is energized. When switch S1 is released, the relay is held in the energized state due to the 28-volt return signal through MANUAL switch S2. In order to select T1 automatic track, the automatic signal on terminal J2-A energizes relay K3 through diode CR12 to apply the required 28-volt return signal to PIN 7 of the angle track integrator assembly A12. Selection of T2 automatic track by the T2 manual tracker operator is identical.

3-1259. The other method of selecting automatic electronic tracking in T1 and T2 is by the guidance operator selection of the full automatic mode. In this mode of operation, pulling the guidance operator azimuth handwheel starts a sequence of events as follows:

a. A stop command is routed to the dish antenna.

b. The target receiver is switched to the track arrangement.

c. When the antenna stops, a signal from the antenna selects the automatic electronic track mode and the range automatic track mode.

d. Pedestal commands are generated from the outputs of the angle tracking loops.

3-1260. When the guidance operator pulls his azimuth handwheel, a 28-volt return signal is routed through switch S30B to the X-band antenna trailer to stop the dish antenna. When the antenna has stopped at boresight, a 28-volt return signal on terminal J3-Z of the guidance operator tracking control is routed through relay K19 to the TRACK SELECT switch S29. Relay K19 is energized when X-band target track is selected. When switch S29 is in the AUTO position, the boresight sense signal from relay K19 is routed through both sections of switch S29 to provide (1) the signal on terminal J7-W and then (2) through terminal J4-A in the track chassis to diodes CR21 and CR14. Thus relays K3 and K4 are energized to select automatic electronic track.

3-1261. If the guidance operator TRACK SELECT switch S29 is in the MANUAL position and low altitude has been selected, the 28-volt return signal generated when the azimuth handwheel is pulled and routed through the TRACK SELECT switch S29 and through relay K8 which is energized to apply the signal to terminal J7-W to select automatic electronic track.

3-1262. When the TRACK SELECT switch is in MANUAL and low altitude has not been selected, the guidance operator handwheel switch S30 generates the transfer command which is routed through switch S29 and relay K8 (deenergized) to allow selection of automatic track by the T1 and T2 manual trackers.

3-1263. OPERATOR CONTROLS - TRANSPONDER. To select transponder operation, the TRANSPONDER/EXTERNAL REF switch S13 (1A3A4) shall be in the TRANSPONDER position. The transponder operator angle tracking controls (1A3A4) are used to align the transponder cursors in angle with the transponder video and to select the automatic track mode. These controls consist of a handwheel-controlled DC tachometer, a TRANSPONDER COMMAND SELECT switch S1, a MANUAL RESET switch S5, and an automatic track switch (S2 or S4) that is actuated when the azimuth or elevation handwheel is pulled outwards. The azimuth and elevation controls are identical so only the azimuth controls are described here. The position of TRANSPONDER CONTROL SELECT switch S1 determines which one of the four tracking loops is connected to the operator controls.

3-1264. The DC voltage developed at the tachometer output (figure 3-160) is integrated by integrator Z1 of the handwheel integrator assembly A53 to generate a position command which is routed through the normally closed contacts of relays K5 and

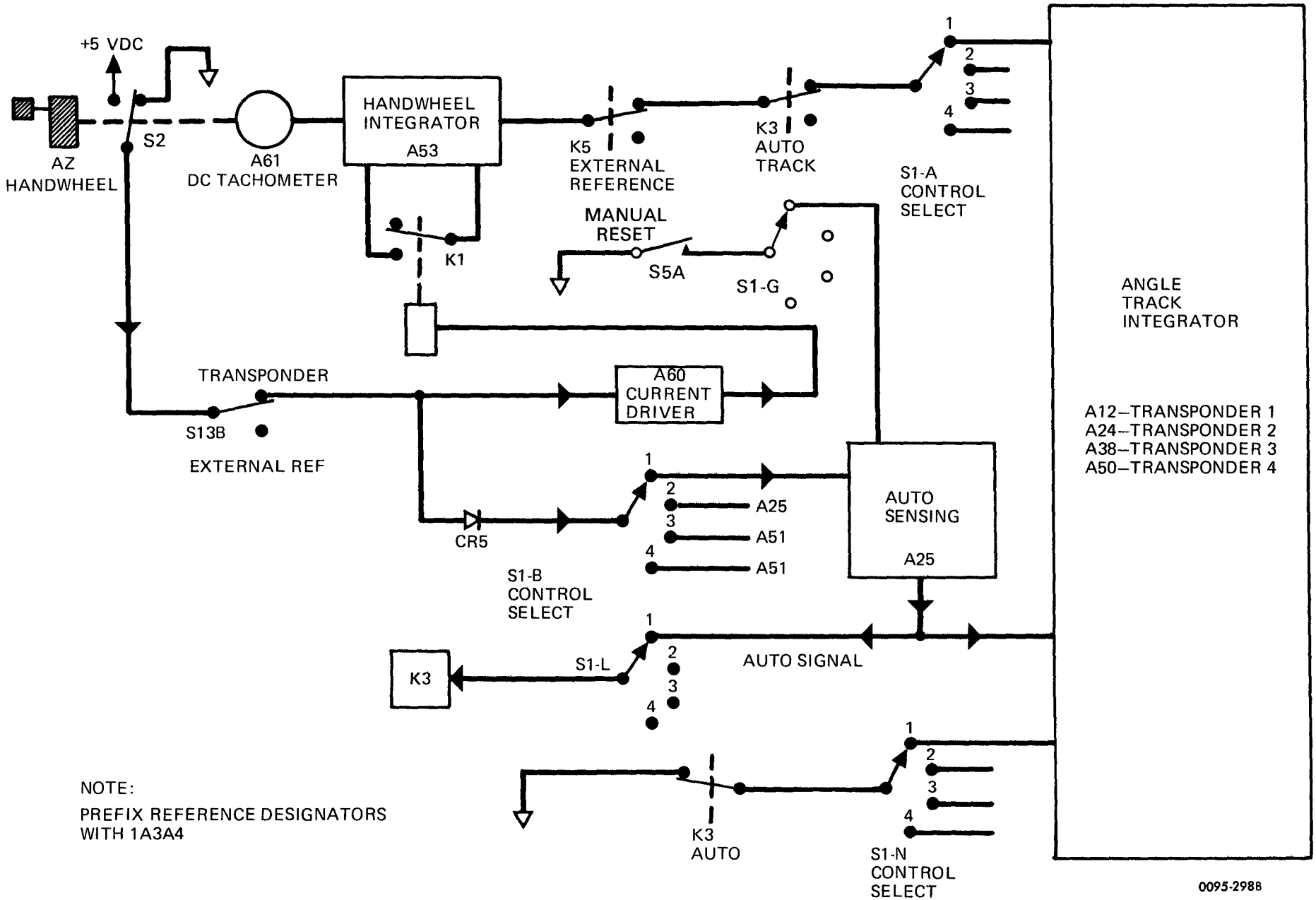


Figure 3-160. Operator Controls, Transponder

K3 and the TRANSPONDER CONTROL SELECT switch S1 to the input of the angle track integrator in the selected angle track loop. When the cursor is aligned with the video, automatic angle tracking is initiated by momentarily pulling the azimuth handwheel outward. This supplies a +5 volt DC signal through switch S13B to a current driver in assembly A60 and through diode CR5 and switch S25 to the automatic sensing circuits A25. The current driver energizes relay K1 which resets the handwheel integrator A53. The signal to the automatic sense circuitry initiates the automatic track mode. If the necessary conditions for automatic tracking are present (boxcar video is present and aligned with the angle tracking gates), the automatic sense circuit will generate the automatic track command. When this signal is generated, relay K3 is energized, thus disconnecting the handwheel command input from the tracking loop and enabling the rate memory circuitry in the tracking loop. The tracking loop can be returned to the acquisition mode by depressing the MANUAL RESET switch S5.

3-1265. A rate memory capacitor within the angle track circuit is discharged through the CONTROL SELECT switch S1N and normally closed contacts of relay K3 when in the manual track mode. When automatic track is enabled, relay K3 is energized and the ground on the memory capacitor is removed, thus allowing the memory capacitor to charge.

3-1266. OPERATOR CONTROLS, REFERENCE TRACK. For reference track operation, the TRANSPONDER/ EXTERNAL REF switch S13 is positioned to EXTERNAL REF and the TRANSPONDER CONTROL SELECT switch S1 is positioned to 1. This connects the number 1 track loops to the correct reference receiver and connects the handwheel tachometer circuit output to the reference pedestal servo system.

3-1267. The operator controls to the track loop for this condition consists of the generation of the automatic command only since the operation is similar to the target azimuth control in S-band or C-band operation. A +5 volt signal generated when the operator handwheel is pulled (figure 3-161), is routed through switches S13, S12B and S1B to the automatic sense circuit A25. As in the transponder case, this circuit generates the 28-volt return automatic signal for the angle track integrator to force it to the automatic mode.

3-1268. MANUAL ANGLE TRACKING - TARGET AZIMUTH AND REFERENCE. During manual track operation, the target azimuth track loop is preset to a condition that generates the azimuth angle cursor and guidance pulse at the center of the azimuth antenna scan. Manual tracking is then accomplished by the operator by positioning the antenna so that the target and the cursor are aligned. In reference operation, the azimuth and elevation reference track loops are preset in the same manner.

3-1269. The angle-tracking loops are synchronized to the antenna by an angle reset pulse that is developed from the selected antenna dead-time gate. This pulse is generated in the antenna group and routed from the angle timing portion of the synchronizer chassis. The angle reset pulse is present on either test point 3 or 4 of the angle track integrator depending on the mode of operation of the radar.

3-1270. During S- or C-band operation, the reset pulse is applied to transistor Q5 which provides a charge path through reference diode CR2 and transistor Q5 to charge integrating capacitor C6 to a negative potential at the output of integrator Z3. At the termination of the angle reset pulse, the integrator network Z3-R19-C6 operates normally to produce a positive-going sawtooth. During X-band operation, the angle reset pulse turns on the silicon controlled rectifier SCR Q4 to discharge the integrating capacitor. The positive-going sawtooth is routed to comparator Z4, and when it exceeds the track angle voltage, causes the output of comparator Z4 to change from a low logic level to a high logic level, thus triggering single-shot Z5A. The output pulse from single-shot Z5A is passed through gate Z1A or is

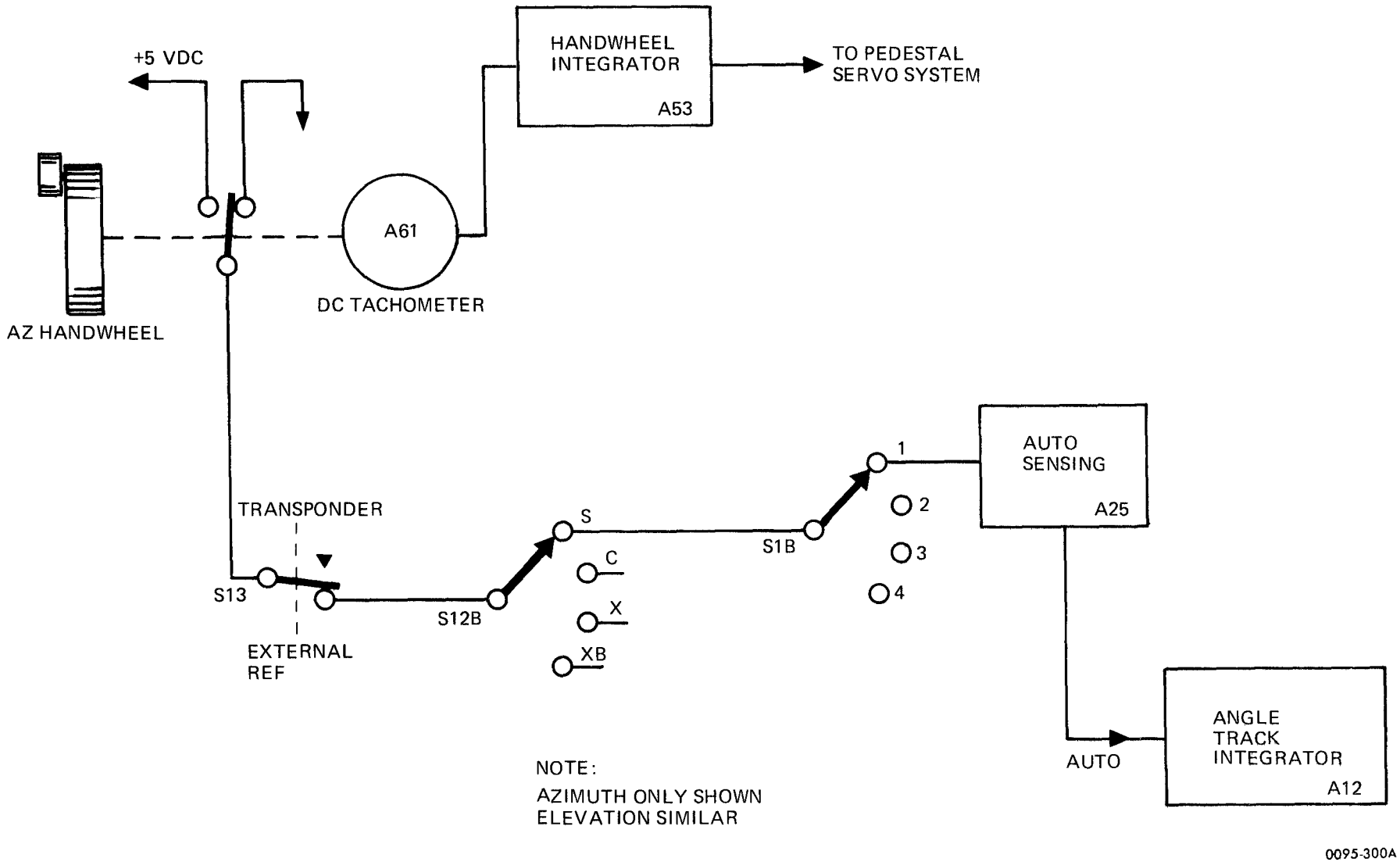


Figure 3-161. Operator Controls, Reference Track

delayed by one of the four single-shots in networks Z6 and Z7. The radar operating mode selection enables either the undelayed path Z1A or one of the single-shot delays.

3-1271. During manual tracking, relay K1 is deenergized, which disconnects the discriminator error input from the amplifier/integrator and also connects resistor R11 in the feedback path of network Z2 connecting network Z2 as an amplifier. There is no operator handwheel input to resistor R9 on the amplifier input, so its output is zero volts. In addition, the junction of resistors R5, R6, and R7 is forced to zero volts by relay 1A17A4K3 during manual tracking. The output of amplifier Z2 and the output of the sawtooth generator Z3 are both applied to voltage comparator Z4. The voltage comparator compares the azimuth sawtooth output voltage and the amplifier/integrator output voltage and generates a positive voltage step at the instant the two voltages are equal. Single-shot Z5A is triggered by this voltage step and generates a 1-microsecond pulse. The output pulse from single-shot Z5A is passed through gate Z1A or is delayed by one of the four single-shots in networks Z6 and Z7. The radar operating mode selection enables either the undelayed path Z1A or one of the single-shot delays. The selected delay network delays the angle premark pulse as a function of radar operating mode so that it is applied to the angle gate generator at a time which will cause the guidance pulse to be generated at the center of the antenna scan.

3-1272 through 3-1278, figure 3-162 and table 3-9. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-1279. The angle premark pulse is routed to flip-flop Z7B and sets the "1" output of the flip-flop to a logic high. These two signals are combined in gate Z9C so that, at the end of the angle premark pulse, the output of gate Z9C is at a logic low as shown in figure 3-163.

3-1280. The output of gate Z9C is inverted by gate Z9D and combined in gating network Z16 by the selected clock "0" output. When the clock is stopped, and therefore the "0" output is at a logic high, the output of the Z16 will go low. This negative-going transistion triggers the single-shot which causes the output of gating network to revert to a logic high for the period of the single-shot. When the single-shot times out, the output of gating network Z16 will again be at a logic low causing the single-shot to trigger again. The selected single-shot clock will continue to free-run in this manner until the "1" output of flip-flop is at a logic Z7B low. The negative-going portions of the signal at the output of gating network Z16 is set by the internal delays of the selected single shot and network Z16.

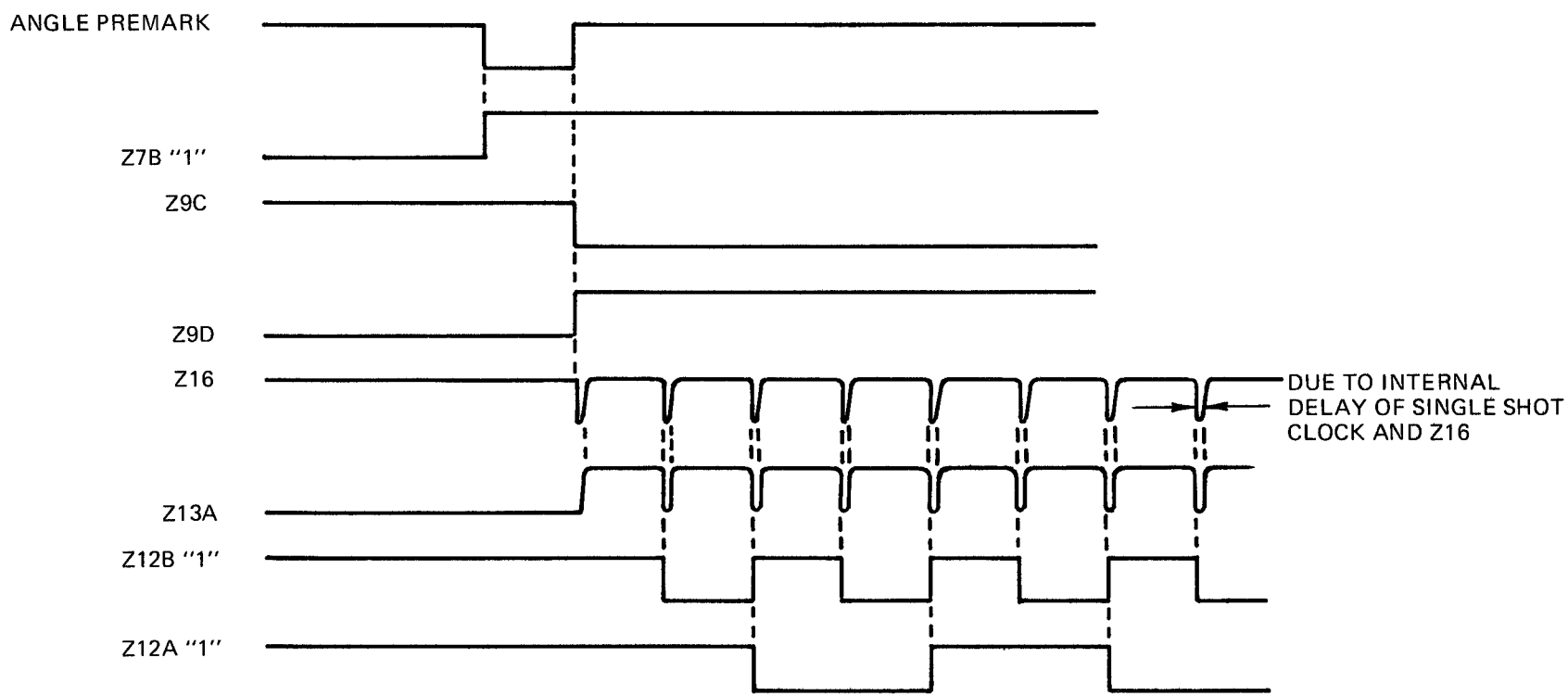
3-1281. The selected clock output is routed through gate Z13A to toggle flip-flop Z12B. Flip-flop Z12B divides the selected clock frequency by two. Flip-flop Z12A divides the "0" output of flip-flop Z12B by two. The "1" outputs of the two flip-flop are held high as long as the output of gate Z9D is low. These flip-flops change states on negative-going transistions at pins 13 and 1. The outputs of flip-flops Z12A and Z12B are routed through mode selection gates to the shift register section.

3-1282. The shift register section, shown in figure 3-164, consists of J-K flip-flops Z5B, Z5A, Z6B, and Z6A and is used to generate the various angle gates shown in figures 3-165, 3-166, and 3-167. In addition, toggle flip-flops Z7A and Z7B are used to generate the AGC gate and the angle selector gate.

3-1283. The angle premark signal is used to ensure that all of the "1" outputs of the flip-flops are initially set at a logic high. Since flip-flops Z5A, Z5B, Z6A, and Z6B are J-K flip-flops, their outputs, after a negative-going transition on the clock input, are determined by the state of the J and K inputs at the time of the transition. That is, if J and K are low, the output will not change; if J and K are high, the output will be low regardless of its previous state; and if J is high and K is low, the "1" output

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS, RADAR TRAINING SET AN/MPS-T1(V), T. O. 43D7-11-21-2-1-1 FOR FIGURE 3-162.

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS, RADAR TRAINING SET, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1 FOR TABLE 3-9.



NOTE:
PULSE WIDTHS ARE NOT SHOWN TO SCALE
SO THAT TRIGGERING POINTS MAY BE SHOWN.

0095-411A

Figure 3-163. Angle Gate Generator Clock Timing

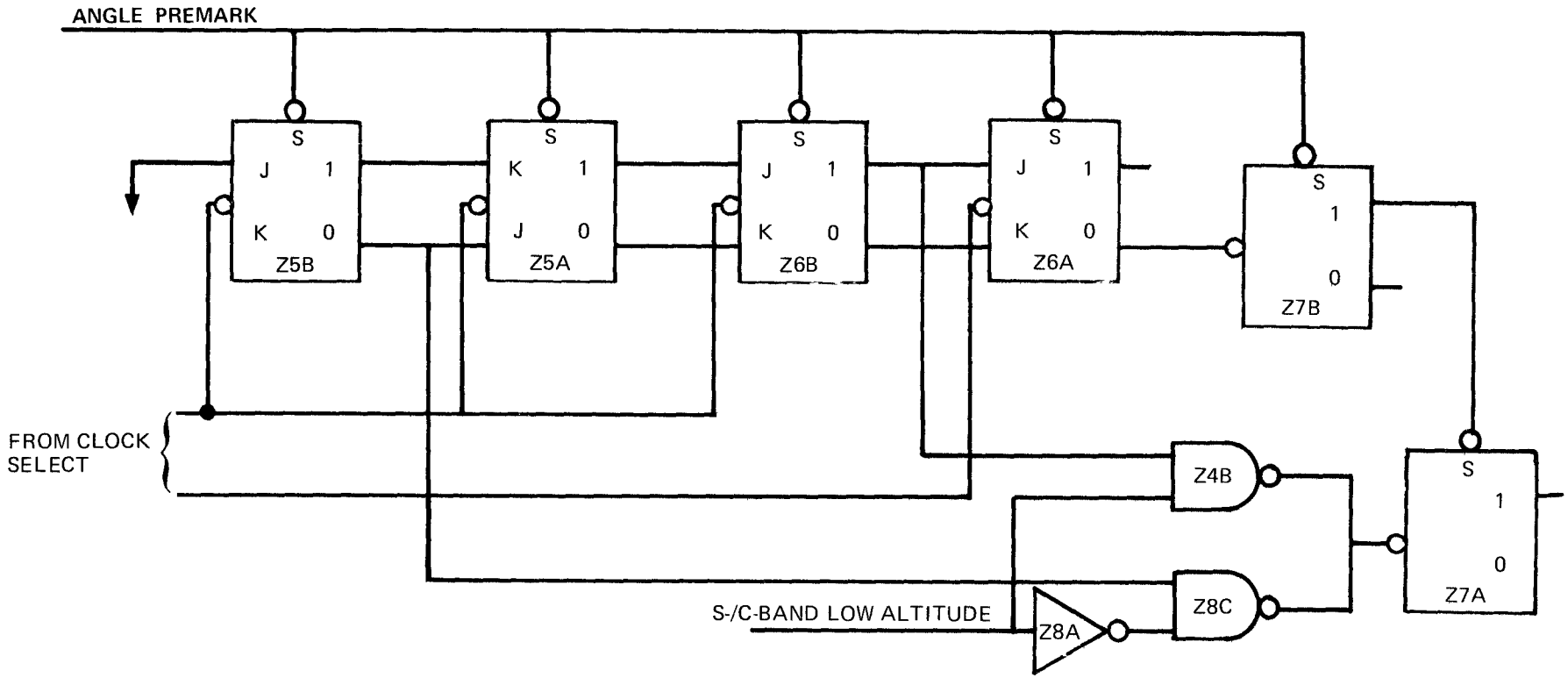


Figure 3-164. Shift Register Section of Angle Gate Generator

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS, RADAR TRAINING SET AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1 FOR FIGURES 3-165 THROUGH 3-167.

will be high regardless of its previous state.

3-1284. The "1" output of flip-flop Z5B is set high at angle premark and becomes low at the first negative transition after the end of angle premark. The flip-flop remains low until the next angle premark since the J and K inputs are low and high, respectively (figure 3-168). The "1" output of flip-flop Z5A is clocked low at the same time since its J and K inputs are controlled by the states of the "0" and "1" outputs of flip-flop Z5B during the preceding clock period. The second negative transition of the clock has no effect on the output of flip-flop Z5B; however, the "1" output of flip-flop Z5A is toggled back to the high state as shown. The successive stages Z6B and Z6A of the shift register are toggled as shown. The clock input to flip-flop Z6A is selected as a function of S- and C-band low altitude.

3-1285. The "0" output of flip-flop Z5B is inverted by gate Z1B to form the angle dump gate. The "1" output of flip-flop Z5A is inverted to form the angle early gate. The "0" output of flip-flop Z6B is combined with the clock for flip-flop Z6D to form the guidance pulse during the last half of the split gate time. The "1" output of flip-flop Z6A is inverted by gate Z2A to form the angle-late gate. During S- and C-band low altitude, the late gate is twice as wide as the dump, early, and split gates.

3-1286. The angle selector gates encompass all of the gates and are formed by flip-flop Z7B. The "0" output of flip-flop Z7B is set to a logic low at angle premark and is toggled back to a logic high at the end of the angle late gate. This output is inverted by gate Z3B to form the angle-selector gate which extends from the angle premark to the end of the late gate.

3-1287. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

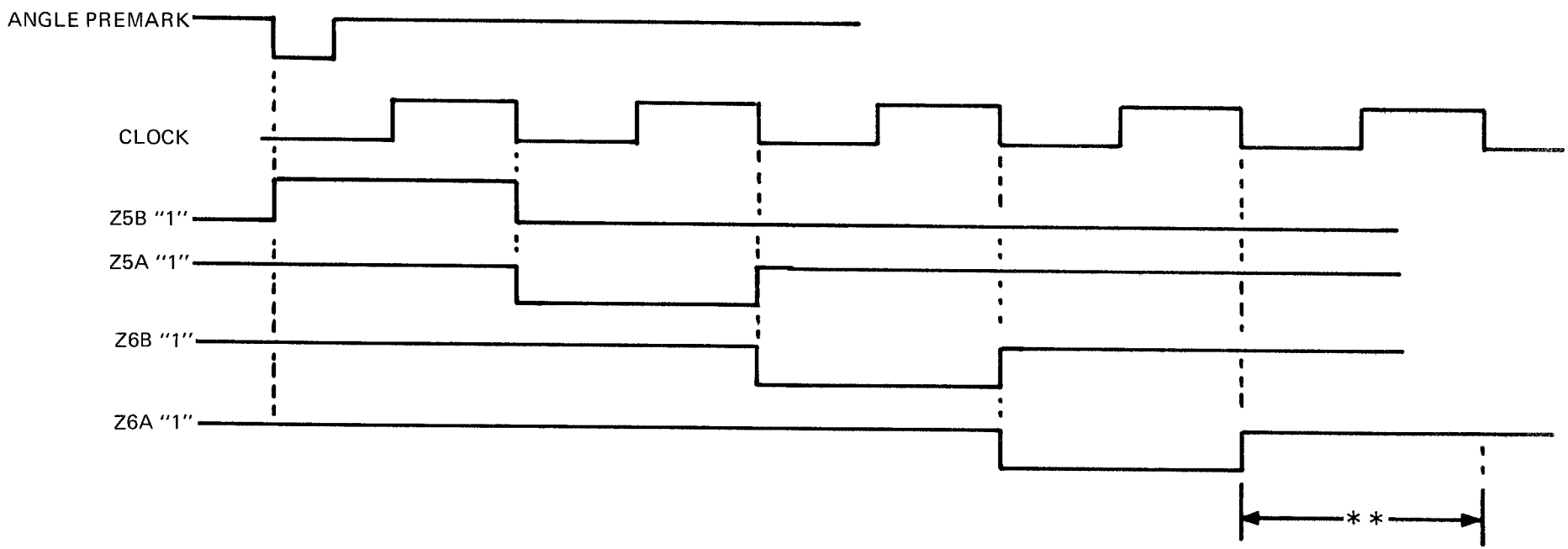
3-1288. ANGLE ERROR CHANNEL. The angle error channel (figure 3-169) develops a tracking error voltage that is proportional to the misalignment of the boxcar video and the early and late angle tracking gates. This circuit operates similarly for all target and transponder angle-tracking systems. The magnitude of the error voltage denotes the amount of misalignment and its polarity denotes the direction of misalignment. A timing diagram of signals on the angle error channel is shown in figure 3-170.

3-1289. The boxcar video input level that is developed in the receiver is adjusted by an attenuator that is controlled as a function of the radar-operating mode, inverted by amplifier Z1, and then gated by the early and late gates into integrators Z2 and Z3, respectively. After processing by integrator Z3 and its associated components, the late-gated boxcar video is first scaled in amplitude by a voltage-divider network selected as a function of the radar mode and then routed to the inverting input of differential amplifier in the angle error amplifier. After the early-gated boxcar video is integrated, it is routed directly to the noninverting input of amplifier Z1. A DC balance voltage that is selected by the radar operating mode is also applied to the inverting input of amplifier Z1.

3-1290. The scaling of boxcar video, the integrated late-gated video level, and the DC balance input to amplifier Z1 are individually adjustable for the radar modes described below. This scaling is accomplished similarly for all cases (figure 3-171).

3-1291. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-1292. After attenuation, the boxcar video is inverted and further scaled by amplifier Z1. The output of amplifier Z1 is gated into integrator Z2 by the early gate. The early gate signal is applied to gate drivers Q1 and Q2 to turn on analog gate Q9 during the early gate. Gate drivers Q1 and Q2 invert and amplify the early gate. Hence, when the early gate input is at +5 volts (logic 1), the output of gate driver Q2 is at -15 volts, which turns on the analog gate transistor Q9. When the early gate input is at 0 volts (logic 0), the



** Z6A "1" OUTPUT TRAILING EDGE POSITION IS DELAYED IN S- & C-BAND LOW ALTITUDE

0095-410A

Figure 3-168. Shift Register Timing

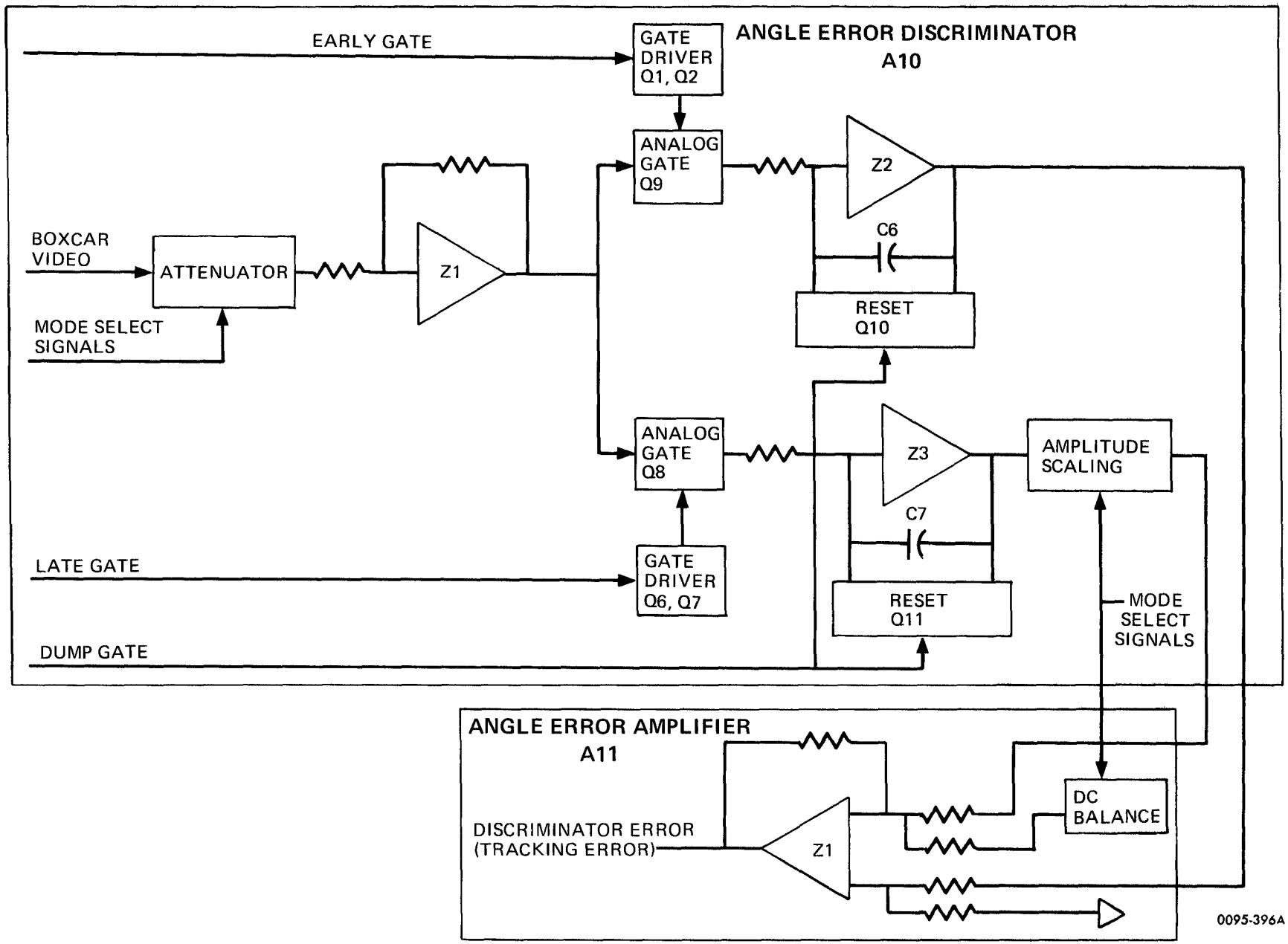


Figure 3-169. Angle Error Channel Block Diagram

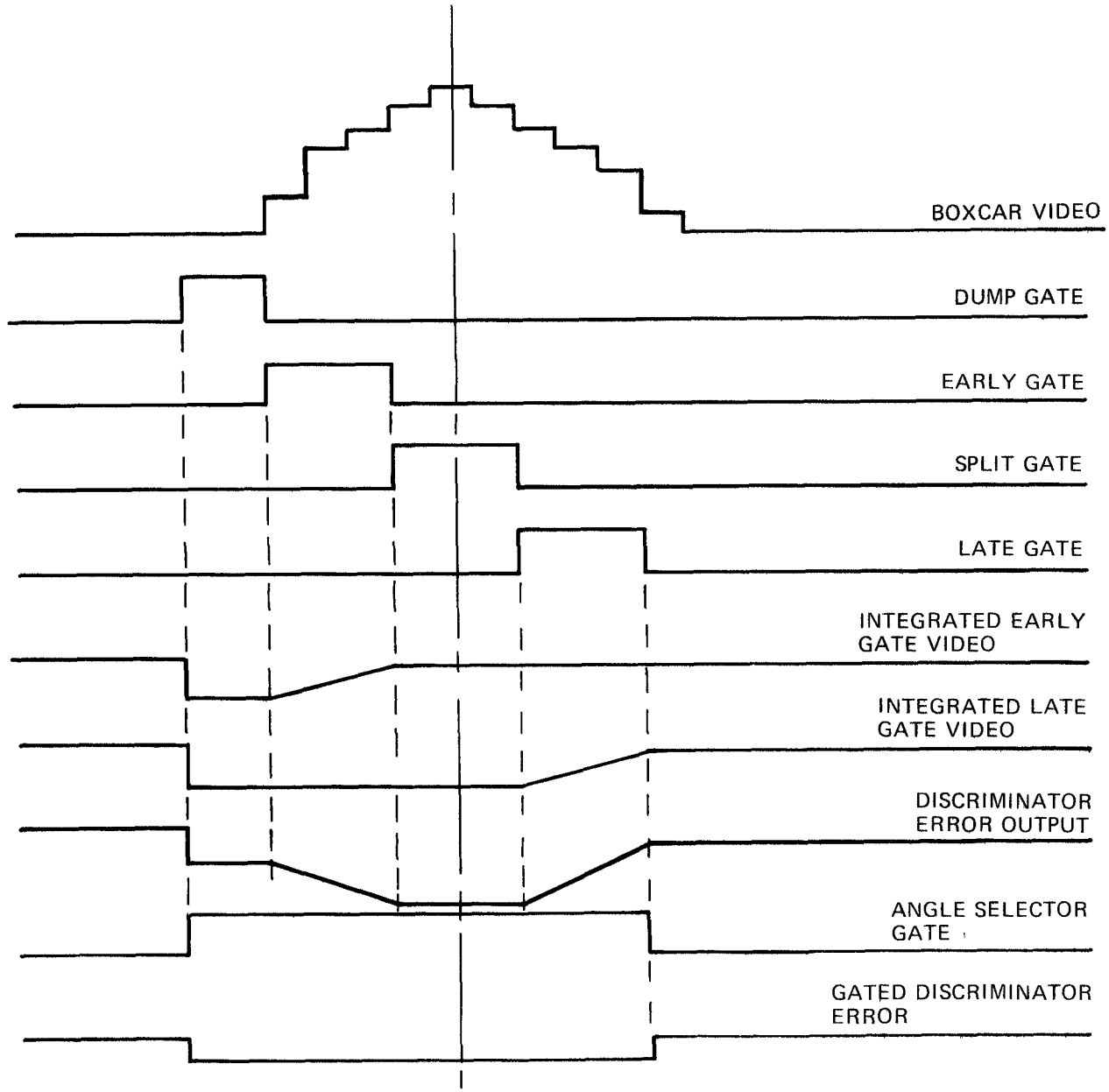


Figure 3-170. Angle Error Channel Timing Diagram

SEE SUPPLEMENTARY MAINTENANCE INSTRUCTIONS, RADAR TRAINING SET, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1 FOR FIGURE 3-171.

output of gate driver Q2 is at +15 volts. The analog gate is turned on when -15 volt power is applied to its gate terminal; in this state, it provides a low impedance path between the source and drain terminals. When +15 volts is applied to the gate terminal, the analog gate is turned off and the source to drain impedance is essentially infinite. The integration time constant of integrator Z2 is determined by network R21-C6. The output voltage of integrator Z2 is proportional to the amplitude and time duration of the boxcar video at the input. The output of integrator Z2 is adjusted to zero volts when no boxcar video is present by adjusting potentiometer R22. The DC voltage on the wiper of potentiometer R22 is divided by divided network R23-R24 and applied to the input of integrator Z2 through resistor R26.

3-1293. Integrator Z2 is reset to 0 volts by the dump gate which occurs just prior to the early gate. The dump gate turns on integrator reset transistor Q10 which allows capacitor C6 to discharge through the saturation resistance of transistor Q10.

3-1294. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-1295. The early gate error signal (the output of integrator Z2) and the late gate error signal (the attenuated output of integrator Z3) are connected to the noninverting and inverting inputs respectively of amplifier Z1 on the angle error amplifier card.

3-1296. In addition to the late-gated signal, a DC bias voltage is also applied to the inverting input of amplifier Z1. In the S-band normal (not low altitude) mode, logic 1 (+5 volt) is applied to gate drivers Q1 and Q2 which turns on analog gate Q3. When gate Q3 is turned on, a DC voltage from the wiper of potentiometer R7 is applied through resistor R38 to the inverting input of amplifier Z1. Potentiometer R7 is adjusted so that the angle track point drift is minimized when no boxcar video is present. Similar track point drift compensation is accomplished for the other radar modes.

3-1297. The discriminator error signal at the output of amplifier Z1 is a voltage that is proportional to the misalignment of the boxcar video signal and the early and late angle tracking gates. This error signal is routed to the discriminator error meter at the azimuth angle tracker station and to the angle track integrator. This signal is the angle tracking error of the system.

3-1298. See Supplementary Maintenance Instructions, Radar Training Set, AN/MPS-T1(V), T.O. 43D7-11-21-2-1-1.

3-1299. Relay K1 on the angle track integrator assembly in the target and transponder track loops and relays K1 and K6 in target track assembly 1A5A4 are energized to accomplish the switching of the inputs.

3-1300. The closed-loop operation of the angle track loops is similar for both target and transponder channels. This closed-loop operation maintains the alignment of the boxcar video and the angle tracking gates. The network consisting of resistors R4, R5, R6 and R7, and capacitor C4 in the angle track integrator assembly is a velocity of angle rate memory circuit and minimizes the angle tracking error developed due to movement of the target between angle scans.

3-1301. AUTO SENSING - TRANSPONDER. The automatic sensing circuits sense a valid automatic tracking condition and generate signals to hold the transponder track loops in the automatic track mode after the initiation of automatic track by the operator when a valid automatic track condition exists (figure 3-172).

