MAINTENANCE MANUAL
PCS REAR ASSEMBLIES
19D902175G1 (136-153 MHz)
19D902175G2 (150-174 MHz)

TABLE OF CONTENTS

DESCRIPTION

The PCS Portable Radio Rear Assemblies 19D902175G1 and G2 provide metal housings for RF Boards 19D438222G1 (136-153 MHz) and 19D438222G3 (150-174) respectively. The RF boards are the same except for certain frequency sensitive elements.

The RF boards consist of the following circuits:

- A frequency synthesizer for generating the transmit carrier frequency and the receive circuit first mixer injection frequency.
- The transmit circuit, receive circuit and TX/RX switch.
- A voltage regulator and low battery switch.

Refer to Figure 1 for a block diagram of the synthesizer circuit. Refer to Figure 2 for a transmit and receive circuit block diagram. Transmit circuit adjustments for frequency and power are accessible from the top side of the board, as are IF alignment, second oscillator and quadrature detector adjustments for the receiver circuit. Chip components on the bottom of the board provide optimum RF performance.

Selected use of sealed modules permits small board size as well as RF and mechanical protection for sensitive circuitry. Modules are NOT repairable and must be replaced if they are determined to be damaged. A single friction fit shield provides RF shielding.

ERICSSON

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CIRCUIT ANALYSIS

SYNTHESIZER CIRCUIT

The frequency synthesizer circuit generates all transmit and receive RF frequencies for the PCS Personal Radio. This circuit uses a phase-locked Voltage Controlled Oscillator (VCO) operating on the actual transmitter frequency (136-153 or 150-174 MHz) during transmit and 45 MHz above the actual receive frequency during receive. The synthesizer output signal is generated directly by VCO module U204 and fed through a low pass filter to a LO buffer, a PA buffer and a prescaler buffer.

The synthesizer frequency output is controlled by a microprocessor on the Audio Logic Board. Frequency stability is maintained by a temperature compensated crystal controlled oscillator (TCXO) module. The oscillator has a stability of 5 PPM over the temperature range of -30C to 60C and determines the overall frequency stability of the radio.

The VCO output is also buffered by transistor Q201 to feed divide by 64/65 dual modulus prescaler U205. The prescaler feeds the Fin input of Phase-Lock-Loop (PLL) chip U201. Within U201, the prescaler signal is further divided down to 5 KHz to be compared with a reference signal. This reference signal is derived from 12.8 MHz TCXO module U203. The PLL chip, U201, divides the 12.8 MHz TCXO down to the 5 KHz reference frequency. Divider circuits in U201 are programmed by three inputs from the Audio/Logic Board. These are **SYN ENABLE, SYN DATA** and **SYC CLOCK** lines. A **LOCK DETECT** line from the PLL chip to the audio board microprocessor for processing to prevent transmissions when the synthesizer is unlocked. A blinking **BAT** flag is displayed on the LCD and a pulsed beep will be sounded if this condition occurs.

Audio modulation from the Audio/Logic Board is applied to loop filter circuit board A201 in the synthesizer circuit. The audio is summed with the unfiltered control voltage and fed to operational amplifier U1 on the loop filter Board. Amplifier U1 is biased to produce gain variation with different control voltages. When the control voltage is below 1.7 volts, both diodes in diode package D1 are biased off. The operational amplifier gain is then one. As the control voltage rises above approximately 1.7 volts, one of the diodes (D1) is forward biased. This increases the operational amplifier gain to approximately 1.2. Further increases in the control voltage above approximately 2.5 volts turns both diode paths on, thus increasing the gain to about 1.4. Gain variation verses control voltage compensates for decreasing VCO gain and keeps the VCO gain constant at higher control voltages. The net effect of this is to linearize the loop response across the frequency band to maintain relatively constant audio modulation and constant digital Channel Guard waveshape.

The synthesizer enable line also drives bilateral switches U2A and U2B on the loop filter board. The pulse applied to these gates, when channel changes occur, turns the gates on which shorts out resistors R11 and R12. This allows rapid channel acquisition.

At low control voltages, below approximately 0.9 volts, operational amplifier U1B is enabled by the pulse on the synthesizer enable line. This enables transistor Q1 for the duration of the channel change pulse. Transistor Q1 acts as a current sink for operational amplifier U1A which speeds up the slow rate on U1A at low voltages.

TRANSMIT CIRCUIT

The transmit circuit consists of a transmit buffer amplifier, a 7-watt power amplifier (U101), a Power Control circuit (A101), a low pass filter circuit and a Tx/Rx switch. Transistors Q102 through Q105 switch power to the TX stages and drives the Disable Line of the Power Control Module.

Tx Buffer

Transmit buffer transistor Q101 is driven by the synthesizer VCO output at a level of approximately 0 dBm. Amplifier transistor Q101, in turn, drives power module U101 at approximately +3 dBm. DC power is applied to the buffer only in the transmit mode and is regulated to provide constant drive with decreasing battery voltage.

Power Module

Power module U101 is a three-stage broadband power amplifier with internal matching. This module mounts to the rear casting for heat sinking. Output power is controlled by varying the supply voltage to stage two of the module. Stage one and bias for stage two are supplied with the same regulated voltage as the transmit buffer. The final PA stage is supplied by the battery voltage in order to obtain maximum power. The final stage power feed is through inductor L103. The d.c. voltage drop across this coil provides the sense voltage for power control.

Power Control Board

The power control circuitry, located on circuit board A101, has the task of sensing the d.c. drop across L103 and producing an output d.c. voltage to control stage two of the PA module. This feedback system holds the current to stage three of the PA module essentially constant as frequency, battery voltage, temperature and load varies. The output current level and output power are set by power adjusting potentiometer R119, located on the RF Board. A lower power level may be set by adjusting potentiometer R11, located on the Power Control Board. Transistor Q2 on the power control board must be turned ON to enable the R11 path. This transistor is in turn controlled by the microprocessor on the Audio/Logic Board to control high or low power operation.

The input voltages to the power control module are on Pins 7 and 8. These voltages are divided down by precision resistors to set input voltages to operational amplifier U1. The voltage on the positive terminal of U1 may be adjusted above and below the divider voltage on the negative terminal of U1. When the positive and negative terminals are at equal potentials, the output of U1 is about 5 volts (depending on battery voltage). As the voltage on the positive terminal is adjusted by potentiometer R11, the output of U1 moves higher or lower in potential by about 60 time the ^ Vin. This output is buffered by emitter follower transistor Q3. The output voltage on Pin 2 is set by the resistor ratio R7+R8/R7. Current is supplied at this output mode by external transistor Q106.

Low Pass Filter

A six element low pass filter is provided to prevent excessive transmitter harmonics from being transmitted. This filter in conjunction with the matching circuitry in the PA module limits the conducted harmonic energy to less than -30 dBm.

Tx/Rx Switch

The Tx/Rx Switch consists of series **PIN** diode D101 and shunt **PIN** diode D102. Both diodes are off during receive and are therefore essentially open. This isolates the transmit circuit from the receive circuit while in the receive mode. During transmit, regulated voltage is switched to inductor L105. This produces a d.c. current through both D101 and D102, which transforms both diodes into RF shorts. This allows the PA output power to be conducted to the radio antenna. The RF short produced by D102 protects the receiver but is still essentially an open to the transmitter. This is true because inductor L106 and part of capacitor C116 form a parallel resonant circuit across the transmit output.

Tx Switches

The transmit circuit is enabled by the **DPTT** line from the Audio/Logic Board. When the PTT button is activated, the **DPTT** line is pulled high. This turns transistor Q102 on and allows transistors Q103, Q104 and Q105 to conduct. The voltage on the emitter of transistor Q104 is approximately 0.7 volts (**VBE** + **VSAT**) below the regulated 5.4 Volts. The voltage at the collector of transistor Q105 is set by the (R117 + R118)/R117 resistor ratio. This boosts the output voltage back to about 5.4 volts while allowing Q105 to supply the relatively high currents needed for the Tx Buffer, the PA module and the **PIN** diode switch.

The collector of transistor Q102 is also used to drive transmit disable transistor Q1 located on the power control module. When in the Rx state, the base of Q1 is baised on by a high voltage level at the collector of Q102. This in turn keeps the positive terminal of U1 sufficiently low to drive the output of U1 low enough to bias Q3 off. When Q102 is turned on by the DPTT line, transistor Q1 is biased off. This allows the normal Tx operation previously described.

RECEIVE CIRCUIT

The dual conversion receive circuit consists of a receiver front end, a 45 MHz first IF and a 455 kHz second IF with an FM detector. All audio processing and squelch functions are accomplished on the Audio/Logic Board.

