MOBILE RADIO

MAINTENANCE SECTION FOR M-PD VOICE GUARD® SCAN PERSONAL RADIO

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

ILLUSTRATIONS

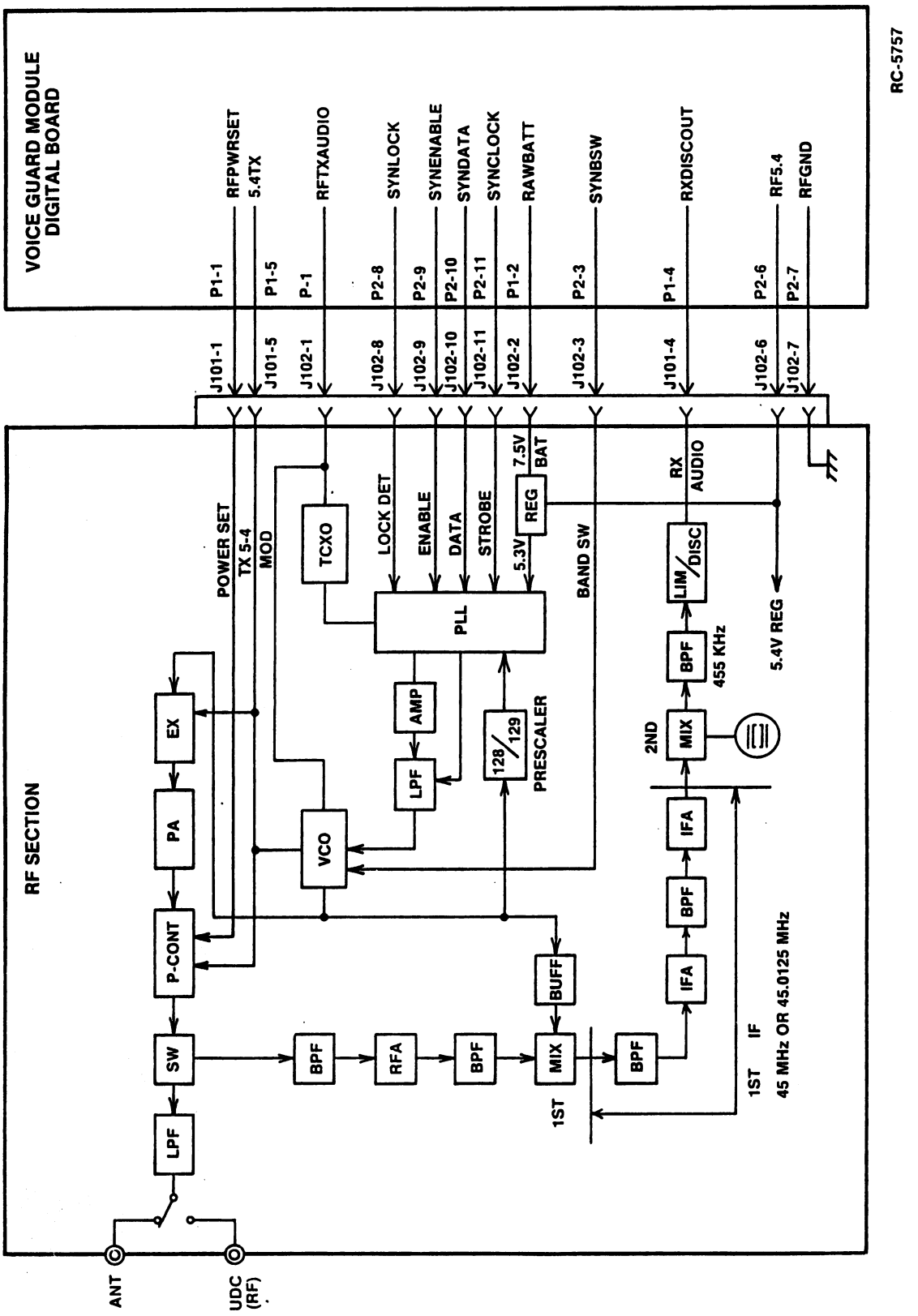


FIGURE 1 - RF SECTION BLOCK DIAGRAM

SYSTEM ANALYSIS

General Electric's M-PD VOICE GUARD SCAN Personal Radio is a two-way, synthesized, FM radio designed for use in public communications systems where PRIVATE voice communications is a requirement. The M-PD VOICE GUARD SCAN Personal radio consists of three major circuit components as follows:

- **Radio Board:** carries the transmit, receive and frequency synthesizer circuits
- **VOICE GUARD Module:** carries an Analog board for system control and a Digital board for voice encryption.
- **Display Board:** carries LCD displays.

Interconnection of the various circuit boards and control circuits is accomplished with flexible circuit boards and connectors (refer to the Interconnection Diagram listed in the Table of Contents).

All control leads shown on schematic diagrams which are **"barred"**, such as $\overline{\text{PTT}}$, mean that the function indicated occurs when the lead is in a low voltage condition.

Circuit illustrations shown in the following text are simplified representatives of actual circuits. They are intended only to illustrate basic circuit functions.

Radio Board

Transmit Circuit:

The M-PD transmit circuit, as shown in Figure 1 - Block Diagram, consists of the following integrated circuit modules:

- Amplifier (TX-Amp)
- Power Amplifier (PA)
- Power Controller (PC)
- Antenna Switch (AS)
- Filter (FN)

Amplifier Module (A201):

Amplifier module (TX-Amp) A201 is a two stage RF amplifier hybrid IC. A 0 dBm RF signal on the input of A201 will produce a +23 dBm signal on the output (refer to Figure 2). This module is broadband and does not require tuning.

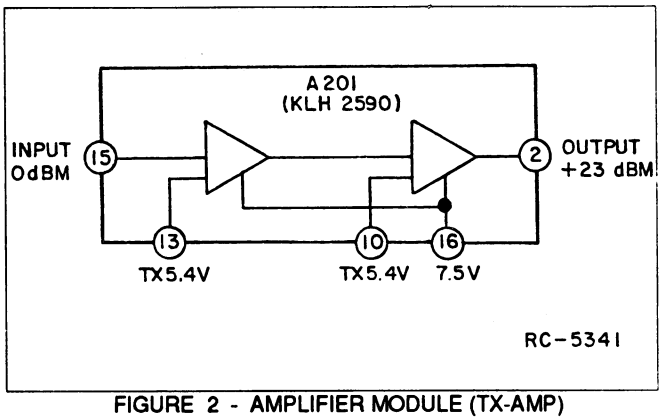


FIGURE 2 - AMPLIFIER MODULE (TX-AMP)

Power Amplifier Module (A202):

Power Amplifier (PA) A202 is a three stage, wide band amplifier module with an input and an output impedance of 50 ohms (refer to Figure 3). The first stage of the PA module has DC power supplied by power control transistor Q202. The RF power output from Pin 2 of TX-Amp A201 is connected through resistor attenuator R-ATT to Pin 1 of the PA module where it is applied to the input of the RF power amplifier stages. The RF power amplifier stages amplify the input from the TX-Amp module to a typical power output level of 5 watts at Pin 5. The output at Pin 5 is connected through power control hybrid IC A203 (PC) and TX-RX switching diode CR201 to low pass filter network FN. A minimum power level of 4 watts is on the output of the filter network.

Power Control Module (A203):

The RF power output of the radio is regulated by sensing variations in the RF power output of the transmit PA module to control the supply voltage going to the first stage of the PA module (refer to Figure 4). Supply voltage cannot be applied to the first stage of the PA module until the transmit circuit is keyed, applying 5.4 Volts to Pin 11 of Power Control (PC) hybrid IC A203. When the transmit circuit is keyed, the output of a reference amplifier, determined by the High-Low power control, is applied to the positive (+) input of a comparator.

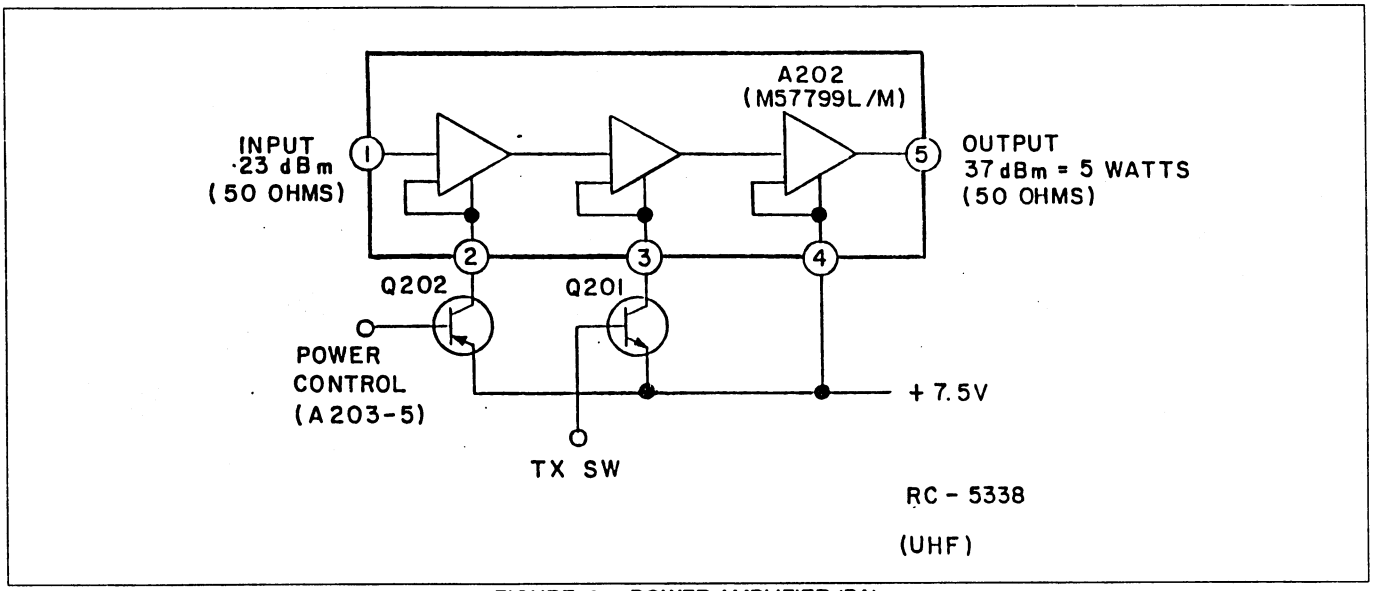


FIGURE 3 - POWER AMPLIFIER (PA)

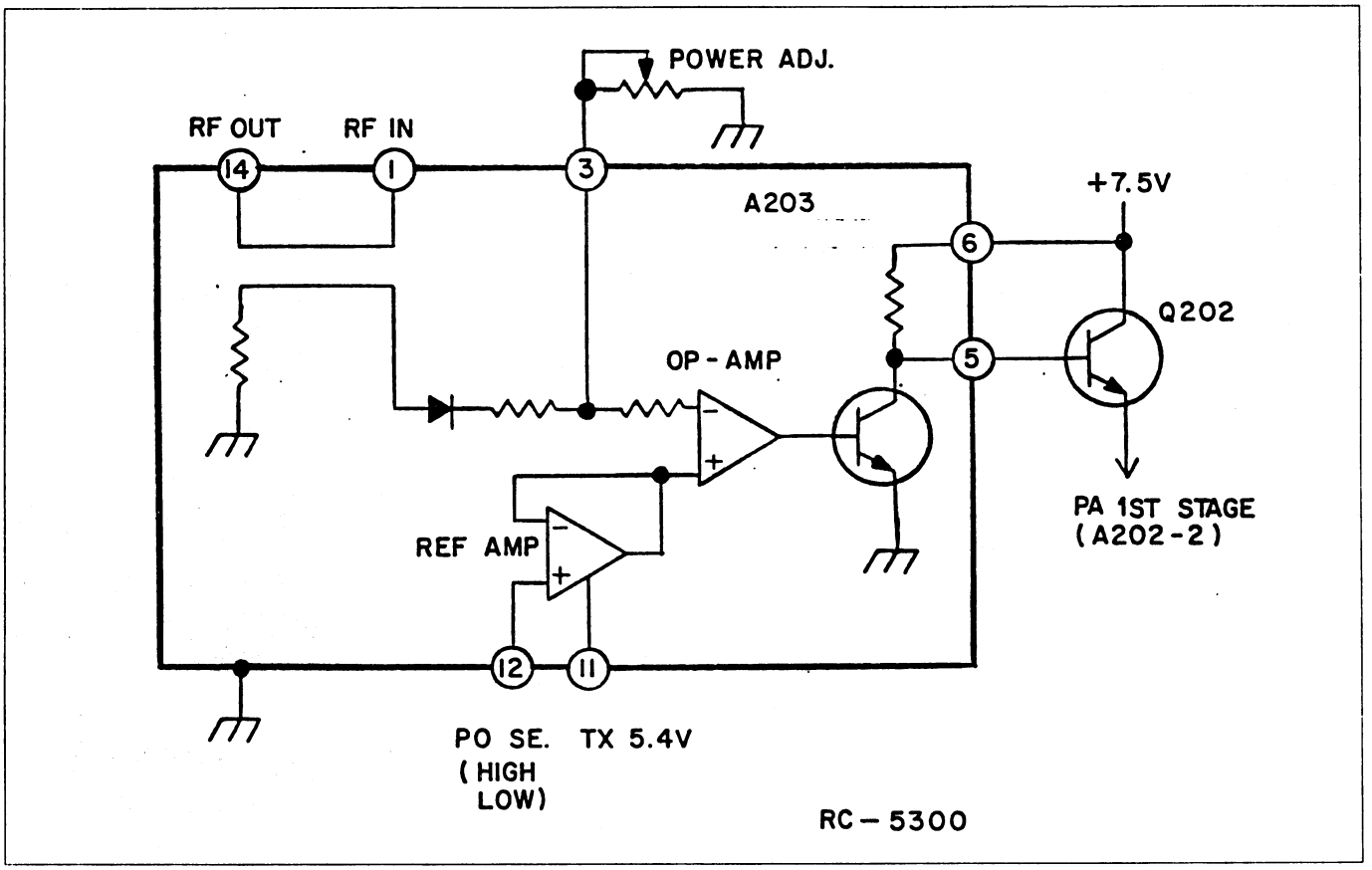


FIGURE 4 - POWER CONTROL MODULE (PC)

The output of the final PA is connected to Pin 1 of the PC module and to the 50 ohm coupled line inside of the PC module. The detected voltage of the coupled output is applied to the negative (-) input of the comparator. The amplifier is enabled when the transmit circuit is keyed. Until then, the output of the amplifier is low and transistor Q202 is held off. As the PA module begins to increase output power, the detected voltage causes the series regulator circuit to regulate the supply voltage to maintain constant RF output power.

Filter Network (FN):

The output of the PA module is connected to filter network FN through TX-RX switching diode CR201. The FN network is a passive LC low pass filter with an insertion loss of less 0.5 dB in the pass band. It also has a refection greater than 45 dB in the stop band. The output of the FN is connected to the system antenna or to the Universal Device Connector (UDC).

Receive Circuit

The M-PD receive circuit, as shown in Figure 1, consists of the following circuits:

- RF Amplifier/Mixer
- First IF Amplifier
- Second IF Amplifier/Discriminator

RF Amplifier/Mixer:

The RF Amplifier/Mixer circuit contains two third order band pass filters (FL301 and FL302), an RF amplifier circuit (Q301) and a Double Balanced Mixer (DBM) circuit (A301). Refer to Figure 5 - RF Amplifier/Mixer. RF from the antenna or UDC is coupled through transmit low pass filter FN and RF switching diode CR201 to the input of the RF amplifier circuit. Low pass filter FN is used in the receive circuit to provide additional receive selectivity. The RF signal on the input of the amplifier is first coupled through band pass filter FL301 to the input of grounded emitter, broad band RF amplifier transistor Q301. This amplifier provides 12 dB of power gain to reduce thermal noise. The output of the RF amplifier is coupled through band pass filter FL302 to drive double balanced mixer circuit A301.