3-1302. Determination of a valid automatic track condition in range, azimuth, and elevation is based on the alignment of the boxcar video and the late angle tracking gates. The existence of boxcar video shows that the range tracking gates and the transponder video have been correctly aligned with the boxcar video.

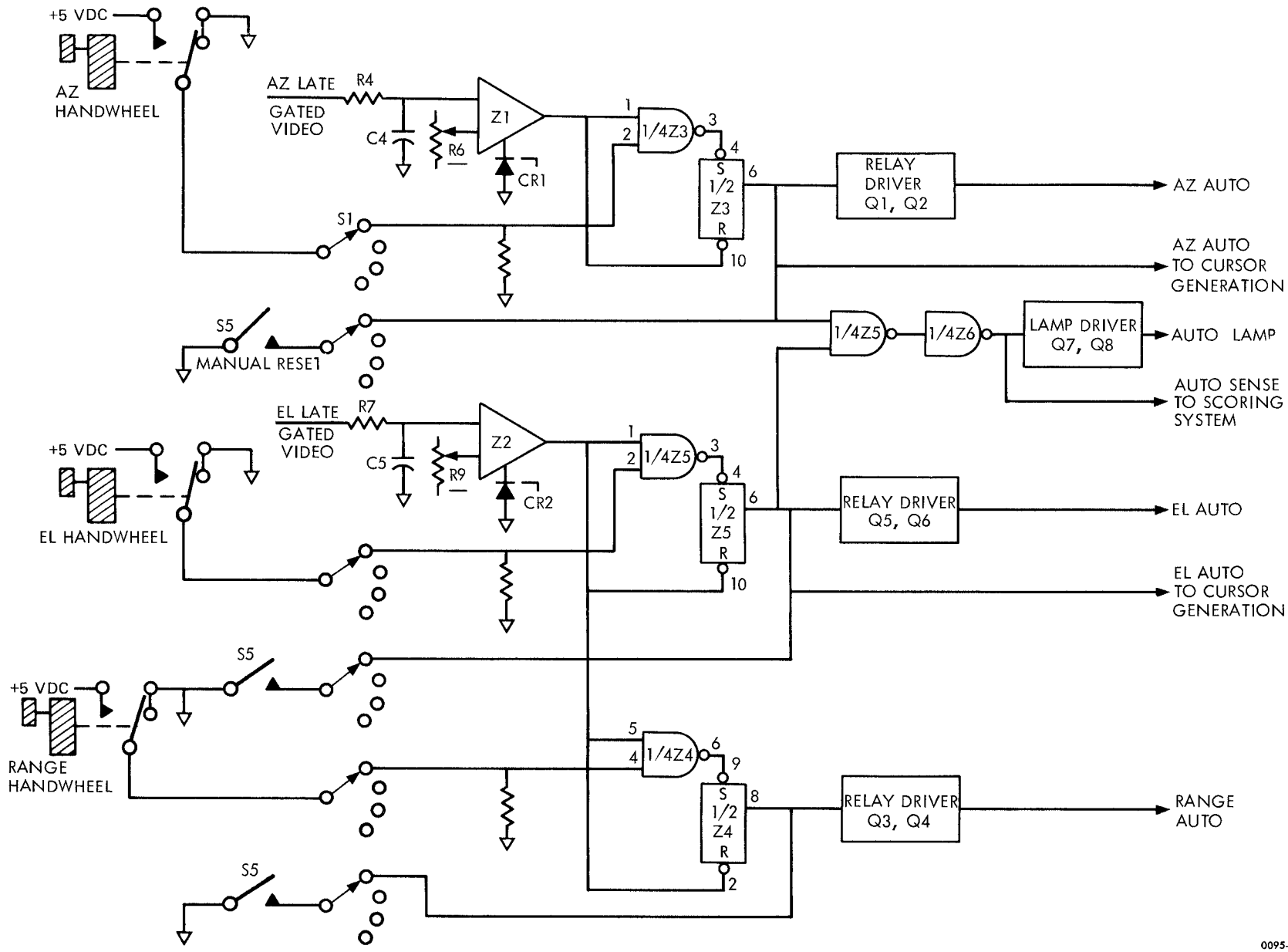


Figure 3-172. Auto-Sensing (Transponder)

3-1303. The boxcar video gated by the late elevation tracking gate is filtered by the integrator composed of resistor R7 and capacitor C5. When this integrated signal exceeds the threshold voltage set by potentiometer R9, comparator Z2 output is +5 volts. If range automatic track is initiated at this time, the output at pin 6 of gate Z4 will go to 0 volts setting the following set/reset flip-flop and causing the output at pin 8 of the flip-flop to go to +5 volts. The relay driver consisting of transistors Q3 and Q4 provides a 28-volt return signal (the range auto signal) to switch the range track loop to automatic. The azimuth automatic and elevation automatic signals are developed similarly.

3-1304. Depressing switch S5 causes the output of the flip-flop to return to zero volts thus removing the range auto signal.

3-1305. When both azimuth automatic and elevation automatic signals exist, the output at pin 11 of gate Z5 is zero volts and pin 6 of gate Z6 is at +5 volts. As a result, the automatic sense signal is generated and routed to the missile simulation and scoring system. The lamp driver consisting of transistors Q7 and Q8 provides a 28-volt return signal to light the AUTO indicator on the transponder operator tracking control unit.

3-1306. The 5-volt automatic track signals are routed from the output of set/reset flip-flops Z3 and Z4, through gates Z5 and Z6 cursor gating circuits where they select the transponder cursors to be displayed.

3-1307. CURSOR GENERATION-TRANSPONDER. The cursor generation circuits generate the transponder cursors for the azimuth and elevation transponder displays. These cursors appear as a short vertical line on the displays. On the horizontal axis of the display the cursors are developed on the next raster line following the angle guidance pulse (center of angle track gates). The cursors start in range at the time of the range guidance pulse (center of the range track gates) and terminate after a fixed delay. This delay is equal to the coded delay of the associated transponder (12, 24, 36, or 48 microseconds) so that, when aligned with the transponder video in the acquisition mode, the cursor will start at the first video return and terminate at the second video return. This allows the operator to "sort" the transponder replies into the correct transponder track loops (i.e., track video from transponder No. 1 (the video separated by 12 microseconds) with the transponder No. 1 tracking loops by matching the cursor length with the video separation).

3-1308. These transponder cursors are gated so that the cursors routed to the displays are the cursors for the transponder track loop being controlled by the operator in the acquisition mode and the cursors for any transponders that are being automatically tracked as determined by the automatic sensing circuits (figure 3-173).

3-1309. The transponder cursor is developed from a RANGE cursor (generated in the transponder range gate generator) that occurs one for every radar PRI and is gated by a signal derived from the angle guidance pulse and enabled as a function of the operating mode of the track loop.

3-1310. The azimuth guidance pulse ($AZ\overline{GP}$) is routed from the angle gate generator A9 to the gate selection logic of circuit board A67. Circuit board A67 is used to select the X-band dish boresight sync signal for cursor generation during X-band reference track operation. The output of the logic selection is routed through the delay card A71 to pin 9 of SET/RESET flip-flop Z6A (when $\overline{GP}$ goes to ground). This output and the next preknock pulse following the guidance pulse causes the output at pin 6 of gate Z5 to go to ground, thereby setting flip-flop Z6B so that its output at pin 6 is at +5 volts (figure 3-174). The next range reset will reset both flip-flops Z6 and Z6B until the next guidance pulse.

3-1311. The gated cursor output on pin 6 of NAND gate Z8 is the range cursor that occurs during the time that the output of flip-flop Z6B is high, when the track loop

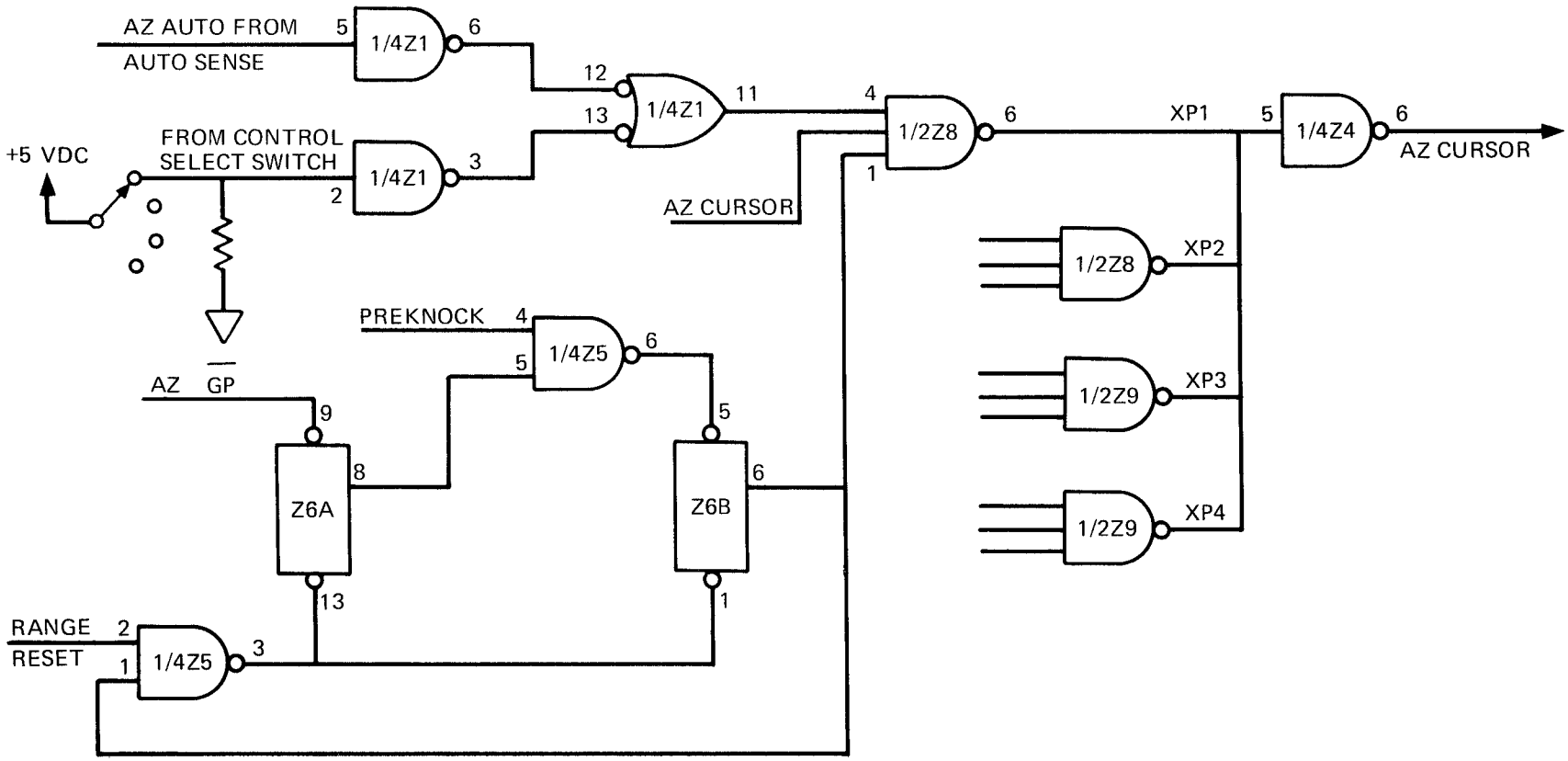


Figure 3-173. Transponder Cursor Generation and Gating

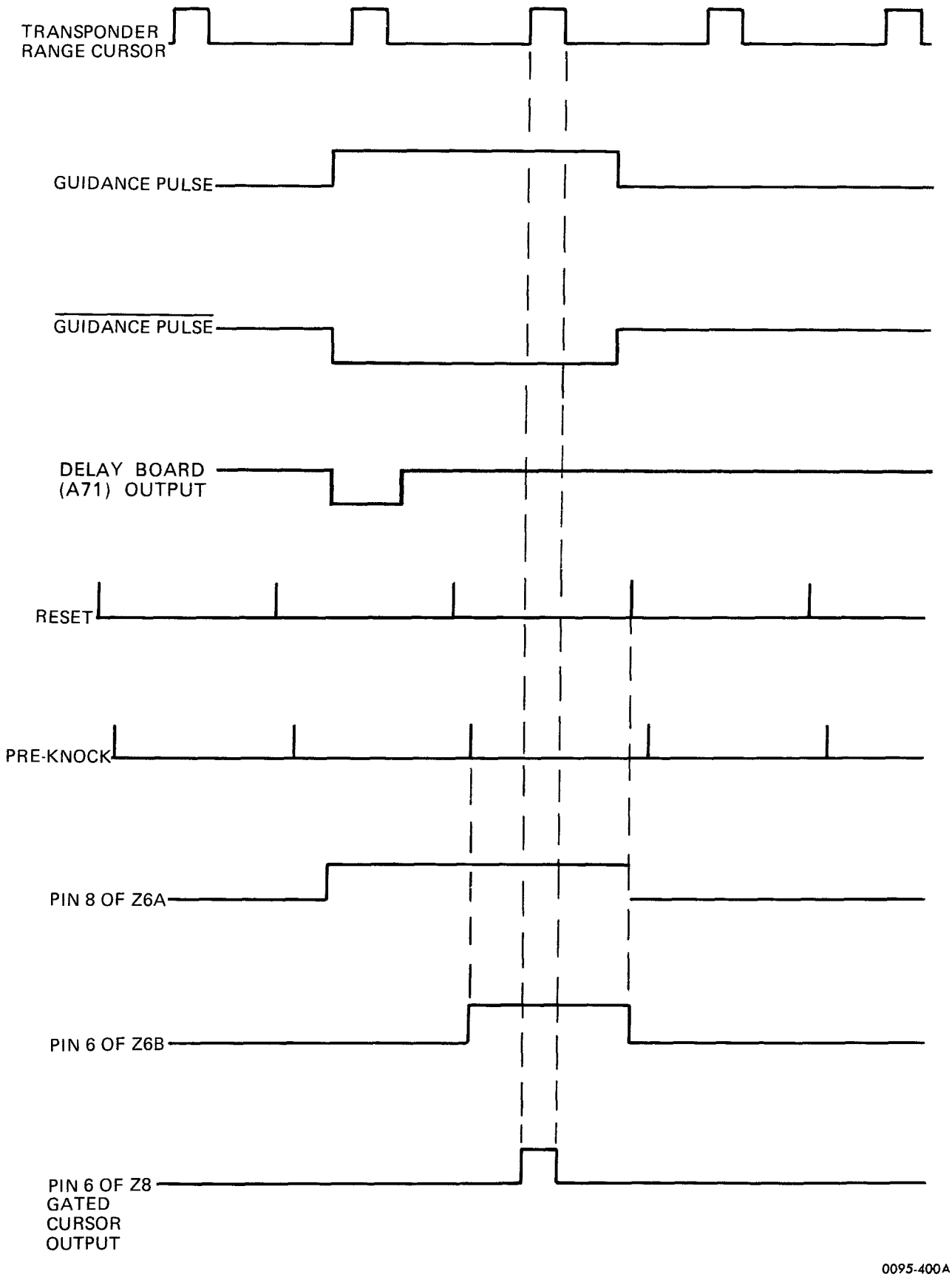


Figure 3-174. Transponder Cursor Generation Timing Diagram

is in the acquisition mode or in the automatic track mode as sensed by the output at pin 11 of NOR gate Z1.

3-1312. The inverted guidance pulses for transponders 2, 3, and 4 are routed from the associated angle gate generators through the delay circuit board and to the cursor gating circuit boards where they are used to generate the respective transponder cursors in a manner similar to that described for transponder No. 1. The gated cursor outputs from the cursor gating sections for transponders 2, 3, and 4 are summed at the output of gate Z8 due to the wired-OR configuration. This summed cursor output is inverted by a section of gate Z4 which provides the azimuth cursor input to the azimuth display. The elevation cursors are generated similarly.

3-1313. MISSILE SIMULATION AND SCORING GROUP.

3-1314. The missile simulation and scoring system consists primarily of a general purpose digital computer and a computer interface unit. The digital computer theory of operation is described in vendor manuals. (Refer to table 1-6.) The circuit descriptions presented in the following paragraphs are limited primarily to the analysis of the computer interface, the methods of data conversion used in the computer interface, and the transfer of data between the computer interface and the digital computer.

3-1315. DATA TRANSFER. Data is transferred between the digital computer and computer interface by means of 16 balanced, twisted pair, bidirectional data lines. The direction of data transfer through these data lines and the timing of the data transfer are controlled by the digital computer by means of six sets of control lines. The control lines are identical to the data transfer lines except that the signal flow is unidirectional (signals are sent in one direction).

3-1316. These control signals consist of output command pulses (OCP's), which control the direction of data transfer through the lines and the routing of the data to the function address decoding circuit; control signals, which are generated when the computer interface and digital computer are ready to send or receive data; and a master clear signal, which resets circuits in the computer interface unit. The master control of date transfer is maintained by the digital computer under the control of the computer program. The six control signals, their designations, and their functions are summarized below:

a. OCP 0030 (SEND) is generated from the computer program and sets the digital computer to the receive mode and the computer interface to the send mode.

b. OCP 0130 (REC) is generated from the computer program and sets the digital computer to the send mode and the computer interface to the receive mode.

c. OCP 0230 (ADDR) is generated from the computer program and sets circuitry within the computer interface control section so that the next data sent through the data lines is routed to the function address decoding section.

d. CHRDY (Channel Ready) is generated by the computer when it is ready to send or receive data.

e. DROPN (DROP IN) is generated by the computer interface when it is ready to send or receive data.

f. MSTCL (Master Clear) is derived from the master clear switch on the computer control panel and resets circuits within the computer interface.

3-1317. Data transfer to the Computer. The computer interface functions which accept data from the radar and transfer it to the computer are enumerated on the upper portion of figure 3-175. The time relationship of the signals necessary to transfer data from the interface unit to the computer are also shown in figure 3-175. All signals except those related to pedestal

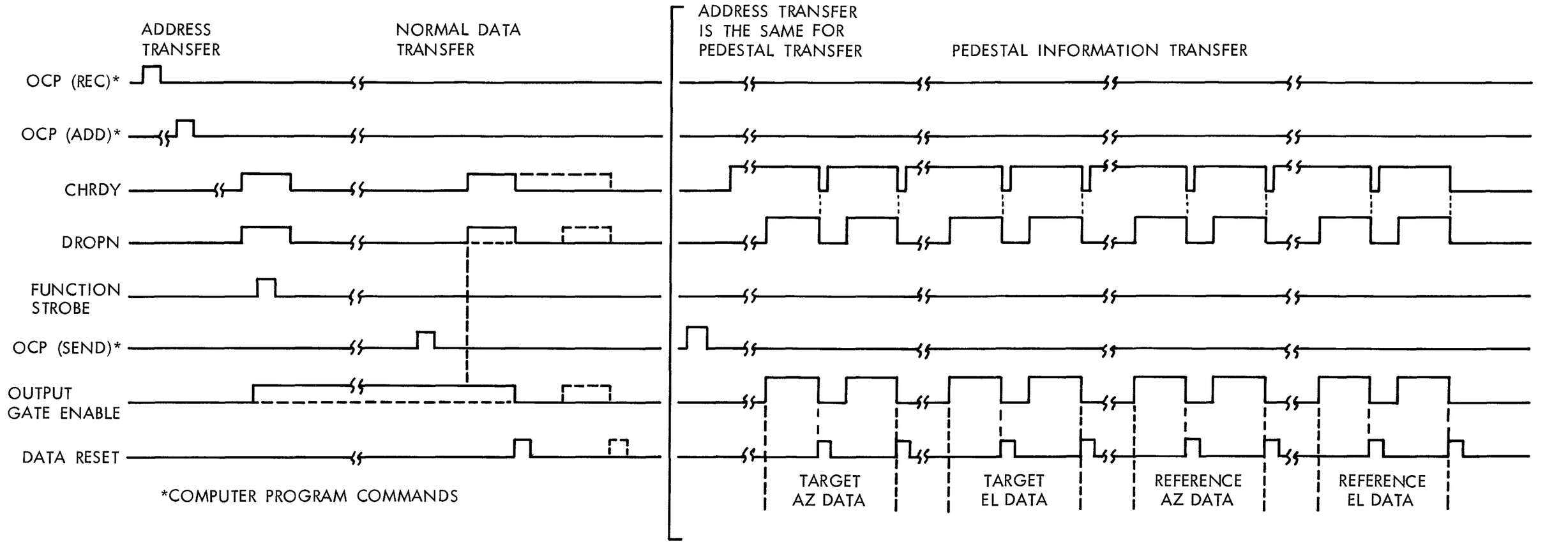


Figure 3-175. Data Tansfer to Computer Timing Diagram

information are transferred to the computer as described below:

a. OCP 0130 (REC) connects the 16 receive lines to the 16 lines so the address word can be transferred to the interface.

b. OCP 0230 (ADDR) sets circuitry within the interface control so that a function strobe is generated when the computer puts the address on the data lines.

c. When the computer puts the address on line, it sends the CHRDY pulse which tells the interface that the address can be decoded.

d. When the CHRDY pulse occurs, the interface control sends the DROPN pulse back to the computer to indicate that decoding is in process.

e. The interface control then sends the function strobe to the function address decoding circuits where the address is decoded. This address function strobe causes the function selected to place its data on the 16 send lines.

NOTE

Range conversion data is not immediately available for transfer to the computer when it has been addressed by the computer. In this case a time delay that is controlled by the computer interface exists before this range data is placed on the send lines to the computer.

f. When the selected function puts the data on the 16 send lines, the output gate enable pulse is sent to the interface control to indicate that the data is ready for transfer.

g. The computer sends an OCP 0030 (SEND) pulse which connects the 16 send lines to the 16 data lines.

h. When the computer is ready to accept the data, it sends the CHRDY pulse.

i. When CHRDY and OUTPUT GATE ENABLE are both present (for range data transfer CHRDY will probably occur before OUTPUT GATE ENABLE as shown by dotted lines), the interface control generates a 1-microsecond delay and sends DROPN back to the computer indicating that the data can be transferred.

j. The trailing edge on DROPN cuts off CHRDY and the end of CHRDY produces a 1-microsecond DATA RESET pulse which resets the interface and disconnects all functions from the data lines.

3-1318. The pedestal data consists of four 17-bit words (Tgt Az, Tgt EL, Ref Az and Ref EL). Two 16-bit words are used to transfer each 17-bit word. Signals relating to the pedestal information are transferred to the computer as described below:

a. OCP 0130 (REC) connects the 16 receive lines to the 16 data lines so the address word can be transferred to the interface.

b. OCP 0230 (ADDR) sets circuitry within the interface control so that a function strobe is generated when the computer puts the address on the data lines.

c. When the computer puts the address on line, it sends the CHRDY pulse which tells the interface that the address can be decoded.

d. When the CHRDY pulse occurs, the interface control sends the DROPN pulse back to the computer to indicate that decoding is in process.

e. The interface control then sends the function strobe to the function address decoding circuits when the address is decoded. This address function strobe causes the function selected to place its data on the 16 send lines.

f. The computer sends an OCP 0030 (SEND) which connects the 16 send lines to the 16 data lines.

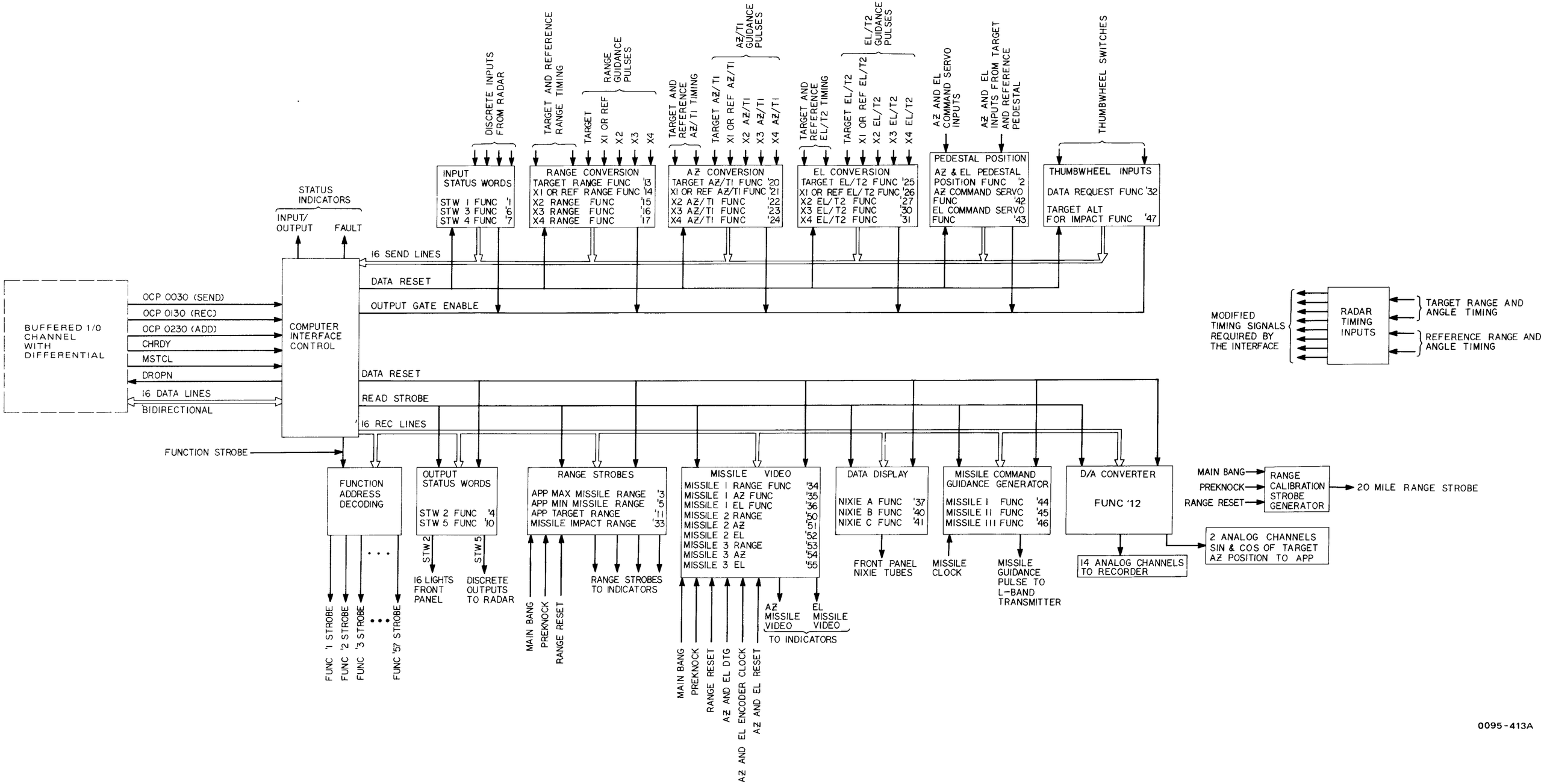


Figure 3-176. Computer Interface Block Diagram

g. When the computer is ready to accept data, it generates the CHRDY pulse.

h. When the first word is ready to be transferred, output gate enable is generated, and the interface control generates a 1-microsecond delay. DROPN is then sent back to the computer indicating that the data can be transferred.

i. Steps g and h are repeated seven more times until all eight 16 bit words have been transferred.

j. The trailing edge of the last CHRDY pulse produces a 1-microsecond data reset pulse which resets the interface.

3-1319. Data Transfer From the Computer. The functions that transfer data from the computer to the radar are shown in the lower portion of figure 3-176. The time relationship of the signal necessary to transfer data from the computer to the interface are shown in figure 3-177. The signals occur in the sequence shown below:

a. OCP 0130 (REC) connects the 16 receive lines to the 16 data lines so the address word can be transferred to the interface.

b. OCP 0230 (ADDR) sets circuitry within the interface control so that a function strobe is generated when the computer puts the address on the data lines.

c. When the computer puts the address on line, it sends the CHRDY pulse which tells the interface that the address can be decoded.

d. When the CHRDY pulse occurs, the interface control sends the DROPN pulse back to the computer to indicate that decoding is in process.

e. The interface control then sends the function strobe to the function address decoding circuits where the address is decoded. This address function strobe causes the function selected to place its data on the 16 send lines.

f. The CHRDY pulse occurs when the computer has placed the data on the 16 data transfer lines.

g. DROPN occurs coincidently with CHRDY since each function has an input resistor in the interface and reading information into the interface occurs without delay.

h. The READ STROBE occurs during DROPN enabling the input register of the addressed location to store the data.

i. When the input register has stored the data from the 16 data receive lines the DROPN pulse ends thus cutting off the CHRDY pulse.

j. The end of CHRDY produces the 1-microsecond data reset pulse. This pulse disconnects all functions from the data lines.

3-1320. The FAULT AND INPUT/OUTPUT signals are connected to indicators on the mode control panel 1A1A1 and on the computer interface 1A5A14 so that the condition of the data transfer between the computer and computer interface can be monitored. The FAULT indicators light when the computer is not transferring data to or from the computer interface at a predetermined normal rate. When the FAULT indicator is lighted, the INPUT or OUTPUT indicator on the mode control panel lights to indicate the direction of the last data transfer. On the computer interface, the INPUT/OUTPUT indicators indicate the direction of data transfer in relation to the computer and operate independently of the FAULT indicator.

3-1321. Differential Transmitter-Receiver. Differential transmitter-receiver circuits in the computer and computer interface are connected to the data transfer and control lines. Under control of the computer, these circuits determine the direction of data transfer and allow bidirectional data transfer over the 16 pair of data lines. Operation of the circuits at either end of the data lines is identical. Only those circuits located in the computer interface will be explained.

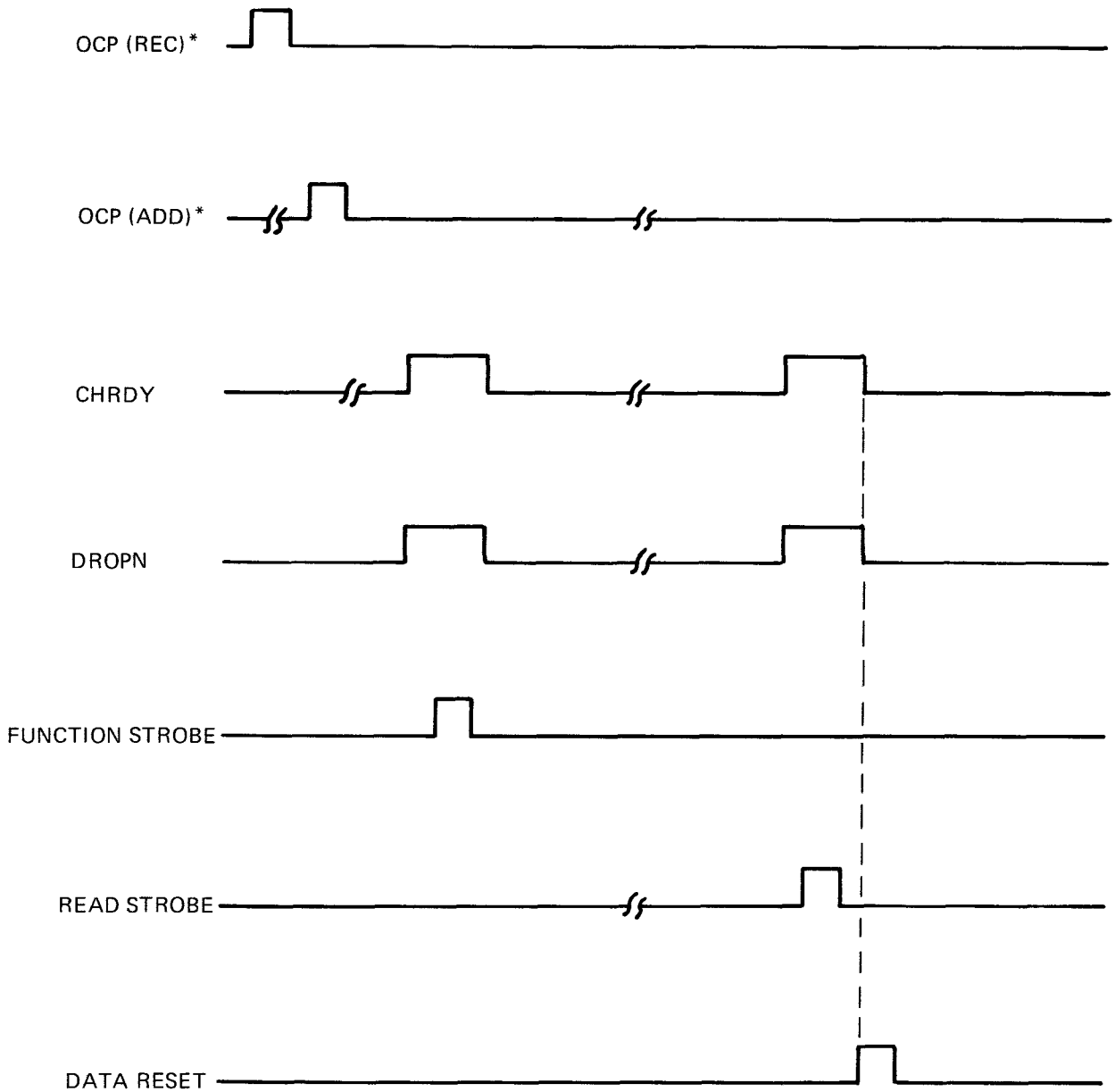


Figure 3-177. Data Transfer From Computer

3-1322. A functional diagram of the transmitter receiver interconnection is shown in figure 3-178. Data lines A and B represent one of the balanced-pair data lines. During the receive function (interface receiving data from the computer) the computer is transferring a logic 1 signal. Conductor A will be more positive than conductor B, differential amplifier Q4-Q5-Q6 will apply a logic 1 to pin 2 of gate network Z2 and the output of gate Z2B will be a logic 0. This logic 0 output is applied to pin 13 of gate Z2A thereby generating a logic 1 on receive output. If the computer is transferring a logic 0, line B will be more positive than line A and the output of differential amplifier Q4-Q5-Q6 will be a logic 0 which is applied to pin 2 of gate network Z2. With a logic 0 applied, the output of gate Z2B is a logic 1 and the receive output at the output of gate Z2A is a logic 0.

3-1323. During the send function (the computer interface sending data to the computer), the occurence of a logic 1 at the send input and a positive send line control signal will cause balanced data line A to be more positive than B. A logic 0 send input will cause the opposite output.

3-1324. The differential transmitter-receiver circuit board assembly contains two identical transmitter channels and two identical receiver channels. One of the receiver channels is made up of transistors Q4, Q6, Q6, and gate Z2. When input B-1 is more positive than input A-1, transistor Q6 turns on. This places a logic 0 at pin 2 of gate Z2 creating a logic 1 at PIN 21 (output 1 minus) and a logic 0 at pin 5 (output 1 plus). If input A-1 is more positive than input B-1, the reverse output logic state will occur. The enable output line is tied to the receive line control to control the data transfer, and it must be at a logic 1 before data transfer can occur.

3-1325. One of the transmitter channels is made up of transistors Q1, Q2, Q3, and two sections of gate Z1. Input 1-1 is tied to the send line control and is a logic 1 for data transfer. When logic 1 is applied to input 2-1, pin 6 of gate Z1 is a logic 1 and transistor Q2 is turned off. With transistor Q2 turned off, transistors Q1 and Q3 are turned on. This allows a current flow of approximately 20 milliamperes at output B-1 and output A-1. Outputs A-1 and B-1 are tied to line A-1 and line B-1 which is the line termination network created by resistors R13 through R16. A similar termination network exists at the other end of the line in the computer. With 20 milliampers current flow through lines A-1 and B-1, line A-1 is more positive than line B-1. If input 2-1 is at 0, transistor Q2 is turned on and transistors Q1 and Q3 are turned off; outputs A-1 and B-1 are in an open circuit condition. With no output current flow, the termination networks cause output B-1 to be more positive than output A-1.

3-1326. Transfer Control Circuit Analysis. The control and data lines section of the computer interface handles the data transfer commands. Data transfer commands consist of output control pulses OCP (REC), OCP (SEND), OCP (ADD), master clear (MSTCL), channel ready (CHRDY), and drop in (DROPN).

3-1327. Each data transfer begins by reading in the address to which the data word is to be sent from the computer or reading in the address from which data is to be sent to the computer. Interface address assignments are listed in table 2-69. The OCP (REC) signal from the computer program is applied through differential receiver A1A9 and starts the sequence by setting flip-flop A1A12-1 which forces the 1 output to a logic 1. The 1 output of flip-flop A1A12-1 enables gates A1A13-1 and 2, and causes the send line control to assume logic 0. The logic 0 output of flip-flop A1A12-1 causes a logic 1 on the receive line control, placing transmitter-receiver circuits A1A1 through A1A8 in the receive mode. The computer next sends the OCP (ADD) which sets flip-flop A1A12-2 and the 1 output enables the second input to gate A1A13-1. The computer now places the function address on the 16 data lines.

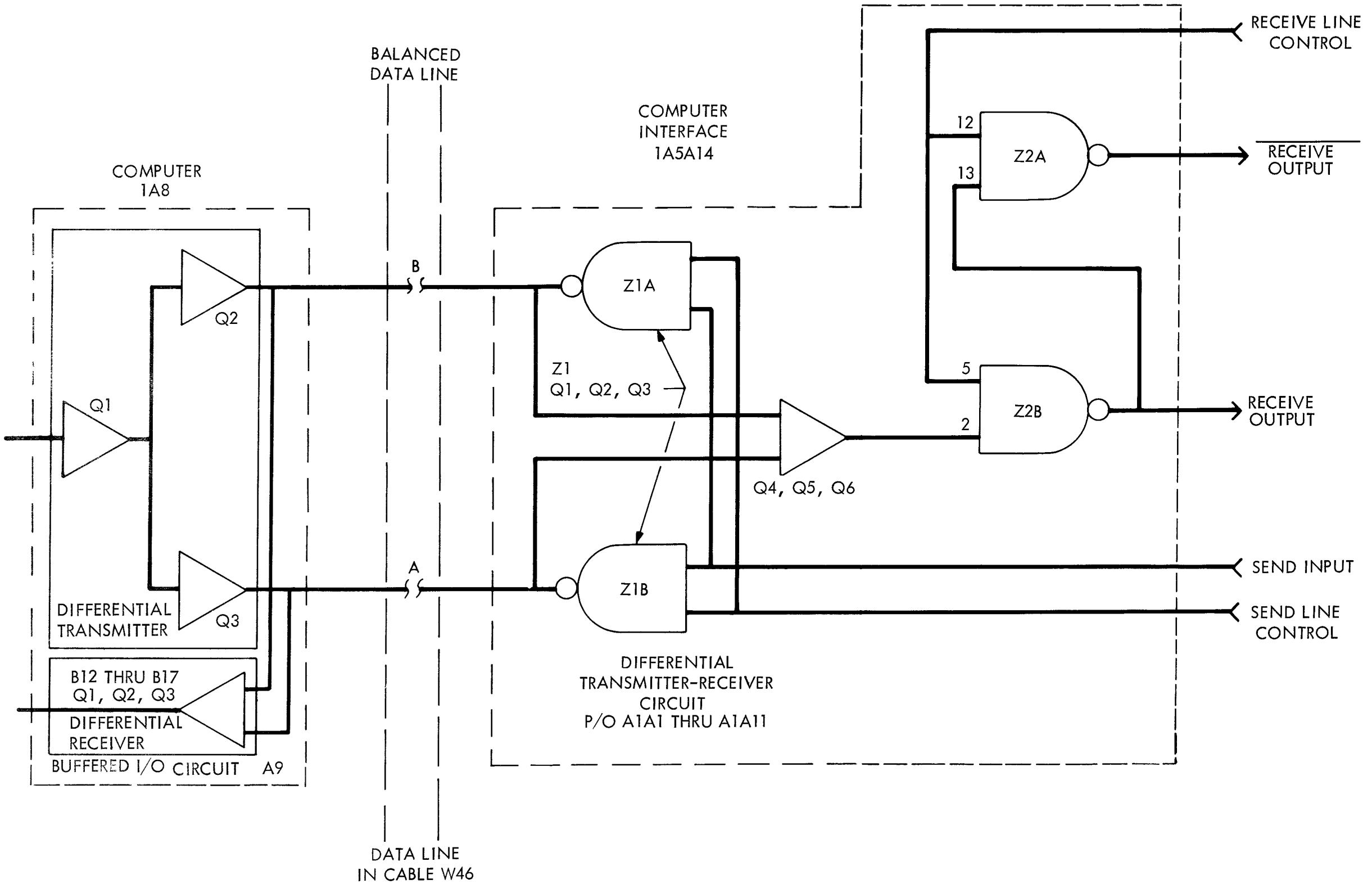


Figure 3-178. Data Transmitter-Receiver Functional Diagram

3-1328. When the function address is on line, the computer sends CHRDY. CHRDY is gated through A1A13-1 to CHRDY-ADD. The leading edge of CHRDY-ADD fires single-shots A1A14-1 and 2. Single-shot A1A14-1 generates a 4-microsecond pulse which is passed through gate A1A13-8 as DROPN. This DROPN pulse informs the computer that the interface is decoding the address. Single-shot A1A14-2 generates a 2-microsecond delay then fires single-shot A1A14-3 which generates a 1-microsecond function strobe. The function strobe is sent to the function address decoding gates. The function address decoding gates transfer the function strobe to the addressed function thereby enabling this function.

