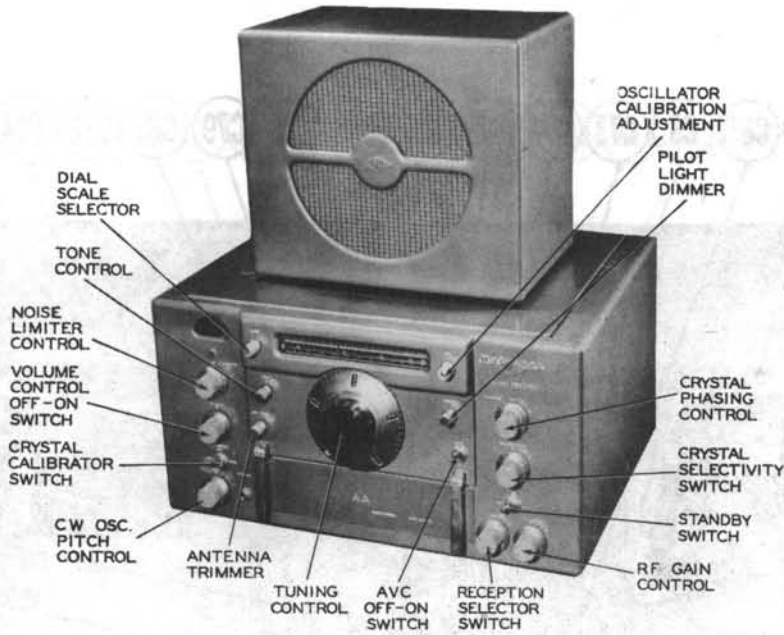




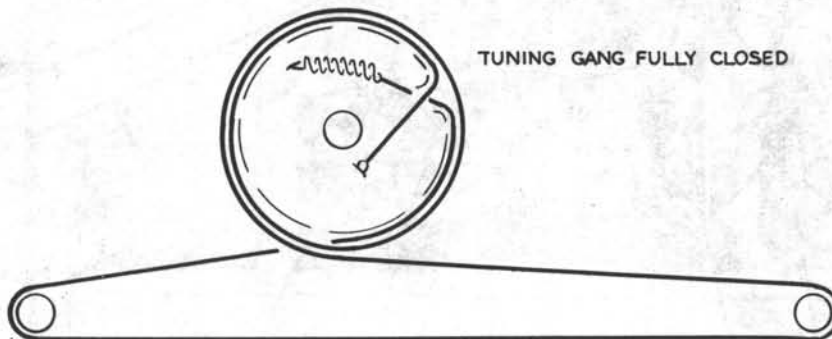
NATIONAL
MODEL HRO-50



NATIONAL MODEL HRO-50

TRADE NAME	National, Model HRO-50 (Accessories-NFM-50, XCU 100/1000)
MANUFACTURER	National Co. Inc., Malden, Mass.
TYPE SET	AC Operated Multi-Band Communications Receiver (Accessories-Narrow Band FM Adaptor, Crystal Calibrator Unit)
TUBES(SEVENTEEN)	Types 6BA6 1st RF Amp., 6BA6 2nd RF Amp., 6BE6 Mixer, 6C4 HF Osc., 6K7 1st IF Amp., 6K7 2nd IF Amp., 6J7 BFO, 6H6 DET-AVC, 6SN7GT S Meter Amp. -Phase Inv., 6H6 Noise Limiter, 6SJ7 Audio Amp., (2) 6V6GT Power Output, 0B2 Voltage Regulator, 5U4G Rectifier, 6AK6 Crystal Osc., 6SK7 FM IF Amp., 6H6 Ratio Det.
POWER SUPPLY	110-120 or 220-240 Volts AC
RATING	.95 Amp. at 117 Volts AC
TUNING RANGE	Band "A" 14-30MC, "B" 7-14.4MC, "C" 3.5-7.3MC, "D" 1.7-4MC, "E" 900-2050KC, "F" 480-960KC, "G" 180-430KC, "H" 100-200KC, "J" 50-100KC, "AA" 27.5-30MC, "AB" 25-35MC, "AC" 21-21.5MC