The RF signal from the RF amplifier and the injection frequency from the synthesizer circuit, provide a difference of 45 MHz IF on the output of the mixer. The double balance mixer has a typical conversion loss of 6 dB between the RF input and the IF output. All inputs and the output of the RF Amplifier/Mixer have 50 ohms matching impedance. The +7 dBm injection frequency level, provided by the synthesizer and amplifier circuit transistor Q106, is connected to the injection frequency input through a 50 ohm matching circuit. The output of the mixer circuit is connected to the input of the first IF Amplifier.

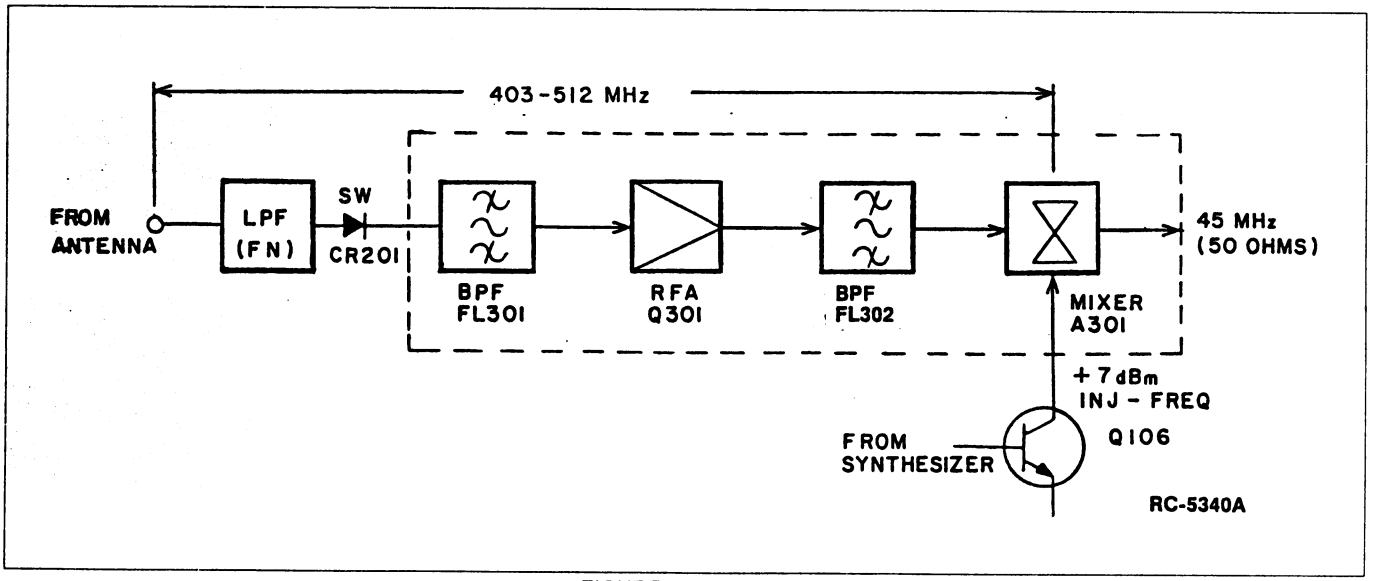


FIGURE 5 - RF AMPLIFIER/MIXER

First IF Amplifier:

The first IF amplifier contains two amplifier circuits and two crystal filters of two and four poles respectively (refer to Figure 6). The first IF signal (45 MHz) from the first mixer circuit connects to the input of pre-amplifier transistor Q302 through pre-crystal filter FL303 with an impedance of approximately 3000 ohms. Pre-amplifier Q302 provides a 17 dB power gain. The output is connected to the input of IF amplifier transistor Q303 through crystal filter FL304. IF amplifier Q303 has a 13 dB power gain, an input impedance of approximately 3000 ohms and an output impedance of approximately 2200 ohms.

Second IF Amplifier/Discriminator (A302):

The Second IF Amplifier/Discriminator circuit contains FM IF IC A302 (HA12442V) and 455 kHz ceramic filter FL305 (refer to Figure 7). The FM IF IC contains a local oscillator, mixer, IF amplifier, FM detector and an audio amplifier. The 45 MHz IF output from the first IF amplifier is connected to the input of second IF amplifier A302a (Pin 2 of HA12442V) and converted to the second IF frequency (455 kHz). The second IF output is connected to Pin 7 of HA12442V through the 455 kHz ceramic filter to the IF amplifier and FM detector circuits. The recovered audio from the FM IF IC is connected to J102-4.

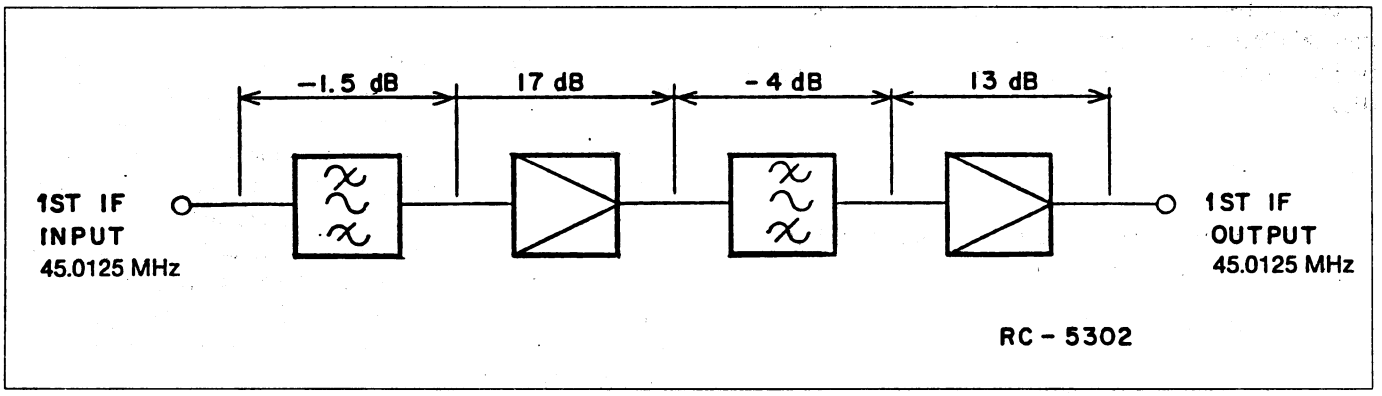


FIGURE 6 - FIRST IF AMPLIFIER

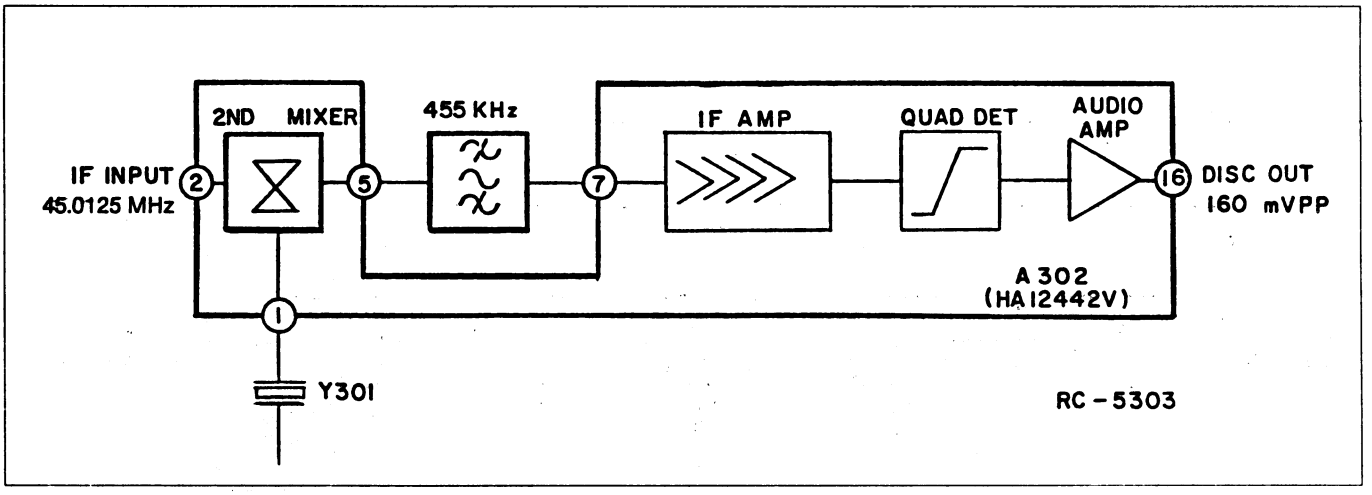


FIGURE 7 - SECOND IF AMPLIFIER/DISCRIMINATOR

Synthesizer Circuit

The synthesizer circuit contains Phase Look Loop module (PLL) A102, Voltage Controlled Temperature Compensated reference oscillator module (VCTCXO) A103, TX/RX voltage controlled oscillator module (VCO) A106 and a low pass filter amplifier (LPF). Refer to Figure 8 - Synthesizer. The VCO used to generate the receive and transmit reference frequencies is phase locked to a stable VCTCXO reference oscillator through the use of the PLL. This feedback loop divides the VCO frequency down to a signal in the range of 7 MHz - 10 MHz; then divides this signal with a programmable divider down to 5/6.25 kHz. A VCO control signal is generated by comparing the 5/6.25 kHz feedback with another 5/6.25 kHz signal which is derived by dividing a 13.5 MHz signal from the VCTCXO by 1056. As the least significant bit in the programming is changed, the VCO is forced to change by 5/6.25 kHz.

The synthesizer circuitry is contained in two modules, the VCO module A106 and the VCTCXO reference Oscillator module A103.

Phase Lock Loop Module (A102):

The PLL module (A102) contains a reference frequency divider, phase detector and a programmable divider. The phase detector DC voltage output signal is filtered by a passive low pass filter followed by a 6.25 kHz filter to reduce the level of reference modulation on the VCO. This DC output represents the error between the VCO frequency (phase) and the reference (VCTCXO) and is applied to the VCO, on frequency. A lock detect output is developed on Pin 9 of A102. This output is checked by the microcomputer to prevent transmission before the VCO is on frequency.

Serial data from the microcomputer is shifted into the PLL to set the division parameter which establishes the RF output frequency. A clock signal is provided on another input and the data is latched with the enable input.

Voltage Controlled Oscillator (A106):

The VCO uses a low noise, high gain transistor as the basic oscillator circuit. The resonant circuit, which determines the frequency of oscillation, is formed by a dielectrics resonator which is used to set the center frequency at the factory. The output of each VCO (TX and RX) is coupled into a cascade amplifier which produces an output of +3 dBm on Pin 7 of A106. The output of the RX-VCO amplifier is coupled through buffered amplifier Q106 into the receive double balanced diode mixer circuit A301. The TX-VCO amplifier output is directly connected to the TX-Amp input through attenuator circuit R201, R202 and R203.

VCTCXO Reference Oscillator (A103):

The VCTCXO oscillator module (A103) is self contained, fully temperature compensated and operates at a frequency of 13.2 MHz. The output frequency is adjusted by a trimmer while monitoring the transmit circuit output at the antenna jack. The VCTCXO also has modulation capability.

VOICE GUARD MODULE

The VOICE GUARD module, as shown in Figure 9 - Block Diagram, consists of analog system control circuits, audio circuits, voltage control and regulator circuits and voice encryption circuits. This module mounts in back of the front section of the radio and interfaces with the RF section through connectors P101 and P102 and with the LCD Display Board through flexible printed circuit cables (refer to the Interconnection Diagram listed in the Table of Contents). Physically, this module consists of two circuit boards as follows:

- Analog Board
- Digital Board

Analog Board

The Analog board provides CLEAR and PRIVATE mode switching, audio processing and supply voltages for various circuits located on the RF board, LCD board and the Digital Board. The Analog Board contains VOICE GUARD circuits as follows:

- Custom Audio Chip (CAC) U14
- Microphone Amplifier Circuits (U13)
- Switch Circuits (U29)
- CODEC In Amplifier (U13)
- TX Band Pass Filter (U12)
- RX audio De-Emphasis Circuit (U27)
- Speaker Amplifier (U15)
- Data Limiter (RXDISC) (U32)
- Encryption/Decryption Module Power supply (U30)
- CODEC-5 Volt Power Supply
- DSP SW5 Power Supply

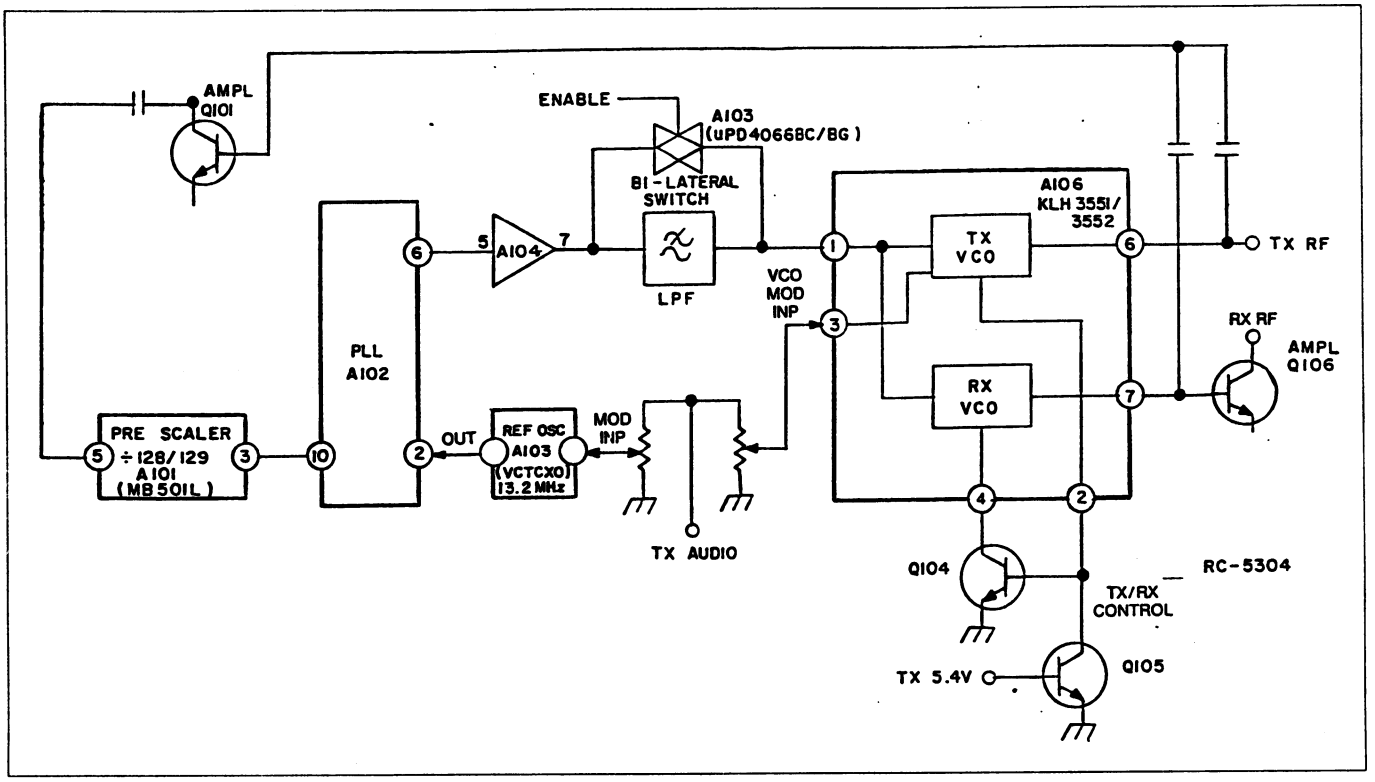


FIGURE 8 - SYNTHESIZER CIRCUIT

- VCCA (U33, Q121 and Q110)
- VCCSW (Q119 & Q120)
- UDCSWBAT (Q100, Q101, Q117 & Q118)
- UCCA/2 (U27)

Custom Audio Chip (CAC) U14:

The CAC audio processor (U14) is a one-chip IC providing almost all of the audio functions for the radio. The audio functions are controlled by System microprocessor U7, located on the Digital Board on demand from the radio unit. The functions of CAC U14 are as follows:

- Tone Reject Filter
- Limiter Amplifier
- Volume and Modulation Level Control
- Post Limiter Filter
- Squelch Filter and Rectifier
- CG/DCG Encode/Decode Filter and Limiter
- D/A Converter and Comparator
- OSC Circuit and Digital Interface for the Control Processor

All of these functions are made up of switched capacitor filters, amplifiers and timing logic. The timing for this logic is derived from the 8 MHz clock generator. The clock signal is also applied to the Control Processor.

