MOBILE RADIO

MAINTENANCE MANUAL
IF/AUDIO AND SQUELCH BOARD 19D417707G1 & G2

LBI-4986J
(DF1105)
(DF1119 IMTS)

TABLE OF CONTENTS

DESCRIPTION

The IF/Audio and Squelch board (IFAS) provides 120 dB IF gain, detects audio and provides squelch control. The IFAS board operates with an IF frequency of 11.2 or 9.4 MHz depending on the operating frequency of the radio. IFAS Board 19D417707G1 operates with an IF frequency of 11.2 MHz and is used in radios operating in the following frequency bands:

- 25 - 30 MHz
- 36 - 42 MHz
- 66 - 88 MHz
- 138 - 174 MHz
- 406 - 420 MHz
- 450 - 512 MHz

IFAS board 19D417707G2 operates with an IF frequency of 9.4 MHz and is used in radios operating in the 30-36 MHz, 42-50 MHz, and 806-825 MHz frequency bands.

CIRCUIT ANALYSIS

Crystal Filters, IF Amp & Limiter

The IF input from the MIF or IF Filter board is applied to a four-pole monolithic crystal filter (FL601 and FL602). The crystal filter provides additional selectivity and is followed by impedance matching network Z601 and IF Amplifier IC U601. The IC amplifier provides approximately 60 dB of gain.

Final IF selectivity is provides by a two-pole crystal filter FL603. Impedance matching network Z602 matches the output impedance of IF amplifier IC U601 to the input of two-pole crystal filter FL603. The IF amplifier output is metered at J601 through a metering network consisting of C611, C612, CR601 and CR602. Impedance matching network Z603 matches the output impedance of FL603 to the input of Limiter/Detector IC U602.

In addition to providing 60 dB of gain at the IF frequency, Limiter/Detector IC U602, C619, C620 and L603 comprise a quadrature phase detector to recover the audio from the IF frequency. The quadrature phase detector utilizes a 90 degree phase shift in the IF frequency to detect the audio signal. It compares the phase of the IF input at U602-4 with the same IF input frequency shifted 90 degrees at U602-2. The resultant signal varies phase linearly as the carrier signal deviates about the center frequency.

The detector output is adjusted for maximum audio output by L603 and is metered at J601 through R607.

AUDIO PREAMPLIFIER

The audio preamplifier consists of transistors Q601, Q602 and Q605. It provides approximately 26 dB of gain.

The output of the Limiter/Detector is coupled to the audio preamplifier through audio level adjust control R608. R608 sets the audio input level to the preamplifier circuit.

The output of the audio preamplifier is coupled through a low pass filter (L604 and C624) to volume and squelch control high. The filter removes any IF signal remaining in the audio output of the preamplifier.

AUDIO IC

The hybrid audio IC (U604) uses a custom flip-chip monolithic integrated circuit. The audio IC contains a standard EIA Channel Guard tone reject filter, a receiver de-emphasis circuit and the low level audio PA drive circuitry.

Audio from the preamplifier is coupled through the VOLUME control to pin 4 of the audio IC from P904-13 (VOL ARM). Audio at pin 4 is applied to the Channel Guard tone reject circuit, and then to the 6 dB/octave de-emphasis circuit. The filter output is coupled through C635 to the differential audio driver circuit. The output of the

audio driver circuit is DC coupled to the push-pull, Class AB audio PA transistors, Q603 and Q604. The PA output is coupled through audio transformer T601 rated power to the 8 ohm loudspeaker. R619 and C637 in the transformer secondary protects the PA transistors against a "no-load" or open circuit. Feedback from windings T601-3 and -4 determines the gain of the audio driver amplifier.

When the receiver is squelched, pin 1 of audio IC U604 is near A-, and the entire audio circuit is turned off to eliminate current drain. Pin 1 is also connected to the system board through P904-7 (RX MUTE) so that the receiver audio can be disabled by the time delay circuit in the 10 Volt regulator, and by the Channel Guard option when used.

