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

SECOND MIXER/LIMITER/FM DETECTOR U501 19A704619P1

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DESCRIPTION

The Ericsson GE 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 board 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.





BLOCK DIAGRAM



Mountain View Road • Lynchburg, Virginia 24502

Printed in U.S.A.

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 O102 through O105 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 O2 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 O3. 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 O106.

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 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 **A** and allows transistors Q103, Q104 and Q105 to conduct. **R** The voltage on the emitter of transistor Q104 is approximately 0.7 volts (**VBE** + **VSAT**) below the regulated 5.4Volts. 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 O1 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.

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.

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.

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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

RECEIVE CIRCUIT

Front End

Ε S Ε Μ B

L

Y

R

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 SO 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

OUTLINE DIAGRAM

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LOOP FILTER BOARD A201

19C851646G1

POWER CONTROL BOARD A101

19B801519G1



COMPONENT SIDE



SOLDER SIDE



COMPONENT SIDE





(19B801519, Sh. 1, Rev. 3) (196801319, Sil. 1, Rev. 3) (19C851653, Component Side, Rev. 4) (19C851653, Solder Side, Rev. 4) LEAD IDENTIFICATION FOR D 1 (TOP VIEW)

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



LEAD IDENTIFICATION FOR Q1 (TOP VIEW)



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SOLDER SIDE





Ε Α R Α S S E Μ B L Y

R



COMPONENT SIDE

SOLDER SIDE

(19D438222, Sh. 4, Rev. 5)

(19D902627, Fourth Layer, Rev. 4)

(19D438222, Sh.3, Rev. 2) (19D902627, First Layer, Rev. 4) (19D902627, Fourth Layer, Rev. 4)

LEAD IDENTIFICATION FOR (SOT) TRANSISTORS



RF BOARDS 19D438222G1 & G3

4





| MODEL NO. | REV. LETTER | |
|---------------|-------------|--|
| PL19D438222G1 | С | |
| PL19D438222G3 | Ċ | |
| | | |
| | | |
| | | |

NOTES:

- NOIES: 1. ALL RESISTORS ARE .1 WATT UNLESS OTHERWISE SPECIFIED. RESISTOR VALUES IN ∩ 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 P∀B.
- 4. ALL D.C. VOLTAGES ARE TAKEN AT B+-7.5V.

| | COMPONENT | NALUE C | CHART |
|---|------------------|---------|---------|
| Ж | | G1 | GJ |
| | | 136-153 | 150-174 |
| | COMP:# | MHZ | MHZ |
| | C220 | | l u |

RF BOARDS 19D438222G1 & G3

(19D438272, Sh. 1, Rev. 4)





А R Α S S E M B L Y

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| | | | _ | | _ |
|--------|-----|------|-----|------|---|
| COMPON | ENT | VALU | E (| CHAR | т |

| | | 61 | 63 |
|---|--------|-----------------|--------------|
| € | | 136-153 | 150-174 |
| | COMP # | MHZ | MHZ |
| | C404, | 3.90 | 8.2r |
| | C405 | 10e | 4.7e |
| | C408 | 15 P | IOP |
| | C410 | 33r | 22P |
| | C411 | 150p | 120 p |
| | C412 | 150e | 120p |
| | C413 | 22P | 15P |
| | C414 | 150e | €2P |
| | C417 | 220P | |
| | L405 | 68n | 82n |
| | L406 | | 15n |

| _ | SQ | ні | 7 |
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RF BOARDS 19D438222G1 & G3

(19D438272, Sh. 3, Rev. 0)