Front End

RF is coupled from antenna jack J1 to the RF Board through antenna clip connector J101. The receive signal is then conducted through the Tx low pass filter to receive preselector filter Z401. This is a fixed tuned 3-pole band pass filter covering the 136 to 153 or 150 to 174 MHz bands. Its output is matched to the input of RF amplifier transistor Q401. A fixed tuned 2-pole output filter is connected between the RF amplifier and double balanced mixer Z402. About 10 dB of RF gain is provided to the mixer input. The Local Oscillator (LO) port of the mixer (Pin 1) is driven by LO buffer transistor Q450. The filtered synthesizer output drives this buffer. The output of Q450 drives a 2-pole filter which couples the drive to the mixer at about +4 dBm.

45 MHz IF

The mixer output is connected to the Source of common Gate Field Effect Transistor (FET) Q501. This stage provides a low impedance input to match the mixer and a high impedance output to drive the 45 MHz 4-pole crystal filter. The crystal filter output is amplified by bipolar device transistor Q502. This IF amplifier output drives the Second Mixer circuit in Mixer/Limiter/FM Detector module U501. Crystal Y101 is an external crystal operating a 45.455 MHz. This crystal when coupled to the internal circuitry forms the second LO for the second mixer circuit. The frequency of the second LO is adjusted with inductor L505. The second mixer output is a 455 kHz IF and is filtered by a 4-pole ceramic filter. This output is further amplified and limited by U501. A quadrature detector circuit provides an audio output from U501. The quadrature detector coil is L506. The audio output is pre-filtered and connected to the Audio/Logic Board as VOL SQ HI.

5.4 Volt Regulator

The 5.4 volt regulator circuit supplies a regulated 5.4 volts to all circuits requiring a stable reference voltage. This regulated voltage is generated by voltage reference diode U801 and transistors Q801, Q802 and Q803. Diode U801 provides 2.5 volts which is stable with both temperature and battery voltage. The 2.5 volt reference is fed to the base of Q802. Transistors Q802 and Q803 form a differential amplifier while Q801 acts as a pass transistor. The regulated 5.4 volts output on the collector of Q801 is divided by voltage divider resistors R805 and R806 to apply 2.5 volts to the base of transistor Q803. With this voltage on the base of Q803 the differential amplifier is balanced.

Battery Indicator

Transistor Q804 senses the battery voltage and compares it to the regulated 5.4 volts on the emitter. When the battery voltage drops to approximately 6.3 volts, Q804 is sufficiently on to produce about 0.4 volts on the battery indicator output (P801-1). This voltage is fed to the audio/logic board to drive an inverter which toggles a microprocessor port to provide a low battery indication.

Another effect at low battery voltage is produced by the voltage on the collector of Q804 driving Pin 6 of power control module U1. A slight increase of this voltage on the negative terminal of U1 causes the output of U1 to drop and the control voltage to be reduced. The final result is a slight drop in RF power output. Consequently, as the end of battery is approached, the RF power is throttled back. This gives the user additional transmit time before total loss of power due to low battery.

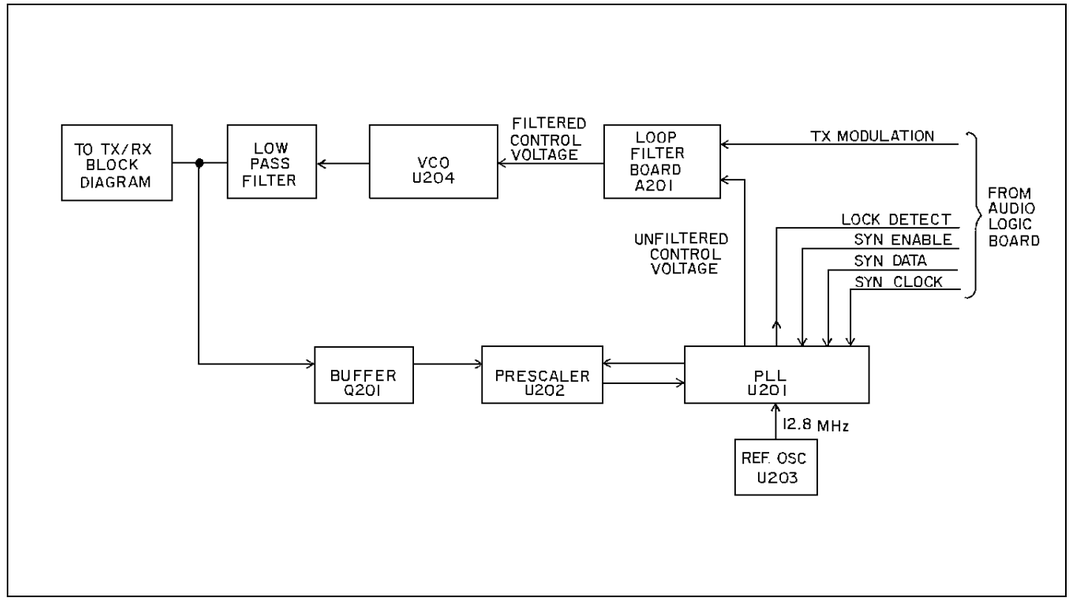


Figure 1 - Synthesizer Circuit

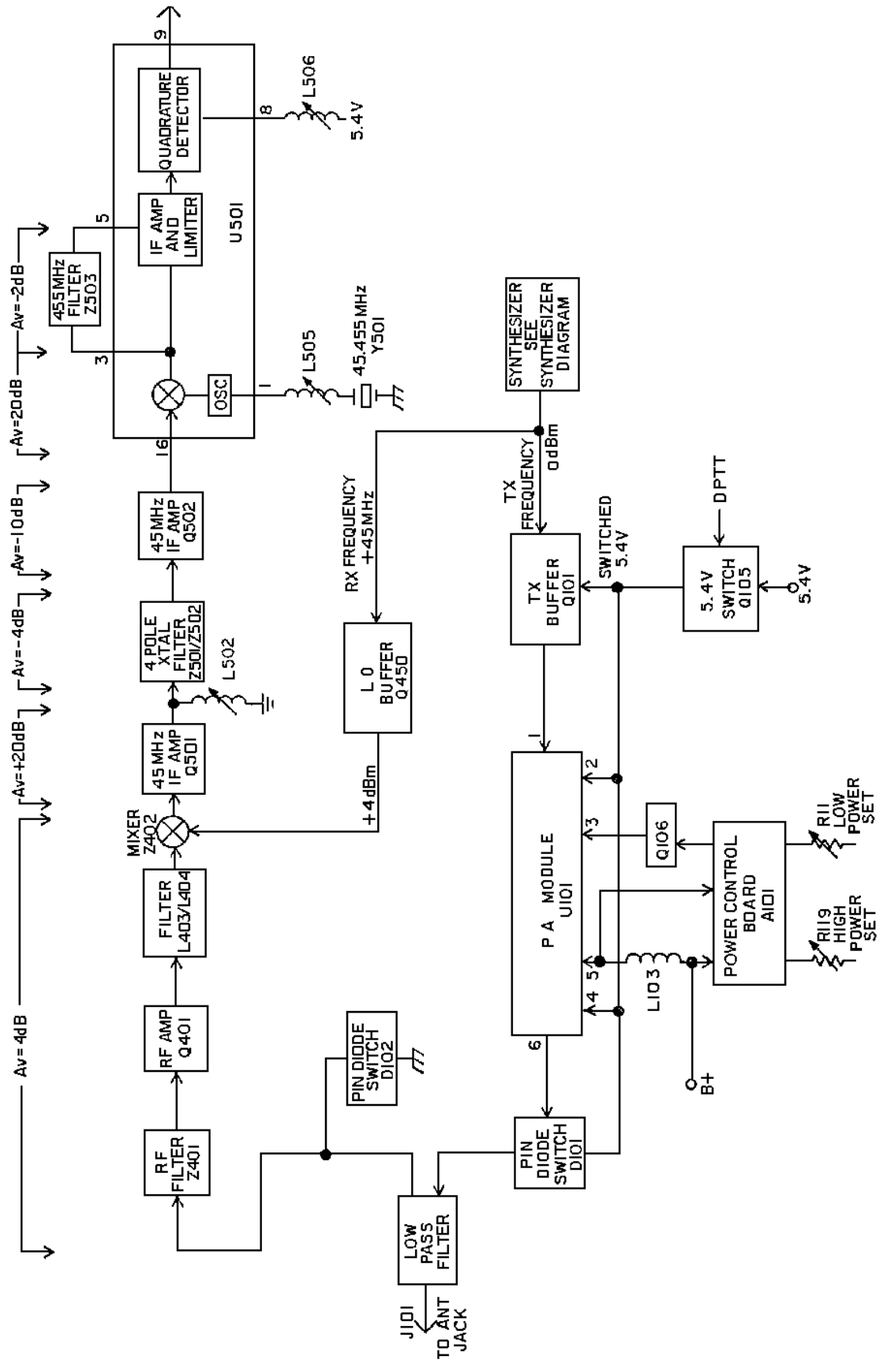
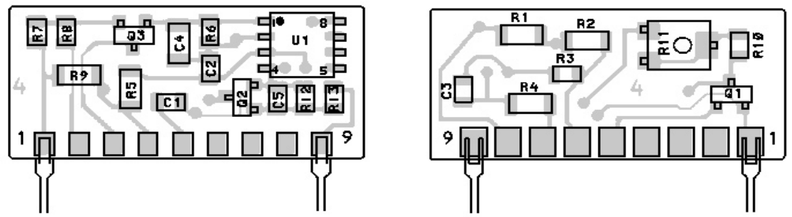