Pins 6 & 7 are connected to the system board through P904-16 (RX PA) and P904-21 (INTCM INPUT) so that the receiver audio stages can be used to provide an audio output when the radio is equipped with the Intercom option.

Pin 2 is connected to the system board through P904-6 (SQ DISABLE) so that the receiver audio stages can be independently activated and used to provide an alert tone output when the radio is equipped with the Carrier Controlled Timer option.

SQUELCH IC

The hybrid squelch IC (U603) also uses a custom flip-chip monolithic integrated circuit. The squelch IC contains the noise amplifier, active noise filter, detector, slow and fast squelch circuits as well as the receiver unsquelched sensor (RUS) switch and carrier activity sensor (CAS) switch.

Noise Amp, Filter & Active Detector

Noise from the limiter/detector is coupled through the SQUELCH control to pins 1 and 2 on the squelch IC. This signal is applied to the noise amplifier and then to the active filter circuit.

The noise amp and active filter provide the gain and selectivity to distinguish between noise and audio. The filter output drives the active detector circuit to provide the squelch switching functions. Thermistor RT601 keeps the input to the active detector constant over wide variations in temperature.

Slow And Fast Squelch

With a signal below the 20 dB quieting level, the slow squelch circuit provides a conventional slow (200 millisecond) squelch operation to prevent rapid squelch opening and closing in weak signal areas.

A signal at or above the 20 dB quieting level is sensed by the signal level detector and activates the fast squelch circuit, providing a fast (10 millisecond) squelch operation.

The squelch circuits have two outputs. One output control the squelch switch and the other output controls the CAS switch.

NOTE

In Station applications, the Fast Squelch function is disabled by removing C630.

Squelch Switch

The squelch switch output at pin 7 is connected to pin 1 of the audio IC. When the receiver is squelched, the output pin at 7 is near A-. This keeps the receiver audio stages turned off, muting the receiver. When the receiver is quieted by an on-frequency signal (unsquelches), the voltage at pin 7 rises to approximately +10 Volts. This turns on the audio stages and sound is heard at the speaker.

With the receiver unsquelched, the output of the squelch switch turns on the RUS switch. The output of the RUS switch is connected to the noise amplifier, providing a hysteresis loop in the squelch circuit. The RUS output increases the gain of the noise amplifier, preventing squelch closing on weak signals. The RUS output at pin 8 is also connected to the system board through P904-8 for special applications.

NOTE

In radios equipped with Channel Guard, the RUS switch will operate only when an "on-frequency" signal with the correct Channel Guard tone is applied to the receiver.

CAS Switch

The squelch circuits also drive the CAS switch. When the receiver unsquelches, the voltage at pin 6 rises to approximately 10 volts. This voltage is connected to the system board through P904-9, and is used to turn on an optional Channel Busy light on the control unit.

NOTE

The CAS switch will operate whenever an "on-frequency" signal is received, with or without a correct Channel Guard tone.