NATIONAL
MODEL HRO-50

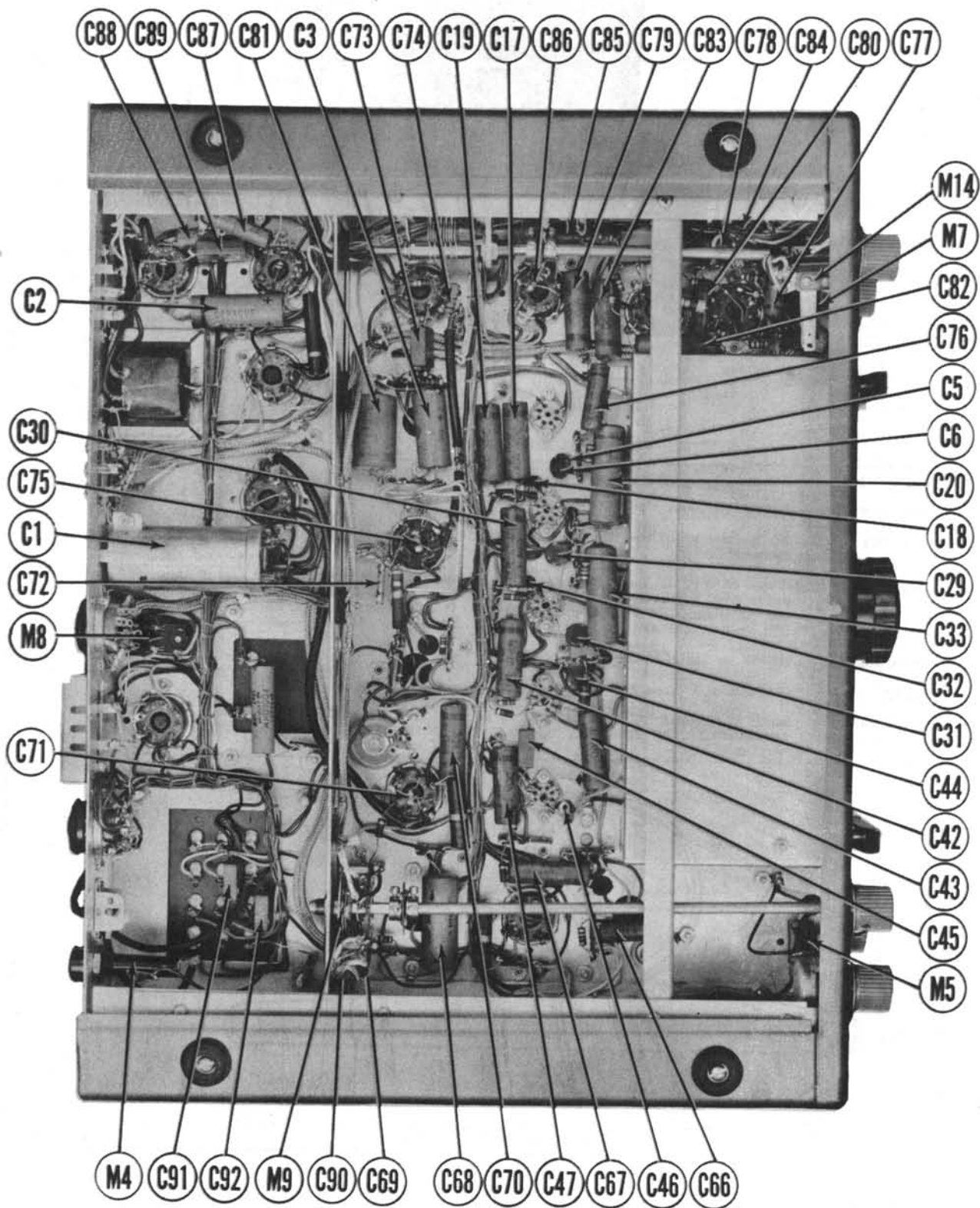


DIAL CORD DRIVE

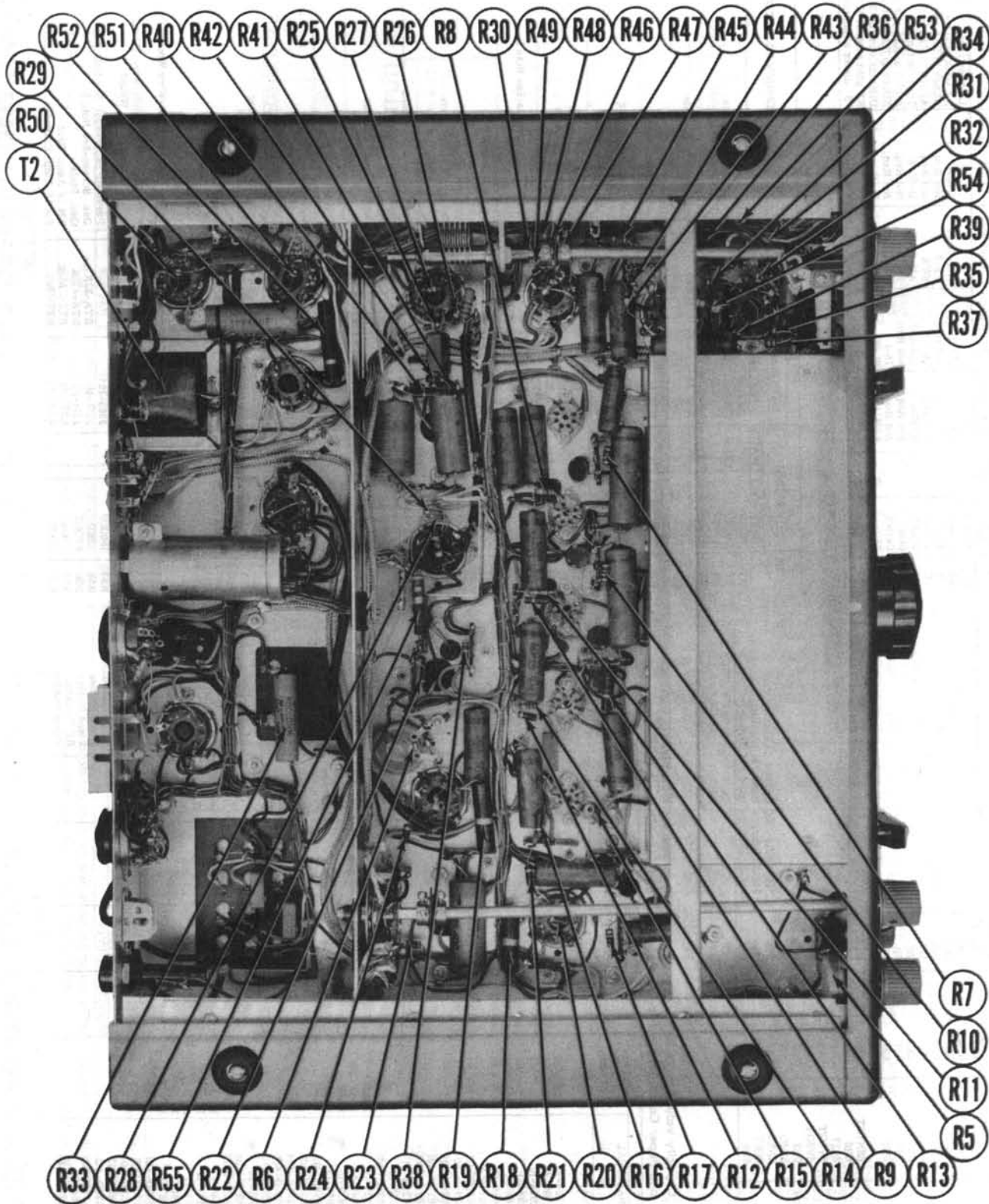
HOWARD W. SAMS & CO., INC. • Indianapolis 1, Indiana

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NATIONAL
MODEL HRO-50



R52 R51 R40 R42 R41 R25 R27 R26 R8 R30 R49 R48 R46 R47 R45 R44 R43 R36 R53 R34

R29

R50

T2

R31

R32

R54

R39

R35

R37

R7

R10

R11

R5

R33 R28 R55 R22 R6 R24 R23 R38 R19 R18 R21 R20 R16 R17 R12 R15 R14 R9 R13

PARTS LIST AND DESCRIPTIONS TUBES (SYLVANIA or Equivalent)

ITEM No.	USE	REPLACEMENT DATA		RMA BASE TYPE	NOTES
		NATIONAL PART No.	STANDARD REPLACEMENT		
V1	1st RF Amp.	6BA6	6BA6	7BK	
V2	2nd RF Amp.	6BA6	6BA6	7BK	
V3	Mixer	6BE6	6BE6	7CH	
V4	HF Oscillator	6C4	6C4	6BG	
V5	1st IF Amp.	6K7	6K7	7R	
V6	2nd IF Amp.	6K7	6K7	7R	
V7	BF Oscillator	6J7	6J7	7R	
V8	Det. -AVC	6H6	6H6	7Q	
V9	"S" Meter Amp. - Phase Inv.	6SN7GT	6SN7GT	8BD	
V10	Noise Limiter	6H6	6H6	7Q	
V11	Audio Amp.	6SJ7	6SJ7	8N	
V12	Power Output	6V6GT	6V6GT	7AC	
V13	Power Output	6V6GT	6V6GT	7AC	
V14	Voltage Regulator	0B2	0B2	5B0	
V15	Rectifier	5U4G	5U4G	5T	
V16	Crystal Osc.	6AK6	6AK6	7BK	XCU (100/1000KC Crystal Calibrator unit)
V17	FM IF Amp.	6SK7	6SK7	8N	NFM-50 (Narrow Band FM adaptor)
V18	Ratio Det.	6H6	6H6	7Q	NFM-50 (Narrow Band FM adaptor)

CAPACITORS

Capacity values given in the rating column are in mfd. for Electrolytic and Paper Capacitors, and in mmfd. for Mica and Ceramic Capacitors.

ITEM No.	RATING		REPLACEMENT DATA					IDENTIFICATION CODES AND INSTALLATION NOTES	
	CAP.	VOLT	NATIONAL PART No.	AEROVOX PART No.	CENTRALAB PART No.	CORNELL-DUBILIER PART No.	ERIE PART No.		SPRAGUE PART No.
C1A	40	475	K945-3	AF88K		UP4450		TVL-2830	▲ Filter
B	40	475						TVA-1306	▲ Filter
C2	25	50	E338-4	PRS50/25		BR255A			Output Cath. Bypass
C3	25	50	E338-4	PRS50/25		BR255A			Tone Comp.
C4	1	450	E338-10	PRS450/4		BR145		TVA-1300	Stabilizing Cap.
C5	5000		K946-1	BPD-005	DD-502	ID5D5	811-005	29C1	AVC Filter
C6	5000		K946-1	BPD-005	DD-502	ID5D5	811-005	29C1	AVC Filter
C7	10000	300	J666-56	1467-01	D6-103	ID3S1		IFM-11	AVC Filter
C8	12		D825D-404						Fixed Padder
C9	5		D825D-401						Fixed Padder
C10	12		D825D-404						Fixed Padder
C11	25.7		D825D-412						Fixed Padder
C12	5		D825D-401						Fixed Trimmer
C13	10		D825D-402						Fixed Trimmer
C14	50		D825D-417						Fixed Trimmer
C15	1200	500	J666-16						Fixed Padder
C16	120		D825C-305						Fixed Padder
C17	.1	400	D927-11	P488-1	DF-104	PTE4P1	811-005	4TM-P1	1st RF Cathode
C18	5000		K946-1	BPD-005	DD-502	ID5D5		29C1	Decoupling
C19	.1	400	D827-11	P488-1	DF-104	PTE4P1		4TM-P1	Decoupling
C20	.1	600	D827-13	P688-1	DF-104	PTE6P1		6TM-P1	Decoupling
C21	21		D825D-410						Fixed Padder
C22	5		D825D-401						Fixed Padder
C23	12		D825D-404						Fixed Padder
C24	27.5		D825D-412						Fixed Padder
C25	21		D825D-410						Fixed Trimmer
C26	470	500	J665-56						RF Coupling
C27	100		D825C-304						Fixed Padder
C28	68		D825D-439						Fixed Trimmer
C29	5000		K946-1	BPD-005	DD-502	ID5D5	811-005	29C1	AVC Filter
C30	.1	400	D827-11	P488-1	DF-104	PTE4P1		4TM-P1	2nd RF Cath.
C31	5000		K946-1	BPD-005	DD-502	ID5D5	811-005	29C1	2nd RF Cath.
C32	5000		K946-1	BPD-005	DD-502	ID5D5	811-005	29C1	Decoupling
C33	.1	600	D827-13	P688-1	DF-104	PTE6P1		6TM-P1	Decoupling
C34	21		D825D-410						Fixed Padder
C35	5		D825D-401						Fixed Padder
C36	12		D825D-404						Fixed Padder
C37	27.5		D825D-412						Fixed Padder
C38	5		D825D-401						Fixed Padder
C39	100		D825C-304						Fixed Padder
C40	470	500	J665-56						RF Coupling
C41	68		D825D-439						Fixed Padder

PARTS LIST AND DESCRIPTIONS (Continued) CONTROLS

ITEM No.	RATING		REPLACEMENT DATA				INSTALLATION NOTES
	RESIST-ANCE	WATTS	NATIONAL PART No.	IRC PART No.	CLAROSTAT PART No.	CENTRALAB PART No.	
R1	500KΩ	1/2	J681-2				Limiter control and switch
R2A	500KΩ	1/2	K347-1	Q13-133	AM-60-Z	B-60-S	AF Gain control
B	Shaft		Not Req.	Not Req.	FS-3	Not Req.	Attach to R2A per instructions
C	Switch		Not Req.	76-1	SWA	Not Req.	Attach to R2A per instructions
R3A	500KΩ	1/2	K347-1	Q13-133	AM-60-Z	B-60-S	Tone control
B	Shaft		Not Req.	Not Req.	FS-3	Not Req.	Attach to R3A per instructions
C	Switch		Not Req.	76-1	SWA	Not Req.	Attach to R3A per instructions
R4	25Ω	2	K915-13	W-25	43-25	V-111	Dimmer control-Wire Wound
R5	10KΩ	2	K349-3				RF gain control-Wire Wound
R6	1000Ω	1	D831-2	WK-1000	43-1000	VK-129	"S" meter adjustment-Wire Wound

