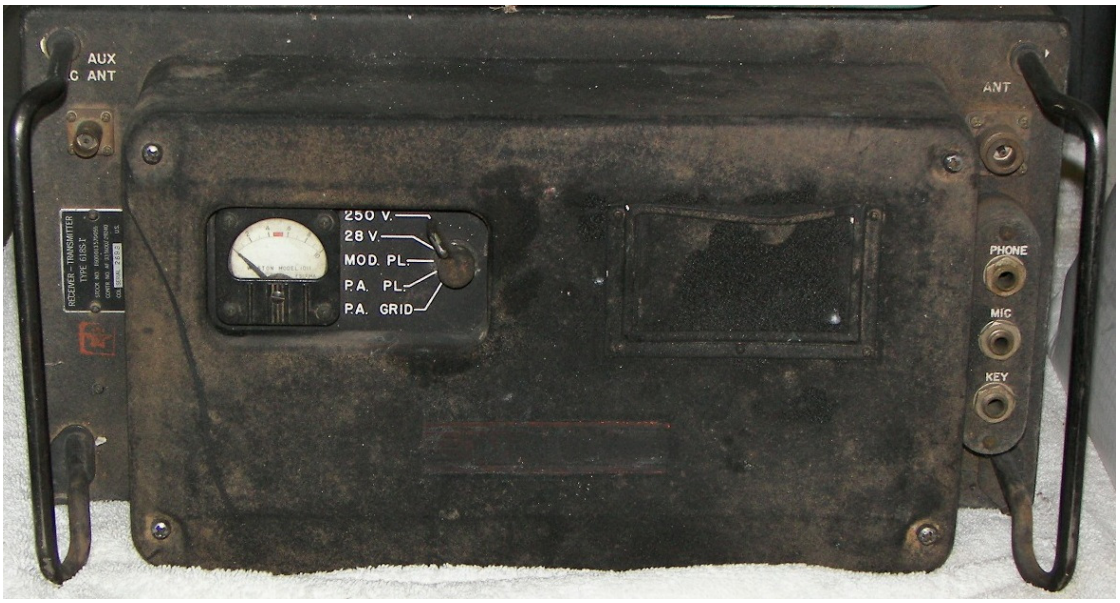
T.O. 12R2-4-6-2

COLLINS
618S-1
618S-1A
HF TRANCEIVER

AM / CW, 2 TO 25MHz, 4 Bands, 144 Channels



Also in this document:
Hookup and Channel Selection Notes
ARC-38 PTO Schematic for Continuous Coverage
BASIC Programs for Frequency and Crystal Calculations

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MOA.
USGW/ARC-38
SMD-
1.75 - 3.5 MC
For cont. Tuning

APPENDIX A
INDEX

	Paragraph	Page
A		
Adjustment		
Antenna	6-72	130
Audio Control (R109)	6-98	140
AGC	6-73	130
Autopositioner Relay	6-55	119
Band 3 Multiplier	6-69	129
Band 4 Multiplier	6-70	129
BFO	6-61	123
CW Sidetone Control (R107)	6-99	140
Final	6-96	138
Gain and Clipping	6-85	134
I-F Gain	6-82	133
Phone Sidetone Control (R106)	6-100	140
PA Discriminator	6-78	132
Roller Coil	6-77	132
Threshold Control (R2602)	6-101	140
Tuner Discriminator	6-67	128
Tuning Rack	6-66	127
250 Kc Oscillator	6-60	122
Alignment		
Equipment	6-48	118
I-F Amplifier Subassembly	6-79	133
Modulator Subassembly	6-83	134
Power Amplifier Subassembly	6-74	131
Procedure	6-46	118
R-F Crystal Oscillator Subassembly	6-53	119
Radio Set Control 614C-2	6-86	134
Tuner Subassembly	6-62	123
250 Kc Oscillator and BFO Subassembly	6-58	121
Application		
Equipment	1-3	1
Audio Amplifier Subassembly		
Removal and Replacement	5-30	89
Trouble Isolation	6-34	111
Automatic Antenna Tuner 180L-3		
Description	1-20	7
B		
Bandchange Autopositioner Unit		
Removal and Replacement, 618S-1	5-35	90
Removal and Replacement, 618S-1A	5-36	90
Trouble Isolation	6-28	103
C		
Cable		
Fabrication	2-7	19
Subassembly	2-8	19
System	2-9	19
Components		
Description	1-15	5
Connections		
Bench Test	3-10	25
Controls		
Operating Function	1-24	10
Control Section		
Theory	4-46	58
D		
Description		
Automatic Antenna Tuner 180L-3 and Mounting 350D-1	1-20	7
Components	1-15	5
Mounting 315S-1 and 350S-3	1-18	7
Power Supply 416W-1 and Mounting 350T-1	1-19	7
Radio Receiver-Transmitter 618S-1 and 618S-1A	1-16	5
Radio Set Control 614C-2	1-21	7
E		
Equipment		
Alternate	2-3	18
Purpose and Application	1-3	1
Required but not Supplied	1-9	3
Supplied	1-7	2
Test	2-1	17
Unpacking and Inspecting	3-1	25
F		
Field Maintenance		
Alignment Procedure	6-46	118
Conversion of 618S-1 to 618S-1A	6-89	135
Final Adjustments	6-96	138
Introduction	6-1	97
Minimum Performance Standards	6-5	97
Trouble Isolation Procedures	6-14	99
G		
Gain		
Audio	4-68	73
Control Circuits	4-66	73
R-F	4-67	73

APPENDIX A
INDEX (CONT)

	Paragraph	Page
H		
Handbook		
Scope	1-1	1
I		
Inspection		
Daily	5-9	78
Equipment	3-3	25
120-Hour	5-11	78
Postinstallation	3-33	32
Preflight	5-7	77
Visual	3-3	25
Installation		
Automatic Antenna Tuner 180L-3	3-26	32
Equipment	3-18	30
Power Supply 416W-1	3-23	31
Radio Receiver-Transmitter 618S-1 and 618S-1A	3-20	30
Radio Set Control 614C-2	3-29	32
I-F Amplifier Subassembly		
Alignment	6-79	133
Removal and Replacement	5-30	89
Trouble Isolation	6-33	110
Introduction		
Difference Data Sheets	8-1	167
Field Maintenance	6-1	97
Handbook		1
Organizational Maintenance	5-1	77
L		
Lubrication		
General	5-39	90
M		
Maintenance		
Field		97
Organizational		77
Measurements		
Voltage and Resistance	6-24	101
Minimum Performance Standards		
Field Maintenance	6-5	97
Organizational Maintenance	5-4	77
Modulator Subassembly		
Alignment	6-83	134
Removal and Replacement	5-30	89
Trouble Isolation	6-32	109
Mounting 350D-3		
Description	1-20	7
Installation	3-28	32
Mounting 350S-1 and 350S-3		
Description	1-18	7
Installation	3-22	31
Mounting 350T-1		
Description	1-19	7
Installation	3-25	32
O		
Operation		
Controls	1-24	10
General Principles	1-11	4
Theory		35
Organizational Maintenance		
Corrective Maintenance	5-21	81
Introduction	5-1	77
Lubrication	5-38	90
Minimum Performance Standards	5-4	77
Subassembly Removal and Replacement	5-27	89
P		
Postinstallation		
Inspection	3-35	32
Test	3-37	33
Power		
Distribution	6-16	99
Requirements	1-27	13
Power Amplifier Subassembly		
Alignment	6-74	131
Removal and Replacement, 618S-1	5-33	90
Removal and Replacement, 618S-1A	5-34	90
Trouble Isolation	6-31	108
Power Supply 416W-1		
Description	1-19	7
Installation	3-23	31
Trouble Isolation	6-44	114
Preinstallation		
Inspection	3-3	25
Test	3-8	25
Purpose		
Equipment	1-3	1
Handbook	1-1	1
R		
R-F Crystal Oscillator Subassembly		
Alignment	6-53	119
Removal and Replacement	5-30	89
Trouble Isolation	6-27	102

APPENDIX A
INDEX (CONT)

	Paragraph	Page
Radio Receiver-Transmitter 618S-1 and 618S-1A		
Description	1-16	5
Installation	3-20	30
Radio Set Control 614C-2		
Description	1-21	7
Installation	3-29	32
Trouble Isolation	6-45	117
Receiver Section		
Theory	4-22	45
Relay Subassembly		
Removal and Replacement	5-30	89
Trouble Isolation	6-36	113
Removal and Replacement		
Blower Motor B101 Unit	5-37	90
General	5-30	89
Power Amplifier Subassembly, 618S-1	5-33	90
Power Amplifier Subassembly, 618S-1A	5-34	90
Servomotor B102 and Bandchange Autopositioner Units, 618S-1	5-35	90
Servomotor B102 and Bandchange Autopositioner Units, 618S-1A	5-36	90
Tuner Subassembly, 618S-1	5-31	89
Tuner Subassembly, 618S-1A	5-32	89
Resistance		
Measurements	6-24	101

S

Scope		
Handbook	1-1	1
Servomotor B102 Unit		
Removal and Replacement, 618S-1	5-35	90
Removal and Replacement, 618S-1A	5-36	90
Trouble Isolation	6-28	103

T

Test Equipment		
Alternate	2-3	18
Required	2-1	17
Tests		
Field Maintenance	6-5	97
Organizational Maintenance	5-4	77
Postinstallation	3-35	32
Preinstallation	3-8	25
Theory		
Control Section	4-46	58
General	4-1	35
Receiver Section	4-22	45
Transmitter Section	4-3	35
Tools		
Special	2-5	18
Transmitter Section		
Theory	4-3	35
Trouble Isolation		
Audio Amplifier Subassembly	6-34	111
Autopositioner System	6-28	103
Field Maintenance	6-14	99
General	6-15	99
I-F Amplifier Subassembly	6-33	110
Modulator Subassembly	6-32	109
Organizational Maintenance	5-25	83
Power Amplifier Subassembly	6-31	108
Power Supply 416W-1	6-44	114
R-F Crystal Oscillator Subassembly	6-27	102
Radio Set Control 614C-2	6-45	117
Relay Subassembly	6-36	113
Tables	6-25	102
Tuner and PA Servo Amplifier Subassemblies	6-41	114
Tuner Subassembly	6-29	106
250 Kc Oscillator and BFO Subassembly	6-35	112
Tuner and PA Servo Amplifier Subassemblies		
Removal and Replacement	5-30	89
Trouble Isolation	6-41	114
Tuner Subassembly		
Alignment	6-62	123
Removal and Replacement, 618S-1	5-31	89
Removal and Replacement, 618S-1A	5-32	89
Trouble Isolation	6-29	106
250 Kc Oscillator and BFO Subassembly		
Alignment	6-58	121
Removal and Replacement	5-30	89
Trouble Isolation	6-35	112

U

Unpacking		
Equipment	3-1	25

V

Vacuum Tube		
Complement	12-9	13
Maintenance	5-23	81
Replacement	5-24	83

APPENDIX A
INDEX (CONT)

	Paragraph	Page
Voltage		
B-Plus Voltage Distribution	6-21	101
Distribution	6-16	99
Measurements	6-24	101
Primary Voltage Distribution	6-17	99

TABLE OF CONTENTS

Section		Page
	INTRODUCTION	1
I	**DESCRIPTION AND LEADING PARTICULARS**	1
1-1.	Scope of Handbook	1
1-3.	Purpose and Application of Equipment	1
1-7.	Equipment Supplied	2
1-9.	Equipment Required but not Supplied	3
1-11.	General Principles of Operation	4
1-15.	Description of Compcnents	5
1-16.	Radio Receiver-Transmitter 618S-1 and 618S-1A	5
1-18.	Mounting 350S-1 and 350S-3	7
1-19.	Power Supply 416W-1 and Mounting 350T-1.	7
1-20.	Automatic Antenna Tuner 180L-3 and Mounting 350D-3	7
1-21.	Radio Set Control 614C-2	7
1-22.	Difference Between Radio Set 618S-1 and Radio Set 618S-1A	7
1-24.	Operating Function of Controls	10
1-26.	Technical Summary	11
1-27.	Power Requirements	13
1-28.	Fuse Complement	13
1-29.	Tube Complement	13
II	**TEST EQUIPMENT AND SPECIAL TOOLS**	17
2-1.	Test Equipment Required	17
2-3.	Use of Alternate Test Equipment	18
2-5.	Special Tools	18
2-7.	Cable Fabrication	19
2-8.	System Cabling	19
2-9.	Subassembly Cabling	19
III	**PREPARATION FOR USE AND RESHIPMENT**	25
3-1.	Unpacking and Inspecting the Equipment	25
3-3.	Visual Inspection	25
3-4.	Radio Receiver-Transmitter 618S-1 and 618S-1A	25
3-5.	Power Supply 416W-1	25
3-6.	Radio Set Control 614C-2.	25
3-7.	Automatic Antenna Tuner 180L-3	25
3-8.	Preinstallation Bench Test	25
3-10.	Connections	25
3-11.	Frequency Selection Tests	27
3-12.	Transmitter Tests.	27
3-13.	R-F Power Output	27
3-14.	Modulation	28
3-15.	Sidetone	29
3-16.	Receiver Tests	29
3-17.	Sensitivity	29
3-18.	Installation of Equipment	30
3-20.	Radio Receiver-Transmitter 618S-1 and 618S-1A	30
3-21.	Location	30
3-22.	Mounting	31
3-23.	Power Supply 416W-1	31
3-24.	Location	31

TABLE OF CONTENTS (Cont)

Section			Page
	3-25.	Mounting	32
	3-26.	Automatic Antenna Tuner 180L-3	32
	3-27.	Location	32
	3-28.	Mounting	32
	3-29.	Radio Set Control 614C-2	32
	3-30.	Location and Mounting	32
	3-31.	Interconnection Between Components	32
	3-33.	Postinstallation Inspection	32
	3-35.	Postinstallation Test	32
	3-37.	Preparation for Reshipment	33
IV		**THEORY OF OPERATION**	**35**
	4-1.	General	35
	4-3.	Transmitter Section	35
	4-5.	Detailed Transmitter Functions	35
	4-6.	R-F Crystal Oscillator	35
	4-7.	First Transmitter Mixer and 250 Kc Oscillator	36
	4-9.	Variable I-F Amplifier	36
	4-10.	Second Transmitter Mixer and Multiplier	36
	4-13.	Second R-F Amplifier and Drivers	40
	4-14.	Power Amplifier	40
	4-15.	Audio Amplifiers and Clipper	42
	4-18.	Audio Drivers and Modulators	43
	4-20.	Side-Tone Circuit	44
	4-22.	Receiver Section	45
	4-24.	Detailed Receive Functions	47
	4-25.	Receiver R-F Amplifiers	47
	4-26.	Receiver Mixers and Variable I-F Amplifier	47
	4-29.	Fixed I-F Input Circuit	51
	4-30.	Mechanical Filters	51
	4-31.	I-F Amplifiers	52
	4-32.	Detector, Noise Limiter, and AVC	52
	4-35.	Audio Amplifiers	54
	4-36.	Beat-Frequency Oscillator	55
	4-37.	AGC and AVC Circuits	55
	4-39.	Filament Circuit	55
	4-40.	Power Supply 416W-1	56
	4-46.	Control Section	58
	4-48.	R-F Crystal Oscillator Subassembly, Frequency Selection	58
	4-50.	Autopositioner Theory	58
	4-51.	Sequence of Operation	58
	4-52.	Tuner Subassembly, Frequency Selection	65
	4-53.	Tuner Table Centering Circuit	65
	4-54.	Tuner Discriminator	66
	4-57.	Tuner Servo Amplifier Subassembly and Servomotor	67
	4-59.	Power Amplifier Subassembly, Frequency Selection	69
	4-60.	Band Centering Circuits	69
	4-61.	PA Phase Discriminator	72
	4-62.	Tuner and Power Amplifier Mechanical Functions	72
	4-63.	Band Selection	72
	4-64.	Tuner Functions	72
	4-65.	Power Amplifier Functions	72
	4-66.	Gain and BFO Control Circuits	73
	4-67.	R-F Gain	73

TABLE OF CONTENTS (Cont)

Section			Page
	4-68.	Audio Gain	73
	4-69.	BFO Control	74
	4-70.	Detailed Sequence of Operation	74
	4-72.	R-F Crystal Oscillator, Sequence of Operation	74
	4-73.	Band Selection, Sequence of Operation	74
	4-74.	Tuner Centering, Sequence of Operation	74
	4-75.	PA Centering, Sequence of Operation	74
	4-76.	Tuner Setup, Sequence of Operation	75
	4-77.	PA Setup, Sequence of Operation	75
V	**ORGANIZATIONAL MAINTENANCE**		**77**
	5-1.	Introduction	77
	5-3.	General	77
	5-4.	Minimum Performance Standards	77
	5-5.	Preflight Inspection and Tests	77
	5-7.	Preflight Inspection	77
	5-8.	Preflight Test	77
	5-9.	Daily Inspection	78
	5-11.	120-Hour Inspection	78
	5-13.	Detailed Performance Tests	79
	5-15.	Receiver Sensitivity	79
	5-16.	Receiver Selectivity	80
	5-17.	Frequency Selection	80
	5-18.	Transmitter R-F Power Output	80
	5-19.	Modulation	80
	5-20.	Side Tone	81
	5-21.	Corrective Maintenance	81
	5-23.	Vacuum Tubes	81
	5-24.	Tube Replacements	83
	5-25.	System Trouble Analysis	83
	5-27.	Subassembly Removal and Replacement	89
	5-30.	General	89
	5-31.	Tuner Subassembly, 618S-1	89
	5-32.	Tuner Subassembly, 618S-1A	89
	5-33.	Power Amplifier Subassembly, 618S-1	90
	5-34.	Power Amplifier Subassembly, 618S-1A	90
	5-35.	Servomotor B102 and Bandchange Autopositioner Units, 618S-1	90
	5-36.	Servomotor B102 and Bandchange Autopositioner Units, 618S-1A	90
	5-37.	Blower Motor B101 Unit	90
	5-38.	Lubrication	90
	5-39.	General	90
VI	**FIELD MAINTENANCE**		**97**
	6-1.	Introduction	97
	6-3.	General	97
	6-5.	Minimum Performance Standards	97
	6-6.	General	97
	6-7.	Preparatory	97
	6-8.	AVC Characteristics	98
	6-9.	Frequency Response	98
	6-10.	CW Frequency Range	98
	6-11.	CW Gain Control	98
	6-12.	Side-Tone Power	98
	6-13.	Modulation Fidelity	99

TABLE OF CONTENTS (Cont)

Section		Page
6-14.	Trouble Isolation Procedures	99
6-15.	General	99
6-16.	Voltage Distribution in Radio Set 618S-1 and 618S-1A	99
6-17.	Primary Voltage Distribution	99
6-21.	B-Plus Voltage Distribution	101
6-24.	Voltage and Resistance Measurements	101
6-25.	Trouble Isolation Tables	102
6-27.	R-F Crystal Oscillator Subassembly	102
6-28.	Autopositioner System	103
6-29.	Tuner Subassembly	106
6-31.	Power Amplifier Subassembly	108
6-32.	Modulator Subassembly	109
6-33.	I-F Amplifier Subassembly	110
6-34.	Audio Amplifier Subassembly	111
6-35.	250 Kc Oscillator and BFO Subassembly	112
6-36.	Relay Subassembly	113
6-41.	Tuner and PA Servo Amplifier Subassemblies	114
6-44.	Power Supply 416W-1	114
6-45.	Radio Set Control 614C-2	117
6-46.	Alignment Procedure	118
6-48.	Alignment Equipment	118
6-49.	Test Set 478H-1	118
6-50.	Maintenance Kit for 618S-1	118
6-51.	Extension Cables	119
6-52.	Gauge Block and Dial Gauge	119
6-53.	Alignment of R-F Crystal Oscillator Subassembly	119
6-55.	Autopositioner Relay Adjustment	119
6-56.	Autopositioner Relay Replacement and Adjustment	119
6-57.	Switch Alignment	121
6-58.	Alignment of 250 Kc Oscillator and BFO Subassembly	121
6-60.	250 Kc Oscillator Adjustment	122
6-61.	BFO Adjustment	123
6-62.	Alignment of Tuner Subassembly	123
6-64.	Coupler and Switch Adjustments, 618S-1	123
6-65.	Coupler and Switch Adjustments, 618S-1A	126
6-66.	Tuning Rack Adjustments	127
6-67.	Tuner Discriminator Adjustments	128
6-68.	Variable I-F Adjustments	129
6-69.	Band 3 Multiplier Adjustments	129
6-70.	Band 4 Multiplier Adjustments	129
6-71.	R-F and Driver Adjustments	129
6-72.	Antenna Adjustments	130
6-73.	AGC Adjustments	130
6-74.	Power Amplifier Subassembly	131
6-76.	Switch Alignment and Adjustments	131
6-77.	Roller Coil Adjustments	132
6-78.	PA Discriminator Adjustments	132
6-79.	I-F Amplifier Subassembly	133
6-81.	Tuned Circuit Adjustments	133
6-82.	I-F Gain Adjustments	133
6-83.	Modulator Subassembly	134
6-85.	Gain and Clipping Adjustments	134
6-86.	Radio Set Control 614C-2	134
6-88.	Switch Alignment	134

TABLE OF CONTENTS (Cont)

Section			Page
	6-89.	Conversion of 618S-1 to 618S-1A.	135
	6-91.	Interchangeability	135
	6-92.	Conversion Processes	135
	6-93.	Shaft Length Reductions	135
	6-94.	Installation of Oldham Couplers	137
	6-95.	Reinstallation Procedures	137
	6-96.	Final Adjustments	138
	6-98.	Adjustment of Audio Control (R109)	140
	6-99.	Adjustment of CW Sidetone Control (R107)	140
	6-100.	Adjustment of Phone Sidetone Control (R106)	140
	6-101.	Adjustment of Threshold Control (R2602)	140
VII	**DIAGRAMS**		**143**
	7-1.	Wire Code Legend	143
VIII	**DIFFERENCE DATA SHEETS**		**167**
	8-1.	Introduction	167
APPENDIX A	**INDEX**		**A-1**

LIST OF ILLUSTRATIONS

Figure		Page
1-1.	Radio Set 618S-1 and 618S-1A, Equipment Supplied	x
1-2.	Radio Receiver-Transmitter 618S-1 and 618S-1A, Front Oblique View	5
1-3.	Radio Receiver-Transmitter 618S-1 and 618S-1A, Top View, Cover Removed	6
1-4.	Mounting 350S-1 and 350S-3, Front Oblique View	7
1-5.	Power Supply 416W-1, Left Oblique View	8
1-6.	Mounting 350T-1, Left Oblique View	8
1-7.	Automatic Antenna Tuner 180L-3, Left Oblique View	9
1-8.	Mounting 350D-3, Left Oblique View	9
1-9.	Radio Set Control 614C-2, Front Oblique View	10
2-1.	Dummy Microphone Circuit, Schematic Diagram	18
2-2.	Radio Set 618S-1 and 618S-1A, System Cabling	20
2-3.	Assembly of Connector UG-21B/U to Coaxial Cable	21
2-4.	Assembly of Connector UG-88/U to Coaxial Cable	22
2-5.	Cable Assembly, 20 Terminal	23
2-6.	Cable Assembly, 15 Terminal	23
2-7.	Cable Assembly, 11 Terminal	24
2-8.	Cable Assembly, 9 Terminal	24
2-9.	Cable Assembly, 7 Terminal	24
3-1.	Radio Set 618S-1 and 618S-1A, Test Bench Setup	26
3-2.	Oscilloscope Modulation Pattern	28
3-3.	Radio Receiver-Transmitter 618S-1 and 618S-1A, Modulation Characteristics	29
3-4.	Radio Set 618S-1 and 618S-1A, Typical System Installation	31
4-1.	Radio Set 618S-1 and 618S-1A, Transmitter Section Block Diagram	34
4-2.	R-F Crystal Oscillator, Simplified Schematic Diagram	36
4-3.	First Transmitter Mixer and 250 Kc Oscillator, Simplified Schematic Diagram	37
4-4.	Variable I-F Amplifier, Simplified Schematic Diagram	37
4-5.	Second Transmitter Mixer and Multiplier, Simplified Schematic Diagram	38
4-6.	Second R-F Amplifier and Drivers, Simplified Schematic Diagram	39
4-7.	Power Amplifier, Simplified Schematic Diagram	41
4-8.	Audio Amplifiers and Clipper, Simplified Schematic Diagram	42
4-9.	Audio Drivers and Modulators, Simplified Schematic Diagram	44
4-10.	Side-Tone Circuit, Simplified Schematic Diagram	45
4-11.	Radio Set 618S-1 and 618S-1A, Receiver Section, Block Diagram	46
4-12.	Receiver R-F Amplifiers, Simplified Schematic Diagram	48
4-13.	Receiver Mixers and Variable I-F Amplifier, Simplified Schematic Diagram	49
4-14.	Receiver Multiplier Circuits, Simplified Schematic Diagram	50
4-15.	Fixed I-F Input Circuit, Simplified Schematic Diagram	51
4-16.	Mechanical Filter, Functional Diagram	51
4-17.	I-F Amplifiers, Simplified Schematic Diagram	52
4-18.	Detector, Noise Limiter, and AVC Stages, Simplified Schematic Diagram	53
4-19.	Receiver Audio Amplifiers, Simplified Schematic Diagram	53
4-20.	Beat-Frequency Oscillator, Simplified Schematic Diagram	54
4-21.	AGC and AVC Circuits, Simplified Schematic Diagram	56
4-22.	Typical Autopositioner System, Simplified Schematic Diagram	57
4-23.	Autopositioner Sequence of Operation (Step 1 of 13 steps)	59
4-23.	Autopositioner Sequence of Operation (Step 2 of 13 steps)	59
4-23.	Autopositioner Sequence of Operation (Step 3 of 13 steps)	60
4-23.	Autopositioner Sequence of Operation (Step 4 of 13 steps)	60
4-23.	Autopositioner Sequence of Operation (Step 5 of 13 steps)	61
4-23.	Autopositioner Sequence of Operation (Step 6 of 13 steps)	61
4-23.	Autopositioner Sequence of Operation (Step 7 of 13 steps)	62
4-23.	Autopositioner Sequence of Operation (Step 8 of 13 steps)	62
4-23.	Autopositioner Sequence of Operation (Step 9 of 13 steps)	63
4-23.	Autopositioner Sequence of Operation (Step 10 of 13 steps)	63

LIST OF ILLUSTRATIONS (Cont)

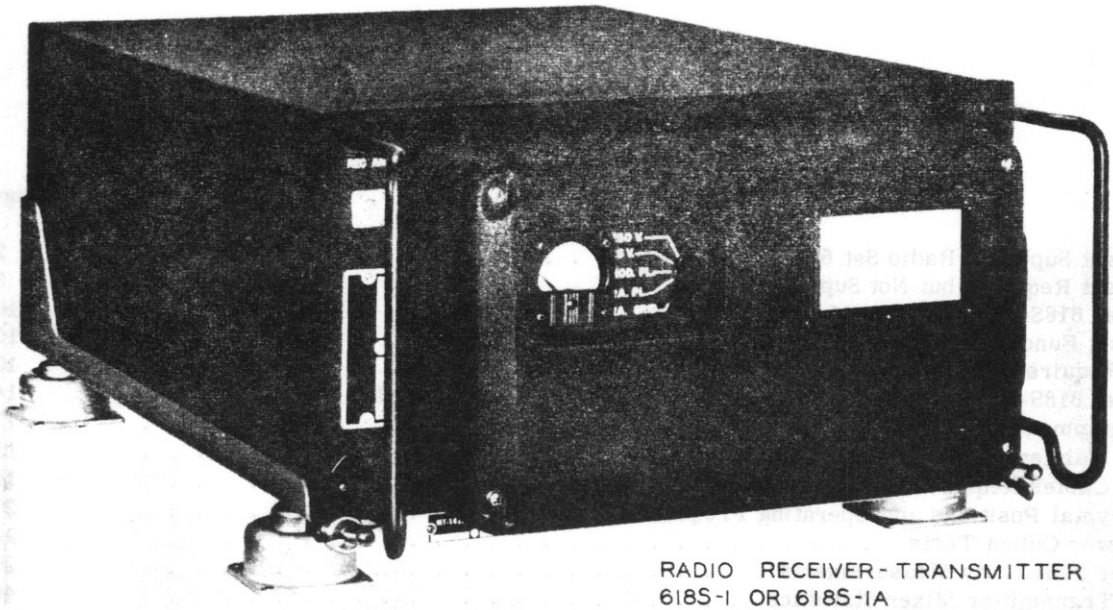
Figure		Page
4-23.	Autopositioner Sequence of Operation (Step 11 of 13 steps)	64
4-23.	Autopositioner Sequence of Operation (Step 12 of 13 steps)	64
4-23.	Autopositioner Sequence of Operation (Step 13 of 13 steps)	65
4-24.	Tuner Table Centering Circuit, Simplified Schematic Diagram	66
4-25.	Tuner Discriminator and Servomotor B102, Simplified Schematic Diagram	67
4-26.	Tuner Servo Amplifier Subassembly and Servomotor B102, Simplified Schematic Diagram	68
4-27.	Rate Bridge, Functional Diagram	69
4-28.	Inductor L1502, Approximate Tuning Ranges, Functional Diagram	69
4-29.	Power Amplifier Band Centering Circuit, Simplified Schematic Diagram (Step 1 of 4 steps)	70
4-29.	Power Amplifier Band Centering Circuit, Simplified Schematic Diagram (Step 2 of 4 steps)	70
4-29.	Power Amplifier Band Centering Circuit, Simplified Schematic Diagram (Step 3 of 4 steps)	71
4-29.	Power Amplifier Band Centering Circuit, Simplified Schematic Diagram (Step 4 of 4 steps)	71
4-30.	Gain and BFO Control Circuits, Simplified Schematic Diagram	73
5-1.	Radio Receiver-Transmitter 618S-1 and 618S-1A, Filament Circuit	82
5-2.	Blower Motor B101, Lubrication Points	92
5-3.	Bandchange Autopositioner Unit, Lubrication Points	92
5-4.	Servomotor B102 Unit, Lubrication Points	92
5-5.	Tuner Subassembly, Front Oblique View, Lubrication Points	93
5-6.	Tuner Subassembly, Rear Oblique View, Lubrication Points	94
5-7.	Power Amplifier Subassembly, Lubrication Points	95
5-8.	R-F Crystal Oscillator Subassembly, Right Side View, Lubrication Points	96
5-9.	R-F Crystal Oscillator Subassembly, Bottom Oblique View, Lubrication Points	96
6-1.	Radio Set 618S-1 and 618S-1A, Voltage Distribution	100
6-2.	R-F Crystal Oscillator Subassembly, Right Side View, Switch Alignment Points	120
6-3.	R-F Crystal Oscillator Subassembly, Correct Switch Alignment	120
6-4.	250 Kc Oscillator and BFO Subassembly, Right Side View, Alignment Points	121
6-5.	Tuner Subassembly, Bottom View, Switch and Tube Location	122
6-6.	Tuner Subassembly, Right Side View, Switch and Coupler Location	123
6-7.	Tuner Subassembly, Switch and Coupler Alignment	124
6-8.	Tuner Subassembly, Mechanical Alignment Points	125
6-9.	Tuner Subassembly, Dial Gauge in Place	126
6-10.	Tuner Subassembly, Electrical Alignment Points	127
6-11.	Power Amplifier Subassembly, Left Oblique View, Mechanical Alignment Points	131
6-12.	Power Amplifier Subassembly, Switch and Coupler Alignment	132
6-13.	Power Amplifier Subassembly, Alignment of Switch S1504	133
6-14.	Radio Set Control 614C-2, Bottom View, Cover Removed	134
6-15.	Radio Set Control 614C-2, Correct Switch Alignment	135
6-16.	Oldham and Pin-Type Couplers, Front and Side Views	136
6-17.	Installation of Oldham Couplers on Servomotor B102 Unit	136
6-18.	Installation of Oldham Couplers on Bandchange Autopositioner Unit	138
6-19.	Installation of Oldham Couplers on Tuner Subassembly	139
6-20.	Installation of Oldham Couplers on Power Amplifier Subassembly	139
6-21.	Radio Receiver-Transmitter 618S-1 and 618S-1A, Front View with Cover Removed, Test and Alignment Point Location	140
6-22.	Radio Receiver-Transmitter 618S-1 and 618S-1A, Top View with Cover Removed, Test and Alignment Point Location	141
6-23.	Radio Receiver-Transmitter 618S-1 and 618S-1A, Bottom View with Cover Removed, Test and Alignment Point Location	142
7-1.	R-F Crystal Oscillator Subassembly, Tube Voltage and Resistance Diagram	144

