MAINTENANCE MANUAL

450-470 MHz 25-WATT TRANSMIT/RECEIVE BOARD 19D901003G1,3

PHOENIX-S, NARROWBAND (SYNTHESIZED)

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DESCRIPTION

The 450-470 MHz transmit/receiver board (Tx Rx) for Phoenix-S contains the receiver, exciter and power amplifier. The audio processor circuitry for the transmit (microphone) audio is included on the synthesizer/interconnect board. Transmit/receiver RF frequency injection (5-15 milliwatts) is provided by a common VCO on the synthesizer/interconnect board. The output of the VCO is tripled by the exciter to generate the transmit frequency and by the receiver to generate the correct Rx injection frequency for the receiver first mixer. A block diagram of the TRS board is shown in Figure 1.

The transmit/receiver board is located on the bottom side of the radio.

CIRCUIT ANALYSIS

EXCITER

The exciter consists of a 150 MHz amplifier, a 150 MHz to 450 MHz tripler and one 450 MHz amplifier. The exciter takes the Tx injection from the synthesizer VCO (5 milliwatts minimum) and amplifies multiplies and amplifies it to provide 60 milliwatts minimum (450-470 MHz) to the power amplifier circuitry. In addition to these functions, the exciter contains the filters that determine the bandwidth and spurious characteristics (exclusive of harmonics) of the transmitter.

RF injection from the synthesizer/ interconnect board is applied to the base of Class A Ampl Q101 through J151, a 2 dB resistive pad, and an impedance matching network consisting of C101, C102 and L101. This network matches the base of Q101 to 50 ohms. The 2 dB attenuator pad (R101-R103) provides a constant load for the VCO output when switching to or from the transmit or receive mode to maintain frequency stability. 8.5V TX is applied to Class A Amplifier Q101 through a collector feed network consisting of L102, R106, and R107. C104 and C105 provide decoupling for the 8.5V Tx supply. 8.5V Tx is used to supply Ampl 1 to assure that the exciter is turned on only in the transmit mode. Base bias is set by R104 and R105. 8.5V Tx also sets the bias for final amplifier Q103.

The output of Q101 is direct coupled to tripler Q102 through C106 and C107. 8.5V CONT is supplied to the tripler through a collector feed network consisting of R111, L104 and L103. Decoupling is provided by C108 and C109. For tuning purposes the collector voltage may be metered at TP101. A matching network consisting of L103, C110, and R112-R114 match the 450 MHz output of the tripler to a two-pole helical filter, L105 and L106. The output of this filter is then matched by L107 and C111-C113 to a single stage broadbanded Class B 450 MHz amplifier Q103. Bias voltage is supplied by the 8.5V Tx source and is set by R115 and R116. Collector voltage is taken from the 8.5V CONT supply and applied to Q103 collector through collector feed network R117, C115, and L108. C118 and C119 provide decoupling for the 8.5V CONT supply. For tuning purposes the collector voltage is measured at TP102. An impedance matching network consisting of C116, L109 and C117 match the collector Q103 to 50 ohms. The exciter provides 60 milliwatts to the power amplifier.

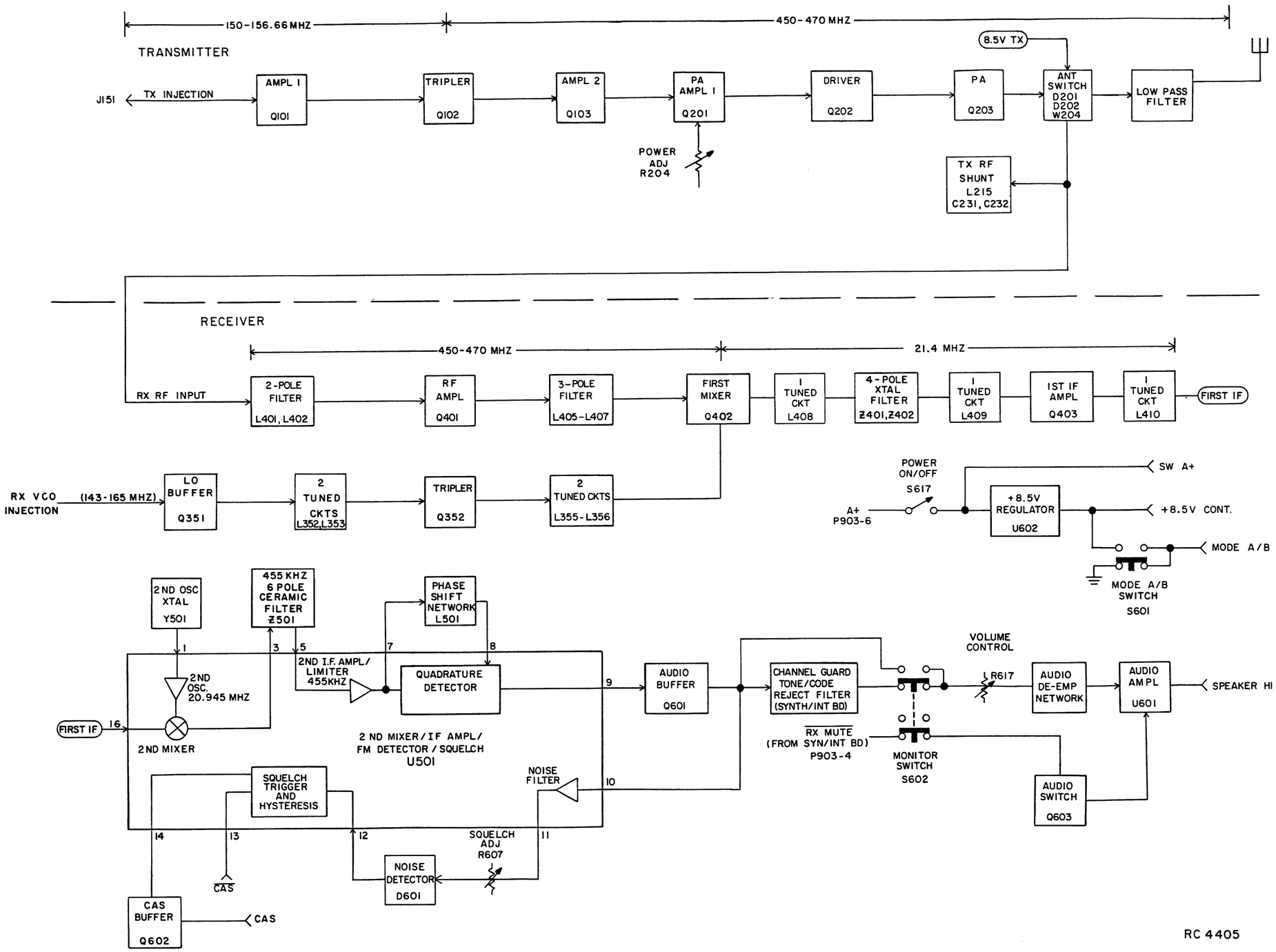

Figure 1 - TRS Board Block Diagram

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NOTE

There are 5 points in the exciter with an impedance of approximately 50 ohms. They are W101, W102, W104, W105, and W106. These points can conveniently be used to monitor or inject signals for troubleshooting and testing using 50 ohm sources and terminations.

POWER AMPLIFIER

The broadband three stage power amplifier consists of amplifier Q201, driver Q202 and power amplifier Q203, and associated circuitry. The 60 milliwatt output of the exciter is amplified to provide the 25 watt output of the radio. No tuning is required.

The 50 ohm output of the exciter is applied to the base of AMPL Q201 through an impedance matching network consisting of L201, C201-C203, and 50 ohm microstrip W201. L203, L204, C206, and C207 match the collector of Q201 to 50 ohms. W202, L205, C208 and C209 match the 50 ohms at W202 to the base of driver Q202. Collector voltage for Q201 is supplied through collector feed network R203-R205, L202, and C205.