Microphone Amplifier U13:

There are two microphone input amplifiers, one for the internal microphone and one for the external microphone. Each amplifier consists of an operational amplifier package from IC package U13 (Pins 1, 2 & 3 and Pins 5, 6 & 7 respectively).

Switch Circuits (U29):

These switch circuits consist of three bilateral switch circuits in IC package U29 (4053). The first switch connects the microphone inputs when the transmit circuit is keyed and the switched 5 volt supply (CACSW5) is applied to U29, Pin 10.

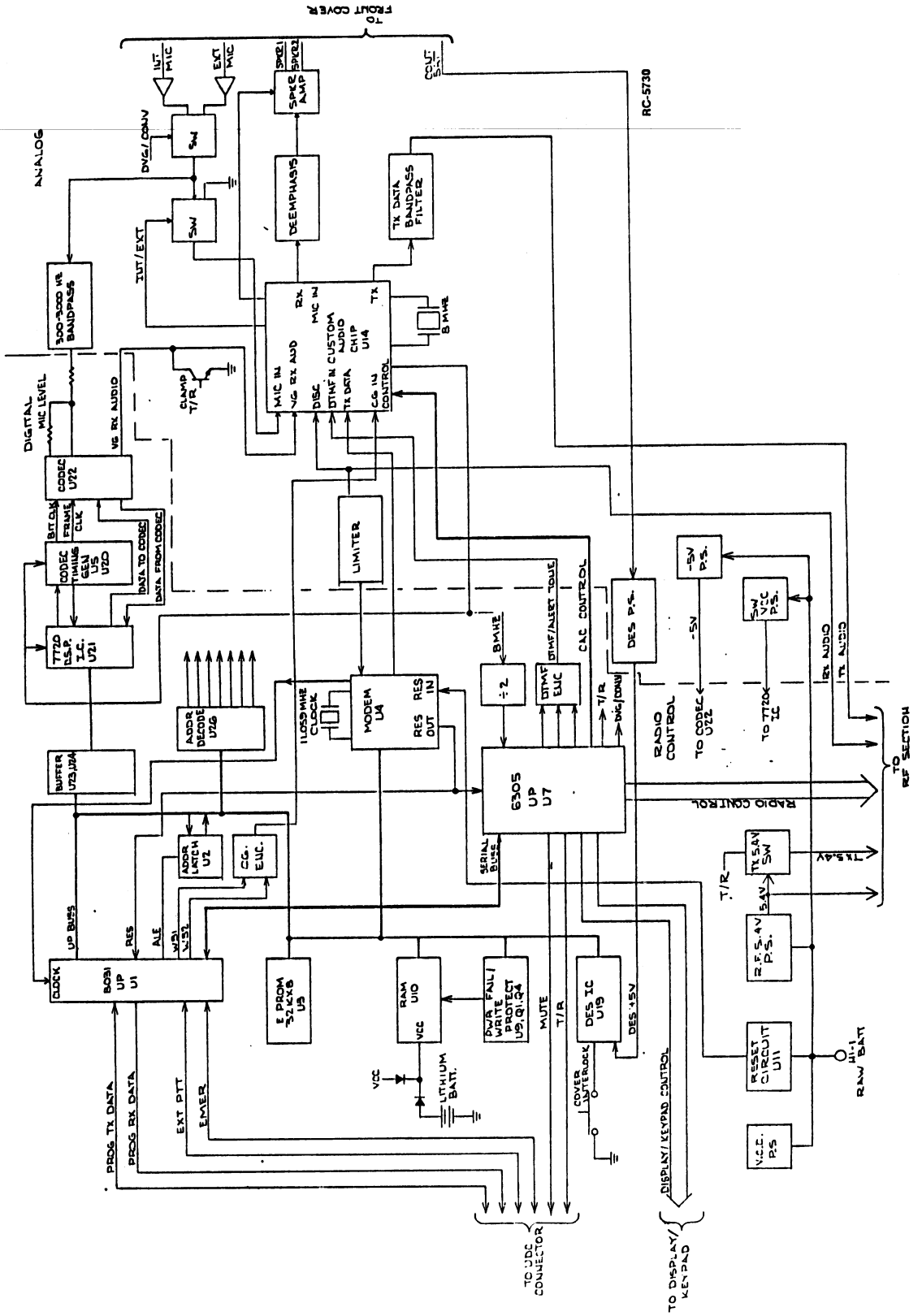


FIGURE 9 - VOICE GUARD MODULE BLOCK DIAGRAM

The second bilateral switch connects the microphone input to the CAC when the radio is transmitting in the CLEAR mode. This switch is activated by a DVGCONV signal originating from system control microprocessor U7 and is applied to U29, P11.

The third bilateral switch in the U29 package is not used.

CODECIN Bandpass Filter (U13):

This is an active 300 - 3000 Hz bandpass filter consisting of an operational amplifier in IC package U13.

Transmit Data Bandpass Filter (U12):

This is an active bandpass filter consisting of two operational amplifiers in IC package U12.

Speaker Amplifiers (U15 and U27):

Speaker audio amplifiers U15 and U27 are located between audio processor U14 and radio speaker. Amplifier U27, Pins 5,6 & 7 provide de-emphasis for the receive audio and amplifier U15 amplifies the output signal of U27 to the level adequate to drive the speaker

DES IC Power Supply (U30):

This power supply consists of regulator module U30, and filter capacitors C196 through C198. Regulator U30 is an S81250 and provides regulated 5 volts to hold the cryptographic keys stored in the DES IC. This continuous battery voltage is provided as long as the battery pack is attached to the radio and for at least 30 seconds after the battery is removed. Regulator U30 regulates from the CONTBATT (unswitched) line from the battery pack. Capacitors C196 and C197 hold up the voltage after the battery is removed.

CODEC -5 Volt Power Supply:

The CODEC -5 volt regulator power supply is needed for CODEC IC U22 located on the Digital Board. It regulates the negative voltage derived from a switching voltage inverter circuit and is only activated during the PRIVATE mode (transmit or receive). The inverter circuit consists of transistors Q104 through Q106, Q113, Q114, and diode packages D101 through D104. The actual regulator consists of regulator module U28 (79L05), filter capacitors C192 and C195, Schottky diode D105 and load resistor R106. Battery voltage is applied to the emitters of PNP transistors Q104 and Q113. A 25 kHz signal turns these two transistors on and off. Because of inverter transistor Q106, Q104 is on when Q113 is off. When Q104 is on, a positive voltage charges capacitor C182. When Q104 is off transistor Q105 conducts and discharges C182 causing a negative current to flow through diode package D104 and a negative voltage to appear on the input of regulator U28. When transistor Q113 is on, a positive voltage charges capacitor C190. When Q113 is off, transistor Q114 conducts and discharges capacitor C190 causing a negative current to flow through diode package D104 and a negative voltage to appear on the input of U28. This operation produces a continuous negative voltage on the input of U28. Any spikes resulting from transistor switching is filtered by capacitors C192 and C195.

DSP SW5 Power Supply:

This 5 volt regulator provides a switched +5 volts to operate the 77C20 Digital Signal Processor (DSP) U21, CODEC U22 and inverter package U25. It consists of transistors Q107, Q108, Q111, Q112 and operational amplifier U27. A control signal 7720PWR from system control microprocessor U7 turns the regulator on. A feedback voltage taken from voltage divider R180 and R181 is compared to reference voltage VREFB to control transistor Q112 and regulate the conduction of pass transistor Q111.

VCCA (U33, Q121 and Q110):

VCCA is a continuous 5.3 volts supplied to the analog circuitry. It is regulated from the battery pack voltage by comparator circuit U33, transistor Q121 and pass transistor Q110. This circuit uses VREFB from reference diode U18 and voltage follower U31C located on the digital board.

VCCSW (Q119 & Q120):

VCCSW is switched to operational amplifier package U13 from VCCA during transmit by the T/R signal controlling transistor Q120 and pass transistor Q119.

UDCSWBATT (Q100, Q101, Q117 & Q118):

UDCSWBAT is a current limited switched battery output on the UDC connector. It is switched by SW1 on the CAC (Pin 34) to control transistors Q100, Q101, Q117 and Q118.

VCCA/2 (U27):

VCCA/2 is a reference voltage used by many of the operational amplifier stages as well as by the CAC. It is derived from VCCA by voltage divider R115/R116 and voltage follower U27C.

Digital Board

The Digital Board provides encryption/decryption of transmit and receive audio respectively. This board also provides system control. Like the Analog board, the Digital board provides power supplies and voltage regulation for various circuits on the Digital board and the RF section of the radio. The Digital Board consists of VOICE GUARD circuits as follows:

- Control Microprocessor (U1)
- ADDR Latch (U2)
- EPROM (U3)
- MODEM (U4)
- System Control Microprocessor (U7)
- RAM (U10)
- Reset Circuit (U11)
- Encryption/Decryption IC (U19)
- CODEC Timing Generator (U5/U20)
- Digital Signal Processor (U21)
- CODEC (U22)
- Buffers (U23/U24)
- ADDR Decode (U26)
- Vcc Power Supply (U17 & Q9)
- RF 5.4 Volt Power Supply (U18, U31 & Q3)
- 5.4TX (U7)

Control Microprocessor U1:

Microprocessor U1 (80C31) is used to control all of the functions of the VOICE GUARD module. It determines the proper mode of operation of the radio (CLEAR, PRIVATE, transmit, receive, etc.) and controls all of the data flow during PRIVATE operation. In addition, it interfaces with the key variable loader, DSP IC U21, encryption/decryption IC U19 and MODEM IC U4. Microprocessor U1 turns on and off the various voltage regulators and insures maximum current savings and battery life. It also inhibits itself most of the time and enables itself periodically to see if another mode of operation needs to be activated. The 80C31 executes programs that are stored in one-time programmable SOT 32K X 8 EPROM U3.

ADDR Latch (U2):

For all read/write cycles, the low order address byte appears on the address/data bus during the first half of the cycle and data appears during the second half of the cycle. ADDR Latch circuit U2 latches low order 8-bits of address during the second half of the 80C32 read/write cycle as they occur. Latching is controlled by ALE from the 80C31.

EPROM (U3):

EPROM U3 is a one time programmable 32K X 8 byte EPROM which stores the operating and test programs for controlling the radio and VOICE GUARD functions.

MODEM IC U4:

The General Electric fully custom MODEM IC U4 is used to acquire bit and word synchronization of the limited discriminator output during receive. It is also used as a parallel to serial converter for PRIVATE transmit. Data is passed between the MODEM IC and the control microprocessor continuously while the radio is in the PRIVATE (PVT) mode. The MODEM also contains the 11.0592 MHz oscillator which provides microprocessor and data timing.

Timing Generators (U5/U20)

The clocks for control microprocrssor U1 and MODEM U4 are derived from a crystal oscillator, running at 11.059 MHz. The DSP, CODEC and CODEC -5 Volt regulator are provided clock inputs derived from an 8.0 MHz crystal oscillator located on the Analog board. These timing and control signals are derived using timing generators U5 (HC393) and U20 (HC390) and consist of the following:

- 3.125 kHz for DSP U21, Pin 27; derived by U5
- 6.25 kHz for CODEC U22, connected through inverter U25, Pins 1 and 2 to U22, Pins 5 and 12; derived by U5
- 25 kHz for the CODEC -5 Volt regulator; derived by U5
- 100 kHz for CODEC U22, connected through inverter U25, Pins 3 and 4 to U22, Pin 10; derived by U5

- 1.6 MHz for CODEC U22, connected through inverter U25, Pins 12 and 13 to U22, Pin 9; derived by U20

System Microprocessor U7:

Microprocessor U7 (63C05) is used as an intelligent I/O device controlled by the 80C31 microprocessor and contains the software to control most of the detailed command functions to the radio, the display, the keypad and the Custom Audio Chip (CAC) as follows:

- Loading data to the frequency synthesizer
- Decoding Channel Guard and Digital Channel Guard (Encoding is in 80C31 code)
- Loading data to the LCD display
- Fetching and processing the PTT, monitor, channel selection and volume control
- Controlling the audio circuit (CAC U14 audio processor)

The clock rate for microprocessor U7 is at 4 MHz and is RESET by the same RESET signal (only inverted) as the 80C31. Microprocessor U7 interfaces to the 80C31 microprocessor through four wire serial bus data and handshake lines: UPDATAIN, UPDATOUT, UPHSIN and UPHSOUT. Commands from the 80C31 and responses to the 80C31 are transferred on these lines.

The 63C05 microprocessor directly controls three serial devices: latched shift register output device U6, LCD display controller and CAC U14 using lines CACDATA, CACCLOCK, CACCS (Chip Select), DISPCS and U7, Pin 18 (shift register chip select). **Note:** the data and clock lines are common. The display also sends back busy indication DISPBUSY.

Shift register U6 provides outputs to the radio synthesizer; SYNENABLE and SYNBSW, to the key pad column; KBC0, KBC1 and KBC2 to the display controller board; DISPLITE and DISPC/D and the UDCMUTE signal to UDC devices.

D/ACOMP is an input from the CAC which indicates whether the value loaded into the CAC D/A produces an analog voltage which is lower than or higher than the analog voltage being compared at the time. This function is used for squelch checks, battery checks and UDC device determination.

CGLIM is the "squared-up" Channel Guard tone after recovery and limiting which is input to the 63C05 for Channel Guard detection. CGLIM is also fed to the 80C31 microprocessor for future application.

SYNDATA and SYNCLOCK provide data and clock to the radio synthesizer. SYNLOCK provides an indication whether or not the synthesizer has properly locked. Note: the SYNDATA and SYNLOCK signals use the same I/O pins on U7, but at different times.

7720PWR turns on the switched 5 Volts to the VOICE GUARD circuits when sending or receiving PRIVATE messages. 7720FLOAT is used to "tri-state" all lines that drive the 77C20 Digital Signal Processor (DSP) U21 from circuits that are on continuously to protect the 77C20 from latchup conditions when it is powered up and powered off.

KBR0 through KBR7 are the key pad row inputs.

Five outputs are used to produce alert tones and DTMF tones through weighting resistors R82 through R86.

U7, Pin 17 switches on the 5.4 volts to the transmit circuit as well as controls T/R, a signal which switches audio paths from transmit to receive condition.

WP controls the RAM write protect circuit.

DVG/CONV switches audio from the conventional to VOICE GUARD paths.

Power Fail/Write Protect (U9):

Prevents the personality portion of the RAM (top 6K) from being written over unless enabled by U7 after command by U1.

RAM (U10):

RAM U10 is a CMOS, 8K X 8 static RAM. The top 6K of memory in U10 stores personality data. The bottom 2K of memory is used to store temporary operating system data. The data stored in the RAM is maintained by lithium battery BT1 soldered on the Digital board. This battery should be changed at regular scheduled times. Refer to the Maintenance Section for instructions on changing the lithium battery.

Transistors Q1 and Q4 prevent the RAM CS from being acitvated unintentionally at power up.

Reset (U18 & U11B)

The 80C31 microprocessor is RESET at power on by a reset circuit consisting of voltage reference diode U18 (LM385) and operational amplifier U11B (LM2903). The 10 millisecond RESET pulse generated at power up is fed into the MODEM where it is buffered and passed on to the microprocessor. The MODEM can also generate a RESET to the microprocessor if its watchdog timer is allowed to expire.

Encryption/Decryption IC U19:

General Electric developed a fully custom CMOS IC (U19) which implements the Encryption/Decryption algorithm. IC U19 has the benefits provided by CMOS with an architecture designed for mobile radio use. The 64 bit Output FeedBack mode (OFB) of operation is used for encryption. This mode of encryption is superior to other modes in that it does not multiply the effects of single bit errors in the recovered data stream. It also contains its own on-chip RAM for key storage. This RAM is "write-only" in that the contents cannot be read outside of IC U19 making it virtually impossible to compromise the keys once they are loaded into the device. It also allows for easy key retention and zeroization (Key Dump).

