MOBILE RADIO

PHOENIX™

MAINTENANCE MANUAL LBI31072

450-470 MHz 20-WATT MOBILE COMBINATION

MOBILE RADIO

MICROPHONE

TWO-WAY FM MOBILE COMBINATIONS

EXTERNAL SPEAKER (OPTIONAL)

GENERAL ELECTRIC

TABLE OF CONTENTS

ILLUSTRATIONS

WARNING

Although the highest DC voltage in this mobile equipment is supplied by the vehicle battery, high currents may be drawn under short circuit conditions. These currents can possibly heat metal objects such as tools, rings, watchbands, etc., enough to cause burns. Be careful when working near energized circuits!

High-level RF energy in the transmitter Power Amplifier assembly can cause RF burns upon contact. Keep away from these circuits when the transmitter is energized!

SYSTEM SPECIFICATIONS*

FCC IDENTIFICATION NUMBER	AXA9MZTR101A
GE IDENTIFICATION NUMBER	TR101A
FREQUENCY RANGE	450-470 MHz
Receiver	
Squelched	250 milliamperes
Unsquelched	650 milliamperes
Transmitter	5.5 Amperes @ 13.8 Volts
FREQUENCY STABILITY	0.0005%
TEMPERATURE RANGE	-30°C (-22°F) to +60°C (140°F)
DUTY CYCLE	20% Transmit, 100% Receive
DIMENSIONS, LESS ACCESSORIES (H X W X D)	65 MM X 190 MM X 240 MM (2.55 X 7.5 X 9.4 inches)
WEIGHT, LESS ACCESSORIES	2.07 kg (4.5 pounds)

TRANSMITTER

POWER OUTPUT	20 Watts
CONDUCTED SPURIOUS AND HARMONIC EMISSION	-70 dB
MODULATION	±4.5 kHz (±3.5 kHz voice modulation and 0.75 kHz CG modulation)
AUDIO SENSITIVITY	65 to 120 Millivolts at J911-4 3.5 to 6 Millivolts at J911-5
AUDIO FREQUENCY CHARACTERISTICS	Within +1 dB to -3 dB of a 6 dB per octave pre-emphasis from 300 to 3000 Hz per EIA standards. Post limiter filter per FCC and EIA.
DISTORTION	Less than 3% (1000 Hz) Less than 5% (300 to 3000 Hz)
DEVIATION SYMMETRY	0.5 kHz maximum
MAXIMUM FREQUENCY SPREAD	5.5 MHz
RF OUTPUT IMPEDANCE	50 ohms

RECEIVER

AUDIO OUTPUT (to 4.0 ohms speaker)	3 Watts (less than 5% distortion)
SENSITIVITY	
12 dB SINAD	0.4 uV
20 dB Quieting Method	0.45 uV
SELECTIVITY	
EIA Two-Signal Method	-85 dB @ ±25 kHz
SPURIOUS RESPONSE	-85 dB
INTERMODULATION	-75 dB
MODULATION ACCEPTANCE	±7.0 kHz
SQUELCH SENSITIVITY	<8 dB SINAD
FREQUENCY RESPONSE	Within +2 and -8 dB of a standard 6 dB per octave de-emphasis curve from 300 to 3000 Hz (1000 Hz reference)
RF INPUT IMPEDANCE	50 ohms

* These specifications are intended primarily for use of the serviceman. Refer to the appropriate Specifications Sheet for the complete specifications.

DESCRIPTION

General Electric Phoenix mobile combinations are fully transistored -- utilizing both discrete components and integrated circuits (IC's) for high reliability. The radio is a self-contained, FM transmitter/receiver with built-in controls and speaker. Its small size makes it ideal for front mounting in conventional vehicles. The standard combinations are equipped with the following:

- One receive frequency, and two transmit frequencies
- Plug-in crystals for ±0.0005% oscillator stability
- Channel Guard (tone squelch)

The radio consists of an effective heat-dissipating, aluminum die cast "H" frame on which two circuit boards are mounted. The transmitter/receiver board is mounted on the bottom of the "H" frame and includes RF and receiver audio circuitry. The Interconnect/Oscillator/Channel Guard (IOC) board contains all interconnections, oscillator circuits, transmitter audio processor, microphone preamplifier, and Channel Guard circuitry. All external connectors, controls and indicators are mounted directly on the two boards for reliability and ease of disassembly.

The boards plug into each other, eliminating the need for interconnecting wires. The only wires used in the radio are the plug-in leads for the internal speaker. The top and bottom covers enclose the "H" frame and provide optimum protection for the radio. The internal speaker mounts on the inside of the top cover.

The front control panel is made of highly durable plastic with rounded corners and recessed controls for passenger safety requirements. The panel provides access to four standard operator controls: a POWER On/Off pushbutton, a momentary MONITOR pushbutton (fixed squelch and Channel Guard monitor), a rotary, an edge-mounted Volume control, and a two-position frequency selector (RPTR-DIR). A red Transmit indicator LED (Light Emitting Diode) and a green power on indicator are provided.

No power supply is required since the highest supply voltage used in the radio is provided by the vehicle battery. The radio is designed for operation only in 12 Volt, negative ground vehicle systems.

The radio is of modular construction. Both major modules and tuning adjustments are easily accessible. Loosening the two screws in the rear of the top cover provides access to the interconnect or multi-frequency/interconnect board. Loosening the two screws in the rear of the bottom cover provides access to the transmitter/receiver board.

An optional set of test probes can be plugged onto the test pins on the board for alignment and troubleshooting. Measurements can be made using GE Test Set 4EX3A11 or a multimeter.

TRANSMITTER

The transmitter consists of an FM exciter with an audio processor and a broadband, fixed-tuned power amplifier. The RF power output level is pre-set internally to rated power. Once the level is set, a sensing control circuit holds it constant as temperature and/or voltage vary within specified limits.

Frequency stability for both the transmitter and receiver is maintained by an electronic compensation network.

RECEIVER

The dual conversion receiver consists of a front end section and two mixer/IF sections operating at 21.4 MHz and 455 kHz. The receiver also contains a squelch and audio section. The audio section provides a 3-watt audio output into a 4-ohm load.

AC POWER SUPPLY OPTION

To use the radio as a base station, an optional 121 Volt AC, 60 Hertz power supply is available. An eight foot cable connects the power supply to the radio. The cable length permits the power supply to be located away from the radio. A green Power On LED is located on the front panel of the power supply.

MICROPHONE

The standard mobile combinations use an electret microphone. The microphone is housed in a sturdy case, and the extendable coiled cord plugs into a jack at the back of the radio. The microphone is secured to the radio by means of a strain relief hook on the microphone cable. A microphone hanger is supplied with the microphone.

HOOKSWITCH OPTION

In Channel Guard applications, a microphone hookswitch may be supplied with the radio. The hookswitch is equipped with a Channel Guard disable switch.

Placing the switch in the "up" position (towards the small speaker symbol) disables the receive Channel Guard. With the switch in the "down" position, the

Channel Guard is disabled when the microphone is removed from the hookswitch.

EXTERNAL SPEAKER (OPTIONAL)

A five-inch speaker, contained in a LEXAN© housing, provides an audio output of 3 watts. The nominal speaker impedance is 3.2 ohms. The speaker leads are connected to pins 3 and 7 of Systems Plug P910. When the External Speaker is used, the jumper from H13 to H14 on the (IOC) board can be removed or P904 unplugged to disconnect the built-in speaker. A LEXAN© bracket is supplied for mounting.

OPERATION

Complete operating instructions for the Two-Way Radio are provided in a separate Operator's Manual. The basic procedures for receiving and transmitting messages follows:

TO RECEIVE A MESSAGE

1. Turn the radio on by pushing in the POWER pushbutton.
2. Push in the MONITOR button to disable the squelch circuit and Channel Guard decoder. Adjust the volume control for a comfortable listening level and then release the MONITOR button for normal operation.

The radio is now ready to receive messages from other radios in the system.

TO TRANSMIT A MESSAGE

1. Turn the radio on as directed in the "To Receive a Message" section.
2. Press the PTT switch on the microphone and speak across the face of the microphone in a normal voice level. Release the PTT switch as soon as the message has been given. The red indicator light on the control panel will glow each time the microphone PTT switch is pressed, indicating that the transmitter is on the air. The receiver is muted when the transmitter is keyed.

INITIAL ADJUSTMENT

After the radio has been installed (as described in the Installation Manual), the following adjustments should be made by an electronics technician who holds a First or Second Class FCC Radiotelephone license (where required).

TRANSMITTER ADJUSTMENT

Adjustments for the transmitter include measuring the forward and reflected power and adjusting the antenna length for optimum VSWR, then setting the transmitter to rated power output. Next, measuring the frequency and modulation and entering these measurements on the FCC required station records. For the complete transmitter adjustment, refer to the Alignment Procedure (see Table of Contents).

RECEIVER ADJUSTMENT

The initial adjustment for the receiver includes tuning the input circuit to match the antenna. For the Receiver Adjustment Procedure, refer to the Alignment Procedure (see Table of Contents).

CHANNEL GUARD DISABLE

All radios are equipped with Channel Guard. In applications where Channel Guard is not desired, disable the Channel Guard circuit by connecting a jumper from J910-8 to J910-9. Also, remove the versatone if present.

RE-INSTALLATION

If the mobile combination is ever moved to a different vehicle, always check the battery polarity of the new system.

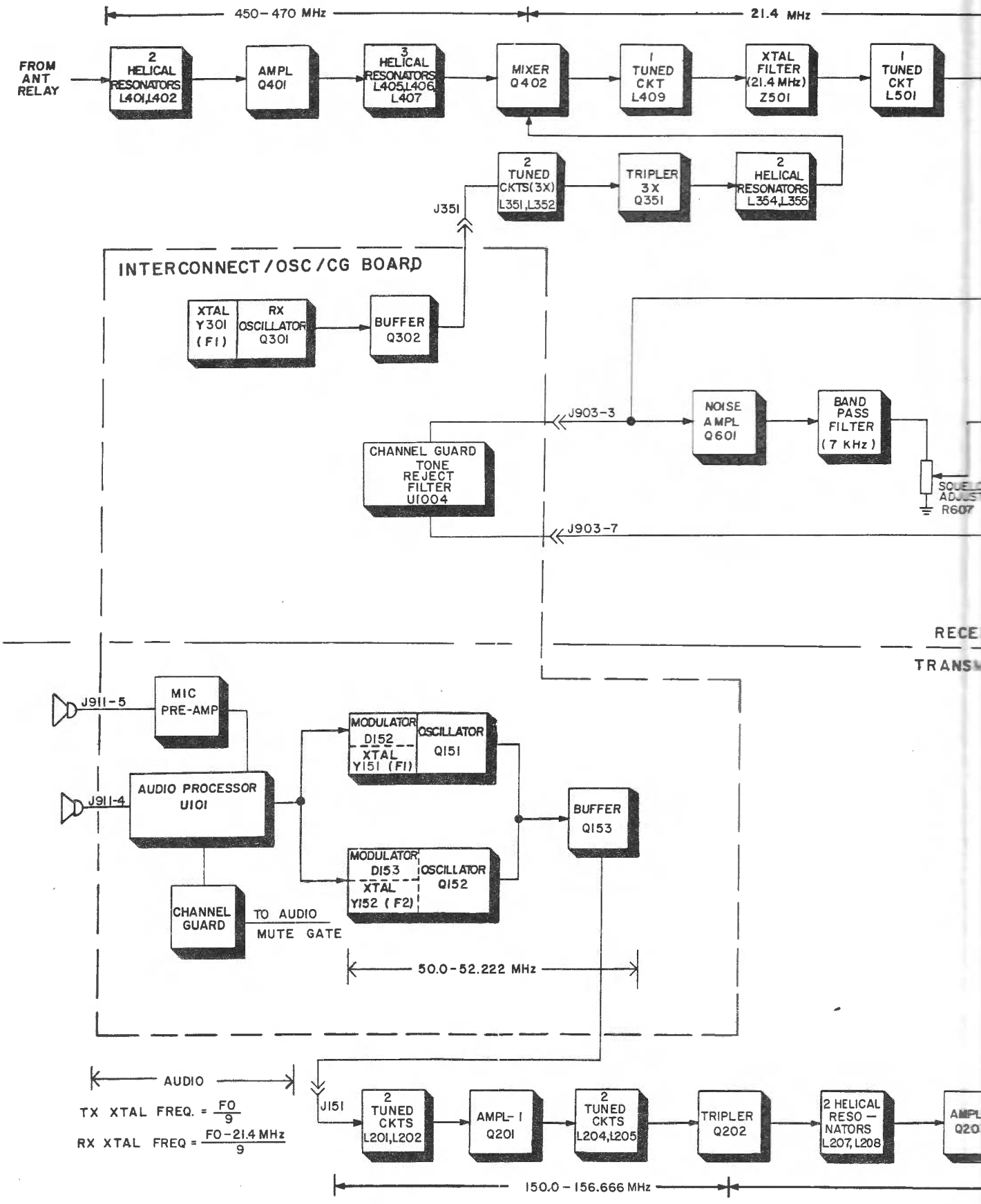
CIRCUIT ANALYSIS

TRANSMITTER

The transmitters utilize a crystal controlled, frequency modulated exciter for two-frequency operation in the 450-470 MHz frequency band. The solid state transmitter uses integrated circuits and discrete components for increased reliability. The transmitter consists of audio processor U101; oscillator Q151, and Q152, buffer Q153, exciter stages Q201 through Q204; PA amplifier Q251 through Q253, and power control circuit Q254 through Q257. The exciter provides approximately 150 milliwatts of modulated RF to the PA which provides rated output power. Figure 1 is a block diagram of the radio showing both the transmitter and receiver.

MICROPHONE PREAMPLIFIER

A preamplifier stage (Q901 and associated circuitry) is provided for the


450-470 MHz
21.4 MHz
FROM ANT RELAY
2 HELICAL RESONATORS L401,L402
AMPL Q401
3 HELICAL RESONATORS L405,L406, L407
MIXER Q402
1 TUNED CKT L409
XTAL FILTER (21.4 MHz) Z501
1 TUNED CKT L501
2 TUNED CKTS(3X) L351,L352
TRIPLER 3X Q351
2 HELICAL RESONATORS L354,L355
J351
INTERCONNECT/OSC/CG BOARD
XTAL Y301 (F1)
RX OSCILLATOR Q301
BUFFER Q302
J903-3
NOISE AMPL Q601
BAND PASS FILTER (7 KHz)
SQUELCH ADJUST R607
CHANNEL GUARD TONE REJECT FILTER U1004
J903-7
RECE
TRANS
J911-5
MIC PRE-AMP
J911-4
AUDIO PROCESSOR U101
MODULATOR D152 XTAL Y151 (F1)
OSCILLATOR Q151
MODULATOR D153 XTAL Y152 (F2)
OSCILLATOR Q152
BUFFER Q153
CHANNEL GUARD
TO AUDIO MUTE GATE
50.0-52.222 MHz
AUDIO
TX XTAL FREQ. = F0/9
RX XTAL FREQ = (F0-21.4 MHz)/9
J151
2 TUNED CKTS L201,L202
AMPL-1 Q201
2 TUNED CKTS L204,L205
TRIPLER Q202
2 HELICAL RESO-NATORS L207,L208
AMPL Q20
150.0-156.666 MHz

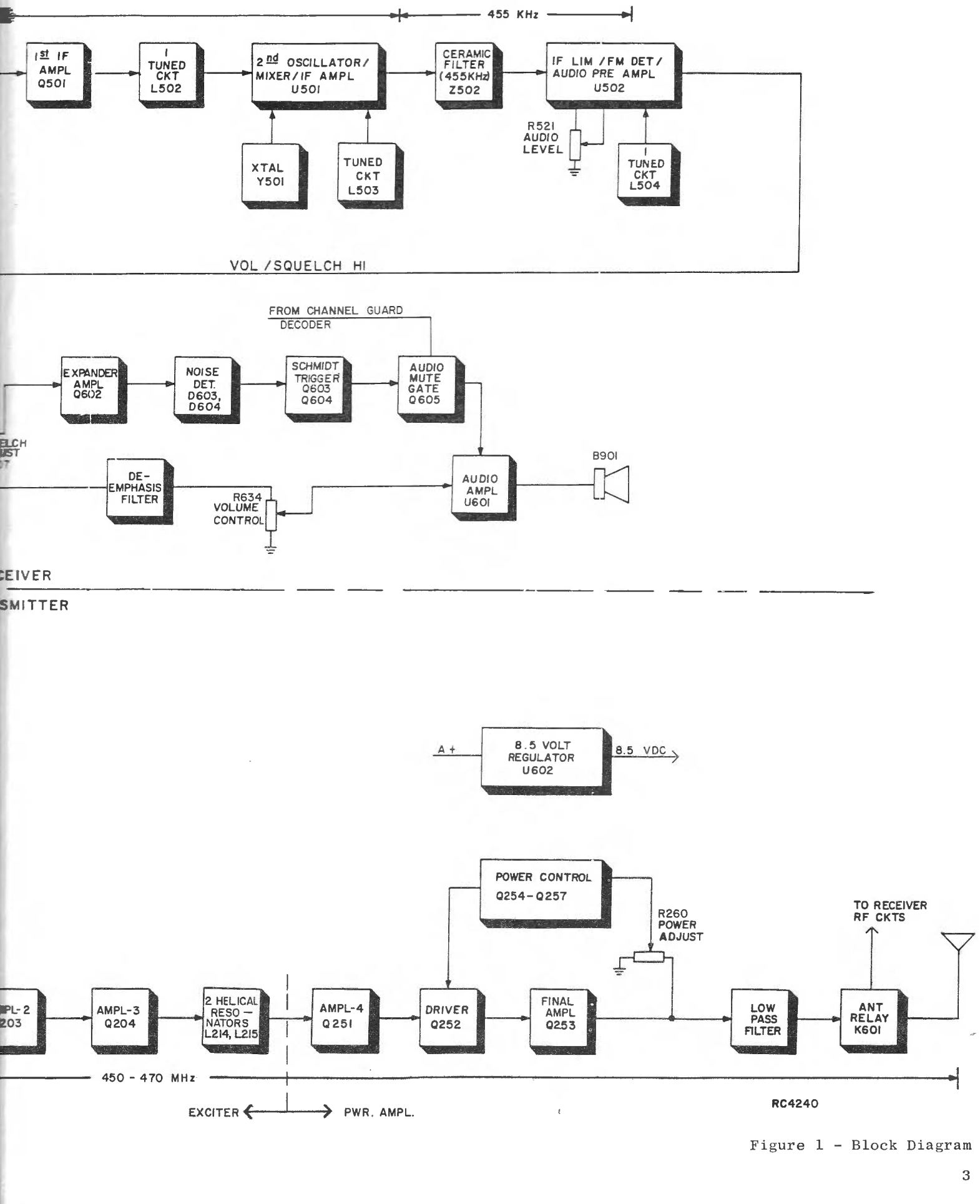


Figure 1 - Block Diagram

standard electret microphone without a built-in preamplifier. The preamplifier circuit is located on the IOC board.

With this microphone, MIC HI is coupled through J911-5 to the preamplifier stage. The amplified output is coupled through R908 and C905 to the audio processor.

For optional microphones with a built-in preamplifier, audio is coupled through J911-4, bypassing MIC PRE AMP Q901.

AUDIO PROCESSOR U101

The audio processor provides audio pre-emphasis with amplitude limiting and post limiter filtering. A total gain of approximately 24 dB is realized through the audio processor. 20 dB is provided by U101B and 4 dB by U101A.

The 8.5 Volt regulator powers the audio processor and applies regulated +8.5V through P903-2 to a voltage divider consisting of R101, R111, R110 and R109. The +4.25V output from the voltage divider establishes the operating reference point for both operational amplifiers. C106 provides an AC ground at the summing input of both operational amplifiers.

Resistors R109, R110, R111 and diodes D101 and D102 provide limiting for U101B. Diodes D101 and D102 are reverse biased at +1.7 VDC. Voltage divider network R109, R110 and R111 provides +5.9 VDC at the cathode of D101 and +2.6 VDC at the anode of D102. The voltage at the junction of D101 and D102 is 4.25 VDC. C104 and C108 permit a DC level change between U101B-7 and the voltage divider network for diode biasing.

When the input signal to U101B-6 is of a magnitude such that the amplifier output at U101B-7 does not exceed 4 volts P-P, the amplifier provides a nominal 20 dB gain. When the audio signal level at U101B-7 exceeds 4 volts PP, diodes D101 and D102 conduct on the positive and negative half cycles providing 100% negative feedback to reduce the amplifier gain to 1. This limits the audio amplitude at U101B-7 to 5 volts PP.

Resistors R105, R106 and R107 and C107 comprise the audio pre-emphasis network that enhances the signal to noise ratio. R107 and C107 control the pre-emphasis curve below limiting. R106 and C107 control the cut-off point for high frequency pre-emphasis. As high frequencies are attenuated, the gain of U101 is increased.

Audio from the preamplifier or microphone is coupled to the input of operational amplifier U101B-6. The amplified output of U101B is coupled through R114, R112, R104 and R117 to a second operational amplifier U101A.

The Channel Guard (CG) tone input is applied to U101A-2. The CG tone is then combined with the microphone audio.

A post limiter filter consisting of U101A, R112-R114, C108 and C110 provides 12 dB per octave roll-off. R104 and C102 provide an additional 6 dB per octave roll-off for a total of 18 dB.

SERVICE NOTE

R112-R114 are 1% resistors. This tolerance must be maintained to assure proper operation of the post limiter filter. Use exact replacements.

The output of the post limiter filter is coupled through C110 to the temperature compensated transmitter oscillators Q151 and Q152.

TRANSMIT OSCILLATOR

A temperature compensating network consisting of R151, R152, R153, R154, D151 and C151 maintains oscillator frequency over a temperature range of -30° to +60°C. The temperature compensating DC voltage and audio is applied to FM modulator D152 through MOD ADJ control R155 and R159. Modulator varactor D151 varies the transmit frequency at the audio rate applied from the audio processor.

Q151, Y151 and associated circuitry comprise a Colpitts oscillator which generates the ninth subharmonic (50 MHz) of the RF carrier frequency. The transmit oscillator is adjusted to the assigned operating frequency by L151. The oscillator output is applied to buffer Q153, and is then coupled through P151 to the exciter circuitry transmitter/receiver (Tx/Rx) board.

The second oscillator stage is identical to the F1 oscillator. The desired frequency is selected through Tx frequency switch S151 and channel common switch Q154.

Q154 is normally turned on so that the emitter of the selected oscillator is grounded through S151 and Q154, turning the selected oscillator on.

SERVICE NOTE

The channel common circuit is for factory test purposes only. The circuit permits both frequencies to be checked regardless of the position of S151. The circuit consists of Q154, R172 and C168. Grounding channel common lead J911-6 turns off Q154 and permits each transmit oscillator to be turned on by grounding P911-7(F1) and then P911-8(F2).

EXCITER

The exciter consists of a 150 MHz amplifier a (150 MHz to 450 MHz) tripler and two 450 MHz amplifiers. The exciter takes the output from the oscillator and buffer circuits (2 milliwatts minimum) and multiplies and amplifies it to provide 140 milliwatts minimum (450-470 MHz) to the power amplifier circuitry. In addition to these functions, the exciter contains all of the filters which determine the bandwidth and spurious characteristics (exclusive of harmonics) of the transmitter.

The output of the oscillator and buffer stages is coupled to the input of the exciter via J151, which is connected to a tap on L201. This tap also supplies voltage to the buffer transistor Q153. L201 along with L202, selects the third harmonic (150 MHz) which is present at J151.

C206 and C207 match the output of this two pole filter to the base of Q201, which provides approximately 10 dB of gain. C213 and C214 match the collector of this transistor to the input of another two pole filter, consisting of L204 and L205. The emitter voltage on L201 (AMPL-1) can be monitored at TP201, and is typically +0.3 volts.

C216 and C217 match the output of L205 to the base of the tripler transistor, Q202. The base voltage on Q202 can be read at TP202, and is typically -1.2 volts. The tripler has approximately 3 dB of gain.

A matching network consisting of L206 and C222 matches the 450 MHz output of the tripler to the first two-pole helical filter, L207 and L208. The output of this filter is then matched by C223 and L209 to a two stage, broadbanded 450 MHz amplifier consisting of Q203 and Q204. C227, C228, L210 and L211 provide proper matching from the collector of Q203 to the base of Q204, providing the necessary bandwidth as well. Although this amplifier is capable of providing 12-15 dB of gain, both stages are biased to provide adequate saturation to ensure no AM components are present at the exciter output. Typical actual gain is 7-9 dB, and typical power output is 150 mW.

The collector of Q204 is matched to the input of the second two pole helical filter (L214 and L215) by C233-C235, L212 and L213. An RF "sniffing" circuit consisting of C236, C237, D201, and R221 allow relative power available at the input of this filter to be monitored at TP203. +0.6 volts is typically present at this point after tuning the exciter.

There is no test point that indicates relative power coming out of this filter TP251 in the PA section indicates relative power coming out of Q251 (Ampl 4), and final tuning for L214 and L215 should be done while monitoring this test point. No test points require the use of special RF detector probes.

SERVICE NOTE

There are 4 points in the exciter which are approximately 50 ohms. W201, W204, W205 and W251 (which interface the 2 helical filters to the other exciter circuitry). These points can conveniently be used to monitor or inject signals for troubleshooting and testing using 50 ohm sources and terminations.

POWER AMPLIFIER

The three stage power amplifier consists of Amplifier Q251, driver Q252 and power amplifier Q253 and associated circuitry. Collector voltage for driver Q252 is applied from A+ through power control transistor Q257 and L256, L257 and R256. The collector voltage for Q252 is a result of the output power setting and voltage variations at any given time. The output of driver Q252 is coupled to the base of Power Amplifier Q253 through an impedance matching network consisting of W254, C292, C267, C268 and C269.

Collector voltage for Q253 is provided from A+ through L261, L262 and R258.

The 20 watt output of the PA is connected to the low-pass filter by W256 and then to antenna relay K601.

RF POWER ADJUST CIRCUIT

The output power adjust circuit allows the transmitter to be set to rated output power. The power adjustment is attained by controlling the DC collector voltage to driver Q252 through pass transistor Q257. The pass transistor is controlled by a feedback loop consisting of Q254 through Q256. The power is set by potentiometer R260.

A change in output power is sensed by D252 causing the base voltage of Q254 to change accordingly. For example, if the output power increases, the base of Q254 goes more positive, causing it to increase conduction which lowers its collector voltage. Q254 controls Q255, therefore as Q254 increases conduction, Q255 decreases conduction. This raises the voltage applied to the base of Q256. The conduction of Q256 decreases proportionally, lowering the base voltage of pass transistor Q257. The resulting decrease in conduction of Q257 lowers the collector voltage of driver Q252, thereby lowering the output power in proportion to the excessive power originally sensed by the base circuit of Q254.

RECEIVER

The receivers are dual conversion, superheterodyne FM receivers designed for one-frequency operation in the 420-512 MHz frequency range. A regulated 8.5 volts is used for all receiver stages except for the audio PA IC, which operates from the A+ supply.

The receiver has intermediate frequencies of 21.4 MHz and 455 kHz. Adjacent channel selectivity is obtained by using two band-pass filters: a 21.4 MHz crystal filter and a 455 kHz ceramic filter.

All of the receiver circuitry except the oscillator is mounted on the transmitter/receiver (Tx/Rx) board. The receiver consists of:

- Receiver Front End
- 21.4 MHz 1st IF circuitry
- 1st and 2nd Oscillators
- 455 kHz 2nd IF circuitry with FM Detector
- Audio PA Circuitry
- Squelch Circuitry

RECEIVER FRONT END

An RF signal from the antenna is coupled through antenna relay K601 and two helical resonators (L401 and L402) to the base of RF amplifier Q401. The output of Q401 is coupled through three more helical resonators consisting of L405-L407 to the gate of 1st Mixer Q402. The front end selectivity is provided by the five helical resonators.

OSCILLATOR & MULTIPLIER

Q301, Y301 and associated circuitry make up a Colpitts oscillator. The frequency is controlled by a third mode crystal operated at one ninth of the required injection frequency. Voltage-variable capacitor D301, L301 and Y301 are connected in series to provide compensation capability. The compensation voltage used to control the transmitter oscillators is applied to D301 to maintain stability. L301 is adjustable to set the oscillator frequency. R301 is in parallel with Y301 to insure operation on the third overtone of the crystal.

The output of Q301 is coupled through C304 to the emitter of buffer Q302. The output of Q302 is coupled through P301 to two tuned circuits (L351 and L352) on the Tx/Rx board. L351 and L352 are tuned to the third harmonic of the oscillator frequency which is applied to the base of Q351. The output of tripler A351 is coupled to the source input of mixer Q402 through helical resonators L354 and L355. L354 and L355 are tuned to the operating frequency minus 21.4 MHz which is the ninth multiple of the crystal frequency.

The DC level of the oscillator/multiplier chain can be monitored at TP351. The meter reading at this point is typically 0.8 VDC. The RF frequency from the oscillator/multiplier chain and input level to the mixer can be measured at TP401. The meter reading at TP401 is typically 0.5 to 1 volts as measured using the Rx RF Detector Probe.

1ST MIXER

The 1st mixer uses a FET (Q402) as the active device. The FET mixer provides a high input impedance, high power gain and an output relatively free of intermodulation products).

In the mixer stage, RF from the front end helical filter is applied to the gate of the mixer. Injection voltage from the multiplier stages is applied to the source of the mixer. The 21.4 MHz mixer 1st IF output signal is coupled from the drain of Q402 through an impedance matching network (L409 and C410-C413) to crystal filter Z501.

The highly-selective crystal filter provides the first portion of the receiver IF selectivity. The output of the filter is coupled through impedance-matching network L501 to the 1st IF amplifier.

IST & 2ND IF & DETECTOR STAGES

1st IF Amplifier Q501 is dual-gate MOSFET. The crystal filter output is applied to Gate 1 of the amplifier, and the amplified signal is taken from the drain. The biasing on Gate 2 and the drain load determines the gain of the stage. The

amplifier provides approximately 20 dB of IF gain. The output of Q501 is coupled through an impedance matching network (L502) that matches the amplifier output to the input of IC U501.

U501 and associated circuitry consists of the 2nd oscillator, mixer and 2nd IF amplifier. The crystal for the oscillator is Y501, and the oscillator operates at 20.945 MHz for low side injection of the 2nd IF (standard), or 21.855 MHz for high side injection with (Structured Option FT) for those radios determined to be operating on a tweet frequency. This frequency is mixed with the 21.4 MHz input. The output of the mixer is limited by D501 and D502. L503 is tuned for the 455 kHz 2nd IF frequency.

The output of U501 is coupled through ceramic filter Z502 which provides the 455 kHz selectivity, and applied to U502. Test Point TP501 is used in aligning the receiver, and can be used to check the output of U501.

U502 and associated circuitry consists of a 455 kHz limiter, a quadrature type FM detector and an audio preamplifier. L504 is the quadrature detector coil. Audio Level potentiometer R521 is used to set the audio output level to the audio amplifier.

AUDIO AND SQUELCH CIRCUITS

Audio

Audio is applied to the Channel Guard tone reject filter through P903-3 and back to the de-emphasis network through P903-7. The audio passes through the de-emphasis network (R633, C608 and C609) to Volume Control R634.