The output power of the driver Q202 is coupled to the final power amplifier Q203 through impedance matching network consisting of W203, C212, C215, C220, and C221. The 25 watt output of Q203 is coupled to the antenna through and impedance matching network (C222-C225, C227, and L212), Tx/Rx switch (D201,D202) and the low pass filter to J601. The low pass filter consists of L214, C230, C229. W205 is a 50 ohm microstrip.

Collector voltage for Q202 and Q203 is provided by the A+ line through P251-3 and collector feed networks consisting of L207, L208, R207, and C210 for Q202 and L216, L211, C218 and C219 for Q203. Decoupling is provided by C211, C216, and C217.

Tx/Rx Antenna Switch

The antenna switch is controlled by 8.5V Tx (present when PTT is pressed) and connects either the PA output or receiver to the antenna. The antenna switch consists of diode D201 quarter wave stub W201, diode D202, C231, C232, and L215.

When the microphone is keyed, 8.5V Tx is applied to D201 through R210 and L213 forward biasing D201 and D202 and passing the PA output directly to the antenna through the low pass filter. At the same time the 1/4 wave stub W204 and forward biased diode D202 presents an open circuit to the receiver preventing any possible damage to the receiver. C235 is a DC blocking capacitor.

In the receive mode D201 and D202 are turned off, the AC short is removed and the 1/4 wave stub now presents a 50 ohm impedance to the receiver, allowing the received RF to pass through the low pass filter to the receiver.

RF POWER ADJUST

RF output power is set by adjusting the collector voltage to Q201. Collector voltage for Ampl Q201 is supplied by the 8.5V CONT source and set by RF Power Adjust control R204. R204 is set for rated output power.

RECEIVER

The FM dual conversion, superheterodyne receiver is designed for operation in the 450-470 MHz frequency range. A regulated 8.5 volts is provided to all receiver stages except for the audio PA IC, which operates from the switched 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 synthesizer is mounted on the Tx/Rx board. The receiver consists of:

- Front End and Mixer
- 21.4 MHz 1st IF o 455 kHz 2nd IF and FM Detector
- Audio PA
- Squelch

RECEIVER FRONT END

An RF signal from the antenna is coupled through the low pass filter, antenna switch, 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.

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 (L408 and C410-C412) to a 4-pole crystal filter consisting of Z401 and Z402.

1st IF

The highly-selective crystal filters Z401 and Z402 provide the first portion of the receiver IF selectivity. The output of the filters is coupled through impedance matching network L409, C414, and R410 to the 1st IF amplifier Q403.

1st IF Amplifier Q403 is a dual-gate MOSFET transistor. The crystal filter output of Z402 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 Q403 is coupled through an impedance matching network, L410, C417, C418, and R415 that matches the amplifier output to the input of IC U501.

2nd IF and DETECTOR

IC U501 and its associated circuitry performs the following functions: 2nd oscillator, mixer, 2nd IF amplifier, FM detector and squelch circuits. The crystal for the oscillator is Y501, and the oscillator operates at 20.945 MHz for low side injection. This frequency is mixed with the 21.4 MHz input to produce the 455 kHz 2nd IF frequency.

The output of the internal mixer is amplified and applied to a 6-pole ceramic filter, Z501, which provides the 455 kHz selectivity. The output of the 455 kHz filter is reapplied to U501-5. The 2nd IF signal is amplified and limited. The audio is recovered by an internal FM quadrature detector. L501 provides the 90° phase shift for the quadrature detector.

AUDIO AND SQUELCH

The audio output of U501 is applied to the base of audio buffer Q601. The output of the audio buffer is applied to the Channel Guard Tone/Code Reject filter on the synthesizer/interconnect board, the MONITOR switch, and to the squelch input U501-10.

Squelch Circuit

The squelch circuit operates on the noise components contained in the FM detector audio output. The squelch input is applied to pin 10 of U501 from audio buffer Q601. Circuits internal to U501 provide filtering and apply received noise in the 6-8 kHz frequency band to potentiometer R607 (squelch adjust). The output of the squelch adjust potentiometer is connected to the noise detector. The noise detector consists of R608, C606, C607, C621 and diode D601. As the noise increases in magnitude in a negative direction, negative spikes cause D601 to conduct and charge C607 and C621 to a DC level proportional to the noise power. The output of the noise detector is applied to the input of squelch trigger (U501-12). The squelch trigger has approximately 3 dB of hysteresis. This prevents sudden noise level changes from effecting the squelch threshold setting. The outputs of squelch trigger are CAS and CAS. The CAS output is applied to Q602 to provide sufficient drive to operate an optional channel busy light or external relay control.

Audio Circuits

Detected audio from audio buffer Q601 is applied to the Channel Guard Tone/Code Reject filter on the synthesizer/interconnect board and returned as filtered volume squelch high through P903-7. Filtered audio is then applied through MONITOR switch S602 and VOLUME control R617 to the deemphasis network (R630, R631, and C615) and audio amplifier U601. Switched A+ is applied to U601 through S617. The RX MUTE line is high when a message is received and accompanied by a correct Channel Guard Tone/Code, keeping audio switch Q603 turned off. This enables audio amplifier U601 which provides up to 4 watts of audio output power into a 4 ohm speaker. The feedback loop consisting of R615, R616, and C611 determine the amplifier closed loop gain. R614 and C612 provide the high audio frequency roll-off above 6 kHz.

The audio amplifier is muted (switched off) when RX MUTE is low. When this occurs (no messages being received) audio switch Q603 is turned on, applying additional bias current to the reference input pin 2 of audio amplifier U601. This turns U601 off causing its output to be grounded.

Monitor

When the MONITOR switch is pressed, detected audio from audio buffer Q601 is applied directly to the audio amplifier through S602-5 and R617, bypassing the Channel Guard Tone/Code Reject Filter.

S602 also opens the $\overline{\text{RX MUTE}}$ line to Q603, causing it to be turned off and allowing audio amplifier U601 to operate. The detected audio is amplified and applied to the speaker. Channel Guard Tones/ Codes may be audible when present.

MODE A/B

Mode A/B Switch S601 doubles the channel selection capability of the radio by controlling the 8.5V CONT line applied to the Mode A/B input of the microcomputer. The microcomputer input (P912-2 is grounded in Mode A or has 8.5 VDC cont. applied for Mode B. Mode B is indicated on the 7 segment display by an illuminated decimal point.

In single frequency radios the MODE A/B switch is not provided. A pull down resistor, R914 on the synthesizer/ interconnect board, holds the MODE A/B input to the microcomputer low, preventing it from selecting a different channel. No jumpers or other connections are required.

In two-frequency radios, the MODE A/B switch is provided. Channel selection (MODE A/B) is controlled by the MODE switch which toggles the MODE A/B input to the microcomputer. When MODE A is selected the input to the microcomputer is held low by the ground connection between S601-2 and 4. In MODE B, pull-up resistor R628 applies +8.5 VDC to the MODE A/B input through S601-5 and 6, holding it high and causing MODE B (second channel) to be selected.

8.5 VOLT REGULATOR

8.5 Volt regulator U602 receives switched A+ from S617 and P903-6 and provides 8.5 Volts regulated to the radio. Switched A+ is available from S617.