RADIO REAR ASSEMBLY 19D901275G1 (136-153 MHz) 19D902175G2 (150-174 MHz) ISSUE 5

| SYMBOL | PART NUMBER | DESCRIPTION |
|-------------------|--------------------------------|---|
| A1 | - | PE BOARD |
| AI | | 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 \pm 5%, 50 VDCW, temp coef 0 \pm 30 PPM. |
| C4 | 19A702052P28 | Ceramic: 0.022 uF ±10%, 50 VDCW. |
| C5 | 19A702061P69 | Ceramic: 220 pF $\pm 5\%,$ 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 $\pm 1\%$, 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 $\pm1\%,$ 200 VDCW, 1/8 w. |
| R5 | 19A702931P358 | Metal film: 39.2K ohms $\pm 1\%,$ 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 $\pm 1\%,$ 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 $\pm 5\%,1/10$ w. |
| | | —— INTEGRATED CIRCUITS ——— |
| U1 | 19A702293P3 | Linear: Dual Op Amp; sim to LM358D. |
| A201 | | LOOP FILTER MODULE 19C851974G1 |
| | | CAPACITORS |
| C1 | 19A702052P114 | Ceramic: 0.01 uF ±5%, 50 VDCW. |
| C2 and C3 | 19A702061P77 | Ceramic: 470 pF 5±%, 50 VDCW, temp coef 0 ±30 PPM. |
| C4 | 19A702061P29 | Ceramic: 22 pF \pm 5%, 50 VDCW, temp coef 0 \pm 30 PPM. |
| C5 | 19A702052P30 | Ceramic: 0.022 uF ±10%, 50 VDCW. |
| D1 | 19A703561P2 | Silicon, fast recovery (2 diodes in series). |
| Q1 | 19A700076P2 | Silicon, NPN: sim to MMBT3904, low profile. |
| R1 | 19B801251P104 | Metal film: 100K ohms ±5%, 1/10 w. |
| R2 | 19B801251P124 | Metal film: 120K ohms ±5%, 1/10 w. |
| R3 | 19B801251P104 | Metal film: 100K ohms ±5%, 1/10 w. |
| | 19B801251P682 | Metal film: 6.8K ohms ±5%, 1/10 w. |
| R4 | | |
| R4 R5 | 19A702931P377 | Metal film: 61.9K ohms ±1%, 200 VDCW, 1/8 w |
| R4 R5 R6 | 19A702931P377 19B801251P393 | Metal film: 61.9K ohms \pm 1%, 200 VDCW, 1/8 w Metal film: 39K ohms \pm 5%, 1/10 w. |

| SYMBOL | PART NUMBER | DESCRIPTION |
|----------------------|---------------|--|
| 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 $\pm 5\%,$ 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 $\pm 5\%,$ 50 VDCW, temp coef 0 ± 30 PPM. |
| C109 | 19A705205P2 | Tantalum: 1 uF, 16 VDCW; sim to Sprague 293D. |
| C110 | 19A702061P77 | Ceramic: 470 pF \pm 5%, 50 VDCW, temp coef 0 \pm 30 PPM. (Used in G1). |
| C110 | 19A702236P34 | Ceramic: 22 pF \pm 5%, 50 VDCW, temp coef 0 \pm 30 PPM. (Used in G3). |
| C111 | 19A702061P77 | Ceramic: 470 pF $\pm 5\%,$ 50 VDCW, temp coef 0 ± 30 PPM. |
| C112 | 19A702061P33 | Ceramic: 27 pF \pm 5%, 50 VDCW, temp coef 0 \pm 30 PPM. (Used in G1). |
| C112 | 19A702236P34 | Ceramic: 22 pF \pm 5%, 50 VDCW, temp coef 0 \pm 30 PPM. (Used in G3). |
| C113 | 19A702061P77 | Ceramic: 470 pF $\pm 5\%,$ 50 VDCW, temp coef 0 ± 30 PPM. |
| C114 | 19A702061P21 | Ceramic: 15 pF \pm 5%, 50 VDCW, temp coef 0 \pm 30 PPM. (Used in G1). |
| C114 | 19A702061P17 | Ceramic: 12 pF \pm 5%, 50 VDCW, temp coef 0 \pm 30 PPM. (Used in G3). |
| C115 | 19A702061P77 | Ceramic: 470 pF \pm 5%, 50 VDCW, temp coef 0 \pm 30 PPM. |
| C116 | 19A702061P33 | Ceramic: 27 pF \pm 5%, 50 VDCW, temp coef 0 \pm 30 PPM. (Used in G1). |
| C116 | 19A702061P29 | Ceramic: 22 pF \pm 5%, 50 VDCW, temp coef 0 \pm 30 PPM. (Used in G3). |
| C117 | 19A702061P17 | Ceramic: 12 pF \pm 5%, 50 VDCW, temp coef 0 \pm 30 PPM. (Used in G1). |
| C117 | 19A702061P13 | Ceramic: 10 pF \pm 5%, 50 VDCW, temp coef 0 \pm 30 PPM. (Used in G3). |
| C118 | 19A702061P25 | Ceramic: 18 pF \pm 5%, 50 VDCW, temp coef 0 \pm 30 PPM. (Used in G1). |
| C118 | 19A702061P21 | Ceramic: 15 pF \pm 5%, 50 VDCW, temp coef 0 \pm 30 PPM. (Used in G3). |
| C119 thru C121 | 19A702052P5 | Ceramic: 1000 pF ±10%, 50 VDCW. |
| C122 | 19A702052P14 | Ceramic: 0.01 uF ±10%, 50 VDCW. |
| D101 and D102 | 19A700155P2 | Silicon: fwd current 100 mA, 35 PIV. |
| J101 | 19B801491P2 | ———— JACKS —————— |
| 0101 | 10000170162 | INDUCTORS |
| L101 and L102 | 19A700024P13 | Coil, RF: 1.0 uH ±10%. |
| L103 | 19A700024P1 | Coil, RF: 100 nH $\pm 10\%$, 0.08 ohms DC res max, 100 v. |