Audio amplifier IC U601 drives the speaker at the desired audio level (up to three watts). The feedback loop containing R637, R638 and C611 determines the amplifiers closed loop gain. R636 and C613 provide the high audio frequency roll-off above 6 kHz.

The audio amplifier can be muted by a DC voltage from the receiver mute gate (Q605) which uses different logic inputs. These inputs are 8.5 V Tx, MONITOR, or a squelch signal. The Rx MUTE function from the Channel Guard circuit which is applied through P903-4.

Squelch

The squelch circuit operates on the noise components contained in the FM detector output. The output of U502 is applied to frequency selective noise amplifier Q601 that has a resonant circuit (L601, R604 and C602) as the collector load. The output is noise in a band around 7 kHz.

The noise output is coupled through Squelch control R607 to expander amplifier Q602 which improves the level discrimination characteristics of the circuit. The output of Q602 is applied to a passive voltage doubler circuit (D603 and D604). This circuit has a high source impedance and operates as an average value rectifier.

Following the voltage doubler is a Schmidt trigger (Q603-Q604). The Schmidt trigger provides the necessary hysteresis and a well-defined output signal for Rx MUTE gate Q605 .

With no RF signal present, the detected noise at the voltage doubler output turns on Q603, turning off Q604. This causes Q605 to turn on, applying +1. volts to pin 2 of audio amplifier U601. This voltage turns off U601 and mutes the receiver.

When an RF signal is received, the noise at the output of Q601 decreases and drive to Q603 is removed. This turns off Q603 and allows Q604 to turn on. With Q604 turned on, Rx MUTE gate Q605 turns off. This turns on U601 so that audio is heard at the speaker.

The squelch sensitivity is adjusted by R607 in the base circuit of expander amplifier Q602.

Pressing in the MONITOR pushbutton on the front of the radio opens the Rx MUTE to disable the Channel Guard. It also grounds the base of Q601 and disables the squelch function.

CHANNEL GUARD

Channel Guard is a continuous tone encoder/decoder for operation on tone frequencies in the 71.9 Hz to 210.7 Hz range. The encoder provides tone-coded modulation to the transmitter. The decoder operates in conjunction with the receiver to inhibit all calls that are not tone coded with the proper Channel Guard frequency.

The Channel Guard circuitry consists of discrete components for the Encode disable, PTT switch, and receiver mute switch; four thick-film integrated circuit modules consisting of Decode Module U1001, Encode Module U1002, Frequency Switchable Selective Amplifier (FSSA) U1003, plug-in Versatone Network Z1001 and monolytic IC U1004 in the tone reject filter.

For a functional diagram of the Channel Guard Encoder/Decoder, refer to the troubleshooting procedures.

References to symbol numbers mentioned in the following text are found on the

Schematic Diagram, Outline Diagram and Parts List.

FSSA

Frequency Switchable Selective Amplifier (FSSA) U1003 is a highly stable active bandpass filter for the 71.9 Hz to 210.7 Hz frequency range. The selectivity of the filter is shifted across the bandpass frequency range by switching Versatone Networks in the filter circuit.

The gain of the FSSA is a function of the tone frequency. The Tone Frequency is determined by the Tone Network connected in the FSSA circuit. Versatone Network Z1001 is a precision resistor network.

ENCODE

When PTT switch is operated, the Channel Guard encode tone is generated by coupling the output of FSSA bandpass filter U1003 back to its input through a phase inverting amplifier circuit and a limiter circuit. The output of the FSSA is coupled from U1003 to the input of the phase inverting amplifier at U1002-9.

An amplifier provides 180° phase shift of the tone frequency at the output. The output of the phase inverting amplifier circuit is coupled from U1002-6 to the input of the limiter circuit at U1002-5.

A limiting network sets the tone output coupled from U1002-4 to the input of the FSSA (U1003-12) at 53 millivolts peak to peak.

The limiter circuit is also used as an encode switch. Keying the transmitter applies +5.4 Volts to U1002-2. This starts the circuit oscillating. The tone frequency is determined by the tone network connected in the FSSA circuit.

The tone output of the encoder circuit is taken from U1002-7 and coupled through tone output amplifier Q1002 and modulation adjustment R1010 to the audio processor on the transmitter/receiver board.

DECODE

Audio from Volume/Squelch high that contains the correct frequency is coupled to pin 1 of Decode Module U1001. Pin 1 of U1001 is the input of an active, three stage, low pass filter. The low pass filter attenuates frequencies over 210.7 Hz. The output of the low pass filter at U1001-15 is applied to U1001-14. U1001-14 is the input of a limiter circuit, limiting the output at U1001-13 to 55 millivolts peak to peak.

The output from the limiter is coupled to Pin 12 of FSSA U1003. Since the tone is the proper frequency, the FSSA will allow it to pass. The output of the FSSA is coupled to U1001-3. U1001-3 is the input to an amplifier circuit. The output of the amplifier at U1001-4 is coupled to the input of a threshold detector at U1001-6.

In the mute mode, when the tone decoder in U1001 detects the Channel Guard frequency, Q1005 turns Q1006 off. This unmutes the receiver audio. In the squelch mode, Q1006 is operating, grounding the Rx MUTE lead and muting the receiver audio.

Audio from VOL/SQ HI is applied to the tone reject filter. The tone reject filter is an active filter consisting of U1004 and associated circuitry. All frequencies from 70 to 210.7 Hz are rejected by the filter, while passing all other audio frequencies back to the receiver audio circuits (filtered VOL/SQ HI).

STANDARD TONE FREQUENCIES (Hz)				
71.9	88.5	107.2	131.8	162.2
74.4	91.5	110.9	136.5	167.9
77.0	94.8	114.8	141.3	173.8
79.7	97.4	118.8	146.2	179.9
82.5	100.0	123.0	151.4	186.2
85.4	103.5	127.3	156.7	192.8
			203.5	
			210.7	

Encode Disable

SERVICE HINT

The Encode Disable circuit has been incorporated as a maintenance aid for the serviceman. This circuit disables the Channel Guard encode circuit and allows the serviceman to make transmitter distortion and modulation checks without removing the cover from the radio.

The Encode Disable circuit consists of Q1003 and Q1004. To disable the encode circuit, a positive voltage (+8.5 to 14 VDC) is applied to Molex connector P910-5 at the rear of the radio. This is accomplished by temporarily jumpering P910-9 (CG DISABLE) to P910-11 (A+). This positive voltage is applied to the base of Q1003, turning on both Q1003 and Q1004.

When turned on, Q1004 applies +8.5 VDC to the base of PTT Switch Q1001, forcing it off. With Q1001 off, the operating voltage for the encoder IC U1002 and Encode Tone Output Stage transistor Q1002 is removed, preventing any tone output.

CAUTION

When using the Encode Disable circuit, do not remove the microphone from the optional hookswitch (if present) or place the monitor switch on the hookswitch in the "up" position. In station applications, do not place the CG MON Switch on the desk microphone in MON position. This will short the supply voltage to ground, resulting in possible damage to the equipment.

POWER DISTRIBUTION

The battery voltage (A+) connects to the radio through J910-1 and J910-11 at the rear system connector to the IOC board. Both inputs are connected to reverse polarity protection diodes D901 and D902. The ground lead is coupled through the same connector and is connected to chassis ground through a fusable printed wiring run which will open if the ground wire is accidently connected to A+ (see Figure 2).

One battery input goes directly from the IOC board through a feed-through capacitor in FL907 to the transmitter PA stages. The other input feeds through P903-6 to the main board for two functions. One branch for the audio amplifier passes through an RC-ripple filter (R642 and C619) and one of the sections of POWER On/Off switch S602. The other section of the POWER On/Off switch controls the A+ to voltage regulator U602. The regulator output is fixed at 8.5 volts by means of selected resistor R640. Refer to the Receiver Schematic Diagram for resistor selection instructions.

Regulated 8.5 volts is switched to either the receiver or the transmitter and Tx indicator by the antenna relay. The antenna relay is also powered by the 8.5 volt regulated supply. The non-latching relay is operated by the PTT switch on the microphone, completing the path to A-.

The squelch circuit, the audio processor and parts of the IF amplifier U502 are supplied directly from the continuous 8.5 volt supply.

The receiver front-end, the receiver oscillator, the 21.4 MHz IF stages and the second oscillator are supplied from 8.5 V Rx. The transmitter oscillator and the exciter are supplied from 8.5 V Tx.

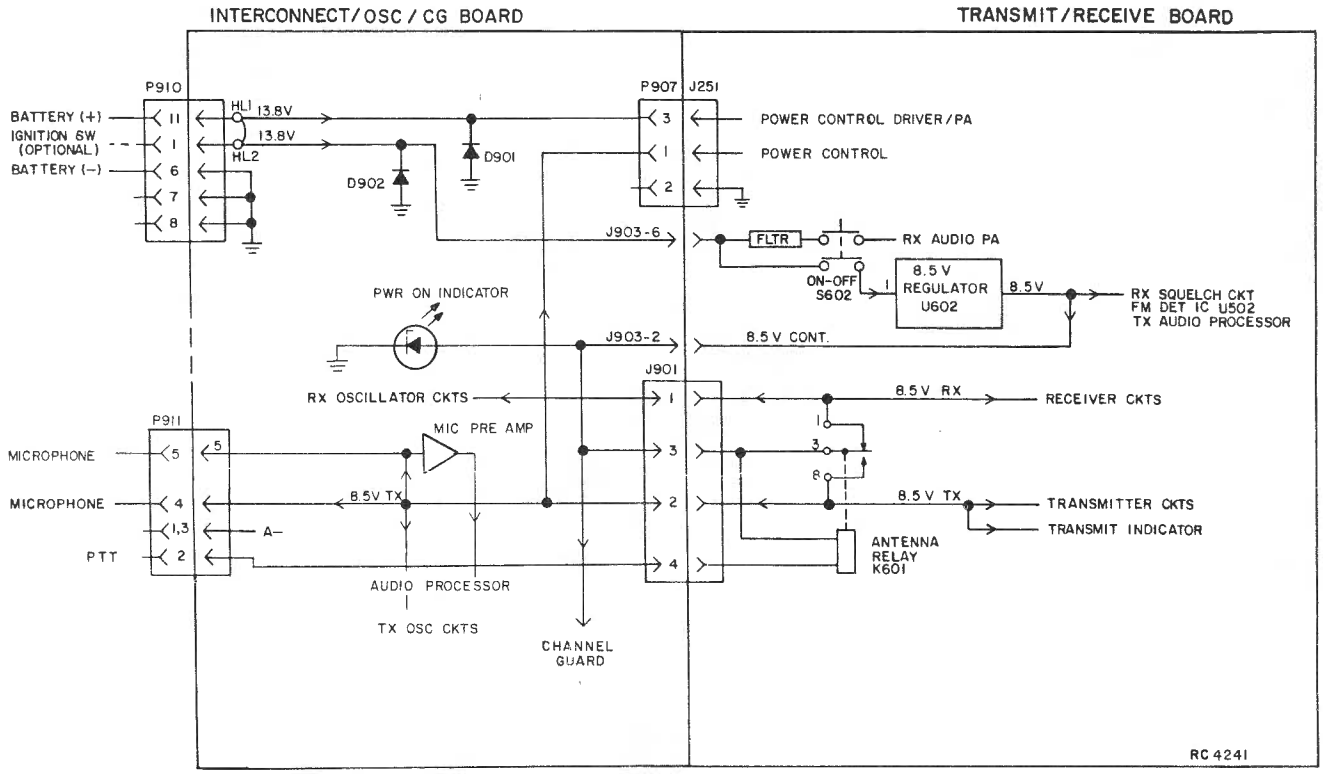


Figure 2 - Power Distribution

MAINTENANCE

PREVENTIVE MAINTENANCE

To insure high operating efficiency and to prevent mechanical and electrical failures from interrupting system operations, routine checks should be made of all mechanical and electrical parts at regular intervals. This preventive maintenance should include the checks as listed in the table of Maintenance Checks.

MAINTENANCE CHECKS	INTERVAL	
	6 Months	As Required
CONNECTIONS - Ground connections and connections to the voltage source should be periodically checked for tightness. Loose or poor connections to the power source will cause excessive voltage drops and faulty operation. When ground connections are not made directly to the battery, the connection from the battery to vehicle chassis must be checked for low impedance. A high impedance may cause excessive voltage drops and alternator noise problems.	X	
ELECTRICAL SYSTEM - Check the voltage regulator and alternator or generator periodically to keep the electrical system within safe and economical operating limits. Over-voltage is indicated when the battery loses water rapidly. Usage of 1 or 2 ounces of water per cell per week is acceptable for batteries in continuous operation. A weak battery will often cause excessive noise or faulty operation.		X
MECHANICAL INSPECTION - Since mobile units are subject to constant shock and vibration, check for loose plugs, nuts, screws and parts to make sure that nothing is working loose.	X	
ANTENNA - The antenna, antenna base and all contacts should be kept clean and free from dirt or corrosion. If the antennas or its base should become coated or poorly grounded, loss of radiation and a weak signal will result.	X	
ALIGNMENT - The transmitter and receiver meter readings should be checked periodically, and the alignment "touched up" when necessary. Refer to the applicable ALIGNMENT PROCEDURE and troubleshooting sheet for typical voltage readings.		X
FREQUENCY CHECK - Check transmitter frequency and deviation as required by FCC. Normally, these checks are made when the unit is first put into operation, after the first six months and once a year thereafter.		X

DISASSEMBLY

- To service the transmitter/receiver (Tx-Rx) board, loosen the two screws securing the bottom cover at the rear of the radio. Then slide the cover out from under the edge of the front control panel and lift off.
- To service the IOC board, loosen the two screws at the rear of the radio and slide the cover out from the edge of the front control panel and lift off.

NOTE

Be careful when removing the top cover as the speaker leads are connected to the board.

- To remove the Tx-Rx board:
  1. Remove the top and bottom covers.
  2. Remove the four screws securing the front panel to the "H" frame and remove the front panel.

3. Remove the eight screws securing the RF shield.

4. Unsolder the antenna connector and remove the two retaining screws.

5. Remove the two screws in the PA transistor Q253.

6. Turn the radio over and remove the hex screw post, washer and copper spacer from the stud of Driver transistor Q252.

7. Remove the 9 screws securing the Tx-Rx board and carefully lift up the board off of the interconnections pins.

- To remove the interconnect/ multi-frequency board:

1. Remove the top cover.

2. In multi-frequency units, remove the five screws securing the RF shield.

3. Remove the 12 screws securing the board and carefully lift the board up to disconnect the interconnection pins.

DRIVER AND PA TRANSISTOR REPLACEMENT

WARNING

The stud mounted RF Power Transistors used in the transmitter contain Beryllium Oxide, a TOXIC substance. If the ceramic or other encapsulation is opened, crushed, broken or abraded, the dust may be hazardous if inhaled. Use care in replacing transistors of this type.

To replace PA RF transistors Q252 and Q253:

1. Remove Tx/Rx board.

2. Unsolder one lead at a time with a 50 watt soldering iron. Use a scribe or X-actro© knife to hold the lead away from the printed circuit board until the solder cools.

3. Lift out the transistor, and remove the old solder from the printed circuit board with a de-soldering tool such as a SOLDA PULLT©. Special care should be taken to prevent damage to the printed circuit board runs because part of the matching network is included in the base and collector runs.

4. Trim the new transistor leads (if required) to the lead length of the removed transistor. The letter "C" on the top of the transistor also indicates the collector (see Figure 3 for transistor lead identification).

5. Apply a coat of silicon grease between the mounting surfaces of the spacer and to both sides of the insulator of Q252 and between the mounting surfaces of Q253 and the heat sink and on both ends of the spacer. Place the transistor in the mounting hole. Align the leads as shown on the Outline Diagram. Then hold the body of the transistor and replace the transistor mounting hardware, using moderate torque of 0.6 Newton meters (Nm) or 6 inch pounds) for M2.5 screw size and 1.0 Nm (8 inch pounds) for the hex screw post. A torque wrench must be used for this adjustment since transistor damage can result if too little or too much torque is used.

6. Solder the leads to the printed circuit pattern. Start at the inner edge of mounting hold and solder the remaining length of transistor lead to the board. Use care not to use excessive heat that causes the printed wire board runs to lift up from the board. Check for shorts and solder bridges.

CAUTION

Failure to solder the transistor leads as directed may result in the generation of RF loops that could damage the transistor or may cause low power output.

7. Replace Tx/Rx board and reassemble radio.

REMOVING IC'S

Removing IC's (and all other soldered-in components) can be easily accomplished by using a de-soldering tool such as a SOLDA PULLT© or equivalent. To remove an IC, heat each lead separately on the solder side and remove the old solder with the de-soldering tool.

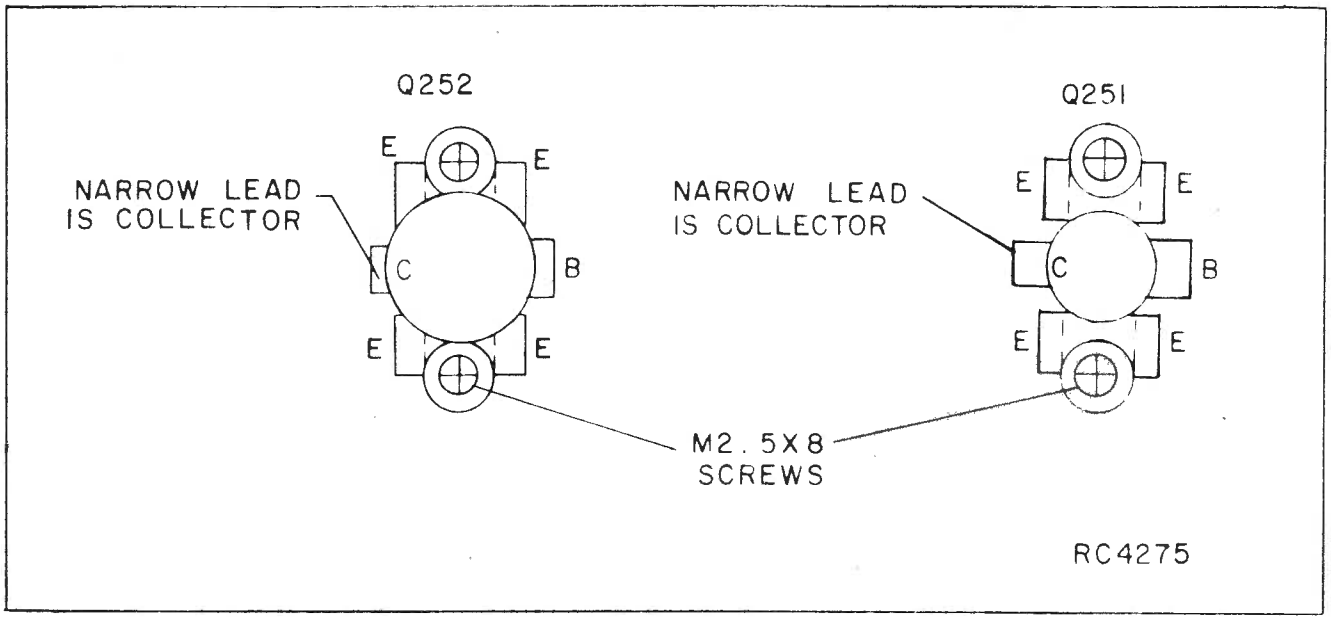


Figure 3 - Q251 Lead Identification

An alternate method is to use a special soldering tip that heats all of the pins simultaneously.

TEST AND TROUBLESHOOTING PROCEDURES

Maintenance of radio is facilitated by use of the Troubleshooting Charts and servicing techniques unique to this radio. The Troubleshooting Chart is designed to lead you rapidly to the defective component or circuit. Typical voltage readings are provided on the Schematic Diagram for your reference when troubleshooting.

Troubleshooting charts are provided for most major problems that might arise in the Transmitter/Receiver section of the radio.

SERVICING TECHNIQUES

The high density plug-in design of the modular radio lends itself well to rapid isolation of malfunctions in the voltage and signal paths. A majority of the signals and voltages pass through the connectors on the IOC board.

To isolate a signal or voltage path to determine loading effects, locate short circuits, etc. carefully insert an insulator (plastic wand, toothpick) between the appropriate pins of the related Molex connector to create an open circuit. Signals paths that may be isolated include: Volume SQ HI, filtered volume squelch HI, PTT, Rx MUTE, and SPKR HI.

TEST POINTS

RF Detector probes for the receiver section are available for alignment purposes and to monitor the 1st receiver injection at TP401 and the 2nd IF at TP501. An RF signal probe also is available to monitor the transmitter frequency.

Seven test points are provided at critical circuit locations to monitor operation.

They are as follows:

TRANSMITTER	RECEIVER
TP201 AMPL 1 (Q201) Emitter Voltage	TP351 Tripler Output - Q351
TP202 TRIPLER (Q202) Base Voltage	TP401 Receiver 1st oscillator injection
TP203 AMPL 3 (Q204) Relative Output	TP501 455 kHz IF
TP251 AMPL 4 (Q251) Relative Output	

CAUTION

Before bench testing the radio, be sure of the output voltage characteristics of your bench power supply.

To protect the transmitter power output transistors from possible instant destruction, the following input voltages must not be exceeded:

Transmitter unkeyed: 20 Volts

Transmitter keyed (50 ohm resistive load): 18 Volts

Transmitter keyed (no load or non-resistive load): 15.5 Volts

These voltages are specified at the normal vehicle battery terminals of the radio and take the voltage drop of standard cables into account. The voltage limits shown for a non-optimum load is for "worst case" conditions. For antenna mismatches likely to be encountered in practice, the actual limit will approach the 18 Volt figure.

Routine transmitter tests should be performed at EIA Standard Test Voltages (13.8 VDC for loads of 0 to 6 amperes: Input voltages must not exceed the limits shown, even for transient peaks of short duration.

Many commonly used bench power supplies cannot meet these requirements for load regulation and transient voltage suppression. Bench supplies which employ "brute force" regulation and filtering may be usable when operated in parallel with a 12 Volt automotive storage battery.

GENERAL ELECTRIC COMPANY • MOBILE COMMUNICATIONS DIVISION
WORLD HEADQUARTERS • LYNCHBURG, VIRGINIA 24502 U.S.A.

GENERAL ELECTRIC*
U.S.A.

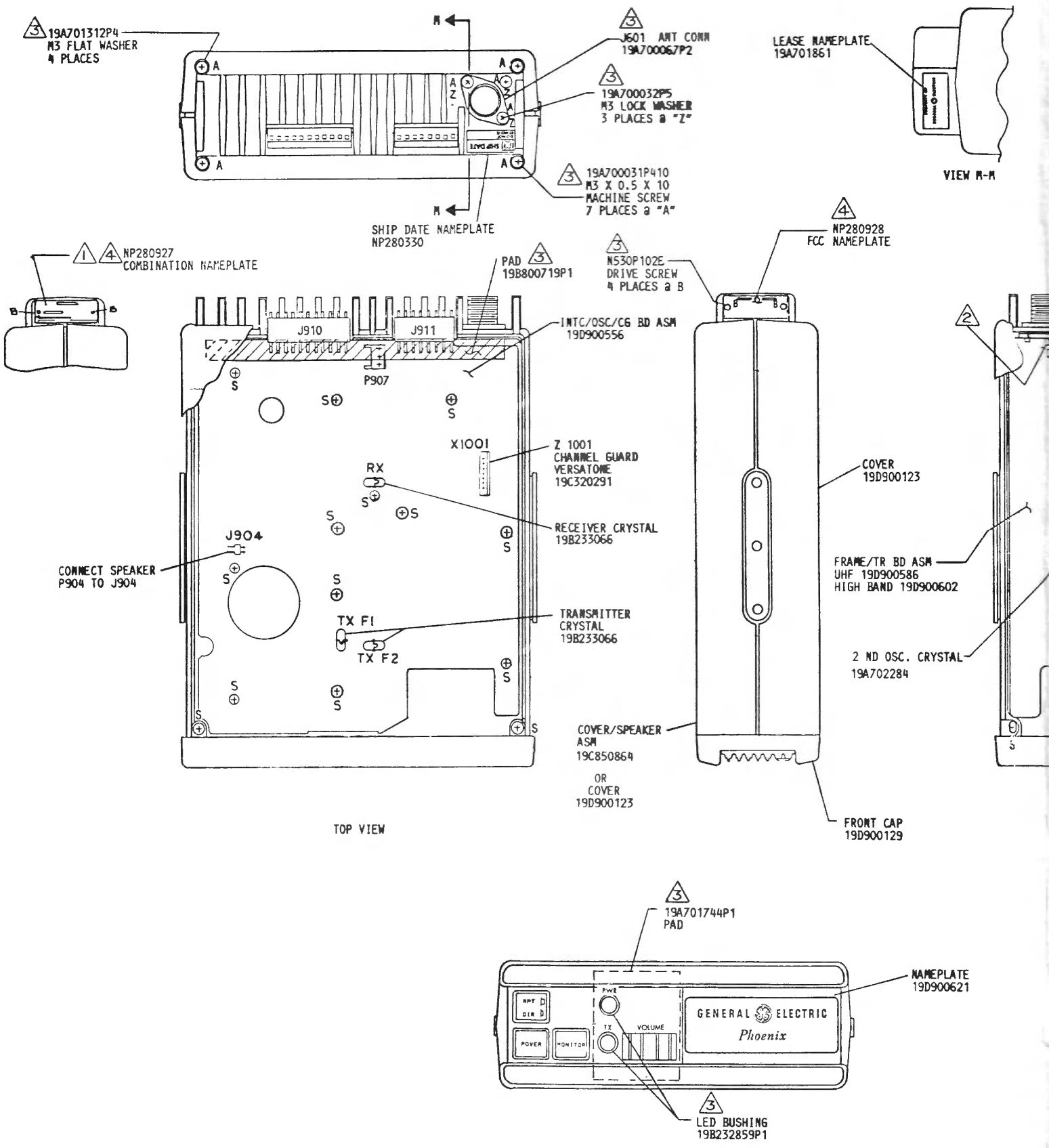
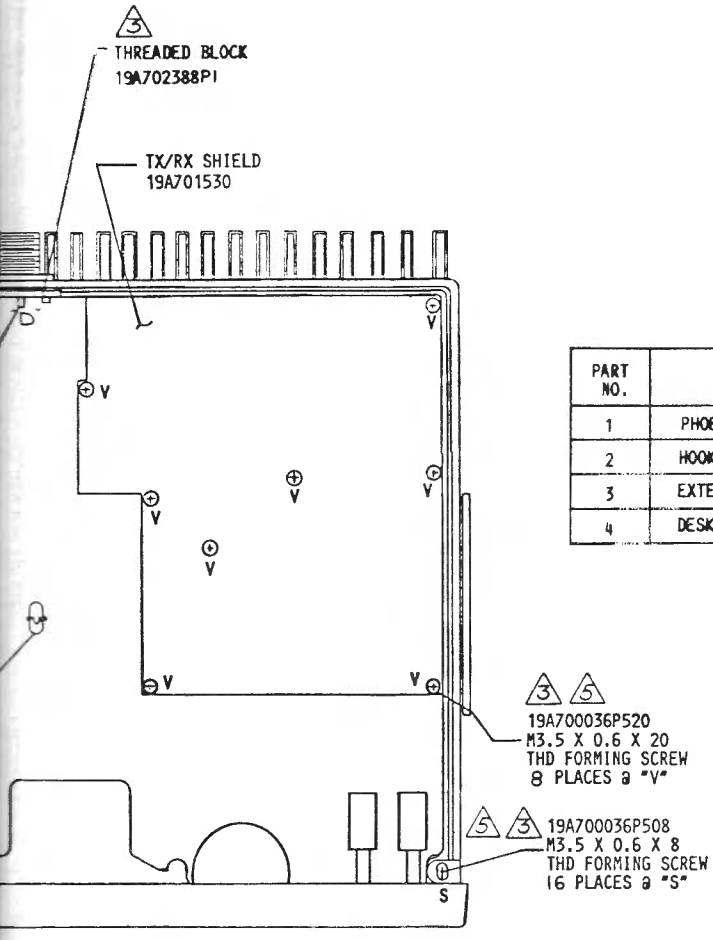


Figure 4 - Mechanical Layout

(19D900640, Sh. 1,

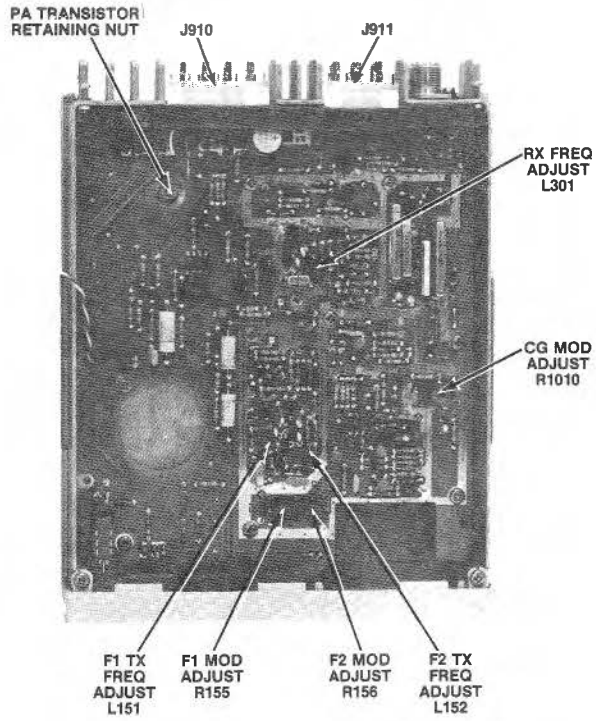


PART NO.	DESCRIPTION
1	PHOENIX/HIGH BAND & UHF
2	HOOKSWITCH APPLICATION
3	EXTERNAL SPEAKER APPLICATION
4	DESK MICROPHONE WITH CHANNEL GUARD

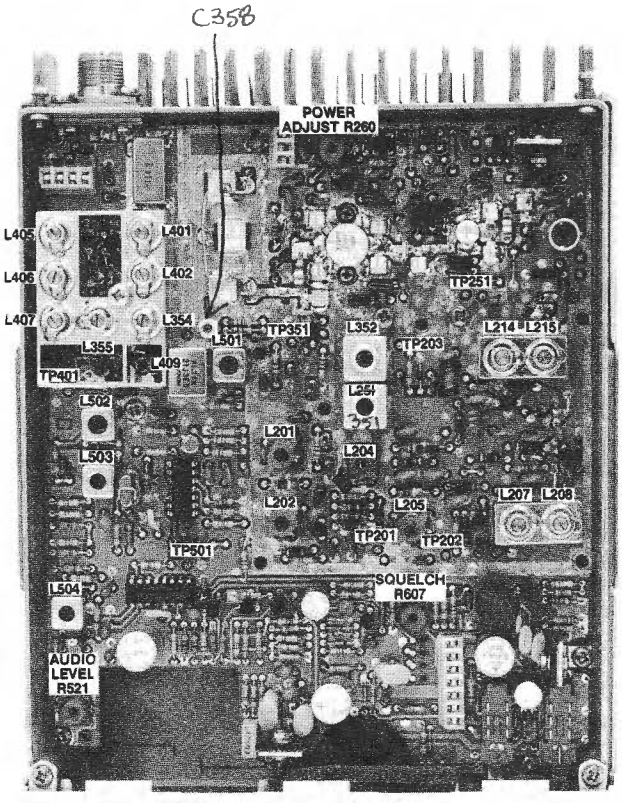
BOTTOM VIEW

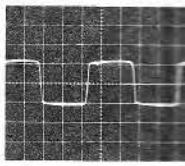
NOTES:

1. MARK AND APPLY PER 19A122529.
2. SOLDER ANT CONNECTOR ONE PLACE @ "D"
3. PART OF KIT PL 19A701522.
4. BEND NAMEPLATE SLIGHTLY TO ACCOUNT FOR TAPER IN CASTING.
5. DIP ENDS OF THD FORMING SCREWS INTO LUBRICANT 19A115204P1 BEFORE INSTALLING IN CASTING.