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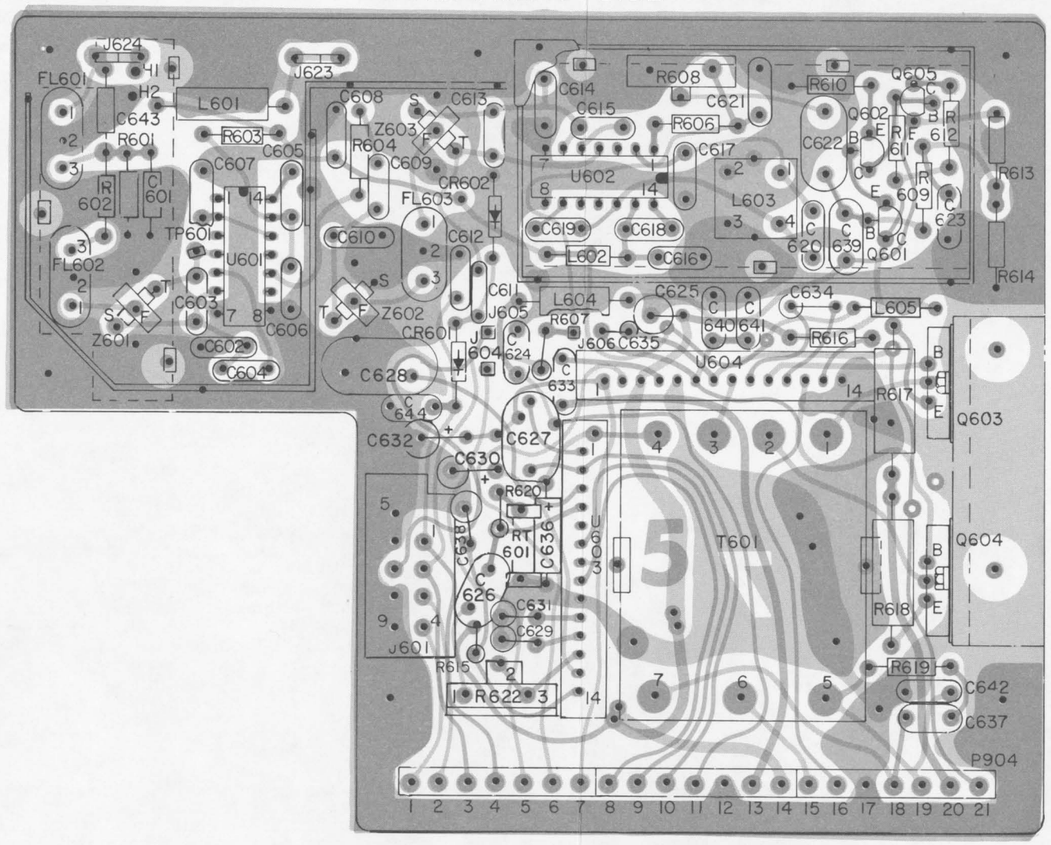
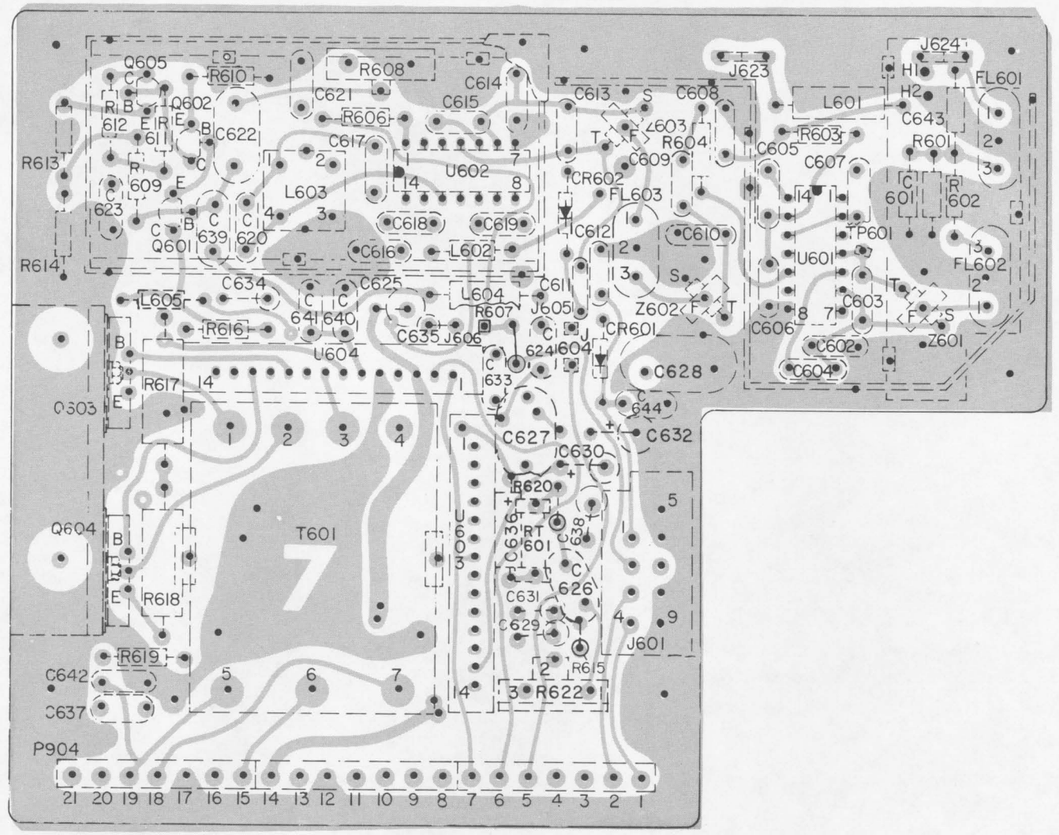
COMPONENT SIDE