PARTS LIST

| SYMBOL | PART NUMBER | DESCRIPTION | SYMBOL |
|-------------|---------------|---|-------------|
| L104 | 19A705470P10 | Coil, 56 nH ±20%. (Used in G3). | C213 |
| L105 | 19A700024P13 | Coil, RF: 1.0 uH ±10%. | |
| L106 | 19B800891P4 | Coil, F Choke: sim to Paul Smith SK-890-1. | C214 |
| L107 | 19B800891P3 | Coil, RF Choke; sim to Paul Smith SK890-1. | C215 |
| | | TRANSISTORS | C216 |
| Q101 | 19A704708P2 | Silicon, NPN: sim to NEC 2SC3356. | C217 |
| Q102 | 19A700076P2 | Silicon, NPN: sim to MMBT3904, low profile. | C218 |
| 103 | 19A700059P2 | Silicon, PNP: sim to MMBT3906, low profile. | 0210 |
| Q104 | 19A700076P2 | Silicon, NPN: sim to MMBT3904, low profile. | C220 |
| Q105 | 19A704972P1 | Silicon, PNP: sim to Motorola 2N4918. | |
| and 106 | | | |
| | | RESISTOR | Q201 |
| R101 | 19B801251P101 | Metal film: 100 ohms ±5%, 1/10 w. | Deed |
| R102 | 19B801251P681 | Metal film: 680 ohms ±5%, 1/10 w. | R201 |
| R103 | 19B801251P680 | Metal film: 68 ohms ±5%, 1/10 w. | R202 |
| R104 | 19B801251P330 | Metal film: 33 ohms ±5%, 1/10 w. | R203 |
| R105 | 19B801251P332 | Metal film: 3.3K ohms ±5%, 1/10 w. | R204 |
| R106 | 19B801251P331 | Metal film: 330 ohms ±5%, 1/10 w. | R205 |
| R107 | 19B801251P271 | Metal film: 270 ohms ±5%, 1/10 w. | R206 |
| and | | | R207 |
| R108 | 1000010510170 | | R208 |
| R109 | 19B801251P473 | Metal film: 47K ohms ±5%, 1/10 w. | R209 |
| R110 | 19B801251P223 | Metal film: 22K ohms ±5%, 1/10 w. | R210 |
| R111 | 19B801251P183 | Metal film: 18K ohms ±5%, 1/10 w. | R211 |
| R112 | 19B801251P473 | Metal film: 47K ohms ±5%, 1/10 w. | R212 |
| R113 | 19B801251P104 | Metal film: 100K ohms ±5%, 1/10 w. | R213 |
| R114 | | | 11213 |
| R115 | 19B801251P102 | Metal film: 1K ohms ±5%, 1/10 w. | |
| and R116 | | | U201 |
| R117 | 19B801251P471 | Metal film: 470 obms +5% 1/10 w | U202 |
| R118 | 19B801251P221 | Metal film: 220 obms +5% 1/10 w | U203 |
| R110 | 19B800779P7 | Variable: 3.3K obms +25%, 100 VDCW, 3.w | U204 |
| R119 | 1088012518184 | Motal film: 180K ohms +5% 1/10 w | U204 |
| R120 | 10D901251D151 | Metal film: 150 obmo $\pm 5\%$, 1/10 w. | |
| RIZI | 196012517151 | | W/201 |
| | | | and |
| U101 | 19A705774P1 | Module: 136-155 MHz RF PA; sim to SHW1030. (Used in G1). | W202 |
| U101 | 19A705774P2 | Module: 146-174 MHz RF PA; sim to SHW1031. (Used in G3). | |
| | | ————— CABLES ————— | C401 |
| W101 | | Part of printed wire board. | C402 |
| | | SYNTHESIZER | |
| | | CAPACITORS | C403 |
| C201 | 19A702061P69 | Ceramic: 220 pF \pm 5%, 50 VDCW, temp coef 0 \pm 30 PPM. | C404 |
| C202 | 19A702052P5 | Ceramic: 1000 pF ±10%, 50 VDCW. | 0 101 |
| and C203 | | | C405 |
| C204 | 19A702061P61 | Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 | C405 |
| | | ±30 PPM. | 0403 |
| C205 | 19A702052P5 | Ceramic: 1000 pF ±10%, 50 VDCW. | C406 |
| C207 | 19A702052P14 | Ceramic: 0.01 uF ±10%, 50 VDCW. | and C407 |
| C208 | 19A702052P5 | Ceramic: 1000 pF ±10%, 50 VDCW. | C408 |
| C209 | | | 0400 |
| C210 | 19A702061P61 | Ceramic: 100 pF \pm 5%, 50 VDCW, temp coef 0 \pm 30 PPM. | C408 |
| C211 | 19A702061P69 | Ceramic: 220 pF \pm 5%, 50 VDCW, temp coef 0 \pm 30 PPM. | C409 |
| C212 | 19A702061P7 | Ceramic: 3.3 pF ± 0.5 pF, 50 VDCW, temp coef 0 ± 120 PPM. | C410 |