LIST OF ILLUSTRATIONS (Cont)

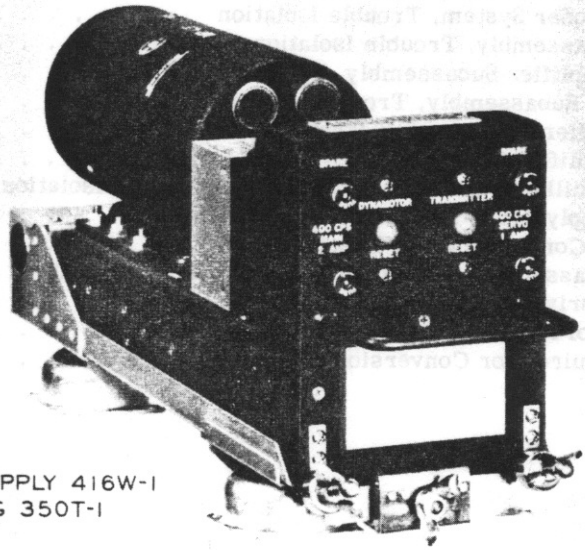
Figure		Page
7-2.	250 Kc Oscillator and BFO Subassembly, Tube Voltage and Resistance Diagram	144
7-3.	Tuner Subassembly, Tube Voltage and Resistance Diagram	145
7-4.	Power Amplifier Subassembly, Tube Voltage and Resistance Diagram	146
7-5.	Modulator Subassembly, Tube Voltage and Resistance Diagram	146
7-6.	I-F Amplifier Subassembly, Tube Voltage and Resistance Diagram	147
7-7.	Audio Amplifier Subassembly, Tube Voltage and Resistance Diagram	147
7-8.	Tuner and PA Servo Amplifier Subassemblies, Tube Voltage and Resistance Diagram	148
7-9.	Relay Subassembly, Tube Voltage and Resistance Diagram	148
7-10.	Radio Receiver-Transmitter 618S-1 or 618S-1A and Mounting 350S-1 or 350S-3, Outline and Mounting Dimensions	149
7-11.	Power Supply 416W-1 and Mounting 350T-1, Outline and Mounting Dimensions	150
7-12.	Automatic Antenna Tuner 180L-3 and Mounting 350D-3, Outline and Mounting Dimensions	151/152
7-13.	Radio Set Control 614C-2, Outline and Mounting Dimensions	153/154
7-14.	Tuner and Power Amplifier Subassemblies, Mechanical Functional Diagram	155/156
7-15.	Radio Set 618S-1 and 618S-1A, External Wiring Diagram	157/158
7-16.	Power Supply 416W-1, Schematic Diagram	159/160
7-17.	Radio Set Control 614C-2, Schematic Diagram	161/162
7-18.	Filter Unit, Schematic Diagram	163
7-19.	Radio Receiver-Transmitter 618S-1 and 618S-1A, Schematic Diagram	164/165

LIST OF TABLES

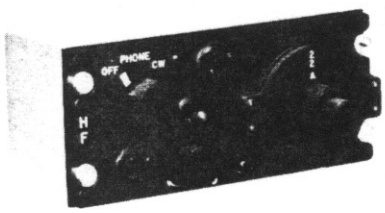
Table		Page
I	Equipment Supplied, Radio Set 618S-1 and 618S-1A	2
II	Equipment Required but Not Supplied	3
III	Radio Set 618S-1A, Effective Mod Numbers	10
IV	Operating Function of Controls	10
V	Power Requirements	13
VI	Radio Set 618S-1 and 618S-1A, Tube and Indicator Lamp Complement	14
VII	Test Equipment Required	17
VIII	Special Maintenance Tools, Equipment Supplied	19
IX	Special Cables Required for Maintenance Procedures	19
X	Test Crystal Positions and Operating Frequencies	27
XI	R-F Power Output Tests	28
XII	Receiver Sensitivity Measurements	30
XIII	Second Transmitter Mixer Statistics	40
XIV	First and Second Receiver Mixer Statistics	50
XV	System Trouble Analysis	83
XVI	Lubrication of Equipment	91
XVII	D-C Resistance Values of Transformers and Inductors	101
XVIII	R-F Crystal Oscillator Subassembly, Trouble Isolation	103
XIX	Autopositioner System, Trouble Isolation	103
XX	Tuner Subassembly, Trouble Isolation	106
XXI	Power Amplifier Subassembly, Trouble Isolation	108
XXII	Modulator Subassembly, Trouble Isolation	109
XXIII	I-F Amplifier Subassembly, Trouble Isolation	110
XXIV	Audio Amplifier Subassembly, Trouble Isolation	111
XXV	250 Kc Oscillator and BFO Subassembly, Trouble Isolation	112
XXVI	Power Supply 416W-1, Trouble Isolation	115
XXVII	Radio Set Control 614C-2, Trouble Isolation	117
XXVIII	Tuner Subassembly, Slug Rack Linearity Measurements	128
XXIX	R-F and Driver Adjustments, Bands 2, 3, and 4	130
XXX	Selection of R1006	130
XXXI	Parts Required for Conversion of 618S-1 to 618S-1A	137



RADIO RECEIVER-TRANSMITTER
618S-1 OR 618S-1A
MOUNTING 350S-1 OR 350S-3



POWER SUPPLY 416W-1
MOUNTING 350T-1



RADIO SET CONTROL 614C-2

Figure 1-1. Radio Set 618S-1 and 618S-1A, Equipment Supplied

INTRODUCTION

This service handbook is prepared for use by organizational and field maintenance personnel as an aid in understanding and performing installation, maintenance, and service procedures for Radio Set 618S-1 and 618S-1A. Repair, replacements, adjustments, and recalibration data for the electronic equipment is limited to that capable of being performed by organizational and field maintenance activities using common tools, test equipment, and spare parts authorized in allowance lists and those specialized tools and test equipment listed in section II of this handbook. For further information concerning any detail part in this equipment, reference is made to T.O. 12R2-4-6-4, Illustrated Parts Breakdown, Radio Set 618S-1 and 618S-1A. This handbook is compiled and printed in accordance with Specifications MIL-H-6757A(ASG) and MIL-H-5474A, and conforms to applicable portions of the following specifications:

JAN-STD-15	Electrical and Electronic Symbols
MIL-STD-15	Electrical and Electronic Reference Designations
MIL-STD-122	Color Code for Chassis Wiring for Electronic Equipment
ANA 261	Abbreviations and Contractions; Approved List of

SECTION I
DESCRIPTION AND LEADING PARTICULARS

1-1. SCOPE OF HANDBOOK.

1-2. This publication comprises service instructions for Radio Set 618S-1, manufactured and supplied under Contracts AF 33(600)-26685 and AF 33(600)-29240 and Radio Set 618S-1A, manufactured and supplied under Contracts AF 33(600)-31045, AF 33(600)-31894, AF 33(600)-32978, AF 33(600)-33900, AF 33(600)-36629, AF 33(600)-37770, AF 33(600)-38251, and AF 33(600)-40935. Sections I through VII of this handbook apply to Radio Set 618S-1 and 618S-1A. Additional models will be covered in section VIII by the use of Difference Data Sheets.

NOTE

This handbook contains service instructions for Radio Set 618S-1, supplied under Contracts AF 33(600)-26685 and AF 33(600)-29240, and Radio Set 618S-1A, supplied under Contracts AF 33(600)-31045, AF 33(600)-31894, AF 33(600)-32978, AF 33(600)-33900, AF 33(600)-36629, AF 33(600)-37770, AF 33(600)-38251, and AF 33(600)-40935. The change of coupling devices on the power amplifier and tuner subassemblies and the bandchange autopositioner and servomotor B102 units from pin-type couplers to Oldham-type couplers necessitated the change in nomenclature from 618S-1 to 618S-1A. Since some units of equipment employing Oldham-type couplers were delivered on Contract AF 33(600)-29240 with 618S-1 name plates, it will be necessary to refer to subassembly MOD stamping to identify the type of coupler in use. The coupler change is effective with serial number 1755 on Contract AF 33(600)-29240 and subassemblies affected are stamped: servomotor B102 unit MOD 1; bandchange autopositioner unit MOD 2; tuner subassembly MOD 7; and power amplifier subassembly MOD 3.

1-3. PURPOSE AND APPLICATION OF EQUIPMENT.

1-4. Radio Set 618S-1 and 618S-1A are designed to provide transmitting and receiving facilities between aircraft and ground station, or between aircraft, within the frequency range of 2 to 25 megacycles. A highly flexible system permits the selection of 144 crystal-controlled frequencies incorporating the use of a common crystal for transmitting and receiving. Two modes of operation are provided, radiotelephone (A-3) and radiotelegraph (A-1). The mode of operation and frequency are selected by the pilot or copilot by operation of Radio Set Control 614C-2. Provision is made in both the 618S-1 and the 618S-1A for adaption to fsk (radioteletype) transmission and reception.

1-5. The 618S-1 and 618S-1A normally is used with Automatic Antenna Tuner 180L-2/3. The 180L-2/3 is designed for automatic tuning of open, fixed-wire antennas between 45 and 100 feet in length. The 52-ohm output of the 618S-1 or 618S-1A is matched automatically to the fixed-wire antenna following rotation of the channel selector knobs of Radio Set Control 614C-2.

1-6. Circuitry is included within the 618S-1 and 618S-1A which automatically tunes both the receiver and transmitter circuits to frequencies determined by selected crystals. No adjustments or tuning procedures are necessary when a new transmitting-receiving frequency is desired.

1-7. EQUIPMENT SUPPLIED.

1-8. Equipment supplied with Radio Set 618S-1 and 618S-1A is illustrated in figure 1-1 and listed in table I.

TABLE I. EQUIPMENT SUPPLIED, RADIO SET 618S-1 AND 618S-1A

QUANTITY PER EQUIPMENT	NAME OF UNIT	AN TYPE DESIGNATION	OVER-ALL DIMENSIONS (INCHES)			WEIGHT (LB)	NUMERICAL SERIES OF REFERENCE SYMBOLS
			LENGTH	WIDTH	HEIGHT		
1	Radio Receiver-Transmitter	618S-1 or 618S-1A	23-7/16	15-7/16	7-25/32	55.0	101-499 601-699 801-1599
1*	Mounting	350S-1	25-3/16	16-3/8	6-13/16	9.0	1801-1899
1*	Mounting	350S-3	25-3/16	16-3/8	6-13/16	9.0	1801-1899
1	Power Supply	416W-1	18-1/16	4-7/8	6-3/4	22.0	1601-1699
1	Mounting	350T-1	17-9/16	5-7/8	3-15/16	4.0	1701-1799
1	Radio Set Control	614C-2	4-9/16	5-3/4	2-19/32	1.75	2601-2699

*Alternate components in a normal installation.

Crystal positions and operating frequencies (in kc). Crystals supplied with Contract AF 33(600)-26685.

A-1	2868.0	B-1	4724.5	B-12	6730.5	C-8	13215.5
A-2	2910.0	B-2	4731.5	B-13	6738.0	C-9	13245.5
A-3	2931.0	B-3	5551.5	B-14	6753.0	C-10	13264.5
A-4	3023.5	B-4	5611.5	B-15	6760.5	C-11	13354.5
A-5	3032.0	B-5	5626.5	C-1	8871.0	C-12	8364.0
A-6	3095.0	B-6	5641.5	C-2	8888.0	D-1	15016.0
A-7	3137.0	B-7	5649.0	C-3	8913.5	D-2	15036.0
A-8	3144.0	B-8	5671.5	C-4	8930.5	D-3	17966.5
A-9	3432.5	B-9	5680.0	C-5	8947.5	D-4	17975.0
A-10	3446.5	B-10	5710.5	C-6	11180.5	D-5	17993.5
A-11	3481.5	B-11	6552.0	C-7	11228.0		

Crystal positions and operating frequencies (in kc). Crystals supplied with Contracts AF 33(600)-29240, AF 33(600)-31045, AF 33(600)-31894, AF 33(600)-32978, AF 33(600)-33900, AF 33(600)-36629, AF 33(600)-37770, AF 33(600)-38251, and AF 33(600)-40935.

A-1	3023.5	A-15	3481.5	A-24	3404.5	B-14	3453.5
A-3	2980.0	A-16	3467.5	B-1	5680.0	B-15	5551.5
A-5	3067.0	A-17	2966.0	B-3	5574.0	B-16	5604.0
A-6	3137.0	A-18	2987.0	B-4	4724.5	B-17	5506.5
A-7	3144.0	A-19	2931.0	B-5	4731.5	B-18	5521.5
A-11	2945.0	A-20	2889.0	B-7	5710.5	B-19	2973.0
A-12	2868.0	A-21	2952.0	B-11	5641.5	B-20	4696.5
A-13	2910.0	A-22	5499.0	B-12	5626.5	B-21	5619.0
A-14	2854.0	A-23	5611.5	B-13	4689.5	B-22	5566.5

TABLE I. EQUIPMENT SUPPLIED, RADIO SET 618S-1 AND 618S-1A (Cont)

Crystal positions and operating frequencies (in kc). Crystals supplied with Contracts AF 33(600)-29240, AF 33(600)-31045, AF 33(600)-31894, AF 33(600)-32978, AF 33(600)-33900, AF 33(600)-36629, AF 33(600)-37770, AF 33(600)-38251, and AF 33(600)-40935.

B-23	6612.0	C-20	6664.5	D-22	6567.0	E-19	11356.5
B-24	3411.5	C-21	8837.0	D-23	8956.0	E-20	13314.5
C-1	4890.0	C-22	6537.0	D-24	5581.5	E-21	13294.5
C-3	8905.0	C-23	8845.5	E-2	10000.0	E-22	13344.5
C-4	6753.0	C-24	3432.5	E-3	5559.0	E-23	13284.5
C-5	6760.5	D-2	5000.0	E-4	15016.0	F-2	15000.0
C-6	6730.5	D-3	3001.0	E-5	15036.0	F-3	8828.5
C-7	6738.0	D-4	11180.5	E-6	13215.5	F-6	17975.0
C-11	5671.5	D-5	11228.0	E-7	13245.5	F-7	17993.5
C-12	8888.0	D-6	9026.5	E-11	13264.5	F-11	17996.5
C-13	6582.0	D-11	8862.5	E-12	13324.5	F-13	8364.0
C-14	5589.0	D-12	8913.5	E-13	11299.5	F-15	17926.5
C-15	8930.5	D-13	8871.0	E-15	13334.5	F-17	17906.5
C-16	8879.5	D-14	8854.0	E-16	13304.5	F-20	17916.5
C-18	8939.0	D-20	8820.0	E-17	13354.5	F-22	17946.5
C-19	5544.0	D-21	10021.0	E-18	13274.5		

NOTE

The frequencies listed correspond to the 618S-1 or 618S-1A operating frequencies and not the actual crystal frequencies. The listed operating frequencies are stamped on the top of each crystal supplied.

1-9. EQUIPMENT REQUIRED BUT NOT SUPPLIED.

1-10. Table II lists the equipment required for operation but not supplied as part of Radio Set 618S-1 or 618S-1A. When installed in the aircraft, the equipment will be connected to and used with auxiliary equipment generally similar to that listed in table II.

TABLE II. EQUIPMENT REQUIRED BUT NOT SUPPLIED

QUANTITY PER EQUIPMENT	NAME OF UNIT	AN TYPE DESIGNATION	REQUIRED CHARACTERISTICS
1	Automatic Antenna Tuner	180L-2 or 180L-3	Provides automatic matching and loading of antenna. (Refer to paragraph 3-7.)
1	Mounting	350D-3	Provides mounting facilities for 180L-2 or 180L-3.
1	Primary D-C Power Source		Refer to table VII.
1	Primary A-C Power Source		Refer to table VII.
1	Antenna	Typical long wire	Fixed wire, 45-100 feet long.

TABLE II. EQUIPMENT REQUIRED BUT NOT SUPPLIED (Cont)

QUANTITY PER EQUIPMENT	NAME OF UNIT	AN TYPE DESIGNATION	REQUIRED CHARACTERISTICS
1	R-F Cable between J110 of 180L-3 and J101 of 618S-1 or 618S-1A, W1	RG-8/U	Coaxial cable. Refer to figure 2-3.
1	R-F Cable between J103 of 180L-3 and J109 of 618S-1 or 618S-1A, W2	RG-58/U	Coaxial cable. Refer to figure 2-3.
1	Cable between J102 of 180L-3 and TB1801 of 618S-1 or 618S-1A, W3		Cable to be made up from stock. Refer to paragraph 2-8 and figures 2-2 and 7-15.
1	Cable between J1601 of 416W-1 and TB1801 of 618S-1 or 618S-1A, W4		Cable to be made up from stock. Refer to paragraph 2-8 and figures 2-2 and 7-15.
1	Cable between J2601 of 614C-2 and TB1801 of 618S-1 or 618S-1A, W5		Cable to be made up from stock. Refer to paragraph 2-8 and figures 2-2 and 7-15.
1	Cable between J1601 of 416W-1 and power source, W6.		Cable to be made up from stock. Refer to paragraph 2-8 and figures 2-2 and 7-15.
1	Connector, P110	UG-21D/U	Refer to figure 2-3 for assembly instructions.
1	Connector, P109	UG-88/U	Refer to figure 2-4 for assembly instructions.
1	Connector, P102	UG-201/U	Refer to T.O. 31R2-4-38-1.
1	Headset	H-1/AR or H-4/AR	300 ohms internal impedance.
1	Microphone	ANB-M-C1 or equal	Hand-held microphone with push-to-talk button.
1	Interphone Amplifier	AN/A1C-4 or equal	

1-11. GENERAL PRINCIPLES OF OPERATION.

1-12. Radio Set 618S-1 and 618S-1A are remotely controlled complete transmitting and receiving systems with all necessary control and mounting equipment. Radio Receiver-Transmitter 618S-1 and 618S-1A are the main system components, which are controlled remotely from the pilot's position with the use of Radio Set Control 614C-2. Any of 144 crystal-controlled frequencies may be selected by operation of Radio Set Control 614C-2, which activates the automatic channeling circuits of the 618S-1 or 618S-1A. Operation of the 614C-2 also energizes Automatic Antenna Tuner 180L-2/3, which correctly matches the 52-ohm output impedance to the aircraft antenna for any frequency within the range of 2 to 25 megacycles.

1-13. Basic frequencies within Radio Receiver-Transmitter 618S-1 and 618S-1A are generated by a temperature-compensated crystal oscillator, which maintains the radiated output signal to less ±0.007% error. The output from the r-f crystal oscillator subassembly is used as both a basic frequency standard and as a means of driving a servo system for tuning all of the low-level circuits. A total of four bands are employed within Radio Receiver-Transmitter 618S-1 and 618S-1A, thus lowering the number of crystals required for operation on the entire 144 channels. Unitized modular construction is employed throughout the 618S-1 and 618S-1A, greatly simplifying trouble-shooting and maintenance procedures.

1-14. All a-c and d-c power requirements of the 618S-1 or 618S-1A systems are satisfied by Power Supply 416W-1. Power Supply 416W-1 is designed to operate on the standard 27.5-volt d-c and 115-volt a-c power source of the aircraft. Overload protection is afforded with fuses and circuit breaker switches located on the 416W-1 front panel.

1-15. DESCRIPTION OF COMPONENTS.

1-16. RADIO RECEIVER-TRANSMITTER 618S-1 AND 618S-1A. Refer to figures 1-2 and 1-3. The main components of the 618S-1 and 618S-1A systems are enclosed in a single case and mounted on a single main chassis. The case is removable by rotating two Dzus fasteners located at the rear of the units and pulling the chassis forward. The main chassis and front panel, form the mounting base for a number of plug-in subassemblies. All these subassemblies, shown in figure 1-3, are removable from the top of the chassis. Captive hold-down screws retain the individual subassemblies in place. All electrical connections to the plug-in subassemblies are made through receptacles mounted on the main chassis. The connections to the Power Supply 416W-1 and Radio Set Control 614C-2 are made through two connectors, mounted in the rear of the main chassis, which mate jacks located on Mounting 350S-1. Two wing nuts at the front of Mounting 350S-1 or 350S-3 retain the 618S-1 or 618S-1A securely in place.

1-17. The front panel cover, which is secured by four screws, houses the blower motor (B101), side tone and volume controls, and the positioning and tuning mechanism needed for remote control of the 618S-1 or 618S-1A main components. Individual plug-in units which require mechanical linkage to each other or to the front panel are built with quick disconnect, pin-type or Oldham couplers to allow removal

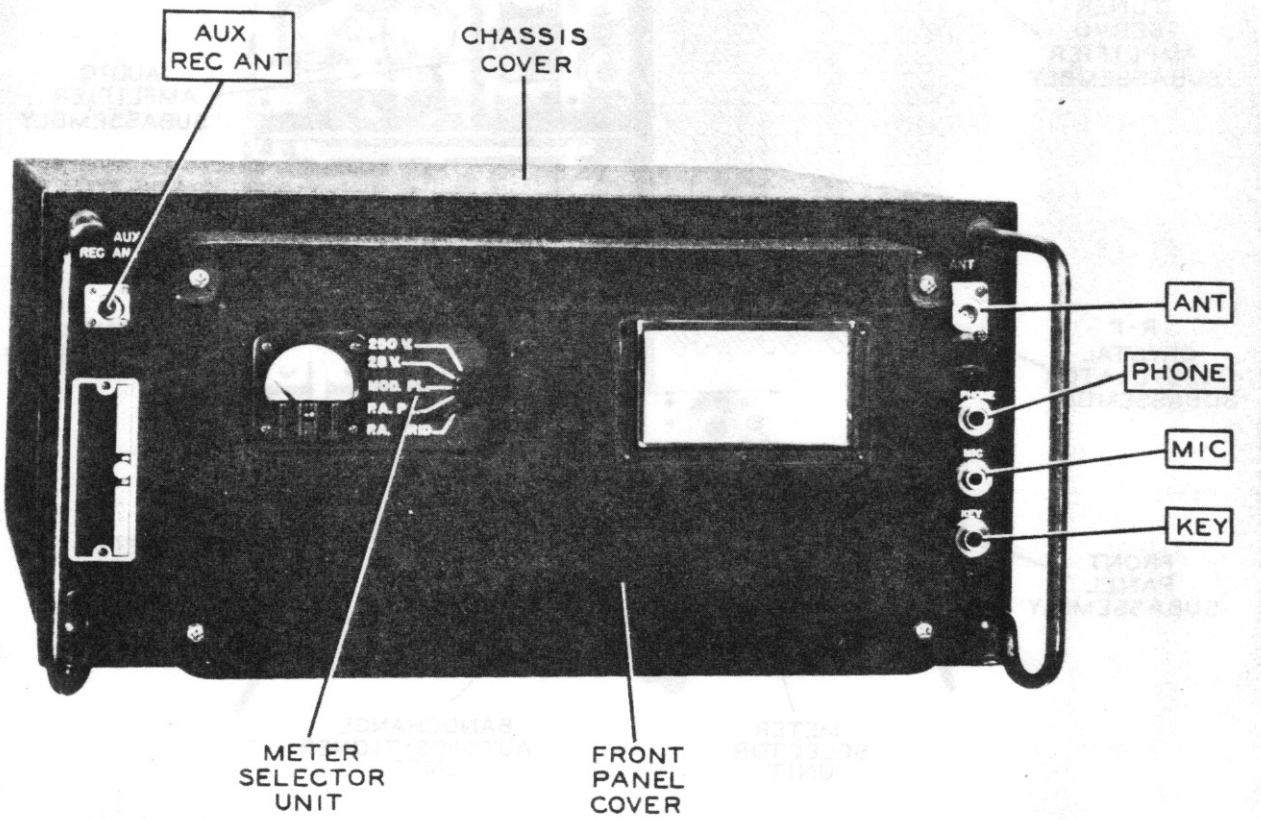


Figure 1-2. Radio Receiver-Transmitter 618S-1 and 618S-1A, Front Oblique View

of the units from the main chassis. Once these linkages are synchronized, it is possible to remove and replace units without additional mechanical alignment. A blower (B101), located on the front panel, draws air in through a filter and distributes the air to various parts of the equipment. The direction of airflow is determined by the positioning of holes in various portions of the chassis. Located on the front panel, in addition, are the MIC, PHONE, and KEY jacks, the ANT and AUX REC ANT terminals, and a meter showing the following switch positions; 250 V., 28 V., MOD. PL., P.A. PL., and P.A. GRID.

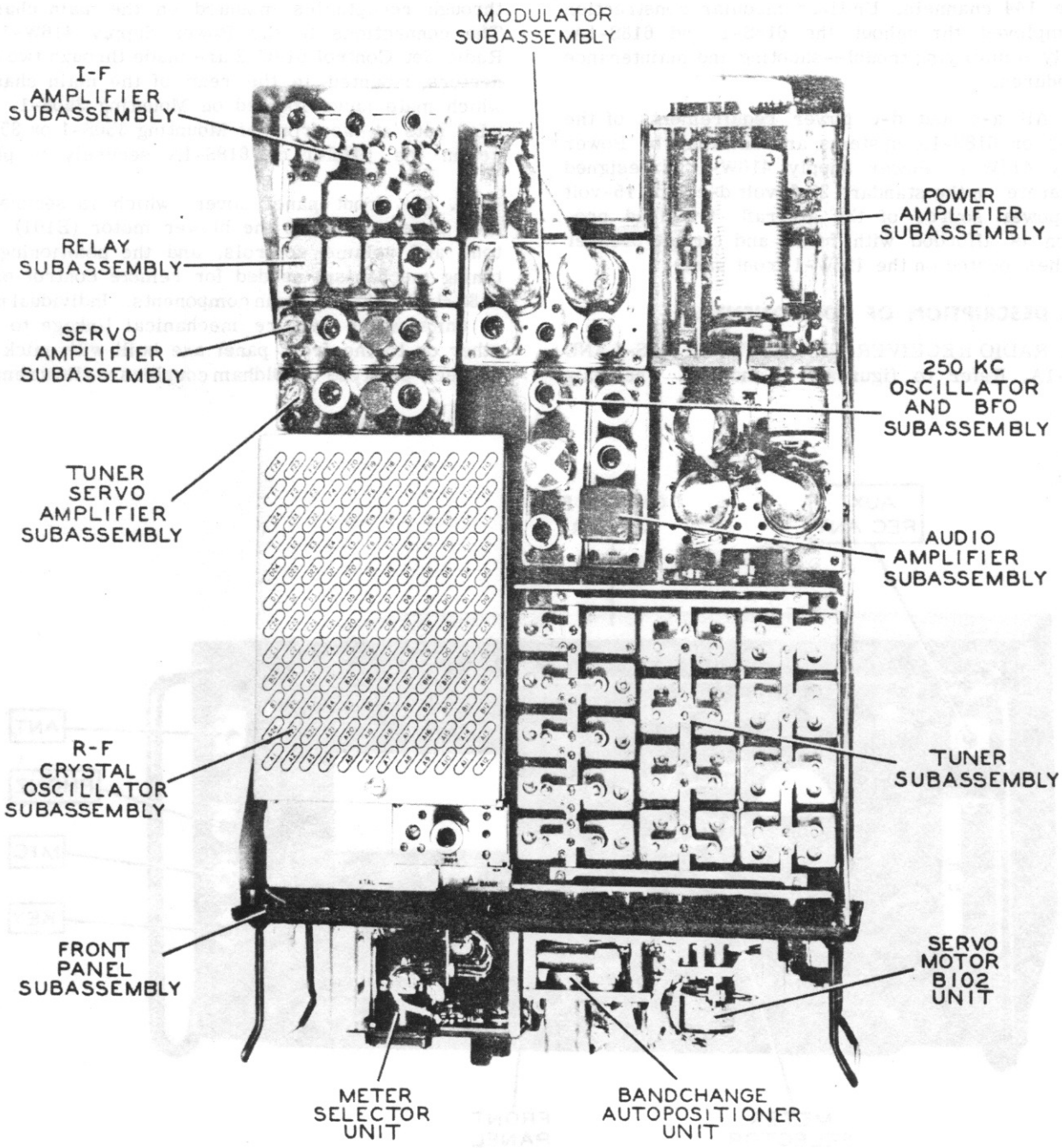


Figure 1-3. Radio Receiver-Transmitter 618S-1 and 618S-1A, Top View, Cover Removed

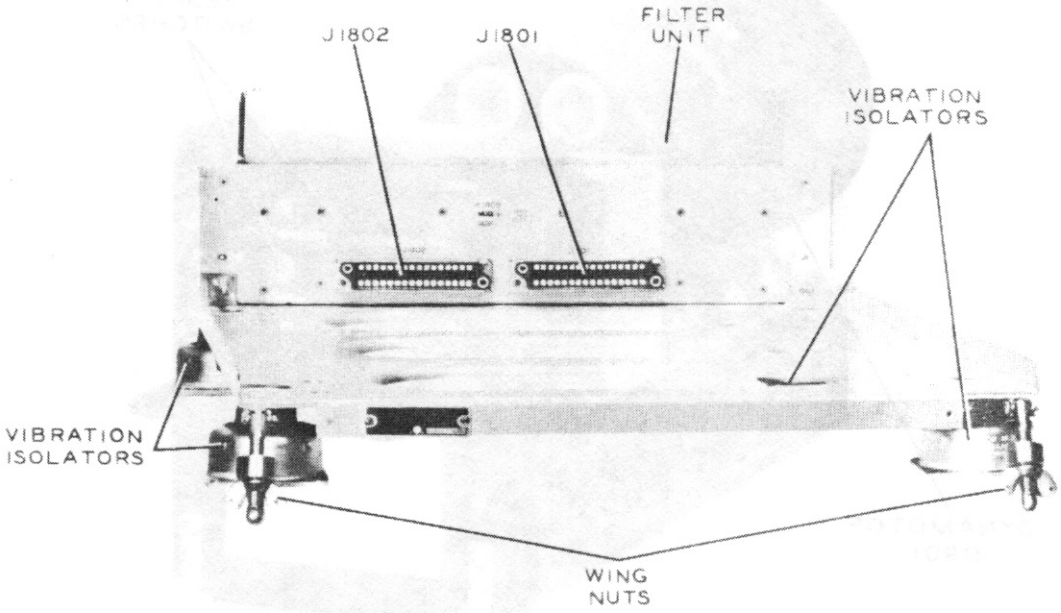


Figure 1-4. Mounting 350S-1 and 350S-3, Front Oblique View

1-18. MOUNTING 350S-1 AND 350S-3. Refer to figure 1-4. Mounting 350S-3 is identical to Mounting 350S-1 in appearance, weight, and mounting dimensions. The difference between the two units is in the method of removal of the filter unit. The filter unit of the 350S-3 is removable from both the front and top; whereas, it is removable only from the top in the 350S-1. The 350S-3 is, therefore, the preferred mounting, since additional space need not be allowed at the top of the 618S-1 or 618S-1A for removal and replacement of the filter unit. Vibration isolators and grounding straps are included on both mountings to assure vibration-free operation and good electrical contact.