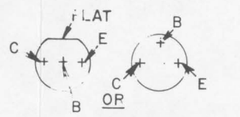
(19D423789, Sh. 2, Rev. 7)
(19D423789, Sh. 3, Rev. 5)

SOLDER SIDE

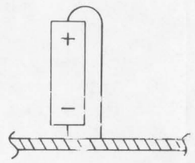


(19D423789, Sh. 2, Rev. 7)

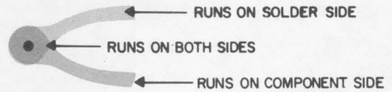
LEAD IDENTIFICATION
FOR Q601, Q602 & Q605



NOTE: LEAD ARRANGEMENT AND NOT CASE SHAPE IS DETERMINING FACTOR FOR LEAD IDENTIFICATION. TAB INDICATES EMITTER LEAD



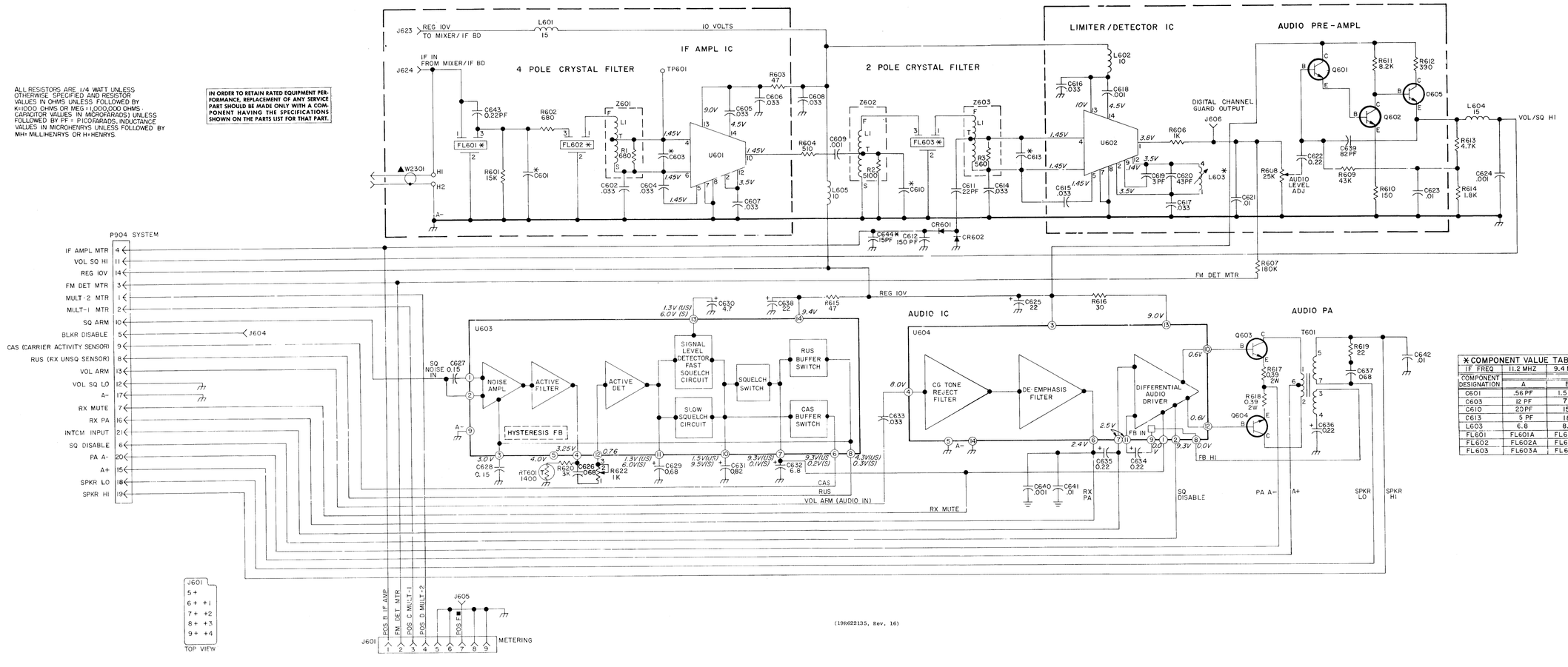
POLARITY FOR C634, C635, C630, C632, C625, C638, C631 & C629