* COMPONENTS, ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

| PART NUMBER | DESCRIPTION |
|---------------|---|
| 19A702061P77 | Ceramic: 470 pF \pm 5%, 50 VDCW, temp coef 0 \pm 30 PPM. |
| T644ACP322K | Polyester: .022 uF ±10%, 50 VDCW. |
| 19A700004P10 | Metallized Polyester: 1.0 uF \pm 10%, 63 VDCW. |
| 19A702052P14 | Ceramic: 0.01 uF ±10%, 50 VDCW. |
| 19A702061P13 | Ceramic: 10 pF \pm 5%, 50 VDCW, temp coef 0 \pm 30 PPM. |
| 19A702061P12 | Ceramic: 8.2 pF \pm 0.5 pF, 50 VDCW, temp coef 0 \pm 60 PPM. |
| 19A705202P2 | Tantalum: 1 uF, 16 VDCW; sim to Sprague 293D. (Used in G3). |
| | |
| 19A704708P2 | Silicon, NPN: sim to NEC 2SC3356. |
| 19B801251P104 | Metal film: 100K ohms ±5%, 1/10 w. |
| 19B801251P224 | Metal film: 220K ohms ±5%, 1/10 w. |
| 19A702931P233 | Metal film: 2150 ohms $\pm 1\%,$ 200 VDCW, 1/8 w. |
| 19B801251P272 | Metal film: 2.7K ohms ±5%, 1/10 w. |
| 19B801251P100 | Metal film: 10 ohms ±5%, 1/10 w. |
| 19B801251P331 | Metal film: 330 ohms ±5%, 1/10 w. |
| 19B801251P103 | Metal film: 10K ohms \pm 5%, 1/10 w. |
| 19B801251P102 | Metal film: 1K ohms ±5%, 1/10 w. |
| 19B801251P470 | Metal film: 47 ohms ±5%, 1/10 w. |
| 19B801251P103 | Metal film: 10K ohms ±5%, 1/10 w. |
| 19B801251P470 | Metal film: 47 ohms ±5%, 1/10 w. |
| 19B801251P2R2 | Metal film: 2.2 ohms ±5%, 1/10 w. — — INTEGRATED CIRCUITS ———— |
| 19B800902P1 | Synthesizer: CMOS, Serial Programming; sim to MC145159P. |
| 19A703091P1 | Digital: /64, /65 Prescaler; sim to MC12017P. |
| 19B801351P8 | Reference Oscillator. |
| 19A705628P1 | Voltage Controlled Oscillator (Used in G1). |
| 19C851913G2 | Voltage Controlled Oscillator (Used in G3). |
| | Part of printed wire board. |
| | RECEIVER |
| | CAPACITORS |
| 19A702052P14 | Ceramic: 0.01 uF ±10%, 50 VDCW. |
| 19A705205P2 | Tantalum: 1 uF, 16 VDCW; sim to Sprague 293D. |
| 19A702052P14 | Ceramic: 0.01 uF ±10%, 50 VDCW. |
| 19A702236P15 | Ceramic: 3.9 pF ±.25 pF, 50 VDCW, temp coef 0 ±30 PPM. (Used in G1). |
| 19A702061P12 | Ceramic: 8.2 pF \pm 0.5 pF, 50 VDCW, temp coef 0 \pm 60 PPM. (Used in G3). |
| 19A702061P13 | ±30 PPM. (Used in G1). |
| 19A702001F9 | coef 0 \pm 60 PPM. (Used in G3). |
| 19A702052P14 | Ceramic: 0.01 uF ±10%, 50 VDCW. |
| 19A702061P21 | Ceramic: 15 pF \pm 5%, 50 VDCW, temp coef 0 \pm 30 PPM. (Used in G1). |
| 19A702061P13 | Ceramic: 10 pF \pm 5%, 50 VDCW, temp coef 0 \pm 30 PPM. (Used in G3). |
| 19A702061P13 | Ceramic: 10 pF \pm 5%, 50 VDCW, temp coef 0 \pm 30 PPM. |
| 19A702061P37 | Ceramic: 33 pF \pm 5%, 50 VDCW, temp coef 0 \pm 30 PPM. (Used in G1). |