Figure 2 - Transmit And Receive Circuit

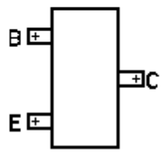
POWER CONTROL BOARD A101

19B801519G1



COMPONENT SIDE SOLDER SIDE

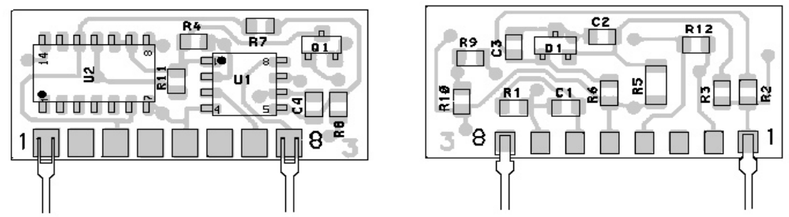
LEAD IDENTIFICATION FOR
Q1, Q2, & Q3
(TOP VIEW)



(19B801519, Sh. 1, Rev. 3)
(19C851653, Component Side, Rev. 4)
(19C851653, Solder Side, Rev. 4)

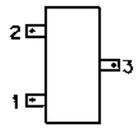
LOOP FILTER BOARD A201

19C851646G1

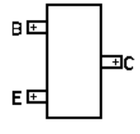


COMPONENT SIDE SOLDER SIDE

LEAD IDENTIFICATION FOR
D1
(TOP VIEW)



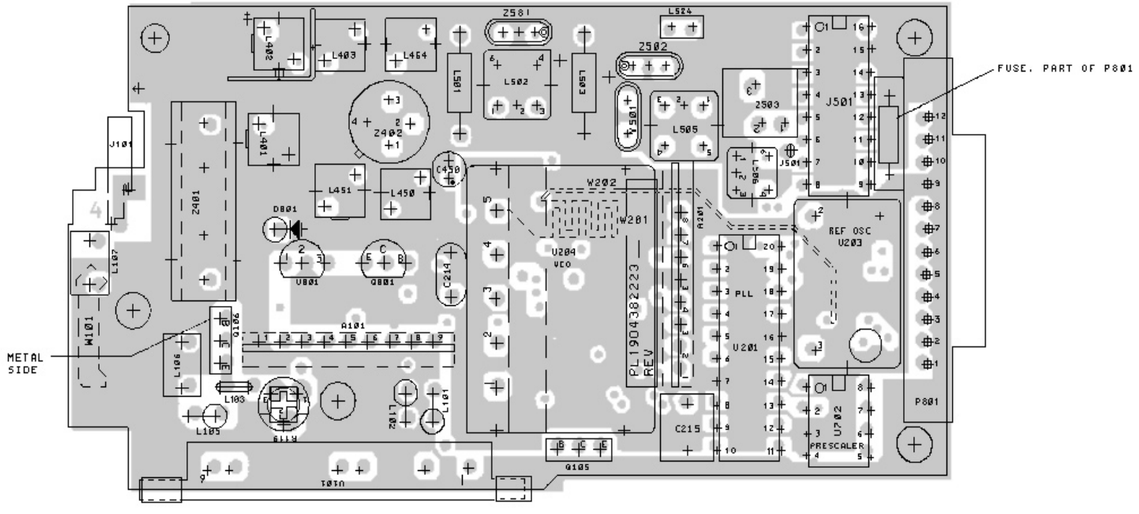
LEAD IDENTIFICATION FOR
Q1
(TOP VIEW)



(19C851646, Sh. 1, Rev. 2)
(19C851647, Component Side, Rev. 3)
(19C851647, Solder Side, Rev. 3)

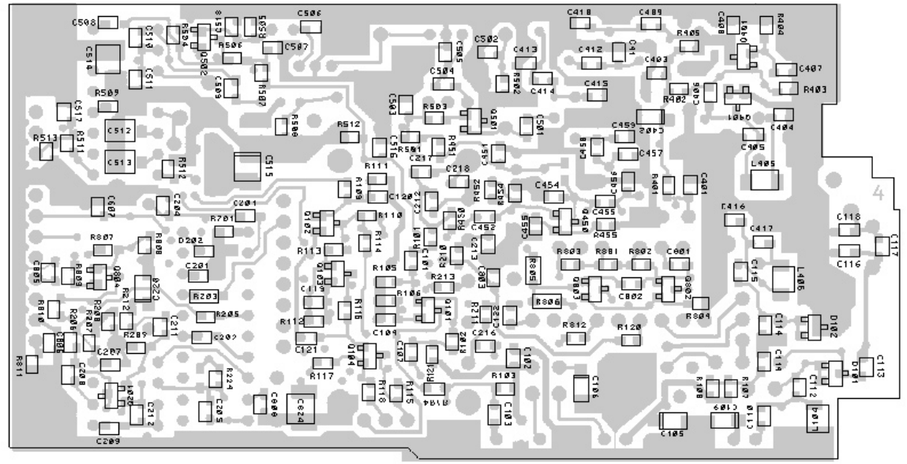
REAR ASSEMBLY

CAUTION
OBSERVE PRECAUTIONS
FOR HANDLING
ELECTROSTATIC SENSITIVE DEVICES



COMPONENT SIDE

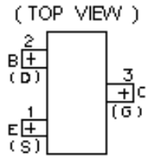
(19D438222, Sh.3, Rev. 3)
(19D902627, First Layer, Rev. 4)
(19D902627, Fourth Layer, Rev. 4)



SOLDER SIDE

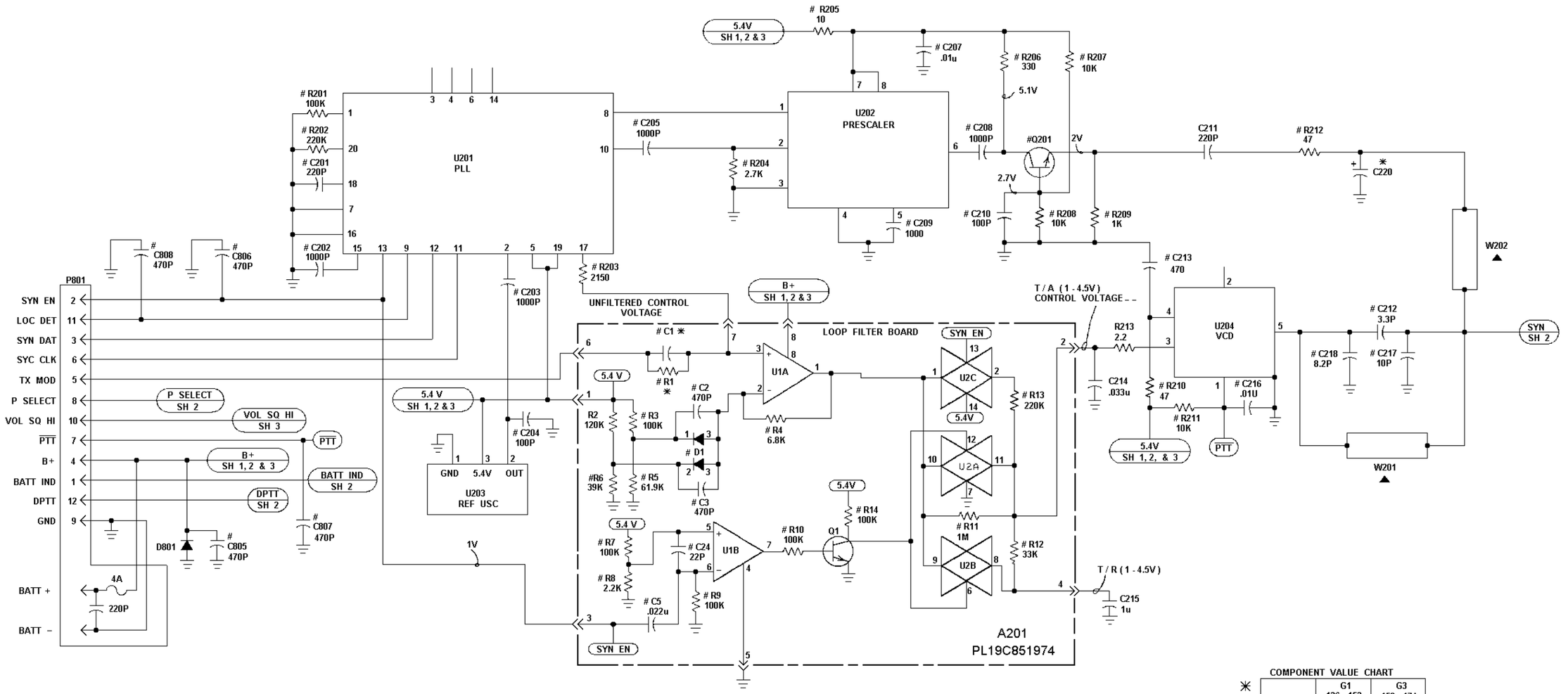
(19D438222, Sh. 4, Rev. 5)
(19D902627, Fourth Layer, Rev. 4)