Digital Signal Processor U21:

The Digital Signal Processor (DSP) IC U21 (77C20) is programmed with a General Electric proprietary Sub-band Coding voice compression algorithm. It receives/transmits serial data from/to CODEC IC U22 during PRIVATE receive/transmit. It processes the raw digitized voice data at 46.4 kilobits/second to about 9.2 kilobits/second. The control processor transfers data with the 77C20 through an 8-bit data bus.

CODEC (U22):

CODEC IC U22 provides input anti-aliasing filtering, A/D conversion, D/A conversion and output reconstruction filtering. On transmit, the A/D converter provides an 8-bit "u-law" companded representation of the input waveform every 172.4 microseconds. This 8-bit sample is shifted serially into the S1 port of the DSP IC (U21).

Buffers (U23/U24):

Buffer IC U23 isolates the CMOS 77C20 from the active data bus while no power is applied to the 77C20. Buffer IC U24 isolates other inputs to the 77C20 from active signals during 77C20 power down for latch up prevention.

ADDR Decoder (U26):

ADDR Decoder U26 generates Chip Select (CS) pulses whenever correct addresses appear on the address bus for the RAM, ROM, DES and MODEM IC's. Hex base addresses are as follows:

Device	Address
RAM	6000
MODEM	8000
DES	A000
DSP	C000

Vcc Power Supply (U17 & Q9):

Vcc is the 5 volts supplied to the digital circuitry which is on continuously. It is regulated from the radio battery pack voltage by regulator U17 (S81250) and pass transistor Q9.

RF5.4 Volt Power Supply (U18, U31B, Q2 & Q3):

RF5.4 is an accurate, continuous supply for the low power circuits in the radio. It is regulated from the battery pack voltage by voltage reference diode U18 (LM385), comparator circuit U31B, transistor Q2 and pass transistor Q3.

5.4TX (U7):

5.4TX is switched on from RF5.4 during transmit by microprocessor U7, Pin 17. This supply voltage is used by low power transmit circuits in the radio.

Audio Paths

CLEAR Receive:

When a clear voice message is received, demodulated audio appears at the receiver discriminator RXDISCOUT. It is buffered by U27D and routed to the UDC at UDCDISC. This audio path is clamped off by transistor Q123 and resistor R187 during transmit to reduce noise. The buffered audio enters the CAC at RX IN (Pin 12). In the CAC Channel Guard is filtered out and applied to the input of the Channel Guard decoder.

The audio level is adjusted and exits the CAC at RXAUDOUT. The audio is de-emphasized by capacitors C101 and C102 and resistor R114 at operational amplifier U27B. This signal is connected to the UDC as UDCRXAUD for the earpiece. It is also routed to audio power amplifier U1

through divider resistors R127 and R128. Amplifier power is switched on when needed by transistor Q103 under the control of CACSW0. Up to one-haft watt of audio is applied to the speaker through floating leads SPKR1 and SPKR2.

CLEAR Transmit:

Transmit audio originates at the internal microphone on the front of the radio or at an external microphone connected to the UDC. Audio is amplified by amplifier U13A or U13B, depending on which device is connected. Bilateral switch U29B switches in the appropriate path controlled by CACSW5. For a CLEAR signal, audio is passed through bilateral switch U29A controlled by DVGCONV to amplifier U13C through pre-emphasis network capacitor C127 and resistor R136. Audio then enters the CAC at INTMIC (Pin 14). In the CAC, the audio is limited and combined with encode tones. Modulation level is set and the audio is passed through a post limiter filter. CLEAR transmit audio exits the CAC at TXAUDOUT (Pin 26). The transmit audio is connected through band pass filters U12B and U12A to the transmitter modulator at RFTXAUDIO.

PRIVATE Receive:

The PRIVATE Digital Data Stream is recovered by the reciever the same as the CLEAR audio and appears at RXDISCOUT. Refer to Digital Data Stream listed in the Table of Contents. The data stream is buffered by operational amplifier U27D which drives digital "slicer" U32B. Digital slicer U32B squares the waveform and connects it to the MODEM IC (U4) at MODRXDAT. The MODEM IC obtains bit and word sync on the incoming data stream and demodulates the data so a plain binary byte is sent to the 80C31 microprocessor each time a byte is recovered by the MODEM. Signal flow is now parallel and takes place over the microprocessor data bus. The processing system next decrypts the data by passing it through the decryption device (U19). This IC performs a very complex decryption, taking eight encrypted bytes from the microprocessor and returning eight decrypted bytes using an approved algorithm. The microprocessor next sends the data to the 77C20 Digital Signal Processor (DSP) IC U21. The DSP IC performs a bandwidth expansion on the data which is the inverse of the sub band coding compression which took place at the transmit end. The DSP transfers the recovered digitized audio to CODEC IC U22 through a high speed serial line. The signal is now serial again. The CODEC and DSP share timing signals to keep bit and frame sync. The CODEC takes each frame of digital data from the DSP and converts it to an analog voltage which appears at CODECOUT. The resulting "stairstep" waveform after filtering is the recovered audio.

CODECOUT is connected to the CAC at EXMIC (a misnomer in this application) Pin 13. Note that this signal is clamped by transistor Q109 during transmit to reduce noise. In the CAC, volume level is adjusted and audio exits the CAC at RXAUDOUT (Pin 27). From this point audio continues to the speaker and UDCRXAUD just as in the CLEAR mode.

PRIVATE Transmit:

Audio from either microphone source (INTMIC or EXTMIC) is switched by bilateral switch U29B through band pass filter U13D and CODEIN to the CODEC IC (U22). Resistors R44 and R113 at the CODEC set gain. The CODEC is an analog to digital converter and a digital to analog converter. On transmit, it is an A/D. It digitizes the audio 6025 times per second and sends the resulting data to DSP IC U21 through a high speed serial line. This digitized version of the audio has a bandwidth of about 40 kHz, which is too wide to transmit over a radio channel. The DSP IC compresses this bandwidth by a process called "sub band coding" which selectively eliminates redundant information until the resulting bandwidth is about 10 kHz which can be transmitted over a radio channel. Parallel data from the DSP is taken by microprocessor U1 and transferred to Encryption/Decryption IC U19. The microprocessor takes back encrypted (scrambled) data from U19 then passes it to MODEM (U4) after adding block headers and other synchronization information. The MODEM synchronizes and modulates the data, producing a continuous serial data stream with clocking information at MODTXDAT. This signal enters the CAC at TONEB (Pin 21). In the CAC the modulation level is set. The data stream to be transmitted exits the CAC at TXAUDOUT (Pin 26) and connects through band pass filters U12B and U12A to RFTXAUDIO and the transmit modulation circuit.

LCD Board

The LCD board is composed of the following items:

- LCD Drive IC (A1)
- LCD
- Backlighting Circuit (Q1, Q2 and CR1 - 6)

The LCD driver converts data from microprocessor U7 on the VOICE GUARD Digital board into signals which drive the LCD display. The LCD display is equipped with eight character, 14 segments each and eight status displays. This board also has a back lighting circuit which is enabled upon receiving a signal from microprocessor U7 when any of the control switches (VOL, PTT, etc.) are operated.

Key Pad

The key pad located on top of the M-PD Radio housing consists of flexible cable CA2 and rubber contacts.

The flexible cable (mechanical part 37) connects to the LCD Board and interfaces with the Analog Board microcomputer to control **CHAN**nel selection, **VOL**ume and the **HOME** function.

4-Button SCAN Key Pad

The 4-Button SCAN Key Pad located on the front of the M-PD Radio, also consists of flexible cable CA2 and rubber contacts. The flexible cable (also mechanical part 37) connects to the LCD Board and interfaces with microcomputer U7 to control **SCAN** functions (**ON/OFF, ADD** and **DEL**ete), enable the encrypted mode (**PVT**) and provide a cryptographic Key Dump operation.

Universal Devices Connector (UDC)

The UDC is located on the side of the radio housing so that various kinds of external equipment can be connected. External equipment connecting signals are as follows:

- TX Data
- RX Data
- CTS

For Data Loader (PC or Key Loader)

- PTT
- EXT MIC
- RX Audio Out
- T/R
- Mute
- Disc Out

For External MIC & SPKR

- +7.5 Volts Switch Out
- EMER

For External MIC & SPKR

- UDCVOLT - Identifies the device.

The radio system control microprocessor (U7) senses the value of voltage at the UDC line and switches the appropriate audio circuits to provide proper radio/accessory operation. The UDC voltage is set by one resistor within the device and one resistor in the radio.

Digital Data Stream

The Digital Data Stream consist of three components: the Preamble, the Frame Header and the End of Message (EOM).

Preamble Format:

At the beginning of transmission (PTT) a preamble consisting of repeated synchronization Initialization Vector (IV) and addressing information is transmitted before voice encryption begins. This preamble provides a high probability of the correct reception of sync, IV and Outside Addresses (OA,s). Refer to Figure 10 - Preamble Format.

Frame Header:

The encrypted voice data frame header is shown expanded in Figure 11. Information is provided at the beginning of a frame to insure maintenance of data and cryptographic synchronization and to allow late entry into a conversation during PRIVATE receive. Following the 112 bits of the VOICE GUARD frame header are 2040 bits of encrypted SBC voice data. The VOICE GUARD frame header is then repeated with a new IV.

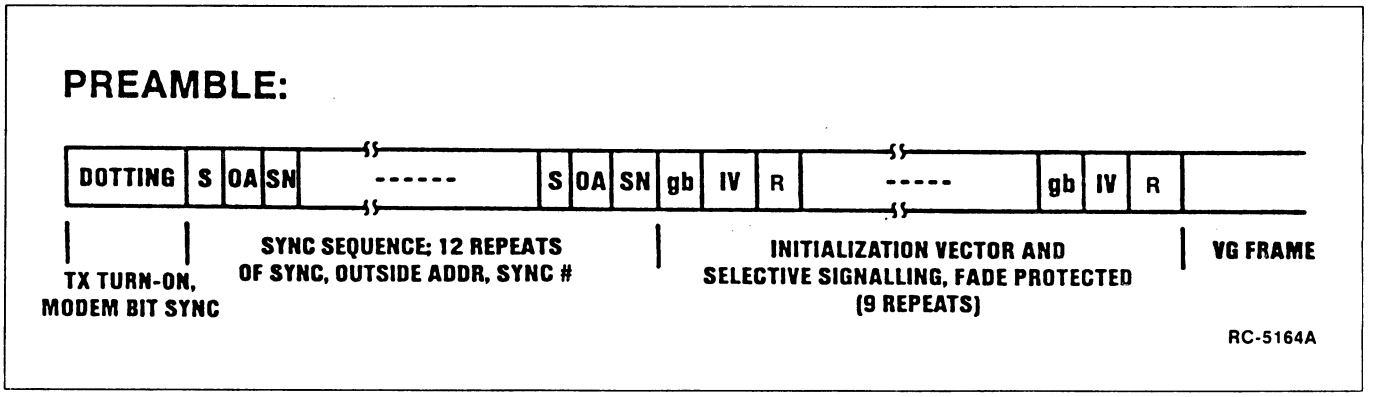


FIGURE 10 - PREAMBLE FORMAT

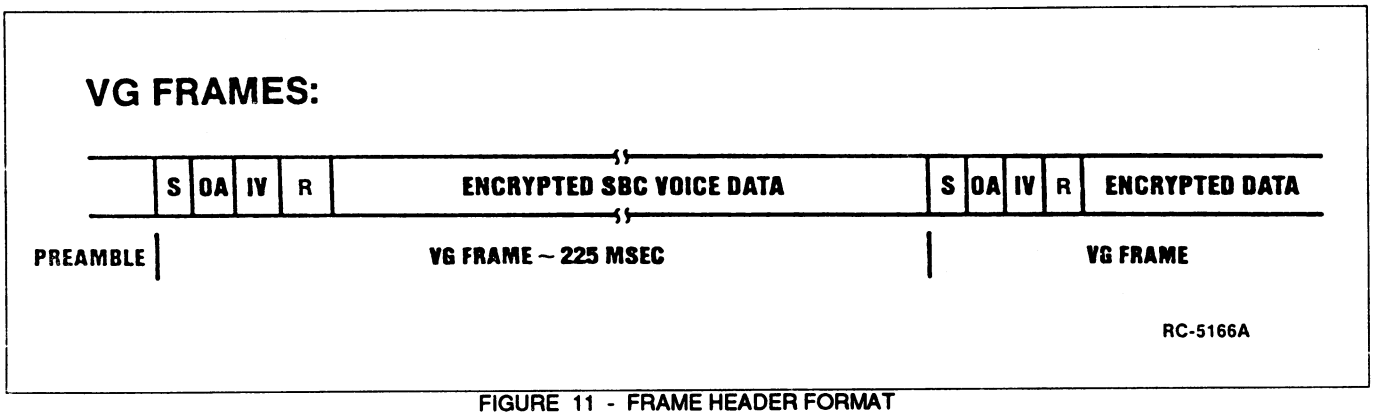


FIGURE 11 - FRAME HEADER FORMAT

End Of Message (EOM):

In order to signal the end of a transmission an inverted syncword plus dotting sequence is transmitted for about 50 milliseconds. This allows for a long fade in the signal and still insures that the receiver decodes the EOM correctly.

Key Dump Function (zeroization)

The cryptographic keys in the VOICE GUARD module are dumped (zeroized) by three different methods. The first method is by simultaneously pressing both the PVT and the SCAN keys on the front key pad of the radio. The second method is by removing the battery pack for three to five minutes. The third method is by removing the back screws from the radio as is done when disassembling the radio for troubleshooting or repair. This will instantaneously dump the keys stored in the encryption/decryption IC.

Interface To RF Section

All connections from the control circuits of the VOICE GUARD module to the RF section of the radio are through connectors P1 and P2.

RAWBATT on P1-2 and P2-2 and **GND** on P1-3 and P2-7 connect directly to the radio and carries up to two amperes during transmit.

RFPWRSET sends a voltage that controls transmit power. This voltage is generated by the CAC based on Tracking Data stored in personality.

RXDISCOUT is the receive discriminator output. Squelch noise and recovered audio first enter the controller here.

5.4 TX is low level power during transmit.

RFTXAUDIO is the transmit modulation input.

SYNBSW, SYNLOCK, SYNENABLE, SYNDATA and **SYNCLOCK** are all controls to and from the radio frequency synthesizer.

RF5.4 is low level power to radio circuits which are on continuously.

Interface To The Front Cover

The control circuits of the VOICE GUARD module interface to four areas of the front cover: the LCD display board, the key pad, the UDC and the speaker/microphone through four ten pin flex strips which plug into connectors P11, P12, P13 and P14.

LCD Display:

The LCD display requires six signals plus Vcc and GND.

DISPLITE commands the display backlights to light for night reading.

DISPCLOCK, DISPDATA and **DISPCS** serially load data into the display.

DISPBSY provides a return signal indicating when the display is ready for further input.

DISPC/D switches the display board from the "command" to the "display" mode. The command mode causes the display to flash or flags to light. The display mode takes in alphanumeric data for display.

Key Pad:

KBC0, KBC1 and **KBC2** send signals to the column lines of the key pad matrix. These signals are sensed on the row lines **KBR0** through **KBR7** if keys are pressed.

UDC:

UDCRXAUD provides recovered audio to external devices such as an earpiece or speaker/microphone.

UDCSWBATT provides battery voltage for external devices which require power such as the speaker/microphone and the programming interface.

UDCVOLT is used for device identification. Every legal UDC device has connected internally a resistor between this line (UDCVOLT) and ground. This resistor when connected to the M-PD radio forms a voltage divider with resistor network R188 and R189. The resulting voltage is sensed by the CAC to determine what device is connected and what action to take with that device.

UDC T/R informs external device if the radio is receiving or transmitting.

UDCEMER is the input from peripheral devices which contain an **EMERGENCY** function, such as a lanyard, which can cause the radio to automatically transmit a **HELP** signal.

UDCMUTE is used to hold external received audio muted in external devices when desired.

UDCPTT is the keying input from external devices used as speaker/microphone.

UDCRXDATA is the serial data input line to the radio in programming and test modes. It is the **KEYFILL ACKNOWLEDGE** signal from the keyfill unit in the keyfill mode.

UDCTXDATA is the serial data output from the radio in programming and test modes. It is the KEYFILL REQUEST line to the Keyfill unit when in the Keyfill mode.