3-1329. Address decoding begins when single-shot A1A14-1 times out (4 microseconds), DROPN ends, and the computer terminates CHRDY at the trailing edge of DROPN. Single-shot A1A14-4 fires from the trailing edge of CHRDY-ADD, generating the 1-microsecond pulse which sets flip-flop A1A12-3. The logic 0 at the 0 output of flip-flop A1A12-3 resets flip-flop A1A12-2, disabling gate A1A13-1. The logic 1 at the 1 output of flip-flop A1A12-3 is sent to gates A1A13-2 and -3. At this time, the addressed function has been enabled and the computer interface is ready to send data to that function or receive data from that function.

3-1330. The state (set or reset) of flip-flop A1A12-1 determines if the interface is in the send or receive mode. The OCP (SEND) signal resets the flip-flop and places the interface in the receive mode. The 1 and 0 outputs which are applied to gates A1A13-1, -2, and -3 determines which gate will pass the next CHRDY signal from the computer.

3-1331. If the interface is to receive data, the next signal from the computer will be CHRDY since the interface is already in the receive mode from the address transfer sequence. Gate A1A13-2 will pass CHRDY and generate CHRDY-REC. CHRDY-REC is sent to single-shots A1A15-1 and -2. Single-shot A1A15-1 generates a 4-microsecond pulse which is sent to the computer as DROPN. Single-shot A1A15-2 generates a 2-microsecond delay and fires one-shot A1A15-3 which generates a 1-microsecond read strobe. The read strobe is sent to the addressed function to strobe the on-line data into the selected register. When DROPN ends, the computer terminates CHRDY and the trailing edge of CHRDY triggers single-shot A1A15-4 (through NOR gate A1A13-4). Single-shot A1A15-4 generates a 1-microsecond data reset pulse. The data reset pulse and MSTCL signal are combined by NOR gate A1A17-11. These two signals are sent to reset all functions in the interface. If the disable data reset signal is at logic 1, the signals also pass through gate A3A33-9 to reset flip-flops A1A12-2 and -3, which places the interface in the standby mode. When the pedestal information is transferred to the computer, eight 16-bit data words are sent to the computer on one interface address. During this time, the disable data reset line is at logic 0 which disables gate A3A33-9. This keeps the data reset signal from resetting flip-flops A1A12-2 and -3 until the eight words are transferred.

3-1332. If the send function is selected (interface sending information to the computer), the next signal after the address from the computer will be OCP (SEND). OCP (SEND) resets flip-flop A1A12-1, which places the transmitter-receiver circuits A1A1 through A1A8 in the send mode by causing a logic 1 on the send line control. The 0 output of flip-flop A1A12-1 also enables gate A1A13-3. The incoming CHRDY signal will gate through A1A13-3 as CHRDY-SEND.

3-1333. When the interface is ready to send data, output gate enable occurs. The occurence of both CHRDY-SEND and output gate enable triggers single-shot A1A16-1 through NAND gate A1A13-6 and inverter A1A30-9. Single-shot A1A16-1 generates a 1-microsecond delay and fires single-shot A1A16-2. The output of single-shot A1A16-2 is sent to the computer as DROPN. DROPN causes the computer to read the data which is on line. When

DROPN ends, CHRDY ends and the trailing edge of CHRDY triggers single-shot A1A16-4, generating the data reset pulse as described in the preceding paragraph.

3-1334. Another input to single-shot A1A16-1 is pedestal data inhibit. This single-shot is used when the pedestal information is transferred to the computer to generate a DROPN signal for each of the eight 16-Bit data words transferred to the computer.

3-1335. FAULT and INPUT/OUT Indicators. The OCP (ADD) signal is received from the computer before each data transfer. OCP (ADD) fires single-shot A1A16-3 which has a time constant longer than the update rate of the computer. Failure to receive OCP (ADD) inputs will allow the single-shot to time out. Timing out of the single-shot will cause a logic 1 on the COMPUTER FAULT output. This output will cause the FAULT indicator on the mode control panel and the interface unit to light indicating that data is not being transferred at a normal rate.

3-1336. The condition of flip-flop A1A12-1 (SET or RESET) determines if the computer interface is in the send or receive mode. The state of this flip-flop determines which indicator (INPUT or OUTPUT) is lighted. Current driver A5A5 drives the FAULT and INPUT-OUTPUT indicators on the computer interface. The 0 output on flip-flop A1A12-1 is applied to the INPUT current driver and the 1 output is applied to the OUTPUT current driver. The INPUT-OUTPUT indicator on the mode control panel is gated by the FAULT indicator and does not operate unless the FAULT indicator is lighted. The INPUT-OUTPUT indicator on the computer interface functions independently of the FAULT indicator.

3-1337. FUNCTION ADDRESS DECODING. The function address decoding circuitry decodes the address word from the computer and enables the addressed function to transfer or accept data from the computer. The address is contained in bits 11 through 16 of the address word. Only these six bits of the address word are used.

3-1338. The function address decoding circuitry consists of forty-seven 8-input NAND gates: cards A1A19 through A1A33 and A1A36. Six inputs to the gates are controlled by the six address bits. One input is not connected and automatically assumes the 1 state. The eighth input is connected to the function strobe. The R11 through R16 and $\overline{R11}$ through $\overline{R16}$ (the receive lines 11 through 16) connections to the 47 gates are arranged so that these six inputs (simultaneously applied) will all be a logic 1 only on the gate corresponding to the addressed function. Only the gate having the six logic 1 inputs will pass the function strobe from the control section to the corresponding function. The function strobe then enables circuitry within the function to transfer data.

3-1339. Output Gate Enable. When the output gate enable is coincident with CHRDY-SEND, DROPN is generated when data is sent to the computer. When the output gate of a selected send function is enabled, the enabling signal is sent to one of the gates on card A5A4 or card A2A7. All of the gate enable inputs are normally at logic 0. This creates a logic 1 on the output gate enable signal line. When one of the send functions enable its output gate, the gate enable line for that function goes to logic 1 and the output gate enable signal goes to logic 0. Therefore, a logic 0 on the output gate enable signifies that data is ready to be sent to the computer.

3-1340. RADAR TIMING INPUTS. The radar timing inputs section receives input signals from the transmitter and antenna groups. These signals are used within the computer interface as timing and gating signals to synchronize the conversion processes. Additional signals are generated within this section by making use of these input signals. The radar timing inputs section contains both the target and reference timing inputs.

3-1341. TARGET RANGE TIMING CIRCUITS. The positive range reset pulse is received from the synchronizer and inverted by gate A1A30-1 which produces the negative range reset pulse that

is used in the computer interface. The preknock pulse is processed through gates A1A30-2 and A1A30-4 to produce the negative and positive preknock pulses. The leading edge of the negative preknock pulse fires either single-shot A1A35-1 or -2. If X-band is selected, single-shot A1A35-2 is enabled and if S- or C-band is selected, single-shot A1A35-1 is enabled. The output of the selected single-shot fires single-shot A2A24-1 which generates a 1-microsecond simulated main bang. This provides two adjustable delays for simulated main bang. The time relationships of range reset, preknock, and simulated main bang are shown on figure 3-179. Simulated main bang sync is inverted by gate A1A17-12 and is sent to start all of the range counters in the computer interface.

3-1342. The AZ/T1 and EL/T2 encoder clock pulses are received from the azimuth and elevation encoders mounted on the X-band receiving antennas. Since the circuitry for these signals is identical, only AZ/T1 is described here. The AZ/T1 encoder signal is sent to single-shot A1A32-2 which fires from the negative-going transition. The output of the single-shot is a series of 1-microsecond pulses which are inverted by gate A1A31-5. The output of gate A1A31-5 is the positive azimuth lockout pulse which also fires single-shot A1A34-1. Single-shot A1A34-1 generates a 0.5-microsecond delay pulse that fires single-shot A1A34-2. The output of single-shot A1A34-2 is the 0.2-microsecond azimuth encoder clock pulse which occurs at the midpoint of each azimuth lockout pulse. The lockout pulses are used to prevent the angle counter contents from being transferred to the angle storage registers during the time that the counter is being updated by the counter clock. The encoder clocks are used as the trigger inputs to the angle counters.

3-1343. The AZ/T1 and EL/T2 dead-time gates generated in the antenna group are received from the synchronizer 1A1A5. The dead-time gates represent the time when the antenna is not scanning. The dead-time gates are inverted by gates A1A31-3 and -4 and are sent to the missile video circuits to control the angle counters.

3-1344. The AZ, El, T1, and T2 reset pulses are received from the transmitter group. When S- or C-band is used, the AZ and EL reset pulses are selected by gates A1A31-7 and -8. When the X-band is used, gates A2A22-1 and -3 are used for selection of the T1 and T2 reset pulses. The selected pulses are inverted by gates A1A30-11 and -12 and are used to reset the angle counters.

3-1345. REFERENCE RADAR TIMING CIRCUITS. Control of the reference range conversion is derived from the Xp range blanking signal. This signal is generated in the synchronizer and is the range blanking for the reference radar. If transponder tracking is used, it is the range blanking for the target tracking radar. The Xp range blanking signal is double-inverted by gates A1A31-9 and 10 and is used to reset the reference range conversion counter. The output of gate A1A31-9 fires either single-shot A1A35-3 or 4. The selected single-shot is enabled by the trailing edge of Xp range blanking. Single-shot A1A35-3 is used for reference S- and C-band tracking, and single-shot A1A35-4 is used for X-band reference tracking. The selected single-shot provides an adjustable delay for the simulated Xp main bang sync. The output of the selected delay single-shot fires single-shot A2A24-2, which generates a 1-microsecond simulated Xp main bang sync pulse. This pulse is used to start the reference range conversion counter when reference tracking is selected. When transponder tracking is selected, the target simulated main bang sync pulse is used. Transponder tracking is selected when the output of gates A4A18-7, 8, and 9 (which are wire-OR'd) are at logic 1 or the S- REF SEL (+), C REF SEL (+), and X REF SEL (+) signals are at logic 0. For this condition, the simulated target main bang signal is selected by gate A5A36-2. If the outputs of gates A4A18-7, 8, and 9 are at logic 0 or S-, C-, or X-band is selected for reference tracking, the simulated Xp main bang sync is selected by gate A5A36-1. The selected simulated main bang sync is transferred to the reference range counter by NOR gate A5A36-3.

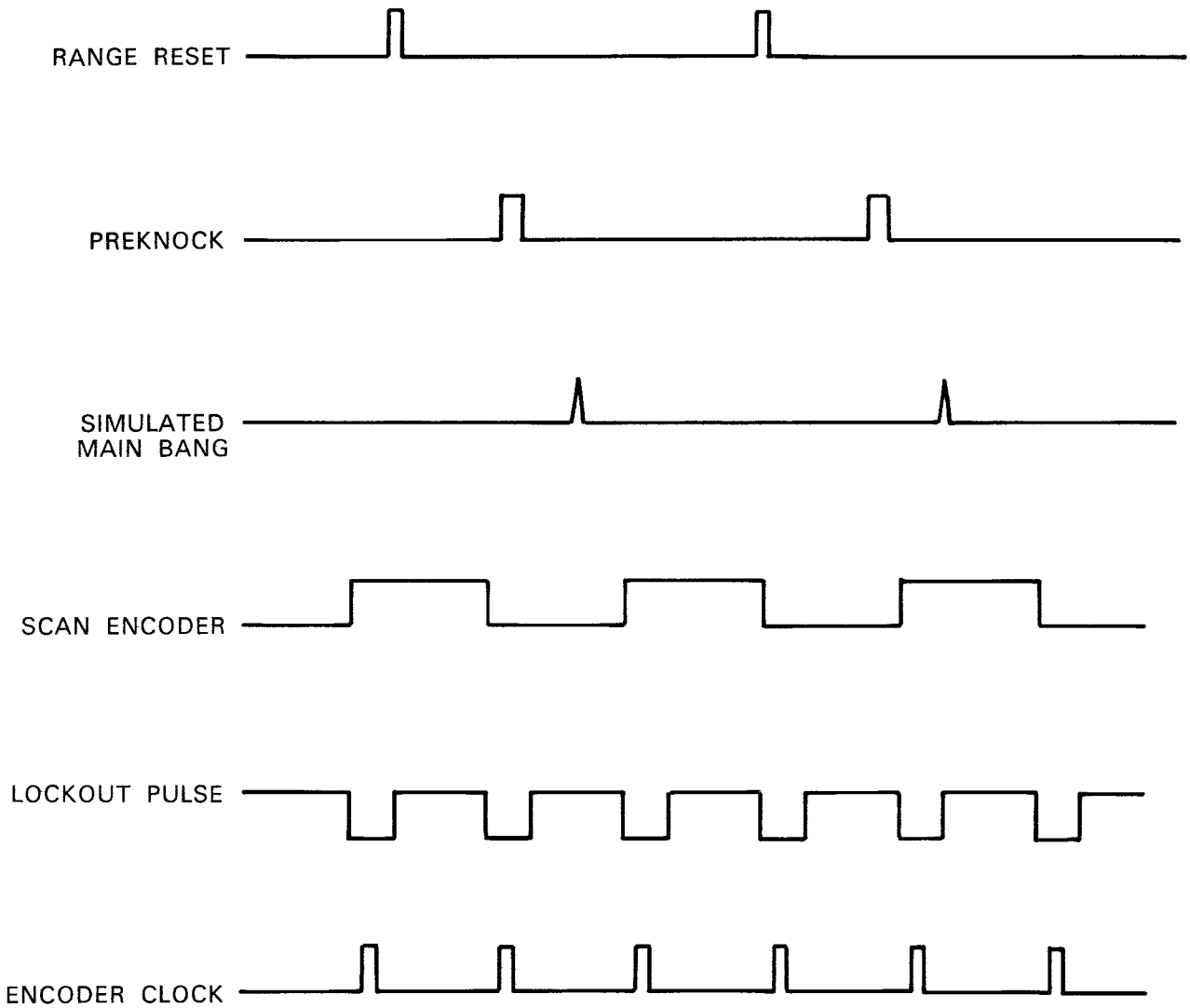


Figure 3-179. Radar Timing Inputs Timing Diagram

3-1346. The Xp AZ/T1 encoder and Xp EL/T2 encoder signals are received from the synchronizer. These signals are processed in the same manner as the target encoder signals to generate the Xp AZ and Xp E4 LOCKOUT signals.

3-1347. The Xp AZ RESET and Xp T1 RESET signals are combined by gates A2A22-4 and 7 and the Xp EL RESET and Xp T2 RESET signal are combined by gates A2A22-6 and 8. These signals are inverted by gates A2A22-5 and 9 and sent to reset the reference angle counters. The correct signals are selected in the synchronizer, and the signals are only combined in the computer interface.

3-1348. INPUT STATUS WORDS. The function of the input status words section is to transfer information derived from various functions in the radar system to the computer. The types of information transferred includes radar operating modes such as automatic or manual track; S-, C-, or X-band; and command signals to the computer such as the missile launch and missile arming commands. There are three input status words: 1, 3 and 4. Each status word is 16-bits long and may contain the status of 16 radar switches, each switch occupying one bit of the 16-bit word.

3-1349. The assigned switch functions are connected to the input of a 16-bit parallel gate. For status word 1, the 16-bit parallel gate is gate A2A25. When the computer requests status word 1, it generates address 1, and the function address decoding circuit generates STW1 strobe which sets flip-flop A2A26-4. The 0 output of this flip-flop is buffered and inverted by gate A2A10-5, and the output of this gate enables the 16-bit parallel gate A2A25. This places the state of the 16 bits of status word 1 on the 16 send lines, which in turn places the data on the 16 bidirectional lines going to the computer. The output of gate A2A10-5 also goes back to the control section as STW1 gate enable to generate DROPN which informs the computer that the data is on line. After the computer reads the data, the control section generates DATA RESET which resets flip-flop A2A26 and takes the data off the line.

3-1350. The circuitry that transfers status word 3 and 4 to the computer operates in the same manner. The only difference in the transfer of these status words is the way in which the missle launch/abort signals are derived for status word 3. Since the same type of circuit is used for all three missiles, the transfer of one missile (Missile 1) is described here. The MSL 1 LAUNCH/ABORT (-) signal is derived from the missile LAUNCH/ABORT switch located on the guidance operators tracking control. The signal goes to the toggle input of flip-flop A2A20-4. In this way, this flip-flop will change state each time the LAUNCH/ABORT switch is depressed. The 1 output of this flip-flop is sent to the computer as launch and the 0 output is sent as the abort condition. When the computer reads a launch condition, it sends back a MSL 1 LAUNCHED signal. If the computer terminates the missile, the MSL 1 LAUNCHED signal goes to logic 0 which fires a single-shot A2A21-1. The output of this signal-shot resets flip-flop A2A20-4. A missile can thus be aborted by depressing the missile LAUNCH/ABORT switch or by the computer terminating the missile.

3-1351. When automatic launch is used in X-band operation, gate A2A32-8 is used. The output of this gate is a logic 0 when the following conditions are selected: X-band selected, launch permission given by the computer, automatic launch selected, and range automatic track obtained. When these conditions exist, flip-flops A2A20-4 and -6 are set which gives a launch command to the computer for missiles 1 and 2. The computer then salvoes the two missiles.

3-1352. RANGE CONVERSION. The range conversion section (figure 3-176) supplies the computer with tracked range information either on the target and the four transponders, or on the target and reference track depending upon the tracking conditions. This information is furnished to the computer in the form of a binary word representing the time between radar main bang and the respective range guidance pulse.

3-1353. The range conversion process for the target and each transponder utilizes a counter which is clocked by a 20-megahertz crystal clock. A separate counter is provided for transponder 1 because this counter is also used for the reference tracker when this mode is selected. The counters are reset by the radar preknock pulse and started by the simulated main bang pulse at a time corresponding to the radar main bang. The count is stopped and held when a range guidance pulse is received from the selected radar tracking loop.

3-1354. When a range is requested by the computer, the address decoding circuitry produces the corresponding range function strobe. This range function strobe gates the associated range guidance pulse to stop the counter when the range guidance pulse occurs and disconnects the preknock and main bang signals to the counter. A range output gate enable pulse which transfers the contents of the counter to the data lines is then generated.

3-1355. The range counters A5A30 and A4A14 are clocked by a 20-megahertz crystal clock A5A25. Each count of the clock is 0.50 nanoseconds and therefore represents 25 feet of range. Counter A5A30 is used for the target and transponders 2, 3, and 4, and counter A4A14 is used for transponder 1 or reference tracking. The circuit associated with counter A5A30 is described first. The preknock pulse stops the counter by resetting flip-flop A5A34-3, which disables the counter clock input gate A5A32-9 and clears the counter through gates A5A32-2 and -5. The main bang pulse sets flip-flop A5A34-3, enabling the counter clock input gate. This input gate then starts the counter. The 1 output of flip-flop A5A34-3 also enables one input to gates A5A33-1, -3, -4 and -5. When the computer requests an input target range, for example, the target range strobe sets flip-flop A5A34-1 which enables the second input to gate A5A33-1. When the target range guidance pulse occurs, it is gated through gates A5A33-1, -6, -8, -10 and A5A32-6 and sets flip-flop A5A34-2. The guidance pulse also resets flip-flop A5A34-3 disabling the counter clock input gate and the counter stops. In the set state, flip-flop A5A34-2 disables the main bang and preknock input signals (gates A5A32-1 and 2) and generates the range gate enable signal. The signal enables the 16 counter output gates causing the counter contents to be transferred to the computer. The data reset pulse resets the five range strobe input flip-flops A5A35-1 through -5 and the lockout and output enable flip-flops A5A34-1 and 2. Counter A4A14 is cleared by Xp range blanking, which is the target range blanking for transponder tracking and the reference blanking for reference tracking. This signal also resets flip-flop A5A34-5 which stops the counter. The simulated Xp main bang sync sets flip-flop A5A34-5 which starts the counter. Transponder 1 range data is selected by the computer through flip-flop A5A35-2, gate A5A33-2, and flip-flop A5A34-1 in the same manner as the target data.

3-1356. AZIMUTH AND ELEVATION ANGLE CONVERSION. The angle conversion sections convert the tracked angular position of the target and transponders into a digital word that represents the number of antenna incremental encoder output pulses that have elapsed between the beginning of the antenna scan and the guidance pulse. From this information, the computer can determine the tracked position of the target in degrees from the center of the antenna scan.

3-1357. Each angle conversion section (azimuth or elevation) consists primarily of two counters and five storage registers. One counter is used for the target Xp2, Xp3, and Xp4 angle conversions. Xp1 has a separate counter because it is also used for reference tracking. There is a 16-bit storage register associated with the target and each of the four transponders.

3-1358. The appropriate counter is reset by the beginning of the dead-time gate and begins to count the incremental encoder pulses at the end of the dead-time gate. The angle guidance pulses received from

the angle-tracking loops transfer the contents of the counter to the corresponding register where it is stored as a binary word for the computer. When the information is requested by the computer, the data is fed to the 16 data lines.

3-1359. The azimuth and elevation angle conversion sections continuously convert tracked angle information of the target and the four transponders to binary words for use by the computer. The encoder pulses occur at a 160 KHz rate for S- and C-band and 320 KHz for X-band; the computer converts the count to angular position. The azimuth and elevation sections are identical with the exception of the target low-altitude guidance pulse delay circuit that is contained in the elevation angle conversion circuit. A description of the azimuth angle conversion circuit follows. This description is followed by a discussion of the target elevation low altitude guidance pulse delay circuit.

3-1360. The counter used for target and transponders 2, 3, and 4 is counter A4A32. Counter A4A13 is used for transponder 1 and reference tracking. Both counters are clocked by the azimuth encoder signals derived in the radar timing circuits. The AZ RESET signal from the radar timing circuits clears the counters and holds the counters in this state for the duration of the azimuth reset pulse. At the end of the azimuth reset pulse, the counters start counting the encoder pulses. The outputs of counter A4A32 are connected to 16-bit storage registers A4A25, A4A27, and A4A29. The outputs of counter A4A13 are tied to register A4A28.

3-1361. When a guidance pulse (target or reference) occurs, the pulse is inverted by gates A5A6-1, 2, 3, 4, or 5 and triggers the corresponding flip-flop A4A16. The flip-flop output is inverted by gates A4A18-1, -2, -3, -4, or -5 and triggers its corresponding single-shot A4A19. The triggered single-shot applies a data strobe to its corresponding register causing the register to read the contents of the counter. Similarly, each of the other guidance pulses strobe the contents of the counter, into the appropriate register when the guidance pulse is received. When the computer addresses one of the angle functions, the address decoding section generates a function strobe. The function strobe sets flip-flops A4A17-1, 2, 3, 4, or 5. The output of this flip-flop locks out the guidance pulse (gates A4A18-1, 2, 3, 4, or 5) to ensure that the contents of the register will not change while the computer is reading the data. Also, this flip-flop output is inverted by gates A4A30-7, -8, -9, -10, or -11 and enables the output gates of the appropriate register and places the register content on the 16-output lines.

3-1362. After the computer has completed the readout, the data reset pulse resets flip-flops A4A17-1 through 5. The encoder lock-out pulse is applied to gates A4A18-1 through -5 to lock out the guidance pulses each time the encoder pulse clocks the counter. The encoder lock-out pulse ensures that the counter contents are not transferred to the registers during the time the counter is changing.

3-1363. Target Elevation Low Altitude Guidance Pulse Delay. The target elevation guidance pulse occurs before the transponder elevation guidance pulse when operating in low altitude mode and tracking the same target. This delay is caused by the narrower width of the target elevation boxcar relative to the transponder boxcar due to the two-way and one-way antenna patterns of transponder pulses and two-way reception of target returns. In order to compensate for this error, the low altitude target elevation guidance pulse is delayed so that it occurs at the same time as the transponder guidance pulse.

3-1364. The target elevation guidance pulse is passed through gates A5A6-6 and A6A14-4 to gate A6A14-5. The guidance pulse is passed through this gate if the output of gate A6A14-3 is at logic 1. A logic 1 is present on the output of gate A6A14-3 except when the target simulator is deactivated and low altitude is selected (radar tracking with the antennas in low

altitude mode). With gate A6A14-3 at logic 1, the guidance pulse is passed through gate A6A14-5, A6A18-6, and A6A14-6 to flip-flop A6A16-1, which means that the guidance pulse is not delayed. If the radar is tracking with the antenna in the low altitude mode, the output of gate A6A14-3 is at logic 0 and gate A6A14-5 is disabled; NOR inputs to single-shots A6A15-1 and 3 are enabled. The guidance pulse is applied to one of the NAND inputs to the single-shots. If S-band is selected, the guidance pulse fires single-shot A6A15-3; if C-band is selected, the guidance pulse fires single-shot A6A15-1. These single shots provide a delay to the guidance pulse. The output of these single-shots fires single-shots A6A15-2 or 4 which generates a 15-microsecond pulse which is OR'd by gate A6A18-6 and sent to flip-flop A6A16-1. The remainder of the angle conversion process is identical to that described for the azimuth angle conversion.

3-1365. PEDESTAL POSITION. The pedestal position section of the computer interface transfers the azimuth and elevation pedestal position information from the target and reference pedestal. The azimuth and elevation pedestal positions from the pedestals are transferred when the computer selects address '2 in the interface. This is the only address in which more than one data word is transferred to the computer for one address. When the computer selects address '2, the interface transfers the target azimuth pedestal position data serially from the pedestal. This serial information is converted to a parallel 17-bit word. This 17-bit word is transferred to the computer in two 16-bit words. When the first word is transferred, output gate enable is generated and the interface control sends DROPN and the computer reads it. The second word is then transferred and again DROPN is sent to the computer indicating that the second word is on line. The interface then transfers the serial target elevation pedestal position from the pedestal and converts it to a parallel 17-bit word and transfers this to the computer as two 16-bit words. The azimuth and elevation position information is transferred from the reference pedestal in the same manner. Therefore, when the computer selects address '2, the interface sends eight 16-bit words to the computer.

3-1366. The '2 address strobe is received from the function address decoding circuits when the computer sends address '2. This 1-microsecond negative pulse is double-inverted by gates A3A21-9 and 10. This strobe pulse is then sent through three drivers A2A18 to the S-, C-, and X-Band pedestals as LOAD S1=1, C1=1 and X-BAND DATA. This pulse freezes the pedestal position data in all three pedestals. The address strobe also sets flip-flop A3A6-4, and the 0 output of this flip-flop is sent to the computer interface control to disable data reset so the control circuitry remains in the present state until all of the pedestal data is transferred. The 1 output of this flip-flop enables flip-flop A3A6-5, so the serial data clock can be enabled.

3-1367. The '2 address strobe clears the 3-bit word transfer counter A3A36-1, 2, and 3 and the 5-bit serial data clock counter A3A32-1, 2, 3, 4, and 5. The strobe also sets flip-flop A3A36-5, which enables the data clock as shown on the diagram in figure 3-180. The data clock is made up of single-shots A3A34-1 and 2. This clock drives the serial data clock counter and it is also sent to the target azimuth pedestal to clock the serial data back to the computer interface. The pedestal selection is controlled by the A, B, C, D, E, or F gate and selected by gates A2A32-2 through 7.

3-1368. The data clock is sent to the pedestal by driver A2A31. The data clock is also sent to shift register A3A30 to load the target azimuth data received from the pedestal into this register. The encoder in the pedestal transfers the data to the computer interface on the negative-going edge of the clock and the data is loaded into the register on the positive-going edge of the clock pulse. The serial data clock counter counts the number of cycles generated by the clock, and, when 18 cycles have been generated, the pedestal data inhibit pulse is generated by gate A3A32-1. This pulse is sent to clear flip-flop A3A36-5 which disables the clock. At this point, the 17 bits

of the target azimuth pedestal data is contained in register A3A30. It should be noted that 18 cycles of the clock are used to transfer the 17 bits of information. The extra cycle of the clock is generated so that the seventeenth bit is loaded into the register on the positive-going edge of this cycle.

3-1369. The pedestal data inhibit pulse also sets flip-flop A3A32-6. The 1 output of this flip-flop goes to a logic high and is called pedestal position output gate enable. This signal enables the 16-bit parallel gate A3A31 which places the first word (word A) of the target azimuth pedestal position data on line to the computer. This signal is also sent to the control section of the computer interface to generate DROPN. The pedestal data ready signal is also sent to the control section to delay the generation of DROPN until the eighteenth cycle of the data clock is completed as shown on the timing diagram (figure 3-180).

3-1370. As stated previously, the data transfer to the computer is word A of the target azimuth pedestal position. The word transfer counter is used to keep track of which data is to be transferred. The 0 output of the first stage of this counter A3A36-1, defines word A and the 1 output defines word B. Gates A3A35-2, 3, 4, and 5 define the pedestal (target, reference, azimuth or elevation) from which the data is derived. Table 3-10 defines the state of the counter and the gate enabled. A gate is enabled only when word A is transferred or the 0 output of flip-flop A3A36-1 is at logic 1.

3-1371. When word A is transferred to the computer, the 16 most significant bits are transferred directly from the shift register A3A30 to the 16-bit parallel gate A3A31. Since the word A line (0 output of flip-flop A3A36-1) is a logic high, gates A3A33-7 and 8 are enabled and bits 1 and 2 of the 17-bit data word are transferred. Therefore, word A consists of the 16 most significant bits of the 17-bit word received from the target azimuth pedestal.

3-1372. After the computer reads word A, the control section generates data reset which resets flip-flop A3A32-6 and ends pedestal position output gate enable, taking word A off the line. It should be noted that the data reset signals sent to the functions by the control section are not disabled by the disable data reset signal. When flip-flop A3A32-6 is reset, the word transfer counter is clocked to the next state so that word B of the target azimuth pedestal data can be transferred. When the 1 output of the first stage of this counter, flip-flop A3A36-1, goes to a logic high, it fires single-shot A3A34-3. The 0 output of this signle-shot clears the serial data clock counter so it will be ready to count the serial data transferred from the target elevation pedestal. The 1 output of single-shot A3A34-3 toggles flip-flop A3A32-6. Flip-flop A3A32-6 generates another pedestal position output gate enable, which enables the 16-bit parallel gate A3A31 and initiates DROPN, telling the computer that word B is on line. Since the word A line is low, gates A3A33-7 and 8 are disabled and the output of gate A3A33-7 is high. This places a logic 1 in the MSB of word B, regardless of the data transferred. The word B line is high, which enables gate A3A33-6 and places bit 17 of the pedestal position word in the bit 2 location of the word B data word. The remaining bits of word B are not used. Therefore, word A transfers the first 16 bits of the pedestal position word and word B transfers bit 17 of the pedestal position word at bit 2 location with bit 1 at a logic 1.

3-1373. After the computer reads word B of the target azimuth pedestal position, the control section generates another data reset which resets flip-flop A3A32-6 and drops pedestal position output gate enable, which takes word B off the line. The 1 output of flip-flop A3A32-6 also toggles the word transfer counter to the third state. When the 1 output of the first stage of this counter, flip-flop A3A36-1, goes to a logic low, it toggles flip-flop A3A36-5, which enables the data clock. The data clock then cycles another 18 times and the target elevation pedestal data is clocked into the shift register A3A30. Words A and B of the target elevation pedestal data are transferred to the computer in the same manner as

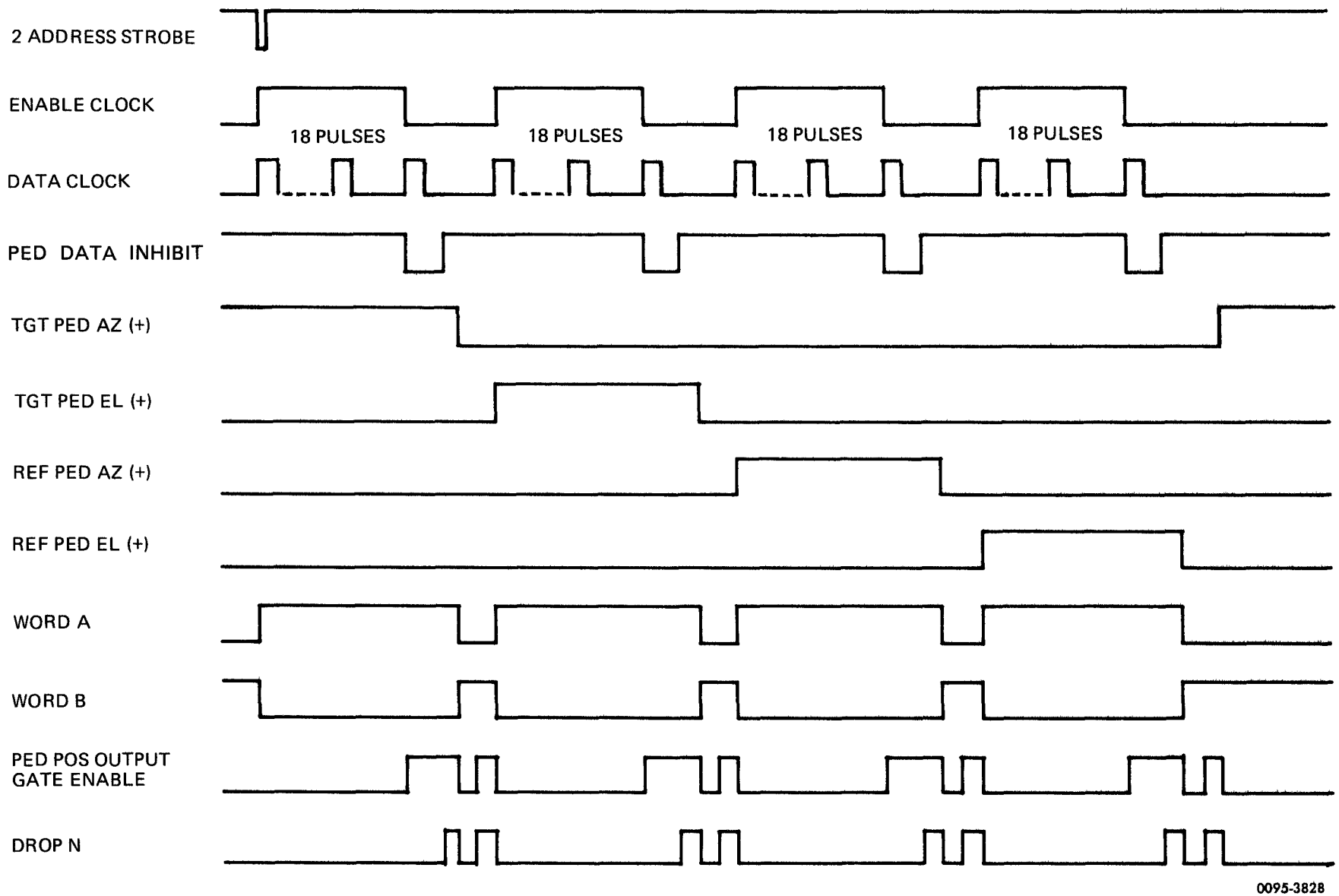


Figure 3-180. Timing Diagram for Pedestal Position Data Transfer

Table 3-10. Pedestal Data Gating Logic

NO.	Data Transferred	Counter A3A36			Gate Enabled
		1	2	3	
1	Target AZ - A	0	0	0	A3A35-2
2	Target AZ - B	1	0	0	
3	Target EL - A	0	1	0	A3A35-3
4	Target EL - B	1	1	0	
5	Reference AZ - A	0	0	1	A3A35-4
6	Reference AZ - B	1	0	1	
7	Reference EL - A	0	1	1	A3A35-5
8	Reference EL - B	1	1	1	

words A and B of the target azimuth pedestal data. The above described process is repeated two more times to transfer words A and B of the reference azimuth and elevation pedestal position data. When the eighth word is transferred to the computer (word B of the reference elevation pedestal), all the stages of the word transfer counter are at logic 1. (See table 3-10.) At the start of this data transfer, the output of gate A3A35-1 goes to logic 0 which fires single-shot A3A2-4 which generates a 1-microsecond delay and fires single-shot A3A34-4. The output of this single-shot resets flip-flop A3A36-4, and the disable data reset line goes high. At the end of this last pedestal position data transfer, the control section generates a data reset which is not disabled and the control circuitry is placed in the standby state, thus completing the pedestal data transfer. Flip-flop A3A36-4 can also be cleared by depressing the MASTER CLEAR switch on the control panel of the computer.

3-1374. Gates A, B, C, D, E, and F define the pedestal from which the data is obtained. The data clock is sent to the selected pedestal and the information received from the pedestal is received by line receiver A3A26. The selection of the data from the pedestal is controlled by the A, B, C, D, E, and F gates and selected by gates A3A28-4, 8, and 12 and A3A29-4, 8 and 12. The pedestal receiving the data clock is also the pedestal from which the data is received. The TGT PED AZ (-), TGT PED EL (-), REF PED AZ (-), and REF PED EL (-) signals are inverted by gates A3A33-1, 10, 11, and 12. These signals define the time slot for the data transfer as shown on the timing diagram (figure 3-180). If S-band is selected for target tracking, gate A3A28-1 selects the TGT PED AZ signal and the A gate occurs during this time period. Also, gate A3A28-5 selects the TGT PED EL signal and the B gate occurs during this time period. If S-band is selected for reference tracking, gate A3A28-2 selects the A gate during the REF PED AZ time period and gate A3A28-6 selects the B gate during the REF PED EL time period. C-band target and reference selection and X-band target and reference selection control the C, D, E, and F gates in the same manner.

3-1375. Azimuth and Elevation Commanded Pedestal Position. The commanded pedestal position is measured by 16-bit "GRAY" position encoders mounted on the synchro shafts of the command servo assemblies in the guidance operator tracking control 1A1A4. The GRAY

code is one in which only one bit is changing at any one time so that regardless of when the encoder is read an error larger than one least significant bit cannot exist. Separate encoders are provided for azimuth and elevation. The encoder outputs are transmitted to the interface over a single set of 16 input data lines. The selection of azimuth or elevation commanded position information is made within the guidance operator tracking control in accordance with the function addressed by the computer. In this manner, a single set of input data lines and interface circuitry can alternately furnish the computer with azimuth and elevation commanded position (figure 3-180). The GRAY position encoders (azimuth and elevation) are mechanically driven by the pedestal commands from the guidance operator or the manual tracker operator. The 16-bit GRAY code output of the encoder is filtered through an RD filter network, then sent through the level converters (current drivers) to the select circuits. The receiver circuit receives the azimuth or elevation select signals from the computer interface and enables the selected output circuit (azimuth or elevation). The selected output is routed through the line drivers to the interface over the 16 data lines.

3-1376. The operation of the pedestal position circuits is identical for both azimuth and elevation so only the azimuth transfer will be explained. The azimuth antenna position strobe (figure 3-180) is received from the address decoding section. The strobe sets flip-flops A2A20-1 and 3. The 1 output of flip-flop A2A20-3 is sent to driver A2A18 and causes a positive azimuth select and a negative elevation select output. This positive azimuth select signal sets the select circuitry in the guidance operator tracking drawer to place the azimuth antenna position word on the 16-lines back to the interface. The position word is received by line receivers A2A15, A2A16, and A2A17. The 0 output of flip-flop A2A20-1 passes through gate A2A10-4 as antenna position gate enable. Antenna position gate enable enables the 16 gates on gate A2A19 and is sent back to the control section. When DROPN occurs in the control section, coincident with the antenna position gate enable, the antenna position word is transferred to the computer. When the computer addresses the elevation antenna function, elevation antenna position is provided in the same manner. The data reset pulse resets flip-flops A2A20-1 and 2, which ends the antenna position gate enable pulse.

3-1377. OUTPUT STATUS WORDS. The output status words section receives status information from the computer and converts the information to a current which is used to drive indicator lights. Status word 2 is utilized to display the contents of any selected computer word on the 16 front panel indicator lights and status word 8 reports missile status.

3-1378. When the computer sends status word 2, the function strobe from the control section sets flip-flop A2A20-6. The flip-flop output is applied to gate A2A10-7. When the control section generates the read strobe, it passes through the gate and strobes the information contained on 16 receive lines (REC 1 through REC 16) into storage register A2A33. Current drivers A2A34 and A2A35 light front panel indicators DS1 through DS16 in accordance with the register contents. The circuitry for status word 5 operates in the same manner except the current drivers for these words are located in the mode control assembly 1A1A1. The missile status indicator associated with status word 5 are located on the front of the mode control assembly. The discrete outputs assigned to status word 5 are identified below:

Bit 1	MSL 1 Underway
2	MSL 2 Underway
3	MSL 3 Underway
4	MSL Delay
5	Spare
6	Launch Permission
7	Spare
8	Spare
9	Spare
10	Spare

Bit 11	Not Used
12	Not Used
13	Not Used
14	MSL 1 Armed
15	MSL 2 Armed
16	MSL 3 Armed

3-1379. THUMBWHEEL INPUTS. The thumbwheel inputs section processes the data derived from two sets of thumbwheel switches. The data includes target altitude from the ALT K FEET thumbwheels on the front of the sweep generator assembly 1A11A5 and the memory location of computer data selected by the DATA REQUEST thumbwheels on the computer interface assembly.

3-1380. Altitude K Feet. The ALT K FEET switches provide the computer with target altitude which is used for missile impact range calculations and miss-distance calculations when the radar cannot track in range due to a jamming environment. When the radar cannot track in range the range tracking operator enters target altitude on these thumbwheels and positions the RANGE-ALT switch to ALT. When the computer requests this data, the target altitude data entered on the thumbwheel switches is transferred to the computer.