IOC BOARD

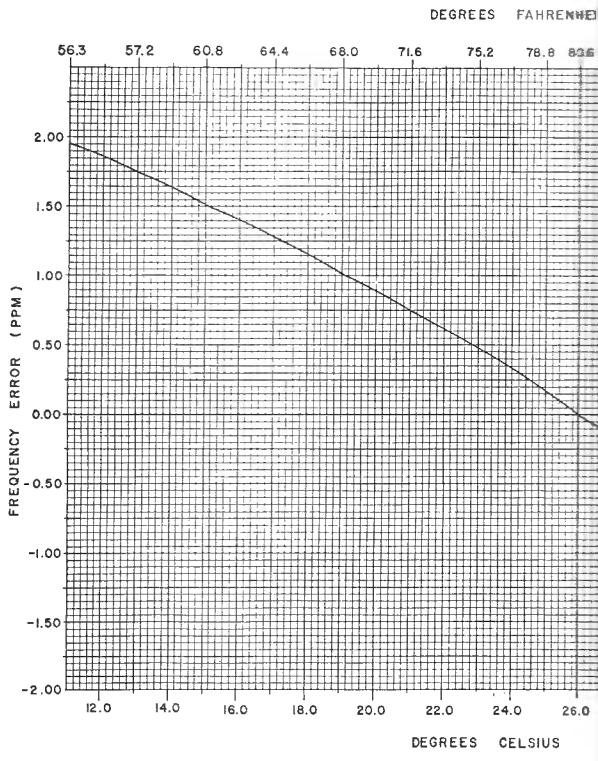


SCOPE SETTING		U101-7
	HORIZONTAL	200 U SEC/DIV
	VERTICAL	2 VOLTS/DIV
SET AUDIO OSCILLATOR AT 1000 Hz WITH OUTPUT OF 1.0 VRMS. R155 ADJUSTED FOR 3.75 KHz DEVIATION. NOTE: AN RMS OR PEAK READING VOLT METER WILL READ 1/2 TO 1/3 OF PEAK-TO-PEAK READINGS.		

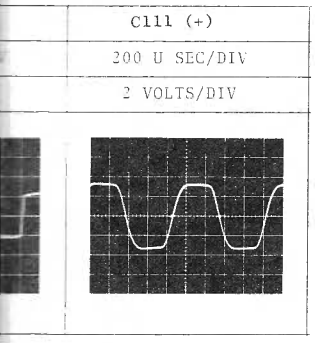
AUDIO SENSITIVITY

1. Connect audio oscillator output across J911-4 just output for 1000 Hz at 1.0 VRMS.

2. Reduce generator output until deviation falls less than 120 millivolts.

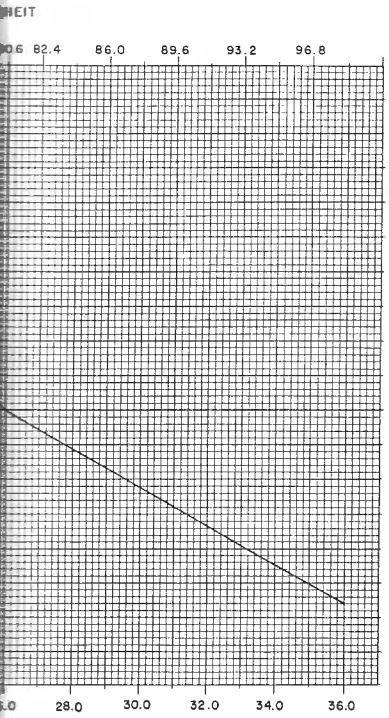


Frequency Offset Ch



-4 (Mic Hi) and J911-3 (Mic Lo). Ad-

ls to 2.25 KHz. Voltage should be



Chart

CRYSTAL OSCILLATOR FREQUENCY ADJUSTMENT

First, check the frequency to determine if any adjustment is required. The frequency should be set with a frequency meter or counter with an absolute accuracy that is 5 to 10 times better than the tolerance to be maintained, and with the entire radio as near as possible to an ambient temperature of 27.0°C (80.6°F).

The oscillator should be reset only when the frequency shows deviation in excess of the following limits:

- ±0.5 PPM, when the radio is at 27.0°C (80.6°F).
- The specification limit of ±5 PPM at any temperature within the ranges of -30°C (-22°F) to +60°C (+140°F).

If the radio is at an ambient temperature of 27.0°C (80.6°F), set the oscillator for the correct operating frequency.

If the radio is not at an ambient temperature of 27.0°C, offset the oscillator, as a function of actual temperature, by the amount shown in the Frequency Off-set Chart.

For example: Assume the ambient temperature of the radio is 22°C (71.6°F). At that temperature, the curve shows a correction factor of +0.75 PPM. (At 450 MHz, 1 PPM is 450 Hz. At 470 MHz, 1 PPM is 470 Hz.)

With an operating frequency of 450 MHz, set the oscillator for a reading of 337.5 Hz (0.75 x 450 Hz) higher than the licensed operating frequency. If a negative correction factor is obtained (at temperatures above 27.0°C), set the oscillator for the indicated PPM lower than the licensed operating frequency.

TRANSMIT FREQUENCY ADJUSTMENT

When setting the transmitter oscillator frequency, adjust L151 OR L152 to the assigned operating frequency. Always set the lower frequency first.

FREQUENCY AND MODULATION ADJUSTMENT

TEST EQUIPMENT REQUIRED

1. Audio Oscillator
2. Deviation Monitor
3. AC Voltmeter
4. Wattmeter, 50 ohm, 50 Watts
5. Frequency Counter

FREQUENCY ADJUSTMENT

Set the transmitter oscillator frequency by adjusting L151 (RPT) and L152 (DIR) to the assigned operating frequency.

NOTE

Always set the frequency first before setting the modulation.

MODULATION LEVEL ADJUSTMENT

CAUTION

DO NOT remove microphone from the optional hookswitch (if present), or place CG MON switch to MON position when making this adjustment. DAMAGE to equipment will result.

A Channel Guard Encode Disable circuit has been incorporated as a maintenance aid to allow the service technician to make transmitter distortion and modulation checks without removing the cover from the radio.

The CG encode circuit can be easily disabled by temporarily connecting a jumper from J910-11 (A+) to J910-9 (CG DISABLE lead).

MOD ADJUST Controls R155 and R156 have been adjusted to the proper setting before shipment and normally do not require readjustment. This setting permits approximately 75% modulation for the average-voice level.

NOTE

The Channel Guard modulation level adjustment should be checked each time the tone frequency is changed.

PROCEDURE

1. Connect the audio oscillator and the AC voltmeter across audio input terminals J911-4 (Hi) and J911-3 (Lo) on the IOC board.
2. Adjust the audio oscillator for 1 Volt RMS at 1000 Hz.
3. Connect RF Wattmeter to antenna jack.

   Set CHANNEL GUARD MOD ADJUST R1010 for zero tone deviation. Next, with the 1 Volt signal at 1000 Hz applied, set MOD ADJUST R155 (F1) for 3.75 kHz deviation. Switch to F2 and adjust R156 for the same deviation. Then remove the signal from the audio oscillator and set Channel Guard MOD ADJUST R1010 for 0.75 kHz tone deviation.

NOTE

If the deviation reading plus (+) or minus (-) differs more than 0.5 kHz, recheck Step 1 as shown in the Transmitter Alignment Chart.

TRANSMITTER ALIGNMENT

TEST EQUIPMENT

1. 50-ohm Wattmeter
2. 50-ohm Load
3. DC Probe (19C330165G1)
4. Voltmeter (20,000 ohms-per-volt)
5. 13.8 V Regulated Power Supply
6. Audio Signal Generator
7. Frequency Counter

PRELIMINARY CHECK AND ADJUSTMENTS

NOTE

Refer to photographs to locate CONTROLS, TEST POINTS and CRYSTALS.

1. Install the transmit crystals in the appropriate sockets.
2. Set the tuning cores in L201, L202, L204, and L205, so that the tops of these cores are flush with the tops of the plastic coil forms. Then, turn the core in L201 2 turns clockwise and turn the core in L202 4 turns clockwise.

Preset L207, L208, L214, and L215 so that the tops of the tuning screws are 1/8 inch (3MM) above the tops of the bushings on the castings. Set RPT/DIR frequency switch to the lower frequency used.

NOTE

When tuning L207, L208, L214, and L215, some of the coils may peak with the tuning screws coming out of their castings. This should only occur near the top end of the band. If it does, the affected screw(s) should be turned clockwise just to the point where the meter reading(s) begin to change, and then turned 1/4 to 1/2 turn counterclockwise.

3. Set power adjust control R260 to maximum (fully clockwise).
4. All adjustments are made with transmitter keyed. Unkey the transmitter between steps to avoid overheating.
5. The DC probe and voltmeter set on the 1 Volt DC scale is used to monitor TP201-TP203 when aligning the transmitter.
6. Transmit Frequency is set by L151 and L152.
7. Check P903-2 for 8.5 volts ±0.15 volt.

AUDIO OSCILLATOR 1000 Hz 1.0 VRMS

ALIGNMENT PROCEDURE

STEP	TEST PROBE	TUNING CONTROLS	METER READING	PROCEDURE
1.	TP201	L151,L152 L201,L202	Maximum (+0.35V Typ.)	Adjust L151, L152 L201 and L202 in that order for maximum meter reading. Do NOT adjust L151/L152. The transmitter has previously been set on frequency.
2.	TP201	L204	Minimum (+0.15V Typ.)	Adjust L204 for minimum meter reading.
3.	TP201	L205	Maximum (+0.30V Typ.)	Adjust L205 for maximum meter reading.
4.	TP202	L201,L202 L204,L205	Maximum (-1.10V Typ.)	Readjust L201, L202, L204 and L205 in that order for maximum meter reading.
5.	TP202	L207	Minimum (-1.0V Typ.)	Adjust L207 for minimum meter reading.
6.	TP203	L208	Maximum (-1.25V Typ.)	Adjust L208 for maximum meter reading.
7.	TP203	L205,L207 L208	Maximum (+1.00V Typ.)	Readjust L205, L207, and L208 in that order for maximum meter reading.
8.	TP203	L214	Minimum (+0.10V Typ.)	Adjust L214 for minimum meter reading.
9.	TP203	L215	Maximum (+0.65V Typ.)	Adjust L215 for maximum meter reading.
10.		L214, L215	Maximum (+0.80V Typ.)	Readjust L214 and L215 for maximum, in that sequence. Wattmeter should indicate at least 20 watts.
11.	TP201	L152	Maximum (20-25 Watts)	Switch the radio to the higher frequency used, and adjust L151/L152 for this higher frequency.
12.	--	--	Rated Power	Wattmeter should indicate at least 20 watts on this channel also. If not, slight readjustments of L207, L208, L214, and/or L215 may be necessary. Switch back and forth between both channels to ensure each channel delivers at least 20 watts after adjustments are completed.
13.	Wattmeter	R260	Rated Power	If necessary, readjust R260 for rated power output.

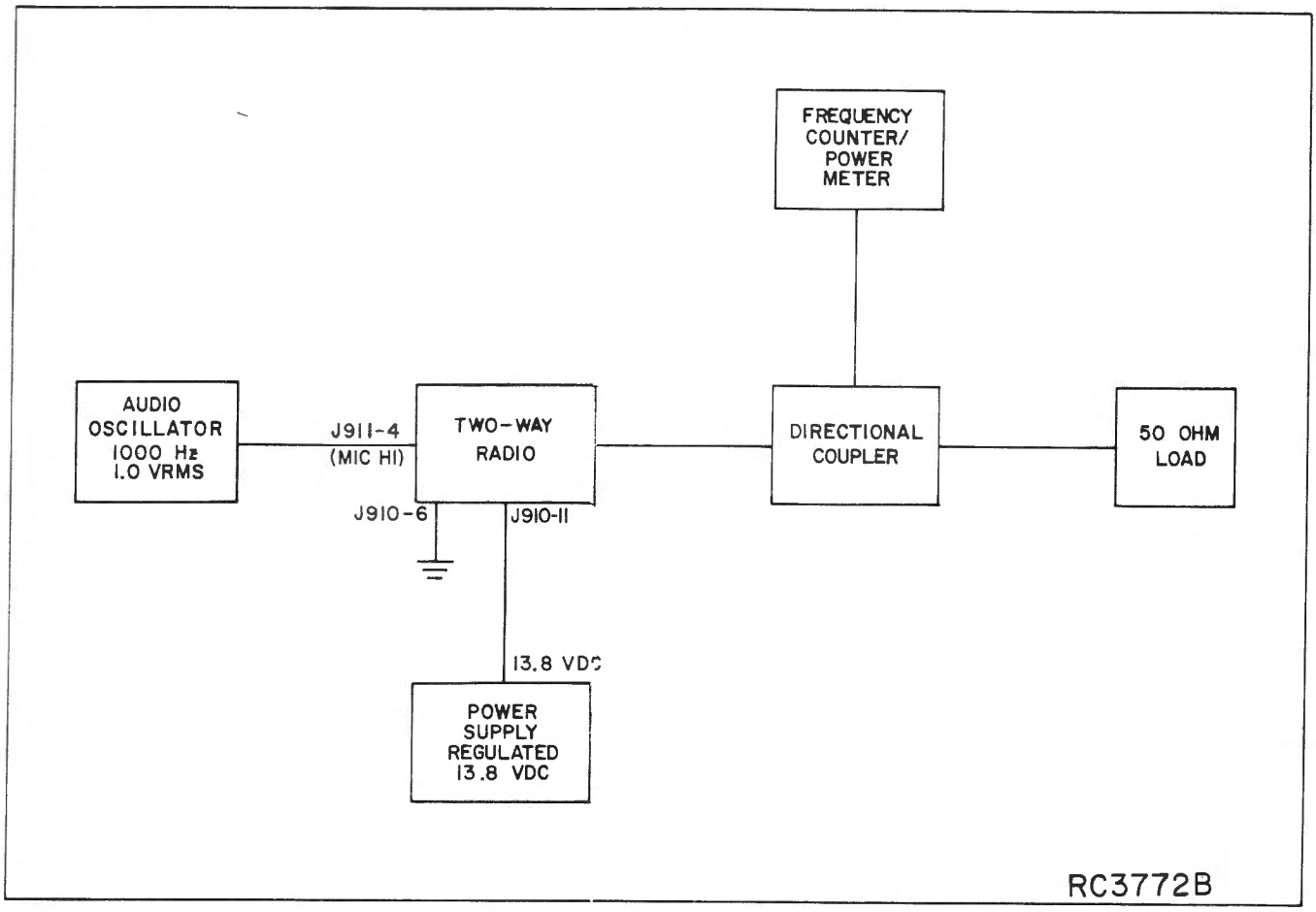


Figure 5 - Test Equipment Set Up

RECEIVER ALIGNMENT

EQUIPMENT REQUIRED

1. RF Signal Generator (450-470 MHz)
2. DC Voltmeter
3. AC Voltmeter
4. Receiver RF Detector Probe 19C330130G2
5. RF Signal Probe 19C330129G1
6. DC Probe 19C330165G1
7. Power Supply, 13.8 V Regulated
8. VOM (20K ohms/volt)
9. 4 ohm, 5 watt resistor

PRELIMINARY CHECKS

1. Plug crystal Y301 into oscillator socket X301.
2. Disable Channel Guard by removing microphone from the optional Channel Guard hookswitch (if present), or by connecting ground to J910-9.
3. Disconnect internal speaker from J904 on IOC board. Terminate either J910-3 or J904 with a 4 ohm, 5 watt resistor.

NOTE

Refer to photographs to locate CONTROLS, TEST POINTS AND CRYSTALS.

ALIGNMENT PROCEDURE

STEP	METERING TEST POINT	PROBE	TUNING CONTROL (s)	PROCEDURE
			1ST OSCILLATOR MULTIPLIER	
1.	TP351	DC Probe	L301	With voltmeter on lowest range adjust L301 for maximum meter reading. NOTE If no meter indication is observed at TP351, connect positive lead of RF Detector probe (red dot) to J301 using a short piece of DA jumper wire (AWG #18 or smaller - 1.024 mm). See photograph for access to J301. Adjust L301 for maximum meter reading then reconnect DC Probe to TP351.
2.	TP351	DC Probe	L351,L352	Alternately adjust L351 and L352 for maximum meter reading.
3.	TP351	DC Probe	~~L358~~ C358,L354 L355	Adjust C358 for dip then peak L354 and dip L355.
4.	TP401	RX RF Detector	C358,L355 L354	Adjust L355 then L354 and ~~C314~~ C358 for maximum meter reading. Continue peaking these controls until no further improvement is recorded. (Typically 0.6 volts.)
5.	TP401	RF Signal	L301	Connect a frequency counter to TP401 using RF signal Probe. Adjust L301 for channel operating frequency.
			IF ALIGNMENT	
6.	TP401, TP501	RF Signal RF DETECTOR	L409,L503 L502,L501	Connect RF signal generator to TP401 using RF Signal Probe. Connect RF DETECTOR Probe and VOM to TP501. Use 0.5 to 1.0 V scale. Set RF signal generator output to channel frequency at the minimum level sufficient to provide a mid scale meter indication. Reduce the output of the signal generator as required to keep the detected RF level within the 0.5 to 1.0 volt range. Adjust L409 first, then L503, L502 and L501 respectively for maximum indication on meter. Alternately adjust L409 and L501 to obtain maximum meter reading. Disconnect RF Signal Generator from TP401.

STEP	ME TES
7.	T
8.	T
9.	T
10.	T
11.	T
12.	—
13.	A O
14.	
15.	P
16.	
17.	

1. Connect
2. Press nomina
3. Set SQ
4. Adjust
5. Adjust
6. Check (±1 dB

STEP	METERING TEST POINT	PROBE	TUNING CONTROL (s)	PROCEDURE
			FRONT END ALIGNMENT	
7.	TP501	Rx RF DETECTOR	---	Connect signal generator to Antenna input jack J601. Verify Rx RF Detector Probe is connected to TP501 and VOM. Adjust signal generator to RF channel frequency. Adjust output level of signal generator for a VOM reading between 0.5 and 1.0 Volts.
8.	TP501	Rx RF DETECTOR	L405,L406 L407	Detune L405 and L407 as much as possible. Tune L406 through entire range while noticing peak readings on VOM. Adjust L406 for maximum meter reading, reducing the output level of signal generator as required. DO NOT Readjust L406 after peaking. Alternately readjust L407 and L405 for maximum VOM reading.
9.	TP501	Rx RF DETECTOR	L402,L401	Alternately adjust L402 and L401 for maximum VOM reading. Reduce generator output to maintain a VOM reading of 0.5 to 1.0 Volts.
10.	TP501	Rx RF DETECTOR	~~L308~~ L355	Carefully adjust L355 (±1/4 turn) for maximum meter reading.
11.	TP501	Rx RF DETECTOR	L405,L410 L407,~~L402~~	Alternately adjust L409, L407 and L405 for maximum meter reading.
12.	---	---	---	Remove all test equipment.
			DETECTOR/AUDIO ALIGNMENT	
13.	Audio Output	---	L504	Apply a 1000 uV RF signal modulated with 1000 Hz to antenna input jack J601. Connect external speaker leads J910-3, J910-7 to a four-ohm resistive load. Set audio level control R521 and volume control R634 to mid position. Connect AC voltmeter/distortion analyzer across four ohm load. Adjust L504 for maximum meter reading. Reduce volume control as necessary to keep output voltage from exceeding 2.0 VRMS.
14.		---	L501,~~L406~~ L409	Adjust volume control for a level of 2.0 VRMS on AC voltmeter. Note the position of tuning slugs in L501 and L409. Slowly adjust L501 and L409 ±1/4 turn for minimum distortion on distortion analyzer. If no improvement is noted return slugs to original position.
15.	P903-3	---	R521	Connect AC voltmeter having a minimum input impedance of 1 megohm to P903-3. Adjust audio level control R521 for a meter reading of 300 mV RMS ±5 mV.
16.				Reconnect AC voltmeter across external speaker leads, J910-3 (SPKR HI) and J910-7 (SPEAKER LO). Adjust volume control for 3 Watts (3.46 VRMS across 4 ohm load).
17.				Measure audio distortion using Distortion Analyzer. Distortion should be less than 5%. Disconnect all test equipment.

FIXED SQUELCH ADJUSTMENT

1. Connect a signal generator to antenna jack J601.
2. Press in and hold in the MONITOR pushbutton and adjust the signal generator for a nominal 9 dB SINAD signal.
3. Set SQUELCH CONTROL pushbutton to its "out" position.
4. Adjust squelch control R607 to maximum squelch. Receiver must be muted.
5. Adjust squelch control R607 slowly until receiver unmutes.
6. Check that the squelch opens at an input signal level corresponding to 8 dB SINAD (±1 dBs).

TEST PROCEDURES

These Test Procedures are designed to help you to service a receiver that is operating---but not properly. The problems encountered could be low power, poor sensitivity, distortion, limiter not operating properly, and low gain. By following the sequence of test steps starting with Step 1, the defect can be quickly localized. Once the defective stage is pin-pointed, refer to the "Service Check" listed to correct the problem. Additional corrective measures are included in the Troubleshooting Procedure. Before starting with the Receiver Test Procedures, be sure the receiver is tuned and aligned to the proper operating frequency.

TEST EQUIPMENT REQUIRED

- Distortion Analyzer
- Signal Generator
- 6 dB attenuation pad, and 4.0 ohm, 5 Watt resistor

PRELIMINARY ADJUSTMENTS

NOTE

These procedures are written around the Heathkit Distortion Analyzer. If a Distortion Analyzer other than the Heath IM-12 is used, measure the sensitivity and modulation acceptance bandwidth in accordance with manufacturer's instructions.

1. **PUSH MONITOR PUSHBUTTON "in" to defeat Squelch Circuit. Do not adjust squelch control.**

STEP 1

AUDIO POWER OUTPUT AND DISTORTION

TEST PROCEDURE

Measure Audio Power Output as follows:

A. Apply a 1000 microvolt, on-frequency test signal modulated by 1,000 hertz with ±3.0 kHz deviation to antenna jack J601.

B. With 3 Watt Speaker

Disconnect speaker J904.

Connect a 4.0 ohm, 5 Watt load resistor across J904-1 & 2.

Connect the Distortion Analyzer input across the resistor as shown.

C. Adjust the VOLUME control for 3 Watt output 3.46 VRMS using the Distortion Analyzer as a voltmeter.

D. Make distortion measurements according to manufacturer's instructions. Reading should be less than 5%. If the receiver sensitivity is to be measured, leave all controls and equipment as they are.

SERVICE CHECK

If the distortion is more than 5%, or maximum audio output is less than 3 Watts, make the following checks:

E. Battery and regulator voltage---low voltage will cause distortion. (Refer to Receiver Schematic Diagram for voltages.)

F. Audio Gain (Refer to Receiver Troubleshooting Procedure).

G. FM Detector Alignment (Refer to Receiver Alignment).

STEP 2

USABLE SENSITIVITY (12 DB SINAD)

If STEP 1 checks out properly, measure the receiver sensitivity as follows:

A. Apply a 1000 microvolt, on-frequency signal modulated by 1000 Hz with 3.0 kHz deviation to J601.

B. Place the RANGE switch on the Distortion Analyzer in the 200 to 2000 Hz distortion range position (1000 Hz filter in the circuit). Tune the filter for minimum reading or null on the lowest possible scale (100%, 30%, etc.)

C. Place the RANGE switch to the SET LEVEL position (filter out of the circuit) and adjust the input LEVEL control for a +2 dB reading on a mid range (30%).

D. Set signal generator output to 0.4 μV. Switch the RANGE control from SET LEVEL to the distortion range. Readjust Distortion Analyzer SET LEVEL as required until a 12 dB difference (+2 dB to -10 dB) is obtained between the SET LEVEL and distortion range positions (filter out and filter in).

E. The 12 dB difference (Signal plus Noise and Distortion to noise plus distortion ratio) is the "usable" sensitivity level. The sensitivity should be less than rated 12 dB SINAD specifications with an audio output of at least 1.5 Watts (0.56 Volts RMS across the 4.0 ohm receiver load using the Distortion Analyzer as a Voltmeter).

F. Leave all controls as they are and all equipment connected if the Modulation Acceptance Bandwidth test is to be performed.

SERVICE CHECK

If the sensitivity level is more than rated 12 dB SINAD, check the alignment of the RF stages as directed in the Alignment Procedure.

STEP 3

MODULATION ACCEPTANCE BANDWIDTH (IF BANDWIDTH)

If STEPS 1 and 2 check out properly, measure the bandwidth as follows:

A. Set the Signal Generator output for twice the microvolt reading obtained in the 12 dB SINAD measurement.

B. Set the RANGE control on the Distortion Analyzer in the SET LEVEL position (1000 Hz filter out of the circuit), and adjust the input LEVEL control for a +2 dB reading on the 30% range.

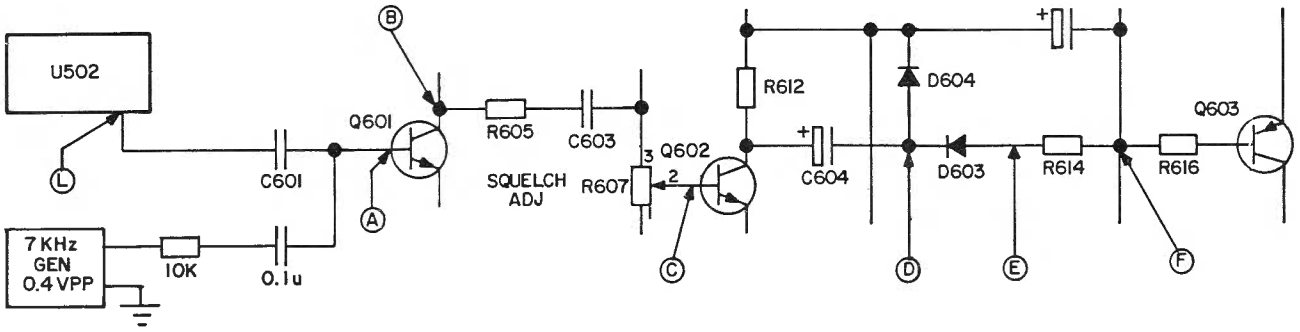
C. While increasing the deviation of the Signal Generator, switch the RANGE control from SET LEVEL to distortion range until a 12 dB difference is obtained between the SET LEVEL and distortion range readings (from +2 dB to -10 dB).

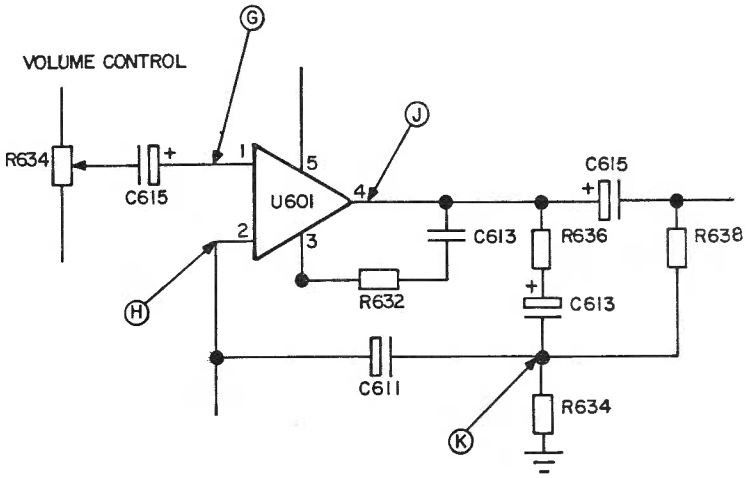
D. The deviation control reading for the 12 dB difference is the Modulation Acceptance Bandwidth of the receiver. It should be more than ±7 kHz.

SERVICE CHECK

If the Modulation Acceptance Bandwidth test does not indicate the proper width, refer to the Receiver Troubleshooting Procedure.

AUDIO AND SQUELCH WAVEFORMS





RC-4260

SQUELCH CIRCUIT T

PRELIMINARY STEPS

1. Quiet receiver with 1000 µV
2. Squelch Adjust at maximum
3. Monitor pushbutton in OUT
4. Use 10 megohm probe

A

HOR. 50 µSEC/DIV
VERT. 0.1 V/DIV
(0.4 V P-P)

B

HOR. 50 µSEC/DIV
VERT. 2 V/DIV
(10 V P-P)

C

HOR. 50 µSEC/DIV
VERT. 1 V/DIV
(5 V P-P)

D

HOR. 50 µSEC/DIV
VERT. 2 V/DIV
(6.2 V P-P)

E

HOR. 50 µSEC/DIV
VERT. 1 V/DIV
(2.5 V P-P)

F

HOR. 50 µSEC/DIV
VERT. 1 V/DIV
(5.5 VDC)

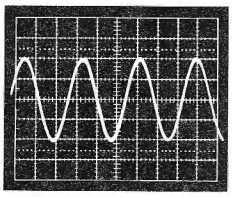
SQUELCH CIRCUIT TEST WITH 7 kHz SIGNAL

PRELIMINARY STEPS

1. Quiet receiver with 1000 uv unmodulated signal.
2. Squelch Adjust at maximum squelch.
3. Monitor pushbutton in OUT position.
4. Use 10 megohm probe.

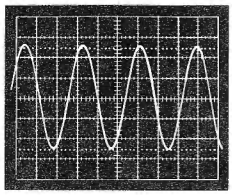
A

HOR. 50 µSEC/DIV
VERT. 0.1 V/DIV
(0.4 V P-P)



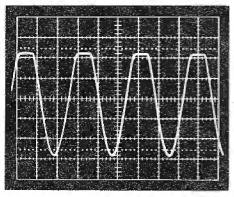
B

HOR. 50 µSEC/DIV
VERT. 2 V/DIV
(8 V P-P)



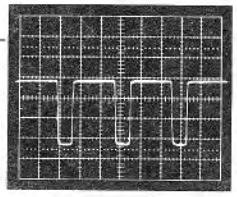
C

HOR. 50 µSEC/DIV
VERT. 1 V/DIV
(5 V P-P)



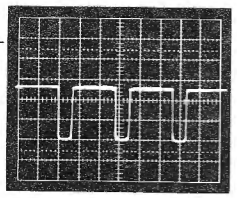
D

HOR. 50 µSEC/DIV
VERT. 2 V/DIV
(6.2 V P-P)



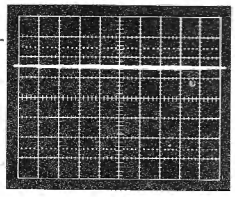
E

HOR. 50 µSEC/DIV
VERT. 1 V/DIV
(2.5 V P-P)



F

HOR. 50 µSEC/DIV
VERT. 1 V/DIV
(5.5 VDC)



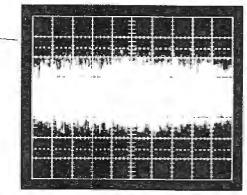
SQUELCH CIRCUIT CHECKS WITH NOISE

PRELIMINARY STEPS

1. No input signal applied.
2. Squelch Adjust at maximum squelch.
3. Monitor pushbutton in OUT position.
4. Use 10 megohm probe.

