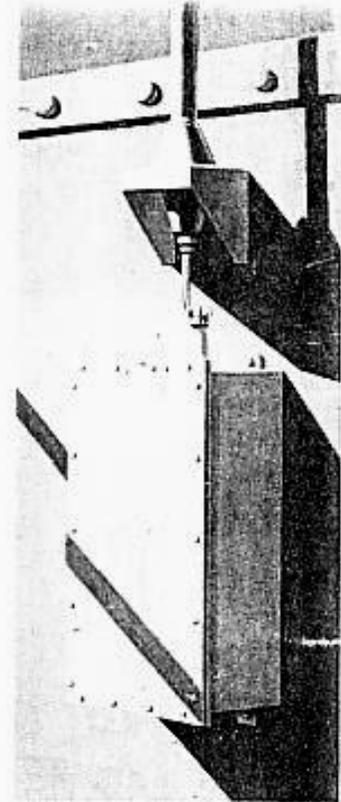




**HARRIS**

COMMUNICATIONS AND  
INFORMATION HANDLING



# RF-230/RF-230M

CHANNELIZED/PROGRAMMABLE  
HF-SSB COMMUNICATIONS SYSTEM



6628-0015B

Publication: June 1980

## SPECIFICATIONS

### GENERAL

<b>Power Output</b>	125 watts PEP (125 Watts AVERAGE with blower option)
<b>Frequency Range</b>	1.6 to 30 MHz
<b>Number of Channels</b>	32 Simplex Channels or 16 Half - Duplex Channels (field programmable channel entry with 100 Hz frequency increments.) Optional channel expansion to 96 Simplex or 48 Half - Duplex Channels.
<b>Frequency Stability</b>	$\pm 1$ part in $10^6$
<b>Emissions Modes</b>	A3J (Single Sideband USB LSB); A3A (Single Sideband Reduced Carrier); A3H Compatible AM); A1 (CW); F1 (radio teletype) and F4 (facsimile) available with optional modems.
<b>Power Input</b>	RF-230 Transceiver: 13.6 VDC $\pm$ 10%, 1.5 amps. receive, 32 amps. peak transmit. RF-230 Transceiver with RF-236 Base Unit AC Power Supply; 115/230 VAC $\pm$ 10%, 50/60 Hz $\pm$ 5%
<b>RF-Input/Output Impedance</b>	50 ohms nominal, unbalanced.
<b>Temperature</b>	30° to -50° C
<b>Size</b>	RF-230 Transceiver: 5.2H x 14.7W x 16.3D inches (13.2H x 37.3W x 41.4D cm). RF-236 Base Unit AC Power Supply: 5.2H x 14.7W x 16.3D inches (13.2H x 37.3W x 41.4D cm).
<b>Weight</b>	RF-230 Transceiver: 25 lbs. (11.2 kg.). RF-236 Base Unit AC Power Supply: 45 lbs. (20.2 kg.).

<b>Power Output</b>	SSB (A3J); 125 watts PEP AVERAGE. AM Compatible (A3H); 40 watts Carrier Nominal. CW (A1); 125 watts AVERAGE.
<b>Overload Protection</b>	P.A. is fully protected from a mismatch including an open or shorted antenna.
<b>Carrier Suppression (A3J Mode)</b>	At least 40 dB below PEP output.
<b>Intermodulation Distortion</b>	Third order, at least 33 dB below PEP output.
<b>Undesired Sideband Suppression</b>	At least 50 dB at 1 KHz.
<b>Harmonic Suppression</b>	At least 46 dB below PEP without coupler and 64 dB with coupler.
<b>Audio Input</b>	Either carbon or dynamic microphone, in addition a 600 ohm input is provided.
<b>Residual Noise Level</b>	At least 43 dB below PEP.
<b>Audio Bandwidth</b>	2.1 KHz (standard) others optionally available.

### RECEIVER

<b>Sensitivity</b>	SSB: 0.5 $\mu$ V for 10 dB S - N/N AM: 3 $\mu$ V for 10 dB S - N/N
<b>Audio Output</b>	Internal Speaker: 4 watts with less than 10% distortion.
<b>Selectivity</b>	SSB: 300-2400 Hz at 6 dB (standard). Others optionally available AM: 6 KHz at 6 dB (standard)
<b>Image Rejection</b>	Greater than 70 dB.
<b>I.F. Rejection</b>	Greater than 70 dB.
<b>AGC Characteristics</b>	Attack Time: SSB 10 ms nominal. Release Time: SSB 1 sec. nominal. Radio Teletype Mode Fast Attack and Release
<b>Intermodulation Distortion</b>	In-Band Third Order: -30 dB or better for two equal 0.1V signals falling within SSB Filter. Out of Band Third Order: -80 dB or better for two equal 5 mv signals falling at $f_0 \pm 30$ KHz and $f_0 \pm 60$ KHz.
<b>Overload Protection</b>	Receiver protected for inputs to 30 Vrms.
<b>Spurious Responses</b>	-70 dB

### RF-231 COUPLER

<b>Input Impedance</b>	50 ohms (maximum VSWR 1.5:1)
<b>Output</b>	Standard coupler will tune the following antennas: 9, 16, 24 or 35 ft. (2.7, 4.9, 7.3, or 10.7m) whips over the frequency range from 1.6 to 30 MHz. 75 ft. (22.9m) long wire over the frequency range from 1.6 to 30 MHz. 150 ft. (45.7m) long wire over the frequency range from 2.6 to 30 MHz. Optional adapter required for operation from 1.6 to 2.6 MHz.
<b>Power Level</b>	125 watts AVERAGE, continuous duty.
<b>Number of Channels</b>	32 programmable channels standard; optional channel expansion to 64 channels.
<b>Size</b>	21H x 11.5W x 7D inches (53.34H x 29.21W x 17.78D cm).
<b>Weight</b>	25 lbs. (11.2 kg).
<b>Case Construction</b>	Waterproof (sealed) for exposed mounting.
<b>Operating Power</b>	Derived from associated RF-230 Transceiver with separation up to 250 ft.

All specifications subject to change without notice.



RF-230, RF-231, RF-236,  
RF-2301 and RF-2302  
**CROSS REFERENCE PARTS LIST**

The following cross reference list consists of two columns. Column A is alphabetized from Harris to Manufacturer/Mil part numbers, while column B is alphabetized from Manufacturer/Mil to Harris part numbers. When ordering replacement items through Harris Corporation, RF Communications Division, please reference all items by a Harris part number. This will assist us in providing you with an accurate and timely parts replacement service for your RF Communications products.

Thank you

A

C-0001 MBP102-500M  
 C-0065 DCM-103  
 C-0103 CD15CD050003  
 C-0104 CD15CD100J03  
 C-0105 CM04CD120J03  
 C-0108 CMR04E2UCJ0DM  
 C-0112 CD10ED300J03  
 C-0113 CD15ED330J03  
 C-0116 CD15ED430J03  
 C-0117 CM05ED470J03  
 C-0120 CD15ED560J03  
 C-0122 CD15ED680J03  
 C-0124 CD15ED820J03  
 C-0125 CD15FD910J03  
 C-0126 CM05FD101J03  
 C-0128 CD15FD121J03  
 C-0129 CD15FD131J03  
 C-0133 CD15FD201J03  
 C-0134 CD15FD221J03  
 C-0152 CM06FD102J03  
 C-0153 CD19FD112J03  
 C-0153 CM06FD112J03  
 C-0155 CD19FD132J03  
 C-0158 CD19FD182J03  
 C-0172 CD19FC562J03  
 C-1187 J-102-100PF  
 C-1419 ET471X025A01  
 C-2465 CM05ED300G03  
 C-2469 CM05ED430G03  
 C-2472 CM05ED510G03  
 C-2476 CM05ED750G03  
 C-2477 CM05ED820G03  
 C-2479 CM05FD101G03  
 C-2480 CM05FD111G03  
 C-2482 CMR04F131J0DM  
 C-2482 CM05FD131G03  
 C-2483 CM05FD151G03  
 C-2485 CM05FD181G03  
 C-2486 CM05FD201G03  
 C-2487 CM05FD221G03  
 C-2489 DM-15-251G  
 C-2491 CM05FD301G03  
 C-2492 CM05FD331G03  
 C-2493 CM05FD361G03  
 C-2495 DM-15-431G  
 C-2496 CD15FD471G03  
 C-2496 DM-15-471G  
 C-2499 DM-15-561G  
 C-2503 CD15FC821G03  
 C-3100 T362A105K035AS  
 C-3101 T362A335K015AS  
 C-3102 T362B685K035AS  
 C-3105 T362C686K025AS

B

E-0280 A10103 CAP  
 K-0119 A41C-36+3e5-JG  
 C-8205 BA2A103H  
 C-8206 BA2A193H  
 C-8216 BA2A332H  
 C-8218 BA2A333H  
 C-8214 BA2A393H  
 C-8217 BA2A473H  
 R-2181 BWH-3.3-2w  
 R-0983 BWHC.10,10PCT  
 CR-0267 BZY88-C5V1  
 C-4754 C-NPC-56-2PCT  
 C-6515 C-NPC-56-2PCT  
 C-6916 C-NPC-62-2PCT  
 C-6917 C-NPC-63-2PCT  
 C-6918 C-NPC-75-2PCT  
 C-6919 C-NPC-82-2PCT  
 C-6620 C-1e-NPC-5  
 C-5193 C-18-NPC-2PCT  
 C-5194 C-20-NPC-2PCT  
 IC-0031 CA3028AS  
 IC-0153 CA3096AE  
 IC-0376 CA3130AS  
 IC-0359 CA324E  
 IC-0295 CA555CE  
 C-0112 CD10ED300J03  
 C-0103 CD15CD050003  
 C-0104 CD15CD100J03  
 C-0113 CD15ED330J03  
 C-0116 CD15ED430J03  
 C-0120 CD15ED560J03  
 C-0122 CD15ED680J03  
 C-0124 CD15ED820J03  
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 C-0129 CD15FD131J03  
 C-0133 CD15FD201J03  
 C-0134 CD15FD221J03  
 C-2496 CD15FD471G03  
 C-0125 CD15FD910J03  
 C-0172 CD19FC562J03  
 C-0153 CD19FD112J03  
 C-0155 CD19FD132J03  
 C-0158 CD19FD182J03  
 IC-0135 CD4001AE  
 IC-0377 CD4008AE  
 IC-0378 CD4010AE  
 IC-0136 CD4011AE  
 IC-0350 CD4011BF  
 IC-0089 CD4012AE  
 IC-0139 CD4017AE  
 IC-0142 CD4023AE  
 IC-0243 CD4024AE

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B

C-3106	T362C157K015AS	IC-0143	CD4025AE
C-3107	T362D337K006AS	IC-0257	CD4028AE
C-3202	8121-050-Y5V-104Z	IC-0352	CD4028AE
C-3502	JE150+10PCTY5E	IC-0090	CD4029AE
C-3508	S471-Y5E-500K	IC-0244	CD4030AE
C-3513	JE1.000+10PCTY5E	IC-0382	CC4042AE
C-3513	S102-Y5E-500K	IC-0383	CD4046AE
C-4727	C030B102S1R0D	IC-0091	CD40513E
C-4730	C030B102S1R8D	IC-0353	CD4051BF
C-4732	CC30B102S2R7D	IC-0384	CD40538E
C-4735	C030B102E3R9D	IC-0354	CD40536F
C-4737	C030B102E5R0D	IC-0385	CD4060AE
C-4738	C030B102E5R6D	IC-0250	CD4066AE
C-4741	C030B102E100D	IC-0386	CD40668E
C-4743	C030B102E150J	IC-0387	CD40698E
C-4744	C030B102F180J	IC-0389	CD40718E
C-4745	C030B102F200J	IC-0390	CD40738E
C-4746	C030B102F220J	IC-0391	CD40758E
C-4750	C030B102G330J	IC-0392	CD40778E
C-4751	C030B102G390J	IC-0393	CD40818E
C-4752	C030B102H470J	IC-0394	CD40828E
C-4754	C-NPC-56-2PCT	IC-0356	CD45188E
C-4754	C030B102J560J	IC-0357	CD45328E
C-4757	C030A102K800J	C-4949	CGS162U075R263PH
C-4947	CKR068X334KM	C-4947	CKR068X334KM
C-4948	602C383G030DC	C-0108	CMR04E200J0DM
C-4949	CGS162U075R263PH	C-2482	CMR04F131J0DM
C-4952	2CDU60F103MA8	C-0105	CMC4CD120JG3
C-5193	C-18-NPO-2PCT	C-2465	CM05ED300G03
C-5194	C-20-NPO-2PCT	C-2469	CM05ED430G03
C-6370	7C25U104X0050E1	C-0117	CM05ED470J03
C-6374	7C25U474X0050E1	C-2472	CM05ED510G03
C-6408	T368B225M050AS	C-2476	CM05ED0750G03
C-6415	T368A104M035AS	C-2477	CM05ED820G03
C-6417	1960224X0035HA1	C-2479	CM05FD101G03
C-6418	T063A334M035AS	C-0126	CM05FD101J03
C-6419	T368A474M035AS	C-2480	CM05FD111G03
C-6440	T362C336M025AS	C-2482	CM05FD131G03
C-6442	T368A105M02CAS	C-2483	CM05FD151G03
C-6444	T368A225M020AS	C-2485	CM05FD181G03
C-6448	T368B106M020AS	C-2486	CM05FD201G03
C-6450	T362C226M020AS	C-2487	CM05FD221G03
C-6452	T362C476M020AS	C-2491	CM05FD301G03
C-6454	T362C102M020AS	C-2492	CM05FD331G03
C-6454	T362C107M02CAS	C-2493	CM05FD361G03
C-6454	T368A107M020AS	C-0152	CM06FD102J03
C-6549	156X9020KAL	C-0153	CMC6FD112J03
C-6620	C-16-NPC-5	C-8084	CSR13F476KL
C-6684	J-112-500PF	C-4757	C030A102K800J
C-6915	C-NPC-56-2PCT	C-4741	C030B102E100D
C-6916	C-NPC-62-2PCT	C-4743	C030B102E150J
C-6917	C-NPC-68-2PCT	C-4735	C030B102E3R9C
C-6918	C-NPC-75-2PCT	C-4737	C030B102E5R0D
C-6919	C-NPC-82-2PCT	C-4738	C030B102E5R6D
C-3000	C230MAE/ALCK	C-4744	C030B102F180J

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C-8031	C280MCH/A100K	C-4745	C030B1J2F200J
C-8043	C280MCH/A1M	C-4746	C030B1J2F220J
C-8084	CSR13F470KL	C-4750	C030B102G330J
C-8205	BA2A103H	C-4751	C030B102G390J
C-8206	BA2A183H	C-4752	C030B102H470J
C-8214	BA2A393H	C-4754	C030B102J560J
C-8216	BA2A332H	C-4727	C030B102S1R00
C-8217	BA2A473H	C-4730	C030B102S1R80
C-8218	BA2A333H	C-4732	C030B102S2R70
CR-0034	30510	C-8000	C280MAE/A10K
CR-0038	MSD6150	C-8043	C280MCH/A1M
CR-0046	1N753A	C-8031	C280MCH/A1COK
CR-0065	1N277	C-0065	00M-103
CR-0215	1N5236	C-2489	DM-15-251G
CR-0218	1N5239	C-2495	DM-15-431G
CR-0265	1N5232	C-2496	DM-15-471G
CR-0267	BZY88-C5V1	C-2499	DM-15-561G
CR-0280	1N4935	C-1419	ET471X025A01
CR-0282	1N4933	IC-0402	F5C11C90
CR-0294	HP3080	CR-0453	GEC1068
CR-0403	HP5082-2800	CR-0294	HP3080
CR-0449	MR-5005R	CR-0403	HP5082-2800
CR-0450	1N5640A	CR-0454	HP5082-2835
CR-0453	GEC1068	C-1187	J-102-100CPF
CR-0454	HP5082-2835	C-6684	J-112-500PF
CR-0701	1N4720	J-0412	J-530018-3
CR-0705	1N4454	C-3513	JE1.000+10PCTY5E
CR-0725	1N4004	C-3502	JE150+10PCTY5E
CR-0731	1N747A	R-4280	KP45J1
CR-0745	MV105	L-0256	L-0256
CR-0746	MPN3401	IC-0359	LM324
D05-0001-041	1N52418	L-0060	LT10K004
E-0280	A10103 DAP	L-0050	LT10K036
E-2192	57-0180	R-4292	LVR-5-.025
F-0013	312003	S-0130	NA-012-4-CE-P-2W
F-0016	MTH6	IC-0291	MA78L05AC
H-4770	103200	C-0001	M8P102-500M
IC-0031	CA3028AS	IC-0058	MC1723CL
IC-0052	MC4044	IC-0171	MC3340P
IC-0058	MC1723CL	IC-0052	MC4044
IC-0062	MC7470P	IC-0062	MC7470P
IC-0089	CD4012AE	IC-0151	MC7805LP
IC-0090	CD4029AE	I12-000	MC7808CT
IC-0091	CD4051BE	Q-0399	MJE-1090
IC-0135	CD4001AE	Q-0142	MJE-1100
IC-0136	CD4011AE	IC-0359	MLM2902
IC-0139	CD4017AE	IC-0359	MLM2902P
IC-0142	CD4023AE	IC-0400	MM80C97
IC-0143	CD4025AE	IC-0400	MM80C97A
IC-0151	MC7805LP	CR-0746	MPN3401
IC-0153	CA3096AE	Q-0076	MPS-A13
IC-0171	MC3340P	Q-0074	MPS-L01
IC-0175	74LS190N	Q-0062	MPS2369
IC-0177	SN74LS00N	Q-0391	MPS6571
IC-0243	CD4024AE	CR-0449	MR-5005R

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IC-0244	CD4030AE	CR-003E	M5C6150
IC-0257	CD4028AE	L-005C	MS90539-15
IC-0290	CD4066AE	F-0016	MTH6
IC-0291	MA7BL05AC	CR-0745	MV109
IC-0291	UA78L05AC	IC-0295	NE555
IC-0295	CA555CE	Q-0405	PT-5701
IC-0295	NE555	R-2199	R-2199
IC-0350	CD40118F	R-1225	RCR07G101J
IC-0352	CD4028AE	R-1249	RCR07G102J
IC-0353	CD40518F	R-1273	RCRC7G103J
IC-0354	CD40538F	R-1297	RCR07G104J
IC-0359	CA324E	R-1321	RCR07G105J
IC-0359	LM324	R-1345	RCR07G106J
IC-0359	MLM2902	R-1274	RCR07G113J
IC-0359	MLM2902P	R-1227	RCR07G121J
IC-0376	CA3130AS	R-1251	RCRC7G122J
IC-0377	CD4008AE	R-1275	RCR07G123J
IC-0378	CD4010AE	R-1300	RCR07G134J
IC-0382	CD4042AE	R-1205	RCR07G150J
IC-0383	CD4046AE	R-1229	RCRC7G151J
IC-0384	CD40538E	R-1253	RCR07G152J
IC-0385	CD4060AE	R-1277	RCR07G153J
IC-0386	CD40688E	R-1301	RCR07G154J
IC-0387	CD40698E	R-1325	RCR07G155J
IC-0389	CD40718E	R-1230	RCR07G161J
IC-0390	CD40738E	R-1207	RCR07G180J
IC-0391	CD40758E	R-1231	RCR07G181J
IC-0392	CD40778E	R-1255	RCR07G182J
IC-0393	CD40818E	R-1279	RCR07G183J
IC-0394	CD40828E	R-1303	RCR07G184J
IC-0396	CD45188E	R-1280	RCR07G203J
IC-0397	CD45328E	R-1209	RCR07G220J
IC-0400	MM80C97	R-1233	RCR07G221J
IC-0400	MM80C97N	R-1257	RCR07G222J
IC-0401	2051	R-1281	RCR07G223J
IC-0402	FSC11C90	R-1305	RCR07G224J
IC-0403	74LS27PC	R-1329	RCR07G225
IC-0410	TBA810DS	R-1258	RCR07G242J
I12-0001-003	MC7808CT	R-1211	RCR07G270J
J-0031	700-209-NP	R-1235	RCR07G271J
J-0065	105-0851-001	R-1259	RCR07G272J
J-0066	105-0852-001	R-1283	RCR07G273J
J-0068	105-0854-001	R-1212	RCR07G300J
J-0069	105-0856-001	R-1213	RCR07G330J
J-0070	105-0857-001	R-1237	RCR07G331J
J-0071	105-0858-001	R-1261	RCR07G332J
J-0072	105-0860-001	R-1285	RCR07G333J
J-0073	105-0862-001	R-1215	RCR07G390J
J-0074	105-0863-001	R-1239	RCR07G391J
J-0371	50-2CB-10	R-1263	RCR07G392J
J-0387	105-1102-001	R-1287	RCR07G393J
J-0389	105-1104-001	R-1311	RCR07G394J
J-0390	105-1106-001	R-1264	RCR07G432J
J-0391	105-1107-001	R-1217	RCRC7G470J
J-0392	105-1108-001	R-1241	RCR07G471J

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J-0393	105-1110-001	R-1265	RCR07G472J
J-0412	J-530018-3	R-1289	RCR07G473J
J-0865	1-27576-C	R-1362	RCR07G5R6J
J-0870	87586-1	R-1219	RCR07G510J
J-0871	87586-4	R-1218	RCR07G510J
J-0880	87225-4	R-1242	RCR07G511J
J-0881	1-87225-0	R-1219	RCR07G560J
J-0882	1-87225-5	R-1243	RCR07G561J
J-0883	1-87225-7	R-1267	RCR07G562J
J46-0001-007	87225-6	R-1291	RCR07G563J
K-0055	1A12A	R-1221	RCR07G680J
K-0113	M65RPCX202	R-1245	RCR07G681J
K-0118	190-128100	R-1269	RCR07G682J
K-0119	A410-364385-00	R-1253	RCR07G683J
L-0035	1537-04	R-1246	RCR07G751J
L-0050	LT1CK036	R-1366	RCR07G8R2J
L-0050	MS90539-15	R-1223	RCR07G820J
L-0050	2500-28	R-1247	RCR07G821J
L-0058	1537-44	R-1271	RCR07G822J
L-0060	LT10K004	R-124e	RCR07G911J
L-0184	VK200	R-1272	RCR07G912J
L-0256	L-0256	R-1567	RCR20G1R0J
L-0606	1025-00	R-1413	RCR20G330J
L-0608	1025-04	R-1417	RCR20G470J
L-0610	4416-7K	R-3763	RCR32G0R5J
L-0611	1025-10	R-1601	RCR32G100J
L-0612	1025-12	R-1625	RCR32G101J
L-0616	1025-20	R-1629	RCR32G151J
L-0623	1025-34	R-1803	RCR42G120J
L-0624	1025-36	R-1807	RCR42G180J
L-0627	1025-42	R-1831	RCR42G181J
L-0628	1025-44	R-1833	RCR42G221J
L-0630	1025-48	R-7298	RNR55C8250F
L-0632	1025-52	R-7301	RNR55C8251F
L-0632	1316-4K	R-7307	RN5501493F
L-0633	1316-5K	R-7321	RN5501542F
L-0637	1025-62	R-7292	RN5501821F
L-0637	1326-4K	R-7294	RN5502210F
L-0640	1025-68	R-7277	RN5502491F
L-0640	1326-7K	R-7295	RN5503320F
L-0644	1025-76	R-7288	RN5503322F
L-0648	1025-84	R-7324	RN5503921F
L-0722	7107-22	R-7318	RN5504751F
L-0724	7107-24	R-7328	RN5504752F
L-0725	7107-25	R-7285	RN5506811F
LS-0014	255E2207	R-7303	RN5507151F
MP-0077	4586-97	R-7248	RN5508250F
MP-0136	Y8 23M	R-7348	RN5508252F
MP-1152	6045B	R-7282	RN5509090F
MP-3544	4586-2	R-7309	RN5509531F
P-C221	22-04-2101	R-7362	RN55N3923F
Q-0026	2N5193	R-5105	RN63039R2F
Q-0037	TIP-30A	TB-0387	SE1FK-2
Q-0062	MPS2309	IC-0177	SN74LS03N
Q-0074	MPS-UJ1	C-3513	S102-Y5E-500K

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Q-0076	MPS-A13	C-3508	S471-Y5E-500K
Q-0142	MJE-1100	IC-0410	T8A8100S
Q-0309	2N3563	Q-0037	TIP-30A
Q-0315	2N3644	C-6418	T068A334M035AS
Q-0320	2N3642	MP-0136	TYB 23M
Q-0334	2N4921	C-3100	T362A105K035AS
Q-0376	2N5486	C-3101	T362A335K015AS
Q-0385	2N4124	C-3102	T3628685K035AS
Q-0386	2N4126	C-6450	T362L226M020AS
Q-0386	2N4126	C-6440	T362C336M025AS
Q-0390-1	2N5179	C-6452	T362C476M020AS
Q-0351	MPS6571	C-6454	T362C102M020AS
Q-0397	2N3866	C-6454	T362D107M020AS
Q-0399	MJE-1090	C-3106	T362C157K015AS
Q-0405	PT-5701	C-3107	T3620337K006AS
Q-0416	2N5150	C-3105	T362D686K025AS
Q-0427	2N5586	C-6415	T368A104M035AS
Q03-0187-000	3N187	C-6442	T368A105M020AS
Q12-2905-000	2N2905A	C-6454	T368A107M020AS
R-0983	B*HO.10,10PCT	C-6444	T368A225M020AS
R-1205	RCR07G150J	C-6419	T368A474M035AS
R-1207	RCR07G180J	C-6448	T368B106M020AS
R-1209	RCR07G220J	C-6408	T368B225M050AS
R-1211	RCR07G270J	IC-0291	UA78L05AC
R-1212	RCR07G300J	L-0184	VK200
R-1213	RCR07G330J	K-0113	W65RPCX202
R-1215	RCR07G390J	J-0881	1-87225-0
R-1217	RCR07G470J	J-0882	1-87225-5
R-1218	RCRC7G510J	J-0883	1-87225-7
R-1218	RCR07G510J	J-0865	1-87576-0
R-1219	RCR07G560J	K-0095	1A12A
R-1221	RCR07G680J	CR-0065	1N277
R-1223	RCR07G820J	CR-0725	1N4004
R-1225	RCR07G101J	CR-0705	1N4454
R-1227	RCR07G121J	CR-0701	1N4720
R-1229	RCR07G151J	CR-0282	1N4933
R-1230	RCR07G161J	CR-0280	1N4935
R-1231	RCRC7G181J	CR-0265	1N5232
R-1233	RCR07G221J	CR-0215	1N5236
R-1235	RCRC7G271J	CR-0218	1N5239
R-1237	RCR07G331J	005-0001-041	1N5241B
R-1239	RCR07G391J	CR-0450	1N5640A
R-1241	RCRC7G471J	CR-0731	1N747A
R-1242	RCRC7G511J	CR-0046	1N753A
R-1243	RCR07G561J	X-0090	102066
R-1245	RCR07G681J	L-0606	1025-00
R-1246	RCR07G751J	L-0608	1025-04
R-1247	RCR07G821J	L-0611	1025-10
R-1248	RCR07G911J	L-0612	1025-12
R-1249	RCR07G102J	L-0616	1025-20
R-1251	RCR07G122J	L-0623	1025-34
R-1253	RCR07G152J	L-0624	1025-36
R-1255	RCR07G182J	L-0627	1025-42
R-1257	RCRC7G222J	L-0628	1025-44
R-1258	RCRC7G242J	L-0630	1025-48

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R-1259	RCR07G272J	L-0632	1025-52
R-1261	RCR07G332J	L-0637	1025-62
R-1263	RCR07G392J	L-0640	1025-68
R-1264	RCRU7G432J	L-0644	1025-7b
R-1265	RCR07G472J	L-0648	1025-84
R-1267	RCRG7G562J	H-4770	103200
R-1269	RCR07G682J	J-0065	105-0851-001
R-1271	RCR07G822J	J-0066	105-0852-001
R-1272	RCR07G912J	J-0068	105-0854-001
R-1273	RCR07G103J	J-0069	105-0856-001
R-1274	RCR07G113J	J-0070	105-0857-001
R-1275	RCR07G123J	J-0071	105-0858-001
R-1277	RCR07G153J	J-0072	105-0860-001
R-1279	RCR07G183J	J-0073	105-0862-001
R-1280	RCR07G203J	J-0074	105-0863-001
R-1281	RCR07G223J	J-0387	105-1102-001
R-1283	RCR07G273J	J-0389	105-1104-001
R-1285	RCR07G333J	J-0390	105-1106-001
R-1287	RCR07G393J	J-0391	105-1107-001
R-1289	RCR07G473J	J-0392	105-1108-001
R-1291	RCR07G563J	J-0393	105-1110-001
R-1293	RCR07G683J	L-0632	1316-4K
R-1297	RCR07G104J	L-0633	1316-5K
R-1300	RCR07G134J	L-0637	1326-4K
R-1301	RCR07G154J	L-0640	1326-7K
R-1303	RCR07G184J	L-0035	1537-04
R-1305	RCR07G224J	L-0058	1537-44
R-1311	RCR07G394J	C-6549	156X9020KA1
R-1321	RCR07G105J	K-0118	190-123100
R-1325	RCR07G155J	C-6417	1960224X0035HA1
R-1329	RCR07G225	C-4952	200U60F103MAB
R-1345	RCR07G106J	Q12-2905-000	2N2905A
R-1362	RCR07G5R6J	Q-0309	2N3563
R-1366	RCR07G8R2J	Q-0320	2N3642
R-1413	RCR20G330J	Q-0315	2N3644
R-1417	RCR20G470J	Q-0397	2N3866
R-1567	RCR20G1R0J	Q-0385	2N4124
R-1601	RCR32G100J	Q-0386	2N4126
R-1625	RCR32G101J	Q-0386	2N4126
R-1629	RCR32G151J	Q-0334	2N4921
R-1803	RCR42G120J	Q-0390-1	2N5179
R-1807	RCR42G180J	Q-0416	2N5190
R-1831	RCR42G181J	Q-0026	2N5193
R-1833	RCR42G221J	Q-0376	2N5486
R-2181	BWH-3.3-2W	Q-0427	2N5986
R-2199	R-2199	IC-0401	2051
R-2205	3386F-1-501	P-0221	22-04-2101
R-2212	3386F-1-503	L-0050	2500-28
R-2222	3386B-1-101	LS-0014	255E2207
R-2222	72XWR100WJ	Q03-0187-000	3N187
R-2223	3386B-1-201	CR-0034	30S10
R-2224	3386B-1-501	R-4059	3006P-1-203
R-2226	3386B-1-202	R-4057	3006P-1-502
R-2227	3386B-1-502	F-0013	312003
R-2228	3386B-1-103	R-2222	3386B-1-101

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R-3763 RCR32GUR5J  
 R-4057 3006P-1-502  
 R-4059 3006P-1-203  
 R-4280 KP45J1  
 R-4292 LVR-5-.025  
 R-5105 RN65039R2F  
 R-7277 RN5502491F  
 R-7282 RN5509090F  
 R-7285 RN5506811F  
 R-7288 RN5503322F  
 R-7292 RN5501821F  
 R-7294 RN5502210F  
 R-7295 RN5503320F  
 R-7298 RNR5508250F  
 R-7248 RN5508250F  
 R-7301 RNR5508251F  
 R-7303 RN5507151F  
 R-7307 RN5501493F  
 R-7309 RN5509531F  
 R-7318 RN5504751F  
 R-7321 RN5501542F  
 R-7324 RN5503921F  
 R-7328 RN5504752F  
 R-7348 RN5508252F  
 R-7362 RN55A3923F  
 S-0130 MA-012-4-CE-P-2w  
 S-0206 435166-4  
 S-0239 39-251-RED  
 TB-0387 SE1FX-2  
 X-0090 102068

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R-2228 33868-1-103  
 R-2223 33868-1-201  
 R-2226 33868-1-202  
 R-2224 33868-1-501  
 R-2227 33868-1-502  
 R-2205 3386F-1-501  
 R-2212 3386F-1-503  
 S-0239 39-251-RED  
 S-0206 435166-4  
 L-0610 4416-7K  
 MP-3544 4586-2  
 MP-0077 4586-97  
 J-0371 50-208-10  
 E-2192 57-0180  
 C-4948 6020383G030CC  
 MP-1152 60458  
 C-6370 7C25U104X0050E1  
 C-6374 7C25U474X0050E1  
 J-0031 700-209-AP  
 L-0722 7107-22  
 L-0724 7107-24  
 L-0725 7107-25  
 R-2222 72XWR100WJ  
 IC-0175 74LS190N  
 IC-0403 74LS27PC  
 C-3202 8121-050-Y5V-104Z  
 J-0880 87225-4  
 J46-0001-007 87225-6  
 J-0870 87586-1  
 J-0871 87586-4

## ABOUT THIS MANUAL

This manual provides complete user information for the type accepted RF-230 Radio Set. In the type accepted configuration, the set incorporates three major elements: the RF-230 Transceiver; the RF-231 Antenna Coupler; and the RF-236 Power Supply. The manual is divided into four color tabulated sections to cover all of these information elements.

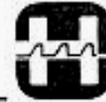
General Information common to the installation, operation, and maintenance of the complete set is contained in Section I, under the Red Tab; detailed RF-230 peculiar information is contained in Section II, under the Yellow Tab; detailed RF-231 Antenna Coupler information is contained in Section III, under the Blue Tab; and, detailed RF-236 Power Supply (and installed option) information is contained in Section IV, under the Green Tab. The following is a detailed summary of this format in tabulated form.

Section I	Red Tab	Introduction Installation and Interface Data Operation Functional Descriptions Maintenance
Section II	Yellow Tab	RF-230 Transceiver 1A1 Interconnecting PC Board Assembly 1A1A1 PA Filter No. 1 PC Board Assembly 1A1A2 PA Filter No. 2 PC Board Assembly 1A1A3 PA Control PC Board Assembly 1A1A4 IF Audio PC Board Assembly 1A1A5 Processor PC Board Assembly 1A1A6 Mixer PC Board Assembly 1A1A7 Program PC Board Assembly 1A1A8 Program PC Board Assembly (option) 1A1A9 LO No. 2 PC Board Assembly 1A1A10 Frequency Standard PC Board Assembly 1A1A11 LO No. 1 PC Board Assembly 1A1A12 Channel Change Key PC Board Assembly 1A2 Front Panel Assembly 1A3 Rear Panel Assembly
Section III	Blue Tab	RF-231 Antenna Coupler 2A1 Primary Program Board 2A3 Interconnecting PWB Assembly 2A4 Phase Discriminator 2A5 Control Assembly Bandswitch Motor 2A6 Input Switch Control
Section IV	Green Tab	RF-236 Power Supply 3A5 Auto Alarm (option)



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## PART 1

## INTRODUCTION

## 1.1 GENERAL DESCRIPTION

The RF-230 HF-SSB Transceiver System is shown in a typical configuration in figure 1-1. The RF-230 Transceiver is shown with the RF-236 AC Power Supply and the RF-231 Antenna Coupler. Salient features are summarized here, and amplified in subsequent paragraphs to pro-

vide the user with a comfortable level of familiarity with all standard and optional system elements.

The RF-230 Transceiver System is compatible with a complete family of options. These options are summarized in table 1-1, along with basic system elements, to facilitate user identification and familiarization.

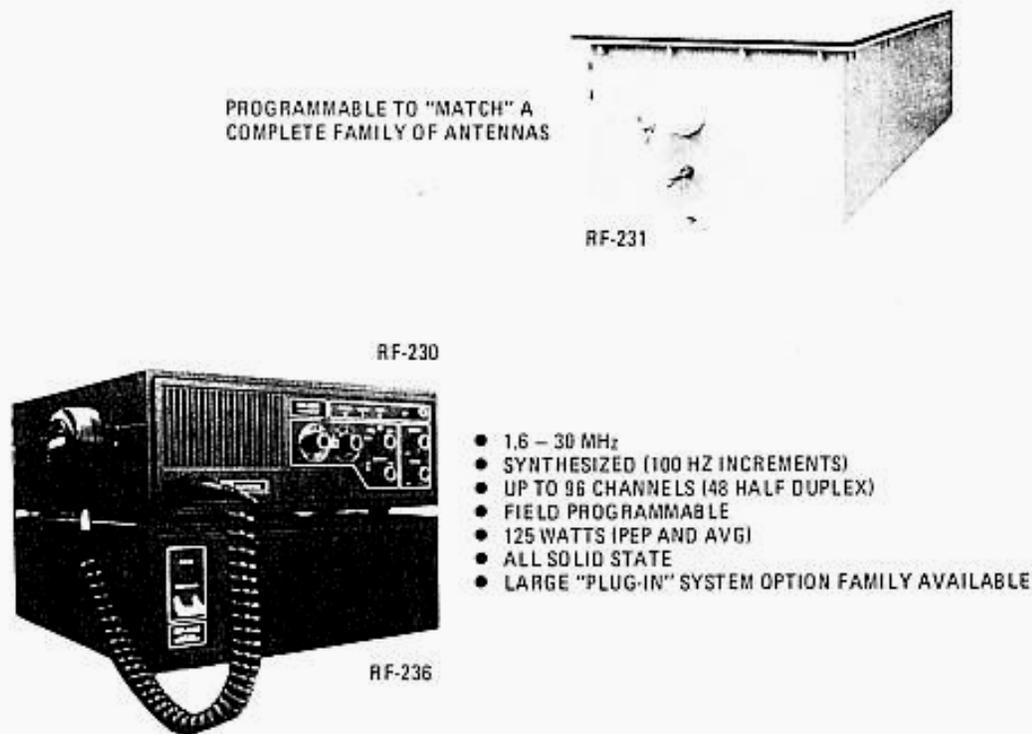


Figure 1-1. Typical RF-230 System



TABLE 1-1. SYSTEM ELEMENT SUMMARY

Unit or Option	Description
RF-230	SSB Channelized Transceiver: 125 watt PEP transmitter. 0.5 uV sensitivity receiver with 4 watt output to internal speaker and including separate line output. Power input 13.2 Vdc @ 1.5 amps in receive mode, 30 amps peak in transmit. 32 through 96 field programmable channels. Operable in all standard modes including continuous duty RTTY.
RF-230-01	Interconnecting Adaptor. Required when RF-230AC is used with RF-231, RF-281, and any RF-236 option.
RF-230-03	Continuous Duty Blower Kit, RF-230DC
RF-231	Channelized Antenna Coupler: For all "type accepted" applications. 125 watt PEP/AVG continuous duty power rating channel capability directly compatible with RF-230. Will match 9 ft, 16 ft, 24 ft, and 35 ft whip antennas; 75 foot long wire, and RF-1912 dipole antennas. Water proof enclosure can be positioned up to 250 feet from RF-230 using appropriate lengths of W-0010 coaxial and W-1795 control cable.
RF-232	Half Duplex Coupler Modification: Required for frequencies below 5 MHz with receive/transmit channel separation less than 10%. Unit provides by-pass in receive for half duplex operation.
RF-233	1 kW System; composed for RF-230, RF-235, and RF-103.
RF-234	Remote Mobile Control
RF-235	1 kW Option Kit: Provides RF-230 to RF-103A/1205 control interface for 1 kW PA/Coupler 10-channel operation.
RF-236	Base Power Supply Unit: Provides for 115/230 Vac, 50/60 Hz operation of RF-230 System. Chassis assembly provides space for mounting plug-in optional accessories. Standard with RF-230AC.
RF-236-04	Continuous Duty Blower Kit: Used in conjunction with the RF-230AC, Stack Mount.
RF-236-05	Interconnecting Kit (optional)
RF-238-32	RF-230 Programming Assembly: Increases RF-230 channelization capability by adding 32 simplex channels, or 16 half-duplex channels.
RF-238-64	RF-230 Programming Assembly: Increases RF-230 channelization capability by adding 64 simplex, or 32 half-duplex channels.
RF-239-32	RF-231 Programming Assembly: Increases RF-231 channelization capability by adding 32 simplex channels, or 16 half-duplex channels.
RF-239-64	RF-231 Programming Assembly: Increases RF-231 channelization capability by adding 64 simplex channels, or 32 half-duplex channels.
RF-260	RF-230 DC Mounting Cradle: A one-piece "U" shaped cradle for mounting the DC series to flat surfaces. Provides for quick removal of RF-230 from permanently mounted cradle.
RF-241	RF-230 DC Shock Mount Kit: Required in high shock or vibration RF-230DC installations. Four shock absorbers isolate standard RF-260 Mounting Cradle supporting RF-230DC.
RF-242	RF-230AC Stack Mounting Brackets: Provides for "stacking RF-230AC on RF-236 base unit.



TABLE 1-1. SYSTEM ELEMENT SUMMARY (Continued)

Unit or Option	Description
RF-243	Rack Mounting Kit: Provides for rack mounting of RF-230 or RF-236 in standard 19 inch rack. Includes slide assemblies for service access. Two required for RF-230AC.
RF-244	RF-230 Shock Mount Kit: For use when RF-230AC is mounted in high shock or vibration environment.
RF-245	RF-231 Mounting Tray: Recommended for vehicular or bulkhead RF-231 installations to facilitate removal and provide solid mounting surface.
RF-246	Programmed Channel Storage Option.
RF-247	Wideband USB Filter Option: Provides 300 - 3000 Hz USB frequency response, for use with operating with external FSK Keyer/Converter centered at 2000 Hz and with $\pm 425$ Hz shift.
RF-248	CW Key Kit: Provides CW key and interfacing connections for use with RF-230 AC or DC.
RF-249	150 Foot Long Wire Antenna Option: Converts the RF_231 for operation with a 150 foot long wire antenna over the 2 - 30 MHz frequency range.
RF-250	Telephone Handset-Wall Mount: Provided with hanging cradle and a privacy providing speaker muting hook switch.
RF-251	Telephone Handset-Desk Mount: Standard desk type cradle and including speaker muting "off-hook" switch.
RF-252	Frequency Controller
RF-253	Marine Auto Alarm
RF-258	Remote Audio
	<b>Note:</b> Antenna control cables, and spares kits options are not included in this list.

## 1.2 RF-230 TRANSCEIVER

The RF-230 is an all solid state channelized Transceiver designed specifically for modern state-of-the-art communications systems.

The basic unit is capable of storing up to 32 simplex or 16 half-duplex field programmable channels; an optional program card extends this number to 96 simplex or 48 half-duplex channels. Mode selection can be programmed to operate automatically in

conjunction with the Channel Selector or manually through the Mode Selector on the front panel.

Digital control information is stored in non-volatile memory elements. This means that if system power is lost, even for ten years, channel control information integrity will not be lost or degraded. The RF-230 is readily field-programmable, without the use of test equipment, as described in the section on operation. Programming the RF-231 Antenna Coupler does require a power meter.



With the potential for over ninety channels, re-programming to accommodate new channel frequencies should be minimal. Because the transceiver is fully synthesized, however, adding new frequencies does not mean adding new crystals. All internal frequencies are referenced back to a single temperature compensated crystal oscillator (TCXO) having a stability of  $\pm 1$  part in  $10^6$  over the operating temperature range of from  $-30^{\circ}$  to  $+65^{\circ}\text{C}$ . (Assumes 125 watt PEP operation. For 125 watt average, continuous duty with external blower, maximum operating temperature should be  $+50^{\circ}\text{C}$ .) All injection frequencies are synthesized from this single highly stable reference. The receive clarifier is also included in the synthesizer, with the variable digital divider locked to the TCXO.

The RF-230 can be operated at full power (125 watts) in all standard modes: A3J (USB suppressed carrier), A3A (USB reduced carrier), A3H (compatible AM), and A1 (CW). Recall that the optional blower should be used for all continuous duty applications, especially those employing high average power levels.

### 1.3 RF-231 CHANNELIZED ANTENNA COUPLER

The RF-231 is a channelized antenna tuning unit designed for use with the RF-230 Transceiver. The coupler is designed for continuous duty operation with 125 watts average input power. Thirty-four programmable channels may be easily expanded to 98 channels with plug-in boards. Any standard antenna from a 9 foot whip to a 150 foot longwire can be quickly tuned to 50 ohms over the full frequency range of 1.6 to 30 MHz. Operation is automatic with the coupler deriving channel and frequency information from the transceiver and resetting itself to a pre-programmed tune point. A fine tune circuit constantly monitors the RF input and corrects for moderate changes in antenna characteristics due to nearby objects and weather conditions. VSWR is always maintained under 1.5:1

The unit is especially well suited for both shipboard and fixed station applications. The welded, light weight aluminum case provides a splash-proof housing designed to survive the severe environmental conditions found in shipboard service.

### 1.4 RF-236 POWER SUPPLY AND BASE UNIT

The RF-236 Base Unit/Power Supply is designed as an extremely rugged and efficient source of primary power for the RF-230 Transceiver. The base unit also houses a series of plug-in options for the RF-230 Transceiver, including a two-tone auto alarm, phone patch, and/or audio frequency shift keyer/converter.

The power supply is very conservatively rated to continuously deliver 13.2 Vdc at 35 amps with an AC line input of 115/230V  $\pm 10\%$ , 50/60 Hz at an ambient temperature of  $-30^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$ . The power supply is cross braced for mechanical ruggedness and uses a cast aluminum rear panel for efficient heat dissipation.

Three universal plug-in-option bays provide system flexibility and several desirable system add-on features. Card extenders provide for up-front servicing of all these readily replaceable plug-in units.

### 1.5 TYPE ACCEPTANCE RF-230M

RF-230M Series Transceivers have been type accepted by the Federal Communications Commission and the Canadian Department of Communications. The applicable type acceptance numbers are:

FCC		
RF-230M		
Rule Parts		81, 83, 87, 89 and 91
DOC		
RF-230M		
RSS-125		122251013 L, M
RSS-181		122811052 V, L, C

Refer to the following pages for circuit differences between RF-230 and RF-230M; Section 1A1A5, page 15/16, note 4A; Section 1A1A6, page 19/20, note 4.

Operation of the RF-230M in CW mode requires the RF-230-06 CW filter option. Operation in the AFSK mode requires the RF-230-07 AFSK filter option. The RF-230M can be supplied with either the RF-230-06 or the RF-230-07.



## PART II

## INSTALLATION AND INTERFACE INFORMATION

## 2.1 POWER REQUIREMENTS

All system power requirements are satisfied by the RF-236 Power Supply. The RF-236 requires 115/230 Vac, 50/60 Hz primary power. The peak input power requirements is 640 watts with the transmitter operating at full rated output. Nominal receive mode system power is approximately 15 watts.

## NOTE

With the front panel power switch on the RF-230 in the "off" position, the power amplifier assembly is still connected to the power supply. The maximum current drain is 30 mA in this mode.

## 2.2 SITE SELECTION

The RF-230 System is designed to operate in a  $-30^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$  temperature environment. Obviously, for maximum operator and equipment efficiency, the RF-230 and RF-236 system elements should be located in a protected environment that provides good ventilation, and also one that considers the following points:

- Ease of operation and functional grouping of controls
- Relation to other units
- Power, control, and other equipment interfaces
- Environmental considerations for equipment and operation.

The antenna coupler should be located within 250 feet (75m) of the RF-230 to prevent cable IR losses from degrading system performance.

## 2.3 INTERCONNECTION REQUIREMENTS

Interconnection requirements for a basic RF-230 RF-231/RF-236 system are shown in figure 2-1. Figure 2-2 gives RF-230 to RF-231 Control Cable detail. The system oriented design of the RF-230 family permits a wide variety of interface options (RTTY/FAX Terminals, scramblers, linear amplifiers, remote control options, etc); our sales/engineering department should be contacted for specific application requirements.

## 2.4 ANTENNA REQUIREMENTS

The RF-231 Channelized Antenna Coupler can be tuned to make any standard antenna, from a 9 foot whip to a 150 foot longwire, appear as an almost purely resistive 50 ohm load to the RF-230 Transceiver. The RF-231 is designed to meet exacting type acceptance requirements and will maintain VSWR at less than 1.5:1.

## 2.5 INITIAL PROGRAMMING

The RF-230 and RF-231 must be "programmed" to operate on the desired channel frequencies, and for duplex or simplex channelization.

For the RF-230, this is a simple, straight-forward process as shown in figure 2-11. RF-231 programming is somewhat more involved, but again, is a relatively simple straight-forward process as shown in figure 2-13.

## 2.5.1 BYPASS Programming

Adding BYPASS to the RF-230 programming instruction for any given channel will automatically bypass reactive elements in the PA Filter section and in the Antenna Coupler in the receive mode. This feature might be desirable in duplex operation where the transmit frequency (the one the coupler is tuned to) is significantly separated from the receive frequency and the normal reactive path thru the coupler might degrade receiver performance.

## 2.5.2 HOP

This is a spur evasion system that shifts LO1 and LO2 injection signals 10 kHz to avoid spurious responses that might be encountered on some channel frequencies. If after programming any given channel a spur (audible whistle or tone on the receive frequency, or undesired modulation component in the transmit signal), is detected, select HOP and if the condition is spur related, it should improve.

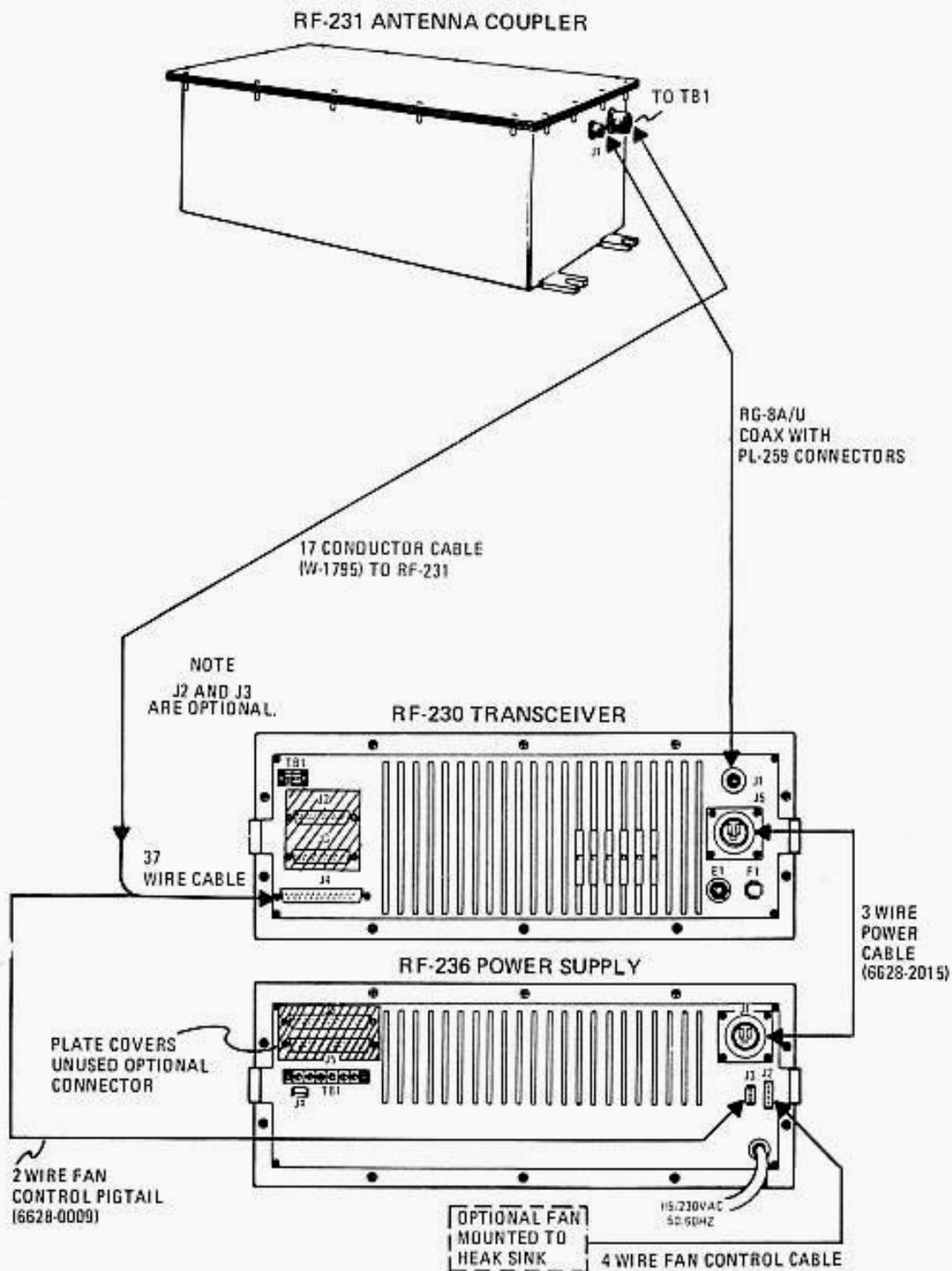


Figure 2-1. Basic RF-230/RF-231/RF-236 System Interconnections

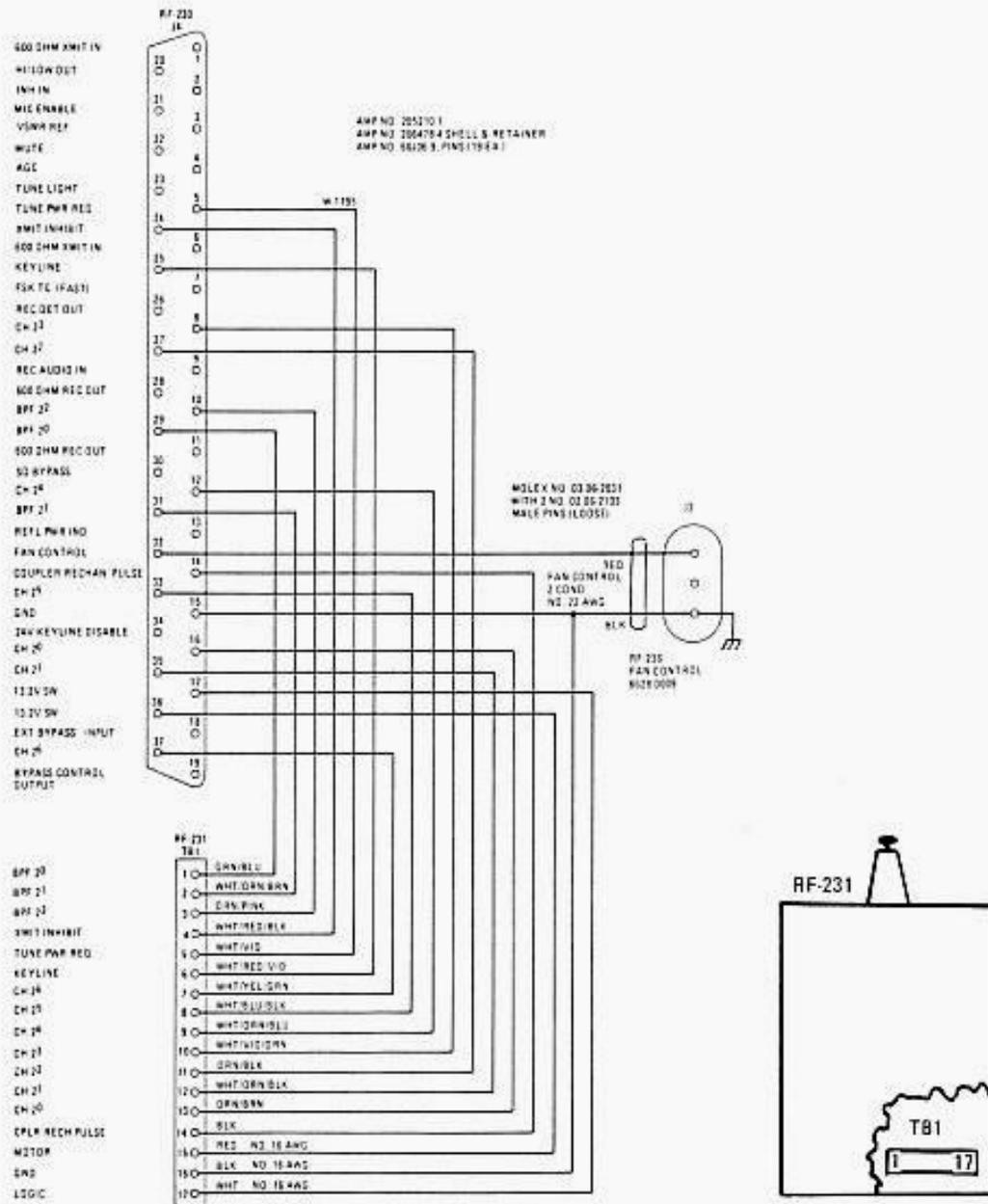


Figure 2-2. RF-230 to RF-231 Control Cable Detail



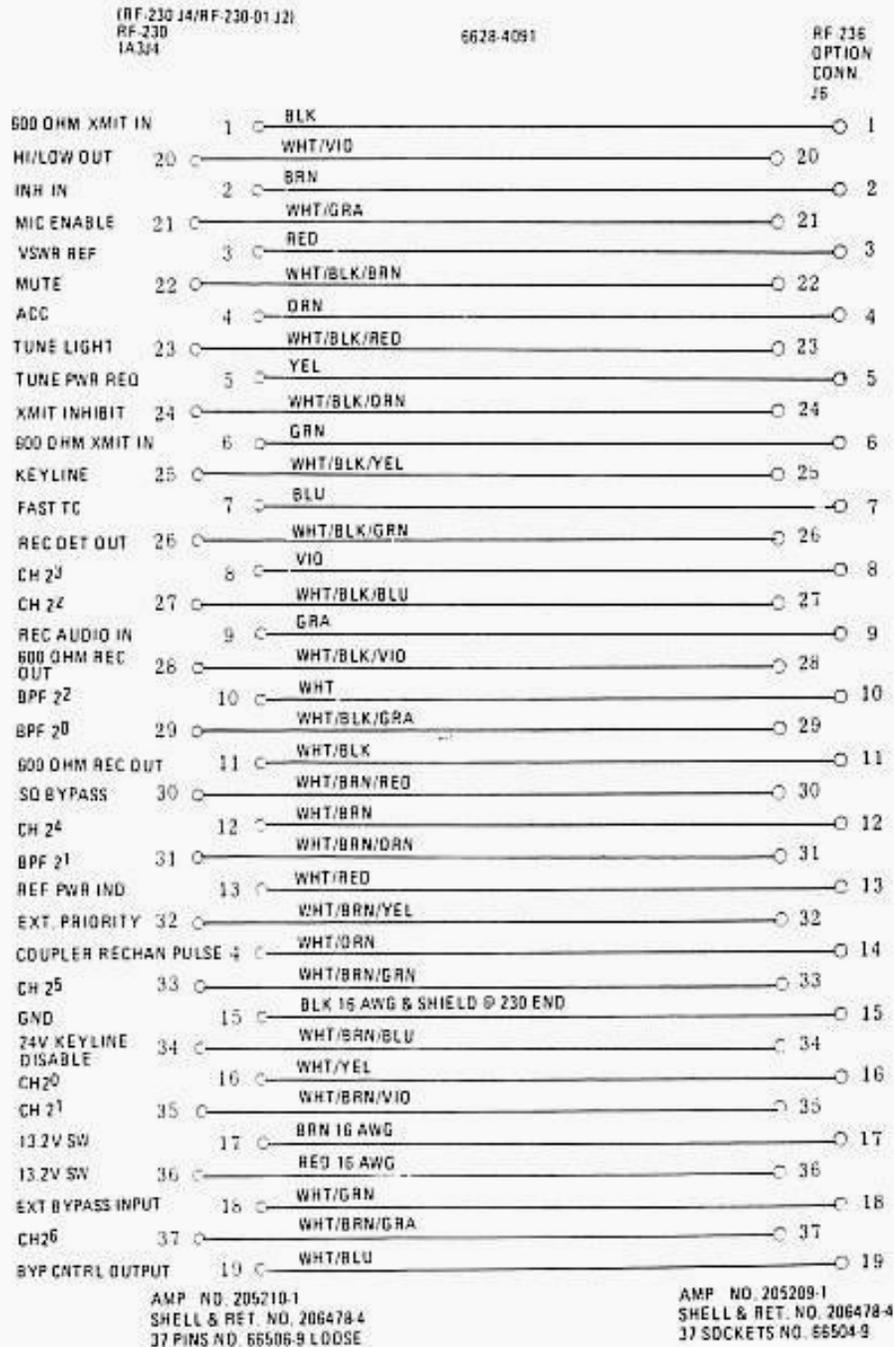


Figure 2-5. Interconnection Detail for Cable Assembly from RF-236 (Option Connector) to RF-230 (Via 4:1 Adapter)

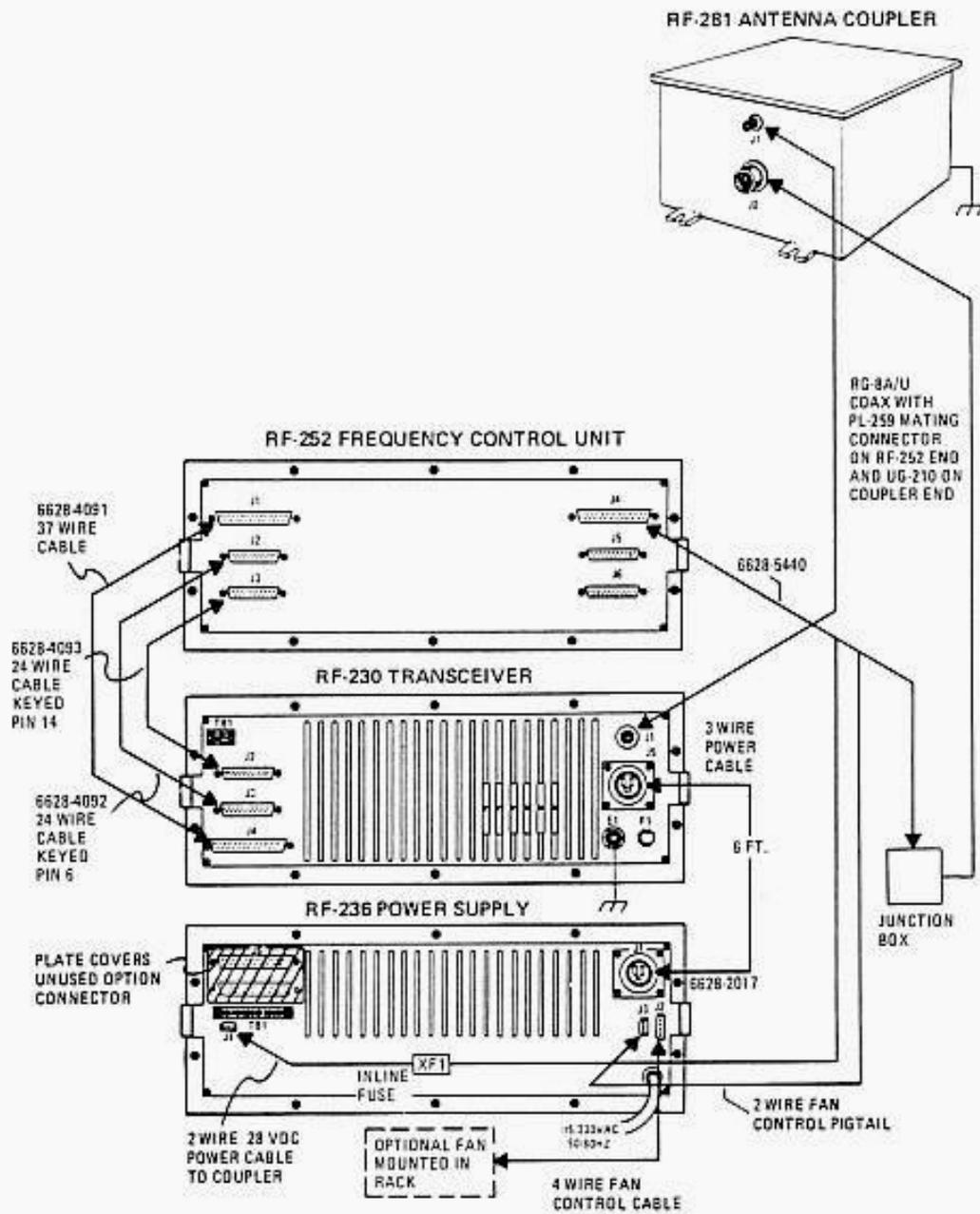


Figure 2-6. RF-230/RF-281/RF-236/RF-252 Cabling Diagram

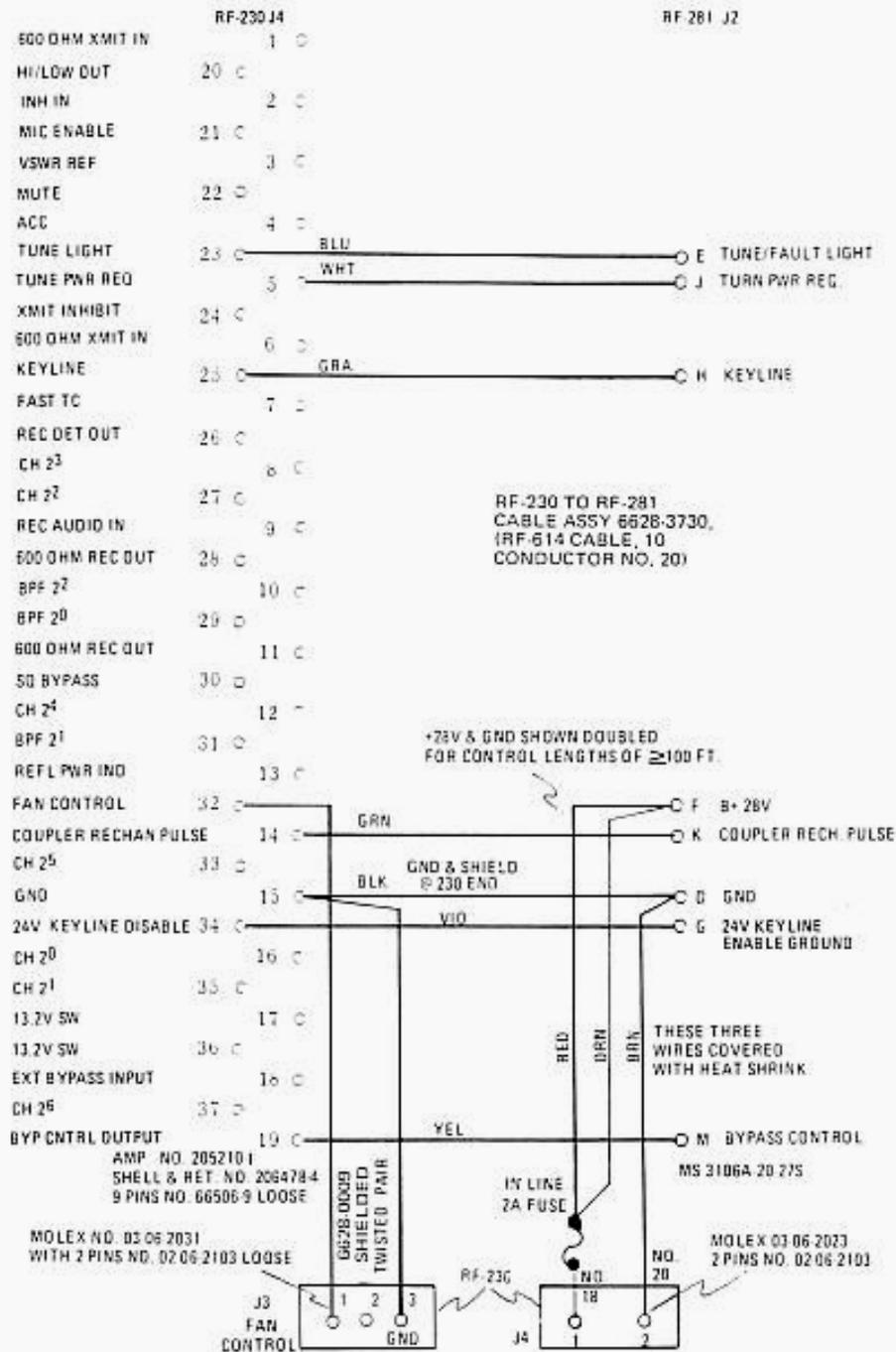
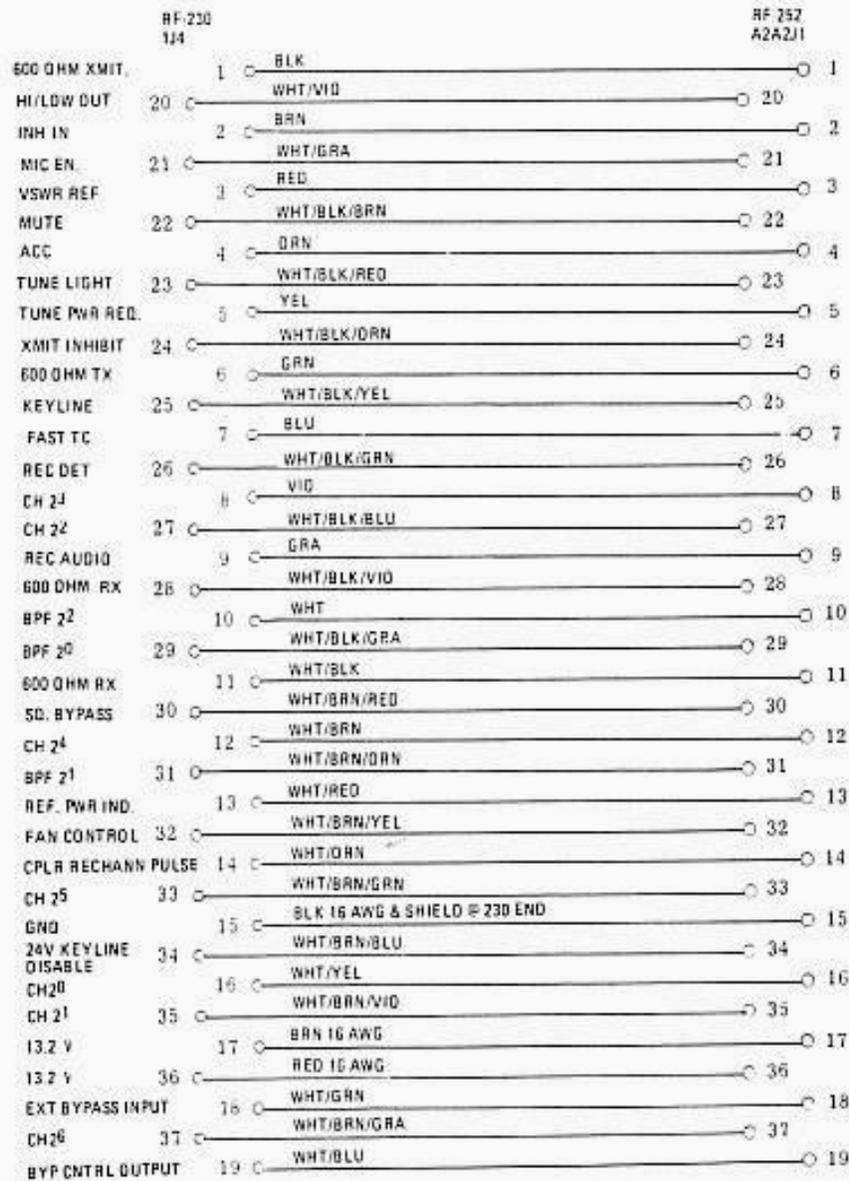


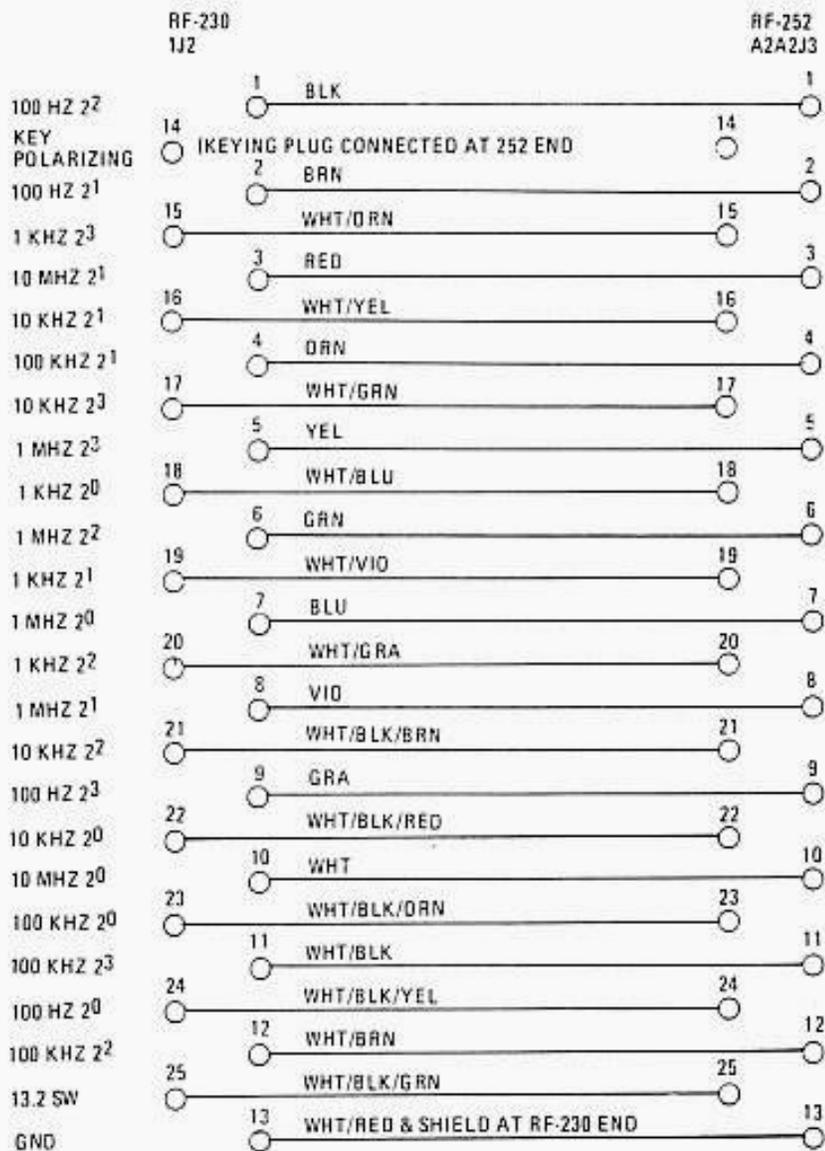
Figure 2-7. Interconnection Detail for Cable Assembly from RF-230 to RF-281



1 EA. (P2) CONNECTOR AMP NO. 205210-1  
 1 EA. SHELL & RET. AMP NO. 206478-4  
 37 EA. PINS AMP NO. 66506-9  
 1 EA. FERRULE RAYCHEM NO. D-142-51  
 2 EA. FERRULE RAYCHEM NO. D-142-50  
 A/R WIRE 22 AWG, BLK W10-0006-000  
 A/R WIRE 22 AWG, BRN W10-0006-111  
 A/R WIRE 22 AWG, RED W10-0006-222  
 A/R WIRE 22 AWG, WHT/RED W10-0006-929

A/R CABLE W-1891  
 1 EA. (P1) CONNECTOR AMP NO. 205209-1  
 1 EA. SHELL & RET. AMP NO. 206478-4  
 37 EA. SOCKETS AMP NO. 66504-4  
 3 EA. FERRULES RAYCHEM NO. D-142-50  
 A/R WIRE 22 AWG, BLK W10-0006-000  
 A/R WIRE 22 AWG, BRN W10-0006-111  
 A/R WIRE 22 AWG, RED, W10-0006-222

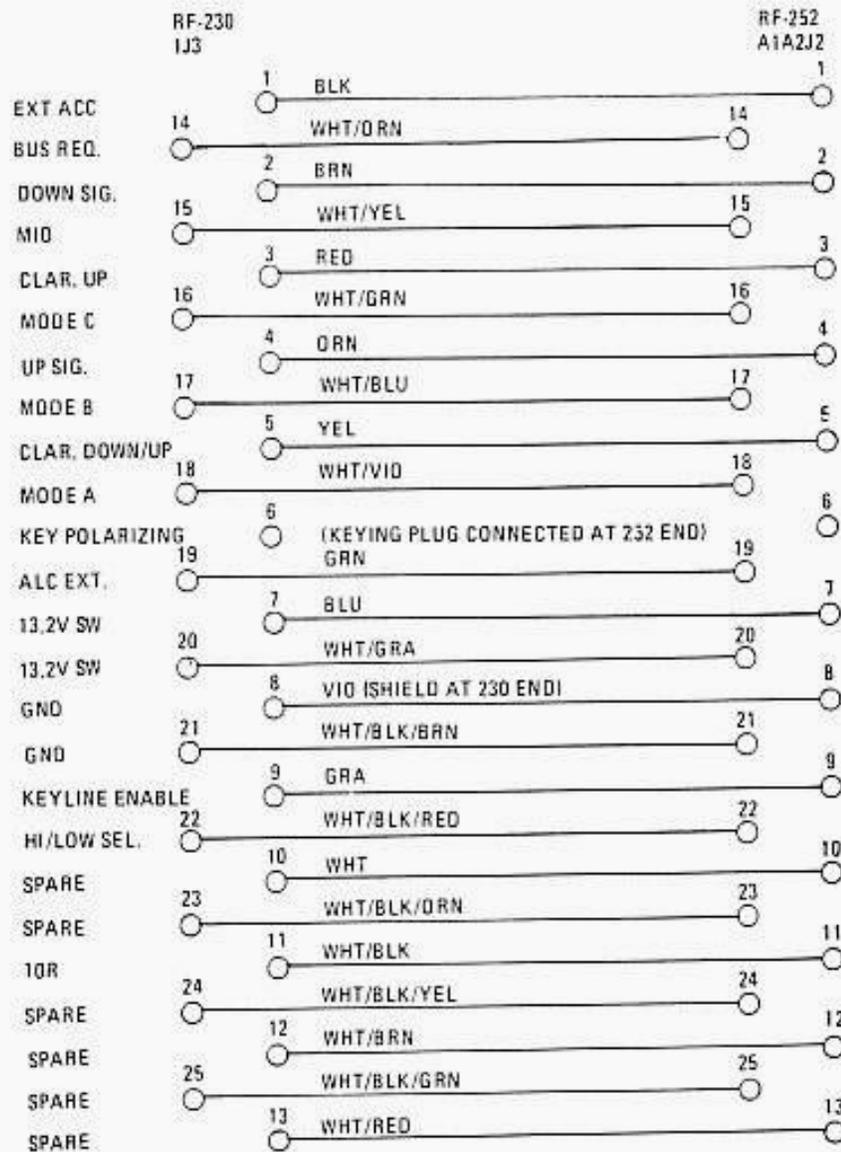
Figure 2-8. RF-230 to RF-252 Detail for Cable Assembly 6628-4091



1 EA. (P2) CONNECTOR AMP NO. 205207-1  
 1 EA. SHELL & RET. AMP NO. 206478-3  
 24 EA. PINS AMP NO. 66506-9  
 1 EA. FERRULE RAYCHEM NO. D-142-50  
 A/R WIRE 22 AWG, WHT/RED W-10-006-929

A/R CABLE W-1891  
 1 EA. (P1) CONNECTOR AMP NO. 205208-1  
 1 EA. SHELL & RET. AMP NO. 206478-3  
 24 EA. SOCKETS AMP NO. 66504-9  
 1 EA. KEYING PLUG AMP NO. 205609-1

Figure 2-9. RF-230 to RF-252 Detail for Cable Assembly 6628-4093



1 EA. IP2I CONNECTOR AMP NO. 205207-1  
 1 EA. SHELL & RET. AMP NO. 206478-3  
 24 EA. PINS AMP NO. 66506-9  
 1 EA. FERRULE RAYCHEM NO. D-142-50  
 A/R WIRE 22 AWG, WHT/RED W-10-006-929

A/R CABLE W-1891  
 1 EA. IP1I CONNECTOR AMP NO. 205208-1  
 1 EA. SHELL & RET. AMP NO. 206478-3  
 24 EA. SOCKETS AMP NO. 66504-9  
 1 EA. KEYING PLUG AMP NO. 205609-1

Figure 2-10. RF-230 to RF-252 Detail for Cable Assembly 6628-4092



## GENERAL INFORMATION

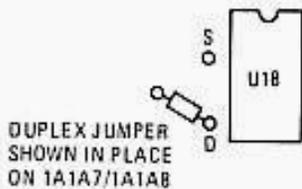
### SIMPLEX PROGRAMMING

REMOVE RF-230 TOP COVER, SELECT CHANNEL TO BE PROGRAMMED, AND PROCEED AS FOLLOWS:

- SELECT DESIRED CHANNEL FREQUENCY
- SELECT DESIRED OPERATING MODE
- SELECT SPECIAL INSTRUCTIONS
- DEPRESS ENTER SWITCH UNTIL ENTER LAMP ILLUMINATES, THEN RELEASE SWITCH.
- WHEN LAMP EXTINGUISHES, CHANNEL IS PROGRAMMED

### DUPLEX PROGRAMMING

IF THE BOARD BEING PROGRAMMED IS JUMPERED FOR DUPLEX OPERATION (SEE BELOW), THE TRANSMIT MODE OPERATING FREQUENCY, MODE OPTION, AND SPECIAL INSTRUCTIONS MUST BE SELECTED INDEPENDENTLY AS FOLLOWS:



- VERIFY DESIRED CHANNEL SELECTED AT FRONT PANEL
- SELECT DESIRED TX CHANNEL FREQUENCY, AND MODE INSTRUCTION
- DEPRESS TX SWITCH
- DEPRESS ENTER SWITCH UNTIL LAMP ILLUMINATES, THEN RELEASE SWITCH. WHEN LAMP EXTINGUISHES, XMIT CHANNEL IS PROGRAMMED.
- CONTINUE SAME PROCEDURE FOR EACH CHANNEL AS DESIRED.

### RECEIVE PROGRAMMING:

- RETURN TX SWITCH TO NORMAL POSITION.
- FOLLOW SAME STEPS AS FOR XMIT PROGRAMMING, EXCEPT FOR DEPRESSING TX SWITCH.

### NOTE

SEE FIGURE 4, SECTION 1A1A7/1A1A8 FOR CONTROL JUMPERING AND FOR MAINTENANCE CHANNEL (96) JUMPERING. USE THE SELECTED CHANNEL (96) TO CONTROL THE RADIO DIRECTLY FROM THE PROGRAM BOARD FOR MAINTENANCE OPERATIONS, WITHOUT THE NECESSITY OF FIRST INSTALLING CONTROL INFORMATION INTO MEMORY.

PGM PCB  
1A1A7/1A1A8

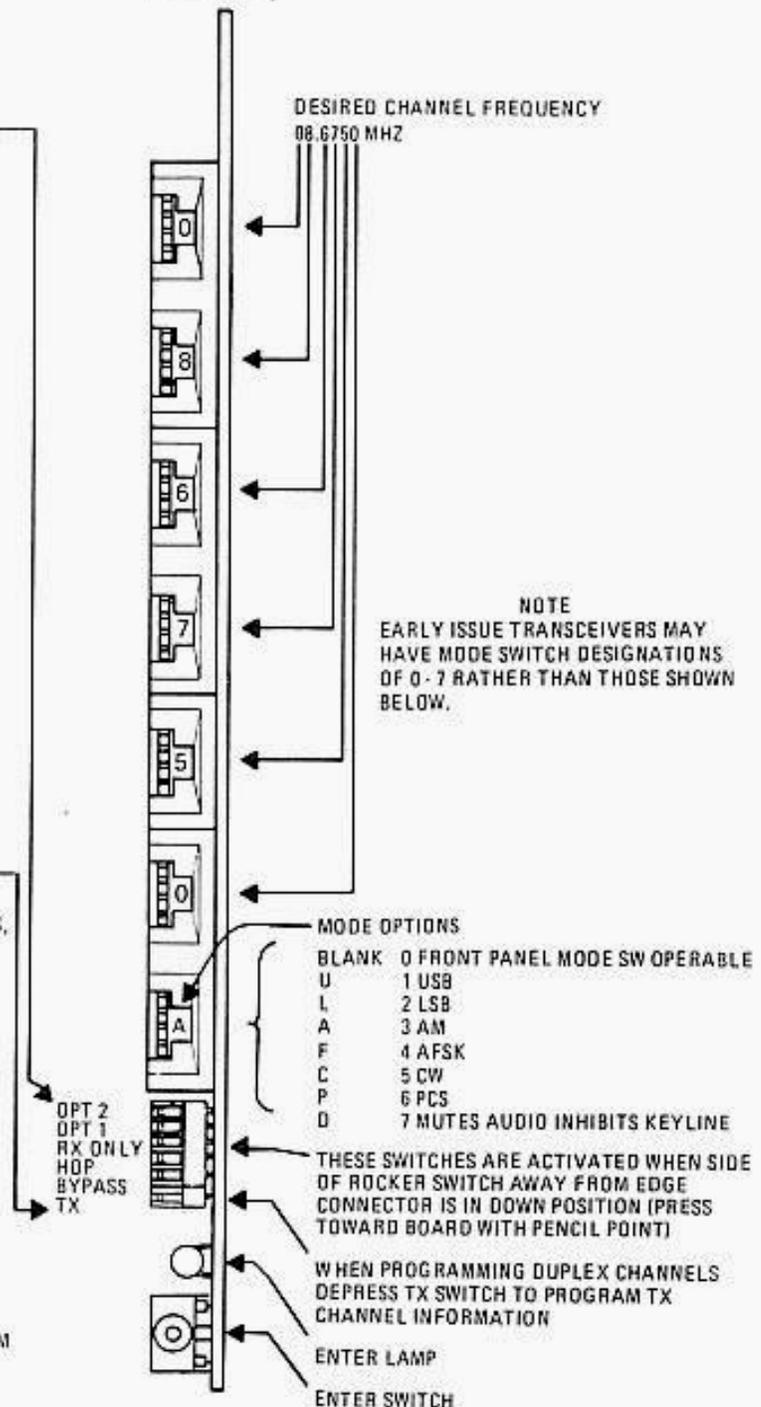


Figure 2-11. RF-230 Programming Detail



### 2.5.3 RX Only

Programming this option will inhibit the transmit function.

### 2.5.4 OPT 1/OPT 2

These bits are uncommitted in the RF-230, and can be brought out on spare pins of 1A3J3 for custom control applications. They are labeled 1 and 2 respectively on the 1A1A7 and 1A1A8 boards.

### 2.5.5 Simplex/Duplex Programming

Programming PC Boards (1A1A7/1A1A8) contain jumper options to select simplex or duplex operation for each programming board. If simplex operation is desired for the group of channels controlled by any given board, install the simplex select programming jumper as shown in figure 4 of section 1A1A7/1A1A8, and program channels accommodated by the board in question as shown in figure 2-11.

If 1A1A7 is to be used to store simplex channel information for channels 0 - 31, programming jumpers must be installed in the "0" and "16" positions at the lower right hand side of the 1A1A7 PC Board adjacent to Q11 (see figure 4 in section 1A1A7/1A1A8). In a 64 channel simplex radio, with 1A1A8 used to store channel 32 thru 63 simplex information, a jumper would be installed in the 32 and 48 position on 1A1A8. These jumpers enable the associated program board to accept related channel control inputs.

If a particular board is to be used in duplex service, the available channel information storage capability is reduced by half. This is because half of the memory locations are required to store receive instructions, and the other half are required to store transmit instructions. As a consequence, if 1A1A7 were to be used in duplex service, a jumper would only be installed in the "0" location. If 1A1A8 were to be used to provide an additional 16 channel duplex capability, a jumper would be installed in the "16" position on this board.

For duplex operation, install duplex programming jumper as shown in figure 4 of section 1A1A7/1A1A8 and program channels as follows:

### Note

Remove RF-230 top cover to access programming switches on 1A1A7/1A1A8.

- a. Select channel 0 at RF-230 front panel.
- b. Select desired channel 0 receive frequency at 1A1A7.
- c. Select desired operating mode and special instructions (see figure 2-11).
- d. Depress Enter Switch - hold depressed until Enter Lamp illuminates.
- e. Release Enter Switch - when Enter Lamp extinguishes, programming information has been "written-in" to the associated ROM.
- f. Change 1A1A7 programming switches to indicate desired Transmit condition setup.
- g. Depress the TX switch on the special instruction switch (see figure 2-11 and again depress Enter Switch until Enter Lamp illuminates - when lamp extinguishes, transmit channel is programmed.
- h. Continue in this manner, programming each of the 16 duplex channels available on the 1A1A7 board. Select the channel to be programmed, adjust program board switches for the desired receive condition setup, and enter the information in the associated memory address by pressing the enter button as described in steps "d" and "e". With the receive condition written-in to the associated memory address, change the program board switch setup to reflect the desired transmit mode condition - depress the TX switch on the special instruction switch (see figure 2-11), and press the enter button as described in steps "d" and "e". By programming in this manner, the 32 memory locations available on 1A1A7 would be utilized as shown in table 2-1.
- i. The standard 1A1A8 PC Board can also be programmed to control 16 duplex channels or 32 simplex channels. This is accomplished using the same procedure as for 1A1A7, however, recall that the board must have the channel block recognition jumper installed so that it will be enabled by the desired channel control signals. With 1A1A7 assigned to duplex channels 0 - 15 by a jumper at "0", 1A1A8 could be programmed for channels 16 - 31



by installing a jumper at "16". Of course, both boards would also (in this instance) be programmed "duplex" by installing a jumper in this position.

TABLE 2-1. DUPLEX MEMORY LOCATIONS

Channel	Receive Information*	Transmit Information**
0	0	16
1	1	17
2	2	18
3	3	19
4	4	20
5	5	21
6	6	22
7	7	23
8	8	24
9	9	25
10	10	26
11	11	27
12	12	28
13	13	29
14	14	30
15	15	31

\* This address selected by front panel switch

\*\* This address selected by front panel switch and the transmit mode logic condition (+10T)

j. This completes the RF-230 programming procedure. For radios with greater than 64 simplex channel capability the same general procedure is used, however, a program board with expanded memory capability would be installed.

2.5.6 RF-231 Programming

Programming the RF-231 involves two distinct steps: the first step selects the optimum coupler output configuration for the type antenna used with the system - this step is performed without the application of rf power; the second step is performed with rf tune power applied. In this step the optimum tune point is found manually, and the position information is stored using multi-turn servo pots and jumpers.

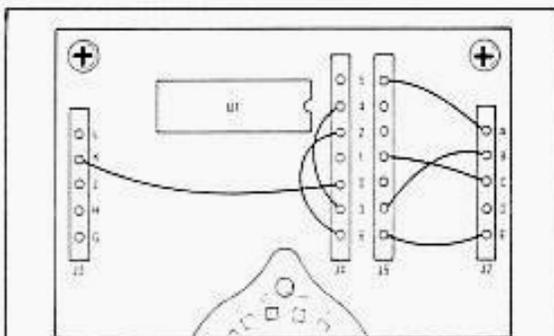
2.5.6.1 Static Coupler Setup

This coupler programming step selects the optimum coupler output configuration to match the antenna selected and is accomplished at the 2A5 Bandswitch Assembly in the RF-231. To perform this step, proceed as follows.

a. Refer to the table in figure 2-13 and under the heading, "ANTENNA LENGTH (FEET)", find the column that agrees with the antenna connected to the RF-231.

b. At the bandswitch programming board (see figure 2-12, program each band, 0 thru 6, to the appropriate control pin at J2 or J3 as indicated by the alpha designator in the table.

c. This completes bandswitch programming. It will not be necessary to re-program the bandswitch unless an antenna change is made. If the antenna is changed, reprogram to agree with the new length antenna.



In this example, the bandswitch is shown programmed for operation with a 35 foot whip antenna as follows:

- BAND 0 TO K
- BAND 1 TO C
- BAND 2 TO E\*
- BAND 3 TO B
- BAND 4 TO B\*
- BAND 5 TO A
- BAND 6 TO E

\*Indicates jumper effected by daisy-chaining at parallel J4-J5 connection.

**CAUTION**

Programming jumpers have self-locking connectors. DO NOT attempt to remove by pulling or bending on the wire portion of the jumper. Grasp the body of the connector at the sides to release the self-locking mechanism and pull straight out. This prevents bending and breaking pins.

Figure 2-12. Bandswitch Programming Detail



RF-231 PROGRAMMING AND TUNING PROCEDURE

1. PROGRAM BANDSWITCH PC BOARD ASSEMBLY PER TABLE BELOW.
2. SELECT DESIRED RF-230 CHANNEL.
3. PROGRAM INPUT SWITCH TO TAP 1.
4. SET CHANNEL SERVO POTENTIOMETER AT MAXIMUM CCW POSITION.
5. SET TUNE POWER REQUEST SWITCH TO TUNE POWER (APPROXIMATELY 25 WATTS).
6. ADJUST CHANNEL SERVO POTENTIOMETER FOR MINIMUM REFLECTED POWER. IF NOT ADJUSTABLE TO ABOUT 1 WATT, OR LESS, SET TUNE POWER REQUEST SWITCH TO OFF AND PROGRAM INPUT SWITCH TO NEXT HIGHER TAP. REPEAT 4, 5, AND 6 UNTIL REFLECTED POWER IS 1 WATT, OR LESS. RECORD ON PROGRAMMING CHART.
7. IF A NO-TUNE, COIL INSTABILITY, OR EXCESSIVE RF VOLTAGE CONDITION EXISTS, THEN INCREASE OR DECREASE NETWORK CONFIGURATION ACCORDING TO BANDSWITCH POSITION AS SHOWN BELOW. REPEAT STEPS 3, 4, 5 AND 6.

FREQUENCY (MHz)	BANDS	INITIAL BANDSWITCH POSITIONS							RF-1912 DIPOLE
		ANTENNA LENGTH (FEET)							
		9	16	24	35	75	150		
1.5 TO 1.9999	0	J	J	J	K	D	G*	D	
2.0 TO 2.5999	1	K	K	D	C	E	G*	C	
2.6 TO 4.1999	2	K	D	C	E	H	H	D	
4.2 TO 6.7999	3	C	D	E	B	L	L	L	
6.8 TO 10.9999	4	A	E	A	B	A	A	B	
11.0 TO 17.9999	5	A	A	A	A	A	A	A	
18.0 TO 29.9999	6	E	E	E	E	E	E	E	

BANDSWITCH POSITION	E	A	B	C	D	K	L	H	J	G*
NETWORK CONFIGURATION	10T	25T	75T	75L	150L	200L	200T	400T	400L	750T

\*SEE INSTRUCTION MANUAL FOR AVAILABLE OPTION FOR POSITION G

Figure 2-13. RF-231 Programming Information



### 2.5.6.2 Servo System Programming

This procedure presupposes that the RF-230 has been programmed and that corresponding channel frequency information has been entered on the channel log located on the inside cover of the RF-231. Programming the servo system involves two inter-related steps: Input switch transformer taps are selected for each channel using an associated programming jumper; and tuning inductor positional information is stored in discrete multi-turn servo potentiometers for each channel. The procedure for finding the precise jumper-servo potentiometer condition for each channel is as follows:

#### Note

For expediency, remove the hex standoffs used to mount the program board, and using the lower two mounting holes, remount the board to the top hex standoff positions. This positions the board above the chassis and facilitates jumpering. Using only one jumper, tune each channel individually for minimum reflected power (1 watt or less) by selecting the lowest input switch tap (at J3) and adjusting the appropriate channel potentiometer. If not adjustable to 1 watt or less change jumper to the next higher impedance tap and readjust the potentiometer. After reaching a good tune log the jumper location and repeat process for the next channel. At completion of tuning all desired channels, using Log, install jumpers as required (jumpers may be daisy chained if necessary). Re-install the program board assembly.

- a. Verify system setup as follows (see figure 2-14):
  - RF-230 RF Output connected to RF-231 RF Input thru VSWR Meter.
  - RF-230/RF-231 Control Cable in place.
  - RF-231 connected to appropriate antenna and corresponding bandswitch programming effected.
- b. At the RF-230, verify channel to be programmed selected and power on.
- c. Preposition the corresponding channel servo potentiometer to the maximum ccw position.

#### Note

Numbers above servopots relate to channel number selected at the RF-230 and to program jumpers at J5.

- d. Verify all other jumpers removed, and install a single jumper from the channel to be programmed to pin 1 (the 2 ohm tap) of J3.

#### Note

J4 and J5 on the Program Boards are in parallel to accommodate "daisy-chaining". Using this method all channel pins could be "linked" to the same tap select pin at J3 if necessary.

- e. Select TUNE at the 2A3A1 Servo Board TUNE/OPERATE toggle switch.
- f. Observe REFLECTED POWER on the Forward/Reflected wattmeter installed at the RF-231 input.

#### Note

If no power is indicated at this point, verify that the SAFETY slide switch on the Servo PC Board is NOT in the SAFETY position. Use this switch to ensure a no-power condition at the coupler during maintenance operations.

- g. Adjust the associated channel servo pot for minimum reflected power. If not adjustable to less than 1 watt, remove power by selecting OPERATE at servo board, and select next higher tap switch position pin. Repeat this procedure to obtain minimum reflected power.

#### Note

If it is not possible to find a less than 1 watt reflected power tune point, it may be necessary to make a lateral change in the bandswitch programming as it relates to the tabular information in figure 2-13.

- h. As the appropriate jumpering is found for each channel, log the information, remove the input switch jumper, and go on to the next channel to be programmed.
- i. When all channels are programmed, use logged information to install jumpers for each channel. As an example, if tap 8 (the 50 ohm tap) proved to be the optimum position for all channels - all channels could be connected to this one tap as shown in figure 2-15.



RF-231 TUNING (PROGRAMMING) PROCEDURE

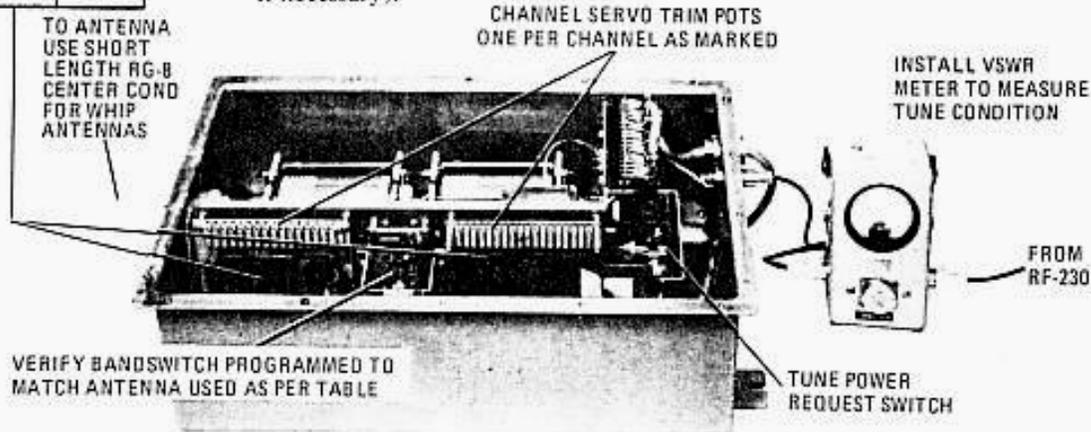
- Verify desired channel selected at RF-230
- Verify bandswitch programmed for antenna used
- Verify antenna, ground, and control cable connections
- Verify VSWR meter connected to measure reflected power

Procedure:

Input Switch Programmable Selections

Tap = Ohms	
1	2
2	3
3	5
4	8
5	12
6	22
7	32
8	50
9	89
10	110
11	200

1. Using only one set of jumpers, connect input switch programming for channel to be programmed to the 2 ohm tap (tap 1, see table at left). Set the channel servo trim potentiometer at maximum ccw position.
2. Select Tune Power at Tune Power Request Switch. This conditions RF-230 to produce approximately 25 watts output for tune purposes.
3. Observe VSWR meter and adjust channel servo programming trim potentiometer for minimum reflected power. If not adjustable to one watt or less, select Tune Power OFF, and try the next higher impedance tap as described in step 1. Continue this 1, 2, and 3 procedure until the optimum input transformer ratio and servo trim position is found for each channel.
4. If a good tune is not obtained at any transformer tap setting, the bandswitch programming may then increase or decrease as shown below. Steps 1, 2, and 3 should then be repeated.  
 Position Sequence: E A B C D K L H J G\*  
 Network Configuration: 10T 25T 75T 75L 150L 200L 200T 400T 400L 750T
5. After tuning, log information and repeat steps 1-4 for next channel. At completion of tuning, use log to install jumpers as required (jumpers may be daisy chained if necessary).



**SAMPLE**  
 SHOWS CHANNEL 4 JUMPED TO THE NO. 3 INPUT SWITCH TAP IS OHMS! AND ADJUSTMENT MADE AT CHANNEL 4 POTENTIOMETER (R5).

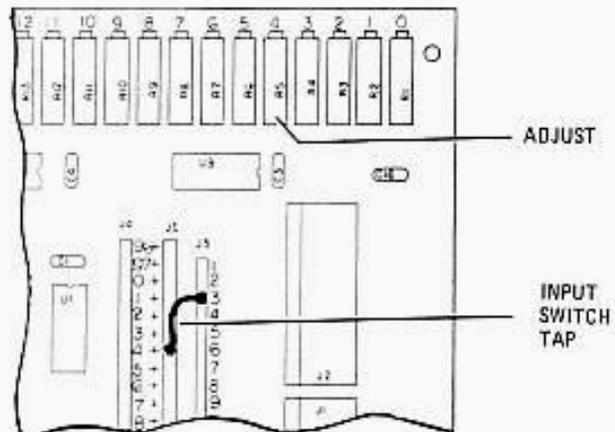
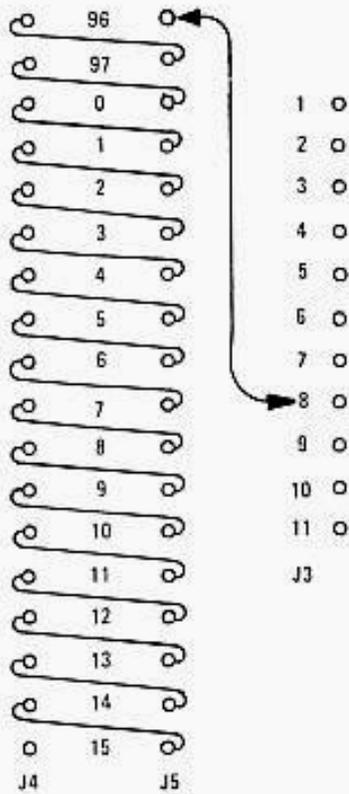


Figure 2-14. Abbreviated RF-231 Programming Procedure



j. This completes all RF-231 programming functions. Remove test equipment and configure for normal operation. Verify:

- TUNE/OPERATE to OPERATE
- SAFETY Switch not in SAFETY position

**2.6 FAN OPTION**

Fan option related information is given in figure 2-16.