OUTLINE DIAGRAM

IF/AUDIO/SQUELCH BOARD
19D417707G1 AND G2

(19D423600, Rev. 8)



*COMPONENT VALUE TABLE		
IF FREQ	11.2 MHZ	9.4 MHZ
COMPONENT DESIGNATION	A	B
C601	.56 PF	1.5 PF
C603	12 PF	7 PF
C610	20 PF	15 PF
C613	5 PF	18 PF
L603	6.8	8.2
FL601	FL601A	FL601B
FL602	FL602A	FL602B
FL603	FL603A	FL603B

VOLTAGE READINGS

VOLTAGE READINGS ARE TYPICAL READINGS MEASURED TO SYSTEM NEGATIVE (P904-17) WITH TEST SET MODEL 4EX3A11 OR A 20,000 OHM-PER-VOLT METER

S=NO SIGNAL IN WITH SQUELCH CONTROL FULLY COUNTERCLOCKWISE (MAXIMUM SQUELCH)

US=SQUELCH CONTROL FULLY CLOCKWISE

IF/AUDIO/SQ BD	REV LETTER	IF FREQ (MHZ)
19D417707G1	K	11.2
19D417707G2	K	9.4

▲W2301 IS USED TO ADAPT A STANDARD BD FOR USE IN A DUAL FRONT END IT SHOULD BE IGNORED IN THE STANDARD BD.

■25-50 & 138-174 MHZ NOISE BLANKER TEST POINT 406-420 & 450-512 MHZ MULT-3 TEST POINT

* C644 IN GROUP 1 ONLY.