1-19. POWER SUPPLY 416W-1 AND MOUNTING 350T-1. Power Supply 416W-1, figure 1-5, consists of a main chassis, a dynamotor, front panel, and associated detail parts. Power Supply 416W-1 provides 250 volts d-c, 600 volts d-c, 115 volts a-c, 18 volts a-c, 6.3 volts a-c, negative 65 volts d-c, and negative 50 volts d-c for operation of the 618S-1 and 618S-1A systems. Two fuses and two circuit breaker switches, each located on the 416W-1 front panel, afford overload protection. Power Supply 416W-1 is designed to mount on Mounting 350T-1, illustrated in figure 1-6.

1-20. AUTOMATIC ANTENNA TUNER 180L-2/3 AND MOUNTING 350D-3. Automatic Antenna Tuner 180L-2/3, figure 1-7, is enclosed in a single aluminum case, secured to the main mounting frame by machine screws. Power and control connections are made through a multicontact fixed plug (P102) at the lower right of the mounting frame. The plug extends through a front panel cutaway area, as does the 52-ohm transmitter plug (P101). An SWR indicator is located adjacent to the r-f line connector and is viewed through a cutaway area. The antenna and auxiliary receiver connectors are located on a molded Fiberglas terminal at the upper right of the 180L-2/3 front panel. The entire 180L-2/3 component is retained on Mounting 350D-3 (see figure 1-8). Knurled fasteners at the front of the 350D-3 tighten clamps into a flange on the 180L-2/3 base plate to assure shakeproof installation. Complete service instructions for both the 180L-2/3 and the 350D-3 are included in the Handbook Service Instructions, T.O. 31R2-4-38-2. These instructions will not be repeated. All references to 180L-3 apply equally to 180L-2 except where noted. For complete information on Antenna Tuner 180L-2/3, refer to Handbook Service Instructions, Automatic Antenna Tuner 180L-2, 180L-3, T.O. 12R2-4-8-2.

1-21. RADIO SET CONTROL 614C-2. Refer to figure 1-9. Radio Set Control 614C-2 is designed to provide complete remote operation of the 618S-1 or 618S-1A systems. Provision is made for channel selection, gain control, bfo control, function selection, and tuning indication. A plastic front panel is included, which is edge lighted by two lamps to provide illumination of the switches and controls.

1-22. DIFFERENCE BETWEEN RADIO SET 618S-1 AND RADIO SET 618S-1A.

1-23. The difference between Radio Set 618S-1 and Radio Set 618S-1A is the type of couplers used within

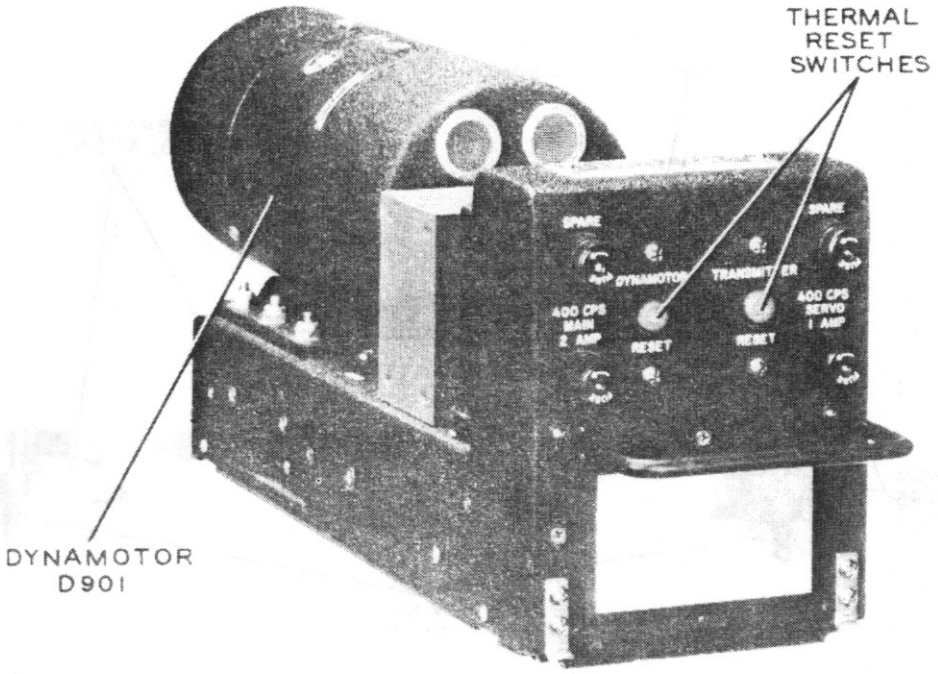


Figure 1-5. Power Supply 416W-1, Left Oblique View

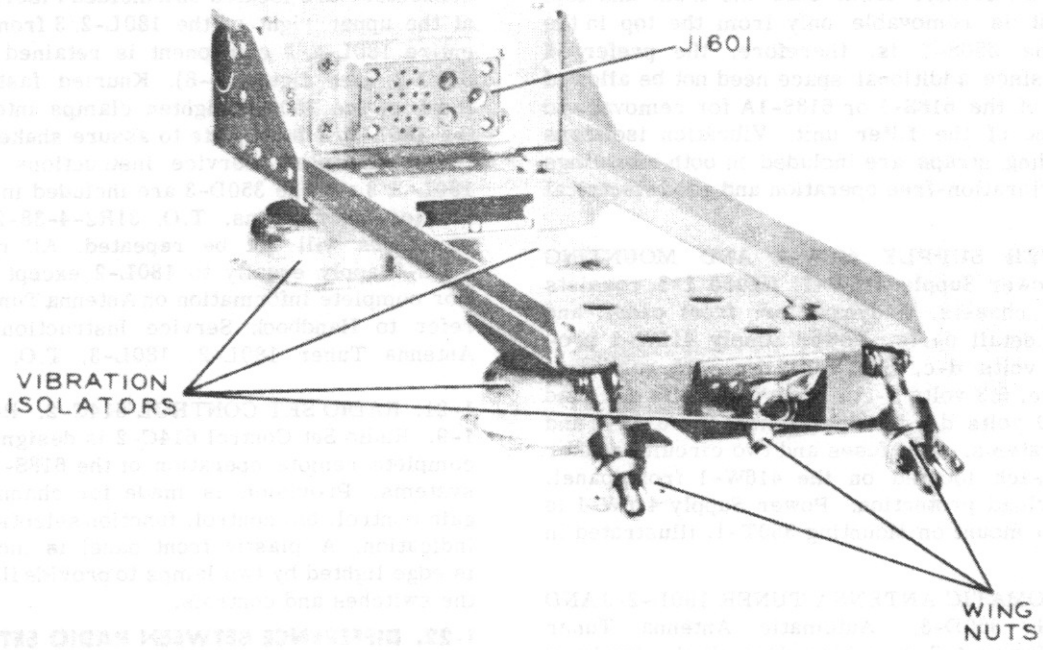


Figure 1-6. Mounting 350T-1, Left Oblique View

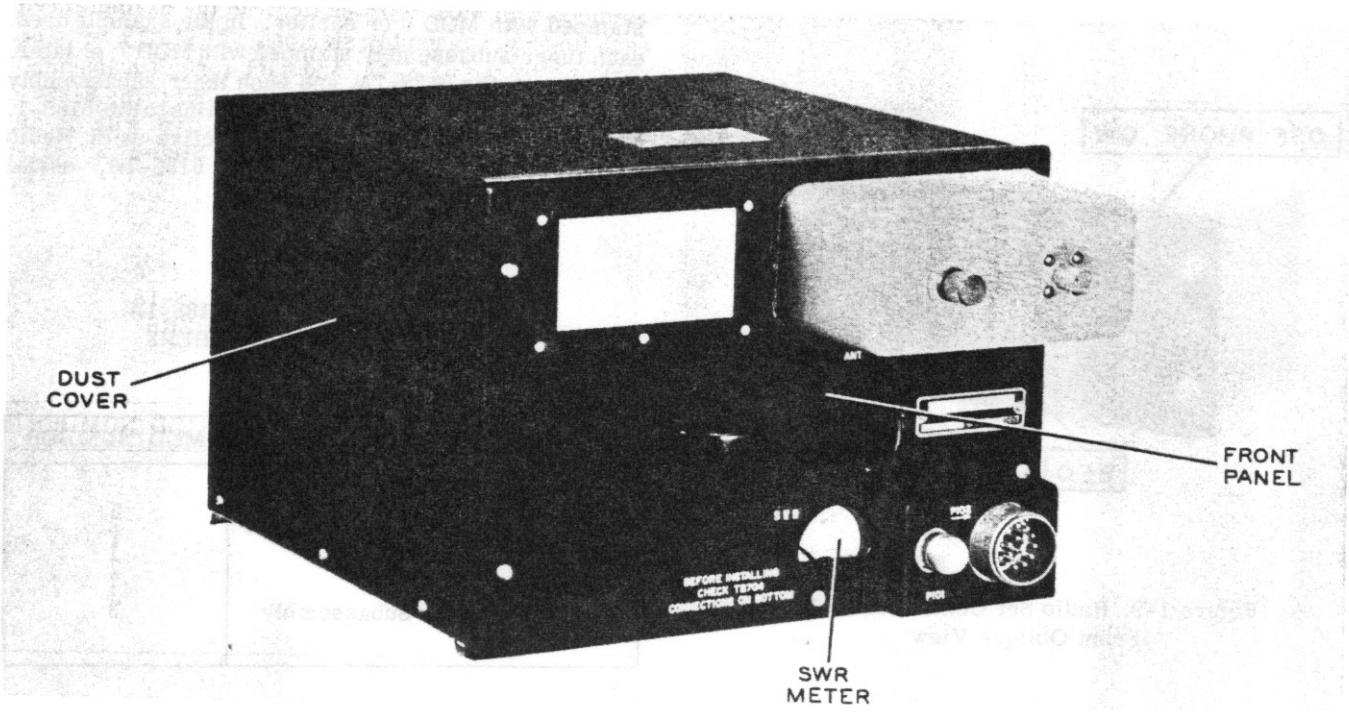


Figure 1-7. Automatic Antenna Tuner 180L-3, Left Oblique View

the main components. Radio Receiver-Transmitter 618S-1 employs pin-type couplers for the two drive motors (B102 and B103) and the tuner and power amplifier subassemblies. Radio Receiver-Transmitter 618S-1A uses Oldham couplers for these units. Oldham couplers eliminate the switch alignment problems inherent with pin-type couplers, and also are more rugged and easier to position. Paragraphs 6-88 through 6-94 of this handbook outline the method of converting Radio Receiver-Transmitter 618S-1 into Radio Receiver-Transmitter 618S-1A. Four units of the 618S-1 are affected by the change to 618S-1A. These are the bandchange autopositioner unit, the servomotor B102 unit, the tuner subassembly, and the power amplifier subassembly. These units are stamped with MOD numbers on each chassis. These MOD numbers correspond to various modifications of each unit. Table III lists the MOD numbers of each unit affected by the coupler change. Any units which are stamped with the MOD numbers listed in table III, or with later MOD numbers, are units of Radio Receiver-Transmitter 618S-1A, and any units which

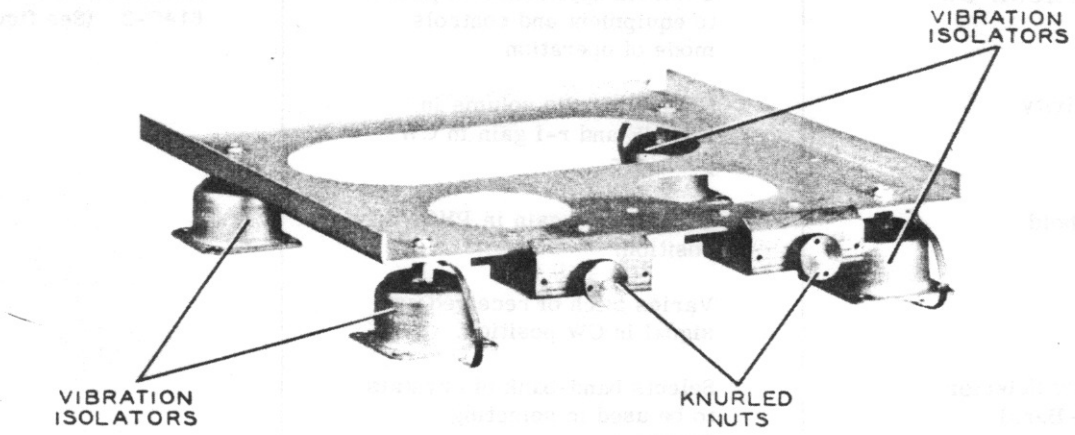


Figure 1-8. Mounting 350D-3, Left Oblique View

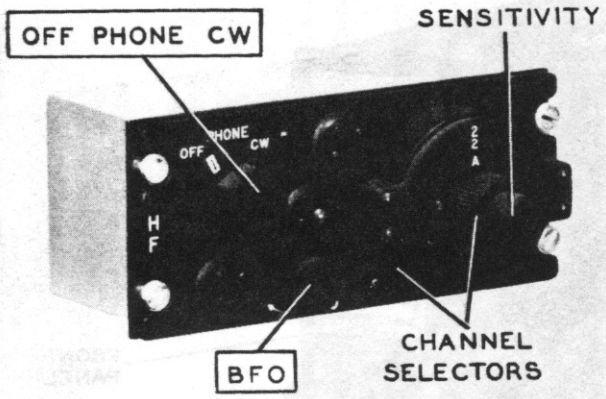


Figure 1-9. Radio Set Control 614C-2, Front Oblique View

are stamped with earlier MOD numbers are units of Radio Receiver-Transmitter 618S-1. For example; the tuner subassembly of Radio Receiver-Transmitter 618S-1A is stamped with MOD 7, and the tuner subassembly of Radio Receiver-Transmitter 618S-1 is stamped with MOD 6 or earlier. In the example used, each tuner subassembly stamped with MOD 7, or later, pertains to the 618S-1A, and each tuner subassembly stamped with MOD 6, or earlier, pertains to the 618S-1. The coupler change becomes effective with Radio Receiver-Transmitter 618S-1 or 618S-1A, serial number 1755.

TABLE III. RADIO SET 618S-1A, EFFECTIVE MOD NUMBERS

UNIT NOMENCLATURE	MOD NUMBER
Bandchange Autopositioner Unit	2
Servomotor B102 Unit	1
Tuner Subassembly	7
Power Amplifier Subassembly	3

1-24. OPERATING FUNCTION OF CONTROLS.

1-25. Table IV lists the operating controls and connectors for each component of Radio Set 618S-1 and Radio Set 618S-1A and the function of each.

TABLE IV. OPERATING FUNCTION OF CONTROLS

NAME OF CONTROL	FUNCTION	LOCATION
RADIO SET CONTROL 614C-2		
OFF PHONE CW	Controls application of power to equipment and controls mode of operation.	Radio Set Control 614C-2. (See figure 1-9.)
Sensitivity	Controls audio volume in PHONE and r-f gain in CW positions.	
Threshold	Controls r-f gain in PHONE position.	
BFO	Varies pitch of received cw signal in CW position.	
Channel Selector (Band-Bank)	Selects band-bank of crystals to be used in selecting frequency.	
Channel Selector (Crystal)	Selects individual crystal within band-bank.	

TABLE IV. OPERATING FUNCTION OF CONTROLS (Cont)

NAME OF CONTROL	FUNCTION	LOCATION
RADIO RECEIVER-TRANSMITTER 618S-1 AND 618S-1A		
PHONE	Connection for headset.	Radio Receiver-Transmitter 618S-1 (See figure 1-2.)
MIC	Connection for microphone	
KEY	Connection for key	
250 V. - 28 V. - MOD. PL. - P.A. PL. - P.A. GRID	Selects function of multiple-use meter on front panel of 618S-1 and 618S-1A.	
ANT	Transmitter antenna jack.	
AUX REC ANT	Receiver antenna jack.	
POWER SUPPLY 416W-1		
RESET	Manual reset for 27.5-volt d-c circuit breaker switches.	Power Supply 416W-1 (See figure 1-5.)
AUTOMATIC ANTENNA TUNER 180L-3		
E102	Antenna Connector	Automatic Antenna Tuner 180L-3 (See figure 1-7.)
J103	Provides connection between the 618S-1 or 618S-1A AUX REC ANT jack and the 180L-3.	
J101	Provides connection between the 618S-1 or 618S-1A ANT jack and the 180L-3.	

1-26. TECHNICAL SUMMARY.

RADIO RECEIVER-TRANSMITTER 618S-1 AND 618S-1A	
Frequency Range:	2.0 mc to 25.0 mc
Number of Channels:	Up to 144
Type of Frequency Control:	Quartz crystal CR-18/U. Only one crystal required for transmitting and receiving. Crossband operation possible only by changing channel selectors of the 614C-2.
Frequency Change Method:	Autopositioner-type remotely controlled switching mechanism. Automatic resonating of tuner subassembly, power amplifier subassembly, and Automatic Antenna Tuner 180L-3.

RADIO RECEIVER-TRANSMITTER 618S-1 AND 618S-1A (Cont)	
Power Output, Transmit:	100 watts minimum from 2.0 mc to 14.2495 mc and 90 watts minimum from 14.250 mc to 25.0 mc.
Output Impedance, Transmit:	52 ohms.
Types of Emission, Transmit:	A-1 (cw telegraphy), A-3 (amplitude-modulated radiotelephony).
Modulation Capacity, Transmit:	95 per cent at rated power output.
Altitude Range, Transmit:	Full power up to 50,000 ft.
Audio Input, Transmit:	100-ohm input from standard aircraft microphone at 0.25 volt rms.
Speech Clipping, Transmit:	Up to 15 db.
Frequency Response, Transmit:	+1.5, -3.5 db from 300 to 3500 cps.
Distortion, Transmit:	Less than 10% at 60% modulation.
Frequency Stability, Transmit:	±0.007 per cent.
Channeling Time, Transmit:	8 seconds maximum, excluding 180L-3.
Spurious Radiation, Transmit:	The strength of any signal other than the desired frequency or its second harmonic will be at least 45 db below the desired frequency. The second harmonic shall be at least 35 db below the desired frequency. (Additional attenuation provided by Automatic Antenna Tuner 180L-3.)
Side Tone, Transmit:	Developed by rectification of the carrier for voice operation. Keyed 400-cps audio for monitoring of cw transmissions. Up to 20 mw available from side-tone output into 300-ohm load, or may be fed through receiver section audio stages.
Keying, Transmit:	Break in operation up to 30 words per minute using a common antenna for transmitting and receiving.
Sensitivity, Receive:	5 microvolt maximum input for 6-db signal-plus-noise to noise ratio with standard test signal modulated 30 per cent at 1000 cps, or for 10-db signal-plus-noise to noise ratio on cw reception.
Control of CW Sensitivity, Receive:	60-db range, with 5000-ohm external control.
AVC, Receive:	Maximum output variation of 3.5 db for signal input of 10 to 100,000 microvolts. No overload below 1 volt signal input.
Selectivity, Receive:	At 5.5 kc, maximum 6 db down; at 14 kc, minimum 60 db down.
I-F and Image Rejection, Receive:	80 db minimum.
Audio Power Output, Receive:	100 mw minimum into 300-ohm load.

RADIO RECEIVER-TRANSMITTER 618S-1 AND 618S-1A (Cont)	
Distortion, Receive:	10 per cent maximum
Response, Receive:	Not more than 3.5 db variation from 300 to 2500 cps. Not more than 10 db variation at 3000 cps.
Noise Limiting, Receive:	Series-type, biased peak noise limiter.
CW Reception:	Remote bfo control with ±2000 cps minimum, ±4000 cps maximum control range.
POWER SUPPLY 416W-1	
Dynamotor Manufacturer:	Wincharger Corporation.
Dynamotor Type:	4159
Dynamotor Catalogue:	SS6012
Dynamotor Input:	27.5 volts d-c at 21.6 amps, full load
Dynamotor Output:	600 volts d-c at 550 milliamperes; 250 volts d-c at 150 milliamperes.
Dynamotor Ambient Operating Temperature:	-55°C (67°F) to +55°C (+131°F)

1-27. POWER REQUIREMENTS. Table V lists the total power required by Radio Receiver-Transmitter 618S-1 or 618S-1A and Automatic Antena Tuner 180L-3.

1-28. FUSE COMPLEMENT. Two fuses are included with the 618S-1 and 618S-1A systems. Both are located on the front panel of Power Supply 416W-1 together with a spare for each. One protects the variable frequency 115-volt source and is rated at 2 amps, 250 volts. The other protects the 115-volt, 380-420 cps source and is rated at 1 amp, 500 volts.

1-29. TUBE COMPLEMENT. Table VI lists the vacuum tubes, crystal rectifiers, and indicator lamps used in the 618S-1 and 618S-1A systems.

TABLE V. POWER REQUIREMENTS

27.5 VOLTS D-C		115 VOLTS, 380-420 CPS		115 VOLTS, 320-1000 CPS	
AMPS	WATTS	AMPS	WATTS	AMPS	WATTS
TOTAL POWER INPUT					
28	770	0.2	30	1.3	150
AUTOMATIC ANTENNA TUNER 180L-3					
2	55	0.13	15		
27.5-VOLT LINE, STANDBY					
6	165				

TABLE VI. RADIO SET 618S-1 AND 618S-1A, TUBE AND INDICATOR LAMP COMPLEMENT

DESIGNATION	TYPE	DESCRIPTION	FUNCTION	LOCATION
RADIO RECEIVER-TRANSMITTER 618S-1 AND 618S-1A				
V401	5654	Pentode	R-F Crystal Oscillator	R-F Oscillator Subassembly
V601	5651	Dual Triode	Servo Amplifier	PA and Tuner Servo Amplifier Subassemblies
V602	5686	Pentode	Servo Amplifier	PA and Tuner Servo Amplifier Subassemblies
V801	0A2WA	Gas Diode	Voltage Regulator	Relay Subassembly
V901	5749	Pentode	I-F Amplifier	I-F Amplifier Subassembly
V902	5749	Pentode	I-F Amplifier	I-F Amplifier Subassembly
V903	5749	Pentode	I-F Amplifier	I-F Amplifier Subassembly
V904	5726	Dual Diode	AVC-Detector	I-F Amplifier Subassembly
V905	5726	Dual Diode	AVC-Noise Limiter	I-F Amplifier Subassembly
V1001	5654	Pentode	Tuner Discriminator	Tuner Subassembly
V1002	5749	Pentode	Variable I-F Amplifier	Tuner Subassembly
V1003	5650	Pentagrid	2nd Transmitter Mixer	Tuner Subassembly
V1004	5650	Pentagrid	1st Transmitter Mixer	Tuner Subassembly
V1005	5750	Pentagrid	1st Receiver Mixer	Tuner Subassembly
V1006	5750	Pentagrid	2nd Receiver Mixer	Tuner Subassembly
V1007	5654	Pentode	Multiplier	Tuner Subassembly
V1008	5749	Pentode	1st R-F Amplifier	Tuner Subassembly
V1009	5749	Pentode	2nd R-F Amplifier	Tuner Subassembly
V1010	5686	Pentode	Driver	Tuner Subassembly
V1011	5686	Pentode	Driver	Tuner Subassembly
CR1001	1N198	Crystal Rectifier	P/O Tuner Discriminator	Tuner Subassembly

TABLE VI. RADIO SET 618S-1 AND 618S-1A, TUBE AND INDICATOR LAMP COMPLEMENT (Cont)

DESIGNATION	TYPE	DESCRIPTION	FUNCTION	LOCATION
RADIO RECEIVER-TRANSMITTER 618S-1 AND 618S-1A				
CR1002	1N198	Crystal Rectifier	P/O Tuner Discriminator	Tuner Subassembly
CR1003	1N198	Crystal Rectifier	P/O Tuner Discriminator	Tuner Subassembly
CR1004	1N198	Crystal Rectifier	P/O Tuner Discriminator	Tuner Subassembly
CR1005	1N198	Crystal Rectifier	P/O Tuner Discriminator	Tuner Subassembly
CR1006	1N198	Crystal Rectifier	P/O Tuner Discriminator	Tuner Subassembly
V1201	5749	Pentode	250 Kc Oscillator	250 Kc Oscillator and BFO Subassembly
V1202	5649	Pentode	BFO	250 Kc Oscillator and BFO Subassembly
CR1201	1N137A	Crystal Rectifier	BFO Rectifier	250 Kc Oscillator and BFO Subassembly
V1301	5814	Dual Triode	Audio Amplifier	Audio Amplifier Subassembly
V1302	5686	Pentode	Audio Output	Audio Amplifier Subassembly
V1401	5751	Dual Triode	Audio Amplifier	Modulator Subassembly
V1402	5726	Dual Diode	Clipper	Modulator Subassembly
V1403	5814	Dual Triode	Audio Driver	Modulator Subassembly
V1404	6159	Pentode	Modulator	Modulator Subassembly
V1405	6159	Pentode	Modulator	Modulator Subassembly
V1501	6159	Pentode	Power Amplifier	Power Amplifier Subassembly
V1502	6159	Pentode	Power Amplifier	Power Amplifier Subassembly
V1503	6159	Pentode	Power Amplifier	Power Amplifier Subassembly
CR1501	1N198	Crystal Rectifier	P/O PA Discriminator	Power Amplifier Subassembly
CR1502	1N198	Crystal Rectifier	P/O PA Discriminator	Power Amplifier Subassembly
CR1503	1N198	Crystal Rectifier	Side Tone Rectifier	Power Amplifier Subassembly

TABLE VI. RADIO SET 618S-1 AND 618S-1A, TUBE AND INDICATOR LAMP COMPLEMENT (Cont)

DESIGNATION	TYPE	DESCRIPTION	FUNCTION	LOCATION
POWER SUPPLY 416W-1				
CR1601		Selenium Rectifier	Voltage Doubling	416W-1
CR1602		Selenium Rectifier	Bias Rectifier	416W-1
CR1603		Selenium Rectifier	Voltage Doubling	416W-1
AUTOMATIC ANTENNA TUNER 180L-3				
V601	5751	Dual Triode	Loading-Phasing Amplifier	180L-3
V602	5751	Dual Triode	Loading-Phasing Amplifier	180L-3
V603	5814	Dual Triode	Loading-Phasing Amplifier	180L-3
RADIO SET CONTROL 614C-2				
I2601	AN3140-327	Indicator Lamp	Light Front Panel	614C-2
I2602	AN3140-327	Indicator Lamp	Light Front Panel	614C-2
I2603	AN3140-327	Indicator Lamp	Tuning Indication	614C-2

SECTION II
TEST EQUIPMENT AND SPECIAL TOOLS

2-1. TEST EQUIPMENT REQUIRED.

2-2. The following test equipment, listed in table VII, or equipment of equal or superior characteristics, must be used in the performance of the tests required by this handbook.

TABLE VII. TEST EQUIPMENT REQUIRED

ITEM NO.	DESCRIPTION	NOMENCLATURE	COMMERCIAL TYPE
1	Multimeter	TS-352/U	Simpson 260
2	Test Set	AN/ARM-7	
3	R-F Indicator Probe	ID-263/U	
4	Interference Generator	SG-23/U	
5	Extension Rod (used with interference generator)	O-904	
6	Tube Tester	TV-3B/U	Hickok Model 539A
7	Signal Generator	AN/URM-25	Measurements Corp Model 65B or 82
8	Dynamotor Test Set	TS-414/U	
9	Vacuum Tube Voltmeter	TS-375/U	Hewlett-Packard Model 410B
10	Audio Oscillator	TS-382/U	Hewlett-Packard Model 200C
11	Oscilloscope	OS-8/U	DuMont Model 304A
12	Output Meter	TS-585B/U	Daven Model OP182
13	Frequency Meter	AN/USM-26	Hewlett-Packard Model 524B
14	Dummy Load; 51.5 ohms		Bird Model 82
15	Headset, cord and plug	H-4/AR or H-1/AR	
16	1 Megohm, 1/2 watt resistor		

TABLE VII. TEST EQUIPMENT REQUIRED (Cont)

ITEM NO.	DESCRIPTION	NOMENCLATURE	COMMERCIAL TYPE
17	Microphone, cord and plug	NAF-213264-6 or ANB-M-C1	
18	0.125/0.130 diameter test pin; used in alignment of tuner subassembly		
19	Capacitor, 0.01 microfarad		
20	Set of 10 crystals: 1.75, 2.0, 2.05, 2.25, 2.5, 2.75, 3.0, 3.09375, 3.25, and 3.5 megacycles.	Supplied with maintenance kit for 618S-1	
21	Gauge Block; 1-3/8 inches wide	Supplied with maintenance kit for 618S-1	
22	Dial Gauge; capable of measuring from zero to 0.8 inch in 0.001 inch increments.	Supplied with maintenance kit for 618S-1	
23	Monitor: A headset or loudspeaker with amplifier and volume control, if desired, including a transformer or other means for making the input impedance at least 10,000 ohms.		
24	Dummy Microphone: A device for connecting Audio Oscillator TS-382A/U to the microphone terminals of the 618S-1 or 618S-1A in such a manner as to simulate the action of a real microphone. See figure 2-1.		
25	Power Source: Capable of delivering 27.5 volts d-c at 28 amperes continuously and 100 amperes surge; and capable of delivering 115 volts, 380-420 cps at 1.025 amperes.		

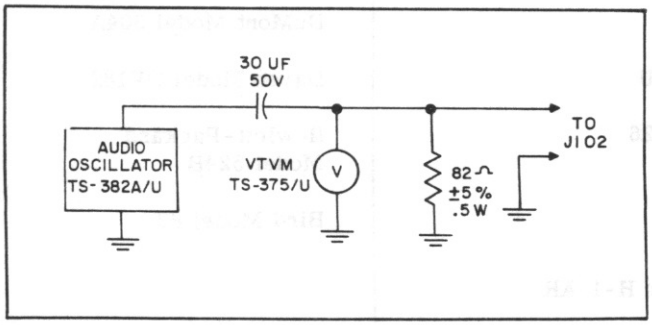


Figure 2-1. Dummy Microphone Circuit, Schematic Diagram

2-3. USE OF ALTERNATE TEST EQUIPMENT.

2-4. When a voltmeter is used in place of Output Meter TS-585B/U, a 300-ohm noninductive resistor should be placed in parallel with the voltmeter to afford proper loading.

2-5. SPECIAL TOOLS.

2-6. Special tools required in the performance of maintenance procedures are listed in table VIII. These tools are included with the 618S-1 and 618S-1A, and are used for removal and replacement of electrical and mechanical parts.

TABLE VIII. SPECIAL MAINTENANCE TOOLS, EQUIPMENT SUPPLIED

PART NUMBER	NAME	APPLICATION
024 2900 00	#4 Bristo Wrench	Removal of setscrews
024 9730 00	#6 Bristo Wrench	Removal of setscrews
024 0019 00	#8 Bristo Wrench	Removal of setscrews
024 9710 00	#10 Bristo Wrench	Removal of setscrews

2-7. CABLE FABRICATION.