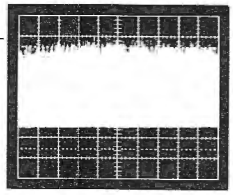
A

HOR. 1 MS/DIV
VERT. 0.5 V/DIV
(≈2 V P-P)



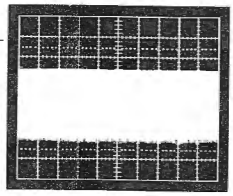
B

HOR. 1 MS/DIV
VERT 5 V/DIV
(≈20 V P-P)



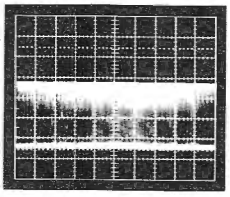
C

HOR. 1 MS/DIV
VERT. 2 V/DIV
(6.8 V P-P)



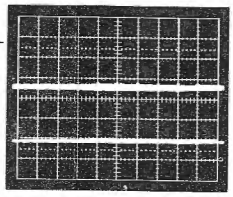
D

HOR. 1 MS/DIV
VERT. 2 V/DIV
(6.2 V P-P)



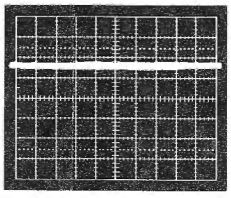
E

HOR. 1 MS/DIV
VERT 1 V/DIV
(2.6 V P-P)



F

HOR. 1 MS/DIV
VERT. 1 V/DIV
(5.6 VDC)



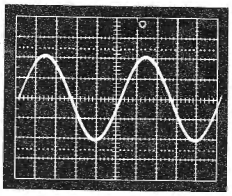
AUDIO CIRCUIT CHECKS

PRELIMINARY STEPS

1. Apply 1000 uv on frequency signal with 1000 Hz modulation and 3 kHz deviation to antenna jack J601.
2. Monitor pushbutton "IN".
3. Output set for 3-Watts (3.46 VRMS) into 4 ohm load.
4. Use 1 megohm probe.

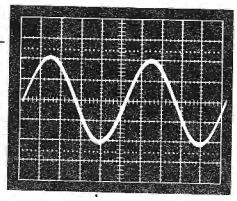
G

HOR. 0.2 MS/DIV
VERT. 20 MV/DIV
(84 MV P-P)



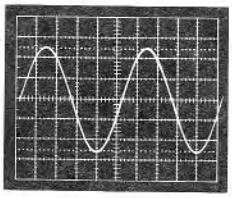
H

HOR. 0.2 MS/DIV
VERT. 20 MV/DIV
(84 MV P-P)



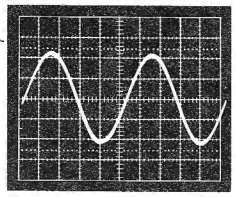
J

HOR. 0.2 MS/DIV
VERT. 2 V/DIV
(9.8 V P-P)



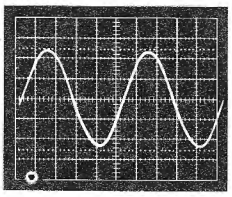
K

HOR. 0.2 MS/DIV
VERT. 20 MV/DIV
(86 MV P-P)

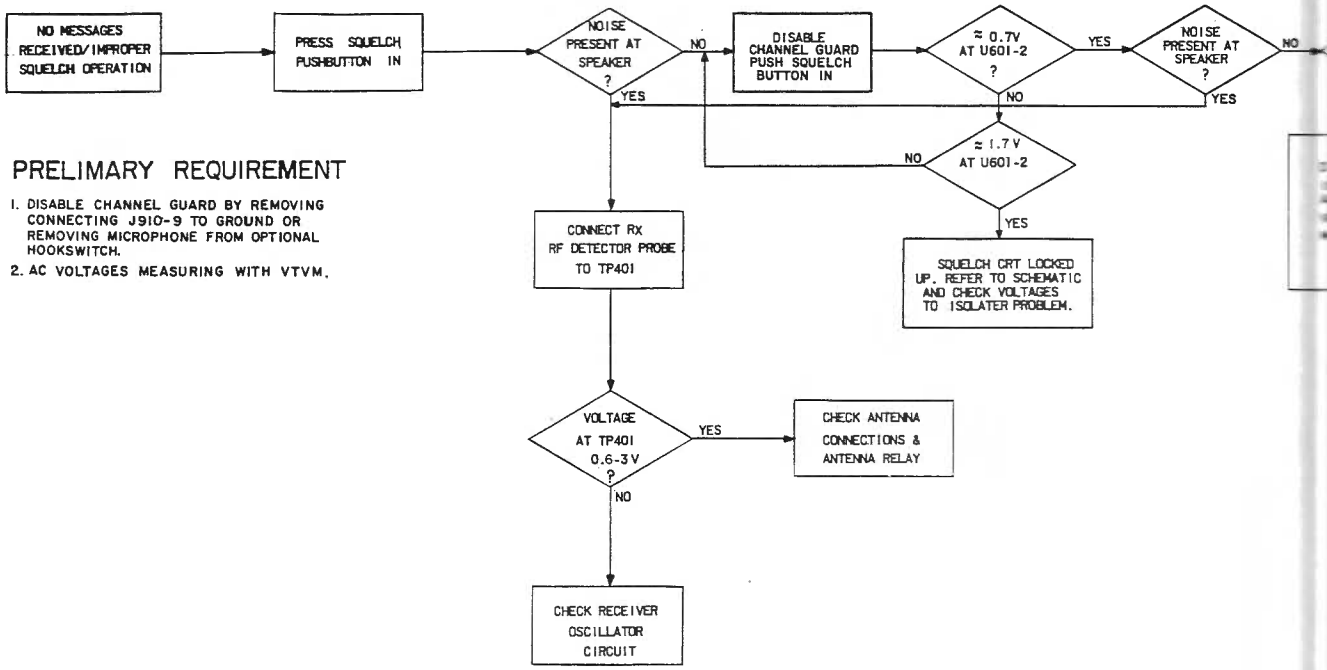


L

HOR. 0.2 MS/DIV
VERT. 0.2 V/DIV
(0.92 V P-P)

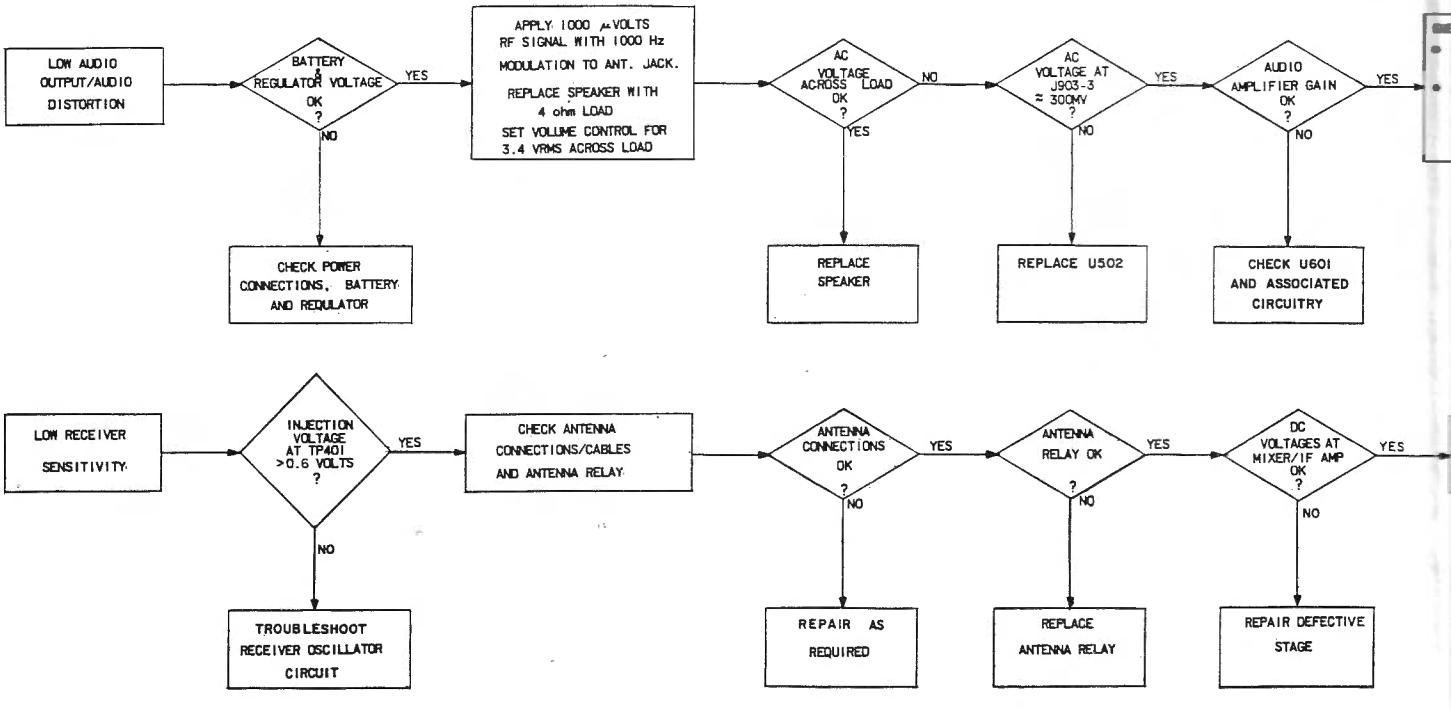


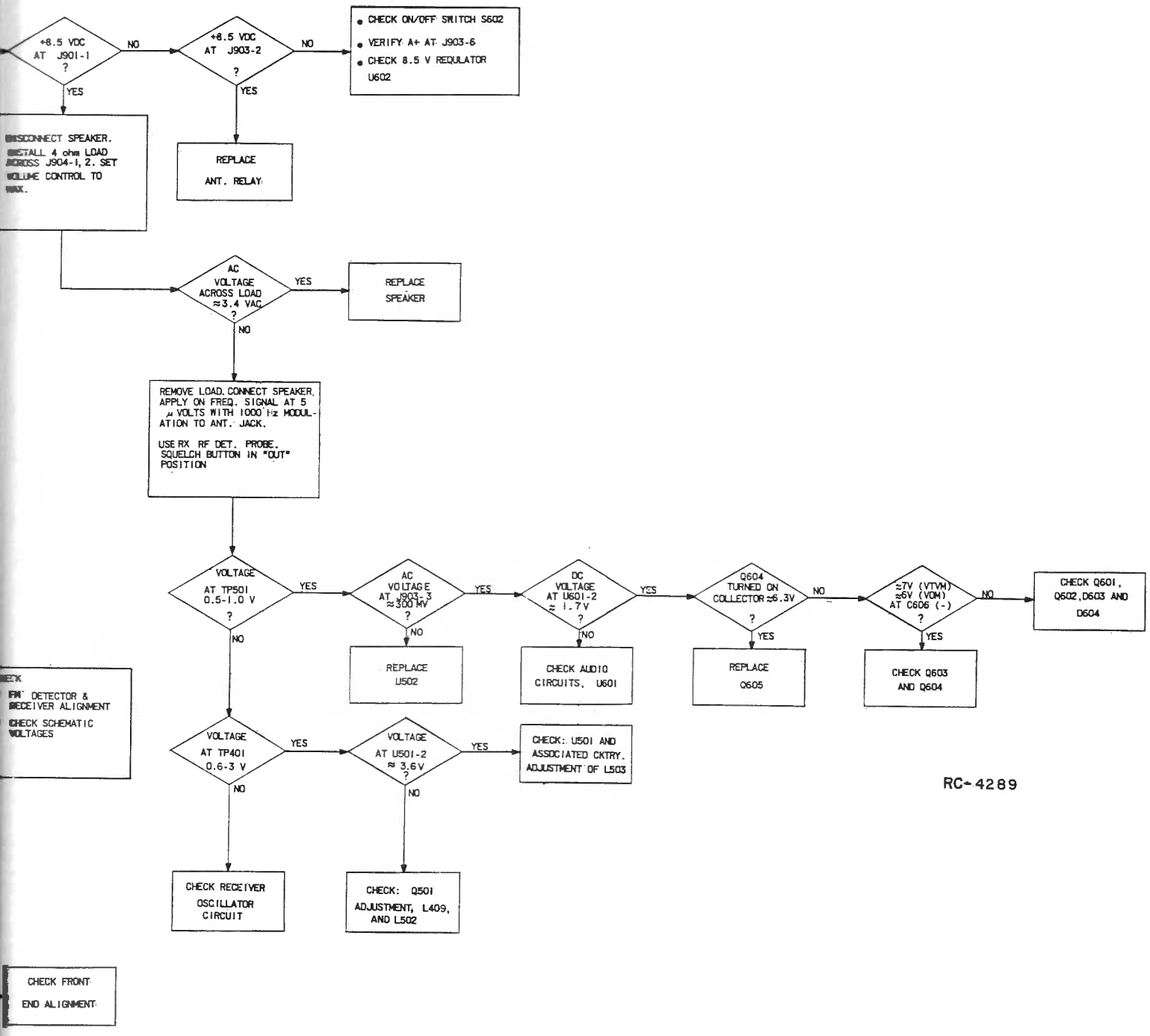
RECEIVER AUDIO AND SQUELCH WAVEFORM CHECKS



PRELIMARY REQUIREMENT

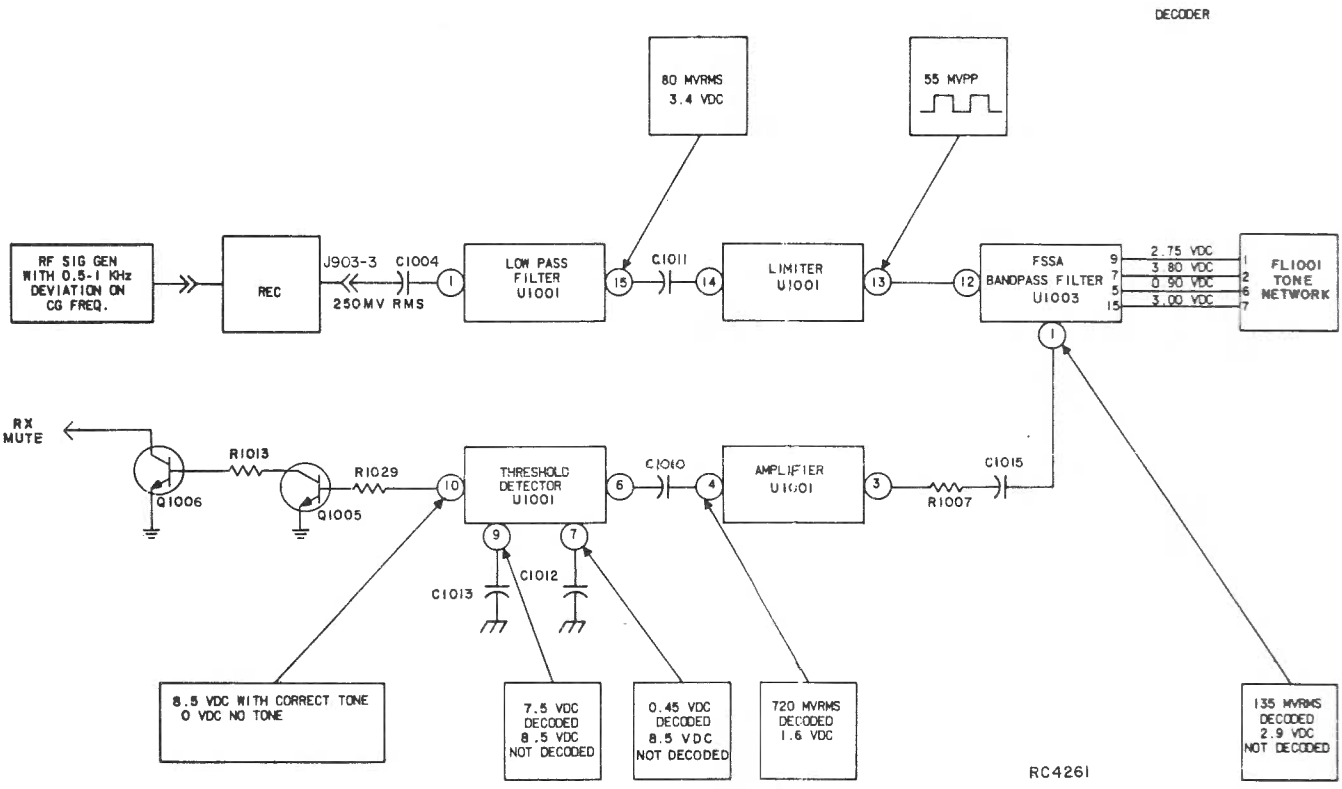
1. DISABLE CHANNEL GUARD BY REMOVING CONNECTING J910-9 TO GROUND OR REMOVING MICROPHONE FROM OPTIONAL HOOKSWITCH.
2. AC VOLTAGES MEASURING WITH VTVM.

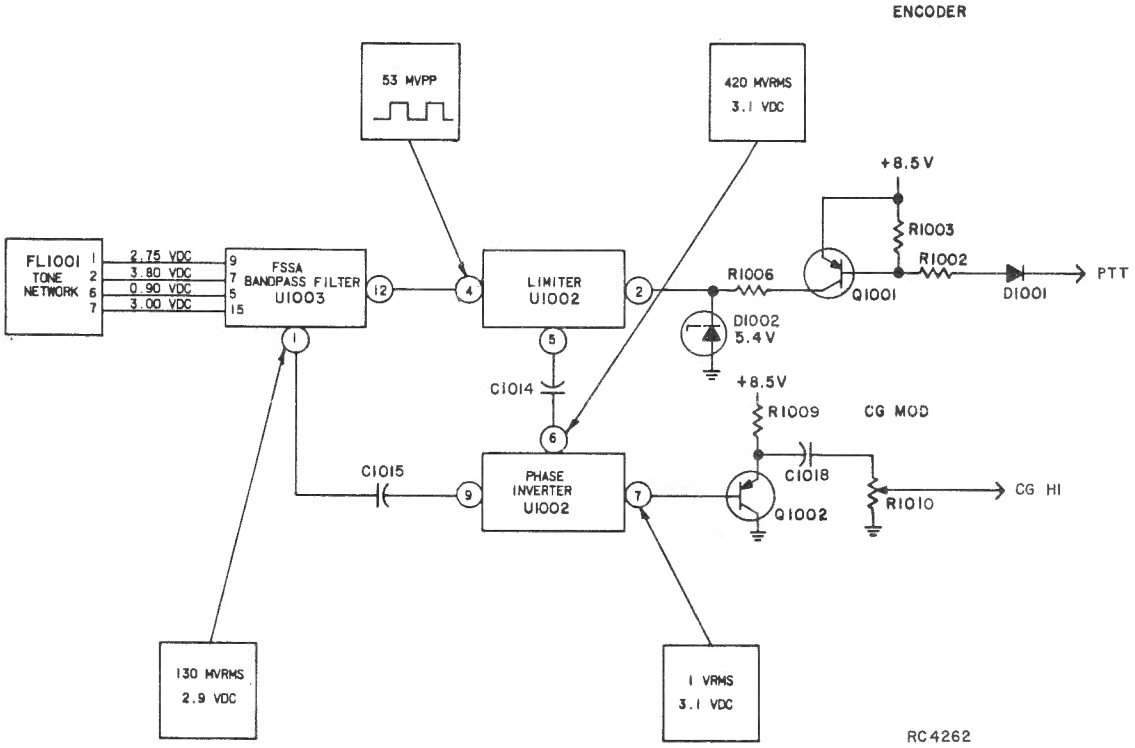




Receiver Troubleshooting Flow Chart

Figure 7





TROU

SYMPTOM	
Unit does not decode.	1. Pla pos cei 2. If set App to at 3. If age the 4. If wor goo and 5. If age ide

TROUBLESHOOTING

450—470 MHz POWER AMPLIFIER AND CHANNEL GUARD

PA TROUBLESHOOTING CHART

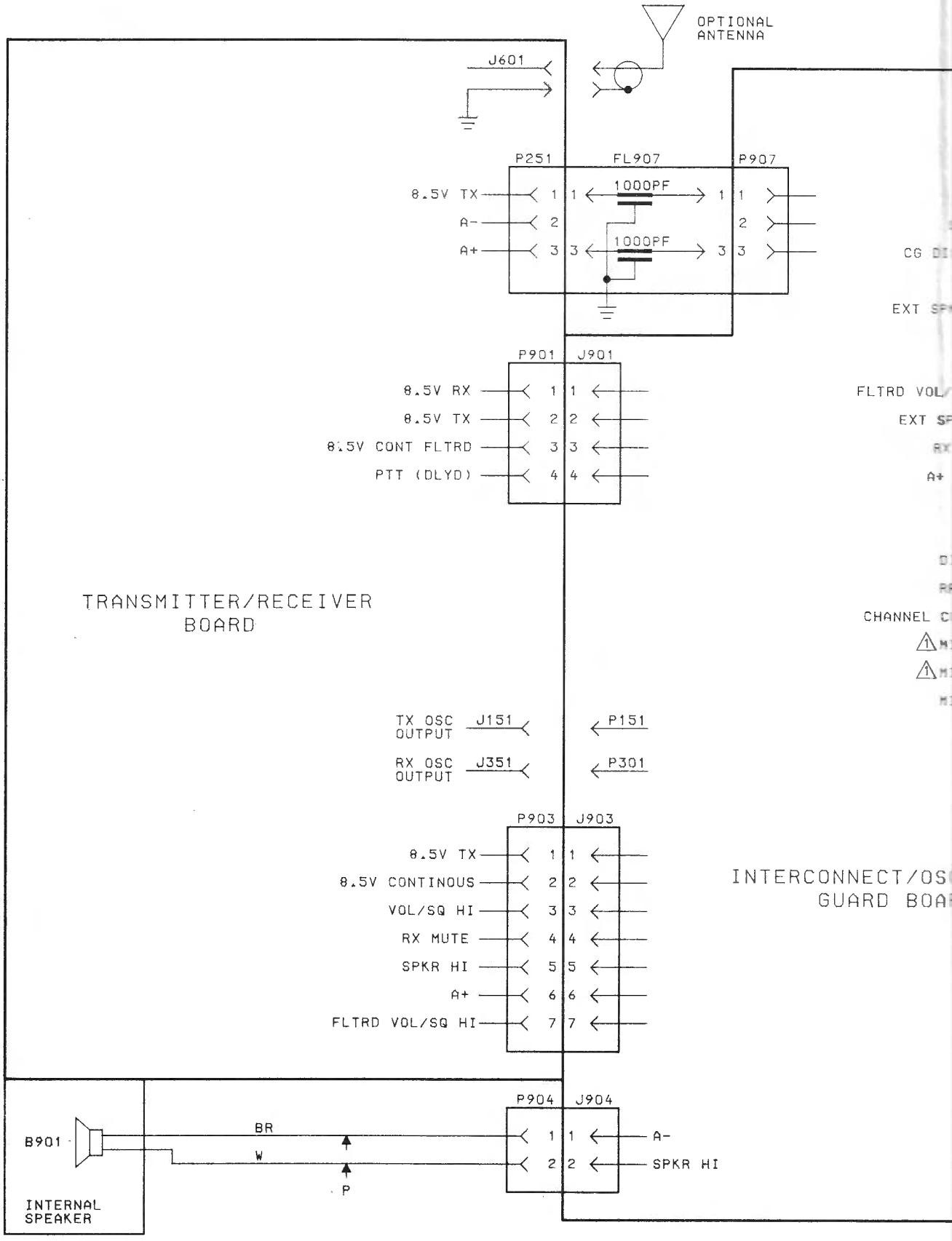
SYMPTOM	TYPICAL VOLTAGE/SIGNAL	PROBABLE CAUSE	TROUBLESHOOTING PROCEDURE
No power	0 volts at TP203	No exciter output.	Repair exciter.
No power	0.65 volts at TP203 but 0 volts at TP251.	Q251 stage inoperative.	Check for A+ at collector of Q251 and check associated circuitry.
No power	0.8 volts at TP251 but 0 volts on collector Q252.	Power control circuitry faulty.	Repair power control circuit. (See circuit analysis for operation).
No power	Radio draws 4 to to 5 amps.	Open circuit after Q253 output.	Check U256, filter, relay, etc. for open circuit.
No power	Radio current less than 2 amps, but 0.8 volts on TP251 and 12 volts collector Q251.	Q252 or Q253 stages inoperative.	If Q252 draws around 0.75 amps, problem is Q253 or associated circuitry. If Q252 draws zero current, problem is Q253 or associated circuitry.
Low power	Significantly less than 0.65 volts at TP203.	Low exciter output.	Repair exciter.
Low power	Significantly less than 0.8 volts at TP251.	Low output from Q251 stage.	Problem is Q251 or associated circuitry.
Low power	Less than 11 volts on collector Q252.	Power control.	Adjust, then if necessary repair power control.
Low power	12 volts on collector Q252, radio draws approx. 5 amps.	Antenna filter.	Tune filter.
Low power	Radio current less than 4 amps.	Q252 or Q253 stages faulty.	If Q252 draws around 0.75 amps, problem is Q253 or associated circuitry. If Q252 draws significantly less than 0.75 amps, problem is Q252 or associated circuitry.

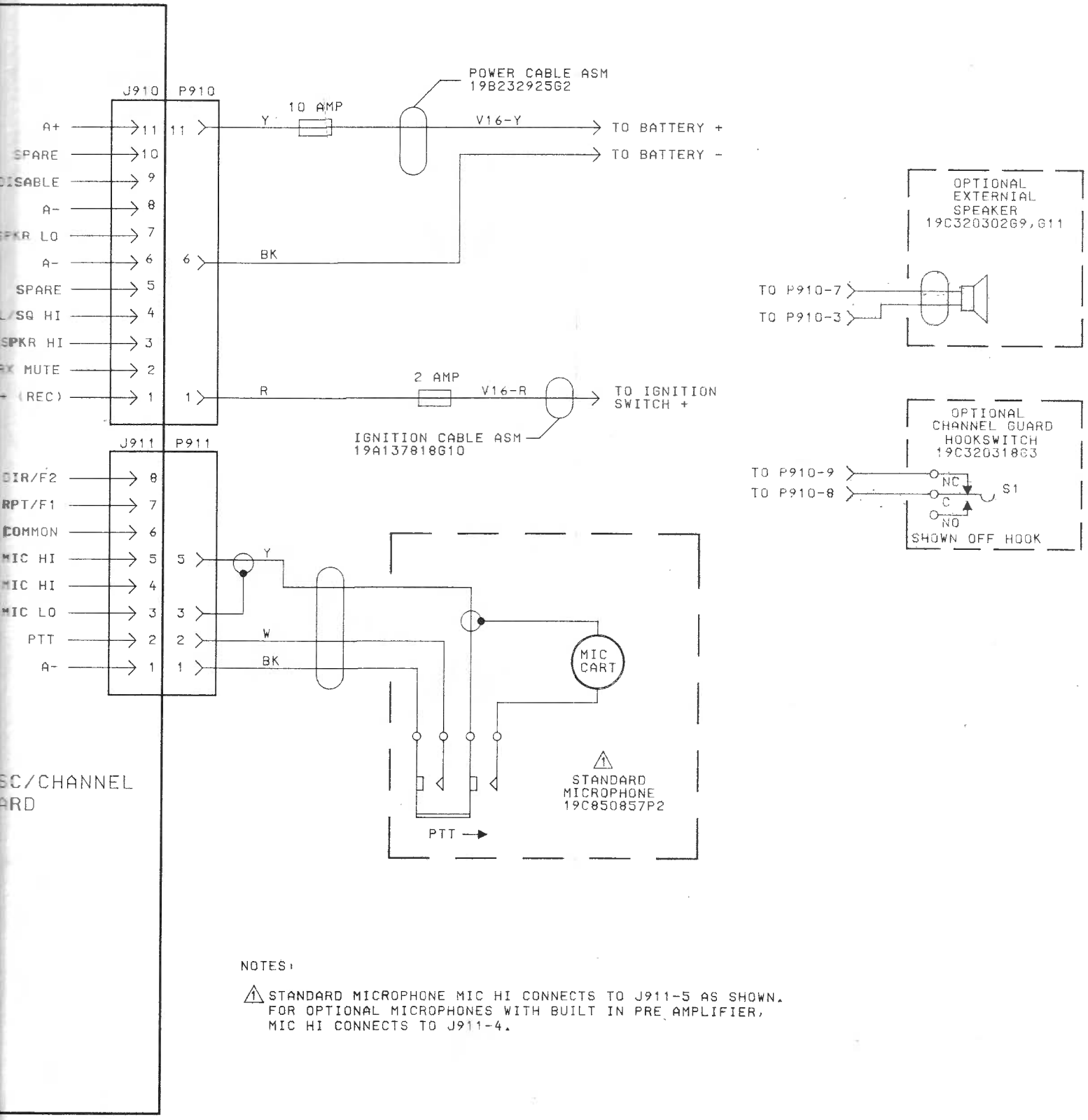
UBLESHOOTING

PROCEDURE
lace squelch switch in the unsquelched osition and check for proper re-eiver operation. f the receiver operates properly, et squelch to the "out" position. pply the proper Channel Guard tone o the radio and check for 8.5 VDC t position U1001-10. f reading is not correct, check volt-ge readings on connections between he tone network FL1001 and U1005. f the readings between the tone net-ork and U1003 are incorrect, insure ood contact between the tone network nd the network socket. f readings are correct, check volt-ge readings at all other points dentified.

TROUBLESHOOTING

SYMPTOM	PROCEDURE
Unit does not encode.	1. Check for 3.1 VDC at U1002-7. 2. If reading is correct, check Mod. Adj. R1010 then check the transmitter oscillator module. 3. If reading is not correct, check voltage readings on connections between the tone network FL1001 and U1003. 4. If the readings between the tone network and U1003 are incorrect, insure good contact between the tone network and the network socket. 5. If readings are correct, check voltage readings at all other points identified.