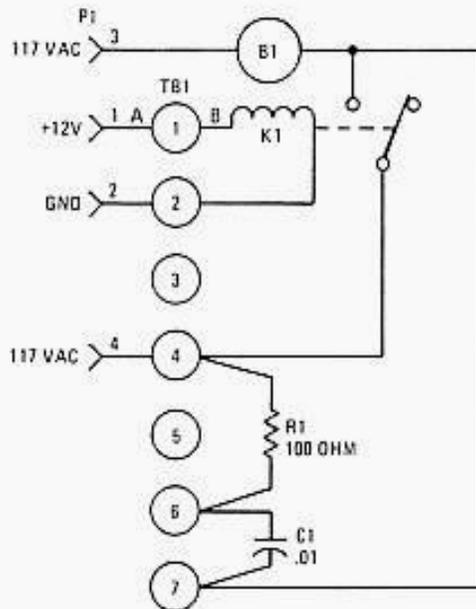
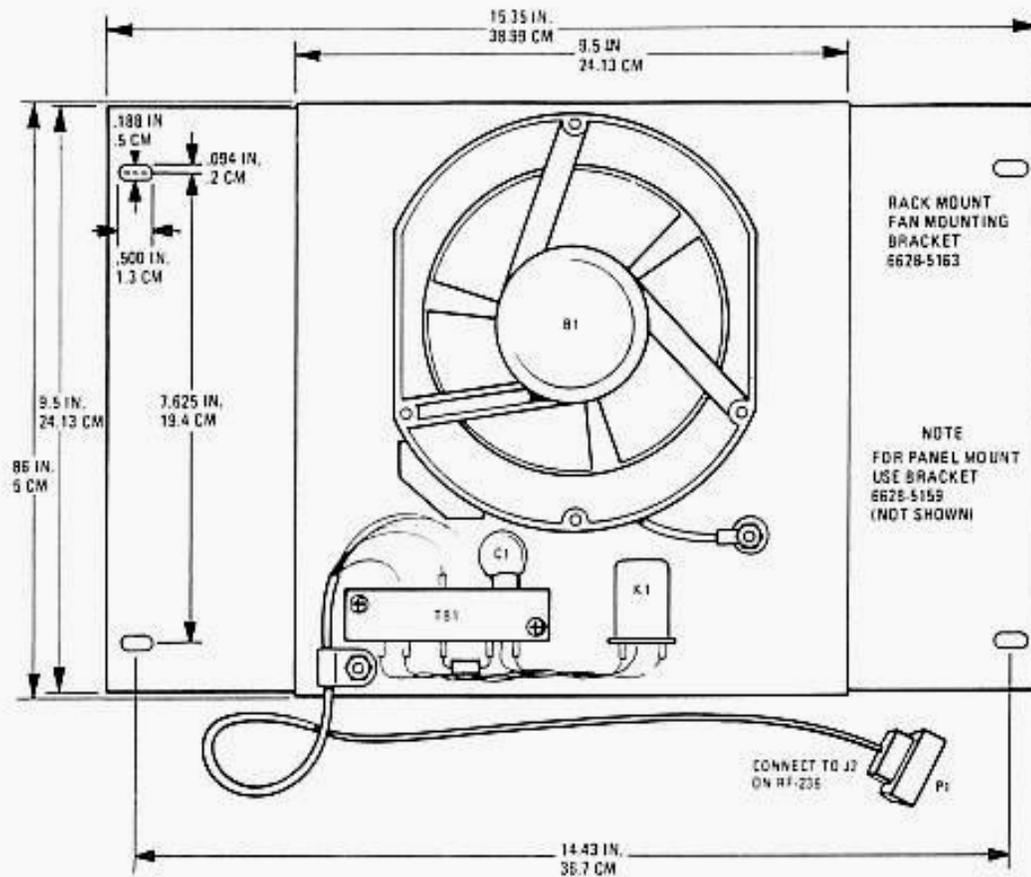
**2.7 MOUNTING**

The RF-230 can be supplied in rack, stack, desk-top, or specialized mounting configurations as per customer requirements. Always provide for unrestricted flow of cooling air over heat-sink assembly at rear of units. Significant space requirements are given in figure 2-17.

**2.8 RF-230-01 ADAPTER**

The RF-230-01 Interconnecting Adapter is shown in figure 2-18. This adapter is used to provide expanded interconnect capability for system applications.

Figure 2-15. 18:1 "Daisy Chain Configuration"



- B1 FAN AXIAL, 115 VAC ROTON NO. MR283
- C1 CAPACITOR, 0.01 MF, 2 KV RMC2KV-10000 GMV
- K1 RELAY, 4 PDT, 3A POTTER & BRUMFIELD KHS-4437
- R1 RESISTOR, 100 OHM, 1/2W RCR20102JM
- TB1 TERMINAL BLOCK, CURTIS NO. 1507

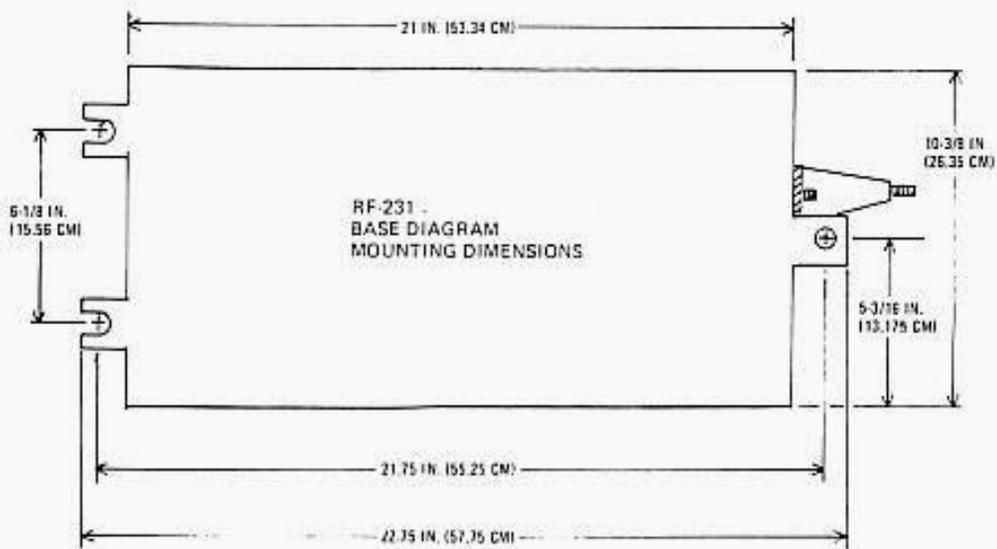
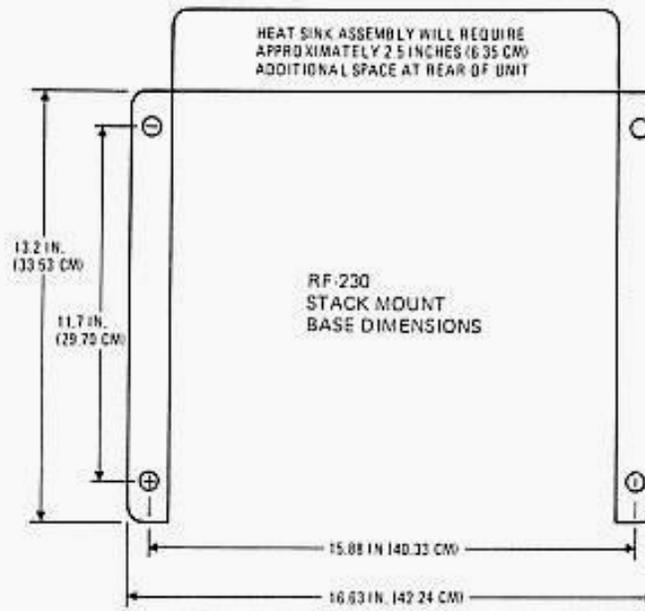
- B0046
- C5000
- K0041
- R1425
- E31-0010-007

Figure 2-16. Fan Option Related Information



TABLE 2-2. RF-230-01 INTERCONNECT ADAPTER ASSY MAINTENANCE PARTS LIST

Ref. Desig.	Name & Description	Mfr. Code	Part Number
	RF-230-01 Interconnect Adapter Assy	14304	6628-5600
A1	RF-230-01 Interconnecting Adapter PWB Assy	14304	6628-5620
AR1,AR2	Integrated Circuit, Audio Amplifier, 1/4W, MC3360P	14304	IC-0172
C1	Capacitor, Fixed, Ceramic, .0047 uF ±20%, 50V	14304	C11-0005-472
C2	Capacitor, Fixed, Ceramic, .1 uF ±20%, 50V	14304	C11-0005-104
C3	Capacitor, Fixed, Tantalum, 6.8 uF ±10%, 35V	14304	C-3102
C4	Capacitor, Fixed, Tantalum, 33 uF ±10%, 25V	14304	C-6540
C5	Capacitor, Fixed, Ceramic, .0047 uF ±20%, 50V	14304	C11-0005-472
C6	Capacitor, Fixed, Ceramic, .1 uF ±20%, 50V	14304	C11-0005-104
C7	Capacitor, Fixed, Tantalum, 33 uF ±10%, 25V	14304	C-6540
C8	Capacitor, Fixed, Tantalum, 6.8 uF ±10%, 35V	14304	C-3102
C9	Capacitor, Fixed, Tantalum, 1 uF ±10%, 35V	14304	C-3100
C10	Capacitor, Fixed, Ceramic, .1 uF ±20%, 50V	14304	C11-0005-104
C11,C12	Capacitor, Fixed, Tantalum, 1 uF ±10%, 35V	14304	C-3100
CR1	Diode, Rectifier, 1N4004	14304	CR-0725
J1-J3	Connector, Socket, 37 Pin	14304	6628-4053
R1	Resistor, Fixed, Composition, 560 ohm ±5%, 1/4W	Mil type	RCR07G561JM
R2	Resistor, Fixed, Composition, 8.2K ±5%, 1/4W	Mil type	RCR07G822JM
R3	Resistor, Fixed, Composition, 3.9K ±5%, 1/4W	Mil type	RCR07G392JM
R4	Resistor, Fixed, Composition, 10K ±5%, 1/4W	Mil type	RCR07G103JM
R5	Not Used		
R6	Resistor, Fixed, Composition, 22 ohm ±5%, 1/4W	Mil type	RCR07G220JM
R7	Resistor, Fixed, Composition, 8.2K ±5%, 1/4W	Mil type	RCR07G822JM
R8	Resistor, Fixed, Composition, 3.9K ±5%, 1/4W	Mil type	RCR07G392JM
R9	Resistor, Fixed, Composition, 10K ±5%, 1/4W	Mil type	RCR07G103JM
R10	Not Used		
R11	Resistor, Fixed, Composition, 22 ohm ±5%, 1/4W	Mil type	RCR07G220JM
T1-T3	Transformer, 600 ohm	14304	6628-0572
VR1	Regulator, 3 Terminal, 10V, LM340T-10	14304	111-0001-004

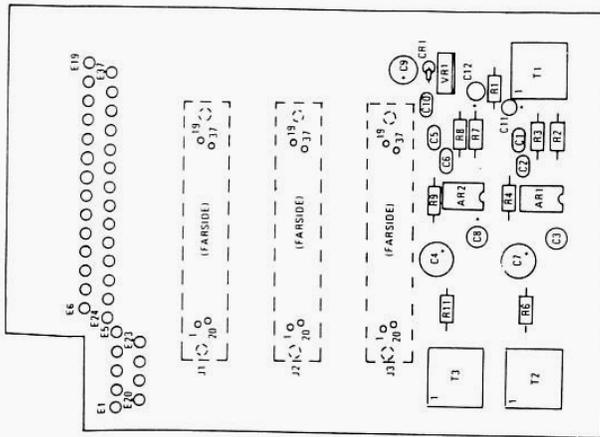
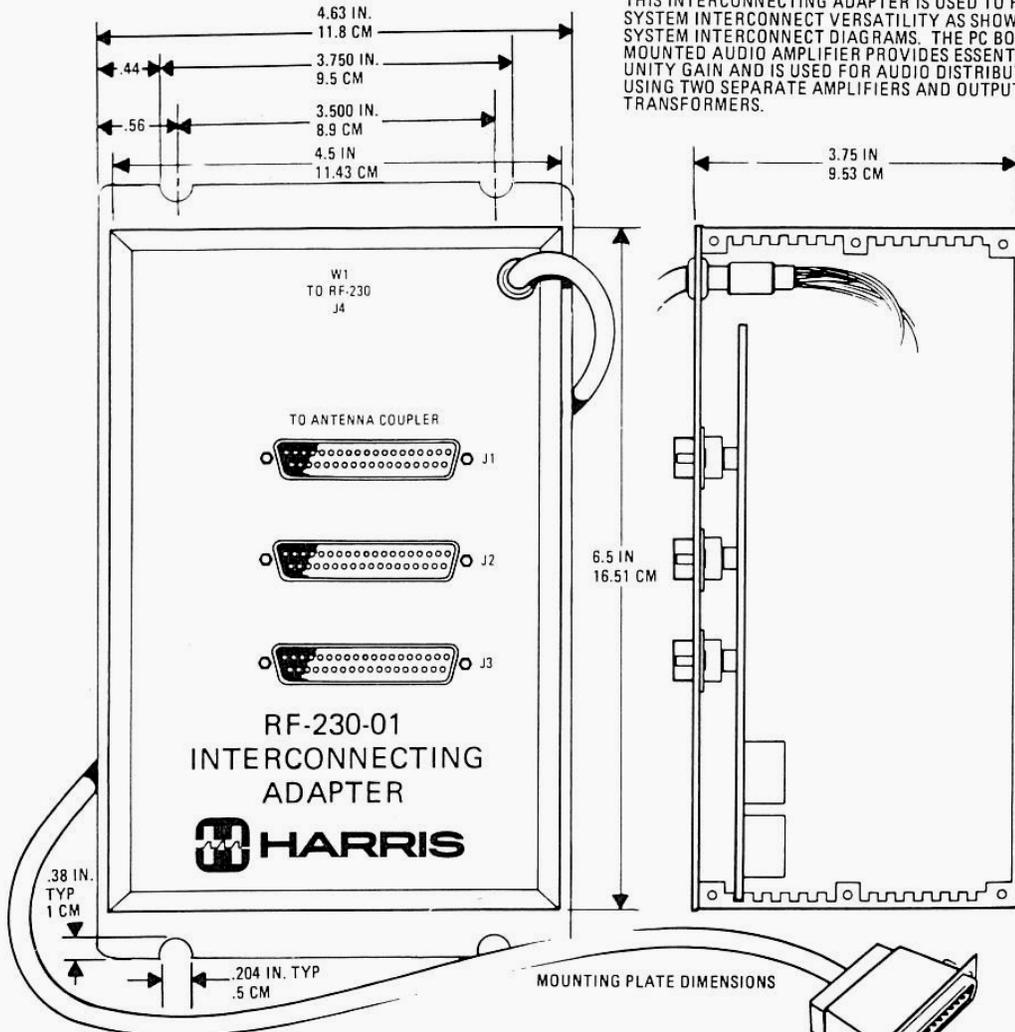


	HEIGHT	WIDTH	DEPTH	WEIGHT
RF-230	5.2 INCHES (13.2 CM)	14.7 INCHES (37.3 CM)	16.3 INCHES (41.4 CM)	25 LBS (11.2 KG)
RF-231	21 INCHES (53.34 CM)	11.5 INCHES (29.21 CM)	7 INCHES (17.78 CM)	25 LBS (11.2 KG)
RF-236	5.2 INCHES (13.2 CM)*	14.7 INCHES (37.3 CM)	16.3 INCHES (41.4 CM)	45 LBS (20.2 KG)

Figure 2-17. Space and Related Physical Data



THIS INTERCONNECTING ADAPTER IS USED TO PROVIDE SYSTEM INTERCONNECT VERSATILITY AS SHOWN IN SYSTEM INTERCONNECT DIAGRAMS. THE PC BOARD MOUNTED AUDIO AMPLIFIER PROVIDES ESSENTIALLY UNITY GAIN AND IS USED FOR AUDIO DISTRIBUTION USING TWO SEPARATE AMPLIFIERS AND OUTPUT TRANSFORMERS.



RF-230-01 Interconnecting Adapter PWB Assembly Component Locations

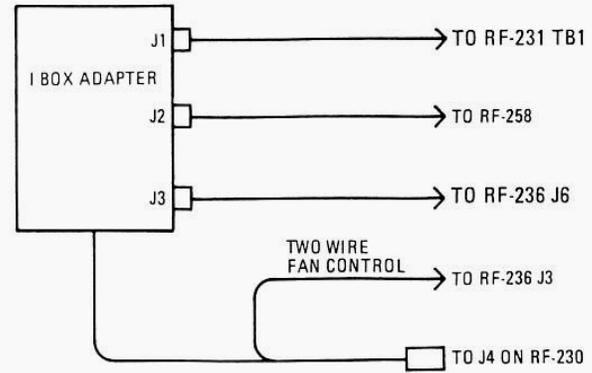


Figure 2-18. RF-230-01 Details



RF-242 Installation Information: The installation dimensions for the RF-242 Stack Mounting Bracket are shown below.

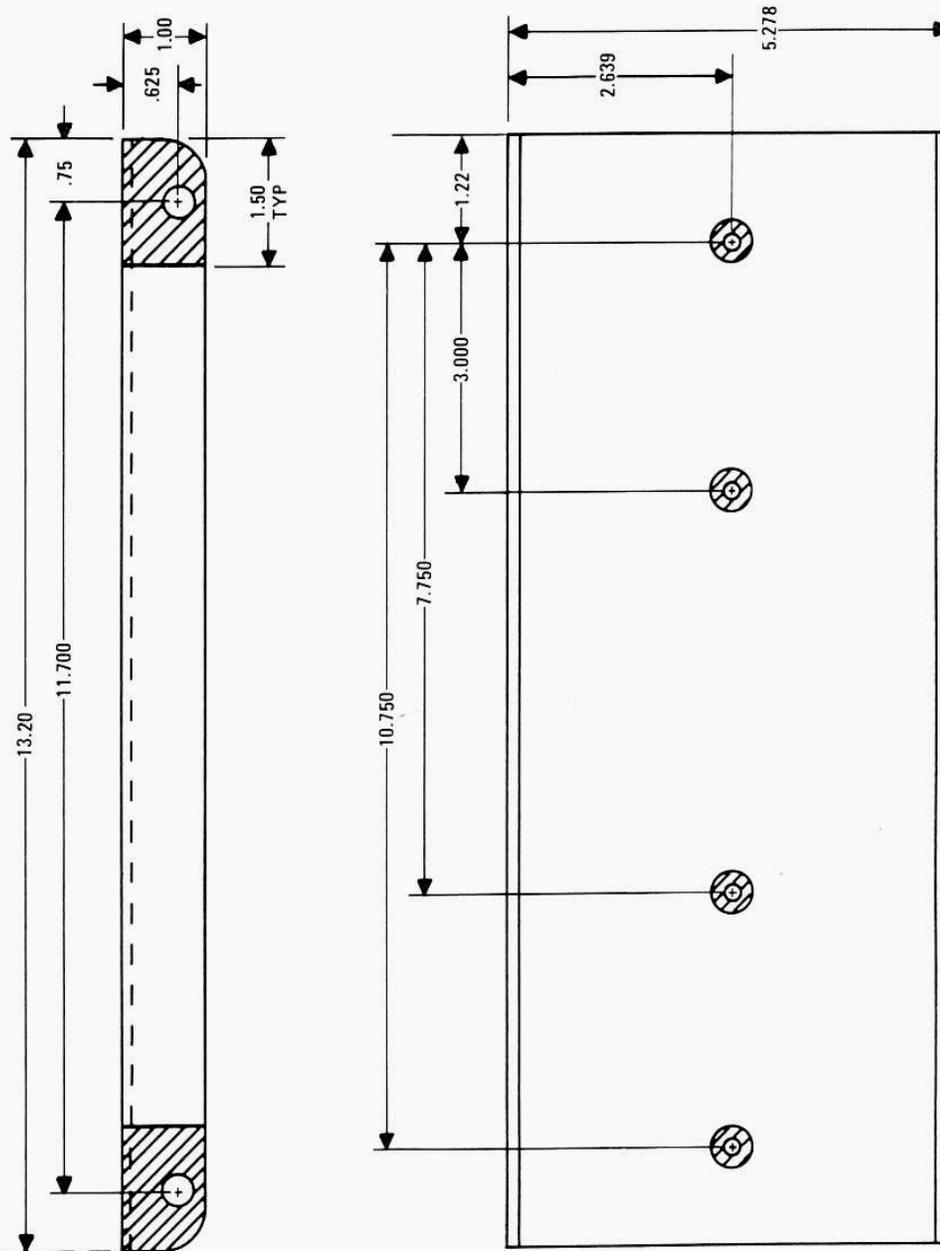


Figure 2-19. RF-242 Stack Mounting Bracket



RF-243 Installation Information (with RF-237 Rack Mount Fan Option): Installation dimensions for the RF-243 Rack Mounting Brackets are shown below.

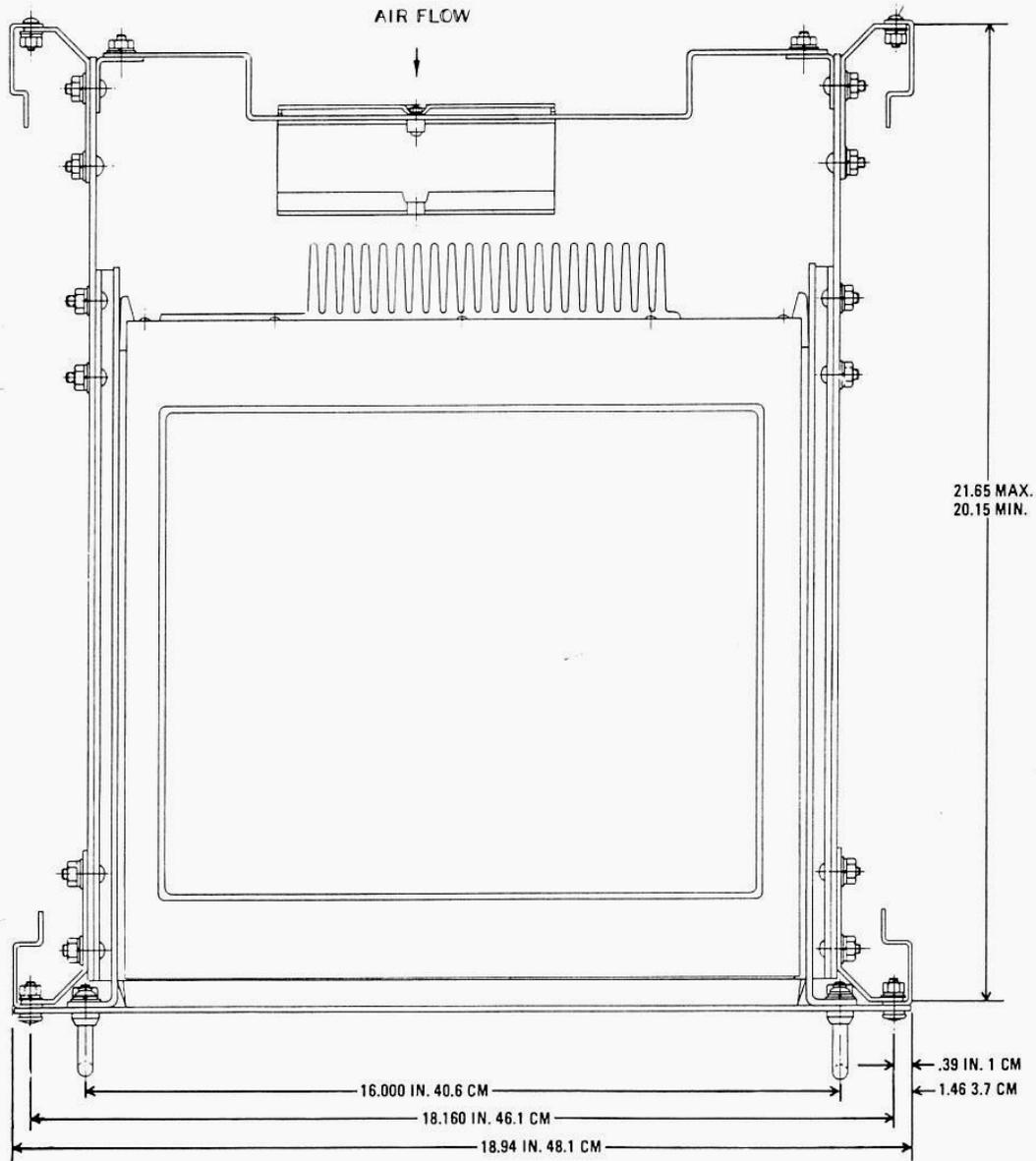


Figure 2-20. RF-243 Rack Mounting Brackets



RF-244 Installation Information: Installation dimensions for the RF-244 Shock Mounting Bracket are shown below.

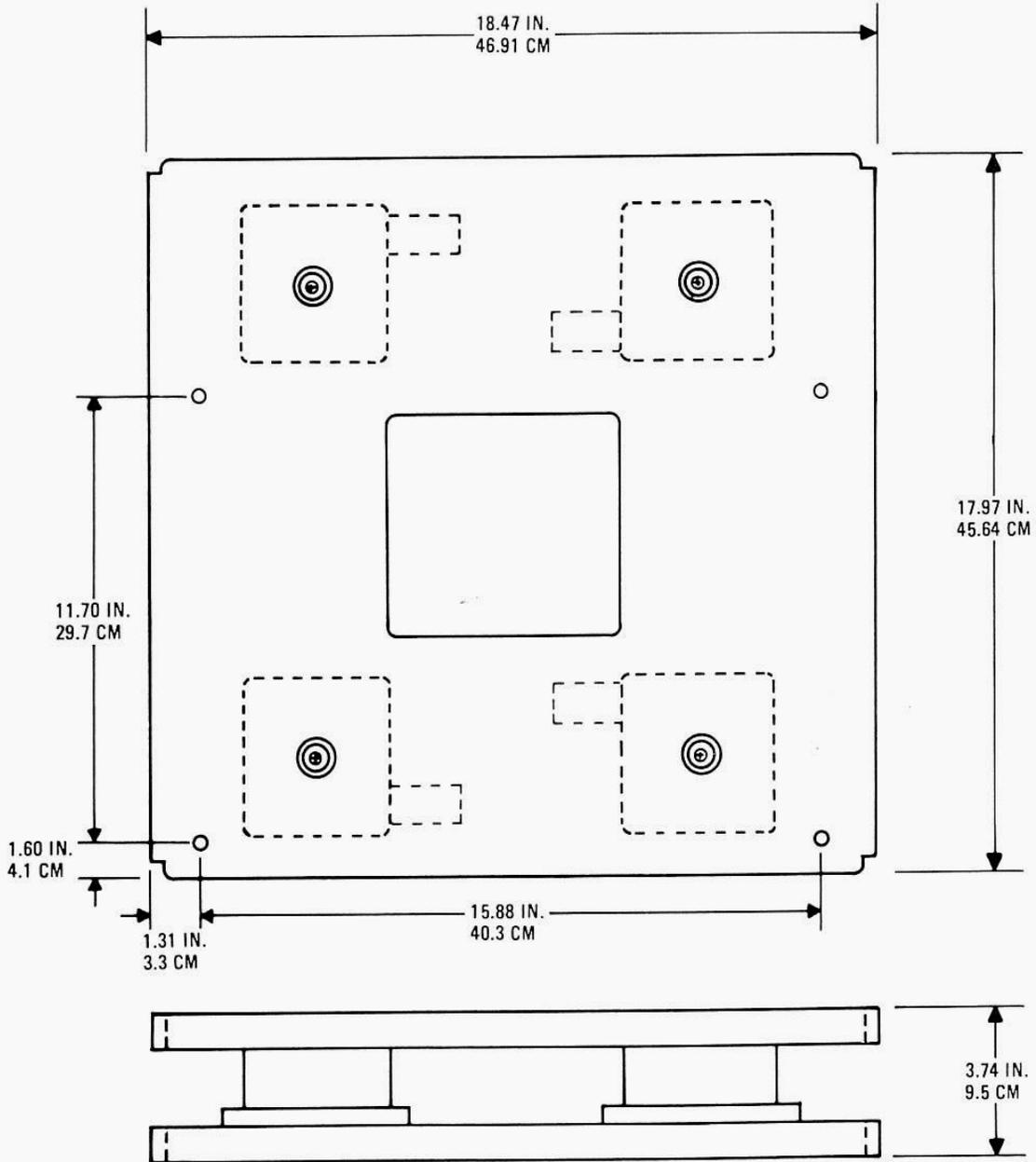


Figure 2-21. RF-244 Shock Mounting Bracket



### PART III OPERATION

#### 3.1 GENERAL

All routine RF-230 system operations can be performed from the Transceiver Front Panel. With power ON in a "programmed" system, selecting the desired operating channel would normally be the only routine operator requirement – everything else is automatic.

#### 3.2 PRE-POWER ON

Verify all system interconnections, especially that the Transceiver rf power output connector, J1 is safely terminated to the Antenna Coupler, and that the coupler is properly terminated in an appropriate antenna.

#### CAUTION

If there is any reason to doubt that the Power Supply is properly configured for the operating voltage used, check S1 inside the power supply. The 115/230 Vac position should agree with the power source used.

#### 3.3 POWER ON

Select MAIN POWER ON at the RF-236. The DC ON indicator should illuminate. Select ON at the RF-230 VOLUME control. Adjust for desired panel lighting. Select desired operating channel and operating mode. If SQUELCH operation is desired, turn control clockwise from OFF position until squelch threshold is reached. Adjusting further clockwise will require a stronger signal to "break" squelch, and returning counterclockwise reduces this threshold. If clarifier operation is available (see section 1A1A10), receive signals that appear un-natural (because the transmitted signal is slightly off frequency) can be "clarified", if they are within  $\pm 240$  Hz of the assigned channel operating frequency.

#### 3.4 STANDARD OPERATIONS SUMMARY

Figure 3-1 summarizes standard RF-230 operations. Table 3-1 gives abbreviated functional descriptions for each control and/or indicator on the RF-230.

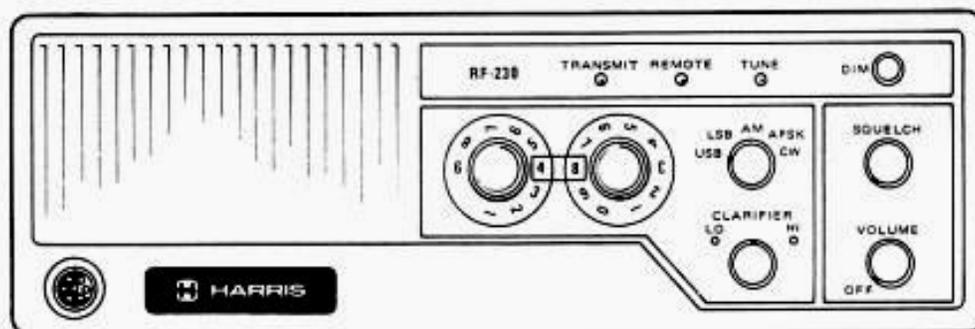


Figure 3-1. Abbreviated Operating Procedure

- VOLUME Select Power ON and desired speaker audio level
- CHANNEL Select desired operating channel
- MODE Select desired operating mode (if not preprogrammed)
- SQUELCH Adjust to desired threshold
- DIM Adjust panel lighting
- CLARIFIER Fine tune off frequency signals (Receive Only)
- TRANSMIT When illuminated, indicates transmitter keyed (brighter flashes indicate power output)
- REMOTE When illuminated, indicates remote control active and channel switches inactive.
- TUNE When illuminated, indicates RF-281 Antenna Coupler is tuning. When flashing, indicates RF-281 in FAULT condition, unable to tune.



TABLE 3-1. RF-230 CONTROLS AND FUNCTIONS

Control	Functional Description
Channel Select switches	Position the two switches (tens select and units select) so that the desired channel number appears in the lighted "window". Always verify that the channel selected is truly the desired channel. Selecting an unused channel will result in an inoperable unit.
CLARIFIER	If a distant transmitting station operating on-channel is slightly off-frequency, the received signal will not sound "natural". The $\pm 240$ Hz range of the receive-only clarifier can be used to fine-tune these signals for optimum clarity. The RF-230 uses a unique frequency stepping technique to cover this $\pm 240$ Hz range. Displacing the spring-loaded clarifier control clockwise or counterclockwise will "step" the frequency up or down in 15 Hz steps. Releasing the control (to its rest position) stops the stepping action and maintains the selected "tune" condition. Powering the unit up, or changing channels will automatically reset the clarifier to zero (both HI and LO lights off).
DIM	This control can be used to effect the desired "dimming" of both the panel illuminators, and the status lights. Note, however, that different "dim rates" are used for the panel and status indicators. By using this system, status lamps will remain visible in the full ccw position, while control indicators will be almost off.
MODE	This control can be used to select the desired operating mode at the front panel if the appropriate instruction has been programmed (see figure 2-9 in the installation section). If the channel is programmed to operate in a specific mode, the front panel mode switch is pre-empted.
REMOTE	When the indicator is illuminated, it indicates that control is being exercised by source other than the front panel control switches. In most cases (if RF-252 not used), indicates that MODE and CLARIFIER are also controlled by other than front panel control.
SQUELCH	Provides manual squelch threshold control. With this control, squelch characteristics are: fast attack, slow decay (about 5 seconds). Therefore, to set this control, preposition to full clockwise, and after the audio level has dropped to indicate squelch activation, slowly return counterclockwise until the audio returns. With a no-signal condition, a slight return clockwise should activate squelch and ensure a maximum sensitivity condition. An incoming signal that exceeds this no-signal threshold will "break" the squelch for normal communication. When the signal disappears (for about 5 seconds), the squelch circuit will again disable the speaker audio for "quiet" operation.
TRANSMIT	This status indicator performs two functions, and has two brightness levels with significance as follows: the first brightness level is relatively dim, and indicates that the transmitter is keyed. When the indicator flashes brighter (as on voice modulation peaks), it shows that power is being emitted to the antenna.



TABLE 3-1. RF-230 CONTROLS AND FUNCTIONS (continued)

Control	Functional Description
TUNE	<p>Several options that require time for tuning have access to this status indicator. When illuminated, the system is not ready for operation, indicating that automatic functions are being performed to configure the system for operation. If these functions are not complete within built-in time limits, this indicator will flash to alert the operator. Also, this indicator remains illuminated in excess of 30 seconds, a tune fault is present.</p> <p style="text-align: center;"><b>Note</b></p> <p style="text-align: center;">The RF-231 does not use this indicator</p>
VOLUME	<p>Adjusts audio output level to speaker and also to headphones (if used). This control is also mechanically coupled to the POWER ON/OFF switch. Positioning to the extreme counterclockwise position removes all low level power from the RF-230. Displacing the control clockwise to effect volume adjustment automatically selects POWER ON.</p>



## PART IV

## FUNCTIONAL DESCRIPTIONS

## 4.1 GENERAL

The RF-230 comprises a modularized state-of-the-art hf communications system. The information presented in this section describes the major functions of the RF-230 Transceiver, the RF-231 Antenna Coupler, and the RF-236 Power Supply. At the heart of the system is the RF-230 Transceiver. This unit requires 13.2 Vdc as operating power and a constant 50 ohm rf output load impedance for optimum efficiency. The RF-236 Power Supply satisfies the system 13.2 Vdc power input requirement, and the RF-231 functions to "tune" a complete family of antennas to satisfy the 50 ohm rf output load requirement of the RF-230. The RF-230 will be discussed first.

## 4.2 RF-230 FUNCTIONAL DESCRIPTION

Figure 4-1 is a simplified block diagram that demonstrates the major functional elements in the transceiver. Refer to the specific sections concerned for detailed functional descriptions for each element.

## 4.2.1 PA Filters, 1A1A1, 1A1A2

PA Filter No. 1 works with PA Filter No. 2 to perform the receive mode preselector function, and in the transmit mode to filter the power amplifier output. PA Filter No. 1 contains three of the six elliptical low/high pass filters required to perform these functions. Input or output signals are all routed through the VSWR assembly on the 1A1A1 board. This "feed-back" information is used in the development of ACC, ALC, and power control. The desired elliptical filter is selected automatically by relay control ground signals from the 1A1A3 PA Control Board. In the transmit mode the filter selected will reduce harmonic output to typically better than  $-50$  dB. In the receive mode, these same filters maintain input losses at such a low level that the signal can be introduced directly to the high dynamic range input mixer on the 1A1A6 Mixer Board.

PA Filter No. 2 works with PA Filter No. 1 to perform the receive mode preselector function and in the transmit mode to filter the power amplifier output. PA Filter No. 2 contains three of the six elliptical low pass filters required to perform these functions. Unlike PA Filter No. 1, there is no VSWR assembly on the PA Filter No. 2 PC Board. The VSWR assembly on PA Filter No. 1 is used by both the 1A1A1 and 1A1A2 assemblies. The desired filter is selected automatically by relay control ground signals from the 1A1A3 PA Control Board. In the transmit mode, the selected filter will reduce harmonic output to typically better than  $-50$  dB.

## 4.2.2 Mixing, 1A1A6

The 1A1A6 Mixer PC Board performs all of the major frequency conversions accomplished within the RF-230. In the transmit signal path, the double sideband 9 MHz input from the balanced modulator on the Processor PCB is selectively filtered to eliminate the unwanted sideband, and two up-conversion functions translate the 9 MHz input first to a 75 MHz intermediate frequency, and then to the final operating frequency. Conversely, receive signals from the PA Filter are translated from the operating frequency, up to the 75 MHz 1st IF, then to the 9 MHz 2nd IF, and filtered before routing to the Audio IF PC Board as a 9 MHz IF signal. The RF-230 incorporates an automatic and programmable spur avoidance technique called "HOP". This system is discussed in detail in sections 1A1A9 and 1A1A11 as it relates to LO2 and LO1 generation. The system involves shifting the LO2 and LO1 injection signals 10 kHz to avoid spurious responses. When any kHz digit less than 4 is selected, control logic on 1A1A9 will automatically effect this shift (HOP), examples demonstrating all four conditions are given in figure 4-2. Tabular information in sections 1A1A9 and 1A1A11 give detailed information on the system also. The automatic system will avoid most "spur" problems, however, if a spur is encountered, selecting "HOP" will cause the shift indicated to counter the problem.

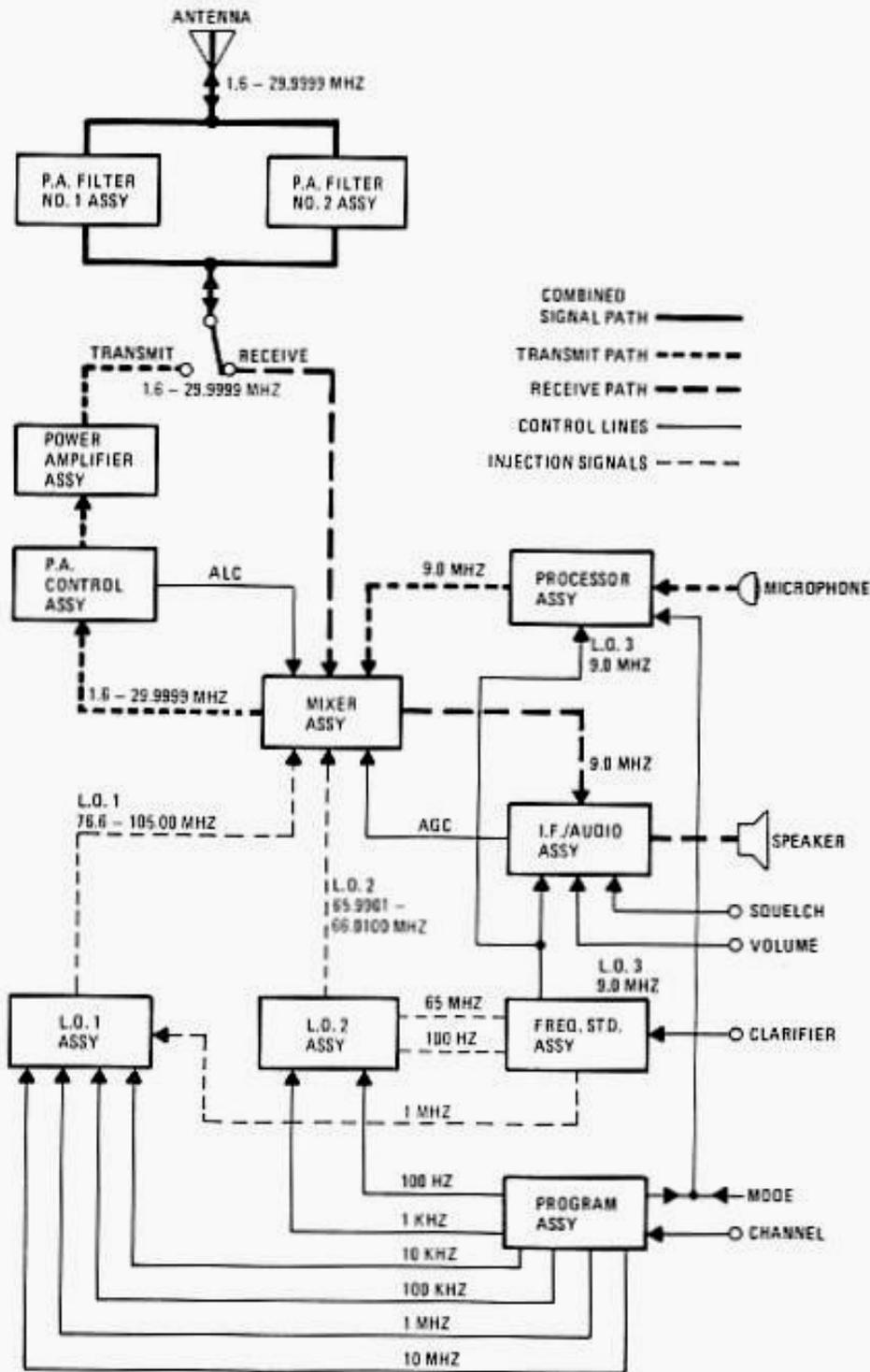
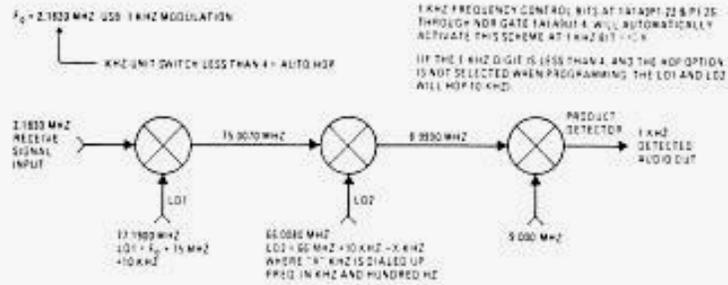


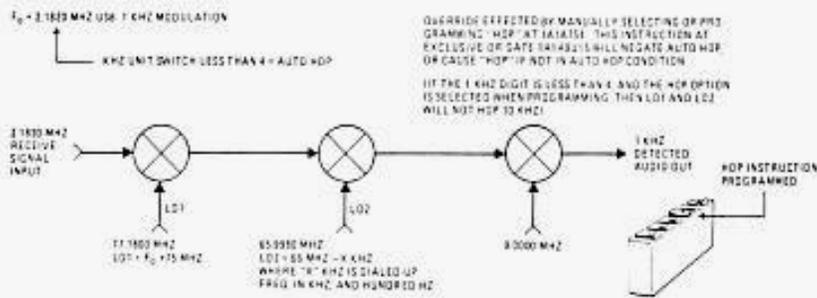
Figure 4-1. RF-230 Functional Block Diagram



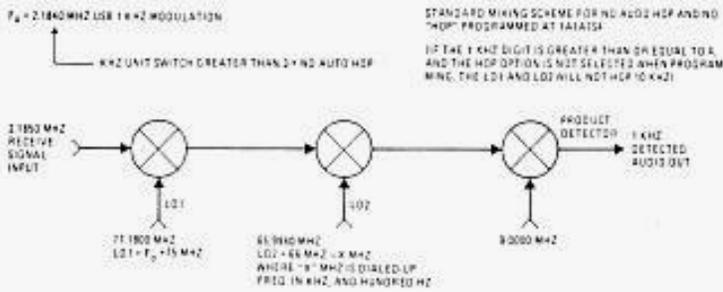
**AUTO HOP – NO MANUAL PROGRAMMING**



**AUTO HOP OVERRIDE (MANUALLY PROGRAMMED)**



**NO HOP**



**NO AUTO HOP (HOP MANUALLY PROGRAMMED)**

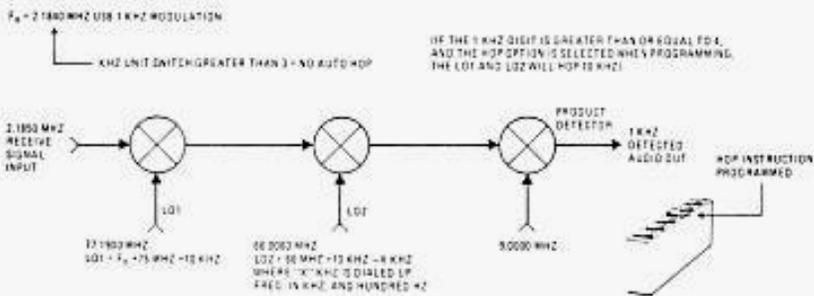


Figure 4-2. Mixing Scheme Demonstrating HOP



An ALC input voltage from 1A1A3 effects a 30 dB control range for transmit signal Automatic Level Control, and the automatically carrier level controlled AM/PCS input from the Processor is recombined in the 9 MHz path on this board. Power limit control information from the Power Amplifier controls the final operating frequency RF Output to the PA Control Board. Receiver protection is also incorporated at this point to automatically react in the presence of excessive signal input voltages. Delayed AGC input from the Audio IF Board provides up to 36 dB attenuation with 1V at the antenna.

#### 4.2.3 IF and Audio 1A1A4

The IF Audio Board accepts the 9 MHz IF Output from the mixer assembly and performs the final detector function to translate the intermediate frequency signal into useable intelligence. This process involves two discrete, but not simultaneous, detector functions: a product detector is operative in the single sideband CW and AFSK mode, and an envelope detector is operative in the AM mode. Two separate audio outputs are provided: a 600 ohm line audio output, and a conventional front panel speaker output.

Mute, squelch and audio enable/disable control is also effected through the Audio IF Board via Logic Level control and COS/MOS Quad Bilateral Switch elements. These switch elements have been shown as simple SPST switches on logic diagrams for simplicity. The 600 ohm audio output is affected only by the MUTE signal: the front panel speaker is controlled by all three (MUTE, SQUELCH, SIDETONE ENABLE/DISABLE).

Squelch and AGC control voltages are also developed and used on the Audio IF Board. In the AM mode, AGC is carrier-derived; in SSB, AFSK, and CW it is derived from the detected audio. AGC is automatically controlled for derivation source (carrier or SSB) and time constant. Fast attack, fast decay is used for typical AM and AFSK signals, and fast attack slow decay for sideband and for CW. A delayed AGC voltage from the Audio IF Board controls front end gain.

#### 4.2.4 Transmit Signal Initial Processing, 1A1A5

The Processor PC Board functions in the transmit signal path to translate audio or other intelligence inputs to a 9 MHz IF frequency for use at the

1A1A6 Mixer. The Processor board will select any one of these four intelligence inputs as the modulation source at the 1st transmit mixer to produce the desired DSB, AM, or CW output. The desired modulation source (600 ohm audio, dynamic mic, carbon mic, or cw) is selected by electronic switching in response to operator inputs and logic control elements.

ACC (Automatic Carrier Control) is effected on the Processor board in response to control inputs developed at the PA Control Board from VSWR and other information. A complete family of mode related control functions are generated on the Processor board in response to 3-bit mode control inputs from the front panel, and as modified by related inhibit, enable, or other logic functions.

#### 4.2.5 Transmit Power Amplifier 1A3 Assembly

The all solid state power amplifier accepts the +14 dBm RF Drive Input from 1A1A4 and provides a nominal 36.5 dB amplification to produce the final RF POWER output to the PA Filters and the antenna system. Receive/transmit signal paths are controlled by K2 to route the antenna input directly to the Mixer in receive mode, and to connect the PA output to the antenna (thru the PA Filters) in the transmit mode. A control voltage analogous to total power amplifier current is also developed on this assembly and fed to 1A1A3 to effect power control.

#### 4.2.6 Frequency Synthesizer

The complete synthesizer assembly actually consists of three subassemblies, the 1A1A10 Frequency Standard PC Board, the 1A1A11 LO1 Generator, and the 1A1A9 LO2 Generator. The Frequency Standard contains the master reference oscillator (TCXO A2), and circuitry to provide the 9 MHz carrier injection signal, the LO1 and LO2 reference signals, and clarifier control circuitry.

LO No. 1 generates the  $F_0 + 75$  MHz signal required at the 1A1A6 Mixer to perform the final transmit mixer up-conversion to the  $F_0$ , and in the receive mode, to perform the first up conversion to the 75 MHz IF. The  $F_0 + 75$  MHz output can be any discrete frequency (in 10 kHz increments) between 75.0 MHz and 104.99 MHz. The output frequency is synthesized from a single 1 MHz signal input. Synthesizer control is exercised automatically in response to BCD frequency control inputs from the program board HOP spur avoidance control is also exercised thru this assembly.



LO No. 2 generates the 66 MHz injection signal used at the 1A1A6 Mixer to convert the 9 MHz transmit input to the 75 MHz Intermediate Frequency, or in the receive mode, to convert the 75 MHz 1st IF 9 MHz 2nd IF. The LO No. 2 assembly uses 100 Hz and 1 kHz BCD input information. HOP (spur evasion technique) control information is also used to shift the output 10 kHz.

BPF (Band Pass Frequency) Select Control signals are also generated on the LO No. 2 assembly. This function is accomplished automatically in response to BCD frequency control inputs. This section also incorporates a priority encoder system to automatically select BYPASS mode in response to control inputs.

All operating frequencies are synthesized from a single standard. This TCXO (Temperature Compensated Crystal Oscillator) is mounted in a protected environment on the Frequency Standard PC Board, and functions to control all operating frequencies to  $\pm 1$  ppm over the full temperature range of  $-30^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$ . Because the TCXO employs "temperature compensated" circuit devices, it does not require a temperature controlled operating environment, with the inherent time lag between turn-on and final temperature stability.

#### 4.2.7 Operator Interface

All operator inputs are effected thru the 1A2 Control Panel Assembly as described in this section on operation.

#### 4.3 POWER SUPPLY, RF-236

The RF-236 Power Supply functions to convert 115/230 Vac power to satisfy the +13.2 Vdc primary input requirement of the RF-230 HF SSB System. In addition, the RF-236 functions as a versatile housing for the RF-253 Auto Alarm.

The RF-236 also supplies control voltage and 117 Vac operating potential for the optional fan. This fan is required for most systems applications.

#### 4.4 ANTENNA COUPLER

The antenna coupler will tune any specified antenna to match the transceiver 50 ohm interface and effect an efficient transmit or receive interface.



## PART V MAINTENANCE

### 5.1 FAULT ISOLATION

Table 5-5 on page 5-73 is a list of possible fault conditions and probable causes. This table is not presented as a comprehensive list of system troubles, but only as a guide to trouble analysis. The first step in troubleshooting is symptom recognition based on knowledge of equipment characteristics. Not all equipment troubles are the direct result of component failure. For example, a condition of less than peak performance can result from component degradation. It is important that degradations be recognized as well as troubles resulting from component failures.

The next step is to determine logical causes of the trouble. A check of operation in different modes and at different frequencies will help to eliminate some causes and will sometimes pinpoint the problem. AGC voltage is a typical measure of receiver gain. See table 5-6 on page 5-74.

Modular construction of the RF-230 System lends itself to a logical and straight forward troubleshooting procedure. By referring to the overall and individual block diagrams, and using related level and frequency information, a trouble can be localized to a particular assembly.

The quickest and most convenient method of confirming input or output levels at a suspected assembly is to temporarily remove it from the chassis, and if necessary, place the assembly on an extender card for test.

Figure 1 shows an RF-230 Card Extender as supplied with the MRK (Maintenance Repair Kit). Use the PC Board Extraction tool located on top of the PA Assembly to remove plug-in component boards.

#### CAUTION

Always select Power OFF when removing or installing subassemblies to prevent possible circuit damage.

After establishing the existence of a trouble in a particular assembly, refer to the servicing information for the assembly given in the unit instruction sections of this manual.

#### Note

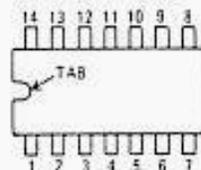
Do not connect the 50-ohm load to digital input, since this is too heavy a load for digital integrated circuits. For these circuits, use an oscilloscope with a high impedance probe.

Figure 2 locates component assemblies in the RF-230. Refer to RF-236 Section and RF-231 Section for component locations within these assemblies. Figure 3 is a bottom view of the RF-230 with the cover removed. Opposite side circuit boards are identified to facilitate orientation.

### 5.2 PW BOARD REPAIRS

The following general rules and techniques are useful in servicing the pw boards of the RF-230.

- When replacing component on printed wiring boards, clip the mounting leads first with a suitable pair of diagonal cutters and remove the component. This is especially helpful on multilead components such as the dual in-line and circular type integrated circuits. The individual leads are then removed from the pw board with a low wattage iron.
- Before removing an integrated circuit from a pw board, note orientation of the pin locating tab and insure the replacement component is reinstalled in exactly the same way.



Integrated Circuit Orientation, (Top View)

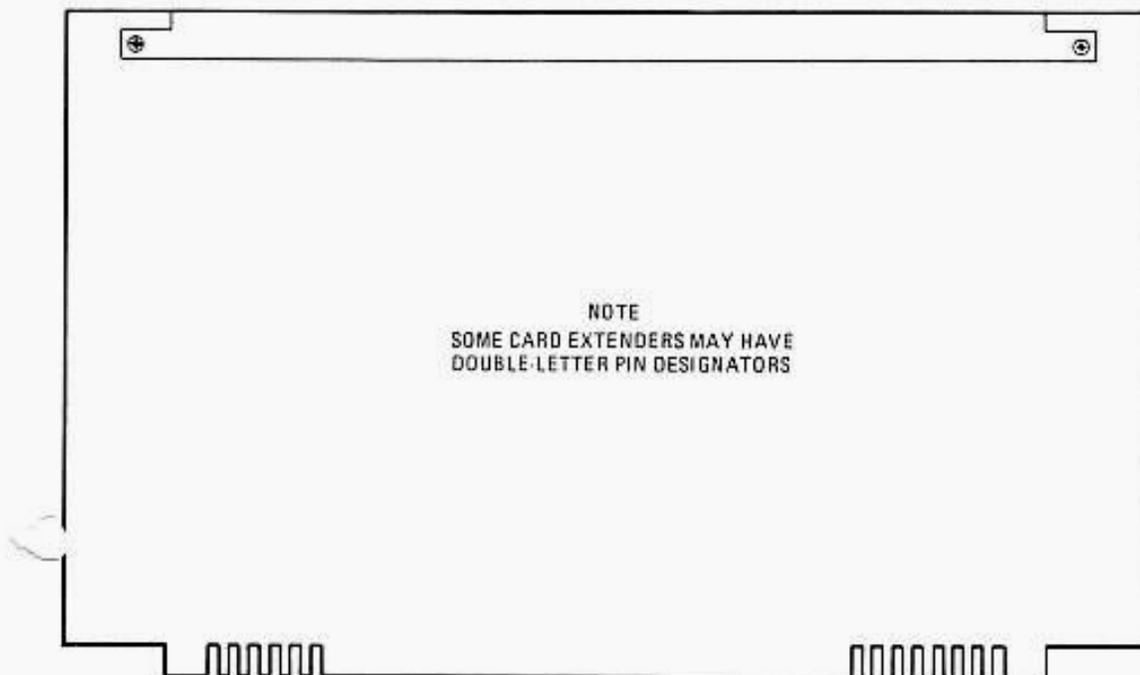


Figure 5-1. PC Board Extender Card, Part of MRK

- Because of the double sided construction used on pw boards in the RF-230, a component lead may be soldered to printed circuit areas on the top and bottom of the pw board. Consequently, when a component lead is removed, the replacement component should be resoldered top and bottom as applicable.
- Overheating a printed circuit conductor may cause it to pull loose from the board material.
  - Apply only the minimum amount of heat necessary for component removal or replacement. The use of a soldering iron in the 25 to 35W range is recommended.
- A soldering tool (solder-sucker) is very convenient (and minimizes board damage) when removing multilead components which cannot be cut loose with diagonal cutters.
- A convenient device to use in place of a solder-sucker is a roll of Solder-Wick, manufactured by Solder Removal Co., Covina, California. This flux-saturated copper braid is often more effective than a solder-sucker for removing solder from pw boards.

#### 5.2.1 MOS-FET Replacement

- a. Remove new MOS-FET from package. The four leads may be connected together with a small ferrule or wire to prevent static charge differences between the gate and substrate terminals. If the ferrule is present, wrap several turns of solder or small gauge wire around the leads and then remove the ferrule.
- b. Position the four leads and install the MOS-FET on the pw board.
- c. Remove the jumper only after the leads are soldered.

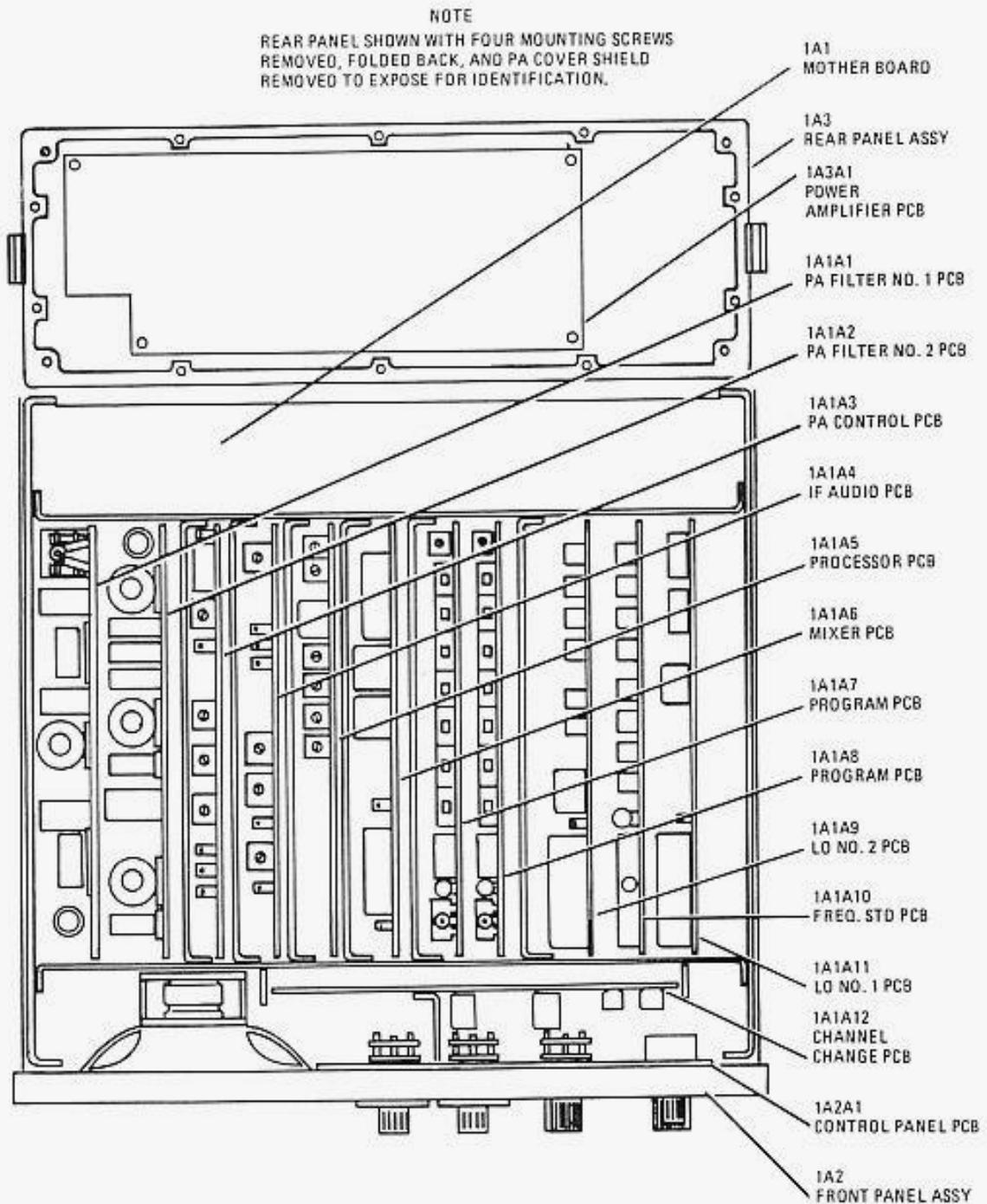


Figure 5-2. RF-230 Subassembly Identification

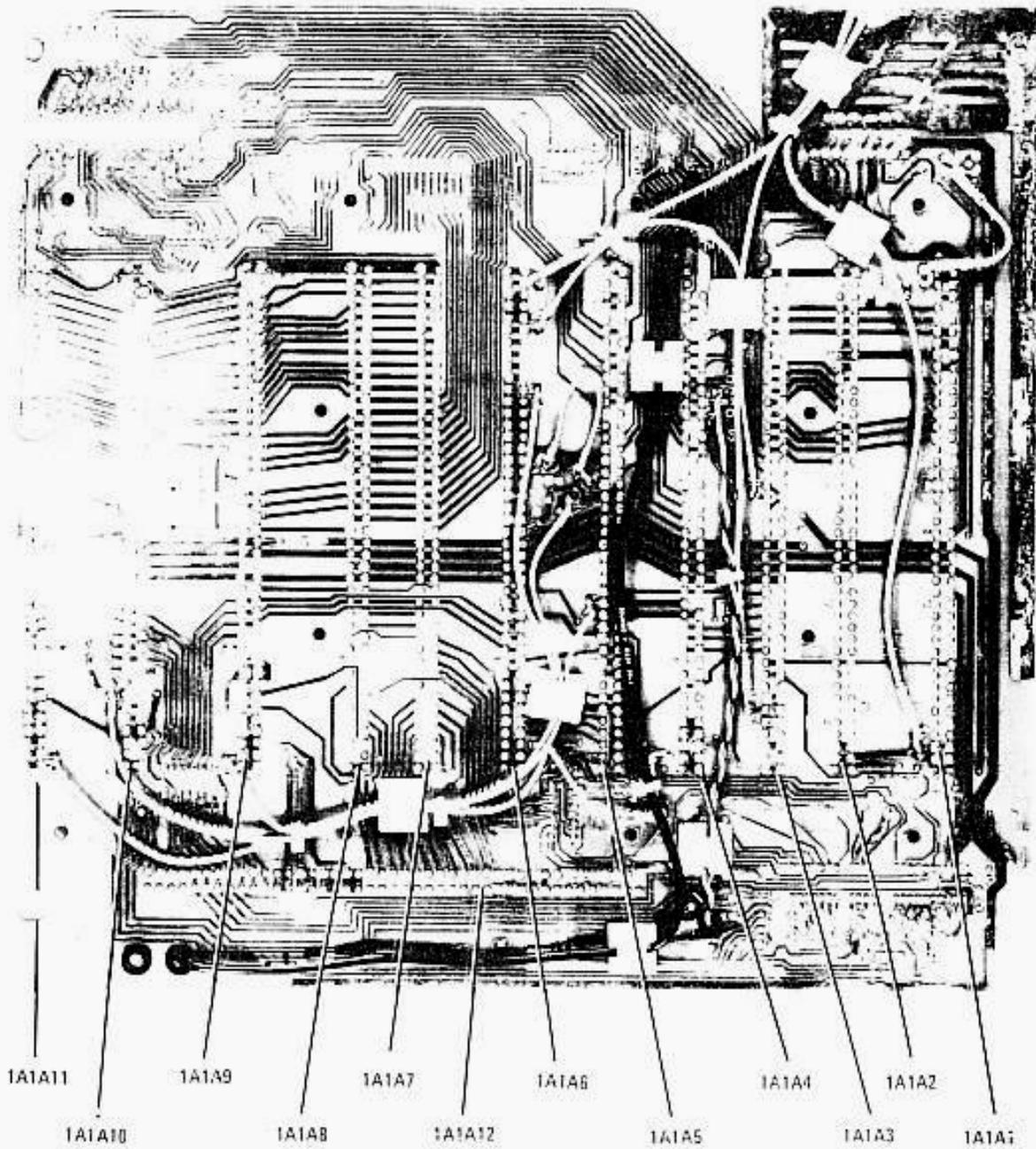


Figure 5-3. RF-230 Mother Board Bottom View



### 5.2.2 CMOS Handling Precautions

All CMOS devices have diode input protection against adverse electrical environments such as static discharge. Although devices contain circuitry to protect inputs against damage due to high static voltages or electric fields, normal precautions should be taken to avoid application of any voltage higher than maximum rated voltages.

Unfortunately, there can be severe electrical environments during the process of handling. For example, static voltage generated by a person walking across a common waxed floor have been measured in the 4 to 15 kV range (depending on humidity, surface conditions, etc.). These static voltages are potentially disastrous when discharge into a CMOS input considering the energy stored in the capacity (about 300 pF) of the human body at these voltage levels.

Present CMOS gate protection structures can generally protect against overvoltages. This is usually sufficient except in the severe cases. Following are some suggested handling procedures for CMOS devices, many of which apply to most semiconductor devices.

1. All MOS devices should be stored or transported in materials that are somewhat conductive. MOS devices must not be inserted into conventional plastic "snow" or plastic trays.
2. All MOS devices should be placed on a grounded bench surface and operators should ground themselves prior to handling devices, since a worker can be statically charged with respect to the bench surface.
3. Nylon clothing should not be worn while handling MOS circuits.
4. Do not insert or remove MOS devices from test sockets with power applied. Check all power supplies to be used for testing MOS devices to be certain there are no voltage transients present.
5. When lead straightening or hand soldering is necessary, provide ground straps for the apparatus used.
6. Do not exceed the maximum electrical voltage ratings specified by the data sheet.

7. Double check test equipment setup for proper polarity of voltage before conducting parametric or functional testing.

8. Cold chambers using CO<sub>2</sub> for cooling should be equipped with baffles, and devices must be contained on or in conductive material.

9. All unused device inputs should be connected to V<sub>DD</sub> or V<sub>SS</sub>.

### 5.3 CONVERSION BETWEEN DBM AND VOLTS RMS

Power levels in this manual are stated in dBm, or decibels with respect to 1 milliwatt. Thus, for example, +6 dBm means 6 dB more than ("above") 1 mW, or 4 mW. Similarly, -6 dBm is 6 dB less than ("below") 1 mW, or 0.25 mW (250 uW).

Notice that every value of dBm corresponds to a particular amount of power. If the impedance in which this power is dissipated is known, the corresponding voltage and current can be determined. Table 5-1 lists 50-ohm voltage equivalents for many dBm power levels. Note that the negative values of dBm, voltages are read in either of the two lefthand columns. For positive values of dBm, voltages are read in the righthand column. For instance, -6 dBm is 0.112V (112 mV), across 50 ohms, while +6 dBm is 0.446V. Similarly, -20 dBm equals 22.4 mV, while +20 dBm equals 2.24 volts (across 50 ohms).

### 5.4 LOGIC INTERPRETATION

Many counting and control functions in the RF-230 are implemented in digital integrated circuits. The basic circuit elements (gates, flip-flops, etc.) are binary in nature, that is, the output voltage of each can lie only in two permissible areas.

The two possible states of each element are called logical "1" and logical "0". The assignment of voltage levels to these logic states is arbitrary; however, in this technical manual positive logic is standardized, which means we define the states as:

	TTL	CMOS
Logical 1: Normally more than	2.4V	7.0V
Logical 0: Normally less than	1.0V	3.0V



**TABLE 5-1. CONVERSION OF DBM TO VOLTS RMS ACROSS 50 OHMS**  
 (Based on 0 dBm = 1 milliwatt)

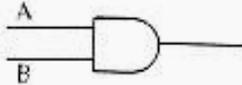
(NEGATIVE DBM)		DBM	(POSITIVE DBM)
VOLTS	MILLIVOLTS		VOLTS
0.224	224	0	0.224
0.199	199	1	0.251
0.178	178	2	0.282
0.158	158	3	0.316
0.141	141	4	0.354
0.126	126	5	0.398
0.112	112	6	0.446
	99.9	7	0.501
	89.0	8	0.562
	79.3	9	0.630
	70.7	10	0.707
	63.0	11	0.793
	56.2	12	0.890
	50.1	13	0.999
	44.6	14	1.12
	39.8	15	1.26
	35.4	16	1.41
	31.6	17	1.58
	28.2	18	1.78
	25.1	19	1.99
	22.4	20	2.24
	19.9	21	2.51
	17.8	22	2.82
	15.8	23	3.16
	14.1	24	3.54
	12.6	25	3.98
	12.0	25.41	—
	11.2	26	4.46
	10.0	27	5.01
	8.90	28	5.62
	7.93	29	6.30
	7.07	30	7.07
	3.98	35	12.6
	2.24	40	22.4
	1.26	45	39.8
	0.707	50	70.7



A gate is a circuit element whose output level depends on the levels at all of its input in a particular pattern.

## AND Gate

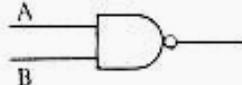
INPUTS		OUTPUT
A	B	
0	0	0
1	0	0
0	1	0
1	1	1



For an AND gate, the output is 1 if and only if all inputs are 1. The output is 0 if any or all inputs are 0. A truth table that lists all possibilities for a two input AND is shown above.

## NAND Gate

INPUTS		OUTPUT
A	B	
0	0	1
1	0	1
0	1	1
1	1	0



The outputs of the NAND gate are the opposite of the AND gate.

## OR Gate

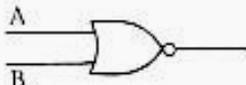
INPUTS		OUTPUT
A	B	
0	0	0
1	0	1
0	1	1
1	1	1



The output of the OR gate is 1 if any (or all) inputs are 1.

## NOR Gate

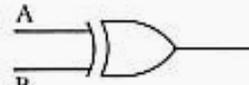
INPUTS		OUTPUT
A	B	
0	0	1
1	0	0
0	1	0
1	1	0



The outputs of the NOR gate are the opposite of the OR gate.

## Exclusive OR Gate

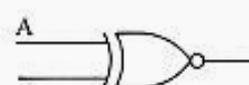
INPUTS		OUTPUT
A	B	
0	0	0
0	1	1
1	0	1
1	1	0



The output of the Exclusive OR Gate will be 1 only if one or the other of the inputs are high, but not for both.

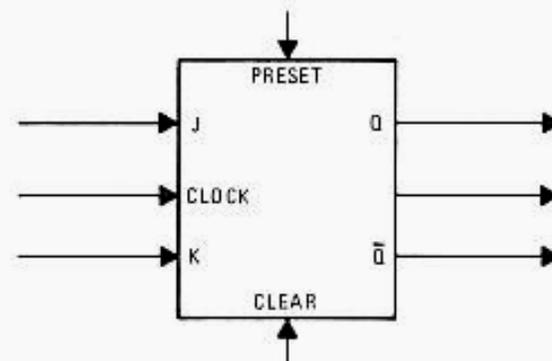
## Exclusive NOR Gate

INPUTS		OUTPUT
A	B	
0	0	1
0	1	0
1	0	0
1	1	1



Functions like the Exclusive OR, however, the output is inverted.

A flip-flop has memory, i.e., it stores a logic state. The logical symbol of the binary storage element called a JK flip-flop (abbreviated FF) is shown below. The state of the FF is referred to by the condition of the Q output. For example, if the Q output is high, the FF contains a 1, if the FF has a 1 output. The Q output is always at the opposite level of the  $\bar{Q}$  output.



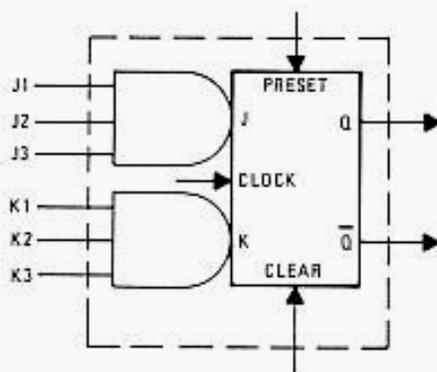
The state of the FF can be changed in two ways: by means of the CLOCK input or by means of PRESET and CLEAR inputs. The effect of an applied clock pulse on the state of an FF depends upon the J and K inputs. The J input must be high for an applied clock pulse to cause a 1 output; similarly, the K input must be high and a clock



pulse applied to cause a 0 output. If both J and K are kept high, the FF toggles (changes state) on each applied clock pulse.

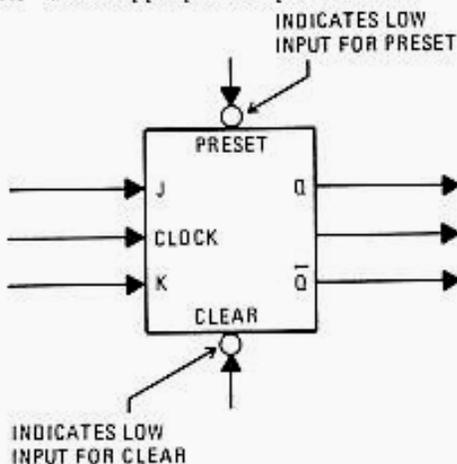
The PRESET and CLEAR inputs operate independently of the clock. A high level input to PRESET drives the FF to 1 (if it is not already at 1) while a high level input to CLEAR drives the FF to 0 (if it is not already at 0).

There are many variations of the basic JK flip-flop. For example, a circuit may have several J and K inputs.



Because of the AND gates, all J's or K's must be high in order to toggle with an applied clock pulse.

Some circuits PRESET or CLEAR with a low level input instead of a high level. This is indicated by a "circle" at the appropriate input terminal.



## 5.5 LIST OF MANUFACTURERS

Table 5-2 is a list of manufacturers for all parts listed in this manual. Parts list for subassemblies are included in individual sections.

## 5.6 INTEGRATED CIRCUITS AND MINI-MODULES

Table 5-4 is a quick reference index of complex devices used in the RF-230 where supplementary data is supplied. When replacing integrated circuits, other devices of the same generic number can be used, however, devices from Harris RF Communications are preferred because they have been prescreened for higher reliability. This is especially true of CMOS devices.

## 5.7 DIGITAL CONTROL LINES

Digital Control lines used in the RF-230 system, whether tri-state bus, open collector bus, or direct logic driven, all respond to 10V CMOS levels. Zero and 1 logic level references are commonly used to describe these HI and LO logic levels are as follows:

- 1 = HI = Nominally 7 thru 10 Vdc
- 0 = LOW = Nominally 0 thru 1.4 Vdc

Common control line functional descriptions are given in alphabetical order in table 5-3 to provide a convenient reference summary.



TABLE 5-2. LIST OF MANUFACTURERS (continued)

CODE NUMBER	MANUFACTURER'S NAME AND ADDRESS	CODE NUMBER	MANUFACTURER'S NAME AND ADDRESS
14304	Harris Corporation RF Communications Division 1680 University Avenue Rochester, New York 14610	Mil type	Government Bureau of Military Specifications, Promulgated by Standardization Division, Directorate of Logistic Services DSA

TABLE 5-3. CONTROL LINE FUNCTION SUMMARY

Function	Description																											
AM Enable	Activates AM detector-AGC system while disabling audio AGC and product detector.																											
BPF	4 bit binary code, derived from operating frequency and transmit/receive condition as follows: <table border="1" style="margin-left: 40px;"> <thead> <tr> <th>Frequency</th> <th>Code</th> <th>Action</th> </tr> </thead> <tbody> <tr> <td>1.60 – 1.990 MHz</td> <td>000</td> <td>Filter 1 select</td> </tr> <tr> <td>2.00 – 2.590 MHz</td> <td>001</td> <td>Filter 1 select</td> </tr> <tr> <td>2.60 – 4.119 MHz</td> <td>010</td> <td>Filter 2 select</td> </tr> <tr> <td>4.20 – 6.790 MHz</td> <td>011</td> <td>Filter 3 select</td> </tr> <tr> <td>6.80 – 10.990 MHz</td> <td>100</td> <td>Filter 4 select</td> </tr> <tr> <td>11.00 – 17.990 MHz</td> <td>101</td> <td>Filter 5 select</td> </tr> <tr> <td>18.00 – 29.990 MHz</td> <td>110</td> <td>Filter 6 select</td> </tr> <tr> <td colspan="2">For any frequency if in Rx mode,</td> <td>111 Filters bypassed at coupler and bypass selected</td> </tr> </tbody> </table>	Frequency	Code	Action	1.60 – 1.990 MHz	000	Filter 1 select	2.00 – 2.590 MHz	001	Filter 1 select	2.60 – 4.119 MHz	010	Filter 2 select	4.20 – 6.790 MHz	011	Filter 3 select	6.80 – 10.990 MHz	100	Filter 4 select	11.00 – 17.990 MHz	101	Filter 5 select	18.00 – 29.990 MHz	110	Filter 6 select	For any frequency if in Rx mode,		111 Filters bypassed at coupler and bypass selected
Frequency	Code	Action																										
1.60 – 1.990 MHz	000	Filter 1 select																										
2.00 – 2.590 MHz	001	Filter 1 select																										
2.60 – 4.119 MHz	010	Filter 2 select																										
4.20 – 6.790 MHz	011	Filter 3 select																										
6.80 – 10.990 MHz	100	Filter 4 select																										
11.00 – 17.990 MHz	101	Filter 5 select																										
18.00 – 29.990 MHz	110	Filter 6 select																										
For any frequency if in Rx mode,		111 Filters bypassed at coupler and bypass selected																										
Bus Request	When utilized in a multi-remote system, places a service request in the priority queue.																											
Bypass Control Output	Controls RF-281 "Bypass" function. This function is not required in systems using the RF-231. The RF-231 uses BPF coding directly to control this function.																											



TABLE 5-3. CONTROL LINE FUNCTION SUMMARY (Continued)

Function	Description
Channel Bus	7 bits binary corresponding to the channel number. Codes 0 – 95 access positions in memory (subject to jumpering on the programming boards). Codes 98 – 127 disable the programming boards and allows input of data from external connector, with codes 112 – 127 enabling the front panel mode switch and clarifier control.
Channel Lines	7 bits binary corresponding to channel number. Provides one level of storage to insure correct channel programming if operator changes channel during that process.
Coupler Rechannel	Provides a pulse of at least 30 mS duration upon power up or during a channel change to allow the RF-281 to home, or the RF-231 to re-enter its preprogrammed mode.
CW Keyline	Allows on-off keying (A1) of carrier. Disabled if not in CW mode. Initiates time hang on T/R relay control to prevent relay drop-out.
Head Mute	Disables speaker amplifier when headset used or if commanded by external circuitry. (i.e., voice privacy module).
Fan Control	When utilized with the RF-236 in a stack-mount, provides control of cooling fan dependent on PA temperature.
Frequency Bus	22 lines providing BCD coding from 0 to 299999.
FSK T.C.	Changes AGC time constant when FSK mode is selected. Also provides external indication to power up RTTY system, or to put a solid state kilowatt in a higher efficiency mode.
HOP	Spur evasion technique - slews LO1 and LO2 up 10 kHz to avoid high order mixer products while maintaining same receive or transmit frequency. User programmed.
Internal/External Bypass	If transceiver is in receive it allows bypassing of coupler and bandpass filters. Defeated automatically in transmit.
Inhibit In	Disables front panel channel switch assembly to allow remote take-over of channel bus. Also disables mode switch and clarifier control unless a channel number from 112 – 127 is present on the channel bus. Lights REMOTE light on front panel.
Keyline	Subject to overriding by the keyline enable and being in a correct mode, allows the transceiver to enter a transmit condition.
Keyline Enable	Enables keyline, used for temperature failsafing as well as to program receive-only channels, and to allow prioritization in multi-remote systems.
LO-3 Inhibit	Shuts off 9 MHz injection when receiving AM
Microphone Enable	Disables microphone inputs to allow options, such as the marine auto-alarm, sole access to modulator.



TABLE 5-3. CONTROL LINE FUNCTION SUMMARY (Continued)

Function	Description
Mode Bus	3 bit binary code as follows: 000 No mode defaults to USB (does not show up on Mode bus) 001 USB 010 LSB 011 AM 100 AFSK 101 CW 110 PCS 111 Kills audio and inhibits keyline
Mode Inhibit Output (MIO)	Disables front panel mode switch if a mode has been preprogrammed into memory. Also present to disable remote mode selection.
Mute Control	Does actual muting of speaker driver as indicated by mute command or mode code 7.
Programming In Progress	Disallows channel lines from changing while the CPSU boards are being reprogrammed.
Speaker Enable	Activates speaker driver while in valid CW transmit condition (or when using line input) to allow sidetone to be audible (always activated in receive).
Squelch Bypass	Disables syllabic rate squelch to allow use of external control, such as voice privacy or scanner system.
T/R Relay Control	Actuates the various T/R relays subject to cw hangtime (on cw only), keyline enable, or mode code 7. Controls front panel transmit light.
Tune Light	Interfacing with RF-281 provides visual indication of coupler status.
Tune Power Request	When combined with a keyline closure, places transmitter in AM and disables transmit audio to provide carrier suitable for coupler tuning.
Tx Inhibit	Disables transmit while not defeating keyline related functions. Activated by synthesizer out of lock, or by Rx - Tx transition relay settling time delay (defeated on cw).
Tx Light	Signals the presence of power output ( $\geq 5W$ ). Used to satisfy FCC Requirements. Causes front panel indicator "Transmit" to change intensity.
Up/Down Clarifier	Control lines for modifying clarifier frequency.
USB/AM/OPT Filter Select	Controls the filter used in the IF. The optional filter may be selected for FSK, CW, or LSB.
Zero Clarifier	Zeros clarifier to center channel. Occurs upon power up, or when channel is changed, either locally or remotely.



TABLE 5-4. INTEGRATED CIRCUIT INDEX

Type	Function	Page
LM324/CA324	Quad Operational Amplifiers	5-13
CA555	Timer	5-14
CA810Q	7-Watt Audio Power Amplifier	5-15
CA3028AS	Differential/Cascode Amplifier	5-16
CA3096AE	N-P-N/P-N-P Transistor Array IC	5-17
CA3130AS	Operational Amplifier	5-18
CD4001AE	Quad 2-Input NOR Gates	5-19
CD4008AE	4-Bit Full Adder	5-20
CD4010	Hex Buffers/Converters	5-21
CD4011AE	Quad 2-Input NAND Gate	5-22
CD4012A	NAND Gates	5-23
CD4017AE	Decade Counter	5-24
CD4023E	Triple 3-Input NAND Gates	5-25
CD4023B	Triple 3-Input NAND Gates	5-26
CD4024AE	7-Stage Binary Counter	5-27
CD4025B	Triple 3-Input NOR Gates	5-28
CD4027A	Dual J-K Master-Slave Flip-Flop	5-29
CD4028AE	BCD-to-Decimal Decoder	5-30
4029A	Presetable Up/Down Counter	5-31
CD4030AE	Quad Exclusive OR Gate	5-32
CD4040A	12-Stage Ripple-Carry Binary Counter/Divider	5-33
CD4042AE	Quad Clocked "D" Latch	5-34
CD4046A	Micropower Phase-Locked Loop	5-35
CD4051BE	8 to 1 Multiplexer	5-37
CD4053	Triple 2-Channel Multiplexer	5-38
CD4060AE	14-Stage Ripple-Carry Binary Counter/Divider and Osc	5-39
CD4066AE	Quad Bilateral Switch	5-40
CD4068	8-Input NAND Gate	5-41
CD4070B	Quad Exclusive-OR Gates	5-42
CD4069BE	Hex Inverter	5-43
CD4071B	Quad 2-Input OR Gates	5-44
CD4073	AND Gates	5-45
CD4075BE	Triple 3-Input OR Gate	5-46
CD4077BE	Quad Exclusive NOR Gates	5-47
CD4081BE	Quad 2-Input AND Gate	5-48
CD4082	Dual 4-Input AND Gate	5-49
CD4096B	Gated J-K Master-Slave Flip-Flop	5-50
CD4518B	Dual BCD Up-Counter	5-51
CD4532B	8-Bit Priority Encoder	5-52
28C2051	512 Bit Electrically Alterable Read Only Memory	5-53
FCS11C90	650 MHZ $\div$ 10/11 Prescaler	5-55
LM317T	Adjustable Output Voltage Regulator	5-56
MC1350	IF Amplifier	5-57
MC1723CL	Monolithic Voltage Regulator	5-58
MC3340P	Electronic Attenuator	5-59
MC3360P	1/4 Watt Audio Amplifier	5-60
MC4044P	Phase Detector TTL	5-61
MC7805CT	Positive 5 Volt Regulator	5-62
MM80C97	Hex Tri-Stage Non-Inverting Buffers	5-63
SN74LS00	Quadruple 2-Input Positive NAND Gates TTL	5-64
SN74LS27	Triple 3-Input Positive NOR Gate TTL	5-65
SN74LS163	Synchronous 4-Bit Binary Counter TTL	5-66
SN74LS190	Synchronous Up/Down BCD Counter TTL	5-67
SN7470	AND Gated J-K Flip-Flop TTL	5-68
SN78L05	Three Terminal Positive Fixed Voltage Regulator	5-69
6628-0666	Balanced Mixer	5-70



TABLE 5-5. TROUBLESHOOTING TABLE

RF-230 Receive Section		
Symptom	Possible Cause	Check
<b>General Notes:</b> Always verify the correct dc power supply voltages, these include: <ul style="list-style-type: none"> <li>• +10 Vdc</li> <li>• +10 Vdc Receive (Present only in receive mode)</li> <li>• +10 Vdc Transmit (Present only in transmit mode)</li> <li>• +10 Vdc supplied by 1A1A10 for the 1A1A9 and 1A1A11 boards.</li> </ul> Always troubleshoot with the RF-230 on a known programmed channel, or to the maintenance channel (96 or 97, see 1A1A7/1A1A8).		
No front panel lighting	No 13.2 Vdc to 1A2A1	<ul style="list-style-type: none"> <li>• Power Supply input</li> <li>• Fuse on 1A3A1</li> </ul>
No receive audio or receiver noise	DC voltages incorrect  Incorrect Mute, Squelch or Sidetone Enable State	Verify +13.2 Vdc, +10 Vdc and +10R at 1A1A4  Verify at 1A1A4
Low Receive Sensitivity	Bandpass filters, 1A3A1K1 or 1A3A1K2  Low oscillator injection voltages  1A1A6 Mixer problem  1A1A4 IF Audio Problem	Check sensitivity at 1A1A6TP7 with 1A1A1 and 1A1A2 removed.  Check oscillator levels at 1A1A9, 1A1A10 and 1A1A11.  Check 1A1A6U1 up mixer and injection levels.  Check AGC voltage
Low AM Sensitivity (SSB Sensitivity OK)	1A1A6 AM peculiar circuits  1A1A4 AM peculiar circuits	Verify filter switching and AM filter output  Check AM Detector 1A1A4Q8
Good AM Sensitivity but poor USB or LSB Sensitivity (but not both)	Low 9 MHz injection	Verify at 1A1A4
Distorted Audio at speaker (OK at line output)	Speaker driver or AGC problem	Check at 1A1A4Q4 and AGC at 1A1A4TP2
Low or distorted line audio output	Line Driver or AGC problem	Check 1A1A4AR3 and AGC at 1A1A4TP2



TABLE 5-5. TROUBLESHOOTING TABLE (Continued)

RF-230 Transmit Section		
Symptom	Possible Cause	Check
No power output in any mode, but receiver works normal	Defective Power Amplifier Defective PA Control Board Defective Mixer Defective Processor	1A3TP1 thru TP4 1A1A3TP1 thru TP5 1A1A6K1 Check gating at 1A1A5U5
No power output in SSB; Carrier output OK in AM	Defective Processor	Check gating at 1A1A5U5
AM Carrier Carrier not adjustable to proper level	Defective ACC (Automatic Carrier Control) circuit.	1A1A5U5 and 1A1A5AR1
SSB output not adjustable to proper level	Defective ALC (Automatic Level Control) circuit. Defective Overcurrent limit to Over temperature cutback	1A1A3AR2 1A1A3AR1

TABLE 5-6. RELATIONSHIP, RF INPUT - AUDIO OUTPUT - AGC VOLTS (TYPICAL)

RF Input (Volts)	Audio Output (3.2 Ohms)	AGC
0.0000	00.0 dB	0.36 Vdc
.39uV	10.0 dB	0.36 Vdc
.78uV	16.0 dB	0.36 Vdc
1.0uV	17.8 dB	0.36 Vdc
1.5uV	21.6 dB	0.36 Vdc
2.0uV	23.9 dB	0.36 Vdc
2.5uV	25.8 dB	0.36 Vdc
3.0uV	27.4 dB	0.63 Vdc
3.5uV	28.3 dB	1.12 Vdc
4.0uV	29.6 dB	1.44 Vdc
6.0uV	31.4 dB	2.09 Vdc
8.0uV	31.5 dB	2.41 Vdc
10.0uV	31.8 dB	2.64 Vdc
30.0uV	32.9 dB	3.28 Vdc
100uV	33.5 dB	3.70 Vdc
300uV	33.9 dB	4.02 Vdc
1mV	34.2 dB	4.32 Vdc
3mV	34.5 dB	4.58 Vdc
10mV	34.9 dB	4.90 Vdc
30mV	35.4 dB	5.40 Vdc
100mV	36.3 dB	6.25 Vdc
300mV	37.3 dB	7.40 Vdc
1.0V	37.6 dB	7.65 Vdc
1.5V	37.7 dB	7.75 Vdc



## PART 1

## INTRODUCTION

## 1.1 GENERAL DESCRIPTION

The RF-230 HF-SSB Transceiver System is shown in a typical configuration in figure 1-1. The RF-230 Transceiver is shown with the RF-236 AC Power Supply and the RF-231 Antenna Coupler. Salient features are summarized here, and amplified in subsequent paragraphs to pro-

vide the user with a comfortable level of familiarity with all standard and optional system elements.

The RF-230 Transceiver System is compatible with a complete family of options. These options are summarized in table 1-1, along with basic system elements, to facilitate user identification and familiarization.

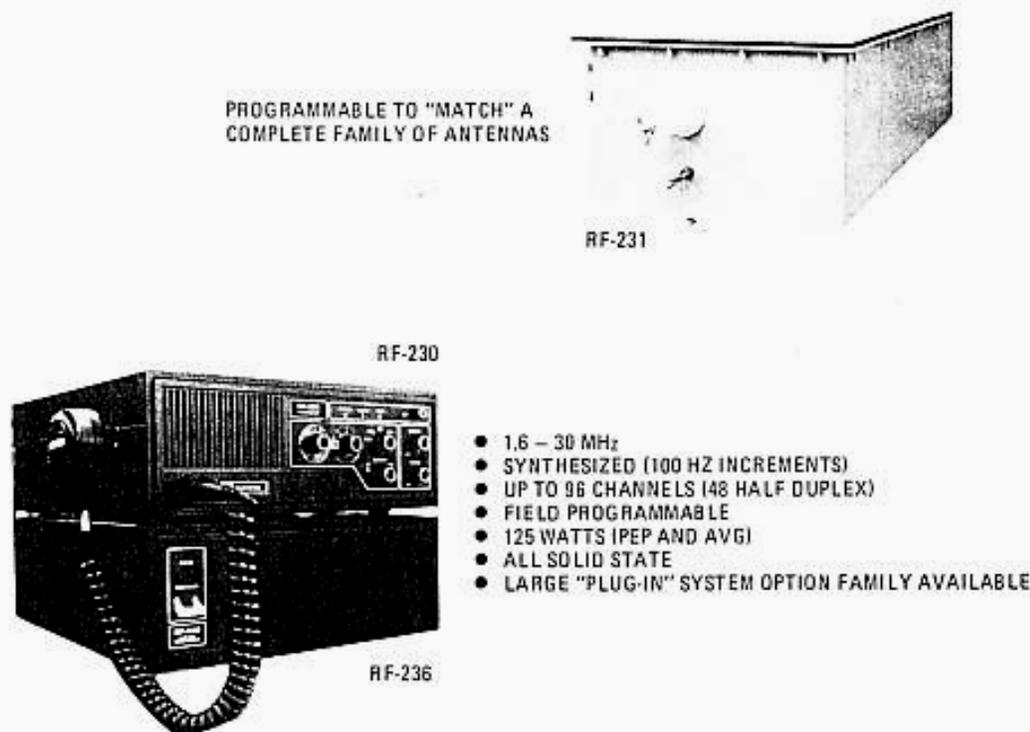


Figure 1-1. Typical RF-230 System



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## RF-230 TRANSCEIVER UNIT LEVEL INSTRUCTIONS

### 1. GENERAL

The RF-230 is a completely modularized transceiver and as a consequence, almost all unit level instructions will be found under the separate tab for the assembly concerned. The one exception is the 1A1 Mother Board Assembly, and that is covered at this introductory level.

### 2. CONSTRUCTION DETAIL

All subassemblies either plug-in directly at the 1A1 Assembly as shown in figure 1, the 1A1 Component Location Diagram, or they connect thru this assembly. Figure 5-2 in the General Information

"Maintenance" Section can be used to identify all of the component assemblies.

### 3. PARTS LIST

Table 1 is a maintenance parts list for all RF-230 Transceiver elements not covered under separate tab. A complete list of manufacturers is included in the General Information Section under Maintenance.

### 4. SCHEMATICS

Figure 2 is a schematic diagram of the RF-230 Mainframe.

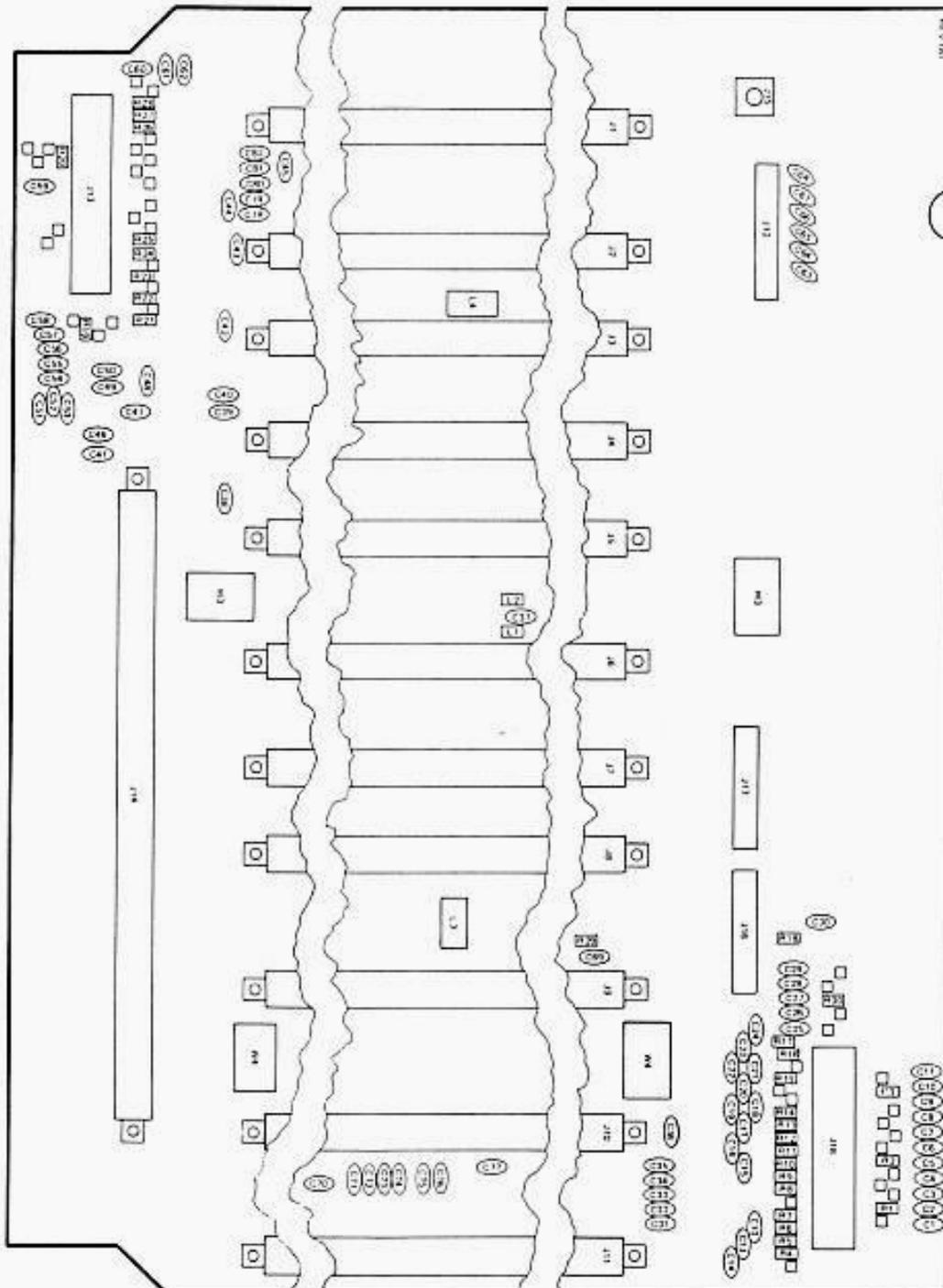
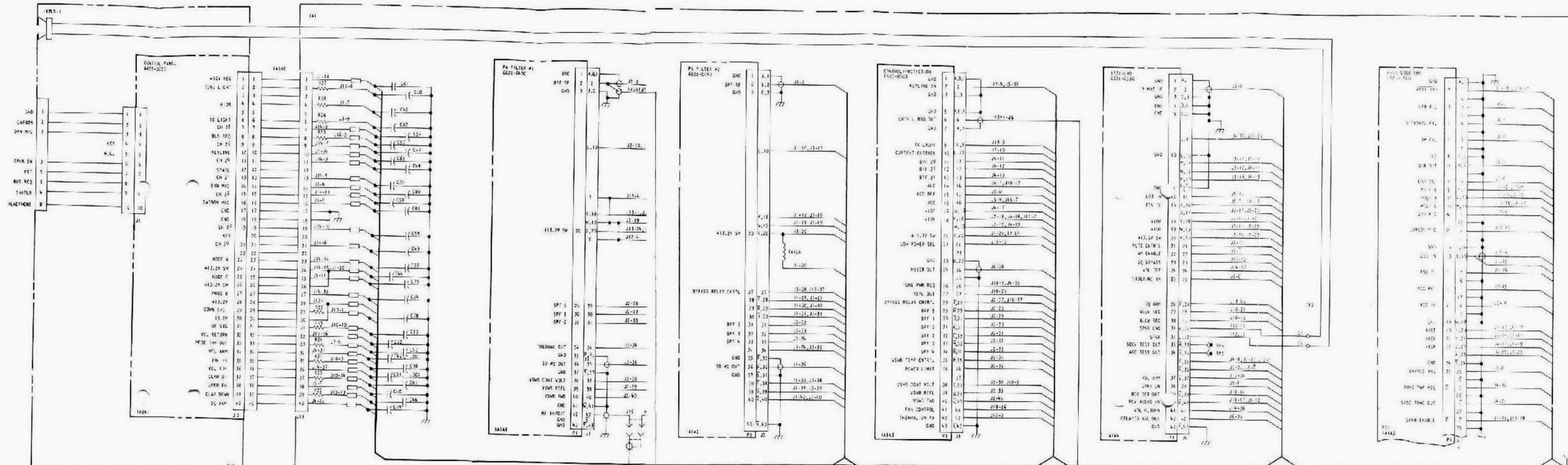


Figure 1. IA1 RF-230 Transceiver Component Locations



Table 1. 1A1 Maintenance Parts List

Ref. Desig.	Name & Description	Mfr. Code	Part Number
1A1	Main Frame Interconnect PWB Assembly	14304	6628-0350
C1-C7	Capacitor, Fixed, Ceramic, .01 uF $\pm$ 20%, 50V	14304	C-4952
C8,C9	Capacitor, Fixed, Ceramic, .001 uF $\pm$ 10%, 500V	14304	C-3513
C10-C36	Capacitor, Fixed, Ceramic, .01 uF $\pm$ 20%, 50V	14304	C-4952
C37	Capacitor, Fixed, Mica, 56 pF $\pm$ 50%, 500V	Mil type	C-0120
C38-C41	Capacitor, Fixed, Ceramic, .01 uF $\pm$ 20%, 50V	14304	C-4952
C42	Capacitor, Fixed, Ceramic, .001 uF $\pm$ 10%, 500V	14304	C-3513
C43-C50	Capacitor, Fixed, Ceramic, .01 uF $\pm$ 20%, 50V	14304	C-4952
C51	Capacitor, Fixed, Ceramic, .001 uF $\pm$ 10%, 500V	14304	C-3513
C52-C66	Capacitor, Fixed, Ceramic, .01 uF $\pm$ 20%, 50V	14304	C-4952
C67,C68	Capacitor, Fixed, Ceramic, .1 uF $\pm$ 80-20%, 50V	14304	C-3202
C69-C82	Capacitor, Fixed, Ceramic, .01 uF $\pm$ 20%, 50V	14304	C-4952
CR1	Diode, Rectifier, 1N4004	14304	CR-0725
CR2	Diode, Rectifier, 1N4004	14304	CR-0725
L1,L2	Choke, RF, .15 uH $\pm$ 10%	14304	L-0606
L3	Choke, RF, 5 mH	14304	L-0184
L4	Toroid Assembly	14304	6628-0370
R1-R17	Resistor, Fixed, Composition, 100 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G101JM
R18	Resistor, Fixed, Composition, 1K $\pm$ 5%, 1/4W	Mil type	RCR07G102JM
R19-R30	Resistor, Fixed, Composition, 100 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G101JM
W1	Cable Assembly, Rear Panel, Tape	14304	6628-0364
W2	Cable Assembly, Front Panel, Tape	14304	6628-0362
W3	Cable Assembly, Tape	14304	6628-0360
W4	Cable Assembly, Tape	14304	6628-0358



NOTES:  
 1. UNLESS OTHERWISE SPECIFIED:  
 A. ALL RESISTORS ARE 100 OHMS, 1/4W, 5% WITH OTHER VALUES GIVEN BY OHMS.  
 B. ALL CAPACITORS ARE .01 MICROFARADS, DISC CERAMIC, WITH REMAINING VALUES IN MICROFARADS.  
 C. ALL INDUCTORS ARE IN MICROHENRIES.  
 2. THE SYMBOL  $\square$  REFERS TO A PEARL BEAD.