2-8. SYSTEM CABLING. Figure 2-2 illustrates a typical bench harness setup for preinstallation tests and adjustments. The power and control cables illustrated must be fabricated, using bulk supplies. Reference is made to the external wiring diagram, figure 7-15, for all necessary cabling information, such as AN nomenclature of plugs and connectors, functions of interconnecting wires, and wire sizes. Further information for fabricating cables may be obtained from publication AN Connector Handbook AN 03-5-90. Figures 2-3 and 2-4 illustrate the method of connecting the r-f cables to the r-f plugs.

2-9. SUBASSEMBLY CABLING. Table IX lists the cables required for maintenance and trouble-shooting procedures for the individual subassemblies of Radio Receiver-Transmitter 618S-1 and Radio Receiver-Transmitter 618S-1A. These cables should be fabricated from bulk supplies, as illustrated in figures 2-5 through 2-9. A length of approximately two feet should be allowed between the cable plugs in each case.

TABLE IX. SPECIAL CABLES REQUIRED FOR MAINTENANCE PROCEDURES

FIGURE REFERENCE	DESCRIPTION	APPLICATION
2-5	20-terminal extension cable with two plugs.	Provides power and control connections between the 618S-1 or 618S-1A main chassis and the tuner, power amplifier, i-f amplifier, and front panel subassemblies.
2-6	15-terminal extension cable with two plugs.	Provides power and control connections between the 618S-1 or 618S-1A main chassis and the modulator, pa servo amplifier, tuner servo amplifier, tuner relay, and front panel subassemblies.
2-7	11-terminal extension cable with two plugs.	Provides power and control connections between the 618S-1 or 618S-1A main chassis and the audio amplifier subassembly.
2-8	9-terminal extension cable with two plugs.	Provides power and control connections between the 618S-1 or 618S-1A main chassis and the bandchange Autopositioner unit.
2-9	7-terminal extension cable with two plugs.	Provides power and control connections between the 618S-1 or 618S-1A main chassis and the PHONE MIC KEY, servomotor B102, meter selector, and blower motor B101 units.

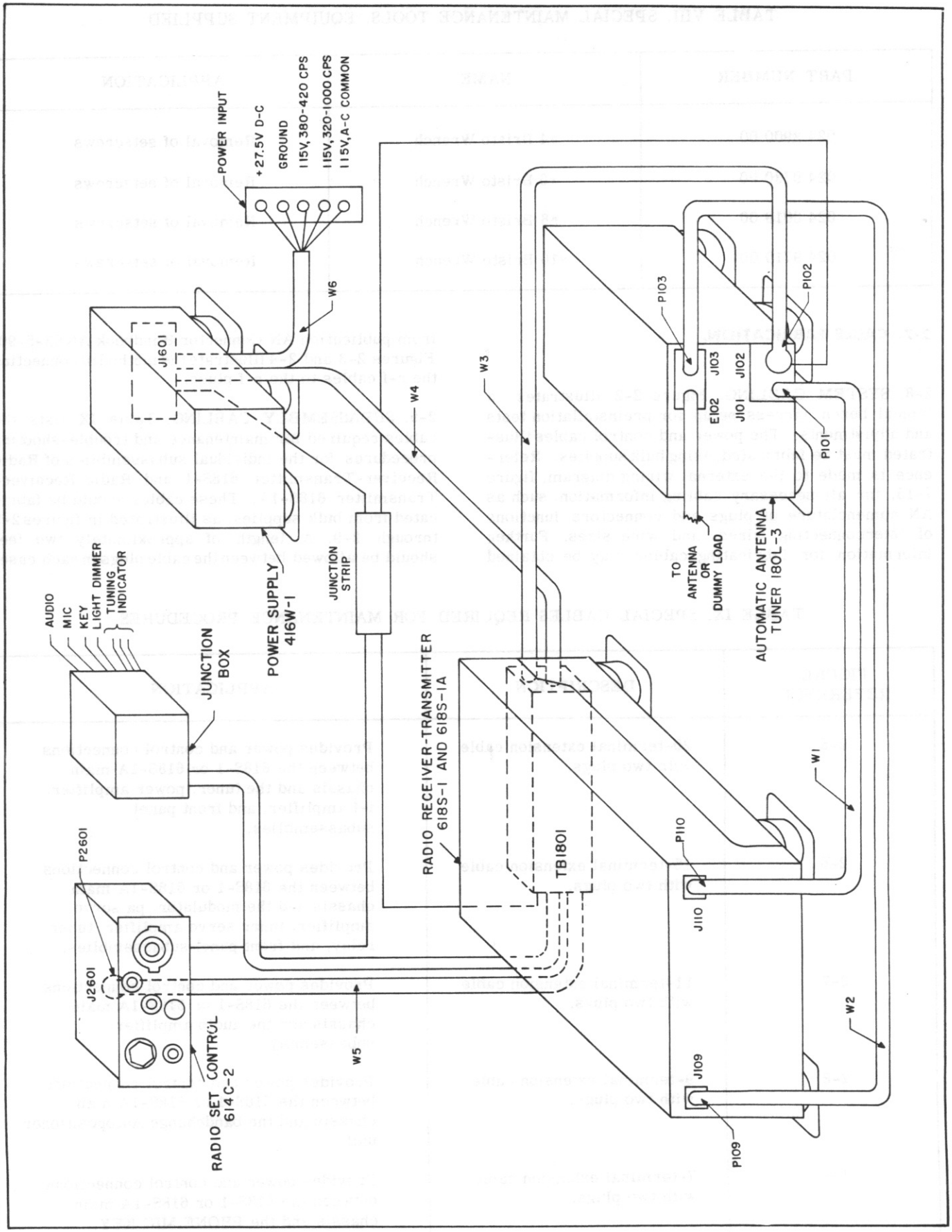


Figure 2-2. Radio Set 618S-1 and 618S-1A, System Cabling

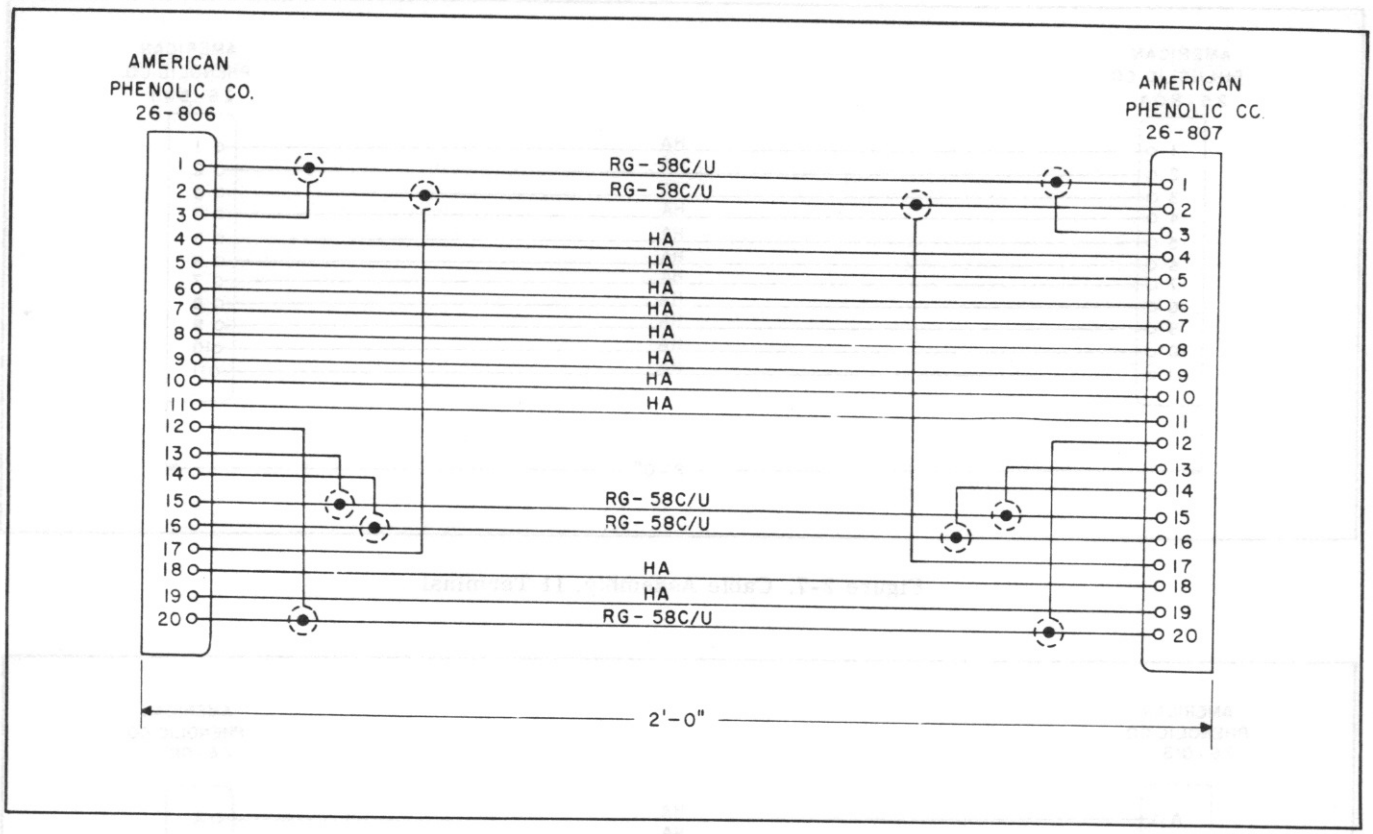


Figure 2-5. Cable Assembly, 20 Terminal

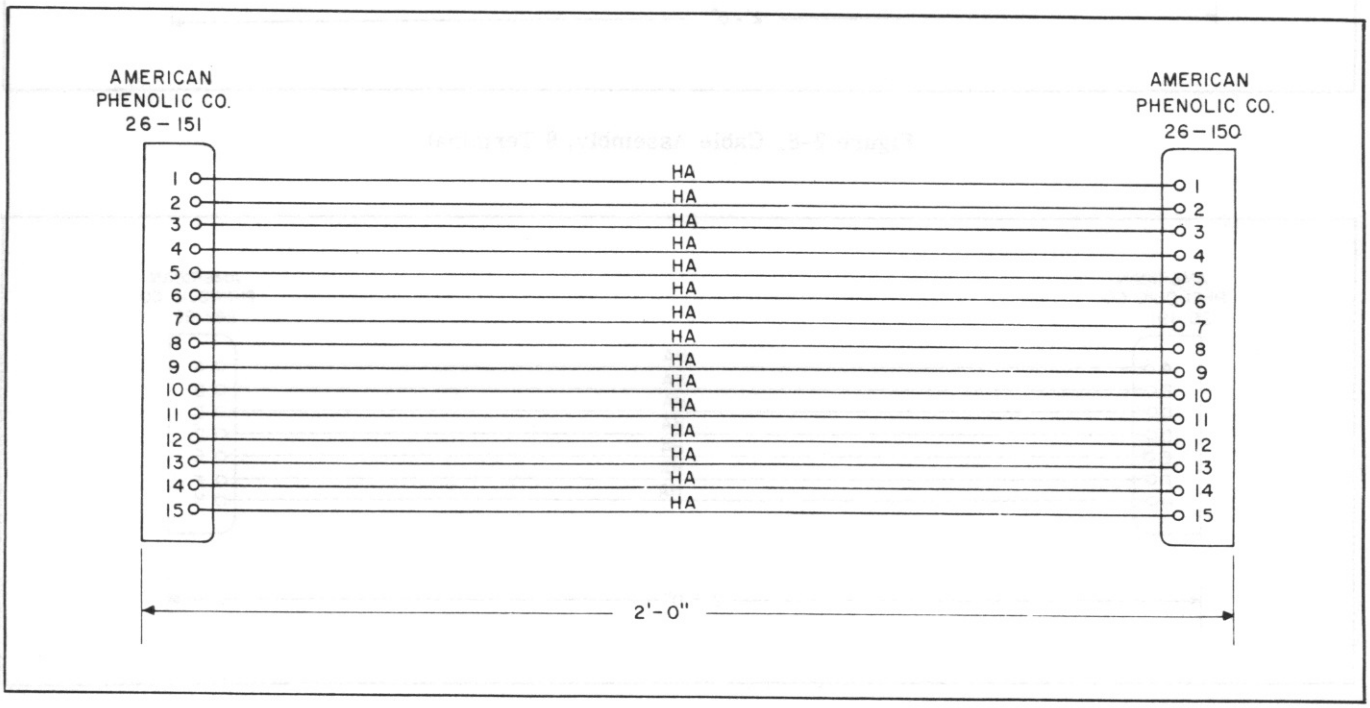


Figure 2-6. Cable Assembly, 15 Terminal

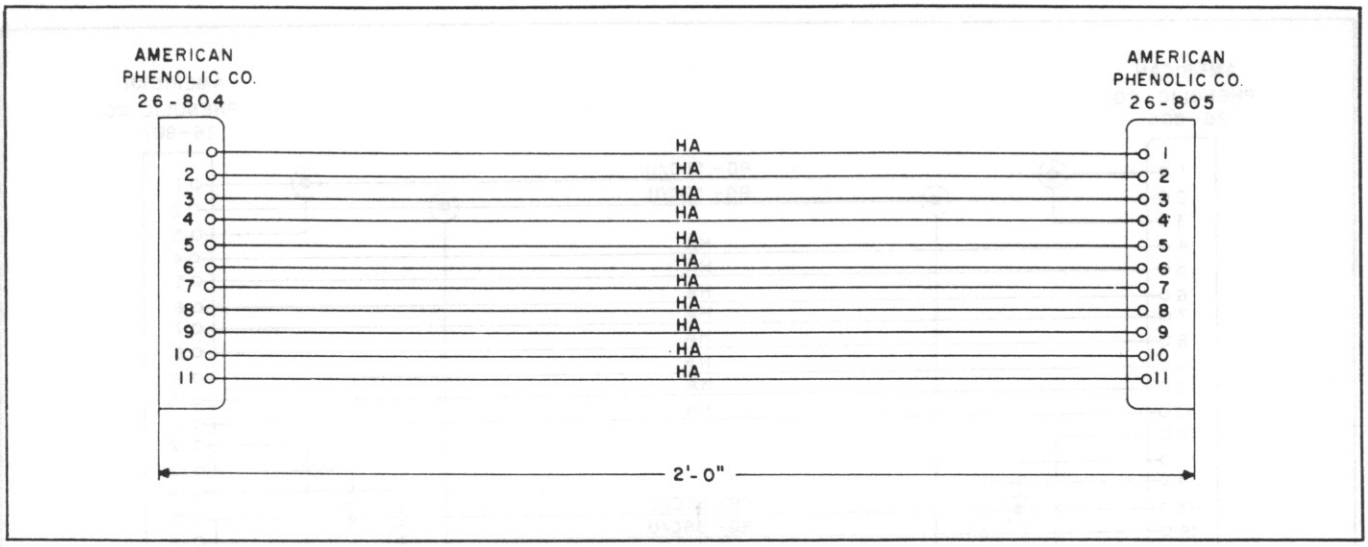


Figure 2-7. Cable Assembly, 11 Terminal

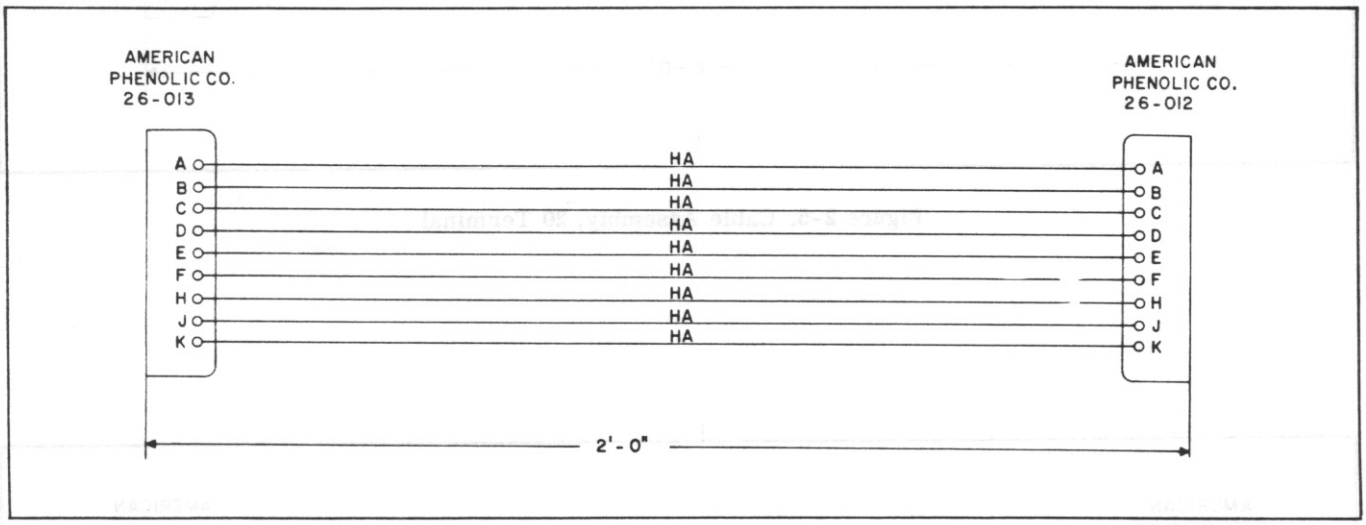


Figure 2-8. Cable Assembly, 9 Terminal

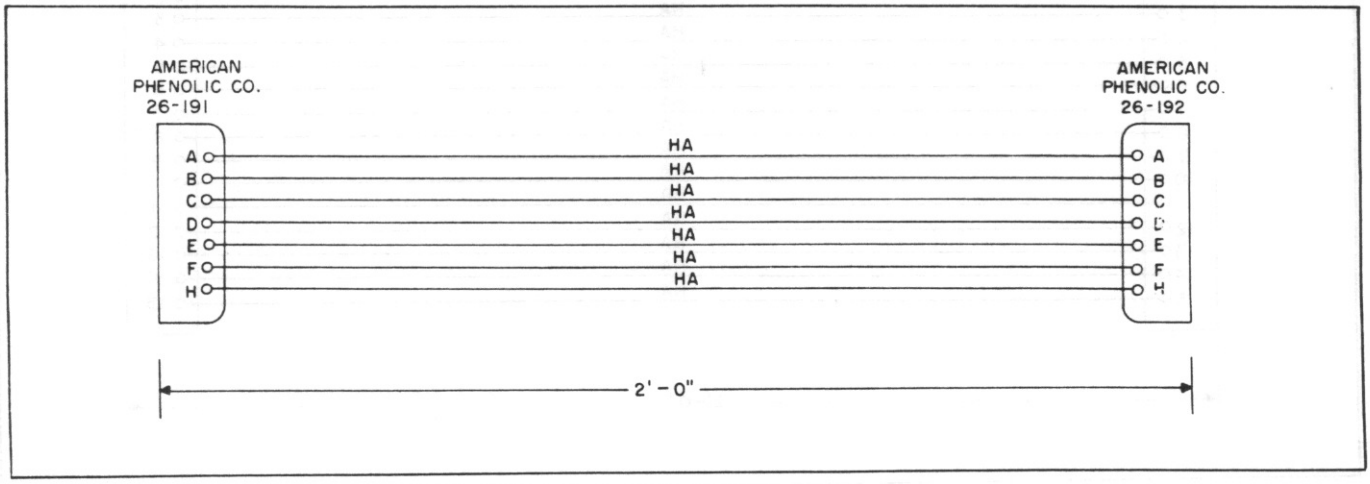


Figure 2-9. Cable Assembly, 7 Terminal

SECTION III
PREPARATION FOR USE AND RESHIPMENT

3-1. UNPACKING AND INSPECTING THE EQUIPMENT.

3-2. The equipment should be handled and unpacked with extreme care. Inspect each unit for evidence of damage during shipment or missing components. The received equipment should be checked against the packing slip and the list of equipment supplied, table I of this handbook. Carefully remove the equipment from the packing boxes. Save all internal packaging, filler, blocking, and bracing to be used with the original packaging containers when the equipment is repacked for storage or shipment. Check the mechanical operation of the equipment by rotating the control knobs. All claims for damage in shipment must be filed promptly with the transportation company involved.

3-3. VISUAL INSPECTION.

3-4. RADIO RECEIVER-TRANSMITTER 618S-1 AND 618S-1A.

a. Rotate the two Dzus fasteners located at the rear of the component and pull the chassis from the cover.

b. Inspect all tubes for proper seating in their sockets, and check the tube shields for mechanical security.

c. Inspect the redheaded captive screws of each subassembly for tightness.

d. Inspect mechanical parts such as gears and rollers for evidence of damage.

e. Remove the front panel cover by removing four screws.

f. Inspect the main chassis and front panel units for dirt, metal scraps, or condensation.

g. Inspect the roller coil (E1513), and adjust if necessary. Refer to paragraph 6-77.

h. Inspect the connection between pins 2 and 4 of K1501. These pins are connected at the factory so that Radio Receiver-Transmitter 618S-1 or 618S-1A is properly wired for use with Automatic Antenna Tuner 180L-2. If Automatic Antenna Tuner 180L-3 is to be used with Radio Receiver-Transmitter 618S-1 or 618S-1A, the connection between pins 2 and 4 of K1501 must be removed.

i. Replace the front panel cover and the main chassis cover.

3-5. POWER SUPPLY 416W-1.

a. Remove the bottom plate from Power Supply 416W-1. The bottom plate is secured by four screws.

b. Inspect for loose or broken parts, dirt, metal scraps, and condensation.

c. Replace the bottom plate.

3-6. RADIO SET CONTROL 614C-2.

a. Remove the rear cover from Radio Set Control 614C-2 by rotating the two Dzus fasteners.

b. Inspect for loose or broken parts, dirt, metal scraps, and condensation.

c. Operate all controls and check mechanical operation.

d. Replace the cover.

3-7. AUTOMATIC ANTENNA TUNER 180L-2 OR 180L-3. Paragraph 3-4 describes the proper wiring of relay K1501 in the power amplifier subassembly when either Automatic Antenna Tuner 180L-2 or 180L-3 is used with Radio Receiver-Transmitter 618S-1 or 618S-1A. Refer to T.O. 31R2-4-38-1, Handbook of Service Instructions, for further information concerning Automatic Antenna Tuner 180L-2 or 180L-3.

3-8. PREINSTALLATION BENCH CHECK.

3-9. A test bench cabled to accommodate the components to be tested, and the various test instruments, should be provided. The cabling between components should simulate that of an actual aircraft and should be in accordance with figures 2-2 and 7-15. Jacks should be included in the bench wiring for connecting the microphone and headset when needed. For aural monitoring, the monitor (item 23 of table VII) may be connected to terminal b of P2601/J2601. If connected to the PHONE jack, the volume is not variable. The power source should be connected into the test bench wiring and should be protected by suitable fuses or circuit breakers.

3-10. CONNECTIONS. Connect all components to be tested to the test bench harness. A typical test bench setup for Radio Set 618S-1 and 618S-1A is illustrated in figure 3-1. Perform the following operations:

a. Connect Bird Model 82 Dummy Load and VTVM TS-375/U to E102 (test point 1) of Automatic Antenna Tuner 180L-3. If the 180L-3 is not used, the dummy load and TS-375/U should be connected to J110 of the 618S-1 or 618S-1A. Adjust VTVM TS-375/U to the 120-volt a-c range.

b. Connect Frequency Meter AN/USM-26 to a 1 megohm, 1/2 watt resistor, and connect the 1 megohm resistor to test point 2. Ground the other AN/USM-26 lead.

c. Connect Signal Generator AN/URM-25 between J109 (test point 3) and ground.

d. Connect Output Meter TS-585B/U between J101 (test point 4) and ground.

e. Connect the dummy microphone, Audio Oscillator TS-382A/U, and VTVM TS-375/U, between J102 (test point 5) and ground, as illustrated in figures 2-1 and 3-1.

f. Connect a telegraph key to J103 (test point 6).

g. Complete cabling to components as illustrated in figure 3-1.

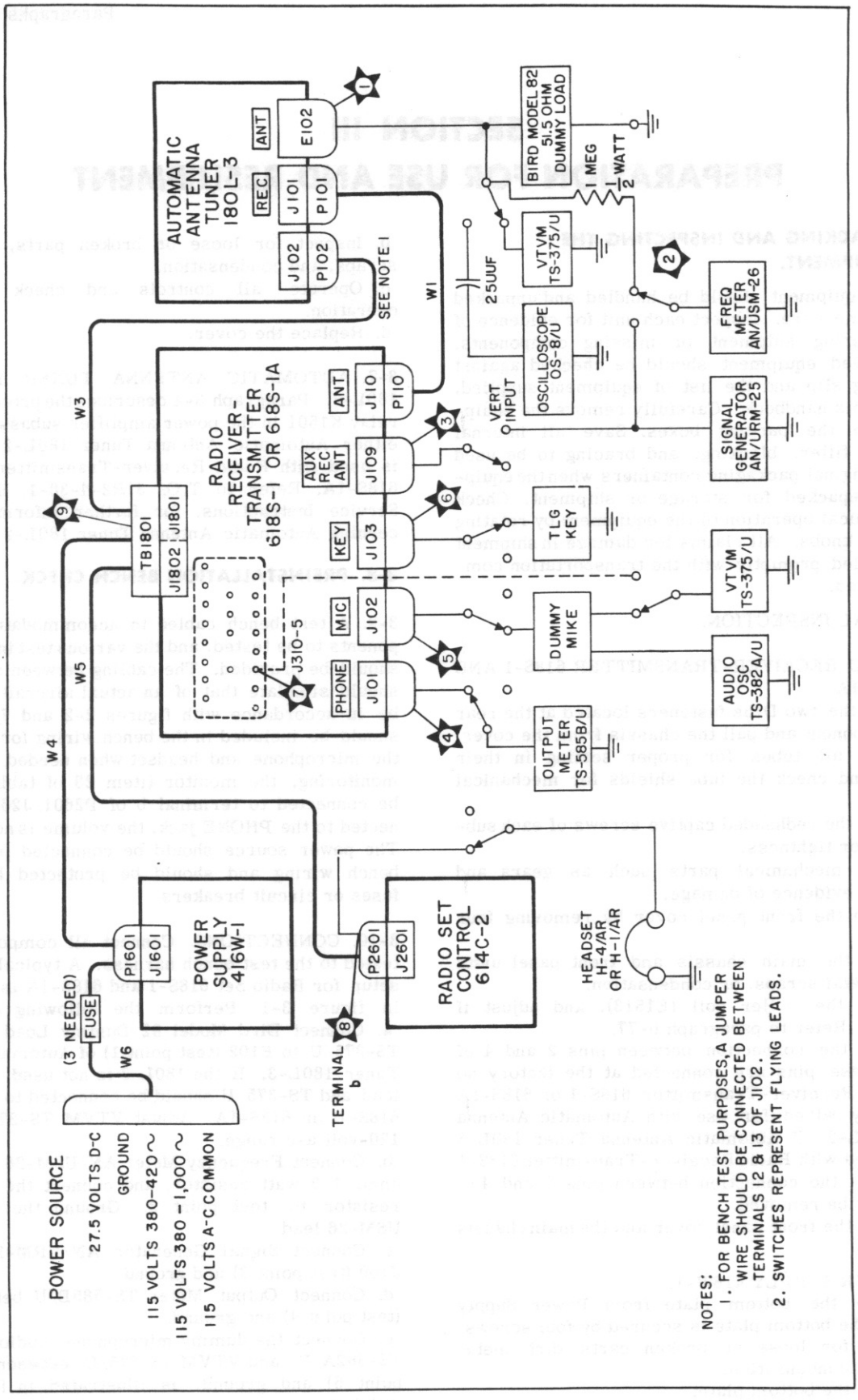


Figure 3-1. Radio Set 618S-1 and 618S-1A, Test Bench Setup

3-11. FREQUENCY SELECTION TESTS. Perform the following operations:

a. Connect the ten test crystals to the r-f crystal oscillator subassembly and remove all other crystals. Refer to table X, crystal placement.

b. Connect the dummy load, VTVM TS-375/U, the 1 megohm resistor and Frequency Meter AN/USM-26 to E102 (test point 1) as illustrated in figure 3-1. All other test equipment should be disconnected at this time.

c. Press the RESET switches of Power Supply 416W-1 and operate the OFF PHONE CW switch of Radio Set Control 614C-2 to the PHONE position. Allow at least ten minutes for warmup.

d. Operate the channel selector switches of Radio Set Control 614C-2 to each position listed in table X, and observe output frequencies as read on Frequency Meter AN/USM-26. Frequencies should not vary over 0.007% of those listed in table X.

E. Check the time interval requred for the tuning cycle to complete when operated from the A1 to the U9 position. Radio Receiver-Transmitter 618S-1 and 618S-1A should complete its tuning cycle in eight seconds or less. Automatic Antenna Tuner 180L-3 should complete its tuning cycle in 22 seconds or less.

NOTE

Do not attempt to channel the 618S-1 or 618S-1A more than once a minute. If channeled too frequently a time-delay relay (K711) in the 180L-3 will heat and prevent the 618S-1 or 618S-1A system from completing its tuning cycle. Relay K711 also will operate if the total tuning time, following the centering cycle of the tuner subassembly, exceeds 45 seconds. If relay K711 does operate, wait at least one minute before rechanneling the equipment.

CAUTION

The maximum duty cycle of Automatic Antenna Tuner 180L-3 is five minutes r-f on and five minutes r-f off. To insure reliable operation, do not exceed this duty cycle.

3-12. TRANSMITTER TESTS.

3-13. R-F POWER OUTPUT. Perform the following operations:

a. Connect the dummy load and the r-f probe of VTVM TS-375/U from test point 1 to ground. Remove the 1 megohm resistor and Frequency Meter AN/USM-26.

b. Connect a telegraph key to test point 6 or a microphone to test point 5. All other test equipment should be removed.

c. Operate the OFF PHONE CW switch to the CW position and allow at least 10 minutes for warmup.

d. Set the 614C-2 channel selectors to the A1 (2.0-megacycle position) and allow the 618S-1 or 618S-1A to complete its tuning cycle.

e. Depress the telegraph key or microphone push-to-talk button and observe indication on VTVM TS-375/U. Reading should be not less than 71.8 volts a-c, which corresponds to 100 watts power output.

TABLE X. TEST CRYSTAL POSITIONS AND OPERATING FREQUENCIES

CRYSTAL POSITION	PLACEMENT FREQ	(BAND 1)		(BAND 2)		(BAND 3)		(BAND 4)	
		FREQ POSITION	TESTS FREQ	FREQ POSITION	TESTS FREQ	FREQ POSITION	TESTS FREQ	FREQ POSITION	TESTS FREQ
A1	1.75	A1	2.00	G1	3.75	M1	7.25	U1	14.25
A2	2.00	A2	2.25	G2	4.25	M2	8.25	U2	16.25
A3	2.25	A3	2.50	G3	4.75	M3	9.25	U3	18.25
A4	2.50	A4	2.75	G4	5.25	M4	10.25	U4	20.25
A5	2.75	A5	3.00	G5	5.75	M5	11.25	U5	22.25
A6	3.00	A6	3.25	G6	6.25	M6	12.25	U6	24.25
A7	3.25	A7	3.50	G7	6.75	M7	13.25	U7	
A8	3.50	A8	3.75	G8	7.25	M8	14.25	U8	
A9	3.09375	A9		G9		M9		U9	25.00
A10	2.05	A10	2.30	G10	4.35	M10	8.25	U10	16.65

NOTE: All frequencies are in megacycles.