OPTIONAL ANTENNA
J601
P251
FL907
P907
8.5V TX
A-
A+
1000PF
1000PF
P901
J901
8.5V RX
8.5V TX
8.5V CONT FLTRD
PTT (DLYD)
TRANSMITTER/RECEIVER BOARD
TX OSC OUTPUT
J151
P151
RX OSC OUTPUT
J351
P301
P903
J903
8.5V TX
8.5V CONTINOUS
VOL/SQ HI
RX MUTE
SPKR HI
A+
FLTRD VOL/SQ HI
P904
J904
B901
BR
W
P
A-
SPKR HI
INTERNAL SPEAKER
CG DI
EXT SP
FLTRD VOL/
EXT SP
RX
A+
CHANNEL C
INTERCONNECT/OS
GUARD BOA

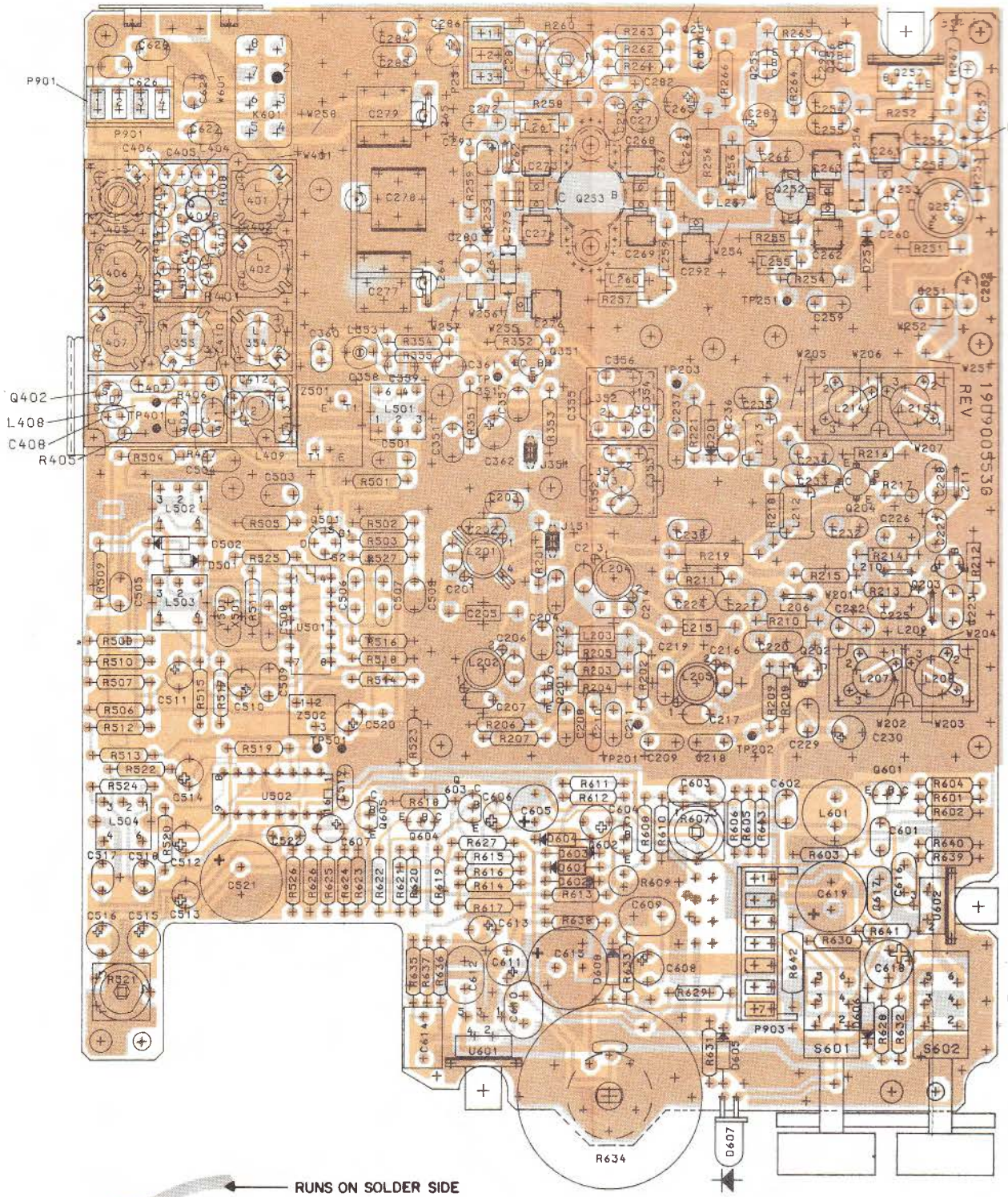


NOTES:

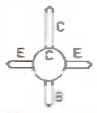
1. STANDARD MICROPHONE MIC HI CONNECTS TO J911-5 AS SHOWN. FOR OPTIONAL MICROPHONES WITH BUILT IN PRE AMPLIFIER, MIC HI CONNECTS TO J911-4.

SYSTEM INTERCONNECTION DIAGRAM

PHOENIX COMBINATIONS



LEAD IDENTIFICATION FOR Q204



TOP VIEW

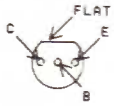
NOTE: COLLECTOR LEAD MARKED AS SHOWN.

LEAD IDENTIFICATION FOR Q351 AND Q401

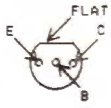
TOP VIEW

NOTE: COLLECTOR LEAD MARKED EITHER WITH CROSS PIECE OR UNDERSIDE BODY DOT AS SHOWN.

LEAD IDENTIFICATION FOR Q201-Q254-Q255 & Q601-Q605



LEAD IDENTIFICATION FOR Q256



IN-LINE

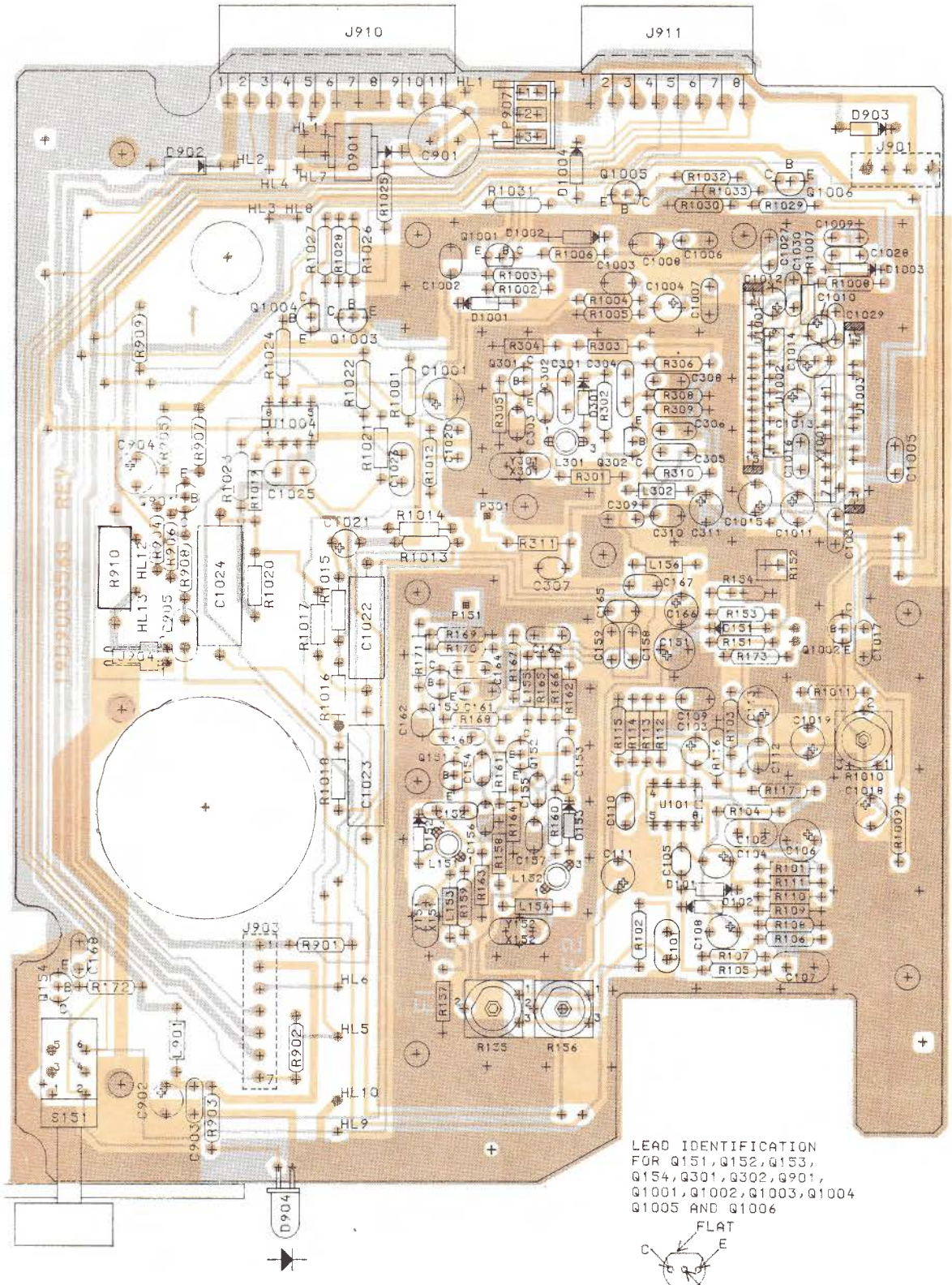
TOP VIEW

NOTE: CASE SHAPE IS DETERMINING FACTOR FOR LEAD IDENTIFICATION

OUTLINE DIAGRAM

450—470 MHz UHF
TRANSMITTER/RECEIVER BOARD

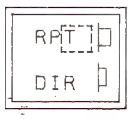
(19D900554, Rev. 0)
(19A702262, Sh. 1, Rev. 0)
(19A702262, Sh. 2, Rev. 0)



LEAD IDENTIFICATION
FOR Q151, Q152, Q153,
Q154, Q301, Q302, Q901,
Q1001, Q1002, Q1003, Q1004
Q1005 AND Q1006

IN-LINE
TOP VIEW

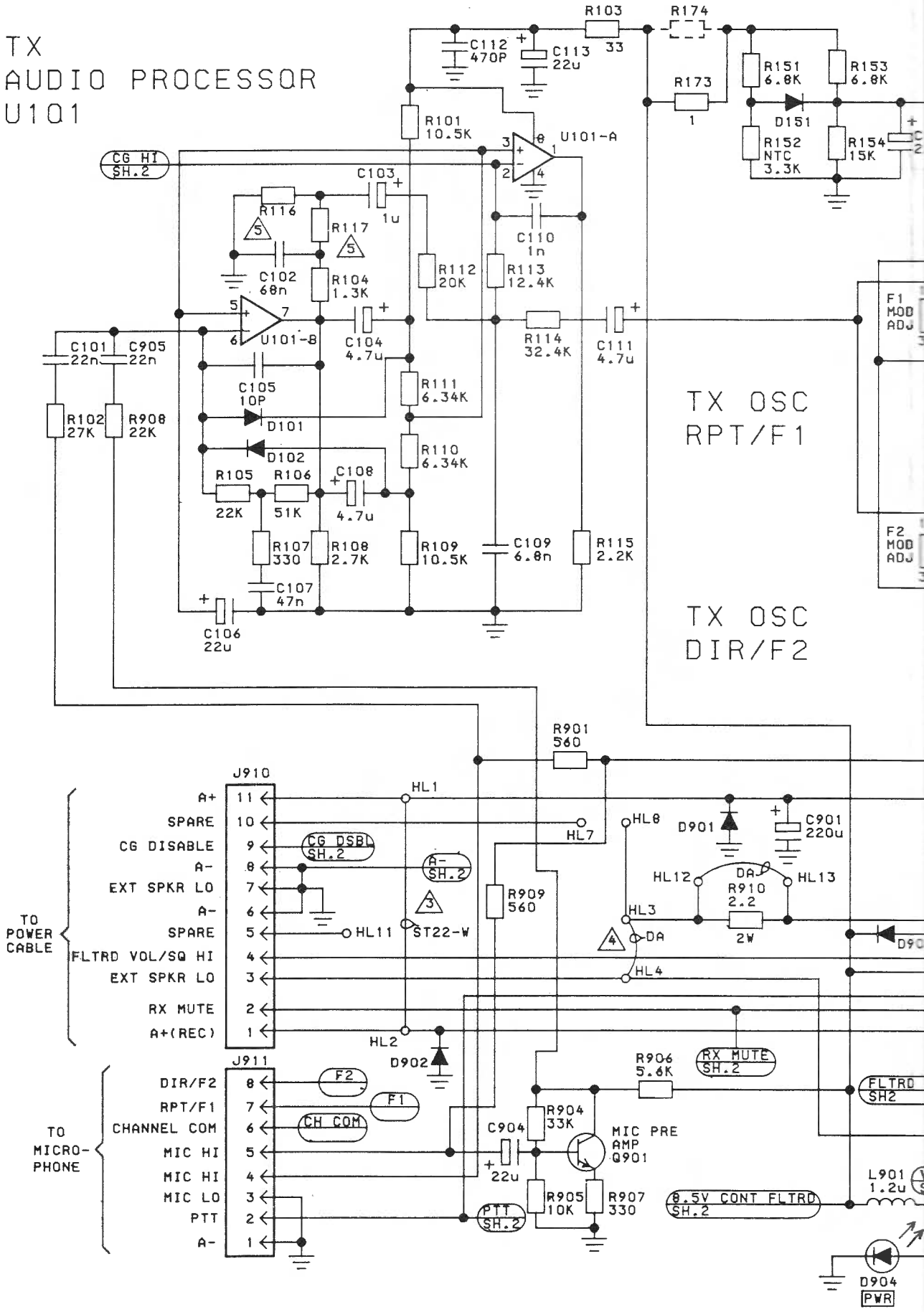
NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

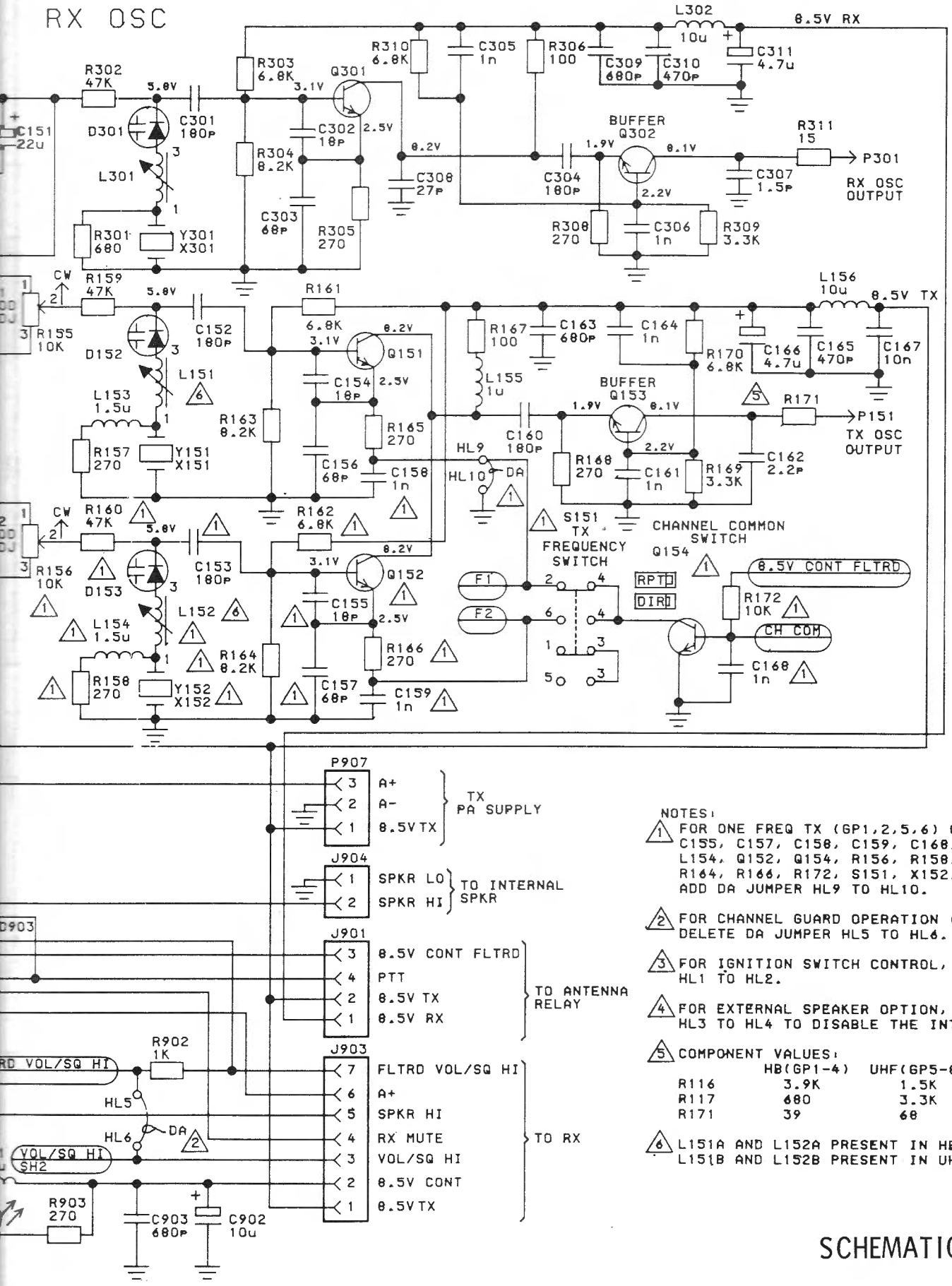


OUTLINE DIAGRAM

(19D900557, Rev. 0)
(19A702264, Sh. 1, Rev. 1)
(19A702264, Sh. 2, Rev. 1)

INTERCONNECT/OSCILLATOR/CHANNEL GUARD BOARD


TX
AUDIO PROCESSOR
U101
TX OSC
RPT/F1
TX OSC
DIR/F2
SYSTEM INTERCONNECT
TO POWER CABLE
TO MICRO-PHONE
J910
J911
U101-A
U101-B
MIC PRE AMP Q901
D904
PWR



NOTES:

1. FOR ONE FREQ TX (GP1,2,5,6) OMIT C153, C155, C157, C158, C159, C168, D153, L152, L154, Q152, Q154, R156, R158, R160, R162, R164, R166, R172, S151, X152, Y152. ADD DA JUMPER HL9 TO HL10.
2. FOR CHANNEL GUARD OPERATION (GP2,4,6,8) DELETE DA JUMPER HL5 TO HL6.
3. FOR IGNITION SWITCH CONTROL, REMOVE JUMPER HL1 TO HL2.
4. FOR EXTERNAL SPEAKER OPTION, REMOVE JUMPER HL3 TO HL4 TO DISABLE THE INTERNAL SPEAKER.
5. COMPONENT VALUES:

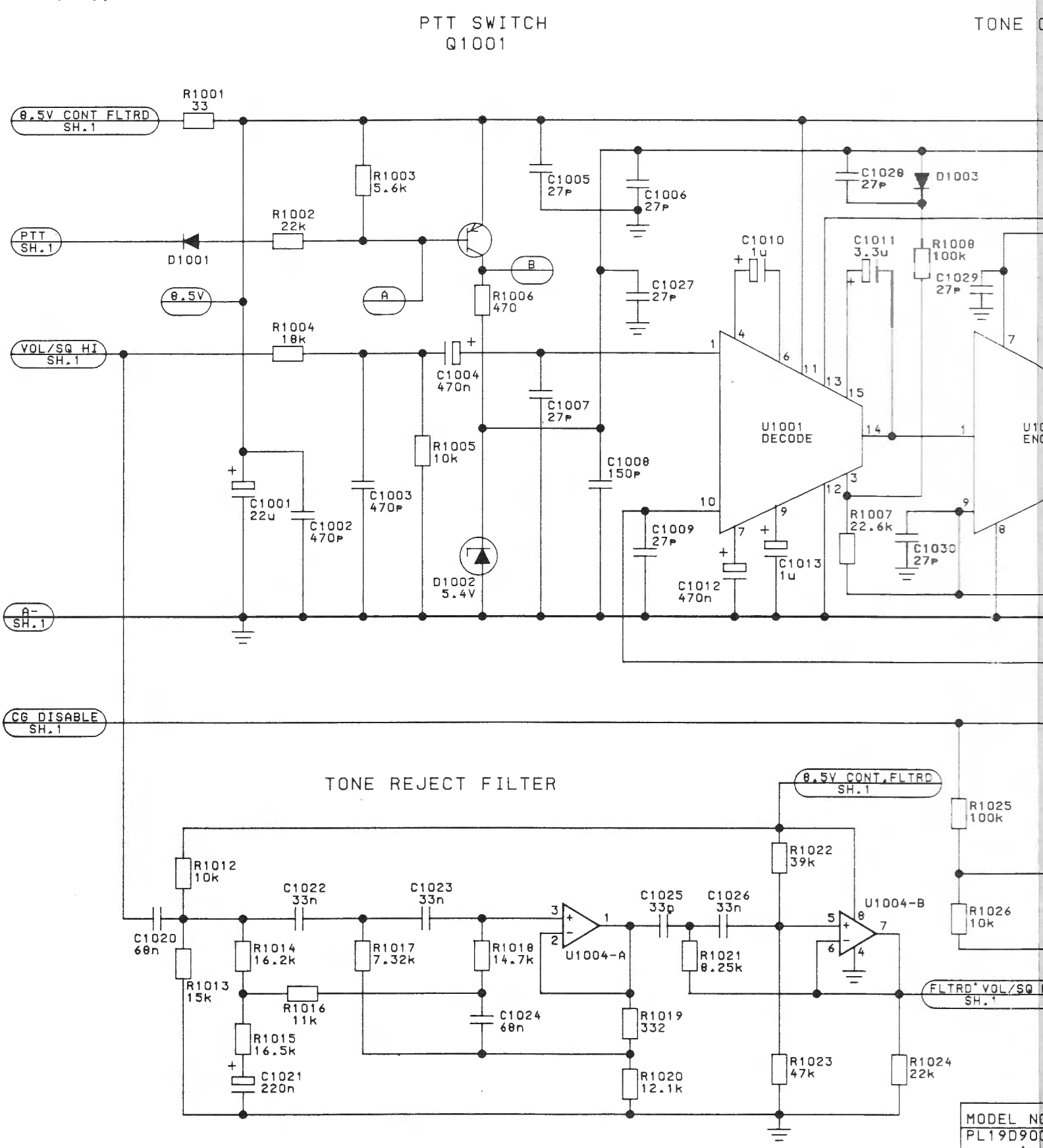
	HB(GP1-4)	UHF(GP5-8)
R116	3.9K	1.5K
R117	680	3.3K
R171	39	68

6. L151A AND L152A PRESENT IN HB. L151B AND L152B PRESENT IN UHF.

SCHEMATIC DIAGRAM

IOC BOARD

Issue 1

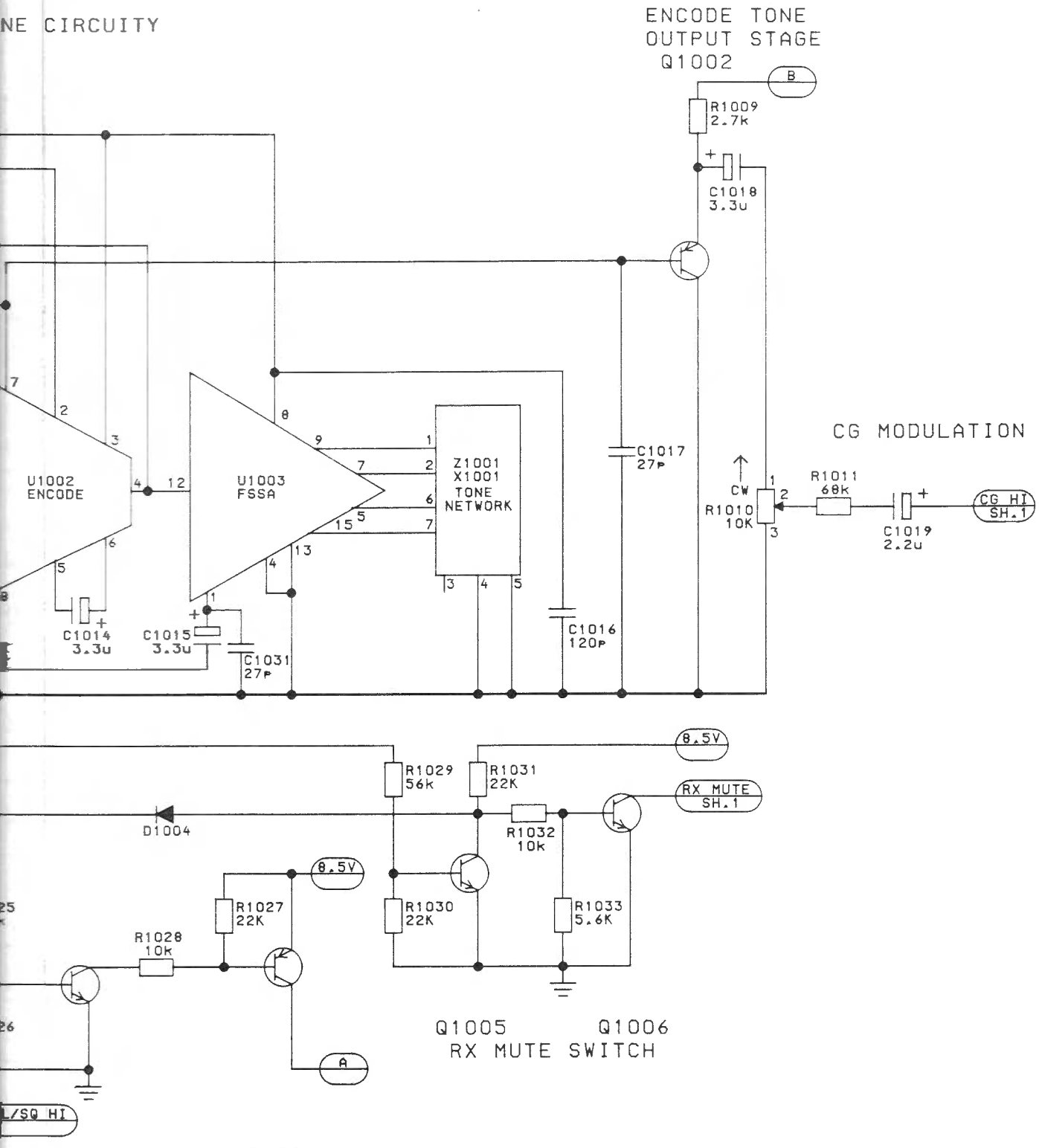


SCHEMATIC DIAGRAM

IOC BOARD (CHANNEL GUARD)

(19D900589, Sh. 2, Rev. 2)

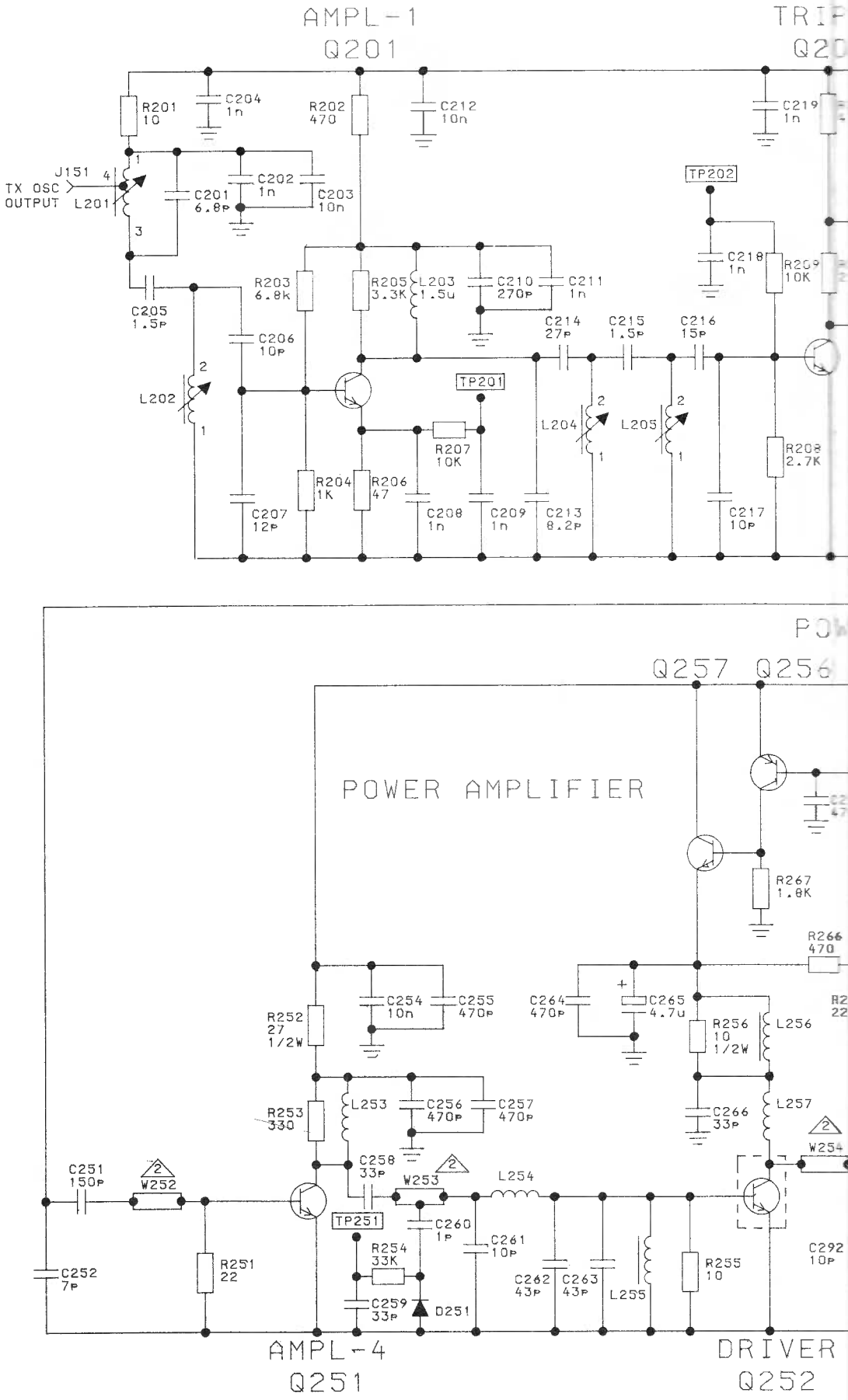
NE CIRCUITY

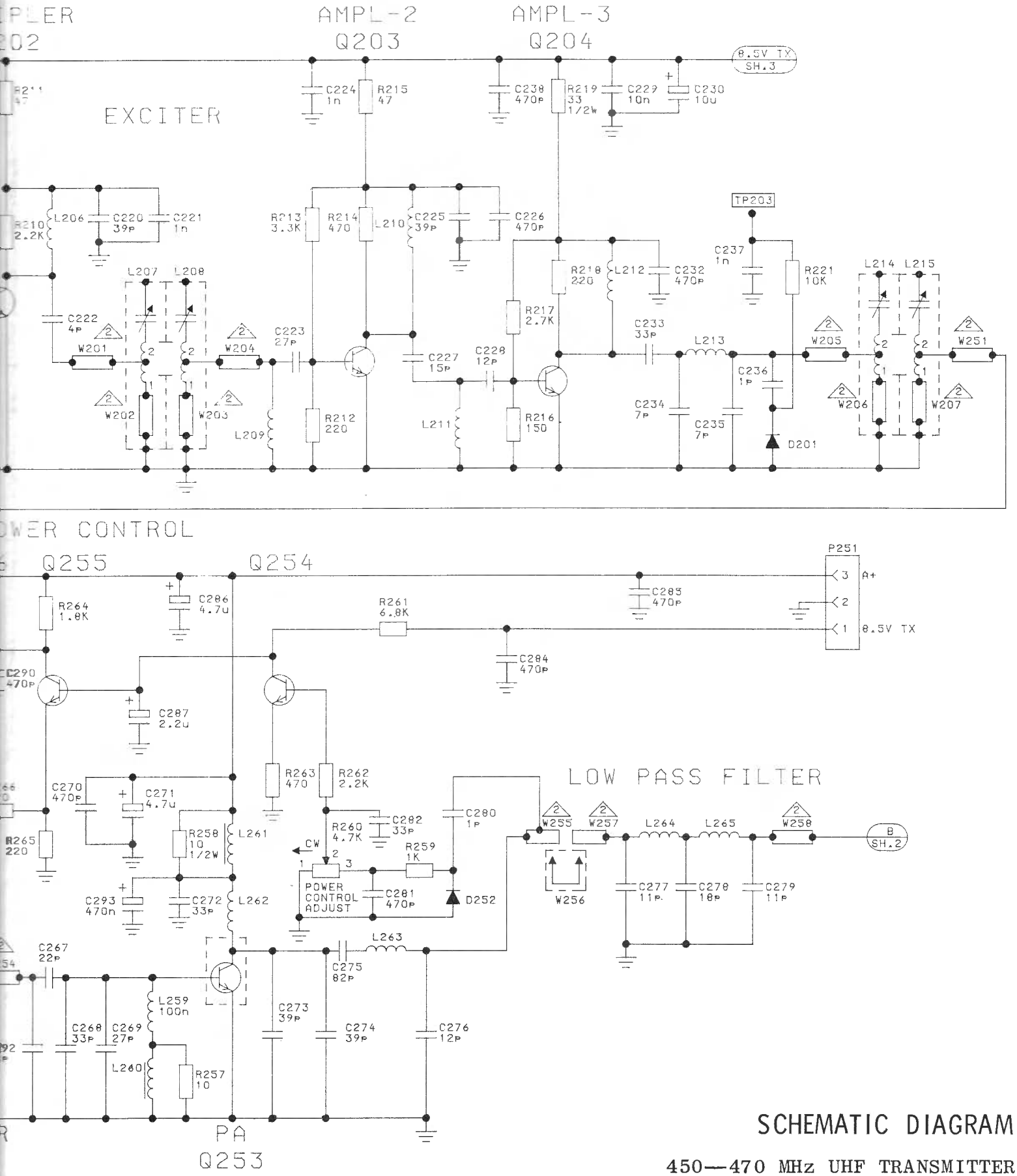


CHANNEL GUARD

EL NO.	REV. LETTER
9D90055661	
	G2
	G3
	G4
	G5
	G6
	G7
9D90055668	

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED.
RESISTOR VALUES IN Ω UNLESS FOLLOWED BY MULTIPLIER k OR M.
CAPACITOR VALUES IN F UNLESS FOLLOWED BY MULTIPLIER μ, n OR p.
INDUCTANCE VALUES IN H UNLESS FOLLOWED BY MULTIPLIER m OR μ.