RESISTORS

ITEM No.	RATING		REPLACEMENT DATA		IDENTIFICATION CODES
	RESISTANCE	WATTS	NATIONAL PART No.	IRC PART No.	
R7	470KΩ	1/2	J569-57	BTS-470K	AVC Network
R8	100Ω	1/2	J569-13	BTS-100	1st RF Amp. Cathode
R9	2200Ω	1/2	J569-29	BTS-2200	RF Screen Dropping
R10	470KΩ	1/2	J569-57	BTS-470K	AVC Network
R11	560Ω	1/2	J569-22	BTS-560	2nd RF Amp. Cathode
R12	22KΩ	1/2	J569-41	BTS-22K	Mixer Grid
R13	33KΩ	1	J571-43	BTA-33K	Mixer Screen
R14	220Ω	1	J569-17	BTS-220	Mixer Cathode
R15	22KΩ	1	J569-41	BTS-22K	Osc. Grid
R16	22Ω	1	J569-5		Parasitic Suppressor
R17	470KΩ	1	J569-57	BTS-470K	AVC Network
R18	27KΩ	2	J572-42	BTB-27K	Voltage Divider
R19	15KΩ	2	J572-39	BTB-15K	Screen Dropping
R20	220Ω	2	J569-17	BTS-220	1st IF Amp. Cathode
R21	330Ω	2	J569-19	BTS-330	1st IF Amp. Cathode
R22	2200Ω	2	J569-29	BTS-2200	Plate Decoupling
R23	470KΩ	2	J569-57	BTS-470K	AVC Network
R24	220Ω	2	J569-17	BTS-220	2nd IF Amp. Cathode-See Note 1
R25	100KΩ	2	J569-49	BTS-100K	Voltage Divider
R26	100KΩ	2	J569-49	BTS-100K	BFO Screen
R27	220KΩ	2	J569-53	BTS-220K	BFO Plate
R28	1.5 Meg.	2	J569-63	BTS-1.5 Meg.	AVC Diode Load
R29	1.5 Meg.	2	J569-63	BTS-1.5 Meg.	AVC Network
R30	47KΩ	2	J569-45	BTS-47K	"S" Meter Amp. Plate
R31	22KΩ	2	J569-41	BTS-22K	Diode Filter
R32	470KΩ	2	J569-57	BTS-470K	Det. Diode Load
R33	5000Ω	2	E959-10	1 3/4A-5000	Decoupling-Wire Wound
R34	220KΩ	2	J569-53	BTS-220K	Noise Limiter Plate
R35	220KΩ	2	J569-53	BTS-220K	Voltage Divider
R36	220KΩ	2	J569-53	BTS-220K	Noise Limiter Cathode
R37	470KΩ	2	J569-57	BTS-470K	Noise Limiter Plate
R38	820KΩ	2	J569-60	BTS-820K	Decoupling
R39	220KΩ	2	J569-53	BTS-220K	Voltage Divider
R40	2200Ω	2	J569-29	BTS-2200	Audio Amp. Cathode
R41	15Ω	2	J569-15	BTS-150	Audio Amp. Cathode
R42	6800Ω	2	J569-35	BTS-6800	Feedback
R43	100KΩ	2	J569-49	BTS-100K	Audio Amp. Screen
R44	100KΩ	2	J569-49	BTS-100K	Audio Amp. Plate
R45	47KΩ	2	J569-45	BTS-47K	Audio Amp. Decoupling
R46	220KΩ	2	J569-53	BTS-220K	Phase Inv. Grid
R47	4700Ω	2	J569-33	BTS-4700	Phase Inv. Cathode
R48	47KΩ	2	J569-45	BTS-47K	Phase Inv. Cathode
R49	47KΩ	2	J569-45	BTS-47K	Phase Inv. Plate
R50	220KΩ	2	J569-53	BTS-220K	Audio Output Grid
R51	220KΩ	2	J569-53	BTS-220K	Audio Output Grid
R52	220Ω	2	J572-17	BW-2-220	Audio Output Cathode-Wire Wound
R53	470Ω	2	J572-21	BTB-470	Voice Coil Shunt
R54	4.3Ω	1	K098-34		Noise Limiter Filament-Wire Wound
R55	4.3Ω	1	K098-34		Det. Filament-Wire Wound
R56	4.7 Meg.	1	J569-69	BTS-4.7 Meg.	Osc. Grid
R57	150Ω	1	J569-15		Parasitic Suppressor-See Note 2
R58	22KΩ	1	J571-41	BTA-22K	Osc. Screen-See Note 3
R59	470KΩ	1	J571-57	BTA-470K	Osc. Plate
R60	1 Meg.	1	K379-61	BTS-1 Meg.	FM IF Amp. Grid
R61	1000Ω	1	K379-25	BTS-1000	FM IF Amp. Cathode

PARTS LIST AND DESCRIPTIONS (Continued)

COILS (RF-IF)

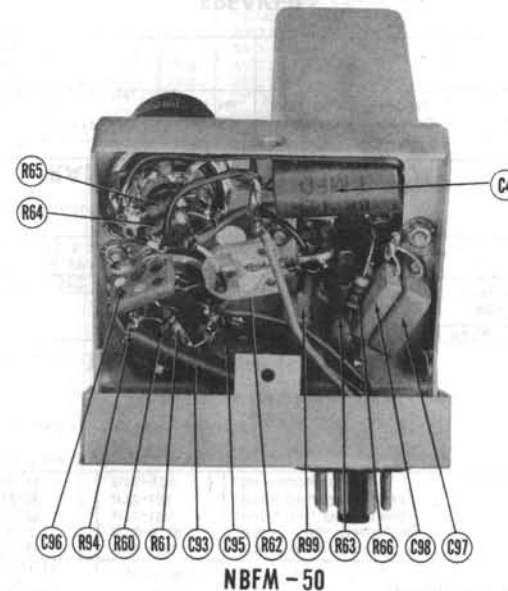
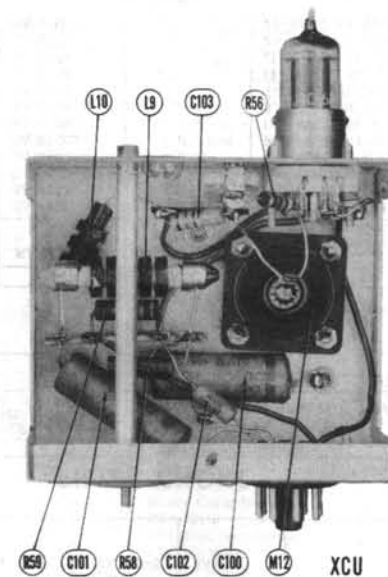
ITEM No.	USE	DC RES.		REPLACEMENT DATA		NOTES
		PRI.	SEC.	NATIONAL	MEISSNER	
				PART No.	PART No.	
L3A	1st RF Trans.	.1Ω	.1Ω	SA:8809		50-100KC J Band
B	1st RF Trans.			SA:8669		100-200KC H Band
C	1st RF Trans.			SA:8667		180-430KC G Band
D	1st RF Trans.			SA:8662		480-960KC F Band
E	1st RF Trans.			SA:8540		900-2050KC E Band
F	1st RF Trans.			SA:8637		1.7-4MC D Band
G	1st RF Trans.			SA:8641		3.5-7.3MC C Band
H	1st RF Trans.			SA:8650		7-14.4MC B Band
I	1st RF Trans.			SA:8751		14-30MC A Band
J	1st RF Trans.			SA:8074		21-21.5MC AC Band
K	1st RF Trans.			SA:8818		25-35MC AB Band
L	1st RF Trans.			SA:8673		27-30MC AA Band
L4A	2nd RF Trans.	.2Ω	.1Ω	SA:8810		50-100KC J Band
B	2nd RF Trans.			SA:8804		100-200KC H Band
C	2nd RF Trans.			SA:8800		180-430KC G Band
D	2nd RF Trans.			SA:8794		480-960KC F Band
E	2nd RF Trans.			SA:8789		900-2050KC E Band
F	2nd RF Trans.			SA:8638		1.7-4MC D Band
G	2nd RF Trans.			SA:8642		3.5-7.3MC C Band
H	2nd RF Trans.			SA:8756		7-14.4MC B Band
I	2nd RF Trans.			SA:8752		14-30MC A Band
J	2nd RF Trans.			SA:8075		21-21.5MC AC Band
K	2nd RF Trans.			SA:8676		25-35MC AB Band
L	2nd RF Trans.			SA:8815		27-30MC AA Band
L5A	HF Osc.	.1Ω		SA:8811		50-100KC J Band
B	HF Osc.			SA:8805		100-200KC H Band
C	HF Osc.			SA:8785		180-430KC G Band
D	HF Osc.			SA:8795		480-960KC F Band
E	HF Osc.			SA:8631		900-2050KC E Band
F	HF Osc.			SA:8776		1.7-4MC D Band
G	HF Osc.			SA:8760		3.5-7.3MC C Band
H	HF Osc.			SA:8678		7-14.4MC B Band
I	HF Osc.			SA:8656		14-30MC A Band
J	HF Osc.			SA:8076		21-21.5MC AC Band
K	HF Osc.			SA:8819		25-35MC AB Band
L	HF Osc.			SA:8816		27-30MC AA Band
L6	1st IF	8.4Ω	8.4Ω	SA:2492		Includes trimmer, 2 capacitors and resistor.
L7	2nd IF	8.4Ω	8.4Ω	SA:41G		
L8	BFO Coil	47KΩ		SA:3361		5 microhenries
L9	100KC Induct- or	95Ω		SA:4373		.5 microhenries
L10	1000KC Induct- or	17Ω		SA:2514		
L11	Ratio Det. Trans.	8Ω	9Ω	SA:4890		