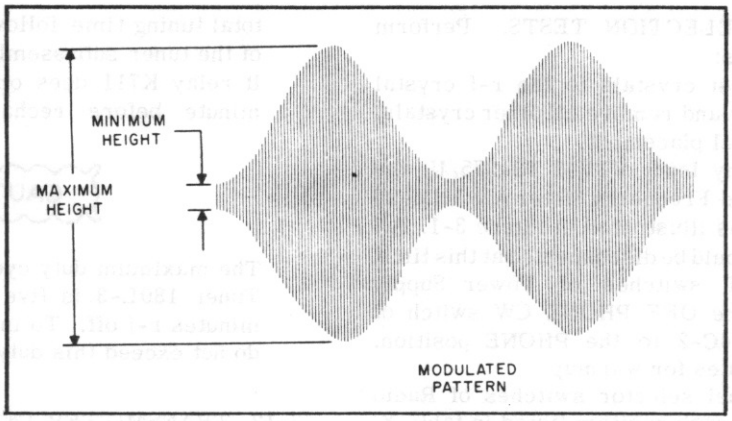


Figure 3-2. Oscilloscope Modulation Pattern

f. Operate the meter selector to the P.A. PL. position and observe indication. Meter should indicate within the red area.

g. Repeat steps e and f for all positions and frequencies listed in table XI. In each case, the TS-375/U should indicate as listed in table XI.

3-14. MODULATION. The operator must perform the following operations:

a. Connect the dummy microphone circuit to test point 5. Refer to figures 2-1 and 3-1.

b. Connect VTVM TS-375/U and Audio Oscillator TS-382A/U to the dummy microphone as illustrated in figure 2-1. Adjust the TS-382A/U to 0.25 volt a-c at 1000 cps.

c. Connect Oscilloscope OS-8/U across the dummy load through a 25-micromicrofarad capacitor and connect to E102 (test point 1). Adjust the OS-8/U for a horizontal sweep capable of reproducing two or three modulated cycles at 1000 cps.

d. Connect a telegraph key to test point 6.

e. Operate the OFF PHONE CW switch to the PHONE position and allow at least ten minutes for warmup.

f. Operate the 614C-2 to the A1 (2.00-megacycle position).

g. Key the 618S-1 or 618S-1A by operating the telegraph key.

h. Adjust the CLIPPING control (R1404 on the bottom of the modulator subassembly) to the maximum clockwise position.

i. Adjust the GAIN control (R1403 on the bottom of the modulator subassembly) for 80% modulation. Use the following formula to calculate the percentage of modulation. Refer to figure 3-2.

$$\% \text{ Modulation} = \frac{\text{Maximum - Minimum}}{\text{Maximum + Minimum}} \times 100$$

NOTE

The minimum percentage of modulation that is allowable depends upon the r-f power output and therefore upon the band of operation. Refer to figure 3-3 for the minimum percentage of modulation allowable for different values of r-f power output. Examination of figure 3-3 will illustrate that a minimum modulation percentage of 95% is allowable with 100 watts r-f power output.

TABLE XI. R-F POWER OUTPUT TESTS

BAND	POSITION	FREQUENCY (MC)	R-F POWER VOLTS A-C	OUTPUT WATTS
1	A1	2.00	71.8	100
	A8	3.75	71.8	100
2	G1	3.75	71.8	100
	G8	7.25	71.8	100
3	M1	7.25	71.8	100
	M8	14.25	68.2	90
4	U1	14.25	68.2	90
	U9	25.00	68.2	90

j. Adjust the CLIPPING control for threshold at the 80% modulation point.

k. Increase the output level of Audio Oscillator TS-382A/U by 12 db. This may be accomplished by increasing the output voltage of the TS-382A/U to 1-volt a-c. The waveform, as observed on Oscilloscope OS-8/U, should be clipped below the 100% modulation point.

l. Lock the CLIPPING and GAIN controls in position.

m. Reduce the TS-382A/U output level to that required for 60% modulation.

n. Vary the frequency of the TS-382A/U between 300 and 3500 cps, holding the audio input level constant. The modulation percentage should remain between 40% and 70%.

o. Adjust the frequency of the TS-382A/U to 5000 cps. The modulation percentage should be not less than 22%.

3-15. SIDETONE. With the equipment setup as described in the preceding paragraph, perform the following operations:

a. Connect a headset to the PHONE jack (test point 4) or to terminal b of P2601/J2601, and monitor the signal as the level and frequency of the TS-382A/U is varied. Signal should be audible.

b. Vary the PHONE SIDETONE control (R106 on the 618S-1 or 618S-1A front panel subassembly) and notice if the amplitude of the side-tone signal is variable.

c. With the TS-382A/U set for 1 volt at 1000 cps, adjust R106 for a comfortable headset level.

d. Operate the OFF PHONE CW switch to the CW position and listen for a 400-cps signal.

e. Vary the CW SIDETONE control (R107 on the 618S-1 or 618S-1A front panel subassembly) and notice if the amplitude of the side-tone signal is variable.

f. Adjust R107 for a comfortable headset level.

3-16. RECEIVER TESTS.

3-17. SENSITIVITY. The operator must perform the following operations:

NOTE

To assure reliability of the sensitivity tests outlined in the following steps, all procedures should be performed in a screen room to prevent man-made noise signals from interfering with results.

a. Connect Signal Generator AN/URM-25 to jack J109 (test point 3). Adjust for an output of 2.75 megacycles at 1000 microvolts, modulated 30% at 1000 cps. Use Frequency Meter AN/USM-26 to set the AN/URM-25 to the correct frequency.

b. Connect Output Meter TS-585B/U to test point 4 and adjust to the 500-milliwatt range with an internal impedance of 300 ohms.

c. Operate the OFF PHONE CW switch to the PHONE position and allow at least ten minutes for warmup.

d. Operate the 614C-2 channel selectors to the A4 position (2.75 megacycles).

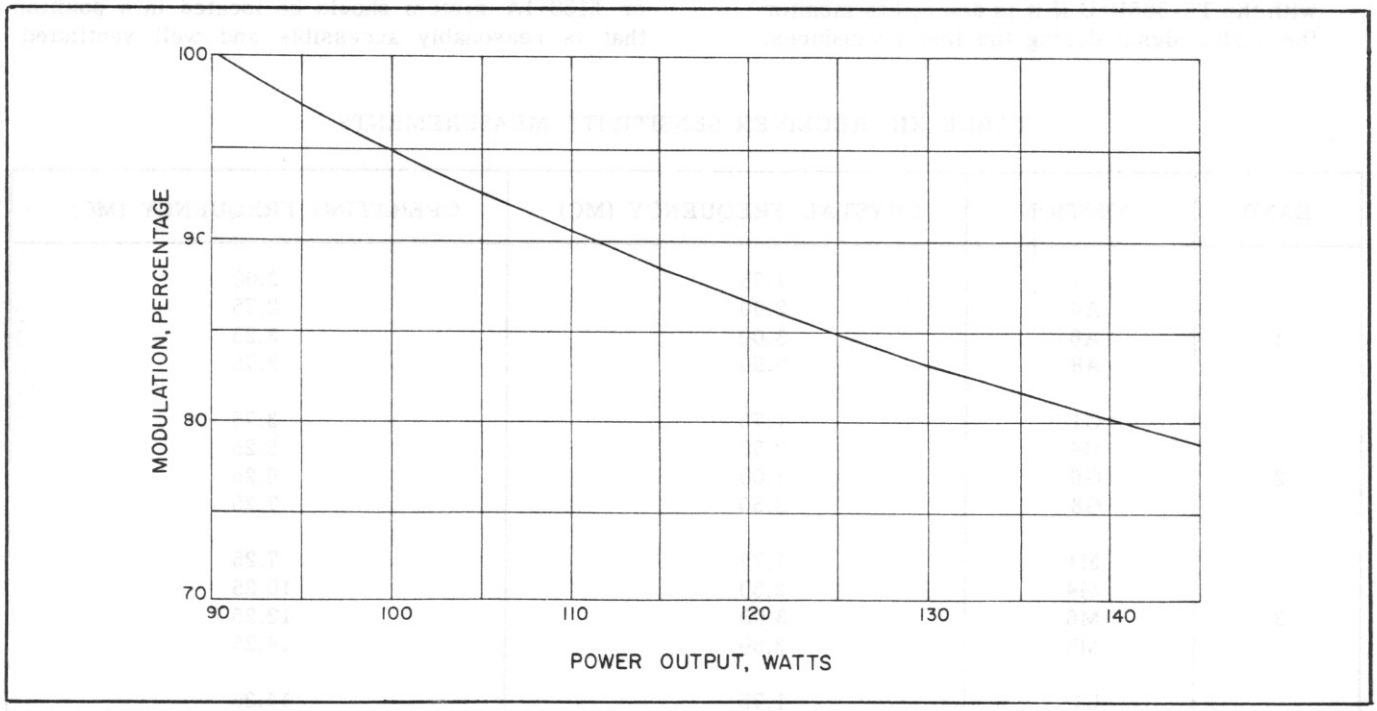


Figure 3-3. Radio Receiver-Transmitter 618S-1 and 618S-1A, Modulation Characteristics

e. Adjust the sensitivity and threshold controls of the 614C-2 for maximum output. The threshold control (R2602) is a screw driver adjustment at the rear of the 614C-2 and the sensitivity control is the small knob on the 614C-2 front panel.

f. Adjust the AUDIO control (R109 on the 618S-1 or 618S-1A front panel subassembly), for an audio power output of 300 milliwatts as read on Output Meter TS-585B/U.

g. Reduce the output level of Signal Generator AN/URM-25 to 5 microvolts. Output Meter TS-585B/U should indicate not less than 100 milliwatts.

h. Remove the modulation. The signal-plus-noise to noise ratio should be at least 6 db (modulation-on to modulation-off ratio of 4 to 1 as read on Output Meter TS-585B/U).

i. Operate the OFF PHONE CW switch to the CW position and remove the modulation.

j. Remove the TS-585B/U and connect a headset to terminal b of P2601/J2601.

NOTE

When a 300-ohm headset such as the H-1/AR or the H-4/AR is connected to either the PHONE jack or to terminal b of P2601, Output Meter TS-585B/U should be removed from the PHONE jack. The TS-585B/U and a low-impedance headset should not be connected across the audio output terminals at the same time or transformer T1301 will be mismatched and the test results will be inaccurate. A high-impedance monitor, such as described in table VII, item 23, may be used in parallel with the TS-585B/U if it is desired to monitor the audio signal during the test procedures.

k. Adjust the 614C-2 BFO control for a signal of approximately 1000 cps.

l. Remove the headset and replace the TS-585B/U. Observe the power output indication on the TS-585B/U with Signal Generator AN/URM-25 adjusted to 5 microvolts output. Output Meter TS-585B/U should indicate at least 100 milliwatts.

m. With the modulation off, remove the r-f input signal and observe the indication on the TS-585B/U. The reading should change at least 10 db (indication in the r-f on position at least 10 times that in the r-f off position).

n. Repeat the sensitivity measurements outlined in steps a through m (excluding step f) for frequencies listed in table XII.

3-18. INSTALLATION OF EQUIPMENT.

3-19. The individual components of Radio Set 618S-1 and 618S-1A must be mounted in a location convenient to the existing facilities of the aircraft. Every consideration must be given in the location of equipment and the design of installation details, to promote operator efficiency, ease of adjustment, and component replacement. No attempt is made in this handbook to present complete installation instructions, since the particular type of aircraft involved will determine the installation procedure. A general procedure is outlined in subsequent paragraphs. Figure 3-4 illustrates a typical 618S-1 or 618S-1A installation.

3-20. RADIO RECEIVER-TRANSMITTER 618S-1 AND 618S-1A.

3-21. LOCATION. The main components of the 618S-1 or 618S-1A system should be located in a position that is reasonably accessible and well ventilated.

TABLE XII. RECEIVER SENSITIVITY MEASUREMENTS

BAND	POSITION	CRYSTAL FREQUENCY (MC)	OPERATING FREQUENCY (MC)
1	A1	1.75	2.00
	A4	2.50	2.75
	A6	3.00	3.25
	A8	3.50	3.75
2	G1	1.75	3.75
	G4	2.50	5.25
	G6	3.00	6.25
	G8	3.50	7.25
3	M1	1.75	7.25
	M4	2.50	10.25
	M6	3.00	12.25
	M8	3.50	14.25
4	U1	1.75	14.25
	U4	2.50	20.25
	U9	3.09375	25.00

Adequate clearance for mounting the main component on Mounting 350S-1 or 350S-3 must be provided. Access to the front panel is necessary to permit removal of the 618S-1 or 618S-1A from the 350S-1 or 350S-3 and to permit checking operation by observation of the front panel meter.

3-22. MOUNTING. Normally, Radio Receiver-Transmitter 618S-1 or 618S-1A is mounted on Mounting 350S-1 or 350S-3. Figure 7-10 shows the outline and mounting dimensions of the main component mounted on the 350S-1 or 350S-3. Note that all power and control connections are made to terminals located on the filter unit at the rear of the 350S-1 or 350S-3. The 350S-1 or 350S-3 should be mounted to the radio shelf by means of No. 8 screws, nuts, and lock washers. The filter unit is held in place by four screws at the rear of Mounting 350S-1 or 350S-3. The cabling may be connected to the filter unit while removed from the 350S-1 or 350S-3. Make certain that the grounding straps are fastened securely under the vibration isolator feet of the 350S-1 or 350S-3 to assure good electrical connection. Perform the following steps to mount Radio Receiver-Transmitter 618S-1 or 618S-1A on Mounting 350S-1 or 350S-3:

a. Loosen the locking mechanisms by rotating the two wing nuts counterclockwise as far as possible.

b. Place the 618S-1 or 618S-1A on the 350S-1 or 350S-3 and push toward the rear, making sure the plugs on the 618S-1 or 618S-1A chassis mesh properly with the jacks on the 350S-1 or 350S-3.

c. Engage the locking mechanisms and tighten the two wing nuts.

d. Safety-wire the locking mechanisms.

3-23. POWER SUPPLY 416W-1.

3-24. LOCATION. Power Supply 416W-1 may be placed at any convenient location that is accessible and reasonably well ventilated. Cabling requirements should be taken into consideration in choosing the location, since the 416W-1 provides power to both the 618S-1 or 618S-1A main component and Automatic Antenna Tuner 180L-3.

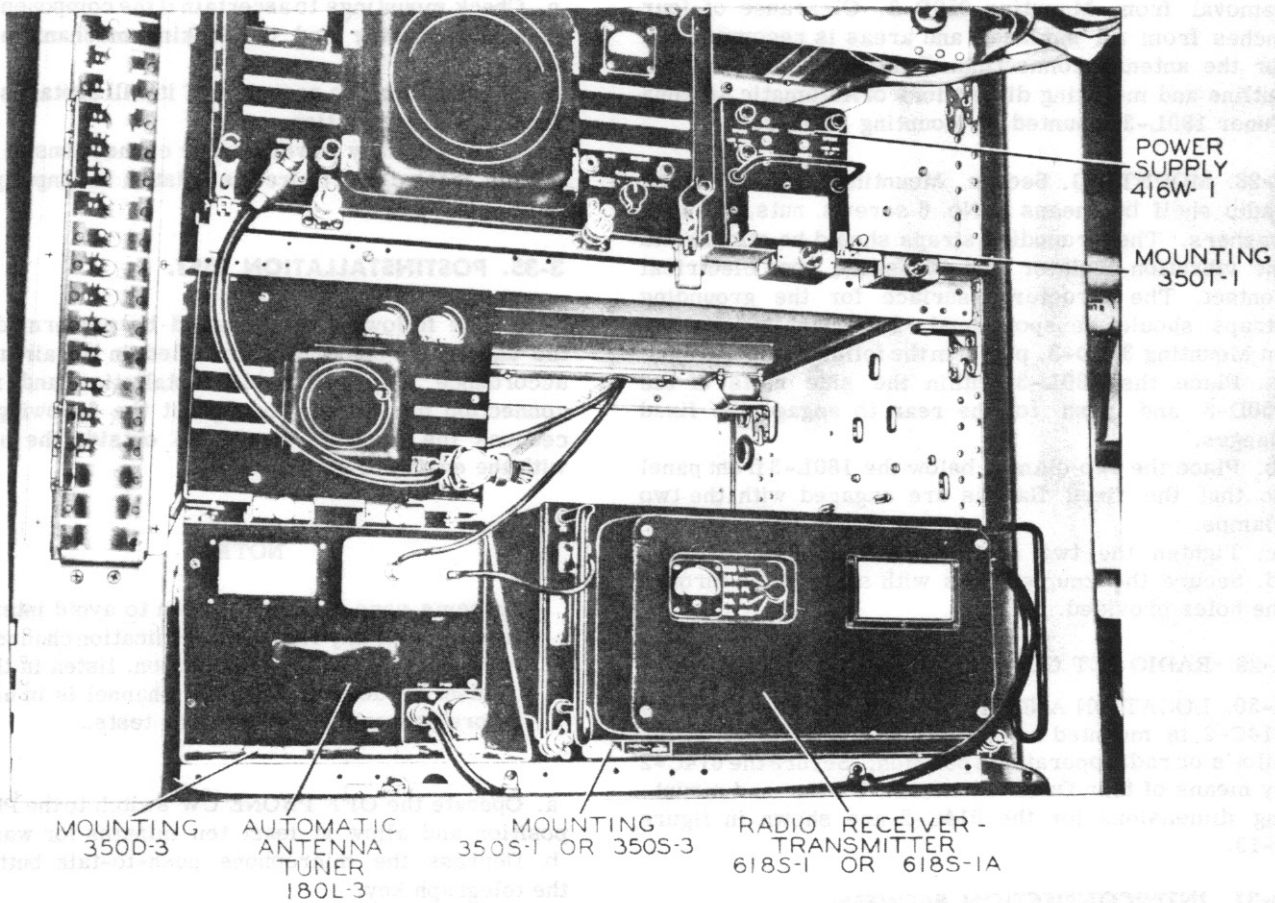


Figure 3-4. Radio Set 618S-1 and 618S-1A, Typical System Installation

3-25. MOUNTING. Power Supply 416W-1 normally is mounted on Mounting 350T-1. Figure 7-11 shows the outline and mounting dimensions of the 416W-1 installed on the 350T-1. The 350T-1 should be mounted on the radio shelf by means of No. 8 screws, nuts, and lock washers. The grounding straps should be fastened securely under the vibration isolators to assure good electrical contact. To install the 416W-1 on Mounting 350T-1, perform the following operations:

a. Operate the extractor mechanism by rotating the middle thumbscrew as far as possible in a counterclockwise direction.

b. Place the 416W-1 on the 350T-1 and push toward the rear so that the front panel drops into the extractor slot.

c. Rotate the middle thumbscrew clockwise until the rear connector is fully engaged.

d. Engage, tighten, and safety-wire the locking mechanisms.

3-26. AUTOMATIC ANTENNA TUNER 180L-3.

3-27. LOCATION. Since Automatic Antenna Tuner 180L-3 requires no adjustments after installation, it may be located some distance from the other 618S-1 or 618S-1A components. The 180L-3 should be mounted in a space which is convenient to the antenna feedthrough insulator, or mast, and will allow easy removal from Mounting 350D-3. Clearance of four inches from all surfaces and areas is recommended for the antenna connection. Refer to figure 7-12 for outline and mounting dimensions of Automatic Antenna Tuner 180L-3 mounted on Mounting 350D-3.

3-28. MOUNTING. Secure Mounting 350D-3 to the radio shelf by means of No. 6 screws, nuts, and lock washers. The grounding straps should be attached to the vibration isolator feet to assure good electrical contact. The structural surface for the grounding straps should be spot-faced. To mount the 180L-3 on Mounting 350D-3, perform the following operations:

a. Place the 180L-3 within the side rails of the 350D-3 and push to the rear to engage the fixed flanges.

b. Place the two clamps below the 180L-3 front panel so that the fixed flanges are engaged with the two clamps.

c. Tighten the two knurled nuts on both clamps.

d. Secure the knurled nuts with safety wire through the holes provided.

3-29. RADIO SET CONTROL 614C-2.

3-30. LOCATION AND MOUNTING. Radio Set Control 614C-2 is mounted as part of the control panel at the pilot's or radio operator's position. Secure the 614C-2 by means of four Dzus fasteners. Outline and mounting dimensions for the 614C-2 are shown in figure 7-13.

3-31. INTERCONNECTION BETWEEN COMPONENTS.

3-32. Location of the individual components of the 618S-1 or 618S-1A is optional, since space allocation is dependent upon the aircraft type; therefore, the interconnecting cables must be fabricated from bulk supplies. The physical cabling layout must be determined for each particular installation by the installing activity. The following general steps should be carried out when installing the cables between components.

a. Allow sufficient slack in cables to avoid restricting movement on mountings, and to permit easy removal and replacement of the cable connectors.

b. Run cables in positions that will reduce chances of damage due to vibration.

c. Avoid running cables over sharp edges.

d. Avoid sharp cable bends allowing, in general, a bending radius of at least 3-1/2 inches.

e. Securely anchor cables to the aircraft structure using clamps or lacing.

3-33. POSTINSTALLATION INSPECTION.

3-34. A thorough check of the complete installation should be made before power is applied to the equipment and before adjustments or tests are begun.

a. Check connections. Make sure the locking rings on connectors are tight.

b. Check the wires entering multiple connectors to be sure the insulation has not been cut back too far, causing wires to short together.

c. Check mountings to ascertain if the components are mounted securely and the locking mechanisms are tight.

d. Check cabling to ascertain if it will sustain severe and prolonged vibration.

e. Check primary power source connections to make certain that no short circuits exist in the input power lines.

3-35. POSTINSTALLATION TEST.

3-36. The following tests should be performed with the equipment completely installed in the aircraft in accordance with applicable installation and interconnection diagrams. Throughout the following procedures the aircraft should be outside the hangar with the engines running.

NOTE

Extreme care should be taken to avoid interference with any local communication channel. After each new channel selection, listen in the headset to determine if the channel is in use before proceeding with further tests.

a. Operate the OFF PHONE CW switch to the PHONE position and allow at least ten minutes for warmup.

b. Depress the microphone push-to-talk button or the telegraph key.

c. Operate the meter selector to the 250 V. position. Meter should indicate within the red area.

d. Operate the meter selector to the 28 V. position. Meter should indicate within the red area.

e. Operate the meter selector to the P.A. GRID position. Meter should indicate above the 3 mark.

f. Operate the meter selector to the P.A. PL. position. Meter should indicate within the red area.

g. Operate the meter selector to the MOD. PL. position. Speak normally into the microphone and watch the meter indication. The meter should show an increased indication. Speech should be heard in the headset through the side-tone circuits.

h. Operate the OFF PHONE CW switch to the CW position. Key the 618S-1 or 618S-1A by operation of the telegraph key. A 400-cps side-tone signal should be heard in the headset when the telegraph key is depressed.

i. Operate the OFF PHONE CW switch to the PHONE position and release the telegraph key. Characteristic hiss should be heard.

j. Operate the channel selector of Radio Set Control 614C-2 to an active channel. With the small 614C-2 knob, determine if the sensitivity is variable.

k. With the OFF PHONE CW switch in the CW position, select an active cw channel. Pitch of cw signal should be variable with the 614C-2 BFO control.

l. Repeat steps c through i for at least one frequency within each band of operations. The bands are as follows: band 1, 2.0 to 3.75 megacycles; band 2, 3.75 to 7.25 megacycles; band 3, 7.25 to 14.25 megacycles; and band 4, 14.25 to 25.00 megacycles.

3-37. PREPARATION FOR RESHIPMENT.

3-38. Removal of the installed components of Radio Set 618S-1 and 618S-1A is accomplished by disconnecting cables and reversing the installation procedures, paragraphs 3-18 through 3-31. No special provisions for repacking the equipment are necessary beyond use of reasonable care. It is recommended that packing cases be used which are similar to those in which the equipment was received.

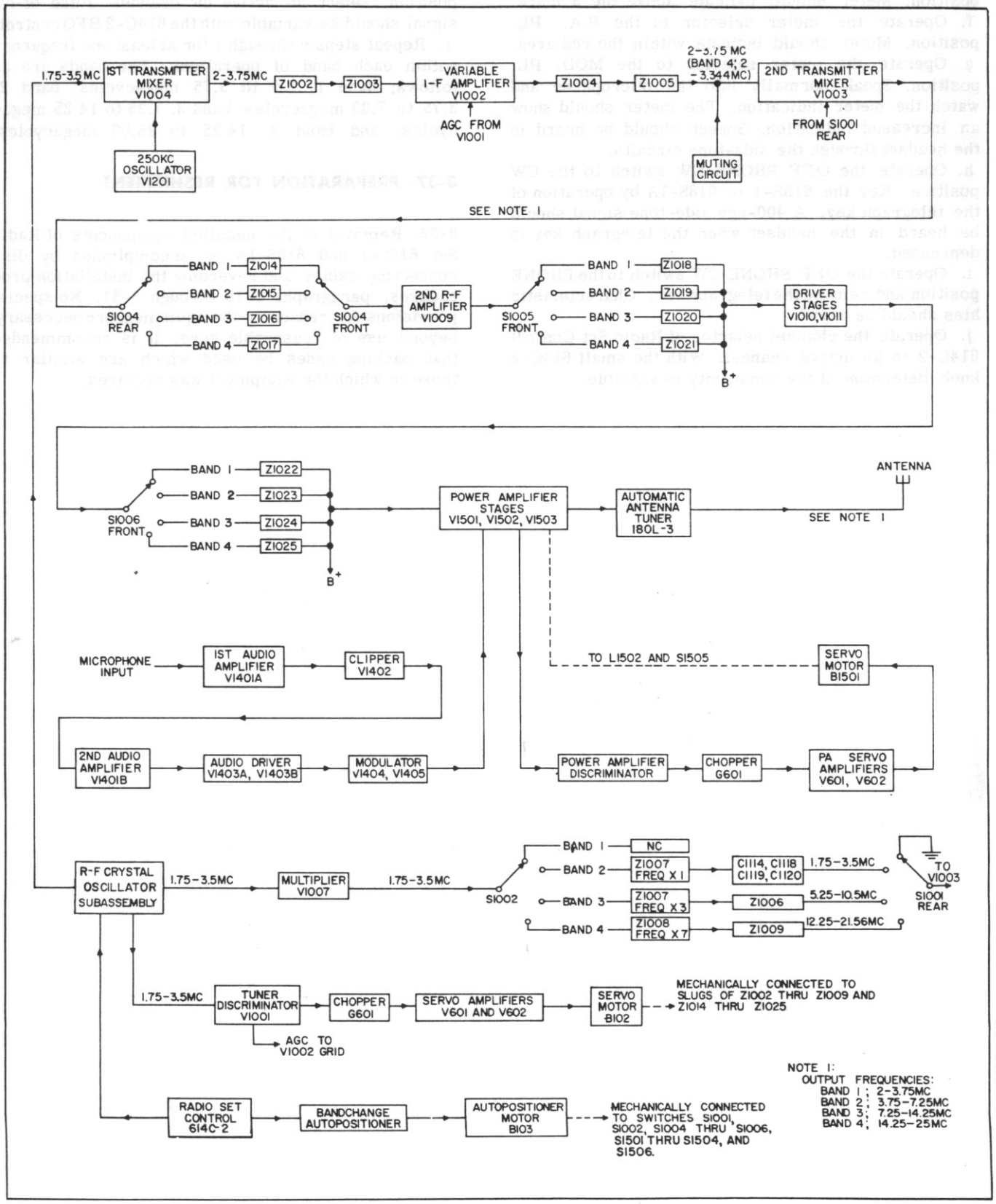


Figure 4-1. Radio Set 618S-1 and 618S-1A, Transmitter Section, Block Diagram

SECTION IV
THEORY OF OPERATION

4-1. GENERAL.

4-2. Radio Sets 618S-1 and 618S-1A include the necessary components to permit operation as both a transmitter and receiver. Radio Receiver-Transmitter 618S-1 or 618S-1A is the main component of the system, controlled by a separately housed control unit. Radio Set Control 614C-2 is used as a master control unit, from which 144 channels may be selected. The 52-ohm transmission line from Radio Receiver-Transmitter 618S-1 or 618S-1A is matched automatically to the antenna with the use of Automatic Antenna Tuner 180L-3. Reference is made to the Handbook Service Instructions, T.O. 31R2-4-38-1, for the theory of operation of Automatic Antenna Tuner 180L-3. The theory of operation of Radio Set 618S-1 and 618S-1A can be broken down into three general descriptive sections; the transmitter section, the receiver section, and the control section. The following discussion will, in general, follow this outline; however, since many of the 618S-1 and 618S-1A functions are interdependent, a certain amount of overlap is unavoidable.

4-3. TRANSMITTER SECTION.

4-4. Reference is made to the block diagram, figure 4-1. Fundamental frequencies within the range of 1.75 to 3.5 megacycles are generated in the r-f crystal oscillator. The exact frequency is dependent upon the selected crystal. Circuitry contained within Radio Set Control 614C-2 supplies the necessary information to the r-f crystal oscillator subassembly to select the correct crystal, as will be described in paragraphs 4-48 through 4-51. The r-f crystal oscillator has three distinct outputs; one which feeds a discriminator and servo system for purposes of tuning all the low-level tuned circuits; one which supplies the basic frequencies to multiplier circuits for the purpose of establishing an injection voltage to the second transmitter mixer; and one which supplies the fundamental frequency to the first transmitter mixer, V1004. The fundamental frequencies (1.75 to 3.5 megacycles) supplied to V1004 are mixed with an injection voltage of 250 kilocycles, supplied by V1201 and associated circuitry. The sum frequency is selected by tuned circuits Z1002 and Z1003 and amplified by variable i-f amplifier V1002. Tuned circuits Z1004 and Z1005 provide further selectivity of the variable i-f signal. The signal then is applied to the second transmitter mixer, V1003, to be mixed with the multiplier output frequencies. A muting circuit is included with V1003 to prevent spurious radiation during the channeling cycle. The two frequencies present at V1003 are mixed and the sum frequency selected by tuned circuit Z1014, Z1015, Z1016, or Z1017, depending upon the band of operation. All band switching is accomplished by autopositioner motor B103 in conjunction with the bandchange autopositioner unit and Radio Set Control 614C-2. The r-f signal then is amplified by the second r-f amplifier, V1009, and developed across one of the four tuned circuits, Z1018 through Z1021, depending upon the band selected. Two tubes, V1010 and V1011, are connected in parallel for final amplification before the r-f signal is applied to the power amplifier stages. Selectivity for the driver stages is accomplished by tuned circuits Z1022 through Z1025. The signal is applied to the power amplifier, consisting of three type 6159 tubes, V1501, V1502, and V1503 connected in parallel. At this point, an audio signal from the modulator is used to vary the plate and screen voltage of the power amplifier tubes to accomplish amplitude modulation of the carrier. The power amplifier subassembly contains its own servo system, which adjusts the main tuning inductor, L1502, to the correct frequency, as established in the low-level circuits. Output of the power amplifier is applied to the antenna through Automatic Antenna Tuner 180L-3.

4-5. DETAILED TRANSMITTER FUNCTIONS.