Figure 2. 1A1 RF-230 Transceiver Schematic Diagram (Sheet 1 of 3)

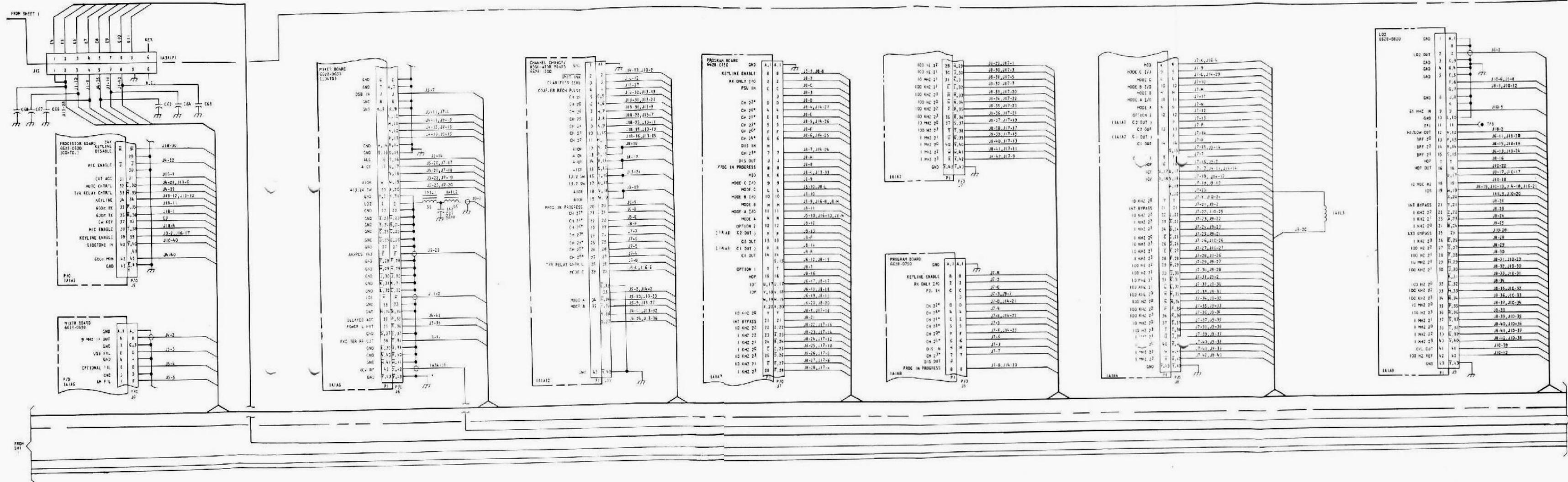


Figure 2. 1A1 RF-230 Transceiver Schematic Diagram (Sheet 2 of 3)

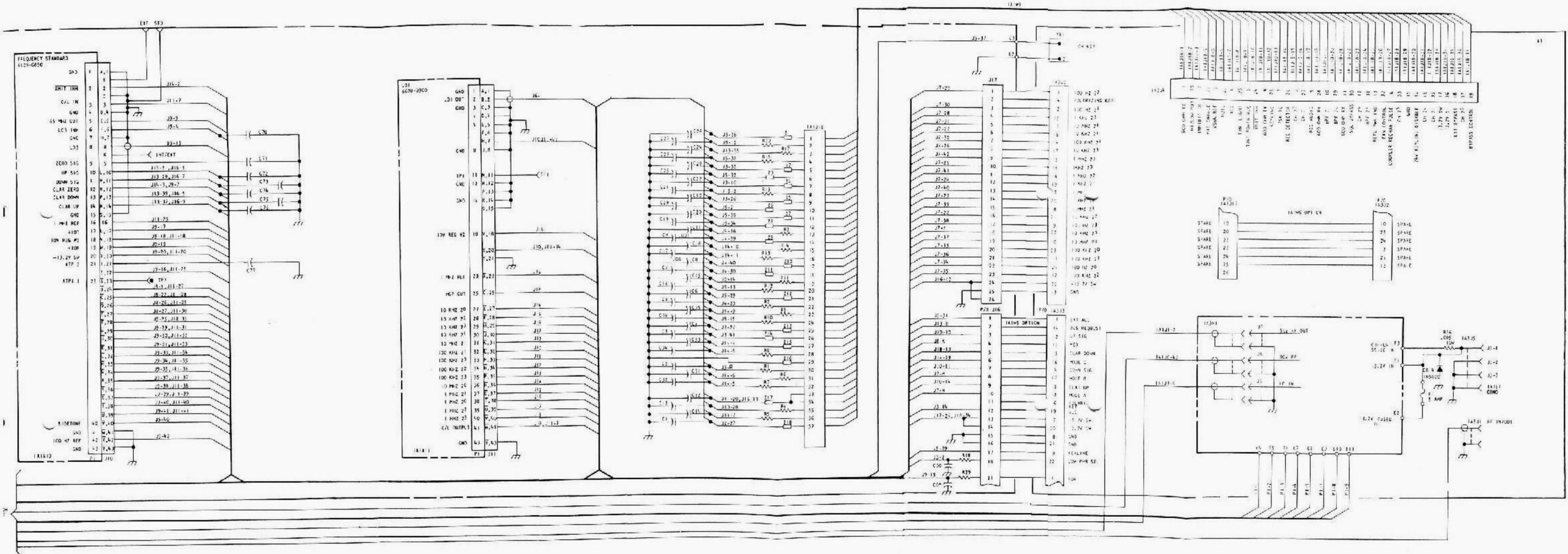
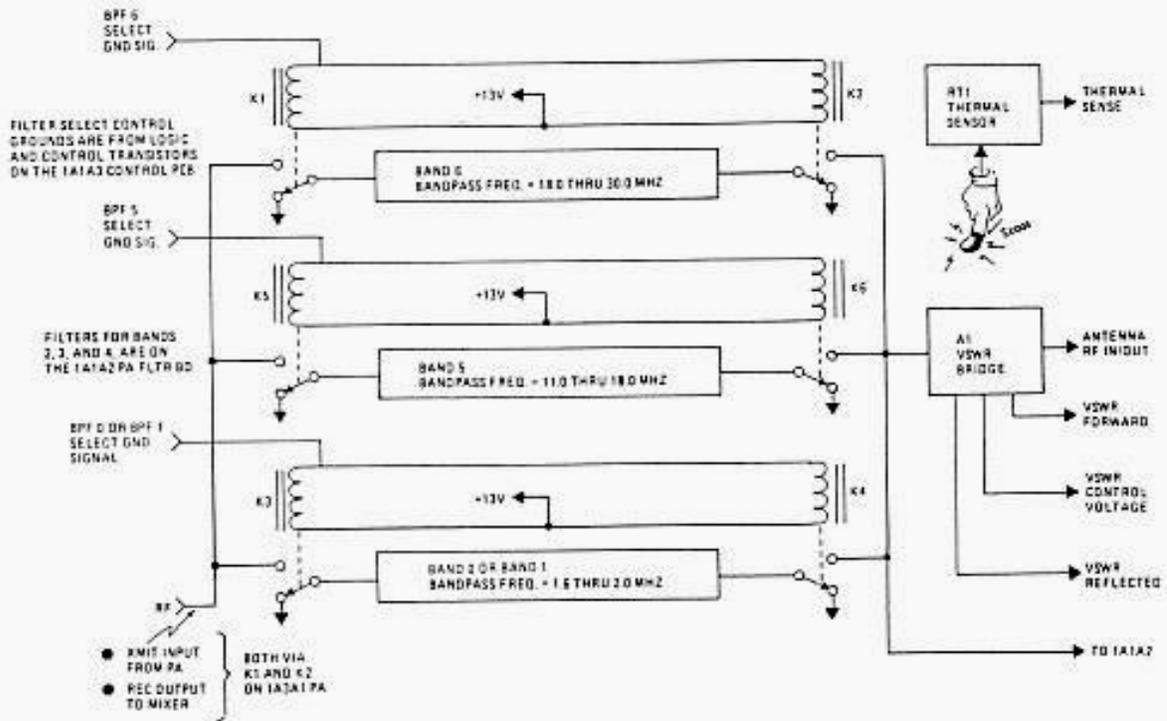


Figure 2. IA1 RF-230 Transceiver Schematic Diagram (Sheet 3 of 3)

# UNIT INSTRUCTIONS



## PA FILTER NO.1 1A1A1





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## 1. GENERAL DESCRIPTION

PA Filter No. 1 works with PA Filter No. 2 to perform the receive mode preselector function, and in the transmit mode to filter the power amplifier output. PA Filter No. 1 contains three of the six elliptical low/high pass filters required to perform these functions. Input or output signals are all routed through the VSWR assembly on the 1A1A1 board. The desired elliptical filter is selected automatically by relay control ground signals from the 1A1A3 PA Control Board. In the transmit mode the filter selected will reduce harmonic output to typically better than  $-50$  dB. In the receive mode, these same filters maintain input losses at such a low level that the signal can be introduced directly to the high dynamic range input mixer on the 1A1A6 Mixer Board. Figure 1 is included to demonstrate spectral relationships, and is not intended to show exact filter response curves.

## 2. TECHNICAL CHARACTERISTICS

Power Requirements:

+13.2V from front panel for band select relays.

Signal Inputs:

PA Output power in transmit mode, typically 125W (or higher to allow for losses).

Receive RF Input, (0.5  $\mu$ V for 10 dB S+N/N).

Control Inputs:

Control ground signals to band select relay from PA Control PC Board, 1A1A3.

VSWR Control

Control Outputs:

Thermal Output

VSWR Forward

VSWR Reflected

Filter Types (Cascaded)

5 Pole Chebyshev High Pass

5 Pole Elliptical Low Pass

Power Handling Capability:

150 Watts average.

Operating Temperature Range:

$-30^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$ .

## 3. SEMICONDUCTOR COMPLEMENT

REF. DESIG.	TYPE	FUNCTION
CR1-CR3	1N4004	Diode
A1CR1-A1CR2	5082-2800	Diode, Hot Carrier

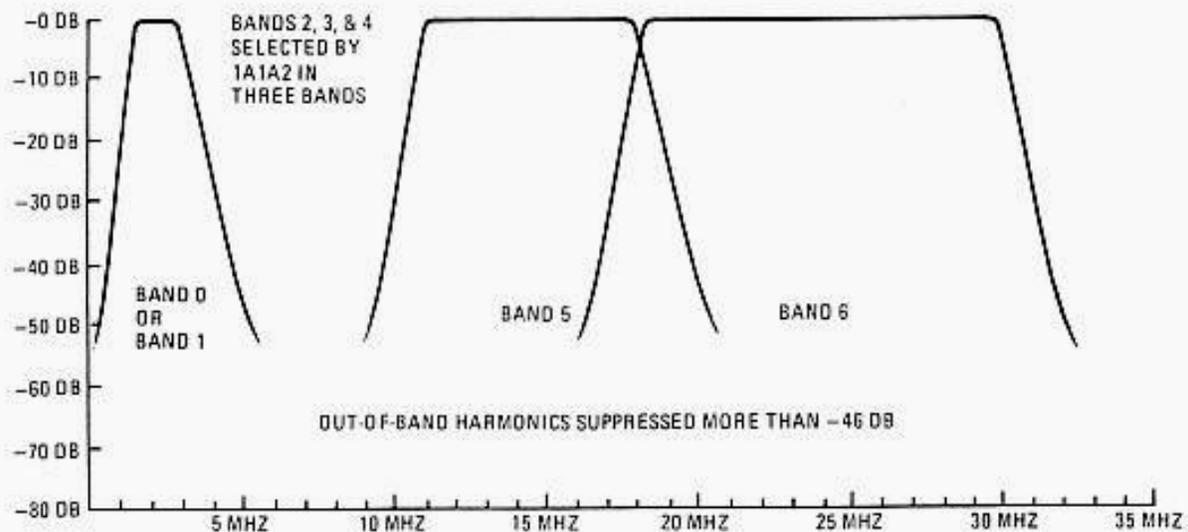


Figure 1. Spectral Band Relationship



#### 4. CIRCUIT DESCRIPTION

Band pass filter select information is decoded on the 1A1A3 PA Control PC Board, and translated to BPF (Band Pass Frequency) select control signals. These control signals are in the form of relay control grounds (minus the drop across the control transistor on the PA Control PC Board). Assuming a channel selection that would result in an operating frequency of . . . say 1.7 MHz, then a relay control ground would be present on pin 30. The +13.2V operating voltage present at the hot side of K3 and K4 would now have a path to ground thru Q8 on the PA Control PC Board, K3 and K4 would energize and the 1.6 – 2.6 MHz frequency select elliptical filter elements would be placed in the signal path.

At the antenna side of the filter, VSWR bridge A1 is also placed in the circuit. Pin 42 at the output connects to the RF IN/OUT connector at the rear of the radio. CR2 and CR1 in the VSWR bridge sense and detect forward and reflected power through L3 and provide corresponding control voltage outputs as shown in figure 2, a simplified diagram demonstrating the VSWR output functions. The reflected (REF) output is used to generate a metering voltage thru buffer amplifier Q17 on the PA Control PC Board. The forward power is also brought out for metering through buffer Q15, as well as to provide for ACC (Automatic Carrier Control) sensing. Together the reflected and forward power outputs are combined to provide automatic level control (ALC) of the output power. AR2 provides additional weighting for reflected power signal to allow protection of the power amplifier when operating into mismatched loads. The RT1 thermal sensor output (THERM OUT) at pin 34 connects to the VSWR TEMP CONTROL circuit as shown to produce constant power output in response to ambient temperature changes. The LOW POWER SELECT function is also shown in this simplified diagram because it operates thru this circuit on the PA Control PC Board to effect HI-LO power control. A logic "0" at pin 21 on the PA Control PC Board Q21 base on to reduce output power to 75 watts.

#### 5. MAINTENANCE

There are no maintenance adjustments on the 1A1A1 PA Filter PC Board. Bandpass filter performance can be measured against the following specifications:

##### Cut off Frequencies:

Band 0 or Band 1	1.6 – 2.6 MHz
Band 5	11.0 – 18.0 MHz
Band 6	18.0 – 30.0 MHz

##### Input VSWR:

Low Pass:	1.353:1 maximum
High Pass:	1.105:1 maximum
Combined:	1.495:1 maximum

##### Insertion Loss:

0.5 dB maximum

##### Stopband Attenuation:

2nd harmonic	– 15 dB minimum
All other harmonic	– 35 dB minimum

##### Temperature Range:

–30°C to +60°C

#### 6. PARTS LIST

Parts list information is given in table 1. All parts are identified in figure 3, the 1A1A1 Component Location Diagram. Complete manufacturers code data is given in the general information section of this under maintenance.

#### 7. SCHEMATICS

Figure 4 is a complete schematic diagram of the assembly.

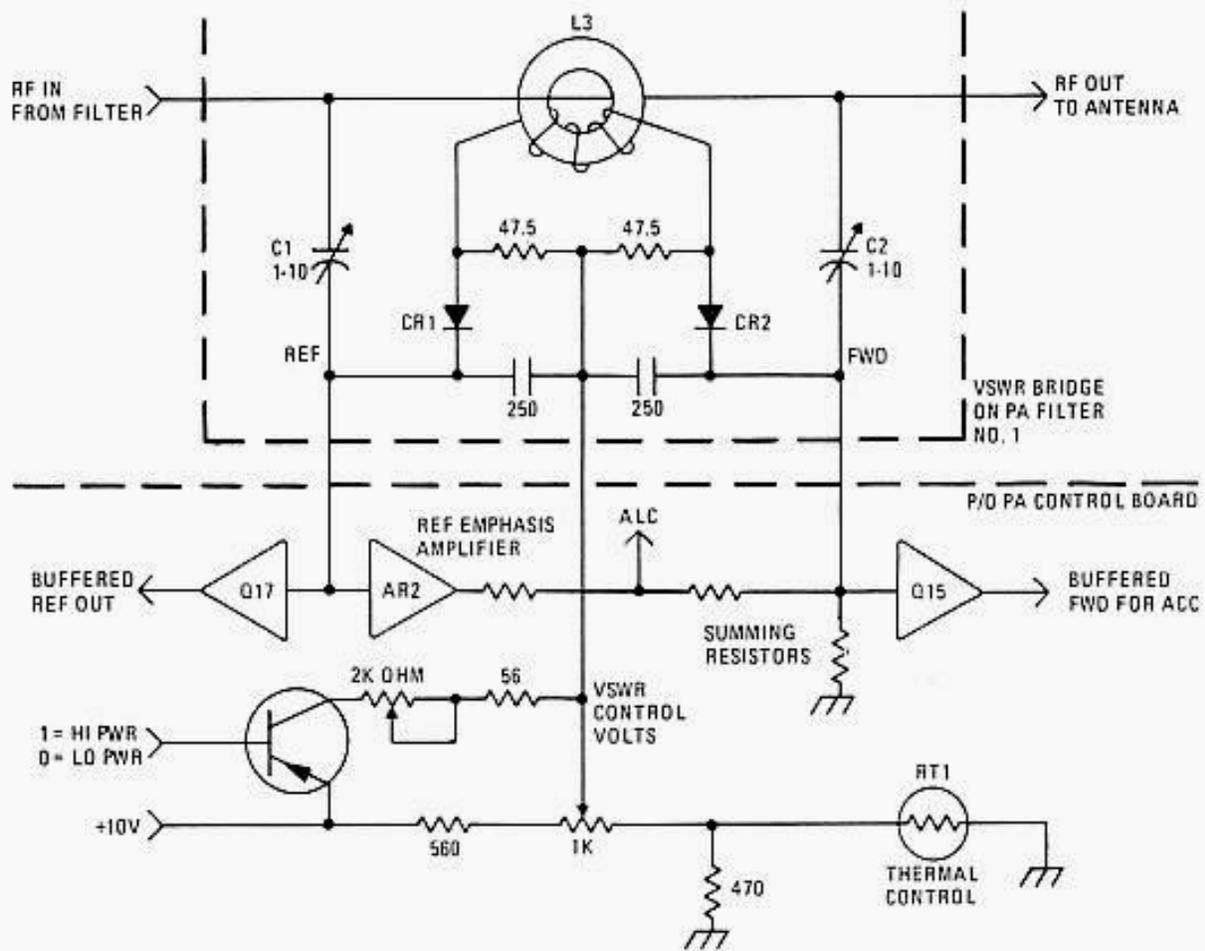


Figure 2. VSWR Functions



TABLE 1. 1A1A1 MAINTENANCE PARTS LIST

Ref. Desig.	Name & Description	Mfr. Code	Part Number
1A1A1	PA Filter No. 1 PW Board Assembly	14304	6628-0400
C1	Capacitor, Fixed, Ceramic, 75 pF $\pm 2\%$ , 1000V	14304	C-6918
C2	Capacitor, Fixed, Ceramic, 68 pF $\pm 2\%$ , 1000V	14304	C-6917
C3	Capacitor, Fixed, Porcelain, 390 pF $\pm 5\%$ , 500V	14304	C50-0001-039
C4	Capacitor, Fixed, Ceramic, 68 pF $\pm 2\%$ , 1000V	14304	C-6917
C5	Capacitor, Fixed, Ceramic, 75 pF $\pm 2\%$ , 1000V	14304	C-6918
C8-C18	Not Used		
C19-C22	Capacitor, Fixed, Ceramic, .01 $\mu$ F $\pm 20\%$ , 50V	14304	C-4952
C23,C24	Capacitor, Fixed, Mica, 560 pF $\pm 2\%$ , 300V	14304	C-2499
C25,C26	Capacitor, Fixed, Mica, 130 pF $\pm 2\%$ , 500V	14304	C-2482
C27-C29	Capacitor, Fixed, Mica, 430 pF $\pm 2\%$ , 500V	14304	C-2495
C30	Capacitor, Fixed, Mica, 470 pF $\pm 2\%$ , 500V	14304	C-2496
C31	Capacitor, Fixed, Mica, 360 pF $\pm 2\%$ , 500V	14304	C-2493
C32	Capacitor, Fixed, Mica, 430 pF $\pm 2\%$ , 500V	14304	C-2495
C33	Capacitor, Fixed, Mica, 360 pF $\pm 2\%$ , 500V	14304	C-2493
C34	Capacitor, Fixed, Mica, 430 pF $\pm 2\%$ , 500V	14304	C-2495
C35,C36	Capacitor, Fixed, Ceramic, .01 $\mu$ F $\pm 20\%$ , 50V	14304	C-4952
C37,C38	Capacitor, Fixed, Ceramic, 82 pF $\pm 2\%$ , 1000V	14304	C-6919
C39	Capacitor, Fixed, Ceramic, 18 pF $\pm 2\%$ , 1000V	14304	C-5913
C40	Capacitor, Fixed, Ceramic, 20 pF $\pm 2\%$ , 1000V	14304	C-5194
C41	Capacitor, Fixed, Ceramic, 62 pF $\pm 2\%$ , 1000V	14304	C-6916
C42-C44	Capacitor, Fixed, Ceramic, 68 pF $\pm 2\%$ , 1000V	14304	C-6917
C45	Capacitor, Fixed, Ceramic, 56 pF $\pm 2\%$ , 1000V	14304	C-6915
C46	Capacitor, Fixed, Ceramic, 62 pF $\pm 2\%$ , 1000V	14304	C-6916
C47	Capacitor, Fixed, Ceramic, 56 pF $\pm 2\%$ , 1000V	14304	C-6915
C48	Capacitor, Fixed, Ceramic, 62 pF $\pm 2\%$ , 1000V	14304	C-6916
C49	Capacitor, Fixed, Ceramic, 56 pF $\pm 2\%$ , 1000V	14304	C-6915
C50	Capacitor, Fixed, Ceramic, 62 pF $\pm 2\%$ , 1000V	14304	C-6916
C51,C52	Capacitor, Fixed, Ceramic, 75 pF $\pm 2\%$ , 1000V	14304	C-6918
C53	Capacitor, Fixed, Ceramic, 62 pF $\pm 2\%$ , 1000V	14304	C-6916
C54	Capacitor, Fixed, Ceramic, 56 pF $\pm 2\%$ , 1000V	14304	C-6915
C55	Capacitor, Fixed, Ceramic, 56 pF $\pm 5\%$ , 200V	14304	C-4754
C56	Not Used		
C57,C58	Capacitor, Fixed, Ceramic, .001 $\mu$ F $\pm 10\%$ , 500V	14304	C-3513
C59	Capacitor, Fixed, Ceramic, .1 $\mu$ F $\pm 2\%$ , 50V	14304	C-6370
C60-C63	Not Used		
C64,C65	Capacitor, Fixed, Ceramic, .01 $\mu$ F $\pm 20\%$ , 50V	14304	C-4952
CR1-CR3	Diode, Rectifier, 1N4004	14304	CR-0725
K1-K6	Relay, SPDT, 12V	14304	K-0113
L1	Inductor, Air Core, .25 $\mu$ H	14304	6628-0427
L2	Inductor, Assembly, 1.64 $\mu$ H	14304	6628-0410
L3	Inductor, Air Core, .12 $\mu$ H	14304	6628-0428
L4	Inductor, Air Core, .25 $\mu$ H	14304	6628-0427
L5	Not Used		



TABLE 1. 1A1A1 MAINTENANCE PARTS LIST (Continued)

Ref. Desig.	Name & Description	Mfr. Code	Part Number
L6	Inductor, Toroid, 3.27 uH	14304	6628-0420
L7	Inductor, Toroid, 2.48 uH	14304	6628-0421
L8	Inductor, Air Core, .503 uH	14304	6628-0422
L9	Inductor, Air Core, .347 uH	14304	6628-0423
L10	Inductor, Toroid, .811 uH	14304	6628-0424
L11	Inductor, Air Core, .420 uH	14304	6628-0425
L12	Inductor, Air Core, .692 uH	14304	6628-0426
L13-L17	Not Used		
L18	Choke, RF, 470 uH $\pm 10\%$	14304	L-0648
R1	Resistor, Fixed, Composition, 180K $\pm 5\%$ , 1/4W	Mil type	RCR07G184JM
RT1	Thermistor, 50K $\pm 10\%$	14304	R-4280

TABLE 2. MAINTENANCE PARTS LIST

Ref. Desig.	Name & Description	Mfr. Code	Part Number
1A1A1A1	VSWR Bridge Assembly	14304	6628-0440
C1,C2	Capacitor, Variable, 1-10 pF	14304	C-2175
C3,C4	Capacitor, Fixed, Silver Mica, Metal Case, 250 pF	14304	C-6673
CR1,CR2	Diode, Hot Carrier	14304	CR-0403
L1,L2	Inductor, RF, 1 mH	14304	L-0652
L3	Inductor, Toroid	14304	919-2759
R1,R2	Resistor, Fixed, Composition, 47.5 ohm 1%, 1/4W	14304	R-3745

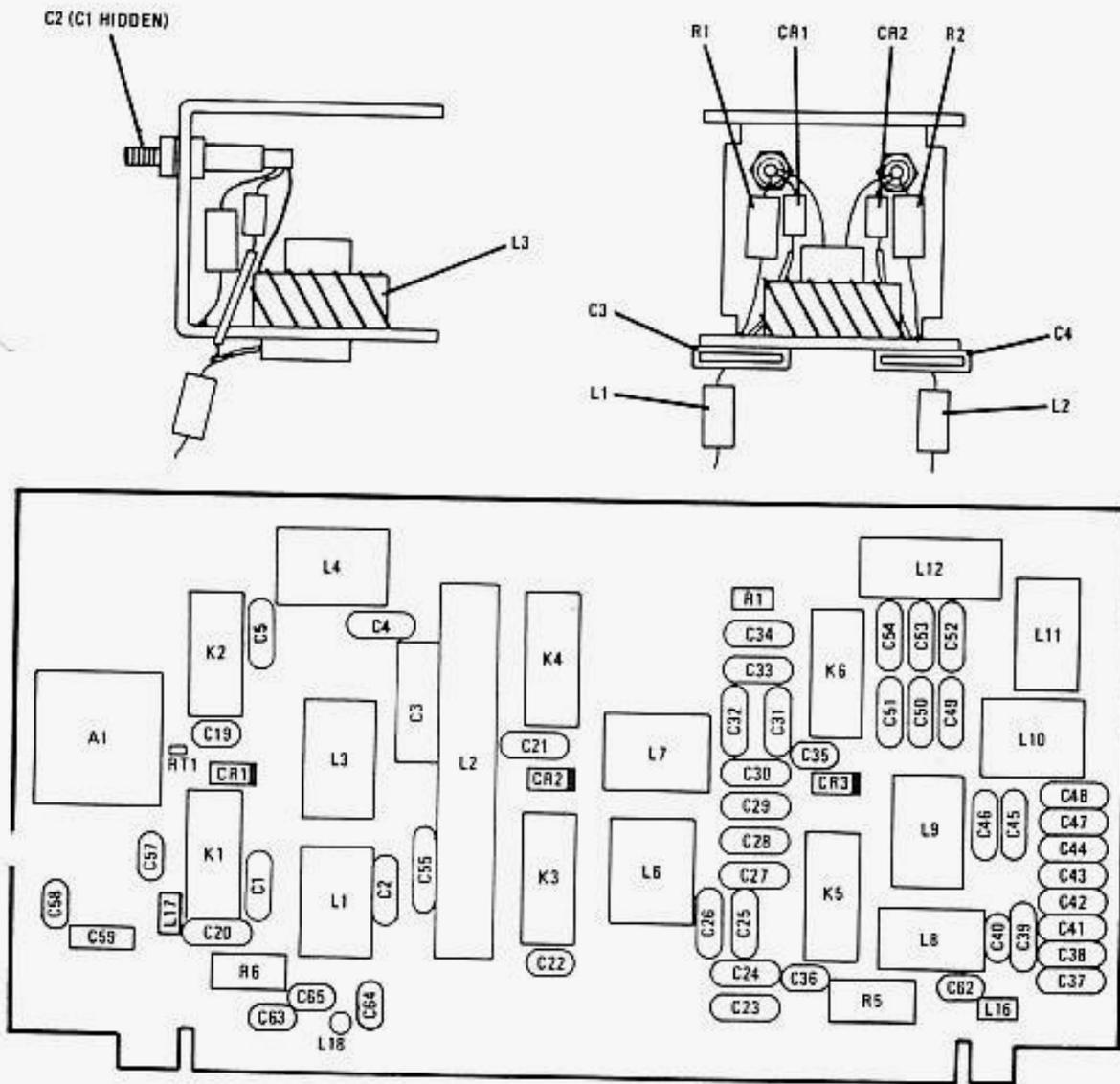


Figure 3. 1A1A1 PA Filter Component Locations

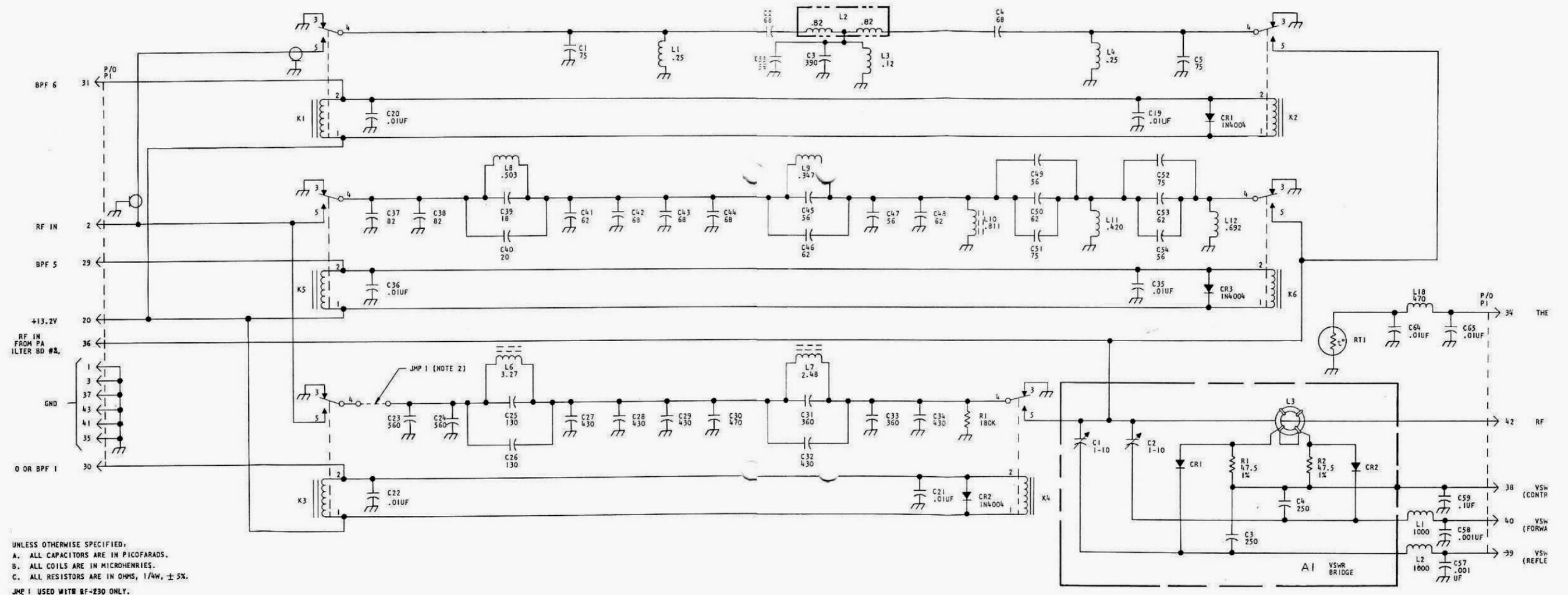
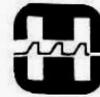


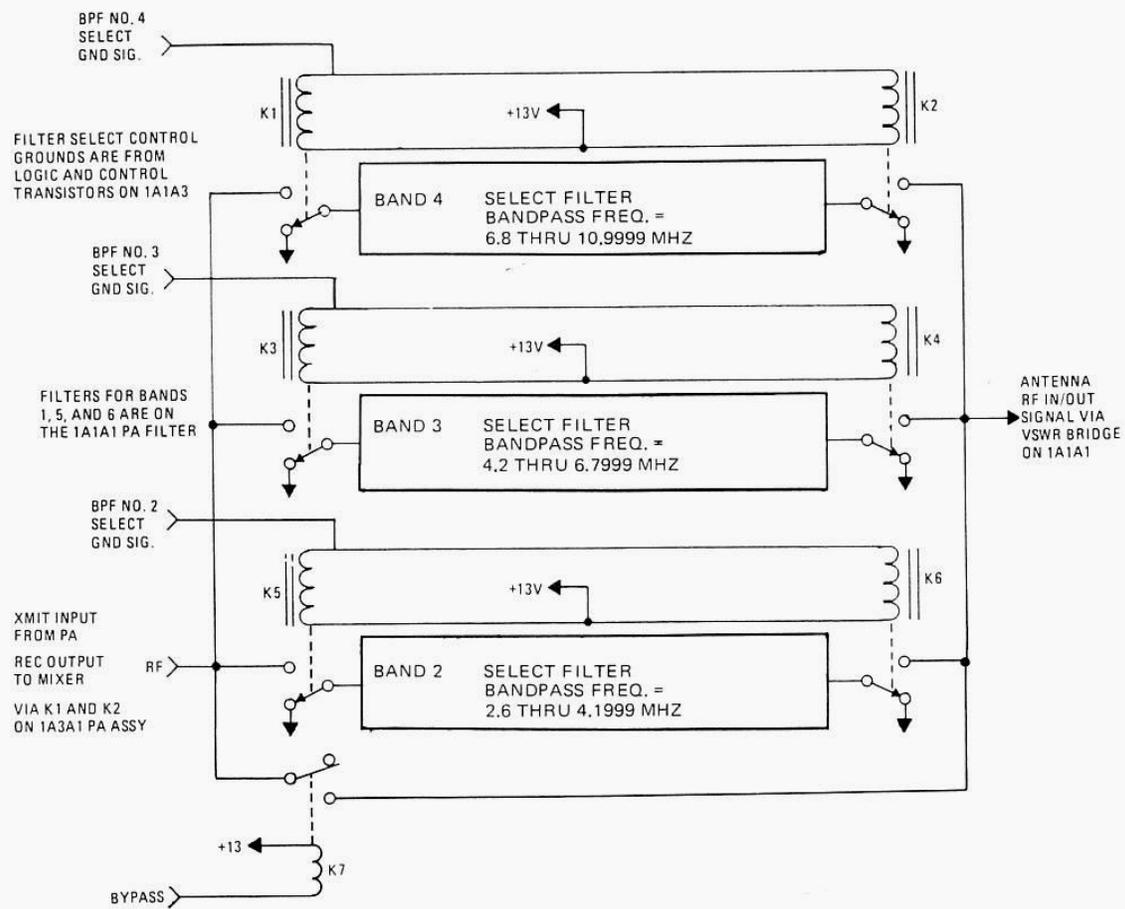
Figure 4. 1A1A1 PC Board Schematic, 66

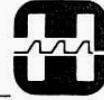
# UNIT INSTRUCTIONS



## PA FILTER NO.2

# 1A1A2





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1. GENERAL DESCRIPTION

PA Filter No. 2 works with PA Filter No. 1 to perform the receive mode preselector function and in the transmit mode to filter the power amplifier output. PA Filter No. 2 contains three of the six elliptical low pass filters required to perform these functions. Unlike PA Filter No. 1, there is no VSWR assembly on the PA Filter No. 2 PC Board. The VSWR assembly on PA Filter No. 1 is used by both the 1A1A1 and 1A1A2 assemblies. The desired filter is selected automatically by relay control ground signals from the 1A1A3 PA Control Board. In the transmit mode, the selected filter will reduce harmonic output to typically better than -50 dB. Figure 1 is included to demonstrate spectral relationships and is not intended to show exact filter response curves. In the transmit mode the filter selected will reduce harmonic output to typically better than -50 dB. In the receive mode, these same filters maintain input losses at such a low level that the signal can be introduced directly to the high dynamic range input mixer on the 1A1A6 Mixer Board.

2. TECHNICAL CHARACTERISTICS

- Power Requirements:
  - +13.2 Vdc from front panel for band select relays.
- Signal Inputs:
  - PA Output power in transmit mode. Typically 125W (or higher to allow for losses).
  - Receive RF Input (0.5 uV for 10 dB S+N/N).

Control Inputs:  
Control ground signals to band select relays from PA Control PC Board.

Filter Types (Cascaded):  
5 pole Chebyshev high pass  
5 pole Elliptical low pass

Cutoff Frequencies:  
Band 2 2.6 - 4.2 MHz  
Band 3 4.2 - 6.8 MHz  
Band 4 6.8 - 11.0 MHz

Input VSWR:  
High pass 1.105:1 maximum  
Low pass 1.353:1 maximum  
Combined 1.495:1 maximum

Insertion Loss:  
0.5 dB maximum

Stop Band Attenuation:  
2nd Harmonic -15 dB minimum  
All others -35 dB minimum

Power Handling Capability:  
150 watts average

Operating Temperature Range:  
-30°C to +50°C.

3. SEMICONDUCTOR COMPLEMENT

REF. DESIG.	TYPE	FUNCTION
CR1 - CR4	1N4004	Diode

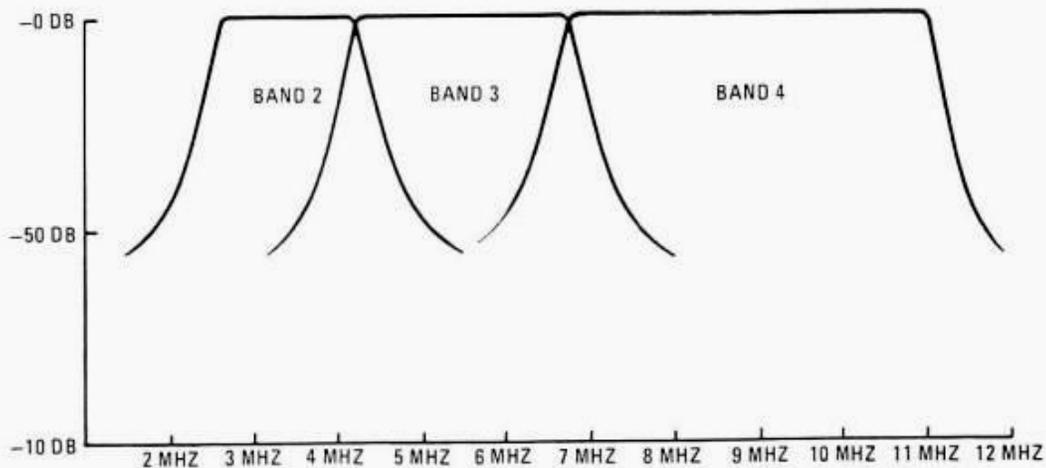


Figure 1. Spectral Band Relationship



#### 4. CIRCUIT DESCRIPTION

Channel frequency information is decoded on the 1A1A3 PA Control PC Board, and translated to BPF (Band Pass Frequency) select control signals. These control signals are in the form of relay control grounds (minus the diode drop of the control transistor on the PA Control PC Board. Assuming a band 2 activation signal (from 1A1A3Q3), band 2 select relays K5 and K6 would be energized and the corresponding filter elements would be placed in the circuit.

Figure 2 shows a typical filter section, and identifies both the high pass filter elements and the low pass filter elements. This same basic configurations is used for bands 2 through 6. Band 1 uses only the low pass filter section because of its position at the low end of the spectrum.

#### 5. MAINTENANCE

There are no maintenance adjustments on assembly 1A1A2. When making RF input and output measurements, recall that input and output impedances are 50 ohms.

#### 6. PARTS LIST

Parts list information is given in table 1. All parts are identified in figure 3, the 1A1A2 Component Location Diagram. Complete manufacturers code data is given in the general information section of this manual under maintenance.

#### 7. SCHEMATICS

Figure 4 is a complete schematic diagram of the assembly.

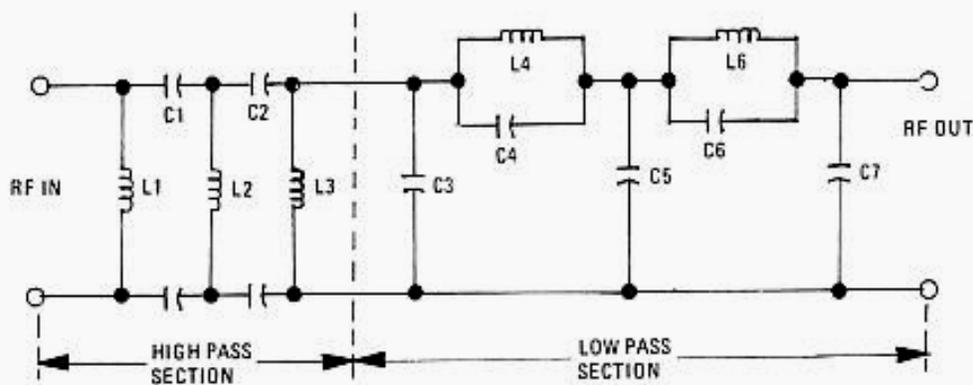


Figure 2. Typical Filter Section



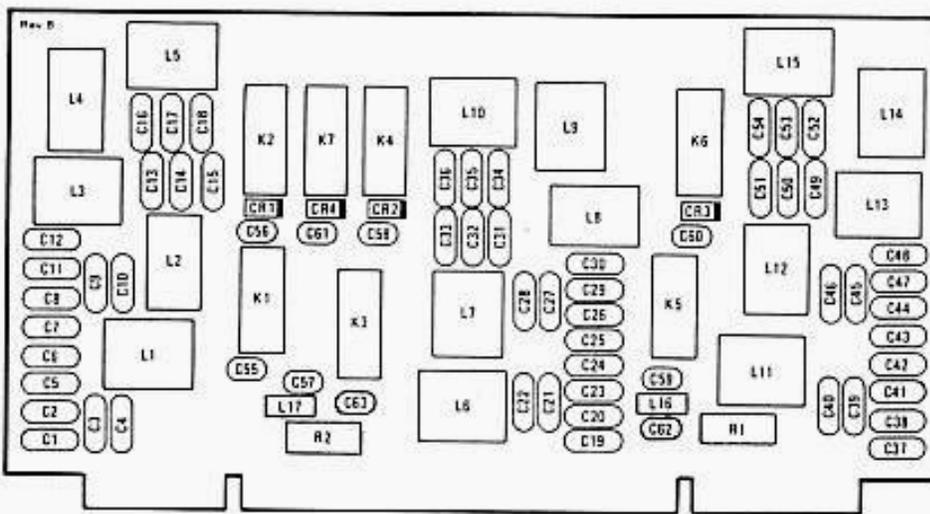
TABLE 1. 1A1A2 MAINTENANCE PARTS LIST

Ref. Desig.	Name & Description	Mfr. Code	Part Number
1A1A2	PA Filter No. 2 PW Board Assembly	14304	6628-0450
C1	Capacitor, Fixed, Mica, 130 pF $\pm$ 2%, 500V	14304	C-2482
C2	Capacitor, Fixed, Mica, 150 pF $\pm$ 2%, 500V	14304	C-2483
C3,C4	Capacitor, Fixed, Mica, 30 pF $\pm$ 2%, 500V	14304	C-2465
C5-C7	Capacitor, Fixed, Mica, 110 pF $\pm$ 2%, 500V	14304	C-2480
C8-C12	Capacitor, Fixed, Mica, 100 pF $\pm$ 2%, 500V	14304	C-2479
C13-C18	Capacitor, Fixed, Mica, 110 pF $\pm$ 2%, 500V	14304	C-2480
C19	Capacitor, Fixed, Mica, 200 pF $\pm$ 2%, 500V	14304	C-2486
C20	Capacitor, Fixed, Mica, 220 pF $\pm$ 2%, 500V	14304	C-2487
C21	Capacitor, Fixed, Mica, 51 pF $\pm$ 2%, 500V	14304	C-2472
C22	Capacitor, Fixed, Mica, 43 pF $\pm$ 2%, 500V	14304	C-2469
C23,C24	Capacitor, Fixed, Mica, 150 pF $\pm$ 2%, 500V	14304	C-2483
C25,C26	Capacitor, Fixed, Mica, 180 pF $\pm$ 2%, 500V	14304	C-2485
C27-C30	Capacitor, Fixed, Mica, 150 pF $\pm$ 2%, 500V	14304	C-2483
C31	Capacitor, Fixed, Mica, 180 pF $\pm$ 2%, 500V	14304	C-2485
C32,C33	Capacitor, Fixed, Mica, 200 pF $\pm$ 2%, 500V	14304	C-2486
C34	Capacitor, Fixed, Mica, 180 pF $\pm$ 2%, 500V	14304	C-2485
C35,C36	Capacitor, Fixed, Mica, 200 pF $\pm$ 2%, 500V	14304	C-2486
C37	Capacitor, Fixed, Mica, 330 pF $\pm$ 2%, 500V	14304	C-2492
C38	Capacitor, Fixed, Mica, 360 pF $\pm$ 2%, 500V	14304	C-2493
C39	Capacitor, Fixed, Mica, 75 pF $\pm$ 2%, 500V	14304	C-2476
C40	Capacitor, Fixed, Mica, 82 pF $\pm$ 2%, 500V	14304	C-2477
C41,C42	Capacitor, Fixed, Mica, 250 pF $\pm$ 2%, 500V	14304	C-2489
C43,C44	Capacitor, Fixed, Mica, 300 pF $\pm$ 2%, 500V	14304	C-2491
C45-C50	Capacitor, Fixed, Mica, 250 pF $\pm$ 2%, 500V	14304	C-2489
C51	Capacitor, Fixed, Mica, 330 pF $\pm$ 2%, 500V	14304	C-2492
C52,C53	Capacitor, Fixed, Mica, 250 pF $\pm$ 2%, 500V	14304	C-2489
C54	Capacitor, Fixed, Mica, 330 pF $\pm$ 2%, 500V	14304	C-2492
C55-C63	Capacitor, Fixed, Ceramic, .01 uF $\pm$ 20%, 50V	14304	C-4952
C64	Capacitor, Ceramic, 0.1 uF	14304	C-3202
CR1-CR4	Diode, Rectifier, 1N4004	14304	CR-0725
K1-K7	Relay, SPDT, 12V	14304	K-0113
L1	Inductor, Toroid, .795 uH	14304	6628-0465
L2	Inductor, Air Core, .576 uH	14304	6628-0466
L3	Inductor, Toroid, 1.268 uH	14304	6628-0467
L4	Inductor, Air Core, .729 uH	14304	6628-0468
L5	Inductor, Toroid, 1.418 uH	14304	6628-0469
L6	Inductor, Toroid, 1.358 uH	14304	6628-0470
L7	Inductor, Toroid, .915 uH	14304	6628-0471
L8	Inductor, Toroid, 1.650 uH	14304	6628-0472
L9	Inductor, Toroid, .904 uH	14304	6628-0473
L10	Inductor, Toroid, 1.572 uH	14304	6628-0474
L11	Inductor, Toroid, 1.996 uH	14304	6628-0475
L12	Inductor, Toroid, 1.500 uH	14304	6628-0476
L13	Inductor, Toroid, 3.649 uH	14304	6628-0477



TABLE 1. 1A1A2 MAINTENANCE PARTS LIST (Continued)

Ref. Desig.	Name & Description	Mfr. Code	Part Number
L14	Inductor, Toroid, 1.895 uH	14304	6628-0478
L15	Inductor, Toroid, 3.521 uH	14304	6628-0479
L16-L18	Inductor, RF, 1 mH	14304	L-0050
R1,R2	Resistor, Fixed, Composition, 180 ohm $\pm 5\%$ , 2W	14304	R-1831



NOTES:  
 1. PREFIX ALL DESIGNATORS WITH 1A1A1 FOR COMPLETE REFERENCE.

Figure 3. 1A1A2 PA Filter No. 2 Component Locations

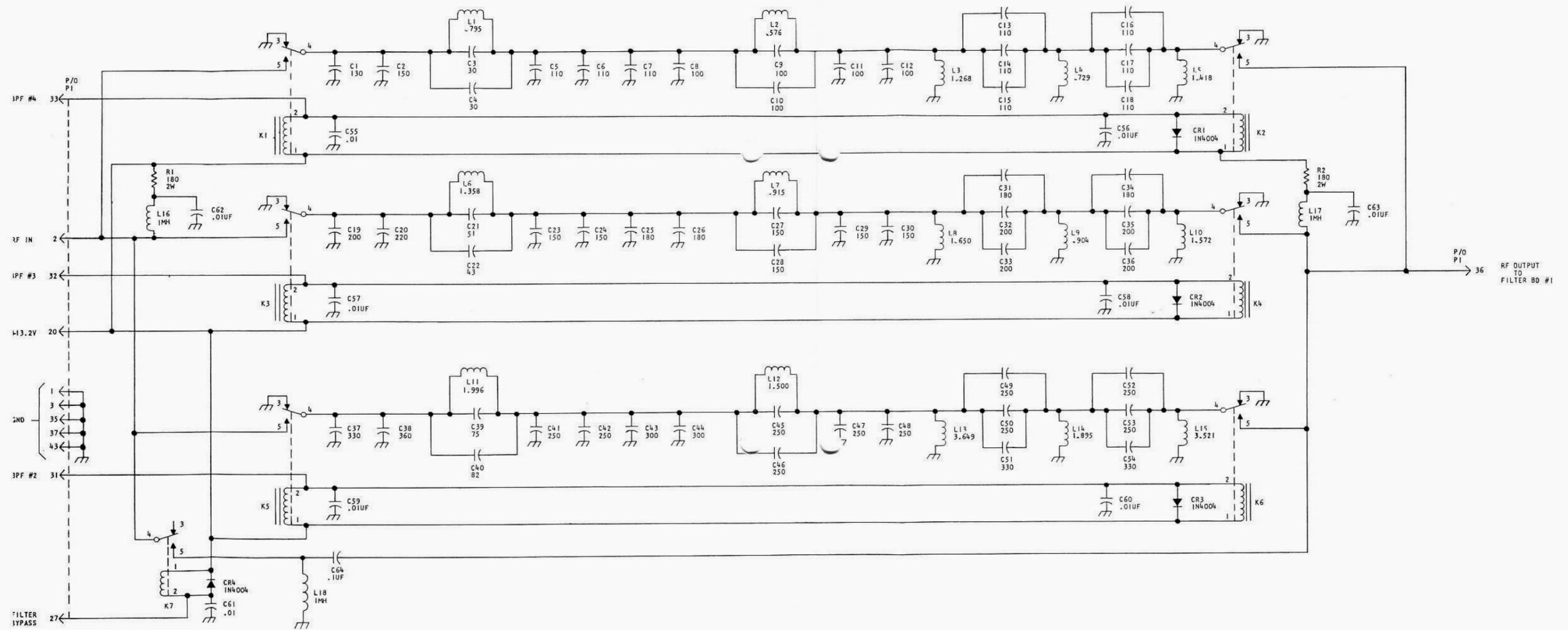


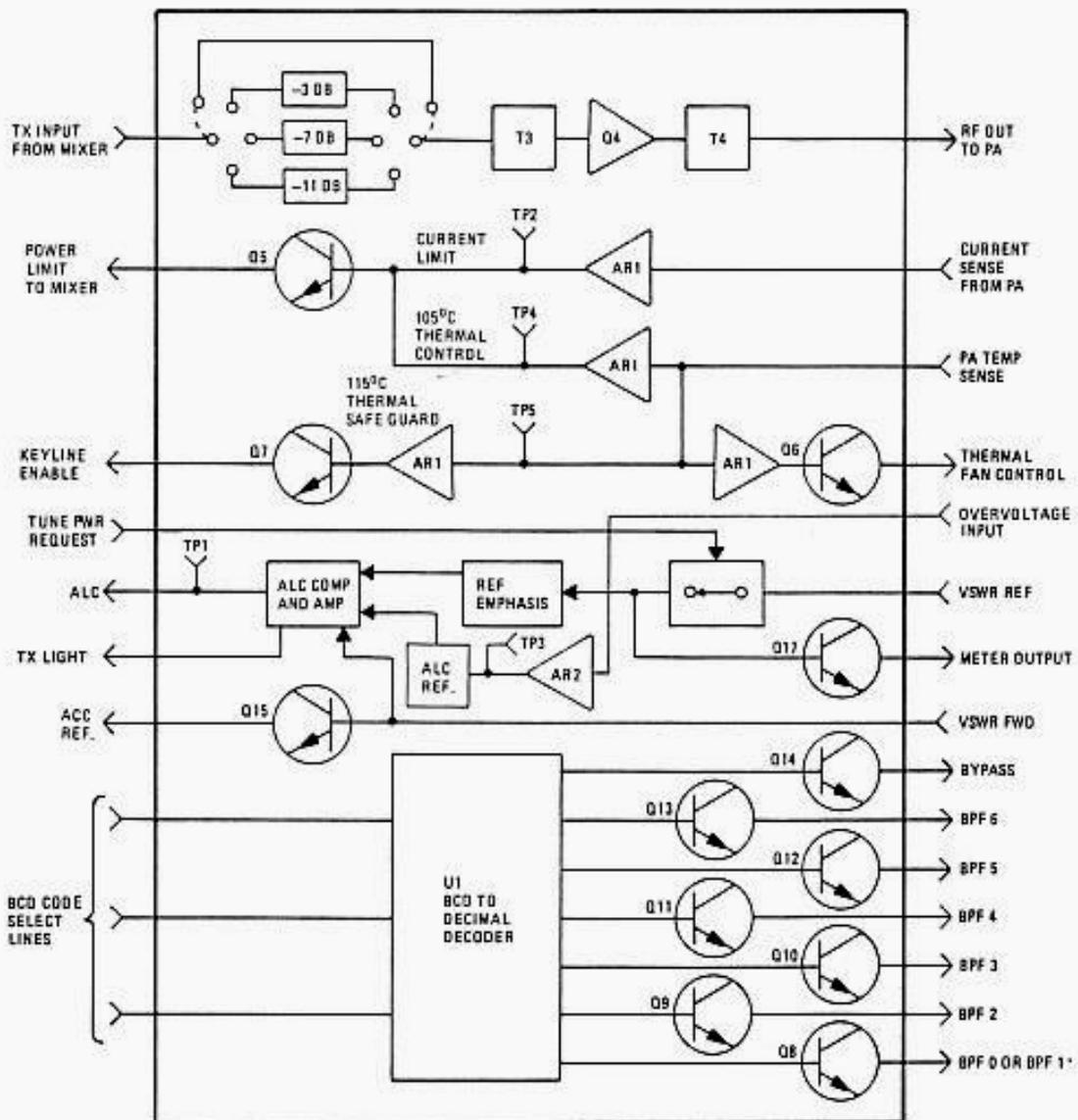
Figure 4. 1A1A2 PC Board Schematic, 6628-9045

# UNIT INSTRUCTIONS



## PA CONTROL BOARD

# 1A1A3





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## 1. GENERAL DESCRIPTION

The 1A1A3 PA Control PC Board functions as an interface between the 1A3A1 Power Amplifier PC Board and other elements of the RF-230 Transceiver. Five distinct functions are performed by the control board; four of these are control functions and one is an active signal processing function.

The four control functions are as follows: Binary coded BPF (Band Pass Frequency) select information from the LO2 assembly is decoded by U1 and translated to PA Filter select ground signals by Q8 through Q14; high/low power select is controlled through Q21, analog forward and reflected power signals are processed to derive ACC (Automatic Carrier Control) and ALC (Automatic Level Control) signals, and analog power amplifier parameters are used to control input signal levels and fan operation.

In the active signal path, Q4 introduces approximately 10 dB gain, to increase the nominal +5 dBm input signal from the mixer, to a level of typically +15 dBm to drive the power amplifier at the output. "T" pad options are provided to reduce overall system gain to accommodate device variations, at time of manufacture.

## 2. TECHNICAL CHARACTERISTICS

### Power Requirements:

- +10 Vdc
- +10Vdc Xmit (+10T)
- +13.2Vdc

### Signal Inputs:

- +5 dBm (nominal) Xmit Fo from mixer

### Signal Outputs:

- +15 dBm (nominal) Xmit Fo to Power Amplifier

### Control Inputs:

- BPF Binary Coded Inputs from LO2 (3)
- Current Cutback control voltage from PA
- Thermal control voltage from PA
- High/Low Power level level select
- VSWR, (Forward and Reflected) analog voltages

### Control Outputs:

- Current Control to PIN diode on mixer
- BPF Select Control Lines (6)
- Bypass Control Line
- ALC
- ACC

### Control Outputs (continued):

- VSWR Reference Control Volts
- ACC Reference Control Volts
- Keyline Enable

## 3. SEMICONDUCTOR COMPLEMENT

REF. DESIG.	TYPE	FUNCTION
AR1, AR2	CA324	Quad Operational Amplifier
CR6, CR7	1N4004	Diode
CR8, CR9	1N4454	Diode
CR11-CR16	1N4004	Diode
CR17-CR18	1N4454	Diode
CR19	1N4004	Diode
Q4	PT5701	Transistor, NPN
Q5-Q7	2N4124	Transistor, NPN
Q8-Q17	MPS-A13	Transistor, NPN Darlington Pair
Q18	2N4124	Transistor, NPN
Q19, Q20	2N3644	Transistor, PNP
Q21	2N4126	Transistor, PNP
U1	CD4028AE	BCD-To-Decimal Decoder
VR1, VR2	1N5232B	Diode, Zener, 5.6V

## 4. CIRCUIT DESCRIPTION

Refer to figure 1, the PA Control PC Board Simplified Diagram, and to the schematic diagram at the end of this section for the following discussion.

### 4.1 Transmit Active Signal Path

RF input from the 1A1A6 Mixer enters the 1A1A3 Control PC Board at a nominal level of +5 dBm. Several factors can affect overall system gain, especially variations in device parameters. In this configuration, the 1.6 – 29.9999 MHz (fo) RF input signal would be fed through the 50 ohm broad band input at T3, amplified approximately 10 dB by Q4, and fed to the 50 ohm output at T4 and P1-6. The +15 dBm output should be adequate to drive the 1A3A1 Power Amplifier Assembly to a full rated output of 125 watts. If the total system gain is significantly high (see system setup procedure in maintenance section), it may be necessary to use a "T" pad option to reduce overall system gain.



#### 4.2 Band Pass Filter Selections

BPF (Band Pass Filter) selections on the Power Amplifier Assembly are controlled by BCD-to-Decimal Decoder U1 and associated circuitry. BCD 2<sup>0</sup>, 2<sup>1</sup>, and 2<sup>2</sup> control information from the LO2 assembly is decoded as shown in table 1.

Selecting a desired operating channel will automatically cause one of the input codes shown to appear at pins P1-11, -12, and -13 of the PA Control PC Board. U1 constantly monitors these lines and will instantly decode any change and produce a logic "1" only at the corresponding decimal output. This "high" output will turn on the corresponding NPN control transistor and provide a ground path for the related bandpass filter select relays in either the 1A1A1 (PA Filter No. 1), or 1A1A2 (PA Filter No. 2) assembly.

#### Hi/Lo Power Control

Hi/Lo Power Select is effected by switching Q21 ON and OFF. With a logic "1" at P1-21, the high power operating mode is selected by biasing Q21 OFF. With Q21 OFF, the ACC and VSWR control reference voltage is established by 1K pot R90. With Q21 ON (logic "0" at the base) 2K ohm pot R101 is selected to establish the low power reference level. R90, the ALC Hi power control is adjusted to limit RF power output to the antenna to 125 watts (with normal audio drive level at the modulation input). The ALC Low Power Control, R101 is adjusted in exactly the same manner, but for a 25 watt output (or as per customer requirements).

#### 4.4 ACC/ALC Control Voltage Development

ACC, ALC, and the TX Lamp are controlled by "weighted" information from the VSWR sensor in PA Filter No. 1. The information is "weighted" in that the Reflected Power analog voltage is amplified by AR2 before it is summed with the Forward Power analog voltage to produce the ALC and ACC control voltages. Two conditions affect the presence of the REF PWR voltage, however, and they are: (1) TUNE PWR Request logic line at P1-26, and (2) The 1.4V threshold established by the diode drops of CR17 and CR18. With the TUNE PWR Request line low, Q18 is biased OFF, K1 is energized, and the VSWR REF signal path is opened. This prevents any tendency the "weighted" REF voltage might have to cause a power reduction during low power tuning operations. The diode drops establish threshold during normal operation allowing for automatic amplifier protection when the VSWR exceeds 1.3:1.

The "summed and weighted" ALC control voltage output from the R65/R63 injunction is compared against a reference voltage at AR2. This reference is determined by VR1, VR2 and divider R84 and R85 and is nominally 7.1 V. Should the +13.2 VDC input line to the transceiver increase, however, the input voltage established by potentiometer R75 would also increase, and because AR2 is operated as a saturated operational amplifier, the typical +8 Vdc output at TP3 would start to decrease pulling the reference voltage from the R84, and R85 divider lower thereby reducing the reference voltage, which in turn lowers the output power. R75 is setup at the factory so that with +15 Vdc on the normal +13.2 Vdc input line, the voltage at TP3

TABLE 1. BPF SELECT CONDITIONS

Frequency	Input Code			Decoded Output	Output Condition
	C	B	A		
DEFAULT	0	0	0	U1-3 = 1	Q8 ON, P1-30 LOW
1.6 - 2.599 MHz	0	0	1	U1-14 = 1	Q8 ON, P1-30 LOW
2.6 - 4.199 MHz	0	1	0	U1-2 = 1	Q9 ON, P1-32 LOW
4.2 - 6.799 MHz	0	1	1	U1-15 = 1	Q10 ON, P1-33 LOW
6.8 - 10.999 MHz	1	0	0	U1-1 = 1	Q11 ON, P1-34 LOW
11.0 - 17.999 MHz	1	0	1	U1-6 = 1	Q12 ON, P1-29 LOW
18.0 - 29.999 MHz	1	1	0	U1-7 = 1	Q13 ON, P1-31 LOW
BYPASS	1	1	1	U1-4 = 1	Q14 ON, P1-28 LOW



BCD CODE INPUT			BPF SELECTED	HIGH UI OUTPUT	LOW BPF SELECT PIN
A	B	C			
0	0	0	BPF 1	U1-3="1"	P1-30
1	0	0	BPF 1	U1-14="1"	P1-30
0	1	0	BPF 2	U1-2="1"	P1-32
1	1	0	BPF 3	U1-15="1"	P1-33
0	0	1	BPF 4	U1-1="1"	P1-34
1	0	1	BPF 5	U1-6="1"	P1-29
0	1	1	BPF 6	U1-7="1"	P1-31
1	1	1	BYPASS	U1-4="1"	P1-28

TEST POINTS	FUNCTIONAL TITLE	RELATED INFORMATION
TP1	ALC OUT	1.4 - 9.5V 1.4V = MAX PWR REDUCTION
TP2	CURRENT CUTBACK	$\approx 1.7V$ = CUTBACK
TP3	OVERVOLTS CUTBACK	6.4V INITIATES POWER CUTBACK
TP4	THERMAL CUTBACK	$\approx 1.7V$ = CUTBACK
TP5	KEYLINE ENABLE	0.7V = DISABLE (LOGIC 0)

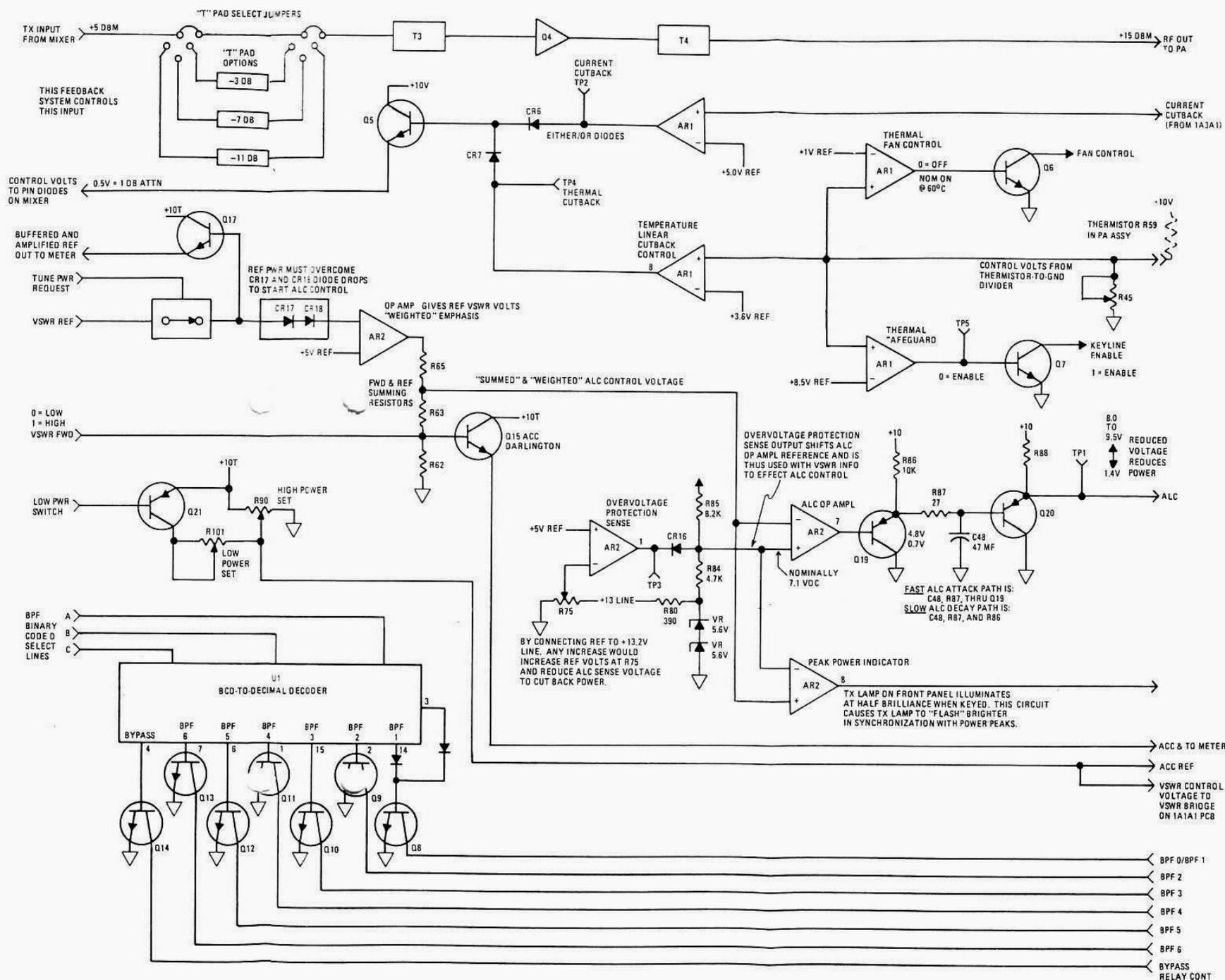


Figure 1. 1A1A3 PA Control PWB, Simplified Diagram



will decrease to +6.4 Vdc. The ALC output voltage, measurable at TP1, would decrease to call for a power reduction at control FET Q11 on the Mixer board. R47 on the 1A1A6 Mixer is adjusted so that a decrease in ALC output voltage at P1-14 (TP1), of from typically +8.5 Vdc to +1.4 Vdc will cause a 30 dB reduction in power output. Q19 and Q20 also function to "shape" ALC characteristics. A fast attack path is provided through C48, R87, and Q19. A slow ALC decay characteristic is achieved through the C48, R87, and R86.

#### 4.5 Power Limit Control

Power Limit Control is effected by controlling the bias on pin diode CR30 at the 1A1A6 Mixer output. This control voltage is developed on the PA Control Board from two inputs from the 1A3-A1 Power Amplifier. These two inputs are: (1) A current sense input, and (2) A thermal sense input. The current sense input monitors the voltage drop across a .005 ohm resistor in the +13.2 Vdc supply line to the PA, and the thermal sense voltage is developed across a thermistor in the PA.

The current cutback sense voltage enters the PA Control Board at P1-10, and is compared in AR1 against a fixed 5.0V reference voltage established by R28 and R29 across the +10T line. This AR1 output is measurable at TP2. When the control threshold is reached, the AR1-1 output will be a linear function of the current cutback input. Similarly, the thermal sense input at P1-42 is compared against a +3.6 Vdc reference, and the AR1-8 output varies linearly with the thermal sense input. Both inputs operate through "either/or" control diodes CR6 and CR7 to control Q5

base bias, and as a consequence, the control voltage output at P1-36 to the pin diodes on the mixer board.

The thermal input is also used to effect fan control through the AR1-7 output, and the Keyline Enable function through the AR1-14 output. Keyline Enable can be measured at TP5. A positive output at AR1-14 will bias Q7 and provide an disabling ground through this NPN Transistor. A +60°C thermistor temperature will normally cause the AR1-7 output to switch from "0" to "1" and turn on the cooling fan (optional) through Q6. At +115°C the unit fail safes and grounds the keyline enable thru Q7, shutting off transmitter until the unit cools.

R45 establishes the reference level for all of these functions and has been setup as shown in figure 2. By substituting a 5K 1% resistor for the thermistor circuit on the PA, the AR1-10 input established by R45 can be varied between 1.5 and 2.75 Vdc. With the setup conditions shown R45 is adjusted to the point that produces a +0.5 Vdc output at P1-36.

#### 5. MAINTENANCE

Significant signal and control inputs and outputs to the 1A1A3 PA Control Board are shown in figure 1 and are described in the text. By installing the 1A1A3 Assembly on an extender card, all circuit elements are accessible for test or adjustment. Setup and adjustment procedures follow.

#### CAUTION

Always remove primary power (select POWER OFF at front panel) when removing or installing plug-in assemblies to prevent accidental damage.

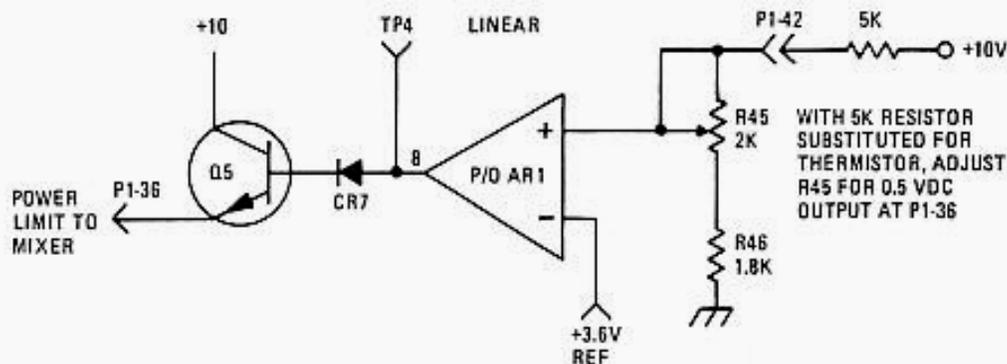


Figure 2. R45 Setup Condition



### 5.1 R75, Overvoltage Sense Threshold Adjustment

- Remove power (select POWER OFF at the front panel).
- Remove RF-230 top and card cage cover.
- Remove 1A1A3 PC Board Assembly using board extractor and reinstall using extender card.
- Verify 13.2 Vdc primary power input to radio.

#### Note

It is important to verify this voltage at the radio as  $I^2R$  losses in the power cable could cause inconsistent results.

- Install VOM at TP3 and note approximate Vdc output.
- Increase primary power to +15 Vdc and adjust R75 for +6.4 Vdc indication at TP3.

- This completes R75 overvoltage sense threshold adjustment. Reconfigure for normal operation or subsequent tests as necessary.

### 5.2 R90, ALC High/Low Power Adjustment

Verify Overcurrent Setup Adjustment (R49 on 1A3A1 PA Assembly) complete before proceeding with ALC High, Low and ACC adjustments. Overcurrent adjustment requires ALC High Control Potentiometer R90 to be prepositioned to the full ccw position, and would negate this setup. Overcurrent threshold adjustment calls for adjusting R49 on PA Assembly for 33 amp threshold (total input current to RF-230). To adjust R90, proceed as follows:

- Configure for test as shown in figure 3, and reposition R90 to full cw (low power) position.
- With 0 dBm, 1 kHz signal at 600 ohm audio input, increase R90 until wattmeter indicates 125 watts output.

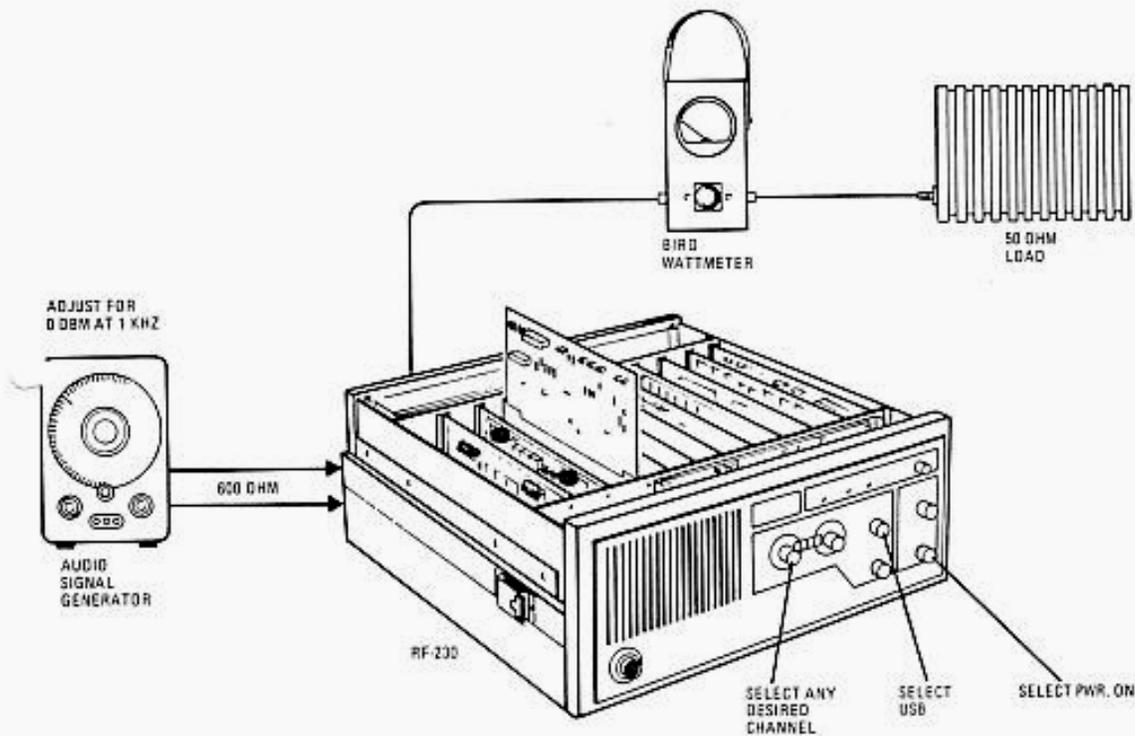


Figure 3. ALC High/Low Test Setup



c. Select low power and adjust R101 for 25W (as desired). Can be done by options or hardwiring to ground at pin 21.

d. This completes High/Low Power Adjustment, configure for normal operation.

### 5.3 R45 Temperature Cutback Control Reference Adjustment

This setup requires substitution of a 5K ohm resistor for the thermistor on the PA. This can be accomplished by unplugging the PA assembly (removing the thermistor to +10V circuit) and by substituting a 5K ohm resistor between the R34, R47, and R45 junction and connecting to +10V at L1. This effectively produces the circuit shown in figure 2. R45 can now be adjusted by measuring the P1-36 output with a dc voltmeter and adjusting

R45 for a 0.5 Vdc indication. This level has been setup at the factory and should never need readjustment.

### 5.4 1A1A3 Input/Output Summary

Figure 4 summarizes all 1A1A3 inputs and outputs and locates all test and adjustment points.

## 6. PARTS LIST

Table 2 lists all 1A1A3 maintenance parts. These parts can be identified on figure 4. Refer to General Information for list of manufacturers.

## 7. SCHEMATICS

Figure 5 is a complete schematic diagram of the 1A1A3 Assembly.

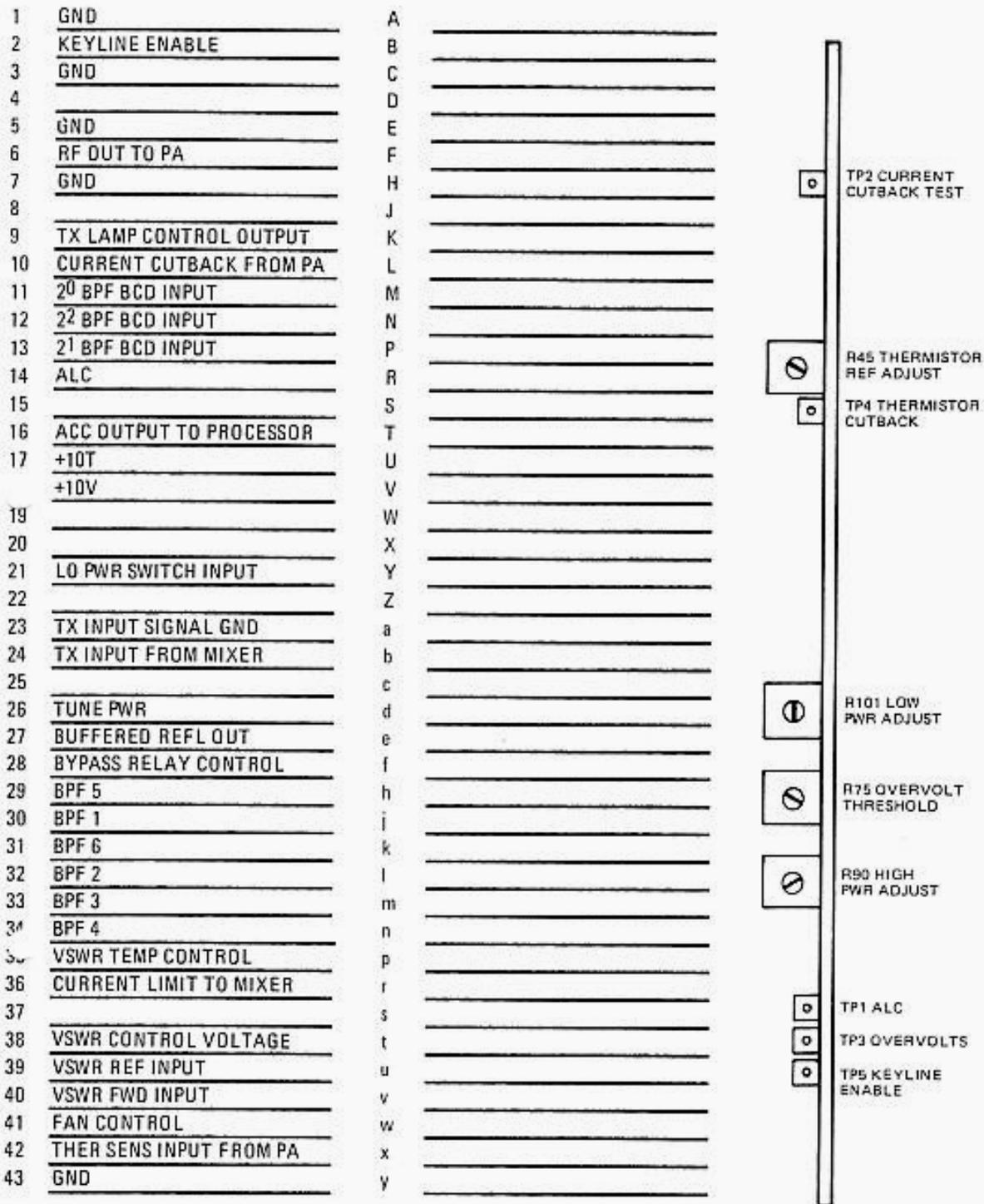


Figure 4. 1A1A3 Input/Output Summary



Table 2. 1A1A3 Maintenance Parts List

Ref. Desig.	Name & Description	Mfr. Code	Part Number
1A1A3	Control/Protection PW Board Assembly	14304	6628-0500
AR1,AR2	Integrated Circuit, Quad Operational Amplifier, CA324E	14304	IC-0359
C1,C2	Capacitor, Fixed, Ceramic, .1 uF +80-20%, 50V	14304	C-3202
C3-C14	Not Used		
C15	Capacitor, Fixed, Mica, 100 pF $\pm$ 5%, 500V	Mil type	CM05FD101J03
C16,C17	Capacitor, Fixed, Ceramic, .1 uF +80-20%, 50V	14304	C-3202
C18	Capacitor, Fixed, Ceramic, .01 uF $\pm$ 20%, 50V	14304	C-4952
C19	Capacitor, Fixed, Ceramic, .47 uF $\pm$ 20%, 50V	14304	C-6374
C20	Capacitor, Fixed, Ceramic, .01 uF $\pm$ 20%, 50V	14304	C-4952
C21	Capacitor, Fixed, Ceramic, .1 uF +80-20%, 50V	14304	C-3202
C22	Capacitor, Fixed, Mica, 47 pF $\pm$ 5%, 500V	Mil type	CM05ED470J03
C23	Capacitor, Fixed, Ceramic, .1 uF +80-20%, 50V	14304	C-3202
C24	Not Used		
C25	Capacitor, Fixed, Tantalum, 150 uF $\pm$ 10%, 15V	14304	C-3106
C26-C47	Capacitor, Fixed, Ceramic, .01 uF $\pm$ 20%, 50V	14304	C-4952
C48	Capacitor, Fixed, Tantalum, 47 uF $\pm$ 20%, 20V	14304	C-6452
C49-C53	Capacitor, Fixed, Ceramic, .01 uF $\pm$ 20%, 50V	14304	C-4952
C54	Capacitor, Fixed, Tantalum, 2.2 uF $\pm$ 20%, 50V	14304	C-6408
C55	Capacitor, Fixed, Ceramic, .01 uF $\pm$ 20%, 50V	14304	C-4952
CR1-CR5	Not Used		
CR6,CR7	Diode, Rectifier, 1N4004	14304	CR-0725
CR8,CR9	Diode, Signal, 1N4454	14304	CR-0705
CR10	Not Used		
CR11-CR14	Diode, Rectifier, 1N4004	14304	CR-0725
CR15	Not Used		
CR16	Diode, Rectifier, 1N4004	14304	CR-0725
CR17,CR18	Diode, Signal, 1N4454	14304	CR-0705
CR19	Diode, Rectifier, 1N4004	14304	CR-0725
CR20	Diode, Germanium, 1N277	14304	CR-0065
JMP1-JMP5	Jumper, Circuit	14304	MP-1142
K1	Relay, SPST, 12V	14304	K-0095
L1	Choke, RF, 3.9 uH $\pm$ 10%	14304	L-0623
L2-L6	Not Used		
L7	Choke, RF, 10 uH $\pm$ 10%	14304	L-0628
L8	Choke, RF, 1 uH $\pm$ 10%	14304	L-0616
L9	Choke, RF, 56 uH $\pm$ 10%	14304	L-0637
L10-L16	Choke, RF, 22 uH $\pm$ 10%	14304	L-0058
Q1-Q3	Not Used		
Q4	Transistor, NPN, PT5701	14304	Q-0405
Q5-Q7	Transistor, NPN, 2N4124	Mil type	Q-0385
Q8-Q15	Transistor, NPN, Darlington, MPS-A13	14304	Q-0076
Q16	Not Used		
Q17	Transistor, NPN, Darlington, MPS-A13	14304	Q-0076
Q18	Transistor, NPN, 2N4124	14304	Q-0385
Q19,Q20	Transistor, PNP, 2N3649	14304	Q-0315
Q21	Transistor, PNP, 2N4126	14304	Q-0386
R1-R9	Not Used		
R10,R11	Resistor, Fixed, Composition, 8.2 ohms $\pm$ 5%, 1/4W	Mil type	RCR07G8R2JM



Table 2. 1A1A3 Maintenance Parts List

Ref. Desig.	Name & Description	Mfr. Code	Part Number
R12	Resistor, Fixed, Composition, 150 ohm $\pm 5\%$ , 1/4W	Mil type	RCR07G151JM
R13,R14	Resistor, Fixed, Composition, 18 ohm $\pm 5\%$ , 1/4W	Mil type	RCR07G180JM
R15	Resistor, Fixed, Composition, 56 ohm $\pm 5\%$ , 1/4W	Mil type	RCR07G560JM
R16,R17	Resistor, Fixed, Composition, 27 ohm $\pm 5\%$ , 1/4W	Mil type	RCR07G270JM
R18	Resistor, Fixed, Composition, 30 ohm $\pm 5\%$ , 1/4W	Mil type	RCR07G300JM
R19,R20	Resistor, Fixed, Composition, 5.6 ohm $\pm 5\%$ , 1/4W	Mil type	RCR07G5R6JM
R21	Resistor, Fixed, Composition, 220 ohm $\pm 5\%$ , 1/4W	Mil type	RCR07G221JM
R22	Resistor, Fixed, Composition, 150 ohm $\pm 5\%$ , 1W	Mil type	RCR32G151JM
R23	Resistor, Fixed, Composition, 33 ohm $\pm 5\%$ , 1/4W	Mil type	RCR07G330JM
R24	Resistor, Fixed, Composition, 10 ohm $\pm 5\%$ , 1/4W	Mil type	RCR07G100JM
R25	Resistor, Fixed, Composition, 150 ohm $\pm 5\%$ , 1/4W	Mil type	RCR07G151JM
R26	Resistor, Fixed, Composition, 180 ohm $\pm 5\%$ , 1/4W	Mil type	RCR07G181JM
R27	Resistor, Fixed, Composition, 4.7K $\pm 5\%$ , 1/4W	Mil type	RCR07G472JM
R28	Resistor, Fixed, Composition, 1K $\pm 5\%$ , 1/4W	Mil type	RCR07G102JM
R29	Resistor, Fixed, Composition, 1.2K $\pm 5\%$ , 1/4W	Mil type	RCR07G122JM
R30	Resistor, Fixed, Composition, 10K $\pm 5\%$ , 1/4W	Mil type	RCR07G103JM
R31	Resistor, Fixed, Composition, 1K $\pm 5\%$ , 1/4W	Mil type	RCR07G102JM
R32	Resistor, Fixed, Composition, 10K $\pm 5\%$ , 1/4W	Mil type	RCR07G103JM
R33	Resistor, Fixed, Composition, 1 Meg $\pm 5\%$ , 1/4W	Mil type	RCR07G105JM
R34	Resistor, Fixed, Composition, 10K $\pm 5\%$ , 1/4W	Mil type	RCR07G103JM
R35	Resistor, Fixed, Composition, 470 ohm $\pm 5\%$ , 1/4W	Mil type	RCR07G471JM
R36	Resistor, Fixed, Composition, 4.7K $\pm 5\%$ , 1/4W	Mil type	RCR07G472JM
R37	Resistor, Fixed, Film, 6.81K $\pm 1\%$ , 1/8W	Mil type	RN55D6811F
R38	Resistor, Fixed, Film, 4.75K $\pm 1\%$ , 1/8W	Mil type	RN55D4751F
R39	Resistor, Fixed, Film, 47.5K $\pm 1\%$ , 1/8W	Mil type	RN55D4752F
R40	Resistor, Fixed, Film, 3.92K $\pm 1\%$ , 1/8W	Mil type	RN55D3921F
R41	Resistor, Fixed, Film, 82.5K $\pm 1\%$ , 1/8W	Mil type	RN55D8252F
R42	Resistor, Fixed, Composition, 330 ohm $\pm 5\%$ , 1/4W	Mil type	RCR07G331JM
R43	Resistor, Fixed, Composition, 1.2K $\pm 5\%$ , 1/4W	Mil type	RCR07G122JM
R44	Resistor, Fixed, Film, 2.49K $\pm 1\%$ , 1/8W	Mil type	RN55D2491F
R45	Resistor, Variable, 2K	14304	R-2226
R46	Resistor, Fixed, Film, 1.82K $\pm 1\%$ , 1/8W	Mil type	RN55D1821F
R47	Resistor, Fixed, Film, 15.4K $\pm 1\%$ , 1/8W	Mil type	RN55D1542F
R48	Resistor, Fixed, Film, 82.5K $\pm 1\%$ , 1/8W	Mil type	RN55D8252F
R49	Resistor, Fixed, Composition, 3.3K $\pm 5\%$ , 1/4W	Mil type	RCR07G332JM
R50	Resistor, Fixed, Composition, 47K $\pm 5\%$ , 1/4W	Mil type	RCR07G473JM
R51-R53	Resistor, Fixed, Composition, 220K $\pm 5\%$ , 1/4W	Mil type	RCR07G224JM
R54	Resistor, Fixed, Composition, 47K $\pm 5\%$ , 1/4W	Mil type	RCR07G473JM
R55	Resistor, Fixed, Composition, 100K $\pm 5\%$ , 1/4W	Mil type	RCR07G104JM
R56-R63	Resistor, Fixed, Composition, 47K $\pm 5\%$ , 1/4W	Mil type	RCR07G473JM
R64	Not Used		
R65	Resistor, Fixed, Composition, 47K $\pm 5\%$ , 1/4W	Mil type	RCR07G473JM
R66	Resistor, Fixed, Composition, 1.8K $\pm 5\%$ , 1/4W	Mil type	RCR07G182JM
R67	Resistor, Fixed, Composition, 15K $\pm 5\%$ , 1/4W	Mil type	RCR07G153JM
R68	Resistor, Fixed, Composition, 390 ohms $\pm 5\%$ , 1/4W	Mil type	RCR07G391JM
R69,R70	Resistor, Fixed, Composition, 330 ohm $\pm 5\%$ , 1/4W	Mil type	RCR07G331JM
R71	Resistor, Fixed, Composition, 470 ohm $\pm 5\%$ , 1/4W	Mil type	RCR07G471JM
R72	Resistor, Fixed, Composition, 220 ohm $\pm 5\%$ , 1/4W	Mil type	RCR07G221JM
R73	Resistor, Fixed, Composition, 10K $\pm 5\%$ , 1/4W	Mil type	RCR07G103JM



Table 2. 1A1A3 Maintenance Parts List

Ref. Desig.	Name & Description	Mfr. Code	Part Number
R74	Resistor, Fixed, Composition, 2.7K $\pm$ 5%, 1/4W	Mil type	RCR07G272JM
R75	Resistor, Variable, 5K	14304	R-2227
R76	Resistor, Fixed, Composition, 6.8K $\pm$ 5%, 1/4W	Mil type	RCR07G682JM
R77	Resistor, Fixed, Composition, 10K $\pm$ 5%, 1/4W	Mil type	RCR07G103JM
R78	Resistor, Fixed, Composition, 15K $\pm$ 5%, 1/4W	Mil type	RCR07G153JM
R79	Resistor, Fixed, Composition, 1.8K $\pm$ 5%, 1/4W	Mil type	RCR07G182JM
R80	Resistor, Fixed, Composition, 390 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G391JM
R81	Resistor, Fixed, Composition, 10 Meg $\pm$ 5%, 1/4W	Mil type	RCR07G106JM
R82	Not Used		
R83	Resistor, Fixed, Composition, 1.8K $\pm$ 5%, 1/4W	Mil type	RCR07G182JM
R84	Resistor, Fixed, Film, 4.75K 1%, 1/8W	Mil type	RN55D4751F
R85	Resistor, Fixed, Film, 8.25K 1%, 1/8W	Mil type	RN55D8251F
R86	Resistor, Fixed, Composition, 10K $\pm$ 5%, 1/4W	Mil type	RCR07G103JM
R87	Resistor, Fixed, Composition, 27 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G270JM
R88,R89	Resistor, Fixed, Composition, 560 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G561JM
R90	Resistor, Variable, 1K	14304	R-2225
R91	Resistor, Fixed, Composition, 470 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G471JM
R92	Resistor, Fixed, Composition, 22K $\pm$ 5%, 1/4W	Mil type	RCR07G223JM
R93	Resistor, Fixed, Composition, 4.3K $\pm$ 5%, 1/4W	Mil type	RCR07G432JM
R94	Resistor, Fixed, Composition, 100K $\pm$ 5%, 1/4W	Mil type	RCR07G104JM
R95,R96	Resistor, Fixed, Film, 1K, 1%, 1/8W	Mil type	RN55D1001F
R97	Resistor, Fixed, Composition, 10K $\pm$ 5%, 1/4W	Mil type	RCR07G103JM
R98,R99	Resistor, Fixed, Film, 1K, 1%, 1/8W	Mil type	RN55D1001F
R100	Resistor, Fixed, Composition, 56 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G560JM
R101	Resistor, Variable, 2K ohm	14304	R-2226
R102	Resistor, Fixed, Composition, 10K $\pm$ 5%, 1/4W	Mil type	RCR07G103JM
R103	Resistor, Fixed, Composition, 1K $\pm$ 5%, 1/4W	Mil type	RCR07G102JM
TP1	Test Point, Brown	14304	J-0392
TP2	Test Point, Red	14304	J-0387
TP3	Test Point, Orange	14304	J-0390
TP4	Test Point, Yellow	14304	J-0391
TP5	Test Point, Green	14304	J-0389
T1,T2	Not Used		
T3	Transformer	14304	919-1280
T4	Transformer	14304	6628-1178
U1	Integrated Circuit, BCD-to-Decimal Decoder,	14304	CD4028AE
VR1,VR2	Diode, Zener, 5.6V $\pm$ 5%, 1N5232	14304	CR-0265

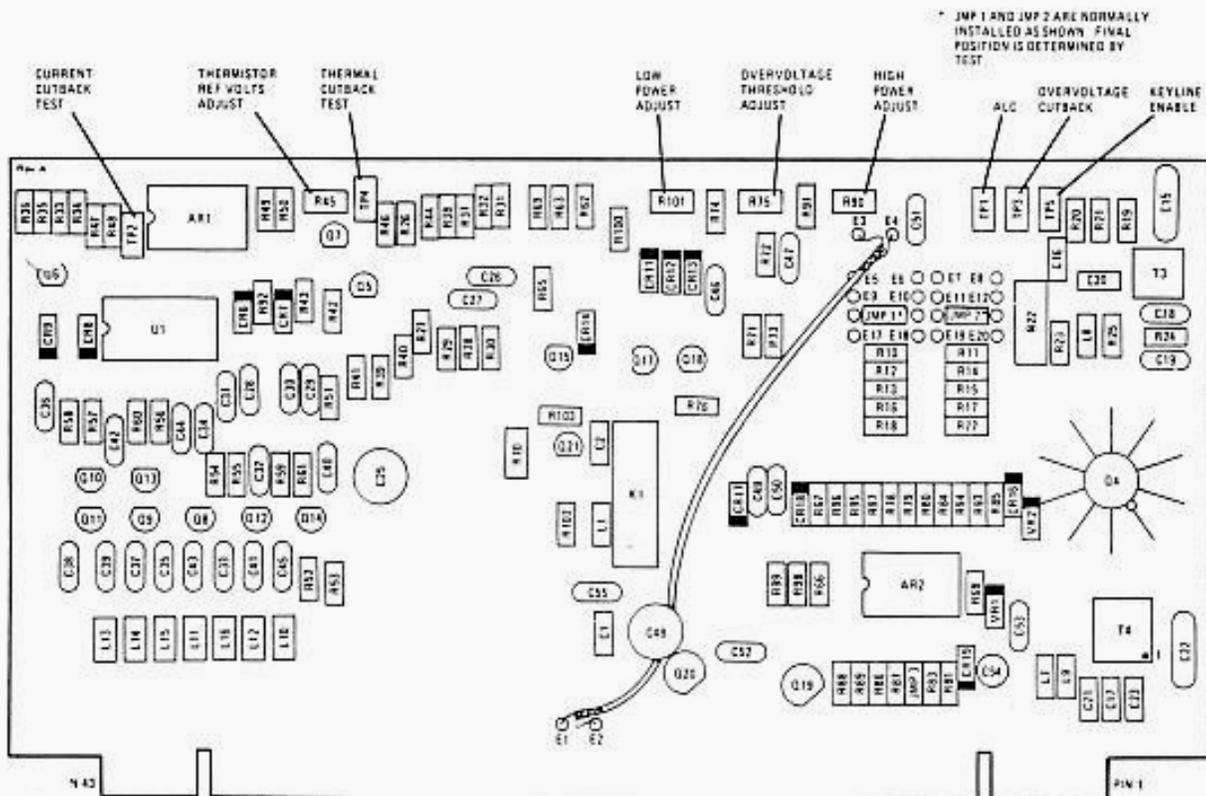


Figure 5. 1A1A3 PA Control Component Locations



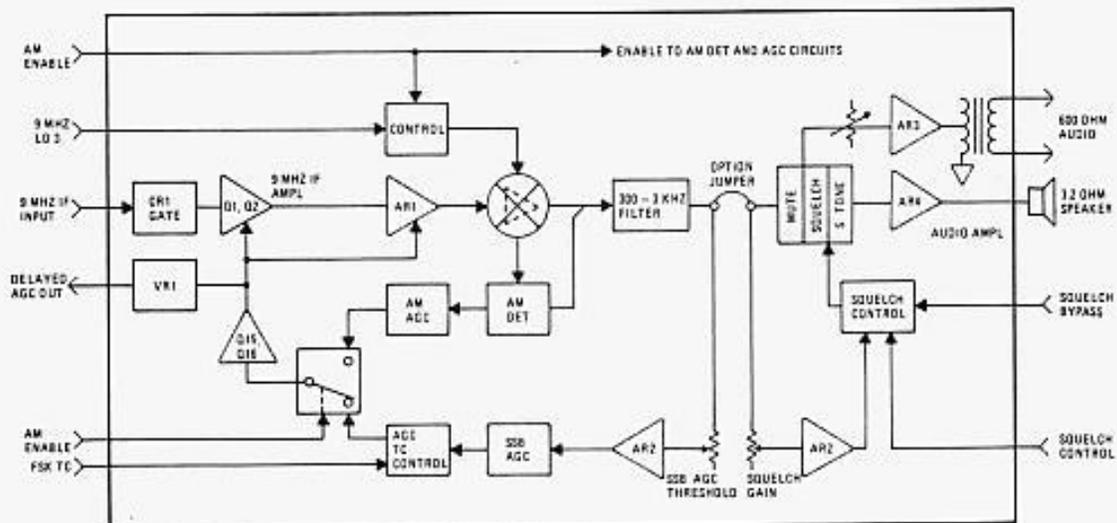
# UNIT INSTRUCTIONS



## IF AUDIO BOARD

# 1A1A4

This section is applicable to RF-230  
Transceivers with serial numbers below  
1833.





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## 1. GENERAL DESCRIPTION

The IF Audio Board accepts the 9 MHz 2nd IF Out put from the mixer assembly and performs the final detector function to translate the intermediate frequency signal into useable intelligence. This process involves two discrete, but not simultaneous, detector functions: a product detector is operative in the single sideband, CW, and AFSK mode, and an envelope detector is operative in the AM mode. Two separate audio outputs are provided: a 600 ohm line audio output, and a conventional front panel speaker output.

Mute, squelch, and speaker enable control is also effected through the Audio IF Board via Logic Level control and COS/MOS Quad Bilateral Switch elements. These switch elements have been shown as simple SPST switches on logic diagrams for simplicity. The 600 ohm audio output is affected only by the MUTE signal; the front panel speaker is controlled by all three (MUTE, SQUELCH, SPEAKER ENABLE).

Squelch and AGC control voltages are also developed and used on the Audio IF Board. AGC is also automatically controlled for derivation source (carrier or SSB) and time constant. Fast attack, fast decay is used for typical AM and AFSK signals, and fast attack slow decay for sideband and for CW. A delayed AGC voltage from the Audio IF Board controls front end gain.

## 2. TECHNICAL CHARACTERISTICS

### Power Requirements:

- +13.2 Vdc for Speaker Audio Amplifier
- +10V R (Present in Receive Mode Only)
- +10V

### Control Inputs:

- FSK 1 = FSK TC
- MUTE 1 = No Muting
- AM Enable 1 = Disabled
- Squelch Bypass 1 = Bypass
- Squelch Control Arm Linear
- Volume Control Arm Modified Log
- Sidetone Enable 1 = Enable

### Control Outputs:

- Delayed AGC Out 0 - 6V

### Signal Inputs:

- 9 MHz IF Input from Mixer 1A1A6
- L.O. 3 in from frequency standard (9 MHz)
- Sidetone Input from Processor 1A1A5
- 600 ohm Monitor from Processor 1A1A5
- (Receive Audio from options)

### Signal Outputs

- 600 ohm Receive Out
- Speaker Audio Out, 3.2 ohms
- Secure Voice Receive Audio Output

## 3. SEMICONDUCTOR COMPLEMENT

REF. DESIG.	TYPE	DESCRIPTION
AR1	MC1350P	IF Amplifier
AR2	CA324E	Quad Operational Amplifier
AR3	MC3360P	1/4 Watt Audio Amplifier
AR4	CA810	Speaker Audio Power Ampl.
AR5, AR6	CA324E	Quad Operational Amplifier
CR1	1N4454	Diode
CR2	HP3080	PIN Diode
CR3, CR4	1N4454	Diode
CR5	MPN3401	PIN Diode
CR6-CR21	1N4454	Diode
Q1	2N4126	Transistor, PNP
Q2	2N5179	Transistor, NPN
Q3-Q5	2N3563	Transistor, NPN
Q6-Q8	2N4126	Transistor, PNP
Q9-Q12	2N4124	Transistor, NPN
Q13	2N4126	Transistor, PNP
Q14, Q15	2N4124	Transistor, NPN
Q16	2N3644	Transistor, PNP
U1	CD4066AE	Quad Bilateral Switch
VR1	1N5228	Diode, Zener, 3.9V

## 4. CIRCUIT DESCRIPTION

Refer to figures 1 and 2 for the following discussions. The 9 MHz IF Input to the Audio IF Board can be measured at TP1. Typical levels are given for all test points on figure 1. IF input to the board is controlled by gate diode CR1. With +10R present at P1-19, CR1 is forward biased, and input amplifiers Q1 and Q2 are active. Note that +10R is used as B+ for all active elements in the IF Amplifier and detector circuits; as a consequence, in the transmit mode, operating potential is removed.

AR1 is a monolithic silicon integrated circuit. The 9 MHz IF input is at pin 4, where internal amplifiers operate at constant emitter currents to hold input impedance constant regardless of AGC action. AGC is fed to pin 5. Increasing the AGC voltage from 5 to 6.75 volts at this point can cause a gain reduction of 60 dB. Again, refer to figure 1 for typical levels. 9 MHz IF section performance can be measured using relative measurements at the input (TP1) and at the IF output (TP3). The AR1



output at pins 1 and 8 terminates in 9 MHz adjustable IF Transformer T1. This Transformer is adjusted for peak output at 9 MHz.

Q3, Q4, and Q5 function as a product detector in SSB, and as an amplifier in AM. In either case, the detected audio can be measured at TP4. Q8 and CR7 perform the envelope detector function in the AM mode. The AM Enable input at P1-22 turns on Q6 and biases on PIN diode CR5 to ground the LO3 input signal for the AM mode. With the LO3 input grounded, Q4 has only one input signal. The 9 MHz IF input, and as a consequence, Q4 functions only as an amplifier to drive the AM detector. Q9 buffers the detected AM output fed to comparator AR7 for carrier derived AGC development. R39 establishes the carrier derived AGC threshold.

Both the AM and SSB signal paths are common at TP4 where the signal is fed to 300 – 3000 Hz filter C<sub>12</sub> and Q13. This filtered output is measurable at TP5. The detected and filtered audio is brought out to the card edge at this point for use with optional secure voice equipment. With no secure voice option, the audio is jumpered and fed directly to an element of the quad bilateral switch. Logic level control inputs at P1-21 effect MUTE control at this point. A logic "1" closes the switch section and the audio is fed via line level adjust potentiometer R54 to an integrated circuit 1/4 watt audio amplifier. This amplifier drives T2, the 600 ohm line audio output transformer. R54 would normally be adjusted to produce a nominal 10 dBm output to a 600 ohm line, or as per customer requirements.

Additional elements of quad bilateral switch CD-4066 are used to provide squelch and sidetone enable logic level controlled functions. With a logic "0" at pin 6, audio is "squelched", and with a logic "0" at pin 5, audio is disabled. Note that R128, a 18K resistor, bypasses the squelch switch section. This bypass provides a low level audio "presence" when the radio is squelched.

The squelch threshold is established by varying R76, the squelch gain control at the inverting input of AR2-9. The non-inverting input is tied to a fixed +5V reference developed by divider R62 and R63. The squelch amplifier output is fed to AR5-10 (see TP7). The squelch circuit uses a syllabic rate detector, that recognizes the 16–25 rate characteristic of human speech, so that squelch action is not solely a function of signal amplitude. This system of speech pattern recognition results in a very high noise immunity in the squelch system. Random and periodic noise, or constant tones are rectified and averaged

to a steady dc level – which is blocked by R56. Detected and filtered syllabic rate elements reference at AR6 to effect squelch control.

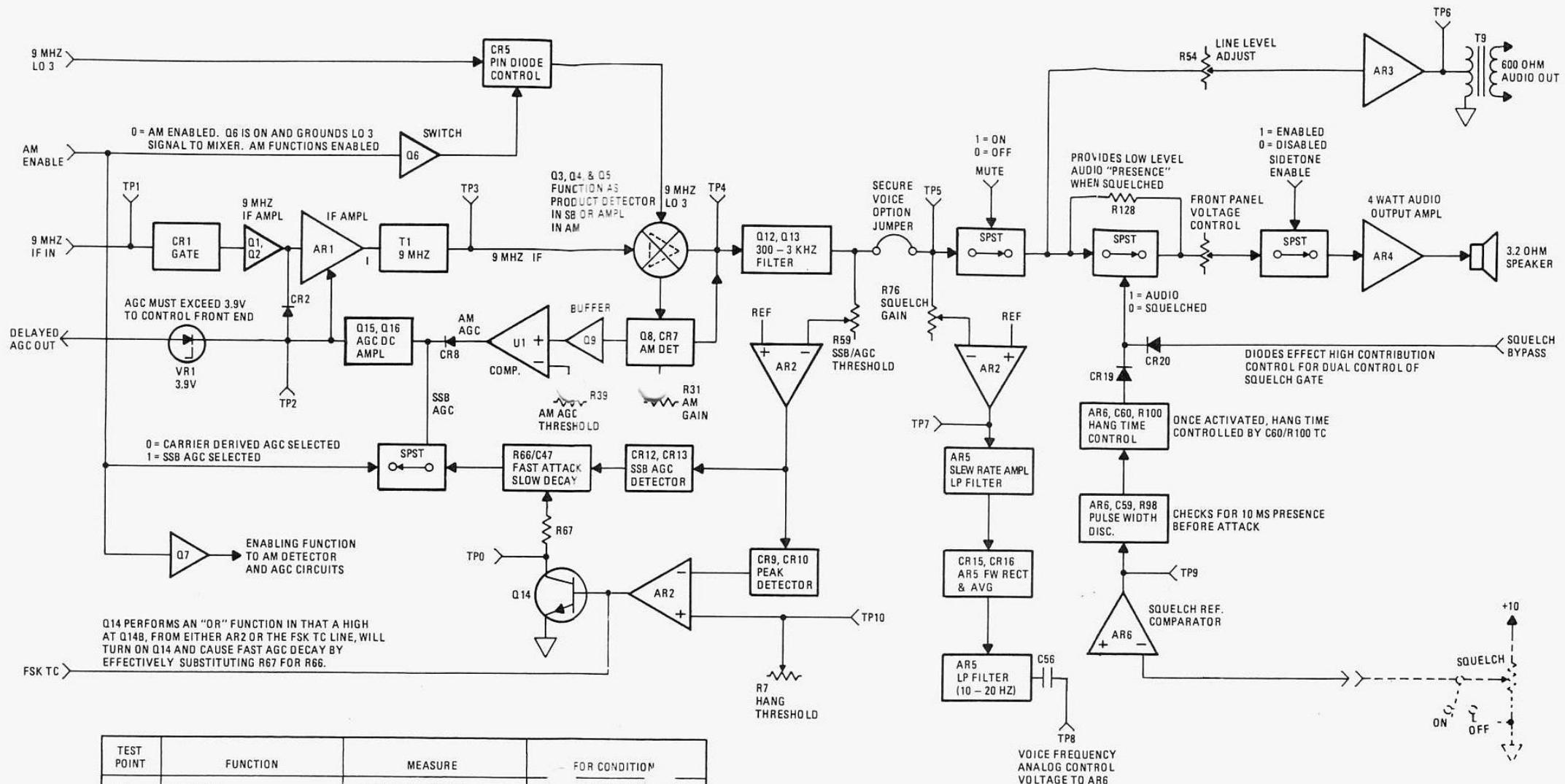
AR6, CR17, C59, and R98 are configured as a pulse width discriminator. This circuit forces a presence greater than 10 ms before it is activated. Hang time control is accomplished by the time constant of C60/R100 at the AR6-14 output. CR19 and CR20 function as high contribution diodes at the squelch control gate to accommodate certain options.