UDCDISC is the buffered receive discriminator output to external devices.

Speaker/Microphone:

SPKR1 and **SPKR2** (connectors P11-2 and 3) are the floating speaker drive lines. The speaker is connected across these two lines and is not grounded. The battery must be attached to the radio to connect audio to the speaker.

CONTBATT is unswitched battery voltage. It is present when a battery is attached to the radio. It is used only to provide cryptographic key storage in the DES IC.

INTMIC is low level audio input from the microphone in the front cover of the radio.

EXTMIC is a low level audio input from external devices through the UDC connector.

MICLO is a separate ground for the microphone audio which is required to reduce noise.

Battery Pack

Two battery packs, one with standard capacity and one with high capacity are available for use with the M-PD SCAN Personal radio with VOICE GUARD. Both battery packs provide a nominal 7.5 VDC output.

CAUTION

The battery pack used with the M-PD VOICE GUARD SCAN Personal radio **must be a PART 4** or later as follows:

19A704860P4 (Intrinsically Safe)
19A704850P5 (Standard Capacity BatteryPack)
19A704860P5 (High Capacity Battery Pack)

To protect the battery pack from external short circuits, the positive (+) charging contact is diode protected (see Figure 12).

An internal thermister senses variations in battery pack temperature to automatically control a charger and provide a maximum charge without overheating the battery pack. Both battery packs can be charged in one hour.

A battery pack should be fully charged before placing in to service.

Charger combinations for charging battery packs are available with charge times of 1 hour and 16 hours. A combination can be a single unit desk or a vehicular charger. It can also be a wall mounted multiple charger with the capability of charging up to five battery packs simultaneously.

Charge Level:

A fully charged battery pack should provide a terminal voltage greater then 7.5 VDC. A discharged battery pack should provide a reading of no less than 6.4 VDC.

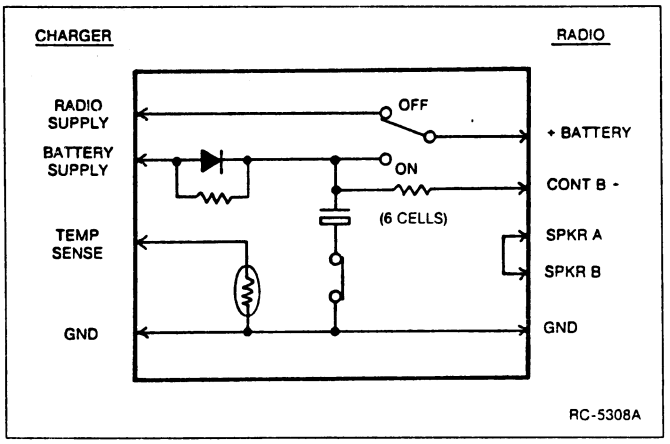


FIGURE 12 - BATTERY PACK

MAINTENANCE

This Maintenance Section provides information on adjustments of the radio (transmit, receive and synthesizer), preventive maintenance and a Disassembly Procedure. Information is also provided for removing and replacing chip components and module replacement. The Service Section, called for on the front cover of this manual, provides a more complete set of alignment procedures for the radio plus a detailed Troubleshooting Procedure.

Initial Adjustment

After the radio has been programmed, as described in the applicable Programming Instructions, no other adjustments are required to the M-PD personal radio.

WARNING

To prevent loss of memory in RAM U10 on the Digital board, lithium battery BT1 should be replaced every three years. A procedure for changing BT1 is provided in Service Section LBI-31918.

Preventive Maintenance

To ensure a high operating efficiency and to prevent mechanical and electrical failures, routine checks should be performed for all mechanical and electrical parts at regular intervals. Preventive maintenance should include the following checks:

Antenna:

The antenna and antenna contact should be kept clean, free from dirt or corrosion. If the antenna or contact should become dirty or corroded, loss of radiation and a weak signal will result.

Mechanical Inspection:

Since portable radio units are subject to irregular shock and vibration, check for loose plugs, nuts, screws and other parts to make sure that nothing is loose or is working loose.

Alignment:

The transmit and receive circuit meter readings should be checked periodically and the alignment "touched up" when necessary. Refer to the Service Section for the applicable alignment procedure and troubleshooting sheet for typical voltage reading found in the Service Section.

Frequency Check:

Check transmit frequency and deviation. Normally, these checks are made when the unit is first put into operation. They should be repeated after the first month of operation, then again one time each year.

Disassembly

To gain access to the Radio Board (transmit, Receive and synthesizer circuits) or VOICE GUARD module for servicing, loosen the captive screws and disassemble as follows:

RF Section	Step 1 through Step 4
VOICE GUARD Module	Step 5
LCD Board	Step 5

Disassembly Procedure (See Figure 13):

CAUTION

ALWAYS remove the battery pack before removing any component board to avoid blowing the fuse.

Equipment Required:

- Small Phillips-head screwdriver
- Small flat-blade screwdriver
- Needlenose pliers
- Allen-head wrench for removing set screws
- Pencil-type soldering iron (25-40 Watts) with a fine tip

Step 1:

To gain access to the radio, loosen, but do not remove, the four screws at (A) and (B). Carefully remove the back cover. For normal radio alignment, the back cover is all that need be removed. When tightening the screws, they should be no tighter than 4 +0.5 inch-pounds (See Figure 14).

NOTE

Screws are not captive,in that they will come out if you continue to turn them. Be careful not to lose them.

Step 2:

To Remove the RF Section, unscrew and remove the antenna at (C) and RF connector at (D). Remove the six screws at (E) using the Phillips-head screwdriver. The radio section can now be detached from the rear cover (see Figure 15).

Step 3:

Remove the shield cover (F) from the eggcrate (see Figure 16).

Step 4:

To remove the antenna changeover switch, remove the tap screw at (G) using the phillips-head screwdriver. Unsolder the antenna switch lead connection at (H). The antenna switch assembly can now readily be removed by hand (see Figure 17).

Step 5:

To remove the VOICE GUARD Module, remove the five screws at (I) from the VOICE GUARD module. Use the Phillips-head screwdriver (see Figure 18). Carefully pull the module from the front cover of the radio.

Step 6:

Disconnect the LCD flex cables at (J) from the connectors at (K) (See Figure 19).

The Digital Board simply plugs into the Analog Board and the two can be easily separated.

CAUTION

Be careful not to bend or break the inter-board connector pins.

Step 7:

To remove the LCD Board, pull the contact pins at (L) out of the socket in the SPK/MIC flex circuit. Remove seven screws at (M), using the Phillips-head screwdriver. The LCD Board can now be readily removed (see Figure 20).

CAUTION

The LCD board should not be removed unless absolutely necessary since re-assembly of the flex strips underneath the board is very difficult.

Replacement of Components

The major components of the M-PD Personal Radio are the PA, TX-AMP (driving amplifier), PC (power Control Module), VCO (Voltage Controlled Oscillator) and the TCXO (Ref. Osc.). These are very reliable devices and will not normally need to be replaced. Before replacing any of these modules, always check out the associated circuitry carefully.

To remove any of these major components, refer to the applicable replace procedure found in the Service Section (LBI-31918).

CAUTION

FOR THE VOICE GUARD MODULE, IT IS NOT RECOMMENDED THAT ANY REPAIR WORK BE PERFORMED ON EITHER THE ANALOG BOARD OR THE DIGITAL BOARD. ALL REPAIRS ON THE VOICE GUARD MODULE SHOULD BE DONE AT THE FACTORY.

Troubleshooting Procedure

Maintenance of the M-PD Personal Radio is facilitated by using the Troubleshooting Procedures and service techniques unique to this radio. The Troubleshooting Procedures are designed to quickly lead the service technician to the defective component or circuit. These procedures are found in the Service Section LBI-31918.

WEATHERPROOF INTEGRITY

The M-PD Voice Guard Scan radio is designed to meet MI-810-D specification for Blowing Rain. All access to the M-PD radio are protected from water entry by suitable gaskets and seals. However, degradation due to use, or disassembly during repairs, may affect the integrity of the seals as provided by factory assembly. A maintenance procedure is provided in the Service Section (LBI-31918) to assure that the radio housing will continue to meet the weatherproof features as designed.