| 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 \pm 5%, 50 VDCW, temp coef 0 \pm 30 PPM/xC. (Used in G1). |
| C412 | 19A702061P63 | Ceramic: 120 pF \pm 5%, 50 VDCW, temp coef 0 \pm 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 \pm 5%, 50 VDCW, temp coef 0 \pm 30 PPM. (Used in G1). |
| C414 | 19A702061P57 | Ceramic: 82 pF \pm 5%, 50 VDCW, temp coef 0 \pm 30 PPM. (Used in G3). |
| C415 | 19A702061P29 | Ceramic: 22 pF \pm 5%, 50 VDCW, temp coef 0 \pm 30 PPM. |
| C416 | 19A702061P9 | Ceramic: 4.7 pF \pm 0.5 pF, 50 VDCW, temp coef 0 \pm 60 PPM. |
| C417 | 19A702061P69 | Ceramic: 220 pF \pm 5%, 50 VDCW, temp coef 0 \pm 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 \pm 5%, 50 VDCW, temp coef 0 \pm 30 PPM. (Used in G1). |
| C454 | 19A702061P11 | Ceramic: 6.8 pF \pm 0.5 pF, 50 VDCW, temp coef 0 \pm 60 PPM. (Used in G3). |
| C455 | 19A702061P12 | Ceramic: 8.2 pF \pm 0.5 pF, 50 VDCW, temp coef 0 \pm 60 PPM. |
| C456 | 19A702061P41 | Ceramic: 39 pF \pm 5%, 50 VDCW, temp coef 0 \pm 30 PPM. (Used in G1). |
| C456 | 19A702061P37 | Ceramic: 33 pF \pm 5%, 50 VDCW, temp coef 0 \pm 30 PPM. (Used in G3). |
| C457 | 19A702061P29 | Ceramic: 22 pF \pm 5%, 50 VDCW, temp coef 0 \pm 30 PPM. (Used in G1). |
| C457 | 19A702061P25 | Ceramic: 18 pF \pm 5%, 50 VDCW, temp coef 0 \pm 30 PPM/xC. (Used in G3). |
| C458 | 19A702061P57 | Ceramic: 82 pF \pm 5%, 50 VDCW, temp coef 0 \pm 30 PPM. (Used in G1). |
| C458 | 19A702061P45 | Ceramic: 47 pF \pm 5%, 50 VDCW, temp coef 0 \pm 30 PPM. (Used in G3). |
| C459 | 19A702061P13 | Ceramic: 10 pF \pm 5%, 50 VDCW, temp coef 0 \pm 30 PPM. (Used in G1). |
| C459 | 19A702061P9 | Ceramic: 4.7 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM. (Used in G3). |
| D401 | 10A700155P2 | Silicon fud current: 100 mA 35 V/P |
| 0401 | 13470013312 | |
| 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 | SYMBOL | PART NUMBER | DESCRIPTION |
|---------------------|-----------------|---|--------------|---------------|--|
| | | RESISTORS | | | RESISTORS |
| R/01 | 1988012518560 | Metal film: 56 ohms +5% 1/10 w | P501 | 1089012518151 | Motal film: 150 abms $\pm 5\%$ 1/10 w |
| P401 | 1088012518123 | Motol film: 12K ohms $\pm 5\%$, 1/10 w. | RSUT | 1980012518151 | Metal film: 1 21/ abma / 59/ 1/10 w. |
| R402 | 100012510102 | Motol film: 10K ohmo $\pm 5\%$, 1/10 w. | R502 | 1980012518122 | Metal film: 12K onms ±5%, 1/10 w. |
| R403 | 1980012518103 | Motol film: 1/c ohmo $\pm 5\%$, 1/10 w. | R503 | 1980012518183 | Metal film: 18K onms ±5%, 1/10 w. |