4-6. R-F CRYSTAL OSCILLATOR. The r-f crystal oscillator, figure 4-2, employs a type 5654 pentode tube in an electron-coupled oscillator circuit. Radio Set Control 614C-2, in conjunction with the Autopositioner system, selects the desired crystal whenever the channel selector is rotated, as will be described in paragraphs 4-48 through 4-51. The oscillator portion of V401 consists of the cathode, the control grid, and the screen grid. The screen grid acts as the oscillator plate circuit with coupling to the actual plate circuit taking place within the electron stream. In this manner, with the oscillator plate circuit isolated from the output plate circuit, frequency stability is improved. The oscillator plate (pin 6 of V401) is held at r-f ground potential by capacitor C405. The grid drive is controlled by the division ratio of capacitors C404 and paralleled capacitors C401 and C402. Capacitor C401 is factory adjusted for optimum grid drive. The 1.75- to 3.5-megacycle signal (exact frequency depending upon the selected crystal) is coupled through capacitor C407 to grid 3 of the first transmitter mixer, V1004. The signal also is applied to the control grid of the tuner discriminator, V1001, and is used to tune all of the low-level circuits, as will be explained in paragraphs 4-52 through 4-58 and 4-62 through 4-64. Provision is made for metering the grid voltage of V401 across the parallel arrangement of R402 and C403.

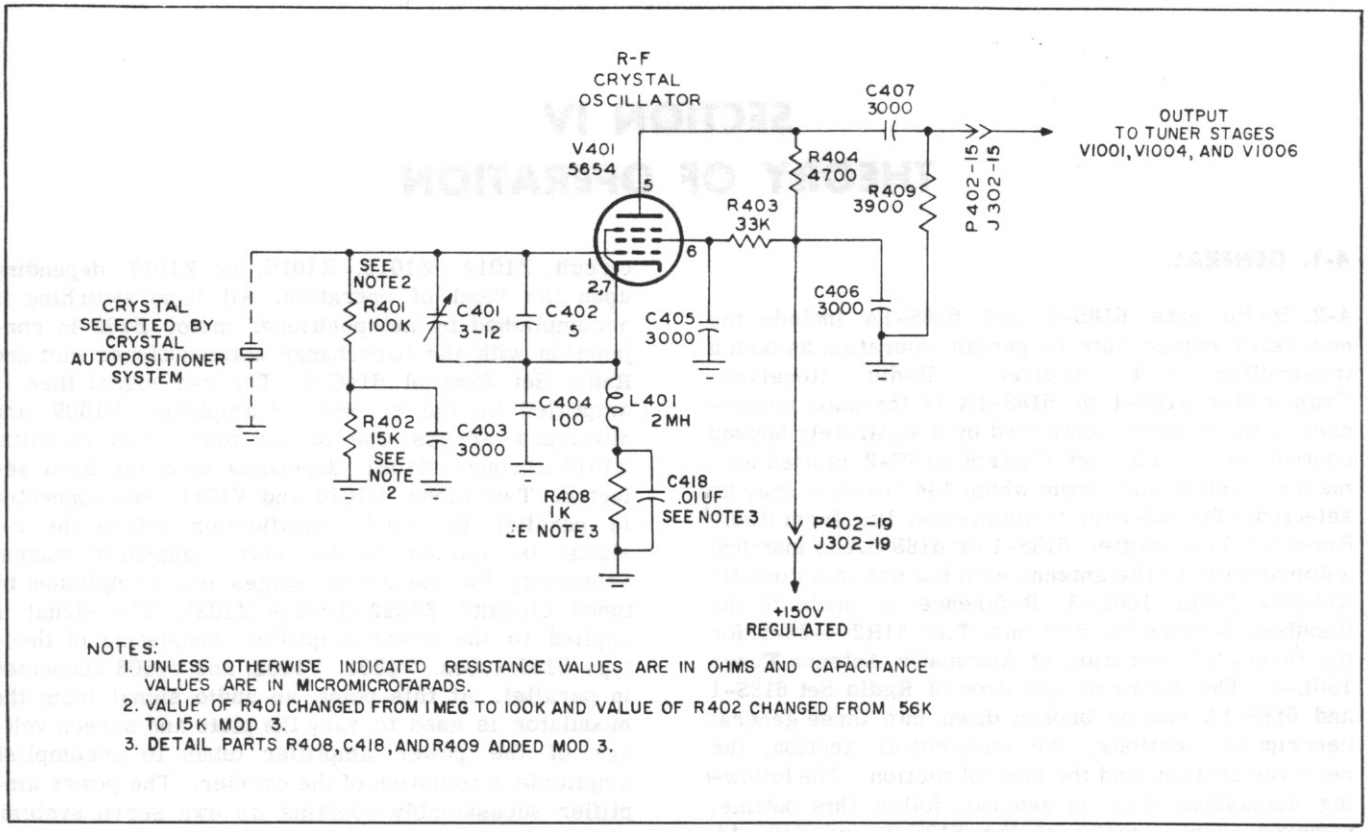


Figure 4-2. R-F Crystal Oscillator, Simplified Schematic Diagram

4-7. FIRST TRANSMITTER MIXER AND 250 KC OSCILLATOR. Refer to figure 4-3. The 1.75- to 3.5-megacycle signal from V401 is applied through capacitors C407 and C1086 to grid 3 of the first transmitter mixer, V1004. The signal is developed across resistor R1021. Another signal is injected into the control grid of V1004. This signal originates in the 250-kc oscillator stage, V1201. The 250 kc oscillator is crystal controlled, with temperature-compensated detail parts. Feedback is accomplished by the capacitance ratio of C1206 and C1201, in conjunction with the tank circuit formed by crystal Y1201. This ratio is slightly adjustable for alignment purposes, and may be used to set the frequency to the desired 250 kilocycles. The cathode is grounded through contacts of K804 and K1502 during transmission and open during reception. The oscillator portion consists of the screen and control grids and the cathode, with the screen acting as the plate of the oscillator. Coupling to the actual plate circuit is accomplished within the electron stream of V1201. Transformer T1201, consisting of inductors L1201 and L1202 and capacitors C1203 and C1204, inductively couples the 250-kc signal from the plate of V1201 to the control grid of V1004. Provision is made for resonating T1201 during alignment procedures by adjustable slugs within the inductors.

4-8. The two signals (1.75 to 3.5 megacycles and 250 kilocycles) are mixed in the electron stream of V1004. The sum frequency (2 to 3.75 megacycles) is selected by plate tuned circuit Z1002. Tuned circuit Z1002 is resonated to the correct frequency by motor B102 in conjunction with the tuner servo amplifier, as will be explained in paragraphs 4-57 and 4-58. Output of the first mixer stage is capacitively coupled to the control grid of V1002.

4-9. VARIABLE I-F AMPLIFIER. Refer to figure 4-4. The variable i-f amplifier stage, V1002, employs a 5749 pentode to amplify the 2- to 3.75-megacycle signal produced in the first transmitter mixer. Two tuned circuits, Z1003 and Z1004, are used to resonate the grid and plate circuits to the particular frequency selected. Cathode bias is supplied by capacitor C1077 and resistor R1012. Resistor R1006, in series with the grid tuned circuit, is selected by factory experimentation for optimum results, and will differ with individual units. The output is capacitively coupled through C1015 to the second transmitter mixer, V1003.

4-10. SECOND TRANSMITTER MIXER AND MULTIPLIER. Refer to figure 4-5. The 2- to 3.75-megacycle signal from the variable i-f amplifier is developed across tuned circuit Z1005 and applied to the control grid of second transmitter mixer V1003. An injection voltage from the multiplier stage and associated tuned circuits is applied to grid three of V1003. The basic r-f crystal oscillator output frequency (1.75 to

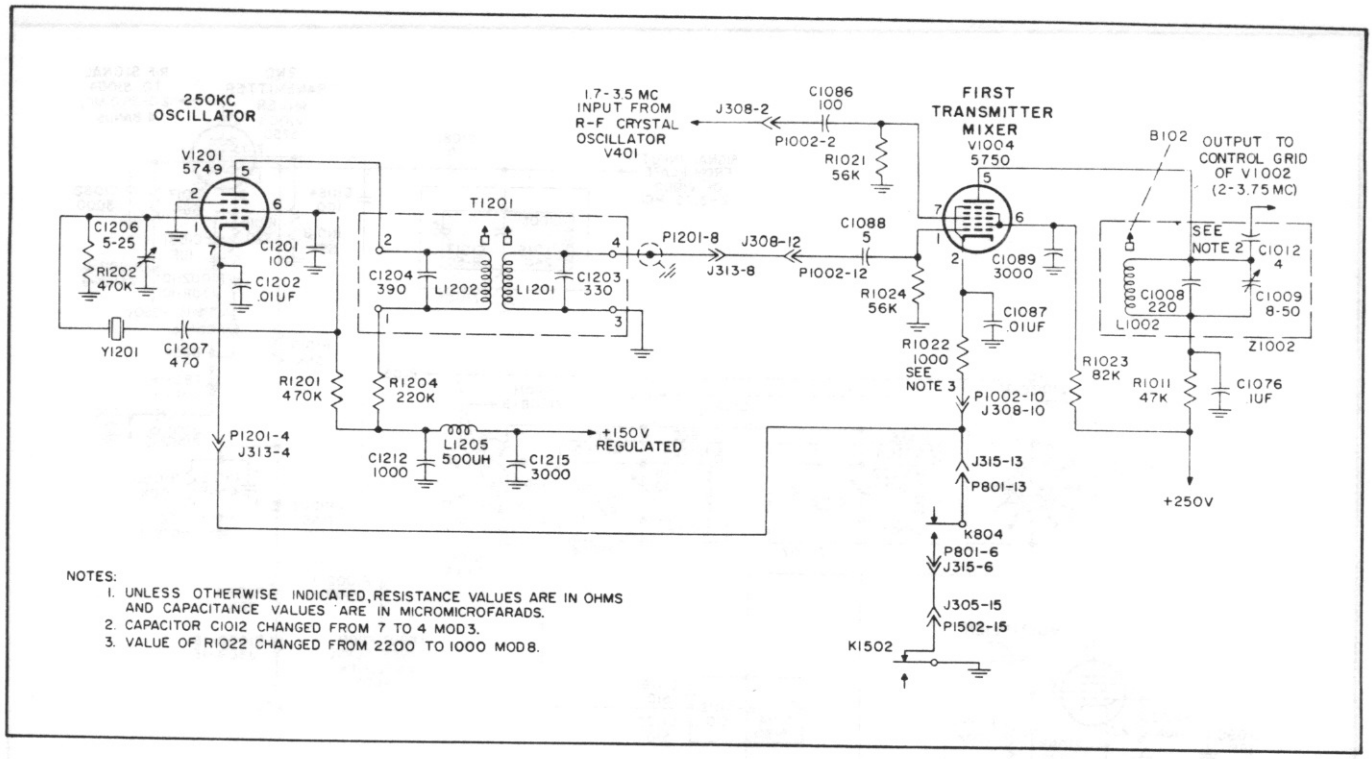


Figure 4-3. First Transmitter Mixer and 250 Kc Oscillator, Simplified Schematic Diagram

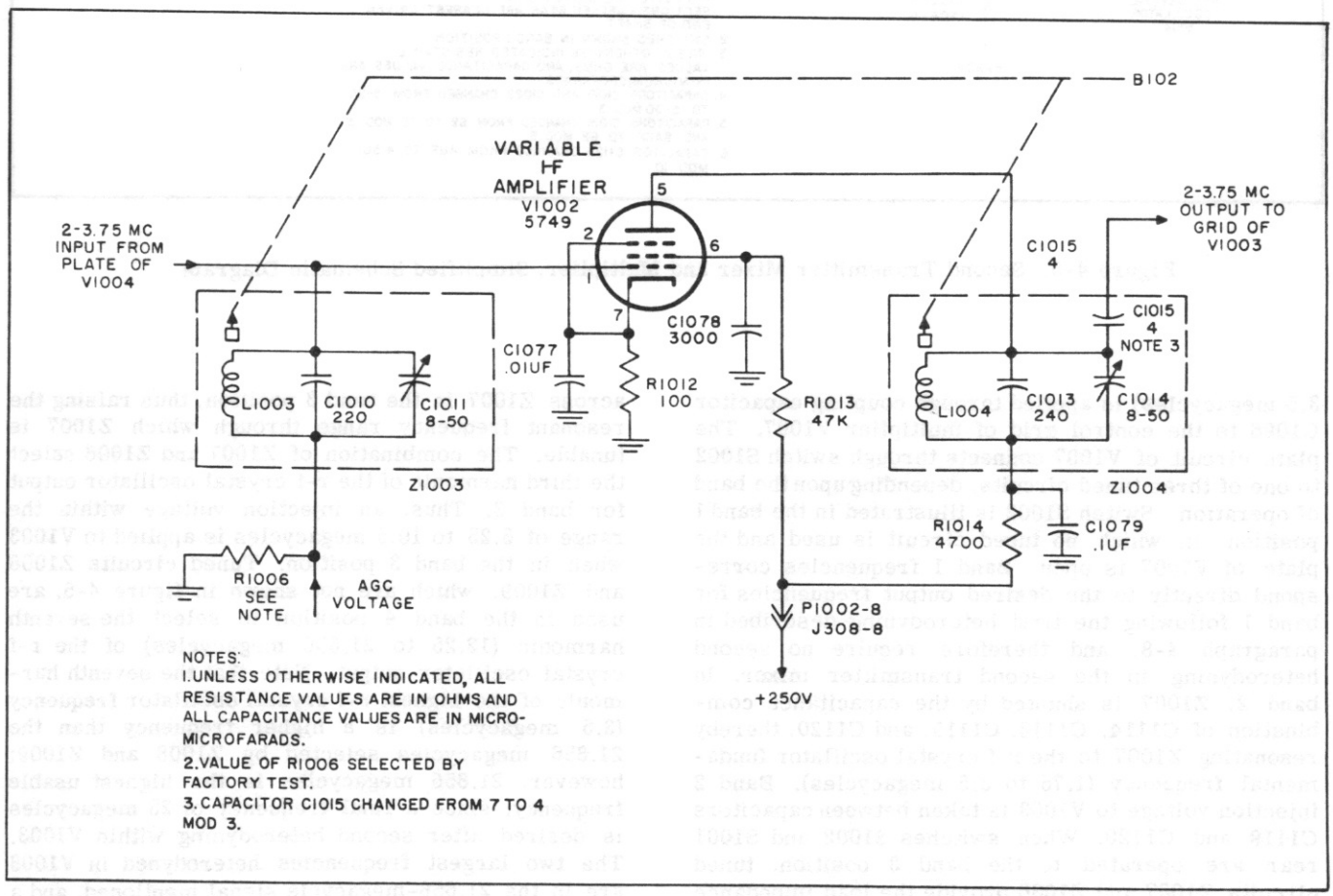


Figure 4-4. Variable I-F Amplifier, Simplified Schematic Diagram

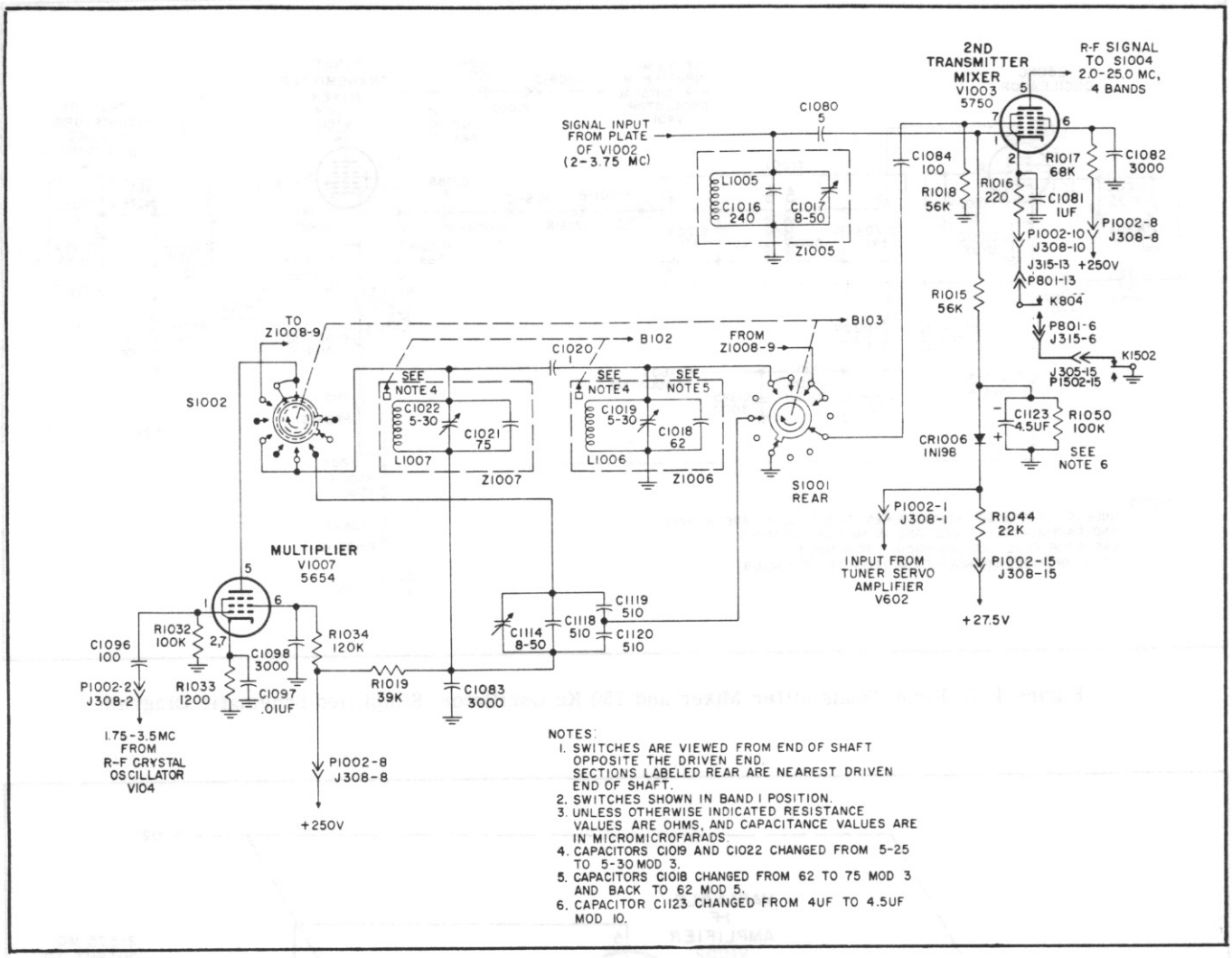
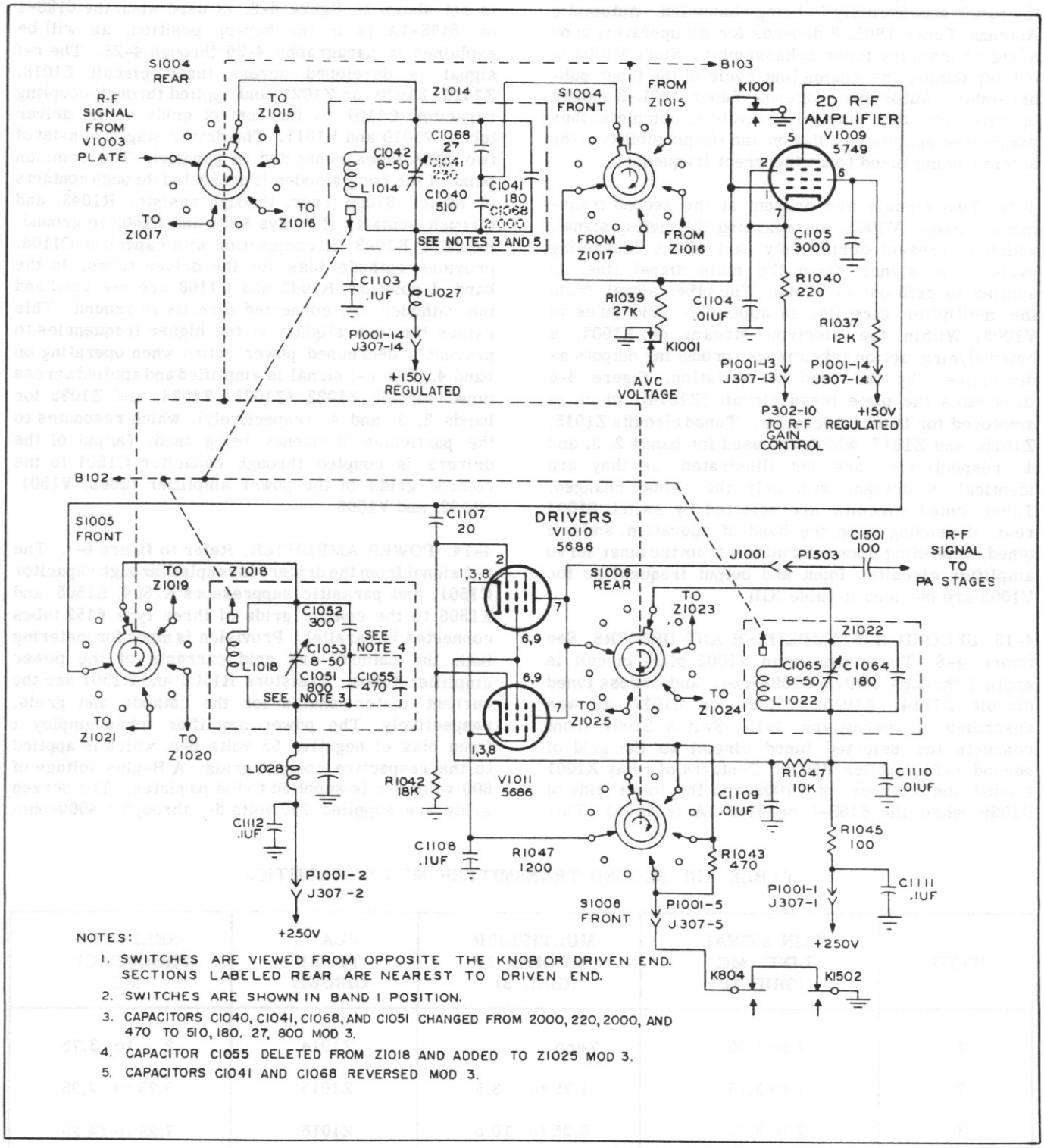


Figure 4-5. Second Transmitter Mixer and Multiplier, Simplified Schematic Diagram

3.5 megacycles) is applied through coupling capacitor C1096 to the control grid of multiplier V1007. The plate circuit of V1007 connects through switch S1002 to one of three tuned circuits, depending upon the band of operation. Switch S1002 is illustrated in the band 1 position, in which no tuned circuit is used and the plate of V1007 is open. Band 1 frequencies correspond directly to the desired output frequencies for band 1 following the first heterodyning described in paragraph 4-8, and therefore require no second heterodyning in the second transmitter mixer. In band 2, Z1007 is shunted by the capacitance combination of C1114, C1118, C1119, and C1120, thereby resonating Z1007 to the r-f crystal oscillator fundamental frequency (1.75 to 3.5 megacycles). Band 2 injection voltage to V1003 is taken between capacitors C1119 and C1120. When switches S1002 and S1001 rear are operated to the band 3 position, tuned circuits Z1007 and Z1006 provide the load impedance between V1007 and V1003. The capacitor combination of C1114, C1118, C1119, and C1120 is not shunted across Z1007 in the band 3 position, thus raising the resonant frequency range through which Z1007 is tunable. The combination of Z1007 and Z1006 select the third harmonic of the r-f crystal oscillator output for band 3. Thus, an injection voltage within the range of 5.25 to 10.5 megacycles is applied to V1003 when in the band 3 position. Tuned circuits Z1008 and Z1009, which are not shown in figure 4-5, are used in the band 4 position to select the seventh harmonic (12.25 to 21.656 megacycles) of the r-f crystal oscillator output. Note that the seventh harmonic of the highest r-f crystal oscillator frequency (3.5 megacycles) is a higher frequency than the 21.656 megacycles selected by Z1008 and Z1009; however, 21.656 megacycles is the highest usable frequency, since a final frequency of 25 megacycles is desired after second heterodyning within V1003. The two largest frequencies heterodyned in V1003 are in the 21.656-megacycle signal mentioned, and a 3.344-megacycle signal from the r-f crystal oscillator and transmitter first mixer, V1004, thus producing

the desired 25-megacycle maximum frequency. The method of frequency selection will be discussed thoroughly in the control section, paragraph 4-46 and subsequent paragraphs.

4-11. Another injection voltage, which is applied to V1003 control grid, originates in the tuner muting circuit. The tuner muting circuit consists of resistors R1044 and R1050, capacitor C1123, and crystal rectifier CR1006. A fixed bias of 27.5 volts d-c is applied to CR1006 at all times. Under normal conditions, CR1006 cannot conduct because of the bias voltage. During channeling, a signal from V602 of the tuner servo amplifier subassembly is applied across



NOTES:

1. SWITCHES ARE VIEWED FROM OPPOSITE THE KNOB OR DRIVEN END. SECTIONS LABELED REAR ARE NEAREST TO DRIVEN END.
2. SWITCHES ARE SHOWN IN BAND I POSITION.
3. CAPACITORS C1040, C1041, C1068, AND C1051 CHANGED FROM 2000, 220, 2000, AND 470 TO 510, 180, 27, 800 MOD 3.
4. CAPACITOR C1055 DELETED FROM Z1018 AND ADDED TO Z1025 MOD 3.
5. CAPACITORS C1041 AND C1068 REVERSED MOD 3.

Figure 4-6. Second R-F Amplifier and Drivers, Simplified Schematic Diagram

CR1006. This signal is sufficient to overcome the 27.5-volt bias, causing CR1006 to conduct through the parallel combination of C1123 and R1050. The drop across C1123 and R1050 results in a negative voltage, sufficient for cutoff, being applied to V1003 control grid. The signal from V602 is applied across CR1006 only during the channeling cycle of the tuner subassembly, thus preventing V1003 from conducting while the tuner subassembly is being channeled. Automatic Antenna Tuner 180L-3 depends for its operation upon a signal from the tuner subassembly. Since V1003 is cut off during the channeling cycle of the tuner subassembly, Automatic Antenna Tuner 180L-3 cannot operate until this channeling cycle is complete, thus preventing spurious radiation and the possibility of the antenna being tuned to an incorrect frequency.

4-12. Two signals are present at the second transmitter mixer, V1003, disregarding the muting signal, which is present during only part of the channeling cycle. One signal, from the main signal line, is applied to grid one of V1003. The other signal, from the multiplier circuits, is applied to grid three of V1003. Within the electron stream of V1003, a heterodyning action takes place, producing outputs as determined by the band of operation. Figure 4-6 illustrates the plate tuned circuit (Z1014), which is employed for band 1 operation. Tuned circuits Z1015, Z1016, and Z1017, which are used for bands 2, 3, and 4, respectively, are not illustrated, as they are identical in design, with only the values changed. These tuned circuits are selected by switch S1004 rear, depending upon the band of operation, and are tuned, depending upon information from the tuner servo amplifier circuits. Input and output frequencies for V1003 are outlined in table XIII.

4-13. SECOND R-F AMPLIFIER AND DRIVERS. See figure 4-6. The signal from V1003 plate circuit is applied through switch S1004 rear and across tuned circuit Z1014, Z1015, Z1016, or Z1017, as was described in paragraph 4-15. Switch S1004 front connects the selected tuned circuit to the grid of second r-f amplifier V1009. Contacts of relay K1001 ground the cathode of V1009 and the lower side of R1039 when the 618S-1 or 618S-1A is keyed. This increases the r-f gain slightly during transmission. The r-f signal, as listed in table XIII, is amplified by V1009 and applied through one of four plate-tuned circuits, depending upon the band of operation. Tuned circuit Z1018 (band 1) is the only plate-tuned circuit illustrated for the sake of simplicity. Tuned circuits Z1019, Z1020, and Z1021 are used when operating on bands 2, 3, and 4, respectively. Switch S1005, which is not shown in figure 4-6, is used when the 618S-1 or 618S-1A is in the key-up position, as will be explained in paragraphs 4-26 through 4-28. The r-f signal is developed across tuned circuit Z1018, Z1019, Z1020, or Z1021, and applied through coupling capacitor C1107 to the control grids of the driver tubes, V1010 and V1011. The driver stages consist of two 5686 tubes connected in parallel. The common point of the two cathodes is connected through contacts of switch S1006 rear, through resistor R1043, and through contacts of relays K804 and K1502 to ground. Resistor R1043, in conjunction with capacitor C1108, provides cathode bias for the driver tubes. In the band 4 position, R1043 and C1108 are not used and the cathodes are connected directly to ground. This raises the gain slightly at the higher frequencies to prevent a decreased power output when operating on band 4. The r-f signal is amplified and applied across tuned circuit Z1022 (Z1023, Z1024, and Z1025 for bands 2, 3, and 4, respectively), which resonates to the particular frequency being used. Output of the drivers is coupled through capacitor C1501 to the control grids of the power amplifier tubes, V1501, V1502, and V1503.