AMPL-1
Q201
TRIP
Q20
POWER AMPLIFIER
Q257 Q256
AMPL-4
Q251
DRIVER
Q252
J151
TX OSC
OUTPUT
L201
L202
L203
L204
L205
L206
L207
L208
L209
L210
L211
L213
L214
L215
L216
L217
L218
L219
L253
L254
L255
L256
L257
R201 10
R202 470
R203 6.8K
R204 1K
R205 3.3K
R206 47
R207 10K
R208 2.7K
R209 10K
R251 22
R252 27 1/2W
R253 330
R254 33K
R255 10
R256 10 1/2W
R266 470
R267 1.8K
C201 6.8P
C202 1n
C203 10n
C204 1n
C205 1.5P
C206 10P
C207 12P
C208 1n
C209 1n
C210 270P
C211 1n
C212 10n
C213 8.2P
C214 27P
C215 1.5P
C216 15P
C217 10P
C218 1n
C219 1n
C251 150P
C252 7P
C254 10n
C255 470P
C256 470P
C257 470P
C258 33P
C259 33P
C260 1P
C261 10P
C262 43P
C263 43P
C264 470P
C265 4.7u
C266 33P
C292 10P
D251
TP201
TP202
TP251
W252
W253
W254

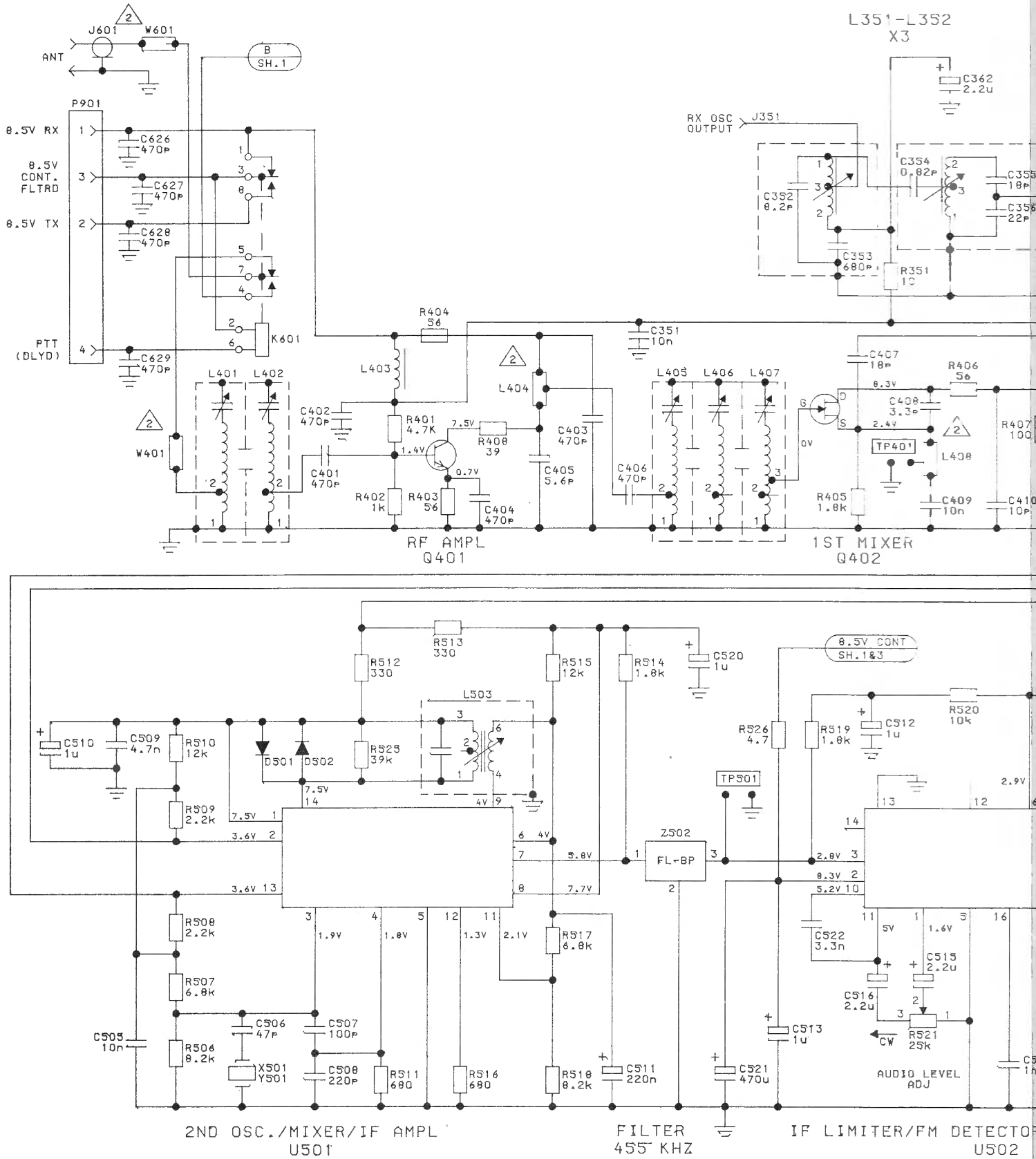


SCHEMATIC DIAGRAM

450—470 MHz UHF TRANSMITTER

Issue 1

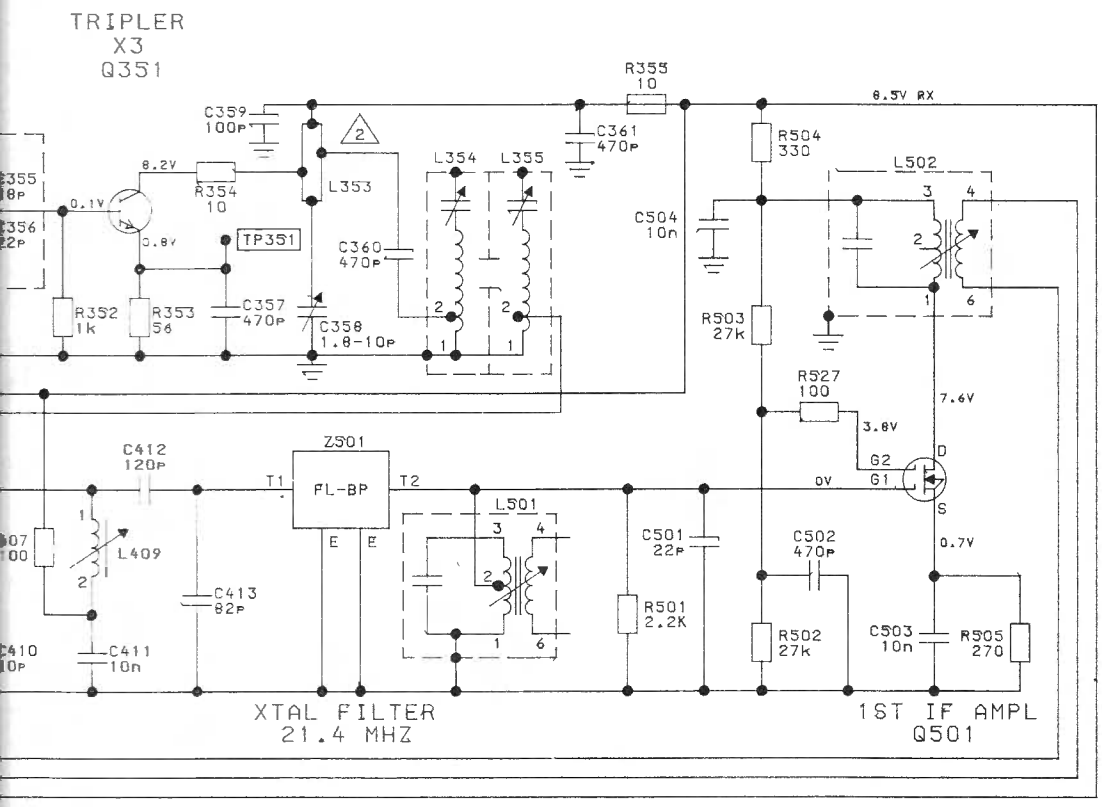
597, Sh. 1, Rev. 2)

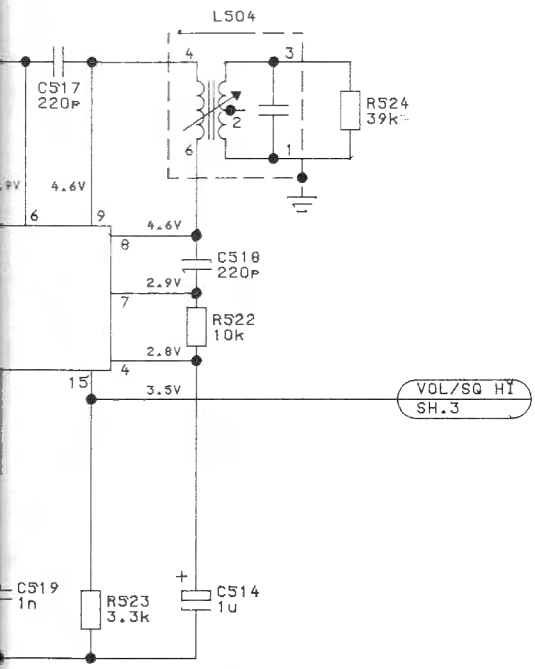


SCHEMATIC DIAGRAM

450—470 MHz UHF RECEIVER

(19D900597, Sh. 2, Rev. 2)


TRIPLER
X3
Q351
R355
10
8.5V RX
C359
100P
C361
470P
R504
330
L502
L354
L355
L353
8.2V
R354
10
0.1V
0.8V
TP351
C360
470P
C504
10n
R352
1k
R353
56
C357
470P
C358
1.8-10P
R503
27k
R527
100
7.6V
3.8V
C412
120P
Z501
T1
FL-BP
T2
G2
D
G1
S
0V
L501
L409
C501
22P
C502
470P
0.7V
C413
82P
R501
2.2K
R502
27k
C503
10n
R505
270
C411
10n
XTAL FILTER
21.4 MHZ
1ST IF AMPL
Q501


L504
C517
220P
R524
39k
4.6V
C518
220P
2.9V
R522
10k
2.8V
3.5V
VOL/SQ HI
SH.3
C519
1n
R523
3.3k
C514
1u
TOR/AUDIO PRE AMPL
2

⚠1 VALUE OF R640 DEPENDS ON COLOR CODE ON U602.

U602 COLOR CODE	R640 VALUE
BROWN	OMIT R640
RED	270
ORANGE	100
YELLOW	47
GREEN	22
BLUE	6.8

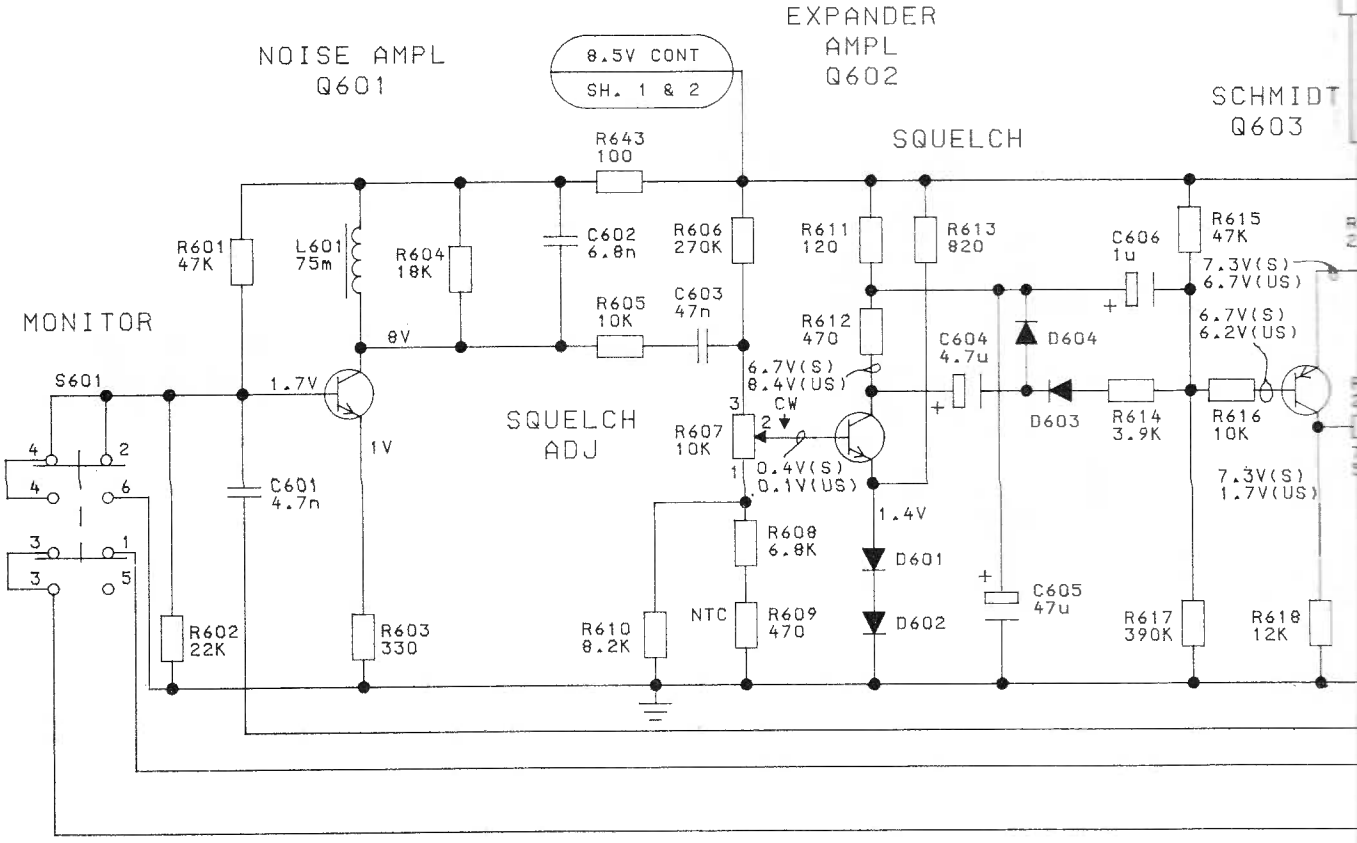
MODEL NO.	REV. LETTER	DESCRIPTION
PL19D90055361 PL19D90058661		PA ASSEMBLY PA BOARD

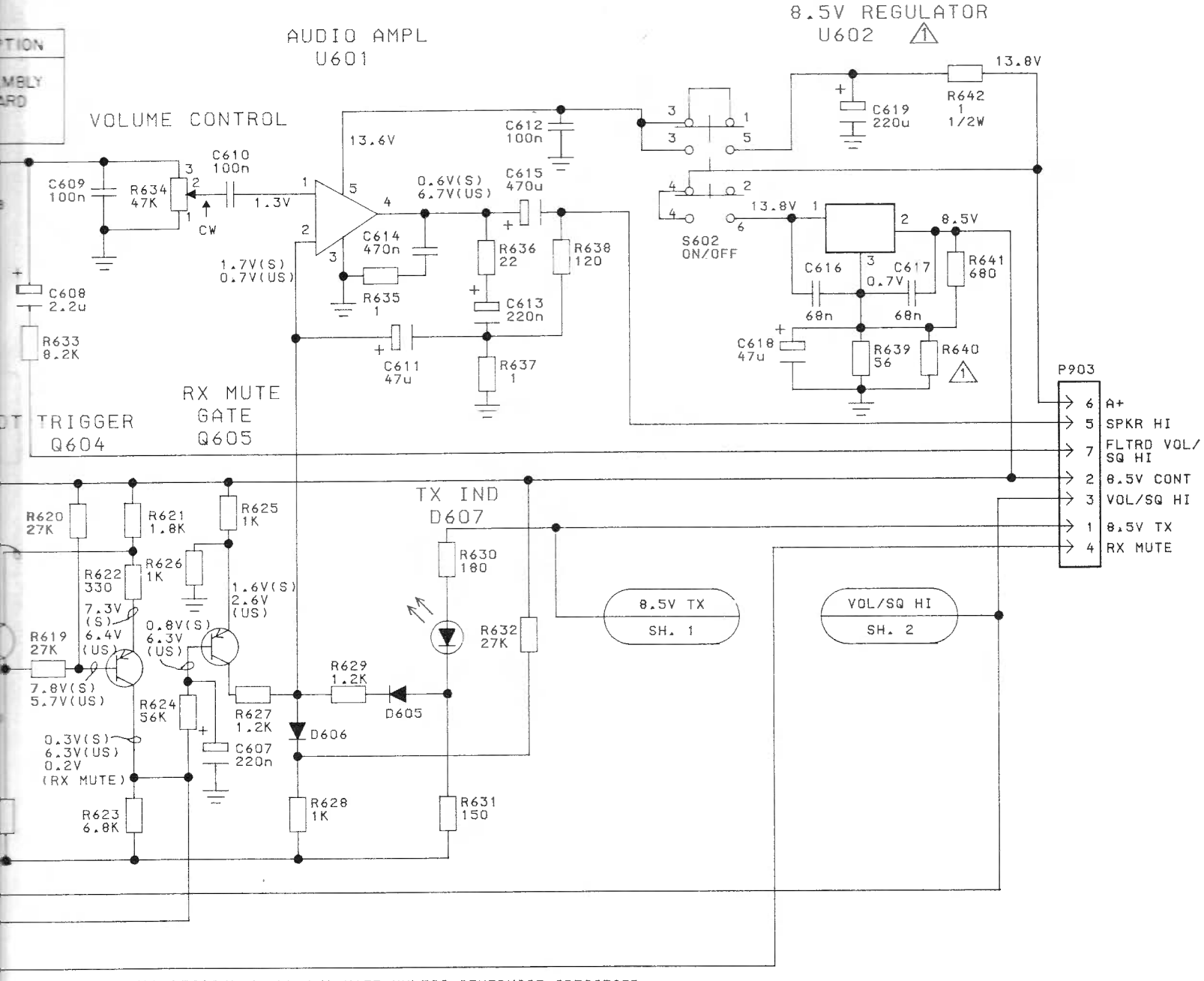
⚠2 PART OF PRINTED CIRCUIT BOARD.

VOLTAGE READINGS

VOLTAGE READINGS ARE TYPICAL READINGS MESURED TO SYSTEM NEGATIVE WITH A 20,000 OHM-PER-VOLT DC VOLT METER UNDER THE FOLLOWING CONDITIONS:

1. NO SIGNAL INPUT
2. VOLUME CONTROL (R634) SET TO MINIMUM
3. MONITOR SWITCH (S601) IN OUT POSITION
4. UNSQUELCHED (US)- SQUELCH ADJUST (R607) SET TO MINIMUM (CW)
5. SQUELCHED (S)- SQUELCH ADJUST (R607) SET TO MAXIMUM (CCW)





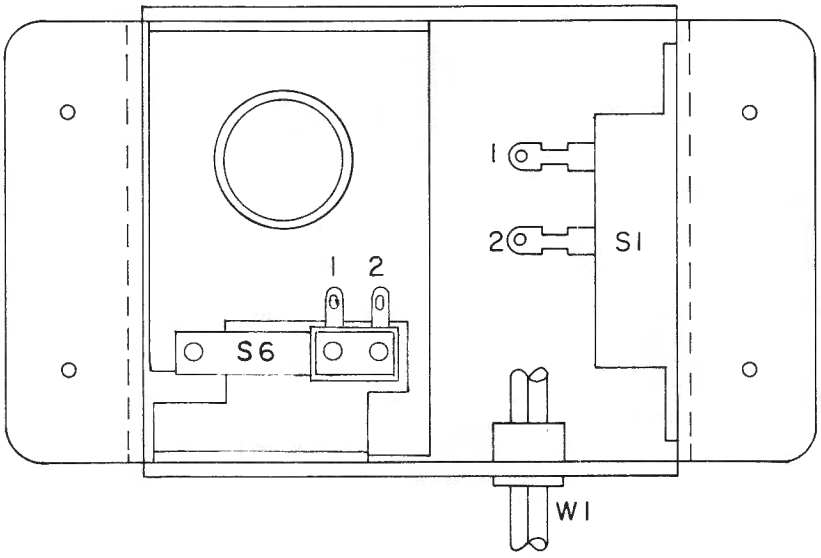
ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED.
RESISTOR VALUES IN Ω UNLESS FOLLOWED BY MULTIPLIER k OR M.
CAPACITOR VALUES IN F UNLESS FOLLOWED BY MULTIPLIER µ, n OR p.
INDUCTANCE VALUES IN H UNLESS FOLLOWED BY MULTIPLIER m OR µ.

(19D900597, Sh. 3, Rev. 1)

SCHEMATIC DIAGRAM

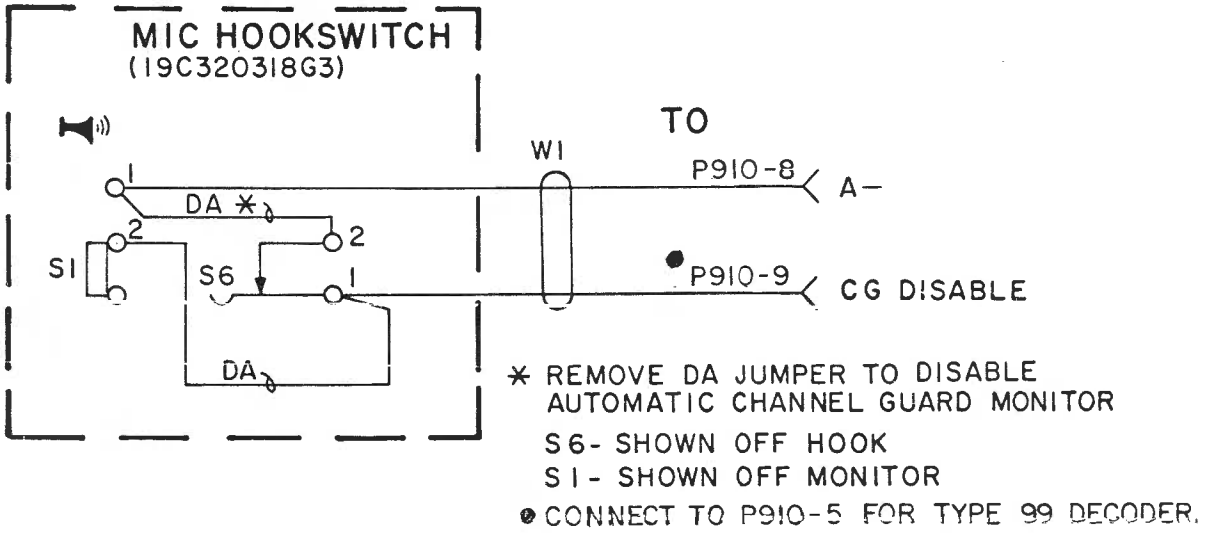
450—470 MHz UHF RECEIVER

OUTLINE DIAGRAM



(19B227626, Rev. 0)

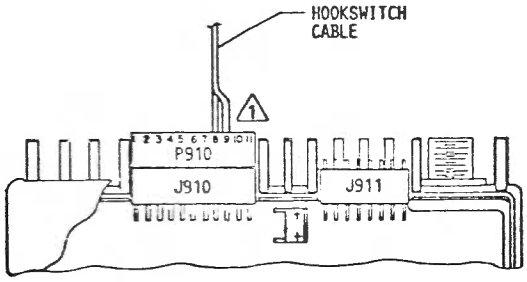
SCHEMATIC DIAGRAM



(19A142809, Rev. 1)

SERVICE SHEET

HOOKSWITCH 19C320318G3

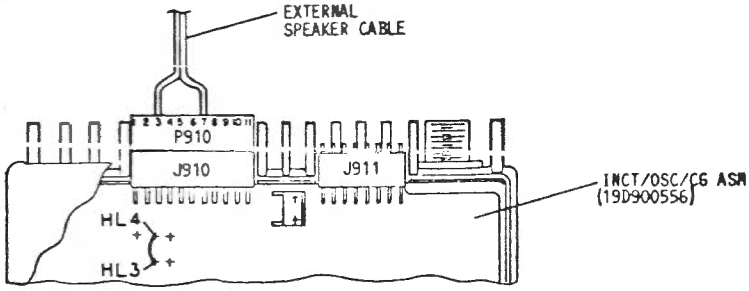


TOP VIEW

HOOKSWITCH APPLICATION (MOBILE MICROPHONE)

NOTES:

1. CONNECT HOOKSWITCH TO P910-8 AND P910-9 FOR CHANNEL GUARD.

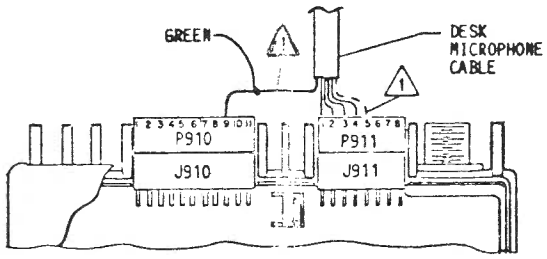


TOP VIEW

EXTERNAL SPEAKER APPLICATION

NOTES:

1. CONNECT SPEAKER LEADS TO P910-3 AND P910-7. TO DISCONNECT INTERNAL SPEAKER (FIELD ONLY) REMOVE JUMPER BETWEEN HL3 AND HL4.
2. FOR EXTERNAL SPEAKER WITH THE AC POWER SUPPLY, REMOVE JUMPER IN POWER CABLE BETWEEN P910-3 & P910-10 AND CONNECT PER NOTE 1.