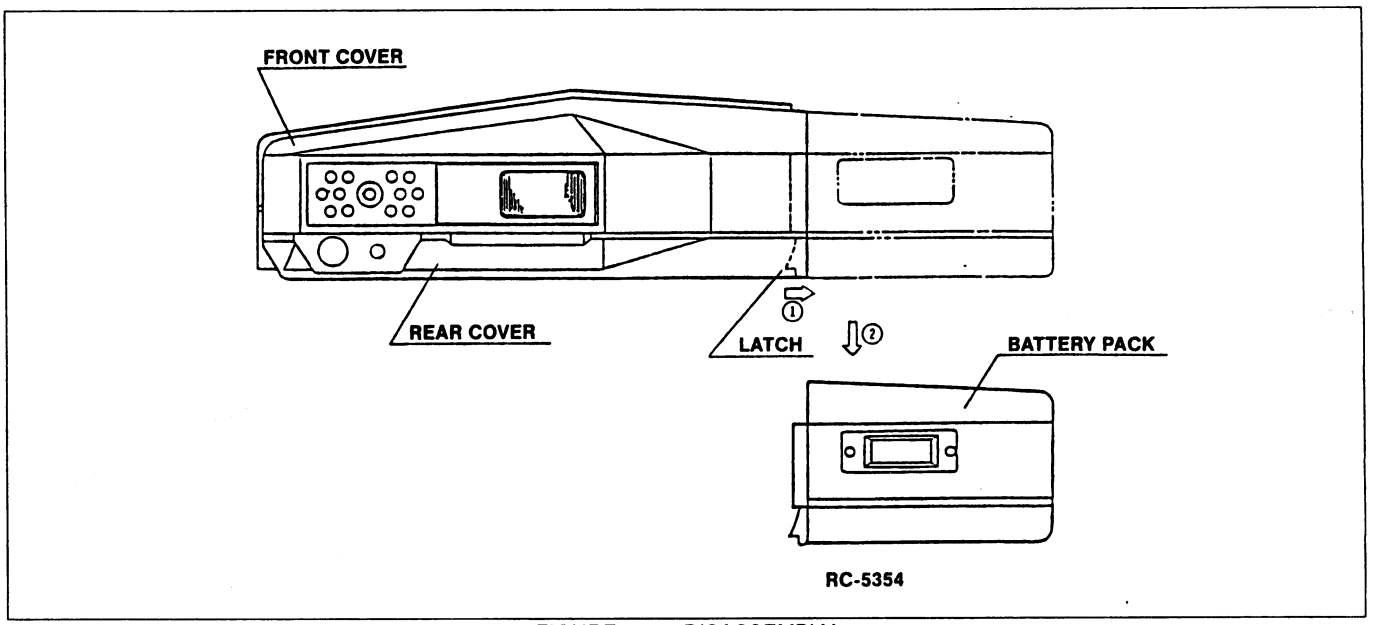


FIGURE 13 - DISASSEMBLY

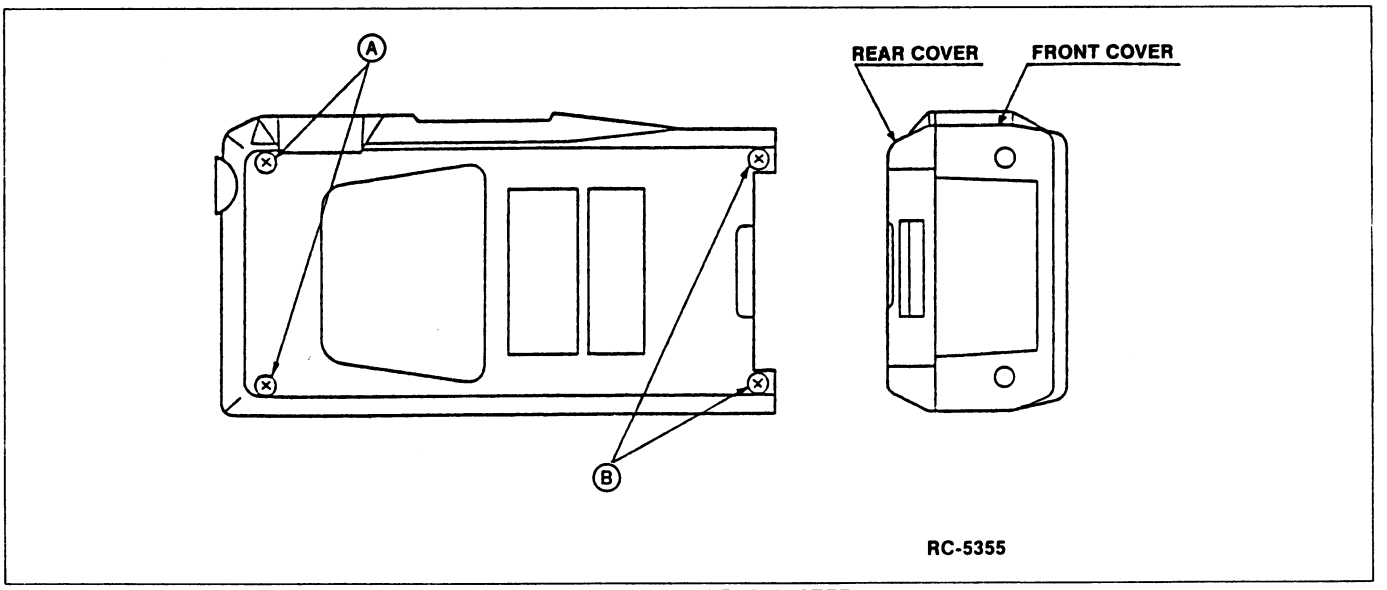


FIGURE 14 - DISASSEMBLY STEP 1

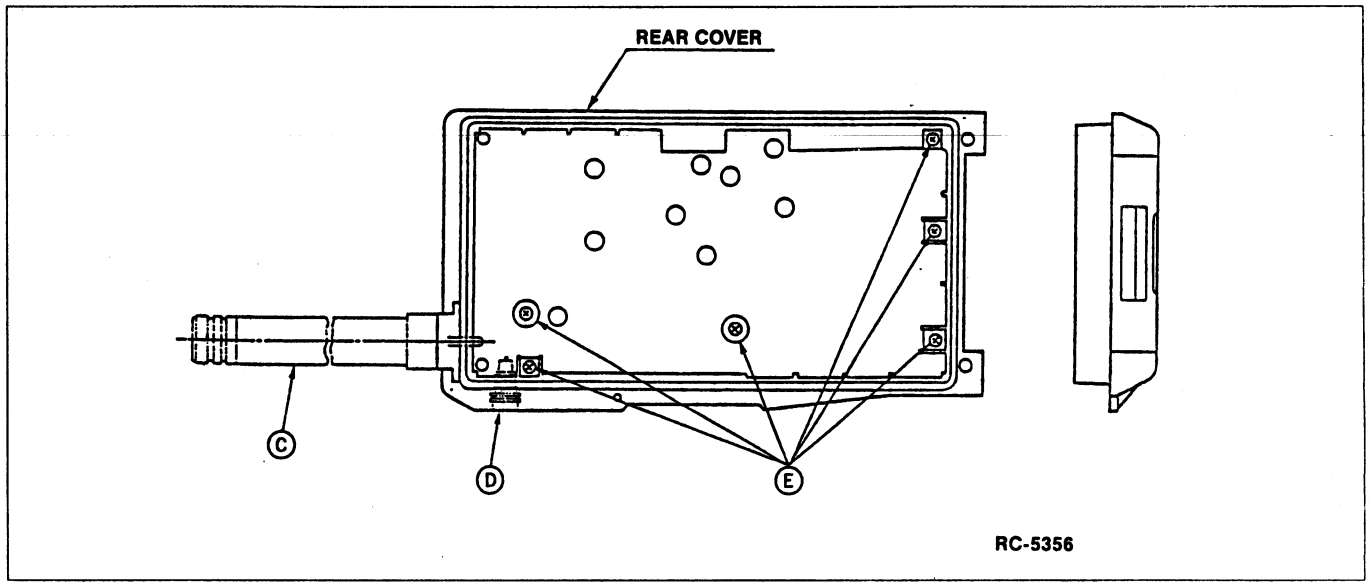


FIGURE 15 - DISASSEMBLY

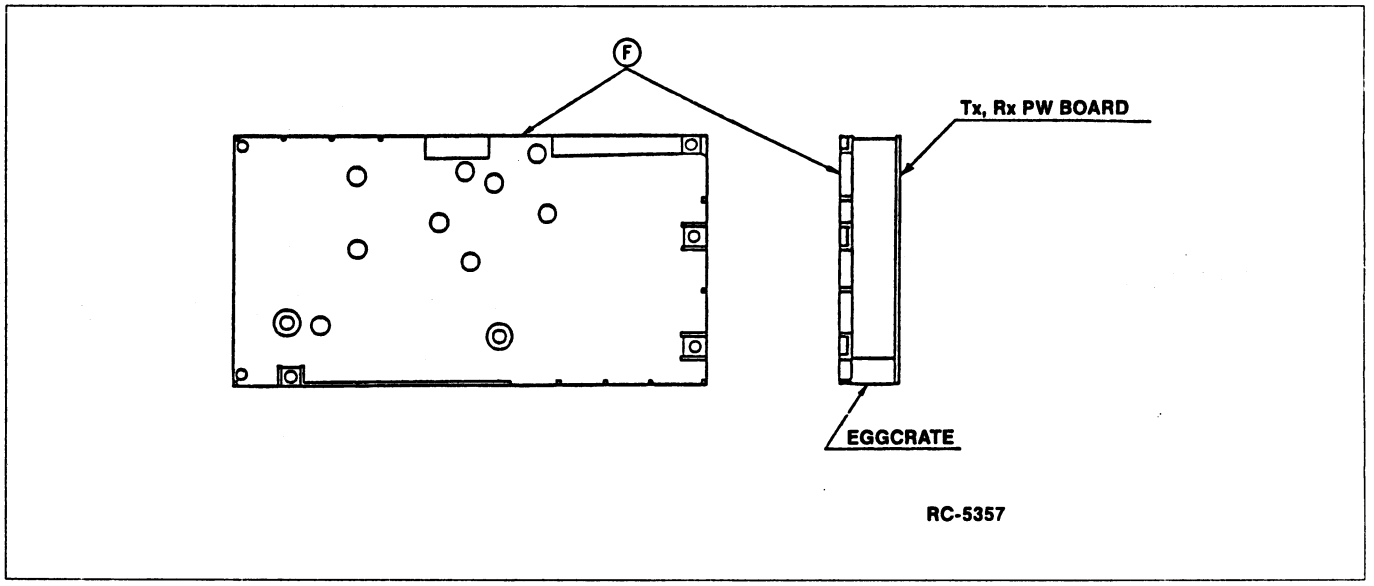


FIGURE 16 - DISASSEMBLY STEP 3

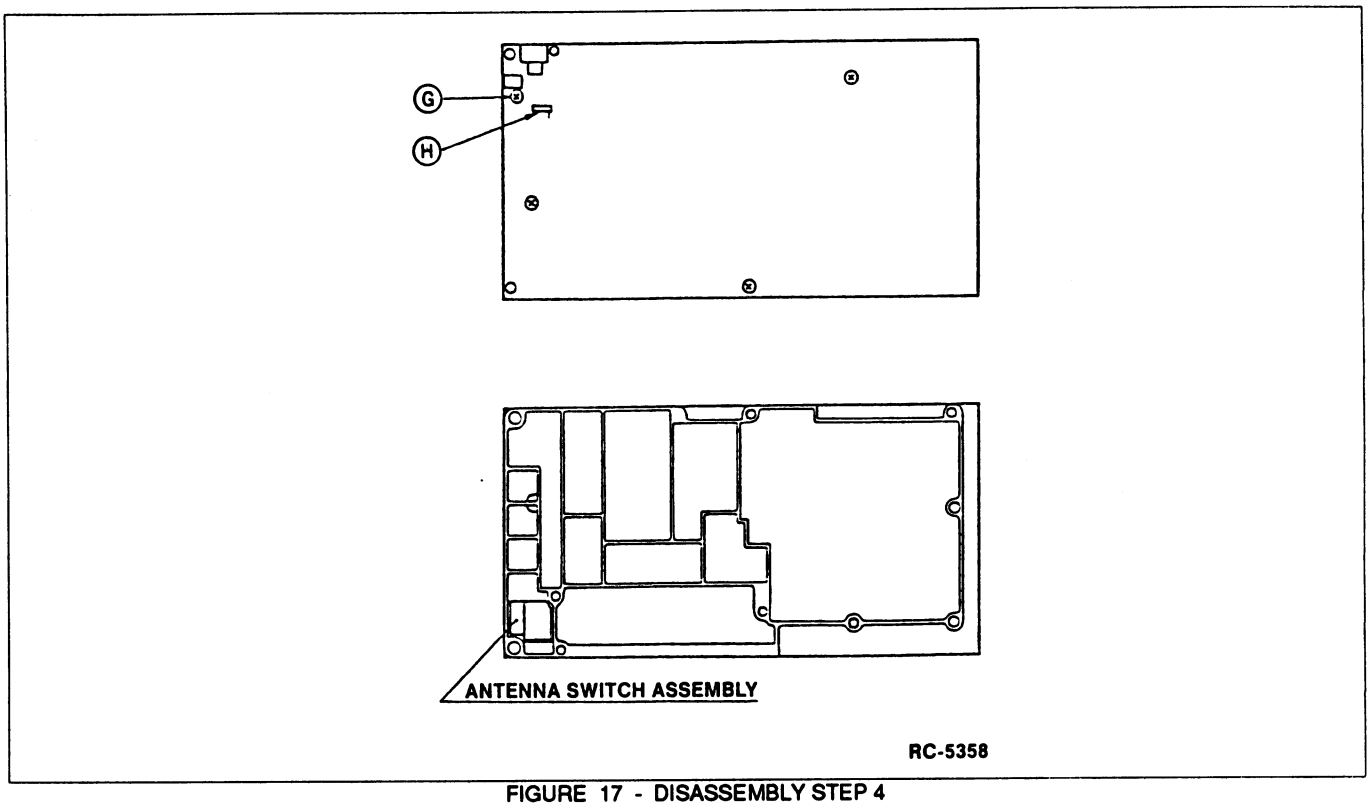


FIGURE 17 - DISASSEMBLY STEP 4

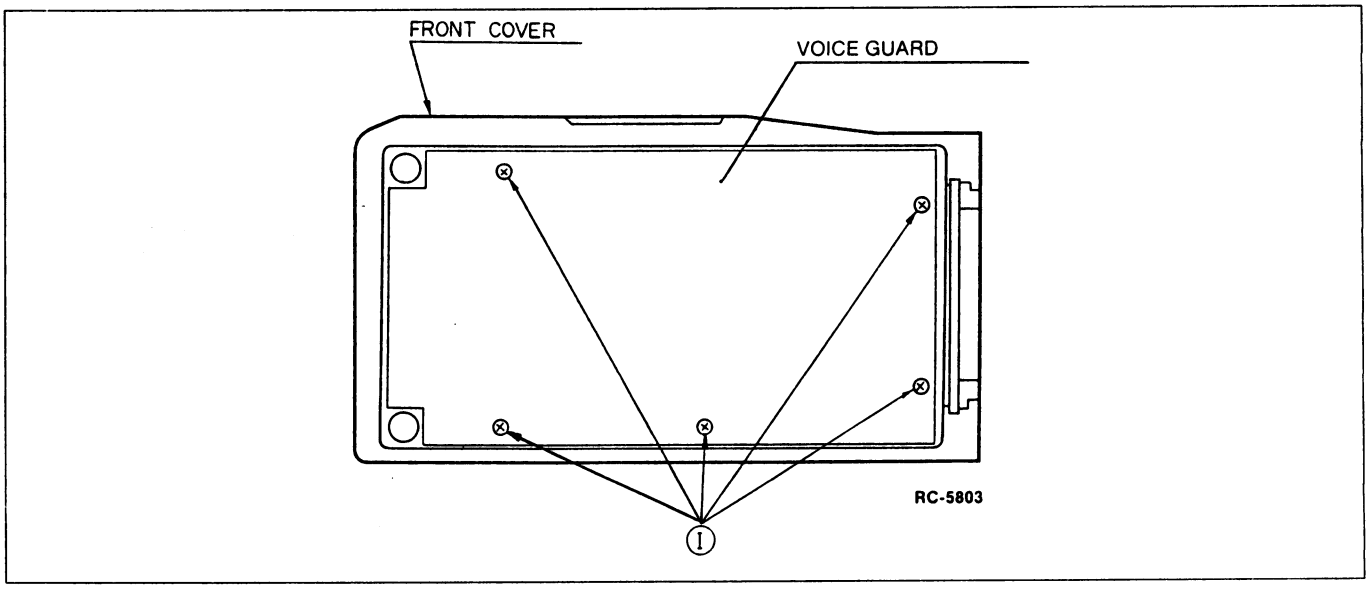


FIGURE 18 - DISASSEMBLY STEP 5

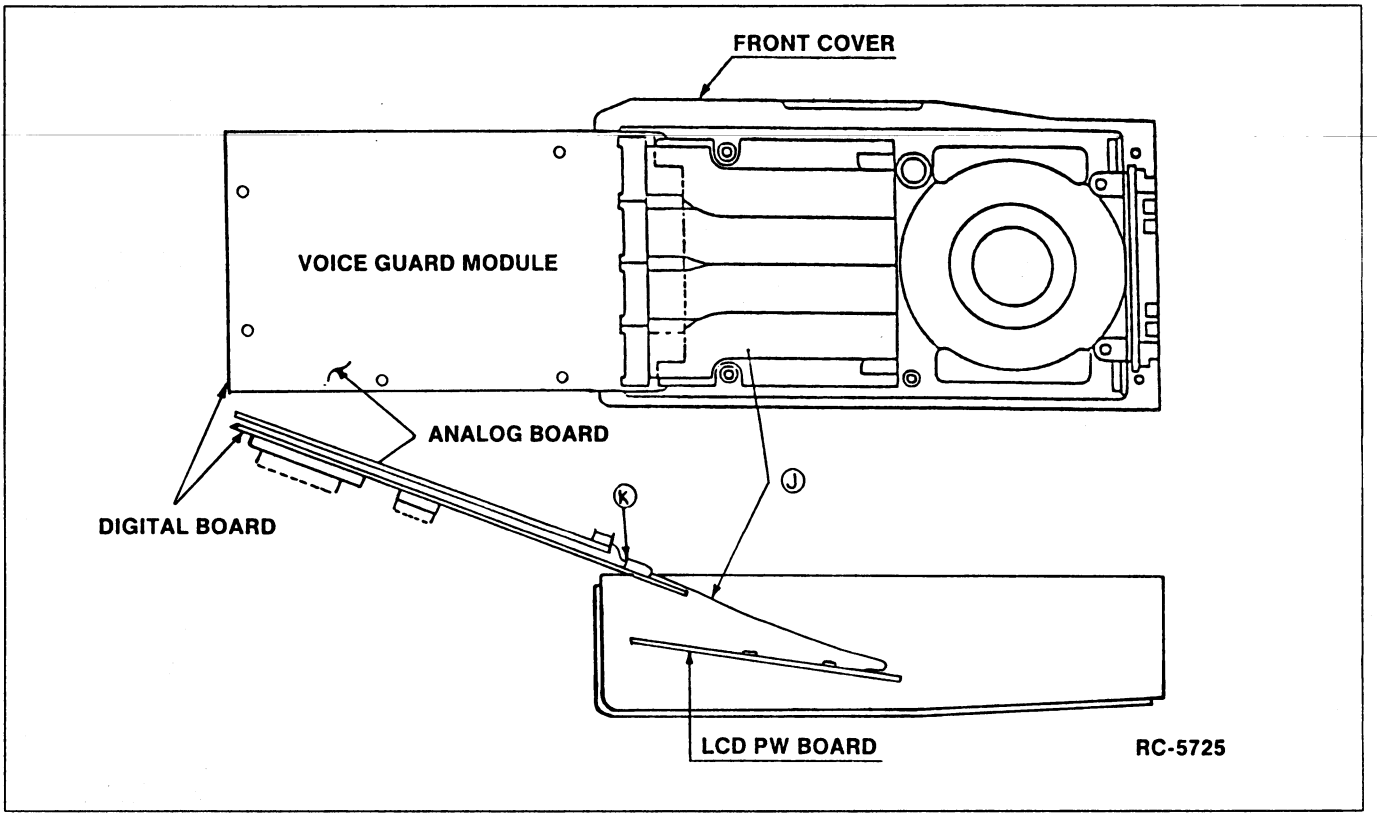


FIGURE 19 - DISASSEMBLY STEP 6

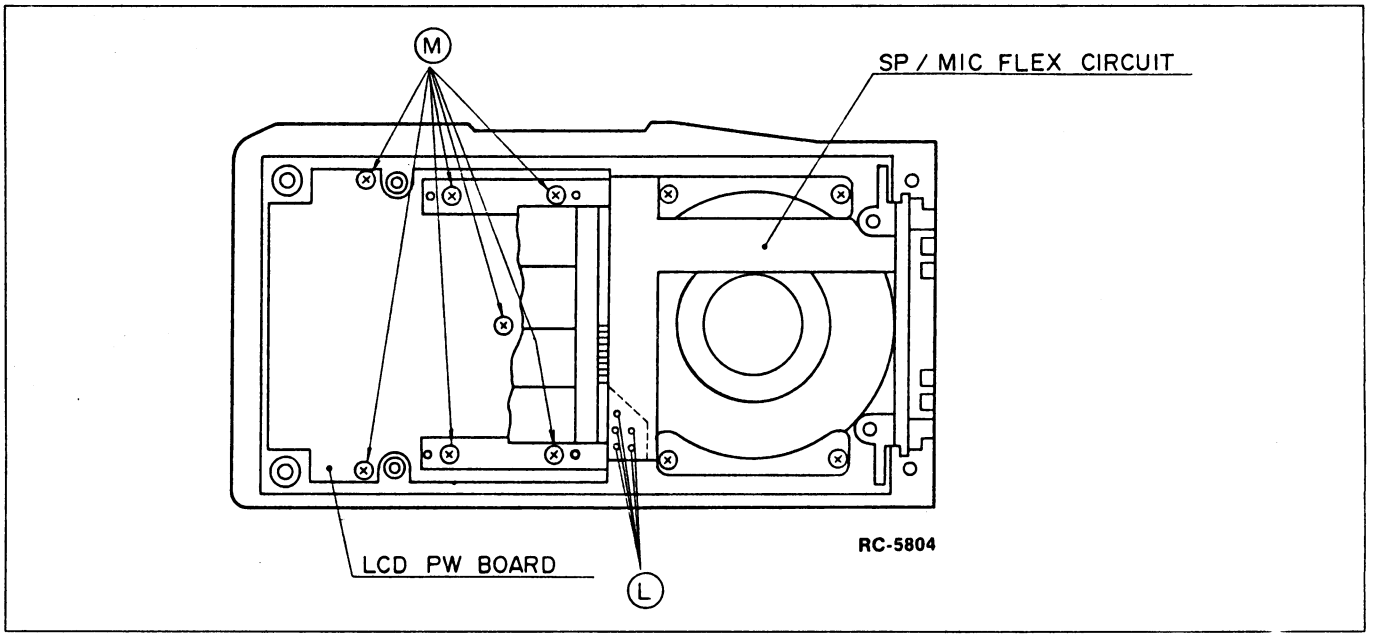
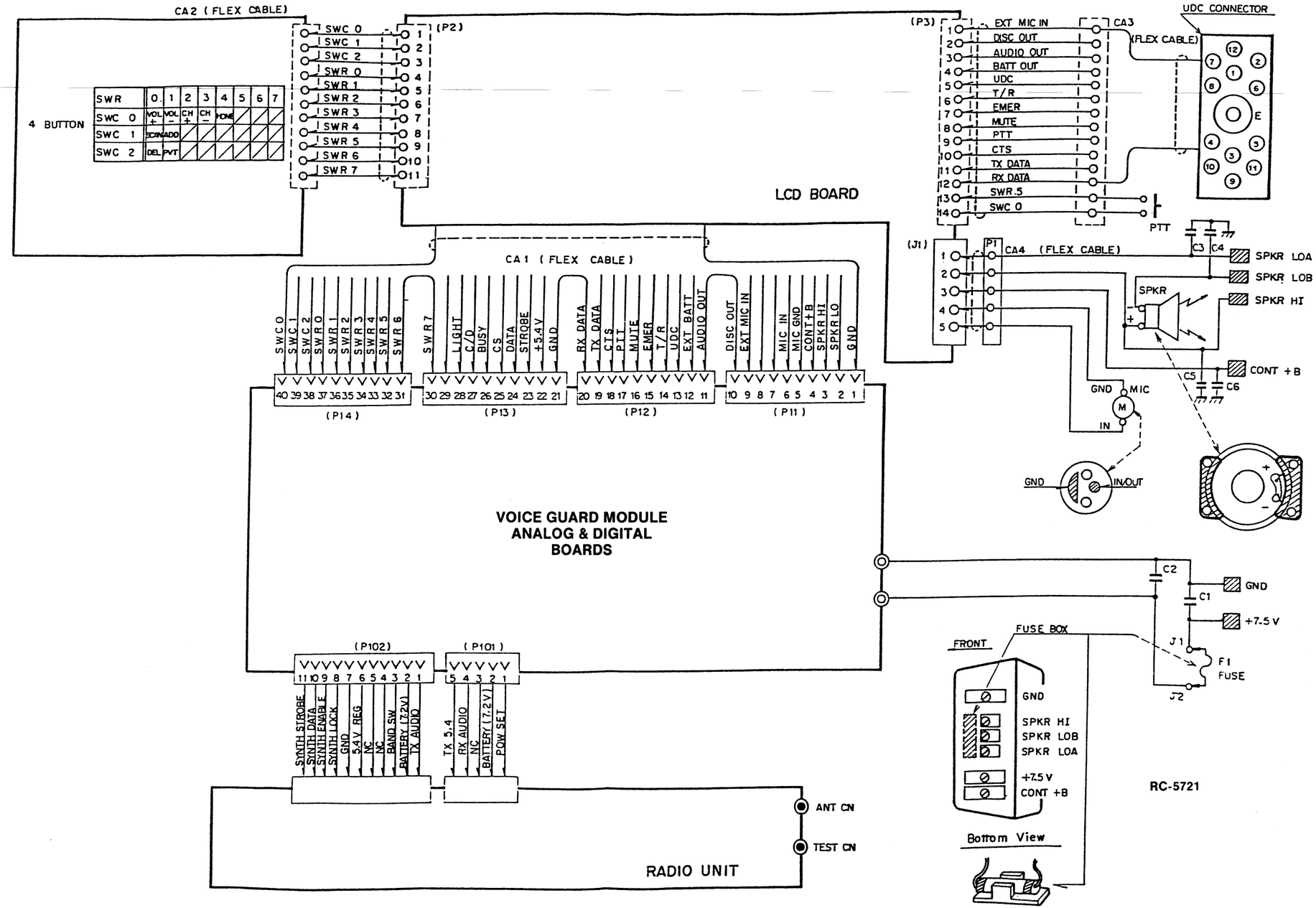