4-14. POWER AMPLIFIER. Refer to figure 4-7. The r-f signal from the drivers is coupled through capacitor C1501, and parasitic suppressors E1504, E1505, and E1506 to the control grids of three type 6159 tubes connected in parallel. Provision is made for metering both the cathode and grid currents of the power amplifier tubes. Resistors R1502 and R1501 are the current meter shunts for the cathode and grids, respectively. The power amplifier tubes employ a fixed bias of negative 65 volts d-c, which is applied to the respective control grids. A B-plus voltage of 600 volts d-c is supplied to the pa plates. The screen grids are supplied 250 volts d-c through a 4000-ohm

TABLE XIII. SECOND TRANSMITTER MIXER STATISTICS

BAND	MAIN SIGNAL LINE, MC (GRID 1)	MULTIPLIER CIRCUITS, MC (GRID 3)	PLATE TUNED CIRCUIT	SELECTED FREQUENCY, MC
1	2 to 3.75	Zero	Z1014	2 to 3.75
2	2 to 3.75	1.75 to 3.5	Z1015	3.75 to 7.25
3	2 to 3.75	5.25 to 10.5	Z1016	7.25 to 14.25
4	2 to 3.344	12.25 to 21.656	Z1017	14.25 to 25

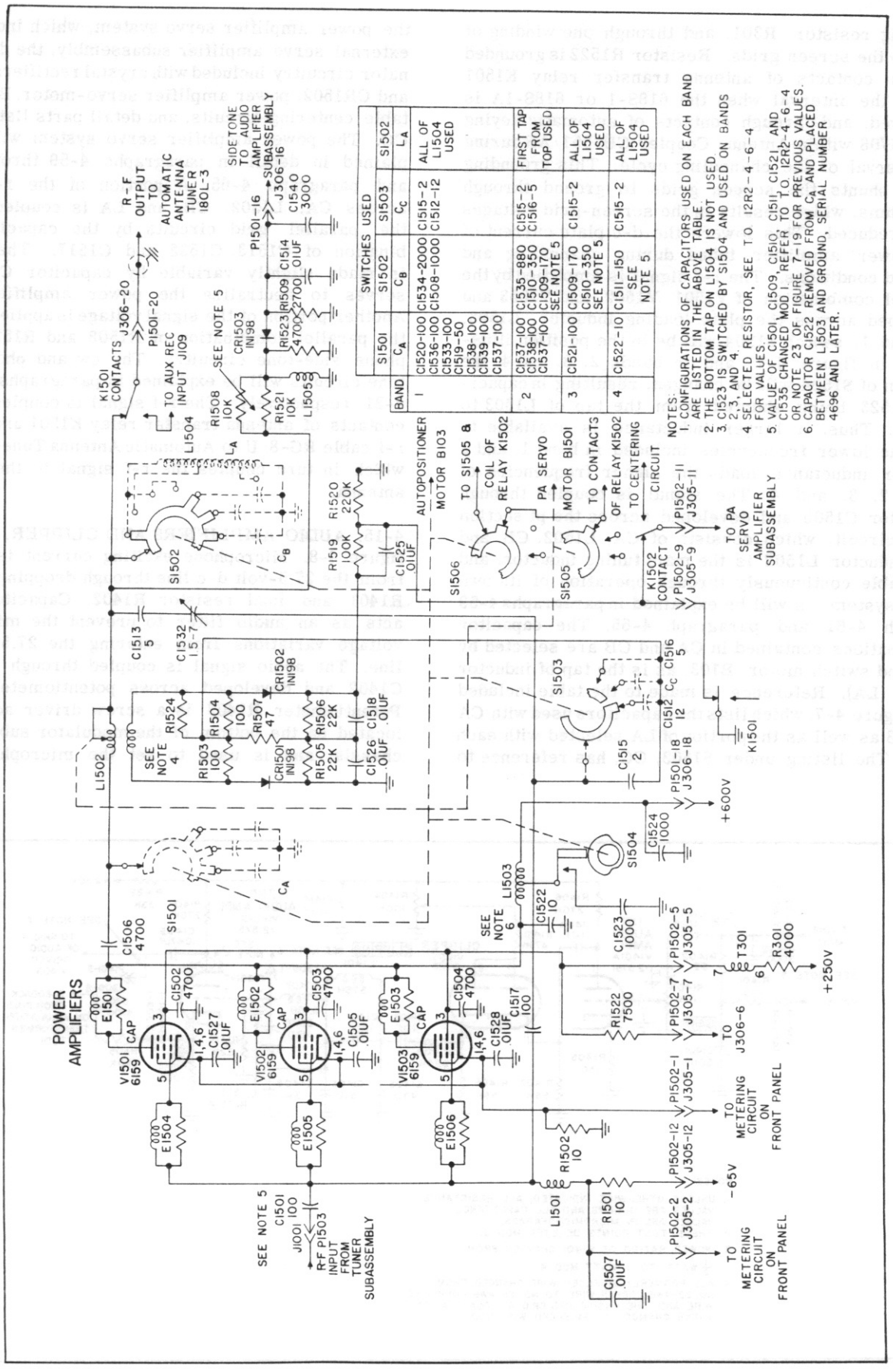
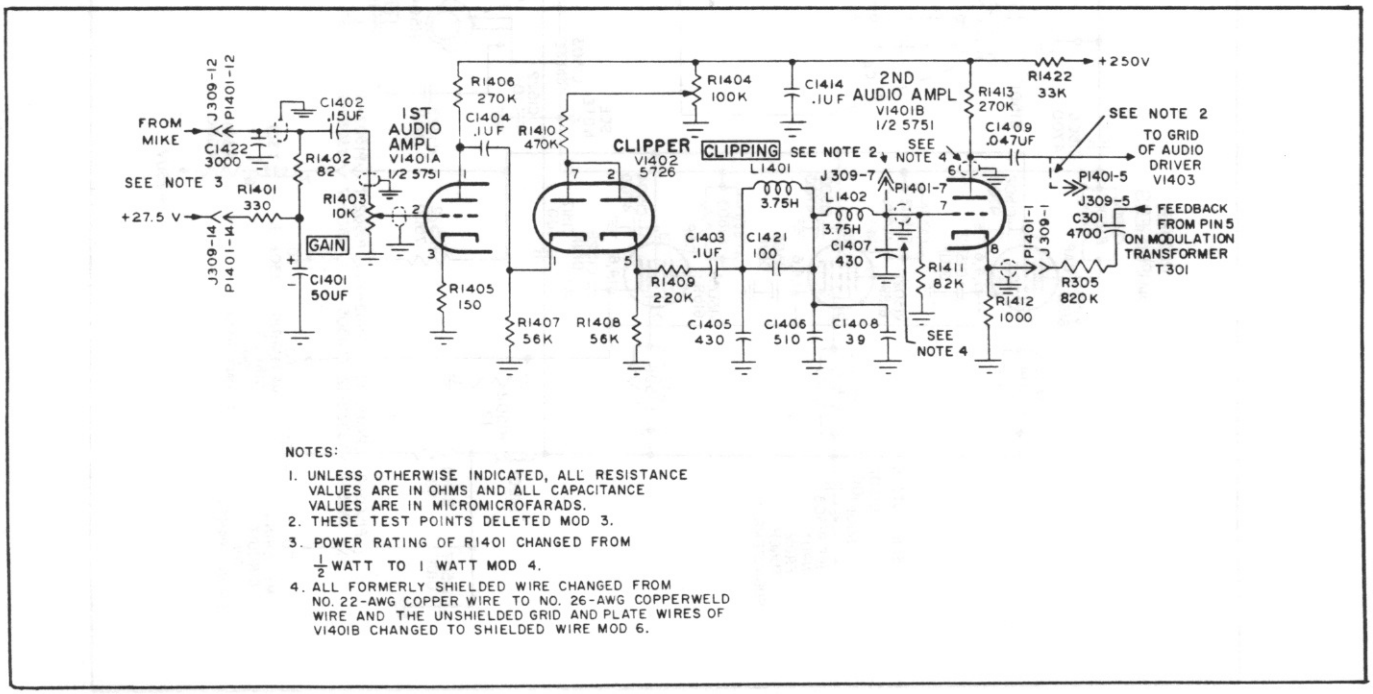


Figure 4-7. Power Amplifier, Simplified Schematic Diagram

dropping resistor, R301, and through one winding of T301 to the screen grids. Resistor R1522 is grounded through contacts of antenna transfer relay K1501 during the interval when the 618S-1 or 618S-1A is not keyed, and through contacts of automatic keying relay K708 within Antenna Coupler CU-351/AR during the interval of the channeling cycle. This grounding action shunts the screen grids to ground through 7500 ohms, which results in the screen-grid voltages being reduced. This lowers the d-c plate current of the power amplifier tubes during channeling and unkeyed conditions. The r-f signal is amplified by the parallel combination of V1501, V1502, and V1053 and developed across the plate loading inductor, L1503. On band 1, switch S1504 will be in the position illustrated in figure 4-7, and in bands 2, 3, and 4, the position of S1504 will be changed, resulting in capacitor C1523 being shunted from the tap of L1503 to ground. Thus, a larger inductance is available to load the lower frequencies included in band 1, and a smaller inductance loads the higher frequencies of bands 2, 3, and 4. The signal is coupled through capacitor C1506 and developed across the pi section tuned circuit, which consists of CA, L1502, CB, and LA. Inductor L1502 is the main tuning inductor, and is tunable continuously through operation of its own servo system, as will be explained in paragraphs 4-59 through 4-61 and paragraph 4-65. The capacitor combinations contained in CA and CB are selected by the band switch motor, B103, as is the tap of inductor L1504 (LA). Reference is made to the table included with figure 4-7, which lists the capacitors used with CA and CB as well as the portion of LA selected with each band. The listing under S1503, CC, has reference to the power amplifier servo system, which includes an external servo amplifier subassembly, the discriminator circuitry included with crystal rectifiers CR1501 and CR1502, power amplifier servo-motor, B1501, the table centering circuits, and detail parts listed under CC. The power amplifier servo system will be explained in detail in paragraphs 4-59 through 4-61 and paragraph 4-65. A portion of the r-f signal across CA, L1502, CB, and LA is coupled back to the parallel grid circuits by the capacitor combination of C1513, C1532, and C1517. The voltage is made slightly variable by capacitor C1532 and serves to neutralize the power amplifier stage. Another portion of the signal voltage is applied through the parallel combination of R1508 and R1521 to the phone side-tone circuitry. The cw and phone side-tone circuits will be explained in paragraphs 4-20 and 4-21, respectively. The r-f signal is coupled through contacts of antenna transfer relay K1501 and through r-f cable RG-8/U to Automatic Antenna Tuner 180L-3, which in turn couples the r-f signal to the aircraft antenna.

4-15. AUDIO AMPLIFIERS AND CLIPPER. Refer to figure 4-8. Microphone exciting current is obtained from the 27.5-volt d-c line through dropping resistor R1401 and load resistor R1402. Capacitor C1401 acts as an audio filter to prevent the microphone voltage variations from entering the 27.5-volt d-c line. The audio signal is coupled through capacitor C1402 and developed across potentiometer R1403. Potentiometer R1403 is a screw driver adjustment located on the bottom of the modulator subassembly chassis, and is used to set the microphone level



NOTES:

1. UNLESS OTHERWISE INDICATED, ALL RESISTANCE VALUES ARE IN OHMS AND ALL CAPACITANCE VALUES ARE IN MICROMICROFARADS.
2. THESE TEST POINTS DELETED MOD 3.
3. POWER RATING OF R1401 CHANGED FROM $\frac{1}{2}$ WATT TO 1 WATT MOD 4.
4. ALL FORMERLY SHIELDED WIRE CHANGED FROM NO. 22-AWG COPPER WIRE TO NO. 26-AWG COPPERWELD WIRE AND THE UNSHIELDED GRID AND PLATE WIRES OF V1401B CHANGED TO SHIELDED WIRE MOD 6.

Figure 4-8. Audio Amplifiers and Clipper, Simplified Schematic Diagram

during alignment procedures. The signal is amplified by V1401A and coupled through capacitor C1404 to the cathode (pin 1) of the clipper stage, V1402.

4-16. The clipper stage, V1402, is a dual diode tube connected as a biased series clipper circuit. The clipping level may be adjusted by R1404, which is connected across the 250-volt d-c line. Assume, for purposes of explanation, that R1404 is set to the correct position for a level of plus 10 volts d-c at the plates of V1402. Under static conditions, the voltage at both cathodes also will be plus 10 volts d-c, and will remain so as long as both diode sections conduct. While the diodes are conducting, the plate resistance may be assumed to be zero, resulting in equal voltages at both the plates and cathodes of the diodes. When an alternating signal is applied across R1407, this signal will both add and subtract from the plus 10 volts d-c present at the input cathode. Assume the alternating signal has a peak-to-peak value of 10 volts. On the positive alternation, as the signal voltage rises from zero to plus 5 volts, the input cathode voltage will rise from the fixed 10 volts to a total of 15 volts. Since a short-circuit condition exists between the input cathode and its plate during conduction, this signal also will appear at the plate (pin 7) and will drive both plates to plus 15 volts. A short circuit also exists between the plate (pin 2) and the output cathode, which drives the output cathode, and therefore the output signal, to plus 15 volts. As the input alternating signal rises to its peak negative value, the negative 5 volts will subtract from the 10 volts present at the input cathode, driving the voltage to plus 5 volts. The short-circuit conditions still exist between all of the tube elements, and the voltage at the output cathode will follow this change to plus 5 volts. From this it may be seen that, as long as the input voltage (through coupling capacitor C1404) does not exceed the ten volts to which the dual diode is biased, the output signal will follow faithfully the input signal, and the clipper stage acts merely as a conductor. Clipping action will start as soon as the input voltage exceeds the plus 10 volts bias, or as soon as the input voltage exceeds a peak-to-peak value of 20 volts. Assume that a strong noise pulse with a peak-to-peak value of 30 volts is coupled through capacitor C1404 and applied to the input cathode. On the positive alternation (zero to plus 15 volts) the input cathode will follow the changing voltage, and will become positive a total of 25 volts (10 volts plus 15 volts). The plates are biased to plus 10 volts, resulting in the input cathode becoming positive 5 volts with respect to the plates. Since the input cathode must be slightly negative with respect to its plate for conduction, the input diode section will open. As long as the input signal was below plus 10 volts, the plate (pin 7) was able to follow the input cathode, and was driven to plus 20 volts (10 volts bias added to the 10 volts of signal). The plate (pin 7) and the plate (pin 2) cannot rise above this plus 20 volts, and will remain at this point until the input cathode voltage decreases to a value no greater than plus 20 volts. The output cathode continues to conduct, resulting in an output voltage of plus 20 volts, even though the input cathode has risen to a total of plus 25 volts. On the negative alternation of the noise pulse, the input cathode is driven to negative five volts (plus 10 volts bias, minus 15 volts signal). The plate (pin 7) will follow this change to negative five volts, and will continue to conduct, because at no time is the input cathode positive with respect to the plate (pin 7). The plate (pin 2) also must become negative a total of 5 volts, as it is paralleled with the plate (pin 7). The output cathode will decrease to as far as zero voltage, at which point, its plate (pin 2) becomes negative, and the output diode circuit must cut off. In this manner, with double clipping action taking place, the output signal will follow the input signal only to the extent of a peak input of 10 volts (20 volts peak-to-peak), and any strong signal, such as a noise pulse, will be clipped off effectively.

4-17. The audio signal from the output cathode of V1402 is fed through resistor R1409, through capacitor C1403, and applied to the low-pass filter arrangement of L1401, L1402, C1421, C1405, C1406, C1408, and C1407. Resistor R1409 performs the function of isolating the filter from the changing impedance of the clipper stage. The low-pass filter is designed for a cutoff frequency of 3500 cps, at which point the maximum attenuation will not exceed 3 db. The minimum attenuation at 6500 cps is at least 17 db, thus, all harmonic frequencies introduced in the clipper stage are removed. The audio signal from the filter is developed across grid resistor R1411, and amplified by V1401B. A feedback voltage from pin 5 of the modulation transformer (T301) is applied through the phasing arrangement C301 and R305, and developed across cathode resistor R1412 of V1401B. This feedback voltage is degenerative in nature, and flattens the over-all frequency response throughout the range of the low-pass filter. The audio signal is amplified by V1401B and coupled through capacitor C1409 to the grid of V1403A.

4-18. AUDIO DRIVERS AND MODULATORS. Refer to figure 4-9. The audio signal from V1401B is developed across grid resistor R1414, causing the grid of V1403A to follow the signal variations. Capacitor C1413 bypasses the grid circuit to high-frequency voltage variations. The audio signal is amplified, and appears at the plate circuit of V1403A. The plate of V1403A is coupled through capacitor C1411 and resistor R1416 to the grid of V1403B. Since the capacitive reactance of C1411 is very small compared to the resistance of R1416 at audio frequencies, the phase of the signal developed across grid resistor R1417 is essentially in phase with the signal at the plate of V1403A and 180 degrees out of phase with the signal at the grid of V1403A. The phase is inverted in the plate circuit of V1403B, resulting in a 180-degree phase relationship between the signals at the plate of V1403A and the plate of V1403B. This phase relationship is necessary to drive the push-pull modulators, V1404 and V1405. The two signals (one from V1403A and the other from V1403B) are coupled through capacitors C1410 and C1412 to the grids of V1404 and V1405, respectively.

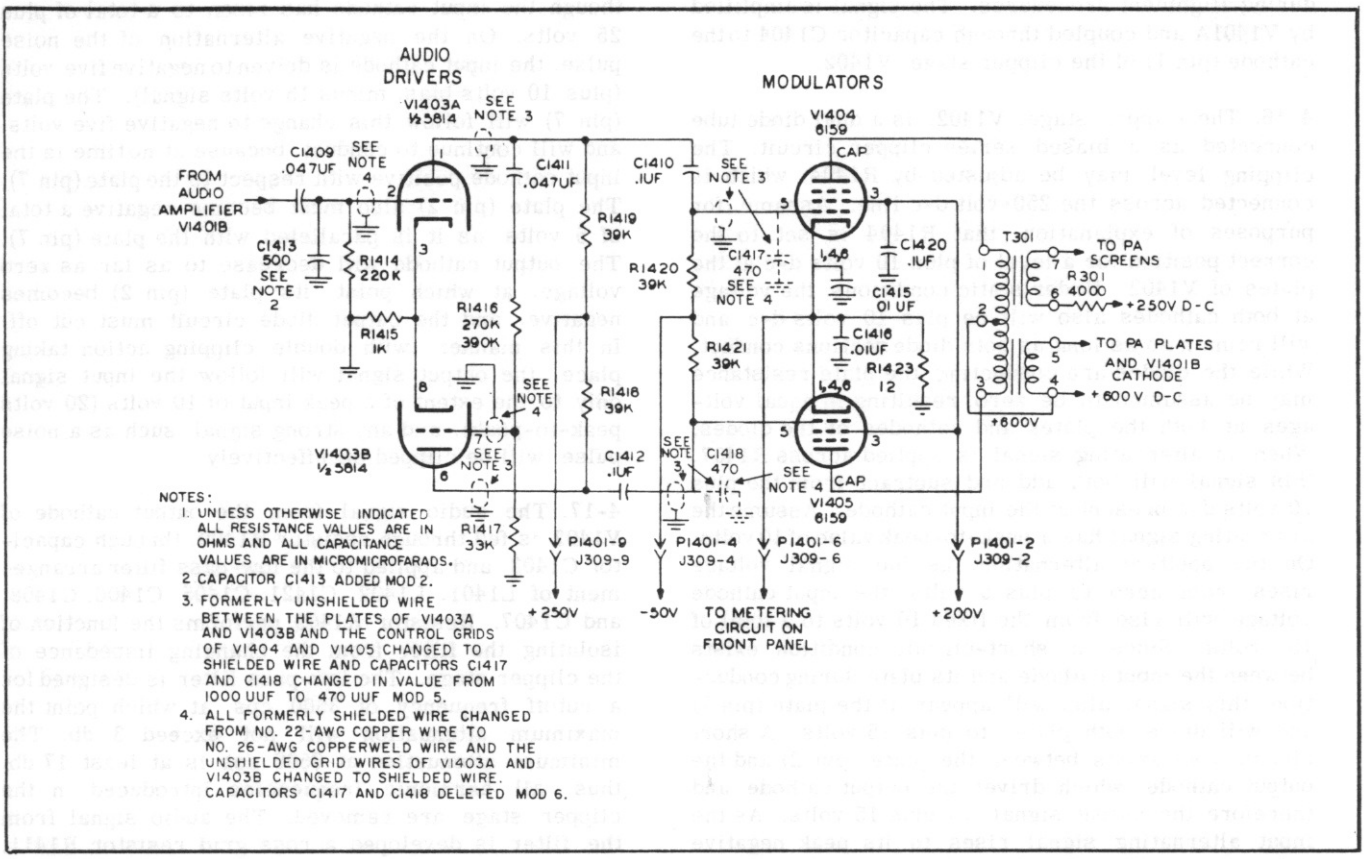


Figure 4-9. Audio Drivers and Modulators, Simplified Schematic Diagram

4-19. The audio signals from V1403A and V1403B are developed across grid resistors R1420 and R1421 of the modulator tubes, V1404 and V1405. The modulator tubes are connected for push-pull operation, under class AB2 conditions. Approximately 100 volts (grid to grid) of audio signal drives the modulator tubes to full output. Provision is made for metering the common cathode current of V1404 and V1405. Resistor R1423 is the current meter shunt, and capacitors C1415 and C1416 perform the dual functions of meter bypass and cathode bypass. The current meter is located on the front panel and may be connected to read the cathode current of V1404 and V1405 by operating the meter selector to the MOD. PL. position. The modulator grids are biased to negative 50 volts d-c from Power Supply 416W-1. The two audio signals present at the modulator grids are amplified and appear across the primary winding of T301. Considering the center tap as the common point, the audio signals at terminals 1 and 3 have a 180-degree phase relationship. Therefore, the signals at secondary terminals 5 and 7 are in phase, and are used to plate and screen modulate the power amplifier tubes. A part of the signal present at terminal 5 is fed back to the second audio amplifier, V1401B, and is used to flatten the over-all frequency response, as was explained in paragraph 4-19.

4-20. SIDE-TONE CIRCUIT. Refer to figure 4-10. Side tone for cw operation is provided by 6.3 volts, 400 cps from Power Supply 416W-1, which is applied through the line filter arrangement of C1850, C1807, and L1807 to resistors R108 and R107. Resistor R107 is a potentiometer, which may be set for the desired cw side-tone amplitude. Relay K803 is energized when the OFF PHONE CW switch of Radio Set Control 614C-2 is operated to the CW position. Relay K804 is energized by operation of either a telegraph key or the microphone push-to-talk button. The 400-cps signal (amplitude dependent upon setting of R107) is coupled through capacitor C1301 and developed across resistor R1302. Resistors R1302 and R1303 form a voltage divider for both side-tone signals. Capacitor C1306 prevents spurious r-f signals from varying the grid voltage of first audio amplifier V1301A. The cw side tone is amplified by V1301A and passed on to the headset, as described in paragraph 4-35.

4-21. Side-tone voltage for voice operation is provided by the power amplifier stage. Resistors R1508

and R1521, in conjunction with the parallel arrangement of resistor R1523 and inductor L1505, perform the dual functions of dividing the r-f signal and isolating the power amplifier plate circuit from the varying impedance of CR1503. The r-f signal is rectified by CR1503 and filtered by the combination of R1509, C1514, and C1540, thus recovering the modulation envelope. The audio signal is made variable by resistor R106, which may be set for the desired side tone amplitude. The audio signal is applied through contacts of K803, at which point operation is identical with the cw side-tone circuit.

4-22. RECEIVER SECTION.

4-23. Reference is made to the block diagram, figure 4-11. An r-f signal, within the frequency range of 2 to 25 megacycles, is received by the antenna and applied through contacts of switch S1003 rear, through 1 of 4 tuned circuits, and through contacts of switch S1003 front to the control grid of V1008. Both sections of switch S1003, as well as all other band switches, are operated by autopositioner motor B103, which receives its information from Radio Set Control 614C-2, in conjunction with the bandchange autopositioner. The slugs of all tuned circuits within the receiver section of Radio Set 618S-1 and 618S-1A are driven by servomotor B102 whenever a new channel is selected. Servomotor B102 receives its information from the r-f crystal oscillator, and a discriminator and servo amplifier system, consisting of V1001, G601, V601, and V602. The r-f signal is amplified by V1008 and applied through a similar tuned circuit and switching arrangement, consisting of Z1014 through Z1017 and switches S1004 front and rear. The signal is amplified by the second r-f amplifier, V1009, applied through Z1018, Z1019, Z1020, or Z1021, depending upon the position of S1005 front and rear, and applied to the control grid of the first receiver mixer, V1005. Another signal, which originates in the r-f crystal oscillator, is applied through the multiplier stage (V1007), through multiplier tuned circuits (Z1006 through Z1009), to grid 3 of V1005. Switches S1002 and S1001 rear select the correct tuned circuit arrangement for the following frequencies: band 1, zero megacycles; band 2, 1.75 to 3.5 megacycles; band 3, 5.25 to 10.5 megacycles; and band 4, 12.25 to 21.656 megacycles. The two signals (one from the antenna and r-f amplifiers, and the other from the r-f crystal oscillator and multipliers) are mixed in the electron stream of V1005, producing an output signal within the range of 2 to 3.75 megacycles. The 2- to 3.75-megacycle signal is applied through tuned circuits Z1002 and Z1003 to the control grid of variable i-f amplifier V1002. The variable i-f signal is amplified by V1002 and applied through tuned circuits Z1004 and Z1005 to the control grid of the second receiver mixer, V1006. An injection voltage from the r-f crystal oscillator within the frequency range of 1.75 to 3.5 megacycles is applied to grid 3 of V1006. The two signals (one of 2 to 3.75 megacycles from the main signal line and the other of 1.75 to 3.5 megacycles from the r-f crystal oscillator) are heterodyned in the electron stream of V1006 and applied through the mechanical filter, FL901. The mechanical

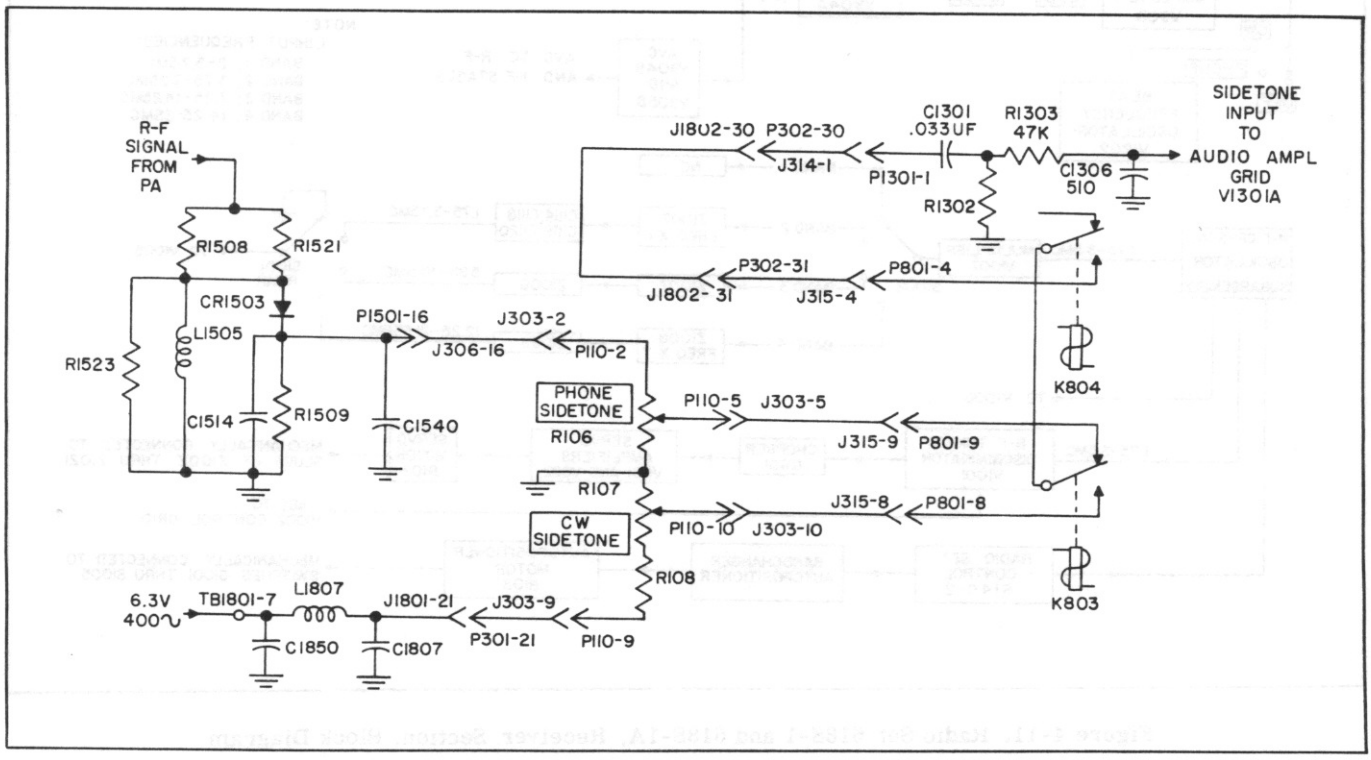


Figure 4-10. Side-Tone Circuit, Simplified Schematic Diagram

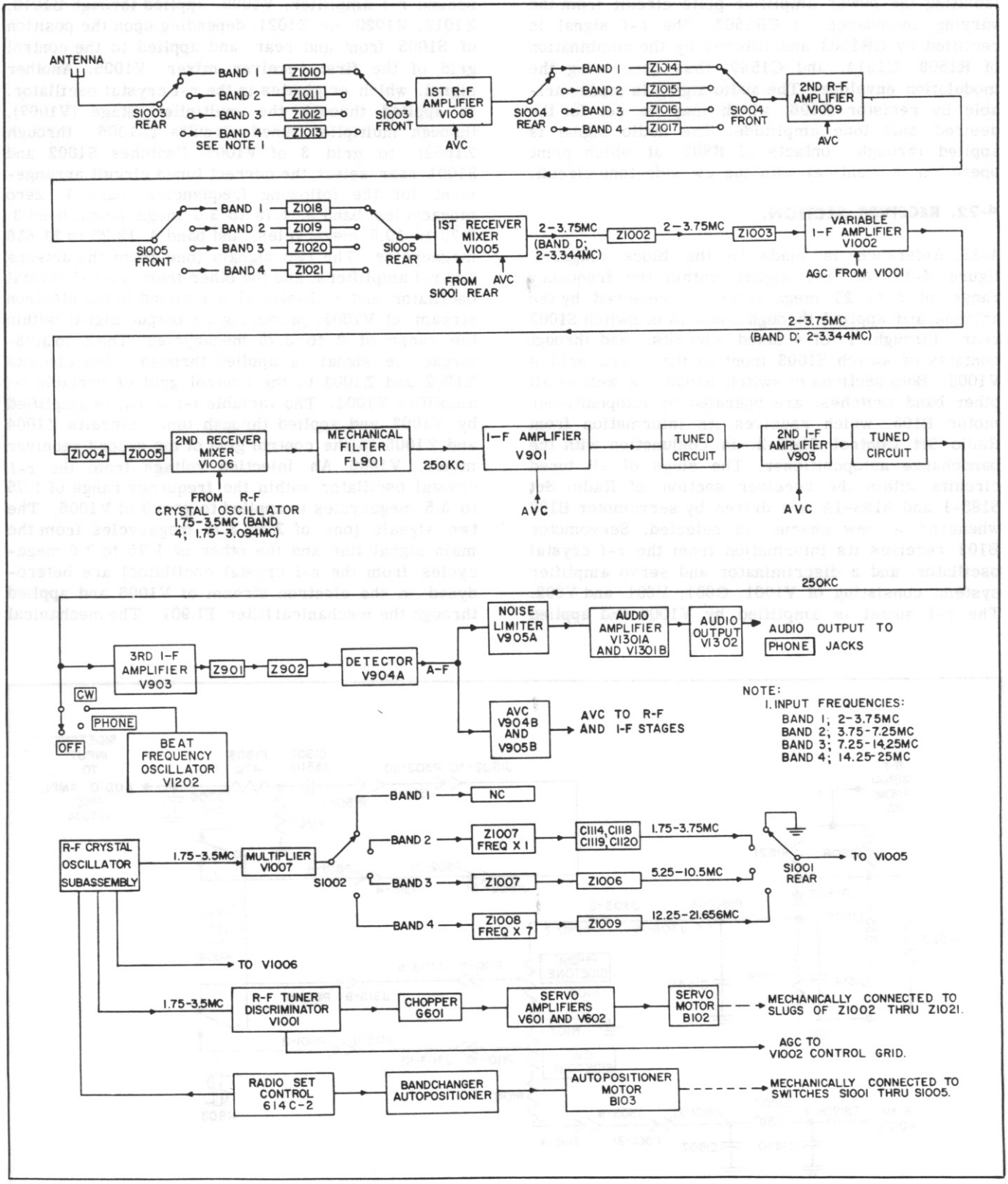


Figure 4-11. Radio Set 618S-1 and 618S-1A, Receiver Section, Block Diagram

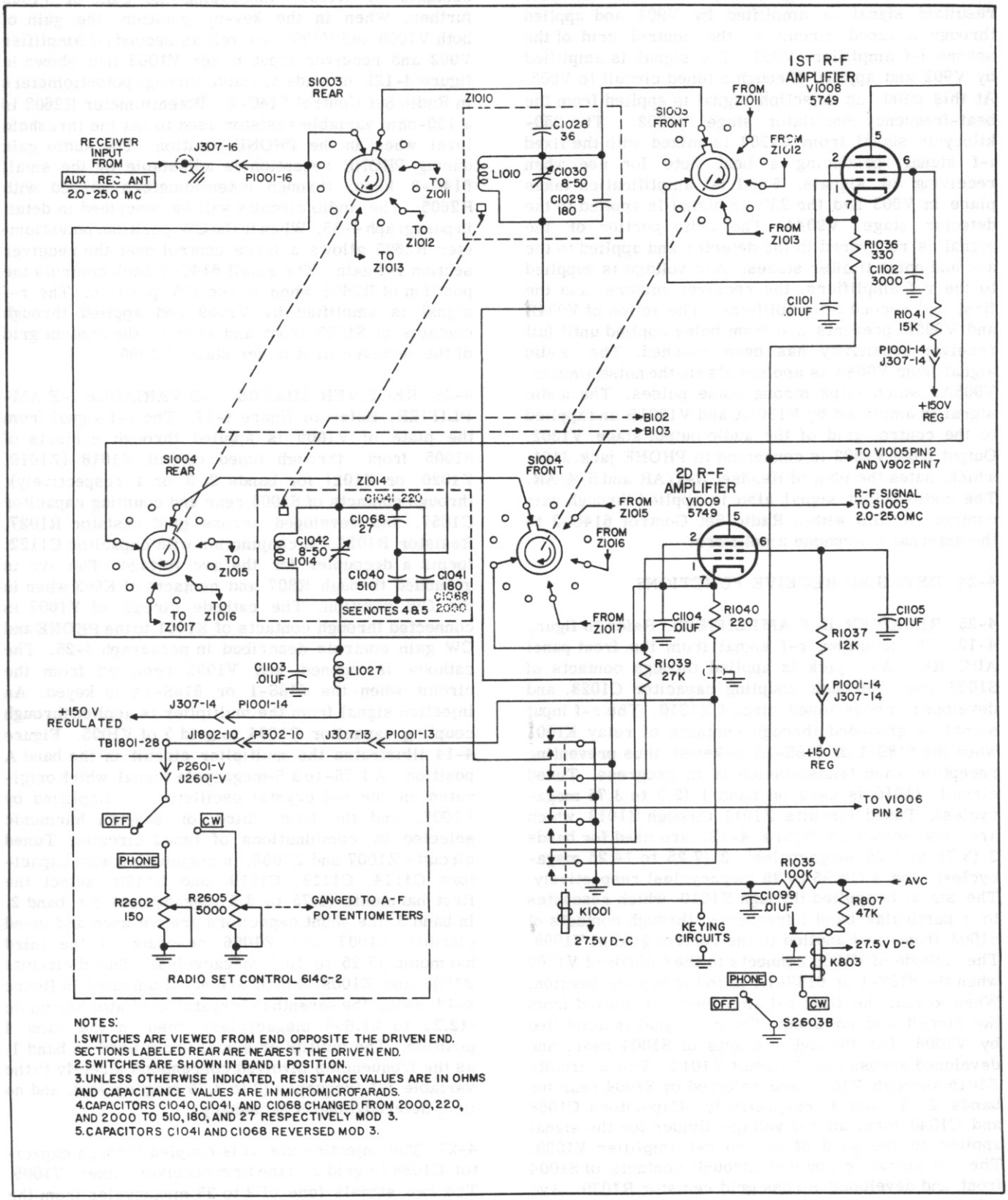
filter has a center frequency of 250 kilocycles, which selects the difference frequency (2 to 3.75 megacycles and 1.75 to 3.5 megacycles). The 250-kilocycle resultant signal is amplified by V901 and applied through a tuned circuit to the control grid of the second i-f amplifier, V902. The signal is amplified by V902 and applied through a tuned circuit to V903. At this point, an injection signal is applied from the beat-frequency oscillator stage, V1202. The 250-kilocycle signal from V1202 is mixed with the fixed i-f signal, producing a beat note for use when receiving cw signals. Final i-f amplification takes place in V903 and the 250-kc signal is applied to the detector stage, V904A. The audio portion of the signal is recovered in the detector and applied to the avc and noise limiter stages. Avc voltage is supplied to the r-f amplifiers, the receiver mixers, and the first and second i-f amplifiers. The action of V904B and V905B prevents avc from being applied until full receiver sensitivity has been reached. The audio signal from V904A is applied also to the noise limiter, V905A, which clips strong noise pulses. The audio signal is amplified by V1301A and V1301B and applied to the control grid of the audio output stage, V1302. Output from V1302 is connected to PHONE jack, J101, which mates the plug of Headset H-1/AR and H-4/AR. The audio output signal also is applied through gain control circuits within Radio Set Control 614C-2 to the external interphone amplifiers.