| R404 | 19B001251F102 | Motol film: 100 obmo $\pm 5\%$, 1/10 w. | R504 | 1980012518273 | Metal film: 27K onms ±5%, 1/10 w. |
| R400 | 100012510101 | Motol film: 22 obmo $\pm 5\%$, 1/10 w. | RSUS | 1980012512103 | Metal film: 2 0K chms ±5%, 1/10 w. |
| R430 | 1980012518220 | Motol film: 220 obmo $\pm 5\%$, 1/10 w. | R506 | 1986012518392 | Metal film: 3.9K onms ±5%, 1/10 w. |
| R401 | 1980012518221 | Metel film: 426 chmc /5%, 1/10 w. | R507 | 19B801251P151 | Metal film: 150 onms ±5%, 1/10 w. |
| R45Z | 1980012518123 | Metal film: 2.7K ohms ±5%, 1/10 w. | R508 | 1988012512821 | Metal film: 820 onms ±5%, 1/10 w. |
| R404 | 1980012518272 | Metal film: 2.7K Onins ±5%, 1/10 w. | and | 19B801251P104 | Metal film: 100K onms \pm 5%, 1/10 w. |
| K400 | 1986012518660 | FILTER | R510 | | |
| | | PILTER | R511 | 19B801251P103 | Metal film: 10K ohms ±5%, 1/10 w. |
| Z401 | 19A705424P2 | Printed mica; sim to SOSHIN BP136-153A1 (Used in G1) | R512 | 19B801251P270 | Metal film: 27 ohms ±5%, 1/10 w. |
| Z401 | 19A705424P1 | Printed mica; sim to SOSHIN BP150-174A1 | R513 | 19B801251P332 | Metal film: 3.3K ohms ±5%, 1/10 w. |
| Z402 | 19A705423P1 | Mixer: Double (balanced): sim to Tele-Tech | 11501 | 19470/61921 | Linear: Osc/Miver/IE/Det/Amp: sim to |
| 2.02 | 10/11/00/1201/1 | MT45. 45 MHz 1F | 0301 | 13/10401311 | MC3361AP. |
| | | | | | |
| C501 | 19A702061P45 | Ceramic: 47 pF ±5%, 50 VDCW, temp coef 0 | Y501 | 19A705376P5 | Crystal, Fixed Frequency: 45.455 MHz 10 PPM. |
| | | ±30 PPM. | | | FILTER |
| C502 and C503 | 19A702052P14 | Ceramic: 0.01 uF ±10%, 50 VDCW. | Z501 | 19A705328P1 | Monolithic Crystal: 45.000 MHz; sim to Toyocom 45E2B2. |
| C504 | 104702061 841 | Coromic: 30 pE +5% 50 VDCW/ town coof | Z502 | | Part of Z501. |
| 0504 | 104702061012 | ± 30 PPM. | Z503 | 19A702171P3 | Bandpass: 455 1.5 KHz; sim to Murata CFU455F2. |
| C505 | 10470206120 | coef 0 ±60 PPM. | | | |
| 0.506 | 19A702061P9 | coef 0 \pm 60 PPM. | C801 | 19A702052P14 | Ceramic: 0.01 uF ±10%, 50 VDCW. |
| C507 and C508 | 19A702052P14 | Ceramic: 0.01 uF ±10%, 50 VDCW. | C802 | 19A702061P73 | Ceramic: 330 pF $\pm 5\%,50$ VDCW, temp coef 0 ± 30 PPM. |
| C509 | 19A702061P33 | Ceramic: 27 pF ±5%, 50 VDCW, temp coef 0 | C803 | 19A702052P14 | Ceramic: 0.01 uF ±10%, 50 VDCW. |
| C510 | 19A702061P29 | ±30 PPM. Ceramic: 22 pF ±5%, 50 VDCW, temp coef 0 | C804 | 19A705205P14 | Tantalum: 6.8 uF, 6 VDCW; sim to Sprague 293D. |
| and C511 | | ±30 PPM. | C805 | 19A702061P77 | Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 |