FIGURE 20 - DISASSEMBLY STEP 7

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

GENERAL ELECTRIC*
U.S.A.

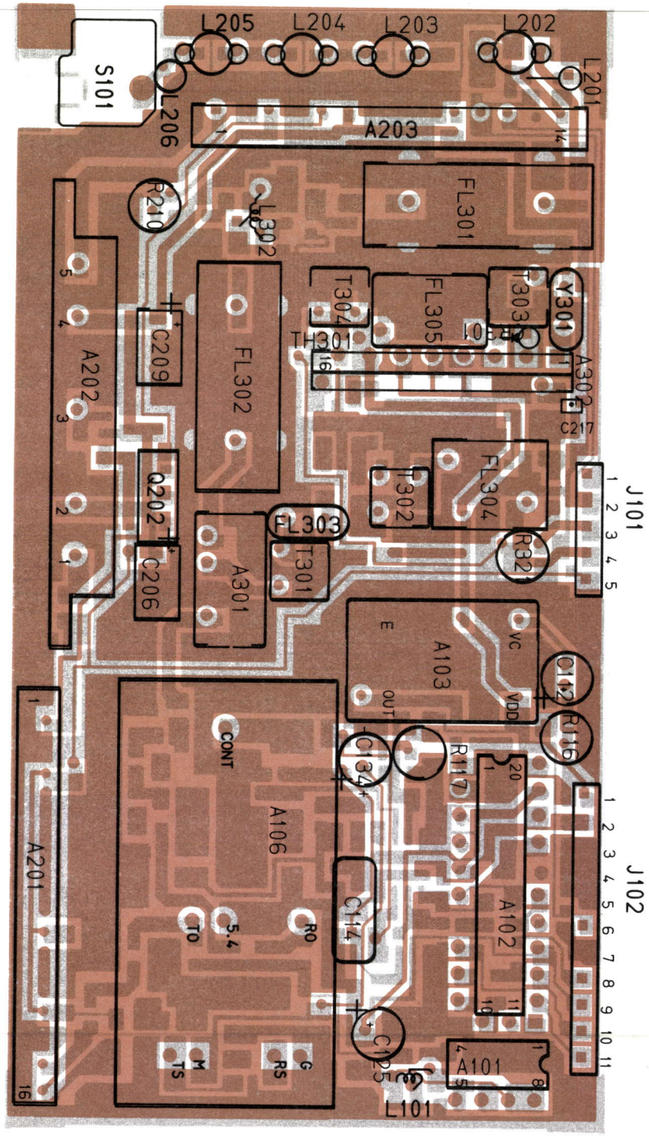


A3WE04126

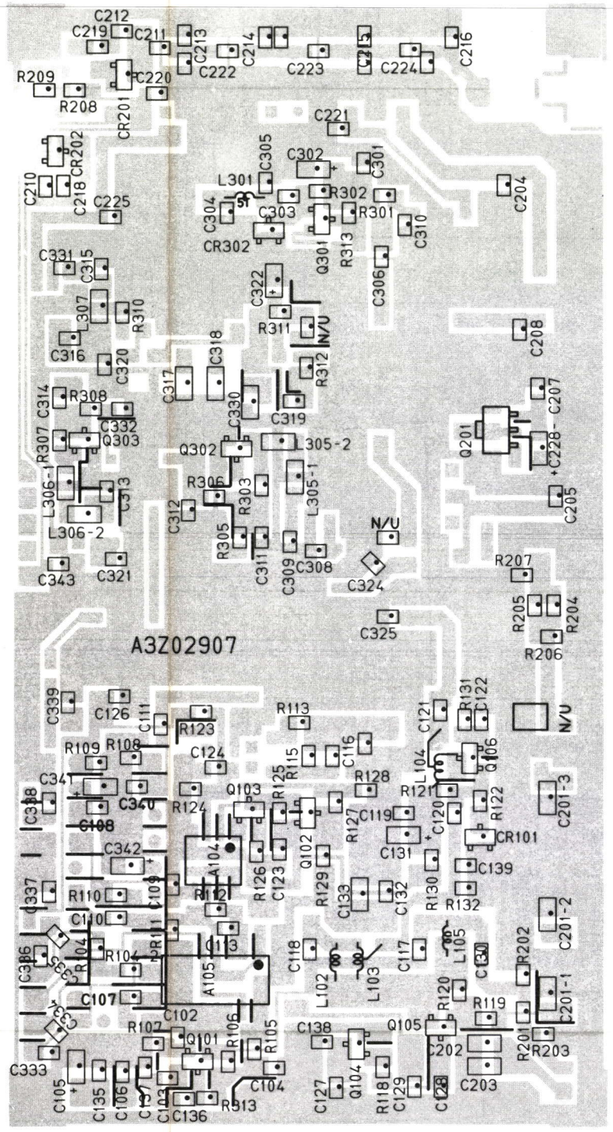
Issue 1

COMPONENT SIDE

SOLDER SIDE

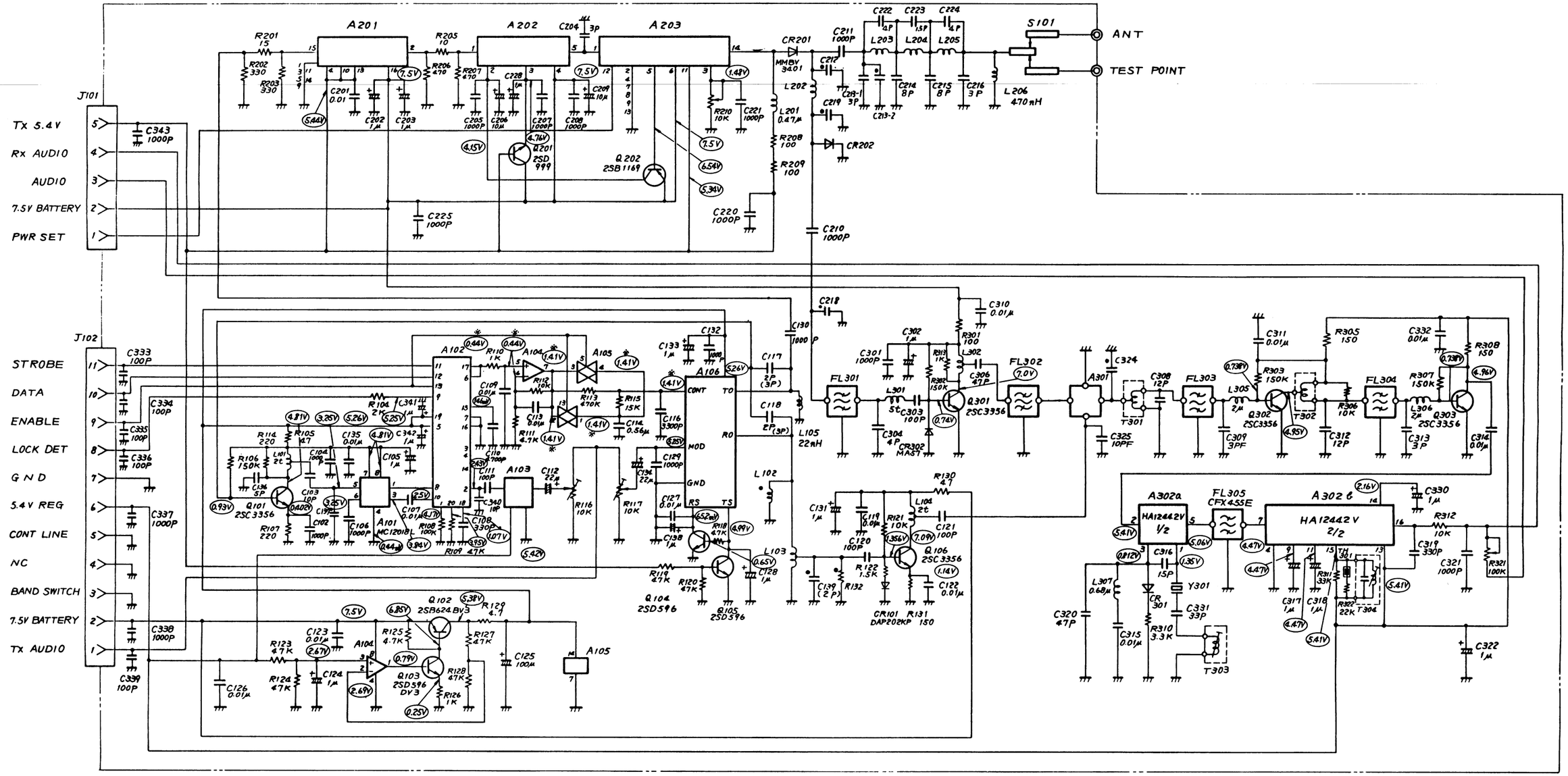


(A3Z02907)



RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

RF SECTION
Issue 1

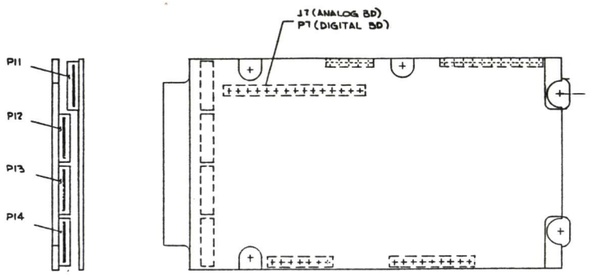


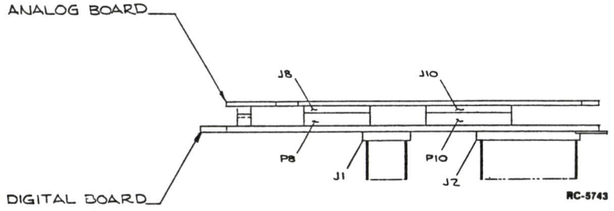
※ ; TYPICAL VOLTAGE AT LOWEST CHANNEL

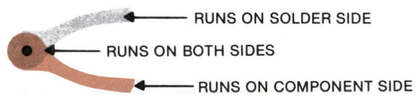
(A2WE03706)