3-1381. Data Request. The DATA REQUEST thumbwheels, located on the front panel of the computer interface, allow the operator to request information from the computer memory for visual display on the Nixie tubes and lamps on the front panel of the computer interface. The data derived from these thumbwheels is supplied to the computer which transfers the data contained in the requested memory location to the output status words section for display on the 16 front panel indicator in binary representation. Circuitry for this display is described in the discussion of the output status words section. The computer program also generates the necessary inputs to drive the Nixie tube decoding section for display of the data on the Nixie tubes.

3-1382. The data request function circuit contains flip-flop A2A9-1 and a 16-bit parallel gate A2A11. The thumbwheel strobe from the function address decoding section sets flip-flop A2A9-1 to generate the data request gate enable pulse. The data request gate enable pulse enables the 16-bit parallel gate on A2A11 and places the data derived from the DATA REQUEST switches (S1 through S5) on the 16 lines. The data request gate enable pulse is routed back to the control section to generate DROPN and to transfer the data to the computer. DATA RESET resets the flip-flop. Target altitude operates in the same manner through the parallel gates on assembly A2A30. Only the first 12 bits of the data word are required to transfer the target altitude data.

3-1383. DATA DISPLAY. The data display section contains the circuits that process the computer data to be displayed on the Nixie tubes. The data to be displayed is selected by means of the front panel thumbwheel switches as described previously. The information requested by these switches is displayed on the computer interface front panel. When the computer reads the data from the thumbwheel switch, the 16-bit binary word requested from memory is converted by a computer subroutine to the form required by the Nixie tubes. The data display section decodes the computer input to drive the Nixie tubes.

3-1384. Three 16-bit words are required to transfer information from the computer to the data display. The first word (word A) contains the first four Nixie digits in binary coded decimal (BCD) notation. Word B contains the last four digits in BCD. The first four bits of word C contain the polarity notation (a positive sign is represented by a BCD 7 code and a negative sign by a BCD 4 code). The last four bits of word C contain the information to position the decimal point on the Nixie display. This decimal point position is represented by a binary number (a binary 1 code places the decimal point before the least significant digit, a binary 2 code places the decimal point before the second least significant

digit, etc.). The three words are transferred in sequence to the data display section.

3-1385. The data display section contains nine Nixie modules, a Nixie decoder driver, and associated flip-flops. The Nixie modules contains storage registers whose outputs drive the associated Nixie tubes in accordance with the register contents. The Nixie decoder driver decodes the decimal point position and applies the decimal point input to the proper Nixie module.

3-1386. When Nixie word A is on the data lines, the computer addresses the Nixie A function and the control section sends the Nixie A strobe. The Nixie A strobe sets flip-flop A2A9-2. The output of flip-flop A2A9-2 enables gate A2A10-1 which gates the strobe through as the digit 1 through 4 read strobe. The Nixie A read strobe places Nixie word A in the module registers (Z2 through Z5) which drives the Nixie tube display. A data reset pulse resets the flip-flop A2A9-2. Nixie word B which contains the least significant four digits is generated and transferred in the same manner to modules Z6 through Z9.

3-1387. Nixie word C contains the plus or minus sign in the first four bits and the decimal position in the last four bits. Nixie C strobe sets flip-flop A2A9-4 allowing the next read strobe to pass through gate A2A10-3 as plus/minus strobe and decimal strobe. Plus/minus strobe places the first four bits of word C in the register of module Z1. A BCD 7 input causes the positive sign to be displayed; a BCD 4 causes the minus sign to be displayed. The decimal point strobe loads the last four digits into flip-flops A2A13-1 through 4. The Nixie decoder driver decodes the last four digits and enables the decimal point circuit in the proper Nixie module. The data reset pulse resets flip-flop A2A9-4.

3-1388. Four range strobes are generated by the computer interface for display on the indicators. These range strobes are missile impact range, maximum missile range, minimum range, and APP target range. The missile range strobes are generated by loading a 16-bit counter in the computer interface to a number equal to the total count of the counter (65,535) minus the computed missile range; enabling the counter at a time corresponding to the transmitter main bang; advancing the counter with a clock derived from the 20 MHz crystal clock; and generating the missile range pulse when the counter contents change from a full count (65,535) to a zero count. The data used to load the counter (65,535 minus the missile range) is sent from the computer on the 16 data lines.

3-1389. The circuitry that generates the range strobes operates the same as the missile impact range circuitry. Only one, the missile impact range circuitry, is discussed here. The range required for the missile video is obtained in the same manner.

3-1390. When the computer addresses the missile impact range function, the missile impact range strobe sets flip-flop A5A13-4 which enables gate A5A16-7. The read strobe loads the data from the computer into storage register A5A7. When the 16-bit register is not being loaded, the 0 output of flip-flop A5A13-4 enables gate A5A16-8 and preknock loads the contents of the register into a 16-bit counter A5A8. The counter is then clocked by the 20-MHz gated clock. The 20-MHz gated clock is gated by range blanking so the clock is not running during this period. The counter runs at 20-MHz and, when the last stage of the counter changes from logic 1 to logic 0, single-shot A5A10-2 fires and generates a 1-microsecond missile impact range pulse.

3-1391. MISSILE VIDEO. The missile video section produces the simulated missile video from missile position data computed by the digital computer. The range position for the missile video is produced in the same manner as the missile impact range strobe. Additional circuits angle gate the missile range video pulses according to the computed missile azimuth and elevation angle data, so that

the missile video is displayed at the correct azimuth and elevation angles. The missile angle is calculated and stored in the computer as a binary word. The angle gating circuits convert this binary word to an angle gate that is generated at a delay after the beginning of the angle scan represented by the binary word. The angle gate passes the missile video range pulses which occur during the angle gate to the presentation group.

3-1392. Missile video is generated for three missiles. For each missile an azimuth missile video is generated for the guidance operators elevation B-scope. The circuits that generate the azimuth and elevation missile video are identical. Also, the circuits required for the three missiles are identical except for the circuit that sets the flag on the missile video. For missile 1, the flag is on the left side of the video; for missile 2, the flag is in the center of the video; and for missile 3, the flag is on the right side of the video (figure 3-181). Therefore, the circuit that generates the missile 1 azimuth video will be discussed and then the circuit that flags missile 2 and 3 will be discussed.

1. . . .	. . 1 . .	 1
Missile 1	Missile 2	Missile 3

Figure 3-181. Missile Video Presentation

3-1393. The missile 1 azimuth angle within the antenna scan window is calculated and stored in the computer as a binary word. This binary word is converted in the computer interface to a pulse delay from the start of the antenna scan. The delay time is controlled by the data from the computer. This conversion is accomplished by loading a 16-bit counter with the total count (65,535) minus the missile azimuth angle during the azimuth dead time date; enabling the counter at the end of dead time; advancing the counter by the azimuth encoder clock; generating an output pulse when the most significant bit of the counter charges from a logic 1 to a logic 0; and generating a 2.5-millisecond video gate to provide the proper width of missile video.

3-1394. When the computer addresses the missile 1 azimuth function, the address decoding section sends the missile 1 azimuth strobe. The strobe sets flip-flop A4A9-1, which enables gate A4A8-1. This gate passes the read strobe to strobe the data from the computer into the storage register A4A2. After the data is read into the register, the data reset pulse resets flip-flop A4A9-1. The 16-bit counter A4A3 is clocked (advanced) by the azimuth encoder signal which is gated off by the azimuth dead time (-) signal in gate A4A8-3 and the counter stops during this time. The azimuth reset pulse clears the counter. The trailing edge of the azimuth reset pulse fires single-shot A4A11-1, which sets flip-flop A4A9-2. The 1 output of this flip-flop is gated through gate A4A8-2 and fires single-shot A4A11-2. The output of this single-shot resets flip-flop A4A9-2, which loads the counter with the contents of the storage register. When the dead-time gate ends, the azimuth encoder clock clocks the counter. When the most significant bit of the counter changes from a logic 1 to logic 0, single-shot A4A10-1 is triggered and produces a 2.5-millisecond azimuth video gate. This 2.5-millisecond output gate enables gate A4A8-6, which gates through the missile range pulses. The 0 output of single-shot A4A10-1 fires single-shot A4A10-3, which sets flip-flop A4A9-3. The 1 output of this flip-flop enables gate A4A8-8 and the first missile 1 range pulse that occurs during the 2.5-millisecond gate fires single-shot A4A10-4. This 10-microsecond pulse is combined with the rest of the 1-microsecond missile 1 range pulses in gate A4A8-5. When this series of pulses is displayed on the B-scope, the missile video will appear as shown in figure 3-182. The missile 1 azimuth video is combined with the missile 2 and 3 azimuth video by gate A4A8-10 and sent to the B-scope.

3-1395. For missile 2 azimuth video, the counter is counter A4A34. In this case, the 10-microsecond flag pulse must occur in

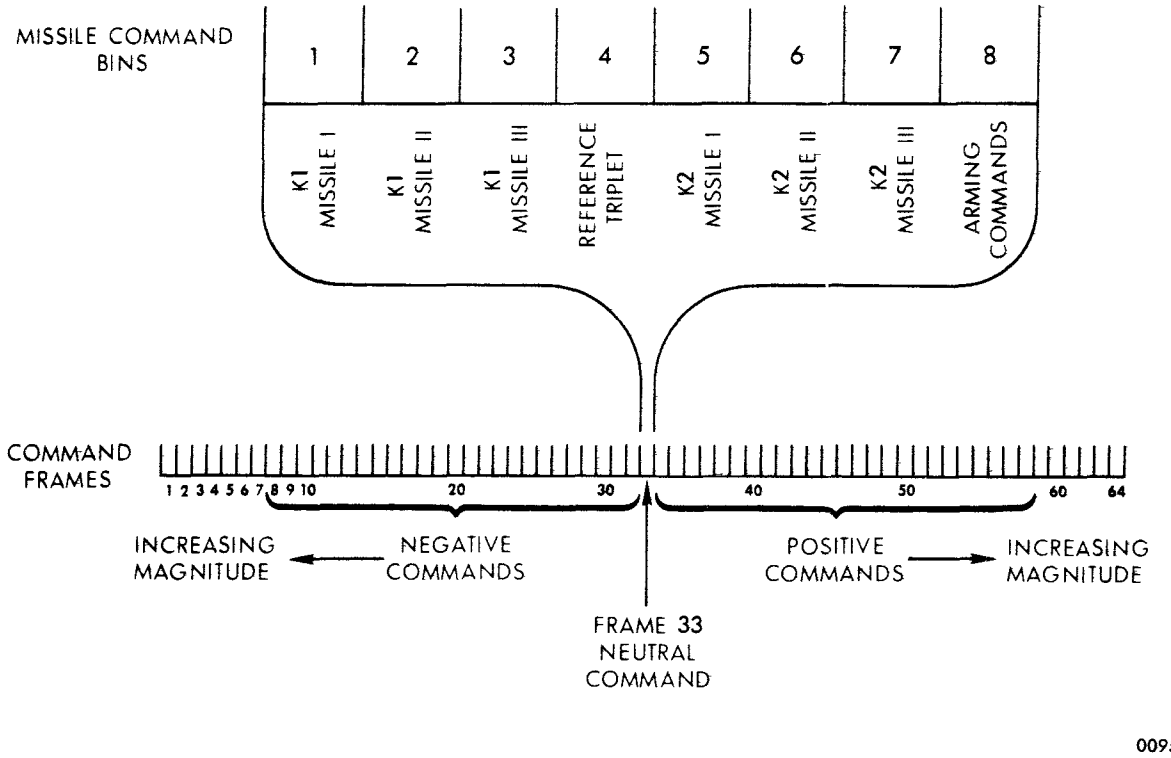


Figure 3-182. Missile Guidance, Command Generation

the middle of the 2.5-millisecond pulse generated by single-shot A4A7-1. The counter output pulse (changing from 1 to 0) also triggers single-shot A4A7-2, which produces a 1.25-millisecond delay (can be adjusted by the missile mark centering adjust) and then triggers single-shot A4A7-3. The output of this single-shot sets flip-flop A4A4-6. The next missile range pulse passes through gate A4A8-8 and triggers single-shot A4A7-4. This single-shot generates a 10-microsecond pulse in the center of the 2.5-millisecond gate. This 10-microsecond pulse is combined with the rest of the 1-microsecond missile 2 range pulses by gate A4A1-5 and then sent to be combined with the missile 1 and 3 azimuth video pulses.

3-1396. The 10-microsecond flag pulse for missile 3 azimuth video is generated at the end of the 2.5-millisecond gate. The counter used for missile 3 azimuth video is counter A4A36 and the 2.5-millisecond gate is generated by single-shot A4A6-1. The trailing edge of this gate fires single-shot A4A6-3 which sets flip-flop A4A4-6, and enables gate A4A1-10. The first missile 3 azimuth video range pulse that occurs after the end of the 2.5-millisecond gate fires single-shot A4A6-4, which generates the 10-microsecond flag pulse. This pulse is combined with the rest of the missile 3 azimuth video range pulses by gate A4A1-11 and sent to be combined with the missile 1 and 2 azimuth video pulses.

3-1397. RANGE CALIBRATE STROBE GENERATOR. The range calibrate strobe generator generates a 20-mile range strobe for indicator calibration purposes. The strobe is applied to the indicators in the presentation group when selected by the guidance operator.

3-1398. Twenty radar miles is 4944 counts of the 20-megahertz clock (247.2 microseconds). Preknock loads the counter A5A15 with a count of 3248 (total count of the counter, 8192 minus 4944 - 3248). Main

bang sets flip-flop A5A13-6, which enables the clock input gate A5A16-6. The 20-megahertz clock then clocks the counter. When the most significant bit of the counter changes from a logic 1 to a logic 0, single-shot A5A10-3 fires and produces the 1-microsecond range calibrate pulse. This pulse also resets flip-flop A5A13-6 which stops the counter.

3-1399. DIGITAL-TO-ANALOG CONVERSION. The digital-to-analog (D/A) converter converts the binary computer data words to an analog voltage. The analog output is then routed to the recording system for recording of the analog data. Two channels (15 and 16) of the digital-to-analog converter are the sine and cosine of the target azimuth position and are sent to the APP. The conversion circuits consist of a 12-bit digital-to-analog converter module whose output is multiplexed to 16 individual sample and hold (S/H) circuits. The first 12 bits of a 16-bit computer word contain the binary data information for the input of the D/A converter. The last 4 bits select the S/H circuit to be enabled. The enabled S/H circuit receives the D/A converter output which is then sampled and held for application to the analog recorder input.

3-1400. The computer places the 16-bit data word on the data lines for transfer. The D/A converter strobe from the address decoding section sets flip-flop A3A22-6. When the read strobe occurs, it is gated through gate A3A21-7 to the D/A converter A8A6 and loads the first 12 bits of the data word into the converter. These 12 bits contain the digital value of the data to be converted. The read strobe also goes to a four-bit register A7A4 which loads the last four bits into this register. These last four bits (and complements) contain the multiplexing channel number address. The read strobe also fires single-shot A7A3-1. Single-shot A7A3-1 creates a 15-microsecond delay and then fires single-shot A7A3-2. Single-shot A7A3-2 generates a 15-microsecond sample strobe which is applied to the binary decoder. The binary decoder transmits the sample strobe to one of the 16 sample and hold circuits (A8A1 through A8A4), depending on the binary value of the four-bit word received from the four-bit register. The sample strobe causes the addressed sample and hold circuit to accept the analog voltage from the buffer amplifier which was developed by the D/A converter. The reference supply A8A5 furnishes positive and negative 10 VDC reference voltages to the D/A converter.

3-1401. Binary Decoder. The last four bits of the 16-bit computer data word and their complements contain the recorder channel number that is to receive the voltage derived from the data in the first 12 data bits. The decoder decodes the last four bits and complements and enables the sample and hold circuit for the designated channel.

3-1402. The binary decoder circuit contains eight integrated circuit chips, each containing two 4-input NAND gates. The NAND gates are connected so that, regardless of four bit-and-complement inputs, only one of the 16 gates will have all four inputs enabled. The enabled gate will then pass the sample strobe to the selected sample and hold circuit.

3-1403. D/A Converter. The converter module contains a 12-bit parallel-entry digital register, a converter, and an analog output amplifier. The circuit converts a 12-bit digital word to the analog voltage represented by the work.

3-1404. Sample and Hold. The 16 sample and hold circuits are identical. The analog voltage input for circuit A is applied to pin F. When the negative-going sample strobe A is applied to pin J, network Z1 applies a positive signal to the emitter of transistor Q1 which turns on transistor Q2. When transistor Q2 conducts, -15 volts is applied to the gate of transistor Q3 which starts to conduct. With transistor Q3 turned on, capacitor C4 charges to the value of the analog input voltage. When the sample strobe ends, transistor Q3 is cut off and because of the high input impedance of voltage follower Z2 and the high-impedance of transistor Q3 when it is turned off, capacitor C4 will retain the charge. The

voltage charge on capacitor C4 appears at output A. When enabled by the sample strobe, the gate of transistor Q3 will conduct in either direction, allowing capacitor C4 to charge to the value of the analog input voltage regardless of the polarity of the input voltage. Potentiometer R4 provides a zero balance adjust for the voltage follower.

3-1405. D/A Converter Power Supply. The power supply unit provides positive and negative 10-volt DC power to the D/A converter. The module contains a temperature stabilized zener, a precision zener current source, and two high gain voltage regulators.

3-1406. MISSILE GUIDANCE COMMAND GENERATOR. The missile guidance command generator produces coded missile commands from information provided by the computer. These commands contain the information that would be used by a missile for guidance and arming. The coded commands conform to those of an operational missile and are subsequently transmitted by the L-band transmitter, thereby creating the RF environment of an operational missile site. Two types of guidance commands are associated with the radar. For S- and C-band operation, the commands will be in the form of pulse-coded triplets; for X-band operation, the commands will be in the form of frequency shift keyed (FSK) CW signals.

3-1407. S- and C-Band Missile Guidance. The missile commands consist of guidance commands, arming commands, and a reference command. The guidance commands are the commands that position the missile control surfaces. The commands are provided by uniquely coded pulse triplets which consist of three 1-microsecond pulses. The time spacing between the first and second pulses of the triplet identify the missile; and the spacing between the second and third pulses identify particular missile functions. The magnitude and direction (sign) of the guidance commands is denoted by the time relationship of the command triplet to the reference triplet as shown in figure 3-182.

3-1408. The time spacing between the pulses of the triplets identifies one of the following functions where K1 and K2 denote specific sets of control surfaces on the missile.

a. K1 command to missile 1

b. K1 command to missile 2

c. K1 command to missile 3

d. Reference triplet (used to establish a common radar-missile time reference)

e. K2 command to missile 1

f. K2 command to missile 2

g. K2 command to missile 3

h. Arming commands. (A different arming command is generated for each of the three missiles.)

3-1409. The basic timing reference for the command guidance generator is the missile clock generated in the transmitter group and routed to the computer interface from the synchronizer 1A1A5. The frequency of this clock may vary slightly depending on the selection of S-band or C-band tracking and the selection of crystal or RC clocks in the range timing portion of the transmitter group. In the following discussion, it is assumed that the radar is tracking in S-band and the crystal clock is in use so that the missile clock rate is 22.5 kilohertz.

3-1410. The missile clock is used to define the missile "bins" (the time in which missile commands may be generated) and is divided by eight to provide the missile command "frames." (The frames are used to transfer the magnitude of the command information. Further division by 64 defines the period required to send one set of commands and is the data rate of data sent to the missile.
(22.5 KHz ÷ 8 ÷ 64 = 44 Hz.)

3-1411. In order to prevent the simultaneous transmission of the commands to the missiles, a specific "bin" is reserved for each of the first seven listed functions. Each required guidance command is transmitted only once every 64 frames. The reference triplet occurs only in frame 1 and is transmitted every 64 frames to determine the command rate of 44 Hz.

3-1412. The reference triplet is transmitted during frame 1 and provides the time reference for the missile so that it may determine the magnitude of the commands it receives. The guidance commands may be sent in any frame between 8 and 58 inclusive. The magnitude and sign (plus or minus flipper control) of these commands are denoted by the frame in which they are inserted. Frame 33 is a neutral command frame. Frames 34 through 58 are positive command frames; the magnitude of the command increases as the frame number increases. Frames 7 through 33 are negative command frames, and the magnitude of the command increases as the frame number decreases.

3-1413. Fuse-arming commands are expressed in three additional coded triplets (one unique triplet for each missile) which are inserted in bin 8. Arming is commanded by transmitting the arming triplet four times during the 64 frames. Simultaneous transmission of the arming commands is prevented by reserving the frames in which they are inserted according to the following sequence:

Missile	Frames
1	3, 19, 35, 51
2	7, 23, 39, 55
3	11, 27, 43, 59

3-1414. The time relationship of the pulses within a triplet is defined below for the different functions and bin numbers:

Bin (Function)	Time Between Pulse 1 to Pulse 2 (usec)	Time Between Pulse 2 to Pulse 3 (usec)
1 (K1 Missile 1)	3	6
2 (K1 Missile 2)	5	8
3 (K1 Missile 3)	7	10
4 (Reference)	9	12
5 (K2 Missile 1)	3	8
6 (K2 Missile 2)	5	10
7 (K2 Missile 3)	7	12
8 (ARM I)	3	10
8 (ARM II)	5	12
8 (ARM III)	7	14

3-1415. X-Band Missile Guidance. The missile command guidance format consists of a complex frequency-modulated base band signal that is used to amplitude modulate (AM) the L-band carrier. The AM signal consists of four frequency shift keyed (FSK) CW signals. Two of the four FSK CW signals provide steering information to one missile while the other two FSK signals provide the same information for a second missile.

3-1416. Two frequencies are associated with each of the four FSK signals, so the AM waveform is made up of eight separate subcarriers that are ON-OFF keyed. The eight frequencies and the manner in which they are keyed ON and OFF are depicted in figure 3-183. The lowest frequency of the eight carriers is 70 KHz while the highest is 135 KHz. Frequencies f_1 and f_2 are used to provide the K1 command for missile 1, and f_3 and f_4 provide the K2 command for missile 1. The commands for missile 2 are provided by f_5, f_6, f_7, and f_8.

3-1417. The keying rate for the FSK signals is 80 Hz, which makes the period of each data transfer 12.5 milliseconds. The FSK signal for K1 missile 1 (f_1 and f_2) transfers a neutral command. Frequency f_1 is turned on for T_1 = 6.25 millisecond, and f_2 is turned on for the same time. The FSK signal for K1 missile 2 transfers a positive command because f_6 is turned on

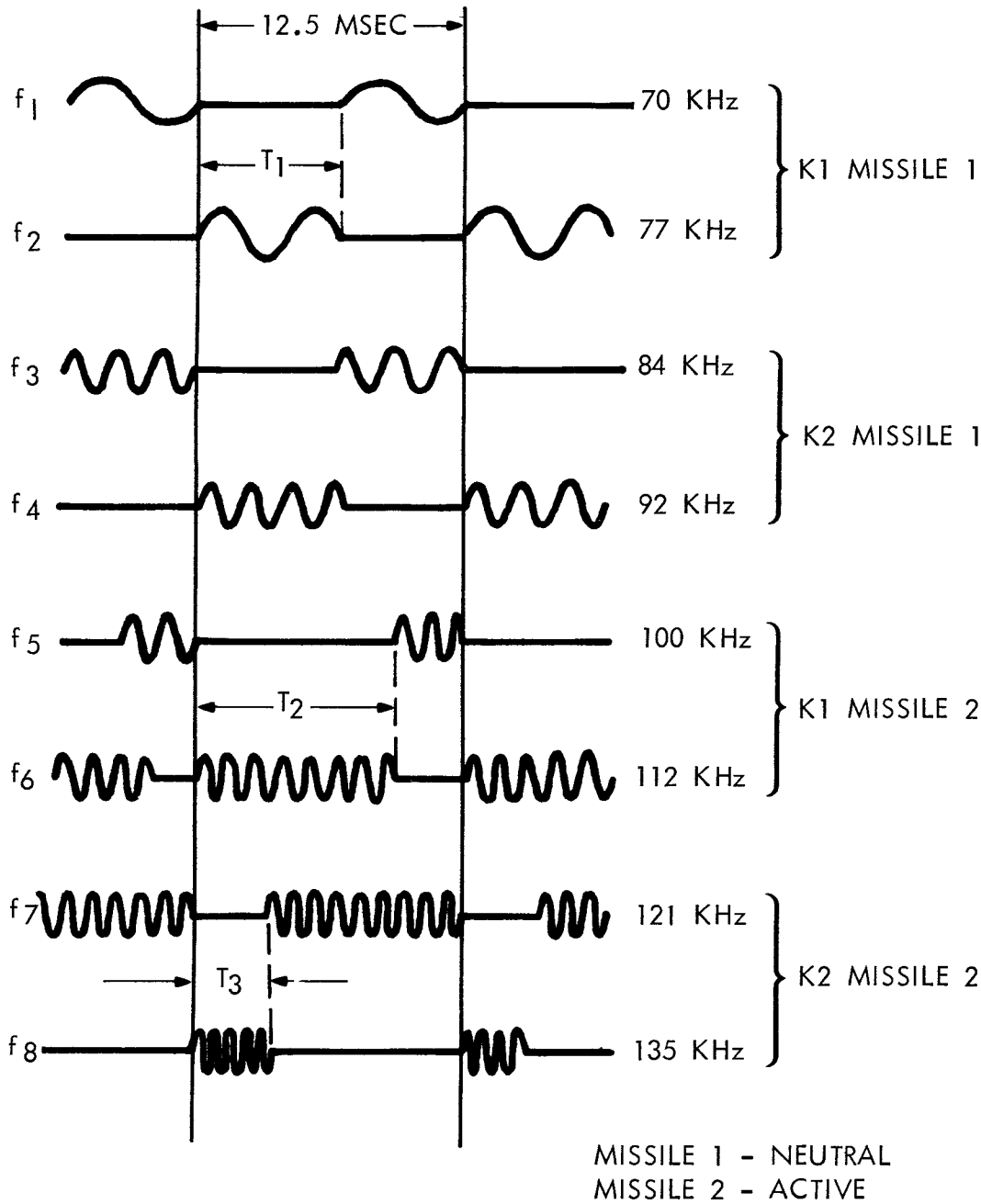


Figure 3-183. X-Band Missile Guidance

during time T_2 which is greater than the time f_5 is turned on. The FSK signal for K2 missile 2 is a negative command because the on time of f_8 is less than f_7.

3-1418. The basic switching rate for the FSK signals is derived from a 5.12 KHz clock. The output of this clock is divided by 64 to obtain the required 80 Hz switching rate. In this way, the 12.5 milliseconds can be divided into 64 increments, and T_1, T_2, and T_3 in figure 3-183 can vary from 0 to 12.5 milliseconds in increments of 159 microseconds.

3-1419. S- and C-Band Guidance Command Generation. The missile clock is gated through gate A3A7-1 when S- C-band operation is selected. The output of this gate fires single-shot A3A2-1. The 0 output of this single-shot clocks the three stage binary counter. The 1 output of this single-shot triggers single-shot A3A2-2. The 0 output of single-shot A3A2-2 passes through gate A3A3-8 as the first 1-microsecond pulse of the triplet. The 1 output is applied to gates A3A3-1 through -4. Gates A3A3-1 through -4 are enabled by the outputs of the binary counter. Since this is binary 1, gate A3A3-1 will pass the pulse, triggering single-shot A3A5-1. Single-shot A3A5-1 triggers single-shot A3A2-3 after a 3-microsecond delay. The 0 output of single-shot A3A2-3 passes through gate A3A3-8 as the second triplet pulse and also clocks flip-flop A3A1-4. The 1 output of single-shot A3A2-3 goes to gates A3A4-4, -5 and -6. Either gate A3A4-5 or gate A3A4-6 is enabled by the binary counter outputs except during binary 8. Binary 8 disables gates A3A4-5 and -6 and enables gate A3A4-4. During the binary 1 count, the 1 output of single-shot A3A2-3 will pass through gate A3A4-5 and trigger single-shot A3A5-1. Single-shot A3A5-1 delays 3 microseconds then triggers single-shot A3A2-3 which generates the third pulse and clocks flip-flops A3A1-4 and -5. The 0 output of flip-flop A3A1-5 disables single-shot A3A2-3 assuring that no more pulses are produced during this binary. The pulse triplets for binaries 1 through 7 are produced in the same manner. Delay between pulses is selected by the binary counter thereby accomplishing the coding. Binary eight is started by the eighth missile clock and is reserved for the arming commands. The eighth missile clock clocks the binary counter to all ones and single-shot A3A2-2 generates the first pulse after a 15-microsecond delay. When the counter is full, gate A3A3-5 is enabled. The output of this gate disables gate A3A4-5 and -6, enables gate A3A4-4, and also enables one of the inputs to gates A3A4-1, -2, and -3. The second input to gates A3A4-1, -2, and -3 is selectively enabled through the outputs of gates A3A8-1, -2, or -3 depending on the count contained in the frame counter and the "missile armed" signals. The first pulse output of single-shot A3A2-2 will pass through enabled gate A3A4-1, -2, or -3, which selects delay single-shot A3A5-1, -2, or -3. In this manner, the delay between the first and second pulse of the arming triplet is selected in accordance with the frame in which it is to be inserted. Missile 1 arming commands, for example, are inserted during binary 8 of frames 3, 19, 35, and 51. The second pulse of the arming triplet is generated by single-shot A3A2-3 after the selected delay. The 1 output of single-shot A3A2-3 passes through gate A3A4-4, is delayed 7 microseconds by single-shot A3A5-3, then triggers single-shot A3A2-3 which generates the third pulse.

3-1420. The output of gate A3A3-8 is the serial coded pulse triplets. The reference triplet passes through gate A3A6-4, which is enabled during binary 4 and through gate A3A7-5 to gate A3A8-4. Gate A3A8-4 will pass the reference triplet only when enabled by the frame counter during frame 0. The arming triplets are passed through gate A3A6-8, which is enabled during binary 8, to gate A3A21-12. Gate A3A21-12 is enabled during arming command frames by gates A3A8-1, -2, or -3. The missile guidance commands pass through gates A3A6-1, -2, -3, -5, -6 and -7, which are enabled at the appropriate times by the binary counter. These six guidance commands contain the coding in the pulse spacing to identify the missile and the control surface. The direction and magnitude of the

the guidance command is denoted by the frame in which the command is inserted. Frame selection for insertion of these command triplets is generated by the computer and selected by the frame selector circuits.

3-1421. When X-band operation is selected, the missile clock is disabled and a 5.1 KHz clock A2A4 is enabled. This clock goes through gate A3A3-6 and drives the frame counter. In this way the frame counter provides the divide-by-64 for both types of command guidance. Also, when X-band is selected, the output of gate A3A7-5 is always at a logic 1 so gate A3A8-4 has a 0 output when the frame counter is in the zero state; this condition defines the reference frame. The FSK period is generated by the computer and selected by the frame selector circuits.

3-1422. For S- and C-band, the frame selection circuitry selects the frame in which the missile directional control command triplets are inserted. Three sets of identical circuitry allow command frame selection of the three missiles; only one missile (Missile 1) is described here. The computer calculates the frame in which the missile command is to be inserted. The frame number for K1 command is contained in bits 4 through 9, and the K2 frame number is contained in bits 11 through 16. K1 and K2 commands refer to the particular missile control surfaces. This data word is loaded into register A3A13 when the computer addresses the missile function. Bits 4 through 9 of the register are sent to comparator circuit A3A11 and bits 11 through 16 are sent to comparator A3A12. The frame counter outputs are also connected to the comparators. When the frame counter input matches the register input, the output of the comparator enables gate A3A10-6 or gate A3A10-8, allowing the missile command to pass through to gate A3A10-4. Gate A3A10-4 will pass the command provided MISSILE UNDERWAY has enabled the gate. The missile guidance commands along with reference and arming commands are wire-OR'd to gate A3A10-2. Gate A3A10-3 will pass the commands provided a MISSILE UNDERWAY signal is applied or the L-band transmitter check switch is depressed.

3-1423. The frame selection circuits from missile 1 and 2 are also used for the two X-band missiles. The two circuits are identical, so only the missile 1 circuit is discussed. When gate A3A8-4 detects, the reference frame flip-flops A3A22-4 and A3A1-6 are set. The FSK period for the K1 and K2 command is obtained from the computer in the same manner as the K1 and K2 frame number required for S- and C-band missiles. In this case, when the frame counter reaches the value obtained from the computer, the digital comparator resets flip-flop A3A22-4 or flip-flop A3A1-6. The output of flip-flop A3A1-6 is the FSK control signal for missile 1 K1 command and the output of flip-flop A3A22-4 is the FSK control signal for missile 1 K2 command. The FSK control signals for missile 1 and 2 are sent from the computer interface to the transmitter coder 1A5A3 where they are used to switch the CW tones.

3-1424. MISCELLANEOUS EQUIPMENT GROUPS.

3-1425. Radar Training Set AN/MPS-T1 is supported by target simulation equipment, intercommunication equipment, and power supply equipment. The intercommunication system and power supplies are identical to equipment presently operated by the using command. Operation of the target simulator is described in the following paragraphs.

3-1426. TARGET SIMULATOR. The target simulator is used to generate four simulated targets with transponder returns and jamming simulation for each target. The inputs to the target simulator consist of angle and range synchronization, azimuth and elevation pedestal position, and radar mode selection signals. The target simulator generates range and angle modulation signals and uses these signals to modulate the intermediate frequency (IF) oscillator outputs. The resultant IF signals are routed to the target and transponder receivers. The target simulator interface diagram is shown in figure 3-184.

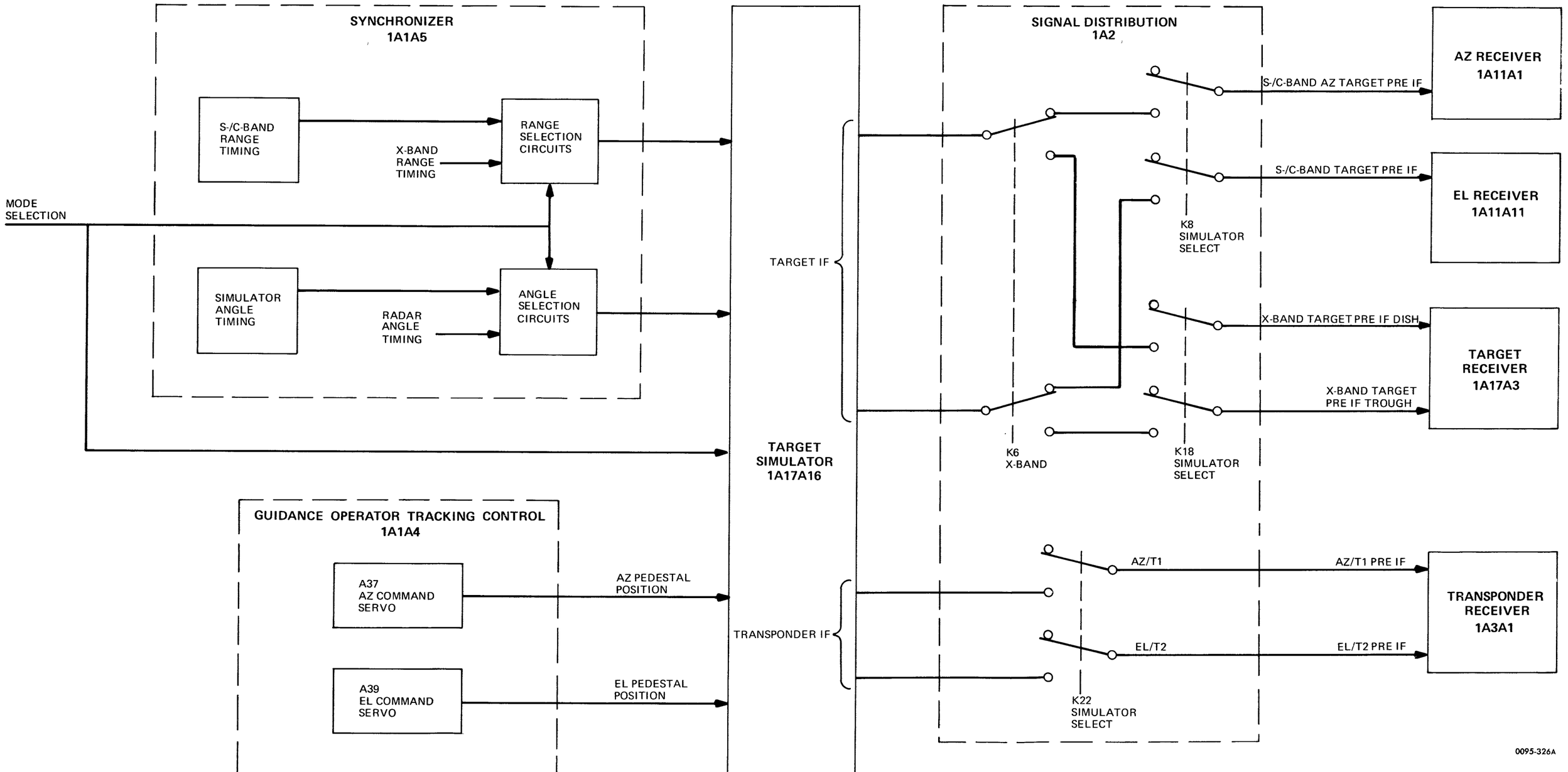


Figure 3-184. Target Simulator Interface

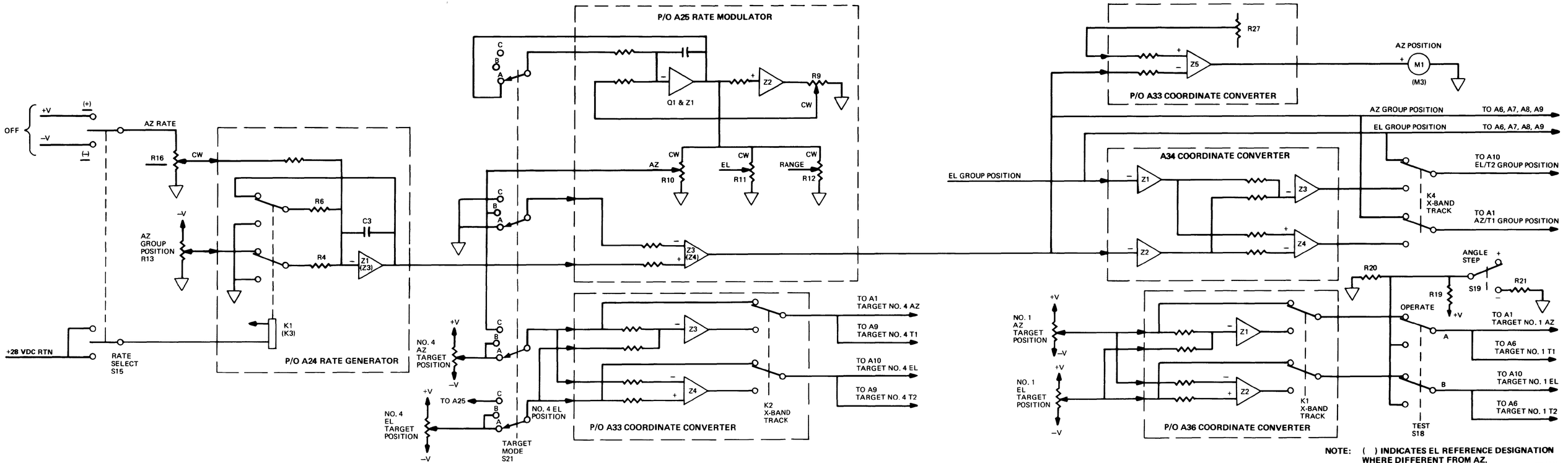


Figure 3-185. Target Angle Control Block Diagram

3-1427. The target simulator circuits can be divided into three sections: target control circuits, angle and range modulation generation circuits, and IF modulator circuits.

3-1428. Target Control. Front panel controls include TARGET ON/OFF, TRANSPONDER ON/OFF, and JAMMING ON/OFF for each of the four targets. In addition, either sector or angle jamming may be selected. The front panel controls are used to control the following functions:

a. Target mode - select mode of target rate modulation

b. Target position - both group and individual positioning in azimuth, elevation, and range

c. Target motion - direction and rate in azimuth, elevation, and range.

3-1429. The TARGET MODE select switch is used to select one of three modes (A, B, or C) of operation. In Mode A, the group position and movement rate may be selected as well as the spacing of the individual targets. Mode B is a programmed modulation of the selected group rate, in which the movement rate is not constant and the target spacing in range is preselected. Mode C is a programmed rate modulation of target No. 4 with options of group rate and position and individual target angle spacing available. In the two programmed modes, the program of movement repeats approximately every 90 seconds.

3-1430. Three internal switches (OPERATE/TEST, ANGLE STEP +/-, and RANGE STEP +/-) are used during the alignment of the tracking loops.

3-1431. Target Position and Motion Controls. The circuits for angle and range are shown in figures 3-185 and 3-186. The azimuth and elevation circuits are identical; therefore, only the azimuth circuit is described here.

3-1432. Target Angle Controls. The circuits shown in figure 3-185, position the target in angle and select the target motion. Outputs of the target angle control circuits are routed to the angle and range modulation generation circuits.