The SSB AGC Threshold is established by R59 and represents a sample of the receive audio at this point. This level is used to develop and to control SSB AGC, the R59 sample is amplified by AR2, and the output at pin 7 is fed via C46 to peak rectifiers CR12 and CR13. This voltage is filtered by C47 and either R66 or R67. With Q14 on, R67 is effectively substituted for R66. Because R67 is only 10k ohms, as compared with the relatively much higher 2.2 meg ohm value of R66, the AGC time constant is shortened considerably. Q14 can be turned on by a logic "1" at the P1-16 FSK-TC input, or by a positive signal from hang time control comparator AR2-14. R70 establishes the internal hang time reference for comparison with the AGC sample via C45 and is peak rectified by CR9, CR10. The AR2-1 AGC output is fed through controls 10 and 11 of quad switch CD4066 for control by the AM enable signal. With a logic "1" at pin 12 of this switch, SSB AGC is selected and fed to dc ampl Q15/Q16. The AGC output at the collector of Q16 controls IF amplifier AR1 and controls Q2 via pin diode CR2. Delayed AGC is fed to the RF section via VR1. Notice that AGC voltage must exceed 3.1V to overcome VR1 and effect control at the RF section. AGC can be measured at TP2.

## 5. MAINTENANCE

Figure 1 gives typical test point information. Figure 3 summarizes all card edge inputs and outputs, and also locates all adjustment points. Figure 4 is a complete component location diagram that locates all test points. Several test points on the Audio IF Board are only accessible with the board mounted on an extender card. T1 and Z1 can only be tuned with the board on an extender card, however, this level of adjustment should never be necessary unless reactive components in the related circuits are changed. The following adjustments should only be made as required.

Audio IF Board setup adjustments can be made in the radio, with the assembly on an extender card.



TEST POINT	FUNCTION	MEASURE	FOR CONDITION
TP1	9 MHZ IN	0.5uV TO 71 mVRMS	NORMAL RECEIVE
TP2	AGC OUT	0.34 TO 8.0 VDC	0.5 uV TO 71 MV RMS
TP3	9 MHZ IF OUT	57 mVRMS @ 9 MHZ	1000 uV IN
TP4	DETECTED AUDIO	110 mVRMS	1000 uV RF IN
TP5	VF FILTER OUT	950 mVRMS	1000 uV RF IN
TP6	LINE AUDIO OUT	0 TO +10 DBM	1000 uV RF IN
TP7	SQ AMPL OUT	225 MV RMS	1000 uV RF IN
TP8	SQ DC CONTROL VOLTS	5 VDC + (±1.5V AUDIO 16 HZ)	1000 uV RF IN
TP9	SQ REF COMP. OUT	5 VDC WITH ±3V AUDIO	1000 uV RF IN
TP10	AGC HANG REF.	5.1 TO 5.6 VDC 5.4 TYP.	REC SSB
TP	AGC FAST/SLOW CONDITION	2.84V OR 0.02V	0.02 FSK ONLY

FUNCTION	PIN	MEASURE	FOR CONDITION
LO 3 IN	15	0 DBM	ALL
FSK TC	16	HI = FSK	LO = ALL OTHER
AM ENABLE	22	LO	AM
MUTE CONTROL	21	LO	1A1A5 PULLED
SQ BYPASS	23	NO VOLTAGE	NORM W/O SQUELCH BYPASS
SIDETONE IN	25	200 mV MIN/28 VDC MAX.	CW XMIT AND KEYED
SIDETONE ENABLE	38	HI	REC/CW OR 600 OHM XMIT
SPKR OUT (3.2 OHM)	32	3.58 VRMS MAX	REC 1000 uV IN

Figure 1. 1A1A4 IF/Audio PWB Simplified Diagram



These setup adjustments presuppose an otherwise operational radio, and that all 1A1A6 Mixer adjustments have been made (Tune LP Filter, LO 1, 75 MHz Matching Network, L6, and 2nd Receive Mixer Bias Adjustment).

### 5.1 Test Equipment

Figure 2 demonstrates test equipment typically required to make all 1A1A4 maintenance or setup adjustments.

### 5.2 Complete Setup/Adjustment Procedure

All IF Audio Board setup or adjustment items are included in this procedure in the sequence that they should normally be performed. This procedure can be performed in its entirety, or if this is not necessary, only out-of-adjustment or questionable items need be performed. Proceed as follows:

a. Assemble required test equipment and set-up for test as shown in figure 2, with RF Signal Generator connected to RF-230 J1 input, and measuring equipment available for use as directed.

b. Install 1A1A4 on extender card.

#### CAUTION

Always select POWER OFF when removing or installing subassemblies to prevent possible damage to equipment. A PCB Extractor is included with the RF-230.

c. Tune Signal Generator to Transceiver receive frequency and adjust generator output to 1.0  $\mu$ V. Use USB receive mode and any convenient frequency.

d. Adjust volume control for a convenient output level.

e. Locate T1 on Audio IF Board and tune for peak indication at audio output.

f. Increase signal generator level to 3  $\mu$ V.

g. Connect dc VM to TP2 and adjust R59, (SSB AGC Threshold) to  $1 \pm 0.1$  Vdc. The AGC

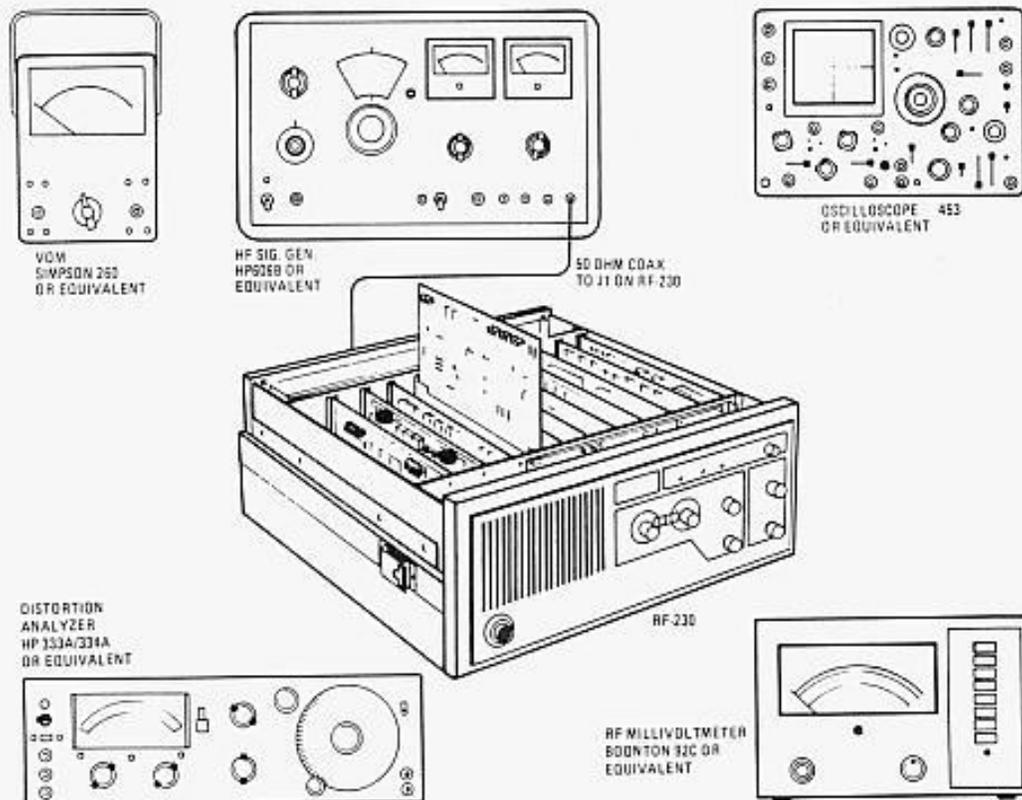


Figure 2. 1A1A4 Test/Setup



voltage at TP2 will vary from approximately 0.34 Vdc, for a no-AGC condition, to approximately 9 Vdc, for a full AGC condition. The AGC Threshold should thus be set for approximately 1.0 Vdc with a 3  $\mu$ V RF input.

h. Adjust Signal Generator output level to 1 mV, and note AGC level at TP2. Momentarily disconnect RF input and observe AGC hang time. With R70 (AGC HANG THRESHOLD) properly adjusted, hang time will be approximately 1 second. Adjust R70 for desired hang time (1 second).

i. Select AM mode at RF-230 front panel and adjust Signal Generator to the receive  $F_o$ , modulate 30% @ 1 kHz, and adjust generator output level to 1.5  $\mu$ V.

j. Adjust Z1 for maximum output at speaker.

k. Adjust R31 and R39 (see figure 3) fully counterclockwise.

l. Adjust R39 for a minimum dc voltmeter reading of approximately 0.35 Vdc at TP2.

m. Adjust R31 for a dc voltmeter reading of  $1 \pm 0.1$  Vdc at TP2.

n. Select USB mode, and using 100 mV signal level from signal generator, with a recovered audio frequency of approximately 1 kHz, adjust SQUELCH GAIN R76, for 600 mV peak-to-peak at Squelch Amplifier Output Test Point, TP7.

o. Adjust signal generator input to 100 mV and using Audio VTVM across 600 ohm receive line output, adjust R54 (600 ohm Audio Line Level Adjust) for +10 dBm output level (or to other level as desired).

p. This completes 1A1A4 adjustments. Configure for normal operation.

## 6. PARTS LIST

Table 1 lists all 1A1A5 Maintenance Parts. All of these components can be identified in figure 4. Refer to the General Information for list of manufacturers.

## 7. SCHEMATIC

Figure 5 is a complete schematic diagram of the 1A1A4 assembly.



1	GND	A		
2	9 MHZ IF IN	B		
3	GND	C		
4		D		
5		E		
6		F		
7		H		
8		J		
9		K		
10		L		
11		M		
12		N		
13		P		
14	GND	R		
15	L.O. 3 IN	S		
16	FSK TC	T		
17		U		
18	+10V	V		
19	+10V R	W		
20	+13.2 VDC	X		
21	MUTE CONTROL	Y		
22	AM ENABLE	Z		
23	SQUELCH BYPASS	a		
24	VOLUME CONTROL, TOP	b		
25	SIDETONE IN	c		
26		d		
27		e		
28	SQUELCH ARM	f		
29	600 OHM REC OUT	h		
30	600 OHM REC OUT	i		
31	SPEAKER GND	k		
32	SPEAKER	l		
33	600 OHM TEST	m		
34	AGC TO TEST SOCKET	n		
35		p		
36		r		
37	VOLUME CONTROL ARM	s		
38	SIDETONE ENABLE	t		
39	REC DET OUT	u		
40	REC AUDIO IN	v		
41	VOLUME RETURN	w		
42	DELAYED AGC OUT	x		
43	GND	y		

⊗	R54 600 OHM AUDIO LINE LEVEL, ADJ.
⊗	R39 AM AGC THRESHOLD (LOWER ON BOARD)
⊗	R31 AM AGC GAIN (LOWER ON BOARD)
⊗	R59 SSB/AGC THRESHOLD
⊗	R70 HANG THRESHOLD
⊗	R76 SQUELCH GAIN

Figure 3. IA1A4 Input/Output Summary



TABLE 1. 1A1A4 MAINTENANCE PARTS LIST

Ref. Desig.	Name & Description	Mfr. Code	Part No.
1A1A4	IF Audio PW Board Assembly	14304	6628-0550
AR1	Integrated Circuit, IF/RF Amplifier, MC1350P	14304	IC-0056
AR2	Integrated Circuit, Quad Operational Amplifier, CA324E	14304	IC-0359
AR3	Integrated Circuit, 1/4W Audio Amplifier, MC3360P	14304	IC-0172
AR4	Integrated Circuit, 7W Audio Power Amplifier, TBA810DS	14304	IC-0410
AR5, AR6	Integrated Circuit, Quad Operational Amplifier, CA324E	14304	IC-0359
C1	Capacitor, Fixed, Tantalum, 6.8 uF ±10%, 35V	14304	C-3102
C2, C3	Capacitor, Fixed, Ceramic, .01 uF ±20%, 50V	14304	C-4952
C4	Capacitor, Fixed, Ceramic, .1 uF +80-20%, 50V	14304	C-3202
C5	Capacitor, Fixed, Tantalum, 6.8 uF ±10%, 35V	14304	C-3102
C6	Capacitor, Fixed, Ceramic, .01 uF ±20%, 50V	14304	C-4952
C7	Capacitor, Fixed, Tantalum, 6.8 uF ±10%, 35V	14304	C-3102
C8	Capacitor, Fixed, Ceramic, .001 uF ±10%, 500V	14304	C-3513
C9 to C11	Capacitor, Fixed, Ceramic, .01 uF ±20%, 50V	14304	C-4952
C12	Capacitor, Fixed, Tantalum, 6.8 uF ±10%, 35V	14304	C-3102
C13 to C17	Capacitor, Fixed, Ceramic, .01 uF ±20%, 50V	14304	C-4952
C18	Capacitor, Fixed, Tantalum, 100 uF ±20%, 20V	14304	C-6454
C19	Capacitor, Fixed, Ceramic, .01 uF ±20%, 50V	14304	C-4952
C20	Capacitor, Fixed, Tantalum, 6.8 uF ±10%, 35V	14304	C-3102
C21	Capacitor, Fixed, Ceramic, .01 uF ±20%, 50V	14304	C-4952
C22	Capacitor, Fixed, Ceramic, .001 uF ±10%, 500V	14304	C-3513
C23	Capacitor, Fixed, Ceramic, .01 uF ±20%, 50V	14304	C-4952
C24, C25	Capacitor, Fixed, Ceramic, .001 uF ±10%, 500V	14304	C-3513
C26	Capacitor, Fixed, Tantalum, 4.7 uF ±20%, 20V	14304	C-6446
C27	Not used		
C28	Capacitor, Fixed, Mylar, .015 uF ±5%, 100V	14304	C-0900
C29	Capacitor, Fixed, Mylar, .0022 uF ±5%, 600V	14304	C-0948
C30, C31	Capacitor, Fixed, Tantalum, 2.2 uF ±20%, 20V	14304	C-6444
C32	Capacitor, Fixed, Tantalum, 6.8 uF ±10%, 35V	14304	C-3102
C33, C34	Capacitor, Fixed, Tantalum, 33 uF ±20%, 35V	14304	C-6430
C35	Capacitor, Fixed, Ceramic, .01 uF ±20%, 50V	14304	C-4952
C36	Capacitor, Fixed, Mica, 1500 pF ±5%, 500V	14304	C-0156
C37	Capacitor, Fixed, Ceramic, .1 uF +80-20%, 50V	14304	C-3202
C38	Capacitor, Fixed, Tantalum, 33 uF ±20%, 35V	14304	C-6430
C39	Capacitor, Fixed, Elect., 470 uF, +50-10%, 25V	14304	C-1419
C40	Capacitor, Fixed, Tantalum, 1 uF ±20%, 20V	14304	C-6442
C41	Capacitor, Fixed, Ceramic, .01 uF ±20%, 50V	14304	C-4952
C42	Capacitor, Fixed, Ceramic, .1 uF +80-20%, 50V	14304	C-3202
C43	Capacitor, Fixed, Tantalum, 33 uF ±20%, 35V	14304	C-6430
C44	Capacitor, Fixed, Tantalum, .47 uF ±20%, 35V	14304	C-6419
C45, C46	Capacitor, Fixed, Tantalum, 100 uF ±20%, 20V	14304	C-6454



TABLE 1. 1A1A4 MAINTENANCE PARTS LIST (Continued)

Ref. Desig.	Name & Description	Mfr. Code	Part Number
C47,C48	Capacitor,Fixed,Tantalum, 22 uF ±20%, 25V	14304	C-6439
C49	Capacitor,Fixed,Tantalum, 4.7 uF ±20%, 20V	14304	C-6439
C50	Capacitor,Fixed,Tantalum, 6.8 uF ±10%, 35V	14304	C-3102
C51	Capacitor,Fixed,Ceramic, .1 uF +80-20%, 50V	14304	C-3202
C52	Capacitor,Fixed,Tantalum, .22 uF ±20%, 35V	14304	C-6417
C53	Capacitor,Fixed,Tantalum, 100 uF ±20%, 20V	14304	C-6454
C54	Capacitor,Fixed,Tantalum, 4.7 uF ±20%, 20V	14304	C-6446
C55	Capacitor,Fixed,Tantalum, .47 uF ±20%, 35V	14304	C-6419
C56	Capacitor,Fixed,Tantalum, 4.7 uF ±20%, 20V	14304	C-6446
C57	Capacitor,Fixed,Tantalum, 150 uF ±20%, 15V	14304	C-4976
C58	Capacitor,Fixed,Ceramic, .01 uF ±20%, 50V	14304	C-4952
C59	Capacitor,Fixed,Tantalum, .1 uF ±20%, 35V	14304	C-6415
C60	Capacitor,Fixed,Tantalum, 22 uF ±20%, 25V	14304	C-6439
C61	Capacitor,Fixed,Tantalum, .47 uF ±20%, 35V	14304	C-6419
C62	Capacitor,Fixed,Elect., 470 uF, +50-10%, 25V	14304	C-1419
C63	Capacitor,Fixed,Ceramic, .001 uF ±10%, 500V	14304	C-3513
C64-C67	Capacitor,Fixed,Tantalum, 6.8 uF ±10%, 35V	14304	C-3102
C68,C69	Capacitor,Fixed,Ceramic, .01 uF ±20%, 50V	14304	C-4952
C70,C71	Capacitor,Fixed,Tantalum, 4.7 uF ±20%, 20V	14304	C-6446
C72	Capacitor,Fixed,Tantalum, 2.2 uF ±20%, 20V	14304	C-6444
CR1	Diode, Signal, 1N4454	14304	CR-0705
CR2	Diode, Pin, HP-3080	14304	CR-0294
CR3,CR4	Diode, Signal, 1N4454	14304	CR-0705
CR5	Diode, Pin, MPN3401	14304	CR-0746
CR6-CR13	Diode, Signal, 1N4454	14304	CR-0705
CR14	Not Used		
CR15-CR21	Diode, Signal, 1N4454	14304	CR-0705
CR22	Not Used		
CR23	Diode, Signal, 30S10	14304	CR-0034
L1	Choke, RF, 47 uH ±10%	14304	L-0636
L2-L4	Choke, RF, 100 uH ±10%	14304	L-0640
L5	Choke, RF, 2.8 mH	14304	6628-0573
Q1	Transistor, PNP, 2N4126	14304	Q-0386
Q2	Transistor, NPN, 2N5179	14304	Q-0390
Q3-Q5	Transistor, NPN, 2N3563	14304	Q-0309
Q6-Q8	Transistor, PNP, 2N4126	14304	Q-0386
Q9	Transistor, NPN, 2N4124	14304	Q-0385
Q10,Q11	Not Used		
Q12	Transistor, NPN, 2N4124	14304	Q-0385
Q13	Transistor, PNP, 2N4126	14304	Q-0386
Q14,Q15	Transistor, NPN, 2N4124	14304	Q-0385
Q16	Transistor, PNP, 2N3644	14304	Q-0415
R1	Resistor, Fixed, Composition, 12K, ±5%, 1/4W	Mil type	RCR07G123JM



TABLE 1. 1A1A4 MAINTENANCE PARTS LIST (Continued)

Ref. Desig.	Name & Description	Mfr. Code	Part No.
R2	Resistor, Fixed, Composition, 27K $\pm$ 5%, 1/4W	Mil type	RCR07G273JM
R3	Resistor, Fixed, Composition, 8.2K $\pm$ 5%, 1/4W	Mil type	RCR07G822JM
R4	Resistor, Fixed, Composition, 2.2K $\pm$ 5%, 1/4W	Mil type	RCR07G222JM
R5	Resistor, Fixed, Composition, 2.7K $\pm$ 5%, 1/4W	Mil type	RCR07G272JM
R6	Resistor, Fixed, Composition, 470 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G471JM
R7	Resistor, Fixed, Composition, 22 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G220JM
R8	Resistor, Fixed, Composition, 56 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G560JM
R9	Resistor, Fixed, Composition, 10 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G100JM
R10	Resistor, Fixed, Composition, 220 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G221JM
R11	Resistor, Fixed, Composition, 100 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G101JM
R12	Resistor, Fixed, Composition, 22K $\pm$ 5%, 1/4W	Mil type	RCR07G223JM
R13	Resistor, Fixed, Composition, 27K $\pm$ 5%, 1/4W	Mil type	RCR07G273JM
R14	Resistor, Fixed, Composition, 10 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G100JM
R15	Resistor, Fixed, Composition, 47K $\pm$ 5%, 1/4W	Mil type	RCR07G473JM
R16	Resistor, Fixed, Composition, 1.2K $\pm$ 5%, 1/4W	Mil type	RCR07G122JM
R17, R18	Resistor, Fixed, Composition, 820 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G821JM
R19	Resistor, Fixed, Composition, 4.7K $\pm$ 5%, 1/4W	Mil type	RCR07G472JM
R20	Resistor, Fixed, Composition, 82 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G820JM
R21	Resistor, Fixed, Composition, 8.2K $\pm$ 5%, 1/4W	Mil type	RCR07G822JM
R22, R23	Resistor, Fixed, Composition, 1.2K $\pm$ 5%, 1/4W	Mil type	RCR07G122JM
R24	Resistor, Fixed, Composition, 470 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G471JM
R25	Resistor, Fixed, Composition, 100 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G101JM
R26	Resistor, Fixed, Composition, 47K $\pm$ 5%, 1/4W	Mil type	RCR07G473JM
R27	Resistor, Fixed, Composition, 220 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G221JM
R28, R29	Resistor, Fixed, Composition, 47K $\pm$ 5%, 1/4W	Mil type	RCR07G473JM
R30	Resistor, Fixed, Composition, 5.6K $\pm$ 5%, 1/4W	Mil type	RCR07G562JM
R31	Resistor, Variable, 500 ohm	14304	R-2224
R32	Resistor, Fixed, Composition, 18K $\pm$ 5%, 1/4W	Mil type	RCR07G183JM
R33	Resistor, Fixed, Composition, 100 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G101JM
R34	Resistor, Fixed, Composition, 4.7K $\pm$ 5%, 1/4W	Mil type	RCR07G472JM
R35	Resistor, Fixed, Composition, 10K $\pm$ 5%, 1/4W	Mil type	RCR07G103JM
R36	Resistor, Fixed, Composition, 1K $\pm$ 5%, 1/4W	Mil type	RCR07G102JM
R37	Resistor, Fixed, Composition, 150K $\pm$ 5%, 1/4W	Mil type	RCR07G154JM
R38	Resistor, Fixed, Composition, 22K $\pm$ 5%, 1/4W	Mil type	RCR07G223JM
R39	Resistor, Variable, 10K	14304	R-2228
R40	Resistor, Fixed, Composition, 150K $\pm$ 5%, 1/4W	Mil type	RCR07G154JM
R41	Resistor, Fixed, Composition, 7.5K $\pm$ 5%, 1/4W	Mil type	RCR07G752JM
R42	Resistor, Fixed, Composition, 3.9K $\pm$ 5%, 1/4W	Mil type	RCR07G392JM
R43	Resistor, Fixed, Composition, 10K $\pm$ 5%, 1/4W	Mil type	RCR07G103JM
R44	Resistor, Fixed, Composition, 2.2K $\pm$ 5%, 1/4W	Mil type	RCR07G222JM
R45	Resistor, Fixed, Composition, 4.7K $\pm$ 5%, 1/4W	Mil type	RCR07G472JM



TABLE 1. 1A1A4 MAINTENANCE PARTS LIST (Continued)

Ref. Desig.	Name & Description	Mfr. Code	Part No.
R46	Resistor, Fixed, Composition, 1K $\pm$ 5%, 1/4W	Mil type	RCR07G102JM
R47	Resistor, Fixed, Composition, 470 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G471JM
R48	Resistor, Fixed, Composition, 47K $\pm$ 5%, 1/4W	Mil type	RCR07G473JM
R49	Resistor, Fixed, Composition, 18K $\pm$ 5%, 1/4W	Mil type	RCR07G183JM
R50	Resistor, Fixed, Composition, 47K $\pm$ 5%, 1/4W	Mil type	RCR07G473JM
R51	Resistor, Fixed, Composition, 47 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G470JM
R52	Resistor, Fixed, Composition, 1 ohm $\pm$ 5%, 1/2W	Mil type	RCR20G1R0JM
R53	Resistor, Fixed, Composition, 100 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G101JM
R54	Resistor, Variable, 20K	14304	R-2229
R55	Resistor, Fixed, Composition, 2.7K $\pm$ 5%, 1/4W	Mil type	RCR07G272JM
R56	Resistor, Fixed, Composition, 15K $\pm$ 5%, 1/4W	Mil type	RCR07G153JM
R57, R58	Resistor, Fixed, Composition, 22 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G220JM
R59	Resistor, Variable, 20K	14304	R-2229
R60	Resistor, Fixed, Composition, 1K $\pm$ 5%, 1/4W	Mil type	RCR07G102JM
R61	Resistor, Fixed, Composition, 39K $\pm$ 5%, 1/4W	Mil type	RCR07G393JM
R62, R63	Resistor, Fixed, Composition, 10K $\pm$ 5%, 1/4W	Mil type	RCR07G103JM
R64	Resistor, Fixed, Composition, 560 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G561JM
R65	Resistor, Fixed, Composition, 1.2K $\pm$ 5%, 1/4W	Mil type	RCR07G122JM
R66	Resistor, Fixed, Composition, 2.2 Meg $\pm$ 5%, 1/4W	Mil type	RCR07G225JM
R67	Resistor, Fixed, Composition, 10K $\pm$ 5%, 1/4W	Mil type	RCR07G103JM
R68	Resistor, Fixed, Composition, 150K $\pm$ 5%, 1/4W	Mil type	RCR07G154JM
R69	Resistor, Fixed, Composition, 8.2K $\pm$ 5%, 1/4W	Mil type	RCR07G822JM
R70	Resistor, Variable, 1K	14304	R-2225
R71	Resistor, Fixed, Composition, 10K $\pm$ 5%, 1/4W	Mil type	RCR07G103JM
R72	Resistor, Fixed, Composition, 47K $\pm$ 5%, 1/4W	Mil type	RCR07G473JM
R73	Resistor, Fixed, Composition, 2.2K $\pm$ 5%, 1/4W	Mil type	RCR07G222JM
R74	Resistor, Fixed, Composition, 10K $\pm$ 5%, 1/4W	Mil type	RCR07G103JM
R75	Resistor, Fixed, Composition, 39K $\pm$ 5%, 1/4W	Mil type	RCR07G393JM
R76	Resistor, Variable, 1K	14304	R-2225
R77	Resistor, Fixed, Composition, 5.6K $\pm$ 5%, 1/4W	Mil type	RCR07G562JM
R78	Resistor, Fixed, Composition, 100 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G101JM
R79 to R81	Resistor, Fixed, Composition, 10K $\pm$ 5%, 1/4W	Mil type	RCR07G103JM
R82	Resistor, Fixed, Composition, 6.8K $\pm$ 5%, 1/4W	Mil type	RCR07G682JM
R83	Resistor, Fixed, Composition, 20K $\pm$ 5%, 1/4W	Mil type	RCR07G203JM
R84	Resistor, Fixed, Composition, 10K $\pm$ 5%, 1/4W	Mil type	RCR07G103JM
R85	Resistor, Fixed, Composition, 20K $\pm$ 5%, 1/4W	Mil type	RCR07G203JM
R86	Resistor, Fixed, Composition, 6.8K $\pm$ 5%, 1/4W	Mil type	RCR07G682JM
R87	Resistor, Fixed, Composition, 2K $\pm$ 5%, 1/4W	Mil type	RCR07G202JM
R88	Resistor, Fixed, Composition, 1.5K $\pm$ 5%, 1/4W	Mil type	RCR07G152JM
R89	Resistor, Fixed, Composition, 270 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G271JM
R90	Resistor, Fixed, Composition, 6.8K $\pm$ 5%, 1/4W	Mil type	RCR07G682JM



TABLE 1. 1A1A4 MAINTENANCE PARTS LIST (Continued)

Ref. Desig.	Name & Description	Mfr. Code	Part No.
TP4	Test Point, Yellow	14304	J-0070
TP5	Test Point, Green	14304	J-0389
TP6	Test Point, Blue	14304	J-0072
TP7	Test Point, Violet	14304	J-0394
TP8	Test Point, Gray	14304	J-0395
TP9	Test Point, White	14304	J-0386
TP10	Test Point, Black	14304	J-0067
VR1	Diode, Zener, 3.9V $\pm$ 10%, 1N5228	14304	CR-0207
Z1	Tank Assembly, 9 MHz	14304	919-1319





- NOTES:  
1. UNLESS OTHERWISE SPECIFIED,  
ALL RESISTORS ARE IN OHMS, 1/K, 10K, 100K.  
ALL CAPACITORS ARE IN MICROFARADS.  
ALL INDUCTORS ARE IN MICROHENRIES.  
ALL DIODES ARE 1N434A.  
K = K1000  
M = M1000000  
2. COND66 ANALOG SWITCH AR2 QUAD OP. AMP.

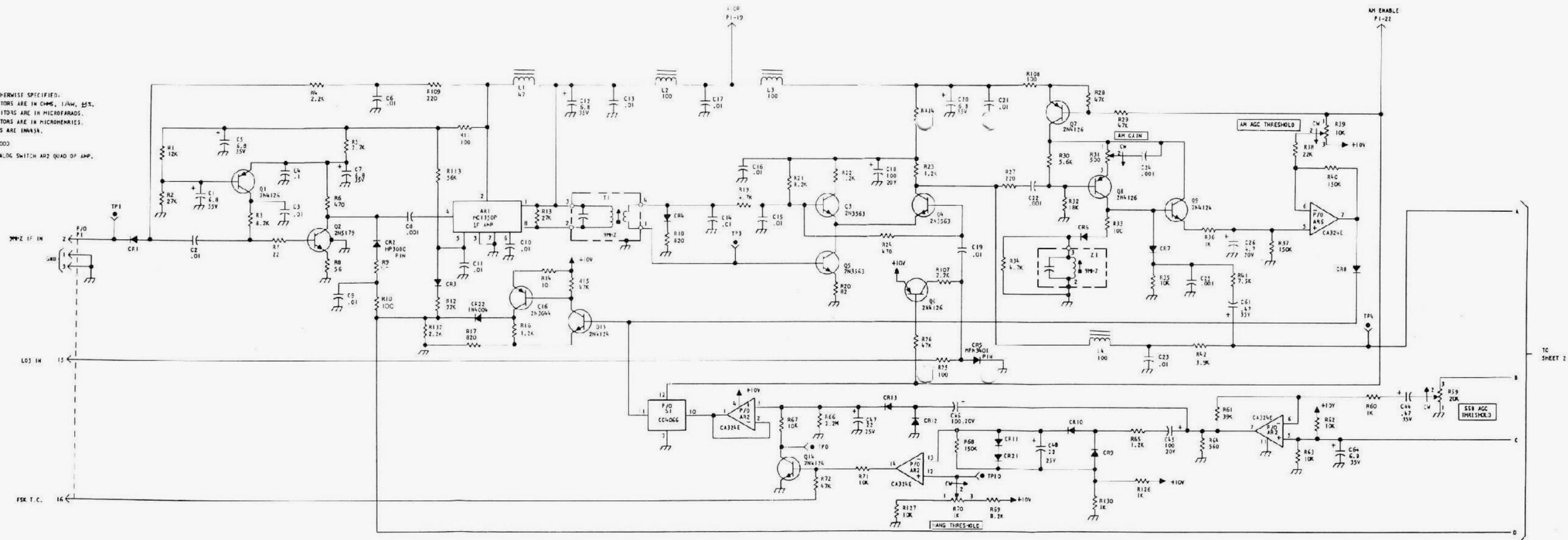


Figure 5. 1A1A4 Schematic Diagram (Sheet 1 of 2)

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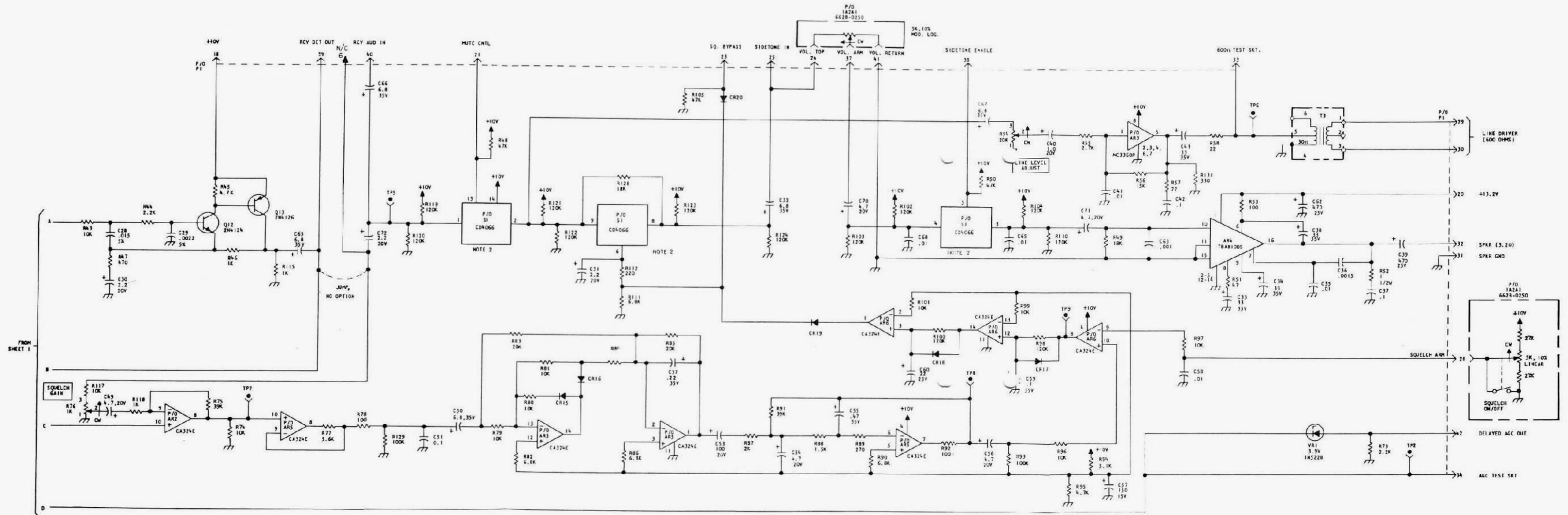


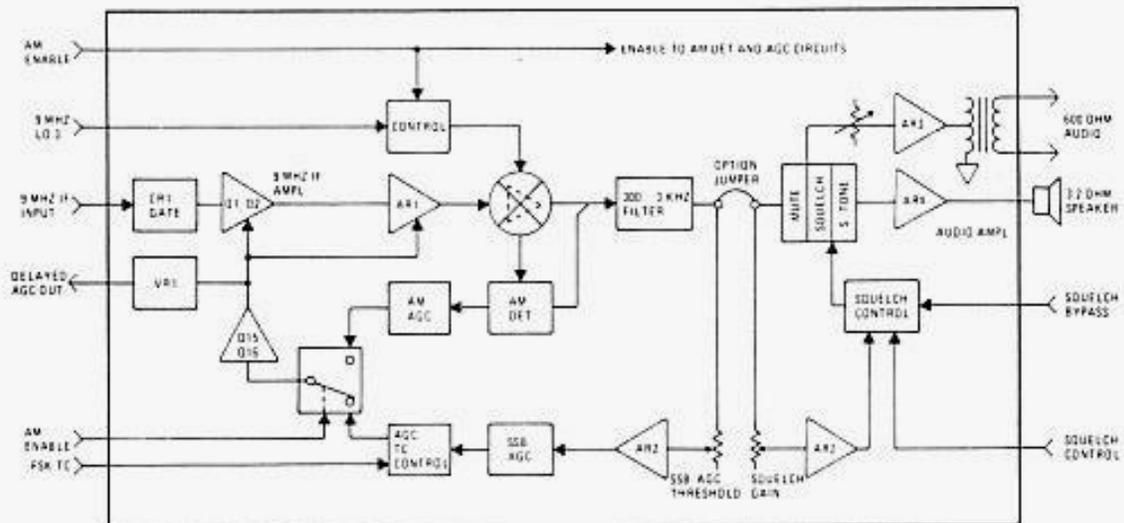
Figure 5. 1A1A4 Schematic Diagram (Sheet 2 of 2)  
6628-9055

# UNIT INSTRUCTIONS



## IF AUDIO BOARD 1A1A4

This section is applicable to RF-230  
Transceivers with serial numbers above  
1834.





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## 1. GENERAL DESCRIPTION

The IF Audio Board accepts the 9 MHz 2nd IF Out put from the mixer assembly and performs the final detector function to translate the intermediate frequency signal into useable intelligence. This process involves two discrete, but not simultaneous, detector functions: a product detector is operative in the single sideband, CW, and AFSK mode, and an envelope detector is operative in the AM mode. Two separate audio outputs are provided: a 600 ohm line audio output, and a conventional front panel speaker output.

Mute, squelch, and speaker enable control is also effected through the Audio IF Board via Logic Level control and J-FET transistors Q17, Q18, Q20, and Q21. These transistors have been shown as simple SPST switches on logic diagrams for simplicity. The 600 ohm audio output is affected only by the MUTE signal; the front panel speaker is controlled by all three signals (MUTE, SQUELCH, SPEAKER ENABLE).

Squelch and AGC control voltages are also developed and used on the Audio IF Board. AGC is also automatically controlled for derivation source (carrier or SSB) and time constant. Fast attack, fast decay is used for typical AM and AFSK signals, and fast attack slow decay for sideband and for CW. A delayed AGC voltage from the Audio IF Board controls front end gain.

## 2. TECHNICAL CHARACTERISTICS

### Power Requirements:

- +13.2 Vdc for Speaker Audio Amplifier
- +10V R (Present in Receive Mode Only)
- +10V

### Control Inputs:

- FSK 1 = FSK TC
- MUTE 1 = No Muting
- AM Enable 1 = Disabled
- Squelch Bypass 1 = Bypass
- Squelch Control Arm Linear
- Volume Control Arm Modified Log
- Sidetone Enable 1 = Enable

### Control Outputs:

- Delayed AGC Out 0 - 6V

### Signal Inputs:

- 9 MHz IF Input from Mixer 1A1A6
- L.O. 3 in from frequency standard (9 MHz)
- Sidetone Input from Processor 1A1A5
- 600 ohm Monitor from Processor 1A1A5 (Receive Audio from options)

### Signal Outputs

- 600 ohm Receive Out
- Speaker Audio Out, 3.2 ohms
- Secure Voice Receive Audio Output

## 3. SEMICONDUCTOR COMPLEMENT

REF. DESIG.	TYPE	DESCRIPTION
AR1	MC1350P	IF Amplifier
AR2	CA324E	Quad Operational Amplifier
AR3 *	MC3360P	1/4 Watt Audio Amplifier
AR4	CA810	Speaker Audio Power Ampl.
AR5, AR6	CA324E	Quad Operational Amplifier
CR1	1N4454	Diode
CR2	HP3080	PIN Diode
CR3, CR4	1N4454	Diode
CR5	MPN3401	PIN Diode
CR6-CR21	1N4454	Diode
Q1	2N4126	Transistor, PNP
Q2	2N5179	Transistor, NPN
Q3-Q5	2N3563	Transistor, NPN
Q6-Q8	2N4126	Transistor, PNP
Q9-Q12	2N4124	Transistor, NPN
Q13	2N4126	Transistor, PNP
Q14, Q15	2N4124	Transistor, NPN
Q16	2N3644	Transistor, PNP
Q17-Q21	2N4392	Transistor, JFET
VR1	1N5228	Diode, Zener, 3.9V

## 4. CIRCUIT DESCRIPTION

Refer to figures 1 and 2 for the following discussions. The 9 MHz IF Input to the Audio IF Board can be measured at TP1. Typical levels are given for all test points on figure 1. IF input to the board is controlled by gate diode CR1. With +10R present at P1-19, CR1 is forward biased, and input amplifiers Q1 and Q2 are active. Note that +10R is used as B+ for all active elements in the IF Amplifier and detector circuits; as a consequence, in the transmit mode, operating potential is removed.

AR1 is a monolithic silicon integrated circuit. The 9 MHz IF input is at pin 4, where internal amplifiers operate at constant emitter currents to hold input impedance constant regardless of AGC action. AGC is fed to pin 5. Increasing the AGC voltage from 5 to 6.75 volts at this point can cause a gain reduction of 60 dB. Again, refer to figure 1 for typical levels. 9 MHz IF section performance can be measured using relative measurements at the input (TP1) and at the IF output (TP3). The AR1



output at pins 1 and 8 terminates in 9 MHz adjustable IF Transformer T1. This Transformer is adjusted for peak output at 9 MHz.

Q3, Q4, and Q5 function as a product detector in SSB, and as an amplifier in AM. In either case, the detected audio can be measured at TP4. Q8 and CR7 perform the envelope detector function in the AM mode. The AM Enable input at P1-22 turns on Q6 and biases on PIN diode CR3 to ground the LO3 input signal for the AM mode. With the LO3 input grounded, Q4 has only one input signal. The 9 MHz IF input, and as a consequence, Q4 functions only as an amplifier to drive the AM detector. Q9 buffers the detected AM output fed to comparator AR7 for carrier derived AGC development. R39 establishes the carrier derived AGC threshold.

Both the AM and SSB signal paths are common at TP4 where the signal is fed to 300 – 3000 Hz filter Q17 and Q13. This filtered output is measurable at TP5. The detected and filtered audio is brought out to the card edge at this point for use with optional secure voice equipment. With no secure voice option, the audio is jumpered and fed directly to J-FET transistor switch Q21. The logic level control inputs at P1-21 effect MUTE control at this point. A logic "1" closes the switch section and the audio is fed via line level adjust potentiometer R54 to an integrated circuit 1/4 watt audio amplifier. This amplifier drives T9, the 600 ohm line audio output transformer. R54 would normally be adjusted to produce a nominal 10 dBm output to a 600 ohm line, or as per customer requirements.

J-FET transistor switches Q17, Q18, Q19, and Q21 are used to provide squelch and sidetone enable logic level controlled functions. With a logic "0" at Q18, audio is "squelched", and with a logic "0" at Q19, audio is disabled. Note that R128, a 18K resistor, bypasses the squelch switch section. This bypass provides a low level audio "presence" when the radio is squelched.

The squelch threshold is established by varying R76, the squelch gain control at the inverting input of AR2-9. The non-inverting input is tied to a fixed +5V reference developed by divider R62 and R63. The squelch amplifier output is fed to AR5-10 (see TP7). The squelch circuit uses a syllabic rate detector, that recognizes the 16–25 rate characteristic of human speech, so that squelch action is not solely a function of signal amplitude. This system of speech pattern recognition results in a very high noise immunity in the squelch system. Random and periodic noise, or constant tones are rectified and averaged

to a steady dc level – which is blocked by R56. Detected and filtered syllabic rate elements reference at AR6 to effect squelch control.

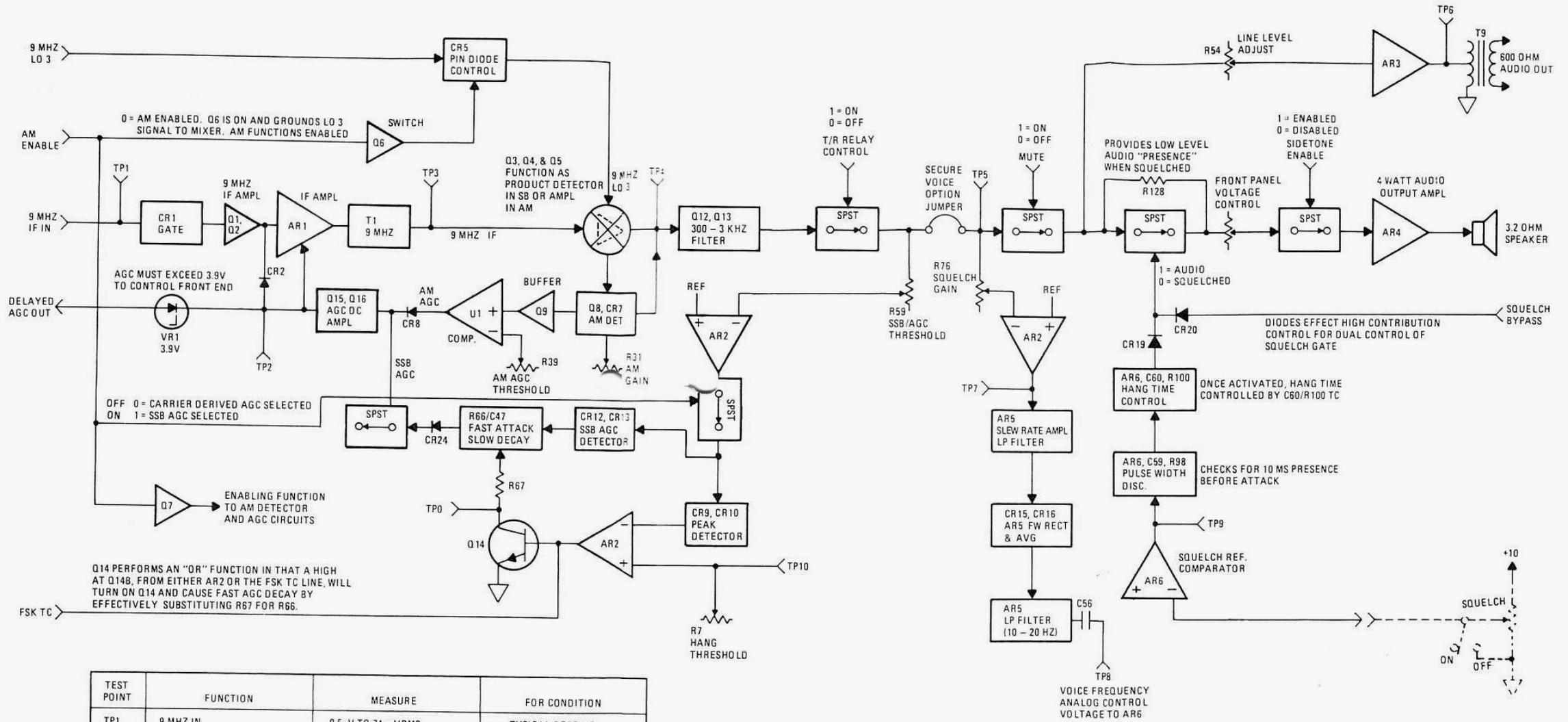
AR6, CR17, C59, and R98 are configured as a pulse width discriminator. This circuit forces a presence greater than 10 ms before it is activated. Hang time control is accomplished by the time constant of C60/R100 at the AR6-14 output. CR19 and CR20 function as high contribution diodes at the squelch control gate to accommodate certain options.

The SSB AGC Threshold is established by R59 and represents a sample of the receive audio at this point. This level is used to develop and to control SSB AGC, the R59 sample is amplified by AR2, and the output at pin 7 is fed via C46 to peak rectifiers CR12 and CR13. This voltage is filtered by C47 and either R66 or R67. With Q14 on, R67 is effectively substituted for R66. Because R67 is only 10k ohms, as compared with the relatively much higher 2.2 meg ohm value of R66, the AGC time constant is shortened considerably. Q14 can be turned on by a logic "1" at the P1-16 FSK-TC input, or by a positive signal from hang time control comparator AR2-14. R70 establishes the internal hang time reference for comparison with the AGC sample via C45 and is peak rectified by CR9, CR10. The AR2-1 AGC output is fed through J-FET transistor switch Q20 for Logic control by the AM enable signal. With a logic "1" at pin 12 of this switch, SSB AGC is selected and fed to dc ampl Q15/Q16. The AGC output at the collector of Q16 controls IF amplifier AR1 and controls Q2 via pin diode CR2. Delayed AGC is fed to the RF section via VRI. Notice that AGC voltage must exceed 3.1V to overcome VRI and effect control at the RF section. AGC can be measured at TP2.

## 5. MAINTENANCE

Figure 1 gives typical test point information. Figure 3 summarizes all card edge inputs and outputs, and also locates all adjustment points. Figure 4 is a complete component location diagram that locates all test points. Several test points on the Audio IF Board are only accessible with the board mounted on an extender card. T1 and Z1 can only be tuned with the board on an extender card, however, this level of adjustment should never be necessary unless reactive components in the related circuits are changed. The following adjustments should only be made as required.

Audio IF Board setup adjustments can be made in the radio, with the assembly on an extender card.



TEST POINT	FUNCTION	MEASURE	FOR CONDITION
TP1	9 MHz IN	0.5uV TO 71 mVRMS	TYPICAL RECEIVE
TP2	AGC OUT	0.34 TO 8.0 VDC	0.5 UV TO 71 MV RMS
TP3	9 MHz IF OUT	57 mVRMS @ 9 MHz	1000 uV IN
TP4	DETECTED AUDIO	110 mVRMS	1000 uV RF IN
TP5	VF FILTER OUT	950 mVRMS	1000 uV RF IN
TP6	LINE AUDIO OUT	0 TO +10 DBM	1000 uV RF IN
TP7	SQ AMPL OUT	225 MV RMS	1000 uV RF IN
TP8	SQ DC CONTROL VOLTS	5 VDC + (±1.5V AUDIO 16 HZ)	1000 uV RF IN
TP9	SQ REF COMP. OUT	5 VDC WITH ±3V AUDIO	1000 uV RF IN
TP10	AGC HANG REF.	5.1 TO 5.6 VDC 5.4 TYP.	REC SSB
TP	AGC FAST/SLOW CONDITION	2.84V OR 0.02V	0.02 FSK ONLY

FUNCTION	PIN	MEASURE	FOR CONDITION
LO 3 IN	15	0 DBM	ALL
FSK TC	16	HI = FSK	LO = ALL OTHER
AM ENABLE	22	LO	AM
MUTE CONTROL	21	LO	1A1A5 PULLED
SQ BYPASS	23	NO VOLTAGE	NORM W/O SQUELCH BYPASS
SIDETONE IN	25	200 mV MIN/28 VDC MAX.	CW XMIT AND KEYED
SIDETONE ENABLE	38	HI	REC/CW OR 600 OHM XMIT
SPKR OUT (3.2 OHM)	32	3.58 VRMS MAX	REC 1000 uV IN

Figure 1. 1A1A4 IF Audio Board Simplified Diagram



These setup adjustments presuppose an otherwise operational radio, and that all 1A1A6 Mixer adjustments have been made (Tune LP Filter, LO 1, 75 MHz Matching Network, L6, and 2nd Receive Mixer Bias Adjustment).

### 5.1 Test Equipment

Figure 2 demonstrates test equipment typically required to make all 1A1A4 maintenance or setup adjustments.

### 5.2 Complete Setup/Adjustment Procedure

All IF Audio Board setup or adjustment items are included in this procedure in the sequence that they should normally be performed. This procedure can be performed in its entirety, or if this is not necessary, only out-of-adjustment or questionable items need be performed. Proceed as follows:

a. Assemble required test equipment and set-up for test as shown in figure 2, with RF Signal Generator connected to RF-230 input, and measuring equipment available for use as directed.

b. Install 1A1A4 on extender card.

#### CAUTION

Always select POWER OFF when removing or installing subassemblies to prevent possible damage to equipment. A PCB Extractor is included with the RF-230.

c. Tune Signal Generator to Transceiver receive frequency and adjust generator output to 1.0  $\mu$ V. Fine tune signal generator for maximum audio output across 3.2 ohm speaker using audio VM or oscilloscope. Use USB receive mode and any convenient frequency.

d. Adjust volume control for 0.2V rms.

e. Locate T1 on Audio IF Board and tune for peak indication at audio output.

f. Increase signal generator level to 3  $\mu$ V.

g. Connect dc VM to TP2 and adjust R59, (SSB AGC Threshold) to  $1 \pm 0.1$  Vdc. The AGC

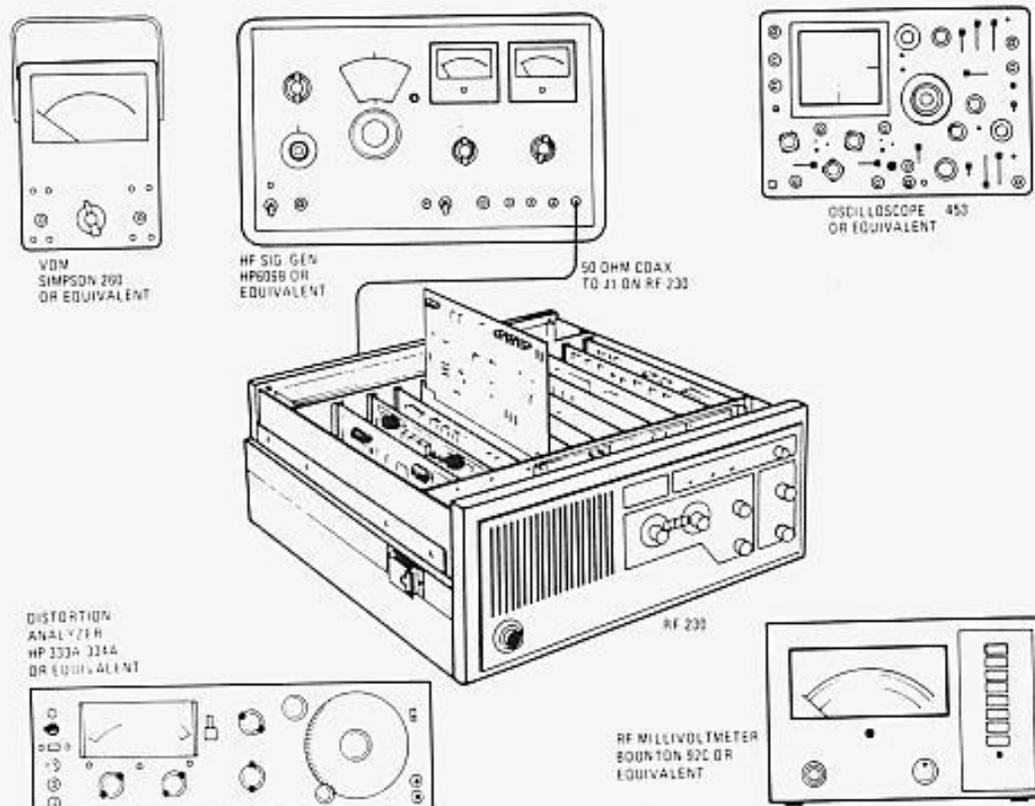


Figure 2. 1A1A4 Test/Setup



voltage at TP2 will vary from approximately 0.34 Vdc, for a no-AGC condition, to approximately 9 Vdc, for a full AGC condition. The AGC Threshold should thus be set for approximately 1.0 Vdc with a 3  $\mu$ V RF input.

h. Adjust Signal Generator output level to 1 mV, and note AGC level at TP2. Momentarily disconnect RF input and observe AGC hang time. With R70 (AGC HANG THRESHOLD) properly adjusted, hang time will be approximately 1 second. Adjust R70 for desired hang time (1 second).

i. Select AM mode at RF-230 front panel and adjust Signal Generator to the receive  $F_0$ , modulate 30% @ 1 kHz, and adjust generator output level to 1.5  $\mu$ V.

j. Adjust Z1 for maximum output at speaker.

k. Adjust R31 and R39 (see figure 3) fully counterclockwise.

l. Adjust R39 for a minimum dc voltmeter reading of approximately 0.35 Vdc at TP2.

m. Adjust R31 for a dc voltmeter reading of  $1 \pm 0.1$  Vdc at TP2.

n. Select USB mode, and using 100 mV signal level from signal generator, with a recovered audio frequency of approximately 1 kHz, adjust SQUELCH GAIN R76, for 600 mV peak-to-peak at Squelch Amplifier Output Test Point, TP7.

o. Adjust signal generator input to 100 mV and using Audio VTVM across 600 ohm receive line output, adjust R54 (600 ohm Audio Line Level Adjust) for +10 dBm output level (or to other level as desired).

p. This completes IA1A4 adjustments. Configure for normal operation.

## 6. PARTS LIST

Table 1 lists all IA1A5 Maintenance Parts. All of these components can be identified in figure 4. Refer to the General Information for list of manufacturers.

## 7. SCHEMATIC

Figure 5 is a complete schematic diagram of the IA1A4 assembly.



1	GND	A		
2	9 MHZ IF IN	B		
3	GND	C		
4		D		
5		E		
6		F		
7		H		
8		J		
9		K		
10		L		
11		M		
12		N		
13		P		
14	GND	R		
15	L.O. 3 IN	S		
16	FSK TC	T		
17		U		
18	+10V	V		
19	+10V R	W		
20	+13.2 VDC	X		
21	MUTE CONTROL	Y		
22	AM ENABLE	Z		
23	SQUELCH BYPASS	a		
24	VOLUME CONTROL, TOP	b		
25	SIDETONE IN	c		
26		d		
27		e		
28	SQUELCH ARM	f		
29	600 OHM REC OUT	h		
30	600 OHM REC OUT	i		
31	SPEAKER GND	k		
32	SPEAKER	l		
33	600 OHM TEST	m		
34	AGC TO TEST SOCKET	n		
35		p		
36		r		
37	VOLUME CONTROL ARM	s		
38	SIDETONE ENABLE	t		
39	REC DET OUT	u		
40	REC AUDIO IN	v		
41	VOLUME RETURN	w		
42	DELAYED AGC OUT	x		
43	GND	y		

⊘	R54 600 OHM AUDIO LINE LEVEL ADJ.
⊘	R39 AM AGC THRESHOLD (LOWER ON BOARD)
⊘	R31 AM AGC GAIN (LOWER ON BOARD)
⊘	R59 SSB/AGC THRESHOLD
⊘	R70 HANG THRESHOLD
⊘	R76 SQUELCH GAIN

Figure 3. 1A1A4 Input/Output Summary



Table 1. 1A1A4 Maintenance Parts List

1A1A4 IF Audio PWB Assembly			
REF. DESIG.	NAME OF PART AND DESCRIPTION	PART NO.	MFR CODE
1A1A4	IF Audio PWB Assembly	6628-0580	14304
AR1	Integrated Circuit, IF/RF Amplifier	IC-0056	
AR2	Integrated Circuit, Quad Operational Amplifier	IC-0359	
AR3	Integrated Circuit, 1/4W Audio Amplifier	IC-0172	
AR4	Integrated Circuit, 7W Audio Power Amplifier	IC-0410	
AR5	Integrated Circuit, Quad Operational Amplifier	IC-0359	
AR6	Integrated Circuit, Quad Operational Amplifier	IC-0359	
C1	Capacitor, Tant, 6.8 uF, 35V	C-3102	
C2	Capacitor, Ceramic, 0.01 uF	C-4952	
C3	Capacitor, Ceramic, 0.01 uF	C-4952	
C4	Capacitor, Ceramic, 0.1 uF	C-3202	
C5	Capacitor, Tant, 6.8 uF, 35V	C-3102	
C6	Capacitor, Ceramic, .01 uF	C-4952	
C7	Capacitor, Tant, 6.8 uF, 35V	C-3102	
C8	Capacitor, Ceramic, .001 uF	C-3513	
C9	Capacitor, Ceramic, .01 uF	C-4952	
C10	Capacitor, Ceramic, .01 uF	C-4952	
C11	Capacitor, Ceramic, .01 uF	C-4952	
C12	Capacitor, Tant, 6.8 uF, 35V	C-3102	
C13	Capacitor, Ceramic, .01 uF	C-4952	
C14	Capacitor, Ceramic, .01 uF	C-4952	
C15	Capacitor, Ceramic, .01 uF	C-4952	
C16	Capacitor, Ceramic, .01 uF	C-4952	
C17	Capacitor, Ceramic, .01 uF	C-4952	
C18	Capacitor, Tant, 100 uF, 20V	C-6454	
C19	Capacitor, Ceramic, .01 uF	C-4952	
C20	Capacitor, Tant, 6.8 uF, 35V	C-3102	
C21	Capacitor, Ceramic, .01 uF	C-4952	
C22	Capacitor, Ceramic, .001 uF	C-3513	
C23	Capacitor, Ceramic, .01 uF	C-4952	
C24	Capacitor, Ceramic, .001 uF	C-3513	
C25	Capacitor, Ceramic, .001 uF	C-3513	
C27	Not Used		
C28	Capacitor, Mylar, 5%, .015 uF	C-0900	
C29	Capacitor, Mylar, 5%, .0022 uF	C-0948	
C30	Capacitor, Tant, 2.2 uF, 20V	C-6444	
C31	Capacitor, Tant, 6.8 uF, 35V	C-3102	
C32	Capacitor, Tant, 6.8 uF, 35V	C-3102	
C33	Capacitor, Tant, 33 uF, 35V	C-6430	
C34	Capacitor, Tant, 33 uF, 35V	C-6430	
C35	Capacitor, Ceramic, .01 uF	C-4952	
C36	Capacitor, Mica, 1500 pF	C-0156	
C37	Capacitor, Ceramic, .1 uF	C-3202	
C38	Capacitor, Tant, 33 uF, 35V	C-6430	
C39	Capacitor, Elec., 470 uF, 25V	C-1419	
C40	Capacitor, Tant, 1 uF, 20V	C-6442	



1A1A4 IF Audio PWB Assembly (continued)			
REF. DESIG.	NAME OF PART AND DESCRIPTION	PART NO.	MFR CODE
C41	Capacitor, Ceramic, .01 uF	C-4952	14304
C42	Capacitor, Ceramic, .1 uF	C-3202	
C43	Capacitor, Tant, 33 uF, 35V	C-6430	
C44	Capacitor, Tant, .47 uF, 35V	C-6419	
C45	Capacitor, Tant, 100 uF, 20V	C-6454	
C46	Capacitor, Tant, 100 uF, 20V	C-6454	
C47	Capacitor, Tant, 22 uF, 25V	C-6439	
C48	Capacitor, Tant, 22 uF, 25V	C-6439	
C49	Capacitor, Tant, 4.7 uF, 20V	C-6446	
C50	Capacitor, Tant, 6.8 uF, 35V	C-3102	
C51	Capacitor, Ceramic, .1 uF	C-3202	
C52	Capacitor, Tant, .22 uF, 35V	C-6417	
C53	Capacitor, Tant, 100 uF, 20V	C-6454	
C54	Capacitor, Tant, 4.7 uF, 20V	C-6446	
C55	Capacitor, Tant, .47 uF, 35V	C-6419	
C56	Capacitor, Tant, 4.7 uF, 20V	C-6446	
C57	Capacitor, Tant, 150 uF, 15V	C-4976	
C58	Capacitor, Ceramic, .01 uF	C-4952	
C59	Capacitor, Tant, .1 uF, 35V	C-6415	
C60	Capacitor, Tant, 22 uF, 35V	C-6439	
C61	Capacitor, Tant, .47 uF, 35V	C-6419	
C62	Capacitor, Elec., 470 uF, 25V	C-1419	
C63	Capacitor, Ceramic, .001 uF	C-3513	
C64	Capacitor, Tant, 6.8 uF, 35V	C-3102	
C65	Capacitor, Tant, 6.8 uF, 35V	C-3102	
C66	Capacitor, Tant, 6.8 uF, 35V	C-3102	
C67	Capacitor, Tant, 6.8 uF, 35V	C-3102	
C68	Capacitor, Ceramic, .01 uF	C-4952	
C69	Capacitor, Ceramic, .01 uF	C-4952	
C70	Capacitor, Tant, 4.7 uF, 20V	C-6446	
C71	Capacitor, Tant, 4.7 uF, 20V	C-6446	
C72	Capacitor, Tant, 2.2 uF, 20V	C-6444	
C73	Capacitor, Ceramic, .01 uF	C-4952	
C74	Capacitor, Tant, 6.8 uF, 35V	C-3102	
C75	Not Used		
C76	Capacitor, Ceramic, .01 uF	C-4952	
C77	Capacitor, Tant, 6.8 uF, 35V	C-3102	
C78	Capacitor, Tant, .47 uF, 35V	C-6419	
C79	Capacitor, Tant, .47 uF, 35V	C-6419	
C80	Capacitor, Tant, 15 uF, 20V	C-3103	
C81	Capacitor, Tant, 6.8 uF, 35V	C-3102	
C82	Capacitor, Tant, 15 uF, 20V	C-3103	
C83	Capacitor, Ceramic, .01 uF	C-4952	
CR1	Diode, 1N4454	CR-0705	
CR2	Diode Pin	CR-0294	
CR3	Diode, 1N4454	CR-0705	
CR4	Diode, 1N4454	CR-0705	



1A1A4 IF Audio PWB Assembly (continued)			
REF. DESIG.	NAME OF PART AND DESCRIPTION	PART NO.	MFR CODE
CR5	Diode Pin	CR-0746	14304
CR6	Diode 1N4454	CR-0705	
CR7	Diode 1N4454	CR-0705	
CR8	Diode 1N4454	CR-0705	
CR9	Diode 1N4454	CR-0705	
CR10	Diode 1N4454	CR-0705	
CR11	Diode 1N4454	CR-0705	
CR12	Diode 1N4454	CR-0705	
CR13	Diode 1N4454	CR-0705	
CR14	Not Used		
CR15	Diode 1N4454	CR-0705	
CR16	Diode 1N4454	CR-0705	
CR17	Diode 1N4454	CR-0705	
CR18	Diode 1N4454	CR-0705	
CR19	Diode 1N4454	CR-0705	
CR20	Diode 1N4454	CR-0705	
CR21	Diode 1N4454	CR-0705	
CR22	Diode 1N4004	CR-0725	
CR23	Diode 30S10	CR-0034	
CR24	Diode 1N4454	CR-0705	
CR25	Not Used		
CR26	Diode 1N4004	CR-0725	
CR27	Diode 1N4004	CR-0725	
CR28	Diode 1N4004	CR-0725	
CR29	Diode 1N4454	CR-0705	
CR30	Diode 1N4454	CR-0705	
L1	Choke, 47 uH	L-0636	
L2	Choke, 100 uH	L-0640	
L3	Choke, 100 uH	L-0640	
L4	Choke, 100 uH	L-0640	
L5	Inductor, Toroid, 2.8 mH	6628-0573	
L6	Choke, 100 uH	L-0640	
L7	Choke, 470 uH	L-0648	
L8	Choke, 100 uH	L-0640	
Q1	Transistor, PNP, 2N4126	Q-0386	
Q2	Transistor, NPN, 2N5179	Q-0390	
Q3	Transistor, NPN, 2N3563	Q-0309	
Q4	Transistor, NPN, 2N3563	Q-0309	
Q5	Transistor, NPN, 2N3563	Q-0309	
Q6	Transistor, PNP, 2N4126	Q-0386	
Q7	Transistor, PNP, 2N4126	Q-0386	
Q8	Transistor, PNP, 2N4126	Q-0386	
Q9	Transistor, NPN, 2N4124	Q-0385	



1A1A4 IF Audio PWB Assembly (continued)			
REF. DESIG.	NAME OF PART AND DESCRIPTION	PART NO.	MFR CODE
Q12	Transistor, NPN, 2N4124	Q-0385	14304
Q13	Transistor, PNP, 2N4126	Q-0386	
Q14	Transistor, NPN, 2N4124	Q-0385	
Q15	Transistor, NPN, 2N4124	Q-0385	
Q16	Transistor, PNP, 2N3644	Q-0415	
Q17	2N4392 JFET	Q02-4392-000	
Q18	2N4392 JFET	Q02-4392-000	
Q19	2N4392 JFET	Q02-4392-000	
Q20	2N4392 JFET	Q02-4392-000	
Q21	2N4392 JFET	Q02-4392-000	
R1	Resistor, $\pm 5\%$ , 1/4W, 12K	R-1275	
R2	Resistor, $\pm 5\%$ , 1/4W, 27K	R-1283	
R3	Resistor, $\pm 5\%$ , 1/4W, 8.2K	R-1271	
R4	Resistor, $\pm 5\%$ , 1/4W, 2.2K	R-1257	
R5	Resistor, $\pm 5\%$ , 1/4W, 2.7K	R-1259	
R6	Resistor, $\pm 5\%$ , 1/4W, 470 ohm	R-1241	
R7	Resistor, $\pm 5\%$ , 1/4W, 22 ohm	R-1209	
R8	Resistor, $\pm 5\%$ , 1/4W, 56 ohm	R-1219	
R9	Resistor, $\pm 5\%$ , 1/4W, 6.8 ohm	R-1304	
R10	Resistor, $\pm 5\%$ , 1/4W, 100 ohm	R-1225	
R11	Resistor, $\pm 5\%$ , 1/4W, 100 ohm	R-1225	
R12	Resistor, $\pm 5\%$ , 1/4W, 22K	R-1281	
R13	Resistor, $\pm 5\%$ , 1/4W, 27K	R-1283	
R14	Resistor, $\pm 5\%$ , 1/4W, 10 ohm	R-1201	
R15	Resistor, $\pm 5\%$ , 1/4W, 47K	R-1289	
R16	Resistor, $\pm 5\%$ , 1/4W, 1.2K	R-1251	
R17	Resistor, $\pm 5\%$ , 1/4W, 820 ohm	R-1247	
R18	Resistor, $\pm 5\%$ , 1/4W, 820 ohm	R-1247	
R19	Resistor, $\pm 5\%$ , 1/4W, 4.7K	R-1265	
R20	Resistor, $\pm 5\%$ , 1/4W, 82 ohm	R-1223	
R21	Resistor, $\pm 5\%$ , 1/4W, 8.2K	R-1271	
R22	Resistor, $\pm 5\%$ , 1/4W, 1.2K	R-1251	
R23	Resistor, $\pm 5\%$ , 1/4W, 1.2K	R-1251	
R24	Resistor, $\pm 5\%$ , 1/4W, 470 ohm	R-1241	
R25	Resistor, $\pm 5\%$ , 1/4W, 100 ohm	R-1225	
R26	Resistor, $\pm 5\%$ , 1/4W, 47K	R-1289	
R27	Resistor, $\pm 5\%$ , 1/4W, 220 ohm	R-1233	
R28	Resistor, $\pm 5\%$ , 1/4W, 47K	R-1289	
R29	Resistor, $\pm 5\%$ , 1/4W, 47K	R-1289	
R30	Resistor, $\pm 5\%$ , 1/4W, 5.6K	R-1267	
R31	Potentiometer, 500 ohm	R-2224	
R32	Resistor, $\pm 5\%$ , 1/4W, 18K	R-1279	
R33	Resistor, $\pm 5\%$ , 1/4W, 100 ohm	R-1225	
R34	Resistor, $\pm 5\%$ , 1/4W, 4.7K	R-1265	
R35	Resistor, $\pm 5\%$ , 1/4W, 10K	R-1273	
R36	Resistor, $\pm 5\%$ , 1/4W, 1K	R-1249	



1A1A4 IF Audio PWB Assembly (continued)			
REF. DESIG.	NAME OF PART AND DESCRIPTION	PART NO.	MFR CODE
R37	Resistor, $\pm 5\%$ , 1/4W, 150K	R-1301	14304
R38	Resistor, $\pm 5\%$ , 1/4W, 22K	R-1281	
R39	Potentiometer, 10K	R-2228	
R40	Resistor, $\pm 5\%$ , 1/4W, 150K	R-1301	
R41	Resistor, $\pm 5\%$ , 1/4W, 7.5K	R-1270	
R42	Resistor, $\pm 5\%$ , 1/4W, 3.9K	R-1263	
R43	Resistor, $\pm 5\%$ , 1/4W, 10K	R-1273	
R44	Resistor, $\pm 5\%$ , 1/4W, 2.2K	R-1257	
R45	Resistor, $\pm 5\%$ , 1/4W, 4.7K	R-1265	
R46	Resistor, $\pm 5\%$ , 1/4W, 1K	R-1249	
R47	Resistor, $\pm 5\%$ , 1/4W, 470 ohm	R-1241	
R48	Resistor, $\pm 5\%$ , 1/4W, 47K	R-1289	
R49	Resistor, $\pm 5\%$ , 1/4W, 18K	R-1279	
R50	Resistor, $\pm 5\%$ , 1/4W, 227K	R-1305	
R51	Resistor, $\pm 5\%$ , 1/4W, 47 ohm	R-1217	
R52	Resistor, $\pm 5\%$ , 1/2W, 1 ohm	R-1567	
R53	Resistor, $\pm 5\%$ , 1/4W, 100 ohm	R-1225	
R54	Potentiometer, 20K	R-2229	
R55	Resistor, $\pm 5\%$ , 1/4W, 2.7K	R-1259	
R56	Resistor, $\pm 5\%$ , 1/4W, 15K	R-1277	
R57	Resistor, $\pm 5\%$ , 1/4W, 22 ohm	R-1209	
R58	Resistor, $\pm 5\%$ , 1/4W, 15 ohm	R-1205	
R59	Potentiometer, 20K	R-2229	
R60	Resistor, $\pm 5\%$ , 1/4W, 1K	R-1249	
R61	Resistor, $\pm 5\%$ , 1/4W, 39K	R-1287	
R62	Resistor, $\pm 5\%$ , 1/4W, 10K	R-1273	
R63	Resistor, $\pm 5\%$ , 1/4W, 10K	R-1273	
R64	Resistor, $\pm 5\%$ , 1/4W, 560 ohm	R-1243	
R65	Resistor, $\pm 5\%$ , 1/4W, 1.2K	R-1251	
R66	Resistor, $\pm 5\%$ , 1/4W, 2.2 Meg	R-1329	
R67	Resistor, $\pm 5\%$ , 1/4W, 22K	R-1281	
R68	Resistor, $\pm 5\%$ , 1/4W, 150K	R-1301	
R69	Resistor, $\pm 5\%$ , 1/4W, 8.2K	R-1271	
R70	Potentiometer, 2K	R-2226	
R71	Resistor, $\pm 5\%$ , 1/4W, 10K	R-1273	
R72	Resistor, $\pm 5\%$ , 1/4W, 47K	R-1289	
R73	Resistor, $\pm 5\%$ , 1/4W, 2.2K	R-1257	
R74	Resistor, $\pm 5\%$ , 1/4W, 10K	R-1273	
R75	Resistor, $\pm 5\%$ , 1/4W, 39K	R-1287	
R76	Potentiometer, 1K	R-2225	
R77	Resistor, $\pm 5\%$ , 1/4W, 5.6K	R-1267	
R78	Resistor, $\pm 5\%$ , 1/4W, 100 ohm	R-1225	
R79	Resistor, $\pm 5\%$ , 1/4W, 10K	R-1273	
R80	Resistor, $\pm 5\%$ , 1/4W, 10K	R-1273	
R81	Resistor, $\pm 5\%$ , 1/4W, 10K	R-1273	
R82	Resistor, $\pm 5\%$ , 1/4W, 6.8K	R-1269	



1A1A4 IF Audio PWB Assembly (continued)			
REF. DESIG.	NAME OF PART AND-DESCRIPTION	PART NO.	MFR CODE
R83	Resistor, $\pm 5\%$ , 1/4W, 20K	R-1280	14304
R84	Resistor, $\pm 5\%$ , 1/4W, 10K	R-1273	
R85	Resistor, $\pm 5\%$ , 1/4W, 20K	R-1280	
R86	Resistor, $\pm 5\%$ , 1/4W, 6.8K	R-1269	
R87	Resistor, $\pm 5\%$ , 1/4W, 2K	R-1256	
R88	Resistor, $\pm 5\%$ , 1/4W, 1.5K	R-1253	
R89	Resistor, $\pm 5\%$ , 1/4W, 270 ohm	R-1235	
R90	Resistor, $\pm 5\%$ , 1/4W, 6.8K	R-1269	
R91	Resistor, $\pm 5\%$ , 1/4W, 39K	R-1287	
R92	Resistor, $\pm 5\%$ , 1/4W, 100 ohm	R-1225	
R93	Resistor, $\pm 5\%$ , 1/4W, 100K	R-1297	
R94	Resistor, $\pm 5\%$ , 1/4W, 5.1K	R-1266	
R95	Resistor, $\pm 5\%$ , 1/4W, 4.7K	R-1265	
R96	Resistor, $\pm 5\%$ , 1/4W, 10K	R-1273	
R97	Resistor, $\pm 5\%$ , 1/4W, 10K	R-1273	
R98	Resistor, $\pm 5\%$ , 1/4W, 120K	R-1299	
R99	Resistor, $\pm 5\%$ , 1/4W, 10K	R-1273	
R100	Resistor, $\pm 5\%$ , 1/4W, 120K	R-1299	
R101	Resistor, $\pm 5\%$ , 1/4W, 10K	R-1273	
R102	Resistor, $\pm 5\%$ , 1/4W, 4.7K	R-1285	
R103	Resistor, $\pm 5\%$ , 1/4W, 1 MEG	R-1321	
R104	Not Used		
R105	Resistor, $\pm 5\%$ , 1/4W, 47K	R-1289	
R106	Not Used		
R107	Resistor, $\pm 5\%$ , 1/4W, 2.2K	R-1257	
R108	Resistor, $\pm 5\%$ , 1/4W, 100 ohm	R-1225	
R109	Resistor, $\pm 5\%$ , 1/4W, 220 ohm	R-1233	
R110	Resistor, $\pm 5\%$ , 1/4W, 120K	R-1229	
R111	Resistor, $\pm 5\%$ , 1/4W, 1.9K	R-1273	
R112	Resistor, $\pm 5\%$ , 1/4W, 2.20K	R-1257	
R113	Resistor, $\pm 5\%$ , 1/4W, 56K	R-1291	
R114	Resistor, $\pm 5\%$ , 1/4W, 150 ohm	R-1229	
R115	Resistor, $\pm 5\%$ , 1/4W, 1K	R-1249	
R116	Not Used		
R117	Resistor, $\pm 5\%$ , 1/4W, 10K	R-1273	
R118	Resistor, $\pm 5\%$ , 1/4W, 1K	R-1249	
R119	Resistor, $\pm 5\%$ , 1/4W, 4.7K	R-1265	
R120	Resistor, $\pm 5\%$ , 1/4W, 2.7K	R-1259	
R121	Resistor, $\pm 5\%$ , 1/4W, 4.7K	R-1265	
R122	Resistor, $\pm 5\%$ , 1/4W, 10K	R-1273	
R123	Not Used		
R124	Not Used		
R125	Not Used		
R126	Resistor, $\pm 1\%$ , 1/8W, 1K	R-7270	
R127	Resistor, $\pm 5\%$ , 1/4W, 10K	R-1273	
R128	Resistor, $\pm 5\%$ , 1/4W, 18K	R-1279	



## 1A1A4 IF Audio PWB Assembly (continued)

REF. DESIG.	NAME OF PART AND DESCRIPTION	PART NO.	MFR CODE
R129	Resistor, $\pm 5\%$ , 1/4W, 100K	R-1297	14304
R130	Resistor, $\pm 5\%$ , 1/4W, 1K	R-7270	
R131	Resistor, $\pm 5\%$ , 1/4W, 330 ohm	R-1237	
R132	Resistor, $\pm 5\%$ , 1/4W, 2.2K	R-1257	
R133	Not Used		
R134	Not Used		
R135	Not Used		
R136	Resistor, $\pm 5\%$ , 1/4W, 100 ohm	R-1225	
R137	Resistor, $\pm 5\%$ , 1/4W, 100 ohm	R-1225	
R138	Resistor, $\pm 5\%$ , 1/4W, 1 MEG	R-1321	
R139	Resistor, $\pm 5\%$ , 1/4W, 220K	R-1305	
R140	Resistor, $\pm 5\%$ , 1/4W, 47K	R-1289	
R141	Resistor, $\pm 5\%$ , 1/4W, 220K	R-1305	
J1	Not Used		
T1	Transformer, 9 MHz	6628-0570	
T2	Not Used		
T3	Transformer, 600 ohm, Audio	6628-0572	
TP0	Test Point, Black	J-0388	
TP1	Test Point, Brown	J-0071	
TP2	Test Point, Red	J-0387	
TP3	Test Point, Orange	J-0069	
TP4	Test Point, Yellow	J-0070	
TP5	Test Point, Green	J-0389	
TP6	Test Point, Blue	J-0072	
TP7	Test Point, Violet	J-0394	
TP8	Test Point, Grey	J-0395	
TP9	Test Point, White	J-0386	
TP10	Test Point, Black	J-0067	
VR1	Diode, Zener, 3.9V, 10%	CR-0207	
Z1	Tank Assembly, 9 MHz IF	919-1319	14304

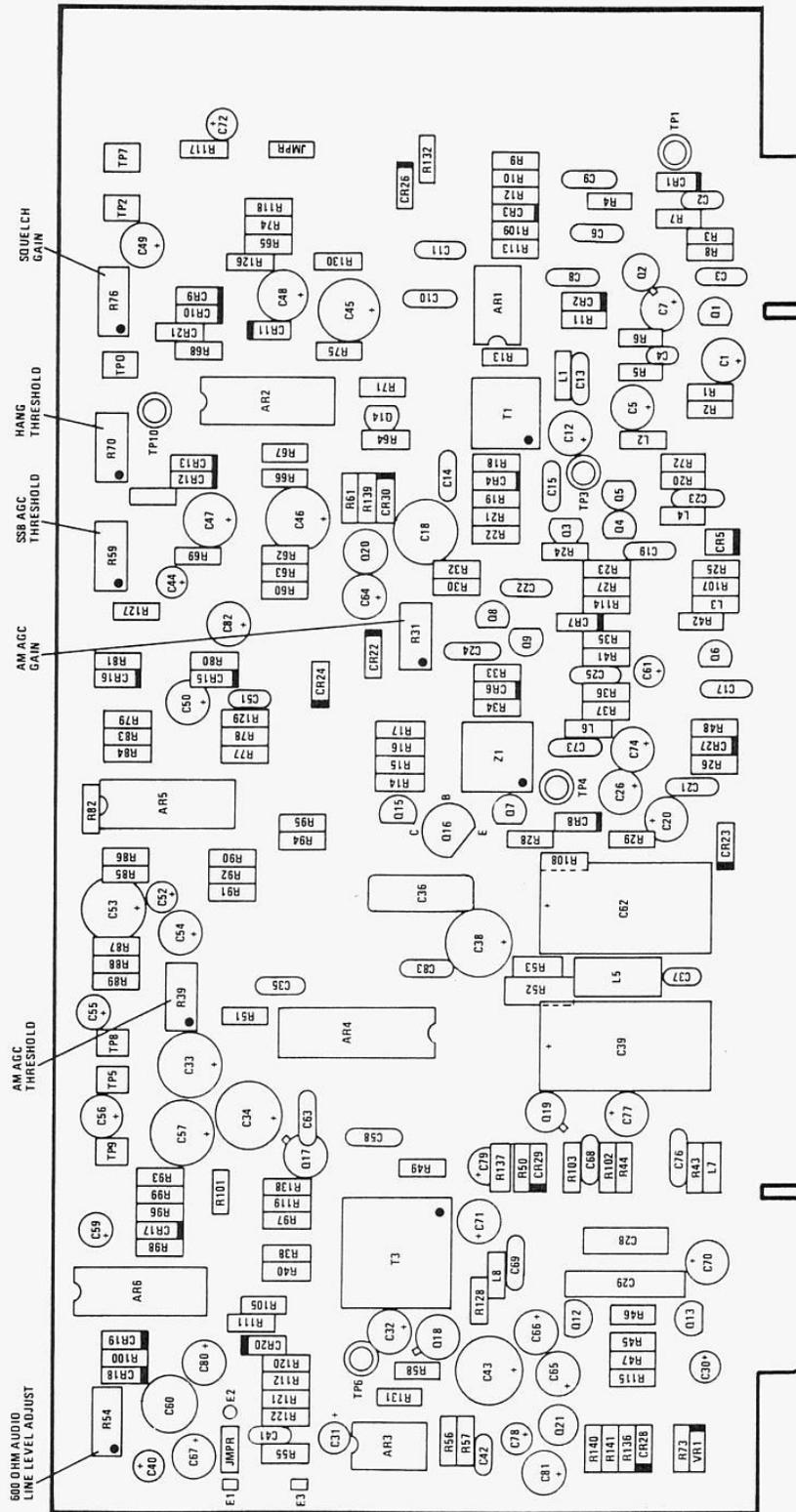


Figure 4. 1A1A4 Component Locations



- NOTES:
1. UNLESS OTHERWISE SPECIFIED, ALL RESISTORS ARE IN OHMS, 1/4w, 45k. ALL CAPACITORS ARE IN MICROFARADS. ALL INDUCTORS ARE IN MICROHENRIES. ALL DIODES ARE 1N4424. K = X1000 H = X1000000
  2. AR2 IS A QUAD OP. AMP.
  3. JUMPER IS NORMALLY INSTALLED BETWEEN E1 AND E2. JUMPER OPTION BETWEEN E1 AND E3 RESULTS IN 600 OHM RCV LINE RESPONDING TO SQUELCH. THIS OPTIONAL MODIFICATION CREATES A 770K-0550 PWB ASSY FROM A 662B-0580 PWB ASSY.
  4.  $\nabla$  1 = RF GND  $\nabla$  2 = AUDIO GND

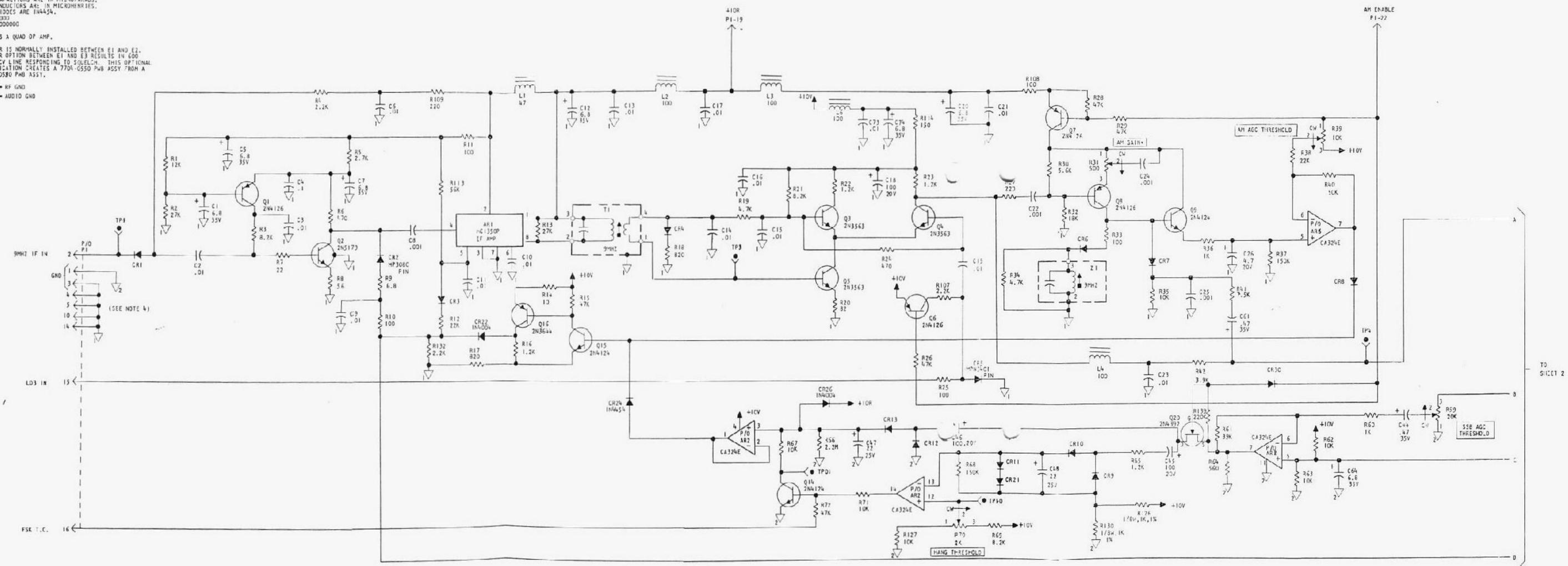


Figure 5. 1A1A4 Schematic Diagram (Sheet 1 of 2)  
6628-9058

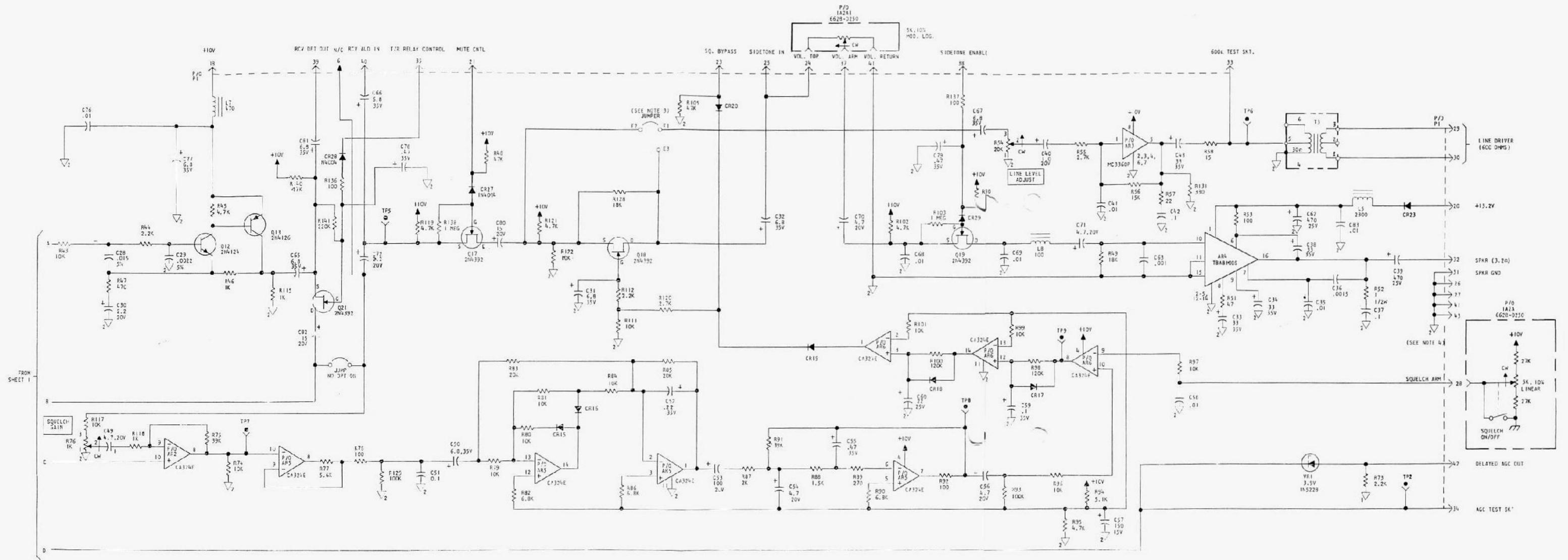


Figure 5. 1A1A4 Schematic Diagram (Sheet 2 of 2) 6628-9058

# UNIT INSTRUCTIONS



## PROCESSOR BOARD

# 1A1A5

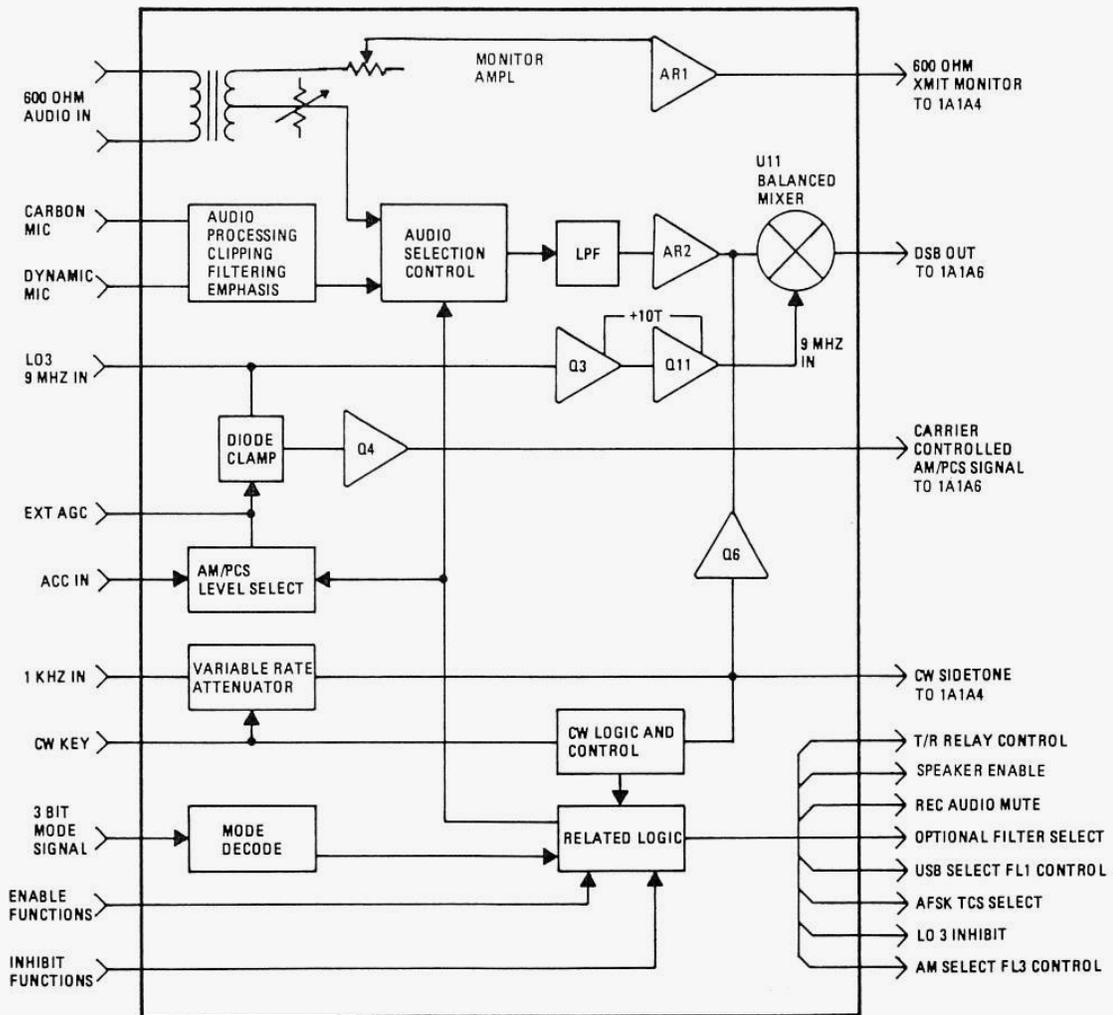




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## 1. GENERAL DESCRIPTION

The Processor PC Board functions in the transmit signal path to translate audio or other intelligence inputs to a 9 MHz IF frequency for use at the 1A1A6 Mixer. The Processor board will select any one of these four intelligence inputs as the modulation source at the 1st transmit mixer to produce the desired DSB output. The desired modulation source (600 ohm audio, dynamic mic, carbon mic, or cw) is selected by electronic switching in response to operator inputs and logic control elements.

ACC (Automatic Carrier Control) is effected on the Processor board in response to control inputs developed at the PA Control Board from VSWR and other information. A complete family of mode related control functions are generated on the Processor board in response to 3-bit mode control inputs from the front panel, as modified by related inhibit, enable, or other logic functions. These significant input and output functions are shown in abbreviated form on the cover to this section, and in increased detail in figure 3, the simplified overall block diagram of the 1A1A5 assembly.

## 2. TECHNICAL CHARACTERISTICS

### Power Requirements:

- +10V from 1A1A12
- +10R from 1A1A12
- +10T from 1A1A12

### Signal Inputs:

- LO3 9 MHz input from 1A1A10
- 1 kHz from 1A1A10
- 600 ohm line audio input via 1J4
- Carbon or dynamic mic input from front panel

### Signal Outputs:

- DSB output to 1A1A6
- 600 ohm transmit monitor to 1A1A4
- AM/PCS injection output to 1A1A6

### Control Inputs

- Transmit inhibit from 1A1A12
- ACC control inputs from 1A1A3 or 1J3
- Mic keyline from 1A2A1
- CW key from 1TB1
- Keyline enable
- 3-bit mode control from 1A1A12
- Tune power receive from 1J4

### Control Inputs (continued):

- Mic enable
- RF-281 keyline enable

### Control Outputs:

- FL1 filter control to 1A1A6 0 = select
- FL2 filter control to 1A1A6 0 = select
- FL3 filter control to 1A1A6 0 = select
- LO3 inhibit to 1A1A10 0 = LO inhibited
- T/R relay control to 1A1A12 0 = Transmit
- FSK TC select to 1A1A4 1 = FSK TC select
- Speaker enable to 1A1A4 1 = speaker on
- AM enable to 1A1A4 0 = AM enable
- Mute control to 1A1A4 0 = mute

## 3. SEMICONDUCTOR COMPLEMENT

REF. DESIG.	TYPE	FUNCTION
AR1, AR2	CA324E	Quad Operational Amplifier
CR1	1N4454	Diode
CR2	HP3080	Diode, Pin
CR3, CR4	1N4454	Diode
CR5	1N277	Diode
CR6	1N4454	Diode
CR7	1N277	Diode
CR8	MPN3401	Diode
CR9	1N4454	Diode
CR10	MSD6150	Dual schottky diode
CR11, CR12	1N4454	Diode
CR13	1N4004	Diode
CR14	1N4454	Diode
Q1, Q2	2N4126	Transistor, PNP
Q3, Q4	2N3563	Transistor, NPN
Q5	2N4126	Transistor, PNP
Q6, Q7	2N4124	Transistor, NPN
Q8	2N4921	Transistor, NPN
Q9, Q10	2N4124	Transistor, NPN
Q11	2N3563	Transistor, NPN
U1	CD4011AE	Quad 2-Input NAND gates
U2	CD4069BE	Hex inverter
U3	CD4001AE	Quad 2-Input NOR gates
U4	CD4028AE	BCD-to-Decimal decoder
U5	CD4053A2	Triple 2-Channel Multiplexer
U6	MC3340D	Electronic Attenuator (sw)
U7, U8	Not used	
U9	CD4073BE	Triple 3-Input AND gates
U10	CA4023AE	Triple 3-Input NAND gates
U11	6628-0666	Double balanced mixer

## 4. CIRCUIT DESCRIPTION

The 1A1A4 PC Board Assembly performs several initial transmitter signal path processing and control



functions. The introductory block diagram on the cover of this section summarizes these functions and shows most significant relationships. Figure 3 is a detailed block diagram showing all significant logic and control elements, and includes all signal inputs and outputs.

#### 4.1 Transmit Audio - to - 9 MHz IF

U11 constitutes the primary 1A1A5 signal processing element. Detailed information on this balanced mixer is given in the General Information Section of this manual under Maintenance. Figure 1 is a schematic diagram of the mixer and provides sufficient information for our purpose here. With a pure, 9 MHz signal input at pins 1 and 2, there will be almost no output at pins 7 and 8. The carrier is essentially cancelled, or "balanced out" by the electrical symmetry of the mixer. As a consequence, in the single sideband mode, with no modulation present, there should be zero power out.

With an audio input to the mixer, sidebands are produced above and below the 9 MHz carrier as a function of the modulating voltage. A pure 1000 Hz audio input would produce two separate sidebands with one displaced 1 kHz above the 9 MHz carrier frequency, and one displaced 1 kHz below the 9 MHz carrier frequency. If the modulating audio were a complex voice signal, the upper and lower sideband energy would be displaced evenly above and below as a function of the modulating voltage. If the complex DSB output at P1-7 were observed on a spectrum analyzer, it would appear similar to that shown in figure 3.

The 9 MHz LO3 carrier signal is generated at 1A1-A10. The modulating audio can originate from either a carbon mic, dynamic mic, 600 ohm audio input, or 1 kHz CW tone. If a carbon mic is used, dc operating potential is obtained through R48 to +10T with developed audio coupled via C25 and C27 to the filter/amplifier and audio processing circuits of AR2.