LEAD IDENTIFICATION FOR
(SOT) TRANSISTORS



RF BOARDS
19D438222G1 & G3

CAUTION
OBSERVE PRECAUTIONS
FOR HANDLING
ELECTROSTATIC
SENSITIVE
DEVICES



COMPONENT VALUE CHART

✳ COMP: #	G1 136 - 153 MHZ	G3 150 - 174 MHZ
C220	——	1u
C1	.0068u	.022u
R1	160K	82K

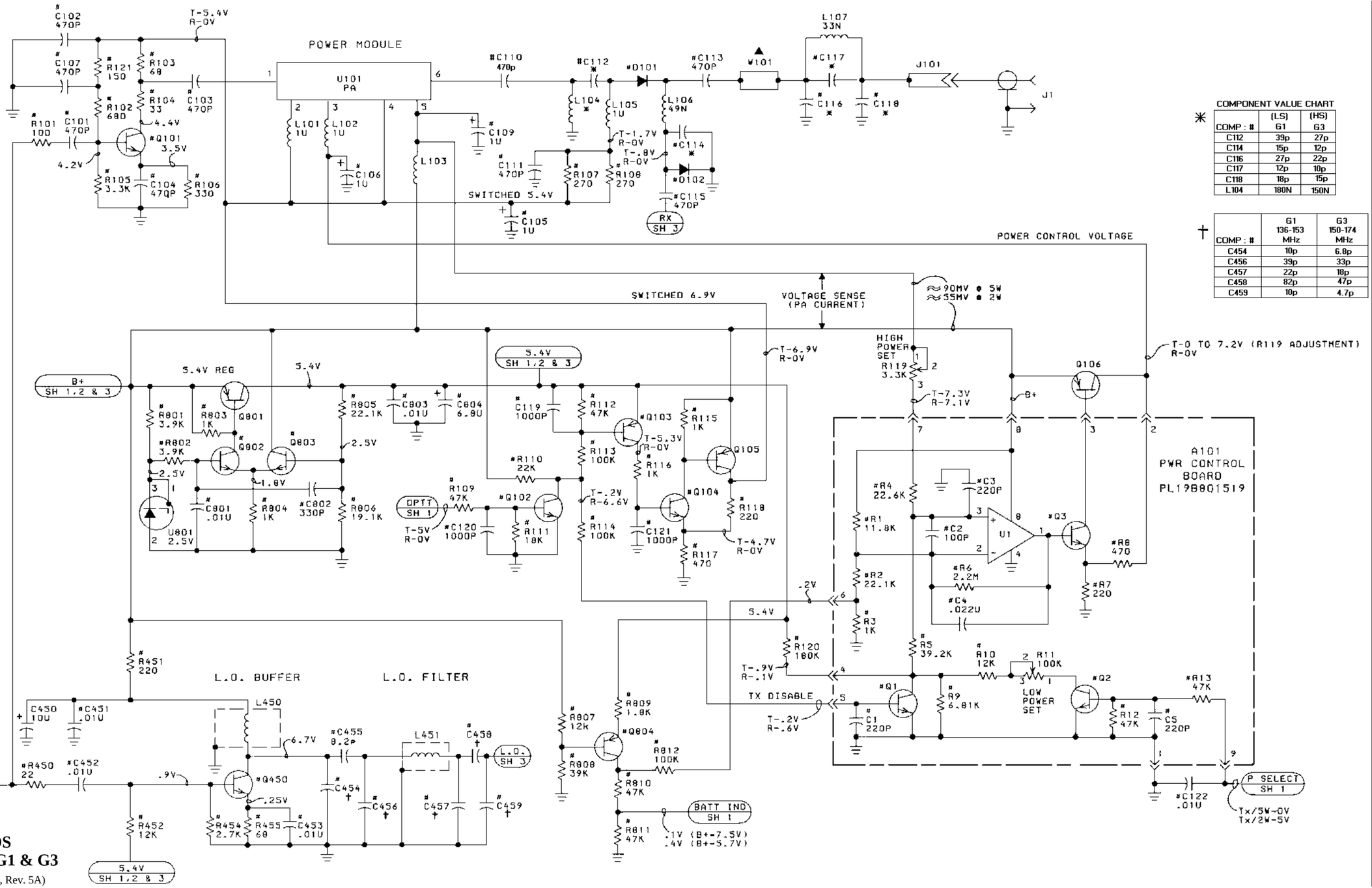
MODEL NO.	REV. LETTER
PL19D438222G1	D
PL19D438222G3	E

NOTES:

1. ALL RESISTORS ARE .1 WATT UNLESS OTHERWISE SPECIFIED
   RESISTOR VALUES IN U UNLESS FOLLOWED BY MULTIPLIER K OR M.
   CAPACITOR VALUES IN F UNLESS FOLLOWED BY MULTIPLIER U, N OR P.
   INDUCTANCE VALUES IN H UNLESS FOLLOWED BY MULTIPLIER M OR U.
2. # INDICATES CHIP COMPONENTS
3. ▲ PART OF PWB.
4. ALL D.C. VOLTAGES ARE TAKEN AT B+ - 7.5V.

REAR ASSEMBLY

RF BOARDS
19D438222G1 & G3
(19D902715, Sh. 1, Rev. 5A)