3-1433. Rate Generator. The azimuth group position voltage from the wiper of R13 is routed to the rate generator board A24. When the RATE SELECT switch S15 is positioned to OFF, amplifier A24Z1 is an inverting amplifier. When the RATE SELECT switch is placed in either the (+) or (-) position, relay A24K1 energizes and removes resistor R6 from the feedback, loop so that amplifier Z1 operates as an integrator. The position voltage from potentiometer A24R13 is removed at this time and a positive or negative voltage proportional to target rate (as selected by the RATE SELECT switch and the rate potentiometer R16) is routed integrator Z1. Capacitor C3 has been charged to the initial position voltage and therefore integrator Z1 begins integrating the voltage from the rate select potentiometer at this point. The output of integrator Z1 is a slowly varying positive voltage, the initial value of which corresponds to initial target position, and the rate of change of the output voltage (and thus the angular rate of the target) is controlled by the setting of azimuth rate potentiometer R16. The direction of change is controlled by the RATE SELECT switch S15. The output of integrator Z1 is routed to the rate modulator A25.

3-1434. Rate Modulator. The rate modulator generates the programmed modulation signal and adds this modulation to the group position/rate signal from the rate generator. The rate modulator contains a triangle waveform generator consisting of integrator Z1 and comparator Z2, and summing amplifiers Z3, Z4, and Z5.

3-1435. The triangle waveform generator is comprised of integrator Z1, comparator Z2, and source followers Q1A and Q1B. The output of comparator Z2 is always saturated at about +13 volts or -13 volts. If it is at +13 volts, the +13 volts will be applied through resistor R1 and source follower Q1A to integrator Z1, the output of

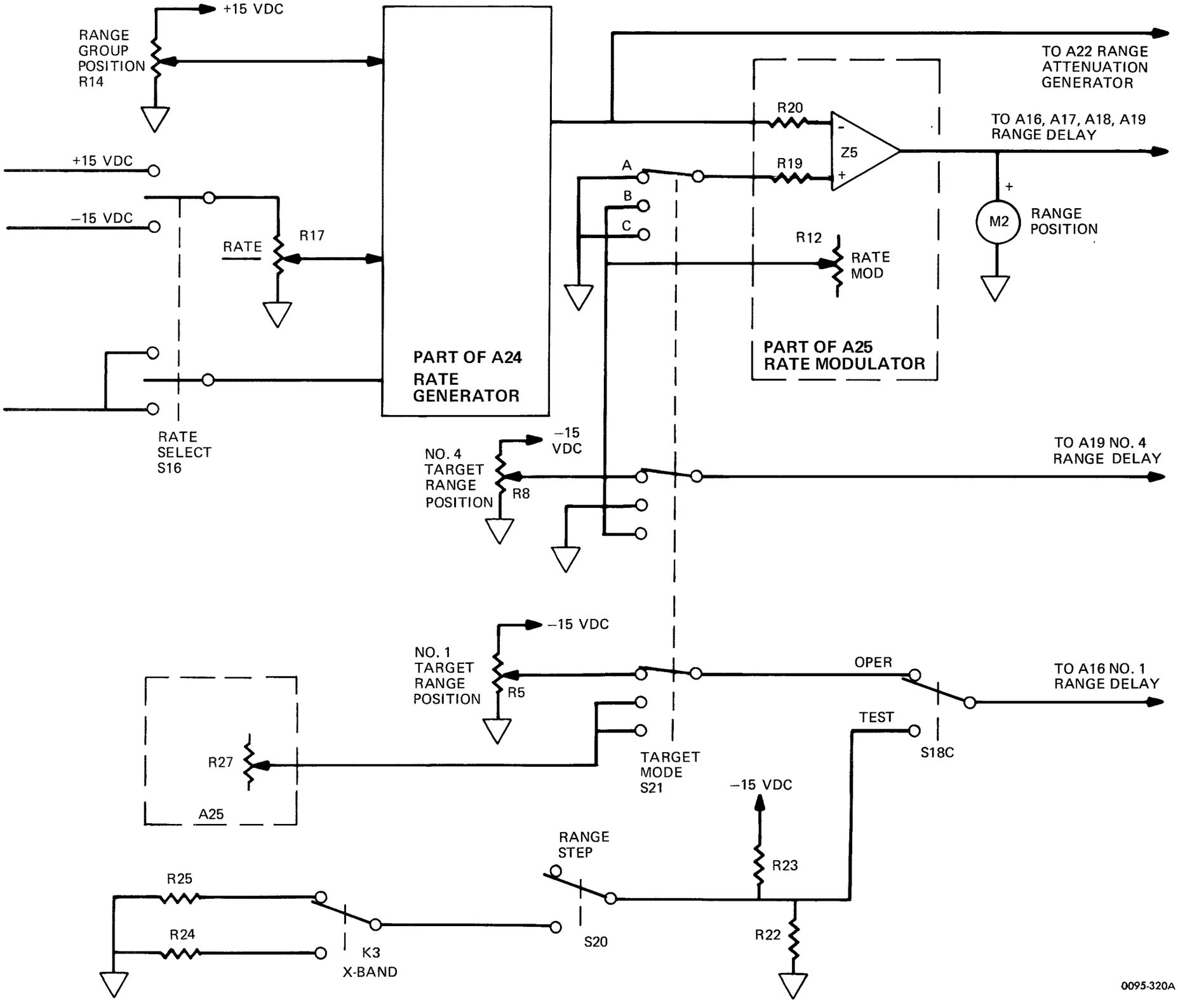


Figure 3-186. Target Range Control Block Diagram

which will be a negative going ramp. When it reaches -10 volts, the voltage at pin 3 of comparator Z2 will be about zero volts, which is the algebraic sum of the outputs of comparator Z2 and integrator Z1 divided across the resistor voltage divider composed of resistors R6 and R7. As the output of integrator Z1 becomes more negative, the voltage at pin 3 of comparator Z2 goes negative. Since comparator Z2 is a positive feedback amplifier, the output of comparator Z2 will go to negative saturation (about -13 volts). The negative voltage is applied to integrator Z1 causing the output of integrator Z1 to become a positive-going ramp which will continue until +10 volts is reached. As the output of integrator Z1 exceeds +10 volts, the voltage at pin 3 of comparator Z2 becomes positive once more, causing the output of comparator Z2 to go to positive saturation. The cycle is self-sustaining and the frequency is set by potentiometer R9 (clockwise increases frequency). The oscillator is disabled during Mode A operation by shorting out capacitor C1. Resistor R25 protects capacitor C1 by preventing too rapid a discharge.

3-1436. The input to the rate modulator from the rate generator is routed to the noninverting input of amplifier Z3. When target Mode B is selected, the output of the triangle wave generator is routed to the inverting input of amplifier Z3, where it is algebraically summed with the group position/rate signal. In Modes A and C, the inverting input is grounded. Potentiometer R10 sets the amplitude of the rate modulation signal that changes the target motion. When the RATE SELECT switch is released and Mode B is selected, the target group will move in a sector scan fashion and the amount of angle change is determined by the setting of potentiometer R10 (i.e., clockwise increases sector angle). The output of amplifier Z3 is routed to coordinate converters A33 and A34, relay K4, and the four antenna gain scaling boards A6, A7, A8, and A9.

3-1437. The output of amplifier Z3, which is routed to coordinate converter A33 is inverted and summed with an offset signal and used to drive the azimuth position meter M1.

3-1438. Coordinate Converter. During X-band track operation, the azimuth group position signal is combined with the elevation group position signal in coordinate converter A34 to provide the required T1 and T2 positioning signals. A positive azimuth signal must be transformed into a positive T1 signal and an equally positive T2 signal. A positive elevation signal must be transformed into a positive T1 output and an equally negative T2 output. Consider the azimuth input at pin F and the elevation input at pin C. The T1 output is at pin V and the T2 output is at pin Z. If a positive elevation signal is applied to inverting amplifier Z1, the inverted signal is applied to the inverting input of amplifier Z3 and the noninverting input of amplifier Z4. The output of amplifier Z3 at pin V is then positive, as required above, and the output of amplifier Z4 at pin Z is negative, as required. Appropriate scaling factors are introduced by the feedback/input resistance ratio of amplifier Z1.

3-1439. If a positive azimuth signal is applied at pin F to comparator Z2, the signal is inverted and applied to the inverting inputs of both amplifier Z3 and Z4. Since both signals are inverted twice, both outputs at pin V and Z are positive as required.

3-1440. Relay K4 is used to select the coordinate converter outputs during X-band track operation.

3-1441. Individual Target Angle Positioning. The individual positioning circuits for targets 1 and 4 are shown. The circuits for targets 2 and 3 are identical to target 1 with the exception of the TEST/OPERATE circuit.

3-1442. Target 1 positioning signals are routed from the azimuth and elevation front panel controls to coordinate converter A36. Coordinate converter A36 functions in the same manner as coordinate converter A34 and relay K4 with the exception that there

are no inverting-amplifiers between the inputs and the summing amplifiers. The outputs of coordinate converter A36 are routed to the TEST/OPERATE switch S18.

3-1443. In the TEST position, the target 1 position voltage is fixed by the voltage dividers R19 and R20 depending upon the position of controls S19 and R21. As the ANGLE STEP switch switches from the plus position to the minus position, the voltage at the junction of resistor R19 and R20 will change slightly. This causes the target to step in angle.

3-1444. Target 4 positioning signals come from the front panel controls during Modes A and B. In Mode C operation, the positioning signals come from the rate modulator as shown.

3-1445. Target Range Controls. The target range control circuit operation is similar to that of the angle control circuits. The range group position voltage from potentiometer R14 is routed to amplifier Z2 of the rate generator A24. The operation of the range circuit of the rate generator is the same as the angle circuits. The output of the rate generator is routed to the inverting input of summing amplifier Z5 on the rate modulator A25. In Mode B operation, the range position/rate signal is modulated by the output of the triangle wave generator. The amplitude of the modulating signal is set by potentiometer R12.

3-1446. The range output of the rate modulator is routed to the range position Meter M2 and to the range delay boards A16, A17, A18, and A19.

3-1447. Individual Target Range Positioning. The individual range position circuits are shown for targets 1 and 4. The circuits for targets 2 and 3 are the same as the target 1 circuit with the exception that there is no range step circuit.

3-1448. During Mode A operation, the target 1 position is controlled from the front panel. In Mode B and C operation, the target 1 range position is preselected by potentiometer R27 on the rate modulator A25. The target 1 range position signal is routed from the MODE SELECT switch through the TEST/OPERATE switch S18 to the target 1 range delay A16.

3-1449. When the TEST/OPERATE switch is in the TEST position, the target 1 range position is determined by the voltage at the junction of resistors R22 and R23. The range step circuit operates the same as the angle step circuit with the exception that relay K3 and resistor R24 have been added. The purpose of relay K3 is to change the size of the range step between S- and C-band operation and X-band operation.

3-1450. In Mode A operation, target 4 position is controlled by the front panel control. In Mode B operation, the position voltage is switched to ground. In Mode C operation, the target 4 position voltage comes from the triangle wave generator through potentiometer R12 on the rate modulator A25.

3-1451. Modulation Generation. The modulation generation circuits, shown in figure 3-187, generate the range and angle signals required to amplitude modulate the target and transponder IF oscillators. The angle modulation generation circuits consist of the sawtooth generators A27, A28, and A29; the coordinate converters A26, A33, and A36; the antenna pattern sync A1 and A10; the antenna pattern generators A2 through A5 and A11 through A14; and, in X-band operation only, the antenna gain scaling boards A6 through A9.

3-1452. The range modulation signals consist of pulse modulation and range attenuation (i.e., the farther the target is in range, the weaker is its return). The pulse generation circuits consist of the range delay board A16 through A19 and the calibration gates board A15. The range attenuation circuit consists of the range attenuation board A22 and the scintillation board A23.

3-1453. Angle Modulation Circuits. The angle modulation signal for the scanning

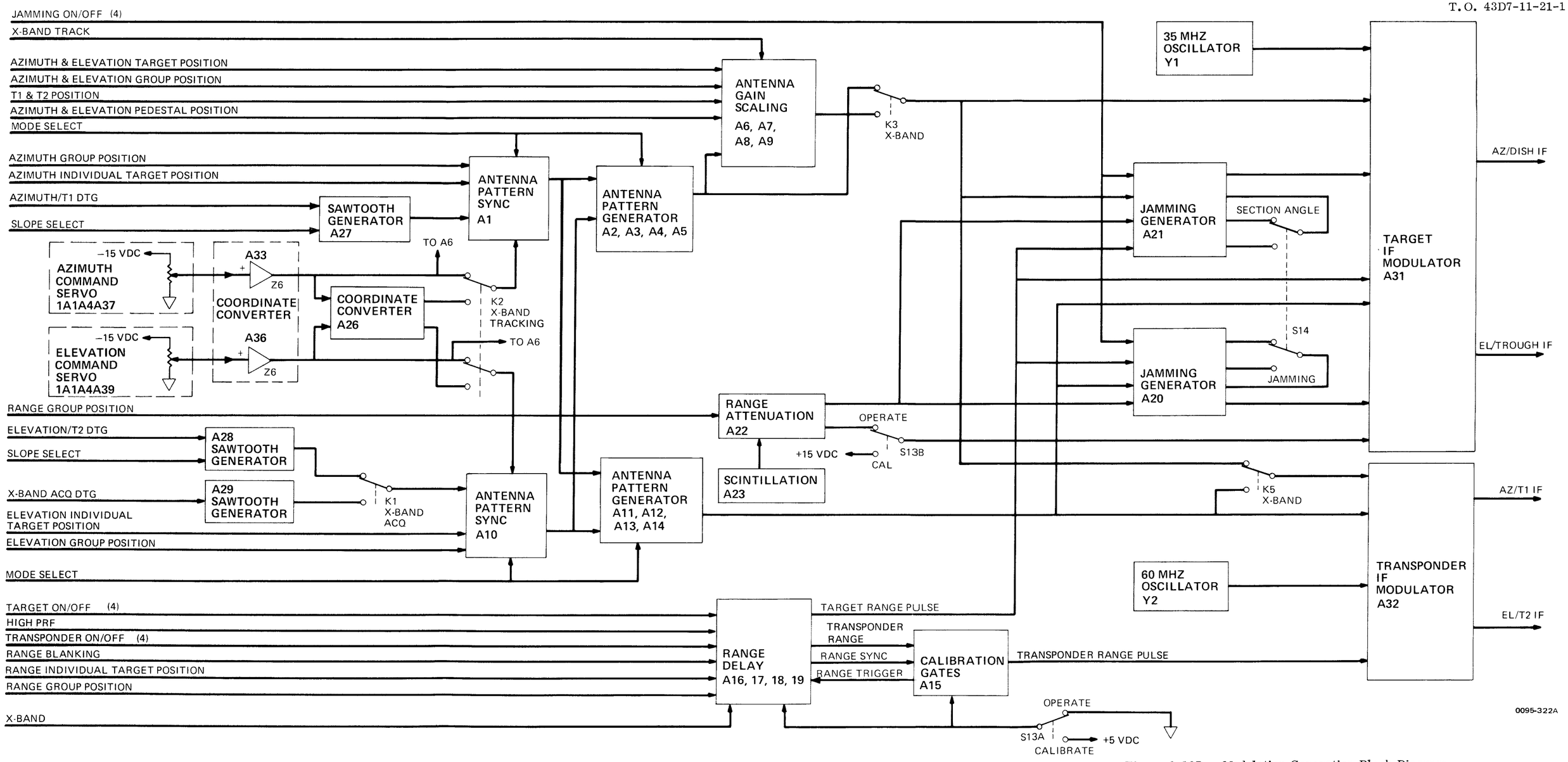


Figure 3-187. Modulation Generation Block Diagram

antennas is a voltage waveform that approximates the shape of the main lobe of the selected antenna pattern. This signal is generated by comparing the pedestal position, the target group position, the target position, and the scan angle position. When these are equal, a pulse is generated to start the antenna pattern generator. The output of the antenna pattern generator is the required modulation signal. In X-band acquisition operation, the dish antenna pattern amplitude is further controlled by the azimuth pedestal position and the azimuth target position relationship with the antenna gain scaling circuit.

3-1454. In X-band track operation, the dish antenna modulation signal is a DC voltage proportional to the azimuth pedestal/target alignment and the elevation pedestal/target alignment.

3-1455. The azimuth and elevation pedestal position information from the guidance operator command servos is routed through noninverting scaling amplifiers Z6 on coordinate converters A33 and A36. These signals are DC voltages corresponding to pedestal angle. The scaled outputs of A33 and A36 are routed to coordinate converter A26 and relay K2. Relay K2 is energized in X-band track operation to select the A26 outputs. The coordinate converter A26 is used to combine the azimuth and elevation pedestal position signals to provide the required T1 and T2 target motion when the pedestal angles are changed. The selected azimuth and elevation pedestal signals are routed to the antenna pattern sync boards A1 and A10.

3-1456. Sawtooth Generators. In addition to pedestal position and target position information, the antenna pattern sync boards require scan angle information. These signals consist of sawtooth waveforms whose amplitude at any instant of time is proportional to scan angle. The waveforms come from sawtooth generators A27, A28, and A29. A27 and A28 are used to generate the sawtooth waveforms during S-band, C-band, and X-band track operation. Sawtooth generator A29 is used to generate the X-band acquisition (dish) scan angle sawtooth. These sawtooth generators are identical to those used to generate the angle and range sweeps for the indicators. The outputs of sawtooth generators A28 and A29 are switched as a function of X-band acquisition by relay K1. The sawtooth generator outputs are then routed to the antenna pattern sync boards.

3-1457. Antenna Pattern Sync. The antenna pattern sync assemblies A1 and A10 consist of four identical channels (one for each target) and mode selection circuitry. Only the number one target channel operation is described here. The antenna pattern sync is determined at comparator Z1. Angle scan (sawtooth signal from the sawtooth generator) pedestal position, group target position, and individual target position are summed and compared to a reference value corresponding to the center of scan at the inputs of voltage comparator Z1. The group position signal is negative and opposite in polarity from the pedestal position. When the group position is the same as the pedestal position, the two inputs will cancel. If the individual target position, with respect to the group position, is zero, the effective input at the summing junction of comparator Z1 is simply the sawtooth, angle scan. The voltage level of the sawtooth indicates the scan position. Therefore, when angle scan is at its midpoint value (indicating center of scan), the summing junction value will equal the reference value and an output is obtained. As the group position and pedestal position become different, or as the individual target position becomes other than zero, the level at which comparator Z1 fires is offset from the angle scan midpoint since the summing junction value is equal to the sum of the four input signals. This will effectively change the output of comparator Z1 from center of scan. When the two inputs to comparator Z1 are equal, the output that is normally a logic high becomes a logic low and triggers single-shot Z5B. The output of single-shot Z5B is antenna pattern sync No. 1, which starts the antenna pattern for target 1.

3-1458. Because the angular scan widths are different for different modes and

bands, the peak amplitude (and therefore the midpoint) of angle scan will vary according to band and mode selection. Since the reference inputs to comparators Z1 through Z4 require a voltage value indicating scan center of the incoming angle scan, the reference level shall be changed with band and mode. Because the trough antennas in X-band have different boresights, the center of scan reference voltage is different. For this reason, the azimuth and elevation antenna pattern sync assemblies will have different inputs. In the azimuth assembly, the maximum reference voltage is obtained when no mode inputs are present and this voltage corresponds to X-band track. In the elevation assembly, the maximum voltage is obtained when no inputs are present and this voltage corresponds to S-band. The reference level is obtained through the voltage divider network consisting of resistors R7, R8, and R9 and either resistor R2, R4, R6, or R11 depending on which transistor Q1, Q2, Q3, or Q4 is energized.

3-1459. The outputs from the antenna pattern sync assemblies are routed to the antenna pattern generators A2 through A5 and A11 through A14.

3-1460. Antenna Pattern Generator. The azimuth and elevation antenna pattern generators are used to generate the respective azimuth and elevation antenna patterns in S-band and C-band operation. In X-band acquisition operation, the azimuth antenna pattern generators A2 through A5 and the antenna gain scaling boards A6 through A9 are used to generate the illuminator (dish) antenna patterns. In X-band track operation, the dish modulation signals come from the antenna gain scaling boards and the elevation antenna pattern generators A11 through A14 are used to generate both the T1 and the T2 antenna patterns.

3-1461. The antenna pattern sync pulse for the azimuth channel is gated into the azimuth antenna pattern generator at gate Z5B by X-band (-) signal. When X-band is selected, the azimuth sync is inhibited at gate Z5B. The X-band acquisition (-) signal is inverted by gate Z5D, becoming a logic high and enabling gate Z5A, thus allowing the elevation/dish sync pulse from the elevation antenna pattern generator to pass. When a signal is gated through either gates Z5A or Z5B, a logic low at the outputs enable the shift registers Z8, Z9, and Z10 and starts a clock running. The input sync sets a latch composed of gates Z7C and Z7B. The output of gate Z7C is the right/left shift control of the register. The running clock shifts the input sync pulse down the register at the clock rate. When the pulse reaches the end of the register, the output at point M, inverted by gate Z7D, resets the right/left shift control latch, causing the register to shift the pulse back to the left and out of the register. The outputs of the registers Z8, Z9, and Z10 are scaled and summed at summing amplifier Z11. The output of amplifier Z11 is the main lobe antenna pattern.

3-1462. The clock rate required for the register differs with mode and band. The antenna pattern widths differ and therefore different clock rates are required. The separate clocks are for S-band, X-band, C-band Mode I or III, and C-band Mode II. The S-band clock is composed of single-shot Z1B, gate Z4B, resistor R2, capacitor C6, and capacitor C7. The C-band Mode I or III clock is composed of single-shot Z1A, gate Z4A, resistor R1, capacitor C4, and capacitor C5; the C-band Mode II clock is composed of single-shot Z2B, gate Z4C, resistor R4, capacitor C10, and capacitor C11; and the X-band clock consists of single-shot Z2A, gate Z4D, resistor R3, capacitor C8, and capacitor C9. Each clock is enabled by the associated mode select signal and by a logic high output from OR gate Z7A. X-band select enables single-shot Z3B and disables single-shot Z3A. The antenna pattern sync pulse from gates Z5A or Z5B triggers single-shot Z3A or Z3B, depending on the state of X-band select. The outputs of the two single-shots are routed through OR gate Z7A to enable the clocks for the period of the single-shot.

3-1463. The outputs from the azimuth antenna pattern generators are routed to the antenna gain scaling boards A6 through A9 and to relay K3. Relay K3 is used to select the antenna gain scaling outputs during X-band operation.

3-1464. The azimuth/dish antenna pattern is then routed to the azimuth jamming generator A21, the target IF modulator A31, and relay K5. Relay K5 is used to switch the elevation antenna pattern generator output into the azimuth/T1 channel of the transponder IF modulator A32 during X-band operation.

3-1465. The elevation antenna pattern generator output is routed to the target IF modulator, the elevation jamming generator A20, the transponder IF modulator, and relay K5.

3-1466. Antenna Gain Scaling. The antenna gain scaling boards A6 through A9 attenuate the X-band dish antenna patterns during X-band acquisition operation as the target moves from the azimuth boresight of the dish. In X-band acquisition mode, X-band track will be a logic low at the emitter of transistor Q1, causing the collector of transistor Q1 to be essentially an open circuit. As a result, -15 volts is applied through resistor R2 to the base of transistor Q2 causing its collector to go to +15 volts. The +15 volts is routed to analog gate Q3, deenergizing it and to analog gate Q4, energizing it. Thus, the X-band acquisition antenna pattern is routed to the noninverting input of differential amplifier Z4. The +15 volts from transistor Q2 also deenergizes analog gate Q5. The azimuth target group position/rate, individual target position, and pedestal position are summed at summing amplifier Z1. If the target position (the sum of group position and individual position) is the same as the pedestal position, the two signals will be equal in magnitude and opposite in polarity, summing to zero. The sum of the signals will be routed through amplifier Z1 and amplifier Z2-Z3 to amplifier Z4. The antenna pattern after passing through amplifier Z4 with no attenuation and through amplifier Z5 and transistor Q7 becomes the X-band dish antenna pattern. As the sum at the input of amplifier Z1 becomes other than zero, plus or minus, the summed signal will be routed to absolute value amplifier Z2-Z3. The output will be equal in magnitude to the input, but will be negative regardless of the input polarity. The antenna pattern at the noninverting input of amplifier Z4 will then be attenuated by the signal at the inverting input. The inverting input (pin 2) signal level is relatively constant compared to the antenna pattern. As the attenuation voltage becomes negative, the dish antenna pattern at the output of amplifier Z5 tries to go positive. Diode CR2 clamps the output of amplifier Z4 until the pattern has become large enough to drive the output negative again. At a complete quiescent condition (both inputs being zero) the output would be zero. The voltage across diode CR1 forces the output to be positive at a level equal to the voltage across the diode, which is constant. Diode CR2 will then be biased ON for all conditions when the antenna pattern is not present. Potentiometer R22 is then adjusted to provide a voltage to the inverting input of differential amplifier Z5-Q7 equal to the diode CR2 voltage. Because both inputs are equal, the output will then be zero for all states except when the negative voltage antenna pattern is present to back bias diode CR2.

3-1467. When X-band track is selected, the dish antenna pattern is a level proportional to pedestal point angle. Therefore, when transistor Q1 is turned on by X-band track, transistor Q2 turns on and a negative voltage is applied to analog gate Q4. Analog gate Q4 is turned off, thus removing any lobing that may be present on the X-band acquisition antenna pattern input. The -15 volts from transistor Q2 energizes analog gate Q5, routing a negative dc voltage to amplifier Z4 in place of the lobed pattern. The -15 volts from transistor Q2 also energizes analog gate Q3. The inputs to the summing amplifier Z1 are then received from both azimuth and elevation positions. If the sum is other than zero, the negative signal of the absolute value is applied to the inverting input of amplifier Z4, and routed to amplifier Z5-Q7. This signal becomes the X-band dish antenna pattern. The output voltage level,

when X-band is selected, will decrease as the pedestal position and the group target position deviates, i.e., as the two add to other than zero.

3-1468. Range Modulation Circuits. The range pulse generation portion of the range modulation circuits consists of the range delay assemblies A16 through A19 and the calibration gate assembly A15. The range attenuation circuit consists of the range attenuation assembly A22 and the scintillation assembly A23.

3-1469. Range Delay. The four range delay boards (one for each target) are synchronized with the radar system by range blanking. The range delay board receives group and individual target position information and generates a simulated target range pulse and two transponder range pulses, delayed from range blanking to simulate the selected range. The range delay board essentially has two circuits; the range sync generator and the target and transponder pulse generator. A timing diagram of the range delay operation is shown in figure 3-188.

3-1470. The range sync generator is comprised of integrator Z1, latch Z9, FET drivers Q2, and Q3, FET switch Q4, and comparator Z2. Range blanking energizes transistor Q1, discharging capacitor C9 and therefore, resetting integrator Z1. The latch comprised of Z9B and Z9C is reset, causing field effect transistor (FET) drivers Q2 and Q3 to drive FET switch Q4 into the energized condition. At the end of range blanking, transistor Q1 deenergizes, removing the short across capacitor C9 and starting integrator Z1. The output of integrator Z1 is a ramp or sawtooth, which is routed to comparator Z2. The group position and the individual target position voltages are applied to the reference input of comparator Z2. When the ramp voltage equals the sum of the reference voltages, the output of comparator Z2 changes to a logic high. The delay between range blanking and the output of comparator Z2 is the simulated range delay. The output of comparator Z2 is routed to the calibration gate board, inverted twice, and routed back to the input of gate Z9A. The logic low output of gate Z9A sets the latch Z9B-Z9C. The logic low output of gate Z9C is applied to FET drivers Q2 and Q3, which drive FET switch Q4 into the open condition, causing integrator Z1 to stop integrating and to maintain a constant output level.

3-1471. The range pulse generator consists of single-shots Z4, Z5, and Z6 and gates Z3, Z7 and Z8. The target sync from gate Z9A is applied to dual single-shots Z4 and Z5. Single-shots Z4A, Z4B, and Z5A are enabled by a logic low from gate Z8A which is present when both TGT ON and OPERATE at connector pins 15 and 16 are logic high. Single-shots Z4A, Z4B, and Z5A are also enabled by a logic high from inverters Z3D, Z3B, Z3C, or the X-band signal at connector pin 22. Single-shot Z4A is enabled when high PRF (+) is present, but X-band (+) is not. Single-shot Z4B is enabled when low PRF, S-band, or C-band are present but high PRF (+) and X-band are not. Single-shot Z5A is enabled when X-band (+) is present. Thus, according to band selection and PRF selection, only one of the single-shots is enabled. The outputs are OR'ed together at gate Z7B, inverted by gate Z7A, and routed out as TGT range pulse (-).

3-1472. The transponder ON (+) signal enables single-shot Z5B. Single-shot Z5B delays the first transponder pulse until 2.35 microseconds after the target pulse. Single-shot Z6A is triggered at the end of the period for single-shot Z5B and is used to provide the coded delay between the first and second transponder returns. This delay is either 12, 24, 36, or 48 microseconds depending on the transponder being simulated.

3-1473. The outputs of single-shots Z5B and Z6A are combined in gate Z8D to produce the signal shown in the timing diagram. The narrow gap in the waveform is due to the triggering delay of single-shot Z6A. Single-shot Z6B is triggered by the negative going transitions from gate Z8D and the pulse width of single-shot Z6B is 0.5 microseconds. Thus the output of single-shot Z6B consists of two pulses.

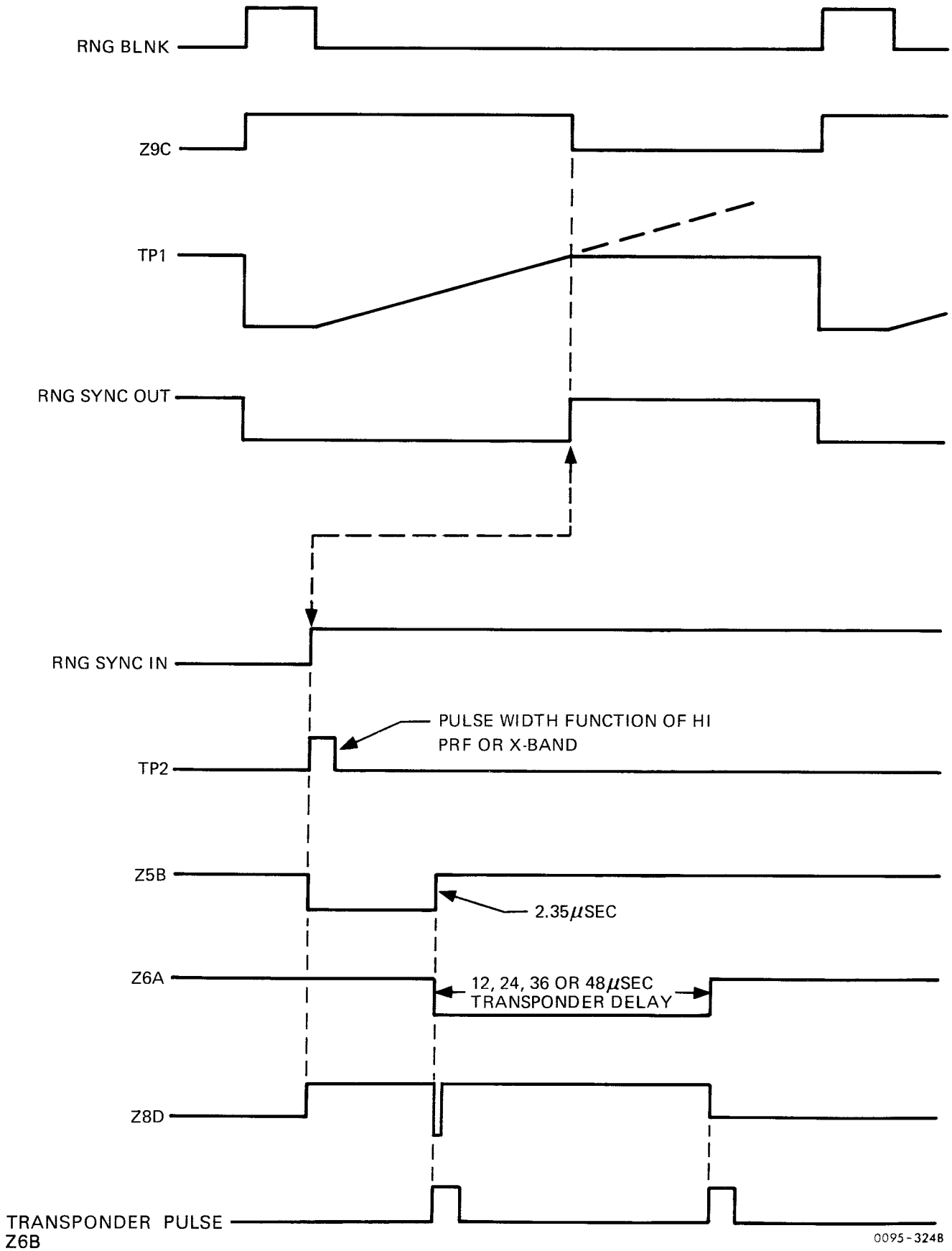


Figure 3-188. Range Delay Timing Diagram

The first delayed 2.35 microseconds from the target pulse and the second delayed from the first by the simulated coded delay.

3-1474. The target pulse is routed to the target IF modulator A31 and to jamming generators A20 and A21. The transponder pulses are routed to the calibration gates A15.

3-1475. Calibration Gates. For calibration purposes, the four simulated targets shall be at the same range. To accomplish this target sync, signals from the range delay boards are all routed to the calibration gates. When CALIBRATE is not selected, the target sync signals are simply inverted twice and routed back to the respective range delay board as target range sync IN. When the CALIBRATE function is selected, the No. 1 target sync pulse is gated and routed to all the range delay boards, while the other target syncs are inhibited.

3-1476. In the OPERATE mode, the transponder 2, 3, and 4 pulses are inverted and routed to their respective channels of the transponder IF modulator. In the CALIBRATE mode, the four sets of transponder pulses are inverted by integrator Z1 and combined in single-shot Z6B. The output of single-shot Z6B is inverted by single-shot Z6A and routed to the transponder 1 IF modulator channel.

3-1477. Range Attenuation. The range attenuation circuit is shown in figure 3-189. The range attenuation board performs two functions: range attenuation is developed and a range attenuated noise signal is generated. Range voltage (group position/rate) is directly proportional to the simulated range, R. The output range attenuation is a voltage proportional to $1/R^2$. Range voltage is amplified by operational amplifier Z1. As the output voltage of amplifier Z1 increases positively, diodes CR6, CR7, CR8, and CR9 begin to conduct, paralleling the feedback resistance, decreasing the gain. Therefore, instead of continuing up from zero volts linearly, the output tends to level off. The output is then summed with the scintillation signal, which is low frequency noise, at the inverting amplifier Z2-Q4. Potentiometer R23 shifts the quiescent output level of amplifier Z2 so that the output is the $1/R^2$ range attenuation function with low frequency noise impressed on it.

3-1478. Zener diode CR1 at the base of transistor Q1 serves as a low level noise source. Transistor Q1 amplifies the signal which is then coupled through C5 to the input of the complementary emitter follower Q2-Q3, which drives the low impedance modulator A1, which acts as a variable attenuator. As the range attenuation functions approaches zero, corresponding to increasing range, the attenuation of A1 increases. The output of modulator A1 is the range attenuated noise signal used in jamming simulation.

3-1479. Scintillation. The scintillation circuits generate low frequency noise by amplifying the noise of a zener diode and then filtering out the high frequency components. Zener diode CR1 in the base of transistor Q1 is used as a low level noise generator. Transistor amplifiers Q1 and Q2 amplify the noise, which is then buffered by emitter follower Q3 and coupled to an active low pass filter composed of amplifier Z1, capacitor C4, resistor R11, R10, capacitor C3 and resistor R9. The filtered noise is then coupled to transistor amplifier Q4, buffered by emitter follower Q5, and applied to a low pass filter composed of amplifier Z2, resistor R18, capacitor C7, resistor R19, and capacitor C8. The resulting noise is further amplified by amplifier Q6 and again buffered by emitter follower Q7. The signal is coupled to a low pass filter composed of resistors R27, R28, capacitor C11, and amplifier Z3. The output bias level of amplifier Z3 is controlled by potentiometer R29. The noise out of amplifier Z3 is buffered by emitter follower Q8 and then routed out. Potentiometers R3, R12, and R21 control the bias levels of transistors Q2, Q4, and Q6, respectively.

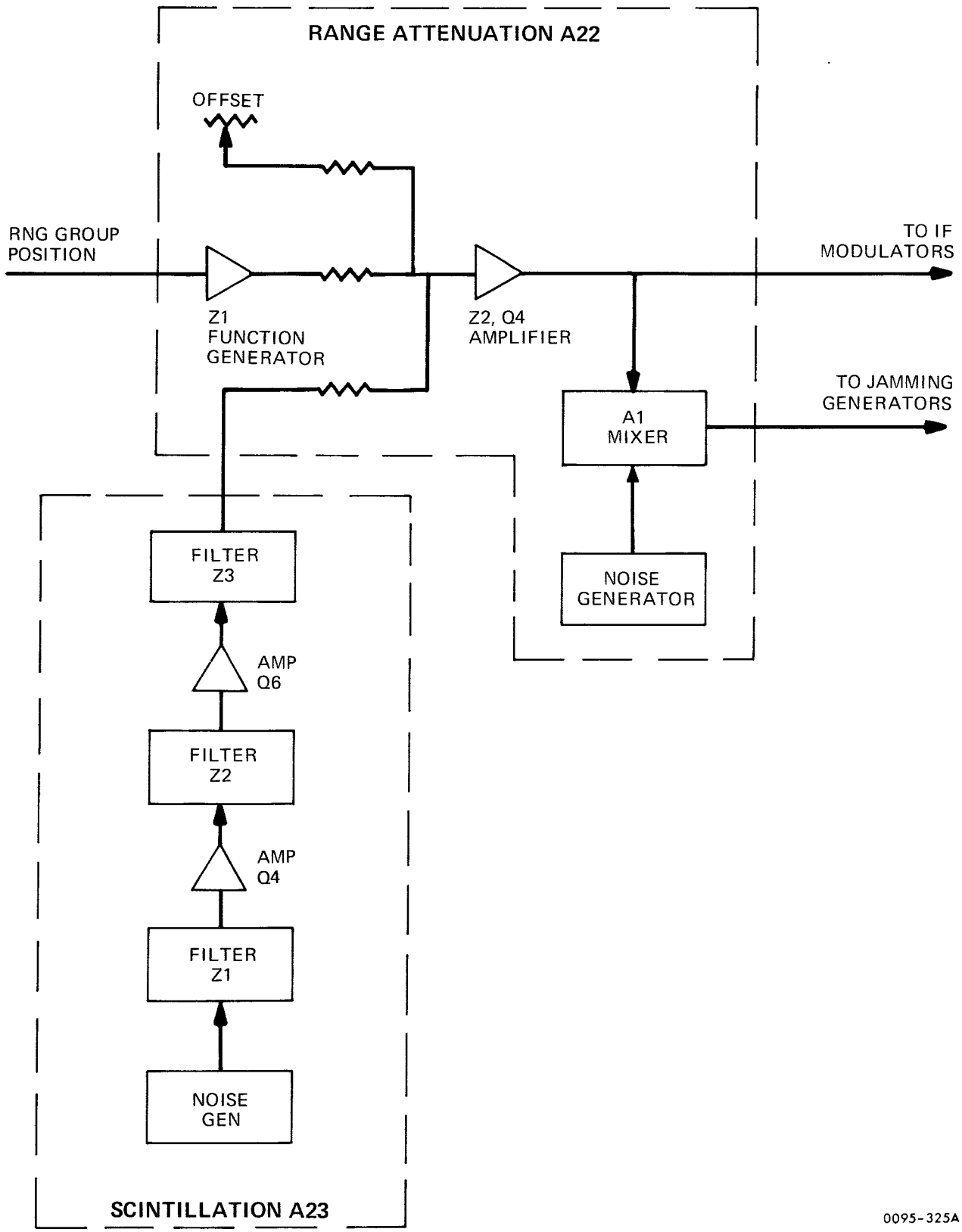


Figure 3-189. Range Attenuation Block Diagram

3-1480. Jamming Generator. The jamming generator consists of three circuits: antenna pattern selection and amplification; range pulse selection; and the noise modulator. The JAMMING ON/OFF switches control the antenna patterns and range pulses simultaneously. When jamming is selected for any or all of the targets, the angle or sector jamming signals (as selected by the SECTOR/ANGLE JAMMINC switch S14) are routed to the noise modulator where they are used to amplitude modulate the range attenuated noise from the range attenuation assembly A22.

3-1481. Angle jamming is developed from the four target range pulse inputs. The target range pulses are inverted through NAND gates Z3A, Z3B, Z3C, and Z3D when the jamming select signal is logic high. The outputs of gates Z3 are combined in gate Z2. The output of gate Z2 is the combined range pulses from each of the selected targets with jamming selected. (If the target is turned off, there is no range pulse and therefore no angle jamming pulse).

3-1482. Sector jamming is developed by summing the four antenna patterns in summing amplifier Z1. Transistors Q3, Q4, Q5, and Q6 function as analog switches and are controlled by the jamming select switch for each target. When an input to either gate Q3, Q4, Q5, or Q6 is -15 volts, the transistor functions as a closed switch and allows the antenna pattern to pass to amplifier Z1. When the gate input voltage is +15 volts, the transistor appears as an open circuit and prevents the antenna pattern from passing to the summing amplifier.