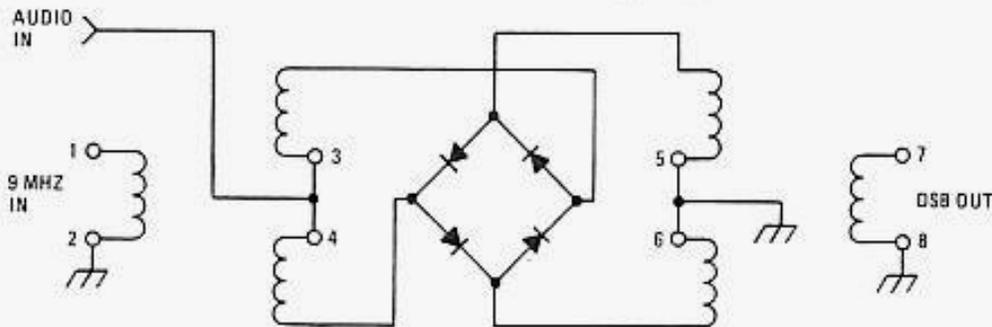


Figure 1. U11 Mixer Schematic

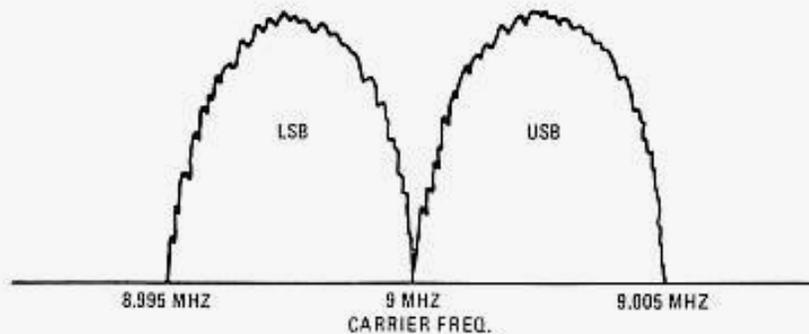


Figure 2. Processor DSB Output

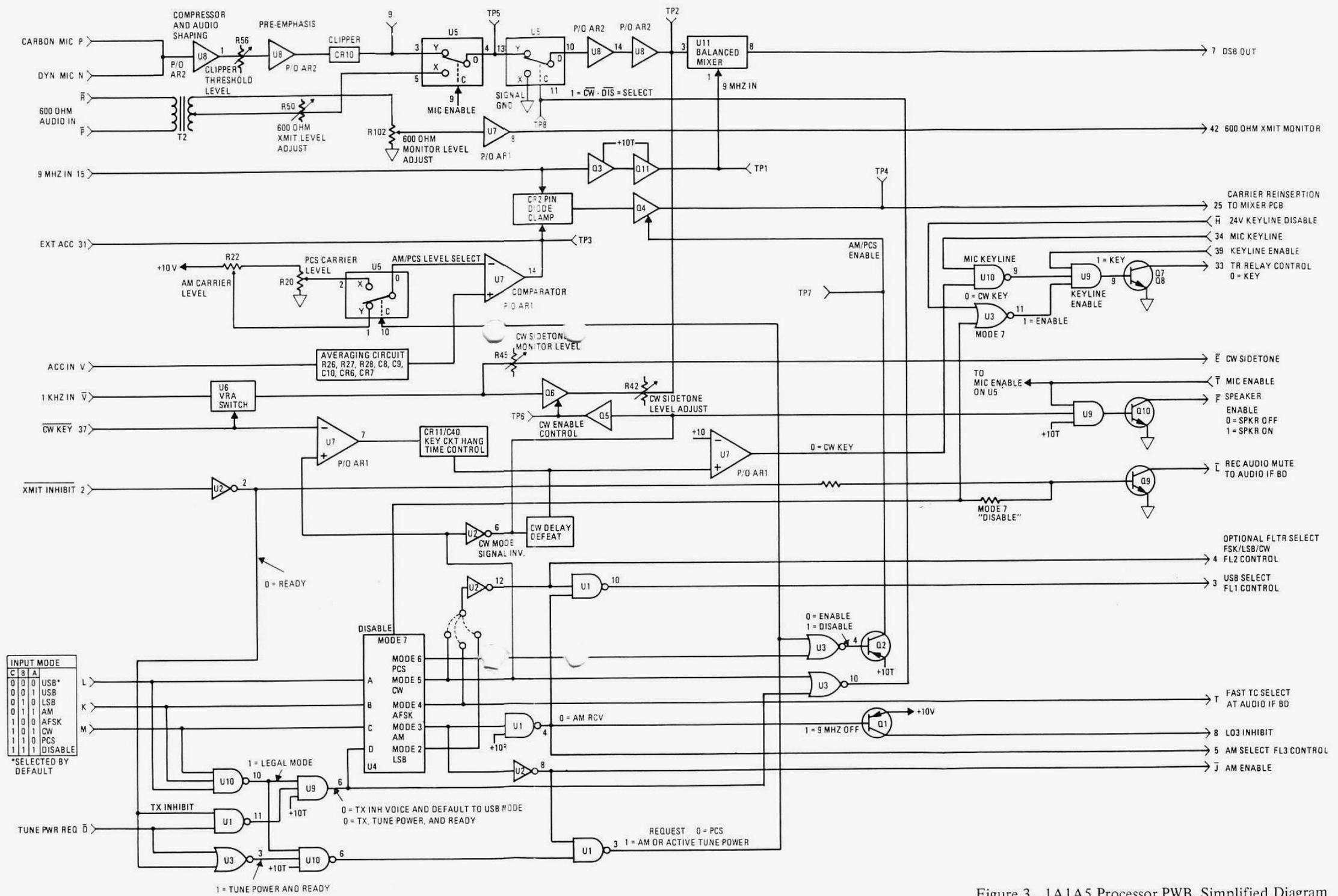


Figure 3. 1A1A5 Processor PWB, Simplified Diagram



If a dynamic mic is used, no power source is required, and the voice generated signal energy is coupled through L3 to C27 where it shares a common signal path with the carbon mic input. R56 at the AR2-1 output establishes the clipper threshold. This threshold is normally adjusted to 0.59V (peak-to-peak) at TP8, with a 1 kHz, 5 mV, (200 ohm source) input at P1-N, USB, Keydown. These clipper amplifier, and emphasis circuits provides maximum talk power output.

The microphone output from the speech processing network is routed through an element of quad bilateral switch U5, for control. With a logic "1" at pin 9, the microphone output is selected. With a logic "0" at pin 9 the 600 ohm audio input from T2 is selected. R50 adjusts the 600 ohm line level. With a 0 dBm input at P1-R and P1-P, R50 is adjusted for a nominal 126 mV (peak-to-peak) level at TP2. The selected audio output at U5-4 is not fed directly to the mixer audio input, but is fed back to another section of quad bilateral switch U5 at the pin 13 "Y" input. With a logic "1" at U5-11, the "Y" input is selected and fed through low pass filter and amplifier AR2. Note that the "X" input at U5-12 is simply the op ampl. reference, and as a consequence, with a logic "0" control input at pin U5-11, the "X" input is selected, and the audio input to the mixer is effectively locked out. This logic level is derived from the mode control logic. Either a "CW", or a "DISABLE" mode control condition would cause the logic line to go low and disable the audio inputs.

#### 4.2 CW Signal Development

With CW selected, normal audio input to the balanced mixer via low pass filter and amplifier AR2 is shut off, and the CW input is "enabled". The CW modulation input is actually a "keyed", and "shaped" 1000 Hz note from the 1A1A10 Frequency Standard PC Board. Keying and shaping is accomplished on the Processor by variable rate attenuator U6. A CW key ground signal from an external hand key would cause P1-37 to go low and effect a "shaped" turn on of U6. Using a variable rate attenuator to control the 1 kHz cw signal produces literally ideal wave-shape characteristics. Key clicks and other undesirable by-products that detract from cw "readability" are completely eliminated in this system. The "shaped" 1 kHz cw note is amplified by U6 (which is enabled by Q5 as a result of the inverted cw mode select signal through U2), level controlled by R42, and applied

as the modulating audio input to balanced mixer U11. CW transmission is thus effected as sideband intelligence, and will appear in the frequency spectrum displaced 1 kHz above the carrier frequency at the transmitter output. For ease of operation a sidetone is taken off U6 and through level control R45 is injected into the speaker/volume control.

#### 4.3 AM/PCS Carrier Level Control

AM/PCS Carrier Level Control is effected through an element of quad bilateral switch U5. A logic "1" at the U5-10 control input will select the AM reference level established by R22, and a logic "0" at the same point will select the PCS level established by R20. This control voltage is used at U7-13 to establish the desired AM or PCS carrier level. An ACC (Automatic Carrier Control) input from the Control PC Board functions to maintain the desired level. If the carrier output should tend to increase, this increase would cause an increased ACC control voltage input at P1-V, which after processing in an averaging circuit, is applied to the non-inverting input of U7 at pin 12. An increasing ACC input will thus cause an increasing control voltage output at U7-14 (TP3) and increase the current through CR2. This diode attenuator control would tend to reduce the AM/PCS output through Q4 to correct for the increase sensed at the output. The AM/PCS output to the 1A1A6 Mixer is thus a precise, level controlled, 9 MHz signal that bypasses the balanced mixer to provide the desired level of carrier re-insertion.

#### 4.4 Mode Control

Mode control information enters the Processor PC Board in a 3-bit code, is applied to the A, B, and C inputs of BCD-to-Decimal decoder U4 and produces a mode-related one of seven output. The input code-to-mode relationship is shown in the table accompanying figure 3.

##### 4.4.1 USB Select

USB is selected by default in that there is no U4 output pin for this function. Whenever another mode is not selected, USB is automatically selected by "default". USB select is controlled by a low logic level output from U1-10,  $USB = \overline{AM} + \overline{FSK} + \overline{LSB} + CW$ . Transmit audio would also be enabled by a logic "1" at U5-11 in the USB mode.

##### 4.4.2 LSB/FSK/CW Select

Decoded control outputs for these modes terminate in a jumper select system. The jumper can be



used to complete only one of these three options. If the system was purchased to include LSB, and a LSB filter was installed in the optional filter position (FL2) on the Mixer PC Board, then the jumper would be installed to pick-off the LSB select signal from U4-2. Inverter U2 would translate the decoded LSB select "1" output from U4-2, to the desired low logic level FL2 select "0" output at P1-4. If the system was purchased for FSK or CW operation, then obviously the corresponding jumper would be installed. Whichever of these modes is not selected by a jumper, the system defaults to USB.

#### 4.4.3 AM Select

The AM mode select high output at U4-3 is inverted by U2 to produce a low AM Enable output at P1-J for use at the IF Audio PC Board; and this same inverted signal is used at U1 to generate the AM Carrier Level Select Signal at U5-10. The AM Mode Select Signal is used with +10R to generate the LO3 select signal and the LO3 Inhibit Signal. In receive mode (+10R), an LO3 Inhibit Signal is generated at U1-4. The two high inputs to NAND gate U1 produce a low output to bias ON PNP transistor Q1. With Q1 ON a high LO3 Inhibit voltage will be present at P1-8. The low U1-4 output is used directly at P1-5 as the FL3 select signal. Note USB filter is used for AM transmit.

#### 4.4.4 PCS Select

The PCS level select function is accomplished by the AM condition at U5-10. The PCS Mode Select high logic level is used at NOR Gate U3 to produce a low at the output, bias ON Q2 and enable Q4 to produce the PCS carrier output to the mixer.

#### 4.4.5 Disable

When U4 decodes a decimal 7 output, U4-4 goes high, biases ON Q9, and produces a low P1-I MUTE control condition to the IF Audio PC Board. The same U4-4 high condition at NOR gate U3-13 produces a disable condition at the U9-1 T/R Relay control gate input to disable the transmitter.

#### 4.4.6 Pre-emptive Control Line Functions

TPR (Tune Power Request) and TXI (Transmit Inhibit) control inputs at U1-13 and U1-12 are tied to pull-up resistors to produce a constant "0" output at U1-11. If either of these lines go low, the U1-11 output state would change to a "1" condition, and when "anded" with the +10T Logic input at U9-4, requires only a "1" input at U9-5 to produce a disable output at U9-6. U10-10 will

produce a "1" output for any mode control input other than the disable code (which would in itself disable the radio), and as a consequence, if either the TPR or the TXI control lines go low, the normal mode control circuitry is disabled. In addition, the TPR signal thru U3-3 would automatically select the following:

- Transmit Audio Off
- AM Injection Amplifiers On
- AM Carrier Level Selected
- USB Filter On

If the TXI control line goes low, the following conditions will be automatically selected:

- Audio Mute (Receive)
- AM/PCS Disabled
- USB Filter Selected
- TX Audio Off

## 5. MAINTENANCE

All of the adjustments indicated in this paragraph have been made at the factory prior to shipment. It should not be necessary to repeat any of these adjustments unless component failure is experienced, or unless readjustment becomes necessary for some other specific reason. All of these adjustments could be made without removing the board from the unit, however, removing the PC Board and re-installing it on the extender card as shown in figure 4 will normally facilitate maintenance and adjustment by making all test points readily available. These adjustments can all be made using the test equipment shown or the electrical equivalents. Figure 5 summarizes IA1A5 Inputs/Outputs and locates significant adjustment points.

### CAUTION

Always remove power when removing or reinstalling subassemblies.

### 5.1 R56, Microphone Level Adjust Control

This procedure establishes the clipper threshold to a level just below the nominal TP9 signal level.

- a. Connect Audio Signal Generator to 200 ohm dynamic mic input at P1-N, and adjust input to 5 mV rms at 1 kHz.



b. Connect the oscilloscope to monitor the 1 kHz audio input waveshape at TP9 (Clipper CR-10 output).

c. Terminate antenna output connector (J1) in 50 ohm dummy load, select USB mode, and complete mic keyline to ground at P1-34.

d. Adjust Microphone Level Adjust control R56, (as observed on oscilloscope) such that wave-peak just begins to flatten (approx. 0.6V P-P).

#### Note

Clipping occurs at approx. 0.6V P-P.

e. Verify 126 mV peak-to-peak at TP2.

f. This completes adjustment. Reconfigure for normal operation or proceed to next step.

### 5.2 R42, CW Sidetone Level Adjustment

This adjustment established cw modulation level. Terminate antenna output connector J1 in 50 ohm dummy load.

a. Select or verify cw mode and complete cw key circuit to ground either at P1-37, or at cw key connection at rear of radio.

b. Verify 1 kHz 280 mV rms input at P1-V.

c. Adjust R42 for 126 mV peak-to-peak at TP2.

d. This completes adjustment. Reconfigure for normal operation or proceed to next step.

### 5.3 R45 CW Sidetone Monitor Adjustment

This adjustment establishes nominal cw sidetone monitor level.

a. Setup for test as for paragraph 5.2 and verify paragraph 5.2 complete.

b. Measure at P1-E and adjust R45 for 220 mV rms.

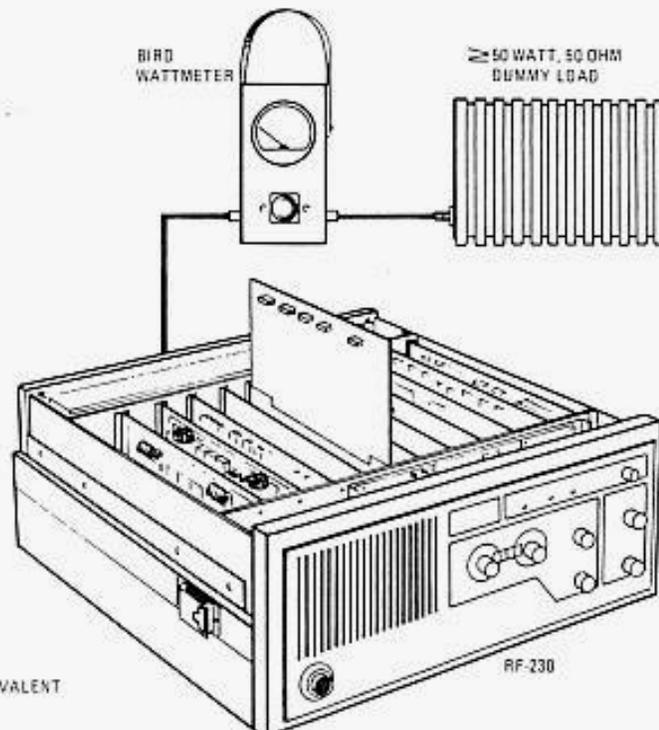
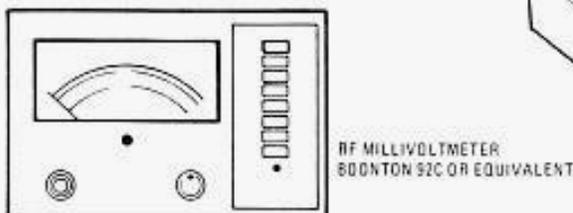
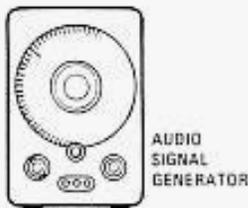


Figure 4. Typical 1A1A5 Test Elements



c. This completes adjustment. Reconfigure for normal operation or proceed to next step.

#### 5.4 R22/R20 AM/PCS Carrier Level Adjustment

This adjustment establishes the normal no-modulation AM carrier level at 40 watts, and PCS level at 3.1 watts.

a. Connect antenna output at J1 through Bird Wattmeter to 50 ohm dummy load. Position wattmeter slug to measure forward power.

b. Select or verify AM Mode at RF-230.

c. Disconnect front panel mic and verify no audio input at 600 ohm transmit audio input – this step verifies no-modulation condition for test.

d. Ground P1-34 on Processor PC Board to key transmitter.

e. Adjust R22 for 40 watts (carrier output) at Bird Wattmeter.

f. Select PCS mode on Program Board 1A1A7, and adjust R20 for 3.1 watts at Bird Wattmeter.

g. This completes adjustment. Reconfigure for normal operation, or as desired.

#### 5.5 R50/R102 600 Ohm Transmit Audio Adjustment.

a. Connect Audio Signal Generator to 600 Ohm Transmit Audio input at P1-P and P1-R and adjust for 0 dBm (0.78V rms) at 1 kHz. This input can also be made at normal system 600 ohm audio input if more convenient.

b. Select USB mode and key transmitter.

c. Adjust R50 for 126 mV peak-to-peak at TP2.

d. Adjust R102 for 220 mV rms Transmit Audio monitor level at P1-42.

e. This completes adjustment. Reconfigure for normal operation.

#### 6. PARTS LISTS

Table 1 lists all 1A1A5 Maintenance Parts. All of these components can be identified in figure 6.

#### 7. SCHEMATIC

Figure 7 is a complete schematic diagram of the 1A1A5 assembly.



1	GND	A	GND		
2	XMIT INHIBIT FROM 1A1A12	B	GND		
3	FL1 USB FILTER CONTROL TO 1A1A6	C	GND		
4	FL2 OPT. FILTER CONTROL TO 1A1A6	D	GND		
5	FL3 AM FILTER CONTROL TO 1A1A6	E	GND		
6	GND (DSB OUT SIGNAL GND)	F	GND	⊗	R56 CLIPPER LEVEL ADJUST
7	DSB OUT TO 1A1A6	H	DSB OUT TO 1A1A6		
8	LO3 INHIBIT TO 1A1A10	J	GND		
9		K	MODE B IN FROM 1A1A12		
10		L	MODE A IN FROM 1A1A12		
11		M	MODE C IN FROM 1A1A12		
12	GND	N	DYN MIC FROM 1A2A1	⊖	R42 1 KHZ LEVEL ADJUST
13	GND	P	CARBON MIC FROM 1A2A1		
14	GND	R	GND	⊗	R45 CW SIDETONE OUTPUT LEVEL
15	LO3 9 MHZ IN FROM 1A1A10	S			
16		T	FSK TC SELECT TO 1A1A4		
17		U	ACC REF FROM 1A1A3	⊖	R22 AM REF
18		V	ACC FROM 1A1A3		
19	GND	W		⊗	R20 PCS REF
20	+10T	X			
21	+10V	Y			
22	+10R	Z		⊗	R50 600 OHM AUDIO INPUT LEVEL ADJ
23		a			
24	GND	b			
25	AM/PCS INJECTION OUT TO 1A1A6	c	GND		
26	GND	d	TUNE PWR REQUIRED FROM 1J4	⊖	R102 600 OHM MONITOR LEVEL ADJ
27	GND	e	SIDETONE OUT TO 1A1A4		
28	GND	f	SPEAKER ENABLE TO 1A1A4		
29	GND	h	RF-281 KEYLINE DISABLE		
30	GND	j	AM ENABLE TO 1A1A4		
31	EXT ACC FROM 1J3	k			
32		l	MUTE CONTROL TO 1A1A4		
33	T/R RELAY CONTROL TO 1A1A12	m			
34	MIC KEYLINE FROM 1A2A1	n			
35		p	600 OHM IN FROM 1J4		
36		r	600 OHM IN FROM 1J4		
37	CW KEY FROM 1TB1	s			
38		t	MIC ENABLE		
39	KEYLINE ENABLE	u			
40		v	1 KHZ FROM 1A1A10		
41		w			
42	600 OHM XMIT MONITOR TO 1A1A4	x			
43	GND	y			

Figure 5. 1A1A5 Input/Output Summary



TABLE 1. 1A1A5 MAINTENANCE PARTS LIST

Ref. Desig.	Name & Description	Mfr. Code	Part Number
1A1A5	Processor PWB Assembly	14304	6628-0600
AR1,AR2	Integrated Circuit, Quad Operational Amplifier, CA324E	14304	IC-0359
AT1	Integrated Circuit, Electronic Attenuator, MC3340P	14304	IC-0171
C1,C2	Capacitor, Fixed, Ceramic, .1 uF +80-20%, 50V	14304	C-3202
C3	Capacitor, Fixed, Ceramic, .01 uF ±20%, 50V	14304	C-4952
C4,C5	Capacitor, Fixed, Ceramic, .1 uF +80-20%, 50V	14304	C-3202
C6-C8	Capacitor, Fixed, Ceramic, .01 uF ±20%, 50V	14304	C-4952
C9,C10	Capacitor, Fixed, Tantalum, 15 uF ±10%, 20V	14304	C-3103
C11	Capacitor, Fixed, Ceramic, .01 uF ±20%, 50V	14304	C-4952
C12	Capacitor, Fixed, Tantalum, 6.8 uF ±10%, 35V	14304	C-3102
C13-C15	Capacitor, Fixed, Ceramic, .01 uF ±20%, 50V	14304	C-4952
C16	Capacitor, Fixed, Ceramic, .1 uF +80-20%, 50V	14304	C-3202
C17-C19	Capacitor, Fixed, Ceramic, .01 uF ±20%, 50V	14304	C-4952
C20	Capacitor, Fixed, Ceramic, .1 uF +80-20%, 50V	14304	C-3202
C21	Capacitor, Fixed, Tantalum, 6.8 uF ±20%, 35V	14304	C-3102
2	Capacitor, Fixed, Ceramic, .01 uF ±20%, 50V	14304	C-4952
C23	Capacitor, Fixed, Tantalum, 6.8 uF ±10%, 35V	14304	C-3102
C24	Capacitor, Fixed, Tantalum, 2.2 uF ±20%, 20V	14304	C-6444
C25	Capacitor, Fixed, Tantalum, 15 uF ±10%, 20V	14304	C-3103
C26	Capacitor, Fixed, Ceramic, .001 uF ±10%, 500V	14304	C-3513
C27	Capacitor, Fixed, Tantalum, .47 uF ±20%, 35V	14304	C-6419
C28,C29	Capacitor, Fixed, Ceramic, .01 uF ±20%, 50V	14304	C-4952
C30	Capacitor, Fixed, Tantalum, 1 uF ±20%, 35V	14304	C-3100
C31	Capacitor, Fixed, Tantalum, 2.2 uF ±20%, 20V	14304	C-6444
C32,C33	Capacitor, Fixed, Ceramic, 150 pF ±10%, 500V	14304	C-3502
C34	Capacitor, Fixed, Tantalum, 2.2 uF ±20%, 20V	14304	C-6444
C35	Capacitor, Fixed, Ceramic, .1 uF +80-20%, 50V	14304	C-3202
C36	Capacitor, Fixed, Ceramic, .033 uF ±10%, 100V	14304	C11-0008-333
C37	Capacitor, Fixed, Ceramic, .01 uF ±10%, 100V	14304	C11-0008-103
C38	Capacitor, Fixed, Tantalum, 2.2 uF ±10%, 20V	14304	C-6444
C39	Capacitor, Fixed, Tantalum, 22 uF ±20%, 25V	14304	C-6439
C40	Capacitor, Fixed, Tantalum, 10 uF ±20%, 20V	14304	C-6448
C41	Capacitor, Fixed, Tantalum, .33 uF ±20%, 35V	14304	C-6418
?	Capacitor, Fixed, Ceramic, .1 uF +80-20%, 50V	14304	C-3202
C43	Capacitor, Fixed, Tantalum, 6.8 uF ±10%, 35V	14304	C-3102
C44	Capacitor, Fixed, Ceramic, .1 uF +80-20%	14304	C-3202
C45	Capacitor, Fixed, Ceramic, .01 uF ±20%, 50V	14304	C-4952
CR1	Diode, Signal, 1N4454	14304	CR-0705
CR2	Diode, Pin, HP-3080	14304	CR-0294
CR3,CR4	Diode, Signal, 1N4454	14304	CR-0705
CR5	Diode, Signal, 1N277	14304	CR-0065
CR6	Diode, Signal, 1N4454	14304	CR-0705
CR7	Diode, Signal, 1N277	14304	CR-0065
CR8	Diode, Pin, MPN3401	14304	CR-0746
CR9	Diode, Signal, 1N4454	14304	CR-0705
CR10	Diode, Twin, Common Anode	14304	CR-0038



TABLE 1. 1A1A5 MAINTENANCE PARTS LIST (Continued)

Ref. Desig.	Name & Description	Mfr. Code	Part No.
CR11, CR12	Diode, Signal, 1N4454	14304	CR-0705
CR13	Diode, Rectifier, 1N4004	14304	CR-0725
CR14	Diode, Signal, 1N4454	14304	CR-0705
CR15 to CR17	Diode, Rectifier, 1N4004	14304	CR-0725
JMP1-JMP11	Jumper, Circuit	14304	MP-1142
L1, L2	Choke, RF, 56 uH	14304	L-0637
L3	Choke, RF, 1 mH	14304	L-0050
L4	Choke, RF, 100 uH	14304	L-0640
Q1, Q2	Transistor, PNP, 2N4126	14304	Q-0386
Q3, Q4	Transistor, NPN, 2N3563	14304	Q-0309
Q5	Transistor, PNP, 2N4126	14304	Q-0386
Q6, Q7	Transistor, NPN, 2N4124	14304	Q-0385
Q8	Transistor, NPN, 2N4921	14304	Q-0334
Q9, Q10	Transistor, NPN, 2N4124	14304	Q-0385
Q11	Transistor, NPN, 2N3563	14304	Q-0309
R1	Resistor, Fixed, Composition, 1K $\pm$ 5%, 1/4W	Mil type	RCR07G102JM
R2	Resistor, Fixed, Composition, 100K $\pm$ 5%, 1/4W	Mil type	RCR07G104JM
R3	Resistor, Fixed, Composition, 39K $\pm$ 5%, 1/4W	Mil type	RCR07G393JM
R4	Resistor, Fixed, Composition, 1K $\pm$ 5%, 1/4W	Mil type	RCR07G102JM
R5 to R7	Resistor, Fixed, Composition, 10K $\pm$ 5%, 1/4W	Mil type	RCR07G103JM
R8, R9	Resistor, Fixed, Composition, 1K $\pm$ 5%, 1/4W	Mil type	RCR07G102JM
R10	Resistor, Fixed, Composition, 39K $\pm$ 5%, 1/4W	Mil type	RCR07G393JM
R11	Resistor, Fixed, Composition, 100K $\pm$ 5%, 1/4W	Mil type	RCR07G104JM
R12	Resistor, Fixed, Composition, 100 Ohm $\pm$ 5%, 1/4W	Mil type	RCR07G101JM
R13	Resistor, Fixed, Composition, 4.7K $\pm$ 5%, 1/4W	Mil type	RCR07G472JM
R14	Resistor, Fixed, Composition, 1K $\pm$ 5%, 1/4W	Mil type	RCR07G102JM
R15	Resistor, Fixed, Composition, 4.7K $\pm$ 5%, 1/4W	Mil type	RCR07G472JM
R16	Resistor, Fixed, Composition, 1K $\pm$ 5%, 1/4W	Mil type	RCR07G102JM
R17	Resistor, Fixed, Composition, 220 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G221JM
R18	Resistor, Fixed, Composition, 220K $\pm$ 5%, 1/4W	Mil type	RCR07G224JM
R19	Resistor, Fixed, Composition, 10K $\pm$ 5%, 1/4W	Mil type	RCR07G103JM
R20	Resistor, Variable, 5K	14304	R-2227
R21	Not Used		
R22	Resistor, Variable, 10K	14304	R-2228
R23	Resistor, Fixed, Composition, 100K $\pm$ 5%, 1/4W	Mil type	RCR07G104JM
R24	Resistor, Fixed, Composition, 180K $\pm$ 5%, 1/4W	Mil type	RCR07G184JM
R25	Resistor, Fixed, Composition, 1.5K $\pm$ 5%, 1/4W	Mil type	RCR07G152JM
R26	Resistor, Fixed, Composition, 33K $\pm$ 5%, 1/4W	Mil type	RCR07G333JM
R27, R28	Resistor, Fixed, Composition, 2.7K $\pm$ 5%, 1/4W	Mil type	RCR07G272JM
R29	Not used		
R30	Resistor, Fixed, Composition, 820 Ohm $\pm$ 5%, 1/4W	Mil type	RCR07G821JM
R31	Resistor, Fixed, Composition, 470 Ohm $\pm$ 5%, 1/4W	Mil type	RCR07G471JM



TABLE 1. 1A1A5 MAINTENANCE PARTS LIST (Continued)

Ref. Desig.	Name & Description	Mfr. Code	Part No.
R32	Resistor, Fixed, Composition, 270 Ohm $\pm 5\%$ , 1/4W	Mil type	RCR07G271JM
R33	Resistor, Fixed, Composition, 160 Ohm $\pm 5\%$ , 1/4W	Mil type	RCR07G161JM
R34	Resistor, Fixed, Composition, 10K $\pm 5\%$ , 1/4W	Mil type	RCR07G103JM
R35	Resistor, Fixed, Composition, 39K $\pm 5\%$ , 1/4W	Mil type	RCR07G393JM
R36	Resistor, Fixed, Composition, 100K $\pm 5\%$ , 1/4W	Mil type	RCR07G104JM
R37	Resistor, Fixed, Composition, 6.8K $\pm 5\%$ , 1/4W	Mil type	RCR07G682JM
R38	Resistor, Fixed, Composition, 3.9K $\pm 5\%$ , 1/4W	Mil type	RCR07G392JM
R39	Resistor, Fixed, Composition, 12K $\pm 5\%$ , 1/4W	Mil type	RCR07G123JM
R40	Resistor, Fixed, Composition, 5.6K $\pm 5\%$ , 1/4W	Mil type	RCR07G562JM
R41	Resistor, Fixed, Composition, 1K $\pm 5\%$ , 1/4W	Mil type	RCR07G102JM
R42	Resistor, Variable, 500 Ohm	14304	R-2224
R43	Resistor, Fixed, Composition, 330 Ohm $\pm 5\%$ , 1/4W	Mil type	RCR07G331JM
R44	Resistor, Fixed, Composition, 51 Ohm $\pm 5\%$ , 1/4W	Mil type	RCR07G510JM
R45	Resistor, Variable, 5K	14304	R-2227
R46	Resistor, Fixed, Composition, 1K $\pm 5\%$ , 1/4W	Mil type	RCR07G102JM
R47	Not used		
R48	Resistor, Fixed, Composition, 4.7K $\pm 5\%$ , 1/4W	Mil type	RCR07G472JM
R49	Resistor, Fixed, Composition, 510 Ohm $\pm 5\%$ , 1/4W	Mil type	RCR07G511JM
R50	Resistor, Variable, 100 Ohm	14304	R-2222
R51	Not Used		
R52, R53	Resistor, Fixed, Composition, 47K $\pm 5\%$ , 1/4W	Mil type	RCR07G473JM
R54	Resistor, Fixed, Composition, 3.3K $\pm 5\%$ , 1/4W	Mil type	RCR07G332JM
R55	Resistor, Fixed, Composition, 130K $\pm 5\%$ , 1/4W	Mil type	RCR07G134JM
R56	Resistor, Variable, 5K	14304	R-2227
R57	Resistor, Fixed, Composition, 3.9K $\pm 5\%$ , 1/4W	Mil type	RCR07G392JM
R58, R59	Resistor, Fixed, Composition, 100K $\pm 5\%$ , 1/4W	Mil type	RCR07G104JM
R60	Resistor, Fixed, Composition, 47K $\pm 5\%$ , 1/4W	Mil type	RCR07G473JM
R61, R62	Resistor, Fixed, Composition, 3.3K $\pm 5\%$ , 1/4W	Mil type	RCR07G332JM
R63	Resistor, Fixed, Composition, 47K $\pm 5\%$ , 1/4W	Mil type	RCR07G473JM
R64	Resistor, Fixed, Composition, 3.3K $\pm 5\%$ , 1/4W	Mil type	RCR07G332JM
R65	Resistor, Fixed, Composition, 68K $\pm 5\%$ , 1/4W	Mil type	RCR07G683JM
R66, R67	Resistor, Fixed, Composition, 2.4K $\pm 5\%$ , 1/4W	Mil type	RCR07G242JM
R68	Resistor, Fixed, Composition, 4.7K $\pm 5\%$ , 1/4W	Mil type	RCR07G472JM
R69	Resistor, Fixed, Composition, 560 Ohm $\pm 5\%$ , 1/4W	Mil type	RCR07G561JM
R70	Resistor, Fixed, Composition, 22K $\pm 5\%$ , 1/4W	Mil type	RCR07G223JM
R71	Resistor, Fixed, Composition, 470 Ohm $\pm 5\%$ , 1/4W	Mil type	RCR07G471JM
R72	Resistor, Fixed, Composition, 33K $\pm 5\%$ , 1/4W	Mil type	RCR07G333JM
R73	Resistor, Fixed, Composition, 390 Ohm $\pm 5\%$ , 1/4W	Mil type	RCR07G391JM
R74, R75	Resistor, Fixed, Composition, 1K $\pm 5\%$ , 1/4W	Mil type	RCR07G102JM
R75	Resistor, Fixed, Composition, 20K $\pm 5\%$ , 1/4W	Mil type	RCR07G203JM
R76, R77	Resistor, Fixed, Composition, 47K $\pm 5\%$ , 1/4W	Mil type	RCR07G473JM
R78	Resistor, Fixed, Composition, 20K $\pm 5\%$ , 1/4W	Mil type	RCR07G203JM



TABLE 1. 1A1A5 MAINTENANCE PARTS LIST (Continued)

Ref. Desig.	Name & Description	Mfr. Code	Part No.
R79, R80	Resistor, Fixed, Composition, 47K $\pm$ 5%, 1/4W	Mil type	RCR07G473JM
R81	Resistor, Fixed, Composition, 150K $\pm$ 5%, 1/4W	Mil type	RCR07G154JM
R82	Not used		
R83	Resistor, Fixed, Composition, 33K $\pm$ 5%, 1/4W	Mil type	RCR07G333JM
R84	Resistor, Fixed, Composition, 27K $\pm$ 5%, 1/4W	Mil type	RCR07G273JM
R85	Resistor, Fixed, Composition, 150K $\pm$ 5%, 1/4W	Mil type	RCR07G154JM
R86	Resistor, Fixed, Composition, 330 Ohm $\pm$ 5%, 1/4W	Mil type	RCR07G331JM
R87	Resistor, Fixed, Composition, 47K $\pm$ 5%, 1/4W	Mil type	RCR07G473JM
R88	Resistor, Fixed, Composition, 390K $\pm$ 5%, 1/4W	Mil type	RCR07G394JM
R89	Resistor, Fixed, Composition, 47K $\pm$ 5%, 1/4W	Mil type	RCR07G473JM
R90	Resistor, Fixed, Composition, 100 Ohm $\pm$ 5%, 1/4W	Mil type	RCR07G101JM
R91, R92	Resistor, Fixed, Composition, 47K $\pm$ 5%, 1/4W	Mil type	RCR07G473JM
R93	Resistor, Fixed, Composition, 10K $\pm$ 5%, 1/4W	Mil type	RCR07G103JM
R94	Resistor, Fixed, Composition, 12K $\pm$ 5%, 1/4W	Mil type	RCR07G123JM
R95 to R100	Resistor, Fixed, Composition, 100K $\pm$ 5%, 1/4W	Mil type	RCR07G104JM
R101	Not used		
R102	Resistor, Variable, 10K	14304	R-2228
R103	Resistor, Fixed, Composition, 15K $\pm$ 5%, 1/4W	Mil type	RCR07G153JM
R104	Not used		
R105	Resistor, Fixed, Composition, 150K $\pm$ 5%, 1/4W	Mil type	RCR07G154JM
R106	Resistor, Fixed, Composition, 470 Ohm $\pm$ 5%, 1/4W	Mil type	RCR07G471JM
R107	Resistor, Fixed, Composition, 2.2K $\pm$ 5%, 1/4W	Mil type	RCR07G222JM
R108	Resistor, Fixed, Composition, 1K $\pm$ 5%, 1/4W	Mil type	RCR07G102JM
R109	Resistor, Fixed, Composition, 56 Ohm $\pm$ 5%, 1/4W	Mil type	RCR07G560JM
R110	Resistor, Fixed, Composition, 30 Ohm $\pm$ 5%, 1/4W	Mil type	RCR07G300JM
R111	Resistor, Fixed, Composition, 39 Ohm $\pm$ 5%, 1/4W	Mil type	RCR07G390JM
R112	Resistor, Fixed, Composition, 270 Ohm $\pm$ 5%, 1/4W	Mil type	RCR07G271JM
R113	Resistor, Fixed, Composition, 51 Ohm $\pm$ 5%, 1/4W	Mil type	RCR07G510JM
R114	Resistor, Fixed, Composition, 22K $\pm$ 5%, 1/4W	Mil type	RCR07G510JM
T1	Not used		
T2	Transformer, 600 ohm, Audio	14304	919-1321
TP1	Test Point, Brown	14304	J-0071
TP2	Test Point, Red	14304	J-0066
TP3	Test Point, Orange	14304	J-0069
TP4	Test Point, Yellow	14304	J-0070
TP5	Test Point, Green	14304	J-0068
TP6	Test Point, Blue	14304	J-0072
TP7	Test Point, Violet	14304	J-0073
TP8	Test Point, Gray	14304	J-0074
TP9	Test Point, White	14304	J-0065
U1	Integrated Circuit, Quad 2-Input NAND Gate CD4011AE	14304	IC-0136
U2	Integrated Circuit, Hex Inverter, CD4069BE	14304	IC-0387



TABLE 1. 1A1A5 MAINTENANCE PARTS LIST (Continued)

Ref. Desig.	Name & Description	Mfr. Code	Part No.
U3	Integrated Circuit, Quad 2-Input NOR Gate, CD4001AE	14304	IC-0135
U4	Integrated Circuit, BDC-to-Decimal Decode, CD4028AE	14304	IC-0257
U5	Integrated Circuit, Triple 2-Channel Multiplexer, CD4053BE	14304	IC-0384
U6-U8	Not Used		
U9	Integrated Circuit, Triple 3-Input AND Gate, CD4073BE	14304	IC-0390
U10	Integrated Circuit, Triple 3-Input NAND Gate, CD4023AE	14304	IC-0142
U11	Mixer, Doubly Balanced	14304	6628-0666

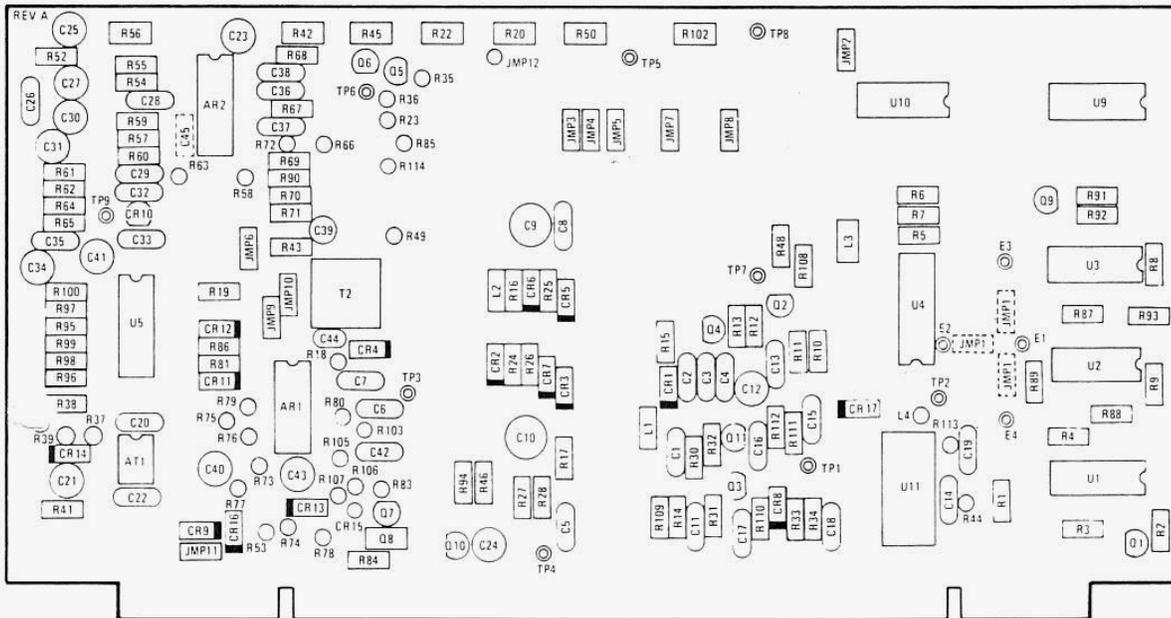


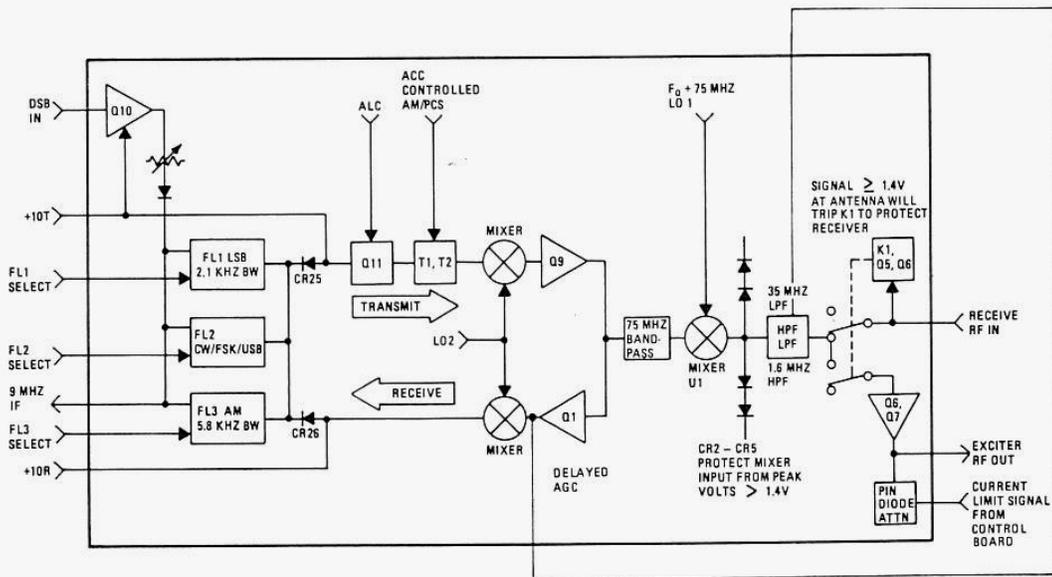
Figure 6. 1A1A5 Component Locations



# UNIT INSTRUCTIONS



# MIXER BOARD 1A1A6





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## 1. GENERAL INFORMATION

The 1A1A6 Mixer PC Board performs all of the major frequency conversion functions accomplished within the RF-230. In the transmit signal path, the double sideband 9 MHz input from the balanced modulator on the Processor PCB is selectively filtered to eliminate the unwanted sideband, and two frequency conversion functions translate the 9 MHz input first to a 75 MHz intermediate frequency, and then to the final operating frequency. Conversely, receive signals from the PA Filter are translated from the operating frequency, up to the 75 MHz 1st IF, then to the 9 MHz 2nd IF, and filtered before routing to the Audio IF PC Board as a 9 MHz IF signal.

In addition, the ALC control voltage input provides a 30 dB control range for transmit signal Automatic Level Control, and the automatically level controlled AM/PCS input from the Processor is recombined in the 9 MHz path on this board. Power limit control information from the Power Amplifier controls the final operating frequency RF Output to the PA Control Board. Receiver protection is also incorporated at this point to automatically react in the presence of excessive signal input voltages. Delayed AGC input from the Audio IF Board provides up to 36 dB attenuation with 1V at the antenna.

## 2. TECHNICAL CHARACTERISTICS

### Power Requirements:

+13.2 Vdc	P1-20
+10T	P1-17
+10R	P1-W

### Signal Inputs:

REC RF	P1-42	0.5 $\mu$ V @ $f_0$
LO1	P1-M	+7 dBm
LO2	P1-Z	+7 dBm
DSB IN	P1-J	9 MHz -20 dBm

### Signal Outputs:

EXCITER RF OUT	P1-38	Xmit $f_0$ at +5 dBm
9 MHz IF	P1-B	Receiver IF Signal

### Control Inputs:

ALC	P1-16	+1.5 - 8 Vdc from 1A1A3
DELAYED AGC	P1-35	0 - 6 Vdc from 1A1A4
CURRENT LIMIT	P1-36	0 - 0.7 Vdc from 1A1A3

### Control Inputs (continued):

FL1 SELECT	P1-D	+0.7V = Select
FL2 SELECT	P1-E	+0.7V = Select
FL3 SELECT	P1-F	+0.7V = Select

## 3. SEMICONDUCTOR COMPLEMENT

REF. DESIG.	TYPE	DESCRIPTION
CR1	5082-3080	Diode, PIN
CR2-CR5	1N4933	Diode, Signal
CR6, CR7	MPN3401	Diode, Pin
CR8	5082-3080	Diode, Pin
CR9-CR22	1N4454	Diode, Signal
CR23	MPN3401	Diode, Pin
CR24-CR26	1N4454	Diode, Signal
CR27	1N4004	Diode, Rectifier
CR28, CR29	1N4454	Diode, Signal
CR30	5082-3080	Diode, Pin
CR31	1N4004	Diode, Rectifier
Q1	2N5486	Transistor, NPN
Q2	3N187	Transistor, Dual Gate
Q3, Q4	2N4124	Transistor, NPN
Q5	MPS-A13	Transistor NPN Darlington Pair
Q6	2N5179	Transistor, NPN
Q7	2N3866	Transistor, NPN
Q8	2N4124	Transistor, NPN
Q9	2N5179	Transistor, NPN
Q10	2N4126	Transistor, PNP
Q11	3N187	Transistor, Dual Gate
Q12-Q15	2N4124	Transistor, NPN
U1, U2	6628-0666	Mixer, Doubly Balanced

## 4. CIRCUIT DESCRIPTION

Figure 2 and 3 are detailed diagrams showing all active mixer board elements and related inputs and outputs. Several other drawings are included, in addition to the complete schematic at the end of the section, as an aid to understanding transmit and receive signal paths and related components.

The Mixer PC Board performs two frequency conversion functions in both the transmit and the receive operating modes. In the transmit mode, the 9 MHz double sideband input from the Processor PC Board is filtered to select the desired spectral element, and converted in two mixing steps to the desired operating frequency. In the receive mode, the operating frequency signal input from the antenna, via filter elements in 1A1A1 or 1A1A2, is filtered and processed down in two mixing steps to a 9 MHz IF output frequency for final detection



at the Audio IF PC Board. Each of these functions will be traced in detail in subsequent paragraphs; the transmit signal path will be discussed first.

#### 4.1 Transmit Function

This discussion will presuppose that the RF-230 is keyed, and that a transmit audio signal is present at a level sufficient to produce full rated output. With these conditions, a nominal  $-20$  dBm signal level would be present at P1-J, the DSB input from the Processor PC Board.

The DSB input signal is fed via C54 to the base of Q10. R44 in the Q10 emitter circuit controls the gain of this stage, and is adjusted to provide the desired  $-14$  dBm drive level at TP4, the input to the first mixer. This adjustment must be made with R47 and the ALC system set for maximum gain.

The desired filter, FL1, FL2 or FL3, is selected by a low logic level on the appropriate filter select control line. As an example, to select FL1, a low logic level at P1-D (from 1A1A5) would bias Q3 and Q4 OFF. With Q3 and Q4 OFF, CR9 and CR10 would be forward biased and the signal path through FL1 would be complete. Note also that Q12, Q13, Q14, and Q15 would be biased ON by the high logic levels at P1-E and P1-F. With these control transistors ON, the voltages at their collectors would drop to approximately 0.7 Vdc and the signal diodes controlling FL2 and FL3 would be

turned OFF. In addition, Q12 through Q14 would provide a low impedance signal path to ground for the FL2 and FL3 input and output circuits.

Because of the frequency mixing scheme used in the RF-230, the LSB filter is actually used to select the upper sideband. This means that passing the DSB input through FL1 (designated LSB Filter) will actually select the lower sideband at this point, however, because of the mixing scheme, at the 2nd mixer output this sideband will actually appear in the operating frequency output spectrum as the upper sideband. Conversely, if the radio were a LSB radio, a USB filter would be installed in the optional filter position (FL2), and with this filter selected, the actual output information would be in lower sideband. Figure 1 shows FL1, FL2, and FL3 response curves to demonstrate spectral relationships at this point.

There are two signal paths at the filter output (with respect to the transmit signal); one is through CR25 and one is through CR26. These signal diodes function as transmit and receive mode gates. In the transmit mode, CR25 is forward biased by +10T through R39 and L23. CR26 is forward biased in the receive mode by +10R through R53.

The transmit output thru CR25 and C49 to Q11 is a 9 MHz signal containing only the selected sideband (or other information). This stage is ALC controlled and has a 25 dB gain control range. This means that the signal level at TP4, the mixer input,

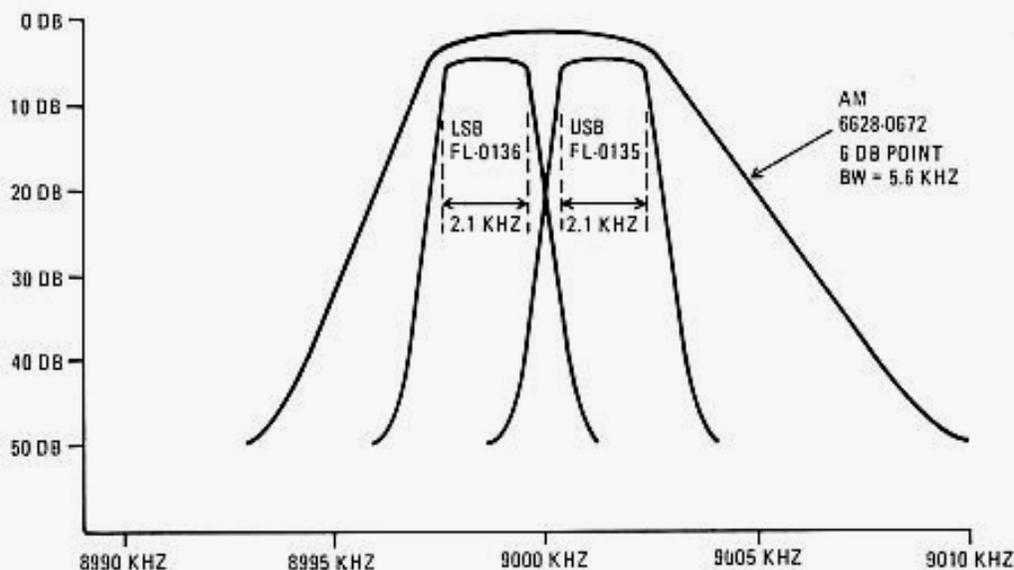


Figure 1. FL1, FL2, and FL3 Spectral Relationships

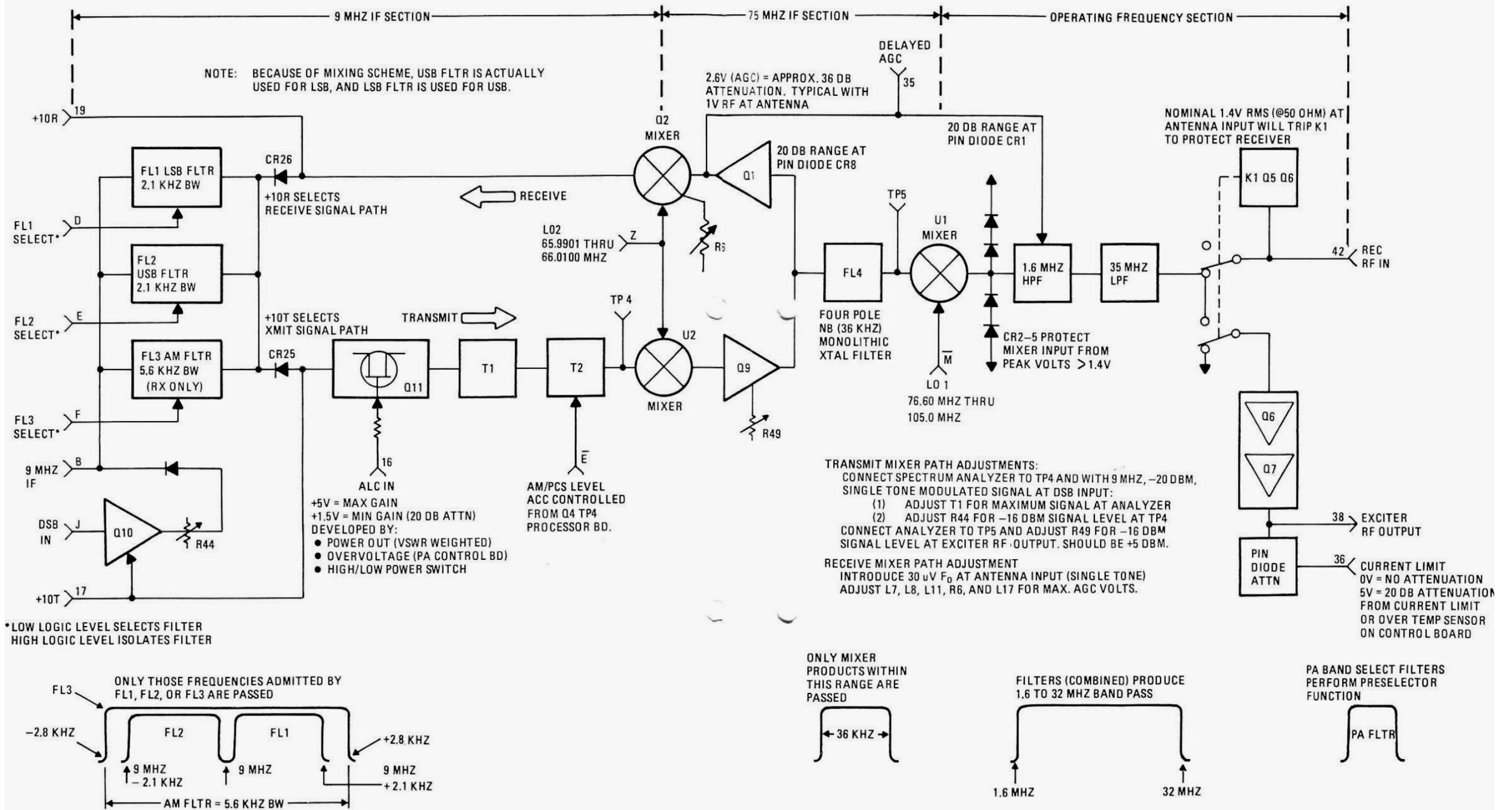
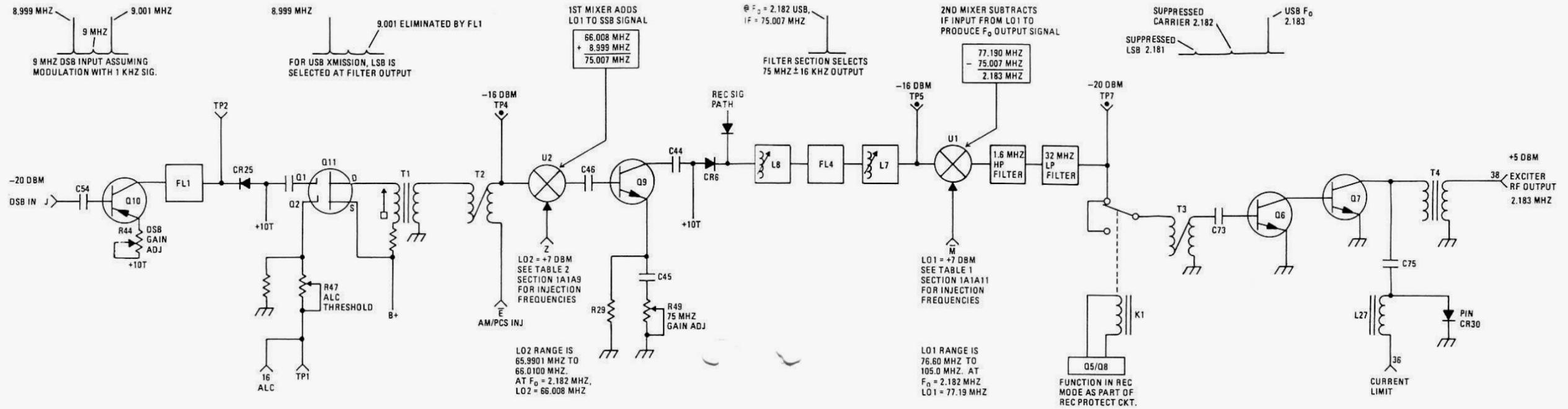


Figure 2. 1A1A6 Mixer PWB, Functional Diagram



TRANSMIT SIGNAL PATH

THIS MIXING SCHEME DEMONSTRATION PRESUPPOSES USB MODE SELECTION, 2.182 MHz F<sub>0</sub>, AND MODULATION WITH 1 KHZ. LEVELS IN DBM ARE TYPICAL UNDER THESE CONDITIONS.



RECEIVE SIGNAL PATH

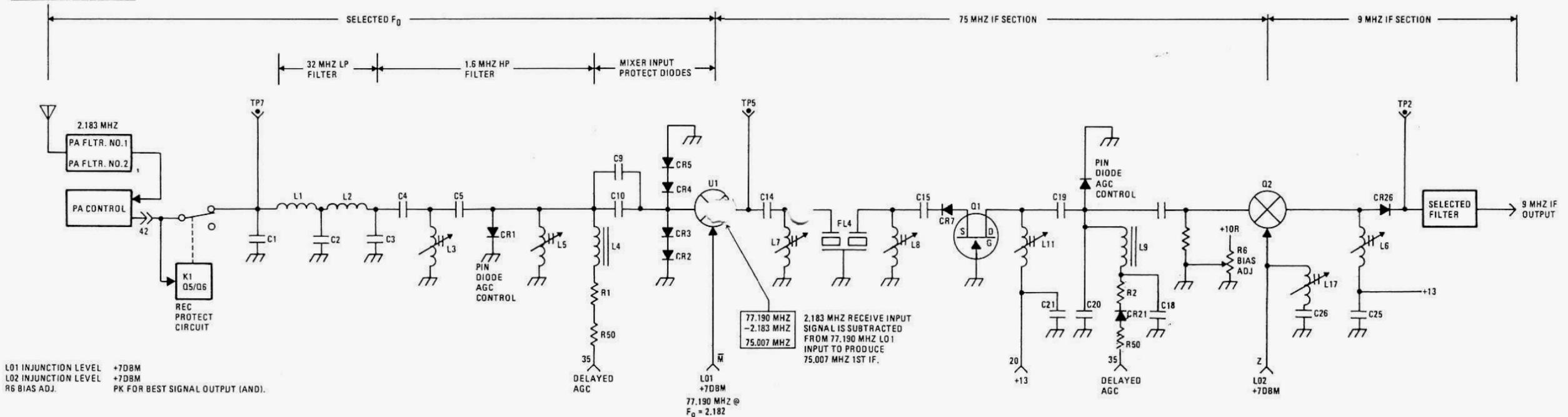


Figure 3. 1A1A6 Mixer PWB Transmit and Receive Signal Path Detail



can be changed from a nominal  $-14$  dBm level with  $+8$  V at pin 16 of the PCB, to a level of  $-44$  dBm with  $+1.5$  V at the ALC control input. This ALC control voltage is developed on the 1A1A3 PA Control PC Board in response to VSWR, overvoltage, and High/Low Power Control inputs.

T1 tunes the 9 MHz Q11 output to the mixer and is peaked for maximum signal level at this point. When properly setup, the signal level at TP4 should be approximately  $-14$  dBm.

Assuming the transmit audio input to be a pure 1 kHz tone, the signal input to U2 at pins 3 and 4 would be 8.999 MHz (with FL1 selected). The LO2 input at U2-8 would be 66.008 MHz (see table 1 section 1A1A9). The desired mixer product is the additive component, or 75.00 MHz. Note that the signal still appears in the LSB position with respect to the suppressed carrier at this point. The mixer output at pin 1 is coupled to Q9 base by C46. Q9 amplifies this 75 MHz output and provides an adjustable level at the 2nd mixer input. L7 and L8 are tuned in the receive mode, and together with 4 pole crystal filter FL4, they discriminate very sharply against out-of-band signals as shown in figure 4. Note that if LSB operation were used, that the 66.008 MHz  $+9.001$  MHz mixer output (75.009 MHz) would still be within the band pass of this filter.

The 75.007 MHz input at U1 pins 3 and 4 is mixed with the LO1 input to produce the final output frequency. The LO1 input at U1-8 is at a frequency of 77.19 MHz, (Again assuming  $F_0 = 2.182$  MHz and no manual HOP switching or programming). In a subtractive mixing process with 75.007 MHz, this would produce an actual USB output frequency of 2.183 MHz. This mixing scheme is used to provide maximum suppression of spurious radiation.

CR2 - CR5 function in the receive mode to protect the mixer input. The high and low pass filter sections are tuned in the receive mode and function in the transmit mode to suppress undesired energy elements. K1 contacts are normally closed. K1 can be energized only in the receive mode (see  $+10$  R at Q5), and functions as a high input signal level receiver protection device. In the transmit mode the high and low pass filtered mixer output is routed via a 5.5 dB attenuator circuit to broad band amplifier Q6 and Q7. The Q7 output is level controlled by pin diode CR30 at the output. With 0 volts at the P1-36 current limit input, CR30 is OFF and will not attenuate the output signal. With  $+5$  V at this same point, CR30 will be full ON and attenuate the output signal 20 dB to protect the output. The transmit signal path output is via T4 and P1-38 to the PA Control PC Board. The nominal output level is  $+5$  dBm at full rated output.

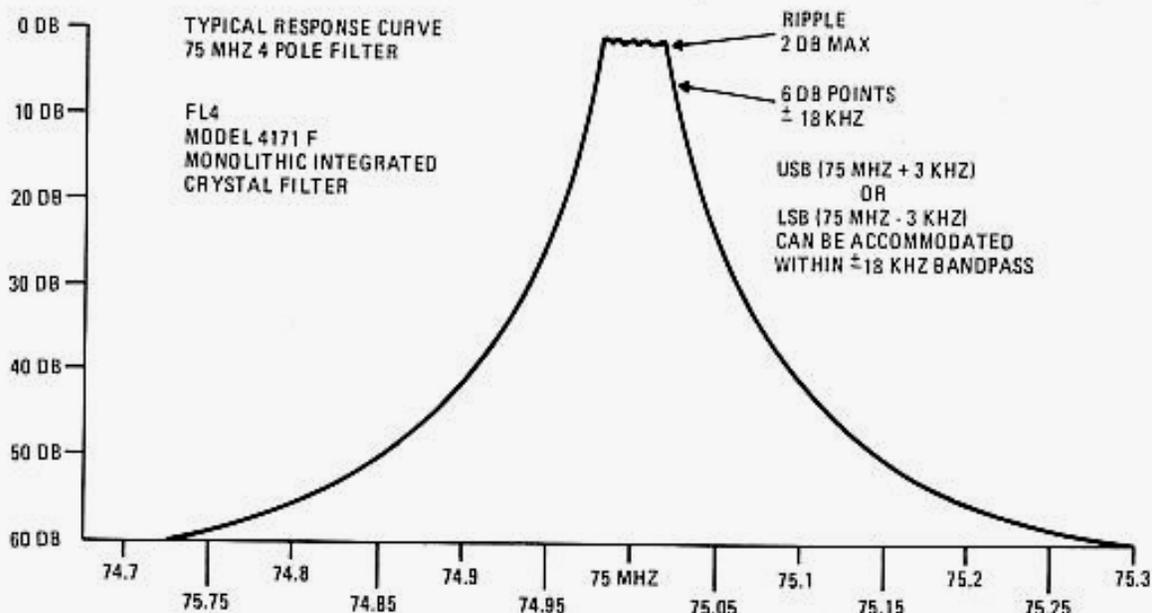


Figure 4. FL4 Band Pass Characteristics



## 4.2 Receive Function

The receive signal enters the Mixer PC Board at P1-42, as shown in figure 3. This input is directly from the antenna/antenna coupler system, and the band selected PA Filter in the RF-230. There are no active circuit elements that precede introduction of the signal at this point. By maintaining very low losses in these circuits, the need for an RF preamplifier has been eliminated. This system provides excellent dynamic range and eliminates the need for tracked tuned circuits at the input.

In the receive mode, K1 is normally energized by +10R through R65. This voltage biases Q8 on and completes the K1 ground path. However, if Q5 is ON, the bias at Q8 base will be pulled down to approximately 0.3 Vdc, Q8 will be "switched" OFF, and K1 will open. A receive signal sample is coupled via C70 to the detector circuit at the base of Q5. Any RF input signal that exceeds a nominal value of 1.4V rms will automatically de-energize K1 to protect the receiver input.

Normally, the receive signal is routed from P1-42, through the closed contacts of K1, and to the high and low pass filter sections that precede the input mixer. The low pass filter section is fixed tuned. L3 and L5 in the high pass filter section are adjusted at 0.8836 MHz and 1.2338 MHz respectively to produce the typical response curve shown in figure 5.

Diodes CR2 thru CR5 at the mixer input also serve to protect the device from high signal level inputs. Any input that tries to exceed the two diode drops ( $2 \times 0.7V = 1.4V$ ) would be clamped at 1.4V.

Delayed AGC is also used to control RF input signal levels thru Pin diode CR1. This "delayed" AGC voltage will not be present until the AGC level from the Audio IF board exceeds 3.9 Vdc. CR1 exercises a 20 dB control range when activated.

U1 is a double balanced diode mixer having an intercept point of +12 dBm. This wide range mixer in combination with the delayed AGC controlled Pin diode attenuator preceding it, provide a signal input capability of more than a volt without degradation. This type mixer also provides outstanding IM (Inter-Modulation) performance (80 dB for two 5 uV signals at  $f_0 + 30$  and  $+60$  kHz).

The remainder of this receive signal path circuit description will presuppose a 2.182 MHz receive operating frequency, and further assume that the transmitted signal was modulated with a pure 1 kHz note, to produce an actual USB receive frequency of 2.183 MHz.

This 2.183 MHz receive  $F_0$  input is subtracted from the 77.190 MHz LO1 input to produce an 75.007 MHz 1st IF output to FL4. See table 1 in section 1A1A11 for  $F_0$  vs LO1 input detail.

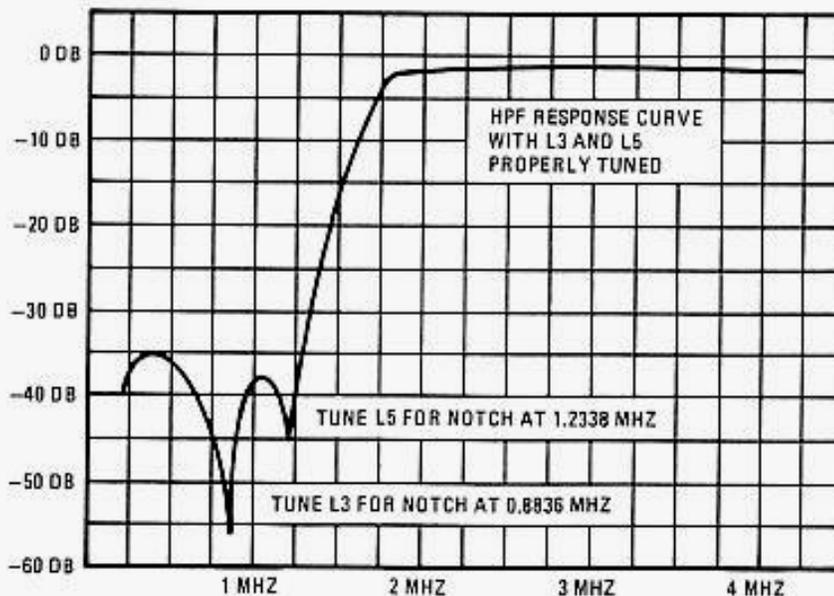


Figure 5. HPF Response Curve



Any other mixer products are sharply discriminated against by FL4 and its related tuned input and output circuits (see figure 4). L7 and L8 are tuned for optimum output at the speaker. FL4 is a four pole narrowband (36 kHz) 75 MHz monolithic crystal filter, and serves to provide a high degree of selectivity before any amplification to maintain the wide dynamic range and IM capability established by the mixer.

The filter output is coupled via CR7 in the receive mode to Q1, the first active element in the receive signal path. This low noise FET amplifier introduces approximately 12 dB of gain at this point to prevent sensitivity degradation. This output is coupled via C19 and C23 to 2nd mixer, Q2. Delayed AGC control is also introduced at this point using Pin diode CR8 for a total 36 dB dynamic control range of the AGC.

Q2, the 2nd mixer, is a dual gate MOSFET, and exhibits IM, cross modulation, and isolation characteristics markedly better than bipolar transistor equivalents. L6, L11, and bias adjustment potentiometer R6, are all adjusted for optimum gain and signal-to-noise ratio performance. The 66 MHz LO2 input at Q2 can be peaked by L17 for optimum output. For a receiver frequency of 2.1820 MHz, the LO2 input to Q2, the 2nd mixer, will be 66.008 MHz (see table 2, section 1A1A9), which when mixed with the 75.007 MHz 1st IF input in a subtractive mixing process, will produce the desired 8.999 MHz 2nd IF output to the desired filter.

L6 and C25 actually function as a parallel resonant trap tuned to 9 MHz, and as a consequence present a high impedance to this frequency and serve as a low impedance path to ground for any other mixer components.

The 8.999 MHz IF frequency is routed via CR26 (which is forward biased by +10R through R53/L22) to FL1. Recall that we are assuming USB operation, and as a consequence, FL1 would be selected. As previously explained in the transmit signal path discussion, the LSB filter is used to receive USB because of the mixing scheme. The 8.999 MHz IF output will be passed by LSB filter FL1 (see figure 1), and beat with the 9 MHz carrier frequency on the Audio IF board to detect the transmitter 1 kHz audio note.

## 5. MAINTENANCE

The 1A1A6 Mixer PC Board can be mounted on an extender card to make all test and adjustment points accessible for maintenance. Figure 6 identifies all significant adjustments on the Mixer PC Board.

### CAUTION

Always remove power when removing or installing subassemblies for maintenance.

### 5.1 Tuning Adjustments

It is not necessary to make any of the following tuning adjustments as part of a routine scheduled maintenance program. These adjustments have been made at the factory and should not require reaccomplishment unless components that relate to the reactive element in question are changed. Most of the circuits are tuned in the receive mode, and as a consequence, should be accomplished first. Test equipment items required for receive signal path adjustments are shown in figure 7.

### 5.2 High Pass Filter Adjustment

- a. With the 1A1A6 PC Board mounted on an extender card as shown, connect the HF Signal Generator output directly to TP7 on the mixer. Remove the 1A1A1 or 1A1A2 input filter p.c. boards.
- b. Adjust the HF Signal Generator output to an unmodulated frequency of 0.8836 MHz and to a level of 1000uV.
- c. Connect the Spectrum Analyzer to pin 1 of U1, the 1st receive mixer, and adjust to display spectral elements shown in figure 5.
- d. Tune L3 for best null at this frequency (0.8836 MHz).
- e. Adjust Signal Generator to 1.2338 MHz and tune L5 for best null at this frequency.
- f. Repeat steps d and e.
- g. This completes HPF adjustment. Reconfigure for normal operation or continue with adjustment procedure.

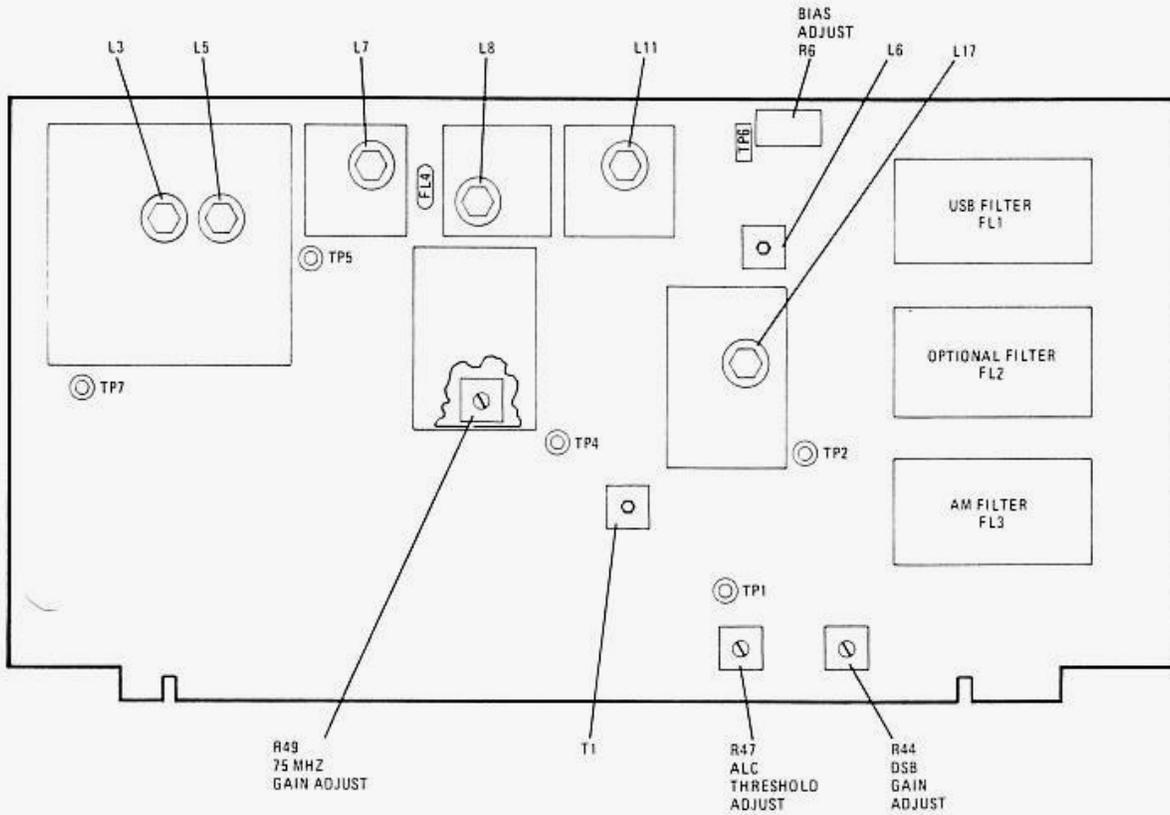


Figure 6. Mixer Adjustments and Test Points

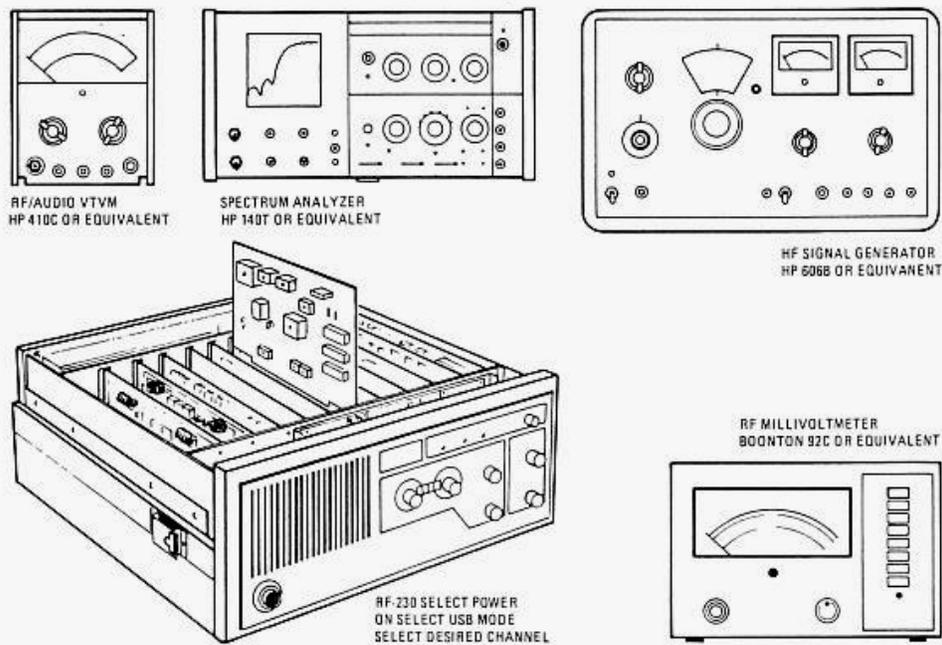


Figure 7. 1A1A6 Receive Signal Path Adjustments



### 5.3 Receive Tuning and Setup Adjustments

This procedure should be used for all remaining receiver tuning or setup adjustments on the mixer board.

a. At the RF-230, select any desired channel frequency. It may be desirable to select the maintenance channel (96) so that any desired operating frequency can be selected directly at the program board. Use USB mode for this test.

#### CAUTION

Keying the transceiver while connected to a signal generator can damage the signal generator.

b. Connect the Signal Generator to J1, the RF Input connector to the RF-230.

#### Note

The signal generator can also be connected to TP7 as desired.

c. Adjust the Signal Generator output to the receive frequency (for USB, this would be approximately 1 kHz above the selected frequency).

d. Adjust the generator signal output for an unmodulated 10  $\mu$ V output. Adjust 1A1A4R59 for ccw.

e. Connect the audio voltmeter across the speaker terminals or at the 600 ohm output to measure audio output.

f. Adjust L6, L7, L8, L11, and L17 all for maximum receiver audio output on the voltmeter.

g. Adjust R6 (BIAS ADJ) for maximum output.

h. Measure signal to noise ratio and if necessary readjust L11 for optimum noise threshold. Readjust 1A1A4R59 as required.

i. This completes receiver adjustments on the mixer. Reconfigure for normal operation or continue with transmit adjustments.

### 5.4 Transmit Signal Path Adjustments

Test equipment items shown in figure 8 will normally be required to make 1A1A6 transmit signal path adjustments.

a. Connect Audio Signal Generator to 600 ohm ohm transmit audio input.

b. Remove the 1A1A3 p.c. board and, using masking tape, tape off pin 6 on the PCB. This in effect, prevents the Power Amplifier from receiving any input during these next tests.

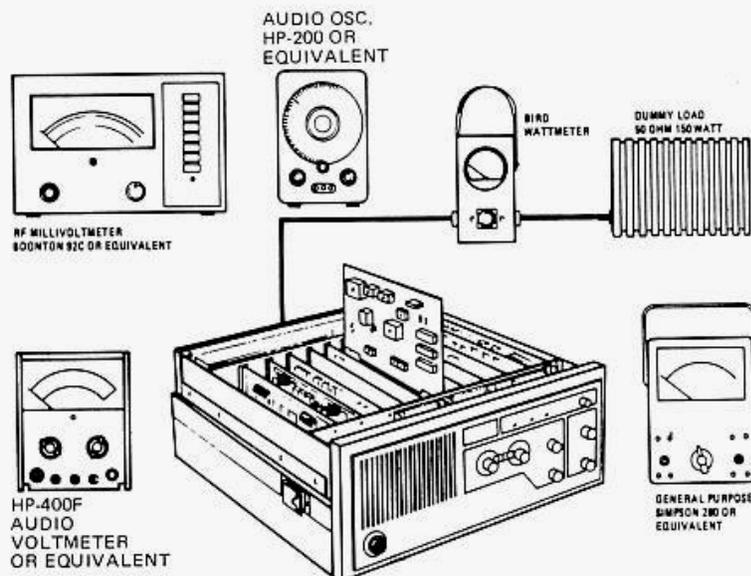
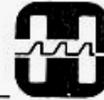


Figure 8. 1A1A6 Transmit Signal Path Adjustments



- c. Use Audio Voltmeter to adjust transmit audio drive level to 0 dBm.
- d. Terminate RF-230 Output in 50 ohm dummy load.
- e. Select any desired test frequency, and select mode at RF-230 front panel.
- f. Key transmitter at CW terminal on rear panel. Using RF millivoltmeter, verify -18 dBm signal level at 1A1A6P1-J, the DSB input from the Processor PC Board.

**Note**

ALC should be calling for maximum gain at this point. Verify by measuring +9.5 Vdc at P1-16. R47 should also be adjusted to produce maximum gain (full cw).

- g. Connect RF Millivoltmeter to TP4 (U2 Mixer input) and adjust R44, the DSB GAIN ADJ, for -11 dBm indication at TP4.
- h. Adjust T1 for peak output as measured by VTVM at TP4.
- i. Readjust R44 for -11 dBm level at TP4.
- j. Connect VTVM to TP5, and adjust R49, 75 MHZ GAIN ADJUST for -19 dBm at this Test Point.

**Note**

Connect ground lead of RF Voltmeter to PWB ground rather than chassis ground.

Unkey transmitter, remove 1A1A1 PC Board to interrupt transmitter output and provide access point to forward VSWR in next step.

- 1. Remove 1A1A3 Control PC Board and terminate P1-6, the RF Output, in a 50 ohm load. Leave the tape on 1A1A3, pin 6 that was previously applied. Jumper +10V from the top side of R24 on the 1A1A12 PWB to P1-40, the VSWR FWD line.

**Note**

This "counterfeit" VSWR signal at this point is used to force the ALC system to a maximum gain reduction condition to adjust R47, the ALC Threshold control.

- m. Key transmitter and measure +1.0 to 1.5 Vdc at the P1-16 ALC input.
- n. Connect RF VTVM at TP4, remove 1A1A9 and 1A1A11 PWBs, and adjust R47 for -34 dBm (1 25 dB gain reduction from the reference level previously setup). Reinsert 1A1A9 and 1A1A11 PWBs.
- o. Unkey transmitter, remove jumper from 1A1A12R24 to P1-40 at 1A1A3, remove masking tape from 1A1A3P1-6, and reinstall 1A1A1 and 1A1A3 for normal operation.

- p. This completes all 1A1A6 adjustments. Reconfigure for normal operation.

### 5.5 1A1A6 Input/Output Summary

Figure 9 is a complete input/output summary of all 1A1A6P1 connections. Many test and adjustment points are not visible from the card edge. See figure 6 for a detail drawing of all these points.

### 6. PARTS LIST

Table 1 lists all 1A1A6 Maintenance Parts. These parts can be identified in figure 10. Refer to General Information Section for list of manufacturers.

### 7. SCHEMATIC

Figure 11 is a complete schematic diagram of the 1A1A6 Assembly.



1	GND	A	GND
2	GND	B	9 MHZ IF TO 1A1A4
3	GND	C	GND
4	GND	D	FL1 SELECT FROM 1A1A5
5	GND	E	FL2 SELECT FROM 1A1A5
6	GND	F	FL3 SELECT FROM 1A1A5
7	GND	H	GND
8	GND	J	DSB IN FROM 1A1A5
9	GND	K	GND
10		L	
11		M	
12		N	
13		P	
14	GND	R	GND
15	GND	S	GND
16	ALC FROM 1A1A3	T	
17	+10T	U	
18		V	
19		W	+10R
20	+13.2 VDC	X	
21	GND	Y	GND
22	GND	Z	LO2 FROM 1A1A9
23	GND	a	GND
24	GND	b	GND
25	GND	c	GND
26	GND	d	GND
27	GND	e	AM/PCS INJ FROM 1A1A5
28	GND	f	GND
29	GND	h	GND
30	GND	j	GND
31	GND	k	GND
32	GND	l	GND
33	GND	m	LO1 FROM 1A1A11
34	GND	n	GND
35	DELAYED AGC FROM 1A1A4	p	
36	CURRENT LIMIT FROM 1A1A3	r	
37	GND	s	GND
38	EXCITER RF OUT TO 1A1A3	t	
39	GND	u	GND
40	GND	v	GND
41	GND	w	GND
42	REC RF	x	REC RF
43	GND	y	GND

TP6  
R6  
BIAS  
ADJ

Figure 9. 1A1A6 Input/Output Summary



TABLE 1. 1A1A6 MAINTENANCE PARTS LIST

Ref. Desig.	Name & Description	Mfr. Code	Part No.
1A1A6	Mixer PW Board Assembly	14304	6628-0650
C1	Capacitor, Fixed, Mica, 91 pF $\pm$ 5%, 500V	14304	C-0125
C2	Capacitor, Fixed, Mica, 200 pF $\pm$ 5%, 500V	14304	C-0133
C3	Capacitor, Fixed, Mica, 91 pF $\pm$ 5%, 500V	14304	C-0125
C4	Capacitor, Fixed, Mica, 1300 pF $\pm$ 5%, 500V	14304	C-0155
C5	Capacitor, Fixed, Mica, 1100 pF $\pm$ 5%, 500V	14304	C-0153
C6, C7	Not used		
C8	Capacitor, Fixed, Mica, 5600 pF $\pm$ 5%, 300V	14304	6628-0660
C9	Capacitor, Fixed, Mica, 1800 pF $\pm$ 5%, 500V	14304	C-0158
C10	Capacitor, Fixed, Mica, 130 pF $\pm$ 5%, 500V	14304	C-0129
C11	Capacitor, Fixed, Mica, 1800 pF $\pm$ 5%, 500V	14304	C-0158
C12	Capacitor, Fixed, Ceramic, .01 $\mu$ F $\pm$ 20%, 50V	14304	C-4952
C13	Capacitor, Fixed, Mica, 130 pF $\pm$ 5%, 500V	Mil type	CMR04F131J0DM
4	Capacitor, Fixed, Ceramic, 16 pF $\pm$ 5%, 1000V	14304	C-6620
C15	Capacitor, Fixed, Mica, 20 pF $\pm$ 5%, 500V	Mil type	CMR04E200J0DM
C16	Capacitor, Fixed, Mica, 56 pF $\pm$ 5%, 500V	14304	C-0120
C17	Capacitor, Fixed, Ceramic, .01 $\mu$ F $\pm$ 20%, 50V	14304	C-4952
C18	Capacitor, Fixed, Ceramic, .001 $\mu$ F $\pm$ 10%, 500V	14304	C-3513
C19	Capacitor, Fixed, Mica, 20 pF $\pm$ 5%, 500V	Mil type	CMR04E200J0DM
C20	Capacitor, Fixed, Mica, 68 pF $\pm$ 5%, 500V	14304	C-0122
C21 to C23	Capacitor, Fixed, Ceramic, .01 $\mu$ F $\pm$ 20%, 50V	14304	C-4952
C24	Not used		
C25	Capacitor, Fixed, Ceramic, .01 $\mu$ F $\pm$ 20%, 50V	14304	C-4952
C26	Capacitor, Fixed, Ceramic, .001 $\mu$ F $\pm$ 10%, 500V	14304	C-3513
C27	Capacitor, Fixed, Ceramic, .01 $\mu$ F $\pm$ 20%, 50V	14304	C-4952
C28	Capacitor, Fixed, Ceramic, 16 pF $\pm$ 5%, 1000V	14304	C-6620
C29	Capacitor, Fixed, Mica, 68 pF $\pm$ 5%, 500V	14304	C-0122
C30	Capacitor, Fixed, Mica, 33 pF $\pm$ 5%, 500V	14304	C-0113
C31	Capacitor, Fixed, Mica, 82 pF $\pm$ 5%, 500V	14304	C-0124
32 to C43	Capacitor, Fixed, Ceramic, .01 $\mu$ F $\pm$ 20%, 50V	14304	C-4952
C44	Capacitor, Fixed, Ceramic, .001 $\mu$ F $\pm$ 10%, 500V	14304	C-3513
C45 to C51	Capacitor, Fixed, Ceramic <sup>o</sup> , .01 $\mu$ F $\pm$ 10%, 50V	14304	C-4952
C52, C53	Capacitor, Fixed, Ceramic, .001 $\mu$ F $\pm$ 10%, 500V	14304	C-3513
C54, C55	Capacitor, Fixed, Ceramic, .01 $\mu$ F $\pm$ 20%, 50V	14304	C-4952
C56	Not used		
C57	Capacitor, Fixed, Tantalum, 100 $\mu$ F $\pm$ 10%, 20V	14304	C-6454
C58	Capacitor, Fixed, Ceramic, .1 $\mu$ F $\pm$ 80-20%, 50V	14304	C-3202
C59	Capacitor, Fixed, Ceramic, .01 $\mu$ F $\pm$ 20%, 50V	14304	C-4952
C60	Capacitor, Fixed, Tantalum, 47 $\mu$ F $\pm$ 20%, 20V	14304	C-6452
C61	Capacitor, Fixed, Mica, 20 pF $\pm$ 5%, 500V	14304	C-0108
C62	Capacitor, Fixed, Mica, 10 pF $\pm$ 5%, 500V	14304	C-0104



TABLE 1. 1A1A6 MAINTENANCE PARTS LIST (Continued)

Ref. Desig.	Name & Description	Mfr. Code	Part No.
C63	Capacitor, Fixed, Mica, 5 pF $\pm$ 5%, 500V	14304	C-0103
C64 to C67	Capacitor, Fixed, Ceramic, .01 uF $\pm$ 20%, 50V	14304	C-4952
C68	Capacitor, Fixed, Ceramic, .1 uF +80-20%, 50V	14304	C-3202
C69	Capacitor, Fixed, Ceramic, 10 pF $\pm$ 5%, 1000V	14304	C-4741
C70	Capacitor, Fixed, Ceramic, 18 pF $\pm$ 5%, 1000V	14304	C-4744
C71	Capacitor, Fixed, Tantalum, 2.2 uF $\pm$ 20%, 20V	14304	C-6444
C72	Capacitor, Fixed, Mica, 470 pF $\pm$ 2%, 500V	14304	C-2496
C73	Capacitor, Fixed, Ceramic, .1 uF +80-20%, 50V	14304	C-3202
C74, C75	Capacitor, Fixed, Ceramic, .01 uF $\pm$ 20%, 50V	14304	C-4952
C76	Capacitor, Fixed, Ceramic, .1 uF +80-20%, 50V	14304	C-3202
C77	Capacitor, Fixed, Mica, 43 pF $\pm$ 5%, 500V	14304	C-0116
C78	Capacitor, Fixed, Mica, 820 pF $\pm$ 2%, 300V	14304	C-2503
C79	Capacitor, Fixed, Ceramic, 22 pF $\pm$ 5%	14304	C-4746
C80	Capacitor, Fixed, Ceramic, .01 uF $\pm$ 20%	14304	C-4952
CR1	Diode, Pin, HP-3080	14304	CR-0244
CR2 to CR5	Diode, Signal, 1N4933	14304	CR-0282
CR6, CR7	Diode, Pin, MPN3401	14304	CR-0746
CR8	Diode, Pin, HP3080	14304	CR-0294
CR9 to CR22	Diode, Signal, 1N4454	14304	CR-0705
CR23	Diode, Pin, MPN3401	14304	CR-0746
CR24-CR26	Diode, Signal, 1N4454	14304	CR-0705
CR27	Diode, Rectifier, 1N4004	14304	CR-0725
CR28, CR29	Diode, Signal, 1N4454	14304	CR-0705
CR30	Diode, Pin, HP3080	14304	CR-0294
CR31	Diode, Rectifier, 1N4004	14304	CR-0725
CR32	Diode, Rectifier, 1N4004	14304	CR-0725
FL1	Filter, 9 MHz, LSB	14304	FL-0136
FL2	Filter, 9 MHz, USB	14304	FL-0135
FL3	Filter, 9 MHz, AM	14304	6628-0672
FL4	Filter, 75 MHz	14304	6628-0671
K1	Relay, 12V, DPDT	14304	K-0118
L1, L2	Choke, RF, .33 uH	14304	L-0035
L3	Inductor, Variable, 5.1 uH	14304	L-0722
L4	Choke, RF, 470 uH	14304	L-0648
L5	Inductor, Variable, 8.3 uH	14304	L-0724
L6	Inductor, Variable, 10 uH	14304	L-0725
L7, L8	Inductor, Variable, .3 uH	14304	L-0256
L9, L10	Choke, RF, 10 uH	14304	L-0628
L11	Inductor, Variable, .3 uH	14304	L-0256
L12	Choke, RF, 10 uH	14304	L-0628
L13	Choke, RF, 220 uH	14304	L-0644
L14	Choke, RF, 56 uH	14304	L-0637
L15	Choke, RF, 22 uH	14304	L-0632



TABLE 1. 1A1A6 MAINTENANCE PARTS LIST (Continued)

Ref. Desig.	Name & Description	Mfr. Code	Part No.
L16	Choke, RF, .47 uH	14304	L-0612
L17	Inductor, Variable, .3 uH	14304	L-0256
L18	Choke, RF, 100 uH	14304	L-0640
L19,L20	Choke, RF, 4.7 uH	14304	L-0624
L20	Choke, RF, 56 uH	14304	L-0637
L21	Choke, RF, 8.2 uH	14304	L-0627
L22	Choke, RF, 220 uH	14304	L-0644
L23	Choke, RF, 15 uH	14304	L-0630
L24	Choke, RF, 100 uH	14304	L-0640
L25,L26	Choke, RF, 3.9 uH	14304	L-0623
L27	Choke, RF, 470 uH	14304	L-0648
L28	Choke, RF, 100 uH	14304	L-0640
Q1	Transistor, NPN, 2N5486	14304	Q-0376
Q2	Transistor, Dual Gate, 3N187	14304	Q03-0187-000
Q3, Q4	Transistor, NPN, 2N4124	14304	Q-0385
Q5	Transistor, NPN, Darlington, MPS-A13	14304	Q-0076
Q6	Transistor, NPN, 2N5179	14304	Q-0390
Q7	Transistor, NPN, 2N3866	14304	Q-0397
Q8	Transistor, NPN, 2N4124	14304	Q-0385
Q9	Transistor, NPN, 2N5179	14304	Q-0390
Q10	Transistor, PNP, 2N4126	14304	Q-0386
Q11	Transistor, Dual Gate, 3N187	14304	Q03-187-000
Q12 to Q15	Transistor, NPN, 2N4124	14304	Q-0385
R1	Resistor, Fixed, Composition, 120 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G121JM
R2, R3	Resistor, Fixed, Composition, 220 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G221JM
R4	Not used		
R5	Resistor, Fixed, Composition, 47K $\pm$ 5%, 1/4W	Mil type	RCR07G473JM
R6	Resistor, Variable, 50K	14304	R-2231
R7	Resistor, Fixed, Composition, 27K $\pm$ 5%, 1/4W	Mil type	RCR07G273JM
R8	Not used		
R9	Resistor, Fixed, Composition, 120K $\pm$ 5%, 1/4W	Mil type	RCR07G124JM
R10	Resistor, Fixed, Composition, 68K $\pm$ 5%, 1/4W	Mil type	RCR07G683JM
R11	Resistor, Fixed, Composition, 390 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G391JM
R12	Resistor, Fixed, Composition, 150 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G151JM
R13, R14	Resistor, Fixed, Composition, 820 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G821JM
R15	Resistor, Fixed, Composition, 470 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G471JM
R16	Resistor, Fixed, Composition, 680 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G681JM
R17, R18	Resistor, Fixed, Composition, 47K $\pm$ 5%, 1/4W	Mil type	RCR07G473JM
R19	Resistor, Fixed, Composition, 820 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G821JM
R20	Resistor, Fixed, Composition, 680 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G681JM
R21, R22	Resistor, Fixed, Composition, 47K $\pm$ 5%, 1/4W	Mil type	RCR07G473JM
R23	Resistor, Fixed, Composition, 820 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G821JM
R24	Resistor, Fixed, Composition, 680 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G681JM



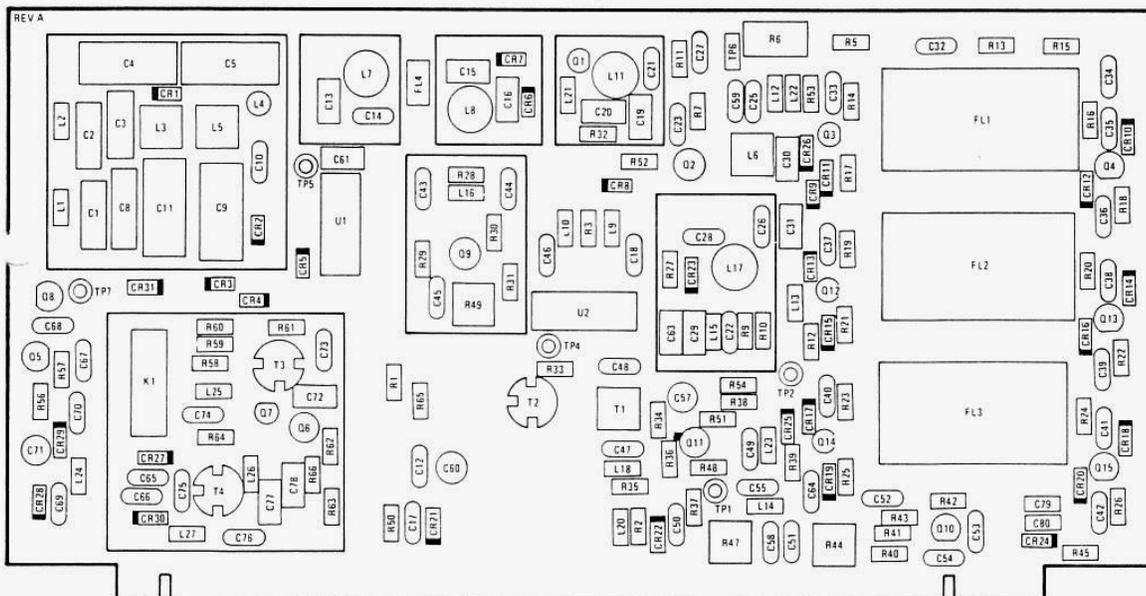
TABLE 1. 1A1A6 MAINTENANCE PARTS LIST (Continued)

Ref. Desig.	Name & Description	Mfr. Code	Part No.
R25, R26	Resistor, Fixed, Composition, 47K $\pm$ 5%, 1/4W	Mil type	RCR07G473JM
R27	Resistor, Fixed, Composition, 100 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G101JM
R28	Resistor, Fixed, Composition, 330 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G331JM
R29	Resistor, Fixed, Composition, 220 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G221JM
R30, R31	Resistor, Fixed, Composition, 470 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G471JM
R32	Resistor, Fixed, Composition, 2.2K $\pm$ 5%, 1/4W	Mil type	RCR07G222JM
R33	Resistor, Fixed, Composition, 220 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G221JM
R34	Resistor, Fixed, Composition, 100 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G101JM
R35	Resistor, Fixed, Composition, 3.9K $\pm$ 5%, 1/4W	Mil type	RCR07G392JM
R36	Resistor, Fixed, Composition, 56 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G560JM
R37	Resistor, Fixed, Composition, 330 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G331JM
R38	Resistor, Fixed, Composition, 820 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G821JM
R39	Resistor, Fixed, Composition, 750 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G751JM
R40	Resistor, Fixed, Composition, 15K $\pm$ 5%, 1/4W	Mil type	RCR07G153JM
R41	Resistor, Fixed, Composition, 5.6K $\pm$ 5%, 1/4W	Mil type	RCR07G562JM
R42	Resistor, Fixed, Composition, 1.5K $\pm$ 5%, 1/4W	Mil type	RCR07G152JM
R43	Resistor, Fixed, Composition, 470 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G471JM
R44	Resistor, Variable, 100 ohm	14304	R-2203
R45	Resistor, Fixed, Composition, 33K $\pm$ 5%, 1/4W	Mil type	RCR07G333JM
R46	Resistor, Fixed, Composition, 390 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G391JM
R47	Resistor, Variable, 50K	14304	R-2212
R48	Resistor, Fixed, Composition, 4.7K $\pm$ 5%, 1/4W	Mil type	RCR07G472JM
R49	Resistor, Variable, 100 ohm	14304	R-2203
R50	Resistor, Fixed, Composition, 100 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G101JM
R51	Resistor, Fixed, Composition, 15K $\pm$ 5%, 1/4W	Mil type	RCR07G153JM
R52	Resistor, Fixed, Composition, 910 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G911JM
R53	Resistor, Fixed, Composition, 750 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G751JM
R54	Resistor, Fixed, Composition, 820 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G821JM
R55	Not used		
R56	Resistor, Fixed, Composition, 4.7M $\pm$ 5%, 1/4W	Mil type	RCR07G475JM
R57	Resistor, Fixed, Composition, 2.2K $\pm$ 5%, 1/4W	Mil type	RCR07G222JM
R58, R59	Resistor, Fixed, Composition, 15 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G150JM
R60	Resistor, Fixed, Composition, 68 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G680JM
R61, R62	Resistor, Fixed, Composition, 820 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G821JM
R63	Resistor, Fixed, Composition, 68 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G680JM
R64	Resistor, Fixed, Composition, 1K $\pm$ 5%, 1/4W	Mil type	RCR07G102JM
R65	Resistor, Fixed, Composition, 10K $\pm$ 5%, 1/4W	Mil type	RCR07G103JM
R66	Resistor, Fixed, Composition, 4.7 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G4R7JM
R67	Resistor, Fixed, Composition, 1 meg $\pm$ 5%, 1/4W	Mil type	RCR07G105JM
T1	Transformer, 9 MHz	14304	919-1319
T2 to T4	Transformer, Trifilar, Toroid	14304	919-1280
TP1	Test Point, Brown	14304	J-0071
TP2	Test Point, Red	14304	J-0066



TABLE 1. 1A1A6 MAINTENANCE PARTS LIST (Continued)

Ref. Desig.	Name & Description	Mfr. Code	Part No.
TP3	Not used		
TP4	Test Point, Yellow	14304	J-0070
TP5	Test Point, Green	14304	J-0068
TP6	Test Point, Blue	14304	J-0393
TP7	Test Point, Violet	14304	J-0073
U1, U2	Mixer, Doubly Balanced	14304	6628-0666



NOTE: L19 AND R46 LOCATED ON CIRCUIT SIDE OF BOARD BENEATH C79 AND C80, RESPECTIVELY.

Figure 10. 1A1A6 Mixer PC Board Component Locations



# UNIT INSTRUCTIONS

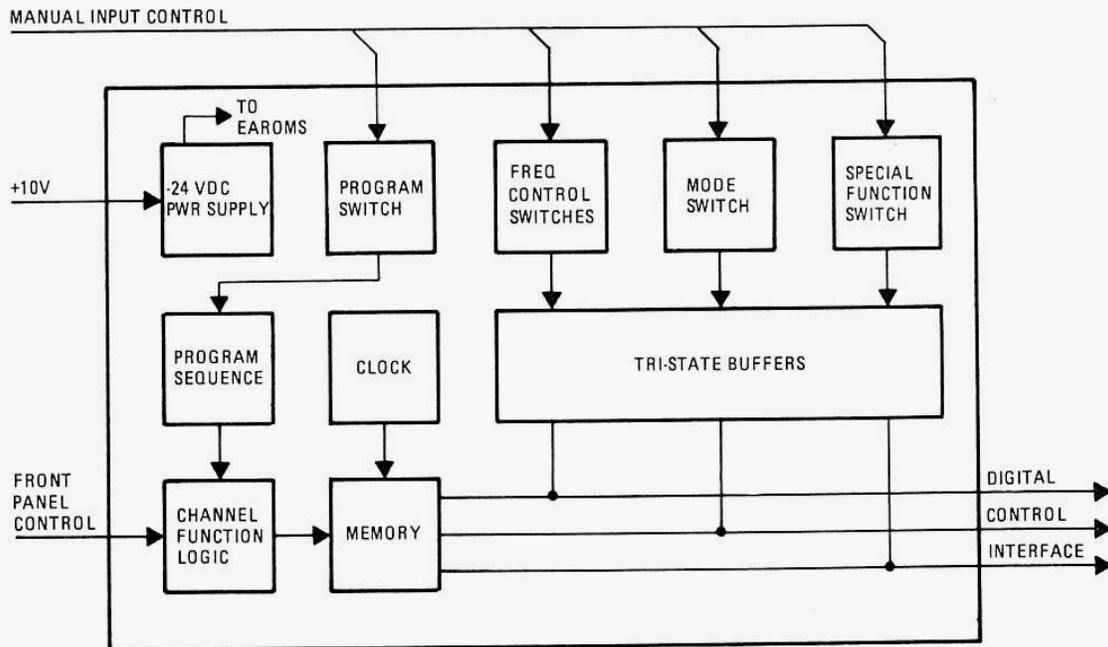


## PROGRAM BOARDS

# 1A1A7

and

# 1A1A8



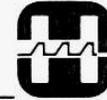


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## 1. GENERAL DESCRIPTION

Program Board Assemblies 1A1A7, and optionally 1A1A8, function as the radio control interface between front panel control inputs, and manual channelization control elements. These boards also contain the EAROM (Electrically Alterable Read Only Memory) information storage elements and the related logic control interface required to operate and protect the radio automatically in response to simple operator inputs.

In the standard RF-230 configuration, the radio is supplied with one program board in the 1A1A7 position. This board provides channel information storage capability for up to 32 simplex channels, or optionally, 16 duplex channels. Installing an additional board in the 1A1A8 position automatically provides for 64 simplex or 32 duplex channels. Channelization capability can be expanded to 96 simplex channels, or a combination of simplex and duplex channels. Either board may be installed in either position. In the event both boards are configured for the same channel blocks, 1A1A7 will exercise priority.

## 2. TECHNICAL CHARACTERISTICS

### Power Inputs:

+10V From 1A1A12, channel change regulator pc board.