SCHEMATIC DIAGRAM

IF/AUDIO/SQUELCH BOARD 19D417707G1 AND G2

PARTS LIST

LBI4987H

IF/AUDIO/SQUELCH BOARD
19D417707G1 11.2 MHz IF/AUDIO SQUELCH (A) REV K
19A417707G2 9.4 MHz IF/AUDIO SQUELCH (B) REV K

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - -
C601A	19A700013P10	Phenolic: 0.56 pf ±5%, 500 VDCW.
C601B	19A700013P15	Phenolic: 1.5 pf ±5%, 500 VDCW.
C602	19A700005P10	Polyester: 0.033 µf ±10%, 50 VDCW.
C603A	5496219P642	Ceramic disc: 12 pf ±5%, 500 VDCW, temp coef -470 PPM.
C603B*	5496219P638	Ceramic disc: 7.0 pf ±0.25 pf, 500 VDCW, temp coef -470 PPM.
		In REV E & earlier:
	5496219P647	Ceramic disc: 22 pf ±5%, 500 VDCW, temp coef -470 PPM.
C604 thru C608	19A700005P10	Polyester: 0.033 µf ±10%, 50 VDCW.
C609	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C610A	5496219P646	Ceramic disc: 20 pf ±5%, 500 VDCW, temp coef -470 PPM.
C610B*	5496219P644	Ceramic disc: 15 pf ±5%, 500 VDCW, temp coef -470 PPM.
		In REV E & earlier:
	5496219P649	Ceramic disc: 27 pf ±5%, 500 VDCW.
C611	5496219P647	Ceramic disc: 22 pf ±5%, 500 VDCW, temp coef -470 PPM.
C612	5494481P101	Ceramic disc: 150 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C613A*	5496219P636	Ceramic disc: 5.0 pf ±0.25 pf, 500 VDCW, temp coef -470 PPM.
		In REV B-D:
	5496219P642	Ceramic disc: 12 pf ±5%, 500 VDCW, temp coef -470 PPM.
		In REV A & earlier:
	5496219P636	Ceramic disc: 5.0 pf ±0.25 pf, 500 VDCW, temp coef -470 PPM.
C613B*	5496219P645	Ceramic disc: 18 pf ±5%, 500 VDCW, temp coef -470 PPM.
		In REV E:
	5496219P649	Ceramic disc: 27 pf ±5%, 500 VDCW, temp coef -470 PPM.
		In REV D & earlier:
	5496219P645	Ceramic disc: 18 pf ±5%, 500 VDCW, temp coef -470 PPM.
C614 thru C617	19A700005P10	Polyester: 0.033 µf ±10%, 50 VDCW.
C618	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C619	19A116656P3J1	Ceramic disc: 3 pf ±0.5 pf, 500 VDCW, temp coef -150 PPM.
C620	19A116656P43J1	Ceramic disc: 43 pf ±5%, 500 VDCW, temp coef -150 PPM.
C621	19A116080P101	Polyester: 0.01 µf ±10%, 50 VDCW.
C622	19A116080P109	Polyester: 0.22 µf ±10%, 50 VDCW.
C623	19A116080P101	Polyester: 0.01 µf ±10%, 50 VDCW.
C624	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C625	5496267P10	Tantalum: 22 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C626	19A116080P106	Polyester: 0.068 µf ±10%, 50 VDCW.
C627	19A116080P108	Polyester: 0.15 µf ±10%, 50 VDCW.
C628*	19A116080P108	Polyester: 0.15 µf ±10%, 50 VDCW.
		In REV B & earlier:
	19A116080P109	Polyester: 0.22 µf ±10%, 50 VDCW.
C629	19A134202P13	Tantalum: 0.68 µf ±20%, 35 VDCW.
C630	19A134202P3	Tantalum: 4.7 µf ±20%, 10 VDCW.
C631	5496267P230	Tantalum: 0.82 µf ±20%, 35 VDCW; sim to Sprague Type 150D.
C632	19A134202P15	Tantalum: 6.8 µf ±20%, 35 VDCW.
C633*	19A700005P10	Polyester: 0.033 µf ±10%, 50 VDCW.
		Earlier than REV A:
	19A116080P105	Polyester: 0.047 µf ±10%, 50 VDCW.
C634 and C635	19A134202P110	Tantalum: 0.22 µf ±10%, 35 VDCW.
C636	5496267P226	Tantalum: 0.22 µf ±10%, 35 VDCW; sim to Sprague Type 150D.
C637	19A116080P106	Polyester: 0.068 µf ±10%, 50 VDCW.
C638	5496267P10	Tantalum: 22 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C639	19A700105P32	Mica: 82 pf ±5%, 500 VDCW.
C640	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW.
C641 and C642	19A116080P101	Polyester: 0.01 µf ±10%, 50 VDCW.
C643	19A700013P5	Phenolic: 0.22 pf ±5%, 500 VDCW.