3-1483. The jamming generator receives range attenuated noise from the range attenuation board. The noise is coupled into modulator A1, where it is attenuated by angle or sector jamming that is applied to pin A1-4. Zero volts at modulator A1 pin 4 causes modulator A1 to introduce maximum attenuation into the noise. The attenuated noise output of modulator A1 is coupled through gain potentiometer R11 to transistor amplifier Q1. The amplified signal is then buffered by emitter follower Q2 and routed to the IF section.

3-1484. IF Modulators. The IF modulators are used to amplitude modulate the IF oscillator outputs with range and angle signals to produce the simulated target, transponder, and jamming returns at the receiver intermediate frequencies of 35 megahertz and 60 megahertz. A block diagram of the target IF modulator A31 is shown in figure 3-190. The transponder IF modulator is nearly identical with the exception that there is no jamming and, therefore, some of the components are not used. The target IF modulator is discussed below with the transponder exceptions noted.

3-1485. The IF signal from the 35 megahertz oscillator Y1 (60-megahertz oscillator Y2 for the transponder) is routed to the power divider A5. The six CW outputs (four outputs for transponder) are routed to the four antenna pattern modulators A1 through A4 and to the range and noise modulator A6. The antenna pattern modulators gate the target in range to produce the IF range pulse. This signal is then modulated by the angle patterns and routed to the range and noise modulator. The range and noise modulator combines the four azimuth and elevation signals and the noise modulated jamming signals.

3-1486. Power Divider. The target IF modulator requires six CW signals (two for azimuth and elevation jamming and one each for the four targets). The target IF oscillator output is routed through power divider Z1, a two-way power divider, to power dividers Z2 and Z3. Power divider Z2 is also a two-way power divider and its outputs are used for the azimuth and elevation jamming signals. Power divider Z3 is a four-way power divider and it produces the four signals for the target returns.

3-1487. The transponder IF modulator does not use power dividers Z1 and Z2 and therefore the transponder IF oscillator output is routed directly to power divider Z3 to produce the four CW signals for the four transponder returns.

3-1488. Antenna Pattern Modulator. The antenna pattern modulator contains a range switch and switch driver, a power

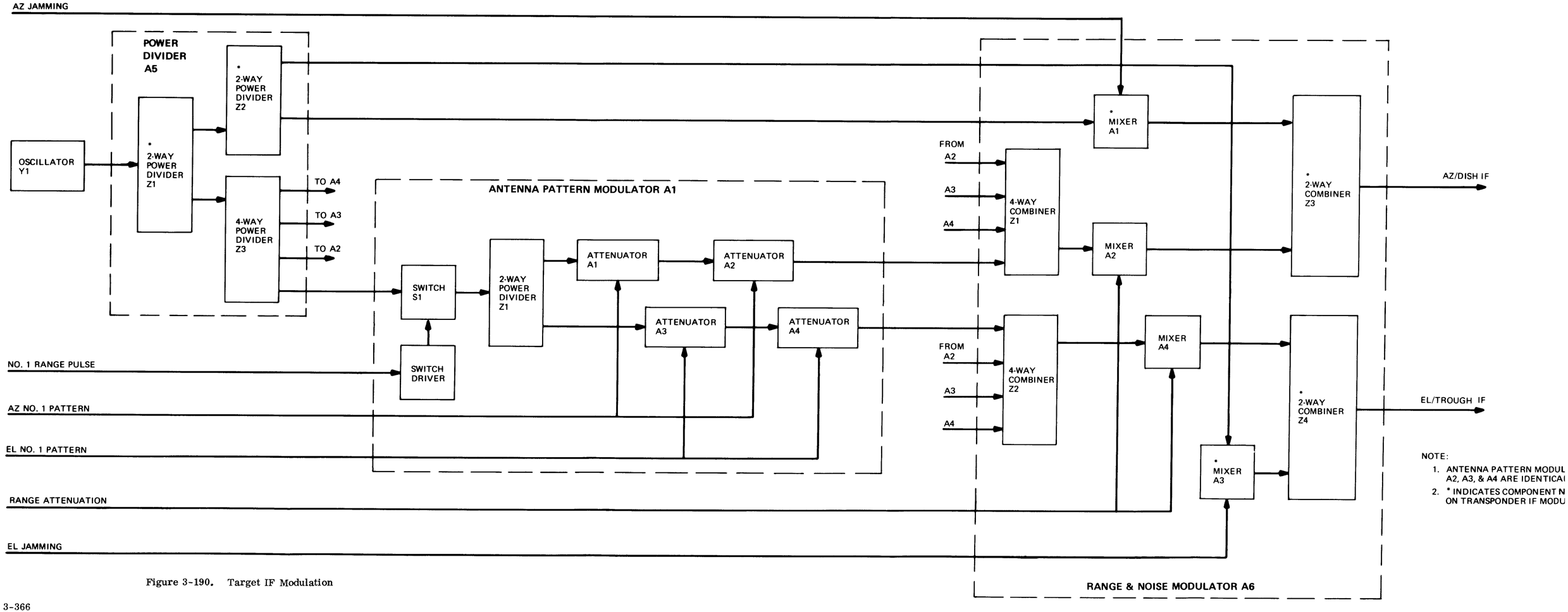


Figure 3-190. Target IF Modulation

divider, and antenna pattern attenuators. With a logic high at the range gate input, transistor Q1 is on, causing a voltage drop across resistor R2. This turns on transistor Q2, which places a -15 volts on the base of transistor Q3. Transistor Q3 is cut off, and a negative voltage applied to Switch S1, holding it open. When the negative range gate is applied to the emitter of transistor Q1, transistor Q1 ceases conduction and transistor Q2 is turned off. With transistor Q2 turned off, +15 volts is applied to the base of transistor Q3 causing saturation. As a result +15 volts is applied to switch S1, switch S1 closes and gates the IF signal to the power divider Z1. The power divider is a two-way power divider, the outputs of which are routed to the antenna pattern attenuators.

3-1489. With 0 volts at pin 4 of the attenuators, the attenuators exhibit maximum attenuation of the IF range pulse. As the pattern signal goes negative, the attenuation decreases and allows more of the input signal to pass. The attenuators, therefore, amplitude modulate the IF range pulse with the main lobe of the antenna pattern. The target IF modulator uses two attenuators in each angle modulation to provide two-way antenna patterns (i.e., transmit and receive antenna patterns). The transponder IF modulator uses one attenuator in each angle to provide one-way (receiver only) antenna patterns. The azimuth and elevation outputs are routed to the range and noise modulator A6.

3-1490. Range and Noise Modulator. The range and noise modulator combines the signals from the four antenna pattern modulators in azimuth and elevation. The combined signals are then attenuated as a function of range and combined with the azimuth and elevation jamming signals.

3-1491. The four-way power combiners Z1 and Z2, sum the four target signals in azimuth and elevation. The combined signals are then routed to mixers A2 and A4. The IF signals are modulated with the range attenuation/scintillation signal and routed to combiners Z3 and Z4.

3-1492. Mixers A1 and A3 are used to amplitude modulate a 35-megahertz signal with the selected jamming signal. The outputs of mixers A1 and A3 are routed to combiners Z3 and Z4 where they are combined with the simulated target returns and routed to the receivers during target simulation operation.

3-1493. Since the Transponder IF modulator does not have jamming, mixers A1 and A3 and power combiners Z3 and Z4 are not used.

3-1494. INSTRUMENTATION SYSTEM. The instrumentation system provides the interface between the radar and the GFE recorder system and the Ground Equipment Instrumentation Set (GEIS). A block diagram of the instrumentation system is shown in figure 3-191. Five types of signals are routed from the radar to the common data point assembly 1A20. They are discrete signals (signals that indicate various radar switch positions), analog signals, audio signals, video signals, and range and angle synchronization signals required for video recording and playback. These signals originate at guidance operators console 1A1, radar console 1A5, AN/GRC-27 radio 1A6, S/C-band manual trackers console 1A11, and X-band manual tracker console 1A17.

3-1495. Discrete and synchronization signals from the radar are buffered in the common data point (CDP) 1A20 and routed to the recorder connectors or differential line drivers. Video from the radar is routed directly through the CDP to the recorder video connector. Audio from the radar intercom and the AN/GRC-27 radio is summed in the CDP and rerouted to the recorder connector. Analog signals from the radar are used in the CDP to generate the transmitter ON discrete signals. All signals available for recording with connector pin assignments are shown in table 3-11.

3-1496. Three 16 bit status words are routed to the computer from the CDP by the Buffered Parallel Input/Output Channel

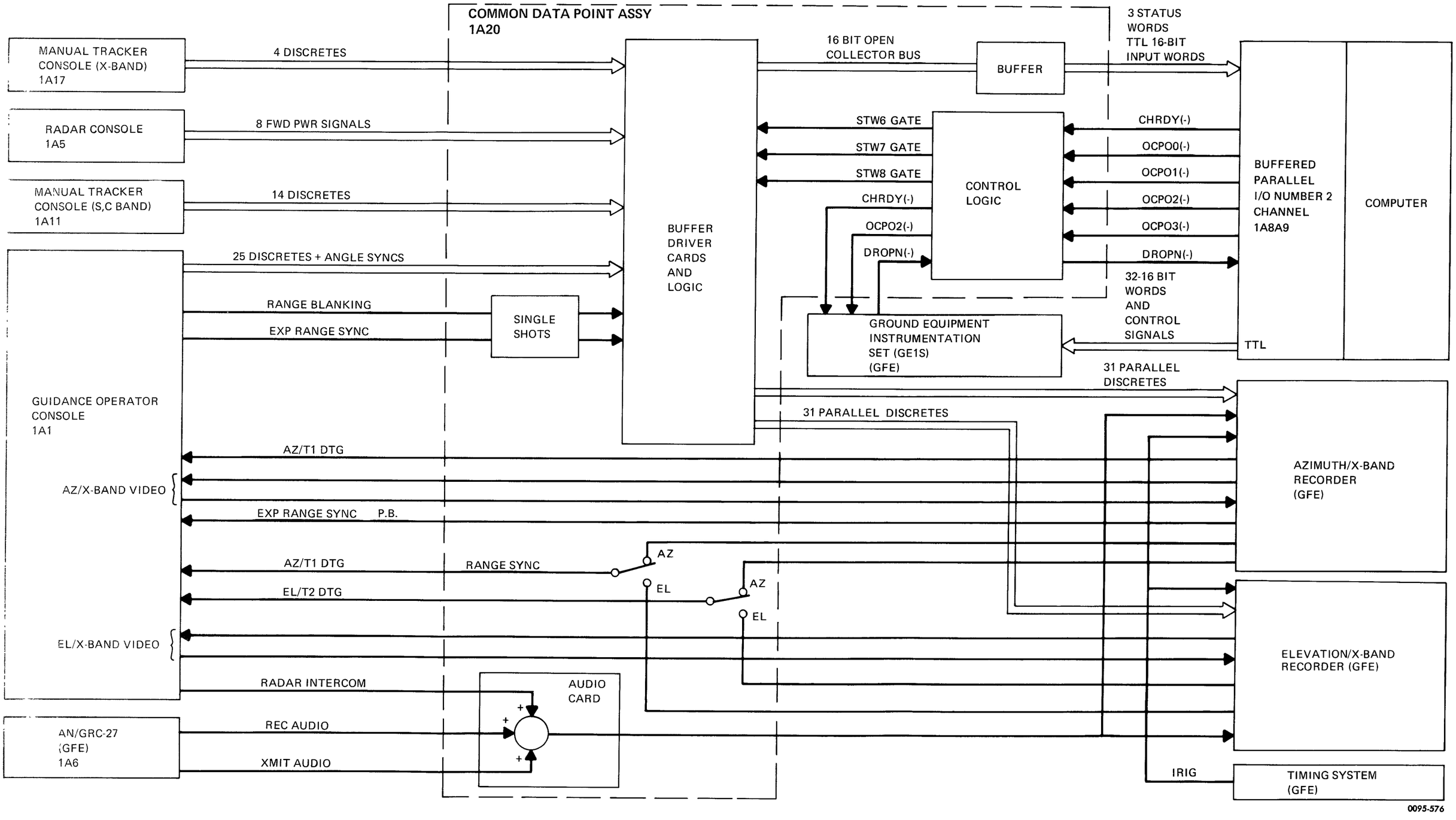


Figure 3-191. Instrumentation System, Block Diagram

Table 3-11. Recorder Connector Pin Assignment

Connector-Pin	Assignment
1A20J21 & J23	
-1	Target High PRF (+)
-2	Target High PRF (-)
-3	C-Band Mode I (+)
-4	C-Band Mode I (-)
-5	C-Band Mode II (+)
-6	C-Band Mode II (-)
-7	C-Band Mode III (+)
-8	C-Band Mode III (-)
-9	Target C-Band Select (+)
-10	Target C-Band Select (-)
-11	Target S-Band Select (+)
-12	Target S-Band Select (-)
-13	Target X-Band Select (+)
-14	Target X-Band Select (-)
-15	Range Transferred (+)
-16	Range Transferred (-)
-17	STC ON (+)
-18	STC ON (-)
-19	IAGC ON (+)
-20	IAGC ON (-)
-21	Expanded Range Indicator Select (+)
-22	Expanded Range Indicator Select (-)
-23	Guidance Operator Target Video Select (+)
-24	Guidance Operator Target Video Select (-)
-25	Guidance Operator Missile Video Select (+)
-26	Guidance Operator Missile Video Select (-)
-27	S-Pedestal Guidance Transmitter ON (+)
-28	S-Pedestal Guidance Transmitter ON (-)
-29	C-Pedestal Guidance Transmitter ON (+)
-30	C-Pedestal Guidance Transmitter ON (-)
-31	X-Pedestal Interrogation Transmitter ON (+)
-32	X-Pedestal Interrogation Transmitter ON (-)
-33	X-Pedestal Guidance Transmitter ON (+)
-34	X-Pedestal Guidance Transmitter ON (-)
-35	Range Track on Azimuth Video (+)
-36	Range Track on Azimuth Video (-)
-37	AZ/Illuminator FTC ON (+)
-38	AZ/Illuminator FTC ON (-)
-39	X-Band Acquisition (+)
-40	X-Band Acquisition (-)

Table 3-11. Recorder Connector Pin Assignment (Continued)

Connector-Pin	Assignment
1A20J21 & J23	
-41	Missile 1 Underway (+)
-42	Missile 1 Underway (-)
-43	Missile 2 Underway (+)
-44	Missile 2 Underway (-)
-45	Not assigned
-46	Not assigned
-47	Not assigned
-48	Not assigned
-49	Not assigned
-50	Not assigned
-51	Not assigned
-52	Not assigned
-53	Not assigned
-54	Not assigned
-55	Ground
1A20J22	
-1	AZ/T1 Transferred (+)
-2	AZ/T1 Transferred (-)
-3	AZ STC ON (+)
-4	AZ STC ON (-)
-5	AZ IAGC ON (+)
-6	AZ IAGC ON (-)
-7	AZ AGC ON (+)
-8	AZ AGC ON (-)

Connector-Pin	Assignment
1A20J22	
-9	T1 AGC ON (+)
-10	T1 AGC ON (-)
-11	AZ Expanded Indicator Select (+)
-12	AZ Expanded Indicator Select (-)
-13	Guidance Operator Expanded Indicator Select (+)
-14	Guidance Operator Expanded Indicator Select (-)
-15	AZ Log Receiver Select (+)
-16	AZ Log Receiver Select (-)
-17	Missile 3 Underway (+)
-18	Missile 3 Underway (-)
-19	Not assigned
-20	Not assigned
-21	Not assigned
-22	Not assigned
-23	AZ/T1/AC4 Playback Dead Time Gate (+)
-24	AZ/TL/AC4 Playback Dead Time Gate (-)
-25	AZ/T1/AC4 Record Dead Time Gate (+)
-26	AZ/T1/AC4 Record Dead Time Gate (-)

Table 3-11. Recorder Connector Pin Assignment (Continued)

Connector-Pin	Assignment	Connector-Pin	Assignment
1A20J22		1A20J22	
-27	Range Record Sync (+)	-49	Not assigned
-28	Range Record Sync (-)	-50	Not assigned
-29	Expanded Range Record Sync (+)	-51	Not assigned
		-52	Not assigned
-30	Expanded Range Record Sync (-)	-53	Not assigned
-31	Playback Range Sync (+)	-54	Not assigned
-32	Playback Range Sync (-)	-55	Ground
-33	Playback Expanded Range Sync (+)	1A20J24	
		-1	EL/T2 Transferred (+)
-34	Playback Expanded Range Sync (-)	-2	EL/T2 Transferred (-)
-35	Not assigned	-3	EL STC ON (+)
-36	Not assigned	-4	EL STC ON (-)
-37	Not assigned	-5	EL IAGC ON (+)
-38	Not assigned	-6	EL IAGC ON (-)
-39	Record Audio (+)	-7	EL AGC ON (+)
-40	Record Audio (-)	-8	EL AGC ON (-)
-41	Not assigned	-9	T2 AGC ON (+)
-42	Not assigned	-10	T2 AGC ON (-)
-43	Not assigned	-11	EL Expanded Indicator Select (+)
-44	Not assigned	-12	EL Expanded Indicator Select (-)
-45	Not assigned		
-46	Not assigned	-13	EL FTC ON (+)
-47	Not assigned	-14	EL FTC ON (-)
-48	Not assigned	-15	EL Log Receiver Select (+)

Table 3-11. Recorder Connector Pin Assignment (Continued)

Connector-Pin	Assignment
1A20J24	
-16	EL Log Receiver Select (-)
-17	Missile 3 Underway (+)
-18	Missile 3 Underway (-)
-19	Not assigned
-20	Not assigned
-21	Not assigned
-22	Not assigned
-23	EL/T2/ACQ Playback Dead-Time Gate (+)
-24	EL/T2/ACQ Playback Dead-Time Gate (-)
-25	EL/T2/ACQ Record Dead-Time Gate (+)
-26	EL/T2/ACQ Record Dead-Time Gate (-)
-27	Record Range Sync (+)
-28	Record Range Sync (-)
-29	Not assigned
-30	Not assigned
-31	Playback Range Sync (+)
-32	Playback Range Sync (-)
-33	Not assigned
-34	Not assigned
-35	Not assigned
-36	Not assigned
-37	Not assigned
-38	Not assigned
-39	Record Audio (+)
-40	Record Audio (-)
-41	Not assigned
-42	Not assigned
-43	Not assigned
-44	Not assigned
-45	Not assigned
-46	Not assigned
-47	Not assigned
-48	Not assigned
-49	Not assigned
-50	Not assigned
-51	Not assigned
-52	Not assigned
-53	Not assigned
-54	Not assigned
-55	Ground
1A20J31	Record AZ/X-Band Video
1A20J32	Playback AZ/X-Band Video
1A20J34	Record EL Video
1A20J35	Playback EL Video
1A20J14	IRIG B Timing INPUT
1A20J30	IRIG B Timing Output
1A20J33	IRIG B Timing Output

Table 3-12. Ground Equipment Instrumentation Set (GEIS) Connector Pin Assignment

1A20J5-HH	Bit 1 (+)	1A20J5-K	Ground
-GG	Ground	-J	Bit 12 (+)
-FF	Bit 2 (+)	-I	Ground
-FE	Ground	-H	Bit 13 (+)
-DD	Bit 3 (+)	-G	Ground
-CC	Ground	-F	Bit 14 (+)
-BB	Bit 4 (+)	-E	Ground
-AA	Ground	-D	Bit 15 (+)
-Z	Bit 5 (+)	-C	Ground
-Y	Ground	-B	Bit 16 (+)
-X	Bit 6	-A	Ground
-V	Bit 7 (+)	-Z	OCPO2 (-)
-U	Ground	-Y	Ground
-T	Bit 8 (+)	-X	DROPN (-)
-S	Ground	-W	Ground
-R	Bit 9 (+)	-V	CHRDY (-)
-Q	Ground	-U	Ground
-P	Bit 10 (+)	-T	MSTCL (-)
-N	Ground	-S	Ground
-M	Bit 11 (+)		

(BPOIC) in the computer (auxiliary unit 1A8A9). The status word bit assignments are shown in table 2-72. The BPIOC in the computer outputs thirty-two 16-bit words (serial by word and parallel by bit) to the GEIS. The GEIS pin assignments are shown in table 3-12. The word assignments are shown in table 2-72. Provisions are included to connect a GFE IRIG B timer into the CDP. Output connectors containing the IRIG B signals are provided to each recorder.

3-1497. Discrete Signal Interface. The discrete signal interface between the radar and the recorder is similiar for all signals and will be discussed for a typical signal. A functional diagram of the discrete signal interface is shown in figure 3-192. The discrete signal input is applied to input 1 or input 2 depending on the signal voltage level. In the case considered here, the guidance operator expanded indicator signal is applied to input 1 with inputs 2 and 3 grounded. Resistors R6 and R8 form a

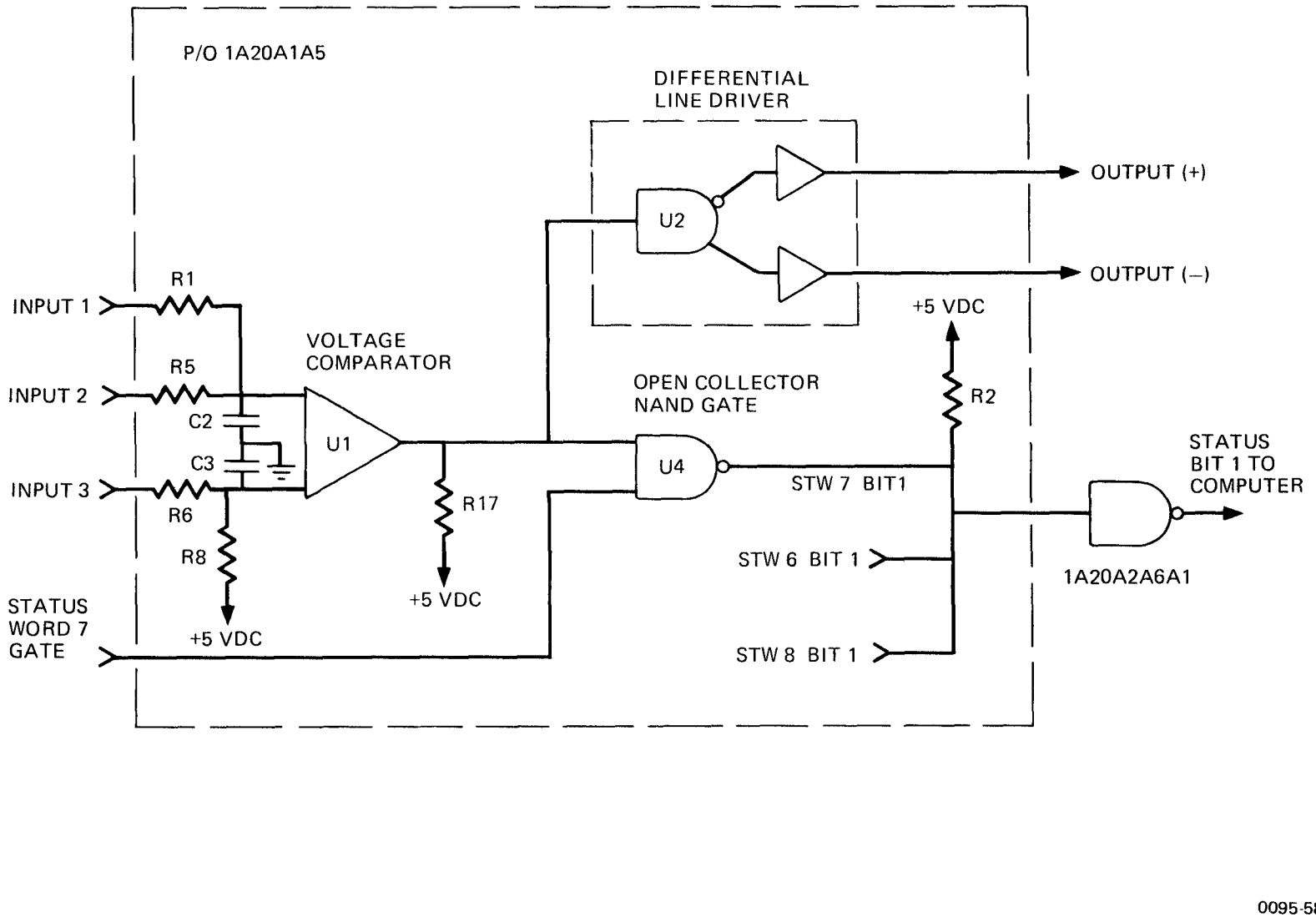


Figure 3-192. Discrete Signal Interface

voltage divider network and apply approximately +1.5 volts to the (-) input of voltage comparator U1. Resistors R1 and R5 form a voltage divider network to reduce the voltage at the (+) input of voltage comparator U1 to approximately +5 volts when the guidance operator expanded indicator is not selected. In this case +28 volts is applied to input 1 and shall be reduced to +5 volts or less or the voltage comparator will latch up. When the guidance operator expanded indicator is selected, input 1 is grounded and the voltage at the (+) input of voltage comparator U1 becomes less than that at the (-) input, the output of voltage comparator U1 then changes from +5 volts to zero volts (logic 0). The output of voltage comparator U1 is routed to differential line driver U2 and the open collector NAND gate U4. If the input of line driver U2 is logic 1 then the output (+) is logic 1 and the output (-) is logic 0. In this case, the input is logic 0 when the guidance operations expanded indicator is selected. Therefore, the output (+) will be logic 0 and the output (-) will be logic 1. The output (-) signal is then routed to the recorder connector and described as the guidance operator expanded indicator select (+) signal since it is logic 1 when the guidance operator expanded indicator is selected. The output (+) signal is also routed to the recorder connector and is described as the guidance operator expanded indicator select (-) signal. When status word 7 gate is logic 1, the signal at the output of voltage comparator U1 is inverted by NAND gate U4, inverted again by NAND gate 1A20A2A6A1, and routed into the computer as bit 1 of status word 7. Bit 1 of status words 6 and 8 are wire OR'ed with bit 1 of status word 7. Hence, the output of 1A20A2A6A1 contains bit 1 of all three words sequentially. Some discrete signals are not applied to the computer. In such a case, the output of the open collector gate is not wired to the input of gate 1A20A2A6A1.

3-1498. Analog Signal Interface. The analog signals input to the CDP are analog voltages proportional to the forward power of the S-band and C-band azimuth and elevation transmitters, the X-band transmitter, and the three pulsed L-band transmitter. A functional diagram of the analog signal interface is shown on figure 3-193. The analog signal is routed to the input of the voltage comparator. Operation of the voltage comparator is the same as that described previously. The +V reference on the (-) input of the voltage comparator is set so that the output state of the comparator will change when the (+) input moves through +4 volts. The output of the voltage comparator is routed to the gating circuitry which generates the transmitter ON signals. The following conditions shall be met for each transmitter ON signal. All transmitter ON signals are routed into the computer as status bits. All L-band transmitter ON signals are also routed to the recorder connector through differential line drivers.

Signal	Condition
AZ Transmitter ON	S or C-band selected for target tracking. The azimuth transmitter in the selected band is energized and transmitting Dummy load is not selected in the selected band
EL Transmitter ON	Same as above except the elevation transmitted in the selected band is energized and transmitting
X-Band Transmitter ON	X-band is selected for target tracking, the transmitter is energized and transmitting and X-band dummy load is not selected
S-Pedestal L-Band Transmitter ON	The transmitter is energized and transmitting and dummy load is not selected

Signal	Condition
C-Pedestal L-Band Transmitter ON	The transmitter is energized and transmitting and dummy load is not selected
X-Pedestal Interrogation L-Band Transmitter ON	The transmitter is energized and transmitting, and dummy load is not selected
X-Pedestal Guidance L-Band Transmitter ON	X-Band is selected for target tracking and Missile 1 or Missile 2 is underway.

3-1499. Audio Signal Interface. The audio interface sums the radar intercom audio and the AN/GRC-27 radio audio on audio amplifier circuit board 1A20A2417 and routes it to the recorder connector.

3-1500. Video Signal Interface. The video signal interface routes video signals from both guidance operators indicators to the video recorder connectors during the record mode and from the video recorder to the guidance operator indicators during the playback mode. A functional diagram of the video signal interface is shown in figure 3-194. During the playback mode of operation, relay K1 on video amplifier A4 of guidance operator indicators 1A1A2 and 1A1A3 is energized and routes the playback video through the amplifier to the grid of the CRT. During the X-band record mode of operation, video from both guidance operator indicators is summed by the network consisting of resistors 1A20R1, R2, and R3 and routed to the AZ/X-band recorder connector. Summing the two videos allows both guidance operator indicators to be recorded on one video recorder.

3-1501. Range and Angle Sychronization Signal Interface. The range and angle synchronization signal interface is shown in figure 3-195. During the record mode of operation, the range blanking and expanded range sync signals are routed from synchronizer 1A1A5 to the CDP 1A20. The signals trigger single-shots SS4 and SS5 on circuit board 1A20A2A10. The single-shots generate a one microsecond pulse which is routed through the line drivers to the recorder connectors. During the playback mode of operation, the range and angle sync signal are routed directly from the recorder to the synchronizer where they are used for display synchronization.

3-1502. Buffered I/O #2 Channel Operation. Buffered I/O #2 channel transfers three status words (each containing 16 bits of discrete system status data) into the computer and subsequently transfers both this discrete data and control signals from the computer to the Ground Equipment Instrumentation Set (GEIS). The transfer of status words into the computer is disdussed in paragraph 3-1503. Data transfer from the computer to the GEIS is described in paragraph 3-1504. Since Buffered I/O #2 channel is used to transfer status words to the computer and also to transfer data from the computer to the GEIS, the logic circuitry shown in figure 3-197 is incorporated in the Common Data Point Assembly (1A20) to properly route various data in the desired sequence. The output state of FF1 determines whether a computer input or output operation is to take place. The output states of FF2 determine whether status word information is to be transferred to the computer or whether operational data is to be transferred from the computer to GEIS. FF3 and FF4 form a counter which designates which of the three status words has been selected for transfer to the computer. Data transfer to the computer and from the computer to GEIS are time shared. That is, transfer to the computer is accomplished during the first 32 microseconds (reference figure 3-196) of each 50 millisecond data interval. Every fifth

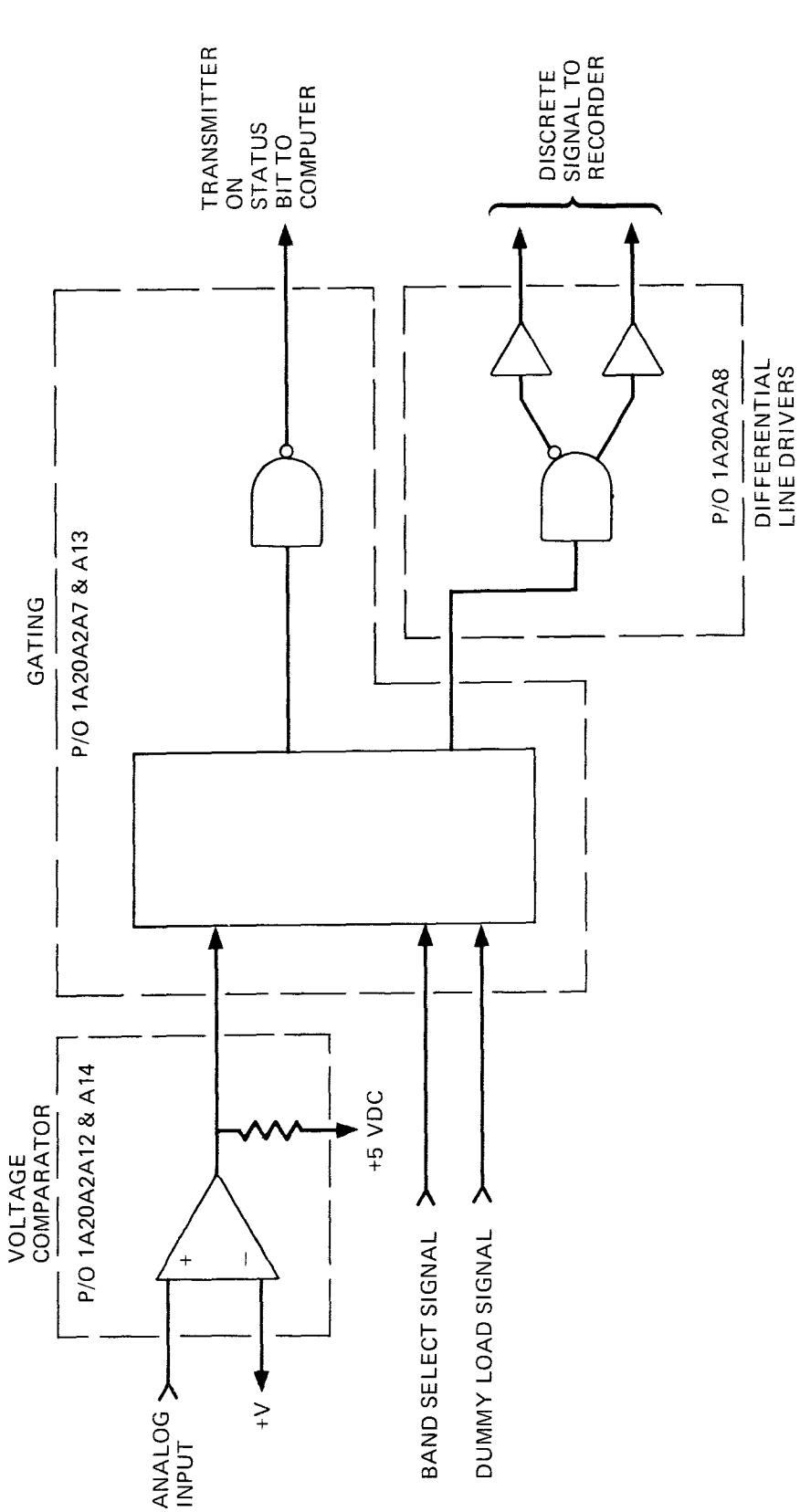


Figure 3-193. Analog Signal Interface

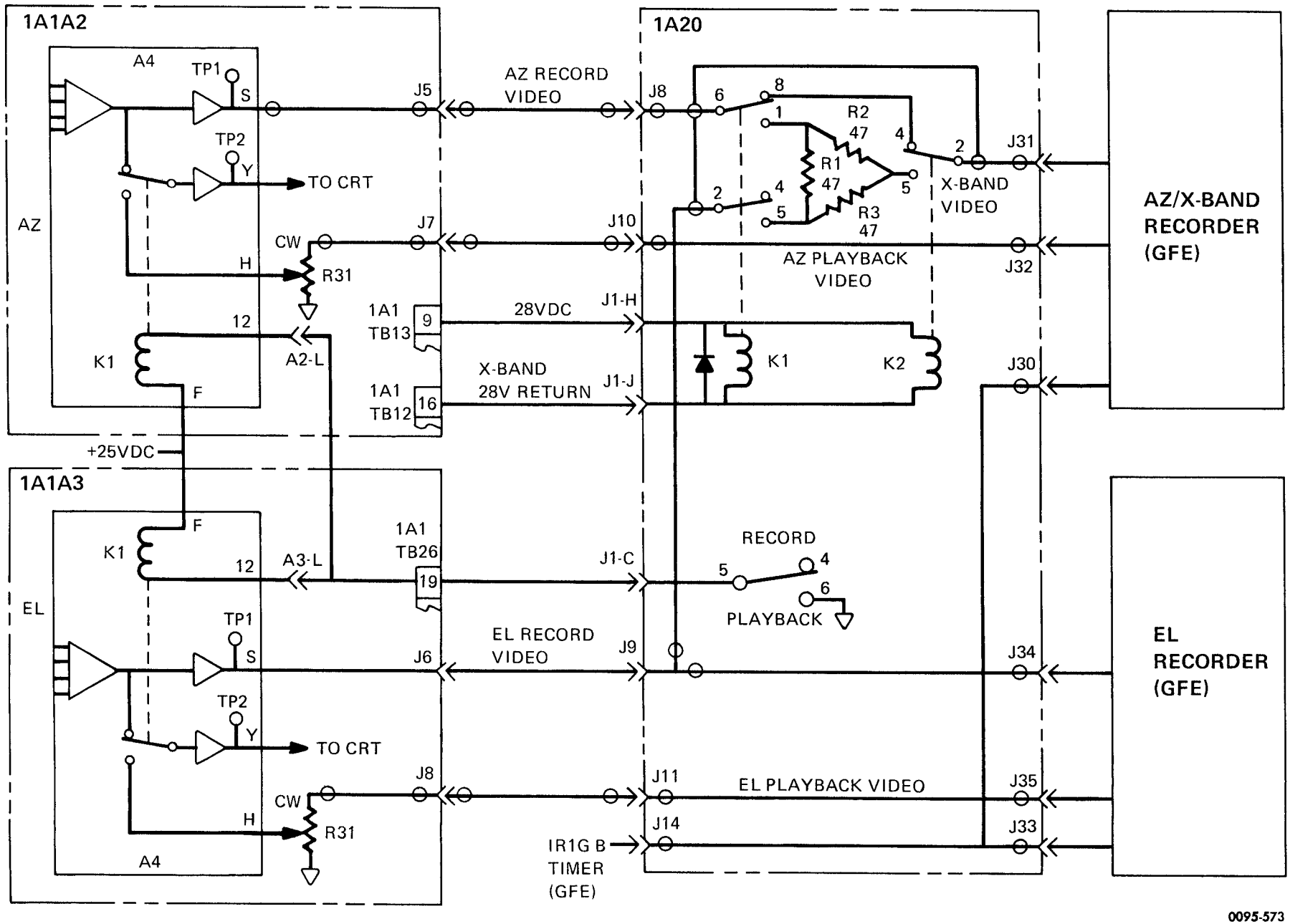


Figure 3-194. Video Interface

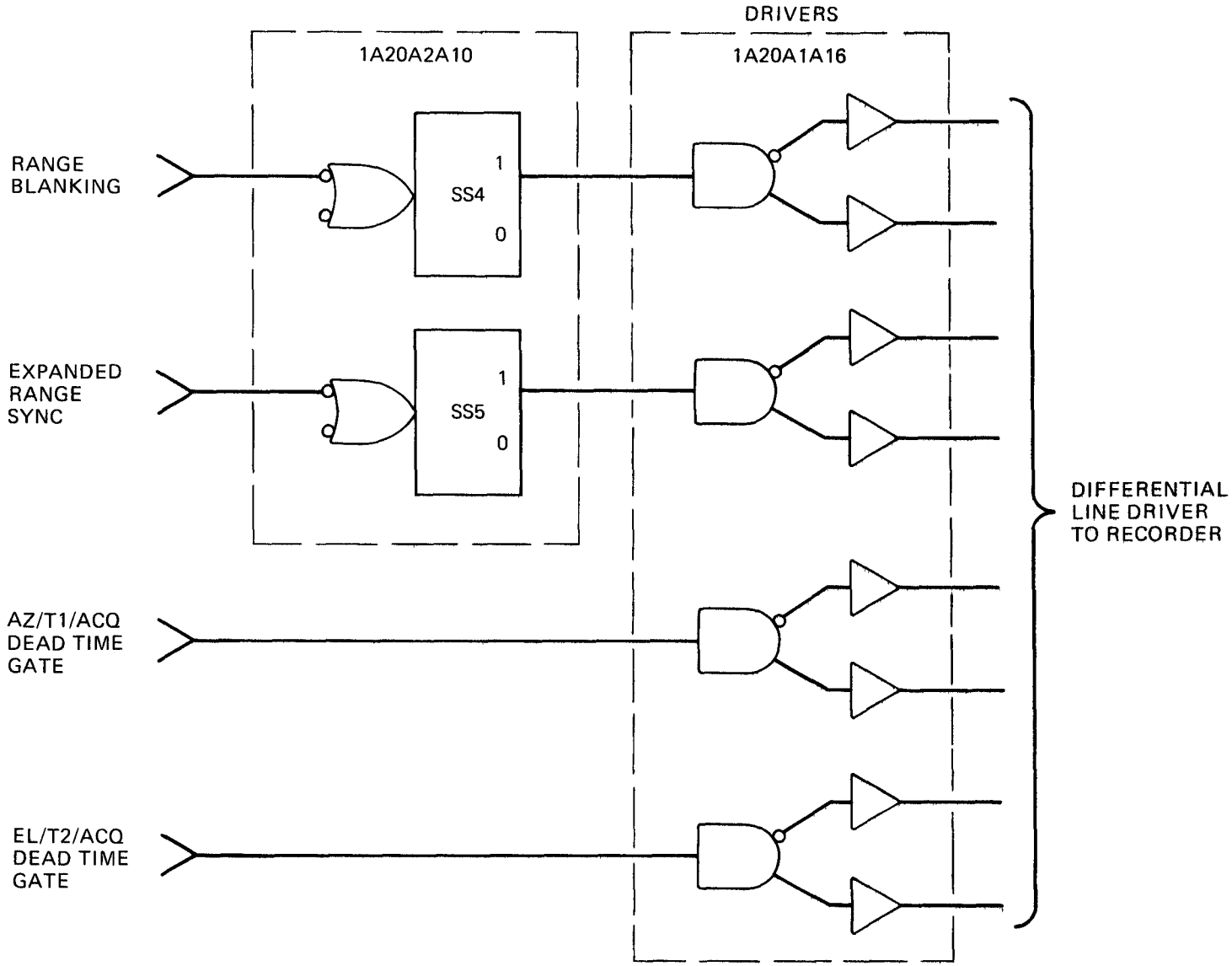
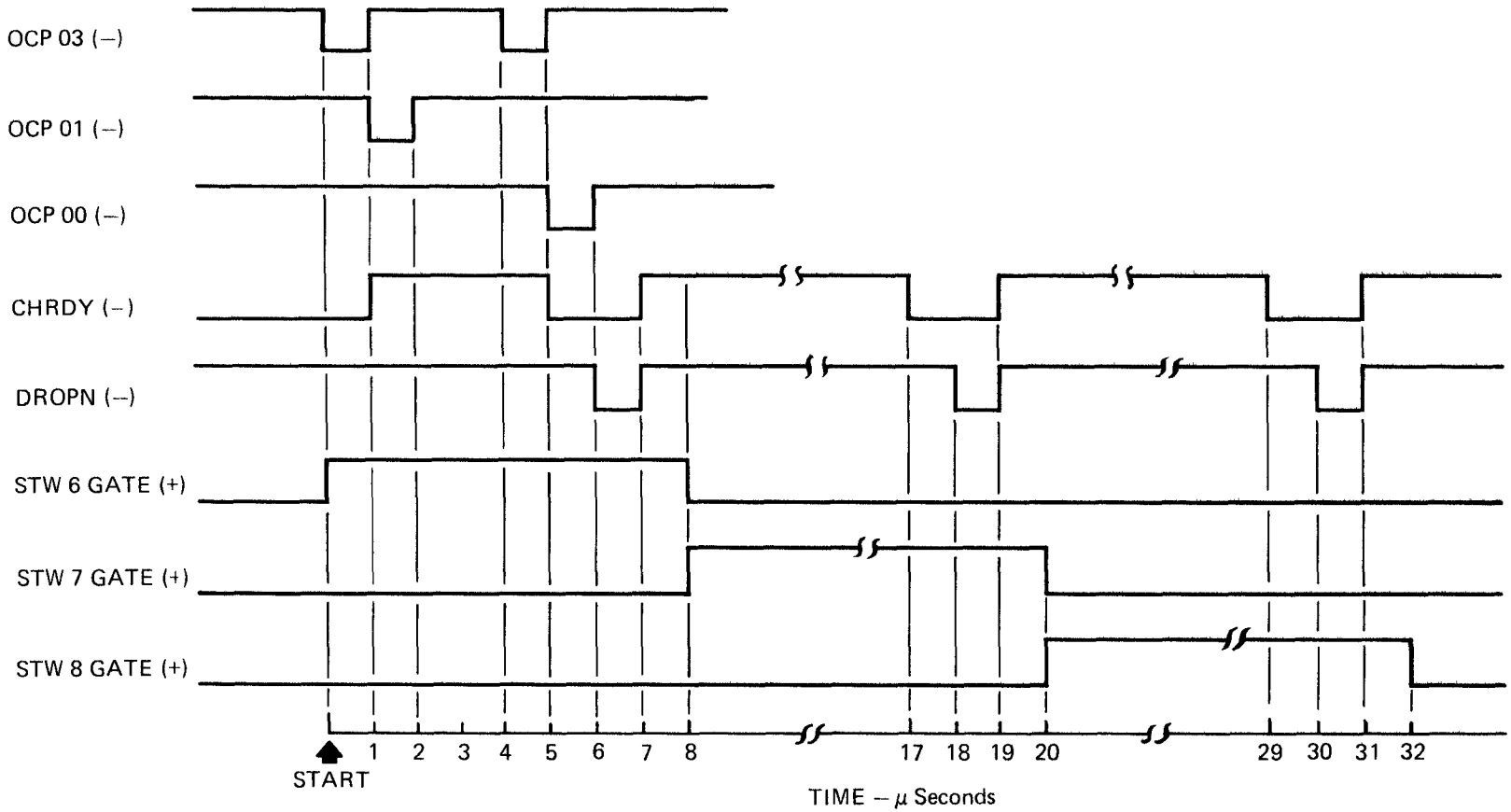


Figure 3-195. Record Range and Angle Sync Signal



NOTES:
1. Timing shown is approximate and time increments specified may vary by as mush as 20%.
2. The cycle is repeated every 50 milliseconds.