TOP VIEW

DESK MICROPHONE WITH CHANNEL GUARD (WITHOUT DC REMOTE)

NOTES:

1. FOR CHANNEL GUARD MOVE GREEN WIRE FROM P911-5 TO P910-9 .

OPTION CONNECTIONS

PARTS LIST

450-470 MHz TRANSMIT/RECEIVE ASSEMBLY
19D900586G1
ISSUE 1

SYMBOL	GE PART NO.	DESCRIPTION
A1		TRANSMIT/RECEIVE BOARD 19D900533G1
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C201	19A700235P11	Ceramic: 6.8 pf ±57, 50 VDCW, -150 PPM temp coef.
C202	19A700233P7	Ceramic: 1000 pf ±20%, 50 VDCW.
C203	19A700234P7	Polyester: 0.1 µf ±10%, 50 VDCW.
C204	19A700233P7	Ceramic: 1000 pf ±20%, 50 VDCW.
C205	19A700013P15	Phenolic: 1.5 pf ±5%, 500 VDCW.
C206	19A700235P13	Ceramic: 10 pf ±5%, 50 VDCW, -150 PPM temp coef.
C207	19A700235P14	Ceramic: 12 pf ±5%, 50 VDCW, -150 PPM temp coef.
C208 and C209	19A700233P7	Ceramic: 1000 pf ±10%, 50 VDCW.
C210	19A700235P30	Ceramic: 270 pf ±5%, 50 VDCW, -750 PPM temp coef.
C211	19A700233P7	Ceramic: 1000 pf ±20%, 50 VDCW.
C212	19A700234P7	Polyester: 0.1 µf ±10%, 50 VDCW.
C213	19A700235P12	Ceramic: 8.2 pf ±5%, 50 VDCW, -150 PPM temp coef.
C214	19A700235P18	Ceramic: 27 pf, ±5%, 50 VDCW, -150 PPM temp coef.
C215	19A700013P15	Phenolic: 1.5 pf ±5%, 500 VDCW.
C216	19A700235P15	Ceramic: 15 pf ±5%, 50 VDCW, -150 PPM temp coef.
C217	19A700013P15	Phenolic: 1.5 pf ±5%, 500 VDCW.
C218 and C219	19A700233P7	Ceramic: 1000 pf ±20%, 50 VDCW,
C220	19A701624P22	Ceramic: 39 pf ±5%, 500 VDCW, 0 PPM temp coef.
C221	19A701602P20	Ceramic: 1000 pf ±10%, 1000 VDCW.
C222	19A701624P2	Ceramic: 4 pf ±0.5 pf, 500 VDCW, 0 PPM temp coef.
C223	19A701624P18	Ceramic: 27 pf ±0.5 pf, 500 VDCW, 0 PPM temp coef.
C224	19A701602P20	Ceramic: 1000 pf ±10%, 1000 VDCW.
C225	19A701624P22	Ceramic: 39 pf ±5%, 500 VDCW, 0 PPM temp coef.
C226	19A701602P14	Ceramic: 470 pf ±10%, 1000 VDCW.
C227	19A701624P12	Ceramic: 15 pf ±5%, 500 VDCW, 0 PPM temp coef.
C228	19A701624P10	Ceramic: 12 pf ±5%, 500 VDCW, 0 PPM temp coef.
C229	19A700234P7	Polyester: 0.1 µf ±10%, 50 VDCW.
C230	19A701534P7	Tantalum: 10 µf ±20%, 16 VDCW.
C232	19A701602P14	Ceramic: 470 pf ±10%, 1000 VDCW.
C233	19A701624P20	Ceramic: 33 pf ±5%, 500 VDCW, 0 PPM temp coef.
C234 and C235	19A701624P5	Ceramic: 7 pf ±0.5 pf, 500 VDCW, 0 PPM temp coef.
C236	19A700235P1	Ceramic: 1 pf ±5%, 50 VDCW, 0 PPM temp coef.
C237	19A700233P7	Ceramic: 1000 pf ±20%, 50 VDCW.
C238	19A701602P14	Ceramic: 470 pf ±10%, 1000 VDCW.
C251	19A701602P8	Ceramic: 150 pf ±10%, 1000 VDCW.
C252	19A701624P5	Ceramic: 7 pf ±0.5 pf, 500 VDCW, 0 PPM temp coef.
C254	19A700234P7	Polyester: 0.1 µf ±10%, 50 VDCW.
C255 thru C257	19A701602P14	Ceramic: 470 pf ±10%, 1000 VDCW.
C258	19A701624P20	Ceramic: 33 pf ±5%, 500 VDCW, 0 PPM temp coef.
C259	19A700235P19	Ceramic: 33 pf ±5%, 50 VDCW, -150 PPM temp coef.
C260	19A700235P1	Ceramic: 1 pf ±5%, 50 VDCW, 0 PPM temp coef.
C261	19A700006P6	Mica: 10 pf ±5%, 100 VDCW.
C262 and C263	19A700006P24	Mica: 43 pf ±5%, 100 VDCW.
C264	19A701602P14	Ceramic: 470 pf ±10%, 1000 VDCW.
C265	19A700534P5	Tantalum: 4.7 µf ±20%, 35 VDCW.
C266	19A700235P19	Ceramic: 33 pf ±5%, 50 VDCW, -150 PPM temp coef.
C267	19A701413P17	Mica: 22 pf ±5%, 100 VDCW.
C268	19A700006P21	Mica: 33 pf ±5%, 100 VDCW.
C269	19A700006P19	Mica: 27 pf ±5%, 100 VDCW.
C270	19A701602P14	Ceramic: 470 pf ±10%, 1000 VDCW.
C271	19A701534P6	Tantalum: 4.7 µf ±20%, 35 VDCW.
C272	19A700235P19	Ceramic: 33 pf ±5%, 50 VDCW, -150 PPM temp coef.
C273 and C274	19A700006P23	Mica: 39 pf ±5%, 100 VDCW.
C275	19A701413P32	Mica: 82 pf ±5%, 100 VDCW.
C276	19A700006P8	Mica: 12 pf ±5%, 100 VDCW.
C277	19A700131P11	Teflon/Mica: 11 pf ±0.5 pf, 250 VDCW.
C278	19A700131P18	Teflon/Mica: 18 pf ±0.5 pf, 250 VDCW.
C279	19A700131P11	Teflon/Mica: 11 pf ±0.5 pf, 250 VDCW.
C280	19A700235P1	Ceramic: 1 pf ±5%, 50 VDCW, 0 PPM temp coef.
C281	19A701602P14	Ceramic: 470 pf ±10%, 1000 VDCW.
C282	19A700235P19	Ceramic: 33 pf ±5%, 50 VDCW, -150 PPM temp coef.
C284 and C285	19A701602P14	Ceramic: 470 pf ±10%, 1000 VDCW.
C286	19A701534P6	Tantalum: 4.7µf ±20%, 35 VDCW.
C287	19A701534P5	Tantalum: 0.47 µf ±20%, 35 VDCW.
C290	19A701602P14	Ceramic: 470 pf ±10%, 1000 VDCW.
C292	19A700006P6	Mica: 10 pf ±5%, 100 VDCW.
C293	19A701352P5	Aluminum: 0.47 µf ±20%, 25 VDCW.
C351	19A700234P7	Polyester: 0.1 µf ±10%, 50 VDCW.
C352	19A700235P12	Ceramic: 8.2 pf ±5%, 50 VDCW, -150 PPM temp coef.
C353	19A700233P6	Ceramic: 680 pf ±20%, 50 VDCW.
C354	19A700013P12	Phenolic: 0.82 pf ±5%, 500 VDCW.
C355	19A700235P16	Ceramic: 18 pf ±5%, 50 VDCW, -150 PPM temp coef.
C356	19A700235P17	Ceramic: 22 pf ±5%, 50 VDCW, -150 PPM temp coef.
C357	19A700233P5	Ceramic: 470 pf ±20%, 50 VDCW.
C358	19A702168P2	Variable: 3 to 11 pf, 100 VDCW; sim to JFD DV2SN11C.
C359	19A700233P1	Ceramic: 100 pf ±20%, 50 VDCW.
C360	19A700001P5	Ceramic: 470 pf ±20%, 50 VDCW.
C361	19A700233P5	Ceramic: 470 pf ±20%, 50 VDCW.
C362	19A701534P5	Tantalum: 0.47 µf ±20%, 35 VDCW.
C401 thru C404	19A700001P5	Ceramic: 470 pf ±20%, 50 VDCW.
C405	19A700002P10	Ceramic: 5.6 pf ±0.25 pf, 50 VDCW, -150 PPM temp coef.
C406	19A700001P5	Ceramic: 470 pf ±20%, 50 VDCW.
C407	19A700235P16	Ceramic: 18 pf ±5%, 50 VDCW, -150 PPM temp coef.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SYMBOL	GE PART NO.	DESCRIPTION
C408	19A700002P7	Ceramic: 3.3 pf ±0.25 pf, 50 VDCW, -150 PPM temp coef.
C409	19A700234P7	Polyester: 0.1 µf ±10%, 50 VDCW.
C410	19A700002P13	Ceramic: 10 pf ±5%, 50 VDCW, -150 PPM temp coef.
C411	19A700234P7	Polyester: 0.1 µf ±10%, 50 VDCW.
C412	19A700002P26	Ceramic: 120 pf ±5%, 50 VDCW, -150 PPM temp coef.
C413	19A700235P24	Ceramic: 82 pf ±5%, 50 VDCW, -150 PPM temp coef.
C501	19A700235P17	Ceramic: 22 pf ±5%, 50 VDCW, -150 PPM temp coef.
C502	19A700233P5	Ceramic: 470 pf ±20%, 50 VDCW.
C503 thru C505	19A700234P7	Polyester: 0.1 µf ±10%, 50 VDCW.
C506	19A700235P21	Ceramic: 47 pf ±5%, 50 VDCW, -150 PPM temp coef.
C507	19A700235P25	Ceramic: 100 pf ±5%, 50 VDCW, -150 PPM temp coef.
C508	19A700235P29	Ceramic: 220 pf ±5%, 50 VDCW, -150 PPM temp coef.
C509	19A700234P5	Polyester: 4700 pf ±10%, 50 VDCW.
C510	19A701534P4	Tantalum: 1 µf ±20%, 35 VDCW.
C511	19A701534P2	Tantalum: 0.22 µf ±20%, 35 VDCW.
C512 thru C514	19A701534P4	Tantalum: 1 µf ±20%, 35 VDCW.
C515 and C516	19A701534P5	Tantalum: 0.47 µf ±20%, 35 VDCW.
C517 and C518	19A700233P3	Ceramic: 220 pf ±20%, 50 VDCW.
C519	19A700233P7	Ceramic: 1000 pf ±20%, 50 VDCW.
C520	19A701534P4	Tantalum: 1 µf ±20%, 35 VDCW.
C521	19A134730P3	Electrolytic: 470 µf +100 -10%, 16 VDCW.
C522	19A700234P4	Polyester: 3300 pf ±10%, 50 VDCW.
C601	19A700234P5	Polyester: 4700 pf ±10%, 50 VDCW.
C602	19A700234P6	Polyester: 6800 pf ±10%, 50 VDCW.
C603	19A700234P11	Polyester: 0.047 µf ±10%, 50 VDCW.
C604	19A701534P6	Tantalum: 4.7 µf ±20%, 35 VDCW.
C605	19A134730P1	Electrolytic: 47 µf +100 -10%, 16 VDCW.
C606	19A701534P4	Tantalum: 1 µf ±20%, 35 VDCW.
C607	19A701534P2	Tantalum: 0.22 µf ±20%, 35 VDCW.
C608	19A701534P5	Tantalum: 0.47 µf ±20%, 35 VDCW.
C609 and C610	19A700234P13	Polyester: 0.1 µf ±10%, 50 VDCW.
C611	19A701534P9	Tantalum: 47 µf ±20%, 6.3 VDCW.
C612	19A700234P13	Polyester: 0.1 µf ±10%, 50 VDCW.
C613	19A701534P2	Tantalum: 0.22 µf ±20%, 35 VDCW.
C614	19A700004P6	Metallized polyester: 0.47 µf ±10%, 63 VDCW.
C615	19A134730P3	Electrolytic: 470 µf +100 -10%, 16 VDCW.
C616 and C617	19A700234P12	Polyester: 0.068 µf ±10%, 50 VDCW.
C618	19A134730P1	Electrolytic: 47 µf +100 -10%, 16 VDCW.
C619	19A134730P2	Electrolytic: 220 µf +100 -10%, 25 VDCW.
C626 thru C629	19A700233P5	Ceramic: 470 pf ±20%, 50 VDCW.
		- - - - - - - - - - - DIODES - - - - - - - - - - -
D201	19A700028P1	Silicon, fast recovery: 75 mA fwd current.
D251 and D252	19A700028P1	Silicon, fast recovery: 75 mA fwd current.
D501 and D502	19A700028P1	Silicon, fast recovery: 75 mA fwd current.
D601 thru D606	19A700028P1	Silicon, fast recovery: 75 mA fwd current.
D607	19A134738P1	Diode, optoelectronic: red; sim to Siemans LD41/11.
D608	19A700028P1	Silicon, fast recovery: 75 mA fwd current.
		- - - - - - - - JACKS AND RECEPTACLES - - - - - - - -
J151	19A701883P4	Contact, electrical: sim to AMP 86444-1.
J351	19A701883P4	Contact, electrical: sim to AMP 86444-1.
		- - - - - - - - - - - RELAYS - - - - - - - - - - -
K601	19A700061P1	Hermetic sealed: 8-16.3 VDC operating, DPDT contact arrangement.
		- - - - - - - - - - - INDUCTORS - - - - - - - - - - -
L201	19J706258P15	Coil, RF: fixed
L202	19J706213P6	Coil, RF: fixed
L203	19A700024P15	Coil, RF: 1.5 µH, 100 VRMS operating.
L204 and L205	19J706213P6	Coil, RF: fixed
L206	19A702028P4	Jumper.
L207 and L208	19J706154P2	Coil, RF: fixed, sim to Paul Smith SK802-1.
L209	19A702028P7	Jumper.
L210	19A702028P4	Jumper.
L211	19A702028P6	Jumper.
L212	19J706085P3	Coil, choke: 0.031 µH ±5%, sim to Paul Smith LM-2.
L213	19J706085P7	Coil, choke: 0.018 µH ±5%, sim to Paul Smith LM-2.
L214 and L215	19J706154P2	Coil, RF: fixed, sim to Paul Smith SK802-1.
L253	19A702028P6	Jumper.
L254	19A701006P5	Strap.
L255 and L256	19A701091G1	Coil, torridal: sim to Stackpole Carbon 88-31959.
L257	19A701237P1	Coil.
L259	19A700024P1	Coil, RF: 100 µH, 100 VRMS operating.
L260 and L261	19A701091G1	Coil, torridal: sim to Stackpole Carbon 88-31959.
L262	19A701237P1	Coil.
L263	19A701006P3	Strap.
L264 and L265	19B233135P1	Coil.
L351	19A134727P8	Coil.
L352	19A134727P7	Coil.
L353		Part of printed board 19D900552P1.
L354 and L355	19J706154P2	Coil, RF: fixed, sim to Paul Smith SK802-1.
L401 and L402	19J706154P2	Coil, RF: fixed, sim to Paul Smith SK802-1.
L403	19A138400G1	Coil.
L404		Part of printed board 19D900552P1.

SYMBOL	GE PART NO.	DESCRIPTION
L405 and L406	19J706154P2	Coil, RF: fixed, sim to Paul Smith SK802-1.
L407	19B209728P1	Coil.
L408		Part of printed board 19D900552P1.
L409	19A134729P2	Coil.
L501 and L502	19A134747P3	Intermediate freq: 21.4 MHz ±3% res. freq. Sim to TOKO, Inc KXM-K3501N.
L503 and L504	19A134747P1	Intermediate freq: 455 KHz res. freq. Sim to TOKO, Inc. RMC 45225-2NO.
L601	19A702322P1	Reactor, audio freq: 75 MHz ±10%, sim to Festinduktivetaten DR 270/5-GL.
		- - - - - - - - - - - PLUGS - - - - - - - - - - -
P251	19A700102P10	Printed wire: 3 contacts, sim to Molex 09-52-3032.
P901	19A116659P15	Connector, printed wiring: 4 contacts; sim to Molex 09-52-3042.
P903	19A116659P83	Connector, printed wiring: 7 contacts; sim to Molex 09-52-3072 (Special).
		- - - - - - - - - TRANSISTORS - - - - - - - - - -
Q201	19A702084P1	Silicon, NPN.
Q202 and Q203	19A701808P1	Silicon, NPN.
Q204	19A701940P1	Silicon, NPN.
Q251	19A134237P1	Silicon, NPN,
Q254 and Q255	19A700023P1	Silicon, NPN.
Q256	19A700020P1	Silicon, PNP.
Q257	19A700054P1	Silicon, NPN.
Q351	19J706514P1	Silicon, NPN.
Q401	19A134775P1	Silicon, NPN, sim to Siemans PFR34A.
Q402	19J706038P1	N Type, field effect.
Q501	19A700075P1	N-Channel, field effect.
Q601 and Q602	19A116774P1	Silicon, NPN, sim to 2N5210.
Q603 thru Q605	19A134749P1	Silicon, PNP, sim to 2N5087.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R201	19A700019P13	Deposited carbon: 10 ohms ±5%, 0.25 w.
R202	19A700019P33	Deposited carbon: 470 ohms ±5%, 0.25 w.
R203	19A700019P47	Deposited carbon: 6.8K ohms ±5%, 0.25 w.
R204	19A700106P63	Composition: 1K ohms ±5%, 1/4 w.
R205	19A700106P75	Composition: 3.3K ohms ±5%, 1/4 w.
R206	19A700019P21	Deposited carbon: 47 ohms ±5%, 0.25 w.
R207	19A700019P49	Deposited carbon: 10K ohms ±5%, 0.25 w.
R208	19A700106P73	Composition: 2.7K ohms ±5%, 1/4 w.
R209	19A700019P49	Deposited carbon: 10K ohms ±5%, 0.25 w.
R210	19A700106P71	Composition: 2.2K ohms ±5%, 1/4 w.
R211	19A700019P21	Deposited carbon: 47 ohms ±5%, 0.25 w.
R212	19A700106P47	Composition: 220 ohms ±5%, 1/4 w.
R213	19A700019P43	Deposited carbon: 3.3K ohms ±5%, 0.25 w.
R214	19A700106P55	Composition: 470 ohms ±5%, 1/4 w.
R215	19A700019P21	Deposited carbon: 18 ohms ±5%, 0.25 w.

SYMBOL	GE PART NO.	DESCRIPTION
R216	19A700106P43	Composition: 150 ohms ±5%, 1/4 w.
R217	19A700019P42	Deposited carbon: 3.7K ohms ±5%, 0.25 w.
R218	19A700106P47	Composition: 220 ohms ±5%, 1/4 w.
R219	19A700113P27	Composition: 33 ohms ±5%, 1/2 w.
R221	19A700019P49	Deposited carbon: 10K ohms ±5%, 0.25 w.
R251	19A700106P23	Composition: 22 ohms ±5%, 1/4 w.
R252	19A700113P25	Composition: 27 ohms ±5%, 1/2 w.
R253	19A700106P51	Composition: 330 ohms ±5%, 1/4 w.
R254	19A700019P55	Deposited carbon: 33K ohms ±5%, 0.25 w.
R255	19A700106P15	Composition: 10 ohms ±5%, 1/4 w.
R256	19A700113P15	Composition: 10 ohms ±5%, 1/2 w.
R257	19A700106P15	Composition: 10 ohms ±5%, 1/4 w.
R258	19A700113P15	Composition: 10 ohms ±5%, 1/2 w.
R259	19A700019P37	Deposited carbon: 1K ohms ±5%, 0.25 w.
R260	19A700185P3	Variable: 94 to 4700 ohms ±20%, 1/3 w.
R261	19A700019P47	Deposited carbon: 6.8K ohms ±5%, 0.25 w.
R262	19A700019P41	Deposited carbon: 2.2K ohms ±5%, 0.25 w.
R263	19A700019P33	Deposited carbon: 470 ohms ±5%, 0.25 w.
R264	19A700019P40	Deposited carbon: 1.8K ohms ±5%, 0.25 w.
R265	19A700019P29	Deposited carbon: 220 ohms ±5%, 0.25 w.
R266	19A700019P33	Deposited carbon: 470 ohms ±5%, 0.25 w.
R267	19A700019P40	Deposited carbon: 1.8K ohms ±5%, 0.25 w.
R351	19A700019P13	Deposited carbon: 10 ohms ±5%, 0.25 w.
R352	19A700019P37	Deposited carbon: 1K ohms ±5%, 0.25 w.
R353	19A700019P22	Deposited carbon: 56 ohms ±5%, 0.25 w.
R354 and R355	19A700019P13	Deposited carbon: 10 ohms ±5%, 0.25 w.
R401	19A700019P45	Deposited carbon: 4.7K ohms ±5%, 0.25 w.
R402	19A700019P37	Deposited carbon: 1K ohms ±5%, 0.25 w.
R403 and R404	19A700019P22	Deposited carbon: 56 ohms ±5%, 0.25 w.
R405	19A700019P40	Deposited carbon: 1.8K ohms ±5%, 0.25 w.
R406	19A700019P22	Deposited carbon: 56 ohms ±5%, 0.25 w.
R407	19A700019P25	Deposited carbon: 100 ohms ±5%, 0.25 w.
R408	19A700019P20	Deposited carbon: 39 ohms ±5%, 0.25 w.
R501	19A700019P41	Deposited carbon: 2.2K ohms ±5%, 0.25 w.
R502 and R503	19A700019P54	Deposited carbon: 27K ohms ±5%, 0.25 w.
R504	19A700019P31	Deposited carbon: 330 ohms ±5%, 0.25 w.
R505	19A700019P30	Deposited carbon: 270 ohms ±5%, 0.25 w.
R506	19A700019P48	Deposited carbon: 8.2K ohms ±5%, 0.25 w.
R507	19A700019P47	Deposited carbon: 6.8K ohms ±5%, 0.25 w.
R508	19A700019P41	Deposited carbon: 2.2K ohms ±5%, 0.25 w.
R509	19A700019P41	Deposited carbon: 2.2K ohms ±5%, 0.25 w.
R510	19A700019P50	Deposited carbon: 12K ohms ±5%, 0.25 w.
R511	19A700019P35	Deposited carbon: 680 ohms ±5%, 0.25 w.
R512 and R513	19A700019P31	Deposited carbon: 330 ohms ±5%, 0.25 w.
R514	19A700019P40	Deposited carbon: 1.8K ohms ±5%, 0.25 w.
R515	19A700019P50	Deposited carbon: 12K ohms ±5%, 0.25 w.
R516	19A700019P35	Deposited carbon: 680 ohms ±5%, 0.25 w.
R517	19A700019P47	Deposited carbon: 6.8K ohms ±5%, 0.25 w.

SYMBOL	GE PART NO.	DESCRIPTION
R518	19A700019P48	Deposited carbon: 8.2K ohms ±5%, 0.25 w.
R519	19A700019P40	Deposited carbon: 1.8K ohms ±5%, 0.25 w.
R520	19A700019P49	Deposited carbon: 10K ohms ±5%, 0.25 w.
R521	19A700185P5	Variable: 440 to 22K ohms ±20%, 1/3 w.
R522	19A700019P49	Deposited carbon: 10K ohms ±5%, 0.25 w.
R523	19A700019P43	Deposited carbon: 3.3K ohms ±5%, 0.25 w.
R524 and R525	19A700019P56	Deposited carbon: 39K ohms ±5%, 0.25 w.
R526	19A700019P9	Deposited carbon: 4.7 ohms ±5%, 0.25 w.
R527	19A700019P25	Deposited carbon: 100 ohms ±5%, 0.25 w.
R601	19A700019P57	Deposited carbon: 47K ohms ±5%, 0.25 w.
R602	19A700019P53	Deposited carbon: 22K ohms ±5%, 0.25 w.
R603	19A700019P31	Deposited carbon: 330 ohms ±5%, 0.25 w.
R604	19A700019P52	Deposited carbon: 18K ohms ±5%, 0.25 w.
R605	19A700019P49	Deposited carbon: 10K ohms ±5%, 0.25 w.
R606	19A700019P66	Deposited carbon: 0.27M ohms ±5%, 0.25 w.
R607	19A700185P4	Variable: 200 to 10K ohms ±20%, 1/3 w.
R608	19A700019P47	Deposited carbon: 6.8K ohms ±5%, 0.25 w.
R609	19A134732P2	Thermistor: 470 ohms ±10%, at 0 power, color code brown; sim to Phillips 2322-642-11471.
R610	19A700019P48	Deposited carbon: 8.2K ohms ±5%, 0.25 w.
R611	19A700019P26	Deposited carbon: 120 ohms ±5%, 0.25 w.
R612	19A700019P33	Deposited carbon: 470 ohms ±5%, 0.25 w.
R613	19A700019P36	Deposited carbon: 820 ohms ±5%, 0.25 w.
R614	19A700019P44	Deposited carbon: 3.9K ohms ±5%, 0.25 w.
R615	19A700019P57	Deposited carbon: 47K ohms ±5%, 0.25 w.
R616	19A700019P49	Deposited carbon: 10K ohms ±5%, 0.25 w.
R617	19A700019P68	Deposited carbon: 0.39M ohms ±5%, 0.25 w.
R618	19A700019P50	Deposited carbon: 12K ohms ±5%, 0.25 w.
R619 and R620	19A700019P54	Deposited carbon: 27K ohms ±5%, 0.25 w.
R621	19A700019P40	Deposited carbon: 1.8K ohms ±5%, 0.25 w.
R622	19A700019P31	Deposited carbon: 330 ohms ±5%, 0.25 w.
R623	19A700019P47	Deposited carbon: 6.8K ohms ±5%, 0.25 w.
R624	19A700019P58	Deposited carbon: 56K ohms ±5%, 0.25 w.
R625 and R626	19A700019P37	Deposited carbon: 1K ohms ±5%, 0.25 w.
R627	19A700019P38	Deposited carbon: 1.2K ohms ±5%, 0.25 w.
R628	19A700019P37	Deposited carbon: 1K ohms ±5%, 0.25 w.
R629	19A700019P38	Deposited carbon: 1.2K ohms ±5%, 0.25 w.
R630	19A700019P28	Deposited carbon: 180 ohms ±5%, 0.25 w.
R631	19A700019P27	Deposited carbon: 150 ohms ±5%, 0.25 w.
R632	19A700019P54	Deposited carbon: 27K ohms ±5%, 0.25 w.
R633	19A700019P48	Deposited carbon: 8.2K ohms ±5%, 0.25 w.
R634	19A134753P1	Variable.
R635	19A700019P1	Deposited carbon: 1 ohm ±5%, 0.25 w.
R636	19A700019P17	Deposited carbon: 22 ohms ±5%, 0.25 w.
R637	19A700019P1	Deposited carbon: 1 ohm ±5%, 0.25 w.
R638	19A700019P26	Deposited carbon: 120 ohms ±5%, 0.25 w.
R639	19A700019P22	Deposited carbon: 56 ohms ±5%, 0.25 w.
R640A	19A700019P30	Deposited carbon: 270 ohms ±5%, 0.25 w.
R640B	19A700019P25	Deposited carbon: 100 ohms ±5%, 0.25 w.
R640C	19A700019P21	Deposited carbon: 47 ohms ±5%, 0.25 w.

(Cont'd on Page 32)

SYMBOL	GE PART NO.	DESCRIPTION
R640D	19A700019P17	Deposited carbon: 22 ohms ±5%, 0.25 w.
R640E	19A700019P11	Deposited carbon: 6.8 ohms ±5%, 0.25 w.
R641	19A700019P35	Deposited carbon: 680 ohms ±5%, 0.25 w.
R642	19A700018P1	Deposited carbon: 1 ohms ±5%, 350 VDCW, 1/3 w.
R643	19A700019P25	Deposited carbon: 100 ohms ±5%, 0.25 w.
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S601	19B800563P3	Push: DPDT, contacts rated 15 mA at 130 VAC; sim to IEE/SCHADOW 51203.
S602	19B800563P1	Push: DPDT, contacts rated at 15 mA at 130 VAC; sim to IEEE/SCHADOW 51281.
		- - - - - - - - - TEST POINTS - - - - - - - - -
TP201 thru TP203	19A700152P1	Contact, electrical.
TP251	19A700152P1	Contact, electrical.
TP351	19A700152P1	Contact, electrical.
TP401	19A700152P1	Contact, electrical.
TP501	19A700152P1	Contact, electrical.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - - -
U501	19A134759P1	Linear. (DUAL DIFFERENTIAL AMPLIFIER).
U502	19A134766P1	Linear. (IF AMPLIFIER & DETECTOR).
U601	19A701830P1	Linear. (AUDIO AMPLIFIER).
U602	19A138414G1	Regulator. 8.5 v.
		- - - - - - - - - - CABLES - - - - - - - - - -
W201 thru W207		Part of printed board 19D900552P1
W251 thru W255		Part of printed board 19D900552P1.
W257 and W258		Part of printed board 19D900552P1.
W401		Part of printed board 19D900552P1.
W601		Part of printed board 19D900552P1.
		- - - - - - - - - - SOCKETS - - - - - - - - - -
X501		Connector. Includes:
	19A134806P1	Jack.
	19B232322P1	Spring.
		- - - - - - - - - - CRYSTALS - - - - - - - - - -
Y501	19A702284G3	Crystal, Quartz: 20945.000 kHz. (STANDARD).
	19A702284G4	Crystal, Quartz: 21855.000 kHz. (TNEET FREQ).
		- - - - - - - - - - FILTERS - - - - - - - - - -
Z501	19A134797P2	Bandpass. 21.4 Ref. Freq. 20 kHz channel spacing. sim to TOYO 21J3E5.
Z502	19A702171P1	Bandpass. 455 kHz ±1.5, sim to Murata CFU455D2.
		- - - - - - - - - TRANSISTORS - - - - - - - - -
Q252	19A134164P2	Silicon, NPN; sim to Type 2N5945.
Q253	19A134239P3	Silicon, NPN.
		- - - - - - - - - - CABLES - - - - - - - - - -
W256	19A701093P1	Strap.

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - MISCELLANEOUS - - - - - - - - -
	19A700036P508	Screw, thread forming: No. M3.5 - .6 x 8. (Secures A1).
	19A130465P1	Spacer. (Used with Q252).
	5492178P2	Washer, spring tension. (Used with Q252).
	7142162P137	Nut, spacer. 8-32. (Used with Q252).
	19A138451P1	Tuning slug. (Used with L207, L208, L214, L215, L354, L355, L401, L402, L405 - L407).
	19A701886P1	Spring. (Used with L207, L208, L214, L215, L354, L355, L401, L402, L405 - L407.)
	19B232901P1	Support. (U601, U602, U257).
	19A700068P1	Insulator, bushing. (Used with U602 & U257).
	19A700115P3	Insulator, plate. (Used with U602 & U257).
	19A700069P1	Can. (Used with L351 & L352).
	19A138274P1	Insulator. (Used with L351 & L352).
	NP280878P1	Nameplate. (POWER).
	NP280878P13	Nameplate. (MONITOR).
	19C328587P1	Pushbutton. (Used with S601 & S602).
	19A134753P5	Machine screw. (Used with R634).
	19J706076P1	Washer, spring. (Used with R634).
	19A134753P2	Washer. (Used with R634).
	19D429826P1	Knob. (Used with R634).
	19A701743P1	Pad. (Used with R634).
	19A700114P1	Terminal, stud. (Used with C277-C279).
	19A701332P4	Disk. (Used with Q251).
	19A701887P1	Heat sink. (Q251).
	19A701900P2	Clip, compression. (Used with Q251).