C644*	19A116656P15J0	Ceramic disc: 15 pf ±5%, 500 VDCW, temp coef 0 PPM. Added to G1 by REV F.
		- - - - - - - - DIODES AND RECTIFIERS - - - - - - - -
CR601 and CR602	4038056P1	Germanium, fast recovery, 20 Rev volts, Fwd. current 40 ma.
		- - - - - - - - - - FILTERS - - - - - - - - - -
FL601A	19B219573G3	Crystal, freq: Resonator A: 11,200000 KHz, Resonator B: 11,196024 KHz. Resonator A: 11,200000 KHz, Resonator B: 11,196024 KHz.
FL601B	19B219574G3	Crystal, freq: Resonator A: 9400.300 KHz, Resonator B: 9396.324 KHz, Resonator A: 9400.300 KHz, Resonator B: 9396.324 KHz.
FL602A		(Part of FL601A).
FL602B		(Part of FL601B).
FL603A*	19B219573G6	Crystal, freq: Resonator A: 11,200000 KHz, Resonator B: 11,200000 KHz, In 19D417707G1 REV D & earlier:
	19B219573G1	Crystal, freq: Resonator A: 11,200000 KHz, Resonator B: 11,200000 KHz.
FL603B	19B219574G1	Crystal freq: Resonator A: 9400.300 KHz, Resonator B: 9400.300 KHz.
		- - - - - - - JACKS AND RECEPTACLES - - - - - -
J601	19B219374G1	Connector. Includes:
	19C317957P1	Shell.
	19A116651P1	Contact, electrical; sim to Malco X0-2864.
J604 thru J606	19A701785P1	Contact, electrical; sim to Molex 08-50-0404.
J623 and J624	19A116975P1	Contact, electrical.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L601	19A700000P25	Coil, RF: 15.0 µh ±10%, 1.20 ohms DC res max.
L602	19A700024P25	Coil, RF: 10.0 µh ±10%, 3.70 ohms DC res max.
L603A	19C311181G13	Coil.
L603B	19C311181G14	Coil.
L604	19A700000P25	Coil, RF: 15.0 µh ±10%, 1.20 ohms DC res max.
L605	19A700024P25	Coil, RF: 10 µh ±10%.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P904	19B219594P1	Contact, electrical: 7 pins.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q601 and Q602	19A115910P1	Silicon, NPN; sim to Type 2N3904.
Q603 and Q604	19A116742P1	Silicon, NPN. (Part of heat sink assembly).
Q605	19A115910P1	Silicon, NPN; sim to Type 2N3904.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R601	19A700019P51	Deposited Carbon: 15K ohms ±5%, 0.25 w.
R602	19A700019P35	Deposited Carbon: 680 ohms ±5%, 0.25 w.
R603	19A700019P21	Deposited Carbon: 47 ohms ±5%, 0.25 w.
R604	19A143400P33	Deposited Carbon: 510 ohms ±5%, 250 VDCW; 1/4 w.
R606	19A700019P37	Deposited Carbon: 1K ohms ±5%, 0.25 w.
R607	19A700019P64	Deposited Carbon: 180K ohms ±5%, 0.25 w.
R608	19B209358P107	Variable, carbon film: approx 800 to 25K ohms ±10%, 0.25 w; sim to CTS Type X-201.
R609	19A143400P56	Deposited Carbon: 43K ohms ±5%, 1/4 w.
R610	19A700019P27	Deposited Carbon: 150 ohms ±5%, 0.25 w.
R611	19A700019P48	Deposited Carbon: 8.2K ohms ±5%, 1/4 w.
R612	19A700019P32	Deposited Carbon: 390 ohms ±5%, 0.25 w.
R613	19A700019P45	Deposited Carbon: 4.7K ohms ±5%, 0.25 w.
R614	19A700019P40	Deposited Carbon: 1.8K ohms ±5%, 0.25 w.
R615	19A700019P21	Deposited Carbon: 47 ohms ±5%, 0.25 w.
R616	19A143400P18	Deposited Carbon: 30 ohms ±5%, 0.25 w.
R617 and R618	19B209022P5	Wirewound: 0.39 ohms ±5%, 2 w; sim to IRC Type BWH.
R619	19A700019P17	Deposited Carbon: 22 ohms ±5%, 0.25 w.
R620	19A143400P42	Deposited Carbon: 3K ohms ±5%, 1/4 w.
R621*	19A700019P45	Deposited Carbon: 4.7K ohms ±5%, 1/4 w. Deleted by REV A.
R622*	19B209358P103	Variable, carbon film: approx 50 to 1K ohms ±10%, 0.2 w; sim to CTS Type X-201. Added by REV B.
R623*	3R151P204J	Composition: 200K ohms ±5%, 1/8 w. Added by REV F.
		- - - - - - - - - - THERMISTORS - - - - - - - - - -