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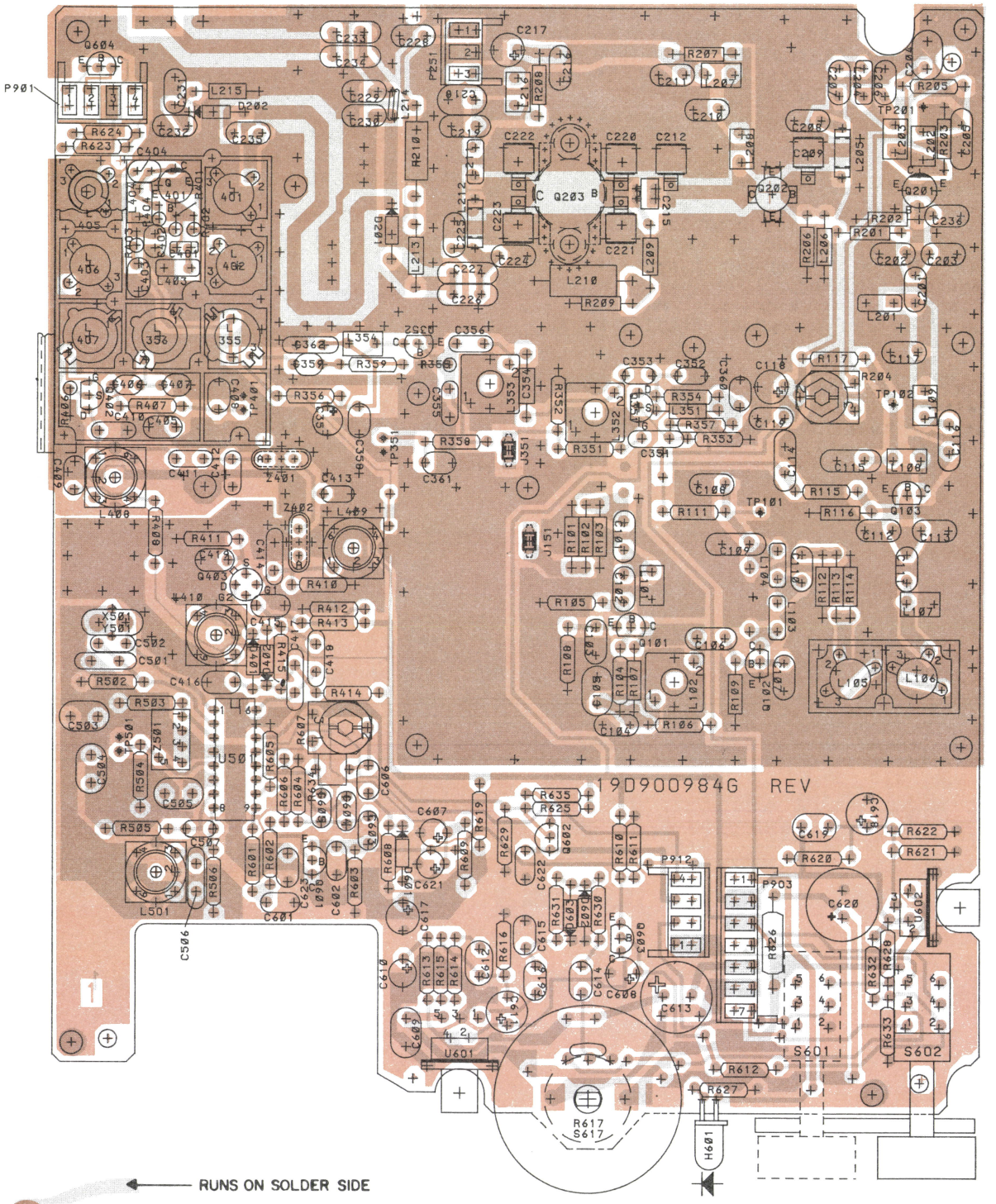
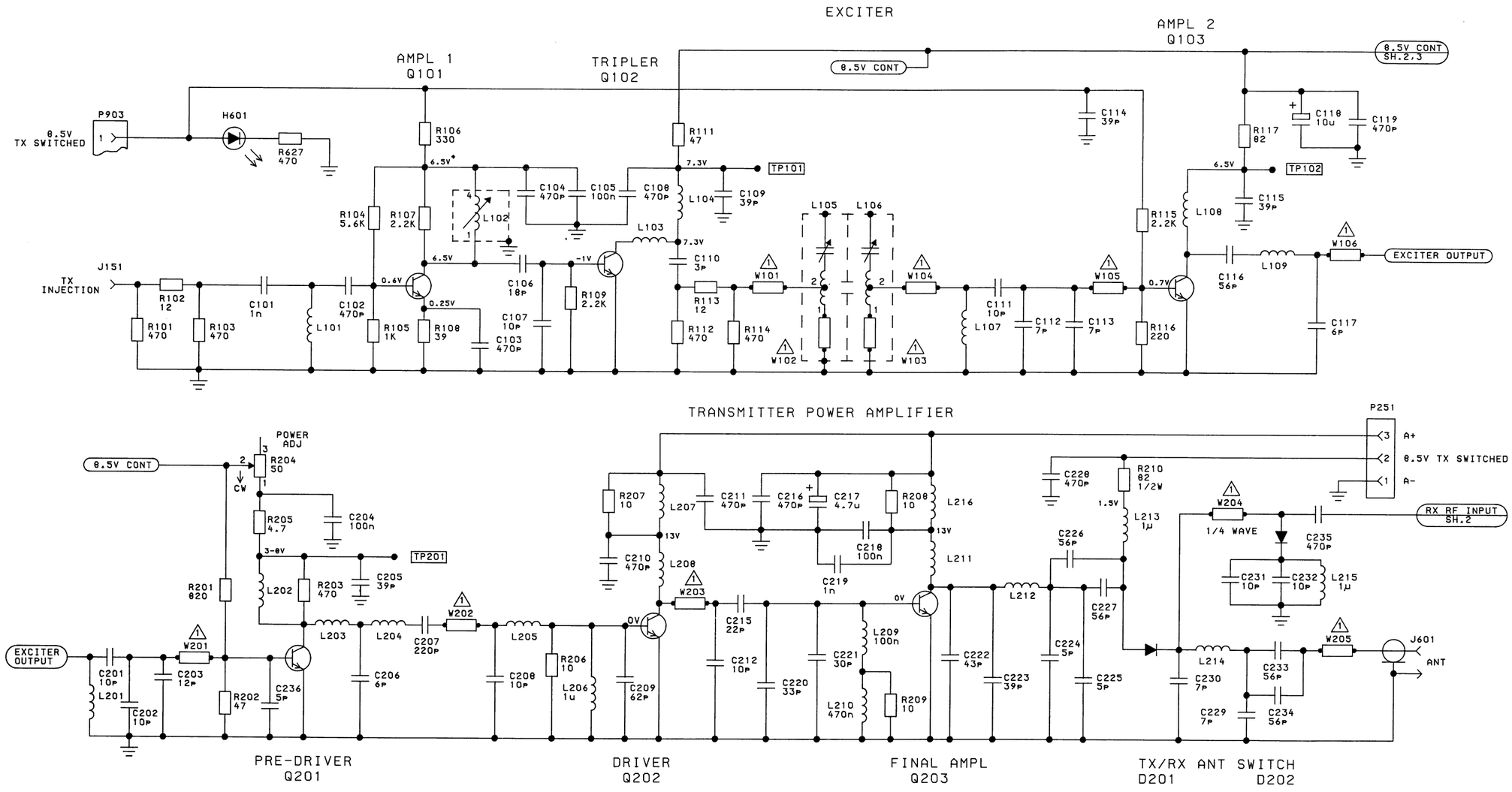


OUTLINE DIAGRAM

450—470 MHz, 25 WATT NARROWBAND TRANSMIT/RECEIVE BOARD

(19D900982, Rev. 2)
(19A703259, Sh. 1, Rev. 1)
(19A703259, Sh. 2, Rev. 1)



NOTES:

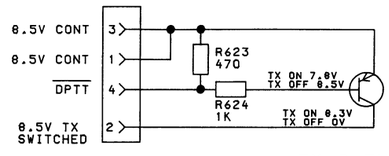
1. PART OF PWB
2. VALUE OF R621 DEPENDS ON COLOR CODE ON U602

U602 COLOR CODE	R621 VALUE
BROWN	OMIT R621
RED	270
ORANGE	100
YELLOW	47
GREEN	22
BLUE	6.8

MODEL NO.	REV. LETTER
PL19D900984G1	
PL19D901003G1	
PL19D901003G3	

◆ ALL VOLTAGE READINGS ARE DC AND ARE UNDER NORMAL OPERATING CONDITIONS

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.