### Control Inputs:

7 bits binary (0 - 127) From Front Panel Channel Switch or external  
DIS IN From 1A1A7 for priority control  
PSU IN  
+10T From 1A1A12 for duplex function

### Control Outputs:

22 Bits BCD To Synthesizer Frequency Bus  
3 Bits Binary To Mode Bus  
Keyline Enable Disable Gnd Signal  
Program in Progress To 1A1A12, Channel Change Regulator  
Mode Inhibit Out To 1J3 Options  
Internal Bypass 1 bit to BPF decoding  
HOP 1 bit to HOP Bus  
MIO Mode Inhibit out to disable front panel mode switch.  
1 Optional bits for special applications.  
2 Optional bits for special applications.

## 3. SEMICONDUCTOR COMPLEMENT

REF. DESIG.	TYPE	DESCRIPTION
CR1-CR4	1N4454	Diode, SI
Q1, Q2	2N4124	Transistor, NPN
Q3, Q4	2N4126	Transistor, PNP
Q5	2N3644	Transistor, PNP
Q6	2N4126	Transistor, PNP
U1, U2	NCR-2051	EAROM, 32 X 16
U3-U8	MM80C97	Hex Tri-State Buffers
U9	CD4017AE	Decade Counter
U10	CD4060AE	Clock Oscillator
U11	CD4051BE	8-1 Multiplexer
U12	CA555CE	Timer
U13	CD4081BE	Quad 2-Input AND Gates
U14	CD4075BE	Triple 3-Input OR Gates
U15	CD4011AE	Quad 2-Input NAND Gates
U16-U18	CD4001AE	Quad 2-Input NOR Gates
VR1	1N5236	Zener Diode, 7.5V
VR2	1N747A	Zener Diode, 3.6V

## 4. CIRCUIT DESCRIPTION

All mode and frequency control signals generated within the RF-230 transceiver originate in, or are controlled through the 1A1A7 and/or 1A1A8 Program Boards. Figure 1 is a simplified overall diagram of these boards (they are identical except for customer installed programming jumpers). While most minor circuit components (i.e., pull-up resistors etc.) have been omitted to facilitate clarity, all major functional elements are included such that logic functions can be traced through the circuit if desired.

EAROMS U1 and U2 require -24 Vdc as the Vcc supply. This requirement has been satisfied by using a unique on-board supply. The fixed pulse width output of timer U12 is used to clock Q5 base on and off. Interrupting the current flow through L3/Q5, and rectifying the negative pulse energy levels stored in L3 provides the negative supply voltage. CR3 rectifies the negative pulses and C5, C6, and L2 function as a "pi" type output filter. R64 provides an adjustable feedback source to control the U12 pulse repetition frequency output, and as a consequence, control the -24 Vdc output to within  $\pm 1$  Vdc.



EAROM function control is accomplished at the C1/C2 inputs in accordance with the following truth table:

C1	C2	EAROM FUNCTION
0	0	Write
0	1	Erase
1	0	Read
1	1	Hold

These control functions are generated by program sequencer U9. A typical programming sequence would be as follows.

With the channel to be programmed selected at the front panel, the 4 least significant bits of the 7 bit binary code are present at the A0 through A4 "address" inputs of the EAROMS to activate the desired "address". For simplex operation in a standard 32 channel unit, a jumper would be installed to connect the CH2<sup>4</sup> data bit to the A4 input of both EAROMS. Refer to table 1, the Control Panel PC Board 7-bit binary output table. For any channel, 0 - 32, the associated EAROM address would be activated.

For duplex operation separate frequencies are used for both receive and transmit; 16 channels would be used for transmit, and 16 for receive. By installing a jumper in the DUPLEX position, and leaving the SIMPLEX position open, the +10T signal is substituted for the CH2<sup>4</sup> data bit. Using this "counterfeit" CH2<sup>4</sup> signal it should be obvious, referring to table 1, that if channel 1 were selected at the front panel, and the set keyed (+10T activated), the address code present at the EAROMS would be as follows: (Both receive and transmit address inputs are shown.)

	A4	A3	A2	A1	A0
REC MODE	0	0	0	0	1
XMIT MODE	1	0	0	0	1

This demonstrates how EAROM addresses are dedicated for duplex operating in a basic 32 EAROM address radio. The 5 least (4 in duplex) significant channel bits tell what position in the EAROM to access. The 3 most significant bits are decoded to provide for where these "EAROM slots" are placed in the 0 - 96 channel range. If a second board were installed in the 1A1A8 position, the board must be programmed to recognize different address codes than the 1A1A7 board. This is accomplished by programming jumpers at the U11 8-1 Multiplexer output as discussed in the following paragraphs.

U11 uses only the three most significant channel select character bits, (CH2<sup>6</sup>, CH2<sup>5</sup>, and CH2<sup>4</sup>), to decode band information as shown in the accompanying table:

CHANNELS	CH2 <sup>6</sup>	CH2 <sup>5</sup>	CH2 <sup>4</sup>
0 - 15	0	0	0
16 - 31	0	0	1
32 - 47	0	1	0
48 - 63	0	1	1
64 - 79	1	0	0
80 - 95	1	0	1
96 - 111	1	1	0
112 - 127	1	1	1

This decoded band information is used, via programming jumpers, to control U1 and U2. As an example, if a programming jumper were installed at the "0" decode output of U11, and if channel 8 were selected (or any channel 0 - 15), then a "1" logic level would be present at the U1 and U2 "CS" (Chip Select) inputs. With a "1" as the CS input, EAROMS U1 and U2 are activated. With a "0" at these CS inputs U1 and U2 are deactivated. In the deactivated state all EAROM outputs are open.

With this information, it should be obvious that several programming options are open. As an example, it is not necessary to start channelization assignments with channel 1 and to progress sequentially until all channels are used. It might be expedient to use channel numbers from any of the groups shown in the table.

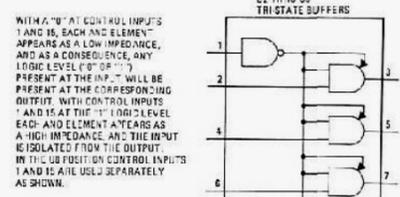
Note, however, that channel 95 is the highest channel option available. There are no decoded band jumper options for channels 96 - 111, or for 112 - 127. If channel 96 is selected, for example, the CS input to both, U1 and U2 would be at a Logic "0" and the EAROM outputs would be open. Refer to figure 1 and notice that the U17-4 outputs terminates in a jumper option labeled "96". By selecting channel 97 at the front panel, the EAROMS are deactivated, and a "0" logic is placed on U3 through U7 to activate program board frequency select switches can be used directly for maintenance functions to manually select any desired frequency and control combination without necessity of first entering the information into memory.

#### Note

No rechannel pulses are generated when changing frequencies unless the channel is changed. This is important to remember when using options that require this pulse.



NOTES:  
 1. U2 THROUGH U8 ARE SHOWN AS SWITCHES FOR SIMPLICITY. THEY ARE ACTUALLY TRI-STATE BUFFERS. THEY PERFORM "TRIPOLAR" SWITCHING FUNCTIONS AS FOLLOWS:



WITH A "0" AT CONTROL INPUTS 1 AND 16, EACH AND ELEMENT APPEARS AS A LOW IMPEDANCE, AND AS A CONSEQUENCE, ANY LOGIC LEVEL ("0" OR "1") PRESENT AT THE INPUT WILL BE PRESENT AT THE CORRESPONDING OUTPUT. WITH CONTROL INPUTS 1 AND 16 AT THE "1" LOGIC LEVEL EACH AND ELEMENT APPEARS AS A HIGH IMPEDANCE AND THE INPUT IS ISOLATED FROM THE OUTPUT. IN THE US POSITION CONTROL INPUTS 1 AND 16 ARE USED SEPARATELY AS SHOWN.

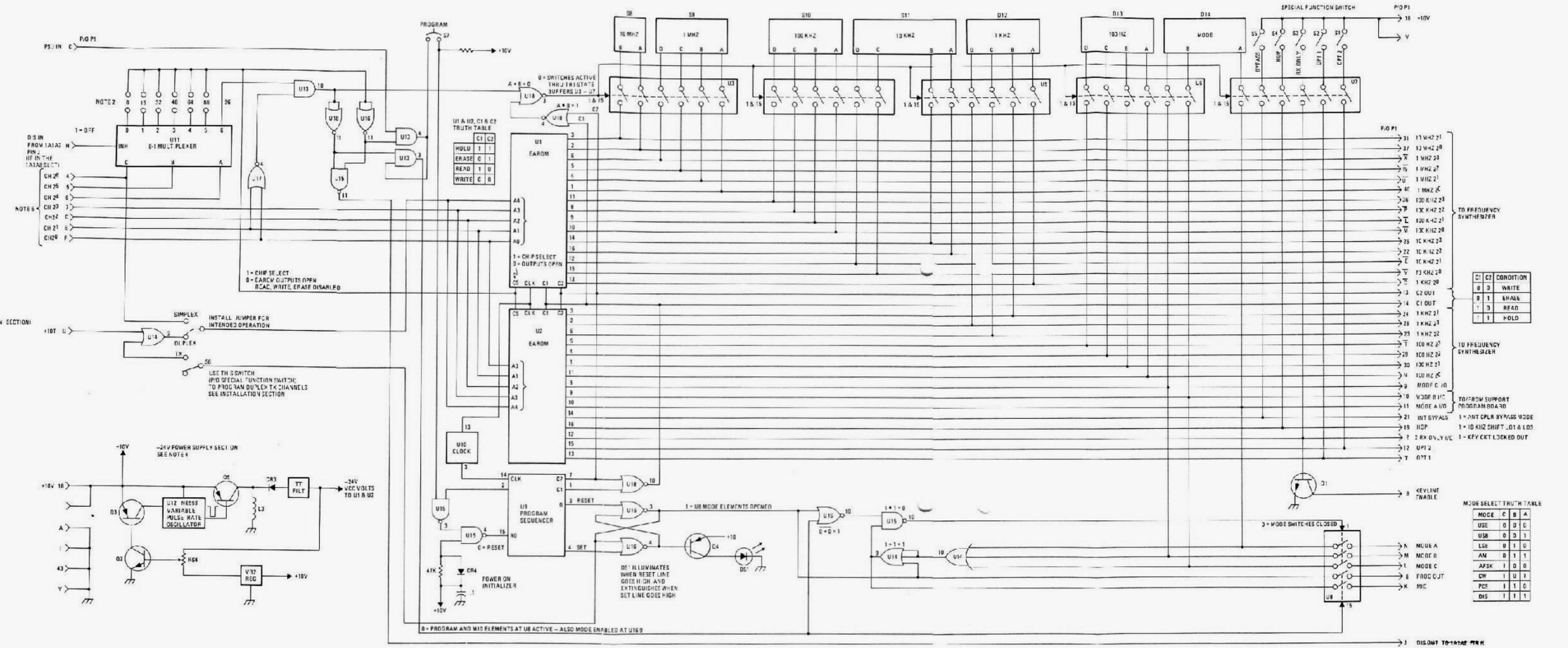
2. INSTALL PROGRAMMING JUMPERS AS PER CUSTOMER REQUIREMENTS. (SEE INSTALLATION SECTION)

3. WHEN CHANNEL 20 IS SELECTED AT THE FRONT PANEL, FREQUENCY AND MODE SELECT SWITCHES S1-S14 ARE ACTIVE. THIS MEANS THAT ANY FREQUENCY OR MODE SELECTION CAN BE MADE DIRECTLY AT THESE SWITCHES, AND WITHOUT INVOLVING ANY PROGRAMMING PROCEDURE.

4. PEA ADJUSTS -24V BY CHANGING U12 PULSE WIDTH RATE OUTPUT TO 25 KHZ. TO INCREASE PEA -24V CURRENT PAI-A, C-2 REGULATOR ENERGY STORED IN L3 TO PRODUCE INCREASED VOLTAGE OUTPUT. P1 FILTER PROVIDES ADEQUATE FILTERING FOR EACH VCC REQUIREMENTS.

5. THE SEVEN CHANNEL BITS FORM A BINARY NUMBER THAT COMES FROM THE DATA CHANNEL CHANGE/REGULATOR PWB.

NOTE: SEE TABLE 1 FOR CHANNEL CODES.



C1	C2	CONDITION
0	0	WRITE
0	1	ERASE
1	0	READ
1	1	HOLD

MODE	C	B	A
USE	0	0	0
USB	0	0	1
LSB	0	1	0
AM	0	1	1
MODE C	1	0	0
CW	1	0	1
PCF	1	1	0
DIS	1	1	1

Figure 1. 1A1A7/1A1A8 Simplified Diagram



TABLE 1. CONTROL PANEL PC BOARD CHANNEL SELECTOR OUTPUTS

CHANNEL	CH2 <sup>6</sup>	CH2 <sup>5</sup>	CH2 <sup>4</sup>	CH2 <sup>3</sup>	CH2 <sup>2</sup>	CH2 <sup>1</sup>	CH2 <sup>0</sup>	CHANNEL	CH2 <sup>6</sup>	CH2 <sup>5</sup>	CH2 <sup>4</sup>	CH2 <sup>3</sup>	CH2 <sup>2</sup>	CH2 <sup>1</sup>	CH2 <sup>0</sup>
0	0	0	0	0	0	0	0	49	0	1	1	0	0	0	1
1	0	0	0	0	0	0	1	50	0	1	1	0	0	1	0
2	0	0	0	0	0	1	0	51	0	1	1	0	0	1	1
3	0	0	0	0	0	1	1	51	0	1	1	0	1	0	1
4	0	0	0	0	1	0	0	53	0	1	1	0	1	0	1
5	0	0	0	0	1	0	1	54	0	1	1	0	1	1	0
6	0	0	0	0	1	1	0	55	0	1	1	0	1	1	1
7	0	0	0	0	1	1	1	56	0	1	1	1	0	0	0
8	0	0	0	1	0	0	0	57	0	1	1	1	0	0	1
9	0	0	0	1	0	0	1	58	0	1	1	1	0	1	0
10	0	0	0	1	0	1	0	59	0	1	1	1	0	1	1
11	0	0	0	1	0	1	1	60	0	1	1	1	1	0	0
12	0	0	0	1	1	0	0	61	0	1	1	1	1	0	1
13	0	0	0	1	1	0	1	62	0	1	1	1	1	1	0
14	0	0	0	1	1	1	0	63	0	1	1	1	1	1	1
15	0	0	0	1	1	1	1	64	1	0	0	0	0	0	0
16	0	0	1	0	0	0	0	65	1	0	0	0	0	0	1
17	0	0	1	0	0	0	1	66	1	0	0	0	0	1	0
18	0	0	1	0	0	1	0	67	1	0	0	0	0	1	1
19	0	0	1	0	0	1	1	68	1	0	0	0	1	0	0
20	0	0	1	0	1	0	0	69	1	0	0	0	1	0	1
21	0	0	1	0	1	0	1	70	1	0	0	0	1	1	0
22	0	0	1	0	1	1	0	71	1	0	0	0	1	1	1
23	0	0	1	0	1	1	1	72	1	0	0	1	0	0	0
24	0	0	1	1	0	0	0	73	1	0	0	1	0	0	1
25	0	0	1	1	0	0	1	74	1	0	0	1	0	1	0
26	0	0	1	1	0	1	0	75	1	0	0	1	0	1	1
27	0	0	1	1	0	1	1	76	1	0	0	1	1	0	0
28	0	0	1	1	1	0	0	77	1	0	0	1	1	0	1
29	0	0	1	1	1	0	1	78	1	0	0	1	1	1	0
30	0	0	1	1	1	1	0	79	1	0	0	1	1	1	1
31	0	0	1	1	1	1	1	80	1	0	1	0	0	0	0
32	0	1	0	0	0	0	0	81	1	0	1	0	0	0	1
33	0	1	0	0	0	0	1	82	1	0	1	0	0	1	0
34	0	1	0	0	0	1	0	83	1	0	1	0	0	1	1
35	0	1	0	0	0	1	1	84	1	0	1	0	1	0	0
36	0	1	0	0	1	0	0	85	1	0	1	0	1	0	1
37	0	1	0	0	1	0	1	86	1	0	1	0	1	1	0
38	0	1	0	0	1	1	0	87	1	0	1	0	1	1	1
39	0	1	0	0	1	1	1	88	1	0	1	1	0	0	0
40	0	1	0	1	0	0	0	89	1	0	1	1	0	0	1
41	0	1	0	1	0	0	1	90	1	0	1	1	0	1	0
42	0	1	0	1	0	1	0	91	1	0	1	1	0	1	1
43	0	1	0	1	0	1	1	92	1	0	1	1	1	0	0
44	0	1	0	1	1	0	0	93	1	0	1	1	1	0	1
45	0	1	0	1	1	0	1	94	1	0	1	1	1	1	0
46	0	1	0	1	1	1	0	95	1	0	1	1	1	1	1
47	0	1	0	1	1	1	1	96	1	1	0	0	0	0	0
48	0	1	1	0	0	0	0	97	1	1	0	0	0	0	1

INTERNAL MODE BUS CODING

MODE C	MODE B	MODE A	MID	ACTION
0	0	0	0	Front Panel Switch determine mode
0	0	1	1	USB SELECTED
0	1	0	1	LSB SELECTED
0	1	1	1	AM SELECTED
1	0	0	1	AFSK SELECTED
1	0	1	1	CW SELECTED
1	1	0	1	PCS SELECTED
1	1	1	1	Disable - NDR REC or XMIT



It is also important to be aware of the "priority" system functioning between the 1A1A7 and 1A1A8 boards when making programming decisions. Refer to figure 1 and note DIS OUT and DIS IN control lines leave and enter the program board at pins P1-J and H respectively. The DIS OUT control function from 1A1A7 is connected to the DIS IN function of 1A1A8. The DIS OUT function from 1A1A8 is not connected to 1A1A7. This system is used to effect a "priority" system. With a logic "1" at pin H of 1A1A8, the U11-8 INHIBIT function is activated and the 8-1 Multiplexer is OFF. As a consequence, if both the 1A1A7 and 1A1A8 boards are selected for the same channel blocks, the 1A1A7 instructions will have priority. This is an incorrect channel block selection, but with the priority system, there is no conflict.

Figure 2 is an EAROM Operation Flow Chart, and demonstrates the sequence of events as they relate to clock periods at the EAROMS. The U10 clock output to U1 and U2 is approximately 128 Hz; the clock output to program sequencer U9 is approximately 4 Hz. The EAROM channelization programming procedure is given in the RF-230 General Information Section covering Installation.

## 5. MAINTENANCE/ADJUSTMENTS

1A1A7 and 1A1A8 PC Board Assemblies can be tested and adjusted in the RF-230 Transceiver by using the PC Board extender supplied as part of the maintenance repair kit.

### CAUTION

Always remove power when removing or installing PC Board Assemblies.

### 5.1 -24 Vdc Adjustment

- a. Remove system power by selecting POWER OFF at the RF-230 front panel.
- b. Remove RF-230 top cover to expose 1A1A7/1A1A8 PC Board Assemblies.
- c. Remove desired PC Board Assembly using extractor furnished with radio.

EAROM OPERATION FLOW CHART

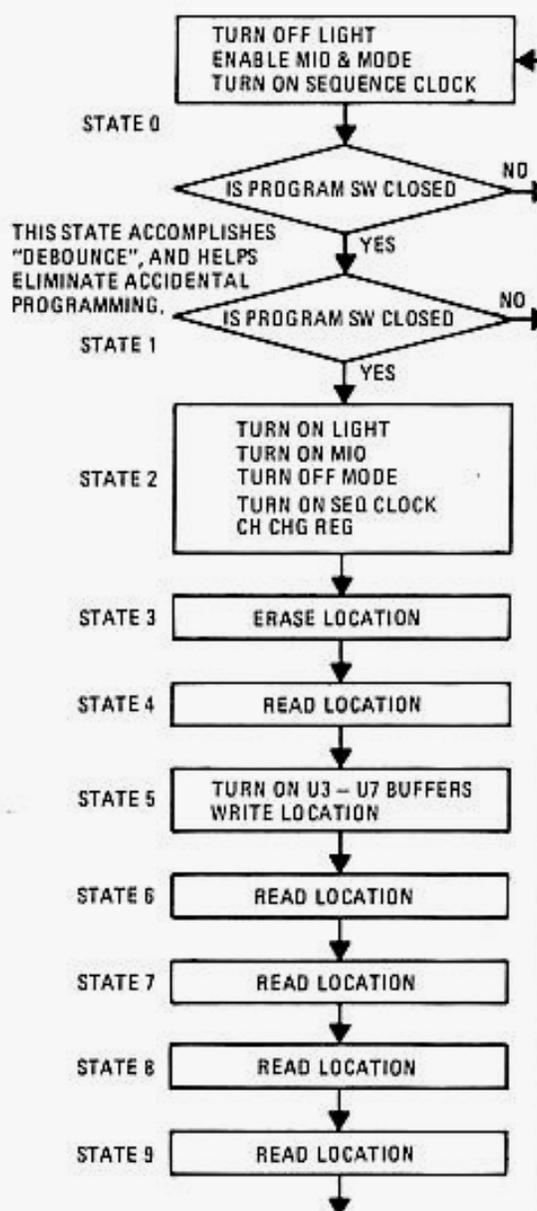


Figure 2. EAROM Operation Flow Chart



- d. Install pc board on board extender and reinstall in radio.
- e. Select POWER ON.
- f. Use calibrated VOM and measure  $-24\text{ Vdc}$  ( $\pm 1\text{ Vdc}$ ) at pin 24 of U1 and U2. If within tolerance, reverse procedure to return to normal operating configuration. If not within tolerance, locate R64 using component location diagram in figure 3, and use small flat-blade screwdriver to adjust voltage to  $-24\text{ Vdc}$ . This completes adjustment.

#### Note

If an oscilloscope is used to make this check/adjustment, a high ripple content will be evident. This is a normal condition with the pulse rectifier circuit employed.

### 5.2 Maintenance Channel Programming

Install jumper to "96" if a direct select maintenance channel is desired. With a jumper to 96 as shown in figure 1, by selecting channel 96 at the front panel, frequency select switches S8 thru S13, and control switches S1 through S5 and

S14 are connected directly (thru tri-state buffers) to synthesizer frequency control circuit elements and EAROMS are deactivated. By using this feature, any desired frequency can be selected without first entering the information in memory. BCD control outputs can be checked at the card edge connector with the board on an extender card.

### 5.3 Card Edge Connector Inputs/Outputs

Figure 3 summarizes, card edge connections and test point or other significant physical board detail as viewed from the top.

## 6. PARTS LIST

Table 2 contains parts list information for these boards. Figure 4 is a component location diagram of the 1A1A7/1A1A8 PC Board. Refer to the General Information section for list of manufacturers.

## 7. SCHEMATICS

Figure 5 is a complete schematic diagram of these assemblies.



1	GND	A	GND
2	RX ONLY	B	KEY ENABLE
3		C	PSU IN
4	CH2 <sup>6</sup>	D	CH2 <sup>2</sup>
5	CH2 <sup>5</sup>	E	CH2 <sup>1</sup>
6	CH2 <sup>4</sup>	F	CH2 <sup>0</sup>
7	CH2 <sup>3</sup>	H	DIS IN
8	PROG IN PROGRESS	J	DIS OUT
9	MODE C I/O	K	MID (TRI-STATE)
10	MODE B I/O	L	MODE C
11	MODE A I/O	M	MODE B
12	OPTION 2	N	MODE A
13	C2 OUT	P	(CSU BD C2 IN N/C) RESERVED
14	C1 OUT	R	(CSU BD C1 IN N/C) BUT NOT USED
15		S	
16	HOP	T	OPTION 1
17	+10T	U	+10T
18	+10V	V	+10V
19		W	
20		X	
21	BYPASS	Y	10 KHZ 2 <sup>0</sup>
22	10 KHZ 2 <sup>2</sup>	Z	
23	1 KHZ 2 <sup>2</sup>	a	
24	1 KHZ 2 <sup>1</sup>	b	
25		c	1 KHZ 2 <sup>0</sup>
26	10 KHZ 2 <sup>3</sup>	d	
27		e	10 KHZ 2 <sup>1</sup>
28	1 KHZ 2 <sup>3</sup>	f	
29	100 HZ 2 <sup>2</sup>	h	
30	100 HZ 2 <sup>1</sup>	i	
31	10 MHZ 2 <sup>1</sup>	k	
32		l	100 KHZ 2 <sup>1</sup>
33		m	100 KHZ 2 <sup>0</sup>
34		n	100 HZ 2 <sup>0</sup>
35		p	100 KHZ 2 <sup>2</sup>
36	100 KHZ 2 <sup>3</sup>	r	
37	10 MHZ 2 <sup>0</sup>	s	
38		t	100 HZ 2 <sup>3</sup>
39		u	1 MHZ 2 <sup>1</sup>
40	1 MHZ 2 <sup>0</sup>	v	1 MHZ 2 <sup>0</sup>
41		w	1 MHZ 2 <sup>2</sup>
42		x	1 MHZ 2 <sup>3</sup>
43	GND	y	GND

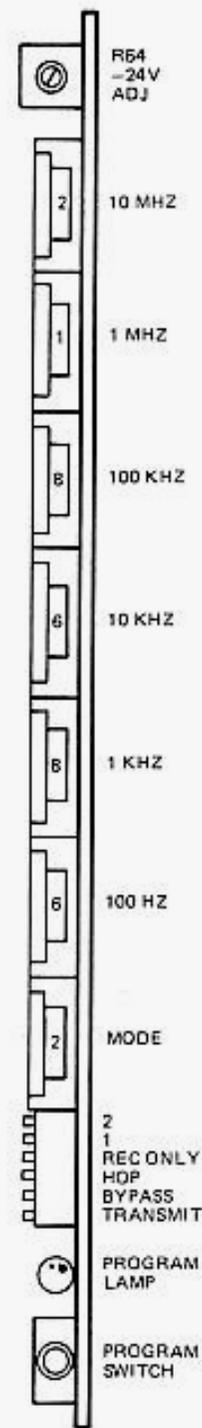


Figure 3. Input/Output Summary



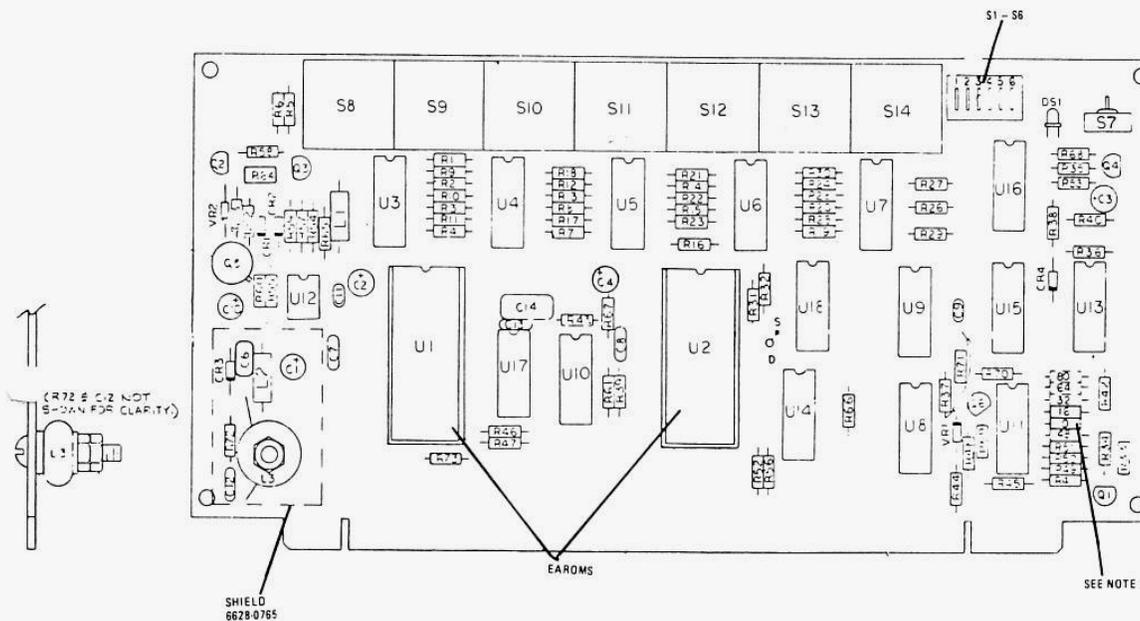
TABLE 2. 1A1A7/1A1A8 MAINTENANCE PARTS LIST

Ref. Desig.	Name & Description	Mfr. Code	Part No.
1A1A7 & 1A1A8	Program PW Board Assembly	14304	6628-0750
C1	Capacitor, Fixed, Tantalum, 47 uF, 35V	14304	C25-0002-117
C2	Capacitor, Fixed, Tantalum, 3.3 uF ±10%, 15V	14304	C-3101
C3	Capacitor, Fixed, Tantalum, 15 uF ±10%, 20V	14304	C-3103
C4	Capacitor, Fixed, Tantalum, 47 uF, 35V	14304	C25-0002-117
C5	Not used		
C6	Capacitor, Fixed, Ceramic, .47 uF, +80-20%, 50V	14304	C11-0005-474
C7	Capacitor, Fixed, Mica, 1000 pF ±5%, 500V	14304	C-0152
C8	Capacitor, Fixed, Ceramic, 470 pF ±20%, 500V	14304	C-3508
C9	Capacitor, Fixed, Ceramic, .1 uF +80-20%, 50V	14304	C-3202
C10	Capacitor, Fixed, Tantalum, 100 uF ±10%, 20V	14304	C6454
C11	Capacitor, Fixed, Ceramic, .01 uF +60-40%, 150V	14304	C-0065
C12, C13	Capacitor, Fixed, Ceramic, .001 uF ±20%, 500V	14304	C-0001
C14	Capacitor, Fixed, Mica, 200 pF	14304	C-0133
CR1, CR2	Diode, Signal, 1N4454	14304	CR-0705
CR3	Diode, Fast Recovery, 1N4935	14304	CR-0280
CR4	Diode, Signal, 1N4454	14304	CR-0705
DS1	L.E.D., Red	14304	919-4314
L1, L2	Choke, RF, 47 uF ±5%	14304	L-0060
L3	Inductor, Toroidal	14304	6628-0768
Q1, Q2	Transistor, NPN, 2N4123	14304	Q-0385
Q3, Q4	Transistor, PNP, 2N4126	14304	Q-0386
Q5	Transistor, PNP, 2N2905A	14304	Q12-2905-000
Q6	Transistor, PNP, 2N4126	14304	Q-0386
R1 to R44	Resistor, Fixed, Composition, 47K ±5%, 1/4W	Mil type	RCR07G473JM
R45 to R52	Resistor, Fixed, Composition, 1 Meg ±5%, 1/4W	Mil type	RCR07G105JM
R53, R54	Resistor, Fixed, Composition, 15K ±5%, 1/4W	Mil type	RCR07G153JM
R55 to R57	Resistor, Fixed, Composition, 2.2K ±5%, 1/4W	Mil type	RCR07G222JM
R58	Resistor, Fixed, Composition, 27K ±5%, 1/4W	Mil type	RCR07G273JM
R59	Resistor, Fixed, Composition, 22K ±5%, 1/4W	Mil type	RCR07G223JM
R60	Resistor, Fixed, Composition, 330 ohm ±5%, 1/4W	Mil type	RCR07G331JM
R61	Resistor, Fixed, Composition, 4.7K ±5%, 1/4W	Mil type	RCR07G472JM
R62	Resistor, Fixed, Composition, 680 ohm ±5%, 1/4W	Mil type	RCR07G681JM
R63	Resistor, Fixed, Film, 825 ohms ±1%, 1/8W	Mil type	RNR55C8250FM
R64	Resistor, Variable, 200 ohms	14304	R-2223
R65	Resistor, Fixed, Film, 8.25K ±1%, 1/8W	Mil type	RNR55C8251FM
R66	Resistor, Fixed, Composition, 47K ±5%, 1/4W	Mil type	RCR07G473JM
R67	Resistor, Fixed, Composition, 1 Meg ±5%, 1/4W	Mil type	RCR07G105JM
R68	Resistor, Fixed, Composition, 470 ohm ±5%, 1/4W	Mil type	RCR07G471JM
R69, R70	Resistor, Fixed, Composition, 10K ±5%, 1/4W	Mil type	RCR07G103JM
R71	Resistor, Fixed, Composition, 470 ohm ±5%, 1/4W	Mil type	RCR07G471JM
R72	Resistor, Fixed, Composition, 2.2K ±5%, 1/4W	Mil type	RCR07G222JM
R73	Resistor, Fixed, Composition, 47K ±5%, 1/4W	Mil type	RCR07G473JM
S1 to S6	Switch, Dip, Side Actuated	14304	6628-0760
S7	Switch, Pushbutton, Red	14304	S-0239
S8	Switch, Thumbwheel	14304	6628-0771



TABLE 2. 1A1A7/1A1A8 MAINTENANCE PARTS LIST (Continued)

Ref. Desig.	Name & Description	Mfr. Code	Part Number
S9 to S12	Switch, Thumbwheel	14304	6628-0772
S13	Switch, Thumbwheel	14304	6628-0774
S14	Switch, Thumbwheel	14304	6628-0773
U1, U2	Integrated Circuit, 512 bit Electrically Alterable Read Only Memory, 2051	14304	IC-0401
U3 to U8	Integrated Circuit, Hex Tri-state Non-Inverting Buffer, MM80C97	14304	IC-0400
U9	Integrated Circuit, Decade Counter, CD4017AE	14304	IC-0139
U10	Integrated Circuit, Binary Counter/Divider and Oscillator, CD4050AE	14304	IC-0385
U11	Integrated Circuit, 8 to 1 Multiplexer, CD4051BE	14304	IC-0041
U12	Integrated Circuit, Timer, CA555CE	14304	IC-0295
U13	Integrated Circuit, Quad 2-Input AND Gate, CD4081BE	14304	IC-0393
U14	Integrated Circuit, Triple 3-Input OR Gate, CD4075BE	14304	IC-0391
U15	Integrated Circuit, Quad 2-Input NAND Gate, CD4011AE	14304	IC-0135
U16 to U18	Integrated Circuit, Quad 2-Input NOR Gate, CD4001AE	14304	IC-0135
VR1	Diode, Zener, 7.5V ± 10%, 1N5236	14304	CR-0215
VR2	Diode, Zener, 3.6V ± 5%, 1N747A	14304	CR-0731



- NOTES: 1. FOR COMPLETE REFERENCE, PREFIX ALL DESIGNATORS WITH 1A1A7.  
 2. INSTALL PROGRAM JUMPER TO ENABLE DESIRED CHANNEL BLOCK. IF BOARD IN QUESTION IS TO BE PROGRAMMED WITH CHANNEL 0 - 15 INFORMATION, INSTALL JUMPER AT "0", IF FOR 0 - 31, INSTALL AT BOTH "0" AND "16", IF FOR 32 - 63, INSTALL AT "32" ETC.

Figure 4. 1A1A7/1A1A8 Component Locations

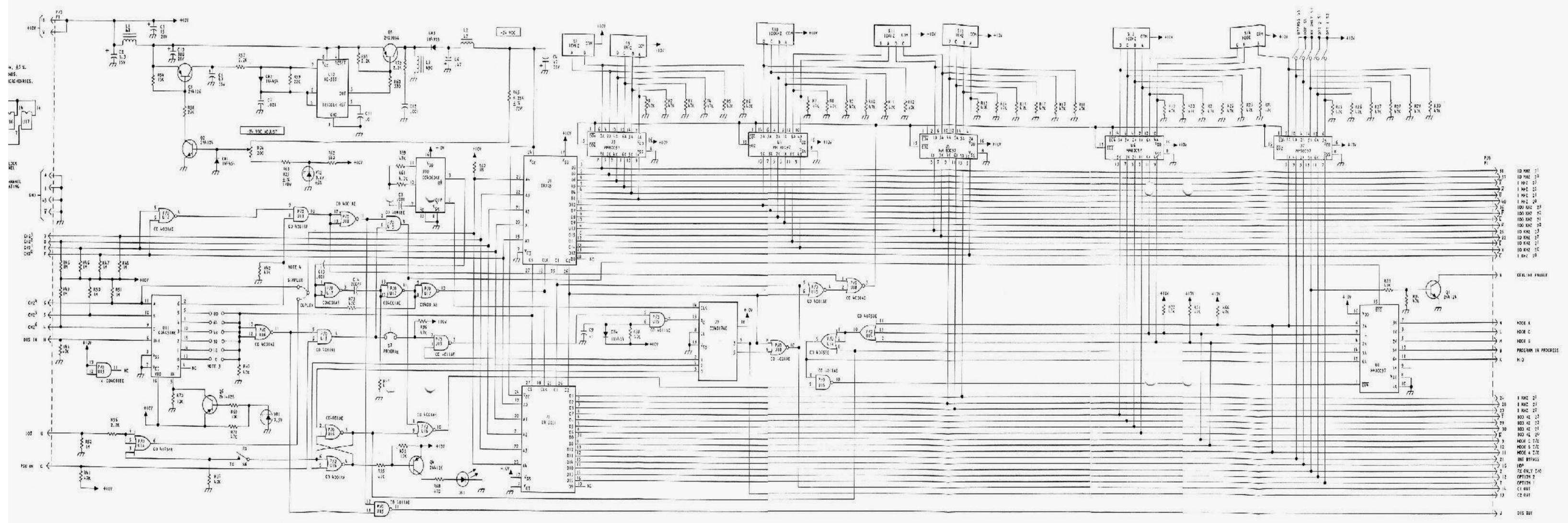


Figure 5. 1A1A7/1A1A8 Schematic Diagram, 6628-9075





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**1. GENERAL DESCRIPTION**

LO No. 2 generates the 66 MHz injection signal used at the 1A1A6 Mixer to convert the 9 MHz transmit input to the 75 MHz Intermediate Frequency, or in the receive mode, to convert the 75 MHz IF input to a 9 MHz IF. The LO No. 2 assembly uses 100 Hz and 1 kHz BCD input information. HOP (spur evasion technique) control information is also used to shift the output 10 kHz.

BPF (Band Pass Frequency) Select Control signals are also generated on the LO No. 2 assembly. This function is accomplished automatically in response to BCD frequency control inputs. This section also incorporates a priority encoder system to automatically select BYPASS mode in response to control inputs.

**2. TECHNICAL CHARACTERISTICS**

**Power Inputs:**

- +10 Vdc P1-18
- +10R P1-19

**Signal Inputs -10 dBm :**

- 65 MHz REF P1-9 From 1A1A10
- 100 Hz REF P1-42 From 1A1A10

**Signal Outputs +7 dBm:**

- LO No. 2 (66 MHz) P1-2 To 1A1A6

**Control Inputs:**

- BPF Control Inputs From 1A1A6/1A1A8
- BYPASS Control INT. EXT., +10R
- 100 Hz Freq. Control From 1A1A7/1A1A8
- 1 kHz Freq. Control From 1A1A7/1A1A8
- HOP From 1A1A7/1A1A8

**Control Outputs:**

- BPF Select Control, 3-Bit
- LO/HI Power Control
- O/L (Out of Lock) = 0

**3. SEMICONDUCTOR COMPLEMENT**

REF. DESIG.	TYPE	DESCRIPTION
AR1	CA3028AS	Differential Cascode Ampl.
AR2	CA3130AS	Operational Amplifier
CR1	MV109	Voltage Variable Capacitance
CR2, CR3	1N4454	Diode, Signal

REF. DESIG.	TYPE	DESCRIPTION
Q1, Q2	2N4124	Transistor, NPN
Q3	MPS2369	Transistor, NPN
Q4	2N3563	Transistor, NPN
Q5	MPS-A13	Transistor, Darlington, NPN
Q6	2N4124	Transistor, NPN
U1	CD4001AE	Quad 2-Input NOR
U2, U3	CD4029AE	Presettable Up/Down Counter
U4	CD4024AE	7 Stage Binary Counter
U5	CD4096BE	Gated J-K Master Slave Flip-Flop
U6	CD4082BE	Dual 4-Input AND Gates
U7	CD4011AE	Quad 2-Input NAND Gates
U8	CD4046AE	Phase Locked Loop
U9, U11	CD4071BE	Quad 2-Input OR Gates
U10	CD4075BE	Triple 3-Input OR Gates
U12	CD4081BE	Quad 2-Input AND Gates
U13	CD4532BE	8-Bit Priority Encoder
U14	CD4081BE	Quad 2-Input AND Gates
U15	CD4030AE	Quad Exclusive OR Gates

**4. FUNCTIONAL DESCRIPTION**

The two major functions performed by the LO2 PC Board are each covered by a separate schematic diagram. Figure 4 (sheet 1 of 2) is a complete schematic diagram of the BPF (Band Pass Frequency Select) function, and figure 4 (sheet 2 of 2) is a complete schematic diagram of the LO2 synthesizer function.

**4.1 BPF Decoder Function**

U13 is an 8-Bit Priority Encoder and functions to translate BCD frequency control elements from the Program Board to the desired band select control elements. U9 looks for a "frequency greater than 4 MHz condition", to generate LO/HI Power Control Logic. With JMP 1 installed, the output at P1-12 will be high for a frequency > 4.000 MHz condition, and it will be low for any frequency ≤ 4.000 MHz condition. This output is not used in a standard 125 watt RF-230 system, however, in systems employing an RF-103 1 kW Power Amplifier, this output will automatically bypass the RF-103 to meet FCC imposed reduced power requirements at frequencies below 4 MHz.

**NOTE**

With JMP 1 removed, the output at P1-12 will be high for frequencies 2-30 MHz.

If in the receive mode, the two BYPASS control lines pre-empt any other band control information, and select BYPASS mode at the coupler.



U13 interprets the decode logic outputs to produce BPF Select Code outputs as shown in table 1.

TABLE 1.  
INPUT FREQUENCIES VS OUTPUT CODES

Input Frequency Range (MHz)	BPF Output Codes		
	2 <sup>2</sup>	2 <sup>1</sup>	2 <sup>0</sup>
0.0 – 1.5999	0	0	0
1.6 – 2.5999	0	0	1
2.6 – 4.1999	0	1	0
4.2 – 6.7999	0	1	1
6.8 – 10.9999	1	0	0
11.0 – 17.9999	1	0	1
18.0 – 29.9999	1	1	0
BYPASS	1	1	1

### LO2 Generation

Phase comparator U8 functions as an edge-controlled digital memory network. It consists of four flip-flop stages, control gating, and a three state output circuit comprising p and n type drivers having a common output mode. When the P-MOS or N-MOS drivers are ON they pull the output up to VDD (+10V), or down to VSS (gnd), respectively. This type comparator acts only on the positive edges of the signal and comparator inputs. The feedback loop signal input is at U8-14, and the reference 100 Hz input is at U8-3. The phase comparator output is at U8-13 and is measurable at TP1.

The duty cycles of the signal and comparator inputs are not important since positive transitions control the PLL system utilizing this type of comparator. If the signal-input frequency is higher than the comparator-input frequency, the p-type output driver is maintained ON most of the time, and both the n and p drivers OFF (3 state) the remainder of the time. If the signal-input frequency is lower than the comparator-input frequency, the n-type output driver is maintained ON most of the time, and both the n and p drivers OFF (3 state) the remainder of the time. If the signal-and comparator-input frequencies are the same, but the signal input lags the comparator input in phase, the n-type output driver is maintained ON for a time corresponding to the phase difference. If the signal-and comparator-input frequencies are the same, but the comparator input lags the signal in phase, the p-type output driver is maintained ON

for a time corresponding to the phase difference. Subsequently, the capacitor voltage of the low-pass filter connected to this phase comparator is adjusted until the signal and comparator inputs are equal in both phase and frequency. At this stable point both p- and n-type output drivers remain OFF and thus the phase comparator output becomes an open circuit and holds the voltage on the capacitor of the low-pass filter constant.

The "phase pulses" output signal at pin 1 is a high level to indicate a locked condition and is used at the frequency standard (1A1A9) for this purpose. At pin 13, the output to the loop filter has three states: The high impedance state indicates a "locked" condition; a high logic level indicates that the frequency is too high; and a low logic level indicates that the frequency is too low. These outputs through loop filter AR2 drive voltage variable capacitor CR1 in the VCXO to correct any error. Normal phase detector operation is 2 – 8V. Therefore, 8 – 10 Vdc indicates LO2 too high in frequency 0 – 2 Vdc indicates LO2 too low in frequency.

S1 on the VCXO is used as a test/adjust switch to bypass the frequency control circuit for initial adjustment of the oscillator. With S1 closed, L6 is adjusted so that the oscillators inherent frequency is 16.5 MHz. L3, L4, and L5 are adjusted for optimum output and spurious rejection. Note that the output section is actually a times 4 multiplier, and that the output at P1-2 is actually 66 MHz. The output level at P1-2 is adjusted to +7 dBm using R11.

A sample of this 66 MHz output is picked off at the Q3 collector and fed to down mixer AR1. AR1 performs a subtractive mixing function using this 66 MHz input and the 65 MHz reference input from the Frequency Standard PC Board via P1-9. The 1 MHz mixer output is fed to Q6 via C27. Q6 functions as an analog to CMOS converter to produce a square wave output from the 1 MHz sine wave input. This output is buffered by U1 elements and closes the feedback loop driving the divide-by-N frequency control circuit. U2 provides 100 Hz frequency control information, and U3 provides 1 kHz information. Each of these frequency control elements are driven by 4-bit control lines from the program pc board.

The divide-by-N function involves three major sub-functions: presettable counters, divider control logic, and HOP control logic, the presettable



counters operate in conjunction with divider control logic to allow division of the input frequency by a number between 9901 and 10100. The actual division ratio is determined as follows. U6 decodes two end states for counter U4. One of these end states is selected by U7 under control of HOP (defined as the condition that exists when U15-4 is high). In the HOP condition, U6-13 will be high and the "100" end-state is selected; If U6-1 is low, there is no HOP condition and the selected end-state will be "99".

Counters U2 and U3 each have a state of 9. There are, therefore, three signals that occur when the counters have reached the end state; which is 9999 with HOP low, or 10099 with HOP high. These three control signals are processed by U5 to reset counters U2, U3, and U4 to zero, and to allow them to count up again.

When not in the HOP condition, after U2 and U3 are preset to zero, the counters will provide an output as they read 9999, reset, and start over. Since the count starts at zero, 10,000 clock pulses are required to produce one output – which translates to a division ratio of 10,000.

The U5-6  $\bar{Q}$  output will thus always be 100 Hz as long as the LO 2 output is "on frequency", and any tendency to deviate from this "on frequency" condition will be detected by Phase Detector U8 and the appropriate correction voltage will be generated.

Let us assume an operating frequency of 2.182 MHz as a practical review example. Referring to table 2, the "normal" LO2 output will be 66.0080 MHz, because the 2<sup>2</sup> and 2<sup>3</sup> kHz control bits at U1-5 and U1-6 respectively will cause a high at U1-4 and at U15-4. This same x.xx20 MHz frequency select control information at U2 and U3 will preset these counters with "20", and in combination with the Automatic HOP forcing signal at U15-4, will cause a total divide-by-N factor of 10080. Dividing (66.008 MHz – 65 MHz) by 10080 will produce the desired 100 Hz Phase Detector signal input. To continue the example using a frequency above the Automatic HOP control crossover point, 2.184 MHz, the LO2 output would be 65.9960 MHz. By subtracting the 65 MHz reference, we find a 0.996 MHz feedback signal to the divide-by-N circuit and a total divide-by-N factor of 9960, to produce the 100 Hz phase detector feed-back signal. An LO2 output can be derived using information presented in table 2. Remember one point, automatically or manually

employing the HOP spur evasion technique will never alter the actual transmit or receive operating frequency because of the complementary mixing process action at LO1.

## 5. MAINTENANCE

All of the adjustments indicated in this paragraph have been made at the factory prior to shipment. It should not be necessary to repeat any of these adjustments unless component failure is experienced, or unless readjustment becomes necessary for some other specific reason. All of these adjustments can be made by removing the PC Board and reinstalling it on the extender card as shown in figure 1. This will facilitate maintenance and adjustment by making all test points readily available. These adjustments can all be made using the test equipment shown or the electrical equivalents. Figure 2 summarizes 1A1A9 Inputs/Outputs and locates significant adjustment points.

### CAUTION

Always remove power when removing or reinstalling subassemblies.

### 5.1 L1/L6 Adjustment

L6 is tuned to establish the normal (no varactor control) resonant frequency of the VCXO at 16.5 MHz. Install the LO2 assembly on a pc board extender card (part of MRK) and connect the rf output to a dummy load to prevent unnecessary test transmissions. Proceed as follows:

- a. Select maintenance channel 96 and verify the "HOP" switch located on the 1A1A7/1A1A8 Program Board is not activated. (See figure 2-11 in General Information, Installation Section.)
- b. Select to verify POWER ON at the RF-230.
- c. Connect a frequency counter to the rf output connector at P1-2.
- d. Close slide switch S1 (by sliding toward top of board) on 1A1A9 to disable CR1 control and adjust L6 for an rf output of 66 MHz  $\pm$  .005 MHz (4 x 16.5 MHz) at P1-2.
- e. Set kHz and 100 Hz programming switches to zero.
- f. Open slide switch S1 (down position), and adjust L1 for a reading of 7.5 Vdc  $\pm$  0.1 Vdc at TP1.



g. Set kHz and 100 Hz programming switch to 9 and verify voltage at TP1 to be  $3.75 \text{ Vdc} \pm 1.0 \text{ Vdc}$ .

h. This completes L1/L6 adjustment. Reconfigure for normal operation or proceed with test. Make certain that S1 is left in the open (down) position for normal operation.

**5.2 L3, L4, L5 Adjustment**

L3, L4, and L5 are all tuned to select the 4th harmonic of the VCXO oscillator frequency, and to produce the optimum spurious attenuation simultaneous with optimum 66 MHz output.

a. Connect a spectrum analyzer to the LO2 output at P1-2.

b. With slide switch S1 in the open position, adjust L3, L4, and L5 for optimum 66 MHz output and spurious rejection.

c. Disconnect the spectrum analyzer and connect an RF Millivoltmeter at P1-2. Adjust R11 to produce a +7 dBm output at this point.

d. This completes 1A1A9 adjustments. Reconfigure for normal operation.

**6. PARTS LIST**

Table 3 lists all 1A1A9 Maintenance Parts. All of these components can be identified in figure 3. Refer to General Information Section for list of manufacturers.

**7. SCHEMATIC**

Figure 4 is a complete schematic diagram of the 1A1A9 assembly.

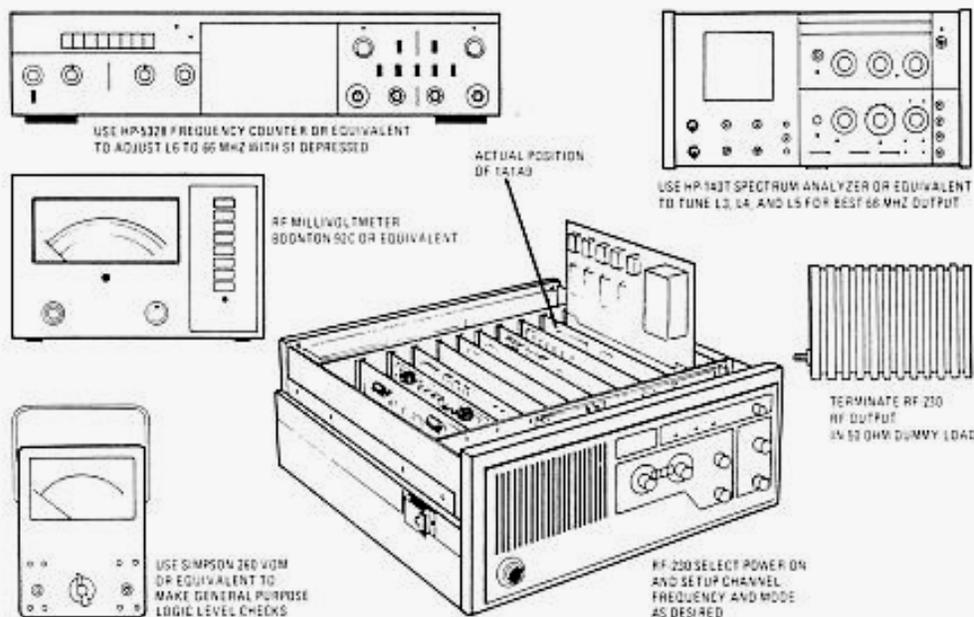


Figure 1. 1A1A9 Test Setup and Equipment



TABLE 2. LO2 OUTPUTS FOR SELECTED F<sub>0</sub> CONDITIONS

SELECTED F <sub>0</sub> IN MHZ	LO2 OUTPUT (NORMAL)	DIVIDE-BY-N FACTOR	HOP CROSSOVER POINT NOTES	LO2 OUTPUT HOP SELECTED	DIVIDE-BY-N FACTOR
X.XX00	66.0100	10100	NORMAL LO2 OUTPUTS ARE AS SHOWN AT LEFT. IF HOP IS MANUALLY SELECTED OR PROGRAMMED, LO2 OUTPUTS WILL BE AS SHOWN AT RIGHT.	65.0000	10000
01	66.0099	10099		65.9999	9999
02	66.0098	10098		65.9998	9998
03	66.0097	10097		65.9997	9997
04	66.0096	10096		65.9996	9996
05	66.0095	10095		65.9995	9995
06	66.0094	10094		65.9994	9994
07	66.0093	10093		65.9993	9993
08	66.0092	10092		65.9992	9992
09	66.0091	10091		65.9991	9991
10	66.0090	10090		65.9990	9990
11	66.0089	10089		65.9989	9989
12	66.0088	10088		65.9988	9988
CONTINUES IN SEQUENCE					
19	66.0081	10081	CROSSOVER CONTROL FOR "AUTO HOP" EFFECTED BY 2 <sup>3</sup> AND 2 <sup>5</sup> KHZ BITS AT UI-5 AND UI-6	65.9981	9981
20	66.0080	10080		65.9980	9980
21	66.0079	10079		65.9979	9979
22	66.0078	10078		65.9978	9978
23	66.0077	10077		65.9977	9977
24	66.0076	10076		65.9976	9976
CONTINUES IN SEQUENCE					
37	66.0063	10063	CROSSOVER POINT	65.9963	9963
38	66.0062	10062		65.9962	9962
39	66.0061	10061	65.9961	9961	
CONTINUES IN SEQUENCE					
40	65.9960	9960	CROSSOVER POINT  FOR FREQUENCIES LESS THAN X.XX40 MHZ, HOP IS AUTOMATICALLY ACTIVATED. MANUALLY SELECTING HOP WILL ALWAYS CHANGE LO2 OUTPUT FROM THAT SHOWN AT THE LEFT, TO THAT SHOWN AT THE RIGHT.	66.0060	10060
41	65.9959	9959		66.0059	10059
42	65.9958	9958		66.0058	10058
43	65.9957	9957		66.0057	10057
44	65.9956	9956		66.0056	10056
45	65.9955	9955		66.0055	10055
46	65.9954	9954		66.0054	10054
47	65.9953	9953		66.0053	10053
48	65.9952	9952		66.0052	10052
49	65.9951	9951		66.0051	10051
50	65.9950	9950		66.0050	10050
51	65.9949	9949		66.0049	10049
52	65.9948	9948		66.0048	10048
53	65.9947	9947		66.0047	10047
54	65.9946	9946		66.0046	10046
55	65.9945	9945		66.0045	10045
56	65.9944	9944		66.0044	10044
CONTINUES IN SEQUENCE					
97	65.9903	9903	CROSSOVER POINT	66.0003	10003
X.XX99	65.9902	9902		66.0002	10002
	65.9901	9901		66.0001	10001



1	GND
2	LO2 OUTPUT (66 MNZ)
3	GND
4	
5	
6	
7	
8	
9	65 MHZ REF INPUT
10	GND
11	TP1
12	LO/HI POWER
13	BPF SELECT CODE 2 <sup>0</sup>
14	BPF SELECT CODE 2 <sup>2</sup>
15	BPF SELECT CODE 2 <sup>1</sup>
16	HOP
17	
1 <sup>P</sup>	+10 VDC
1 <sup>V</sup>	+10R
20	
21	BYPASS (INT)
22	1 KHZ FREQ SELECT 2 <sup>2</sup>
23	1 KHZ FREQ SELECT 2 <sup>1</sup>
24	1 KHZ FREQ SELECT 2 <sup>0</sup>
25	BYPASS (EXT)
26	1 KHZ FREQ SELECT 2 <sup>3</sup>
27	100 HZ FREQ SELECT 2 <sup>2</sup>
28	100 HZ FREQ SELECT 2 <sup>1</sup>
29	10 MHZ 2 <sup>1</sup>
30	100 KHZ 2 <sup>1</sup>
31	
32	100 HZ FREQ SELECT 2 <sup>0</sup>
33	100 KHZ 2 <sup>2</sup>
34	100 KHZ 2 <sup>3</sup>
3 <sup>V</sup>	10 MHZ 2 <sup>0</sup>
36	100 HZ FREQ SELECT 2 <sup>3</sup>
37	1 MHZ 2 <sup>1</sup>
38	1 MHZ 2 <sup>0</sup>
39	1 MHZ 2 <sup>2</sup>
40	1 MHZ 2 <sup>3</sup>
41	O/L OUT
42	100 HZ REF INPUT
43	GND

A	
B	
C	
D	
E	
F	
H	
J	
K	
L	
M	
N	
P	
R	
S	
T	HOP
U	
V	
W	
X	
Y	
Z	
a	
b	
c	
d	
e	
f	
h	
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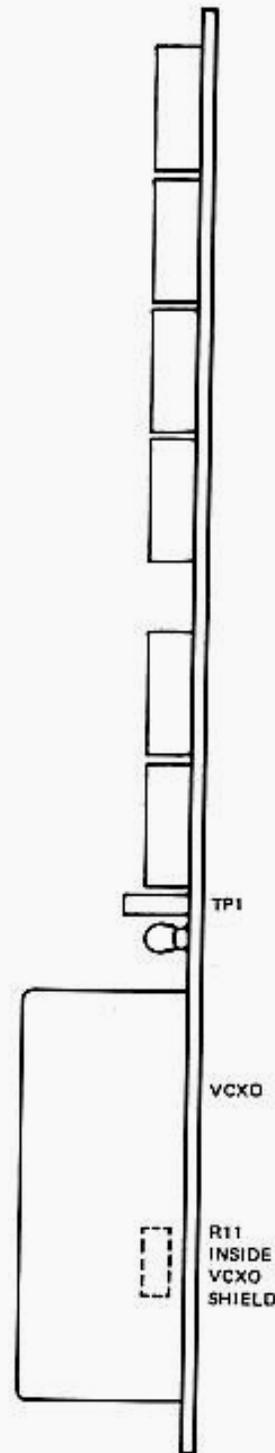


Figure 2. 1A1A9 Input/Output Summary



TABLE 3. 1A1A9 MAINTENANCE PARTS LIST

Ref. Desig.	Name & Description	Mfr. Code	Part Number
1A1A9	L.O. No. 2 PWB Assembly	14304	6628-0800
AR1	Integrated Circuit, Differential/Cascode Amplifier, CA028AS	14304	IC-0031
AR2	Integrated Circuit, Operational Amplifier, CA3130AS	14304	IC-0376
C1	Capacitor, Fixed, Mica, 470 pF $\pm$ 2%, 500V	14304	C-2496
C2	Capacitor, Fixed, Mica, 680 pF $\pm$ 2%, 500V	14304	C-2501
C3	Capacitor, Fixed, Tantalum, 6.8 uF $\pm$ 10%, 35V	14304	C-3102
C4	Capacitor, Fixed, Ceramic, .01 uF $\pm$ 20%, 50V	14304	C11-0007-103
C5	Capacitor, Fixed, Ceramic, 33 pF $\pm$ 5%, 1000V	14304	C-4750
C6	Capacitor, Fixed, Ceramic, .01 uF $\pm$ 20%, 50V	14304	C11-0007-103
C7	Capacitor, Fixed, Ceramic, 15 pF $\pm$ 5%, 1000V	14304	C-4743
C8	Capacitor, Fixed, Ceramic, 20 pF $\pm$ 5%, 1000V	14304	C-4745
C9	Capacitor, Fixed, Mica, 100 pF $\pm$ 5%, 500V	14304	C-0126
C10	Capacitor, Fixed, Ceramic, .01 uF $\pm$ 20%, 50V	14304	C11-0007-103
C11	Capacitor, Fixed, Ceramic, .001 uF $\pm$ 10%, 500V	14304	C-3513
C12	Capacitor, Fixed, Ceramic, 15 pF $\pm$ 5%, 1000V	14304	C-4743
C13	Capacitor, Fixed, Ceramic, 39 pF $\pm$ 5%, 1000V	14304	C-4751
C14	Capacitor, Fixed, Ceramic, 1 pF $\pm$ 5%, 1000V	14304	C-4727
C15	Capacitor, Fixed, Ceramic, .01 uF $\pm$ 20%, 50V	14304	C11-0007-103
C16	Capacitor, Fixed, Tantalum, 6.8 uF $\pm$ 10%, 35V	14304	C-3102
C17	Capacitor, Fixed, Mica, 220 pF $\pm$ 5%, 500V	14304	C-0134
C18	Capacitor, Fixed, Ceramic, 20 pF $\pm$ 5%, 1000V	14304	C-4745
C19	Capacitor, Fixed, Ceramic, 47 pF $\pm$ 5%, 1000V	14304	C-4752
C20	Capacitor, Fixed, Ceramic, .01 uF $\pm$ 20%, 50V	14304	C-4952
C21	Capacitor, Fixed, Ceramic, 56 pF $\pm$ 5%, 1000V	14304	C-4754
C22	Capacitor, Fixed, Mica, 120 pF $\pm$ 5%, 500V	14304	C-0128
C23, C24	Capacitor, Fixed, Ceramic, .01 uF $\pm$ 20%, 50V	14304	C-4952
C25	Capacitor, Fixed, Mica, 220 pF $\pm$ 5%, 500V	14304	C-0134
C26	Capacitor, Fixed, Tantalum, 6.8 uF $\pm$ 10%, 35V	14304	C-3102
C27	Capacitor, Fixed, Ceramic, .01 uF $\pm$ 20%, 50V	14304	C-4952
C28	Capacitor, Fixed, Tantalum, 1 uF $\pm$ 10%, 35V	14304	C-3100
C29	Capacitor, Fixed, Tantalum, 150 uF $\pm$ 10%, 15V	14304	C-3106
C30	Capacitor, Fixed, Tantalum, 1 uF $\pm$ 10%, 35V	14304	C-3100
C31	Capacitor, Fixed, Ceramic, 47 pF $\pm$ 5%, 1000V	14304	C-4752
C32	Capacitor, Fixed, Ceramic, .047 uF $\pm$ 80-20%, 50V	14304	C-3201
C33	Capacitor, Fixed, Polycarbonate, .1 uF $\pm$ 10%, 100V	14304	C-8031
C34	Capacitor, Fixed, Polycarbonate, 1 uF $\pm$ 10%, 100V	14304	C-8043
C35	Capacitor, Fixed, Tantalum, 150 uF $\pm$ 10%, 15V	14304	C-3106
C36, C37	Capacitor, Fixed, Ceramic, .01 uF $\pm$ 10%, 50V	14304	C-4952
C38	Capacitor, Fixed, Ceramic, .001 uF $\pm$ 10%, 500V	14304	C-3513
C39	Capacitor, Fixed, Tantalum, 6.8 uF $\pm$ 10%, 35V	14304	C-3102
C40	Capacitor, Fixed, Ceramic, .01 uF $\pm$ 20%, 50V	14304	C-4952



TABLE 3. 1A1A9 MAINTENANCE PARTS LIST (Continued)

Ref. Desig.	Name & Description	Mfr. Code	Part No.
C41 to C49	Capacitor, Fixed, Ceramic, .001 uF $\pm$ 10%, 500V	14304	C-3513
C50	Capacitor, Fixed, Ceramic, .01 uF $\pm$ 20%, 50V	14304	C11-0007-103
C51 to C53	Capacitor, Fixed, Ceramic, .1 uF +80-20%, 50V	14304	C-3202
C54	Capacitor, Fixed, Ceramic, .001 uF $\pm$ 10%, 500V	14304	C-3513 $\pm$ 10%Y5E
C55	Capacitor, Fixed, Ceramic, 6.8 pF $\pm$ .5 pF, 1000V	14304	C-4735
C56	Capacitor, Fixed, Ceramic, 1.8 pF $\pm$ .5 pF, 1000V	14304	C-4730
CR1	Diode, Voltage Variable Capacitance, MV109	14304	CR-0745
CR2,CR3	Diode, Signal, 1N4454	14304	CR-0705
JMP1	Jumper	14304	MP1142
L1	Inductor, Variable, 3.3 uH	14304	6628-0812
L2	Choke, RF, 10 uH $\pm$ 10%	14304	L-0628
L3 to L6	Inductor, Variable, .34 uH	14304	L-0251
7	Choke, RF, .39 uH $\pm$ 10%	14304	L-0611
L8	Choke, RF, .15 uH $\pm$ 10%	14304	L-0606
L9	Choke, RF, 100 uH $\pm$ 10%	14304	L-0640
L10	Choke, RF, 56 uH $\pm$ 10%	14304	L-0637
Q1,Q2	Transistor, NPN, 2N4124	14304	Q-0385
Q3, Q4	Transistor, NPN, 2N3563	14304	Q-0309
Q5	Transistor, NPN, Darlington, MPSA13	14304	Q-0076
Q6	Transistor, NPN, 2N4124	14304	Q-0385
R1	Resistor, Fixed, Composition, 33K $\pm$ 5%, 1/4W	Mil type	RCR07G333JM
R2	Resistor, Fixed, Composition, 4.3K $\pm$ 5%, 1/4W	Mil type	RCR07G432JM
R3	Resistor, Fixed, Composition, 910 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G911JM
R4	Resistor, Fixed, Composition, 3.3K $\pm$ 5%, 1/4W	Mil type	RCR07G332JM
R5	Resistor, Fixed, Composition, 330 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G331JM
R6	Resistor, Fixed, Composition, 82 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G820JM
R7	Resistor, Fixed, Composition, 8.2K $\pm$ 5%, 1/4W	Mil type	RCR07G822JM
R8	Resistor, Fixed, Composition, 1.8K $\pm$ 5%, 1/4W	Mil type	RCR07G182JM
9	Resistor, Fixed, Composition, 560 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G561JM
R10	Resistor, Fixed, Composition, 100 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G101JM
R11	Resistor, Variable, 500 ohm	14304	R-2205
R12	Resistor, Fixed, Composition, 6.8K $\pm$ 5%, 1/4W	Mil type	RCR07G682JM
R13	Resistor, Fixed, Composition, 18K $\pm$ 5%, 1/4W	Mil type	RCR07G183JM
R14	Resistor, Fixed, Composition, 100K $\pm$ 5%, 1/4W	Mil type	RCR07G104JM
R15	Resistor, Fixed, Composition, 2.2K $\pm$ 5%, 1/4W	Mil type	RCR07G222JM
R16	Resistor, Fixed, Composition, 82 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G820JM
R17	Resistor, Fixed, Composition, 5.6K $\pm$ 5%, 1/4W	Mil type	RCR07G562JM
R18	Resistor, Fixed, Composition, 2.7K $\pm$ 5%, 1/4W	Mil type	RCR07G272JM
R19	Resistor, Fixed, Composition, 100 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G101JM
R20	Resistor, Fixed, Composition, 220 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G221JM
R21	Resistor, Fixed, Composition, 2.2K $\pm$ 5%, 1/4W	Mil type	RCR07G222JM



TABLE 3. 1A1A9 MAINTENANCE PARTS LIST (Continued)

Ref. Desig.	Name & Description	Mfr. Code	Part No.
R22	Resistor, Fixed, Composition, 68K $\pm$ 5%, 1/4W	Mil type	RCR07G683JM
R23	Resistor, Fixed, Composition, 12K $\pm$ 5%, 1/4W	Mil type	RCR07G123JM
R24	Resistor, Fixed, Composition, 470 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G471JM
R25	Resistor, Fixed, Composition, 100 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G101JM
R26,R27	Resistor, Fixed, Composition, 27K $\pm$ 5%, 1/4W	Mil type	RCR07G273JM
R28	Resistor, Fixed, Composition, 33K $\pm$ 5%, 1/4W	Mil type	RCR07G333JM
R29	Resistor, Fixed, Composition, 56K $\pm$ 5%, 1/4W	Mil type	RCR07G563JM
R30	Resistor, Fixed, Composition, 2.7K $\pm$ 5%, 1/4W	Mil type	RCR07G272JM
R31	Resistor, Fixed, Composition, 10K $\pm$ 5%, 1/4W	Mil type	RCR07G103JM
R32	Resistor, Fixed, Composition, 100 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G101JM
R33	Resistor, Fixed, Composition, 10K $\pm$ 5%, 1/4W	Mil type	RCR07G103JM
R34	Resistor, Fixed, Composition, 1K $\pm$ 5%, 1/4W	Mil type	RCR07G102JM
R35,R36	Resistor, Fixed, Composition, 100K $\pm$ 5%, 1/4W	Mil type	RCR07G104JM
R37	Resistor, Fixed, Composition, 1K $\pm$ 5%, 1/4W	Mil type	RCR07G102JM
R38	Resistor, Fixed, Composition, 100 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G101JM
R39 to R46	Resistor, Fixed, Composition, 100K $\pm$ 5%, 1/4W	Mil type	RCR07G104JM
R47 to R58	Resistor, Fixed, Composition, 1K $\pm$ 5%, 1/4W	Mil type	RCR07G102JM
R59 to R67	Resistor, Fixed, Composition, 100K $\pm$ 5%, 1/4W	Mil type	RCR07G104JM
R68	Resistor, Fixed, Composition, 220K $\pm$ 5%, 1/4W	Mil type	RCR07G224JM
R69,R70	Resistor, Fixed, Composition, 100K $\pm$ 5%, 1/4W	Mil type	RCR07G104JM
R71 to R82	Resistor, Fixed, Composition, 2.7K $\pm$ 5%, 1/4W	Mil type	RCR07G272JM
R83	Resistor, Fixed, Composition, 1K $\pm$ 5%, 1/4W	Mil type	RCR07G102JM
R84	Resistor, Fixed, Composition, 100K $\pm$ 5%, 1/4W	Mil type	RCR07G104JM
R85	Resistor, Fixed, Composition, 100 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G101JM
R86	Resistor, Fixed, Composition, 47K $\pm$ 5%, 1/4W	Mil Type	RCR07G473JM
S1	Switch, SPST	14304	S-0130-4-CE-P-2W
TP1	Test Point, Brown	14304	J-0392-8-001
U1	Integrated Circuit, Quad 2-Input NOR Gate	14304	IC-0135
U2,U3	Integrated Circuit, Presettable UP/DOWN Counter	14304	IC-0090
U4	Integrated Circuit, 7-Stage Binary Counter	14304	IC-0243
U5	Integrated Circuit, Gated J-K Master Slave Flip-Flop	14304	IC-0395
U6	Integrated Circuit, Dual 4-Input AND Gate	14304	IC-0394
U7	Integrated Circuit, Quad 2-Input NAND Gate	14304	IC-0136
U8	Integrated Circuit, Micropower Phase-Locked Loop	14304	IC-0383
U9	Integrated Circuit, Quad 2-Input OR Gate	14304	IC-0389
U10	Integrated Circuit, Triple 3-Input OR Gate	14304	IC-0391
U11	Integrated Circuit, Quad 2-Input OR Gate	14304	IC-0389
U12	Integrated Circuit, Quad 2-Input AND Gate	14304	IC-0393
U13	Integrated Circuit, 8-Bit Priority Encoder	14304	IC-0397
U14	Integrated Circuit, Quad 2-Input AND Gate	14304	IC-0393
U15	Integrated Circuit, Quad Exclusive OR Gate	14304	IC-0244
Y1	Crystal, VCXO, 16.5000 MHz	14304	6628-0810

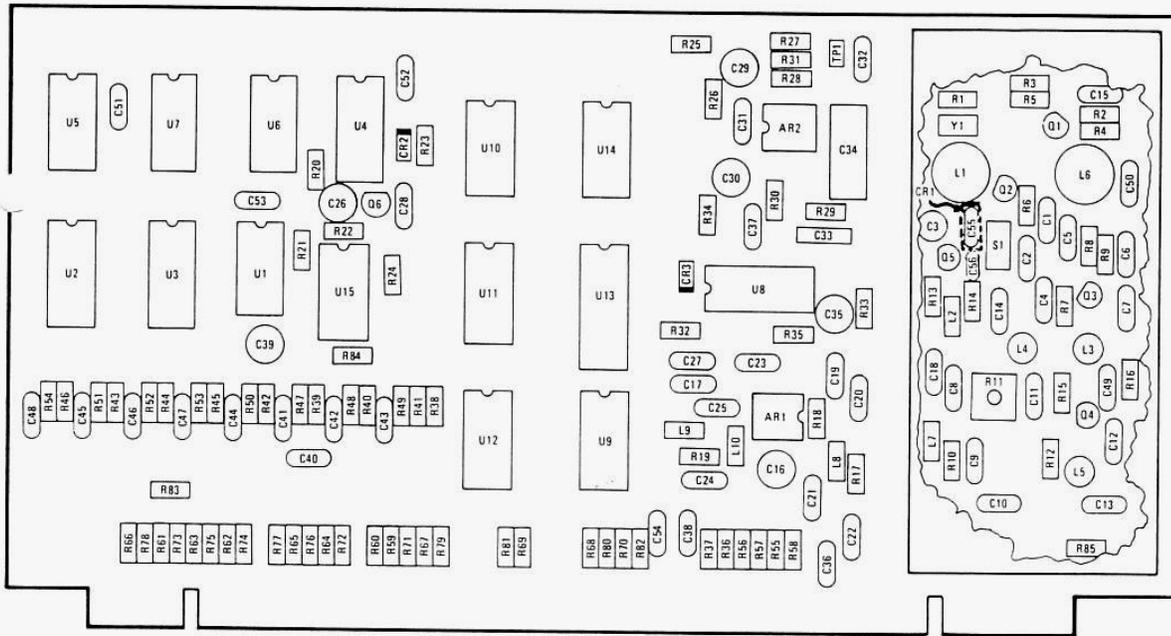


Figure 3. 1A1A9 Component Locations

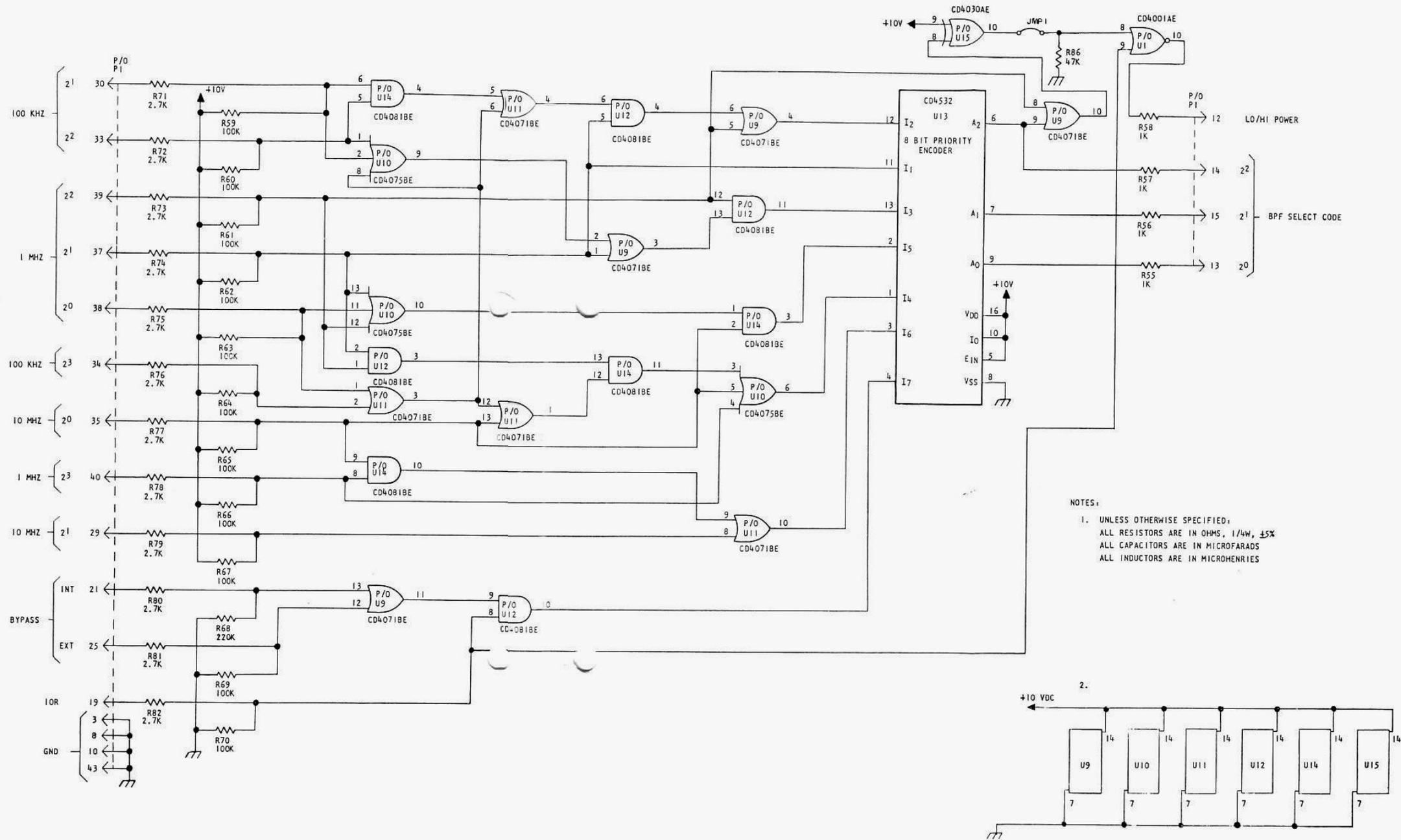
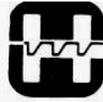
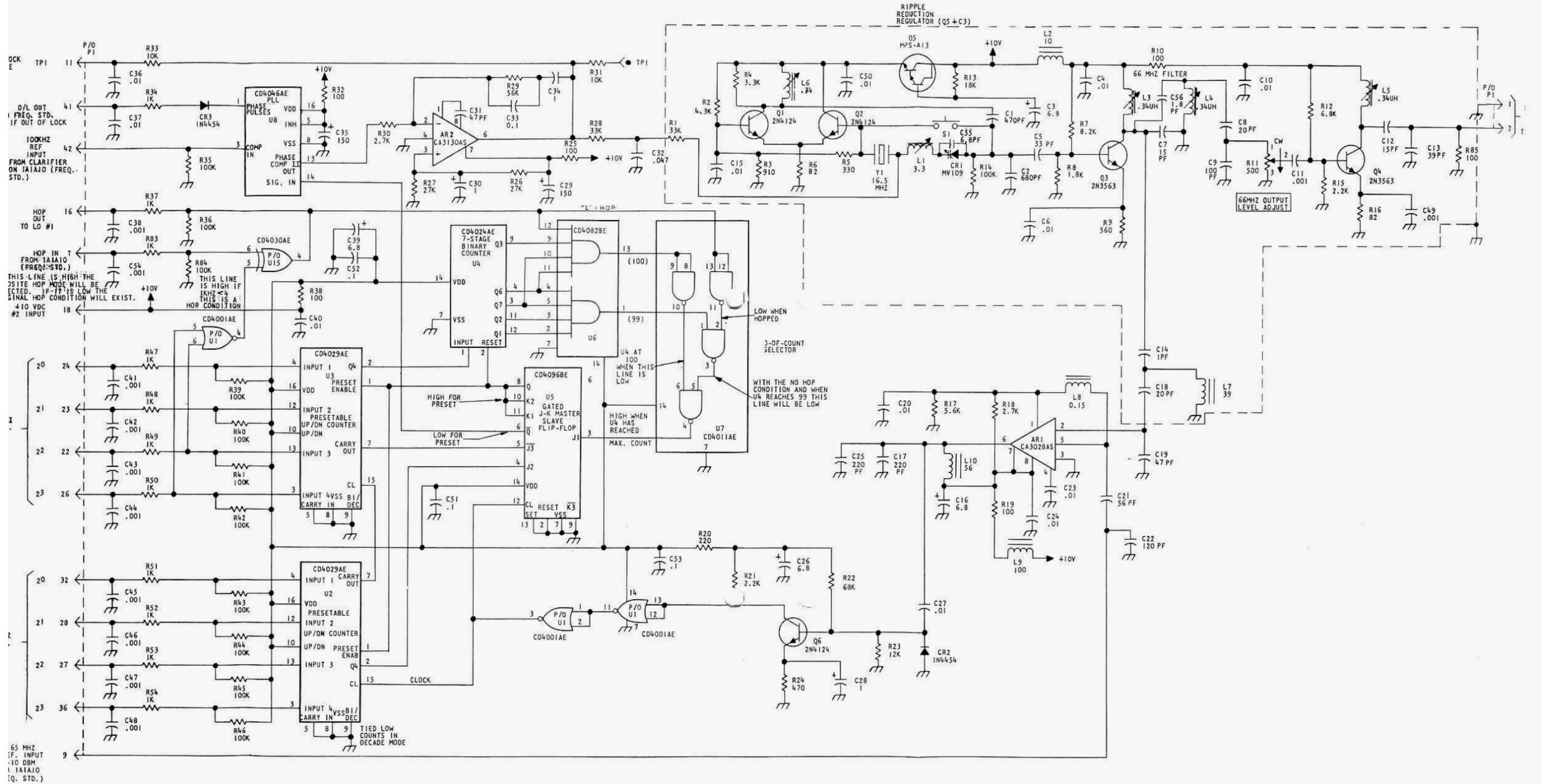


Figure 4. 1A1A9 LO No. 2 PC Board Schematic 6628-9080 (Sheet 1 of 2)







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## 1. GENERAL DESCRIPTION

The 1A1A10 Frequency Standard PWB generates all reference frequencies from a TCXO (Temperature Compensated Xtal Oscillator) internal standard or from an optional 13 MHz external source. The 1A1A10 Frequency Standard PWB Simplified Diagram is illustrated on the cover. It demonstrates all significant internal functions and their related inputs and outputs. Figure 1 illustrates the 1A1A10 Input/Output Summary.

## 2. TECHNICAL CHARACTERISTICS

### Power Requirements:

+13.2 Vdc Input	P1-20
+10T	P1-17
+10R	P1-19

### Control Inputs

O/L In	P1-3
Clarifier Down	P1-13 (0 = Down)
Clarifier Up	P1-14 (0 = Up)
Clarifier Zero	P1-12 (0 = Zero)
+10T	P1-17
+10R	P1-19
LO3 Inhibit	P1-6

### Control Outputs

Zero Output	P1-9 (1 = Zero)
Up Output	P1-10 (1 = Up)
Down Output	P1-11 (1 = Down)
Xmit Inhibit	P1-2 (1 = Inhibit)

### Signal Outputs

9 MHz	P1-8	0 dBm
65 MHz	P1-5	-10 ± 5 dBm
100 Hz Ref	P1-42	(10V P-P)
1 MHz	P1-16	(10V P-P)
1 kHz	P1-40	280 mV rms

## 3. SEMICONDUCTOR COMPLEMENT

REF. DESIG.	TYPE	FUNCTION
AR1	LM124J	Quad Op Amp
U1	SN5400J	Quad 2-Input NAND Gate
U11	CD4011B	Quad 2-Input NAND Gate
U15	SN54LS00	Quad 2-Input NAND Gate
U16	CD4518BF	Dual Decade Counter
U17	CS4518BF	Dual Decade Counter
U18	SN54LS163J	Programmable Counter
U20	SN54LS26J	Quad 2-Input NAND Gate
U21	CA3083F	NPN Transistor Array

## 4. TECHNICAL DESCRIPTION

### 4.1 65 MHz LO2 Reference

The 65 MHz LO2 reference is synthesized by selecting the 5th harmonic of the 13 MHz TCXO output. When 1A1A10 is in the normally closed position, NAND Gate U1-2 is enabled and the 13 MHz TCXO output at U1-1 is gated through to U1-12. The other S1 normally closed contacts produce a low at U1-5, forcing U1-6 and U1-13 high. The internal TCXO output is then gated through at U1-11 and U1-8. The U1-11 13 MHz output is applied to band-pass filter elements L3, L4, and L5 for selection of the 5th harmonic. The filter group insertion loss is approximately 8 dB when properly tuned. The output to the base of 65 MHz output amplifier Q6 is approximately -25 dBm. Q6 provides a fixed gain of 15 dB to produce the desired -10 dBm drive level to the 1A1A9 LO2 PWB.

### 4.2 1 MHz, 1 kHz, -100 Hz Reference Frequencies

The 1 MHz, 1 kHz, and 100 Hz reference frequencies are developed from the 13 MHz square wave output at U1-8. U18 is a synchronous 4-bit counter configured to divide by 13 to produce a 1 MHz output at U18-11, the QD output. This 1 MHz output is routed via R31 to P1-16 at a level of approximately 280 mV rms. The signal is then fed to U16 to derive the 1 kHz and 100 Hz outputs. U16 performs a divide by 100 function to produce a 10 kHz output at U16-14, the Q4B output. This 10 kHz output is divided by 10 and by 100 at U17 to produce the desired 1 kHz and 100 Hz outputs. The divide-by-100 output (100 Hz) is selected at U17 Q4B. The divide-by-10 function is accomplished as shown in Figure 1 for optimum harmonic attenuation in the 1 kHz output. This 1 kHz signal is used for CW tone generation because of its low harmonic content. The U17/U11 Timing Diagram is illustrated in Figure 2. Operational amplifier AR1 and related circuitry provide a sinusoidal output at the required 0.7V P-P level.

### 4.3 9 MHz LO3 Output

The 9 MHz LO3 output is derived by selecting the 1 MHz U18 QD output and routing this square wave signal through two NAND Gate elements of U15. The U15 output section is configured as an inverter and is coupled through C32 to drive T1. Each transformer, T1, T2, T3, and T4 is resonated at 9 MHz. U21 at the output section is a Darlington pair driving an emitter follower, with the output controlled (switched on or off) by the logic level at 1A1A10 P1-6.



1	GND	A	
2	XMT INH	B	EXT STD
3	O/L IN	C	SHLD GND
4	GND	D	
5	65 MHZ	E	
6	LO3 INH	F	
7	GND	H	
8	LO3 9 MHZ	J	
9	ZERO SIG	K	
10	UP SIG	L	
11	DOWN SIG	M	
12	ZERO CLARIFIER	N	
13	DOWN CLARIFIER	P	
14	UP CLARIFIER	R	
15	GND	S	
16	1 MHZ REF	T	
	+10T	U	
18	+10V REG	V	
19	+10R	W	
20	UNREG IN	X	
21	ATP2	Y	
22		Z	
23	ATP1	a	
24		b	
25		c	
26		d	
27		e	
28		f	
29		h	
30		j	
31		k	
32		l	
33		m	
34		n	
35		p	
36		r	
37		s	
38		t	
39		u	
40	1 KHZ TONE	v	
41	GND	w	
42	100 HZ REF	x	
43	GND	y	



Figure 1. 1A1A10 Input/Output Summary

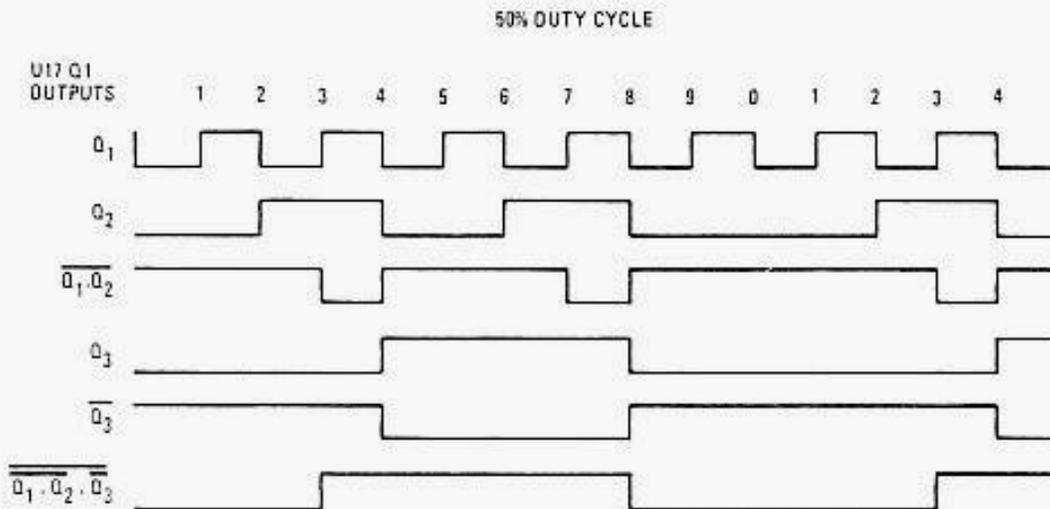


Figure 2. U17/U11 Timing Diagram

#### 4.4 Clarifier Control Signal

Clarifier operation is inhibited in the receive and transmit modes with CR2 and CR3 installed. U13 has two inputs when no inhibit voltage is present at U13-11; an end-of-range signal from U12-10 and the Up/Down control signal from P1-14. The zero output driving Q7 enables C35 to slow U6 as it reaches zero. U6 timer output is available at P1-23.

##### 4.4.1 Clarifier Inhibit and Control

When CR2 and CR3 are present in the circuit, the +10V at P1-17 or P1-19 is inverted to a ground signal via U10. This forces U11-4 high, grounding a bit dB on U19 and causing U19 to divide by 16. U13-6 enables U14-9 and associated circuitry to divide by 8125. This provides a total division of 130,000 and an output of 100 Hz. If the clarifier is not inhibited, a control counter comprising U4, U7, and U14 instructs U19 to divide by 14 the amount of times commanded by U5 and U7. U14-9 then goes high, causing its associated circuitry to divide by 8127. U19 divides by 14 a total of 16 times and by 16 a total of 8111 times with U5 and U7 set for zero offset. This again provides a total division of 130,000 and an output of 100 Hz. If U5 and U7 are set for one increment above zero, U19 divides by 14 a total of 17 times and by 16 a total of 8110 times. This provides

a total division of 129,998 and an output of 100.00153 Hz. This raises the LO2 frequency by 15.3 Hz. The clarifier range is approximately -246 Hz to +230 Hz.

##### 4.5 Out of Lock/TX Inhibit

If a synthesizer phase locked loop goes out of lock, 1A1A10 P1-3 goes low and turns Q2 on. This generates a Tx (Transmit Inhibit) control output via Q4 and an out-of-lock indication via Q3 and DS1. When Q4 is on 1A1A10, P1-2 goes low. The O/L indicator is visible from the top of the unit.

##### 4.6 +10V and +5V Regulators

VR1, AR1, and Q1 provide a fold-back protected and regulated +10V power source. This supply is also provided for other exciter voltages and drives the VR2 +5 Vdc regulator.

## 5. MAINTENANCE

The Frequency Standard PC Board is mounted on an extender card (part of the MRK) during test and adjustment procedures. All test equipment items required for test and adjustment of this assembly are shown in Figure 3.

### CAUTION

Ensure primary power is removed when removing or installing plug-in assemblies.

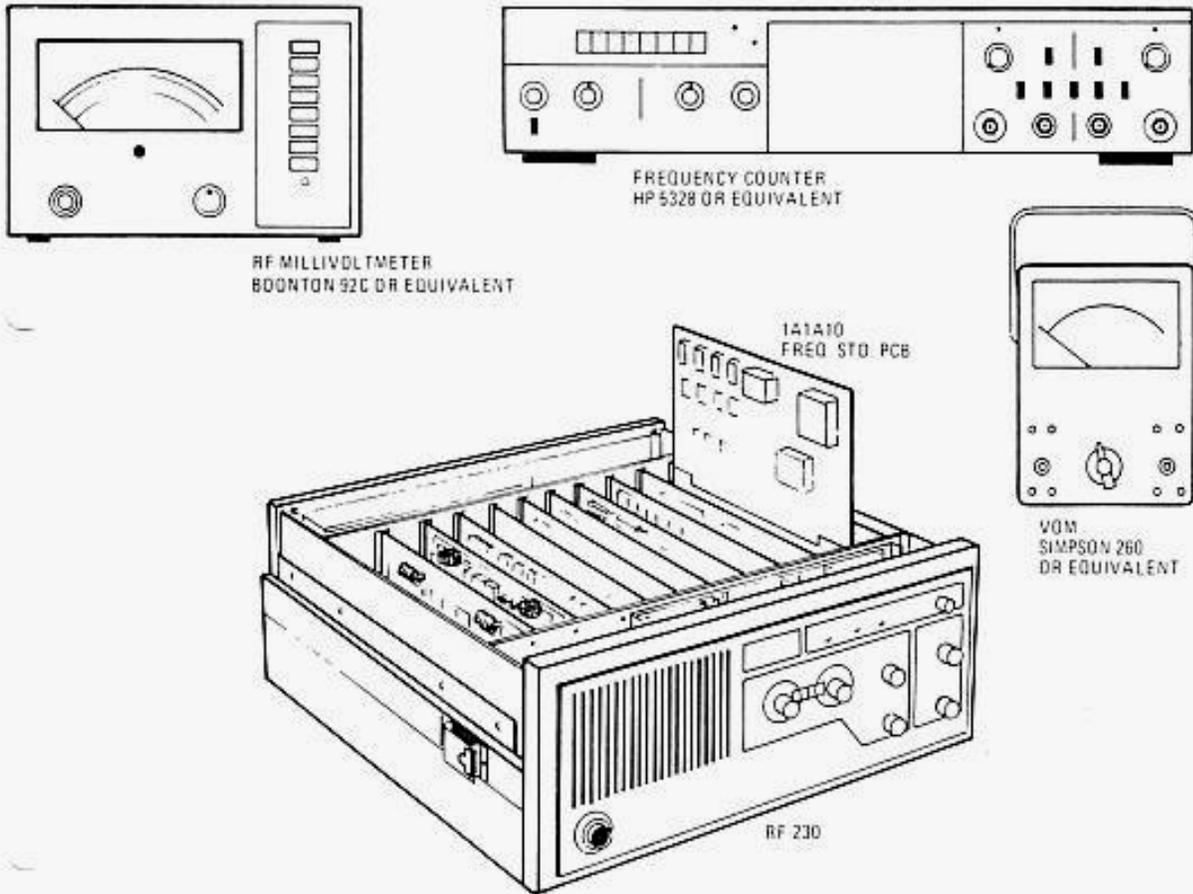


Figure 3. 1A1A10 Test Configuration



### 5.1 R1, +10V Regulator Adjustment

With the 1A1A10 Frequency Standard PWB mounted on an extender card and POWER ON for normal operation, perform the following:

- a. Verify 11-16 Vdc (nominal 14.0 Vdc) at P1-20.
- b. Connect VOM to P1-18 and verify +10 Vdc. If +10 Vdc is not indicated, adjust R1 as required for a +10 Vdc indication.
- c. Disconnect all test equipment. The adjustment procedure is not complete.

### 5.2 65 MHz Output Tuning and Verification

With the 1A1A10 Frequency Standard PWB mounted on an extender card, and POWER ON for normal operation, connect VTVM and a frequency counter at P1-5. Proceed as follows:

- a. Verify 65 MHz output frequency and a (-10 to -15 dBm) level at P1-5. This is a nominal level with L3 and L4 properly adjusted. Verify tuning and adjustment as follows. If the level indicated is more than -15 dBm:
- b. Adjust L3 and L4 for maximum output on VTVM.
- c. Use TCXO adjustment at top of sealed assembly and adjust for 65 MHz indication on frequency counter.

#### Note

The number stamped on TCXO is offset in Hz at 25°C.

- d. Disconnect all test equipment. The adjustment procedure is now complete.

### 5.3 R1, 9 MHz RF Output Level Tuning and Adjustment

With the 1A1A10 Frequency Standard PWB mounted on an extender card, connect VTVM and a frequency counter at P1-8 and verify 9 MHz at 0 dBm. If 0 dBm is not indicated, proceed as follows:

- a. Tune T1, T2, T3, and T4 for maximum indication on VTVM.
- b. Verify 0 dBm at P1-8.

#### Note

A logic "1" at P1-6 will inhibit this output.

- c. Disconnect all test equipment. The adjustment procedure is now complete.

### 5.4 100 Hz Reference Output Verification

Verify 100 Hz, 10V peak-to-peak (CMOS) at P1-42.

### 5.5 1 MHz Output Verification

The 1 MHz output is at T<sup>2</sup>L levels. The "1" level is 2.4 Vdc, and the "0" is 0.7 Vdc.

### 5.6 1 kHz Output Verification

The 1 kHz output is approximately 976 Hz and the output level is approximately 800 mV p-p. The frequency is not exactly 1 kHz because it is derived by dividing 1 MHz by 1024. The output is developed by passing the square wave divider output through a low pass filter and amplifier (Q7).

## 6. PARTS LIST

Table 1 gives 1A1A10 parts list information. Related components are identified in Figure 4.

## 7. SCHEMATIC

Figure 5 is the 1A1A10 schematic.