RT601	5490828P38	Thermistor: 1.4K ohms ±5%, color code green and white; sim to Carborundum 723H-2.
		- - - - - - - - - - TRANSFORMERS - - - - - - - -
T601	19A116747P1	Audio freq: 500 to 4000 Hz, ±0.25 dB, Pri: 12.0 ohm ±5%, Sec 1: 8.0 ohms. 15 w, Sec 2: 1.4 ±0.10 VRMS.
		- - - - - - - - - - TEST POINTS - - - - - - - - - -
TP601	N503P304F15	Cotter pin.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - -
U601 and U602	19A116445P1	Linear: sim to ULN 2111.
U603*	19D416560G3	Squelch Hybrid.
		In REV B & C:
	19D416560G2	Squelch Hybrid.
		In REV A & earlier;
	19D416560G1	Squelch Hybrid.
U604	19D416573G1	Audio Hybrid.
		- - - - - - - - - - NETWORKS - - - - - - - - - -
Z601*	19B226649G4	Coil assembly. Includes:
R1	19A700106P59	Resistor, composition: 680 ohms ±5%, 1/4 w.
		In REV E & earlier:
	19B226649G1	Coil assembly. Includes:
R1	3R152P681J	Resistor, composition: 680 ohms ±5%, 1/4 w.
Z602*	19B226649G5	Coil assembly. Includes:
R2	3R152P512J	Resistor, composition: 5100 ohms ±5%, 1/4 w.
		In REV E & earlier:
	19B226649G2	Coil assembly. Includes:
R2	3R152P512J	Resistor, composition: 5.1K ohms ±5%, 1/4 w.
Z603*	19B226649G6	Coil assembly. Includes:
R3	19A700106P57	Resistor, composition: 560 ohms ±5%, 1/4 w.
		In REV E & earlier:
	19B226649G3	Coil assembly. Includes:
R3	3R152P561J	Resistor, composition: 560 ohms ±5%, 1/4 w.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - -
	19B226657G1	Heat sink. (Includes Q603, Q604).
	19A700068P1	Insulator, bushing. (Used with Q603, Q604).
	4029846P1	Hex nut: No. 4-40. (Used with Q603, Q604).
	19A700115P3	Insulator, plate. (Used with Q603, Q604).
	N187P9006C6	Machine screw, slotted, hex/washer head: 4-40 x 3/8. (Secures Q603 & Q604).
	19B226648G1	Shield. (Located by FL601, FL602).
	19B219571G1	Shield. (Located on opposite side of printed boarr from R601, R602).
	19B219727G1	Shield. (Located under can).
	19B219554G1	Can. (Located around U602).
	19B219555P1	Cover. (Used with can).
	19A701883P4	Contact, electrical: sim to AMP 86444-1.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

PRODUCTION CHANGES

Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter," which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for descriptions of parts affected by these revisions.

REV. A - To improve audio frequency response. Changed C633 and deleted R621.

REV. B - To improve operation of squelch circuit. Changed R603, added R622 and changed PWB from 19D417682 to 19D423789.

REV. C - To improve operation of squelch circuit. Changed C628.

REV. D - To improve operation of squelch circuit. Changed U603.

REV. E - 19D417707G1
To facilitate manufacturing. Changed C613A and FL603A.

REV. E - 19D417707G2
To improve operation. Changed C613B.

REV. F - 19D417707G2
To improve IF response. Changed C603B, C610B and C613B.

REV. F - 19D417707G1
To improve operation. Added C644.

REV. G - 19D417707G1 & G2
To improve performance of audio PA when using MASTR II Speaker out of housing or when a Non Standard Speaker is used, Added R623.

REV. H - To improve operation of audio PA at low voltage. Deleted R623 R623 was: 3R151P204J, composition: 200K ohms ±5%, 1/8 W.

REV. J - Add output Jack to make compatible with Digital Channel Guard. Added J606.

REV. K - To prevent the receiver from self quieting. Added L605. (Also changed C401 on UHF Oscillator/Multiplier boards).