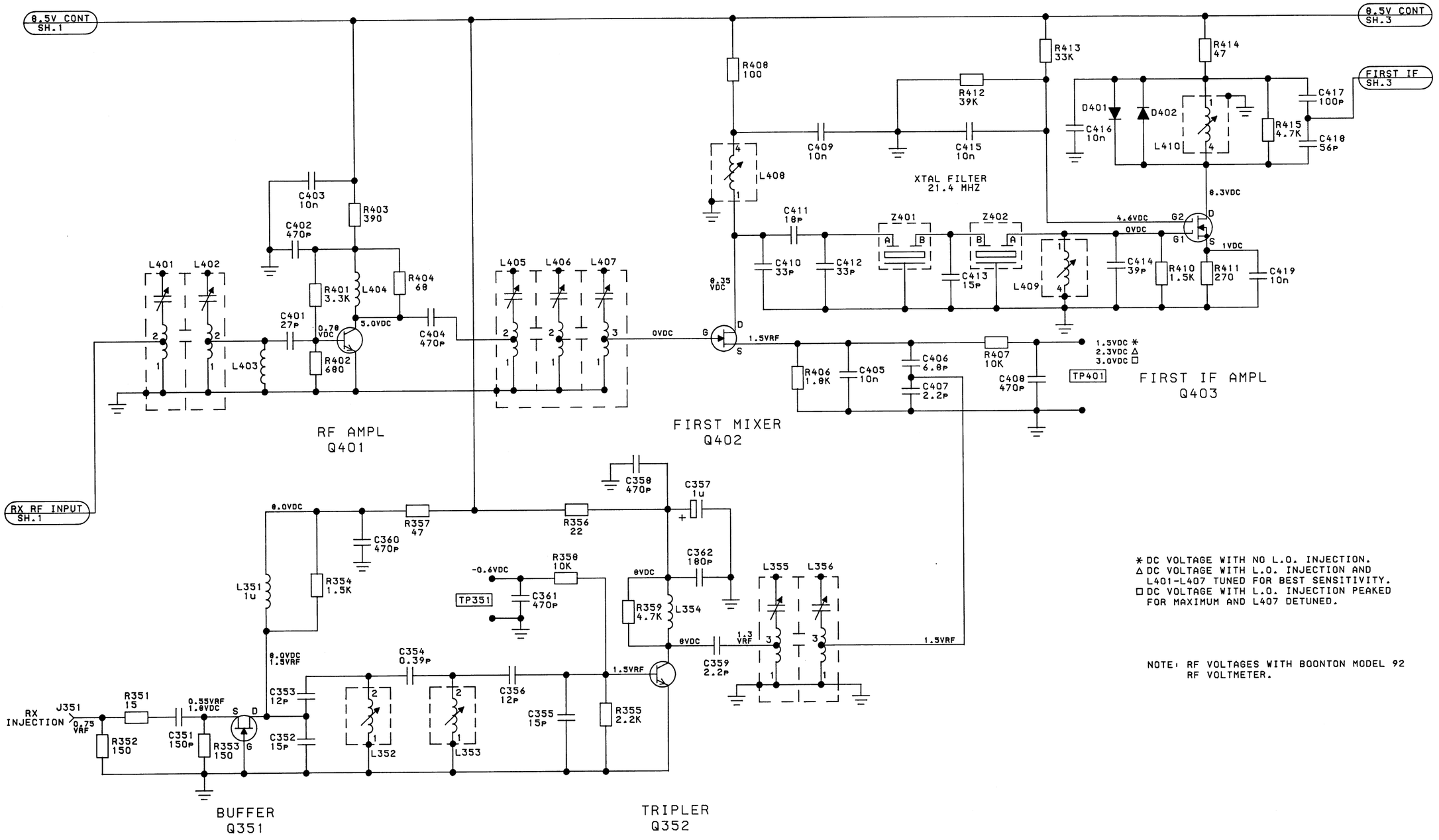


TX 8.5V SWITCH
Q604

(19D900981, Sh. 1, Rev. 1)

SCHEMATIC DIAGRAM

EXCITER/POWER AMPLIFIER



* DC VOLTAGE WITH NO L.O. INJECTION.
△ DC VOLTAGE WITH L.O. INJECTION AND L401-L407 TUNED FOR BEST SENSITIVITY.
□ DC VOLTAGE WITH L.O. INJECTION PEAKED FOR MAXIMUM AND L407 DETUNED.

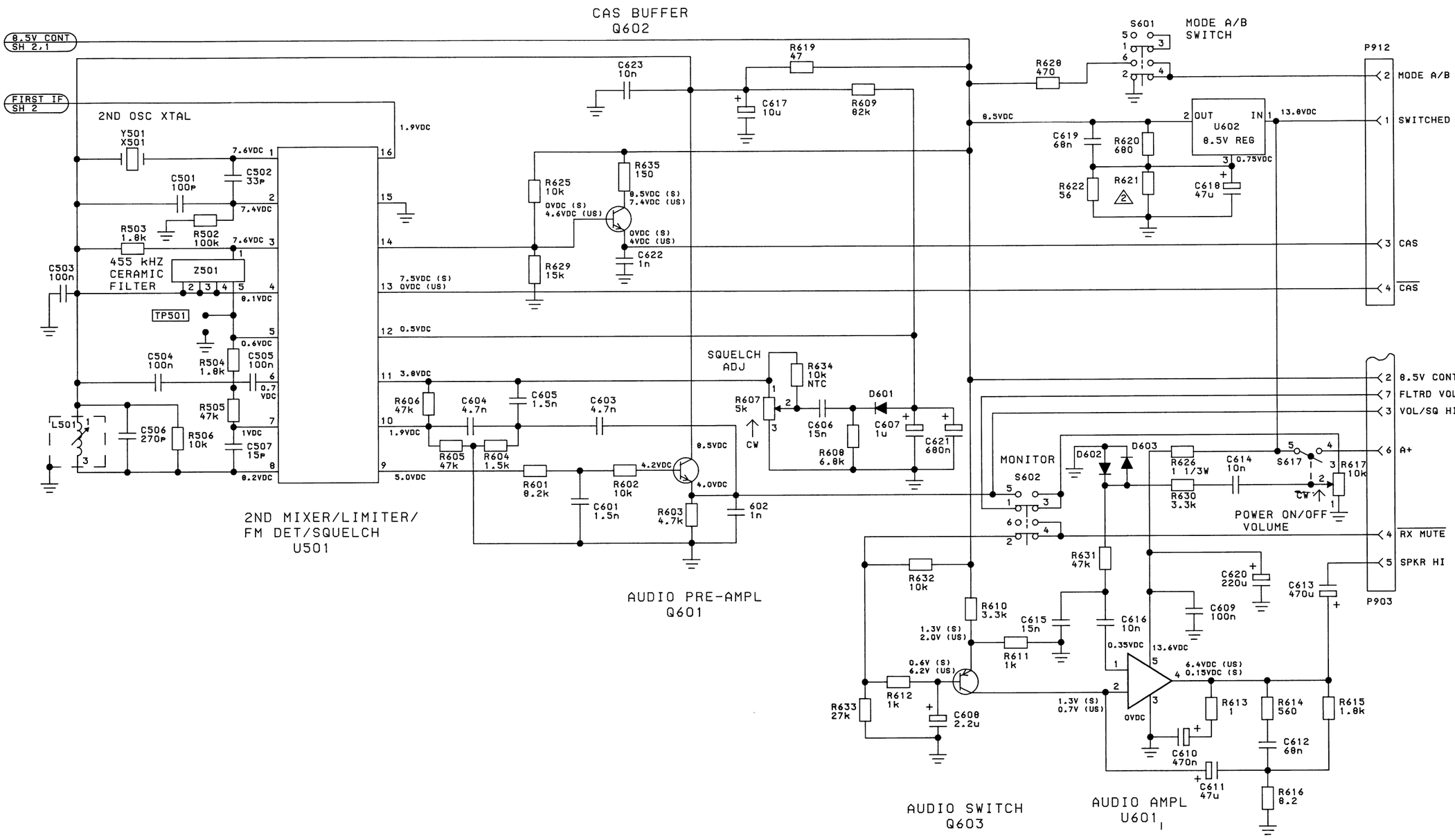
NOTE: RF VOLTAGES WITH BOONTON MODEL 92 RF VOLTMETER.