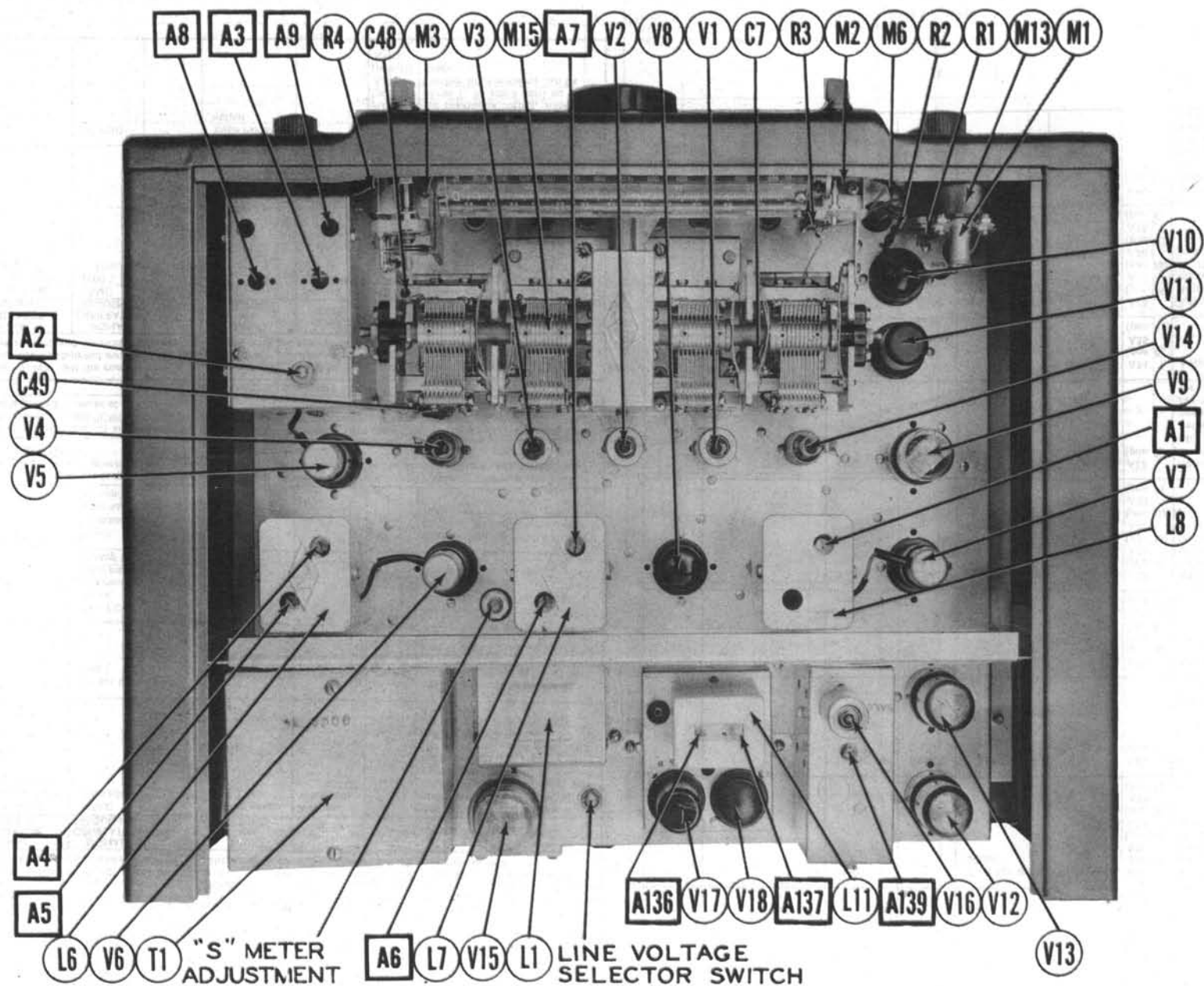
DIAL LIGHTS

ITEM No.	BASE TYPE	VOLTS	AMPS.	BEAD COLOR	REPLACEMENT DATA		NOTES
					NATIONAL		
					PART No.		
M1	Bayonet	6-8	.15	Brown	F136-6		Type #47
M2	Bayonet	6-8	.15	Brown	F136-6		Type #47
M3	Bayonet	6-8	.15	Brown	F136-6		Type #47

MISCELLANEOUS

ITEM No.	PART NAME	NATIONAL	NOTES
		PART No.	
M4	Fuse	F135-4	3AG 2 Amp. at 250V
M5	Switch	E230-2	B+ On-Off
M6	Switch	E230-2	AVC
M7	Switch	P738-1	Calibrate
M8	Switch	H340-4	110-120/220-240
M9	Switch	SA:6546	Function
M10	Switch	E195-3	Selectivity
M11	Crystal Filter	SA:3654	455KC
M12	Crystal	E979-1	
M13	Meter	J984-5	Carrier Level
M14	Phone Jack	F316-1	
M15	Tuning Gang	SA:6592	Four Section





NATIONAL
MODEL HRO-50

ALIGNMENT INSTRUCTIONS (CONT.)

46.	400Ω carbon res.	High side antenna terminals "A". Low side to chassis.	30MC	Band AB	Tune for max. output	Across voice coil	A88 (pos. 16) A89 (pos. 13) A90 (pos. 11) A91 (pos. 9)	Adjust A88 until signal is heard. Adjust A89, A90 and A91 for maximum output. Repeat steps 43, 44, 45 and 46 until no further improvement can be made.	54.	400Ω carbon res.	High side to antenna terminal "A". Low side to chassis.	14.4MC	Band B	14.4MC	Across voice coil	A112 (pos. 7)	Adjust until signal is heard. Tune signal generator to 15.31 MC. If signal is not heard, re-tune generator to 14.4MC and open A112 to next peak. Adjust for maximum output and recheck for image.
47.	"	"	21.5MC	Band AC	21.5MC	"	A92 (pos. 7)	Adjust until signal is heard. Tune signal generator to 22.41 MC. If signal is not heard, re-tune generator to 21.5MC and open A92 to next peak. Adjust for maximum output and recheck for image.	55.	"	"	"	"	"	"	A113 (pos. 5) A114 (pos. 3) A115 (pos. 1)	Adjust for maximum output.
48.	"	"	"	"	"	"	A93 (pos. 5) A94 (pos. 3) A95 (pos. 1)	Adjust for maximum output.	56.	"	"	14MC	"	Tune for max. output	"	A116 (pos. 15) A117 (pos. 14) A118 (pos. 12) A119 (pos. 10)	Adjust A116 until signal is heard. Adjust A117, A118 and A119 for maximum output. Repeat steps 54, 55 and 56 until no further improvement can be made.
49.	"	"	21MC	"	Tune for max. output	"	A96 (pos. 8) A97 (pos. 6) A98 (pos. 4) A99 (pos. 2)	Adjust A96 until signal is heard. Adjust A97, A98 and A99 for maximum output.	57.	"	"	7.3MC	Band C	7.3MC	"	A120 (pos. 7)	Adjust until signal is heard. Tune signal to 8.21MC. If signal is not heard, retune generator to 7.3MC and open A120 to next peak. Adjust for maximum output and recheck for image.
50.	"	"	21.3MC	"	"	"	A100 (pos. 16) A101 (pos. 13) A102 (pos. 11) A103 (pos. 9)	Adjust A100 until signal is heard. Adjust A101, A102 and A103 for maximum output. Repeat steps 47, 48, 49 and 50 until no further improvement can be made.	58.	"	"	"	"	"	"	A121 (pos. 5) A122 (pos. 3) A123 (pos. 1)	Adjust for maximum output.
BANDSPREAD ALIGNMENT																	
Set the bandspread switch to the bandspread position. All other controls remain the same as in GENERAL COVERAGE ALIGNMENT.																	
General coverage alignment should be completed before bandspread alignment.																	
Tracking of the RF stages at low frequency end of each band may be checked as follows: After adjustments of padders is completed, attempt to peak each stage with its associated high frequency trimmer. Any change in capacity should cause a decrease in output if that stage is tracking correctly. This checking procedure will misalign the high frequency trimmers, therefore, they should be repeated at the high frequency end of the band per alignment instructions.																	
	DUMMY ANTENNA	SIGNAL GENERATOR COUPLING	SIGNAL GENERATOR FREQUENCY	COIL SET	RADIO DIAL SETTING	OUTPUT METER	ADJUST	REMARKS									
51.	400Ω carbon res.	High side to antenna terminal "A". Low side to chassis.	30MC (400% Mod.)	Band A	30MC	Across voice coil	A104 (pos. 7)	Adjust until signal is heard. Tune signal generator to 30.91 MC. If signal is not heard, retune generator to 30MC and open A104 to next peak. Adjust for maximum output and recheck for image.	60.	"	"	4MC	Band D	4MC	"	A128 (pos. 7)	Adjust until signal is heard. Tune signal generator to 4.91 MC. If signal is not heard, re-tune generator to 4MC and open A128 to next peak. Adjust for maximum output and recheck for image.
52.	"	"	"	"	"	"	A105 (pos. 5) A106 (pos. 3) A107 (pos. 1)	Adjust for maximum output.	61.	"	"	"	"	"	"	A129 (pos. 5) A130 (pos. 3) A131 (pos. 1)	Adjust for maximum output.
53.	"	"	27.2MC	"	Tune for max. output	"	A108 (pos. 15) A109 (pos. 14) A110 (pos. 12) A111 (pos. 10)	Adjust A108 until signal is heard. Adjust A109, A110 and A-111 for maximum output. Repeat steps 51, 52 and 53 until no further improvement can be made.	62.	"	"	3.5MC	"	Tune for max. output	"	A132 (pos. 15) A133 (pos. 14) A134 (pos. 12) A135 (pos. 10)	Adjust A132 until signal is heard. Adjust A133, A134 and A135 for maximum output. Repeat steps 60, 61 and 62 until no further improvement can be made.

ALIGNMENT INSTRUCTIONS (CONT.)

1st RF STAGE ALIGNMENT WITH LOW IMPEDANCE TRANSMISSION LINE

If a low impedance transmission line is to be used with the receiver it may be necessary to realign the first RF amplifier at the high frequency end of each band.

GENERAL COVERAGE ALIGNMENT

Set the bandsread switch to "General Coverage" position. Coil sets A, D, E and G do not have a first RF trimmer but is peak tuned by the antenna trimmer control on front panel of receiver.