0095-583

Figure 3-196. Timing Diagram for Status Word Input to Computer From Common Data Point

50 millisecond interval data is transferred to the computer during the first 32 microseconds as above, and data is transferred from the computer to GEIS at some time during the remaining 49.968 milliseconds of this interval.

3-1503. Status Word Control Logic. The status word control logic receives OCP and CHRDY signals from the computer to initiate status word transfer to the computer and send a DROPN signal to the computer when transfer is complete. A timing diagram for status word input to the computer is shown in figure 3-196 and the control logic diagram is shown in figure 3-197. OCP03 (-) followed by OCP01 (-) is received from the computer. The OCP03 (-) signal clears the status word counter consisting of flip-flops 1A20A2A8FF3 and FF4 and sets flip-flop 1A20A2A8 FF2, which enables CHRDY (-) to trigger single-shot 1A20A2A10 SS1 if flip-flop 1A20A2A8 FF1 is set. Flip-flop FF1 is set by the negative going edge of the OCP00 (-) signal and is cleared by the negative going edge of OCP01 (-). Therefore, flip-flop FF1 is set because OCP00 (-) occurs after OCP01 (-). The DROPN (-) signal is generated by single-shot 1A20A2A10SS2 one microsecond after the negative going edge of CHRDY (-) and is routed to the computer through gates 1A20A2A9-4 and 1A20A2A7-1. The DROPN signal is an indication to the computer that data transfer is on line and must be accepted by the computer. One microsecond after the negative going edge of DROPN, the status word counter is toggled by the output of single-shot 1A20A2A10 SS3. The output of decoding gate 1A20A2A911 thus goes low, selecting status word 7 gate. The CHRDY and DROPN signals repeat until the three status words have been transferred into the computer. Data is transferred to the computer during the DROPN (-) pulse. The OCP signals repeat every 50 milliseconds; therefore, the three status words are transferred into the computer at 50 millisecond intervals.

3-1504. GEIS Control Logic. The GEIS control logic sends an OCP02 (-) signal to the GEIS each time a block of 32 words are ready for transfer to the GEIS. A CHRDY (-) signal is sent to the GEIS to indicate that a word is available for transfer. The GEIS replies with a DROPN (-) signal after each word is transferred. A timing diagram of the GEIS control logic is shown in figure 3-198, and the logic diagram is shown in figure 3-197. To initiate the data transfer sequence, OCP01 (-) followed by OCP02 (-) is sent to the control logic from the computer. OCP01 (-) clears flip-flop 1A20A2A8 FF1 and OCP02 (-) clears gate 1A20A2A8 FF2. OCP02 (-) is also sent to the GEIS to indicate that a block of 32 words is ready to be transferred. With flip-flops FF1 and FF2 cleared, both inputs to gate 1A20A2A9-6 are high and its output is low which causes the output of gate 1A20A2A9-3 to be high. The CHRDY (-) signal is then routed through gates 1A20A2A9-7 and -5 to the GEIS to indicate that word 1 is ready for transfer. The GEIS then replies with the DROPN (-) signal when transfer of the word is complete. The DROPN (-) signal is routed through gates 1A20A2A9-1, -2 and -4 and gate 1A20A2A7-1 to the computer. The CHRDY (-) and DROPN (-) sequence is repeated 32 times for each block of words. The word block transfer rate is four times each second.

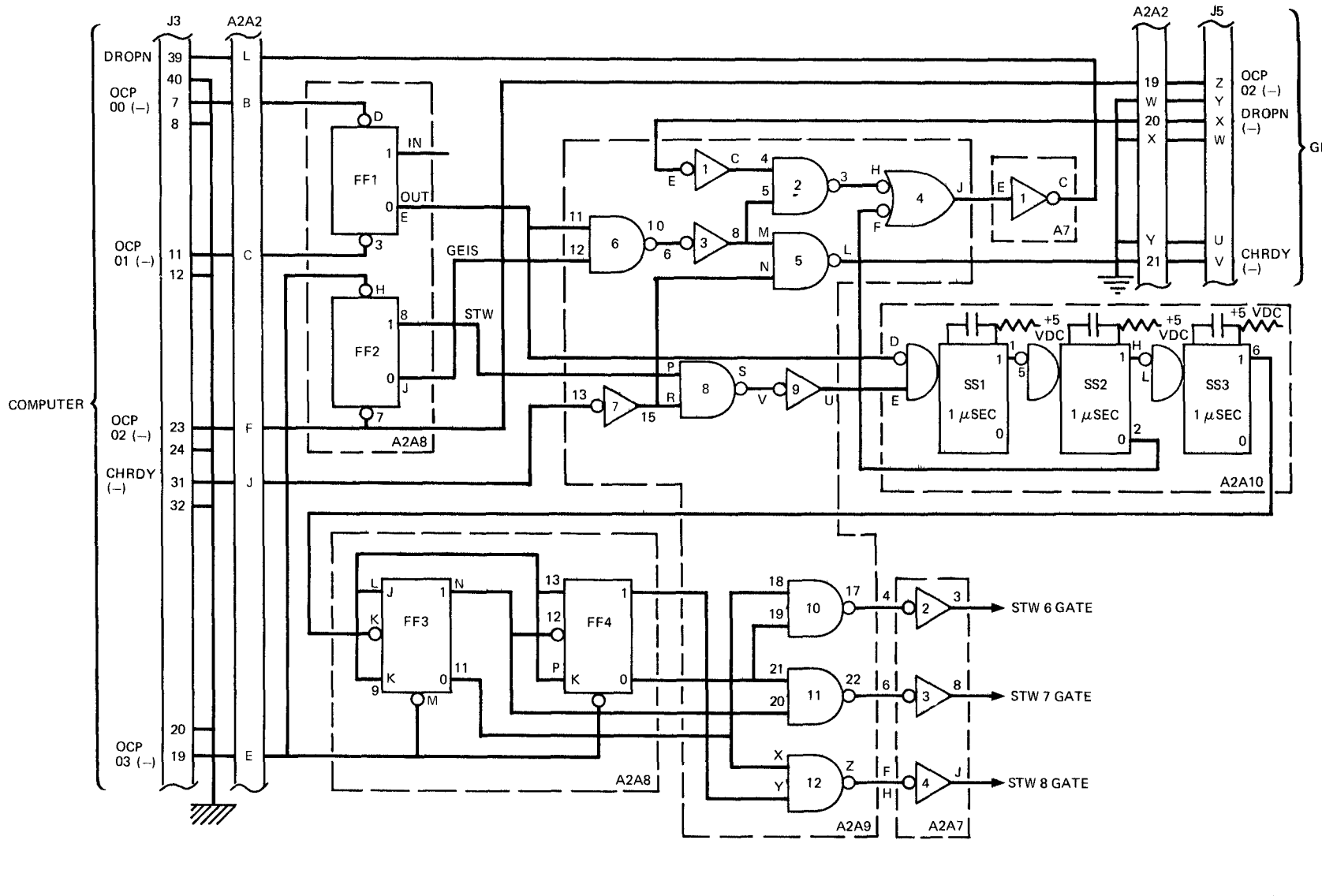
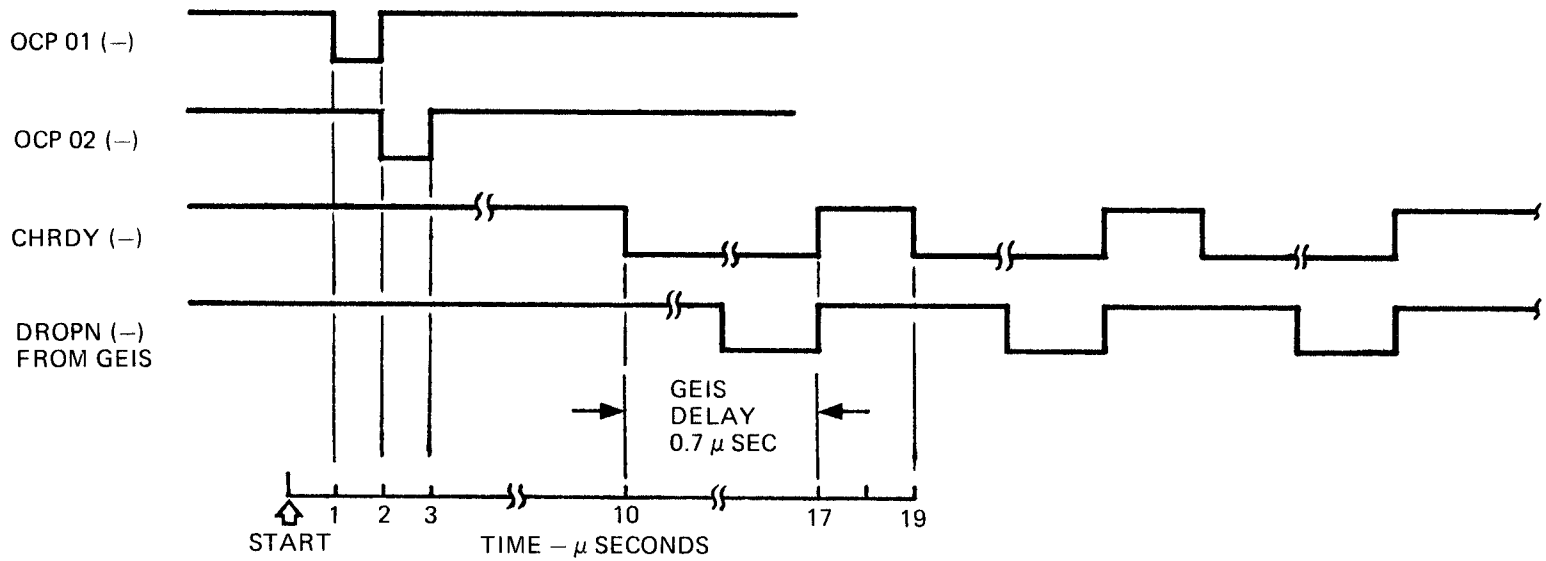


Figure 3-197. Control Logic Diagram P/O 1A20



NOTE: CHRDY (–) and DROPN (–) occur 32 times for each OCP 01 (–) and OCP 02 (–). OCP 01 (–) and OCP 02 (–) occur 4 times pr per second.

0095-585

Figure 3-198. Timing Diagram for Word Output From Computer to GEIS

ALPHABETICAL INDEX

Subject — Paragraph, Figure, Table, Number

A

Access, Transmitter Interlocks . . . 2-8, T2-54
Acquisition, X-Band, Operation 3-775
Address Assignments, Interface . . . T2-69
Address Decoding, Function 3-1337
AFC Clock 3-568
  Simplified Diagram . . . F3-78
  Timing Diagram . . . F3-79
AGC, Boxcar and 3-787
AGC Gating 3-790
Air Conditioning/Heating 2-134
  Radar Antenna Trailers 2-137
  Radar Control Trailer 2-135
Air Conditioning Turn On . . . 2-20
Amplifier
  DC . . . 3-1039, F1-3, F3-134
    Recorder and Master Power Panel F1-3, F2-20, T2-20
  Logarithmic IF 3-678
  Main IF 3-688
  Pulse . . . 3-1183, F3-147
  SCR Power 3-1070, 3-1166, F3-138, F3-146
  Servo . . . 3-1048, F3-135, T1-3
  TWT 3-622
Analog Plot Variables . . . T2-71
Analog Recording System . . . 3-190, T1-4
Analog Signal Interface . . . 3-1498, F3-193
Analog-to-Digital Converter Data Inputs . . . T2-68
Angle
  Calibration Constants . . . T2-70
  Difference . . . T2-71
  Relative to Boresight . . . T2-71
  Tracking 3-126
Angle Cursor Generation 3-945
  Azimuth Cursor Generation F3-120
  Low Altitude Cursor Generation 3-949, F3-121, F3-122
Angle Gate Generator, Angle Tracking 3-1276
  Angle Gate Timing – S- and C-Band Low Altitude Mode F3-166
  Angle Gate Timing – S- and C-Band Normal Mode F3-165
  Angle Gate Timing, X-Band F3-167
  Clock Control Logic/Timing . . . F3-162, F3-163
  Shift Register Section/Timing . . . F3-164, F3-168
Angle Sawtooth Generation . . . 3-901, T3-5
Angle Timing 3-561
  C-Band 3-577, F3-80
  Internal, Generation 3-594
  S-Band 3-563, F3-77
  X-Band 3-586, F3-83

ALPHABETICAL INDEX (Continued)

Subject	Paragraph, Figure, Table Number
A	
Angle Track Loop Functional Diagram	F3-156
Angle Tracking	3-126, 3-1248, F3-156
Angle Acquisition – Transponder	3-1275
Angle Error Channel	3-1288, F3-169, F3-170
Angle Gate Generator	3-1276
Auto Sensing – Transponder	3-1301, F3-172
Automatic Angle Tracking	3-1298
Manual Angle Tracking – Target Azimuth and Reference	3-1268
Manual Angle Tracking – Target Elevation	3-1273
Operator Controls – Reference Track	3-1266, F3-161
Operator Controls – Target, S- or C-Band	3-1251, F3-157
Operator Controls – Target, X-Band	3-1257, F3-159
Operator Controls – Transponder	3-1263, F3-160
AN/MPS-T1, Radar Training Set	3-4, F1-1, F1-2, F3-1
Capabilities and Limitations	1-15, F1-2, T1-2
Description and Purpose	1-1, F1-1
Description of Equipment	1-8, T1-3
Equipment Supplied	1-17, F1-1, T1-3
Introduction	xvii
Leading Particulars	1-13, T1-1
Trailers	1-11, F1-1 thru F1-12
Turnoff Procedure	2-32
Antenna,	
Azimuth Trough	F1-4, F1-5
Azimuth Scanned Dish	F1-5
C-Band Dish	3-531, F1-5
L-Band	3-548
L-Band Cut Dish	3-560, F1-4, F1-5, F1-6
Trailers, Radar	1-11, F1-1 thru F1-12
S-Band and C-Band Trough	3-521, F1-4, F1-5, F1-6
S-Band Dish Illuminator	3-553, F1-6
X-Band Trough	3-549, F1-6
Antenna and Antenna Support Semitrailers	1-12, F1-7 thru F1-12
Antenna Group	3-37, 3-494
C-Band Antenna System	3-46, 3-499, F3-56
S-Band Antenna System	3-39, 3-496, F3-55
X-Band Antenna System	3-52, 3-501, F3-57
Antenna Mode Selection	3-504
C-Band Waveguide Switching	3-510, F3-59
S-Band Waveguide Switching	3-505, F3-58
X-Band Waveguide Switching	3-515
Antenna Pedestal Servo Group	3-75, 3-90, 3-966, F3-12, F3-124, F3-15
Automatic Pedestal Servo System	3-79, F3-12, F3-14
Command Servos	3-1004
Guidance Operator Azimuth Pedestal Controls	3-973, F3-125
Guidance Operator Elevation Pedestal Control	3-981
Instrumentation Outputs	3-82
Manual	3-78, F3-13

ALPHABETICAL INDEX (Continued)

Subject	Paragraph, Figure, Table Number
A	
Manual Pedestal Control – X-Band Low Altitude Mode	3-1003
Manual Tracker Controls – S-Band and C-Band	3-991, F3-128
Manual Tracker Controls – X-Band	3-999
Operator Controls	3-970
Target Simulator Operation	3-89
Antenna-Receiver-Transmitter Groups, Trailer Mounted	1-11, F1-4, F1-5, F1-6
Antenna Trailer	1-12, F1-7 thru F1-12
Disconnect Panel	F2-47, T2-47, T2-64, T2-65
Encoder	3-83, 3-93, 3-1193
Initial Control Settings	2-25
Power Panel	
S- and C-Band	F2-34, T2-34
X-Band	F2-34, T2-34
Radar, Air Conditioning/Heating	2-134, 2-137
Antenna, Trough	3-521, 3-549
Construction	3-525, F3-64
Geometry	F3-73
Scanner	3-526, F1-4, F1-5
Scanner and Controls	F3-65
Rotation	F3-74
Timing Diagram	F3-84
X-Band	3-549, F3-63
Scanner Mechanism	3-555, F3-75
APP (Automatic Position Plotter) Display	3-110, F3-22
APP Indicator Video System	3-941, F3-119, F3-123
APP Sawtooth and Sweep Blanking Generation	3-914, F3-115
Multiplier	3-922
One-Hertz Oscillator	3-921
Range Sawtooth Generator	3-920
Application of Primary Power	2-18
Assembly,	
Azimuth Pedestal	F2-45, T2-45
Elevation Pedestal	F2-46, T2-46
Assignment, Multiple Missile Variable	T2-66
Assignment, Status Word Bit	T2-72
Auto Pedestal Operation, X-Band	3-1106, F3-144
Automatic Pedestal Servo System	3-79, F3-14
Automatic Position Plotter (APP) Display	3-110, F3-22
Indicator	F2-39, T2-39
Operation	2-110
Auto Sensing – Transponder	3-1301, F3-172
Auxiliary Equipment Console	
C-Band Trailer	F1-5
S-Band Trailer	F1-4
Azimuth	
and Elevation Angle Conversion	3-1356
and Elevation Transmitter Panel	F2-42, T2-42
C-Band Dish Antenna Support Fixture	F1-11
C-Band Trough Antenna Support Fixture	F1-10
Indicator	F1-3

ALPHABETICAL INDEX (Continued)

Subject	Paragraph, Figure, Table Number
A	
Pedestal	
Azimuth Assembly	F2-45, T2-45
Elevation, Assembly	F2-46, T2-46
C-Band Trailer	F1-5
S-Band Trailer	F1-4
X-Band Trailer	F1-6
Radar Consoles	F1-4, F1-5
Range and Elevation Indicator	F2-27, T2-27
Receiver	F2-28, T2-28, F1-3, F1-4
S-Band Trough Antenna Support Fixture	F1-8
Scanned Dish Antenna	F1-5
Tracking Control	F1-3, F2-29, T2-29
Trough Antenna	F1-4, F1-5
Azimuth and Elevation Receivers	
C-Band Trailer	F1-5
S-Band Trailer	F1-4
Azimuth Cursor Generation Logic Diagram	F3-120
Azimuth Pedestal Controls, Guidance Operator	3-973, F3-125
Sector/Search Pedestal Control	F3-126
Sector Scan Generator Timing	F3-127
B	
Band, Type Format	F2-55
Bidirectional Coupler	3-29, 3-288
Bit Assignment, Status Word	T2-72
Bleeder Assembly, Diode	3-402
Boxcar and AGC	3-787
Boxcar Video Attenuation Network	3-1289, F3-171
Boxcar Video Generation	3-712, F3-93
Box, Junction	
C-Band Trailer	F1-5
S-Band Trailer	F1-4
X-Band Trailer	F1-6
B-Scope Indicator Video System	3-930, F3-112, F3-117, F3-118
Sweep Protection Circuits	3-935, T3-7
B-Scope Sawtooth and Sweep Blanking Generation	3-898, F3-113
Angle Sawtooth Generation	3-901, T3-5
Angle Sawtooth Generator	3-903
Range Sawtooth Generation	3-906, F3-114
C	
Cable, Reels	
A and B (Dish Antenna Trailer)	F1-11
C (C-Band Trailer)	F1-9

ALPHABETICAL INDEX (Continued)

Subject	Paragraph, Figure, Table Number
C	
D (S-Band Trailer)	F1-7
E and F (X-Band Trailer)	F1-12
Calibration, Angle Constants	T2-70
Cam/Pawl Relationship	3-559, F3-76
C- and S-Band	
Antenna Trailer	
Initial Control Settings	2-25, T2-63
Power Panel	F2-34, T2-34
Turnoff	2-37
Magnetron	3-282
Manual Tracker Azimuth, Range and Elevation	F2-27, T2-27
Manual Tracker Control Diagram	F3-128
Manual Tracker Displays	3-103, F3-19
Modulators	3-260
Operator Controls – Target	3-1251, F3-157, F3-150
Prereceivers	3-618, F3-86
Range Timing Generation	3-206, F3-32
Receiver Block Diagram	F3-91
Receiver Control Diagram	F3-92
Receiver Interface	F3-90
Reference Track	2-125
Reference Tracking Receiver	3-760, F3-96
Target Simulator Operation	3-20, F3-6
Target Track	2-99
Transmitter Control	F2-8, T2-8
Transmitter Protective Interlocks	T2-55
Transmitter Runup	2-28
Transmitters	3-26, 3-247, F3-34
Trough Antennas	3-521, F3-63
Waveguide Pressurization Systems	3-290, F3-36
Cancellation System	3-810, F3-102
Target Video	3-814, F3-103
Capabilities and Limitations	1-15, T1-2
Cathode-to-Helix Power Supply	3-472, F3-49
C-Band	
Angle Timing	3-577, F3-80
Antenna Mode Switching Logic	3-511, F3-60
Antenna Structure Transport Trailer (Unloaded)	F1-9
Antenna System	3-46, 3-499, F3-56
Antenna Trailer Components	F1-5
Azimuth Dish Antenna Support Fixture	F1-11
Azimuth Trough Antenna Support Fixture	F1-10
Dish Antennas	3-531, F3-66
Elevation Dish Antenna Support Fixture	F1-11
Elevation Trough Antenna Support Fixture	F1-10
Pedestal L-Band Transmitter Interface Diagram	F3-38
Trough Antenna Transport Trailer (Unloaded)	F1-10
Reference System, S-Band Target Tracking	3-15, F3-3
Waveguide Switching	3-510, F3-60

ALPHABETICAL INDEX (Continued)

Subject	Paragraph, Figure, Table Number
C	
Charging Diode	.3-265
Checks, DC Voltage	2-22
Circuits,	
Gain Control	.3-723, F3-94
Interlock	2-7, 2-138, T2-54 thru T2-62
Receiver Select	.3-672
RPM Sense	.3-543, F3-71
Circuit Card Location, Tracking Loops	T3-8
Coder, Transmitter	.3-467
Coherent Oscillator (COHO)	3-875, F3-107
Collector Power Supply	.3-479, F3-51
Command Servos, Antenna Pedestal	3-1004
Azimuth Command Servos	3-1010
Command Servo Motor Drive	3-1011
Converter	3-1014
Elevation Command Servo	3-1008
Filter	3-1017
Servo Amplifier	3-1018, F3-130
Command Transmitter, Pulsed	.F2-41, T2-41
L-Band	.3-323
Power Supply	F1-4, F1-5
Common Data Point Assembly	.F2-40, T2-40
Computer Interface	.3-159, F1-3, F2-16, F3-27, F3-176, T2-16
Azimuth and Elevation Conversion	3-1356
Data Display	3-1383
Data Transfer	3-1315, F3-175, F3-177
Digital-to-Analog Conversion	3-1399
Function Address Decoding	3-1337
Input Status Words	3-1348
Missile Command Guidance Generator	3-1406, F3-182
Missile Video	3-1391, F3-181
Output Status Words	3-1377
Pedestal Position	3-1365, F3-180
Radar Timing Inputs	3-1340
Range Calibration Strobe Generator	3-1397
Range Conversion	3-1352
Reference Radar Timing Circuits	3-1345
Target Range Timing Circuits	3-1341, F3-179
Thumbwheel Inputs	3-1379
Computer System	.3-178
Computer System Operating Procedure	2-43
A.G.C. Format, Punch Format	F2-54
Band, Type Format	F2-55
Computer Turn-On	2-45
Miss Distance, Type Format	F2-59
Missile Status, Type Format	F2-58
Normal Operation	2-50
Program Loading Procedure	2-46

ALPHABETICAL INDEX (Continued)

Subject	Paragraph, Figure, Table Number
C	
Program Tape Rewind Procedure	2-48
Sense Switch Options	2-49
Target Track Data, Type Format	F2-56
Transponder Track Data, Type Format	F2-57
Computer System Test Routines	2-51
Analog Plot Variables	T2-71
Analog-to-Digital Converter Data Inputs	T2-68
Angle Calibration Constants	T2-70
Angle Difference	T2-71
Angle Relative to Boresight	T2-71
Data Word Format	T2-73
General	2-52
Honeywell Diagnostic Routines	2-91
Interface Address Assignments	T2-69
Line-of-Sight Distances	T2-71
Multiple Missile Variable Assignments	T2-66
Radar Set Programmed Test Routines	2-53, T2-67
Range Differences	T2-71
Ranges	T2-71
Status Word Bit Assignment	T2-72
Test Instructions	T2-67
Truncated Sawtooth Waveform	F2-60
Computer Turn-On	2-45
Conditioning, Signal	F2-50, T2-50
Consoles,	
Auxiliary Equipment	F1-4, F1-5
Azimuth Radar	F1-4, F1-5
Center RTM (X-Band)	F1-6
Command Transmitter	F1-6
Power Supply	F1-4
Elevation Radar	F1-4, F1-5
Fan	F1-4, F1-5
High Voltage Power Supply	F1-6
L-Band CW Transmitter	F1-6
L-Band Transmitter	F1-4, F1-5
Left RTM (X-Band)	F1-6
Microwave Section	F1-6
Modulator Assembly	F1-6
Performance Monitor	F1-4
Power Distribution	F1-3, F2-34, T2-34
Power Supplies	F1-5, F1-6
Prereceiver and AFC	F1-6
Right RTM (X-Band)	F1-6
Signal Conditioning	F1-5, F1-6
Storage Drawer	F1-4
Waveguide and Scanner Switching	F1-4, F1-5
X-Band Transmitter Control	F1-6
Construction, Trough Antenna	3-525, F3-64
Continental Operation Range (COR) Video Recorder Instrumentation Operation	2-94, F3-28

ALPHABETICAL INDEX (Continued)

Subject	Paragraph, Figure, Table Number
C	
Control	
Automatic Gain	3-744, F3-93
Encoder Unit	3-1086, F3-141, F3-142, F3-143
Group, Radar Set	1-10, F1-3
Guidance Operator	3-973, 3-981, F3-125
Manual Gain Pedestal	3-728
Operator	3-970
Phase Lock	3-856
Radar Trailer	2-26, T2-65
Radio Remote	F1-3
Reference Pedestal	3-1113, F3-145
Sensitivity Time, (STC) Generation	3-752
Servo, Unit	3-1026
Settings, Initial	2-24
Antenna Trailers	2-25, T2-63
Radar Control Trailer	2-26, T2-65
Sweep	F1-3
T1 and T2 Tracking	F2-37, T2-37
Target (T1 and T2)	F1-3
Unit	3-87
Voltage	3-397
Control Logic	F3-197
Controls and Indicators	2-5, F2-1 thru F2-53
Antenna Trailer Disconnect Panel	F2-47, T2-47
Automatic Position Plotter	F2-39, T2-39
Azimuth	
Pedestal Assembly	F2-45, T2-45
Receiver	F2-28, T2-28
Tracking Control	F2-29, T2-29
Common Data Point Assembly	F2-40, T2-40
Computer Interface	F2-16, T2-16
Control Panel	F2-25, T2-25
Digital Voltmeter	F2-13, T2-13
Digital Voltmeter Test Panel	F2-17, T2-17
Down Link Jammer Receiver	F2-35, T2-35
Elevation	
and Azimuth Transmitter	F2-42, T2-42
Pedestal Assembly	F2-46, T2-46
Receiver	F2-32, T2-32
Tracking Control	F2-33, T2-33
General	2-3
Guidance Operator Indicators	F2-2, T2-2
High Speed Tape Punch	F2-22, T2-22
Intercom	F2-19, T2-19
Interlock Circuits	2-7, T2-54 thru T2-62
L-Band CS Command Transmitter	F2-49, T2-49
L-Band Pulsed Command Transmitter	F2-41, T2-41
L-Band Transmitter Control	F2-12, T2-12

ALPHABETICAL INDEX (Continued)

Subject	Paragraph, Figure, Table Number
C	
Mode Control	F2-1, T2-1
Noise Figure Meter	F2-14, T2-14
Pedestal	
Disable Switches	T2-61
Interlock	T2-60
Interlock Circuits	2-7, T2-54 thru T2-62
Interlock Switch Panel	F2-48, T2-48
Power	
Distribution Console	F2-34, T2-34
Distribution Panel	F2-44, F2-53, T2-44, T2-53
Distribution Unit	F2-26, T2-26
Monitor	F2-11, T2-11
Prereceiver	F2-43, F2-51, T2-43, T2-51
Range Track Control	F2-31, T2-31
Receiver Select	F2-10, T2-10
Recorder DC Amplifier and Master Power Panel	F2-20, T2-20
Recorder and Take-Up Reel	F2-21, T2-21
S- and C-Band Manual Tracker Azimuth, Range and Elevation	F2-27, T2-27
Scanner Disable Switches	T2-62
Servo Control	F2-15, T2-15
Signal Conditioning	F2-50, T2-50, T2-44A
Spooler	F2-24, T2-24
Sweep Generator	F2-30, T2-30
Synchronizer	F2-4, T2-4
Tape Reader	F2-23, T2-23
Target Simulator	F2-38, T2-38
Tracking Controls	F2-3, F2-7, T2-3, T2-7
Transmitter	
Access Interlocks	T2-54
Control, S- and C-Band	F2-8, T2-8
Control, X-Band	F2-52, T2-52
Disable Switches	T2-59
Protection Interlocks	2-7, T2-55 thru T2-58
Transponder Indicators	F2-6, T2-6
Transponder Receiver	F2-5, T2-5
T1 and T2 Indicators	F2-36, T2-36
T1 and T2 Tracking Controls	F2-37, T2-37
Conversion, Azimuth and Elevation Angle	3-1356
Conversion, Digital-to-Analog	3-1399
Conversion, Range	3-1352
Coupler, Bidirectional	3-29, 3-288
Coupling Assembly	3-412
Crossover Pulse Generator	3-1059, F3-137
Current Flow Through SCR Bridge	3-1187, F3-148
Cursor Generation	3-944
Angle	3-945
Azimuth	F3-120
Low Altitude	3-949, F3-121, F3-122

ALPHABETICAL INDEX (Continued)

Subject	Paragraph, Figure, Table Number
C	
Missile Video	.3-959
Range – APP Indicator	3-956, F3-123
Range – Guidance Operator Indicators	.3-951
Range – Manual Tracker Indicators	3-955, 3-1307, F3-173, F3-174
Transponder Tracker Indicators	.3-960
CW Command Transmitter, L-Band	.3-36, 3-465, F2-49, F3-46, F3-48, F3-53, T2-49
Cathode-to-Helix Power Supply	.3-472, F3-49
Collector Power Supply	.3-479, F3-51
Filament and Anode Power Supply	.3-476, F3-50
Protection Interlocks	T2-58
RF Control	.3-486, F3-53
Runup	2-31
D	
Data	
Inputs, Analog-to-Digital Converter	T2-68
Display	.3-1383
Target Track Data, Type Format	F2-56
Transponder Track Data, Type Format	F2-57
Data Transfer	3-1315, F3-175
Data Transfer from Computer	3-1319, F3-177
Data Transfer to Computer	3-1317, F3-175
Differential Transmitter-Receiver	3-1321, F3-178
DC Amplifier	3-1039, F3-134, F1-3
DC Recorder Amplifier and Master Power Panel	.F1-3, F2-20, T2-20
DC Voltage Checks	2-22
Deflection System,	3-923, F3-116
Horizontal Deflection	.3-925
Power	3-929, T3-6
Vertical Deflection	.3-927
Delay Line A.G.C.	.3-854
Delay Line Input	.3-863
Delay Line Output	.3-871
Description and Purpose	1-1
General Description	1-3
Purpose	1-2
Description of Equipment	1-8, F1-1 thru F1-6
Antenna/Antenna Support Semitrailers	1-12, F1-7 thru F1-12
Radar Set Control Group	1-10, F1-3
Trailer-Mounted Antenna-Receiver Transmitter Groups	1-11, F1-4 thru F1-12
Detector, Phase	.3-868
Diagnostic Routines, Honeywell	2-91
Difference, Angle	T2-71
Digital-to-Analog Conversion	.3-1399
Digital Voltmeter	.F1-3, F2-13, T2-13
Digital Voltmeter Test Panel	.F2-17, T2-17
Diode Bleeder Assembly	.3-402

ALPHABETICAL INDEX (Continued)

Subject	Paragraph, Figure, Table Number
D	
Diode, Charging	3-265
Disable Switches	T2-59, T2-61
Disconnect, Antenna Trailer Panel	F2-47, T2-47
Discrete Signal Interface	F3-192
Dish Antennas, C-Band	3-531
Scanner Controls	3-540, F3-68
Dish Antenna Transport Transport Trailer (Unloaded)	F1-11
Dish Scanned, Azimuth Antenna	F1-5
Dish Scanner Center Scan Pulse Generator	3-582, F3-82
Dish Scanner Start and End Scan Pulse Generator	3-581, F3-81
Display	
Automatic Position Plotter (APP)	3-110
B-Scope Indicator	3-930, F3-112
Sweep Function Locations	T3-4
Distances, Line-of-Sight	T2-71
Divider, Power	3-624
Down Link Jammer (DLJ) and Transponder, Prereceiver, X-Band	3-660
Down Link Jammer Receiver	3-890, F2-35, F3-110, F3-111, T2-35
Drawer, Storage	F1-4, F1-5
Dual Peak Detector	3-350
Duplexer	3-516, F3-62
DVM Test Panel	F1-3
E	
Electromechanical Operation	3-1121
Elevation,	
and Azimuth Transmitter	F2-42, T2-42
Azimuth and Range Indicator	F2-27, T2-27
C-Band Dish Antenna Support Fixture	F1-11
C-Band Trough Antenna Support Fixture	F1-10
Indicator	F1-3
Pedestal	F1-4, F1-5, F1-6
Pedestal Assembly	2-46, T2-46
Radar Consoles	F1-4, F1-5
Receiver	F1-3, F1-4, F1-5, F2-32, T2-32
S-Band Trough Antenna Support Fixture	F1-8
Scanned Dish Antenna (C-Band)	F1-5
Tracking Control	F1-3, F2-33, T2-33
Transmitter	
C-Band Trailer	F1-5
S-Band Trailer	F1-4
Trough Antenna	F1-4, F1-5
Elevation and Azimuth Receivers (C-Band Trailer)	F1-5
Elevation Pedestal Control, Guidance Operator	3-981
Emergency Operation	2-129
Encoder	
Antenna Trailer	3-83, 3-93, 3-1193
Control Unit	3-1086, F3-141, F3-142, F3-143

ALPHABETICAL INDEX (Continued)

Subject	Paragraph, Figure, Table Number
E	
Scan	3-604
Selection	3-613, T3-3
Simulation	3-612
Transducer	3-85, 3-1083
Equipment, Description of	1-8, F1-1 thru F1-6
Antenna and Antenna Support Semitrailers	1-12, F1-7 thru F1-12
Radar Set Control Group	1-10, F1-3
Trailer Mounted Antenna-Receiver-Transmitter Groups	1-11, F1-4 thru F1-12
Equipment Group, Miscellaneous	3-179
Equipment Subsystems, Major	3-21
Equipment Supplied	1-17, T1-3
Excessive Service Conditions	2-131
External Interlocks, Transmitter	F3-27
F	
Fan (C-Band Trailer)	F1-5
Fan (S-Band Trailer)	F1-4
Filament and Anode Power Supply, Block Diagram	F3-50
Format,	
A.G.C., Punch Format	F2-54
Band Type	F2-55
Miss Distance Type	F2-59
Missile Status Type	F2-58
Target Track Data, Type	F2-56
Transponder Track Data, Type	F2-57
Frequency	
and Power Control	F2-9, T2-9
Control, Power	F1-3
Frequency Monitor	3-346, F3-42
Full-Wave Rectifier	3-1053, F3-136
Full Wave Rectifier, Video	3-851
Function Address Decoding	3-1337
G	
Gain Control Circuits	3-723, F3-94, F3-100
Automatic Gain Control (AGC)	3-744
Manual Gain Control (MGC)	3-728
Sensitivity Time Control (STC) Generation	3-752, F3-95
Gate and Drivers, Video	3-792
General	
Computer System Test Routines	2-51
Controls and Indicators	2-3
Description	1-3
Operating Instructions	2-15

ALPHABETICAL INDEX (Continued)

Subject	Paragraph, Figure, Table Number
G	
Generator	
Range Gate	3-717, 3-785
Signal	F1-3
Sweep	F2-30, T2-30
Guidance Operator Pedestals	
Controls	3-973, 3-981, F3-125
Guidance Operator	See 43D7-11-21-2-1-1 .2-100
Guidance Operator Console	F1-3
Guidance Operator Indicators	F2-2, T2-2
Ground Equipment Instrumentation Set Connector Pin Assignment	T3-12
H	
Helical Slot Scanner	F3-67
High Speed Punch	F1-3
High Voltage Control and Interlock	3-329, F3-41
High Voltage Power Supply	3-293, 3-368, 3-396, 3-961
Diode Bleeder Assembly	3-402
Voltage Control	3-397
Hold, Sample and	3-853
Honeywell Diagnostic Routines	2-91
Horizontal Counterweight Support Fixture	F1-7, F1-9
I	
IAGC Generation	3-700
Illuminator Antenna	F1-6
Indicators	
Antenna Trailer Disconnect Panel	F2-47, T2-47
Automatic Position Plotter	F2-39, T2-39
Azimuth	
Pedestal Assembly	F2-45, T2-45
Receiver	F2-28, T2-28
Tracking Control	F2-29, T2-29
Common Data Point Assembly	F2-40, T2-40
Computer Interface	F2-16, T2-16
Control Panel	F2-25, T2-25
Digital Voltmeter	F2-13, T2-13
Test Panel	F2-17, T2-17
Down Link Jammer Receiver	F2-35, T2-35
Elevation	
and Azimuth Transmitter	F2-42, T2-42
Pedestal Assembly	F2-46, T2-46
Receiver	F2-32, T2-32
Tracking Control	F2-33, T2-33
General	2-3
Guidance Operator Indicators	F2-2, T2-2
High Speed Tape Punch	F2-22, T2-22