TABLE 1. 1A1A10 MAINTENANCE PARTS LIST

Ref. Desig.	Name & Description	Mfr. Code	Part Number
1A1A10	Frequency Standard PWB	14304	6628-0880
AR1	IC, Quad, OP, Amp	14304	I30-0011-000
C1	Capacitor, .01 uF, CER	Mil type	M39014/02-1378
C2	Capacitor, 47 pF, Mica	Mil type	CM04ED470J03
C3	Capacitor, 220 pF, Mica	Mil type	CM04FD221J03
C4	Capacitor, 3 pF, Mica	14304	C40-0002-003
C5	Capacitor, 39 pF, Mica	Mil type	CM04ED390J03
C6	Capacitor, 3 pF, Mica	14304	C40-0002-003
C7	Capacitor, 47 pF, Mica	Mil type	CM04ED470J03
C8	Capacitor, 220 pF, Mica	Mil type	CM04FD221J03
C9-C11	Capacitor, .001 uF, Ceramic	Mil type	M39014/01-1238
C12	Capacitor, Fixed, Mica, 820 pF	Mil type	CM05FC821J03
C13	Capacitor, 6.8 uF, Tant, 35V	Mil type	M39003/1-2305
C14	Capacitor, .1 uF, Ceramic	Mil type	M39014/02-1391
C15	Capacitor, 1 uF, Tantalum 50V	Mil type	M39003/1-2357
C16	Capacitor, 6.8 uF, Tantalum 35V	Mil type	M39003/1-2305
C17	Capacitor, .01 uF, Ceramic	Mil type	M39014/02-1378
C18	Capacitor, 1 uF, Tantalum 50V	Mil type	M39003/1-2357
C19	Capacitor, .01 uF, Ceramic	Mil type	M39014/02-1378
C20	Capacitor, 2700 pF, Mica	Mil type	CM06FD272J03
C21	Capacitor, 910 pF, Mica	Mil type	CM05FA911J03
C22	Capacitor, 910 pF, Mica	Mil type	CM05FA911J03
C23,C24	Capacitor, .1 uF, Ceramic	Mil type	M39014/02-1391
C25	Capacitor, 47 pF, Mica	Mil type	CM04ED470J03
C26	Capacitor, .01 uF, Ceramic	Mil type	M39014/02-1378
C27	Capacitor, 3 pF, Mica	14304	C40-0002-003
C28	Capacitor, 2 pF, Mica	14304	C40-0002-002
C29	Capacitor, 3 pF, Mica	14304	C40-0002-003
C30	Capacitor, 2 pF, Mica	14304	C40-0002-002
C31	Capacitor, 3 pF, Mica	14304	C40-0002-003
C32	Capacitor, 820 pF, Mica	Mil type	CM05FC821J03
C33	Capacitor, 68 uF, Tantalum, 25V	14304	C25-0002-212
C34	Capacitor, 2.2 uF, Tantalum, 20V	14304	C25-0001-303
C35	Capacitor, 3.3 uF, Tantalum, 15V	14304	C25-0002-403
C36	Capacitor, .01 uF, Ceramic	Mil type	M39014/02-1378
C37,C38	Capacitor, .1 uF, Ceramic	Mil type	M39014/02-1391
C39	Capacitor, .01 uF, Ceramic	Mil type	M39014/02-1378
C40,C41	Capacitor, .1 uF, Ceramic	Mil type	M39014/02-1391
CR1-CR6	Diode, Signal, 1N4454	14304	CR-0705
DS1	LED, Red	14304	919-4314
JMP1	Circuit Jumper	14304	MP-1142
JMP2	Not Used		
JMP3	Circuit Jumper	14304	MP-1142
L1	Choke, RF, 100 uH	14304	L-0640
L2	Choke, RF, 39 uH	14304	L-0635
L3	Inductor, Variable	14304	L11-0004-003
L4	Inductor, Variable	14304	L11-0004-003
L5	Inductor, Variable	14304	L11-0004-003



TABLE 1. 1A1A10 MAINTENANCE PARTS LIST (Continued)

Ref. Desig.	Name & Description	Mfr. Code	Part Number
L6	Choke, RF, .47 uH	14304	L-0612
L7	Choke, RF, 100 uH	14304	L-0640
L8	Choke, RF, 39 uH	14304	L-0635
Q1	Transistor, PNP, 2N6312	14304	Q02-6312-000
Q2	Transistor, PNP, 2N2907A	14304	Q12-2907-000
Q3,Q4	Transistor, NPN, 2N2222A	14304	Q12-2222-000
Q5	Transistor, NPN, MPS2369	14304	Q25-2369-000
Q6	Transistor, NPN, 2N5031	14304	Q02-5031-000
Q7	Transistor, NPN, MPS2369	14304	Q25-2369-000
R1	Resistor, Variable, 5K	14304	R40-0015-502
R2	Resistor, 1/8W, 5%, 560	Mil type	RCR05G561JM
R3	Resistor, 1/8W, 5%, 100	Mil type	RCR05G101JM
R4	Resistor, 1/8W, 100	Mil type	RCR05G101JM
R5	Resistor, 1/8W, 4.7K	Mil type	RCR05G472JM
R6	Resistor, 1/8W, 1K	Mil type	RCR05G102JM
R7	Resistor, 1/8W 2.2K	Mil type	RCR05G222JM
R8	Resistor, 1/8W, 5%, 470	Mil type	RCR05G471JM
R9	Resistor, 1/4W, 5%, 1.1	14304	R17-0001-002
R10	Resistor, 1/8W, 5%, 100	Mil type	RCR05G101JM
R11	Resistor, 1/8W, 5%, 100	Mil type	RCR05G101JM
R12	Resistor, 1/2W, 5%, 27	Mil type	RCR20G270JM
R13	Resistor, 1/8W, 1%, 3.92K	Mil type	RNR55H3921FS
R14	Resistor, 1/8W, 5%, 3.3K	Mil type	RCR05G3332JM
R15	Resistor, 1/8W, 5%, 27K	Mil type	RCR05G273JM
R16	Resistor, Wirewound, 2W, 5%, .51	14304	R13-0001-005
R17	Resistor, 1/8W, 5%, 3.3K	Mil type	RCR05G332JM
R18	Resistor, 1/8W, 1%, 4.75K	Mil type	RNR55H4751FS
R19	Resistor, 1/8W, 1%, 4.75K	Mil type	RNR55H4751FS
R20	Resistor, 1/8W, 5%, 27K	Mil type	RCR05G273JM
R21	Resistor, 1/8W, 5%, 1K	Mil type	RCR05G102JM
R22	Resistor, 1/8W, 1%, 3.92K	Mil type	RNR55H3921FS
R23	Resistor, 1/8W, 5%, 100K	Mil type	RCR05G104JM
R24	Resistor, 1/8W, 5%, 3.3K	Mil type	RCR05G332JM
R25	Resistor, 1/8W, 5%, 100K	Mil type	RCR05G104JM
R26	Resistor, 1/8W, 5%, 1K	Mil type	RCR05G102JM
R27	Resistor, 1/4W, 5%, 470	Mil type	RCR07G471JM
R28	Resistor, 1/8W, 5%, 1K	Mil type	RCR05G102JM
R29	Resistor, 1/8W, 5%, 1K	Mil type	RCR05G102JM
R30	Resistor, 1/2W, 5%, 22	Mil type	RCR20G220JM
R31	Resistor, 1/8W, 5%, 1K	Mil type	RCR05G102JM
R32	Resistor, 1/8W, 5%, 2.2K	Mil type	RCR05G222JM
R33	Resistor, 1/4W, 5%, 100	Mil type	RCR07G101JM
R34	Resistor, 1/4W, 5%, 220K	Mil type	RCR07G224JM
R35	Resistor, 1/8W, 5%, 68K	Mil type	RCR05G683JM
R36	Resistor, 1/8W, 5%, 68K	Mil type	RCR05G683JM



TABLE 1. 1A1A10 MAINTENANCE PARTS LIST (Continued)

Ref. Desig.	Name & Description	Mfr. Code	Part Number
R37	Resistor, 1/8W, 5%, 27K	Mil type	RCR05G273JM
R38	Resistor, 1/8W, 5%, 1K	Mil type	RCR05G102JM
R39	Resistor, 1/8W, 5%, 10	Mil type	RCR05G100JM
R40	Resistor, 1/4W, 5%, 220	Mil type	RCR07G221JM
R41	Resistor, 1/8W, 5%, 3.3K	Mil type	RCR05G332JM
R42	Resistor, 1/8W, 5%, 4.7K	Mil type	RCR05G472JM
R43	Resistor, 1/8W, 5%, 4.7K	Mil type	RCR05G472JM
R44	Resistor, 1/8W, 5%, 56	Mil type	RCR05G560JM
R45	Resistor, 1/2W, 5%, 560	Mil type	RCR20G561JM
R46	Resistor, 1/8W, 5%, 3.3K	Mil type	RCR05G332JM
R47	Resistor, 1/8W, 5%, 2.2K	Mil type	RCR05G222JM
R48	Resistor, 1/4W, 5%, 27	Mil type	RCR07G270JM
R49	Resistor, 1/8W, 5%, 560	Mil type	RCR05G561JM
R50	Resistor, 1/8W, 5%, 3.3K	Mil type	RCR05G332JM
R51	Resistor, 1/4W, 5%, 1K	Mil type	RCR07G102JM
R52	Resistor, 1/4W, 5%, 1K	Mil type	RCR07G102JM
R53	Resistor, 1/4W, 5%, 1K	Mil type	RCR07G102JM
R54	Resistor, 1/4W, 5%, 27K	Mil type	RCR07G273JM
R55	Resistor, 1/4W, 5%, 27K	Mil type	RCR07G273JM
R56	Resistor, 1/8W, 5%, 100K	Mil type	RCR05G104JM
R57	Resistor, 1/4W, 5%, 3.9K	Mil type	RCR07G392JM
R58	Resistor, 1/4W, 5%, 27K	Mil type	RCR07G273JM
R59	Resistor, 1/4W, 5%, 27K	Mil type	RCR07G273JM
R60	Resistor, 1/4W, 5%, 27K	Mil type	RCR07G273JM
R61	Resistor, 1/4W, 5%, 1K	Mil type	RCR07G102JM
R62	Resistor, 1/8W, 5%, 2.2K	Mil type	RCR05G222JM
R63	Resistor, 1/8W, 5%, 2.2K	Mil type	RCR05G222JM
R64	Resistor, 1/4W, 5%, 100	Mil type	RCR07G101JM
R65	Resistor, 1/8W, 5%, 2.2K	Mil type	RCR05G222JM
R66	Resistor, 1/8W, 5%, 1K	Mil type	RCR05G102JM
S1	Switch, DPDT	14304	S30-0006-000
T1	Transformer 9 MHz	14304	919-1319
T2	Transformer 9 MHz	14304	919-1319
T3	Transformer 9 MHz	14304	919-1319
T4	Transformer 9 MHz	14304	919-1319
TP1	Test Point, Brown	14304	J-0071
TP2	Test Point, Red	14304	J-0006
U1	IC, Quad 2 Input NAND	14304	101-0034-000
U2	IC, Dual Flip-Flop	14304	105-0010-000
U3	IC, Ripple Counter	14304	141-0007-000
U4	IC, Counter	14304	141-0001-000
U5	IC, Counter	14304	141-0001-000
U6	IC, Timer	14304	135-0004-000
U7	IC, Dual Flip-Flop	14304	105-0010-000



TABLE 1. 1A1A10 MAINTENANCE PARTS LIST (Continued)

Ref. Desig.	Name & Description	Mfr. Code	Part Number
U8	IC, Quad Exclusive OR	14304	101-0038-000
U9	IC, Triple Gate	14304	101-0037-000
U10	IC, Dual 4 Input AND	14304	101-0032-000
U11	IC, Quad 2 Input NAND	14304	101-0039-000
U12	IC, Quad 2 Input NOR	14304	101-0003-000
U13	IC, Triple 3 Input NOR	14304	101-0024-000
U14	IC, Analog Multiplexer	14304	109-0005-000
U15	IC, Quad 2 Input NAND	14304	101-0033-000
U16	IC, Dual Decade Counter	14304	140-0006-000
U17	IC, Dual Decade Counter	14304	140-0006-000
U18	IC, Programmable Counter	14304	141-0010-000
U19	IC, Programmable Counter	14304	141-0011-000
U20	IC, Quad 2 Input NAND	14304	102-0013-000
U21	IC, NPN Transistor Array	14304	190-0001-001
VR1	IC, Voltage Regulator	14304	112-0004-000
VR2	IC, Voltage Regulator, 5V	14304	111-0004-005
VR3	Zener Diode, 6.2V	14304	D30-0047-962

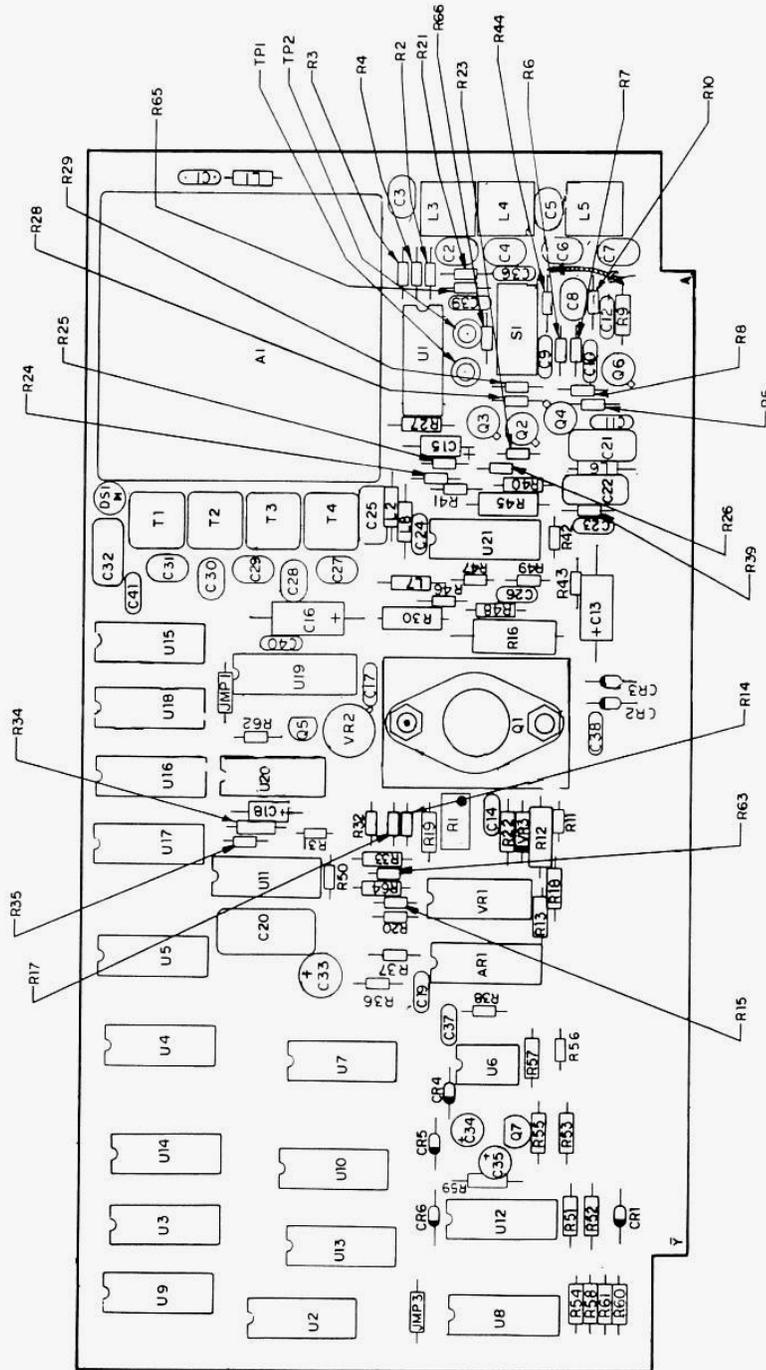


Figure 4. 1A1A10 Frequency Standard Component Locations

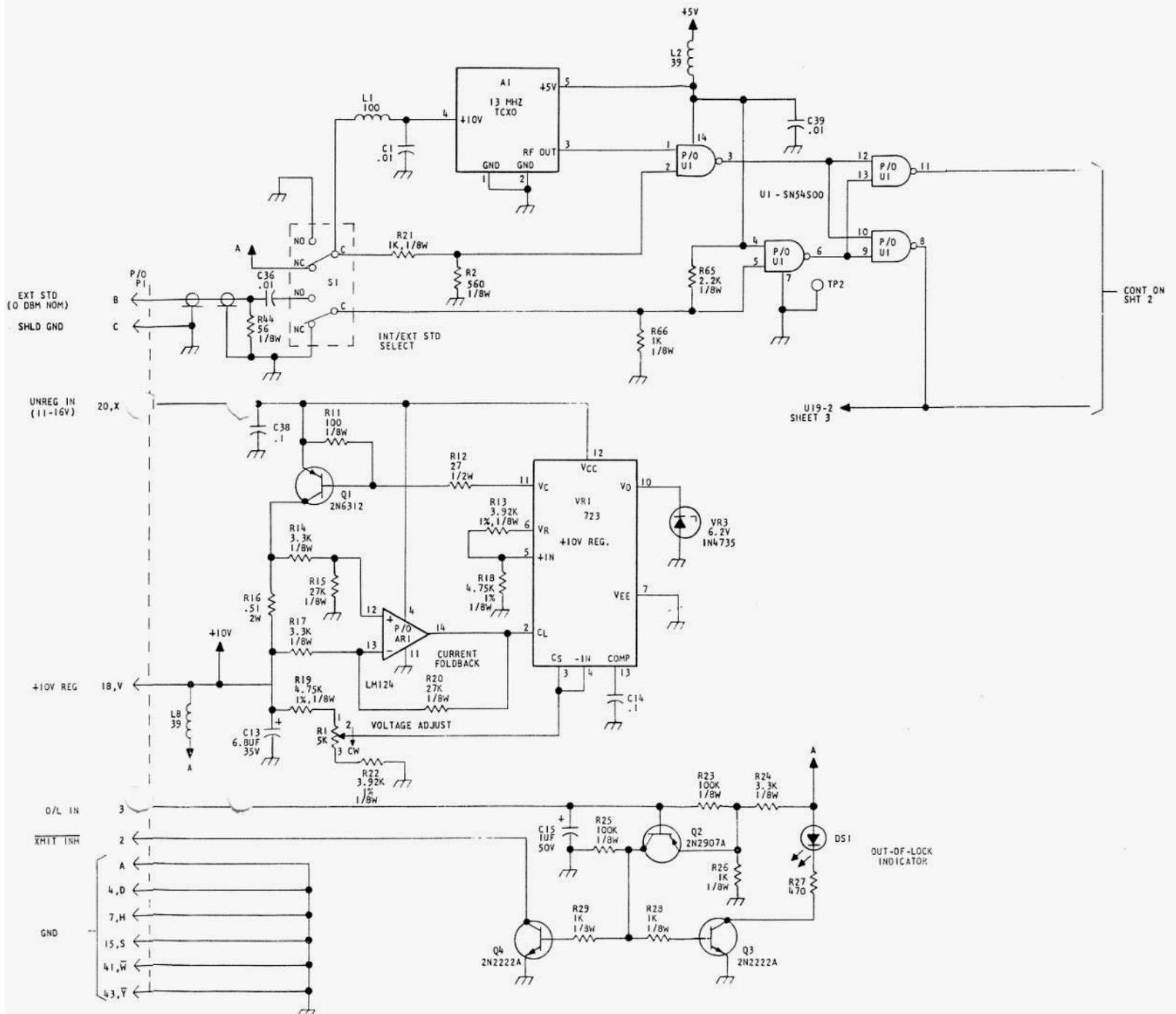
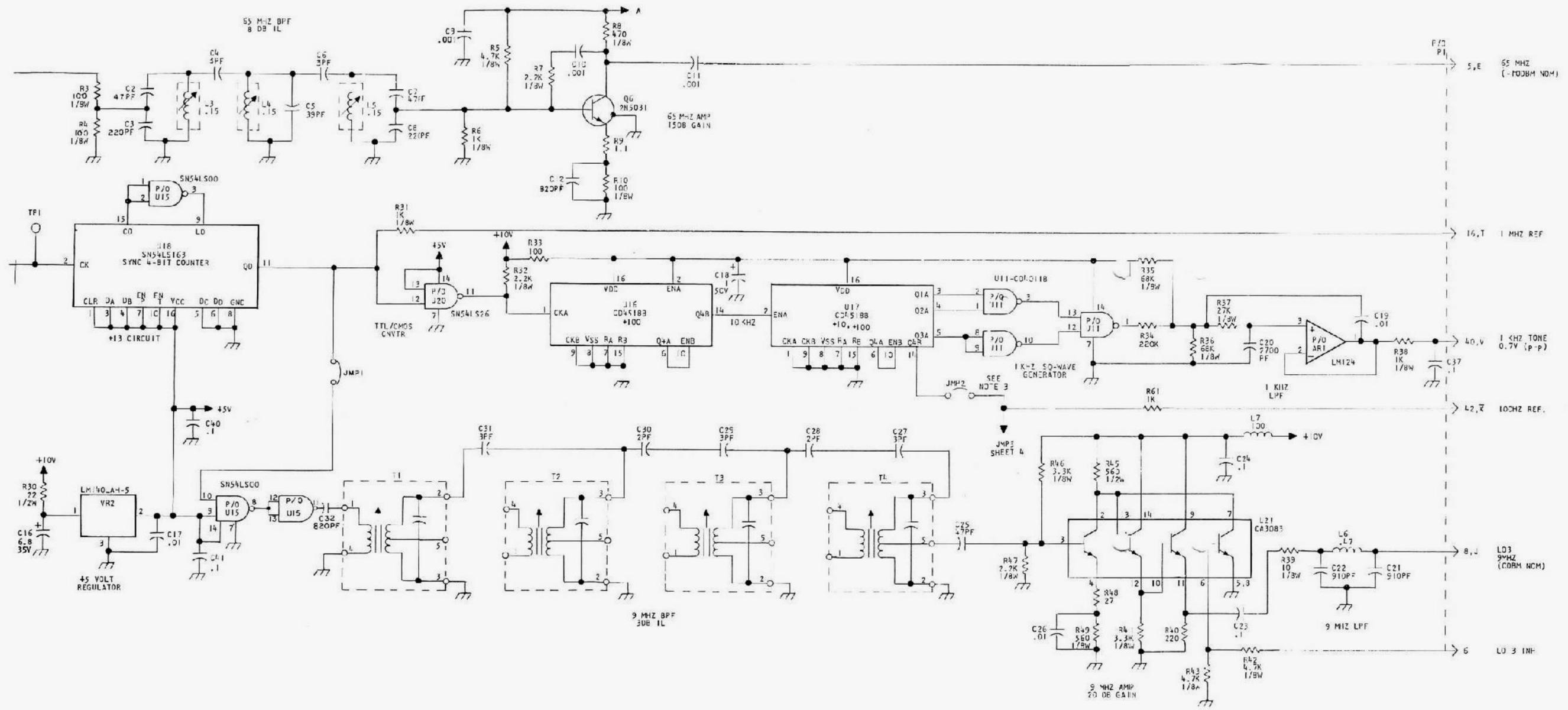


Figure 5. 1A1A10 Frequency Standard PC Board  
Schematic Diagram 6628-9088  
(Sheet 1 of 4)



- NOTES:
1. UNLESS OTHERWISE SPECIFIED, ALL RESISTORS ARE IN OHMS, 1/4W, ±5%. ALL CAPACITORS ARE IN MICROFARADS. ALL INDUCTORS ARE IN MICROHENRIES. ALL DIODES ARE 1N4148.
  2. DIGITAL CLARIFIER CIRCUITRY, (SHTS 394) IS NOT USED ON SYSTEMS WITHOUT CLARIFIER.
  3. FOR SYSTEMS WITH CLARIFIER, DELETE JMP2.
  4. VR2 BOTTOM VIEW:

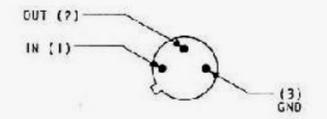


Figure 5. 1A1A10 Frequency Standard PC Board Schematic Diagram 6628-9088 (Sheet 2 of 4)

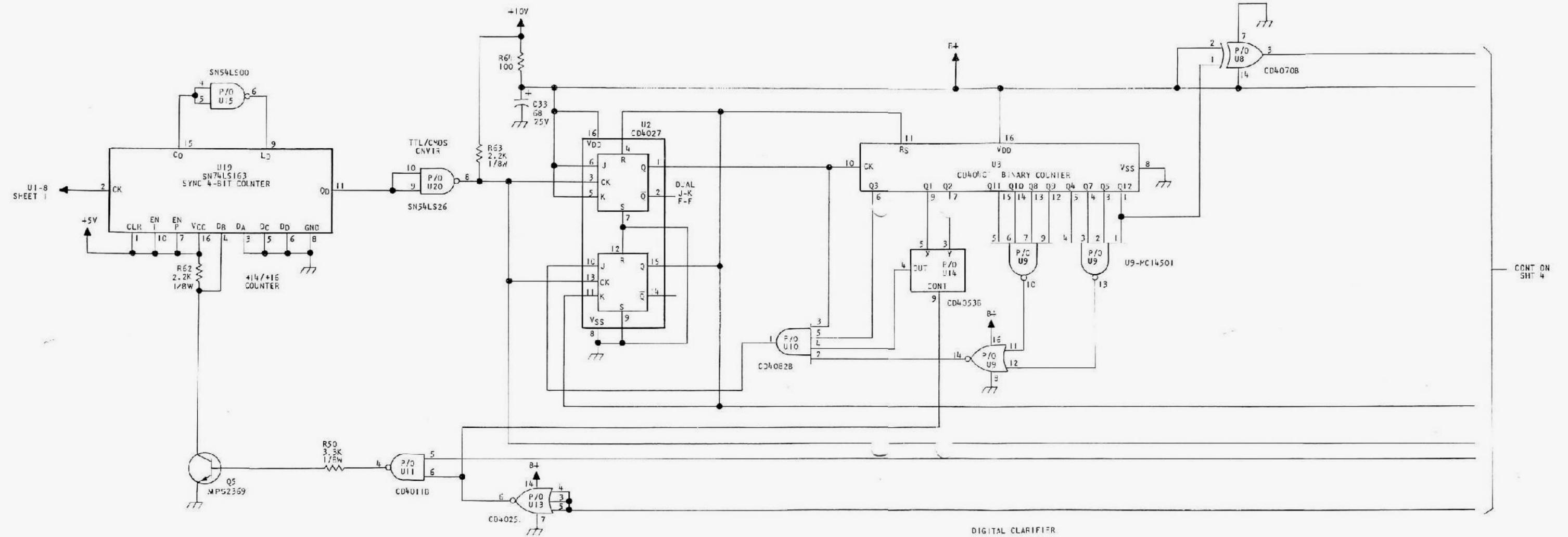


Figure 5. 1A1A10 Frequency Standard PC Board Schematic Diagram 6628-9088 (Sheet 3 of 4)

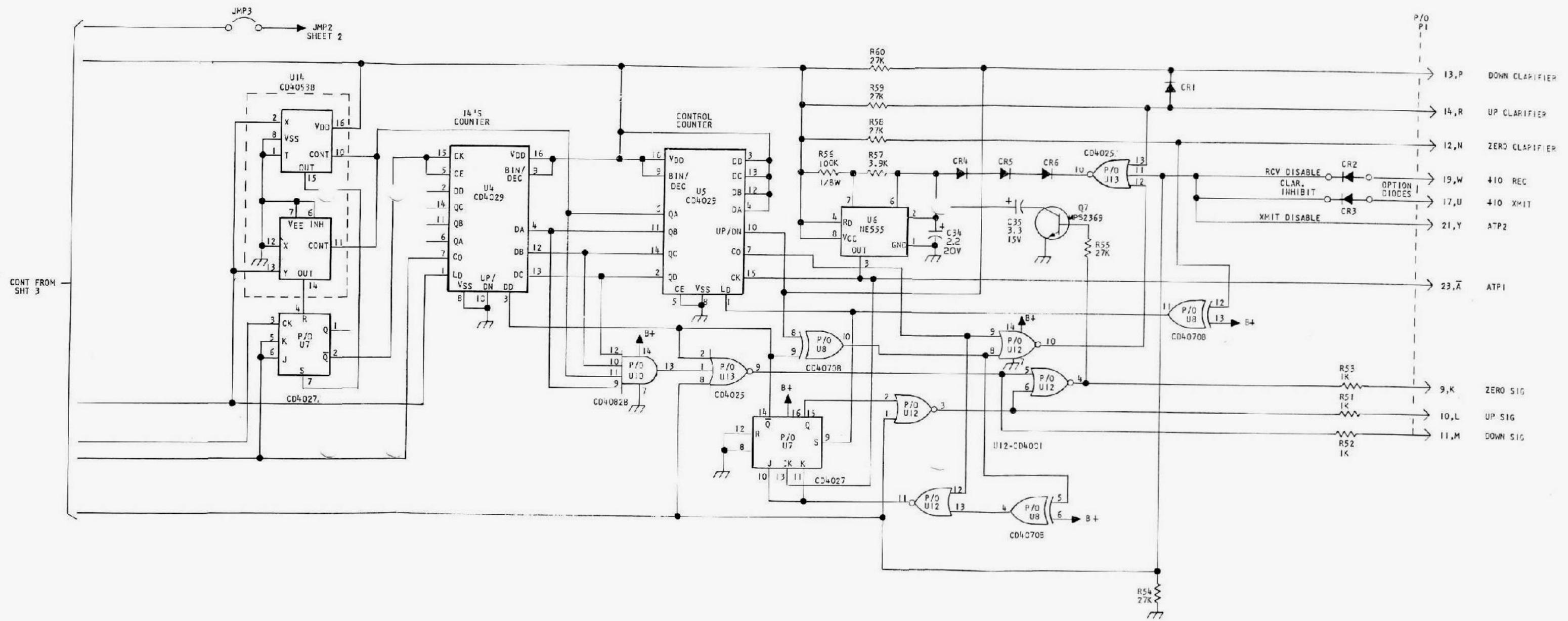


Figure 5. 1A1A10 Frequency Standard PC Board Schematic Diagram 6628-9088 (Sheet 4 of 4)

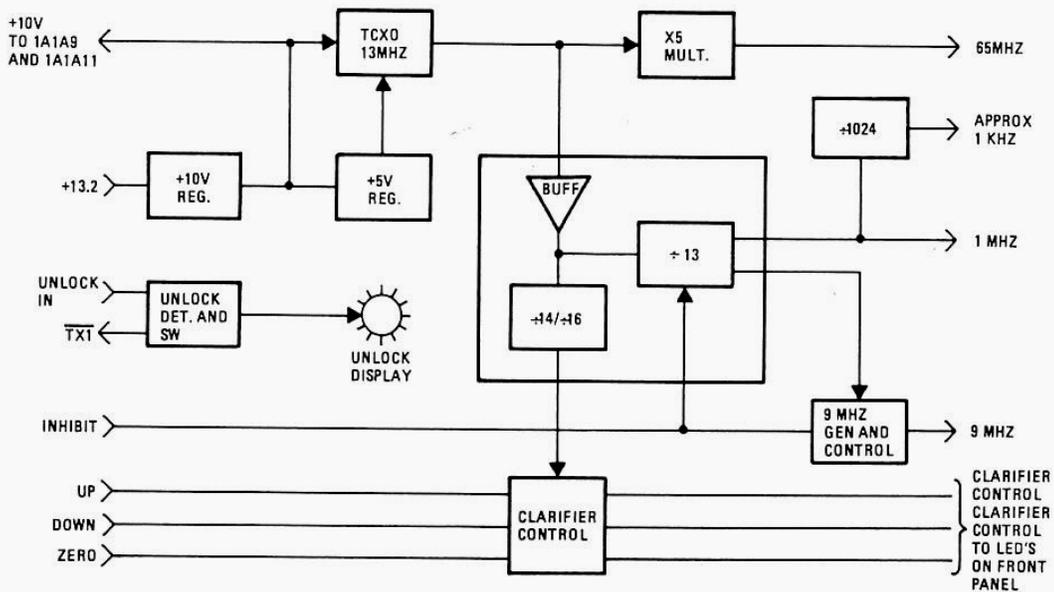
# UNIT INSTRUCTIONS



# FREQUENCY STANDARD

# 1A1A10

This section is applicable to RF-230  
Transceivers with serial numbers below  
1833.





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**1. GENERAL DESCRIPTION**

The Frequency Standard contains the master reference oscillator (TCXO A2), and circuitry to provide the 9 MHz carrier injection signal, the LO1 and LO2 reference signals, and clarifier control circuitry.

**2. TECHNICAL CHARACTERISTICS**

**Power Requirements:**

- +13.2 Vdc Input P1-20
- +10VT P1-17
- +10VR P1-19

**Control Inputs**

- O/L In P1-3
- Clarifier Down P1-13 (0 = Down)
- Clarifier Up P1-14 (0 = Up)
- Clarifier Zero P1-12 (0 = Zero)
- +10T P1-17
- +10R P1-19
- LO3 Inhibit P1-6

**Control Outputs**

- Zero Output P1-9 (1 = Zero)
- Up Output P1-10 (1 = Up)
- Down Output P1-11 (1 = Down)
- Xmit Inhibit P1-2 (1 = Inhibit)

**Signal Outputs**

- 9 MHz P1-8 0 dBm
- 65 MHz P1-5  $-10 \pm 5$  dBm
- 100 Hz Ref P1-42
- 1 MHz P1-16
- 1 kHz P1-40 280 mV rms

**3. SEMICONDUCTOR COMPLEMENT**

REF. DESIG.	TYPE	DESCRIPTION
AR1	CA3028AS	Differential Cascode Ampl.
CR1-CR7	1N4454	Diode
Q1	2N4126	Transistor, PNP
Q2	2N4124	Transistor, NPN
Q3	2N4126	Transistor, PNP
Q4, Q5	2N4124	Transistor, NPN
Q6	MPS2369	Transistor, NPN
Q7	2N4124	Transistor, NPN
Q8	MPS2369	Transistor, NPN
Q9	2N4126	Transistor, PNP
Q10	TIP30A	Transistor, PNP
Q11, Q12	MPS2369	Transistor, NPN

REF. DESIG.	TYPE	DESCRIPTION
Q13	2N4124	Transistor, NPN
Q14	MPS2369	Transistor, NPN
U1	CD4040	12 Stage Ripple Carry Binary Counter Divider
U2	CD4027	Dual J-K Master-Slave Flip-Flop
U3	CD4040	12 Stage Ripple Carry Binary Counter Divider
U4, U5	CD4029	Presetable Up/Down Counter
U6	NE555	Timer
U7	CD4027	Dual J-K Master-Slave Flip-Flop
U8	CD4070	Quad Exclusive OR Gates
U9	CD4068	8-Input NAND Gate
U10	CD4012	Dual 4-Input NAND Gates
U11	CD4023	Triple 3-Input NAND Gates
U12	CD4001	Quad 2-Input NOR Gates
U13	CD4025	Triple 3-Input NOR Gates
U14	CD4053	Triple 2-Channel Multiplexer
VR1	MC1723CL	Monolithic Voltage Reg.
VR2	78L05	3 Terminal Positive Fixed 5V Regulator
A1		
Q1	MPS2369	Transistor, NPN
U1	SN74LS00	Quad 2-Input NAND
U2, U3	SN74LS163	Synchronous 4-Bit Binary Counter

**4. CIRCUIT DESCRIPTION**

The Frequency Control PC Board contains the TCXO (Temperature Controlled Crystal Oscillator) and several support or parallel functions as shown in the simplified diagram on the section cover, and in the more detailed diagram in figure 1.

**4.1 Regulator Circuits**

Two regulators support the +10 Vdc and +5 Vdc TCXO input requirements. Current boost pass element Q9 controls the 11 - 15 Vdc input voltage (+13.2 nominal), and functions with voltage regulator VR1, and control elements Q10 and R36 to provide a precise +10 Vdc supply. This regulated source satisfies all on-board requirements, and also appears at P1-18 for use in the synthesizer. VR2 supplies the +5 Vdc requirements of the TCXO and several other circuit elements as shown in the overall schematic at the end of this section.



### 4.2 Out-of-Lock Indicator/Control Circuit

An Out-of-Lock condition from either LO assembly would cause P1-3 to go low and bias ON PNP transistor Q3. With Q3 ON, DS1 control transistor Q4 is also "switched" ON and DS1 illuminates to provide an on-board indication of the out-of-lock condition. This same control condition will cause Q5 base to go high and turn ON Q5. With Q5 on, P1-2 will go low to produce a XMIT INH (Transmit Inhibit) control output condition.

### 4.3 TCXO

TCXO assembly A2 is operative whenever primary power is applied to the RF-230. All frequency determining outputs are synthesized from this single highly stable reference to produce an operating frequency stable to within  $\pm 1 \times 10^{-6}$  ( $\pm 13$  Hz @ 13 MHz) over the full temperature range. The 13 MHz TCXO output at pin 3 drives Q8 and also Q1 on the A1 Divider sub-assembly.

### 4.4 65 MHz Reference

Q8, L3, and L4 operate in a X5 multiplier circuit to derive the 65 MHz reference from the TCXO input via C20. This multiplier is housed in a shielded environment located just below the A2 TCXO assembly. Q8 is biased so that the TCXO input will drive the amplifier into distortion to produce a harmonic-rich output. By resonating L3 and L4 to 65 MHz, the 5th harmonic of the 13 MHz input, the desired reference output is obtained. L3 and L4 are "peaked" for maximum output at P1-5.

### 4.5 1 MHz Reference

The TCXO output also drives Q1 in the A1 Divider assembly. A1Q1 and A1U1 buffer the 13 MHz output from the TCXO. The buffered TCXO output drives two separate signal paths via separate binary counters. A1U2 is a synchronous 4-bit binary counter configured to divide the 13 MHz reference input by 13 to produce the desired 1 MHz reference output at P1-16.

### 4.6 9 MHz Carrier Output

The 9 MHz generator also uses binary counter A1U3, but does not use the same  $\div 13$  output as described for the 1 MHz reference. The carry output at U2-15 is a short duration pulse to produce a high harmonic content for filtering as 9 MHz in tuned circuits T1, T2, T3, and T4.

When LO3 is not desired, U1-1 is gated OFF by Q2. R1 establishes the 9 MHz drive level to AR1 (also controlled by the LO3 INHIBIT signal), and Q1, the 9 MHz line driver.

### 4.7 CW Tone

The 1 MHz ( $\div 13$  output from A1U3) is also used to generate the 1 kHz (approximately) cw signal. The 1 MHz output from A1U2-11 is level shifted by Q6 and the output is fed to binary counter U1. This counter is actually configured as a  $\div 1024$  device, and as a consequence, the cw output is not exactly 1 kHz, but rather a fraction above 976 Hz. This 976 Hz "note" is very effective for cw communication.

### 4.8 Clarifier Control Signal

Clarifier control is effected through option diodes CR2 and CR3. In most applications, clarifier operation would only be desirable in the receiver mode (to prevent the operational phenomenon called "leap frogging"). Clip-out type diodes are installed to provide a normal one-time selection of this option. With both diodes installed, clarifier operation is inhibited in both the transmit and receive modes. By "clipping" CR2 to remove the +10V control signal, clarifier operation would not be inhibited in the receive mode. By "clipping" CR3, clarifier operation would not be inhibited in the transmit mode, and obviously by "clipping" both, full time clarifier operation would be available. With no inhibit voltage at U13-3, this control NOR gate has only two inputs; an end-of-range signal from U12-4, and the UP control signal from P1-14. The zero output driving Q13 places C28 in the timing circuit to slow U6, an NE-555, as it reaches zero. This allows easy manual zeroing of the clarifier. The U6 timer output is available at P1-23 (to ATP1). In RF-230M (FCC Type Accepted Units), only CR2 is removed to provide receive only clarifier operation.

### 4.9 Clarifier Inhibit and Control

If either clarifier inhibit diode is present to allow the +10V at either P1-17 (diode CR3) or P1-19 (diode CR2) control NAND gate U10 inverts this signal to a ground. This in turn forces U11-10 to go high, grounding bit DB on A1U3 causing A1U3 to divide by 16. U10-13 also commands U14-11 to cause its associated circuit to divide by 8125. This gives a total division of 130,000 giving a resultant output of exactly 100 Hz. If the clarifier is not inhibited a control counter composed of U4, 7, 14 instructs A1U3 to divide by 14 for the number of

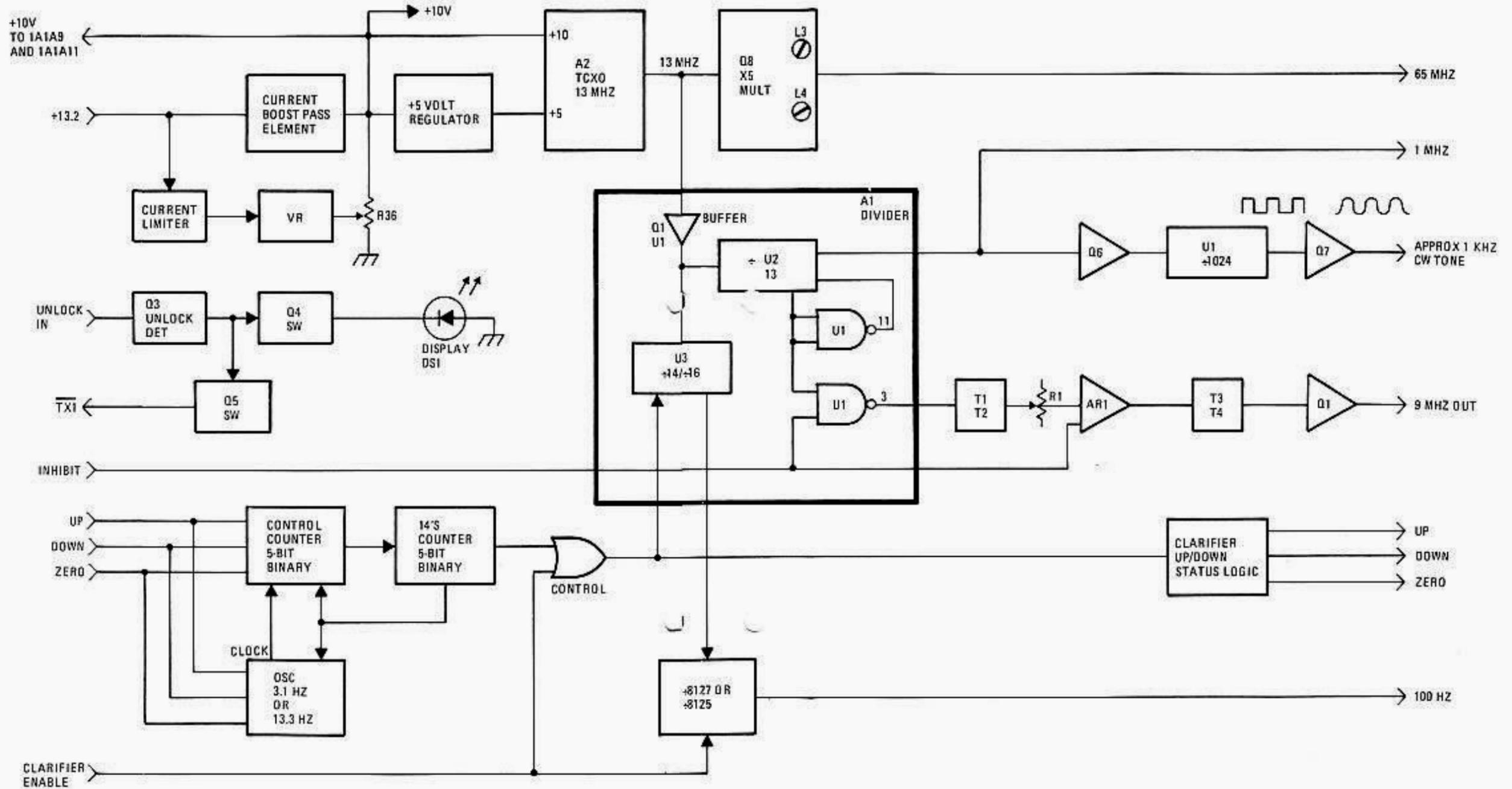


Figure 1. 1A1A10 Frequency Standard PC Board Functional Diagram



times commanded by U5, and U7. U14-11 is now HIGH, causing its associated circuitry to divide by 8127. With U5 and U7 set for zero offset, A1U3 divides by 14 sixteen times and by 16 for 8111 times, for a total division of 130,000 giving the same 100 Hz output. If U5 and U7 are set for one a step above zero A1U3 divides by 14 seventeen times and by 16 for 8110 times giving a division of 129,998 giving a resultant frequency of 100.00153 Hz, which when provided to LO2 causes it to be 15.3 Hz higher. Because there are 32 steps, the total range is approximately  $\pm 246$  Hz, and plus 230 Hz. The exact step size can vary slightly.

## 5. MAINTENANCE

The 1A1A10 Frequency Standard PC Board must be removed from the RF-230 and mounted on an

extender card (part of the MRK) for test and adjustment. All test equipment items required for test and adjustment of this assembly are shown in figure 2.

### CAUTION

Always remove primary power (select POWER OFF at front panel) when removing or installing plug-in assemblies to prevent accidental damage.

Figure 3 summarizes all 1A1A10 card-edge input/output connections and presents a "top side" view of the assembly. Most maintenance problems can be solved by measuring input functions required to produce any given output, and by measuring for the corresponding output.

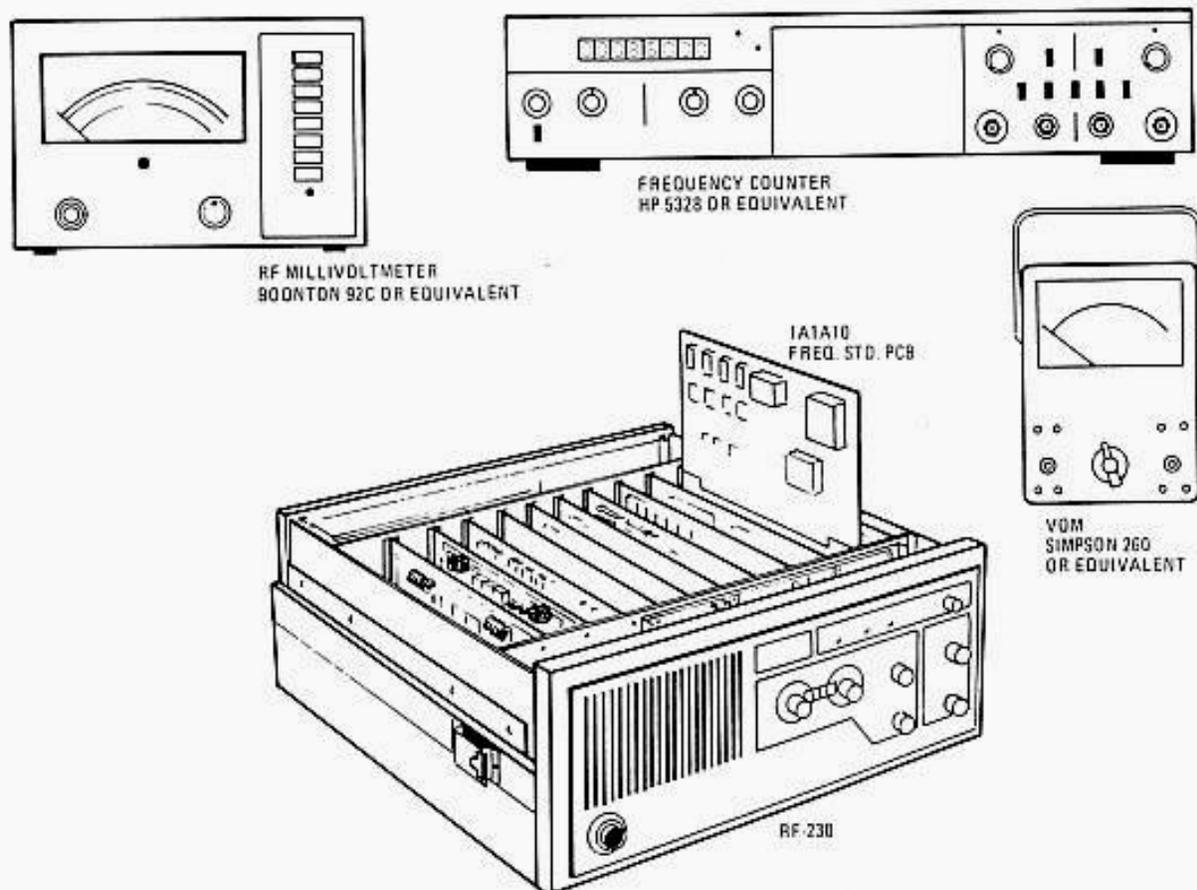


Figure 2. 1A1A10 Test Configuration



**5.1 R36, +10V Regulator Adjustment**

With the 1A1A10 PC Board mounted on an extender card and POWER ON for normal operation, perform the following:

- a. Verify 11 – 15 Vdc (nominal 13.2 Vdc) at P1-20.
- b. Connect VOM to P1-18 and verify +10 Vdc. If there is a measurable difference, adjust R36 to provide +10 Vdc at this point.
- c. This completes +10R adjustment. Reconfigure for normal operation or continue with tests.

**5.2 65 MHz Output Tuning and Verification**

With the 1A1A10 PC Board mounted on an extender card, and POWER ON for normal operation, connect an rms VTVM and a frequency counter to K-5. Proceed as follows:

- a. Output frequency and level at P1-5 should be 65 MHz @ –10 to –15 dBm. This is a nominal level with L3 and L4 peaked. Do not de-tune L3 or L4 to produce an exact –10 dBm. If the level is below –15 dBm, verify tuning and adjustment as follows:
- b. Adjust L3 and L4 for peak output on VTVM. Verify circuit parameters (i.e. +10V) to correct discrepancy. This completes test. Reconfigure for normal operation or proceed with tests.
- c. Use TCXO adjustment at top of sealed assembly and adjust 65 MHz output to exact frequency.

**Note**

- Verify frequency standard accuracy is at least 1 ppm and note offset stamped on TCXO. Make adjustment at 25°C.

**5.3 R1, 9 MHz RF Output Level Tuning and Adjustment**

With the 1A1A10 PC Board mounted on an extender card, connect an rms VTVM and a frequency counter to P1-8 and verify 9 MHz at 0 dBm. If not at this level, proceed as follows:

- a. Tune T1, T2, T3, and T4 for peak output indication on the VTVM.

- b. Adjust R1 to produce 0 dBm output at P1-8.

**Note**

A logic “1” at P1-6 will inhibit this output.

- c. This completes 9 MHz output tuning and adjustment. Reconfigure for normal operation or proceed with tests.

**5.4 100 Hz Reference Output Verification**

Verify “fixed” tuning mode and measure 100 Hz 10V peak-to-peak (CMOS) at P1-42. For “clarifier” operation, there will be a very subtle frequency change at this output (99.975 Hz at the low end and 100.0230 Hz at the high end). This very subtle change, when multiplied by 10,000 (on LO2), can equal an operating frequency change of +230 Hz, or –246 Hz.

**5.5 1 MHz Output Verification**

The 1 MHz output is at T<sup>2</sup>L levels. This means that the “1” level will be 2.4 Vdc, and the “0” will (nominally) be 0.7 Vdc. The frequency should be at 1 MHz.

**5.6 1 kHz Output Verification**

The 1 kHz output will measure approximately 976 Hz, and the level will be an approximate 800 mV peak-to-peak sine wave. The frequency of this output is not critical. The frequency is not exactly 1 kHz because it is derived by dividing 1 MHz by 1024. The sine wave output is developed by passing the square wave divider output thru a low pass filter and amplifier (Q7).

**5.7 ATP1 Clock Output**

This is a CMOS output (approximately 9V/1V), with very narrow on pulses at approximately 13 Hz when clarifier is stepping up or down.

APPROXIMATELY 13 HZ PRF IN FIXED MODE



In the clarifier mode, the PRF is slowed to approximately one fourth this rate (just over 3 Hz), and it is not a continuous series of pulses, but rather a single pulse as the frequency reaches zero.



### 5.8 Zero Output

This output does not provide an external control function, but can be used as a test point to observe the control condition. With a high logic level at this point, Q13 is switched ON and C28 is added in parallel with C27 to control U6 operating frequency. The narrow pulse width is obtained by the long charge path through R56 and R57, and the relatively quick discharge path of C27 through only R57.

### 5.9 Up/Down Control Outputs

These outputs control UP/DOWN front panel indicators. The "1" state equals a related lamp ON condition (active).

### 5.10 Other Functions

A logic "1" on the O/L control line indicates an out-of-lock condition, and will be associated

with a TXI (transmit inhibit) condition. The TXI line will be low (0.7V) in response to an O/L IN "high" condition. A logic "1" on the INHIBIT line inhibits the 9 MHz carrier output.

## 6. PARTS LIST

Table 1 lists all 1A1A10 Maintenance Parts. These parts can be identified in figure 4. Refer to General Information Section for list of manufacturers.

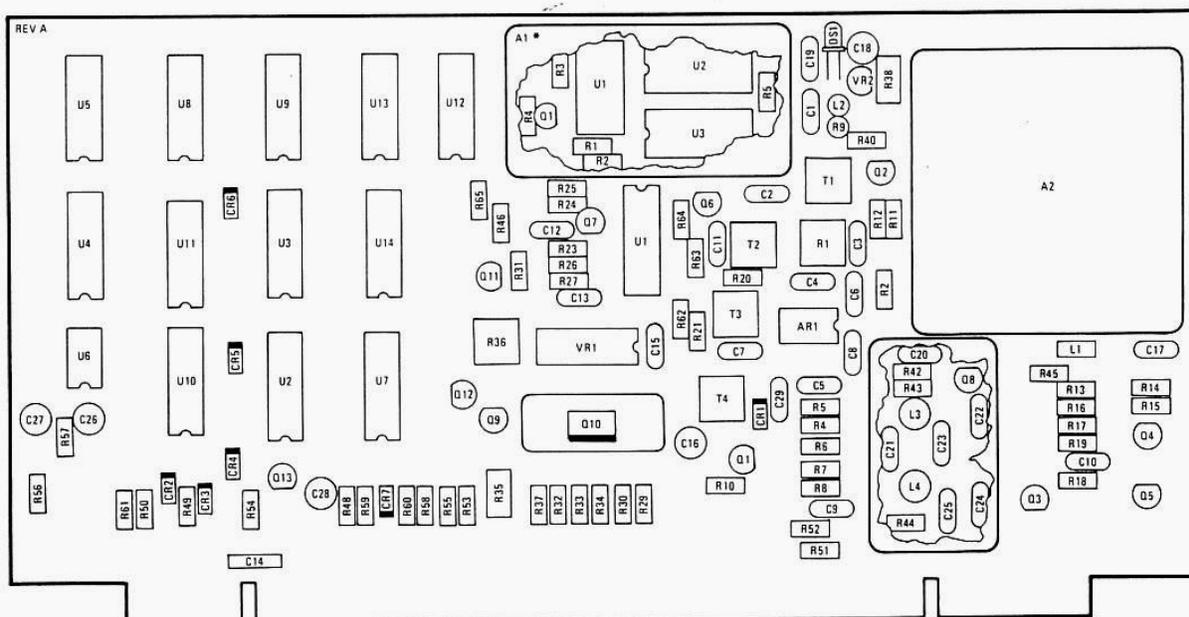
## 7. SCHEMATIC

Figure 5 is a complete schematic diagram of the 1A1A10 Assembly.

### NOTE

INSTALLING CR2 DISABLES CLARIFIER IN RECEIVE MODE, NORMALLY NOT INSTALLED.

INSTALLING CR3 DISABLES CLARIFIER IN TRANSMIT MODE. NORMALLY INSTALLED. MUST BE DISCONNECTED BY CUSTOMER IF DESIRED.



\* A1 ASSEMBLY INSTALLED WITH COMPONENT SIDE FACING COMPONENT SIDE OF 1A1A10 BOARD.

Figure 4. 1A1A10 Component Locations



1	GND	A	
2	OUT	B	
3	IN	C	
4	65 MHZ GND	D	
5	65 MHZ OUTPUT	E	
6	INHIBIT (1 = INHIBIT)	F	
7	GND	H	
8	9 MHZ RF OUT	J	
9	ZERO OUTPUT	K	
10	UP OUTPUT (1 = UP)	L	
11	DOWN OUTPUT (1 = DOWN)	M	
12	ZERO	N	
13	DOWN (0 = DOWN)	P	
14	UP (0 = UP)	R	
15	GND	S	
16	1 MHZ OUTPUT	T	
17	+10T	U	
18	+10V REG OUTPUT	V	
19	+10R	W	
20	11 - 15 VDC INPUT	X	
21	ATP2	Y	
22		Z	
23	ATP1	a	
24		b	
25		c	
26		d	
27		e	
28		f	
29		h	
30		i	
31		k	
32		l	
33		m	
34		n	
35		p	
36		r	
37		s	
38		t	
39		u	
40	1 KHZ CW TONE	v	
41	GND	w	
42	100 HZ REF OUTPUT	x	
43	GND	y	

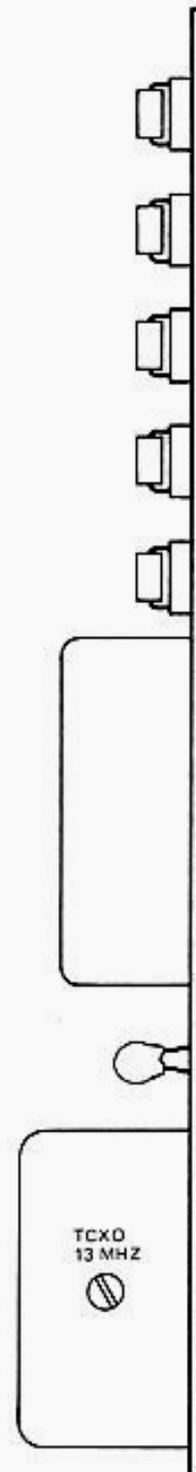


Figure 3. 1A1A10 Input/Output Summary



TABLE 1. 1A1A10 MAINTENANCE PARTS LIST

Ref. Desig.	Name & Description	Mfr. Code	Part Number
1A1A10	Frequency Standard PWB Assembly	14304	6628-0850
AR1	Integrated Circuit, Differential/Cascade Amplifier, CA3028AS	14304	IC-0031
C1	Capacitor, Fixed, Mica 220 pF $\pm$ 5%, 500V	14304	C-0134
C2	Capacitor, Fixed, Ceramic 2.7 pF $\pm$ 5%, 1000V	14304	C-4732
C3 - C6	Capacitor, Fixed, Ceramic, .01 uF $\pm$ 20%, 50V	14304	C-4952
C7	Capacitor, Fixed, Ceramic, 2.7 pF $\pm$ 5%, 1000V	14304	C-4732
C8, C9	Capacitor, Fixed, Ceramic, .01 uF $\pm$ 20%, 50V	14304	C-4952
C10, C11	Capacitor, Fixed, Tantalum, 1 uF $\pm$ 10%, 35V	14304	C-3100
C12	Capacitor, Fixed, Ceramic, .05 uF $\pm$ 80-20%, 50V	14304	C-3201
C13	Capacitor, Fixed, Ceramic, .01 uF $\pm$ 20%, 50V	14304	C-4952
C14	Capacitor, Fixed, Ceramic, .1 uF $\pm$ 80-20%, 50V	14304	C-3202
C15	Capacitor, Fixed, Ceramic, .01 uF $\pm$ 20%, 50V	14304	C-4952
C16	Capacitor, Fixed, Tantalum, 6.8 uF $\pm$ 10%, 35V	14304	C-3102
C17	Capacitor, Fixed, Ceramic, .01 uF $\pm$ 20%, 50V	14304	C-4952
C18	Capacitor, Fixed, Tantalum, 6.8 uF $\pm$ 10%, 35V	14304	C-3102
C19 - C21	Capacitor, Fixed, Ceramic, .01 uF $\pm$ 10%, 50V	14304	C-4952
C22	Capacitor, Fixed, Ceramic, .001 uF $\pm$ 10%, 500V	14304	C-3513
C23	Capacitor, Fixed, Ceramic, 15 pF $\pm$ 5%, 1000V	14304	C-4743
C24	Capacitor, Fixed, Ceramic, 82 pF $\pm$ 5%, 1000V	14304	C-4757
C25	Capacitor, Fixed, Ceramic, 20 pF $\pm$ 5%, 1000V	14304	C-4745
C26	Capacitor, Fixed, Tantalum, 68 uF $\pm$ 10%, 25V	14304	C-3105
C27	Capacitor, Fixed, Tantalum, 1 uF $\pm$ 10%, 35V	14304	C-3100
C28	Capacitor, Fixed, Tantalum, 3.3 uF $\pm$ 10%, 15V	14304	C-3101
C29	Capacitor, Fixed, Ceramic, .01 uF $\pm$ 20%, 50V	14304	C-4952
CR1 CR7	Diode, Signal, 1N4454	14304	CR-0705
DS1	L.E.D., Red	14304	919-4314
L1	Choke, RF, 100 uH	14304	L-0640
L2	Choke, RF, 27 uH	14304	L-0633
L3, L4	Inductor, Variable, .34 uH	14304	L-0251
Q1	Transistor, PNP, 2N4126	14304	Q-0386



TABLE 1. 1A1A10 MAINTENANCE PARTS LIST (Continued)

Ref. Desig.	Name & Description	Mfr. Code	Part No.
Q2	Transistor, NPN, 2N4124	14304	Q-0385
Q3	Transistor, PNP, 2N4126	14304	Q-0386
Q4,Q5	Transistor, NPN, 2N4124	14304	Q-0385
Q6	Transistor, NPN, MPS2369	14304	Q-0062
Q7	Transistor, NPN, 2N4124	14304	Q-0385
Q8	Transistor, NPN, MPS2369	14304	Q-0062
Q9	Transistor, PNP, 2N4126	14304	Q-0386
Q10	Transistor, PNP, TIP-304	14304	Q-0037
Q11,Q12	Transistor, NPN, MPS2369	14304	Q-0062
Q13	Transistor, NPN, 2N4124	14304	Q-0385
Q14	Transistor, NPN, MPS2369	14304	Q-0062
R1	Resistor, Variable, 500 ohm	14304	R-2205
R2	Resistor, Fixed, Composition, 2.7K $\pm$ 5%, 1/4W	Mil type	RCR07G272JM
R3	Not used		
R4	Resistor, Fixed, Composition, 2.7K $\pm$ 5%, 1/4W	Mil type	RCR07G272JM
R5	Resistor, Fixed, Composition, 5.6K $\pm$ 5%, 1/4W	Mil type	RCR07G562JM
R6	Resistor, Fixed, Composition, 6.8K $\pm$ 5%, 1/4W	Mil type	RCR07G682JM
R7	Resistor, Fixed, Composition, 560 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G561JM
R8	Resistor, Fixed, Composition, 22 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G220JM
R9	Resistor, Fixed, Composition, 10K $\pm$ 5%, 1/4W	Mil type	RCR07G103JM
R10	Resistor, Fixed, Composition, 100 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G101JM
R11,R12	Resistor, Fixed, Composition, 27K $\pm$ 5%, 1/4W	Mil type	RCR07G273JM
R13	Resistor, Fixed, Composition, 6.8K $\pm$ 5%, 1/4W	Mil type	RCR07G682JM
R14	Resistor, Fixed, Composition, 390 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G391JM
R15	Resistor, Fixed, Composition, 2.2K $\pm$ 5%, 1/4W	Mil type	RCR07G222JM
R16	Resistor, Fixed, Composition, 100K $\pm$ 5%, 1/4W	Mil type	RCR07G104JM
R17,R18	Resistor, Fixed, Composition, 1K $\pm$ 5%, 1/4W	Mil type	RCR07G102JM
R19	Resistor, Fixed, Composition, 100K $\pm$ 5%, 1/4W	Mil type	RCR07G104JM
R20	Resistor, Fixed, Composition, 100 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G101JM
R21	Resistor, Fixed, Composition, 2.7K $\pm$ 5%, 1/4W	Mil type	RCR07G272JM
R22	Not used		
R23	Resistor, Fixed, Composition, 100 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G101JM
R24,R25	Resistor, Fixed, Composition, 6.8K $\pm$ 5%, 1/4W	Mil type	RCR07G682JM
R26,R27	Resistor, Fixed, Composition, 1K $\pm$ 5%, 1/4W	Mil type	RCR07G102JM
R28	Not used		
R29	Resistor, Fixed, Composition, 10 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G100JM
R30	Resistor, Fixed, Composition, 1K $\pm$ 5%, 1/4W	Mil type	RCR07G102JM
R31	Resistor, Fixed, Composition, 2.2K $\pm$ 5%, 1/4W	Mil type	RCR07G222JM
R32	Resistor, Fixed, Composition, 1.8K $\pm$ 5%, 1/4W	Mil type	RCR07G182JM
R33	Resistor, Fixed, Composition, 120 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G121JM
R34	Resistor, Fixed, Composition, 1K $\pm$ 5%, 1/4W	Mil type	RCR07G102JM
R35	Resistor, Fixed, Wirewound, .5 ohm $\pm$ 5%, 1W	14304	R-3763



TABLE 1. 1A1A10 MAINTENANCE PARTS LIST (Continued)

Ref. Desig.	Name & Description	Mfr. Code	Part No.
R36	Resistor, Variable, 5K	14304	R-2208
R37	Resistor, Fixed, Composition, 5.6K $\pm 5\%$ , 1/4W	Mil type	RCR07G562JM
R38	Resistor, Fixed, Composition, 33 ohm $\pm 5\%$ , 1/2W	Mil type	RCR20G330JM
R39	Not used		
R40	Resistor, Fixed, Composition, 1.2K $\pm 5\%$ , 1/4W	Mil type	RCR07G122JM
R41	Not used		
R42	Resistor, Fixed, Composition, 15K $\pm 5\%$ , 1/4W	Mil type	RCR07G153JM
R43	Resistor, Fixed, Composition, 82K $\pm 5\%$ , 1/4W	Mil type	RCR07G823JM
R44	Resistor, Fixed, Composition, 1K $\pm 5\%$ , 1/4W	Mil type	RCR07G102JM
R45	Resistor, Fixed, Composition, 100 ohm $\pm 5\%$ , 1/4W	Mil type	RCR07G101JM
R46	Resistor, Fixed, Composition, 2.2K $\pm 5\%$ , 1/4W	Mil type	RCR07G222JM
R47	Not used		
R48	Resistor, Fixed, Composition, 2.2K $\pm 5\%$ , 1/4W	Mil type	RCR07G222JM
R49	Resistor, Fixed, Composition, 100 ohm $\pm 5\%$ , 1/4W	Mil type	RCR07G101JM
R50	Resistor, Fixed, Composition, 2.7K $\pm 5\%$ , 1/4W	Mil type	RCR07G272JM
R51 to R53	Resistor, Fixed, Composition, 1K $\pm 5\%$ , 1/4W	Mil type	RCR07G102JM
R54	Resistor, Fixed, Composition, 27K $\pm 5\%$ , 1/4W	Mil type	RCR07G273K
R55	Resistor, Fixed, Composition, 47K $\pm 5\%$ , 1/4W	Mil type	RCR07G473JM
R56	Resistor, Fixed, Composition, 100K $\pm 5\%$ , 1/4W	Mil type	RCR07G104JM
R57	Resistor, Fixed, Composition, 3.9K $\pm 5\%$ , 1/4W	Mil type	RCR07G392JM
R58 to R60	Resistor, Fixed, Composition, 27K $\pm 5\%$ , 1/4W	Mil type	RCR07G273JM
R61	Resistor, Fixed, Composition, 1K $\pm 5\%$ , 1/4W	Mil type	RCR07G102JM
R62	Resistor, Fixed, Composition, 1.8K $\pm 5\%$ , 1/4W	Mil type	RCR07G182JM
R63	Resistor, Fixed, Composition, 10K $\pm 5\%$ , 1/4W	Mil type	RCR07G103JM
R64,R65	Resistor, Fixed, Composition, 2.7K $\pm 5\%$ , 1/4W	Mil type	RCR07G272JM
T1 to T4	Transformer, RF	14304	919-1319
U1	Integrated Circuit, 12 Stage Ripple-Carry Binary Counter/Divider	14304	IC-0381
U2	Integrated Circuit, Dual J-K Master Slave Flip-Flop	14304	IC-0380
U3	Integrated Circuit, 12 Stage Ripple-Carry Binary Counter/Divider	14304	IC-0381
U4,U5	Integrated Circuit, Presettable UP/DOWN Counter	14304	IC-0090
U6	Integrated Circuit, Timer	14304	IC-0295
U7	Integrated Circuit, Dual J-K Master Slave Flip-Flop	14304	IC-0380
U8	Integrated Circuit, Quad Exclusive OR Gate	14304	IC-0388
U9	Integrated Circuit, 8-Input NAND Gate	14304	IC-0386
U10	Integrated Circuit, Dual 4-Input NAND Gate	14304	IC-0089
U11	Integrated Circuit, Triple 3-Input NAND Gate	14304	IC-0142
U12	Integrated Circuit, Quad 2-Input NOR Gate	14304	IC-0135
U13	Integrated Circuit, Triple 3-Input NOR Gate	14304	IC-0143
U14	Integrated Circuit, Triple 2-Channel Multiplexer	14304	IC-0384
VR1	Integrated Circuit, Positive Voltage Regulator	14304	IC-0058



TABLE 1. 1A1A10 MAINTENANCE PARTS LIST (Continued)

Ref. Desig.	Name & Description	Mfr. Code	Part No.
VR2	Integrated Circuit, Three Terminal Positive Fixed Voltage Regulator, MA78L05AC	14304	IC-0291

TABLE 2. MAINTENANCE PARTS LIST

Ref. Desig.	Name & Description	Mfr. Code	Part Number
1A1A10A1	Divider Circuit PWB	14304	6628-0870
Q1	Transistor, NPN, MPS2369	14304	Q-0062
	Resistor, Fixed, Composition, 1/4W, 5%, 2.2K	Mil type	RCR07G272JM
R2	Resistor, Fixed, Composition, 1/4W, 5%, 1K	Mil type	RCR07G102JM
R3	Resistor, Fixed, Composition, 1/4W, 5%, 470	Mil type	RCR07G471JM
R4	Resistor, Fixed, Composition, 1/4W, 5%, 2.7	Mil type	RCR07G272JM
R5	Resistor, Fixed, Composition, 1/4W, 5%, 2.7	Mil type	RCR07G272JM
U1	IC, Quad 2 in Nand, SN74LS00	14304	IC-0177
U2	IC, Synchronous 4-Bit Counter, SN74LS163	14304	IC-0189
U3	IC, Synchronous 4-Bit Counter, SN74LS163	14304	IC-0189

TABLE 3. MAINTENANCE PARTS LIST

Ref. Desig.	Name & Description	Mfr. Code	Part Number
1A1A10A2	TCXO, Frequency Standard, 13.00 MHz	14304	6628-0860

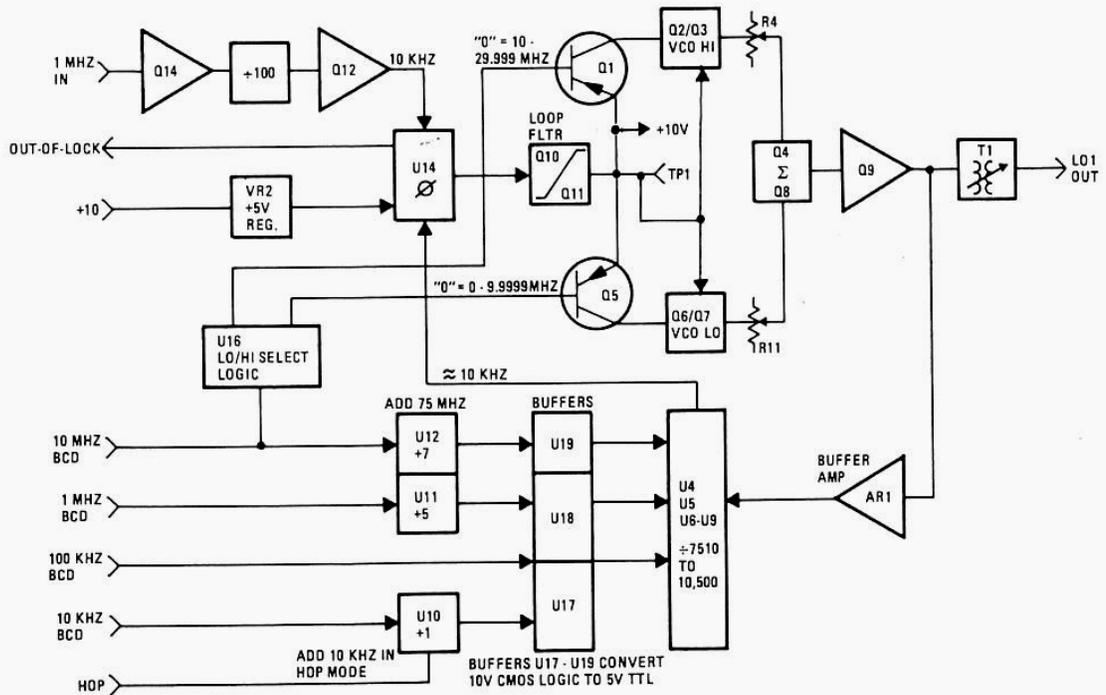


# UNIT INSTRUCTIONS



## LO NO.1

# 1A1A11





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### 1. GENERAL DESCRIPTION

LO No. 1 generates the  $F_0 + 75$  MHz signal required at the 1A1A6 Mixer to perform the final transmit mixer up-conversion to the  $F_0$ , and in the receive mode, to perform the first up conversion to the 75 MHz IF. The  $F_0 + 75$  MHz output can be any discrete frequency (in 10 kHz increments) between 76.60 MHz and 105.00 MHz. The output frequency is synthesized from a single 1 MHz signal input. Synthesizer control is exercised automatically in response to BCD frequency control inputs from the program board (or in non-type accepted versions, via an optional RF-252 Frequency Controller). HOP spur avoidance control is also exercised thru this assembly.

### 2. TECHNICAL CHARACTERISTICS

- Power Inputs:  
 +10V P1-18
- Signal Inputs:  
 1 MHz Ref. P1-23
- Signal Outputs:  
 LO No. 2 Out P1-2 76.60 MHz – 105.00 MHz (10 kHz Increments)
- Control Inputs:  
 10 kHz  $2^0, 2^1, 2^2, 2^3$   
 100 kHz  $2^0, 2^1, 2^2, 2^3$   
 1 MHz  $2^0, 2^1, 2^2, 2^3$   
 10 MHz  $2^0, 2^1$   
 HOP P1-25 1 = +10 kHz

- Control Outputs:  
 Out-of-Lock P1-41 0 = Out-of-Lock

### 3. SEMICONDUCTOR COMPLEMENT

REF. DESIG.	TYPE	DESCRIPTION
AR1	CA3028AS	Differential Cascode Ampl.
CR1-CR3	MV109	Diode, Voltage, Variable Capacitance
CR4, CR5	1N4454	Diode, Signal
Q1	2N4126	Transistor, PNP
Q2, Q3	2N5486	Transistor, FET
Q4	2N3563	Transistor, NPN
Q5	2N4126	Transistor, PNP
Q6, Q7	2N5486	Transistor, FET
Q8, Q9	2N3563	Transistor, NPN

REF. DESIG.	TYPE	DESCRIPTION
Q10, Q11	MPS6571	Transistor, NPN
Q12	MPS2369	Transistor, NPN
Q13	MPSA13	Transistor, Darlington, NPN
Q14	MPS2369	Transistor, NPN
U4	FSC11C90	650 MHz $\div 10/11$ Prescaler
U5	MC7470P	Gated JK Flip-Flop
U6 - U9	74LS190N	Synchronous Up/Down BCD Counter
U10-U12	CD4008	4-Bit Full Adder
U13	SN78L05	Positive Fixed Voltage Regulator
U14	MC4044	Phase Detector
U15	CD4518BE	Dual BCD Up-counter
U16	CD4001AE	Quad 2-Bit NOR Gates
U17-U19	CD4010	Hex Buffers/Converters
U20	74LS27PC	Triple 3-Input NOR Gates
VR1	MC7805CP	Positive 5-Volt Regulator
VR2	SN78L05	3-Terminal 5 Volt Regulator

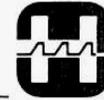
### 4. FUNCTIONAL DESCRIPTION

The LO No. 1 output signal is synthesized from a single 1 MHz reference signal input in response to BCD control inputs of 10 MHz, 1 MHz, 100 kHz, and 10 kHz. Recall that 1 kHz and 100 Hz frequency control elements are added to the signal by LO2. HOP, the 10 kHz frequency shift spur evasion technique, is also effected at LO1.

The 1 MHz reference input from 1A1A10 enters LO1 at P1-23 and is buffered at Q14 to drive U15, configured to divide by 100. The 10 kHz CMOS output from U15 is converted to TTL by Q12.

Refer to figure 1, a detail diagram of Phase Detector U14 as it is employed in this circuit, for the following discussion. Only the phase detector and charge pump features of U14 are used in this circuit. They are used to measure a phase lock condition and to generate an error voltage proportional to departure of the divide-by-N input from the reference input.

Loop Lockup occurs when both outputs U1 and D1 remain high. This occurs only when all the negative transitions on R, the reference input, and V, the feedback input, coincide. The circuit responds only to transitions, and as a consequence, phase error is independent of input waveform, duty cycle, or amplitude variation. As long as the loop remains locked (no phase or frequency difference of the input signals), the output voltage at R56 will be low and the U1 and D1 outputs will be low.



With an out of lock condition, there will be a pulsed waveform on either U1 or D1 (to either PU or PD), depending on the phase-frequency relationship of the two inputs at R and V. The charge pump serves to invert one of the waveforms (D1) and translates the voltage levels before they are applied to the loop filters. When PD is low and PU is high, Q1 will be conducting in the normal direction and Q2 will be off. Current will be following through Q3 and CR2; the base of Q3 will be two  $V_{BE}$  drops above ground or approximately 1.5 volts. Since both of the resistors connected to the base of Q3 are equal, the emitter of Q4 (base of Q5) will be approximately 3.0 volts. For this condition, the emitter of Q5 (DF) will be one  $V_{BE}$  below this voltage, or about 2.25 volts. The PU input to the charge pump is high ( $>2.4$  volts) and CR1 will be reversed biased.

When PU is low and PD is high, CR1 is forward biased and UF will be approximately one  $V_{BE}$  at ground (neglecting the  $V_{CE(sat)}$  of the driving gate). With PD high, Q1 conducts in the reverse direction, supplying base current for Q2. While Q2 is conducting, Q4 is prevented from supplying base drive to Q5.

If both inputs to the charge pump are high (zero phase difference), both CR1 and the base-emitter

junction of Q5 are reverse biased and there is no tendency for the error voltage to change.

The phase detector output is fed via Q10 and Q11 and the Loop Filter circuit to both the VCO High, and the VCO Low circuits. Loop characteristics are set by L6 and L7. The VCO control voltage is measurable at TP1. U16 monitors the 10 MHz control line to select VCO High whenever a frequency equal to or greater than 10 MHz is selected. A low logic level output from U16-10 will enable Q1, and a low logic level at U16-11 will enable Q5.

With VCO Low selected, the dc control voltage at varicap CR3 will drive this oscillator frequency until it agrees with the reference input, as modified by the frequency control reference inputs. L2 is adjusted for +6.5 Vdc at TP1 (with 9.999 MHz selected). R11 adjusts the VCO Low output level to +7 dBm at P1-2, with the output coupled to this point via Q8, Q9, and T1 (tuned for optimum output).

Q13 is used to provide super decoupling for the +10 Vdc oscillator supply volts. VCO High provides an identical function for frequencies 10 MHz and above, with CR1 and CR2 providing the frequency

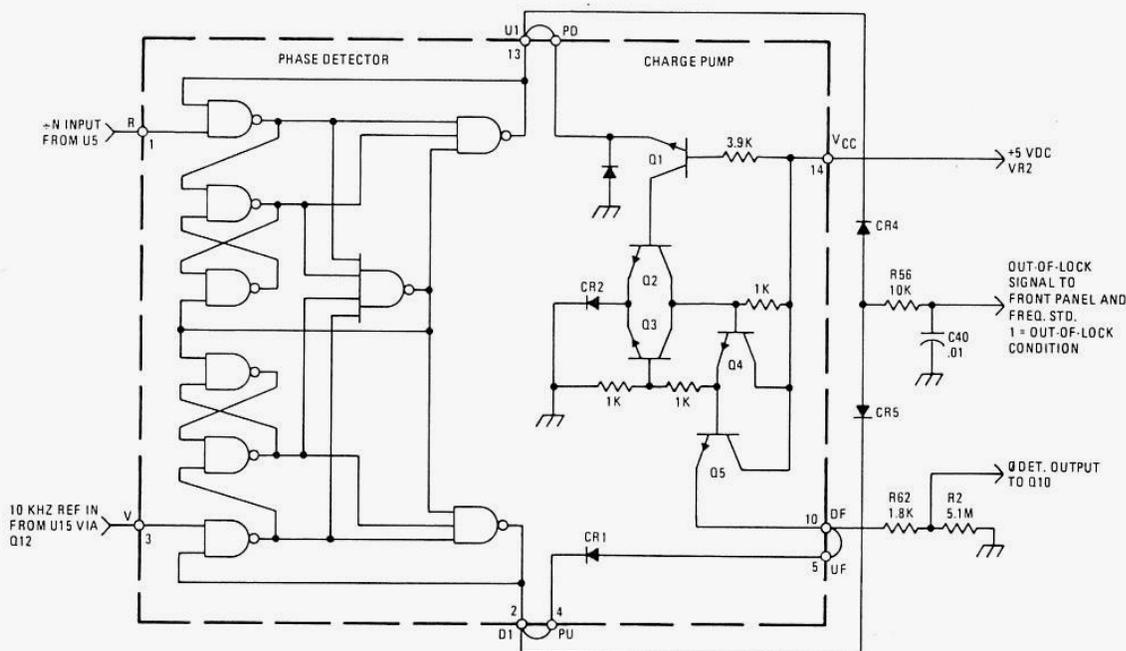


Figure 1. 1A1A11 U14 Phase Detector Detail



control in response to the control input. L1 is also adjusted for +6.5 Vdc at TP1, but with a frequency of 29.999 MHz selected. R4 adjusts this level to +7 dBm at the output.

Part of the Q9 output of T1 is picked off by C14 and fed via buffer amplifier AR1 to the divide-by-N circuit. The divide-by-N function will produce the desired 10 kHz (approximately) output to the phase detector in response to control inputs from the frequency control lines and the associated adders, buffers, and counters.

On the MHz control lines, U11 and U12 are configured to add 75 (7 at U12 and 5 at U11), to any BCD input instructions. 100 kHz control lines are fed direct to the CMOS-TO-TTL converters because no "add" function is required. U10 will automatically add +1 to any 10 kHz BCD instructions under control of the HOP select line. With P1-23 high, U10 will add +10 kHz to counter the complimentary 10 kHz HOP instruction at LO2. This system of adding 10 kHz as a spur evasion technique will not actually alter the frequency of operation because of the cancelling effect inherent in the mixing process. Buffer/converters U17, U18, and U19 perform the 10V CMOS to 5V TTL conversion function for use by the divide-by-N logic.

Table 1 is included to demonstrate the relationship of the LO1 output to the selected  $F_0$ . 10 kHz select information is included, even though this function is accomplished at LO2 and not at LO1, to demonstrate the "Auto HOP" effect when the sel-

ected 10 kHz digit is greater than 3, and less than 4. The columns at the right demonstrate the effect of manually selecting or programming HOP for both conditions.

## 5. MAINTENANCE

All of the adjustments indicated in this paragraph have been made at the factory prior to shipment. It should not be necessary to repeat any of these adjustments unless component failure is experienced, or unless readjustment becomes necessary for some other specific reason. All of these adjustments can be made by removing the PC Board and reinstalling it on the extender card as shown in figure 2 this will facilitate maintenance and adjustment by making all test points readily available. These adjustments can all be made using the test equipment shown or the electrical equivalents. Figure 2 summarizes 1A1A11 Inputs/Outputs and locates significant adjustment points.

### CAUTION

Always remove power when removing or reinstalling subassemblies.

### 5.1 L6/L7/T1 Adjustment

- a. Terminate the RF-230 RF Output in a 50 ohm load.

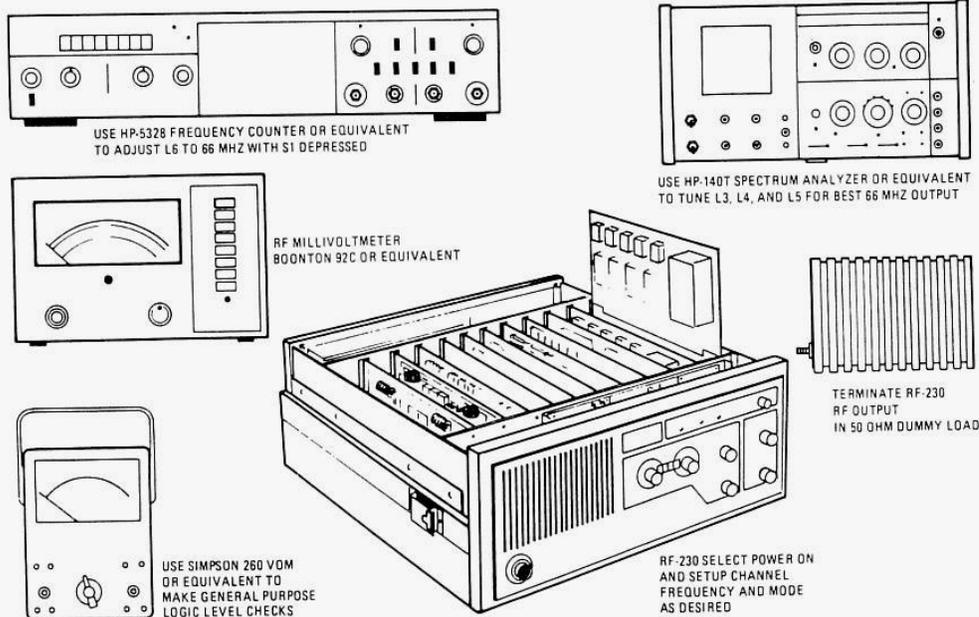


Figure 2. 1A1A11 Test Setup and Equipment



- b. Connect a spectrum analyzer to the 1A1-A11 RF Output at P1-2 and adjust to display 10 kHz components on either side of the desired output.
- c. Adjust L6 and L7 for minimum 10 kHz component in the RF output at P1-2.
- d. Remove the spectrum analyzer from the RF output at P1-2 and connect an RF Sensitive VTVM (Boonton 92C unterminated).
- e. Adjust T1 for maximum output at P1-2, using a channel frequency close to mid range (i.e., approximately 15 MHz).
- f. This completes adjustment. Reconfigure for normal operation or as desired.

**5.2 HI/LO VCO Adjustments**

- a. Terminate RF-230 RF Output in a 50 ohm load.
- b. Set frequency to 09.99 MHz. Adjust L2 for 6.5 volts on the TP1 Voltmeter.
- c. Set frequency to 00.00 MHz. Observe that the TP1 Voltmeter is between 1.5 and 3.5 volts.

- d. Set frequency to 29.99 MHz. Adjust L1 for 6.5 volts on the TP1 Voltmeter.
- e. Set frequency to 10.00 MHz. Observe that the TP1 Voltmeter is between 1 and 3 volts.
- f. Set frequency to 15.00 MHz. With the analyzer set at 90 MHz peak T1.
- g. Set frequency to 09.99 MHz. Adjust R11 for +7 dBm at 84.99 MHz.
- h. Set frequency to 29.99 MHz. Adjust R4 for +7 dBm at 104.99 MHz.
- i. This completes all LO1 adjustments. Reconfigure for normal operation.

**6. PARTS LISTS**

Table 1 lists all 1A1A11 Maintenance Parts. All of these components can be identified in figure 4. Refer to General Information Section for list of manufacturers.

**7. SCHEMATIC**

Figure 5 is a complete schematic diagram of the 1A1A11 assembly.

**TABLE 1. PARTIAL F<sub>0</sub> VS LO1 OUTPUT TABLE DEMONSTRATING HOP ACTION**

SELECTED F <sub>0</sub> IN MHZ	LO1 OUTPUT (NORMAL)	DIVIDE-BY-N FACTOR	HOP NOTES	LO1 OUTPUT IN MHZ HOP MANUALLY SELECTED	DIVIDE-BY-N FACTOR	
01.6000	76.61*	7661	FOR FREQUENCIES WHERE THE KHZ SELECT DIGIT IS LESS THAN 4, "AUTO HOP" IS COMMANDED BY LO2 AND WILL FORCE U10 TO ADD 10 KHZ TO THE F <sub>0</sub> SHOWN.	76.60	7660	
01.7000	76.71*	7671		76.70	7670	
01.8000	76.81*	7681		76.80	7680	
01.9000	76.91*	7691		76.90	7690	
02.0000	77.01*	7701		77.00	7700	
02.1820	77.19*	7719		77.18	7718	
02.2010	77.21*	7721		77.20	7720	
02.2020	77.21*	7721		77.20	7720	
02.2030	77.21*	7721		77.20	7720	
02.2040	77.20	7720		77.21	7721	
02.2050	77.20	7720		77.21	7721	
02.2060	77.20	7720		77.21	7721	
INCOMPLETE TABLE - ELEMENTS SHOWN TO DEMONSTRATE PROGRESSION AND HOP ACTION						
29.8000	104.81*	10481		THE EFFECT OF MANUALLY SELECTING OR PROGRAMMING HOP IS SHOWN AT THE RIGHT.	104.80	10480
29.9000	104.91*	10491			104.90	10490
29.9100	104.92*	10492			104.91	10491
29.9200	104.93*	10493	104.92		10492	
29.9300	104.94*	10494	104.93		10493	
29.9400	104.95*	10495	104.94		10494	
29.9500	104.96*	10496	104.95		10495	
29.9600	104.97*	10497	104.96		10496	
29.9700	104.98*	10498	104.97		10497	
29.9800	104.99*	10499	104.98		10498	
29.9900	105.00*	10500	104.99		10499	
29.9910	105.00*	10500	104.99		10499	
29.9920	105.00*	10500	104.99		10499	
29.9930	105.00*	10500	104.99		10499	
29.9940	104.99	10499	105.00		10500	
29.9950	104.99	10499	105.00		10500	
29.9960	104.99	10499	105.00		10500	
29.9970	104.99	10499	105.00		105.00	
29.9980	104.99	10499	105.00		10500	
29.9990	104.99	104.99	105.00		10500	
29.9991	104.99	10499	105.00	10500		
THRU 29.9999						

\*DENOTES 10 KHZ ADDED BY "AUTO HOP"

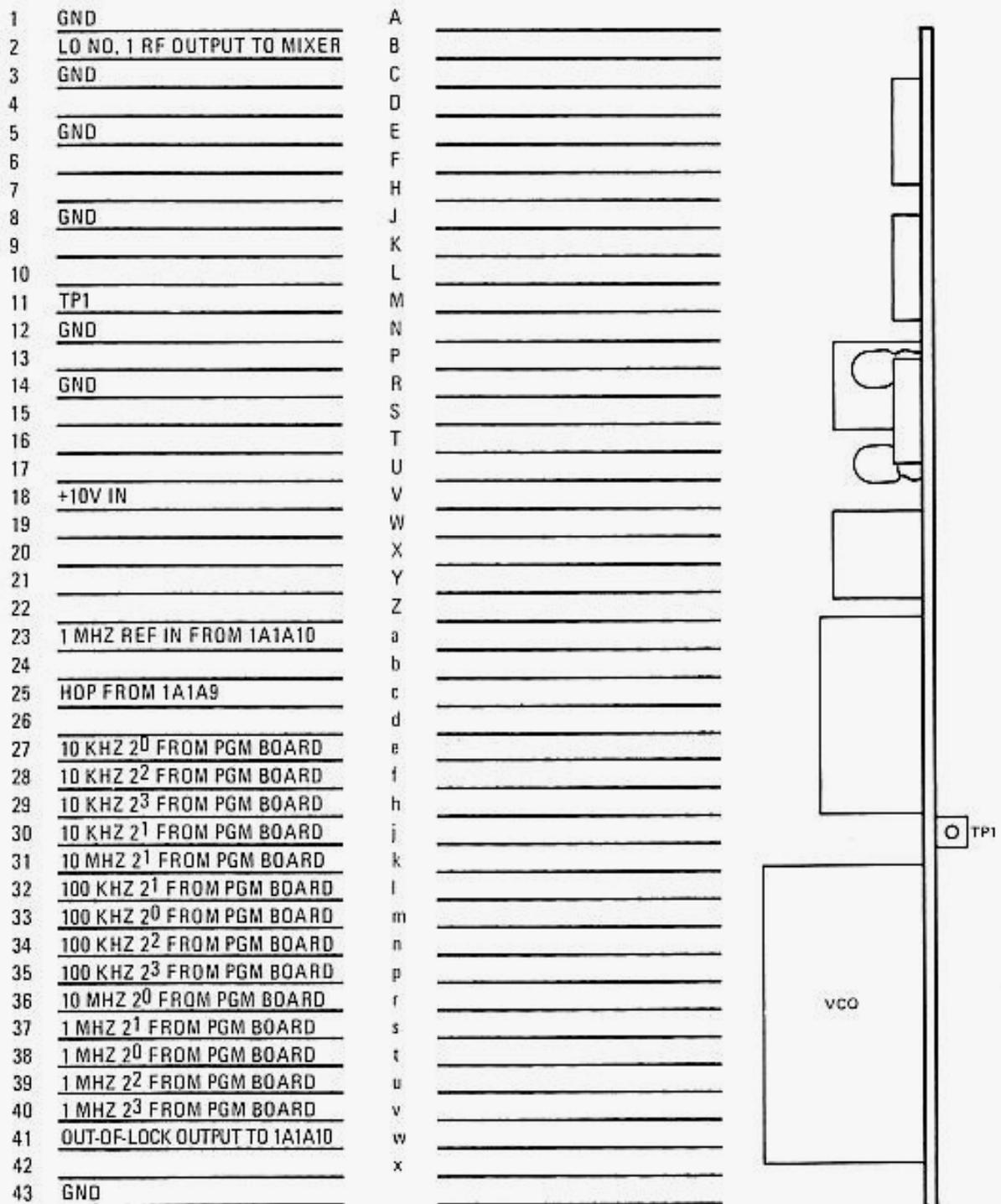


Figure 3. 1A1A11 Input/Output Summary



TABLE 1. 1A1A11 MAINTENANCE PARTS LIST

Ref. Desig.	Name & Description	Mfr. Code	Part No.
1A1A11	L.O. No. 1 PWB Assembly	14304	6628-0900
AR1	Integrated Circuit, Differential/Cascade Amplifier	14304	IC-0031
C1 to C3	Capacitor, Fixed, Ceramic, .01 uF ± 20%, 50V	14304	C-4952
C4	Capacitor, Fixed, Ceramic, .001 uF ± 10%, 500V	14304	C-3513
C5	Capacitor, Fixed, Ceramic, 5.6 pF ± 5 pF, 1000V	14304	C-4738
C6,C7	Capacitor, Fixed, Ceramic, .001 uF ± 10%, 500V	14304	C-3513
C8	Capacitor, Fixed, Ceramic, 10 pF ± 5%, 1000V	14304	C-4741
C9	Capacitor, Fixed, Mica, 91 pF ± 5%, 500V	14304	C-0125
C10	Capacitor, Fixed, Ceramic, .001 pF ± 10%, 500V	14304	C-3513
C11	Capacitor, Fixed, Ceramic, 150 pF ± 10%, 500V	14304	C-3502
C12,C13	Capacitor, Fixed, Ceramic, .01 uF ± 20%, 50V	14304	C-4952
C14	Capacitor, Fixed, Ceramic, 1 pF ± .5 pF, 1000V	14304	C-4727
C15	Capacitor, Fixed, Ceramic, .001 uF ± 10%, 500V	14304	C-3513
C16	Capacitor, Fixed, Ceramic, .01 uF ± 20%, 50V	14304	C-4952
C18	Capacitor, Fixed, Tantalum, 68 uF ± 10%, 25V	14304	C-3105
C19 to C22	Capacitor, Fixed, Ceramic, .01 uF ± 20%, 50V	14304	C-4952
C23	Capacitor, Fixed, Tantalum, 1 uF ± 10%, 35V	14304	C-3100
C24 to C37	Capacitor, Fixed, Ceramic, .001 uF ± 10%, 500V	14304	C-3513
C38,C39	Capacitor, Fixed, Tantalum, 1 uF ± 10%, 35V	14304	C-3100
C40	Capacitor, Fixed, Ceramic, .01 uF ± 20%, 50V	14034	C-4952
C41	Capacitor, Fixed, Mylar, .01 uF ± 10%, 250V	14304	C-8000
C42	Capacitor, Fixed, Polycarbonate, 1 uF ± 10%, 100V	14304	C-8043
C43	Capacitor, Fixed, Tantalum, 150 uF ± 10%, 15V	14304	C-3106
C44	Capacitor, Fixed, Polycarbonate, .039 uF ± 3%, 50V	14304	C-8214
C45	Capacitor, Fixed, Polycarbonate, .0033 uF ± 3%, 50V	14304	C-8216
C46	Capacitor, Fixed, Polycarbonate, .047 uF ± 3%, 50V	14304	C-8217
C47	Capacitor, Fixed, Polycarbonate, .018 uF ± 3%, 50V	14304	C-8206
C48	Capacitor, Fixed, Polycarbonate, .033 uF ± 3%, 50V	14304	C-8218
C49	Capacitor, Fixed, Tantalum, 1 uF ± 10%, 35V	14304	C-3100
C50 to C52	Capacitor, Fixed, Ceramic, .01 uF ± 20%, 50V	14304	C-4952
C53	Capacitor, Fixed, Tantalum, 6.8 uF ± 10%, 35V	14304	C-3102
CR1 to CR3	Diode, Voltage Variable Capacitance, MV109	14304	CR-0705
CR4, CR5	Diode, Signal, 1N4454	14304	CR-0745
L1,L2	Inductor, Variable, .13 uH	14304	L-0253
L3,L4	Choke, RF, 15 uH ± 10%	14304	L-0630
L5	Choke, RF, .22 uH ± 10%	14304	L-0608
L6	Inductor, Variable, 14.3 mH	14304	6628-0920
L7	Inductor, Variable, 19.2 mH	14304	6628-0921
L8	Choke, RF, 1 uH ± 10%	14304	L-0616
Q1	Transistor, PNP, 2N4126	14304	Q-0386
Q2,Q3	Transistor, NPN, 2N5486	14304	Q-0376
Q4	Transistor, NPN, 2N3563	14304	Q-0309



TABLE 1. 1A1A11 MAINTENANCE PARTS LIST (Continued)

Ref. Desig.	Name & Description	Mfr. Code	Part No.
Q5	Transistor, PNP, 2N4126	14304	Q-0386
Q6,Q7	Transistor, NPN, 2N5486	14304	Q-0376
Q8,Q9	Transistor, NPN, 2N3563	14304	Q-0309
Q10,Q11	Transistor, NPN, MPS6571	14304	Q-0391
Q12	Transistor, NPN, MPS2369	14304	Q-0062
Q13	Transistor, NPN, Darlington, MPS-A13	14304	Q-0076
Q14	Transistor, NPN, MPS2369	14304	Q-0062
R1	Resistor, Fixed, Composition, 18K $\pm$ 5%, 1/4W	Mil type	RCR07G183JM
R2	Resistor, Fixed, Composition, 1.5M $\pm$ 5%, 1/4W	Mil type	RCR07G155JM
R3	Resistor, Fixed, Composition, 47 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G470JM
R4	Resistor, Variable, 500 ohm	14304	R-2205
R5	Resistor, Fixed, Composition, 6.8K $\pm$ 5%, 1/4W	Mil type	RCR07G682JM
R6	Resistor, Fixed, Composition, 1.8K $\pm$ 5%, 1/4W	Mil type	RCR07G182JM
R7	Resistor, Fixed, Composition, 5.6K $\pm$ 5%, 1/4W	Mil type	RCR07G562JM
R8	Resistor, Fixed, Composition, 1K $\pm$ 5%, 1/4W	Mil type	RCR07G102JM
R9	Resistor, Fixed, Composition, 5.6K $\pm$ 5%, 1/4W	Mil type	RCR07G562JM
R10	Resistor, Fixed, Composition, 1K $\pm$ 5%, 1/4W	Mil type	RCR07G102JM
R11	Resistor, Variable, 500 ohm	14304	R-2205
R12	Resistor, Fixed, Composition, 6.8K $\pm$ 5%, 1/4W	Mil type	RCR07G682JM
R13	Resistor, Fixed, Composition, 1.8K $\pm$ 5%, 1/4W	Mil type	RCR07G182JM
R14	Resistor, Fixed, Composition, 82 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G820JM
R15	Resistor, Fixed, Composition, 1K $\pm$ 5%, 1/4W	Mil type	RCR07G102JM
R16 to R19	Resistor, Fixed, Composition, 15K $\pm$ 5%, 1/4W	Mil type	RCR07G153JM
R20	Resistor, Fixed, Composition, 470 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G471JM
R21	Resistor, Fixed, Wirewound, 8.2 ohm $\pm$ 10%, 2W	14304	R-3792
R22	Resistor, Fixed, Composition, 100 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G101JM
R23	Resistor, Fixed, Composition, 2.7K $\pm$ 5%, 1/4W	Mil type	RCR07G272JM
R24	Resistor, Fixed, Composition, 470 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G471JM
R25	Resistor, Fixed, Composition, 5.6K $\pm$ 5%, 1/4W	Mil type	RCR07G562JM
R26 to R40	Resistor, Fixed, Composition, 100K $\pm$ 5%, 1/4W	Mil type	RCR07G104JM
R41 to R54	Resistor, Fixed, Composition, 1K $\pm$ 5%, 1/4W	Mil type	RCR07G102JM
R55	Resistor, Fixed, Composition, 100 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G101JM
R56	Resistor, Fixed, Composition, 10K $\pm$ 5%, 1/4W	Mil type	RCR07G103JM
R57	Resistor, Fixed, Composition, 2.7K $\pm$ 5%, 1/4W	Mil type	RCR07G272JM
R58	Resistor, Fixed, Composition, 27K $\pm$ 5%, 1/4W	Mil type	RCR07G273JM
R59	Resistor, Fixed, Composition, 100 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G101JM
R60	Resistor, Fixed, Composition, 2.2K $\pm$ 5%, 1/4W	Mil type	RCR07G222JM
R61	Resistor, Fixed, Composition, 100 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G101JM
R62	Resistor, Fixed, Composition, 1.8K $\pm$ 5%, 1/4W	Mil type	RCR07G182JM
R63	Resistor, Fixed, Composition, 8.2K $\pm$ 5%, 1/4W	Mil type	RCR07G822JM
R64	Resistor, Fixed, Composition, 1K $\pm$ 5%, 1/4W	Mil type	RCR07G102JM



TABLE 1. 1A1A11 MAINTENANCE PARTS LIST (Continued)

Ref. Desig.	Name & Description	Mfr. Code	Part No.
R65	Resistor, Fixed, Composition, 100K $\pm$ 5%, 1/4W	Mil type	RCR07G104JM
R66	Resistor, Fixed, Composition, 1K $\pm$ 5%, 1/4W	Mil type	RCR07G102JM
R67	Resistor, Fixed, Composition, 100 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G101JM
R68	Resistor, Fixed, Composition, 10K $\pm$ 5%, 1/4W	Mil type	RCR07G103JM
R69	Resistor, Fixed, Composition, 100 ohm $\pm$ 5%, 1/4W	Mil type	RCR07G101JM
R70,R71	Resistor, Fixed, Composition, 2.7K $\pm$ 5%, 1/4W	Mil type	RCR07G272JM
T1	Transformer	14304	L-0129
TP1	Test Point, Brown	14304	J-0392
U1 to U3	Not used		
U4	Integrated Circuit, 650 MHz $\div$ 10/11 Prescaler	14304	IC-0402
U5	Integrated Circuit, Gated J-K Flip-Flop	14304	IC-0062
U6 to U9	Integrated Circuit, Synchronous Up/Down BCD Counter	14304	IC-0175
U10 to U12	Integrated Circuit, 4-Bit Full Adder	14304	IC-0377
U13	Not used		
U14	Integrated Circuit, Phase Detector	14304	IC-0052
U15	Integrated Circuit, Dual BCD Up-Counter	14304	IC-0396
U16	Integrated Circuit, Quad 2-Input NOR Gate	14304	IC-0135
U17 to U19	Integrated Circuit, HEX Buffer/Converter	14304	IC-0378
U20	Integrated Circuit, Triple 3-Input NOR Gate	14304	IC-0403
VR1	Integrated Circuit, Positive 5 Volt Regulator	14304	IC-0151
VR2	Integrated Circuit, Three Terminal Positive Fixed Voltage Regulator	14304	IC-0291

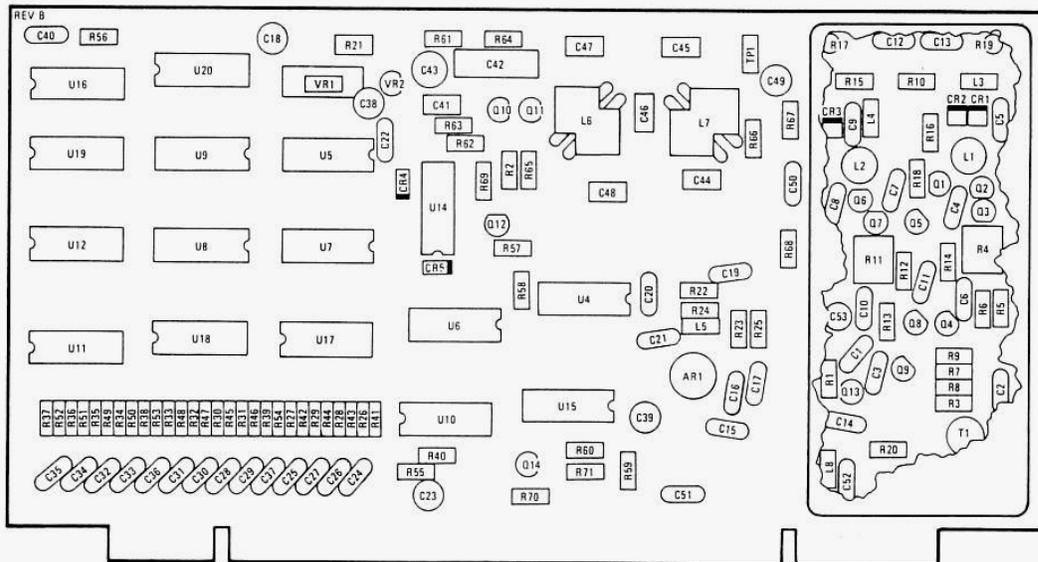


Figure 4. 1A1A11 Component Locations

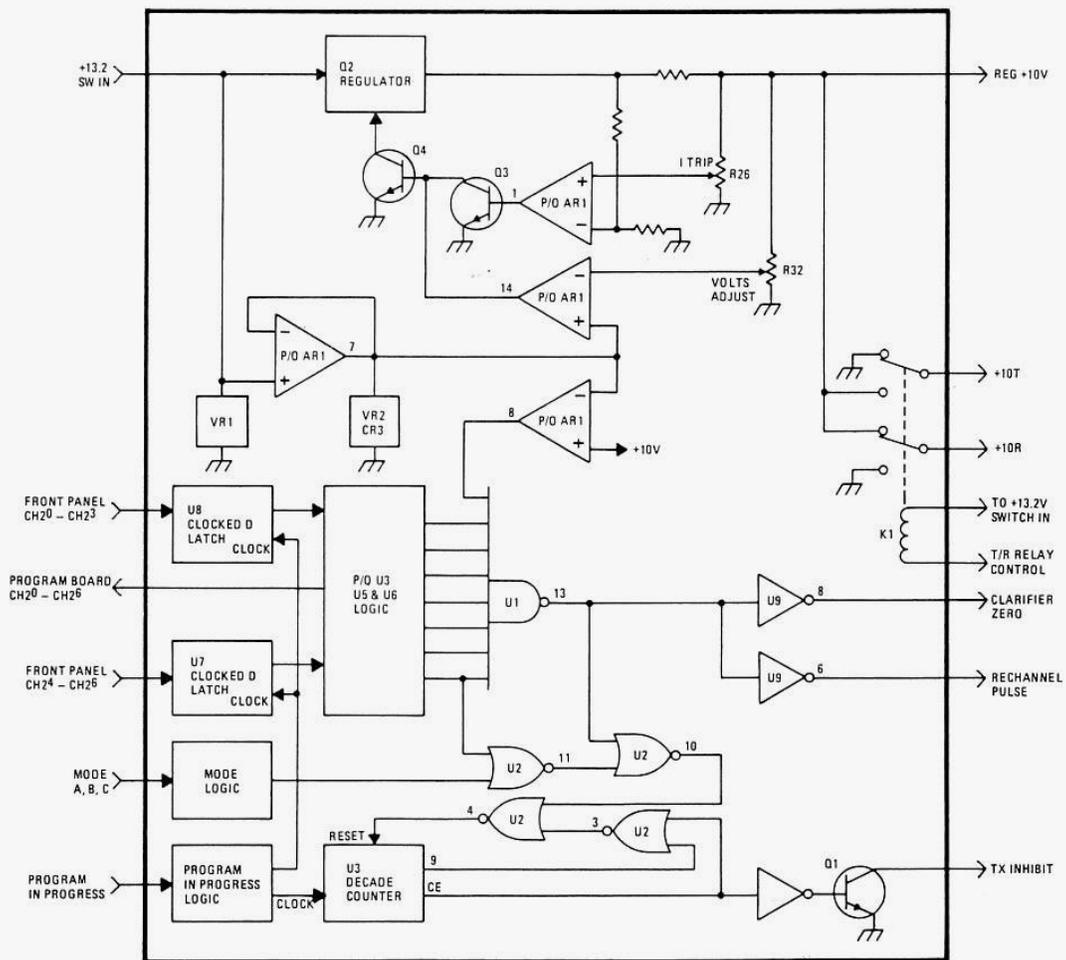


# UNIT INSTRUCTIONS



## CHANNEL CHANGE/REGULATOR

# 1A1A12



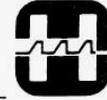


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## 1. GENERAL DESCRIPTION

The Channel Change/Regulator PC Board automatically controls initiation of events required by a channel change or "power on". The 1A1A12 PC Board monitors front panel channel control lines, mode control, program-in-progress, and the +10T line, for changes or conditions that require accomplishment of: Clarifier Zero, Rechannel Pulse Generation, or Tx Inhibit Control. The transmitter is inhibited during channel change operations. A rechannel pulse is generated to cause the RF-231 or RF-281 to retune to the new frequency in response to channel change instructions, and the clarifier is reset to the exact  $F_o$  whenever a new channel is selected.