DUMMY ANTENNA	SIGNAL GENERATOR COUPLING	SIGNAL GENERATOR FREQUENCY	COIL SET	RADIO DIAL SETTING	OUTPUT METER	ADJUST	REMARKS
63. Direct	High side to antenna terminal "A". Low side to chassis.	14.4MC (400 ν Mod.)	Band B	Tune for max. output	Across voice coil	A20 (pos.2)	Adjust for maximum output.
64. Direct	"	7.3MC	Band C	"	"	A28 (pos.2)	"
65. Direct	"	900KC	Band F	"	"	A48 (pos.2)	"
66. Direct	"	200KC	Band H	"	"	A59 (pos.2)	"
67. Direct	"	100KC	Band J	"	"	A65 (pos.2)	"
68. Direct	"	30MC	Band AA	"	"	A71 (pos.1)	"
69. Direct	"	35MC	Band AB	"	"	A83 (pos.2)	"
70. Direct	"	21.5MC	Band AC	"	"	A95 (pos.1)	"

BANDSPREAD ALIGNMENT

Set the bandsread switch to "Bandspread" position.

DUMMY ANTENNA	SIGNAL GENERATOR COUPLING	SIGNAL GENERATOR FREQUENCY	COIL SET	RADIO DIAL SETTING	OUTPUT METER	ADJUST	REMARKS
71. Direct	High side to antenna terminal "A". Low side to chassis.	30MC (400 ν Mod.)	Band A	Tune for max. output	Across voice coil	A107 (pos.1)	Adjust for maximum output.
72. Direct	"	14.4MC	Band B	"	"	A115 (pos.1)	"
73. Direct	"	7.3MC	Band C	"	"	A123 (pos.1)	"
74. Direct	"	4MC	Band D	"	"	A131 (pos.1)	"

"S" METER ADJUSTMENT

Before attempting this adjustment set the controls as follows: Set the RF gain control at zero, the AVC switch to "AVC", the control switch to "AM" and the AC switch to "ON".

Adjust the "S" meter balancing control R6 for a zero reading on the "S" meter.

NARROW BAND FM ADAPTOR ALIGNMENT

It will be necessary to realign primary trimmer A6 as follows: Plug in the adaptor and adjust all controls for normal "AM" operation. Disconnect the antenna and adjust A6 for maximum background noise.

The NFM-50 adaptor unit is pre-aligned at the factory and realignment should not be required unless the adaptor is accidentally misaligned.

If the adaptor requires alignment set the controls as follows: Control switch to "NFM", the selectivity switch to "OFF", the limiter control to "OFF", the B+ switch to "ON", the AVC switch to "AVC", the RF gain control to "10". Plug in coil set "E" if available, if not plug in coil set "D".

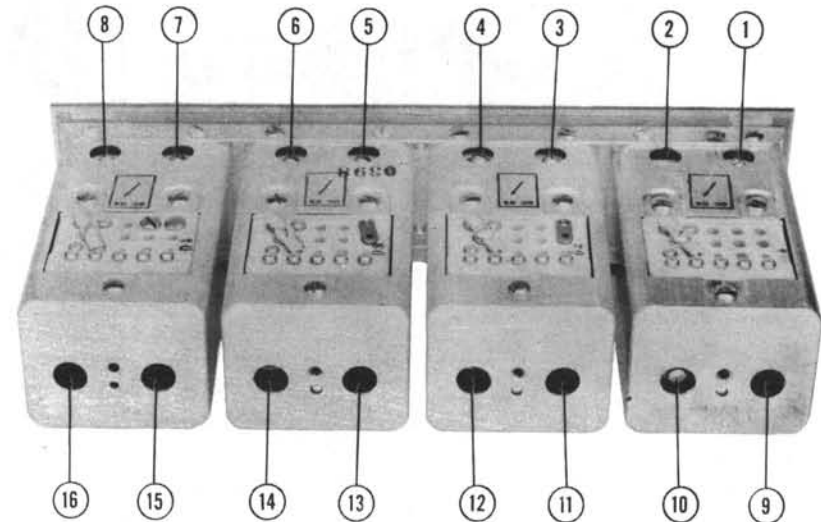
DUMMY ANTENNA	SIGNAL GENERATOR COUPLING	SIGNAL GENERATOR FREQUENCY	COIL SET	RADIO DIAL SETTING	CONNECT VTVM	ADJUST	REMARKS
75. 300 Ω carbon res.	High side thru antenna terminal "A". Low side to other antenna terminal "A".	1500KC (Unmod.) or 2.25MC	Band E or Band D	Tune for max. deflection.	DC Probe to Point A. Common to chassis.	A136 A137	Detune A136 and A137 by turning adjustment screws counter-clockwise as far as possible. Then adjust A136 for maximum deflection. Adjust A137 for zero reading.
76. "	"	"	"	"	Not used	A138	Adjust for a null in audio output. Readjust A137 and A138 until a zero reading and a null in audio output is obtained.

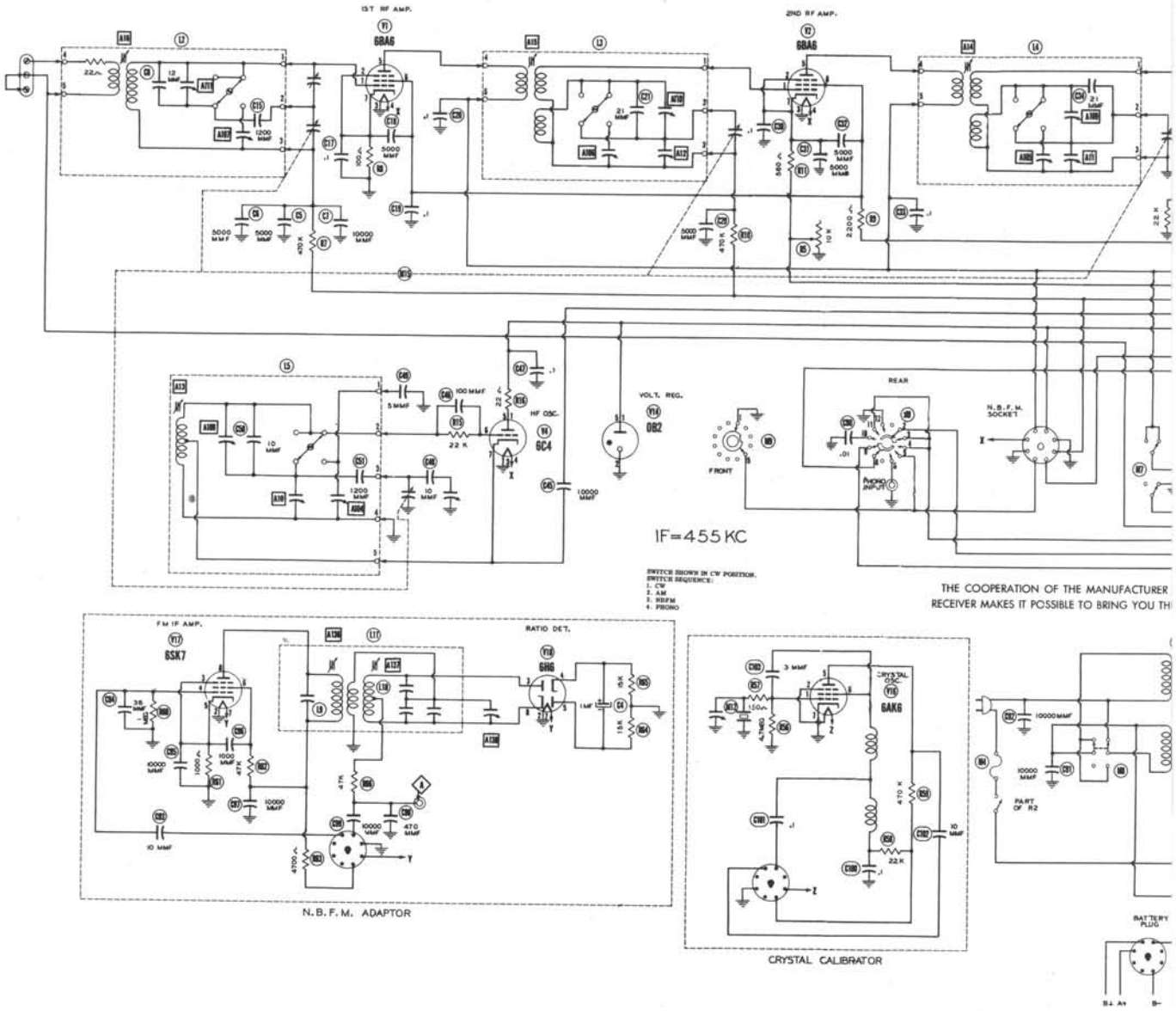
CRYSTAL CALIBRATOR UNIT ADJUSTMENT

Set controls of receiver for normal CW operation.

Set the front panel calibrate switch at the 100KC position.