ALPHABETICAL INDEX (Continued)

Subject	Paragraph, Figure, Table Number
I	
Intercom	F2-19, T2-19
Mode Control	F2-1, T2-1
Noise Figure Meter	F2-14, T2-14
Pedestal Interlock Switch Panel	F2-48, T2-48
Power and Frequency	F2-9, T2-9
Power Distribution Console	F2-34, T2-34
Power Distribution Panel	F2-44, F2-53, T2-44, T2-53
Power Distribution Unit	F2-26, T2-26
Power Monitor	F2-11, T2-11
Prereceiver	F2-43, F2-51, T2-43, T2-51
Range Tracking Control	F2-31, T2-31
Receiver Select	F2-10, T2-10
Recorder and Take-Up Reel	F2-21, T2-21
Recorder DC Amplifier and Master Power Panel	F2-20, T2-20
S- and C-Band Manual Tracker Azimuth, Range and Elevation	F2-27, T2-27
Scanner Disable Switches	T2-62
Servo Control	F2-15, T2-15
Signal Conditioning	F2-50, T2-50
Spooler	F2-24, T2-24
Synchronizer	F2-4, T2-4
Tape Reader	F2-23, T2-23
Target Simulator	F2-38, T2-38
Tracking Control	F2-3, F2-7, T2-3, T2-7
Transmitter Access Interlocks	T2-54
Transmitter Control	F2-8, F2-12, F2-18, F2-42, F2-49, T2-8, T2-12, T2-18, T2-42, T2-49
Transponder Indicators	F2-6, T2-6
Indicator System	F3-117, F3-118
Indicator (MTI) System, Moving Target	3-803
Initial Control Settings	2-24, 2-25, 2-26, T2-63, T2-64
Input, Delay Line	3-863
Instructions, Operating	
Air Conditioning Turn On	2-20
Application of Primary Power	2-18
DC Voltage Checks	2-22
General	2-15
Initial Control Settings	
Radar Control Trailer	T2-65
S- and C-Band Antenna Trailers	2-24, T2-63
X-Band Antenna Trailer	T2-64
Instructions, Test (Computer System Test Routines)	2-51
Instrumentation System	3-200, 3-1494, F3-191
Intercom	F1-3, F2-19, T2-19
Panel	3-194, F1-3
Power Supply	F1-3
Interconnect Diagrams	F3-23, F3-61
Interface	
Address Assignment	T2-69
Analog Signal	3-1498, F3-193

ALPHABETICAL INDEX (Continued)

Subject	Paragraph, Figure, Table Number
I	
Computer	F2-16, T2-16
Discrete Signal	F3-192
Video Signal	F3-194
Interface Diagrams	
C-Band Pedestal, L-Band Transmitter	3-323, F3-38
Computer	3-178, F3-27
Down Link Jammer Receiver	3-890, F3-110
L-Band CW Transmitter	3-470, F3-48
S- and C-Band Receiver	F3-90
S- and C-Band Reference Receiver	F3-96
Target Simulator	F3-184
Transponder Receiver	F3-109
X-Band Pedestal L-Band Transmitter	F3-39
X-Band Receiver	F3-98
Interlock Circuits	2-7, 2-138, T2-54 thru T2-62
Interlocks, Transmitter (S- and C-Band)	3-303, F3-37
Interlocks, Transmitter (X-Band)	3-387, F3-45
High Voltage	3-368
Internal Angle Timing Generation	3-594
Isolator-Filter Network	3-627
J	
Jammer, Down Link, Receiver	3-890, F2-35, F3-110, F3-111, T2-35
Junction Box,	
C-Band Trailer	F1-5
S-Band Trailer	F1-4
X-Band Trailer	F1-6
K	
Keyer Tube Driver Chassis	3-373, 3-406, F3-44
Keyer Tube, Modulator (X-Band)	3-405
L	
L-Band,	
Antenna	3-548
Antenna Support Fixture (X-Band Trailer)	F1-12
Cut Dish Antenna	3-560
CW Transmitter	3-36, 3-465, 3-470, F2-49, F3-46, T2-49
Protection Interlocks	T2-58
Runup	2-31
X-Band	F1-6
Dish Antenna	F1-4, F1-5
Storage	F1-11
Pulse, Transmitter Protection Interlocks	T2-57
Pulse Command Transmitter Power Supply	3-340

ALPHABETICAL INDEX (Continued)

Subject	Paragraph, Figure, Table Number
L	
Pulsed Command Transmitter Runup	2-30
Transmitter Control	F2-12, T2-12
L-Band Transmitter Console	F1-4, F1-5
Command Transmitter Power Supply	F1-4, F1-5
Fan	F1-4, F1-5
Performance Monitor	F1-4, F1-5
Storage Drawer	F1-4, F1-5
Leading Particulars	1-13, T1-1
Left RTM Console (X-Band)	F1-6
Limitations and Capabilities	1-15, T1-2
Line-of-Sight Distances	T2-71
Loading Procedure, Program	2-46
Local Oscillators	
Target	3-651
Target, AFC	3-638
Target Receiver, X-Band	3-667
Transponder and Down Link (S- and C-Band)	3-655
Log IF Power Supply	3-684
Logarithmic IF Amplifier	3-678
Logic and Protection Diagram	F3-52
Local/Remote Switching	F3-54
RF Control	F3-53
Logic, Switching, C-Band Antenna Mode	F3-60
M	
Magnetron	3-282
Bidirectional Coupler	3-29, 3-288
Filament Voltage	3-275
Filament Voltage Control, S- and C-Band	3-276, 3-448
Isolator	3-286
Tuning	3-283, 3-457
Main IF Amplifier	3-688
Main Receiver System	3-64
Major Equipment Subsystems	3-21
Antenna Group	3-494
Antenna Pedestal Servo Group	3-75, 3-90, 3-966
Miscellaneous Equipment Group	3-179, 3-1424
Missile Simulation and Scoring Group	3-139, 3-1313
Presentation Group	3-94, 3-896
Receiver Group	3-58, 3-615
Tracking Group	3-111, 3-1195
Transmitter Group	3-23, 3-201
Manual Antenna Pedestal Servo System	3-78
Manual Pedestal Control – X-Band Low Altitude Mode	3-1003
Manual Pedestal Servo Operation	3-92
Manual Tracker Controls – S- and C-Band	3-991
Manual Tracker Control – X-Band	3-999

ALPHABETICAL INDEX (Continued)

Subject	Paragraph, Figure, Table Number
M	
Manual Tracker Console (X-Band)	F1-3
Manual Trackers (S- and C-Band)	F1-3
Control Block Diagram	F3-128
Manual Trackers	
Console (X-Band)	F1-3
Operation	2-105
Master Power Panel, Recorder DC Amplifier and	F2-20, T2-20
Meter Noise Fixture	F1-3, F2-14, T2-14
Meter Driver Assembly, Transmitter (X-Band)	3-431
High Voltage Regulator	3-441
Magnetron Filament Control	3-448
Magnetron Filament Current Monitor	3-446
Meter Driver PCB	3-439
Pulse Generator	3-453
Voltage Current Sense	3-433
Microwave	
Assembly	F1-4, F1-5
Section	F1-6
Microwave Block Diagram, Prereceiver	F3-86
Miscellaneous Equipment Group	3-179, 3-1424
Analog Recording System	3-190
Intercommunication System	3-194
Power Supply System	3-198
Radio Communication System	3-197
Target Simulator	3-180, 3-1426, F3-184
Miss Distance, Type Format	F2-59
Missile	
Guidance Command Generator	3-1406, F3-182
Guidance Timing (X-Band)	F3-47, F3-183
Simulation Computations	3-148, F3-25
Status, Type Format	F2-58
Variable Assignments, Multiple	T2-66
Video	3-1391, F3-181
Missile Simulation and Scoring Group	3-139, 3-1313, F3-24
Computer Interface	3-159, F3-27
Computer System	3-178
Data Transfer	3-1315, F3-175, F3-177
Scoring Computations	3-154, F3-26
Mixer-IF Preamplifier	3-628, T3-2
Mobile Trailers	F1-7 thru F1-12
Mode Control	F1-3, F2-1, T2-1
Mode II Scanner Control	3-540, F3-69
Mode III Scanner Control (High RPM)	3-540, F3-70
Mode III Scanner Control (Low RPM)	3-540, F3-72
Modulation Generation	F3-187
Modulator Assembly	F1-6
Modulators, S- and C-Band	3-260
Remote Controls	3-319
Trigger Generator	3-248

ALPHABETICAL INDEX (Continued)

Subject	Paragraph, Figure, Table Number
M	
Modulator, Transmitter X-Band	3-370
Coupling Assembly	3-412
Keyer Tube	3-405
Keyer Tube Driver	3-373, 3-406, F3-44
Monitor,	
Input Power	F2-34
Frequency	3-346, F3-42
Power	F2-11
Transmitter Performance	3-348
Moving Target Indicator (MTI) System	3-803, F3-101, F3-102
Delay and Delay Control	F3-104
MTI Cancellation	3-814, F3-101, F3-102, F3-103
MTI I Operation – Staggered PRF	3-829, F3-101, F3-105
MTI Synchronizer	3-835
Target Video Cancellation System	3-814, F3-103
Multiple Missile Variable Assignments	T2-66
Multiplier	3-922
Multiverter	F1-3
N	
Noise Figure Meter	F1-3, F2-14, T2-14
Normal Operation (Computer System Operating Procedure)	2-50
O	
One-Hertz Oscillator	3-921
Operating Instructions	
Air Conditioning Turn On	2-20
Application of Primary Power	2-18
DC Voltage Checks	2-22
General	2-15
Initial Control Settings	2-24
Antenna Trailers	2-25
Radar Control Trailer	2-26, T2-65
S- and C-Band Antenna Trailers	2-25, T2-63
X-Band Antenna Trailer	2-25, T2-64
Operating Modes, Pedestal	3-1124
Operating Modes, System	3-9, T3-1
Operating Procedure, Computer System	2-43
A.G.C. Format, Punch Format	F2-54
Band, Type Format	F2-55
Computer Turn-On	2-45
Miss Distance, Type Format	F2-59
Missile Status, Type Format	F2-58
Normal Operation	2-50
Program Loading Procedure	2-46
Program Tape Rewind Procedure	2-48

ALPHABETICAL INDEX (Continued)

Subject	Paragraph, Figure, Table Number
O	
Sense Switch Options	2-49
Target Track Data, Type Format	F2-56
Transponder Track Data, Type Format	F2-57
Operating Procedures, Typical	2-96
Operating Tasks and Sequences, Typical	F2-61
Operation	
Automatic Position Plotter (APP)	2-110
Emergency	2-129
Introduction	2-1
Manual Tracker	2-105, 2-121
Transmitter	3-419
Operator, Guidance (X-Band)	2-112
Options, Sense Switch	2-49
Oscillator, Coherent	3-875
Oscillator, One-Hertz	3-921
Oscilloscopes	F1-3
P	
Panel,	
Antenna Trailer Disconnect	F2-47, T2-47
Azimuth and Elevation Transmitter	F2-42, T2-42
Control	F2-25, T2-25
Control Diagram, T1 and T2	F3-129
Digital Voltmeter Test	F2-17, T2-17
Intercom	F2-19, T2-19
Pedestal Interlock Switch	F2-48, T2-48
Power Distribution	F2-44, F2-53, T2-44, T2-53
Pedestal,	
Azimuth	
Assembly	F2-45, T2-45
Elevation	F1-3, F2-46, T2-46
C-Band Trailer	F1-5
Disable Switches	T2-61
Interlock	T2-60
Circuits	2-7
Switch Panel	F2-48, T2-48
Position	3-1365, F3-180
Reference, Control	3-1113, F3-145
X-Band Trailer	F1-6
Pedestal Data Gate Logic	T3-10
Pedestal Drive Circuits	F3-131
DC Amplifier	3-1039, F3-134
Encoder	3-1083, 3-1086
Power Supply	3-1143
Servo Amplifier	3-1048, F3-135
Servo Control Unit	3-1026

ALPHABETICAL INDEX (Continued)

Subject	Paragraph, Figure, Table Number
P	
Pedestal Drive Servo System	3-1020, 3-1117, F3-131
Auto Pedestal Operation X-Band	3-1106, F3-144
Interlocks	F3-133
Reference Pedestal Control	3-1113, F3-145
Synchro Selection	F3-132
Pedestal Operating Modes	3-1124
Pedestal Servo Operation, Manual	3-92
Performance Monitor	F1-4, F1-5
Dual Peak Detector	3-350
Filter Network	3-365
Log and Scaling Amplifier	3-362
RF Detector	3-352
Sample Pulse Driver	3-353
Video Detection and Sampling	3-357
Phase Detector	3-868
Phase, Lock Control	3-856
Plot, Analog Variables	T2-71
Plotter, Automatic Position	F1-3
Indicator	F1-3
Intercom	F1-3
Power Supplies	F1-3
Radio Remote Control	F1-3
Sweep Control	F1-3
Power	
Amplifier	F3-146
and Frequency Control	F2-9, T2-9
Distribution	
Consoles	F1-3, F2-34, T2-34
Panels	F1-4, F2-44, F2-53, T2-44, T2-53
Unit	F2-26, T2-26
Deflection System	3-929, T3-6
Divider	3-624
Entry Panels	F1-3
Frequency Control	F1-3
High Voltage, Supply	3-396, 3-961
High Voltage (X-Band)	F1-6
Monitor	F1-3, F2-11
Monitor, Input (Power Dist. Console)	F2-34
Panel, S- and C-Band Antenna Trailer Power	F2-34
Panel, X-Band Antenna Trailer	F2-34
Primary, Application of	2-18
Supplies	F1-3 thru F1-6
Supplies Command Transmitter	F1-4
Supply System	3-198
Switch (Spooler)	F2-24
Switches, Pedestal	F2-1
Power Supply	
Cathode-to-Helix, CW L-Band Transmitter	F3-49
Collector, CW L-Band Transmitter	F3-51

ALPHABETICAL INDEX (Continued)

Subject	Paragraph, Figure, Table Number
P	
High Voltage, S- and C-Band	3-293
Filament and Anode	F3-50
Log IF	3-684
Trigger Generator	3-252
Preamplifier, Encoder Transducer and	3-1083
Prereceiver and AFC	F2-43, F2-51, T2-43, T2-51
C-Band Trailer	F1-5
S-Band Trailer	F1-4
X-Band Trailer	F1-6
Prereceiver Channels, Target, Transponder and Down Link (S- and C-Band)	3-625, F3-87
Isolator – Filter Network	3-627
Mixer-IF Preamplifiers	3-628
Target AFC – Local Oscillator	3-638, F3-88
Transponder and Down Link Local Oscillator	3-655
Prereceiver Microwave Block Diagram	F3-86
Prereceiver, S- and C-Band	3-61, 3-618, F3-86
Power Divider	3-624
TWT Amplifier	3-622
Prereceiver System, Receiver Group	3-61
Prereceiver, X-Band	3-657, F3-89
DLJ and Transponder	3-660
Target	3-662
Presentation Group	3-94, 3-896
Automatic Point Plotter (APP) Display	3-110, F3-22
Guidance Operator Display Group	3-96, F3-16, F3-17, F3-18
S- and C-Band Manual Tracker Displays	3-103, F3-19
Transponder (Reference) Displays	3-107, F3-21
X-Band Manual Tracker Displays	3-106, F3-20
Pressurization Waveguide	3-32, 3-290, F3-36
Primary Power, Application of	2-18
Procedure, Program Loading	2-46
Program Loading Procedure	2-46
Program Tape Rewind Procedure	2-48
Programmed Test Routines, Radar Set	2-53
Protection, Transmitter Interlocks	
Circuits	2-7
CW L-Band	T2-58
Pulse L-Band	T2-57
S- and C-Band	T2-55
X-Band	T2-56
Pulse Amplifier	3-1183, F3-147
Pulse Forming Network (PFN)	3-267, F3-35
Pulse Comparator, Timing	3-859
Pulse Generator, Crossover	3-1059, F3-137
Pulsed L-Band Transmitters	3-323, F3-40
C-Band Pedestal Interface	F3-38
Power Supply	3-340
X-Band Pedestal Interface	F3-39

ALPHABETICAL INDEX (Continued)

Subject	Paragraph, Figure, Table Number
P	
Pulsed L-Band Command, Transmitter Protection Interlocks	T2-57
Punch Format, A.G.C. Format	F2-54
Punch, High-Speed	F1-3
Purpose and Description	1-1
General Description	1-3
Purpose	1-2
Q	
R	
Radar	
Antenna Trailers	1-11, F1-1 thru F1-12
Band Selection	F3-29
Control Trailers Initial Control Settings	2-24, T2-65
Control Trailers Panel	F2-34
Set Programmed Test Routines	2-53
Set Turn-Off Procedure	2-32
Timing Inputs	3-1340
Radar, AN/MPS-T1, Training Set	3-4, F1-1, F1-2, F3-1
Capabilities and Limitations	1-15, F1-2, T1-2
Description and Purpose	1-1, F1-1
Description of Equipment	1-8, T1-3
Equipment Supplied	1-17, F1-1, T1-3
Leading Particulars	1-13, T1-1
Trailers	1-11, F1-1 thru F1-12
Radar Control Trailer	2-135
Air Conditioning/Heating	2-134
Components	F1-3
Initial Control Settings	2-26, T2-65
Operating Instructions	2-26
Turn-Off	2-40
Radar Console	F1-3
Radar Mode Angle Gate Generator Clock Selection	T3-9
Radiation Envelope	F3-8, F3-9, F3-10
Radio	
Communication System	3-197, T1-4
Remote Control	F1-3
Set Antenna	F1-3
Range	
Attenuation Block Diagram	3-1477, F3-189
Calibrate Strobe Generator	3-1397
Conversion	3-1352
Delay Timing Diagram	3-1469, F3-188
Gate Generator	3-717, 3-785
Timing Circuits Target	3-1341, F3-179
Timing Pulse Distribution	F3-30
Timing Pulse Timing Diagram	F3-31

ALPHABETICAL INDEX (Continued)

Subject	Paragraph, Figure, Table Number
R	
Range Sawtooth Generation	3-906, F3-114, F3-113
Generator	3-920
Range Tracking	3-116, 3-1197, F3-149, F3-150, F3-151
Automatic	3-1245
Control	F2-31, T2-31
Manual	3-1223
Operator Controls	3-1203, 3-1214, 3-1218, F3-150, F3-151, F3-152
Reader, Tape	F1-3
Receivers,	
Antenna (X-Band)	F1-6
Azimuth	F1-3, F2-28, T2-28
Down Link Jammer (DLJ)	3-890, F2-35, F3-110, F3-111, T2-35
Elevation	F1-3, F2-32, T2-32
Reference Tracking, S-Band and C-Band	3-760
Select Circuit	3-63, 3-672, F1-3, F2-10, T2-10
Target Tracking	F1-3
S- and C-Band	3-674
X-Band	3-770
Target Down Link Jammer	F1-3
Transponder	3-880, F2-5, F3-108, F3-109, T2-5
Receiver, Azimuth and Elevation (S-Band Trailer)	F1-4
Receiver Control, X-Band	3-783, F3-100
Receiver Group	3-58, 3-615, F3-11, F3-85
Main Receiver System	3-64
Prereceiver System	3-61, 3-618
Receiver Select	3-63, 3-672
Receiver, S- and C-Band Target Tracking	3-674
Receiver, X-Band Target	3-770
Record Range and Angle Sync Signal	F3-195
Recorder	F1-3
and Take-Up Reel	F2-21, T2-21
DC Amplifier, and Master Power Panel	F2-20, T2-20
Master Power	F1-3
Reels,	
A and B, Cable (Dish Antenna Trailer)	F1-11
C, Cable (C-Band Trailer)	F1-9
D, Cable (S-Band Trailer)	F1-7
E and F (X-Band Trailer)	F1-12
Recorder and Take-Up	F2-21, T2-21
Reference	
Pedestal Control	F1-3, F3-145
Radar Timing Circuits	3-1345
Receiver	3-760, F3-96, F3-97
Track, Operator Controls	3-1266, F3-161
Track, Transponder	2-122
Track, X-Band Radar	2-127
Reference System	
C-Band, S-Band Target Tracking	3-15, F3-3

ALPHABETICAL INDEX (Continued)

Subject	Paragraph, Figure, Table Number
R	
Tracking, X-Band	3-19, F3-5
Transponder, S-Band Target Tracking	3-12, F3-2
Related Technical Manuals	1-19, T1-4
Relay Assembly	.3-427
Reverse Power Sensing	.3-259
Rewind Switch (Spooler)	F2-24
Routines	
Honeywell Diagnostic	2-91
Radar Set Programmed Test	2-53
RPM Sense Circuit	F3-71
RTM	F1-6
Runup Procedure, Transmitter	2-27
L-Band CW	2-31
L-Band Pulsed	2-30
S- and C-Band	2-28
X-Band	2-29
S	
Sample and Hold	.3-853
S- and C-Band	
Antenna Trailer Initial Control Settings	2-25, T2-63
Antenna Trailer Power Panel	F2-34
Antenna Trailer Turn-Off	2-37
Magnetron	.3-282
Manual Tracker Azimuth, Range and Elevation	.F2-27, T2-27
Manual Tracker Controls	3-991, F3-128
Manual Tracker Displays	.3-103, F3-19
Modulators	.3-260
Operator Controls	3-1251, F3-157, F3-158
Prereceivers	.3-618, F3-86
Range Timing Generation	.3-206, F3-32
Receiver Block Diagram	F3-91
Receiver Control Diagram	F3-92
Receiver Interface	F3-90
Reference Track, Radar	.2-125
Reference Tracking Receiver	.3-760
Target Simulator Operation	3-20, F3-6
Target Track	2-99
Transmitter Control	F2-8, T2-8
Transmitter Protective Interlock	T2-55
Transmitter Runup	2-28
Transmitter Systems	.3-26, 3-247, F3-34
Trough Antennas	.3-521
Waveguide Pressurization Systems	.3-290, F3-36
Sawtooth, Truncated Waveform	F2-60
S-Band Angle Timing	.3-563, F3-77
S-Band Antenna Structure Transport Trailer (Unloaded)	F1-7

ALPHABETICAL INDEX (Continued)

Subject	Paragraph, Figure, Table Number
S	
S-Band Antenna System	3-39, 3-496, F3-55
Waveguide Switching	3-505, F3-58
S-Band Antenna Trailer Components	F1-4
S-Band Frequency Monitor	3-346, F3-42
S-Band Target Tracking, C-Band Reference System	3-15, F3-3
S-Band Trough Antenna Transport Trailer (Unloaded)	F1-8
Scan Encoder	3-604
Selection	3-613, T3-3
Simulation	3-612
Scanner and Waveguide Switching (S-Band Trailer)	F1-4
Scanner Assembly	
Dish Scanning Diagram, C-Band	F3-66
Trough Antenna, Scanner and Controls	F3-65
Scanner Controls, Dish Antenna (C-Band)	
Mode II Scanner Control	F3-69
Mode III (High RPM)	F3-70
Mode III (Low RPM)	F3-72
RPM Sense Circuit	F3-71
Scanner Disable Switches	T2-62
Scanner, Helical Slot	F3-67
Scanning	
Dish Antenna C-Band	3-531, F3-66
Scoring Computations	3-154, F3-26
SCR Power Amplifier	3-1070, 3-1166, F3-138, F3-146
Select, Receiver	F2-10, T2-10
Selection, Video	3-702
Semitrailer, Antenna and Antenna Support	1-12
Sense Switch Interconnect Diagram, Waveguide Switch	F3-61
Sense Switch Options	2-49
Sensitivity Time Control Simplified Functional Diagram	F3-95
Service Conditions, Excessive	2-131
Servo	
Amplifier	3-1048, F3-135, T1-3
Block Diagram	F3-124
Control Unit	3-1026, F2-15, T2-15
S- and C-Band	F1-3
X-Band	F1-6
Reference Pedestal	F1-3
Servo Amplifier, Pedestal Drive	3-1020, 3-1117, F3-131
Crossover Pulse Generator	3-1059, F3-137
Full Wave Rectifier	3-1053, F3-136
Timing Diagram	F3-135
SCR Power Amplifier	3-1070, 3-1166, F3-138, F3-140
Servo, Command	
Azimuth	3-1010
Converter	3-1014
Elevation	3-1008
Filter	3-1017

ALPHABETICAL INDEX (Continued)

Subject	Paragraph, Figure, Table Number
S	
Motor Drive	3-1011
Servo Amplifier	3-1018
Servo Group	
AN/MPS-T1(V)1, (V)2 and (V)3, Antenna Pedestal	3-75, F3-12
AN/MPS-T1(V)4, Antenna Pedestal	3-90, F3-15
Instrumentation Outputs	3-82
Target Simulation Operation	3-89
Servo Pedestal Drive, AN/MPS-T1(V)1, (V)2 and (V)3	3-1020, F3-131
Servo Pedestal Drive, AN/MPS-T1(V)4	3-1117
Setting, Initial Control	2-24
Radar Control Trailers	2-26, T2-65
S- and C-Band Antenna Trailers	2-25, T2-63
X-Band Antenna Trailers	2-25, T2-64
Signal Conditioning	F1-4, F1-5, F2-50, T2-50
Simulator Operation, Target	3-20, 3-89, 3-180, 3-1426, F2-38, F3-6, F3-184, T2-38
Spooler	F2-24, T2-24
Status Word Bit Assignment	T2-72
Status Words, Inputs	3-1348, F3-196
Status Words, Outputs	3-1377, F3-198
Storage	
Chest	F1-7
Drawer	F1-4, F1-5
L-Band Dish Antenna	F1-11
Strut Support Fixture (C-Band Trailer)	F1-9
Supplied Equipment	1-17, T1-3
Support Fixture,	
Azimuth Dish Antenna, C-Band	F1-11
Azimuth Trough Antenna, C-Band	F1-10
Elevation Dish Antenna, C-Band	F1-11
Elevation Trough Antenna, C-Band	F1-10
Horizontal Counterweight (C-Band Trailer)	F1-9
Horizontal Counterweight (S-Band Trailer)	F1-7
Horizontal Support Structure (C-Band Trailer)	F1-9
Horizontal Support Structure (S-Band Trailer)	F1-7
L-Band Antenna (X-Band Trailer)	F1-12
Receiving Antenna (X-Band Trailer)	F1-12
S-Band Azimuth Trough Antenna	F1-8
S-Band Elevation Trough Antenna	F1-8
Strut (C-Band Trailer)	F1-9
Vertical Counterweight (C-Band Trailer)	F1-9
Vertical Support Structure	F1-7, F1-9
Sweep Blanking Generation, B-Scope Sawtooth and	3-898, F3-113
Sweep Control	F1-3
Sweep Function Locations in Display Groups	T3-4
Sweep Protection Circuits	T3-7
Switches	
Options, Sense	2-49
Panel, Pedestal Interlock	F2-48, T2-48

ALPHABETICAL INDEX (Continued)

Subject	Paragraph, Figure, Table Number
S	
Pedestal Disable	T2-61
Power (Spooler)	F2-24
Rewind (Spooler)	F2-24
Scanner Disable	T2-62
Transmitter Disable	T2-59
Switching, Waveguide and Scanner	F1-4, F1-5
Synchro Selection Functional Diagram	F3-132
Synchronizer	F1-3, F2-4, T2-4
Synchronizer, X-Band	3-837
Trigger Generation, MTI Off	3-839
Trigger Generation, MTI On	3-845
System Operating Modes	3-9, T3-1
S- and C-Band Target Simulator Operation	3-20, F3-6
S-Band Target Tracking	
C-Band Reference System	3-15, F3-3
Transponder Reference System	3-12, F3-2
X-Band Reference Track System	3-19, F3-5
X-Band Target Track System	3-18, F3-4
T	
Take-Up Reel	F1-3
Recorder and	F2-21, T2-21
Tape	
Advance Lever (High Speed Tape Punch)	F2-22
Reader	F1-3, F2-23, T2-23
Rewind Procedure, Program	2-48
Spooler	F2-24, T2-24
Target	
Angle Control	3-1432, F3-185
Range Control	3-1445, F3-186
Receiver, X-Band	3-770, F3-98
Track Data, Type Format	F2-56
Tracking, X-Band	F1-3
Target AFC-Local Oscillator	3-638, F3-88
Target and Transponder Prereceiver Block Diagram	F3-87
Target IF Modulation Block Diagram	F3-190
Target Range Gate Generator	F3-154
Target Range Timing Circuits	3-1341, F3-179
Target Receiver, X-Band Local Oscillators	3-667
Target Video Cancellation System	3-814, F3-103
Target Simulator	3-20, 3-89, 3-180, 3-1426, F2-38, F3-6, F3-184, T2-38.
Target Track, S- and C-Band	2-99
Automatic Position Plotter (APP) Operation	2-110
Manual Tracker Operations	2-105, 2-121
Receivers	3-674
Target Track, X-Band	2-111
Guidance Operator	2-112

ALPHABETICAL INDEX (Continued)

Subject	Paragraph, Figure, Table Number
T	
Manual Tracker Operations	2-121
System	3-18, F3-4
Technical Manuals, Related	1-19, T1-4
Test Panel, DVM	F1-3
Test Routines, Computer System	2-51
Analog Plot Variables	T2-71
Analog-to-Digital Converter Data Inputs	T2-68
Angle Calibration Constants	T2-70
Angle Differences	T2-71
Angle Relative to Boresight	T2-71
Data Word Format	T2-73
General	2-52
Honeywell Diagnostic Routines	2-91
Interface Address Assignments	T2-69
Line of Sight Distances	T2-71
Multiple Missile Variable Alignments	T2-66
Radar Set Programmed Test Routines	2-53, T2-67
Range Differences	T2-71
Ranges	T2-71
Status Word Bit Assignments	T2-72
Truncated Sawtooth Waveform	F2-60
Thumbwheel Inputs	3-1379
Thyratron Switch	3-266
Timing, Angle	3-561
C-Band	3-577, F3-80
Internal, Generation	3-594
S-Band	3-563, F3-77
X-Band	3-586, F3-83
Timing Inputs, Radar	3-1340
Timing Pulse	
AFC Clock (S-Band)	3-568, F3-78, F3-79
Angle Gate Generator Clock Timing	F3-163
Angle Gate Timing	
Low Altitude Mode (S- and C-Band)	F3-166
Normal Mode (S- and C-Band)	F3-165
X-Band	F3-167
Boxcar Video-AGC Generation (S-, C-Band)	F3-93
Comparator, Time Pulse	3-859
COHO Timing Sequence	3-875, F3-107
Data Transfer	3-1317, 3-1319, F3-175, F3-177, 3-1315
Divide By 12/13 Counter (S-, C-Band)	3-223, F3-33
Encoder	F3-143
Low Altitude Cursor Generation	F3-121, 3-949, F3-122
Missile Guidance Timing (X-Band)	F3-47
MTI Timing	F3-105
Pedestal Position Data Transfer Timing	3-1365, F3-180
Pulse Forming Network Discharge	3-267, F3-35

ALPHABETICAL INDEX (Continued)

Subject	Paragraph, Figure, Table Number
T	
Radar Timing Inputs	3-1341, F3-179
Range	
Delay Timing	3-1469, F3-188
Sweep Generation	F3-114
Timing (S-, C-Band)	F3-32
Track Loop Pulse Timing	F3-153
Sector Scan Generation	F3-127
Servo Amplifier	F3-135
Shift Register Timing	F3-164, F3-168
Synchronous Gates Timing	F3-139
Target Range Gate Timing	F3-154
Transponder Cursor Generation Timing	F3-174
Transponder Range Gates Timing	F3-155
Trough Antenna (X-Band)	F3-84
Track Operation, Manual	2-105
Tracker Operation, X-Band	3-777
Tracking,	F1-3
Azimuth Control	F2-29, T2-29
Controls	F1-3, F2-3, F2-7, T2-3, T2-7
Controls, T1 and T2	F2-37, T2-37
Elevation Control	F2-33, T2-33
Range Control	F2-31, T2-31
Tracking Control	F1-3
Power Supply	F1-3
T1 and T2	F1-3
Tracking Group	3-111, 3-1195, F3-23, T3-8
Angle Tracking System	3-126, 3-1248, F3-156
Range Tracking System	3-116, 3-1197, F3-149
Tracking Receiver, Reference, S-Band and C-Band	3-760
Tracking, Target (X-Band)	F1-3
Trailer	
Antenna	2-25, T2-63, T2-64
Antenna Disconnect Panel	F2-47, T2-47
Assembly	F1-3
Mobile	F1-4 thru F1-6
Radar Antenna	2-137
Radar Control	2-26, 2-135, T2-65
Trailer, C-Band Antenna Structure Transport	F1-9
Trailer, Dish Antenna Transport	F1-11
Trailer, S-Band Antenna Structure Transport	F1-7
Trailer, S-Band Trough Antenna Transport	F1-8
Trailer-Mounted Antenna-Receiver-Transmitter Groups	1-11
Training Set, Radar	F1-1, F1-2, F3-1
Capabilities and Limitations	1-15, T1-2
Description and Purpose	1-1, F1-1
Description of Equipment	1-8, T1-3
Equipment Supplied	1-17, F1-1, T1-3

ALPHABETICAL INDEX (Continued)

Subject	Paragraph, Figure, Table Number
T	
Leading Particulars	1-13, T1-1
Trailers	F1-1 thru F1-12
Transmitter,	
Access Interlocks	2-8, T2-54
Azimuth and Elevation	F2-42, T2-42
C-Band Trailer	F1-5
S-Band Trailer	F1-4
Block Diagram, S- and C-Band	F3-34
Coder	3-467, F1-3
Command	F2-41, F2-41
X-Band	F1-6
Control	
L-Band	F1-3, F2-12, T2-12
S- and C-Band	F1-3, F2-8, T2-8
X- and L-Band	F1-3
X-Band	F2-18, F2-52, T2-18, T2-52
Disable Switches	T2-59
External Interlocks	F3-37
L-Band CW	F2-49, T2-49
X-Band Trailer	F1-6
Low Band Command	F1-4, F1-5
Performance Monitor	3-348
X-Band Control	F1-6
Transmitter Group	3-23, 3-201, F3-7
L-Band CW	3-36, 3-465, 3-470
Radar Band Selection	3-202, F3-29
Transmitter Protection Interlocks	2-7, T2-55 thru T2-58
Transmitter Runup Procedure	2-27 thru 2-31
Transmitters, S- and C-Band	3-247, F3-34
Frequency Monitor	3-346, F3-42
High Voltage Power Supply	3-293
L-Band Pulsed, Power Supply	3-340
Magnetron Filament Voltage Control	3-276
Modulator	3-248, 3-260, 3-319
Performance Monitor	3-348
Pulse Forming Network (PFN)	3-267
Pulsed L-Band	3-323, F3-40
Reverse Power Sensing	3-259
Thyratron Switch	3-266
Trigger Generator Inhibit Circuits	3-255
Power Supply	3-252
Transmitter, X-Band	3-33, 3-366, 3-377
Control Panel	3-381, 3-421
Control Power Supply	3-380, 3-424
High Voltage Power Supply	3-368
Interlocks	3-387, F3-45
Keyer Tube Driver	3-373, 3-406, F3-44
Magnetron Tuning Control	3-457

ALPHABETICAL INDEX (Continued)

Subject	Paragraph, Figure, Table Number
T	
Meter Driver Assembly	.3-431
Modulator	.3-370
Transponder	
Auto-Sensing	3-1301, F3-172
Indicators	F2-6, T2-6
Operator Controls	.F3-160
Range Gate Generator	.F3-155
Receiver	3-880, F2-5, F3-108, F3-109, T2-5
Reference Track	.2-122
Track Data, Type Format	F2-57
Transponder and Down Link Local Oscillator	.3-655
Transponder Cursor Generation	.3-960
Cursor Generation and Gating	.F3-173
Timing	.F3-174
Transponder (Reference) Displays	.3-107, F3-21
Transponder Reference System, Target Tracking S-Band	3-12, F3-2
Transport Trailer	
C-Band Antenna Structure	F1-1
Trough Antennas	F1-1
L and C-Band Dish Antennas	F1-1
S-Band Antenna Structure	F1-1
Trough Antennas	F1-1, F1-4
X-Band Antenna	F1-1
Trigger Generation, Synchronizer (X-Band) – MTI ON	.3-845
Coherent Oscillator (COHO)	3-875, F3-107
Delay Line	
AGC	.3-854
Input	.3-863
Output	.3-871
Phase Detector	.3-868
Phase Lock Control	.3-856
Sample and Hold	.3-853
Timing Pulse Comparator	.3-859
Video Full Wave Rectifier	.3-851
Trigger Generator, Modulator	.3-248
Inhibit Circuits	.3-255
Power Supply	.3-252
Trough Antenna	3-521, 3-549, F3-63, F3-64
C-Band Transport Trailer	F1-10
Construction	F3-64
Geometry	F3-73
S-Band	F1-8
Scanner	F1-4, F1-5
Scanner and Controls	F3-65
Rotation	F3-74
Timing Diagram	F3-84
X-Band	F3-63
Scanner Mechanism	F3-75

ALPHABETICAL INDEX (Continued)

Subject	Paragraph, Figure, Table Number
T	
Truncated Sawtooth Waveform	F2-60
Turn Off Procedure, Radar Set	2-32
Turn On, Air Conditioning	2-20
Turn On, Computer	2-45
TWT Amplifier	3-622
Type Format,	
Miss Distance	F2-59
Missile Status	F2-58
Target Track Data	F2-56
Transponder Track Data	F2-57
Typical Operating Procedure	2-96
Typical Operating Tasks and Sequence	F2-61
T1 and T2	
Indicator	F2-36, T2-36
Pedestal Control	F3-129
Tracking Controls	F2-37, T2-37
U	
Unit, Control	3-87
Unit, Power Distribution	F2-26, T2-26
V	
Variables, Analog Plot	T2-71
Vertical Counterweight Support Fixture (C-Band Trailer)	F1-9
Vertical Support Structure Support Fixture	F1-9
C-Band Trailer	F1-9
S-Band Trailer	F1-9
Voltage	
Checks, DC	2-22
Control	3-397
Voltmeter	
Digital	F1-3, F2-13, T2-13
Digital Test Panel	F2-17, T2-17
W	
Waveform, Truncated Sawtooth	F2-60
Waveguide and Scanner Switching	F1-4, F1-5
Waveguide Pressurization	3-32, 3-290, F3-36
Waveguide Switch, Sense Switch Interconnect Diagram	F3-61
Word Bit Assignment, Status	T2-72
Work Bench (Control Trailer)	F1-3

ALPHABETICAL INDEX (Continued)

Subject	Paragraph, Figure, Table Number
X	
X-Band	
Acquisition Operation	3-775
Antenna System	3-52, 3-501, F3-57
Auto Pedestal Operation	3-1106, F3-144
Manual Tracker Displays	3-106, F3-20
Missile Guidance Timing	F3-47
Prereceivers	3-657, F3-89
Range Timing Generation	3-246
Receiver Control	3-783
Reference Track System	3-19, F3-5
Transmission Protection Interlocks	T2-56
Transmitter Control	F1-6, F2-18, T2-18
Transmitter Runup	2-29
Transmitter System	3-33, 3-366, F3-43
Trough Antenna	3-549
Waveguide Switching	3-515
X-Band Angle Timing Block Diagram	F3-83
X-Band Antenna Trailer Components	F1-6
Initial Control Settings	2-24, T2-64
X-Band Antenna Transport Trailer (Unloaded)	F1-12
X-Band Gain Control Select Logic	F3-100
X-Band Missile Guidance Timing Diagram	F3-47
X-Band Pedestal L-Band Transmitter Interface Diagram	F3-39
X-Band Prereceiver Block Diagram	F3-89
X-Band Radar Reference Track	2-127, 3-19, F3-5
X-Band Target Receiver	3-770, F3-98, F3-99
X-Band Target Track	2-111, F3-159
Guidance Operator	2-112
Manual Tracker Operation	2-121
System	3-18, F3-4
Transponder Reference Track	2-122
X-Band Operation	3-777
X-Band Transmitter	F1-6, F2-18, T2-18
Block Diagram	F3-43
Control Panel	3-381, 3-421
Control Power Supply	3-380, 3-424
High Voltage Power Supply	3-368
Interlocks	3-382, 3-387, F3-45
Magnetron	3-34, 3-385, 3-457
Meter Driver Assembly	3-431 thru 3-456
Modulator	3-370
Operation	3-419
Relay Assembly	3-427
X-Band Trough Antenna Timing Diagram	F3-84
X-Band Trough Scanner Mechanism	F3-75
Y	
Z	

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