SCHEMATIC DIAGRAM

RECEIVER

450—470 MHz RECEIVER, FRONT END AND FIRST MIXER/IF

(19D900981, Sh. 2, Rev. 1)



(19D900981, Sh. 3, Rev. 2)

SCHEMATIC DIAGRAM

450—470 MHz RECEIVER, SECOND IF AND AUDIO

PARTS LIST

450-470 MHz
25 WATT TRANSMIT/RECEIVE BOARD
19D901003G1 STD
19D901003G3 W MODE SWITCH
ISSUE 2

SYMBOL	GE PART NO.	DESCRIPTION
A1		COMPONENT BOARD 19D900984G1 (NARROW BAND) - REV C 19D901043G1 (WIDE BAND) - REV B **EXCITER**
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C101	19A701602P20	Ceramic: 1000 pF ±10%, 1000 VRMS.
C102 thru C104	19A701602P14	Ceramic: 470 pF ±10%, 1000 VDCW.
C105	19A702250P113	Polyester: .1 uF ±10%, 50 VDCW.
C106	19A701624P14	Ceramic disc: 18 pF ±5%, 500 VDCW, temp coef 0 PPM.
C107	19A701624P8	Ceramic, disc: 10 pF ±0.5 pF, 500 VRMS, temp coef 0 PPM.
C108	19A701602P14	Ceramic: 470 pF ±10%, 1000 VDCW.
C109	19A701624P122	Ceramic: 39 pF ±5%, 500 VDCW, N80 ±30 PPM temp coef.
C110	19A701624P1	Ceramic, disc: 3 pF ±0.5 pF, 500 VRMS, temp coef 0 PPM.
C111	19A701624P8	Ceramic, disc: 10 pF ±0.5 pF, 500 VRMS, temp coef 0 PPM.
C112 and C113	19A701624P5	Ceramic, disc: 7 pF ±0.5 pF, 500 VRMS, temp coef 0 PPM.
C114 and C115	19A701624P122	Ceramic: 39 pF ±5%, 500 VDCW, N80 ±30 PPM temp coef.
C116	19A701624P326	Ceramic: 56 pF ±5%, 500 VDCW, N220 ±30 PPM temp coef.
C117	19A701624P4	Ceramic, disc: 6 pF ±0.5 pF, 500 VRMS, temp coef 0 PPM.
C118	19A703314P10	Electrolytic: 10 uF -10+50% tol, 50 VDCW; sim to Panasonic LS Series.
C119	19A701602P14	Ceramic: 470 pF ±10%, 1000 VDCW.
C121	19A701602P14	Ceramic: 470 pF ±10%, 1000 VDCW.
		- - - - - - - - - - JACKS - - - - - - - - - -
J151	19A701883P4	Contact, electrical; sim to AMP 86444-1.
		- - - - - - - - - - COILS - - - - - - - - - -
L101	19B800891P5	Coil, RF: .064 uH; sim to Paul Smith SK-890-1.
L102	19B800965P223	Coil, RF: variable, sim to Paul Smith SK767-2.
L103	19B800890P5	Coil, RF: sim to Paul Smith SK-891-1.
L104	19B800890P6	Coil, RF: 14.7 nH ±5%, sim to Paul Smith SK-891-1.
L105 and L106	19J706154P8	RF Coil: sim to Paul Smith SK802-1.
L107	19B800891P2	Coil, RF Choke: sim to Paul Smith SK-890-1.
L108	19B800891P6	Coil, RF: .084 uH; sim to Paul Smith SK-890-1.
L109	19B800891P2	Coil, RF Choke: sim to Paul Smith SK-890-1.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q101	19A702084P1	Silicon, NPN; sim to MPS 2369.
Q102 and Q103	19A703027P1	Silicon, NPN; sim to MPS 3866.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R101	19A700106P55	Composition: 470 ohms ±5%, 1/4 w.
R102	19A700106P17	Composition: 12 ohms ±5%, 1/4 w.
R103	19A700106P55	Composition: 470 ohms ±5%, 1/4 w.
R104	19A700019P46	Deposited carbon: 5.6K ohms ±5%, 1/4 w.
R105	19A700019P37	Deposited carbon: 1K ohms ±5%, 1/4 w.
R106	19A700019P31	Deposited carbon: 330 ohms ±5%, 1/4 w.
R107	19A700106P71	Composition: 2.2K ohms ±5%, 1/4 w.
R108	19A700019P20	Deposited carbon: 39 ohms ±5%, 1/4 w.
R109	19A700106P71	Composition: 2.2K ohms ±5%, 1/4 w.
R111	19A700019P21	Deposited carbon: 47 ohms ±5%, 1/4 w.
R112	19A700106P55	Composition: 470 ohms ±5%, 1/4 w.
R113	19A700106P17	Composition: 12 ohms ±5%, 1/4 w.
R114	19A700106P55	Composition: 470 ohms ±5%, 1/4 w.
R115	19A700019P41	Deposited carbon: 2.2K ohms ±5%, 1/4 w.
R116	19A700106P47	Composition: 220 ohms ±5%, 1/4 w.
R117	19A700019P24	Deposited carbon: 82 ohms ±5%, 1/4 w.
		- - - - - - - - - - TEST POINTS - - - - - - - - - -
TP101 and TP102	19A703248P1	Contact, electrical.
		- - - - - - - - - - CABLES - - - - - - - - - -
W101 thru W106		Part of Printed Board 19D900983P1.
		POWER AMPLIFIER
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C201 and C202	19A701624P8	Ceramic, disc: 10 pF ±0.5 pF, 500 VRMS, temp coef 0 PPM.
C203	19A701624P10	Ceramic, disc: 12 pF ±5%, 500 VRMS, temp coef 0 PPM.
C204	19A702250P113	Polyester: .1 uF ±10%, 50 VDCW.
C205	19A701624P122	Ceramic: 39 pF ±5%, 500 VDCW, N80 ±30 PPM temp coef.
C206	19A701624P4	Ceramic, disc: 6 pF ±0.5 pF, 500 VRMS, temp coef 0 PPM.
C207	19A701602P9	Ceramic: 220 pF ±20%, 1000 VDCW; sim to Radio Materials Type JF DISCAPS.
C208	19A701624P8	Ceramic, disc: 10 pF ±0.5 pF, 500 VRMS, temp coef 0 PPM.
C209	19A700006P29	Mica: 62 pF ±5%, 100 VDCW; sim to Underwood 3HS0020.
C210 and C211	19A701602P14	Ceramic: 470 pF ±10%, 1000 VDCW.
C212	19A700006P6	Mica: 10 pF ±5%, 100 VDCW; sim to Underwood 3HS0020.
C215	19A701413P17	Mica: 22 pF ±5%, 100 VDCW.
C216	19A701602P14	Ceramic: 470 pF ±10%, 1000 VDCW.
C217	19A703314P9	Electrolytic: 4.7 uF -10+50% tol, 50 VDCW; sim to Panasonic LS Series.
C218	19A702250P113	Polyester: .1 uF ±10%, 50 VDCW.
C219	19A701602P20	Ceramic: 1000 pF ±10%, 1000 VDCW.
C220	19A700006P21	Mica: 33 pF ±5%, 100 VDCW; sim to Underwood 3HS0020.
C221	19A700006P20	Mica: 30 pF ±5%, 100 VDCW; sim to Underwood 3HS0020.