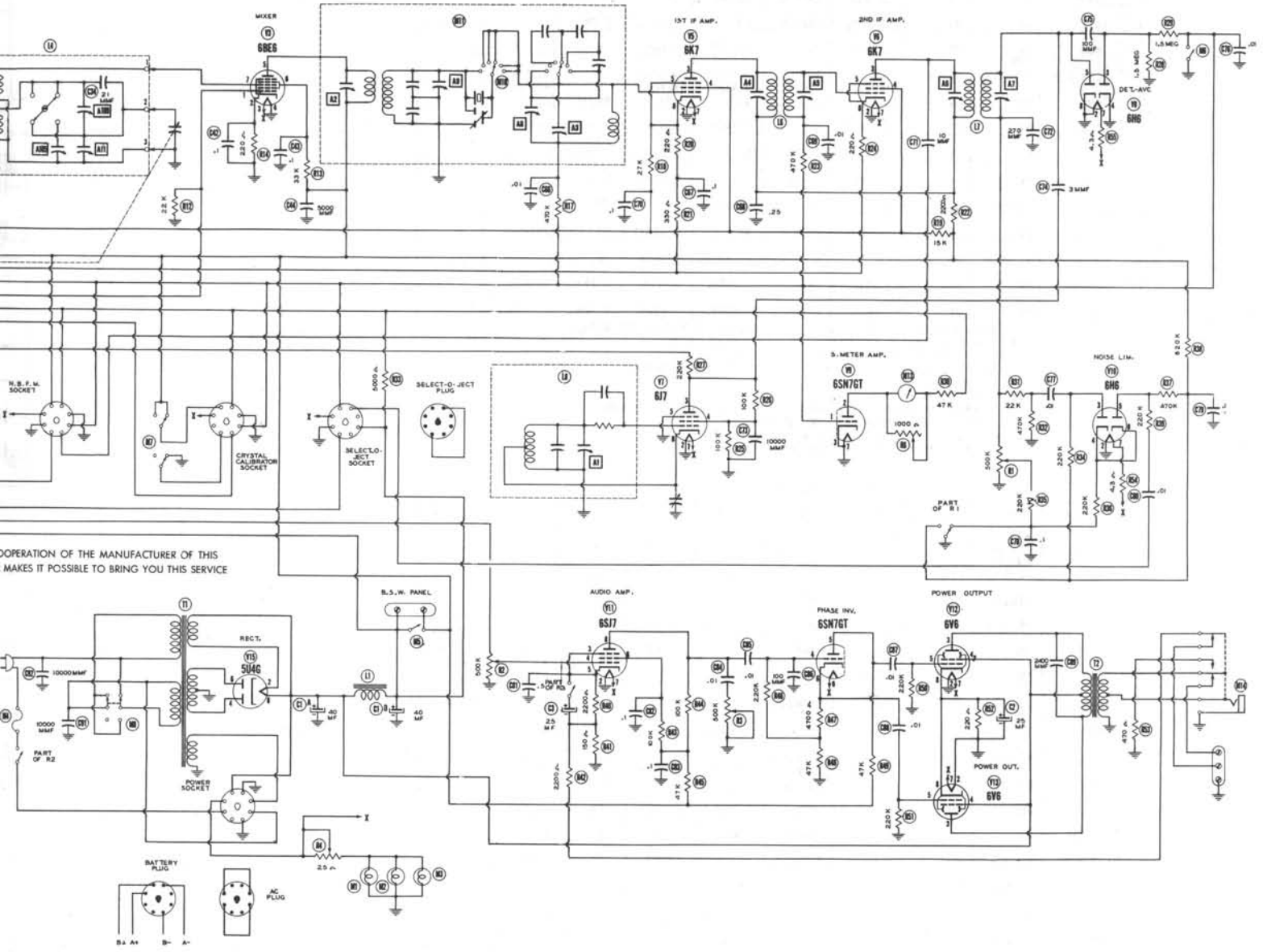
Tune in the signal from WWV and adjust A139 so that 100KC signal harmonic is zero beat with the signal received from WWV.





SWITCH BROWE IN CW POSITION.
 SWITCH SEQUENCE:
 1. CW
 2. AM
 3. REFM
 4. PRONO

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VOLTAGE READINGS

Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Top Cap
V 1	6BA6	±0V. #-.3VDC	1.4VDC	0V.	6.3VAC	245VDC	120VDC	1.4VDC		
V 2	6BA6	±0V. #-.3VDC	34VDC	0V.	6.3VAC	245VDC	120VDC	34VDC		
V 3	6BE6	0V.	1.2VDC	6.3VAC	0V.	245VDC	85VDC	0V.		
V 4	6C4	105VDC	0V.	6.3VAC	0V.	105VDC	§-7.6VDC	0V.		TOP CAP ±0V. #-.2VDC
V 5	6K7	0V.	0V.	245VDC	130VDC	37VDC	35VDC	6.3VAC	37VDC	±0V. #-.2VDC
V 6	6K7	0V.	0V.	245VDC	130VDC	35VDC	0V.	6.3VAC	35VDC	±0V. #-.2VDC
V 7	6J7	0V.	0V.	†60VDC	†22VDC	0V.	†245VDC	6.3VAC	0V.	-.4VDC
V 8	6H6	0V.	0V.	-.5VDC	0V.	-3VDC	-3VDC	5VAC	0V.	
V 9	6SN7GT	±0V. #-.6VDC	30VDC	0V.	30VDC	190VDC	80VDC	0V.	6.3VAC	
V 10	6H6	0V.	0V.	42VDC ±0V.	42VDC ±0V.	42VDC ±0V.	35VDC ±0V.	5VAC	42VDC ±0V.	
V 11	6SJ7	0V.	0V.	4.7VDC	0V.	4.7VDC	115VDC	6.3VAC	34VDC	
V 12	6V6GT	0V.	0V.	245VDC	250VDC	0V.	245VDC	6.3VAC	16VDC	
V 13	6V6GT	0V.	0V.	245VDC	250VDC	0V.	250VDC	6.3VAC	16VDC	
V 14	OB2	105VDC	0V.	0V.	0V.	105VDC	0V.	0V.		
V 15	5U4G	0V.	285VDC	0V.	255VAC	0V.	255VAC	0V.	285VDC	
V 16	6AK6	±.5VDC	0V.	0V.	6.3VAC	±3.4VDC	±70VDC	0V.		
V 17	6SK7	0V.	0V.	7.3VDC	0V.	7.3VDC	120VDC	6.3VAC	210VDC	
V 18	6H6	0V.	0V.	-.1VDC	.4VDC	-.4VDC	-.4VDC	6.3VAC	-.1VDC	

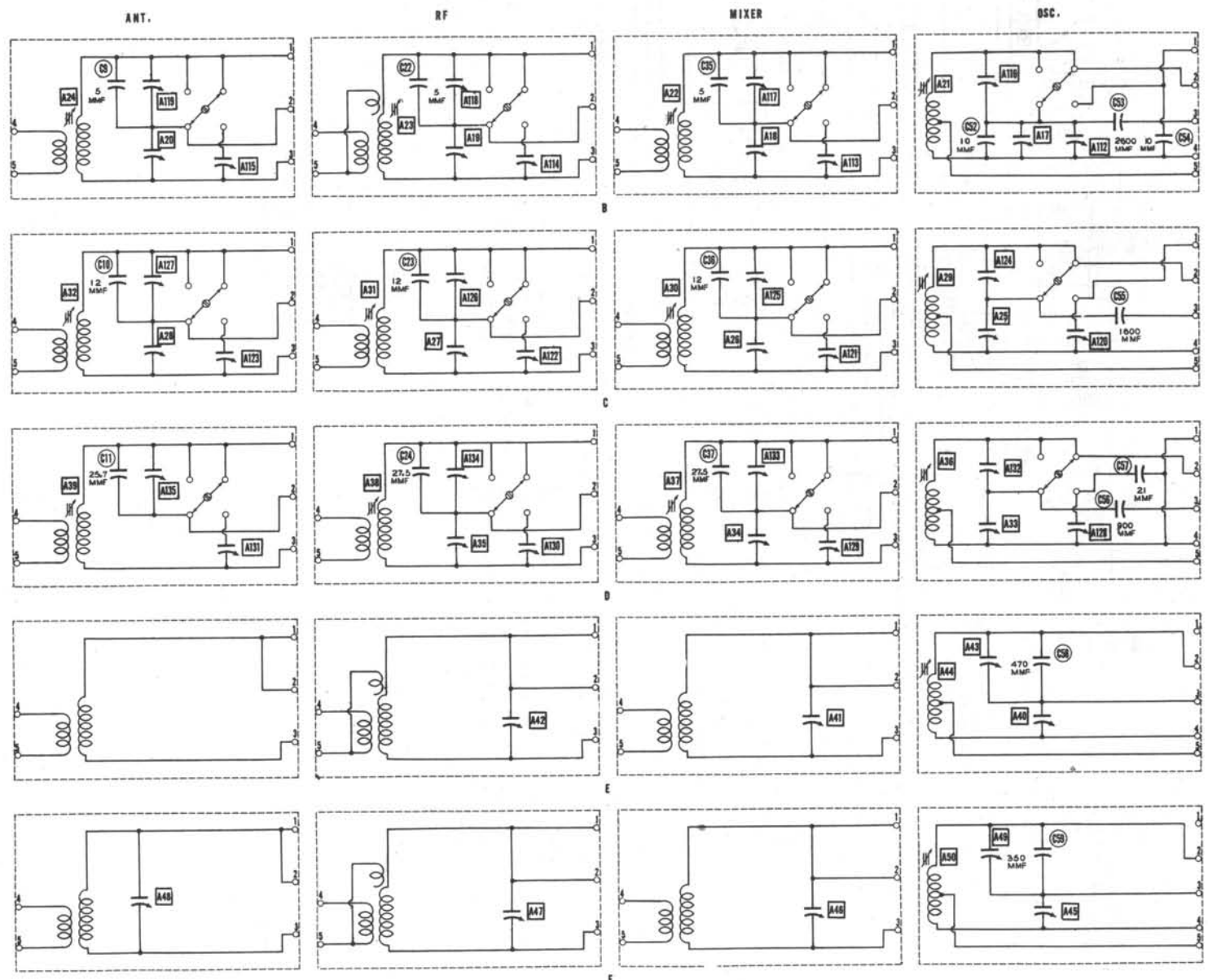
FUNCTION SWITCH IN "AM" POSITION UNLESS OTHERWISE NOTED.
 LIMITER SWITCH "OFF" UNLESS OTHERWISE NOTED.
 B+ SWITCH MUST BE ON FOR THESE MEASUREMENTS.
 CALIBRATION SWITCH "OFF" UNLESS OTHERWISE NOTED.
 * AVC SWITCH "OFF".
 # AVC SWITCH "ON".
 † LIMITER SWITCH "ON" AND CONTROL TURNED CLOCKWISE.
 ‡ FUNCTION SWITCH IN "CW" POSITION.
 § CALIBRATION SWITCH 100 or 1000 POSITION.
 § TAKEN WITH VACUUM TUBE VOLTMETER.