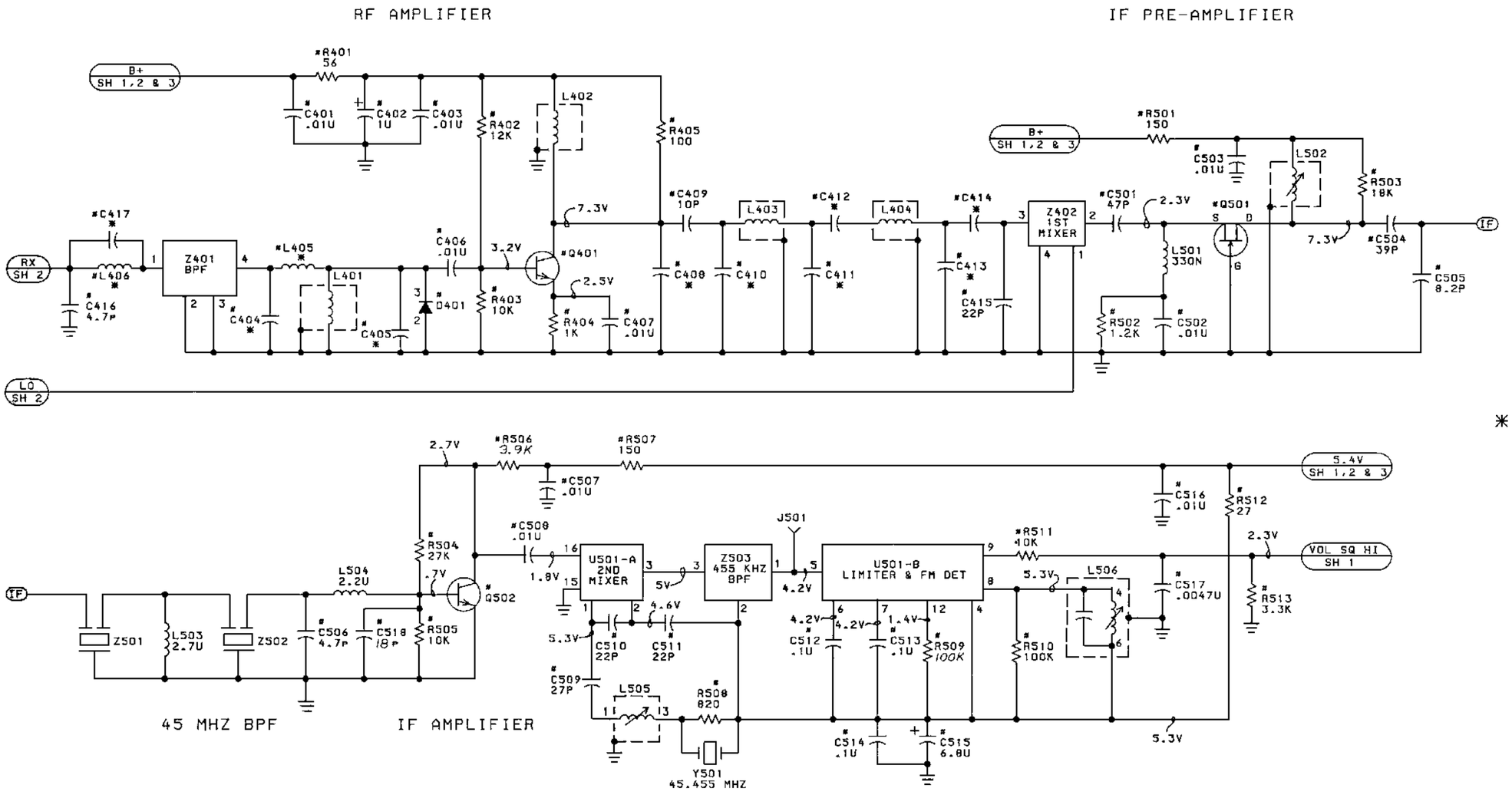
✳ COMPONENT VALUE CHART

COMP : #	(LS) G1	(HS) G3
C112	39p	27p
C114	15p	12p
C116	27p	22p
C117	12p	10p
C118	18p	15p
L104	180N	150N

†

COMP : #	G1 136-153 MHz	G3 150-174 MHz
C454	10p	6.8p
C456	39p	33p
C457	22p	18p
C458	82p	47p
C459	10p	4.7p

RF BOARDS
19D438222G1 & G3
(19D902715, Sh. 2, Rev. 5A)



REAR ASSEMBLY

COMPONENT VALUE CHART

* COMP.#	G1 136-153 MHZ	G3 150-174 MHZ
C404	3.9P	8.2P
C405	10P	4.7P
C408	15P	10P
C410	33P	22P
C411	150P	120P
C412	150P	120P
C413	22P	15P
C414	150P	82P
C417	220P	
L405	68n	82n
L406		15n

RF BOARDS
19D438222G1 & G3
(19D902715, Sh. 3, Rev. 5A)