C222	19A700006P24	Mica: 43 pF ±5%, 100 VDCW; sim to Underwood 3HS0020.
C223	19A700006P23	Mica: 39 pF ±5%, 100 VDCW; sim to Underwood 3HS0020.
C224 and C225	19A701624P3	Ceramic, disc: 5 pF ±0.5 pF, 500 VRMS, temp coef 0 PPM.
C226 and C227	19A701624P5	Ceramic: 7 pF ±0.5%, 500 VRMS, temp coef 0 PPM
C228	19A701602P14	Ceramic: 470 pF ±10%, 1000 VDCW.
C229	19A701624P2	Ceramic, disc: 4 pF ±0.5 pF, 500 VRMS, temp coef 0 PPM.
C230	19A701624P4	Ceramic, disc: 6 pF ±0.5 pF, 500 VRMS, temp coef 0 PPM.
C231 and C232	19A701624P8	Ceramic, disc: 10 pF ±0.5 pF, 500 VRMS, temp coef 0 PPM.
C233 and C234	19A701624P326	Ceramic: 56 pF ±5%, 500 VDCW, N220 ±30 PPM temp coef.
C235	19A701602P14	Ceramic: 470 pF ±10%, 1000 VDCW.
C236	19A701624P3	Ceramic, disc: 5 pF ±0.5 pF, 500 VRMS, temp coef 0 PPM.
		- - - - - - - - - - DIODES - - - - - - - - - -
D201 and D202	19J706892P2	Silicon.
		- - - - - - - - - - COILS - - - - - - - - - -
L201	19B800890P8	Coil, RF: sim to Paul Smith SK-891-1.
L202	19B800891P6	Coil, RF: .084 uH; sim to Paul Smith SK-890-1.
L203	19B800891P1	Coil, RF Choke: sim to Paul Smith SK-890-1.
L204	19B800890P7	Coil, RF: 15.8 nH ±5%; sim to Paul Smith SK-891-1.
L205	19A701006P5	Strap.
L206	19A700024P13	Coil, RF: 1.0 uH ±10%.
L207	19B800891P6	Coil, RF: .084 uH; sim to Paul Smith SK-890-1.
L208	19B800890P6	Coil, RF: 14.7 nH ±5%, sim to Paul Smith SK891-1
L209	19A700024P1	Coil, RF: 100 nH ±10%, 0.08 ohms DC res max, 100 v.
L210	19A700000P8	Coil, RF: 470 nH ±12%; sim to Jeffers 4411-4K.
L211	19B800890P6	Coil, RF: 14.7 nH ±5%; sim to Paul Smith SK891-1
L212	19A701006P6	Strap.
L213	19A700024P13	Coil, RF: 1.0 uH ±10%.
L214	19A701237P1	Coil.
L215	19A700024P13	Coil, RF: 1.0 uH ±10%.
L216	19B800891P6	Coil, RF: .084 uH; sim to Paul Smith SK-890-1.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P251	19A700102P10	Printed wire: 3 contacts; sim to Molex 09-52-3032.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q201	19A701940P1	Silicon, NPN; sim to MRF-559.
Q204	19A700054P1	Silicon, NPN; 60 w; sim to BD-201.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R201	19A700106P61	Composition: 820 ohms ±5%, 1/4 w.
R202	19A700106P31	Composition: 47 ohms ±5%, 1/4 w.
R203	19A700106P55	Composition: 470 ohms ±5%, 1/4 w.
R203	19A700106p39	Composition: 100 ohms ±5%, 1/4 w.
R204	19B800784P106	Variable: 5K ohms ±20%, 1/2 watt.
R205	19A700019P9	Deposited carbon: 4.7 ohms ±5%, 1/4 w.
R206 thru R209	19A700106P15	Composition: 10 ohms ±5%, 1/4 w.
R210	19A700113P37	Composition: 82 ohms ±5%, 1/2 w.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - TEST POINTS - - - - - - - - - -
TP201	19A703248P1	Contact, electrical.
		- - - - - - - - - - CABLES - - - - - - - - - -
W201 thru W205		Part of Printed Board 19D900983P1.
		RECEIVER-INJECTION
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C351	19A700235P27	Ceramic: 150 pF ±5%, 50 VDCW.
C352	19A700235P15	Ceramic: 15 pF ±5%, 50 VDCW.
C353	19A700235P14	Ceramic, disc: 12 pF ±5%, 50 VDCW.
C354	19A700013P8	Phenolic: 0.39 pF ±5%, 500 VDCW.
C355	19A700235P15	Ceramic: 15 pF ±5%, 50 VDCW.
C356	19A700235P14	Ceramic, disc: 12 pF ±5%, 50 VDCW.
C357	19A703314P6	Electrolytic: 1 uF -10+50% tol, 50 VDCW; sim to Panasonic LS Series.
C358	19A700233P5	Ceramic: 470 pF ±20%, 50 VDCW.
C359	19A700235P5	Ceramic: 2.2 pF ±0.25 pF, 50 VDCW, temp coef -150 PPM.
C360 and C361	19A700233P5	Ceramic: 470 pF ±20%, 50 VDCW.
C362	19A700235P28	Ceramic: 180 pF ±5%, 50 VDCW.
		- - - - - - - - - - JACKS - - - - - - - - - -
J351	19A701883P4	Contact, electrical; sim to AMP 86444-1.
		- - - - - - - - - - COILS - - - - - - - - - -
L351	19A700024P13	Coil, RF: 1.0 uH ±10%.
L352 and L353	19B801014P323	Coil, RF: sim to Paul Smith SK767-1.
L354	19B800891P2	Coil, RF Choke: sim to Paul Smith SK-890-1.
L355 and L356	19B209728P7	Coil, RF: sim to Paul Smith SK-801-1.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q351	19A700060P2	N Type, field effect.
Q352	19A701808P1	Silicon, NPN; sim to MPS 6595.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R351	19A700019P15	Deposited carbon: 15 ohms ±5%, 1/4 w.
R352 and R353	19A700019P27	Deposited carbon: 150 ohms ±5%, 1/4 w.
R354	19A700019P39	Deposited carbon: 1.5K ohms ±5%, 1/4 w.
R355	19A700019P41	Deposited carbon: 2.2K ohms ±5%, 1/4 w.
R356	19A700019P17	Deposited carbon: 22 ohms ±5%, 1/4 w.
R357	19A700019P21	Deposited carbon: 47 ohms ±5%, 1/4 w.
R358	19A700019P49	Deposited carbon: 10K ohms ±5%, 1/4 w.
R359	19A700019P45	Deposited carbon: 4.7K ohms ±5%, 1/4 w.
		- - - - - - - - - - TEST POINTS - - - - - - - - - -
TP351	19A703248P1	Contact, electrical.
		RECEIVER - FRONT END
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C401	19A700219P44	Ceramic: 27 pF ±5%, 100 VDCW.
C402	19A700001P5	Ceramic: 470 pF ±20%, 50 VDCW.
C403	19A700234P7	Polyester: 0.01 uF ±10%, 50 VDCW.