4-24. DETAILED RECEIVE FUNCTIONS.

4-25. RECEIVER R-F AMPLIFIERS. Refer to figure 4-12. The incoming r-f signal from the front panel AUX REC ANT jack is applied through contacts of S1003 rear, through coupling capacitor C1028, and developed across tuned circuit Z1010. The r-f input signal is grounded through contacts of relay K1001 when the 618S-1 or 618S-1A is keyed, thus preventing reception when transmission is in progress. Tuned circuit Z1010 is used on band 1 (2.0 to 3.75 megacycles). Tuned circuits Z1011 through Z1013, which are not shown in figure 4-12, are used for bands 2 (3.75 to 7.25 megacycles), 3 (7.25 to 14.25 megacycles), and 4 (14.25 to 25 megacycles) respectively. The signal is applied through Z1010, which resonates to a particular band 1 frequency, through contacts of S1003 front, and applied to the control grid of V1008. The cathode of V1008 connects to the cathode of V1009 when the 618S-1 or 618S-1A is in the key-up position. When keyed, the first r-f amplifier is removed from the circuit and not used. The r-f signal is amplified by V1008, fed through contacts of S1004 rear, and developed across tuned circuit Z1014. Tuned circuits Z1015 through Z1017 are selected by S1004 rear for bands 2, 3, and 4, respectively. Capacitors C1068 and C1040 form an r-f voltage divider for the signal applied to the grid of second r-f amplifier V1009. The r-f signal is coupled through contacts of S1004 front and developed across grid resistor R1039. Avc voltage is supplied directly to V1008 and through contacts of K1001 to V1009. When receiving in the CW position, avc is grounded through resistor R807, thereby lowering the avc voltage and increasing the gain of V1008 and V1009. When keyed, the grid and cathode circuits of V1009 are grounded through contacts of K1001, increasing the gain of V1009 further. When in the key-up position, the gain of both V1008 and V1009, as well as second i-f amplifier V902 and receiver input mixer V1005 (not shown in figure 4-12), is made variable through potentiometers in Radio Set Control 614C-2. Potentiometer R2602 is a 150-ohm variable resistor used to set the threshold level when in the PHONE position. The audio gain during PHONE reception is adjustable by the small 614C-2 knob, through potentiometers ganged with R2605. The audio circuits will be described in detail in paragraph 4-35. When in the CW position, potentiometer R2605 allows a large control over the receiver section r-f gain. The small 614C-2 knob controls the position of R2605 when in the CW position. The r-f signal is amplified by V1009 and applied through contacts of S1005 front and rear to the control grid of the receiver first mixer stage, V1005.

4-26. RECEIVER MIXERS AND VARIABLE I-F AMPLIFIER. Refer to figure 4-13. The r-f signal from the plate of V1009 is applied through contacts of S1005 front, through tuned circuit Z1018 (Z1019, Z1020, or Z1021 for bands 2, 3, or 4, respectively), through contacts of S1005 rear and coupling capacitor C1057, and developed across grid resistor R1027. Resistor R1027, in conjunction with capacitor C1122, forms a decoupler for the avc voltage. The avc is grounded through R807 and contacts of K803 when in the CW position. The cathode circuit of V1005 is connected through contacts of K1001 to the PHONE and CW gain controls described in paragraph 4-25. The cathode is opened and V1005 removed from the circuit when the 618S-1 or 618S-1A is keyed. An injection signal from the multiplier is applied through coupling capacitor C1084 to grid 3 of V1005. Figure 4-14 illustrates the multiplier circuit in the band A position. A 1.75- to 3.5-megacycle signal, which originates in the r-f crystal oscillator, is amplified by V1007, and the first, third, or seventh harmonic selected by combinations of tuned circuits. Tuned circuits Z1007 and Z1006, in conjunction with capacitors C1114, C1118, C1119, and C1120, select the first harmonic (1.75 to 3.5 megacycles) for band 2. In band 3, the shunt capacitors are not used and tuned circuits Z1007 and Z1006 resonate at the third harmonic (5.25 to 10.5 megacycles). Tuned circuits Z1008 and Z1009, which are not illustrated in figure 4-14, select the seventh r-f crystal oscillator harmonic (12.25 to 21.656 megacycles) when in the band 4 position. The multiplier signal is not used on band 1, as the frequencies involved correspond directly to the variable i-f frequency (2 to 3.75 megacycles), and no first heterodyning is necessary.

4-27. The injection signal is coupled through capacitor C1084 to grid 3 of the first receiver mixer, V1005. The two signals (one of 2 to 25 megacycles from the main signal line and the other of zero to 21.656 megacycles from the multiplier circuits) are heterodyned within the electron stream of V1005, and the difference frequency (2 to 3.75 megacycles) selected



NOTES:
1. SWITCHES ARE VIEWED FROM END OPPOSITE THE DRIVEN END. SECTIONS LABELED REAR ARE NEAREST THE DRIVEN END.
2. SWITCHES ARE SHOWN IN BAND I POSITION.
3. UNLESS OTHERWISE INDICATED, RESISTANCE VALUES ARE IN OHMS AND CAPACITANCE VALUES ARE IN MICROMICROFARADS.
4. CAPACITORS C1040, C1041, AND C1068 CHANGED FROM 2000, 220, AND 2000 TO 510, 180, AND 27 RESPECTIVELY MOD 3.
5. CAPACITORS C1041 AND C1068 REVERSED MOD 3.

Figure 4-12. Receiver R-F Amplifiers, Simplified Schematic Diagram

by tuned circuits Z1002 and Z1003. The 2- to 3.75-megacycle signal is applied to the control grid of variable i-f amplifier V1002. The variable i-f signal is amplified by V1002 and developed across tuned circuits Z1004 and Z1005. The variable i-f amplifier stage, in conjunction with tuned circuits Z1002 through Z1005, is used during both transmission and reception. An agc voltage, which originates in the r-f crystal oscillator and tuner discriminator, is applied to the control grid of V1002. This agc voltage faithfully follows the output level of the r-f crystal oscillator; thus, as the over-all gain tries to decrease as a result of a decreased r-f crystal oscillator output level, the gain of V1002 increases. In this manner, V1002 performs the dual functions of amplifying the variable i-f signal and maintaining a constant over-all gain with a varying r-f crystal oscillator signal.

4-28. Output from V1002 is developed across Z1004 and Z1005 and applied to the control grid of the

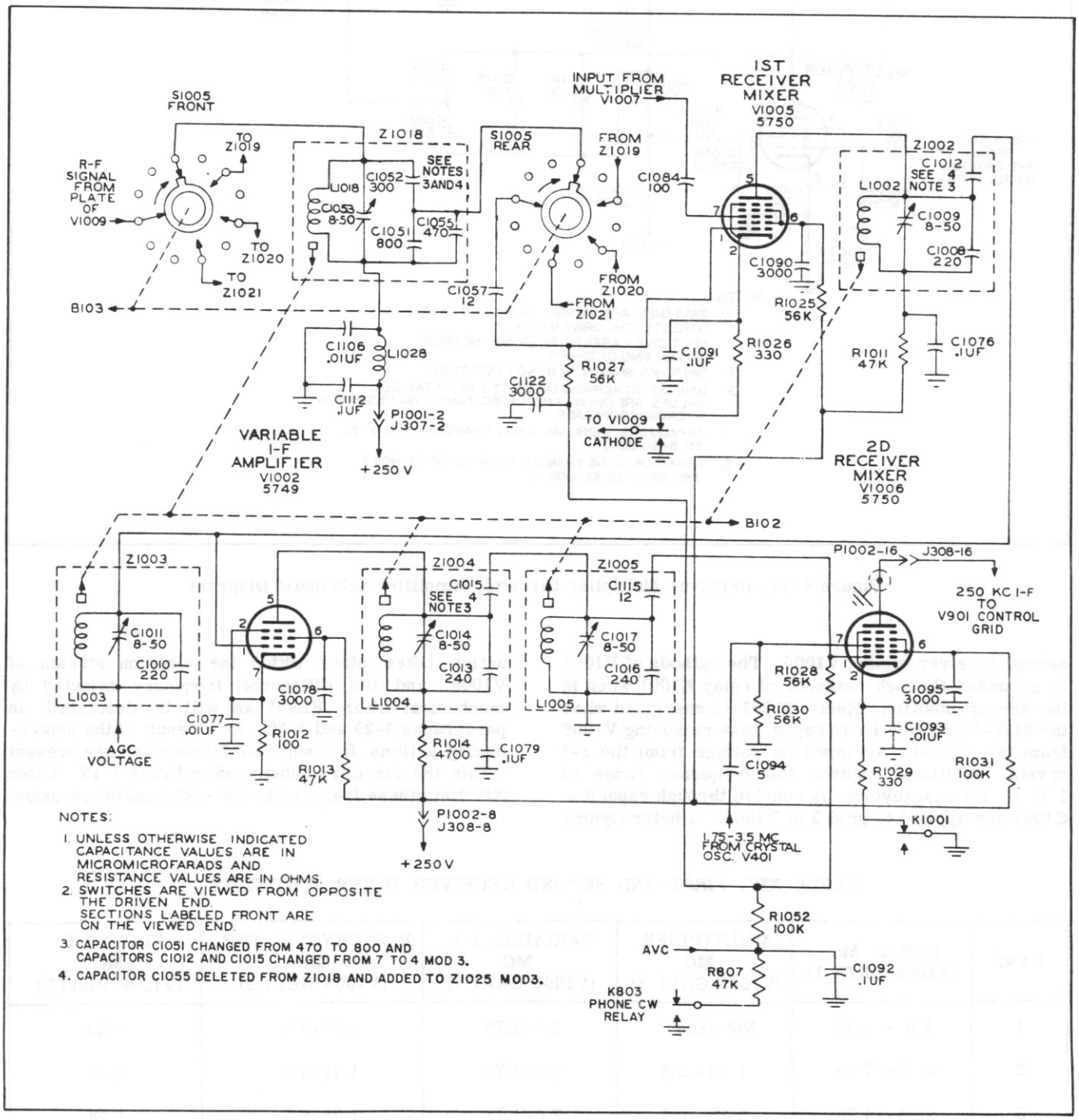


Figure 4-13. Receiver Mixers and Variable I-F Amplifier, Simplified Schematic Diagram

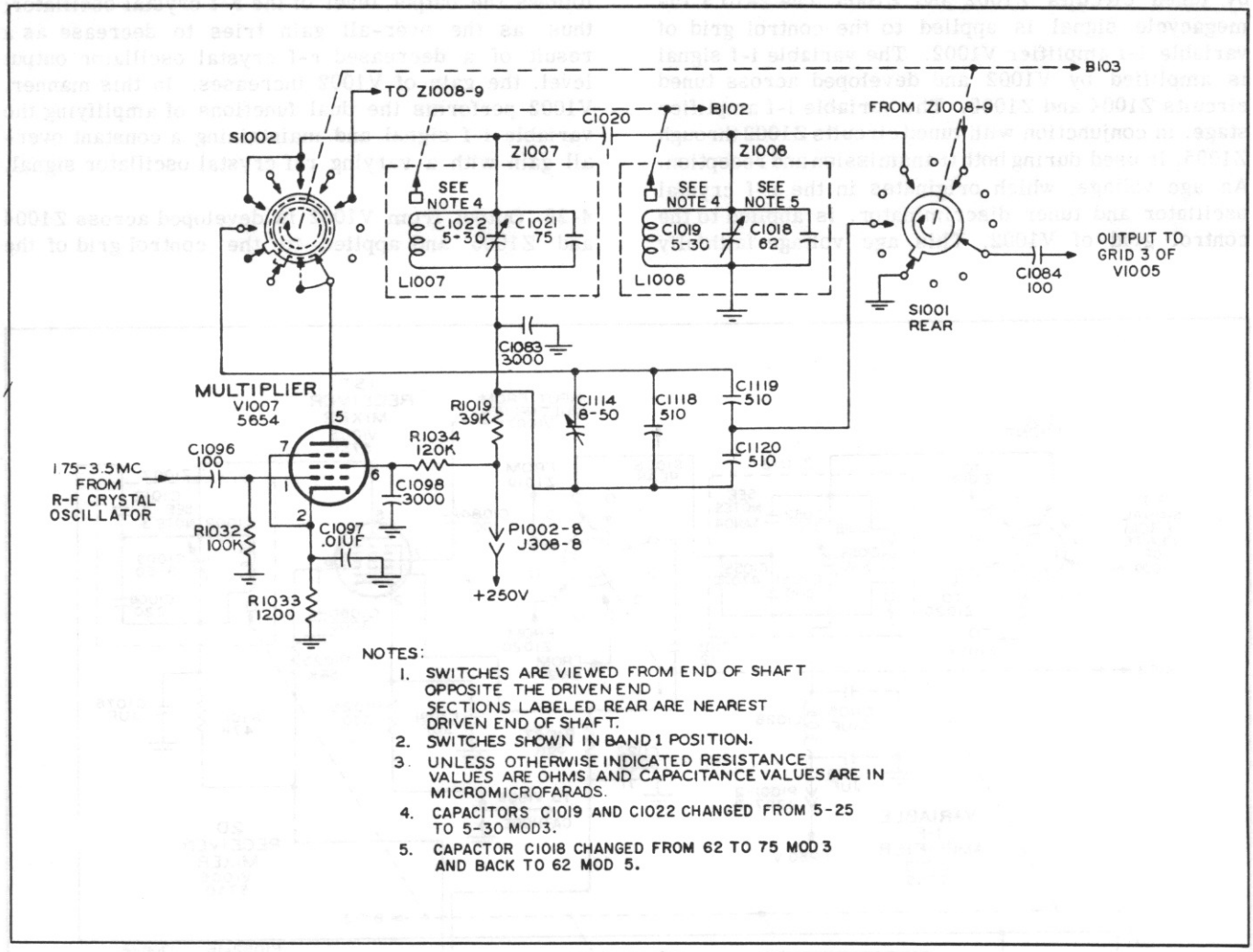


Figure 4-14. Receiver Multiplier Circuits, Simplified Schematic Diagram

second receiver mixer, V1006. The cathode of V1006 is grounded through contacts of relay K1001 when in the key-up position. Relay K1001 is energized when the 618S-1 or 618S-1A is keyed, thus removing V1006 from the circuit. An injection voltage from the r-f crystal oscillator, within the frequency range of 1.75 to 3.5 megacycles, is coupled through capacitor C1094 and applied to grid 3 of V1006. A heterodyning action takes place within the electron stream of V1006, and the difference frequency selected by mechanical filter FL901 as will be described in paragraphs 4-29 and 4-30. As a result of the heterodyning actions, five separate frequencies are present within the circuitry illustrated in figure 4-13. Table XIV lists these frequencies for each band of operation.

TABLE XIV. FIRST AND SECOND RECEIVER MIXER STATISTICS

BAND	INPUT, MC (V1005 GRID 1)	MULTIPLIER, MC (V1005 GRID 3)	VARIABLE I-F, MC (V1006 GRID 1)	R-F CRYSTAL OSC, MC (V1006 GRID 3)	FIXED I-F, MC (V1006 PLATE)
1	2.0 - 3.75	Not used	2.0-3.75	1.75-3.5	0.25
2	3.75- 7.25	1.75- 3.5	2.0-3.75	1.75-3.5	0.25
3	7.25-14.25	5.25-10.5	2.0-3.75	1.75-3.5	0.25
4	14.25-25.00	12.25-21.656	2.0-3.344	1.75-3.095	0.25

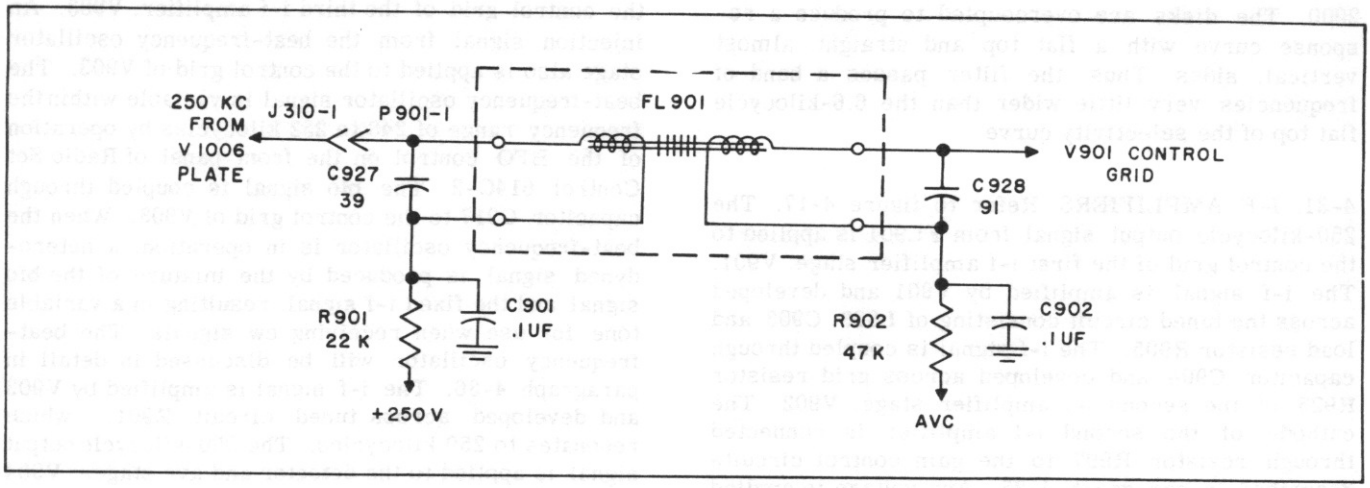


Figure 4-15. Fixed I-F Input Circuit, Simplified Schematic Diagram

NOTE

On band 4, slugs within the tuner subassembly have a limited range of movement, necessitating frequencies as listed in table XIV.

4-29. FIXED I-F INPUT CIRCUIT. Refer to figure 4-15. The signal from the plate of V1006 is developed across the tuned circuit consisting of C927 and the input transducer coil of FL901. The mechanical filter, FL901, employs the principle of magnetostriction to convert electrical energy into mechanical energy and back again, as will be described in the following paragraph. Output from FL901 is developed across the tuned circuit, consisting of C928 and the output transducer coil, and applied to the control grid of the first i-f amplifier stage, V901. B-plus voltage for V1006 and avc voltage for V901 is applied through the transducer coils of FL901. The small d-c current through the transducer coils does not affect the 250-kilocycle signal characteristics.

4-30. MECHANICAL FILTERS. Refer to figure 4-16. The signal from the plate of V1006 is developed across the tuned circuit, consisting of C927 and the input transducer coil, which resonates to the 250-kilocycle i-f frequency. A nickel wire within the input transducer coil is caused to vibrate mechanically from the changing flux created by the input tank current. This mechanical vibration is transferred to the first of six nickel alloy disks. The disks are coupled together by means of nickel interconnecting rods, and vibrate in direct accordance with the 250-kilocycle input signal. The last disk is connected mechanically to a nickel wire, identical to the wire used on the input side. Vibration of this wire sets up a changing flux, which is picked up by the output transducer coil. An alternating current is set up in the output tuned circuit, which is in direct accordance with the input current. The process by which the electrical input signal is changed to a mechanical vibration, and the reverse process of mechanical to electrical is called magnetostriction. Biasing magnets at each end of the mechanical filter polarizes the resonant disks to prevent frequency doubling in much the same manner that biasing magnets in a headphone prevent the diaphragm from bending in the same direction for both halves of an a-c signal. Each of the nickel alloy disks has a resonant Q exceeding

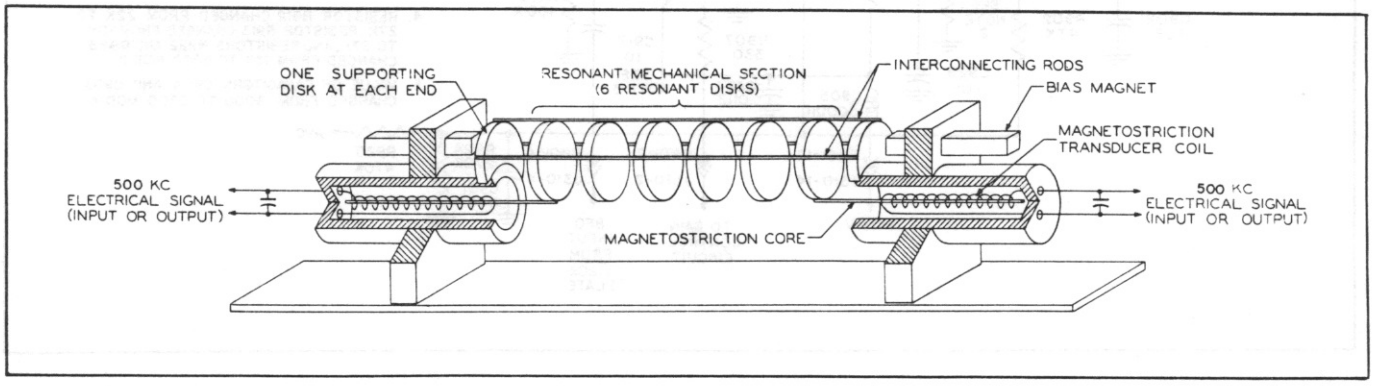


Figure 4-16. Mechanical Filter, Functional Diagram

2000. The disks are overcoupled to produce a response curve with a flat top and straight, almost vertical, sides. Thus, the filter passes a band of frequencies very little wider than the 6.6-kilocycle flat top of the selectivity curve.

4-31. I-F AMPLIFIERS. Refer to figure 4-17. The 250-kilocycle output signal from FL901 is applied to the control grid of the first i-f amplifier stage, V901. The i-f signal is amplified by V901 and developed across the tuned circuit consisting of L903, C903, and load resistor R905. The i-f signal is coupled through capacitor C904 and developed across grid resistor R925 of the second i-f amplifier stage, V902. The cathode of the second i-f amplifier is connected through resistor R907 to the gain control circuits described in paragraph 4-25. Avc voltage is applied to both the first and second i-f amplifier stages through the avc filter arrangement of R920, R924, and C931. The avc circuits will be described in detail in paragraphs 4-32 through 4-34 and paragraphs 4-37 and 4-38. The output from V902 is developed across the tuned circuit consisting of L904, C906, and load resistor R906, and coupled through capacitor C908 to the control grid of the third i-f amplifier, V903. An injection signal from the beat-frequency oscillator stage also is applied to the control grid of V903. The beat-frequency oscillator signal is variable within the frequency range of 248 to 252 kilocycles by operation of the BFO control on the front panel of Radio Set Control 614C-2. The bfo signal is coupled through capacitor C917 to the control grid of V903. When the beat-frequency oscillator is in operation, a heterodyned signal is produced by the mixture of the bfo signal and the fixed i-f signal, resulting in a variable tone for use when receiving cw signals. The beat-frequency oscillator will be discussed in detail in paragraph 4-36. The i-f signal is amplified by V903 and developed across tuned circuit Z901, which resonates to 250 kilocycles. The 250-kilocycle output signal is applied to the detector and avc stages, V904 and V905.

4-32. DETECTOR, NOISE LIMITER, AND AVC. Refer to figure 4-18. One half of dual diode V904 is used as a detector. Signal voltage is coupled through C912 and applied to the cathode of V904A. Rectified voltage appears across resistors R909 and R916. A series-type noise limiter is employed. One half of dual

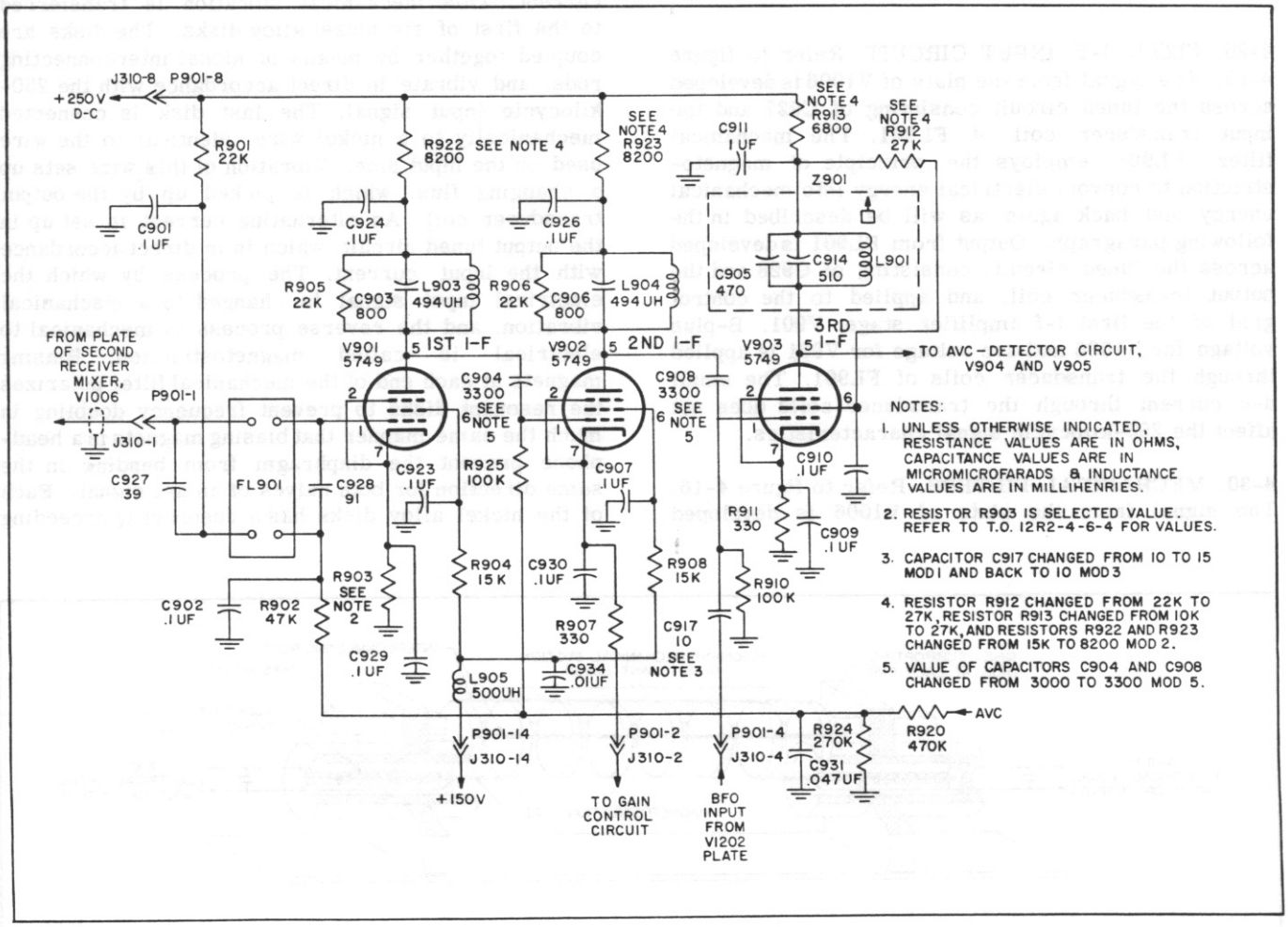


Figure 4-17. I-F Amplifiers, Simplified Schematic Diagram