RESISTANCE READINGS

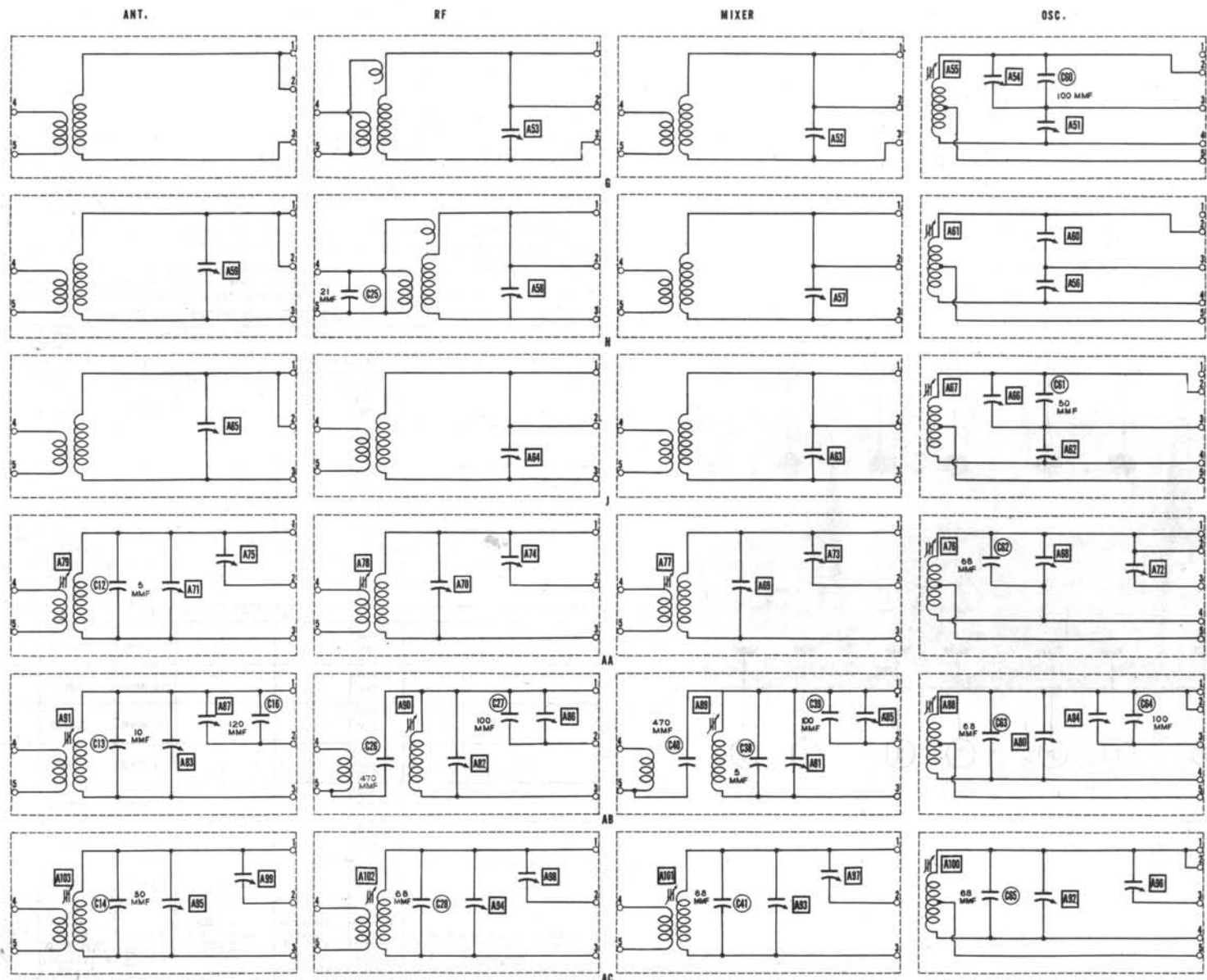
Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Top Cap
V 1	6BA6	±470KΩ #3.5Meg.	100Ω	0Ω	.1Ω	†290Ω	†17KΩ	100Ω		
V 2	6BA6	±470KΩ #3.5 Meg.	10KΩ	0Ω	.1Ω	†290Ω	†17KΩ	10KΩ		
V 3	6BE6	22KΩ	220Ω	.1Ω	0Ω	†290Ω	†33KΩ	.1Ω		
V 4	6C4	†5.3KΩ	0Ω	.1Ω	0Ω	†5.3KΩ	22KΩ	0Ω		
V 5	6K7	0Ω	0Ω	†2.5KΩ	†15KΩ	10KΩ	10KΩ	.1Ω	10KΩ	±470KΩ #3.5 Meg.
V 6	6K7	0Ω	0Ω	†2.5KΩ	†15KΩ	10KΩ	Inf.	.1Ω	10KΩ	±470KΩ #3.5 Meg.
V 7	6J7	0Ω	0Ω	††120KΩ	††100KΩ	0Ω	†† 290Ω	.1Ω	2Ω	47KΩ
V 8	6H6	0Ω	0Ω	±750KΩ #1.5 Meg.	0Ω	150KΩ ±300KΩ	150KΩ ±300KΩ	2.5Ω	0Ω	
V 9	6SN7GT	#3 Meg.	†50KΩ	0Ω	270KΩ	†47KΩ	50KΩ	0Ω	.1Ω	
V 10	6H6	0Ω	0Ω	† 1 Meg. † 350KΩ	220KΩ ± 500KΩ	†1.3Meg. † 600KΩ	†1.5 Meg. † 800KΩ	2.5Ω	220KΩ 500KΩ	
V 11	6SJ7	0Ω	0Ω	2.3KΩ	100Ω	2.3KΩ	†147KΩ	.1Ω	†147KΩ	
V 12	6V6GT	0Ω	0Ω	†340Ω	†290Ω	220KΩ	†340Ω	.1Ω	220Ω	
V 13	6V6GT	0Ω	0Ω	†340Ω	†290Ω	220KΩ	†290Ω	.1Ω	220Ω	
V 14	OB2	†5.3KΩ	0Ω	Inf.	0Ω	†5.3KΩ	Inf.	0Ω		
V 15	5U4G	Inf.	45KΩ	Inf.	115Ω	Inf.	115Ω	Inf.	45KΩ	
V 16	6AK6	4.7 Meg.	0Ω	0Ω	.1Ω	†±470KΩ	†± 22KΩ	0Ω		
V 17	6SK7	0Ω	0Ω	1000Ω	1 Meg.	1000Ω	†50KΩ	.1Ω	†5KΩ	
V 18	6H6	0Ω	0Ω	Inf.	15KΩ	15KΩ	15KΩ	.1Ω	Inf.	

FUNCTION SWITCH IN "AM" POSITION UNLESS OTHERWISE NOTED.
 LIMITER SWITCH OFF UNLESS OTHERWISE NOTED.
 B+ SWITCH MUST BE ON FOR THESE MEASUREMENTS.
 CALIBRATION SWITCH "OFF" UNLESS OTHERWISE NOTED.
 * AVC SWITCH "OFF".
 # AVC SWITCH "ON".
 † LIMITER SWITCH "ON" AND CONTROL TURNED CLOCKWISE.
 ‡ MEASURED FROM PIN 8 OF V15.
 ‡ FUNCTION SWITCH IN "CW" POSITION.
 § CALIBRATION SWITCH IN 100 or 1000 POSITION.

- DC-Voltage measurements are at 20,000 ohms per volt; AC Voltages measured at 1,000 ohms.
- Socket connections are shown as bottom views.
- Measured values are from socket pin to common negative.
- Line voltage maintained at 117 volts for voltage readings.
- Nominal tolerance on component values makes possible a variation of ±15% in voltage and resistance readings.
- Volume control at maximum, no signal applied for voltage measurements.



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ALIGNMENT INSTRUCTIONS—READ CAREFULLY BEFORE ATTEMPTING ALIGNMENT

To set the main tuning dial turn the tuning gang fully closed, loosen set screws and turn the dial slowly until the dial reads zero.

To set pointer, set the band selector until the band "D" scale appears and turn the main tuning dial to 490 and set pointer to 4MC reference mark on dial scale.

IF ALIGNMENT "CHECK" TO BE MADE PRIOR TO ALIGNMENT

(a) Set the AVC switch to "OFF", the control switch to "CW", the phasing control at zero, the selectivity switch at "5" and the RF gain control at 10.

(b) Vary the CWO control to point of lowest background noise and note the setting.

(c) Turn the selectivity switch to "OFF" position, and adjust "CWO" control to point of lowest background noise and note the setting.

(d) If IF Alignment is correct the two settings (b) and (c) should coincide and steps 1 thru 6 may be omitted.

IF ALIGNMENT

Controls should be set as follows except where noted otherwise: Set the control switch to "CW", the AVC switch to "OFF", the phasing control to zero, the selectivity switch to "5", the AF gain control to 10, and the RF gain control to 9.