SYMBOL	GE PART NO.	DESCRIPTION
C404	19A700001P5	Ceramic: 470 pF ±20%, 50 VDCW.
C405	19A700234P7	Polyester: 0.01 uF ±10%, 50 VDCW.
C406	19A700235P11	Ceramic: 6.8 pF ±5%, 50 VDCW.
C407	19A700235P5	Ceramic: 2.2 pF ±0.25 pF, 50 VDCW, temp coef -150 PPM.
C408	19A700233P5	Ceramic: 470 pF ±20%, 50 VDCW.
C409	19A700234P7	Polyester: 0.01 uF ±10%, 50 VDCW.
C410	19A700235P19	Ceramic: 33 pF ±5%, temp coef -150 PPM.
C411	19A700235P16	Ceramic: 18 pF ±5%, 50 VDCW.
C412	19A700235P19	Ceramic: 33 pF ±5%, temp coef -150 PPM.
C413	19A700235P15	Ceramic: 15 pF ±5%, 50 VDCW.
C414	19A700235P20	Ceramic: 39 pF ±5%, 50 VDCW.
C415 and C416	19A700234P7	Polyester: 0.01 uF ±10%, 50 VDCW.
C417	19A700235P25	Ceramic: 100 pF ±5%, 50 VDCW.
C418	19A700235P22	Ceramic: 56 pF ±5%, 50 VDCW.
C419	19A700234P7	Polyester: 0.01 uF ±10%, 50 VDCW.
		- - - - - - - - - - DIODES - - - - - - - - - -
D401 and D402	19A700028P1	Silicon, fast recovery: fwd current 75 mA, 75 PIV; sim to Type 1N4148.
		- - - - - - - - - - COILS - - - - - - - - - -
L401 and L402	19J706154P2	RF Coil: sim to Paul Smith SK802-1.
L403	19B800890P5	Coil, RF: sim to Paul Smith SK-891-1.
L404	19B800891P3	Coil, RF Choke; sim to Paul Smith SK890-1.
L405 and L406	19J706154P2	RF Coil: sim to Paul Smith SK802-1.
L407	19B209728P7	Coil, RF: sim to Paul Smith SK-801-1.
L408 thru L410	19A703311P2	Coil, RF: sim to TOKO AMERICA KON-K6672BA.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q401	19A702062P1	Silicon, NPN.
Q402	19J706038P1	N Type, field effect.
Q403	19A700075P1	N-CHANNEL, field effect. (MOS DUAL GATE).
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R401	19A700019P43	Deposited carbon: 3.3K ohms ±5%, 1/4 w.
R402	19A700019P35	Deposited carbon: 680 ohms ±5%, 1/4 w.
R403	19A700019P32	Deposited carbon: 390 ohms ±5%, 1/4 w.
R404	19A700019P23	Deposited carbon: 68 ohms ±5%, 1/4 w.
R406	19A700019P40	Deposited carbon: 1.8K ohms ±5%, 1/4 w.
R407	19A700019P49	Deposited carbon: 10K ohms ±5%, 1/4 w.
R408	19A700019P25	Deposited carbon: 100 ohms ±5%, 1/4 w.
R410	19A700019P39	Deposited carbon: 1.5K ohms ±5%, 1/4 w.
R411	19A700019P30	Deposited carbon: 270 ohms ±5%, 1/4 w.
R412	19A700019P56	Deposited carbon: 39K ohms ±5%, 1/4 w.
R413	19A700019P55	Deposited carbon: 33K ohms ±5%, 1/4 w.
R414	19A700019P21	Deposited carbon: 47 ohms ±5%, 1/4 w.
R415	19A700019P45	Deposited carbon: 4.7K ohms ±5%, 1/4 w.
		- - - - - - - - - - TEST POINTS - - - - - - - - - -
TP401	19A703248P1	Contact, electrical.
		- - - - - - - - - - NETWORKS - - - - - - - - - -
Z401	19A702522G3	Crystal pair.
Z402		Part of Z401.

SYMBOL	GE PART NO.	DESCRIPTION
		RECEIVER - IF/DETECTOR
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C501	19A700235P25	Ceramic: 100 pF ±5%, 50 VDCW.
C502	19A700235P19	Ceramic: 33 pF ±5%, temp coef -150 PPM.
C503 thru C505	19A702250P113	Polyester: .1 uF ±10%, 50 VDCW.
C506	19A700235P30	Ceramic: 270 pF ±5%, 50 VDCW.
C507	19A700235P15	Ceramic: 15 pF ±5%, 50 VDCW.
		- - - - - - - - - - COILS - - - - - - - - - -
L501	19B801023P1	Coil, RF: 450 uH ±6%, sim to TOKO AMERICAN 124LN-A064HM.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R502	19A700019P61	Deposited carbon: 0.1M ohms ±5%, 1/4 w.
R503 and R504	19A700019P40	Deposited carbon: 1.8K ohms ±5%, 1/4 w.
R505	19A700019P57	Deposited carbon: 47K ohms ±5%, 1/4 w.
R506	19A700019P49	Deposited carbon: 10K ohms ±5%, 1/4 w.
		- - - - - - - - - - TEST POINTS - - - - - - - - - -
TP501	19A703248P1	Contact, electrical.
		- - - - - - - - - - INTEGRATED CIRCUITS - - - - - - - -
U501	19A701780P1	Linear: IF AMPLIFIER AND DETECTOR.
		- - - - - - - - - - SOCKETS - - - - - - - - - -
X501	19A702742P1	Crystal socket. (Quantity 2).
		- - - - - - - - - - CRYSTALS - - - - - - - - - -
Y501	19A702284G3	Quartz: 20945.000 kHz.
		- - - - - - - - - - NETWORKS - - - - - - - - - -
Z501	19B801021P2	Bandpass filter: 455 ±1.5 KHz; sim to Murata CFW-4555E
		RECEIVER - AUDIO
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C601	19A700234P2	Polyester: 1500 pF ±10%, 50 VDCW.
C602	19A700234P1	Polyester: 1000 pF ±10%, 50 VDCW.
C603 and C604	19A700234P5	Polyester: 4700 pF ±10%, 50 VDCW.
C605	19A700234P2	Polyester: 1500 pF ±10%, 50 VDCW.
C606	19A700234P9	Polyester: .022 uF ±10%, 50 VDCW.
C607 and C608	19A701534P5	Tantalum: 2.2 uF, ±20%, 35 VDCW.
C609	19A702250P113	Polyester: .1 uF ±10%, 50 VDCW.
C610	19A701534P3	Tantalum: 0.47 uF ±20%, 35 VDCW.
C611	19A701534P9	Tantalum: 47 uF ±20%, 6.3 VDCW.
C612	19A702250P112	Polyester: .068 uF ±10%, 50 VDCW; sim to NISSEI TYPE AMZ.
C613	19A701225P8	Electrolytic: 470 uF -10+75%, 16 VDCW; sim to Sprague 5002D477-G016DGIC.
C614	19A700234P7	Polyester: 0.01 uF ±10%, 50 VDCW.
C615	19A700234P8	Polyester: .015 uF ±10%, 50 VDCW; sim to NISSEI AMXV or AMZV.
C616	19A700234P7	Polyester: 0.01 uF ±10%, 50 VDCW.
C617	19A703314P10	Electrolytic: 10 uF -10+50% tol, 50 VDCW; sim to Panasonic LS Series.