RADIO REAR ASSEMBLY
19D901275G1 (136-153 MHz)
19D902175G2 (150-174 MHz)
ISSUE 7

SYMBOL	PART NUMBER	DESCRIPTION
A1		**RF BOARD 19D438222G1 (136-153 MHz) 19D438222G3 (150-174 MHz)**
A101		**POWER CONTROL MODULE 19B801519G1**
		——— CAPACITORS ———
C1	19A702061P69	Ceramic: 220 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C2	19A702061P61	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C3	19A702061P69	Ceramic: 220 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C4	19A702052P28	Ceramic: 0.022 uF ±10%, 50 VDCW.
C5	19A702061P69	Ceramic: 220 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
		——— TRANSISTORS ———
Q1 thru Q3	19A700076P2	Silicon, NPN: sim to MMBT3904, low profile
		——— RESISTORS ———
R1	19A702931P308	Metal film: 11.8K ohms ±1%, 200 VDCW, 1/8 w.
R2	19A702931P334	Metal film: 22.1K ohms ±1%, 200 VDCW, 1/8 w.
R3	19B801251P102	Metal film: 1K ohms ±5%, 1/10 w.
R4	19A702931P335	Metal film: 22.6K ohms ±1%, 200 VDCW, 1/8 w.
R5	19A702931P358	Metal film: 39.2K ohms ±1%, 200 VDCW, 1/8 w.
R6	19B801251P225	Metal film: 2.2M ohms ±5%, 1/10 w.
R7	19B801251P221	Metal film: 220 ohms ±5%, 1/10 w.
R8	19B801251P471	Metal film: 470 ohms ±5%, 1/10 w.
R9	19A702931P281	Metal film: 6810 ohms ±1%, 200 VDCW, 1/8 w.
R10	19B801251P123	Metal film: 12K ohms ±5%, 1/10 w.
R11	19A705496P8	Variable: 200K ohms max, 1/10 w.
R12 and R13	19B801251P473	Metal film: 47K ohms ±5%, 1/10 w.
		—— INTEGRATED CIRCUITS ———
U1	19A702293P3	Linear: Dual Op Amp; sim to LM358D.
A201		**LOOP FILTER MODULE 19C851974G1**
		——— CAPACITORS ———
*C1	19A702052P12	Ceramic: 0.0068 uF ±5%, 50 VDCW.
C2 and C3	19A702061P77	Ceramic: 470 pF 5±%, 50 VDCW, temp coef 0 ±30 PPM.
C4	19A702061P29	Ceramic: 22 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C5	19A702052P30	Ceramic: 0.022 uF ±10%, 50 VDCW.
		——— DIODES ———
D1	19A703561P2	Silicon, fast recovery (2 diodes in series).
		——— TRANSISTORS ———
Q1	19A700076P2	Silicon, NPN: sim to MMBT3904, low profile.
		——— RESISTORS ———
*R1	REP624656/16	Metal film: 160K ohms ± 1%, 1/10 ω.
R2	19B801251P124	Metal film: 120K ohms ±5%, 1/10 w.
R3	19B801251P104	Metal film: 100K ohms ±5%, 1/10 w.
R4	19B801251P682	Metal film: 6.8K ohms ±5%, 1/10 w.
R5	19A702931P377	Metal film: 61.9K ohms ±1%, 200 VDCW, 1/8 w
R6	19B801251P393	Metal film: 39K ohms ±5%, 1/10 w.
R7	19B801251P104	Metal film: 100K ohms ±5%, 1/10 w.
R9 and R10	19B801251P104	Metal film: 100K ohms ±5%, 1/10 w.
R11	19B801251P105	Metal film: 1M ohms ±5%, 1/10 w.
R12	19B801251P333	Metal film: 33K ohms ±5%, 1/10 w.
R13	19B801251P224	Metal film: 220K ohms ±5%, 1/10 w.
R14	19B801251P104	Metal film: 100K ohms ±5%, 1/10 w.
		—— INTEGRATED CIRCUITS ———
U1	19A702293P3	Linear: Dual Op Amp; sim to LM358D.
U2	19A702705P4	Digital: uad Analog Switch/Multiplexer; sim to 4066BM.
		TRANSMITTER
		——— CAPACITORS ———
C101 thru C104	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C105 and C106	19A705205P2	Tantalum: 1 uF, 16 VDCW; sim to Sprague 293D.
C107	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C109	19A705205P2	Tantalum: 1 uF, 16 VDCW; sim to Sprague 293D.
C110	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM..
C111	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C112	19A702061P33	Ceramic: 27 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G3).
C112	19A702236P40	Ceramic: 39 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G1).
C113	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C114	19A702061P21	Ceramic: 15 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G1).
C114	19A702061P17	Ceramic: 12 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G3).
C115	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C116	19A702061P33	Ceramic: 27 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G1).
C116	19A702061P29	Ceramic: 22 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G3).
C117	19A702061P17	Ceramic: 12 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G1).
C117	19A702061P13	Ceramic: 10 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G3).
C118	19A702061P25	Ceramic: 18 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G1).
C118	19A702061P21	Ceramic: 15 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G3).
C119 thru C121	19A702052P5	Ceramic: 1000 pF ±10%, 50 VDCW.
C122	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
		——— DIODES ———
D101 and D102	19A700155P2	Silicon: fwd current 100 mA, 35 PIV.
		——— JACKS ———
J101	19B801491P2	Clip, Antenna.
		——— INDUCTORS ———
L101 and L102	19A700024P13	Coil, RF: 1.0 uH ±10%.
L103	19B801566P11	Shield.
L104	19A705470P15	Coil, 150 nH ±20% (Used in G3).
L104	19A705470P10	Coil, 56 nH ±20%. (Used in G3).
L105	19A700024P13	Coil, RF: 1.0 uH ±10%.
L106	19B800891P4	Coil, F Choke: sim to Paul Smith SK-890-1.
L107	19B800891P3	Coil, RF Choke; sim to Paul Smith SK890-1.
		——— TRANSISTORS ———
Q101	19A704708P2	Silicon, NPN: sim to NEC 2SC3356.
Q102	19A700076P2	Silicon, NPN: sim to MMBT3904, low profile.
103	19A700059P2	Silicon, PNP: sim to MMBT3906, low profile.
Q104	19A700076P2	Silicon, NPN: sim to MMBT3904, low profile.
Q105 and 106	19A704972P1	Silicon, PNP: sim to Motorola 2N4918.
		——— RESISTOR ———
R101	19B801251P101	Metal film: 100 ohms ±5%, 1/10 w.
R102	19B801251P681	Metal film: 680 ohms ±5%, 1/10 w.
R103	19B801251P680	Metal film: 68 ohms ±5%, 1/10 w.
R104	19B801251P330	Metal film: 33 ohms ±5%, 1/10 w.
R105	19B801251P332	Metal film: 3.3K ohms ±5%, 1/10 w.
R106	19B801251P331	Metal film: 330 ohms ±5%, 1/10 w.
R107 and R108	19B801251P271	Metal film: 270 ohms ±5%, 1/10 w.
R109	19B801251P473	Metal film: 47K ohms ±5%, 1/10 w.
R110	19B801251P223	Metal film: 22K ohms ±5%, 1/10 w.
R111	19B801251P183	Metal film: 18K ohms ±5%, 1/10 w.
R112	19B801251P473	Metal film: 47K ohms ±5%, 1/10 w.
R113 and R114	19B801251P104	Metal film: 100K ohms ±5%, 1/10 w.
R115 and R116	19B801251P102	Metal film: 1K ohms ±5%, 1/10 w.
R117	19B801251P471	Metal film: 470 ohms ±5%, 1/10 w.
R118	19B801251P221	Metal film: 220 ohms ±5%, 1/10 w.
R119	19B800779P7	Variable: 3.3K ohms ±25%, 100 VDCW, .3 w.
R120	19B801251P184	Metal film: 180K ohms ±5%, 1/10 w.
R121	19B801251P151	Metal film: 150 ohms ±5%, 1/10 w.
		—— INTEGRATED CIRCUITS ———
U101	19A705774P1	Module: 136-155 MHz RF PA; sim to SHW1030. (Used in G1).
U101	19A705774P2	Module: 146-174 MHz RF PA; sim to SHW1031. (Used in G3).
		——— CABLES ———
W101		Part of printed wire board.
		SYNTHESIZER
		——— CAPACITORS ———
C201	19A702061P69	Ceramic: 220 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C202 and C203	19A702052P5	Ceramic: 1000 pF ±10%, 50 VDCW.
C204	19A702061P61	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C205	19A702052P5	Ceramic: 1000 pF ±10%, 50 VDCW.
C207	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C208 and C209	19A702052P5	Ceramic: 1000 pF ±10%, 50 VDCW.
C210	19A702061P61	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C211	19A702061P69	Ceramic: 220 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C212	19A702061P7	Ceramic: 3.3 pF ±0.5 pF, 50 VDCW, temp coef 0 ±120 PPM.
C213	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
*C214	T644ACP333K	Polyester: 0.033 uF ±10%, 50 VDCW.
C215	19A700004P10	Metallized Polyester: 1.0 uF ±10%, 63 VDCW.
C216	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C217	19A702061P13	Ceramic: 10 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C218	19A702061P12	Ceramic: 8.2 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM.
C220	19A705202P2	Tantalum: 1 uF, 16 VDCW; sim to Sprague 293D. (Used in G3).
		——— TRANSISTOR ———
Q201	19A704708P2	Silicon, NPN: sim to NEC 2SC3356.
		——— RESISTORS ———
R201	19B801251P104	Metal film: 100K ohms ±5%, 1/10 w.
R202	19B801251P224	Metal film: 220K ohms ±5%, 1/10 w.
R203	19A702931P233	Metal film: 2150 ohms ±1%, 200 VDCW, 1/8 w.
R204	19B801251P272	Metal film: 2.7K ohms ±5%, 1/10 w.
R205	19B801251P100	Metal film: 10 ohms ±5%, 1/10 w.
R206	19B801251P331	Metal film: 330 ohms ±5%, 1/10 w.
R207 and R208	19B801251P103	Metal film: 10K ohms ±5%, 1/10 w.
R209	19B801251P102	Metal film: 1K ohms ±5%, 1/10 w.
R210	19B801251P470	Metal film: 47 ohms ±5%, 1/10 w.
R211	19B801251P103	Metal film: 10K ohms ±5%, 1/10 w.
R212	19B801251P470	Metal film: 47 ohms ±5%, 1/10 w.
R213	19B801251P2R2	Metal film: 2.2 ohms ±5%, 1/10 w.
		—— INTEGRATED CIRCUITS ———
U201	19B800902P1	Synthesizer: CMOS, Serial Programming; sim to MC145159P.
U202	19A703091P1	Digital: /64, /65 Prescaler; sim to MC12017P.
U203	19B801351P8	Reference Oscillator.
U204	19A705628P1	Voltage Controlled Oscillator (Used in G1).
U204	19C851913G2	Voltage Controlled Oscillator (Used in G3).
		——— CABLES ———
W201 and W202		Part of printed wire board.
		RECEIVER
		——— CAPACITORS ———
C401	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C402	19A705205P2	Tantalum: 1 uF, 16 VDCW; sim to Sprague 293D.
C403	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C404	19A702236P15	Ceramic: 3.9 pF ±.25 pF, 50 VDCW, temp coef 0 ±30 PPM. (Used in G1).
C404	19A702061P12	Ceramic: 8.2 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM. (Used in G3).
C405	19A702061P13	Ceramic: 10 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G1).
C405	19A702061P9	Ceramic: 4.7 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM. (Used in G3).
C406 and C407	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C408	19A702061P21	Ceramic: 15 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G1).
C408	19A702061P13	Ceramic: 10 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G3).
C409	19A702061P13	Ceramic: 10 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C410	19A702061P37	Ceramic: 33 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G1).

* COMPONENTS, ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SYMBOL	PART NUMBER	DESCRIPTION
C410	19A702061P29	Ceramic: 22 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G3).
C411	19A702061P65	Ceramic: 150 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/xC. (Used in G1).
C411	19A702061P63	Ceramic: 120 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G3).
C412	19A702061P65	Ceramic: 150 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/xC. (Used in G1).
C412	19A702061P63	Ceramic: 120 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G3).
C413	19A702061P29	Ceramic: 22 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G1).
C413	19A702061P21	Ceramic: 15 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G3).
C414	19A702061P65	Ceramic: 150 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G1).
C414	19A702061P57	Ceramic: 82 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G3).
C415	19A702061P29	Ceramic: 22 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C416	19A702061P9	Ceramic: 4.7 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM.
C417	19A702061P69	Ceramic: 220 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G1).
C450	19A704879P5	Electrolytic: 10 uF ±20%, 16 VDCW.
C451 thru C453	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C454	19A702061P13	Ceramic: 10 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G1).
C454	19A702061P11	Ceramic: 6.8 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM. (Used in G3).
C455	19A702061P12	Ceramic: 8.2 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM.
C456	19A702061P41	Ceramic: 39 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G1).
C456	19A702061P37	Ceramic: 33 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G3).
C457	19A702061P29	Ceramic: 22 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G1).
C457	19A702061P25	Ceramic: 18 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/xC. (Used in G3).
C458	19A702061P57	Ceramic: 82 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G1).
C458	19A702061P45	Ceramic: 47 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G3).
C459	19A702061P13	Ceramic: 10 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in G1).
C459	19A702061P9	Ceramic: 4.7 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM. (Used in G3).
		——— DIODES ———
D401	19A700155P2	Silicon, fwd current: 100 mA, 35 VIP.
		——— INDUCTORS———
L401	19B801493P6	Coil, RF; sim to Toko NE545GNAS-1130.
L402 thru L404	19B801493P3	Coil, RF; sim to Toko NE545GNAS-100127.
L405	19A705470P11	Coil, Fixed: 68 nH; sim to Toko 380NB-68nM. (Used in G1).
L405	19A705470P12	Coil, Fixed: 82 nH; sim to Toko 380NB-82nM. (Used in G3).
L406	19A705470P3	Coil, Fixed: 15 nH; sim to Toko 380NB-15nM. (Used in G3).
L450 and L451	19B801493P3	Coil, RF; sim to Toko NE545GNAS-100127.
		——— TRANSISTORS ———
Q401	19A704708P2	Silicon, NPN: sim to NEC 2SC3356.
Q450	19A704708P2	Silicon, NPN: sim to NEC 2SC3356.