DUMMY ANTENNA	SIGNAL GENERATOR COUPLING	SIGNAL GENERATOR FREQUENCY	COIL SET	RADIO DIAL SETTING	OUTPUT METER	ADJUST	REMARKS
1. Direct	High side to pin 7 (Grid) of 6BE6 (V3). Low side to chassis.	455KC (Unmod.)	Any	Tuning gang fully open	Across voice coil		Adjust the "CWO" control for audio beat-note. If it is difficult to obtain the beat note, an adjustment of A1 will be required. Vary the signal generator between 453 and 457KC for a sharp peak response. Set the generator at this peak for IF Alignment.
2. Direct	"	As set in step 1	"	"	"	A2, A3, A4, A5, A6, A7	Set the selectivity switch to "OFF", the control switch to "AM" position. Turn modulation of signal generator on. Adjust for maximum output.
3. Direct	"	Two KC above frequency determined in step 1	"	"	"	A2,	Set the selectivity switch to "1" and adjust A2 for maximum output.
4. Direct	"	Exact frequency determined in step 1	"	"	"	A8	Turn selectivity switch to "OFF" position. Adjust for maximum output.

5. The phasing control is pre-set at the factory, and should not require adjustment, when correctly set a decrease in the background level will be noted with the selectivity switch at "5" and the phasing control at zero. If not, a slight adjustment of A9 will be required for proper setting.

6. Turn modulation of signal generator off and set control switch to "CW" position. Turn the "CWO" control fully clockwise and set knob to "5" on its scale. Adjust "CWO" control to zero beat with signal generator. If zero beat does not occur at "0" on the control dial a careful readjustment of A1 will be required.

GENERAL COVERAGE ALIGNMENT

Set all controls as follows: Set the control switch to "AM", the AVC switch to "OFF", the selectivity switch to "OFF", the RF gain control to 10, the bandspread switch to the general coverage position.

The position of the antenna and oscillator trimmers should be with the arrows of these controls in a vertical position.

DUMMY ANTENNA	SIGNAL GENERATOR COUPLING	SIGNAL GENERATOR FREQUENCY	COIL SET	RADIO DIAL SETTING	OUTPUT METER	ADJUST	REMARKS
7. 400Ω carbon res.	High side antenna terminal "A". Low side to chassis.	30MC (400% Mod.)	Band A	30MC	Across voice coil	A10 (pos. 8)	Adjust until signal is heard. Tune signal generator to 30.91 MC. If signal is not heard, retune generator to 30MC and open A10 to next peak. Adjust for maximum output and recheck for image.
8. "	"	"	"	"	"	A11 (pos. 6) A12 (pos. 4)	Adjust for maximum output.
9. "	"	14.4MC	"	Tune for max. output	"	A13 (pos. 16) A14 (pos. 13) A15 (pos. 11) A16 (pos. 9)	Adjust A13 until signal is heard. Adjust A14, A15 and A16 for maximum output. Repeat steps 7, 8, and 9 until no further improvement can be made.

10.	400Ω carbon res.	High side antenna terminal "A". Low side to chassis.	14.4MC	Band B	14.4MC	Across voice coil	A17 (pos. 8)	Adjust until signal is heard. Tune signal generator to 15.31 MC. If no signal is heard, retune generator to 14.4MC and open A17 to next peak. Adjust for maximum output and recheck for image.
11.	"	"	14.4MC	"	14.4MC	"	A18 (pos. 6) A19 (pos. 4) A20 (pos. 2)	Adjust for maximum output.
12.	"	"	7MC	"	Tune for max. output	"	A21 (pos. 16) A22 (pos. 13) A23 (pos. 11) A24 (pos. 9)	Adjust A21 until signal is heard. Adjust A22, A23 and A24 for maximum output. Repeat steps 10, 11 and 12 until no further improvement can be made.
13.	"	"	7.3MC	Band C	7.3MC	"	A25 (pos. 8)	Adjust until signal is heard. Tune signal generator to 8.21MC. If signal is not heard retune generator to 7.3MC and open A25 to next peak and adjust for maximum output and recheck for image.
14.	"	"	"	"	"	"	A26 (pos. 6) A27 (pos. 4) A28 (pos. 2)	Adjust for maximum output.
15.	"	"	3.5MC	"	Tune for max. output	"	A29 (pos. 16) A30 (pos. 13) A31 (pos. 11) A32 (pos. 9)	Adjust A29 until signal is heard. Adjust A30, A31 and A32 for maximum output. Repeat steps 13, 14 and 15 until no further improvement can be made.
16.	"	"	4MC	Band D	4MC	"	A33 (pos. 8)	Adjust until signal is heard. Tune signal generator to 4.91 MC. If no signal is heard, retune generator to 4MC and open A33 to next peak. Adjust for maximum output and recheck for image.
17.	"	"	"	"	"	"	A34 (pos. 6) A35 (pos. 4)	Adjust for maximum output.
18.	"	"	1.8MC	"	Tune for max. output	"	A36 (pos. 16) A37 (pos. 13) A38 (pos. 11) A39 (pos. 9)	Adjust A36 until signal is heard. Adjust A37, A38 and A39 for maximum output. Repeat steps 16, 17 and 18 until no further improvement can be made.
19.	"	"	2MC	Band E	2MC	"	A40 (pos. 8)	Adjust until signal is heard. Tune signal generator to 2.91 MC. If signal is not heard, retune generator to 2MC and open A40 to next peak. Adjust for maximum output and recheck for image.

ALIGNMENT INSTRUCTIONS (CONT.)

20.	400Ω carbon res.	High side antenna terminals "A". Low side to chassis.	2MC	Band E	2MC	Across voice coil	A41 (pos. 6) A42 (pos. 4)	Adjust for maximum output.
21.	"	"	1MC	"	Tune for max. output	"	A43 (pos. 7)	Adjust until signal is heard.
22.	"	"	1.4MC	"	"	"	A44 (pos. 16)	Adjust until signal is heard. Repeat steps 19 thru 22 until no further improvement can be made.
23.	"	"	900KC	Band F	900KC	"	A45 (pos. 8)	Adjust until signal is heard. Tune signal generator to 1.81MC. If signal is not heard, retune generator to 900KC and open A45 to next peak. Adjust for maximum output and recheck for image.
24.	"	"	"	"	"	"	A46 (pos. 6) A47 (pos. 4) A48 (pos. 2)	Adjust for maximum output.
25.	"	"	500KC	"	500KC	"	A49 (pos. 7)	Adjust until signal is heard.
26.	"	"	700KC	"	700KC	"	A50 (pos. 16)	Adjust until signal is heard. Repeat steps 23, 24, 25 and 26 until no further improvement can be made.
27.	"	"	400KC	Band G	400KC	"	A51 (pos. 8)	Adjust until signal is heard. Tune signal generator to 1310 KC. If signal is not heard, retune generator to 400KC and open A51 to next peak. Adjust for maximum output and recheck for image.
28.	"	"	"	"	"	"	A52 (pos. 6) A53 (pos. 4)	Adjust for maximum output.
29.	"	"	200KC	"	200KC	"	A54 (pos. 7)	Adjust until signal is heard.
30.	"	"	300KC	"	300KC	"	A55 (pos. 16)	Adjust until signal is heard. Repeat steps 27, 28, 29 and 30 until no further improvement can be made.
31.	"	"	200KC	Band H	200KC	"	A56 (pos. 8)	Adjust until signal is heard. Tune signal generator to 1110KC. If signal is not heard, retune generator to 200KC and open A56 to next peak. Adjust for maximum output and recheck for image.
32.	"	"	"	"	"	"	A57 (pos. 6) A58 (pos. 4) A59 (pos. 2)	Adjust for maximum output.
33.	"	"	100KC	"	100KC	"	A60 (pos. 7)	Adjust until signal is heard.
34.	"	"	150KC	"	150KC	"	A61 (pos. 16)	Adjust until signal is heard. Repeat steps 31, 32, 33 and 34 until no further improvement can be made.

35.	400Ω carbon res.	High side antenna terminals "A". Low side to chassis.	100KC	Band J	100KC	Across voice coil	A62 (pos. 8)	Adjust until signal is heard. Tune signal generator to 1010KC. If signal is not heard, retune generator to 100KC and open A62 to next peak. Adjust for maximum output and recheck for image.
36.	"	"	"	"	"	"	A63 (pos. 6) A64 (pos. 4) A65 (pos. 2)	Adjust for maximum output.
37.	"	"	50KC	"	50KC	"	A66 (pos. 7)	Adjust until signal is heard.
38.	"	"	75KC	"	75KC	"	A67 (pos. 16)	Adjust until signal is heard. Repeat steps 35, 36, 37 and 38 until no further improvement can be made.
39.	"	"	30MC	Band AA	30MC	"	A68 (pos. 7)	Adjust until signal is heard. Tune signal generator to 30.91 MC. If no signal is heard, retune generator to 30MC and open A68 to next peak. Adjust for maximum output and recheck for image.
40.	"	"	"	"	"	"	A69 (pos. 5) A70 (pos. 3) A71 (pos. 1)	Adjust for maximum output.
41.	"	"	27.2MC	"	Tune for max. output	"	A72 (pos. 8) A73 (pos. 6) A74 (pos. 4) A75 (pos. 2)	Adjust A72 until signal is heard. Adjust A73, A74 and A75 for maximum output.
42.	"	"	28MC	"	"	"	A76 (pos. 16) A77 (pos. 13) A78 (pos. 11) A79 (pos. 9)	Adjust A76 until signal is heard. Adjust A77, A78 and A79 for maximum output. Repeat steps 39, 40, 41 and 42 until no further improvement can be made.
43.	"	"	35MC	Band AB	35MC	"	A80 (pos. 8)	Adjust until signal is heard. Tune signal generator to 35.91 MC. If signal is not heard, retune generator to 35MC and open A80 to next peak. Adjust for maximum output and recheck for image.
44.	"	"	"	"	"	"	A81 (pos. 6) A82 (pos. 4) A83 (pos. 2)	Adjust for maximum output.
45.	"	"	25MC	"	Tune for max. output	"	A84 (pos. 7) A85 (pos. 5) A86 (pos. 3) A87 (pos. 1)	Adjust A84 until signal is heard. Adjust A85, A86 and A87 for maximum output.