SYMBOL	GE PART NO.	DESCRIPTION
C618	19A703314P4	Electrolytic: 47 uF -10+50% tol, 16 VDCW; sim to Panasonic LS Series.
C619	19A702250P112	Polyester: .068 uF ±10%, 50 VDCW; sim to NISSEI TYPE AMZ.
C620	19A701225P3	Electrolytic: 220 uF, -10+50%, 25 VDCW.
C621	19A701534P12	Tantalum: .33 uF ±20%, 35 VDCW.
C622	19A700234P1	Polyester: 1000 pF ±10%, 50 VDCW.
C623	19A700234P7	Polyester: 0.01 uF ±10%, 50 VDCW.
		- - - - - - - - - - - DIODES - - - - - - - - - -
D601 thru D603	19A700028P1	Silicon, fast recovery: fwd current 75 mA, 75 PIV; sim to Type 1N4148.
		- - - - - - - - - - INDICATORS - - - - - - - - - -
H601	19J706135P2	Optoelectronic: red; sim to Hewlett Packard 5082-4655.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q601 and Q602	19A700023P1	Silicon, NPN; sim to Type 2N3904.
Q603	19A700022P1	Silicon, PNP; sim to Type 2N3906.
Q604	19A134960P1	Silicon, PNP; sim to Type 2N4403.
Q605 and Q606	19A700023P1	Silicon, NPN; sim to Type 2N3904.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R601	19A700019P48	Deposited carbon: 8.2K ohms ±5%, 1/4 w.
R602	19A700019P49	Deposited carbon: 10K ohms ±5%, 1/4 w.
R603	19A700019P45	Deposited carbon: 4.7K ohms ±5%, 1/4 w.
R604	19A700019P39	Deposited carbon: 1.5K ohms ±5%, 1/4 w.
R605 and R606	19A700019P57	Deposited carbon: 47K ohms ±5%, 1/4 w.
R607	19B800784P106	Variable: 5K ohms ±20%, 1/2 w.
R608	19A700019P46	Deposited carbon: 5.6K ohms ±5%, 1/4 w.
R609	19A700019P59	Deposited carbon: 68K ohms ±5%, 1/4 w.
R610	19A700019P43	Deposited carbon: 3.3K ohms ±5%, 1/4 w.
R611 and R612	19A700019P37	Deposited carbon: 1K ohms ±5%, 1/4 w.
R613	19A700019P1	Deposited carbon: 1 ohms ±5%, 1/4 w.
R614	19A700019P34	Deposited carbon: 560 ohms ±5%, 1/4 w.
R615	19A700019P40	Deposited carbon: 1.8K ohms ±5%, 1/4 w.
R616	19A700019P12	Deposited carbon: 8.2 ohms ±5%, 1/4 w.
R617	19A703313P1	Variable: 10K ohms ±20%, .1 watt.
R619	19A700019P21	Deposited carbon: 47 ohms ±5%, 1/4 w.
R620	19A700019P35	Deposited carbon: 680 ohms ±5%, 1/4 w.
R621A	19A700019P30	Deposited carbon: 270 ohms ±5%, 1/4 w.
R621B	19A700019P25	Deposited carbon: 100 ohms ±5%, 1/4 w.
R621C	19A700019P21	Deposited carbon: 47 ohms ±5%, 1/4 w.
R621D	19A700019P17	Deposited carbon: 22 ohms ±5%, 1/4 w.
R621E	19A700019P11	Deposited carbon: 6.8 ohms ±5%, 1/4 w.
R622	19A700019P22	Deposited carbon: 56 ohms ±5%, 1/4 w.
R623	19A700019P33	Deposited carbon: 470 ohms ±5%, 1/4 w.
R624	19A700019P37	Deposited carbon: 1K ohms ±5%, 1/4 w.
R625	19A700019P49	Deposited carbon: 10K ohms ±5%, 1/4 w.
R626	19A700018P1	Deposited carbon: 1 ohm ±5%, 1/3 w.
R627 and R628	19A700019P33	Deposited carbon: 470 ohms ±5%, 1/4 w.
R629	19A700019P51	Deposited carbon: 15K ohms ±5%, 1/4 w.
R630	19A700019P43	Deposited carbon: 3.3K ohms ±5%, 1/4 w. (NARROW BAND).
R630	19A700019P59	Deposited carbon: 68K ohms ±5%, 1/4 w. (WIDE BAND).
R631	19A700019P61	Deposited carbon: 0.1M ohms ±5%, 1/4 w. (WIDE BAND).
R631	19A700019P57	Deposited carbon: 47K ohms ±5%, 1/4 w. (NARROW BAND).
R632	19A700019P49	Deposited carbon: 10K ohms ±5%, 1/4 w.
R633	19A700019P54	Deposited carbon: 27K ohms ±5%, 1/4 w.
R634	5490828P9	Thermal: 10K ohms ±10%; sim to Carborundum 551J-8.
R635	19A700019P27	Deposited carbon: 150 ohms ±5%, 1/4 w.
R636	19A700019P59	Deposited carbon: 68K ohms ±5%, 1/4 w.
R637	19A700019P51	Deposited carbon: 15K ohms ±5%, 1/4 w. (WIDE BAND).
R637	19A700019P61	Deposited carbon: 0.1M ohms ±5%, 1/4 w. (NARROW BAND).
R638	19A700019p51	Deposited carbon: 15K ohms ±5%, 1/4 w.
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S602	19B800563P3	Push: DPDT, contacts rated 15 mA at 130 VDC; sim to IEEE/SCHADOW 51203.
S617		Part of R617.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - - -
U601	19A701830P1	Linear, Audio AMPLIFIER; sim to TDA 2003.
U602	19A138414G1	Regulator: 8.5 V.
		- - - - - - - - - - CABLES - - - - - - - - - -
W601 and W602	19A700019P1	Deposited carbon: 1 ohm ±5%, 1/4 w.
		SYSTEM INTERCONNECT
		- - - - - - - - - - PLUGS - - - - - - - - - -
P901	19A116659P15	Connector, printed wiring: 4 contacts rated at 5 amps; sim to Molex 09-52-3042.
P903	19A116659P83	Connector, printed wiring: 7 contacts rated at 5 amps; sim to Molex 09-52-3072 SPECIAL.
P912	19A116659P15	Connector, printed wiring: 4 contacts rated at 5 amps; sim to Molex 09-52-3042.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q202	19A134164P2	Silicon, NPN; sim to Type 2N5945.
Q203	19A134239P2	Silicon, NPN.
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S601	19B800563P1	Push: DPDT, 1 station, alternate action; sim to IEEE/SCHADOW 51281(F2UEE).
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - - -
	19A130465P1	Spacer, inner. (Used with Q202).
	7142162P137	Spacer, outer: No. 8-32. (Used with Q202).
	5492178P2	Washer, spring tension: sim to Wallace Barnes 375-20. (Used with Q202).
	19C328587P1	Pushbutton. (S601 & S602).
	NP280878P15	Nameplate. (MODE A, B - Used with S601).
	NP280878P17	Nameplate. (MONITOR - Used with S602).
	19A702381P508	Screw, thd. forming: No. 3.5-0.6 x 8. (Secures A1).
	19A701886P1	Spring. (Used with L105, L106, L355, L356, L401, L402, L405-L407).
	19B232901P1	Support. (Used with U601 & U602).
	19A700068P1	Insulator, bushing. (Used with U601 & U602).
	19A700115P3	Insulator, plate. (Used with U601 & U602).
	19A701516P2	Insulator, plate. (Used with Z401 & Z402).
	19B233285P1	Ground tab. (Located at L401-L407 casting).
	19A701905P3	Tuning screw. (Used with L105, L106, L355, L356, L401, L402, L405-L407).
	19C851075P1	Knob. (R617).
	19A703313P2	Screw. (Secures R617 knob).
	19A700032P1	Lockwasher, internal tooth: No. 2. (Secures R617 knob).
	19A701743P1	Pad. (Located behind S602 knob).
	19D429946P3	Casting. (Located at L401 & L407).
	19C850619G6	Casting. (Located at L105 & L106).

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 - Transmitter/Receiver Board 19D900984G1

To improve receiver modulation. Changed Z401.
Z401 was: 19A702522G11 - Crystal pair.

REV. B - To improve transmitter operation. Added C121.

REV. C - To allow transmitter operation down to 15 watts
Changed R203.
R203 was: 19A700106P55 Composition: 470 ohms ±5% 1/4 w.