The regulator portion of the assembly converts the 11 – 15 Vdc (nominal 13.2 Vdc) input from the front panel to the regulated +10 Vdc level required throughout the radio. +10T and +10R control voltages are also developed in response to T/R Relay Control from the PA Control PC Board.

## 2. TECHNICAL CHARACTERISTICS

### Power Inputs:

+13.2 Vdc Switched, From Front Panel

### Control Inputs:

T/R Relay Control From 1A3A1  
 Program In-Progress From 1A1A7/1A1A8  
 Mode Control 3-Bit From Front Panel  
 Channel Control 7-Bit From Front Panel  
 Channel Control 7-Bit From 1A1A7/1A1A8

### Control Outputs:

Clarifier Zero  
 Rechannel Pulse  
 Tx Inhibit  
 +10T  
 +10R

## 3. SEMICONDUCTOR COMPLEMENT

REF. DESIG.	TYPE	DESCRIPTION
AR1	CA324E	Quad Operational Ampl.
CR1, CR2	1N4004	Diode, Rectifier
CR3	1N4454	Diode, Signal
Q1	2N4124	Transistor, NPN
Q2	2N5986	Transistor, PNP
Q3	2N4124	Transistor, NPN

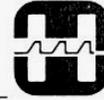
REF. DESIG.	TYPE	DESCRIPTION
Q4	2N5190	Transistor, NPN
U1	CD4068BE	8-Input NAND
U2	CD4001AE	QUAD 2-Input NOR
U3	CD4017AE	Decade Counter
U4	CD4025AE	Triple 3-Input NOR
U5, U6	CD4077BE	Quad 2-Input Exclusive NOR
U7, U8	CD4042AE	Quad Clocked "D" Latch
U9	CD4069BE	Hex Inverter
VR1	1N5239	Diode, Zener, 9.1V
VR2	1N753A	Diode, Zener, 6.2V

## 4. CIRCUIT DESCRIPTION

Figure 1 is a simplified diagram of the 1A1A12 assembly, and demonstrates both the regulator and the channel change functions incorporated in the board.

### 4.1 Voltage Regulator

The nominal +13.2 Vdc input voltage from the front panel POWER ON/OFF control switch enter the assembly at P1-16 and P1-17. This voltage is fed directly to +10T/+10R switching relay K1, and to the 10 Vdc regulator circuit. K1 is controlled to ground by a transistor on the 1A1A5 Processor PC Board to effect receive/transmit switching functions throughout the radio. An element of AR1 is connected to provide a zener regulated output at pin 7 and provides constant current drive to VR2, giving a steady reference at the AR1-12 input. The other input terminal of this op amp is connected to VOLTS ADJ potentiometer R32. The AR1-14 output controls the base of Q4 to regulate the bias on Q2, the heatsink mounted series pass transistor. Current trip protection is accomplished by monitoring the voltage drop across R24, a 0.1 ohm 2 watt resistor in series with Q2. The sensitivity of this current-load-monitoring device is adjusted by monitoring the voltage drop across shunt resistor R26. In the tripped condition, Q3 shuts off Q4, Q2 base bias increases to +13.2 Vdc, and the regulated 10 Vdc system is shut OFF to the complete radio (except for the synthesizer). To recover, the fault must be removed. When properly adjusted, tripping of this circuit should alert the operator of a possible problem. Solving this sort of problem is a completely modularized radio is a simple and straight-forward process of elimination.



### 4.2 Channel Change Sequence Generation

Clarifier Zero, and Channel Change Pulse generation are required at power ON and whenever a new operating channel is selected. The Clarifier Zero pulse ensures precise Fo setup for any new operating channel, and the Rechannel Pulse initiates a tune cycle at the antenna coupler. A Transmit Inhibit signal is also generated during this period – to prevent transmission during the transition.

U1, an 8-Input Combiner monitors all significant functions for any change that would require control action. Seven of the inputs to this device are via “Exclusive NOR gates” that will always produce a high output with both inputs are the same. Note that slightly after power ON, U1-9 also goes high (and generates Clarifier Zero and Rechannel Pulses in the process), so that “normally”, all U1 inputs are high. Figure 2 simplifies the control

logic functions to show only one typical channel control input – all others perform similar functions at separate U1 inputs.

The CH2<sup>0</sup> bit is shown at U5-1. This same input would normally already have been clocked (strobed) thru U8 to appear at the Q1 output also, and as a consequence, U5-1 and U5-2 would both be the same – and produce a high output at U5-3. Now, assume a front panel change that would cause CH2<sup>0</sup> to change state. U5-1 would no longer be at the same level as U5-2, and as a consequence, U5-3 will go low, causing U1-13 to go high – and producing the required output pulses thru U9.

This same U1-13 output causes U2-8 to go high and produce a low at U2-5. U2-6 would also be low because of the high at U3-9 as the counter “waits” for the next RESET pulse, As U2-5 goes low, the RESET pulse for U3 is generated and the device

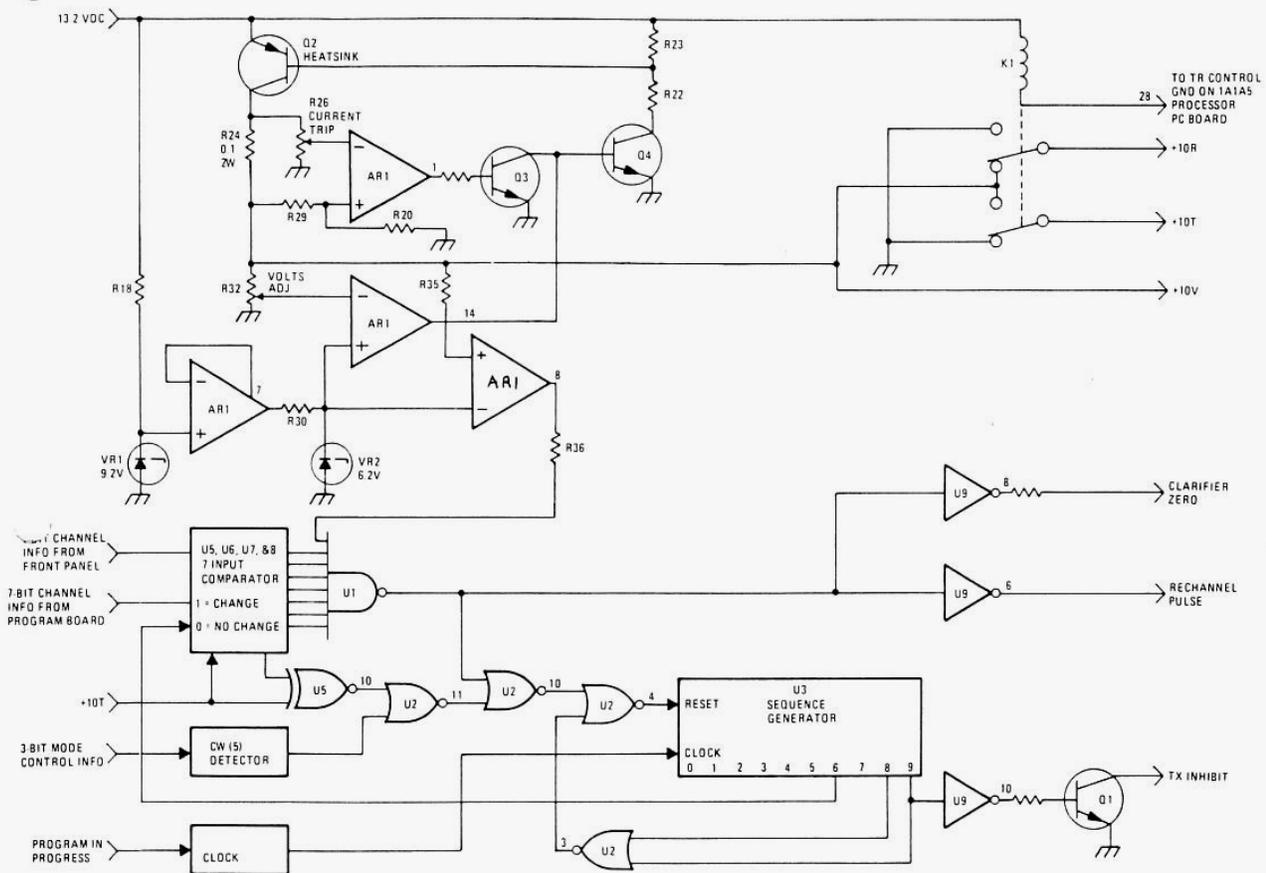


Figure 1. 1A1A12 Functional Diagram

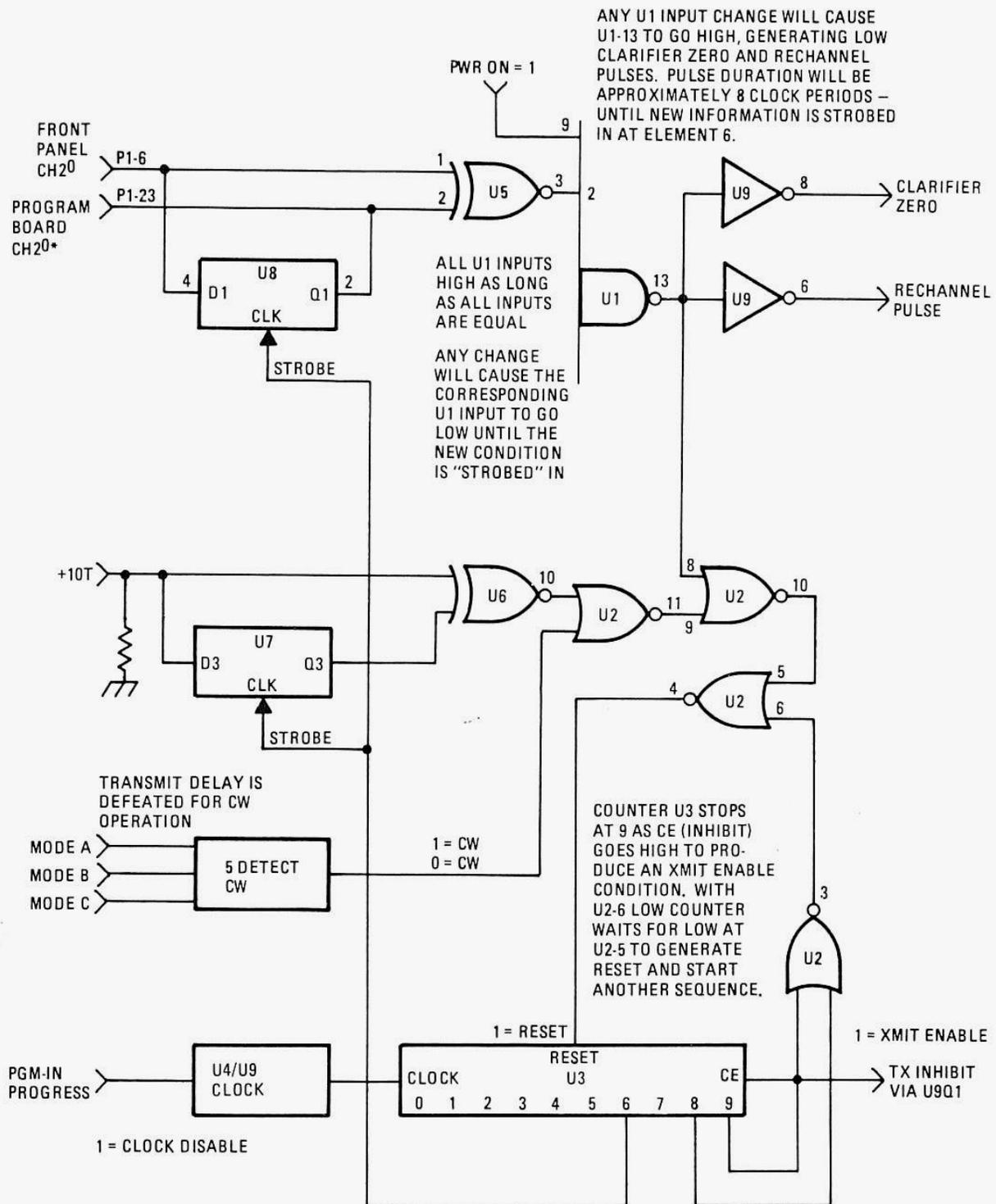


Figure 2. Simplified 1A1A12 Control Circuit Diagram



resets to zero, removing the inhibit signal at CE from the "9" count output. Assuming that the enableable clock is not inhibited by a program-in-progress logic level, U3 will count 0, 1, 2, 3, 4, 5, 6, and on the 6 count, this output would strobe the new condition thru to U5-2 (and also to the program board). U5 would again be "happy" with equal levels at both inputs and the system waits for the next instruction. This sequence is shown in flow chart form in figure 3.

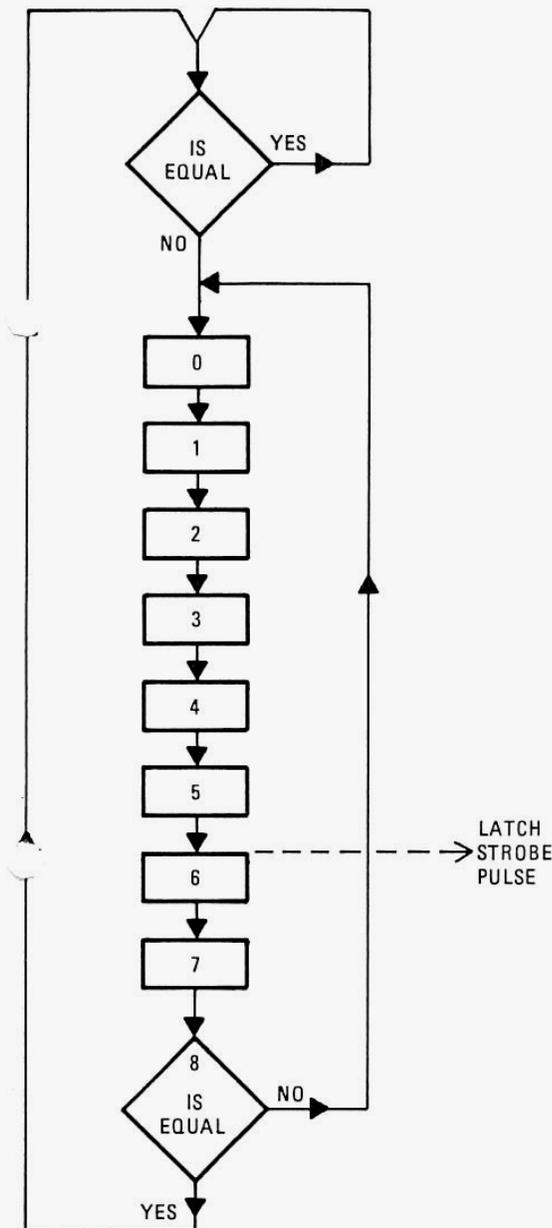


Figure 3. Exclusive OR Gate Control Functions

## 5. MAINTENANCE

There are only two maintenance adjustments on the 1A1A12 PC Board; the regulated +10 Vdc adjustment, and the current trip adjustment. These adjustments have been made at the factory and should not be readjusted unless required by physical change. R26 and R32 are both accessible from the top of the PC Board with the assembly in place, however, the unit can be removed from the radio and operated on an extender card (part of MRK) if necessary for test. Figure 4 demonstrates a typical 1A1A12 test setup. Figure 5 locates R26 and R32 and summarizes all inputs and outputs.

### CAUTION

Always select POWER OFF when removing or installing subassemblies to prevent possible damage.

### 5.1 R32, Voltage Adjustment

- With 1A1A12 installed on extender card, verify dc input at P1-16 or P1-17 at between 11 and 15 Vdc, nominally +13.2 Vdc.
- Measure +10 Vdc regulated output at P1-12 and P1-13. If not exactly +10 Vdc, adjust R32 to correct.
- +10R can be verified at P1-18 or P1-19. To verify +10T, ensure RF-230 safely terminated in normal load (or dummy load) and momentarily key transmitter. Measure at P1-14 or P1-15.
- This completes +10 Vdc adjustment. Configure for normal operation or as desired.

### 5.2 R26, Current Trip Adjustment

- Install 1A1A12 on extender card and configure RF-230 for full power operation (transmit) into dummy load.
- Measure voltage at AR1-2 and record. This voltage should be approximately 8.2 Vdc.
- Measuring voltage at AR1-3, adjust R26 for 8.4 Vdc. A 10% increase in load current through R24 should increase the bias voltage at AR1-3 sufficiently to cause the output to turn on Q3 and shut off the 10 Vdc at Q4.
- This completes R26 adjustment. Configure for normal operation.



6. PARTS LIST

Table 1 lists all 1A1A12 maintenance parts. These parts can be identified on figure 6. Refer to General Information for list of manufacturers.

7. SCHEMATIC

Figure 7 is a complete schematic diagram of the 1A1A12 Assembly.

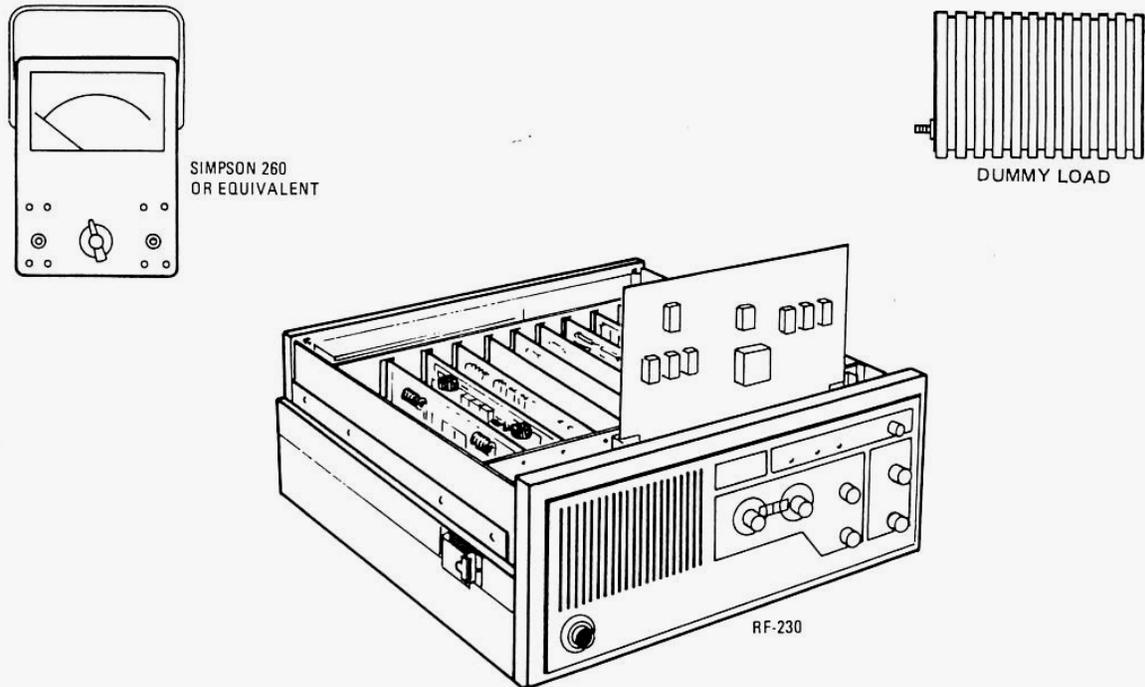


Figure 4. 1A1A12 Test Setup and Equipment.



CHANNEL CHANGE/REGULATOR

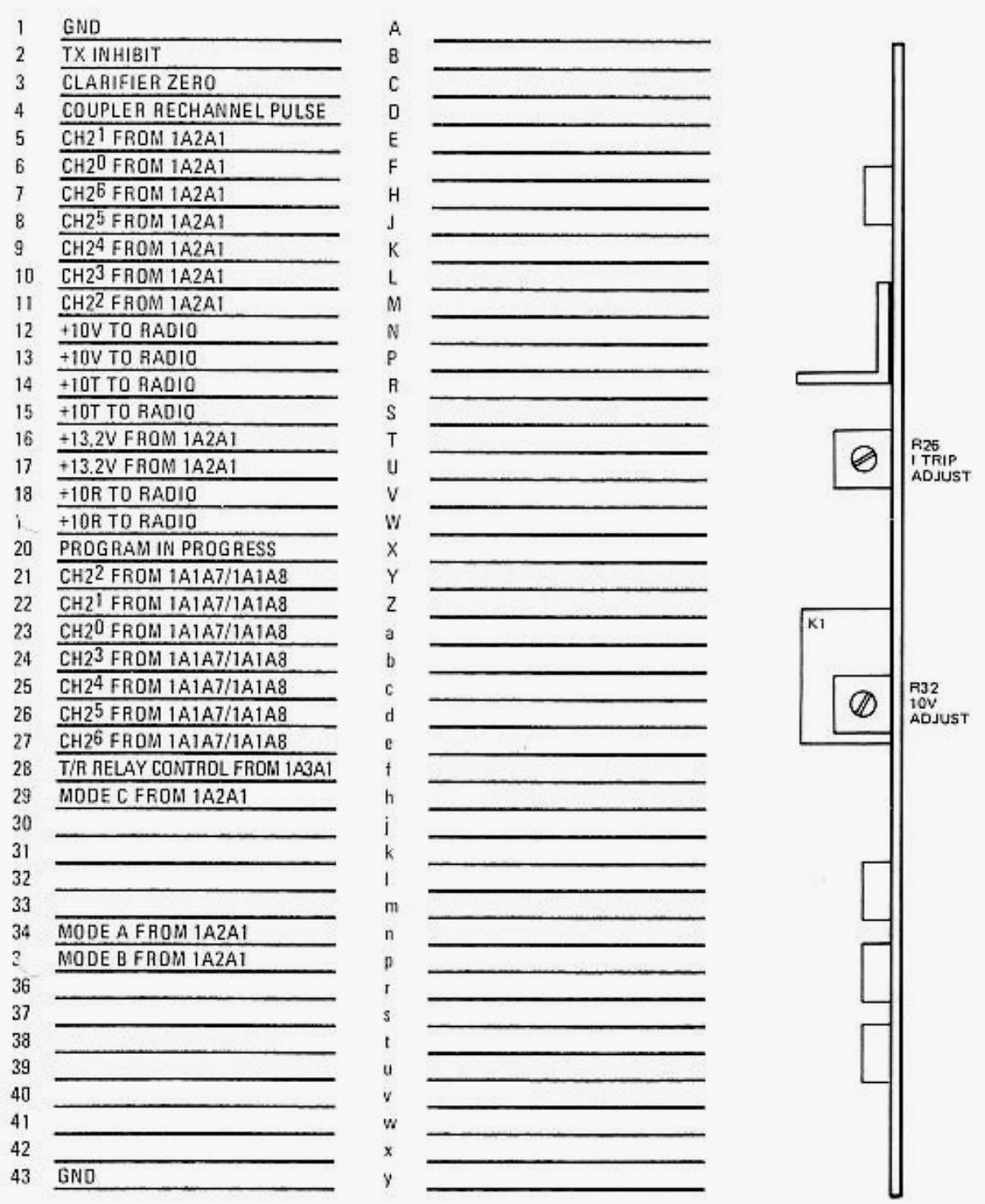


Figure 5. 1A1A12 Input/Output Summary



TABLE 1. 1A1A12 MAINTENANCE PARTS LIST

Ref. Desig.	Name & Description	Mfr. Code	Part No.
1A1A12	Channel Change/Req PWB Assembly	14304	6628-1200
AR1	Integrated Circuit, Quad Op Amplifier, CA324E	14304	IC-0359
C1	Capacitor, Fixed, Tantalum 33 uF ±20%, 25V	14304	C-6440
C2	Capacitor, Fixed, Ceramic, 470 pF ±10%, 500V	14304	C-3508
C3	Capacitor, Fixed, Ceramic, .001 uF ±10%, 500V	14304	C-3513
C4	Capacitor, Fixed, Tantalum, .1 uF ±20%, 35V	14304	C25-0003-101
C5	Capacitor, Fixed, Tantalum, 1 uF ±20%, 20V	14304	C-6442
C6	Capacitor, Fixed, Tantalum, 100 uF ±20%, 20V	14304	C-6454
CR1, CR2	Diode, Rectifier, 1N4004	14304	CR-0725
CR3	Diode, Signal, 1N4454	14034	CR-0705
K1	Relay, DPDT, 12V	14304	K-0119
Q1	Transistor, NPN, 2N4124	14304	Q-0385
Q2	Transistor, PNP, 2N5986	14304	Q-0427
Q3	Transistor, NPN, 2N4124	14304	Q-0385
Q4	Transistor, NPN, 2N5190	14304	Q-0416
R1 to R10	Resistor, Fixed, Composition, 1 Meg ±5%, 1/4W	Mil type	RCR07G105JM
R11,R12	Resistor, Fixed, Composition, 47K ±5%, 1/4W	Mil type	RCR07G473JM
R13	Resistor, Fixed, Composition, 27K ±5%, 1/4W	Mil type	RCR07G273JM
R14	Resistor, Fixed, Composition, 56K ±5%, 1/4W	Mil type	RCR07G563JM
R15	Resistor, Fixed, Composition, 47K ±5%, 1/4W	Mil type	RCR07G473JM
R16	Resistor, Fixed, Composition, 1K ±5%, 1/4W	Mil type	RCR07G102JM
R17	Not used		
R18 to R20	Resistor, Fixed, Composition, 1K ±5%, 1/4W	Mil type	RCR07G102JM
R21	Resistor, Fixed, Composition, 47 ohm ±5%, 1/2W	Mil type	RCR20GF470JM
R22	Resistor, Fixed, Composition, 100 ohm ±5%, 1W	Mil type	RCR32G101JM
R23	Resistor, Fixed, Composition, 10K ±5%, 1/4W	Mil type	RCR07G103JM
R24	Resistor, Fixed, Wirewound, .1 ohms ±10%, 2W	14304	R-0983 10%
R25	Resistor, Fixed, Film, 221 ohm ±1%, 1/8W	Mil type	RN55D2210F
R26	Resistor, Variable, 100 ohm	14304	R-2222
R27	Resistor, Fixed, Film, 909 ohms ±1%, 1/8W	Mil type	RN55D9090F
R28	Resistor, Fixed, Film, 33.2K ±1%, 1/8W	Mil type	RN55D3322F
R29	Resistor, Fixed, Composition, 2.7K ±5%, 1/4W	Mil type	RCR07G272JM
R30	Resistor, Fixed, Composition, 330 ohm ±5%, 1/4W	Mil type	RCR07G331JM
R31	Resistor, Fixed, Film, 332 ohm ±1%, 1/8W	Mil type	RN55D3320F
R32	Resistor, Variable, 100 ohm	14304	R-2222
R33	Resistor, Fixed, Film, 825 ohm ±1%, 1/8W	Mil type	RN55D8250F
R34	Resistor, Fixed, Film, 7.15K ±1%, 1/8W	Mil type	RN55D7151F
R35	Resistor, Fixed, Composition, 100K ±5%, 1/4W	Mil type	RCR07G104JM
R36	Resistor, Fixed, Composition, 10K ±5%, 1/4W	Mil type	RCR07G103JM
R37	Resistor, Fixed, Composition, 1 Meg ±5%, 1/4W	Mil type	RCR07G105JM
U1	Integrated Circuit, 8-Input NAND Gate, CD4068BE	14304	IC-0386



TABLE 1. 1A1A12 MAINTENANCE PARTS LIST (Continued)

Ref. Desig.	Name & Description	Mfr. Code	Part Number
U2	Integrated Circuit, Quad 2-Input NOR Gate, CD4001AE	14304	IC-0135
U3	Integrated Circuit, Decade Counter, CD4017AE	14304	IC-0139
U4	Integrated Circuit, Triple 3-Input NOR Gate, CD4025AE	14304	IC-0143
U5, U6	Integrated Circuit, Quad Exclusive NOR Gate, CD4077BE	14304	IC-0392
U7, U8	Integrated Circuit, Quad Clocked "D" Latch, CD4042AE	14304	IC-0382
U9	Integrated Circuit, Hex Inverter, CD4069BE	14304	IC-0387
VR1	Diode, Zener, 9.1V ±10%, 1N5239	14304	CR-0218
VR2	Diode, Zener, 6.2V ±5%, 1N753A	14304	CR-0046

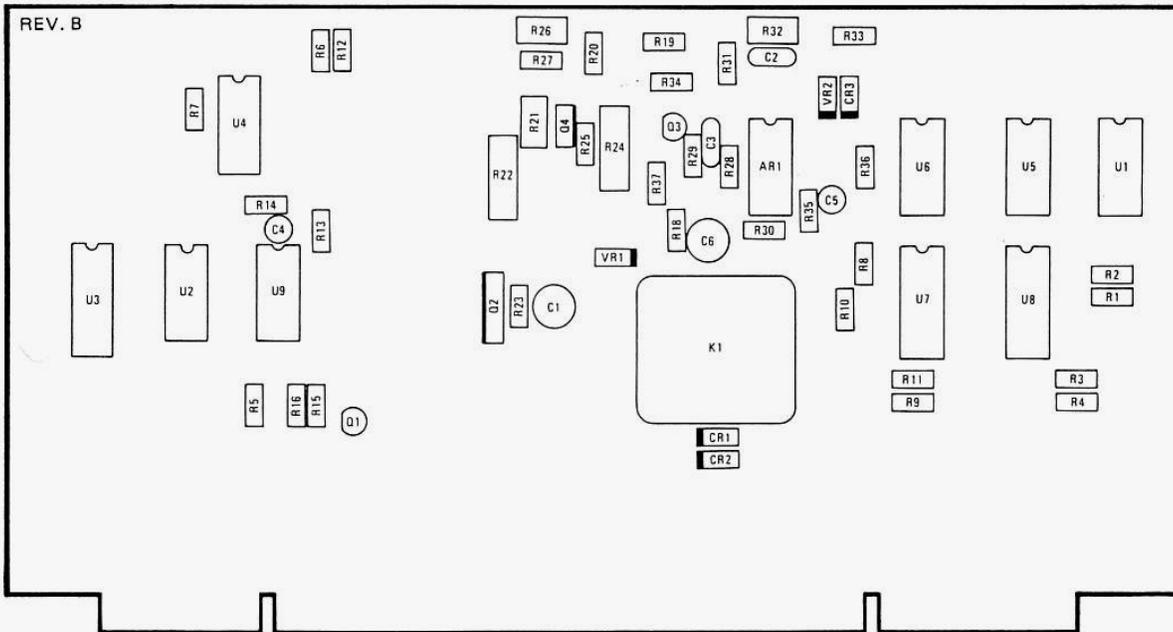


Figure 6. 1A1A12 Component Locations

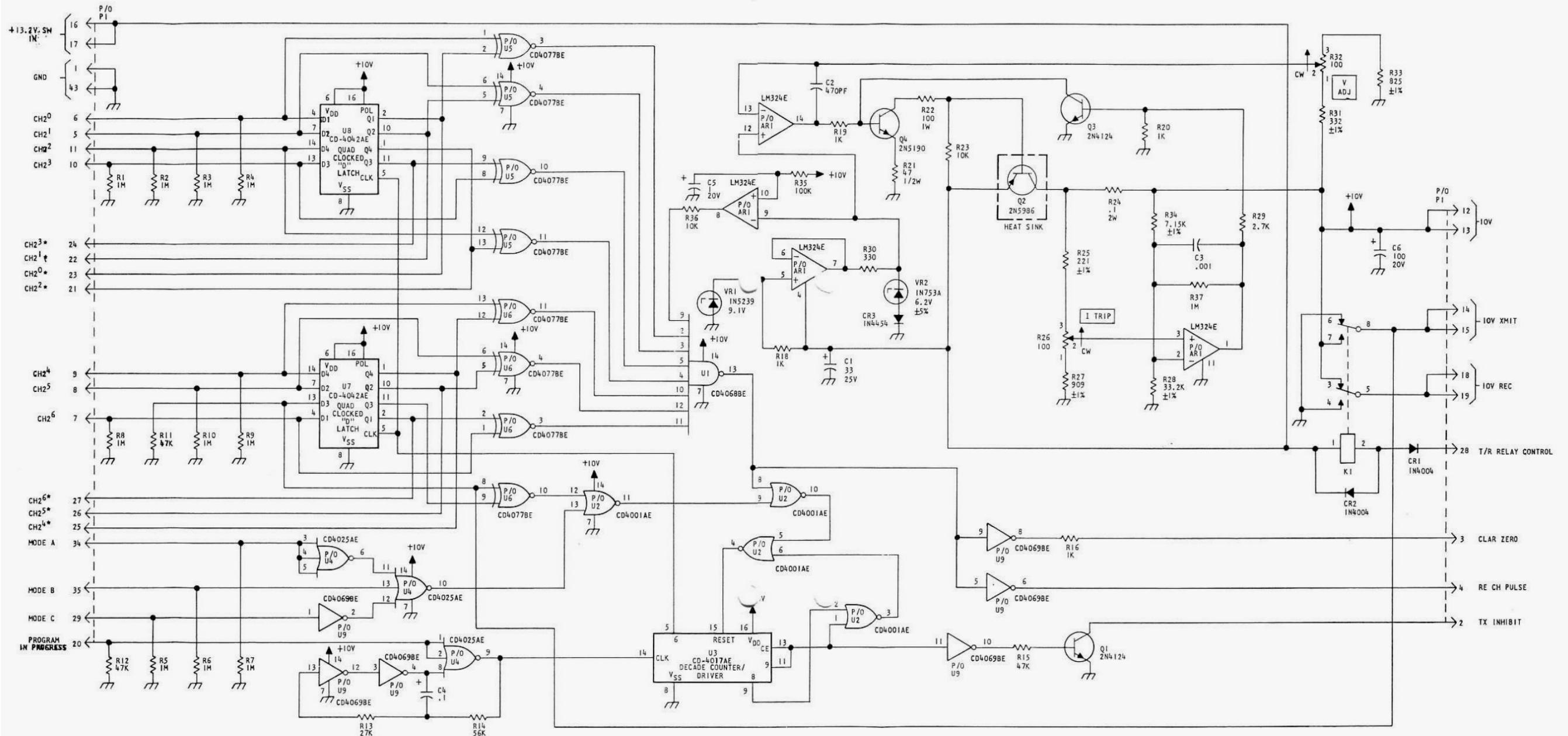


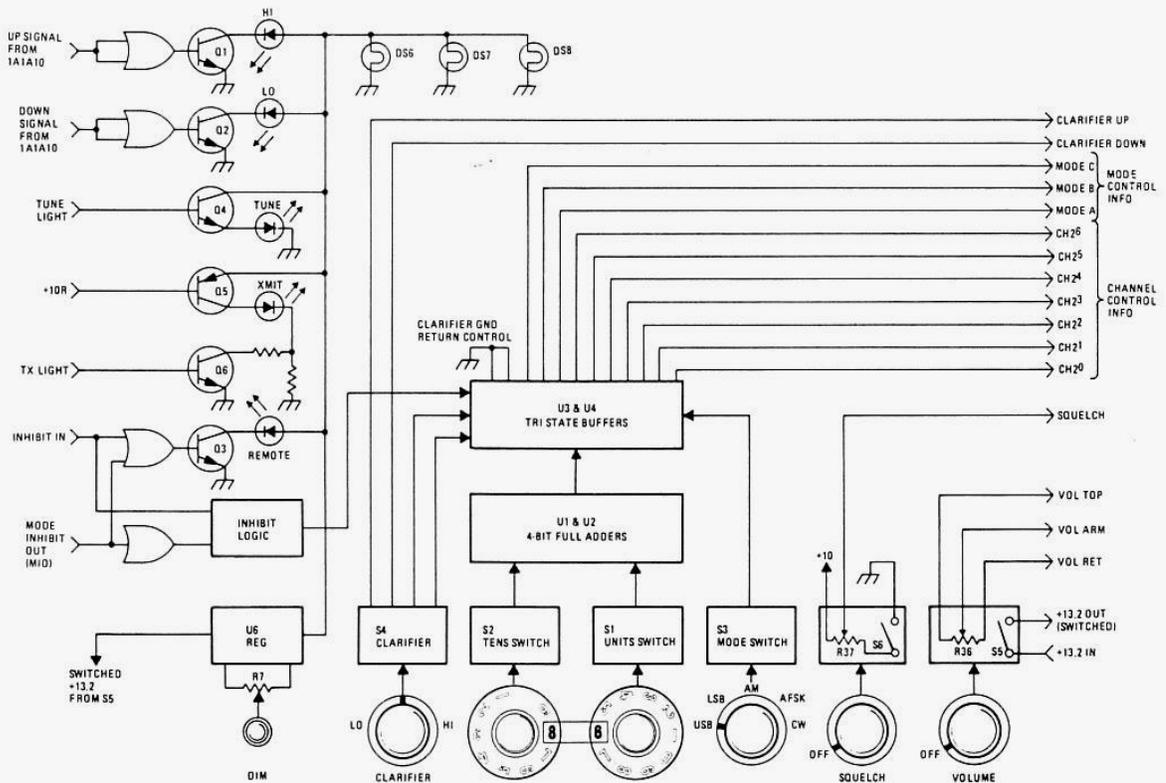
Figure 7. 1A1A12 Channel Change/Regulator PC Board Schematic Diagram 6628-9120

# UNIT INSTRUCTIONS



## CONTROL PANEL PC BOARD

# 1A2A1





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## 1. GENERAL DESCRIPTION

The Control Panel and integral Control Panel PC Board comprise the primary operator interface with the RF-230 System. The simplified diagram of the section cover demonstrates this interface. Microphone connector inputs/outputs at front panel connector J1 are not shown on this diagram. With the exception of headphone audio, all of these lines are simply routed thru.

## 2. TECHNICAL CHARACTERISTICS

### Power Inputs/Outputs

+13.2 Vdc	From Rear Panel
+13.2 Vdc (switched)	To Radio

### Signal Inputs:

Audio to Volume Control Potentiometer

### Signal Outputs:

Audio to 1A1A4  
Carbon/Dynamic Microphone to 1A1A5  
Headphone Out at Microphone Jack

### Control Inputs:

+10R from 1A1A12  
Tune Lamp Control from coupler  
Tx Lamp Control from 1A1A3  
Up Lamp Control from 1A1A10  
Down Lamp Control from 1A1A10  
Inhibit in from rear panel  
MIO from program board

### Control Outputs:

7-Bit Channel Control to 1A1A12  
3-Bit Mode Control to 1A1A12  
Keyline to 1A1A5  
Clarifier Up Control to 1A1A10  
Clarifier Down Control to 1A1A10  
Speaker Enable to 1A1A4

## 3. SEMICONDUCTOR COMPLEMENT

REF. DESIG.	TYPE	DESCRIPTION
Q1 - Q5	2N4124	Transistor, NPN
Q6	2N4126	Transistor, PNP
Q7	MPS-A13	Transistor, Darlington, NPN
U1, U2	CD4008AE	4-Bit Full Adder
U3, U4	MM80C97N	Hex Tri-State Buffer
U5	CD4071BE	Quad 2-Input OR Gate
U6	LM317T	VR, Adjustable Output
U7	CD4023AE	Triple 3-Input NAND Gate

## 4. FUNCTIONAL DESCRIPTION

Figure 1 is a functional diagram of the Control Panel PC Board. The control functions shown at the top of the diagram are largely self explanatory. Q1 thru Q4 are all NPN devices which cause their associated displays to illuminate with positive true input.

U5 elements are used as buffers for the Inhibit signal input or from the clarifier Up or Down signal from the Frequency Standard. Tune lamp logic from the coupler drives Q4 directly. +10R at pin 14 will bias OFF Q6 to extinguish the XMIT lamp. In the transmit mode DS5 illuminates and the brilliance will vary dependent on drive to Q5.

### 4.1 Power ON/VOLUME

Volume control potentiometer R36 is mechanically coupled to Power ON/OFF switch S5 so that both of these logically associated functions can be accomplished in one operator motion. Opening S5 interrupts all primary power to the RF-230 except for the +13.2 Vdc supply line to the power amplifier section. Power must be removed at the RF-236 to interrupt final amplifier B+.

### 4.2 Squelch

Squelch control R37 and S6 are also mechanically coupled. With Squelch OFF selected at S6, the squelch system is defeated. With squelch ON selected, the threshold must be adjusted using R37.

### 4.3 Clarifier UP/DOWN

Clarifier UP/DOWN action can be controlled by S4, assuming that this function is otherwise enabled. S4 places a control ground on the UP or DOWN control line, however, the ground is effected thru 5X, 5A contacts of U3, and a low logic level must be present at U3-15, for this function to be enabled. As a consequence, a high INH IN at J2-35 would also inhibit clarifier operation.

### 4.4 Head Phone Audio

Head Phone Audio is picked off at the volume control arm and amplified by darlington pair Q7 to make this function available at J1-19.

### 4.5 Channel Selection

Channel select functions are accomplished directly at units control switch S2, and at tens control

# CONTROL PANEL

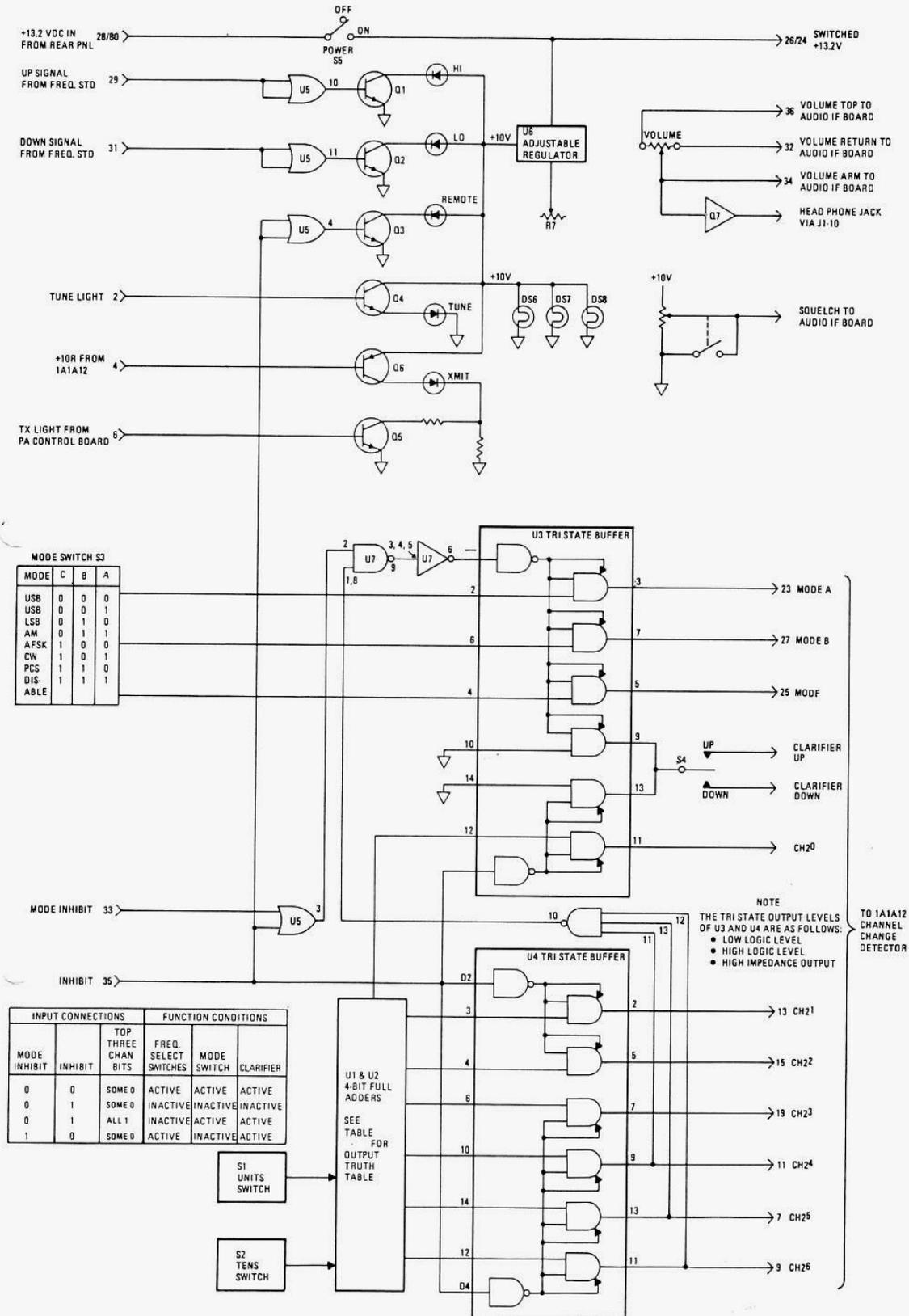


Figure 1. 1A2A1 Control Panel PC Board Simplified Diagram



switch S1. The 8-bit BCD output of these switches is translated to 7-bit Binary by U1 and U2. The outputs of these two 4-bit full adders are controlled thru Tri-State Buffers U3 and U4. Recall that with a low logic level at U3 and U4, pins 1 and 15, that channel control logic from U1 and U2 is "switched thru". An inhibit signal at these same control inputs would select the high impedance state at U3 and U4 and interrupt channel control information.

#### 4.6 Mode Control

Mode Control Switch S3 generates 3-bit mode control signals directly, however, this information is also controlled thru U3. The logic level at U3-1 controls the state of tri-state buffer elements in the mode control signal path (and also the U3-9 to U3-10 clarifier path). A high logic level at U3-1 interrupts front panel mode control. Notice that either a high on the Inhibit line, or on the MIO line will interrupt mode control – unless a channel higher than 112 is selected (CH24, CH25, CH26 high at NAND gate U7). This feature is designed for compatibility with a remote control option, in which case, by forcing these three lines high, the mode and clarifier lines are all enabled.

#### 4.7 Dimmer Control

Dimming of the front panel status indicators and legend back lighting is effected by R7 controlling VR1. The inherent response of the incandescent lights causes them to "blank out" at low settings while the LED status indicators are clearly visible.

## 5. MAINTENANCE

The front panel can be readily removed to gain access to all 1A2A1 elements by removing the four phillips head screws securing the assembly to the body of the radio.

### CAUTION

Always remove primary power when removing or installing assemblies to prevent possible equipment damage.

Table 1 lists complete channel select code information. Figure 2 gives an input/output summary for all connectors at this point.

## 6. PARTS LIST

Table 2 is a complete parts list for the 1A3 and 1A3A1 assemblies. Figure 3 is a component location diagram of the 1A3 and 1A3A1 assemblies. Refer to General Information Section for list of manufacturers.

## 7. SCHEMATICS

Figure 4 is a complete schematic diagram of these assemblies.



TABLE 1. CONTROL PANEL PC BOARD CHANNEL SELECTOR OUTPUTS

CHANNEL	CH2 <sup>6</sup>	CH2 <sup>5</sup>	CH2 <sup>4</sup>	CH2 <sup>3</sup>	CH2 <sup>2</sup>	CH2 <sup>1</sup>	CH2 <sup>0</sup>	CHANNEL	CH2 <sup>6</sup>	CH2 <sup>5</sup>	CH2 <sup>4</sup>	CH2 <sup>3</sup>	CH2 <sup>2</sup>	CH2 <sup>1</sup>	CH2 <sup>0</sup>
0	0	0	0	0	0	0	0	49	0	1	1	0	0	0	1
1	0	0	0	0	0	0	1	50	0	1	1	0	0	1	0
2	0	0	0	0	0	1	0	51	0	1	1	0	0	1	1
3	0	0	0	0	0	1	1	51	0	1	1	0	1	0	0
4	0	0	0	0	1	0	0	53	0	1	1	0	1	0	1
5	0	0	0	0	1	0	1	54	0	1	1	0	1	1	0
6	0	0	0	0	1	1	0	55	0	1	1	0	1	1	1
7	0	0	0	0	1	1	1	56	0	1	1	1	0	0	0
8	0	0	0	1	0	0	0	57	0	1	1	1	0	0	1
9	0	0	0	1	0	0	1	58	0	1	1	1	0	1	0
10	0	0	0	1	0	1	0	59	0	1	1	1	0	1	1
11	0	0	0	1	0	1	1	60	0	1	1	1	1	0	0
12	0	0	0	1	1	0	0	61	0	1	1	1	1	0	1
13	0	0	0	1	1	0	1	62	0	1	1	1	1	1	0
14	0	0	0	1	1	1	0	63	0	1	1	1	1	1	1
15	0	0	0	1	1	1	1	64	1	0	0	0	0	0	0
16	0	0	1	0	0	0	0	65	1	0	0	0	0	0	1
17	0	0	1	0	0	0	1	66	1	0	0	0	0	1	0
18	0	0	1	0	0	1	0	67	1	0	0	0	0	1	0
19	0	0	1	0	0	1	1	68	1	0	0	0	1	0	1
20	0	0	1	0	1	0	0	69	1	0	0	0	1	0	1
21	0	0	1	0	1	0	1	70	1	0	0	0	1	1	0
22	0	0	1	0	1	1	0	71	1	0	0	0	1	1	1
23	0	0	1	0	1	1	1	72	1	0	0	1	0	0	0
24	0	0	1	1	0	0	0	73	1	0	0	1	0	0	1
25	0	0	1	1	0	0	1	74	1	0	0	1	0	1	0
26	0	0	1	1	0	1	0	75	1	0	0	1	0	1	1
27	0	0	1	1	0	1	1	76	1	0	0	1	1	0	0
28	0	0	1	1	1	0	0	77	1	0	0	1	1	0	1
29	0	0	1	1	1	0	1	78	1	0	0	1	1	1	0
30	0	0	1	1	1	1	0	79	1	0	0	1	1	1	1
31	0	0	1	1	1	1	1	80	1	0	1	0	0	0	0
32	0	1	0	0	0	0	0	81	1	0	1	0	0	0	1
33	0	1	0	0	0	0	1	82	1	0	1	0	0	1	0
34	0	1	0	0	0	1	0	83	1	0	1	0	0	1	1
35	0	1	0	0	0	1	1	84	1	0	1	0	1	0	0
36	0	1	0	0	1	0	0	85	1	0	1	0	1	1	1
37	0	1	0	0	1	0	1	86	1	0	1	0	1	1	0
38	0	1	0	0	1	1	0	87	1	0	1	0	1	1	1
39	0	1	0	0	1	1	1	88	1	0	1	1	0	0	0
40	0	1	0	1	0	0	0	89	1	0	1	1	0	0	1
41	0	1	0	1	0	0	1	90	1	0	1	1	0	1	0
42	0	1	0	1	0	1	0	91	1	0	1	1	0	1	1
43	0	1	0	1	0	1	1	92	1	0	1	1	1	0	0
44	0	1	0	1	1	0	0	93	1	0	1	1	1	0	1
45	0	1	0	1	1	0	1	94	1	0	1	1	1	1	0
46	0	1	0	1	1	1	0	95	1	0	1	1	1	1	1
47	0	1	0	1	1	1	1	96	1	1	0	0	0	0	0
48	0	1	1	0	0	0	0	97	1	1	0	0	0	0	1



J2	
1	+10V FROM 1A1A12
2	TUNE LIGHT FROM COUPLER
3	
4	+10R FROM 1A1A12
5	
6	TX LIGHT FROM 1A1A3
7	CH2 <sup>5</sup> TO 1A1A12
8	BUSS, REQUIRED FROM 1J3
9	CH2 <sup>6</sup> TO 1A1A12
10	KEYLINE TO 1A1A5
11	CH2 <sup>4</sup> TO 1A1A12
12	SPARE
13	CH2 <sup>1</sup> TO 1A1A12
14	DYNAMIC MICROPHONE TO 1A1A5
15	CH2 <sup>2</sup> TO 1A1A12
16	CARBON MICROPHONE TO 1A1A5
17	GND
18	GND
19	CH2 <sup>3</sup> TO 1A1A12
20	
21	CH2 <sup>0</sup> TO 1A1A12
22	
23	MODE A TO 1A1A12 ETC.
24	+13.2 (SW) TO 1A1A12
25	MODE C TO 1A1A12 ETC.
26	+13.2 (SW) TO 1A1A12
27	MODE B TO 1A1A12 ETC.
28	+13.2V IN FROM REAR PANEL
29	UP SIGNAL FROM 1A1A10
30	+13.2V IN FROM REAR PANEL
31	DOWN SIGNAL FROM 1A1A10
32	VOLUME CONTROL RETURN TO 1A1A4
33	M10 FROM PROGRAM BOARD
34	VOLUME CONTROL ARM TO 1A1A4
35	INHIBIT IN FROM COUPLER
36	VOLUME CONTROL TOP TO 1A1A4
37	CLARIFIER UP TO 1A1A10
38	MUTE FROM 1A1A5
39	CLARIFIER DOWN TO 1A1A10
40	SQUELCH ARM TO 1A1A4
41	
42	
43	

Figure 2. J2 Input/Output Summary



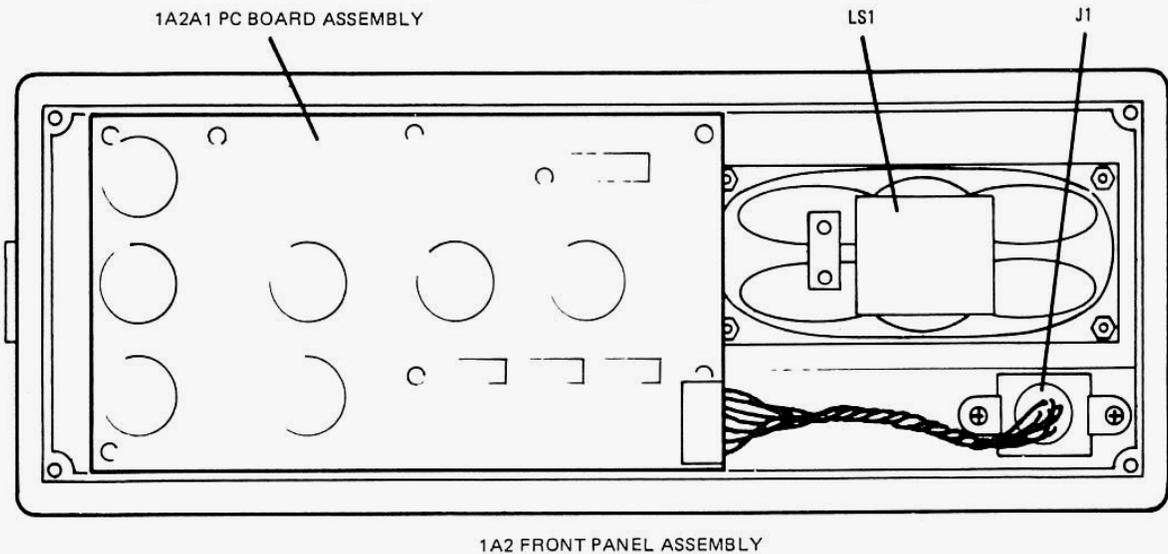
TABLE 2. 1A2 MAINTENANCE PARTS LIST

Ref. Desig.	Name & Description	Mfr. Code	Part No.
1A2	Front Panel Assembly	14304	6628-0200
J1	Connector, 8 Contact (P/O 6628-0255)	14304	206433-2
LS1	Speaker, 3.2 ohm	14304	LS-0014
1A2A1	Control Panel PWB Assembly	14304	6628-0250
C1	Capacitor, Fixed, Tantalum, 15 uF ±10%, 20V	14304	C-3103
C2	Capacitor, Fixed, Tantalum, 6.8 uF ±10%, 35V	14304	C-3102
C3	Capacitor, Fixed, Tantalum, 1 uF ±20%, 20V	14304	C-6442
C4	Capacitor, Fixed, Tantalum, 22 uF ±20%, 25V	14304	C-6439
C5	Capacitor, Fixed, Tantalum, 1 uF ±20%, 20V	14304	C-6442
C6	Not Used		
C7	Capacitor, Fixed, Ceramic, 470 pF ±10%, 100V	14304	C11-0008-471
C8	Capacitor, Fixed, Ceramic, .001 uF ±10%, 500V	14304	C-3513
DS1-DS5	Lamp, LED, Yellow	14304	DS-0224
DS6-DS8	Lamp, Miniature, 14V	14304	DS-0127
J1	Connector, 10 Contact, Right Angle	14304	P-0425
J2	Connector, 40 Contact	14304	P-0427
J3	Connector, 4-Pin Male, Modified	14304	6628-0258
JMP1-JMP5	Jumper, Molded	14304	MP-1142
Q1 to Q5	Transistor, NPN, 2N4124	14304	Q-0385
Q6	Transistor, PNP, 2N4126	14304	Q-0386
Q7	Transistor, NPN, Darlington, MPS-A13	14304	Q-0076
R1,R2	Resistor, Fixed, Composition, 470 ohm ±5%, 1/4W	Mil type	RCR07G471JM
R3	Resistor, Fixed, Composition, 1K ±5%, 1/4W	Mil type	RCR07G102JM
R4,R5	Resistor, Fixed, Composition, 470 ohm ±5%, 1/4W	Mil type	RCR07G471JM
R6	Resistor, Fixed, Composition, 220 ohm ±5%, 1/4W	Mil type	RCR07G221JM
R7	Resistor, Variable, Linear, 500 ohm	14304	6628-0277
R8	Resistor, Fixed, Composition, 1K ±5%, 1/4W	Mil type	RCR07G102JM
R9	Resistor, Fixed, Composition, 27K ±5%, 1/4W	Mil type	RCR07G273JM
R10	Resistor, Fixed, Composition, 24K ±5%, 1/4W	Mil type	RCR07G243JM
R11	Resistor, Fixed, Composition, 560 ohm ±5%, 1/4W	Mil type	RCR07G561JM
R12 to R27	Resistor, Fixed, Composition, 39K ±5%, 1/4W	Mil type	RCR07G393JM
R28,R29	Resistor, Fixed, Composition, 1 Meg ±5%, 1/4W	Mil type	RCR07G105JM
R30 to R32	Resistor, Fixed, Composition, 10K ±5%, 1/4W	Mil type	RCR07G103JM
R33	Resistor, Fixed, Composition, 22K ±5%, 1/4W	Mil type	RCR07G223JM
R34	Resistor, Fixed, Composition, 2.2K ±5%, 1/4W	Mil type	RCR07G222JM
R35	Resistor, Fixed, Composition, 4.7K ±5%, 1/4W	Mil type	RCR07G472JM
R36	Resistor, Variable, 5K, Modified Logarithmic, W/Switch	14304	6628-0275
R37	Resistor, Variable, Linear, 5K, W/Switch	14304	6628-0276
R38	Resistor, Fixed, Composition, 270 ohm ±5%, 1/4W	Mil type	RCR07G271JM
R39	Resistor, Fixed, Composition, 24 ohm ±5%, 1/4W	Mil type	RCR07G240JM
R40	Not used		
R41	Resistor, Fixed, Composition, 27K ±5%, 1/4W	Mil type	RCR07G273JM
R42	Resistor, Fixed, Composition, 120K ±5%, 1/4W	Mil type	RCR07G124JM

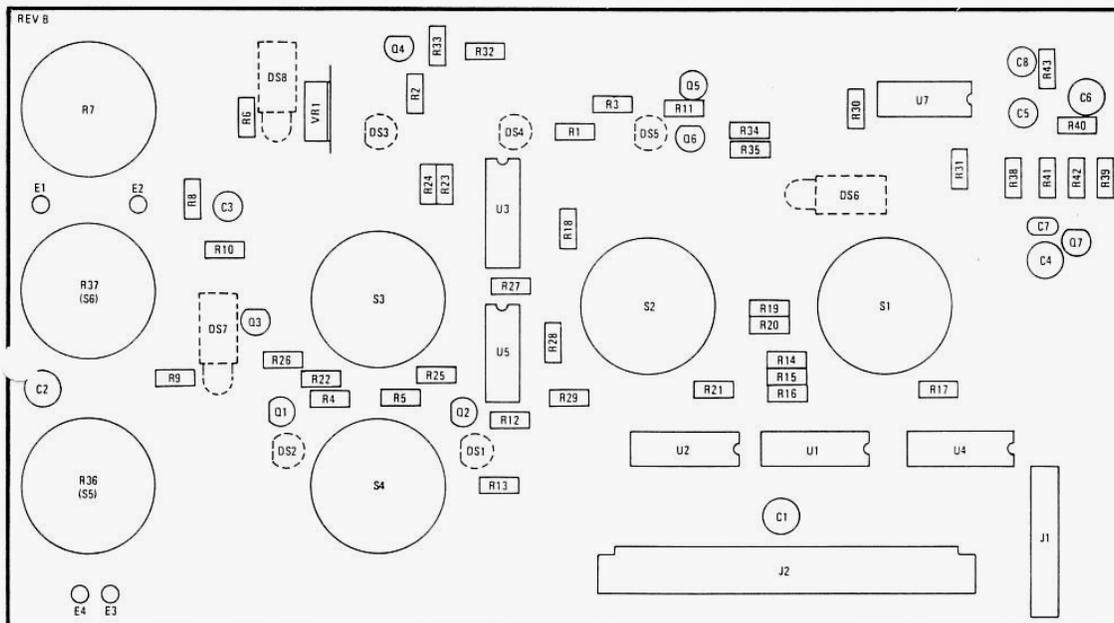


TABLE 2. 1A2 MAINTENANCE PARTS LIST (Continued)

Ref. Desig.	Name & Description	Mfr. Code	Part No.
S1,S2	Switch, Rotary	14304	6628-0279
S3	Switch, Rotary, 5 Position	14304	6628-0281
S4	Switch, SPDT, Center Off	14304	6628-0282
S5	Switch, SPST		P/O R36
S6	Switch, SPST		P/O R37
U1,U2	Integrated Circuit, 4-Bit Full Adder, CD4008AE	14304	IC-0377
U3-U5	Integrated Circuit, Hex Tri-State Non-Inverting Buffer, MM80C97N	14304	IC-0400
U5	Integrated Circuit, Quad 2-Input OR Gate, CD4071BE	14304	IC-0389
U6	Not used		
U7	Integrated Circuit, Triple 3-Input NAND Gate CD4023AE	14304	IC-0142
VR1	Integrated Circuit, Adjustable Output Voltage Regulator, LM317T	14304	IC-0358



1A2 FRONT PANEL ASSEMBLY



1A2A1 CONTROL PANEL PC BOARD

Figure 3. 1A2 Control Panel PC Board Component Locations



NOTES:

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTORS ARE 1% DUMPS, ±5%, 1/4W. ALL CAPACITORS ARE IN MICROFARADS.
2. SWITCH CONTACTS OF S1, S2, & S3 ARE SHOWN AS SEEN FROM FRONT OF RADIO (FROM FRONT OF SWITCH SHAFT).
3. S1, S2 SHOWN IN CHANNEL SEVEN (07).
4. S3 SHOWN IN USB MODE.
5. U3, U4 MM-80C97 HEX TRI-STATE BUFFER.

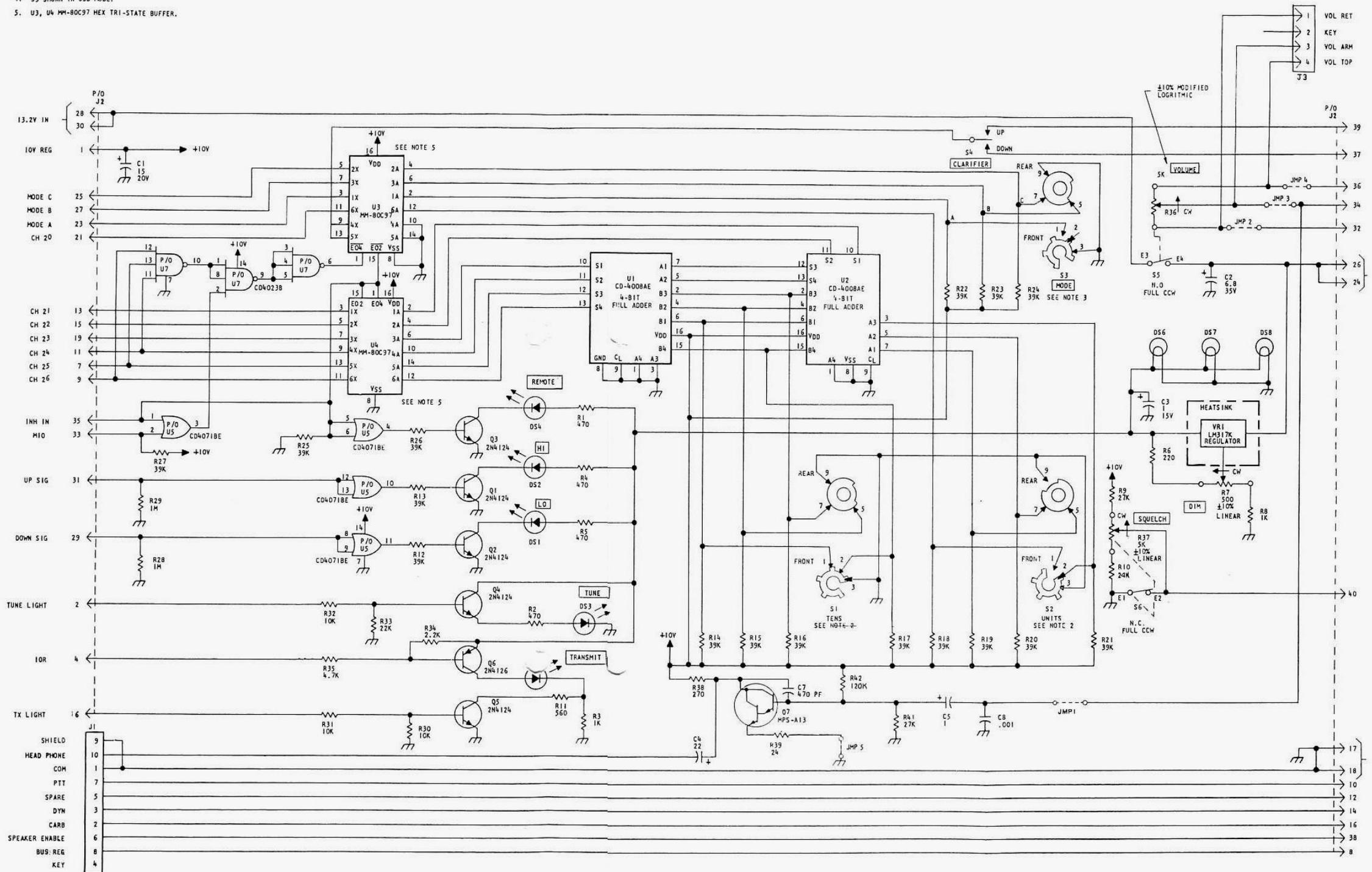


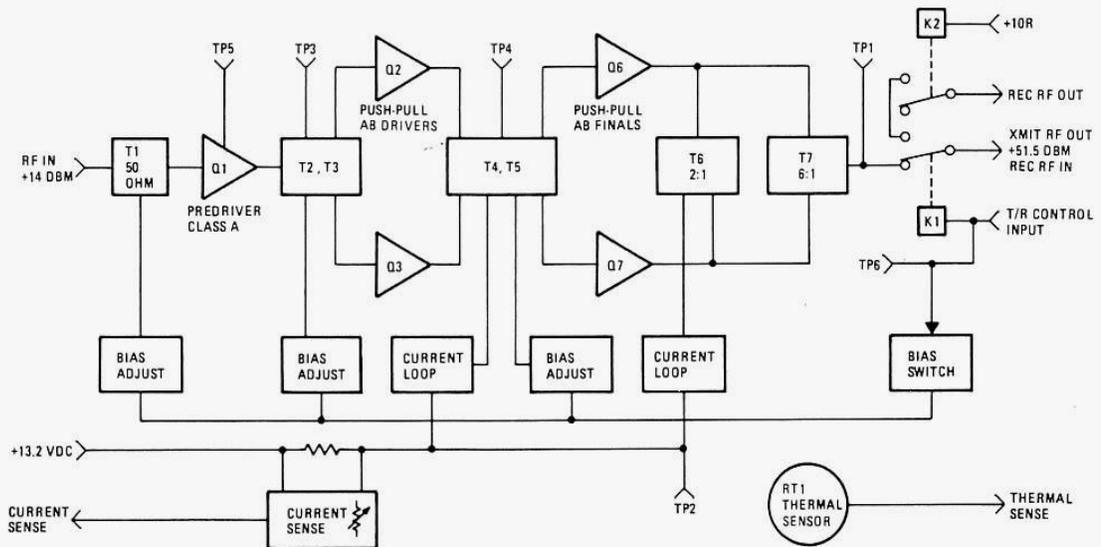
Figure 4. 1A2A1 Control Panel PC Board Assembly  
6628-9025

# UNIT INSTRUCTIONS



## POWER AMPLIFIER PC BOARD

# 1A3A1





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## 1. GENERAL DESCRIPTION

The all solid state power amplifier accepts the +14 dBm RF Drive Input from 1A1A4 and provides a nominal 36.5 dB amplification to produce the final  $\geq 125$  watt output to the PA Filters and the antenna system. Receive/transmit signal paths are controlled by K1 & K2 to route the antenna input directly to the Mixer in receive mode, and to connect the PA output to the antenna (thru the PA Filters) in the transmit mode. A control voltage analogous to total power amplifier current is also developed on this assembly and fed to 1A1A3 to effect power control.

## 2. TECHNICAL CHARACTERISTICS

### Power Inputs:

- +13.2 Vdc from RF-236
- +10 Vdc from 1A1A12

### Power Outputs:

- +13.2 Vdc to front panel

### Control Inputs:

- T/R Relay Control gnd from 1A1A12
- +10R K2 control from 1A1A12

### Control Outputs:

- Thermal Sense Analog voltage to 1A1A3
- Current Sense Analog voltage to 1A1A3

### Signal Inputs:

- +14.5 dBm PA drive from 1A1A3
- Rec RF In From 1A3A1-J1

### Signal Outputs:

- +51.5 dBm PA Output to 1A1A1
- Rec RF Out To 1A1A6

## 3. SEMICONDUCTOR COMPLEMENT

REF. DESIG.	TYPE	DESCRIPTION
CR1	1N4004	Diode, Rectifier
CR2	1N4720	Diode, Rectifier
CR3	1N4004	Diode, Rectifier
CR4, CR5	1N4454	Diode, Signal
CR6	1N4004	Diode, Rectifier
CR7, CR8	1N4454	Diode, Signal
CR9, CR10	1N4004	Diode, Rectifier
CR12	1N4720	Diode, Rectifier
CR13	1N4004	Diode, Rectifier

REF. DESIG.	TYPE	DESCRIPTION
CR14	MR5005R	Diode, Reverse Polarity
CR16	1N4004	Diode, Rectifier
CR17, CR18	1N4754	Diode, Signal
Q1	6628-1126	Transistor, NPN
Q2, Q3	6628-1177	Transistor, NPN
Q4	MJE1100	Darlington, NPN
Q5	2N4124	Transistor, NPN
Q6, Q7	6628-1175	Transistor, NPN
Q8	MJE1100	Darlington, NPN
Q9	2N4124	Transistor, NPN
Q10	MJE1090	Darlington, NPN
Q11	2N4124	Transistor, NPN
VR1	BZY88-C5V1	Diode, Zener 5.1V
VR2	1N5640A	Diode, Transient Suppressor

## 4. FUNCTIONAL DESCRIPTION

Figure 1 is a detailed diagram of the Power Amplifier Assembly showing functional relationships of all major elements. Refer to the complete schematic diagram of the end of this section for circuit details. The nominal signal input level at J6 is +14.5 dBm. This input level from the 1A1A3 PA Control Board should drive the amplifier to full rated output. The transmit RF Output level at J7 will be greater than 125 watts for a normally functioning system. The output at J7 is not directly to the 50 ohm antenna system, but rather to PA Filter No. 1, or for bands 2, 3, and 4, to PA Filter No. 2 via PA Filter No. 1. The PA Filter transmit output is routed back through P2 on the PA Assembly, and via coaxial to J1. J1 is the 50 ohm interface with the antenna system. The antenna system will normally comprise the RF-231 channelized antenna coupler and a suitable radiating element such as the SBV-35 whip, etc.

### 4.1 Pre-Driver

Q1 is operated as a class A amplifier and functions to introduce approximately 12.5 dB gain to the nominal +14.5 dBm input. All amplifier stages are broad-banded so that no tuning is required. Pre-Driver operating parameters are established by adjusting R9 for an 0.3 Vdc indication at TP5. Notice on figure 1 that each stage has a convenient test output. Assuming full rated output, the test point level at TP3 should be approximately 5.7 Vdc. This level corresponds to a signal level of +27 dBm.



#### 4.2 Driver

Q2 and Q3 operate in class AB as the driver amplifier. With +27 dBm input from the predriver, this stage will introduce approximately 13 dB gain to provide a +40 dBm drive level to the final amplifiers. Driver amplifier parameters are established by adjusting R20 for 610 mV across R62 (with R62 current shunt temporarily removed). Driver output can be measured at TP4. The test point voltage at this point is a detected sample of the driver output and is analogous to the signal level. At full power output this level should be approximately 11.8 Vdc.

#### 4.3 Final Amplifier

Q6 and Q7 are the class AB final amplifiers, and introduce the final 11 dB gain to increase the output signal level to greater than 125 watts. Final amplifier operating parameters are established by adjusting potentiometer R40. This level is adjusted by temporarily removing the shunt across R63 and adjusting R40 until the voltage drop across R63 is exactly 83 mV.

#### CAUTION

Do not use a grounded voltmeter for this adjustment. An accurate VOM such as a Simpson 260 should be satisfactory.

TP1 is the final amplifier output test point, and like for the predriver and driver output test points this is an analog voltage representative of the detected sample, in this case from Q9. At full power this test point voltage will be approximately 11.7 Vdc.

#### 4.4 T/R Relay Control

Transmit/Receive Relay K1 is controlled by the voltage at P1-5. With this line low the +13 Vdc operating potential on K1 has a ground path thru the relay, thru CR16, and to the control ground at 1A1A12. This line will read +13.2 Vdc when unkeyed, and ground (minus diode drop) when keyed. This same control ground will bias ON Q10 to effect bias control for the predriver, driver, and final amplifiers. In the receive position, note that K1 is relaxed and that K2 is energized by +10R from 1A1A12, and thus will route the incoming receive signal to the 1A1A6 Mixer PC Board.

#### 4.5 Current Limit

Power Amplifier current loading is monitored by U1, an NPN/PNP transistor array configured to produce a "current sense output" proportional to the voltage drop across R56, the .005 ohm 10 watt resistor in series with the +13.2 Vdc supply line to the PA. The sense output level can be adjusted by R49. R49 is adjusted so that current cutback action will start simultaneous with a 220 mV voltage drop across R56.

#### 4.6 Thermal Sense

RT1 is mounted to the PA heatsink to monitor PA operating temperature. The resistance of RT1 is nominally 119 K ohms, and will change as a function of temperature so that at 105°C, the resistance drops to 5K ohms (the point at which power cutback would start). If the temperature should increase to 115°C, the resistance of RT1 would drop to 3.6K ohm, and at this point the thermal sense output voltage would shut off the transmitter. This control is adjusted at 1A1A3.

### 5. MAINTENANCE

Power Amplifier performance can be measured using test point data shown in figure 2. TP5 and TP6 measurements can only be made by lowering the assembly as shown in figure 2. These test points can be identified on component location diagram figure 3. Table 1 gives a complete input/output summary for the assembly. All tests and adjustments in the following paragraphs have been made at the factory and should not be reaccomplished unless required by associated circuit changes.

#### 5.1 Test Setup

Terminate the transmitter output (J1) in a 50 ohm dummy load for all of these tests. Install a Bird thru-line wattmeter (or equivalent) in series with the output for these tests.

#### 5.2 Bias Adjustments

This procedure involves gaining access to 1A3A1 PC Board components, and as a consequence, the rear panel PA Assembly must be removed as shown in figure 2. The transmitter can be safely operated in this manner for short periods.

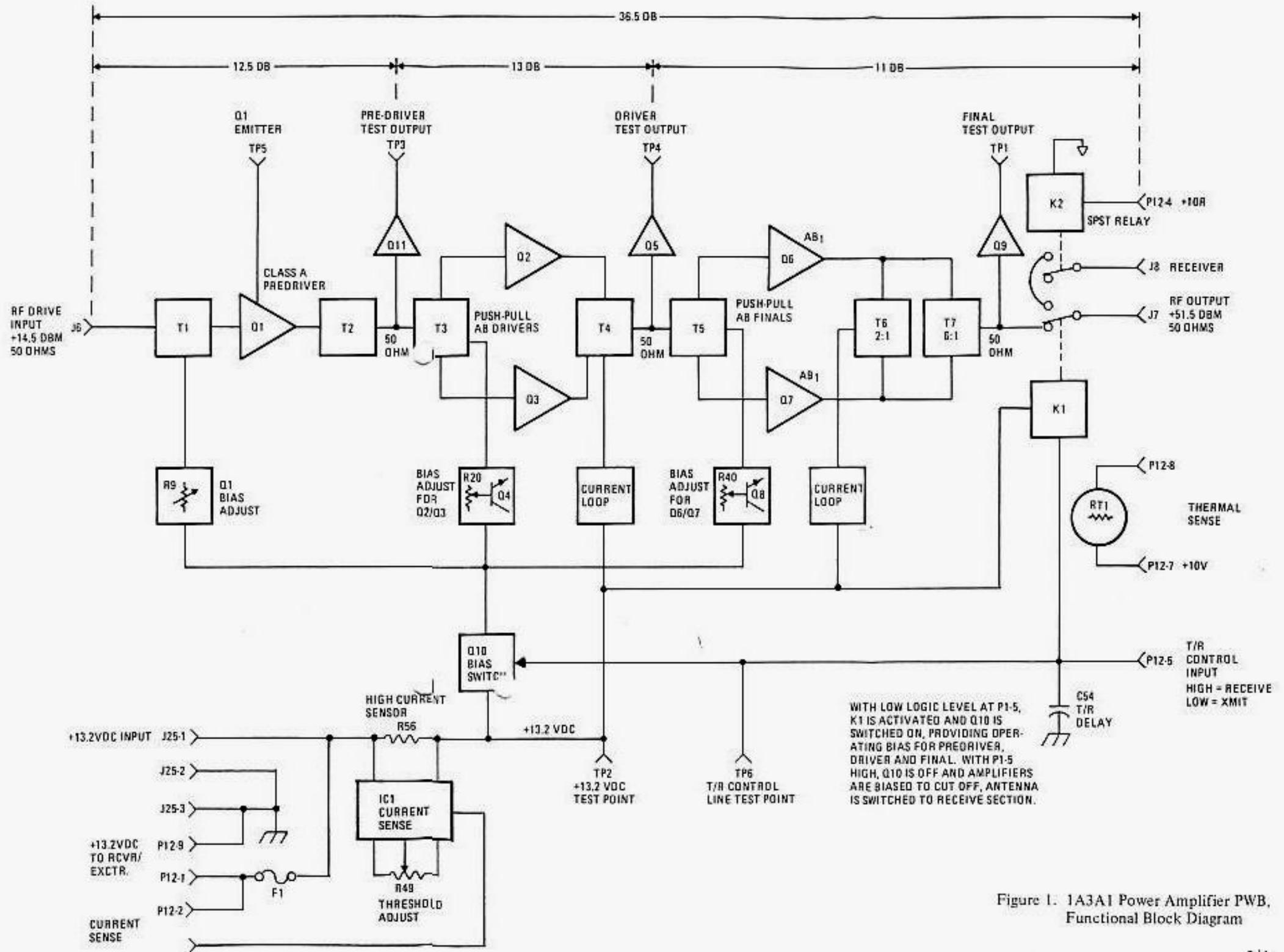


Figure 1. 1A3A1 Power Amplifier PWB, Functional Block Diagram

**CAUTION**

When operating the PA in an exposed position, as described in this procedure, be very careful to verify all inter-and terminating connections, and a general safe test setup.

- With the PA component board exposed, locate TP5 and connect a VOM to read 0.3 Vdc.
- Select any operating channel, USB mode, and verify no audio input.
- With properly terminated transmitter (50 ohm load at output), key transmitter and adjust R9 for 0.3 Vdc at TP5. This completes predriver bias adjustment. Temporarily unkey transmitter.
- Temporarily remove the current shunt by-passing R62 (see component location diagram for details), and connect an ungrounded voltmeter to measure the voltage drop between these two points (across R62).

e. Key transmitter (USB, no modulation) and adjust R20 for 610 mV across R62. There should be 130 mA flowing thru R62 when properly adjusted.

f. This completes the driver bias adjustment, unkey transmitter and replace R62 current shunt.

g. Temporarily remove the final amplifier current shunt by-passing R63 and connect a voltmeter (ungrounded) to measure the voltage drop between these two points (across R63).

h. Key transmitter (USB, no modulation) and adjust R40 for 83 mV across R63. (There should be 250 mA flowing through R63 when properly adjusted.)

i. This completes final amplifier bias adjustment, unkey transmitter and replace R63 current shunt.

**Note**

If current limit adjustment is to be made, do not reassemble PA.

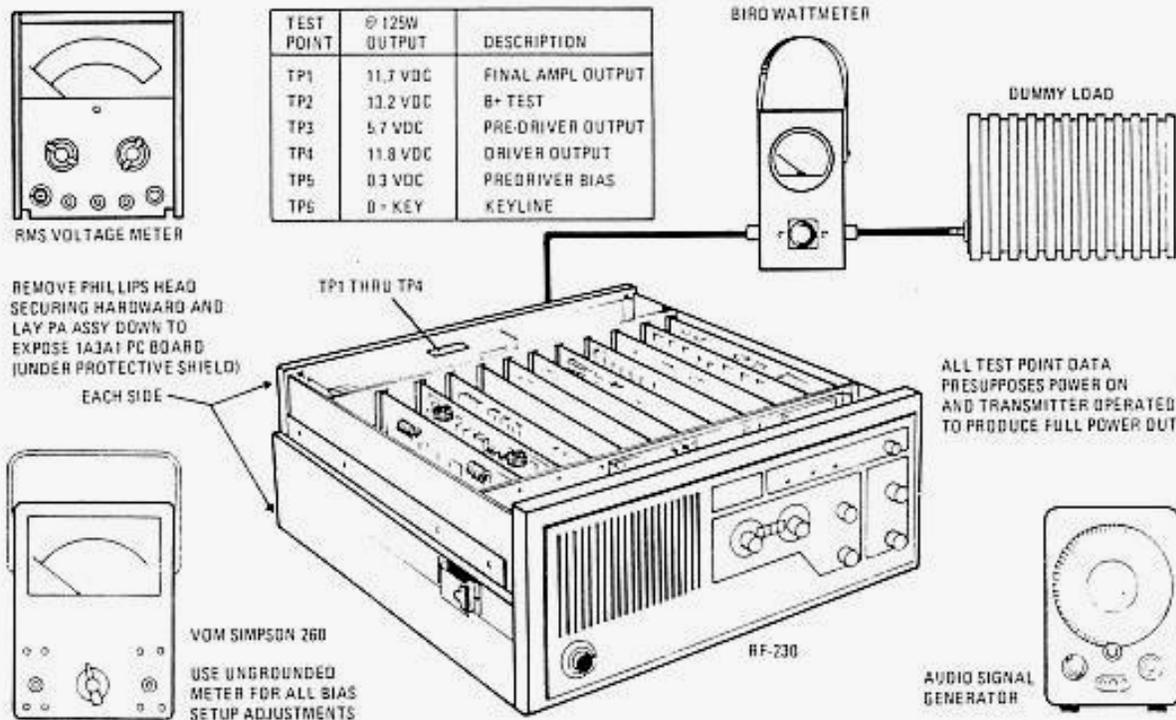


Figure 2. Power Amplifier Tests and Adjustments



TABLE 1. INPUT/OUTPUT SUMMARY

Connector	Function	To/From General
P1-1	+13.2 Vdc	6 Amp fused output to front panel
P1-2	+13.2 Vdc	6 Amp fused output to front panel
P1-3	Current Sense	0 – 5V analog voltage to 1A1A3
P1-4	+10R	K2 control from 1A1A12
P1-5	T/R Relay	K1 control ground from 1A1A12
P1-6	N/C	
P1-7	+10 Vdc	Thermistor B+ from 1A1A12
P1-8	Thermal Sense	Thermal analog voltage to 1A1A3
P1-9	Gnd	
P2	RF IN/OUT	Via 1A1 to 1A1A1 PA Filters (from J1)
J1*	RF IN/OUT	To Antenna System (from 1A1A1 via P2)
J2*	N/C	For Optional Use
J3*	N/C	For Optional Use
J4*	Control Interconnect	To external system elements
J5-1*	+13.2 Vdc	Primary Power IN from RF-236 (etc.)
J5-2*	Gnd	
J5-3*	Gnd	
1A3A1-J1	RF IN +14 dBm	Transmit RF IN from 1A1A3
1A3A1-J3	RF OUT +51.5 dBm	Transmit RF OUT to 1A1A1 (Receive RF IN from 1A1A1)
1A3A1-J8	Receive RF	Receive RF Out to 1A1A6

\*Denotes rear panel connector to system

### 5.3 Current Limit Adjustments

- a. Select USB Mode and 2.599 MHz channel frequency.
- b. Set Current Limit Adjust Control R49 to extreme position.
- c. Connect audio oscillator to 600 ohm line audio input and adjust level to minimum.
- d. Set ALC control R90 on 1A1A3 PA Control PC Board to maximum ccw position.
- e. Connect a dc voltmeter from E1 to E3 (positive lead to E1) on the PA Assembly and gradually increase the audio drive level until the voltage drop from E1-E3 equals 170 mV.
- f. Adjust current limit adjust control R49 for a 165 mV indication at E1-E3.
- g. Adjust ALC Control A3R90 as described in 1A1A3 PA Control PWB of this manual.

h. This completes all PA adjustments. Unkey transmitter, remove power by selecting power OFF at the front panel, and also at the RF-236. Reconfigure for normal operation.

#### Note

Selecting POWER OFF at the front panel does not remove +13.2 Vdc from the PA. This can be removed by selecting POWER OFF at the RF-236.

## 6. PARTS LIST

Table 2 is a Maintenance Parts List for the Power Amplifier Assembly. These parts can be identified on figure 3. Refer to the General Information Section for list of manufacturers.

## 7. SCHEMATIC

Figure 4 is a complete schematic of the 1A3A1 Power Amplifier Assembly.



TABLE 2. 1A3 MAINTENANCE PARTS LIST

Ref. Desig.	Name & Description	Mfr. Code	Part Number
1A3	Rear Panel Assembly	14304	6628-1000
CR1	Not Used		
CR2	Diode, Rectifier, 1N4720	14304	CR-0701
CR3-CR11	Not Used		
CR12	Diode, Rectifier, 1N4720	14304	CR-0701
CR13	Not Used		
CR14	Diode, Reverse Polarity, MR-5005R	14304	CR-0449
F1	Fuse, 6A, 250V	14304	F-0016
J1	Connector, Coaxial	14304	J-0200
J2-J4	Not Used		
J5	Connector, Power, Modified	14304	6628-1003
Q1	Transistor, NPN, RF Power	14304	6628-1176
Q2,Q3	Not Used		
Q4	Transistor, NPN, Darlington, MJE-1100	14304	Q-0142
Q5-Q7	Not Used		
Q8	Transistor, NPN, Darlington, MJE-1100	14304	Q-0142
Q9	Not Used		
Q10	Transistor, PNP, Darlington, MJE-1090	14304	Q-0399
R1-R21	Not Used		
R22,R23	Resistor, Fixed, Composition, 12 ohm, $\pm 5\%$ , 2W	Mil type	RCR42G120JM
R24,R25	Resistor, Fixed, Composition, 220 ohm, $\pm 5\%$ , 2W	Mil type	RCR42G221JM
R26	Not Used		
R27-R30	Resistor, Fixed, Composition, 18 ohm, $\pm 5\%$ , 2W	Mil type	RCR42G180JM
R31,R32	Not Used		
R33-R36	Resistor, Fixed, Composition, 18 ohm, $\pm 5\%$ , 2W	Mil type	RCR42G180JM
R37-R55	Not Used		
R56	Resistor, Fixed, Wirewound, .005 ohm, $\pm 3\%$ , 10W	14304	R-2199
RT1	Thermistor Assembly	14304	6628-1050
TB1	Terminal Strip	14304	TB-0387
XF1	Fuseholder	14304	F01-0002-102



TABLE 3. 1A3A1 MAINTENANCE PARTS LIST

Ref. Desig.	Name & Description	Mfr. Code	Part Number
1A3A1	Power Amplifier Board Assembly	14304	6628-1150
C1,C2	Capacitor, Fixed, Ceramic, .1 uF +80-20%, 50V	14304	C-3202
C3	Capacitor, Fixed, Ceramic, .01 uF ±20%, 50V	14304	C-4952
C4-C6	Capacitor, Fixed, Ceramic, .1 uF, +80-20%, 50V	14304	C-3202
C7	Capacitor, Fixed, Ceramic, .01 uF, ±20%, 50V	14304	C-4952
C8	Capacitor, Fixed, Tantalum, 330 uF, ±10%, 6V	14304	C-3107
C9	Capacitor, Fixed, Polycarb, .1 uF, 100V	14304	C-8031
C10	Capacitor, Fixed, Ceramic, .01 uF ±20%, 50V	14304	C-4952
C11	Capacitor, Fixed, Polycarb, .1 uF, 100V	14304	C-8031
C12,C13	Not Used		
C14	Capacitor, Fixed, Polycarb, .1 uF, 100V	14304	C-8031
C15	Capacitor, Fixed, Ceramic, .01 uF, ±20%, 50V	14304	C-4952
C16	Capacitor, Fixed, Ceramic, 15 pF, 1000V	14304	C-4743
C17	Capacitor, Fixed, Ceramic, .01 uF, ±20%, 50V	14304	C-4952
C18	Capacitor, Fixed, Electrolytic, 100 uF, 25V	14304	C-6468
C19	Capacitor, Fixed, Polycarb, .22 uF, 100V	14304	C-8035
C20	Capacitor, Fixed, Mica, 82 pF, 500V	14304	C-0124
C21	Capacitor, Fixed, Mica, 180 pF, 500V	14304	C-0132
C22	Not Used		
C23	Capacitor, Fixed, Ceramic, 39 pF, 1000V	14304	C-4751
C24	Capacitor, Fixed, Tantalum, 330 uF, 6V	14304	C-3107
C25	Capacitor, Fixed, Polycarb, .1 uF, 100V	14304	C-8031
C26	Capacitor, Fixed, Ceramic, .01 uF, ±20%, 50V	14304	C-4952
C27	Capacitor, Fixed, Polycarb, .39 uF ±10%, 100V	14304	C-8038
C28	Not Used		
C29,C30	Capacitor, Fixed, Mica, 1000 pF, ±10%, 350V	14304	C-1187
C31	Capacitor, Fixed, Mica, 500 pF, ±20%, 350V	14304	C-6684
C32	Capacitor, Fixed, Ceramic, .33 uF, ±10%, 50V	14304	C-4947
C33	Capacitor, Fixed, Ceramic, .22 uF, ±10%, 50V	14304	C-4947
C34	Capacitor, Fixed, Polycarb, .39 uF, ±10%, 100V	14304	C-8038
C35	Capacitor, Fixed, Ceramic, .01 uF, ±20%, 50V	14304	C-4952
C36	Capacitor, Fixed, Ceramic, .33 uF, ±10%, 50V	14304	C-4947
C37	Capacitor, Fixed, Ceramic, .01 uF, ±20%, 50V	14304	C-4952
C38	Capacitor, Fixed, Mica, 12 pF, ±5%, 500V	14304	C-0105
C39	Capacitor, Fixed, Mica, 180 pF, ±5%, 500V	14304	C-0132
C40,C41	Capacitor, Fixed, Ceramic, .01 uF, ±20%, 50V	14304	C-4952
C42	Capacitor, Fixed, Ceramic, .1 uF, +80-20%, 50V	14304	C-3202
C43-C45	Capacitor, Fixed, Ceramic, .01 uF, ±20%, 50V	14304	C-4952
C46	Not Used		
C47	Capacitor, Fixed, Mica, 270 pF, ±2%, 500V	14304	C-0137
C48	Capacitor, Fixed, Mica, 43 pF, ±5%, 500V	14304	C-0116
C49	Capacitor, Fixed, Ceramic, 5.6 pF, 1000V	14304	C-4738
C50	Capacitor, Fixed, Ceramic, .01 uF, ±20%, 50V	14304	C-4952
C51	Capacitor, Fixed, Ceramic, .1 uF, +80-20%, 50V	14304	C-3202



TABLE 3. 1A3A1 MAINTENANCE PARTS LIST (Continued)

Ref. Desig.	Name & Description	Mfr. Code	Part Number
C52-C55	Not Used		
C56-C59	Capacitor, Fixed, Ceramic, .01 uF, $\pm 20\%$ , 50V	14304	C11-0005-103
C60	Capacitor, Fixed, Mica, 30 pF, $\pm 5\%$ , 500V	14304	C-0112
C61	Capacitor, Fixed, Mica, 68 pF, $\pm 5\%$ , 500V	14304	C-0122
C62,C63	Capacitor, Fixed, Ceramic, .01 uF, $\pm 20\%$ , 50V	14304	C-4952
C64	Capacitor, Fixed, Ceramic, .1 uF, $+80-20\%$ , 50V	14304	C-3202
CR1	Diode, Rectifier, 1N4004	14304	CR-0725
CR2	Not Used		
CR3	Diode, Rectifier, 1N4004	14304	CR-0725
CR4,CR5	Diode, Signal, 1N4454	14304	CR-0705
CR6	Diode, Rectifier, 1N4004	14304	CR-0725
CR7,CR8	Diode, Signal, 1N4454	14304	CR-0705
CR9,CR10	Diode, Rectifier, 1N4004	14304	CR-0725
CR11,CR12	Not Used		
CR13	Diode, Rectifier, 1N4004	14304	CR-0725
CR14,CR15	Not Used		
CR16	Diode, Rectifier, 1N4004	14304	CR-0725
CR17,CR18	Diode, Signal, 1N4454	14304	CR-0705
CR19,CR20	Diode, Rectifier, 1N4004	14304	CR-0725
J1-J5	Not Used		
J6-J8	Connector, Coaxial	14304	J-0031
JMP1,JMP2	Jumper, Circuit	14304	MP-1142
K1	Relay, SPST, 12 VDC	14304	K-0113
K2	Relay, SPST, 12 VDC	14304	K-0095
L1	Not Used		
L2	Choke, RF, .22 uH, $\pm 10\%$	14304	L-0632
L3	Choke, RF, .33 uH, $\pm 10\%$	14304	L-0610
L4,L5	Not Used		
L6	Choke, RF, .33 uH, $\pm 10\%$	14304	L-0610
L7	Choke, RF, .33 uH, $\pm 20\%$	14304	L-0035
L8,L9	Choke, RF, .15 uH, $\pm 20\%$	14304	L-0074
L10,L11	Not Used		
L12	Choke, RF, .15 uH, $\pm 20\%$	14304	L-0074
L13,L14	Choke, RF, .15 uH, $\pm 20\%$	14304	L-0630
Q1-Q4	Not Used		
Q5	Transistor, NPN, 2N4124	14304	Q-0385
Q6-Q8	Not Used		
Q9	Transistor, NPN, 2N4124	14304	Q-0385
Q10	Not Used		
Q11	Transistor, NPN, 2N4124	14304	Q-0385
R1	Not Used		
R2	Resistor, Fixed, Composition, 27 ohm $\pm 5\%$ , 1/4W	Mil type	RCR07G270JM
R3	Not Used		
R4	Resistor, Fixed, Composition, 1K $\pm 5\%$ , 1/4W	Mil type	RCR07G102JM
R5	Resistor, Fixed, Composition, 47 ohm $\pm 5\%$ , 1/2W	Mil type	RCR07G640JM



TABLE 3. 1A3A1 MAINTENANCE PARTS LIST (Continued)

Ref. Desig.	Name & Description	Mfr. Code	Part Number
R6,R7	Resistor, Fixed, Composition, 1 ohm $\pm 5\%$ , 1/2W	Mil type	RCR20G1R0JM
R8	Resistor, Fixed, Composition, 4.7 ohm $\pm 5\%$ , 1/2W	Mil type	RCR07G64R7JM
R9	Resistor, Variable, 200 ohm	14304	R-2223
R10	Resistor, Fixed, Composition, 68 ohm $\pm 5\%$ , 1/2W	Mil type	RCR07G680JM
R11	Resistor, Fixed, Composition, 1K $\pm 5\%$ , 1/2W	Mil type	RCR07G102JM
R12	Resistor, Fixed, Composition, 39 ohm $\pm 5\%$ , 2W	Mil type	RCR42G6390JM
R13	Not Used		
R14,R15	Resistor, Fixed, Composition, 10 ohm $\pm 5\%$ , 1/2W	Mil type	RCR20G100JM
R16	Resistor, Fixed, Composition, 39 ohm $\pm 5\%$ , 1/2W	Mil type	RCR42G6390JM
R17	Not Used		
R18	Resistor, Fixed, Wirewound, 3.3 ohm $\pm 5\%$ , 2W	14304	R-2181
R19	Resistor, Fixed, Composition, 100 ohm $\pm 5\%$ , 1/4W	Mil type	RCR07G101JM
R20	Resistor, Variable, 200 ohm	14304	R-2223
R21	Resistor, Fixed, Composition, 390 ohm $\pm 5\%$ , 1/4W	Mil type	RCR07G391JM
R22-R25	Not Used		
R26	Resistor, Fixed, Composition, 10K $\pm 5\%$ , 1/4W	Mil type	RCR07G103JM
R27-R30	Not Used		
R31,R32	Resistor, Fixed, Composition, 10 ohm $\pm 5\%$ , 1W	Mil type	RCR32G100JM
R33-R36	Not Used		
R37,R38	Resistor, Fixed, Wirewound, 1 ohm $\pm 5\%$ , 2W	14304	
R39	Resistor, Fixed, Composition, 33 ohm $\pm 5\%$ , 1/4W	Mil type	RCR07G330JM
R40	Resistor, Variable, 200 ohm	14304	R-2223
R41	Resistor, Fixed, Composition, 270 ohm $\pm 5\%$ , 1/4W	Mil type	RCR07G271JM
R42	Resistor, Fixed, Composition, 1K $\pm 5\%$ , 1/4W	Mil type	RCR07G102JM
R43	Resistor, Fixed, Composition, 3.3K $\pm 5\%$ , 1/4W	Mil type	RCR07G332JM
R44-R46	Resistor, Fixed, Composition, 1K $\pm 5\%$ , 1/4W	Mil type	RCR07G102JM
R47	Resistor, Fixed, Composition, 3.3K $\pm 5\%$ , 1/4W	Mil type	RCR07G332JM
R48	Resistor, Fixed, Composition, 4.7K $\pm 5\%$ , 1/4W	Mil type	RCR07G472JM
R49	Resistor, Variable, 200 ohm	14304	R-2223
R50	Resistor, Fixed, Composition, 120 ohm $\pm 5\%$ , 1/4W	Mil type	RCR07G121JM
R51	Resistor, Fixed, Composition, 82 ohm $\pm 5\%$ , 1/4W	Mil type	RCR07G821JM
R52	Resistor, Fixed, Composition, 8.2K $\pm 5\%$ , 1/4W	Mil type	RCR07G822JM
R53	Resistor, Fixed, Composition, 100 ohm $\pm 5\%$ , 1/4W	Mil type	RCR07G101JM
R54,R55	Resistor, Fixed, Composition, 4.7K $\pm 5\%$ , 1/4W	Mil type	RCR07G472JM
R56	Not Used		
R57	Resistor, Fixed, Composition, 1K $\pm 5\%$ , 1/4W	Mil type	RCR07G102JM
R58	Resistor, Fixed, Composition, 8.2K $\pm 5\%$ , 1/4W	Mil type	RCR07G822JM
R59	Not Used		
R60	Resistor, Fixed, Composition, 10K $\pm 5\%$ , 1/4W	Mil type	RCR07G103JM
R61	Resistor, Fixed, Composition, 1K $\pm 5\%$ , 1/4W	Mil type	RCR07G102JM
R62	Resistor, Fixed, Composition, 4.7 ohm $\pm 5\%$ , 1/4W	Mil type	RCR20G1R7JM
R63	Resistor, Fixed, Wirewound, .33 ohm $\pm 5\%$ , 1W	14304	R-2190
T1	Transformer	14304	919-1280
T2	Transformer	14304	6628-1178



TABLE 3. 1A3A1 MAINTENANCE PARTS LIST (Continued)

Ref. Desig.	Name & Description	Mfr. Code	Part Number
T3	Transformer	14304	6628-1180
T4	Transformer	14304	6628-1182
T5	Transformer	14304	6628-1181
T6	Transformer	14304	6628-1183
T7	Transformer	14304	6628-1179
TP1	Test Point, Brown	14304	J-0392
TP2	Test Point, Red	14304	J-0387
TP3	Test Point, Orange	14304	J-0390
TP4	Test Point, Yellow	14304	J-0391
TP5	Test Point, Green	14304	J-0068
TP6	Test Point, Blue	14304	J-0072
U1	Integrated Circuit, NPN/PNP Transistor Array, CA3096AE	14304	IC-0153
VR1	Diode, Zener, 5.1V, $\pm 5\%$	14304	CR-0267
VR2	Diode, Transient Suppressor, 20V	14304	CR-0450
VR3	Voltage Regulator, 8 Vdc, MC7808CT	14304	I12-0001-003



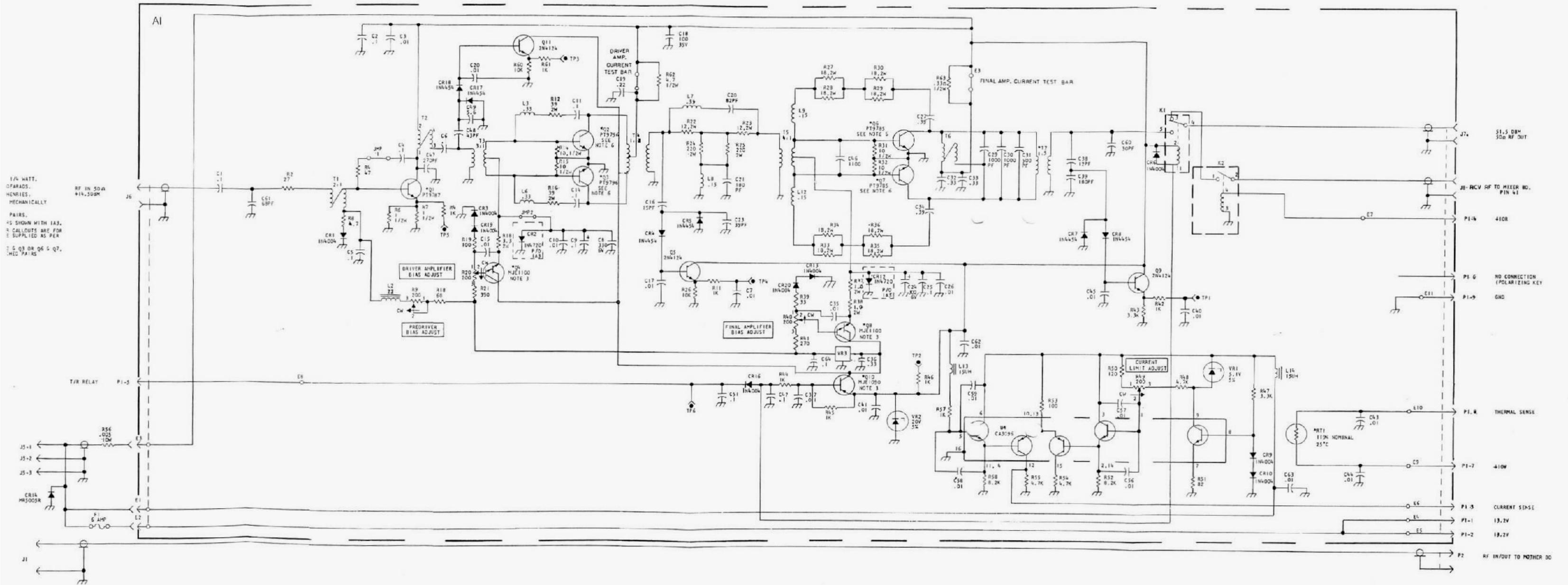


Figure 4. Power Amplifier Assembly Schematic Diagram 6628-9115