SYMBOL	PART NUMBER	DESCRIPTION
		——— RESISTORS ———
R401	19B801251P560	Metal film: 56 ohms ±5%, 1/10 w.
R402	19B801251P123	Metal film: 12K ohms ±5%, 1/10 w.
R403	19B801251P103	Metal film: 10K ohms ±5%, 1/10 w.
R404	19B801251P102	Metal film: 1K ohms ±5%, 1/10 w.
R405	19B801251P101	Metal film: 100 ohms ±5%, 1/10 w.
R450	19B801251P220	Metal film: 22 ohms ±5%, 1/10 w.
R451	19B801251P221	Metal film: 220 ohms ±5%, 1/10 w.
R452	19B801251P123	Metal film: 12K ohms ±5%, 1/10 w.
R454	19B801251P272	Metal film: 2.7K ohms ±5%, 1/10 w.
R455	19B801251P680	Metal film: 68 ohms ±5%, 1/10 w.
		——— FILTER ———
Z401	19A705424P2	Printed mica; sim to SOSHIN BP136-153A1 (Used in G1).
Z401	19A705424P1	Printed mica; sim to SOSHIN BP150-174A1 (Used in G3).
Z402	19A705423P1	Mixer: Double (balanced); sim to Tele-Tech MT45. **45 MHz 1F**
		——— CAPACITORS ———
C501	19A702061P45	Ceramic: 47 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C502 and C503	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C504	19A702061P41	Ceramic: 39 pF ±5%, 50 VDCW, temp coef ±30 PPM.
C505	19A702061P12	Ceramic: 8.2 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM.
C506	19A702061P9	Ceramic: 4.7 pF ±0.5 pF, 50 VDCW, temp coef 0 ± 60 PPM.
C507 and C508	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C509	19A702061P33	Ceramic: 27 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C510 and C511	19A702061P29	Ceramic: 22 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C512 thru C514	19A702052P26	Ceramic: 0.1 uF ±10%, 50 VDCW.
C515	19A705205P14	Tantalum: 6.8 uF, 6 VDCW; sim to Sprague 293D.
C516	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C517	19A702052P10	Ceramic: 4700 pF ±10%, 50 VDCW.
C518	19A702061P25	Ceramic: 18 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
		——— JACKS ———
J501	19A701622P1	Cotter pin.
		——— INDUCTORS ———
L501	19A700024P7	Coil, RF: 330 nH ±10%.
L502	19B801413P4	Coil, 39 MHz.
L503	19A700024P18	Coil, RF: 2.7 uH ±10%.
L504	19A705753P17	Coil, Toroidal: 2.2uH ±5%.
L505	19B801413P4	Coil, 39 MHz.
L506	19A703591P1	IF: sim to Toko America P5SVLC-A291EL.
		——— TRANSISTORS———
Q501	19A702524P3	N-Type, field effect; sim to MMBFJ310.
Q502	19A704708P2	Silicon, NPN: sim to NEC 2SC3356.

SYMBOL	PART NUMBER	DESCRIPTION
		——— RESISTORS ———
R501	19B801251P151	Metal film: 150 ohms ±5%, 1/10 w.
R502	19B801251P122	Metal film: 1.2K ohms ±5%, 1/10 w.
R503	19B801251P183	Metal film: 18K ohms ±5%, 1/10 w.
R504	19B801251P273	Metal film: 27K ohms ±5%, 1/10 w.
R505	19B801251P103	Metal film: 10K ohms ±5%, 1/10 w.
R506	19B801251P392	Metal film: 3.9K ohms ±5%, 1/10 w.
R507	19B801251P151	Metal film: 150 ohms ±5%, 1/10 w.
R508	19B801251P821	Metal film: 820 ohms ±5%, 1/10 w.
R509 and R510	19B801251P104	Metal film: 100K ohms ±5%, 1/10 w.
R511	19B801251P103	Metal film: 10K ohms ±5%, 1/10 w.
R512	19B801251P270	Metal film: 27 ohms ±5%, 1/10 w.
R513	19B801251P332	Metal film: 3.3K ohms ±5%, 1/10 w.
		—— INTEGRATED CIRCUITS ———
U501	19A704619P1	Linear: Osc/Mixer/IF/Det/Amp; sim to MC3361AP.
		——— CRYSTALS———
Y501	19A705376P5	Crystal, Fixed Frequency: 45.455 MHz 10 PPM.
		——— FILTER ———
Z501	19A705328P1	Monolithic Crystal: 45.000 MHz; sim to Toyocom 45E2B2.
Z502		Part of Z501.
Z503	19A702171P3	Bandpass: 455 1.5 KHz; sim to Murata CFU455F2. **REGULATOR**
		——— CAPACITORS ———
C801	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C802	19A702061P73	Ceramic: 330 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C803	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C804	19A705205P14	Tantalum: 6.8 uF, 6 VDCW; sim to Sprague 293D.
C805 thru C808	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
		——— DIODES ———
D801	19A116585P1	Silicon, fast recovery, 600 mA, 50 PIV.
		——— PLUGS ———
P801	19C851673P2	Connector.
		——— TRANSISTORS ———
Q801	19A700026P2	Silicon, PNP: sim to BC369.
Q802 and Q803	19A700076P2	Silicon, NPN: sim to MMBT3904, low profile.
Q804	19A700059P2	Silicon, PNP: sim to MMBT3906, low profile.
		——— RESISTORS ———
R801 and R802	19B801251P392	Metal film: 3.9K ohms ±5%, 1/10 w.
R803 and R804	19B801251P102	Metal film: 1K ohms ±5%, 1/10 w.
R805	19A702931P334	Metal film: 22.1K ohms ±1%, 200 VDCW, 1/8 w.
R806	19A702931P328	Metal film: 19.1K ohms ±1%, 200 VDCW, 1/8 w.
R807	19B801251P123	Metal film: 12K ohms ±5%, 1/10 w.
R808	19B801251P393	Metal film: 39K ohms ±5%, 1/10 w.
R809	19B801251P182	Metal film: 1.8K ohms ±5%, 1/10 w.

SYMBOL	PART NUMBER	DESCRIPTION
R810 and R811	19B801251P473	Metal film: 47K ohms ±5%, 1/10 w.
R812	19B801251P104	Metal film: 100K ohms ±5%, 1/10 w.
		—— INTEGRATED CIRCUITS ———
U801	19A702939P2	Linear: Adjustable Shunt Regulator; sim to TL431CLP.
		——— MISCELLANEOUS ———
	19D902174G1	Cover.
	19A702364P304	Screw, Machine.
	19B801572G1	Shield, RF.
	19A705732P329	Screw, Machine.
	19A705732P333	Screw, Machine.
	19B801492P2	Clip.
	19A705883P3	Crystal cushion.
	19B801657P1	Insulating plate.
	19B801655P1	Shield.

REAR ASSEMBLY

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 the descriptions of parts affected by these revisions.

REV. A - RF BOARD 19D438222G1

REV. A - RF BOARD 19D438222G3

To improve selectivity, changed IF bandpass filter Z503. To improve low level frequency stability, removed capacitor C206. To allow scan operation, changed loop filter module A201. Old part numbers were:

Z503 - 19A702171P1, Filter, Bandpass.

C206 - 19A702061P69, Ceramic: 220 pF ±5%, 50 VDCW temp coef 0 ±30 PPM,

A201 - 19C851646, Loop Filter Module.

REV. B - RF BOARD 19D438222G3

To improve radio performance changed C110, C112, L104 and U204. Old part numbers were:

C110 - 19A702061P77, Ceramic: 470 pF ±5%, 50 VDCW temp coef 0 ±30 PPM.

C112 - 19A702061P33, Ceramic: 33 pF 5±%, 50 VDCW temp coef 0 ±30 PPM.

L104 - 19A700024P2, Coil, RF; 120 nH.

U204 - 19A705628P2, Voltage Controlled Oscillator.

REV. C - RF BOARD 19D438222G1 & G3

To improve receiver adjacent channel selectivity, improve a receiver spur and resolve an out of lock condition the following were changed.
L104 changed to a surface mount component.
R213 was 1k ohms (19B801251P102).
C219 deleted.
C220 added (19A705205P2).
C808 added (19A702061P77).

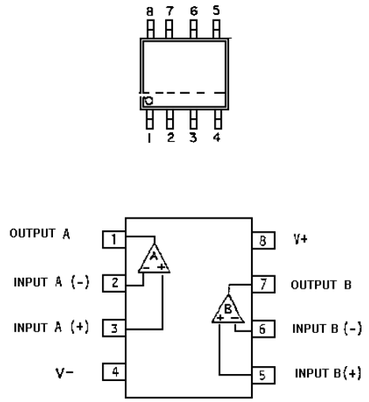
REV. D - RF BOARD 19D438222G1 & G3

To improve impedance matching.
C110 in G3 was 22 pF (19A702236P34).
C112 in G3 was 22 pF (19A702236P34).
C112 in G1 was 27 pF (19A702061P33).
L103 was a coil (19A700024P1).
L104 was 56 NH (19A705470P10).