PARTS LIST

SPEAKER
19C320302G9
ISSUE 1

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - LOUDSPEAKERS - - - - - - - - -
LS2	19A116910P1	Permanent magnet: 5 inch, 3.2 ohms ±15% imp, 5 w max operating; sim to Pioneer 002009.
		- - - - - - - - - - CABLES - - - - - - - - - -
W1	19A129414G1	2 conductor cable: approx 5 feet long, includes (2) 19A116781P3 contacts.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19B227593G2	Housing.
	19B219692G2	Grille.
	19C320016P2	Mounting bracket. (Mounts speaker to mounting surface).
	N187P16010C6	Machine screw: No. 10-32 x 5/8. (Secures speaker to mounting bracket).
	N403P19C6	Lockwasher, external tooth: No. 10. (Secures speaker to mounting bracket).
	N402P39C6	Flatwasher: No. 10. (Secures speaker to mounting bracket).
	N130P160110C6	Tap screw, thread forming: No. 10-16 x 5/8. (Secures mounting bracket to mounting surface).
	19A116986P108	Tap screw, with lockwasher: No. 7-19 x 1/2. (Secures speaker to grille).
	19A116986P112	Tap screw, with lockwasher: No. 7-19 x 3/4. (Secures housing to grille).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PARTS LIST

MIKE HANGER/HOOKSWITCH
19C320318G3
ISSUE 1

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - - SWITCHES - - - - - - - - -
S6	19A134398P1	Push: sim to Chicago Switch S-1527-1.
		- - - - - - - - - - - CABLES - - - - - - - - - -
W1	19A129414G1	Cable: approx 5 feet. Includes (2) contacts 19A116781P5.
		- - - - - - - - - MISCELLANEOUS - - - - - - - -
S1	19B209261P18	Switch, slide: 1 pole, 2 positions, 0.5 amp VDC or 3 amp VAC at 125 v; sim to Switchcraft 46202LH.
	19B219694P1	Base plate.
	19B219698G4	Housing.
	19B219693P2	Spring.
	19A116768P6	Strain relief. (W1).
	N193P1410C6	Tap screw, phillip head: No. 8-18 x 5/8. (Secures assembly to mounting surface).
	19A134398P101	Plate. (Located on S6).
		ASSOCIATED PARTS MIKE KIT 7141414G2
	4031457P1	Support.
	4031458P1	Spring.
	N193P1408C6	Tap screw, phillip head: No. 8-18 x 1/2.
	19A116773P105	Tap screw, Phillips POZIDRIV©: No. 7-19 x 5/16.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PARTS LIST

TRANSISTORIZED MICROPHONE
19B209670P1
ISSUE 2

SYMBOL	GE PART NO.	DESCRIPTION
	19A116659P20	Cable connector shell; sim to Molex 09-50-3081.
	19A116781P6	Contact, electrical: wire range No. 22-26 AWG; sim to Molex 08-50-0107. (Quantity 4- Used with 19A116659P20 connector shell).
	NP280575	Faceplate. (GENERAL ELECTRIC).
	4033271G1	Strain relief. (Located on cable 10 inches from connector).
	MP101	Case, front & back with push to talk switch.
	MP102	Cartridge, with leads.
	MP103	Cable assembly.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PARTS LIST

ASSOCIATED PARTS AND ASSEMBLIES
(LBI-31072)
ISSUE 1

SYMBOL	GE PART NO.	DESCRIPTION
	19D900123P2	Bottom cover.
	19A701530G2	Casting. (Rear heatsink).
	19D900129P2	Front cap.
	19D900621P1	Faceplate. (GENERAL ELECTRIC - Standard).
	19D900621P2	Faceplate. (GENERAL ELECTRIC - 2 Tx, 1 Rx TALKAROUND).
		TOP COVER AND SPEAKER ASSEMBLY 19C850864G1
		- - - - - - - - - LOUDSPEAKERS - - - - - - - - -
B901	19B800867P1	Permanent magnet: 290 ±45 Hz Resonant freq, 3 watt
		- - - - - - - - - - - PLUGS - - - - - - - - - - -
P904		Connector. Includes:
	19A700041P28	Shell.
	19A700041P26	Contact, electrical. (Quantity 2).
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19A702403P1	Screen. (Used with B901 speaker).
	N84P13006C6	Machine screw: Phillips head, No 6-32 x 3/8. (Secures B901 speaker).
		HARDWARE KIT 19A701522G4
		- - - - - - - - JACKS AND RECEPTACLES - - - - - - - -
J601B	19A700067P2	Receptacle: Coax., sim to Amphenal 83-876-1002.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19A700036P520	Top screw. M 3.5 x 0.6 x 20. (Secures Tx Rx shield).
	19A700031P410	Machine screw. M3 x 0.5 x 10. (Secures J601 and covers at rear).
	19A700036P508	Top screw. M 3.5 x 0.6 x 8. (Secures Interconnect/Oscillator/Channel Guard Board).
	19A700032P5	Lockwasher. M 3. (Secures J601).
	19B232859P1	Bushing. (Used with LED's on faceplate).
	19A701744P1	Pad. (Located behind volume switch).
	19B800719P1	Dust Pad. (Located at J910 and J911).
	19A702388P1	Block, threaded. (Located behind J601).
		- - - - - - - - - - CRYSTALS - - - - - - - - - -
		NOTE: When reordering, give GE part number and specify exact operating frequency needed.
		Tx 150 - 174 MHz Fx = $\frac{Fo}{3}$
Y151	19B233066G1	Crystal.
		Tx 450 - 470 MHz Fx = $\frac{Fo}{9}$
Y151	19B233066G5	Crystal.
		Rx 150 - 174 MHz Fx = $\frac{Fo - 10.7}{3}$

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PARTS LIST

ASSOCIATED ASSEMBLIES
(LBI-31072)
ISSUE 1

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - MICROPHONES - - - - - - - - - -
	19C850857P2	Microphone: Dynamic, with Electret cartridge EM-60, supplied with hang up bracket and screws. Connector consists of 19A116659P20 shell and (4) 19A116781P6 contacts.
		STANDARD MOUNTING HARDWARE KIT 19A138051G5 BLACK 19A138051G6 PEBBLE 19A138051G8 DESK TOP
	19A134653P4008	Bolt, machine, hex: Metric, 8MM. (Secures radio to mounting bracket).
	19A700032P7	Lockwasher, internal tooth: No. M2.2 (Metric) (Secures radio to mounting bracket).
	19J706152P9	Retaining strap: sim to Dennison BAR-LOK 08471. (Secures power leads under dash).
	N130P1610C6	Screw, thread forming: No. 10-16 x 5/8. (Secures mounting bracket to mounting surface with thin mounting surface).
	N130P1624C6	Screw, thread forming: No. 10-16 x 1-1/2. (Secures mounting bracket to mounting surface when thick carpet is on mounting surface).
	5490407P6	Rubber grommet. (Located in fire wall).
	19C850638P2	Mounting bracket. Black
	19C850638P3	Mounting bracket. Pebble
	19A702241G1	Mounting bracket, desk top.
		POWER CABLE 19B232925G2
P910	19A116659P143	Connector, printed wiring; sim to Molex 09-05-3111.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19A137818G3	Lead, black. (Includes 19A116781P5 contact).
		FUSED LEAD ASSEMBLY 19A137818G9 10 AMP 19A137818G10 2 AMP
	19A116781P5	Contact, electrical: wire range No. 18-24 AWG; sim to Molex 08-50-0106. (Hung in wiring on red & yellow wires).
	19A115776P3	Contact, electric: sim to Littelfuse 904-88. (Located in fuseholder - Quantity 2).
	7484390P1	Fuse cartridge, 10 amp.
	1R16P5	Fuse cartridge, 2 amp.
	19A115776P6	Fuseholder: sim to Bussman 9835. (Mates with 19A115776P5 knob).
	19A115776P7	Spring: sim to Bussman 1A1853. (Used with fuseholder).
	19A115776P5	Spring: sim to Bussman 9953 1/2. (Used with fuseholder).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

SYMBOL	GE PART NO.	DESCRIPTION
Y301	19B233066G2	Crystal. Rx 450 - 470 MHz Fx = $\frac{Fo - 21.4}{9}$
Y301	19B233066G7	Crystal.
Y501	19A702284G1	2nd Oscillator Crystal. 10,245.000 KHz.
	19A702284G2	2nd Oscillator Crystal. 11,155.000 KHz.
	19A702284G3	2nd Oscillator Crystal. 20,945.000 KHz.
	19A702284G4	2nd Oscillator Crystal. 21,855.000 KHz.

PARTS LIST

RUGGEDIZED MICROPHONE
19B233577P2
ISSUE 1

SYMBOL	GE PART NO.	DESCRIPTION
	RP117	Cartridge.
	RP128	Switch.
	RP277	Switch button, Pebble.
	RP275	Case set, Pebble.
	RP263	Cable assembly. (Includes connector shell 19A116659P20 & 4 contacts 19A116781P6).
	RP276	Chassis assembly, inner module.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PARTS LIST

132-512 MHz ANTENNA
19B209568P1

ISSUE 2

SYMBOL	GE PART NO.	DESCRIPTION
		Whip assembly. Decibel Products 068110-001.
		Whip nut assembly. Decibel Products 068047-001.
		Base nut assembly. Decibel Products 068048-001.
		"O" Ring (LARGE). Decibel Products 007059-122.
		Stud assembly. Decibel Products 068046-001.
		RG58/U Cable, 15 feet. Decibel Products 068115-001.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

PARTS LIST

SPEAKER (PEBBLE)
19C320302G11
ISSUE 1

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - LOUDSPEAKERS - - - - - - - - -
LS2	19A116910P1	Permanent magnet: 5 inch, 3.2 ohms ±15% imp, 5 w max operating; sim to Pioneer 002009.
		- - - - - - - - - - CABLES - - - - - - - - - -
W1	19A129414G1	2 conductor cable: approx 5 feet long, includes (2) 19A116781P5 contacts.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19B219692G4	Grille.
	19B227593G4	Housing.
	19C320016P3	Mounting bracket. (Located between housing & retaining bracket).
	19A116986P108	Tap screw, with lockwasher: No. 7-19 x 1/2. (Secures speaker to housing).
	19A116986P112	Tap screw, with lockwasher: No. 7-19 x 3/4. (Secures grille to housing).
	N187P16010C6	Screw, hexhead, slotted: No. 10-32 x 5/8. (Quantity 2- Secures mounting bracket to housing).
	N403P19C6	Lockwasher, external tooth: No. 10. (Quantity 2- Secures mounting bracket to housing).
	N402P39C6	Flatwasher: No. 10. (Quantity 2- Secures mounting bracket to housing).
	N130P1610C6	Tap screw, thd. forming: No. 10-16 x 5/8. (Secures mounting bracket to mounting surface).

*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 - Tx/Rx Board 19D900533G1
Incorporated in initial shipment.

PARTS LIST

INTERCONNECT/OSCILLATOR/CHANNEL GUARD BOARD

19D900556G1	150-174 MHz, 1 TX/1 RX
19D900556G2	150-174 MHz, 1 TX/1 RX W CHAN GD
19D900556G3	150-174 MHz, 2 TX/1 RX
19D900556G4	150-174 MHz, 2 TX/1 RX W CHAN GD
19D900556G5	450-470 MHz, 1 TX/1 RX
19D900556G6	450-470 MHz, 1 TX/1 RX W CHAN GD
19D900556G7	450-470 MHz, 2 TX/1 RX
19D900556G8	450-470 MHz, 2 TX/1 RX W CHAN GD

ISSUE 1

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - - CAPACITORS - - - - - - - - - -
C101	19A700234P9	Polyester: 0.022 µf ±10%, 50 VDCW.
C102	19A702059P12	Polyester: 0.068 µf ±5%, 50 VDCW.
C103	19A701534P4	Tantalum: 1 µf ±20%, 35 VDCW.
C104	19A701534P6	Tantalum: 0.47 µf ±20%, 35 VDCW.
C105	19A700235P13	Ceramic: 10 pf ±5%, 50 VDCW, -150 PPM temp coef.
C106	19A701534P8	Tantalum: 22 µf ±20%, 16 VDCW.
C107	19A702059P11	Polyester: 0.047 µf ±5%, 50 VDCW.
C108	19A701534P6	Tantalum: 0.47 µf ±20%, 35 VDCW.
C109	19A702059P6	Polyester: 6800 pf ±5%, 50 VDCW.
C110	19A702059P1	Polyester: 1000 pf ±5%, 50 VDCW.
C111	19A701534P6	Tantalum: 0.47 µf ±20%, 35 VDCW.
C113	19A700233P5	Ceramic: 1000 pf, ±20%, 50 VDCW.
C151	19A701534P8	Tantalum: 22 µf ±20%, 16 VDCW.
C152 and C153	19A700235P28	Ceramic: 180 pf ±5%, 50 VDCW, -750 PPM temp coef.
C154 and C155	19J706256P202	Ceramic disc: 18 pf ±5%, 50 VDCW, -1500 ±250 PPM temp coef.
C156 and C157	19J706256P205	Ceramic disc: 68 pf ±5%, 50 VDCW, -1500 ±250 PPM temp coef.
C158 and C159	19A700233P7	Ceramic: 1000 pf ±20%, 50 VDCW.
C160	19A700235P28	Ceramic: 180 pf ±5%, 50 VDCW, -750 PPM temp coef.
C161	19A700233P7	Ceramic: 1000 pf ±20%, 50 VDCW.
C162	19A700235P5	Ceramic: 2.2 pf ±.25 pf, 50 VDCW, -150 PPM temp coef.
C163	19A700233P6	Ceramic: 680 pf ±20%, 50 VDCW.
C164	19A700233P7	Ceramic: 1000 pf ±20%, 50 VDCW.
C165	19A700233P5	Ceramic: 1000 pf ±20%, 50 VDCW.
C166	19A701534P6	Tantalum: 4.7 µf ±20%, 35 VDCW.
C167	19A700234P7	Polyester: 0.01 µf ±10%, 50 VDCW.
C168	19A700233P7	Ceramic: 1000 pf ±20%, 50 VDCW.
C301	19A700235P28	Ceramic: 180 pf ±5%, 50 VDCW, -750 PPM temp coef.
C302	19J706256P202	Ceramic disc: 18 pf ±5%, 50 VDCW, -1500 ±250 PPM temp coef.
C303	19J706256P205	Ceramic disc: 68 pf ±5%, 50 VDCW, -1500 ±250 PPM temp coef.
C304	19A700235P28	Ceramic: 180 pf ±5%, 50 VDCW, -750 PPM temp coef.
C305 and C306	19A700233P7	Ceramic: 1000 pf ±20%, 50 VDCW.
C307	19A700235P3	Ceramic: 1.5 pf ±.25 pf, 50 VDCW, -150 PPM temp coef.
C308	19A700235P18	Ceramic: 28 pf ±5% pf, 50 VDCW, -150 PPM temp coef.
C309	19A700233P6	Ceramic: 680 pf ±20%, 50 VDCW.
C310	19A700233P5	Ceramic: 1000 pf ±20%, 50 VDCW.
C311	19A701534P6	Tantalum: 0.47 µf ±20%, 35 VDCW.
C901	19A134730P2	Electrolytic: 220 µf, -10 +100%, 25 VDCW.
C902	19A701534P7	Tantalum: 10µf ±20%, 16 VDCW.
C903	19A700233P6	Ceramic: 680 pf ±20%, 50 VDCW.
C904	19A701534P8	Tantalum: 22 µf ±20%, 16 VDCW.
C905	19A700234P9	Polyester: 0.022 µf ±10%, 50 VDCW.
C1001	19A701534P8	Tantalum: 22 µf ±20%, 16 VDCW.
C1002 and C1003	19A700233P5	Ceramic: 1000 pf ±20%, 50 VDCW.
C1004	19A701534P3	Tantalum: 0.47 µf ±20%, 35 VDCW.
C1005 thru C1007	19A700235P18	Ceramic: 28 pf ±5%, 50 VDCW, -150 PPM temp coef.
C1008	19A700233P2	Ceramic: 1000 pf ±20%, 50 VDCW.
C1009	19A700235P18	Ceramic: 28 pf ±5%, 50 VDCW, -150 PPM temp coef.
C1010	19A701534P4	Tantalum: 1 µf ±20%, 35 VDCW.
C1011	19A701534P15	Tantalum: 3.3 µf ±20%, 35 VDCW.
C1012	19A701534P3	Tantalum: 0.47 µf ±20%, 35 VDCW.
C1013	19A701534P4	Tantalum: 1 µf ±20%, 35 VDCW.
C1014 and C1015	19A701534P15	Tantalum: 3.3 µf ±20%, 35 VDCW.
C1016	19A700235P26	Ceramic: 120 pf ±5%, 50 VDCW, -750 PPM temp coef.
C1017	19A700235P18	Ceramic: 28 pf ±5%, 50 VDCW, -150 PPM temp coef.
C1018	19A701534P15	Tantalum: 3.3 µf ±20%, 35 VDCW.
C1019	19A701534P5	Tantalum: 2.2 µf ±20%, 35 VDCW.
C1020	19A702059P12	Polyester: 0.068 µf ±5%, 50 VDCW.
C1021	19A701534P2	Tantalum: 0.22 µf ±20%, 35 VDCW.
C1022 and C1023	19A701594P1	Polyester: 0.033 µf ±2%, 100 VDCW.
C1024	19A701594P2	Polyester: 0.068 µf ±2%, 100 VDCW.
C1025 and C1026	19A702059P10	Polyester: 0.04 µf ±5%, 50 VDCW.
C1027 thru C1031	19A700235P18	Ceramic: 28 pf ±5%, 50 VDCW, -150 PPM temp coef.
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
D101 and D102	19A702015P1	Silicon. Sim to IN458A.
D151	19A700028P1	Silicon, fast recovery: 75 mA fwd. current.
D152 and D153	19J706262P1	Silicon. Sim to BB117
D301	19J706262P1	Silicon. Sim to BB117.
D901	19A700082P1	Rectifier, silicon.
D902	19J706100P1	Rectifier, silicon. Sim to IN4001.
D903	19A700028P1	Silicon, fast recovery: 75 mA fwd. current.
D904	19J706135P4	Optoelectronic: Green, sim to Hewlett Packard 5082-4955.
D1001	19A700028P1	Silicon, fast recovery: 75 mA fwd. current.
D1002	19A700025P6	Silicon, zener, 400mW max, sim to type BZX55-C5V1.
D1003 and D1004	19A700028P1	Silicon, fast recovery: 75 mA fwd. current.
		- - - - - - - JACKS AND RECEPTACLES - - - - - - -
J901	19A134734P1	Connector, 4 contacts: sim to Molex A-2461(09-67-1042).

COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SYMBOL	GE PART NO.	DESCRIPTION
J903	19A134735P1	Connector, 7 contacts: sim to Molex A-2461 (09-67-1072).
J904	19A700072P132	Printed wire: 2 contacts; sim to Molex 22-05-3021
J910	19A116659P151	Printed wire: 11 contacts; sim to Molex 09-75-1111
J911	19A116659P145	Printed wire: 8 contacts; sim to Molex 09-75-1081.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L151A	19J706029P1	Coil, RF: Variable.
L151B	19J706029P4	Coil, RF: Variable.
L152A	19J706029P1	Coil, RF: Variable.
L152B	19J706029P4	Coil, RF: Variable.
L153 and L154	19A700024P15	Coil, RF: 1.5 µH, 100 VRMS operating.
L155	19A700024P13	Coil, RF: 1.0 µH, 100 VRMS operating.
L156	19A700024P25	Coil, RF: 10 µH, 100 VRMS operating.
L301	19J706029P4	Coil, RF: Variable.
L302	19A700024P25	Coil, RF: 10 µH, 100 VRMS operating.
L901	19A700024P14	Coil, RF: 1.2 µH, 100 VRMS operating.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P151	19A701785P3	Contact, electrical.
P301	19A701785P3	Contact, electrical.
P907	19A700102P10	Printed wire: 3 contacts, sim to Molex 09-52-3032.
		- - - - - - - - - TRANSISTORS - - - - - - - - -
Q151 thru Q153	19A701351P1	Silicon; NPN.
Q154	19A700023P1	Silicon: NPN, sim to 2N3904.
Q301 and Q302	19A701351P1	Silicon: NPN.
Q901	19A116774P1	Silicon: NPN, sim to 2N5210.
Q1001 and Q1002	19A700022P1	Silicon: PNP, sim to 2N3906
Q1003	19A700023P1	Silicon: NPN, sim to 2N3904.
Q1004	19A700022P1	Silicon: PNP, sim to 2N3906.
Q1005 and Q1006	19A700023P1	Silicon: NPN, sim to 2N3904.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R101	19A701250P303	Metal film: 10.5K ohms ±1%, 250 VDCW, 1/4 w.
R102	19A700019P54	Deposited Carbon: 27K ohms ±5%, 250 VDCW, 1/4 w.
R103	19A700019P19	Deposited Carbon: 33 ohms ±5%, 250 VDCW, 1/4 w.
R104	19A143400P38	Deposited Carbon: 1.3K ohms ±5%, 250 VDCW, 1/4 w.
R105	19A700019P53	Deposited Carbon: 22K ohms ±5%, 250 VDCW, 1/4 w.
R106	19A143400P57	Deposited Carbon: 51 ohms ±5%, 250 VDCW, 1/4 w.
R107	19A700019P31	Deposited Carbon: 330 ohms ±5%, 250 VDCW, 1/4 w.
R108	19A700019P42	Deposited Carbon: 2.7K ohms ±5%, 250 VDCW, 1/4 w.
R109	19A701250P303	Metal film: 10.5K ohms ±1%, 250 VDCW, 1/4 w.
R110 and R111	19A701250P278	Metal film: 6340 ohms ±1%, 250 VDCW, 1/4 w.
R112	19A701250P330	Metal film: 20.0K ohms ±1%, 250 VDCW, 1/4 w.
R113	19A701250P310	Metal film: 12.4K ohms ±1%, 250 VDCW, 1/4 w.
R114	19A701250P350	Metal film: 32.4K ohms ±1%, 250 VDCW, 1/4 w.
R115	19A700019P41	Deposited Carbon: 2.2K ohms ±5%, 250 VDCW, 1/4w.

(Cont'd on Page 34)

SYMBOL	GE PART NO.	DESCRIPTION
R116A	19A700019P44	Deposited Carbon: 3.9K ohms ±5%, 250 VDCW, 1/4 w.
R116B	19A700019P39	Deposited Carbon: 1.5K ohms ±5%, 250 VDCW, 1/4 w.
R117A	19A700019P35	Deposited Carbon: 680 ohms ±5%, 250 VDCW, 1/4 w.
R117B	19A700019P43	Deposited Carbon: 3.3K ohms ±5%, 250 VDCW, 1/4 w.
R151	19A700019P47	Deposited Carbon: 6.8K ohms ±5%, 250 VDCW, 1/4 w.
R152	19A134732P1	Thermal: 3300 ohms ±5%, sim to Phillips 2322-642-12332.
R153	19A700019P47	Deposited Carbon: 6.8K ohms ±5%, 250 VDCW, 1/4 w.
R154	19A700019P51	Deposited Carbon: 15K ohms ±5%, 250 VDCW, 1/4 w.
R155 and R156	19A700185P4	Variable: 200 ohms to 10K ohms ±20%, 500 VDCW, 1/3 w.
R157 and R158	19A700106P49	Composition: 270 ohms ±5%, 250 VDCW, 1/4 w.
R159 and R160	19A700019P57	Deposited Carbon: 47K ohms ±5%, 250 VDCW, 1/4 w.
R161 and R162	19A700106P83	Composition: 6.8K ohms ±5%, 250 VDCW, 1/4 w.
R163 and R164	19A700106P85	Composition: 8.2K ohms ±5%, 250 VDCW, 1/4 w.
R165 and R166	19A700106P49	Composition: 270 ohms ±5%, 250 VDCW, 1/4 w.
R167	19A700019P25	Deposited Carbon: 100 ohms ±5%, 250 VDCW, 1/4 w.
R168	19A700019P30	Deposited Carbon: 270 ohms ±5%, 250 VDCW, 1/4 w.
R169	19A700019P43	Deposited Carbon: 3.3K ohms ±5%, 250 VDCW, 1/4 w.
R170	19A700019P47	Deposited Carbon: 6.8K ohms ±5%, 250 VDCW, 1/4 w.
R171A	19A700106P29	Composition: 39 ohms ±5%, 250 VDCW, 1/4 w.
R171B	19A700106P35	Composition: 68 ohms ±5%, 250 VDCW, 1/4 w.
R172	19A700019P49	Deposited Carbon: 10K ohms ±5% VDCW, 1/4 w.
R173	19A700019P1	Deposited Carbon: 1 ohms ±5%, 250 VDCW, 1/4 w.
R301	19A700106P59	Composition: 680 ohms ±5%, 250 VDCW, 1/4 w.
R302	19A700019P57	Deposited Carbon: 47K ohms ±5%, 250 VDCW, 1/4 w.
R303	19A700106P83	Composition: 6.8K ohms ±5%, 250 VDCW, 1/4 w.
R304	19A700106P85	Composition: 8.2K ohms ±5%, 250 VDCW, 1/4 w.
R305	19A700106P49	Composition: 270 ohms ±5%, 250 VDCW, 1/4 w.
R306	19A700019P25	Deposited Carbon: 100 ohms ±5%, 250 VDCW, 1/4 w.
R308	19A700019P30	Deposited Carbon: 270 ohms ±5%, 250 VDCW, 1/4 w.
R309	19A700019P43	Deposited Carbon: 3.3K ohms ±5%, 250 VDCW, 1/4 w.
R310	19A700019P47	Deposited Carbon: 6.8K ohms ±5%, 250 VDCW, 1/4 w.
R311	19A700106P19	Composition: 15 ohms ±5%, 250 VDCW, 1/4 w.
R901	19A700019P34	Deposited Carbon: 560 ohms ±5%, 250 VDCW, 1/4 w.
R902	19A700019P37	Deposited Carbon: 1K ohms ±5%, 250 VDCW, 1/4 w.
R903	19A700019P30	Deposited Carbon: 270 ohms ±5%, 250 VDCW, 1/4 w.
R904	19A700019P55	Deposited Carbon: 33K ohms ±5%, 250 VDCW, 1/4 w.
R905	19A700019P49	Deposited Carbon: 10K ohms ±5%, 250 VDCW, 1/4 w.
R906	19A700019P46	Deposited Carbon: 5.6K ohms ±5%, 250 VDCW, 1/4 w.
R907	19A700019P31	Deposited Carbon: 330 ohms ±5%, 250 VDCW, 1/4 w.
R908	19A700019P53	Deposited Carbon: 22K ohms ±5%, 250 VDCW, 1/4 w.
R909	19A700019P34	Deposited Carbon: 560 ohms ±5%, 250 VDCW, 1/4 w.
R910	19A700050P17	Wirewound: 2.2 ohms ±10%, 2 w.
R1001	19A700019P19	Deposited Carbon: 33 ohms ±5%, 250 VDCW, 1/4 w.
R1002	19A700019P53	Deposited Carbon: 22K ohms ±5%, 250 VDCW, 1/4 w.
R1003	19A700019P46	Deposited Carbon: 5.6K ohms ±5%, 250 VDCW, 1/4 w.

SYMBOL	GE PART NO.	DESCRIPTION
R1004	19A700019P52	Deposited Carbon: 18K ohms ±5%, 250 VDCW, 1/4 w.
R1005	19A700019P49	Deposited Carbon: 10K ohms ±5%, 250 VDCW, 1/4 w.
R1006	19A700019P33	Deposited Carbon: 470 ohms ±5%, 250 VDCW, 1/4 w.
R1007	19A701250P335	Metal film: 22.6K ohms ±1%, 250 VDCW, 1/4 w.
R1008	19A700019P61	Deposited Carbon: 0.1 Meg ohms ±5%, 250 VDCW, 1/4 w.
R1009	19A700019P42	Deposited Carbon: 2.7K ohms ±5%, 250 VDCW, 1/4 w.
R1010	19A700185P4	Variable: 200 ohms to 10K ohms ±20%, 500 VDCW, 1/3 w.
R1011	19A700019P59	Deposited Carbon: 68K ohms ±5%, 250 VDCW, 1/4 w.
R1012	19A700019P49	Deposited Carbon: 10K ohms ±5%, 250 VDCW, 1/4 w.
R1013	19A700019P51	Deposited Carbon: 15K ohms ±5%, 250 VDCW, 1/4 w.
R1014	19A701250P321	Metal film: 16.2K ohms ±1%, 250 VDCW, 1/4 w.
R1015	19A701250P322	Metal film: 16.5K ohms ±1%, 250 VDCW, 1/4 w.
R1016	19A701250P305	Metal film: 11K ohms ±1%, 250 VDCW, 1/4 w.
R1017	19A701250P284	Metal film: 7320 ohms ±1%, 250 VDCW, 1/4 w.
R1018	19A701250P317	Metal film: 14.7K ohms ±1%, 250 VDCW, 1/4 w.
R1019	19A701250P151	Metal film: 332 ohms ±1%, 250 VDCW, 1/4 w.
R1020	19A701250P309	Metal film: 12.1K ohms ±1%, 250 VDCW, 1/4 w.
R1021	19A701250P289	Metal film: 8250 ohms ±1%, 250 VDCW, 1/4 w.
R1022	19A700019P56	Deposited Carbon: 39K ohms ±5%, 250 VDCW, 1/4 w.
R1023	19A700019P57	Deposited Carbon: 47K ohms ±5%, 250 VDCW, 1/4 w.
R1024	19A700019P53	Deposited Carbon: 22K ohms ±5%, 250 VDCW, 1/4 w.
R1025	19A700019P61	Deposited Carbon: 0.1 Meg ohms ±5%, 250 VDCW, 1/4 w.
R1026	19A700019P49	Deposited Carbon: 10K ohms ±5%, 250 VDCW, 1/4 w.
R1027	19A700019P53	Deposited Carbon: 22K ohms ±5%, 250 VDCW, 1/4 w.
R1028	19A700019P49	Deposited Carbon: 10K ohms ±5%, 250 VDCW, 1/4 w.
R1029	19A700019P58	Deposited Carbon: 56K ohms ±5%, 250 VDCW, 1/4 w.
R1030 and R1031	19A700019P53	Deposited Carbon: 22K ohms ±5%, 250 VDCW, 1/4 w.
R1032	19A700019P49	Deposited Carbon: 10K ohms, ±5%, 250 VDCW, 1/4 w.
R1033	19A700019P46	Deposited Carbon: 5.6K ohms ±5%, 250 VDCW, 1/4 w.
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S151	19B800563P1	Push: DPDT, contacts rated 15 mA at 130 VAC.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - - -
U101	19A700086P4	Linear. DUAL OR AMP
U1001	19D417763G1	Decoder.
U1002	19C321133G1	Encoder.
U1003	19D417833G1	Selective Amplifier.
U1004	19A134511P2	Linear. DUAL OR AMP
		- - - - - - - - - - SOCKETS - - - - - - - - - -
X151 and X152		Socket. Includes:
	19A134806P1	Connector. (Quantity 2 each).
	19B232322P1	Spring.
X301		Socket. Includes;
	19A134806P1	Connector.
	19B232322P1	Spring.
X1001	19C320299G1	Connector. Includes:
	19D416714P1	Shell.
	19B219681P1	Contact, electrical. (Quantity 7).

PTION
ohms ±5%, 250 VDCW, 1/4 w.
ohms ±5%, 250 VDCW, 1/4 w.
ohms ±5%, 250 VDCW, 1/4 w.
±1%, 250 VDCW, 1/4 w.
eg ohms ±5%, 250 VDCW,
ohms ±5%, 250 VDCW, 1/4 w.
0K ohms ±20%, 500 VDCW,
ohms ±5%, 250 VDCW, 1/4 w.
ohms ±5%, 250 VDCW, 1/4 w.
ohms ±5%, 250 VDCW, 1/4 w.
±1%, 250 VDCW, 1/4 w.
±1%, 250 VDCW, 1/4 w.
, 250 VDCW, 1/4 w.
%, 250 VDCW, 1/4 w.
±1%, 250 VDCW, 1/4 w.
, 250 VDCW, 1/4 w.
±1%, 250 VDCW, 1/4 w.
%, 250 VDCW, 1/4 w.
ms ±5%, 250 VDCW, 1/4 w.
ms ±5%, 250 VDCW, 1/4 w.
ms ±5%, 250 VDCW, 1/4 w.
g ohm ±5%, 250 VDCW,
ms ±5%, 250 VDCW, 1/4 w.
ms ±5%, 250 VDCW, 1/4 w.
ms ±5%, 250 VDCW, 1/4 w.
hs ±5%, 250 VDCW, 1/4 w.
ms ±5%, 250 VDCW, 1/4 w.
ms, ±5%, 250 VDCW, 1/4 w.
ms ±5%, 250 VDCW, 1/4 w.
NES - - - - - - - - - - -
ed 15 mA at 130 VAC.
CIRCUITS - - - - - - - -
TS - - - - - - - - - - -
ch).
tity 7).

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - MISCELLANEOUS - - - - - - - - -
	19A129811P2	Insulator. (Used with U1002).
	19C328587P1	Pushbutton. (S151).
	19A701743P1	Pad. (Located at S151).
		ASSOCIATED ASSEMBLIES
		- - - - - - - - - - CRYSTALS - - - - - - - - - -
		NOTE: When reordering give GE part number and specify exact frequency needed.
Y151 and Y152	19B233066G1	Crystal, transmit 5 PPM. 150-174-MHz $Fx = \frac{Fo}{3}$
Y151 and Y152	19B233066G5	Crystal, Transmit 5 PPM. 450-470-MHz $Fx = \frac{Fo}{9}$
Y301	19B233066G2	Crystal, Receive 5 PPM. 150-174-MHz $Fx = \frac{Fo - 10.7}{3}$
	19B233066G7	Crystal, Receive 5 PPM. 450-470-MHz $Fx = \frac{Fo - 21.4}{9}$
		- - - - - - - - - - NETWORKS - - - - - - - - - -
Z1001	19C320291G1	Tone network.