| C512 | 104702052826 | Coromic: 0.1 UE +10% 50 \/DCW | thru C807 | | ±30 PPM. |
| thru | 13A702032F20 | | | | DIODES |
| C514 | | | D801 | 10011659501 | Silicon fact receivery 600 mA 50 PIV |
| C515 | 19A705205P14 | Tantalum: 6.8 uF, 6 VDCW; sim to Sprague 293D. | 0001 | 13A110303F1 | PLUGS |
| C516 | 19A702052P14 | Ceramic: 0.01 uF ±10%, 50 VDCW. | P801 | 19C851673P2 | Connector. |
| C517 | 19A702052P10 | Ceramic: 4700 pF ±10%, 50 VDCW. | | | TRANSISTORS |
| C518 | 19A702061P25 | Ceramic: 18 pF ±5%, 50 VDCW, temp coet 0 +30 PPM. | Q801 | 19A700026P2 | Silicon, PNP: sim to BC369. |
| | | JACKS | Q802 | 19A700076P2 | Silicon, NPN: sim to MMBT3904, low profile. |
| 1501 | 10470162201 | Cottor pip | and Q803 | | |
| 3501 | 19A701022F1 | | Q804 | 19A700059P2 | Silicon, PNP: sim to MMBT3906, low profile. |
| | | | | | RESISTORS |
| L501 | 19A700024P7 | Coil, RF: 330 nH ±10%. | B8 01 | 100012510202 | Matal film: 2.0K abma ±5% 1/10 w |
| L502 | 19B801413P4 | Coil, 39 MHz. | and | 1980012318392 | Metal IIII. 3.9K 011115 ±3%, 1/10 W. |
| L503 | 19A700024P18 | Coil, RF: 2.7 uH ±10%. | R802 | | |
| L504 | 19A705753P17 | Coil, Toroidal: 2.2uH ±5%. | R803 and | 19B801251P102 | Metal film: 1K ohms ±5%, 1/10 w. |
| L505 | 19B801413P4 | Coil, 39 MHz. | R804 | | |
| L506 | 19A703591P1 | | R805 | 19A702931P334 | Metal film: 22.1K ohms $\pm 1\%,$ 200 VDCW, 1/8 w. |
| Q501 | 19A702524P3 | N-Type, field effect; sim to MMBFJ310. | R806 | 19A702931P328 | Metal film: 19.1K ohms ±1%, 200 VDCW, 1/8 |
| Q502 | 19A704708P2 | Silicon, NPN: sim to NEC 2SC3356. | R807 | 19B801251P122 | w. Metal film: 12K obms +5% 1/10 w |
| | | | R808 | 19B801251P302 | Metal film: 39K ohms ±5% 1/10 w |
| | | | RAUD | 19B801251P195 | Metal film: 1.8K ohme +5% 1/10 w. |
| | | | 1003 | 100012016102 | Notal IIII. 1.00 01113 ±070, 1/10 ₩. |
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PARTS LIST

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LBI-38275

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| 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. |
| | | |

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 $\pm 5\%, 50$ 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 $\pm 5\%, 50$ 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.



PLL MODULE U201 19B800902P1



IC DATA

VCO U204

19A705628P2

$\overset{1}{\odot}\overset{2}{\odot}\overset{3}{\odot}\overset{4}{\odot}\overset{5}{\odot}$

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

4

3 ||

2

1 – INPUT

4 - OUTPUT