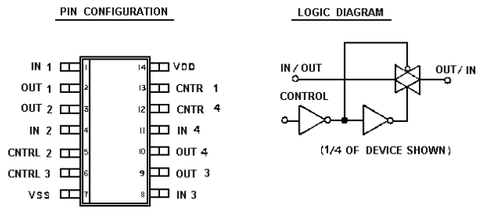
REV. E - RF BOARD 19D438222G3

To improve frequency response.
C214 was 0.022uF (T644ACP322K).
C1 was 0.01uF (19A702052P114).
R1 was 100K ohms (19B801251P104).

OPERATIONAL AMPLIFIER U1
19A702293P2

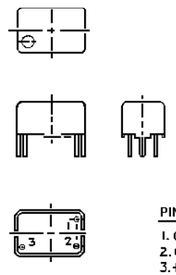


BILATERAL SWITCH U2
19A702705P1

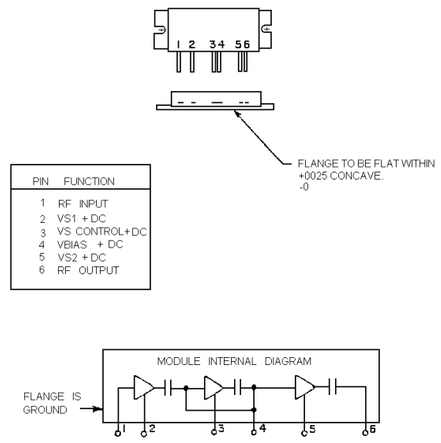


CONTROL	SWITCH
0	OFF
1	ON

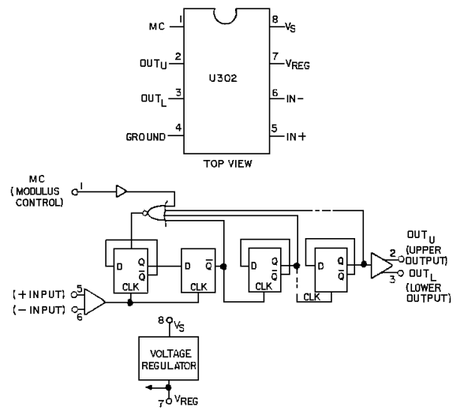
REFERENCE OSCILLATOR U203
19B801351P8



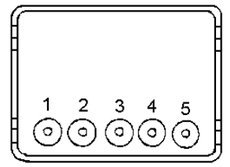
POWER MODULE U101
19A705418P2



PRESCALER MODULE U202
19A703091P1

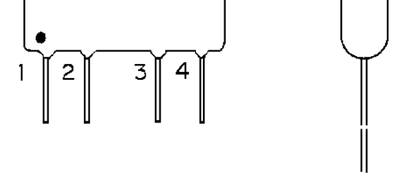


VCO U204
19A705628P2



PIN	FUNCTION
1	TX / RX
2	N.C.
3	CONTROL
4	B+
5	OUTPUT

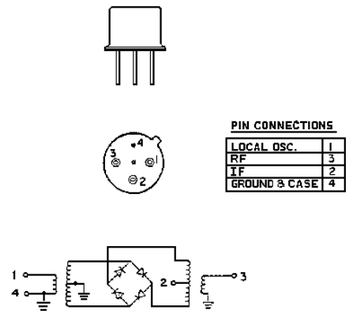
BANDPASS FILTER Z401
19A705424P1



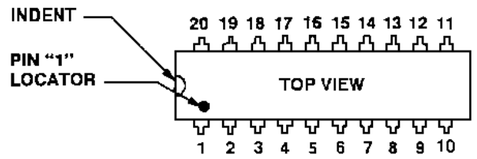
PIN CONNECTIONS:

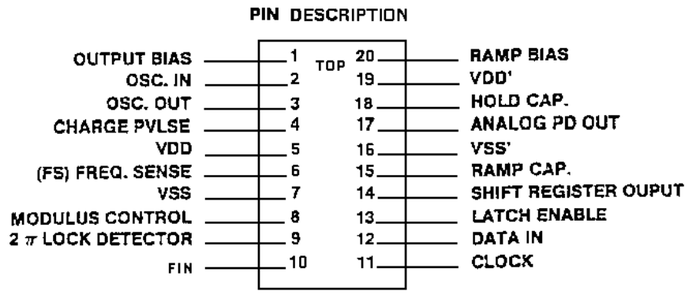
1 - INPUT
4 - OUTPUT
2,3 - GROUND

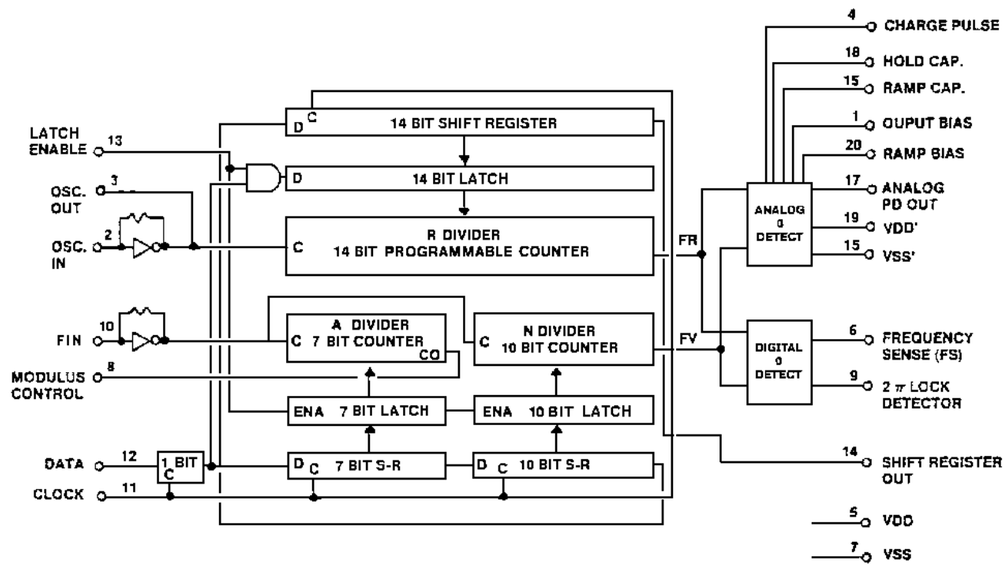
FIRST MIXER Z402
19A705423P1



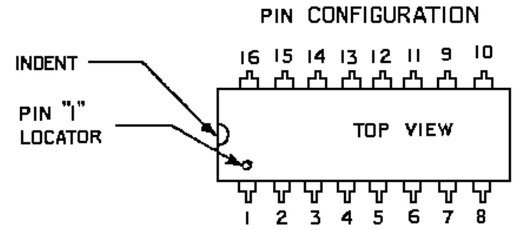
PLL MODULE U201
19B800902P1

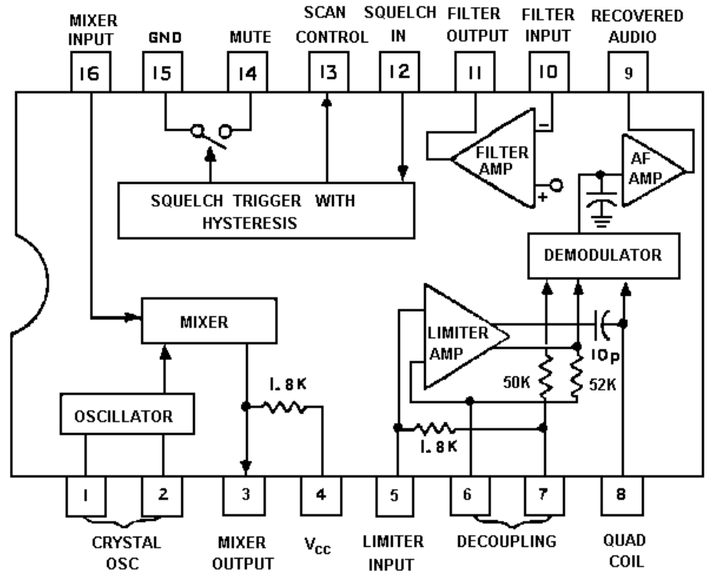






SECOND MIXER/LIMITER/FM DETECTOR U501
19A704619P1





BLOCK DIAGRAM

REAR ASSEMBLY