RF SECTION
Issue 1

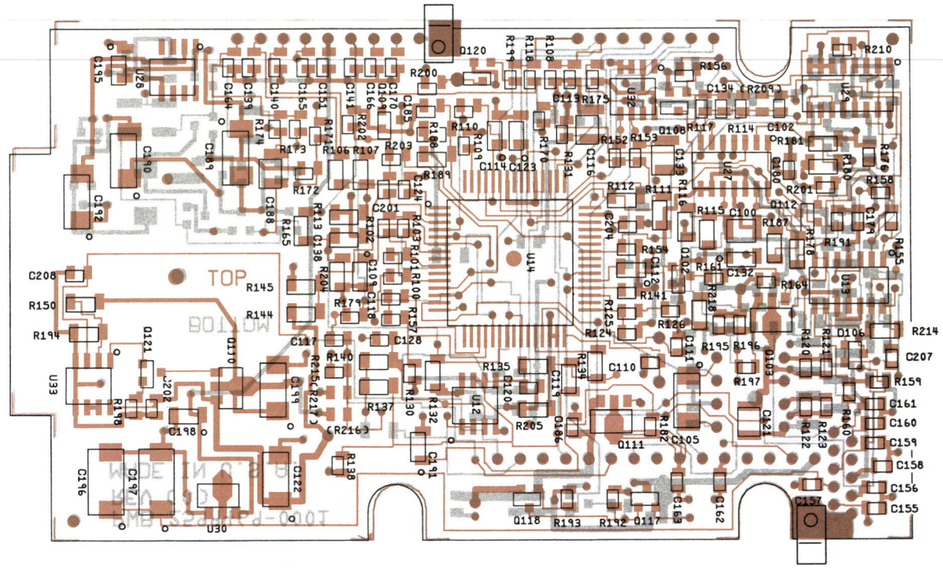
REV.0 / 860828



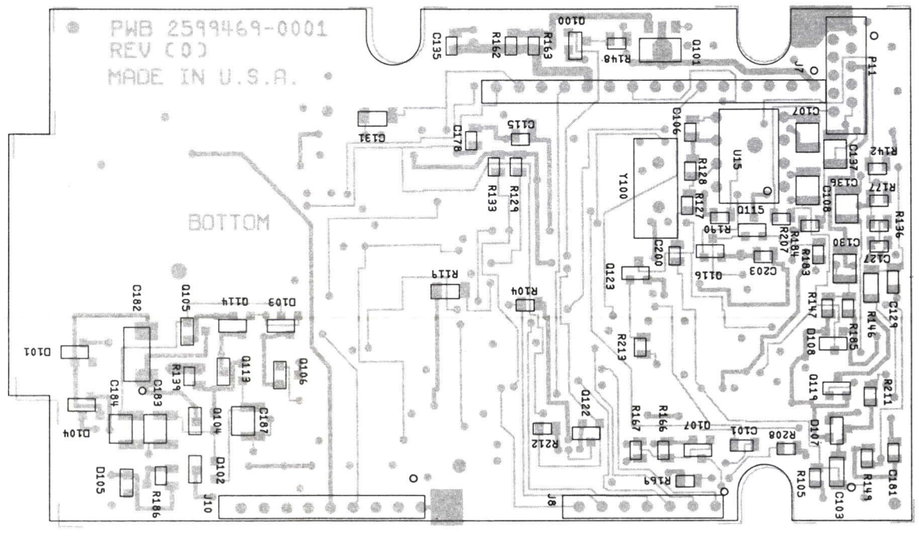




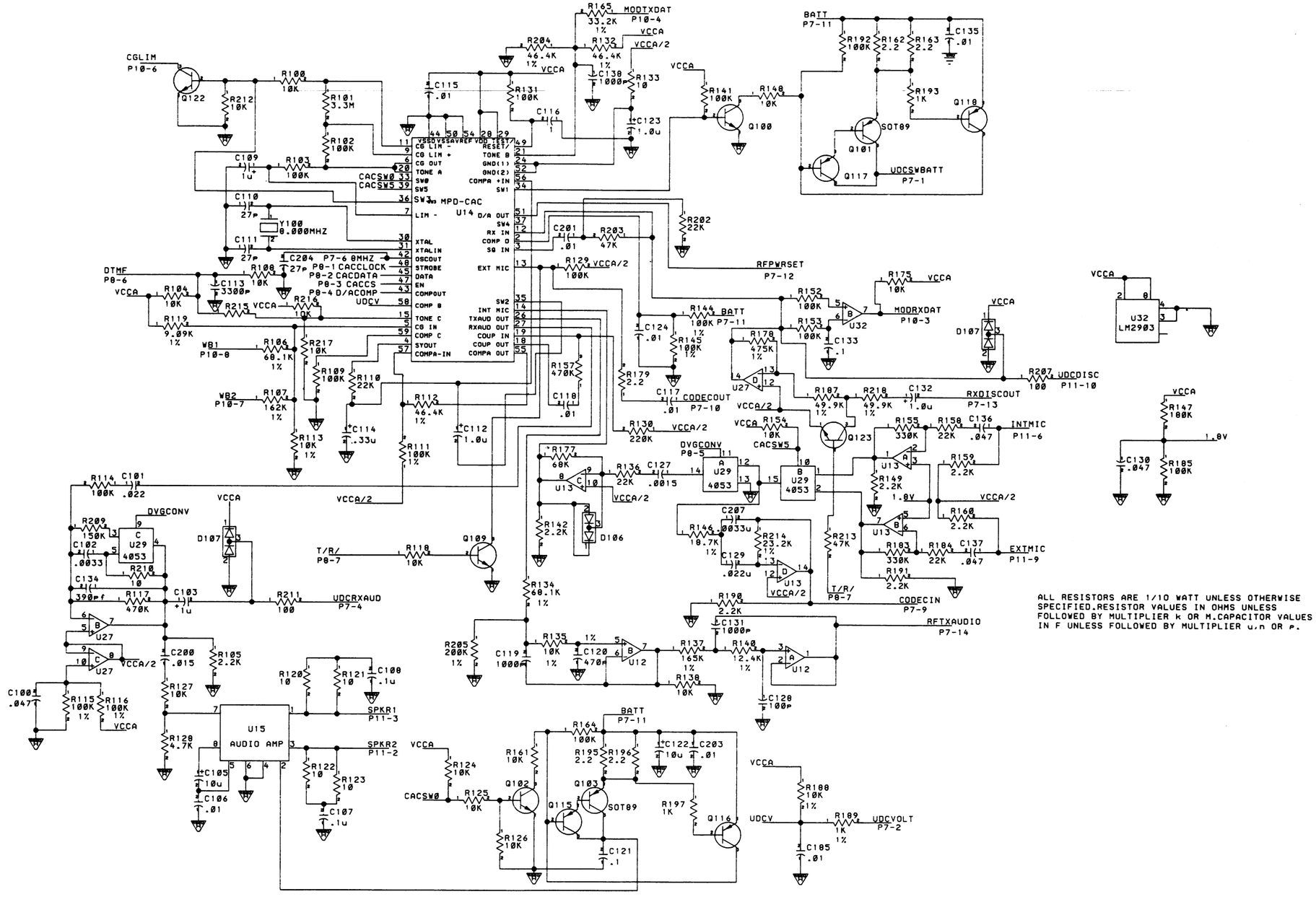
TOP SIDE



BOTTOM SIDE



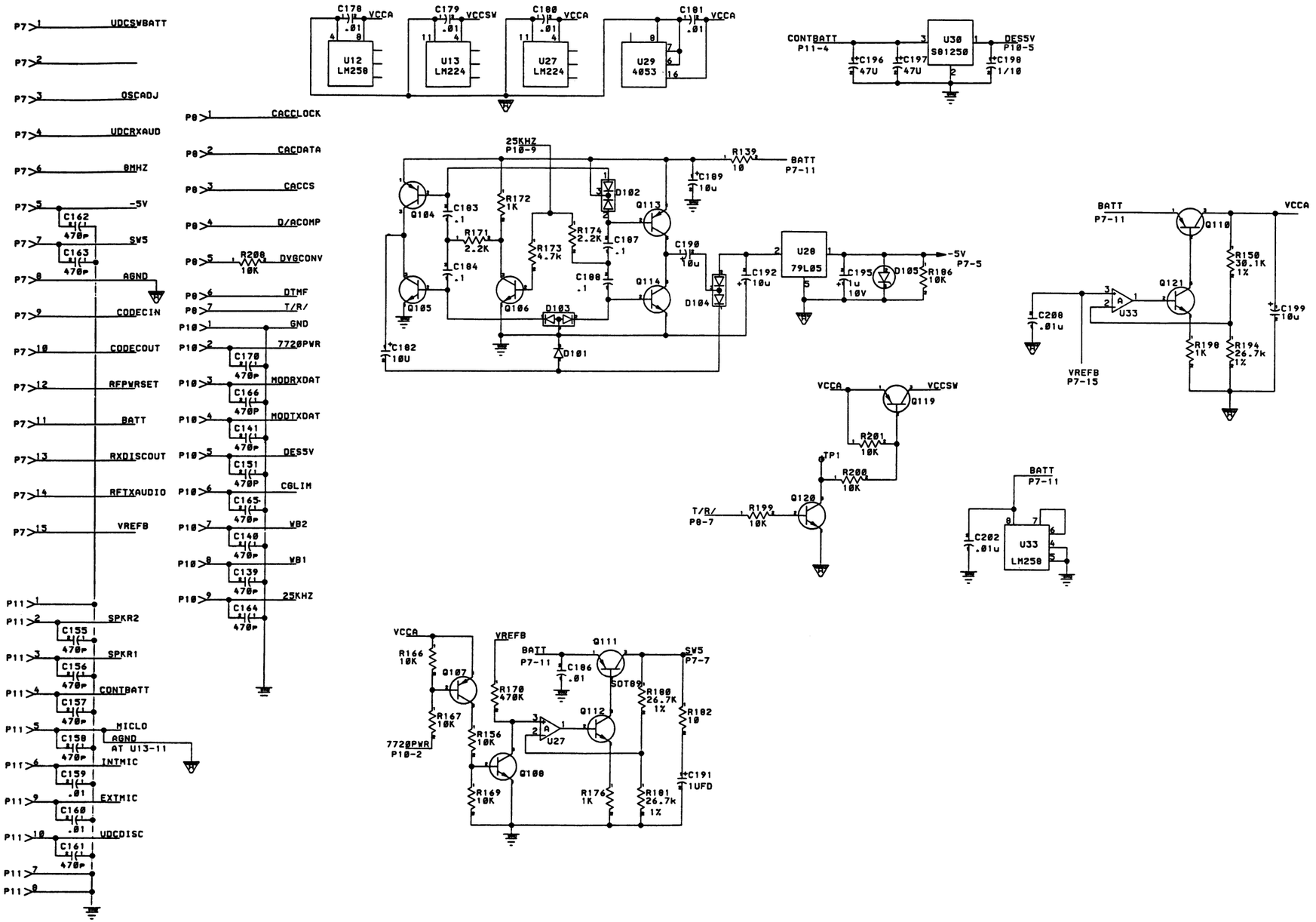
VOICE GUARD MODULE
Analog Board
Issue 1



ALL RESISTORS ARE 1/10 WATT UNLESS OTHERWISE SPECIFIED.RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY MULTIPLIER k OR M.CAPACITOR VALUES IN F UNLESS FOLLOWED BY MULTIPLIER u,n OR p.

(19D438234, Sheet 1)

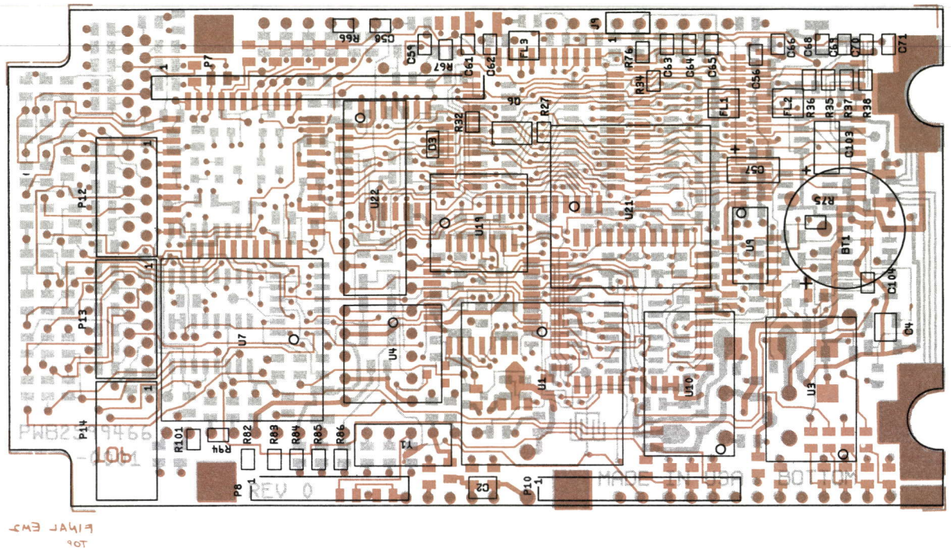
VOICE GUARD MODULE
Analog Board
Issue 1



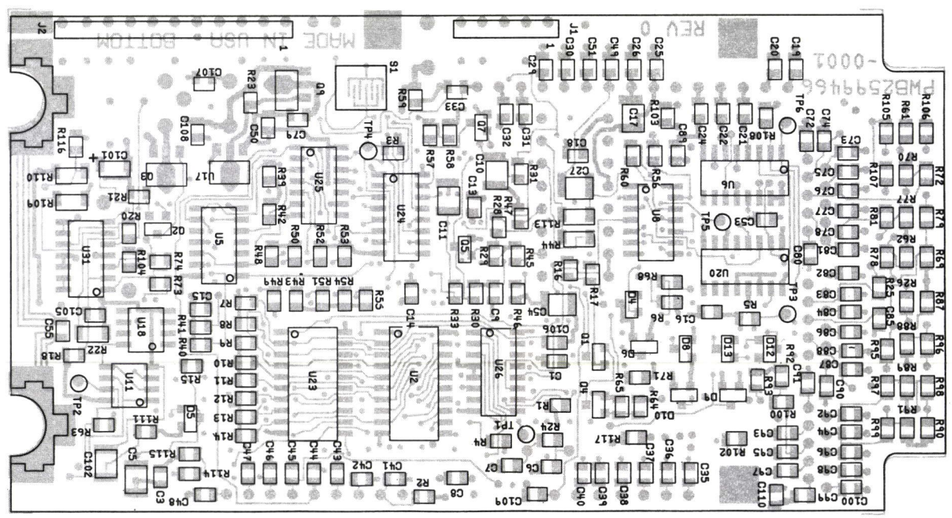
(19D438234, SHEET 2)

VOICE GUARD MODULE
Analog Board
Issue 1

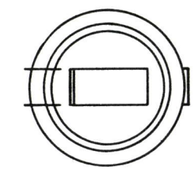
TOP SIDE

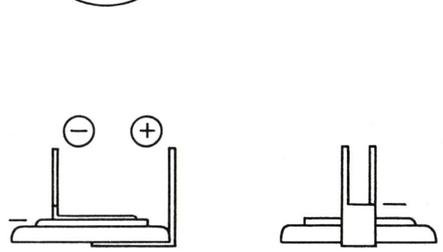


BOTTOM SIDE

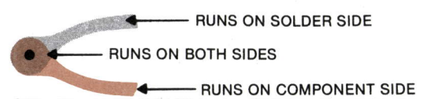


BATTERY BT1
(19B801255P1)

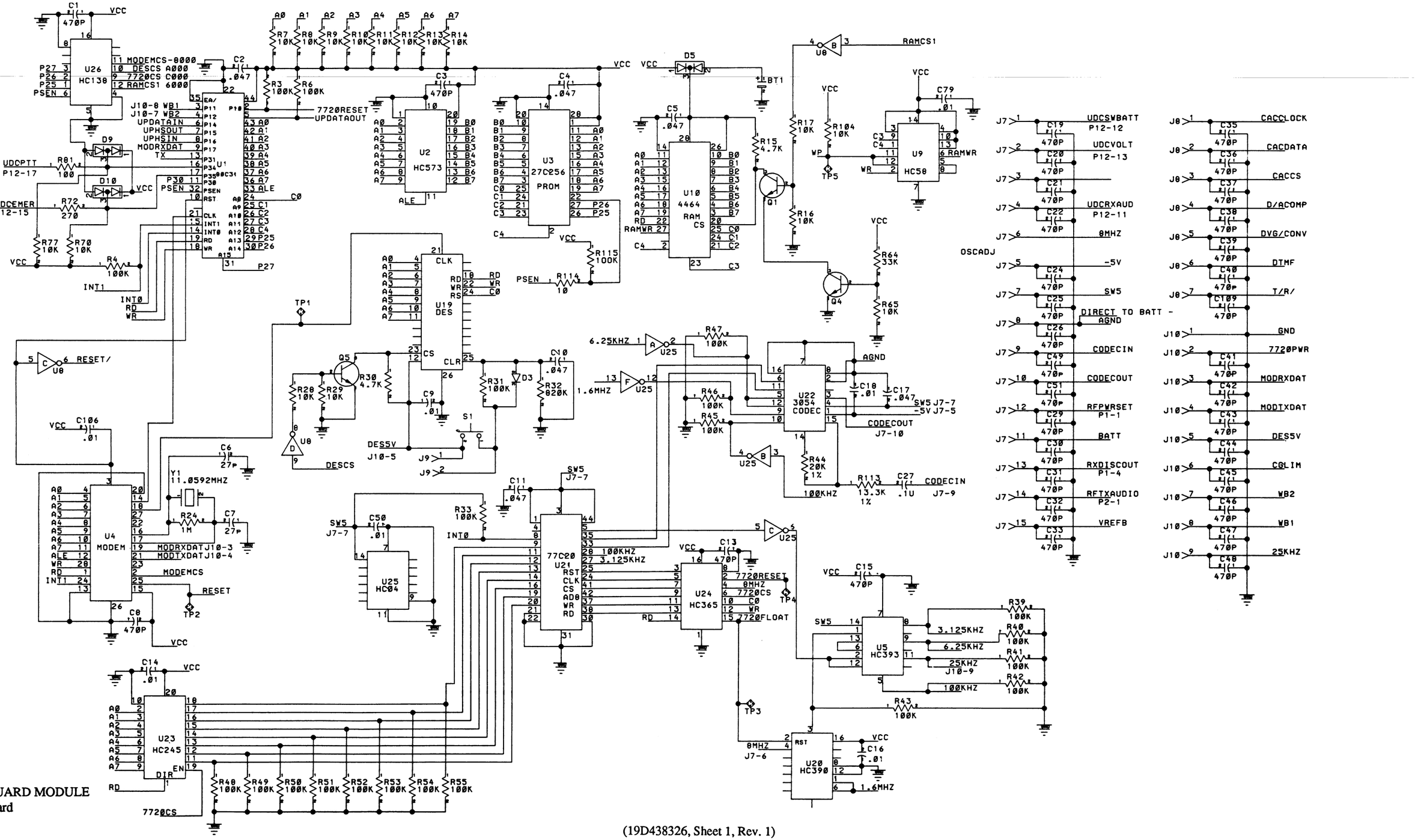




RC-5753

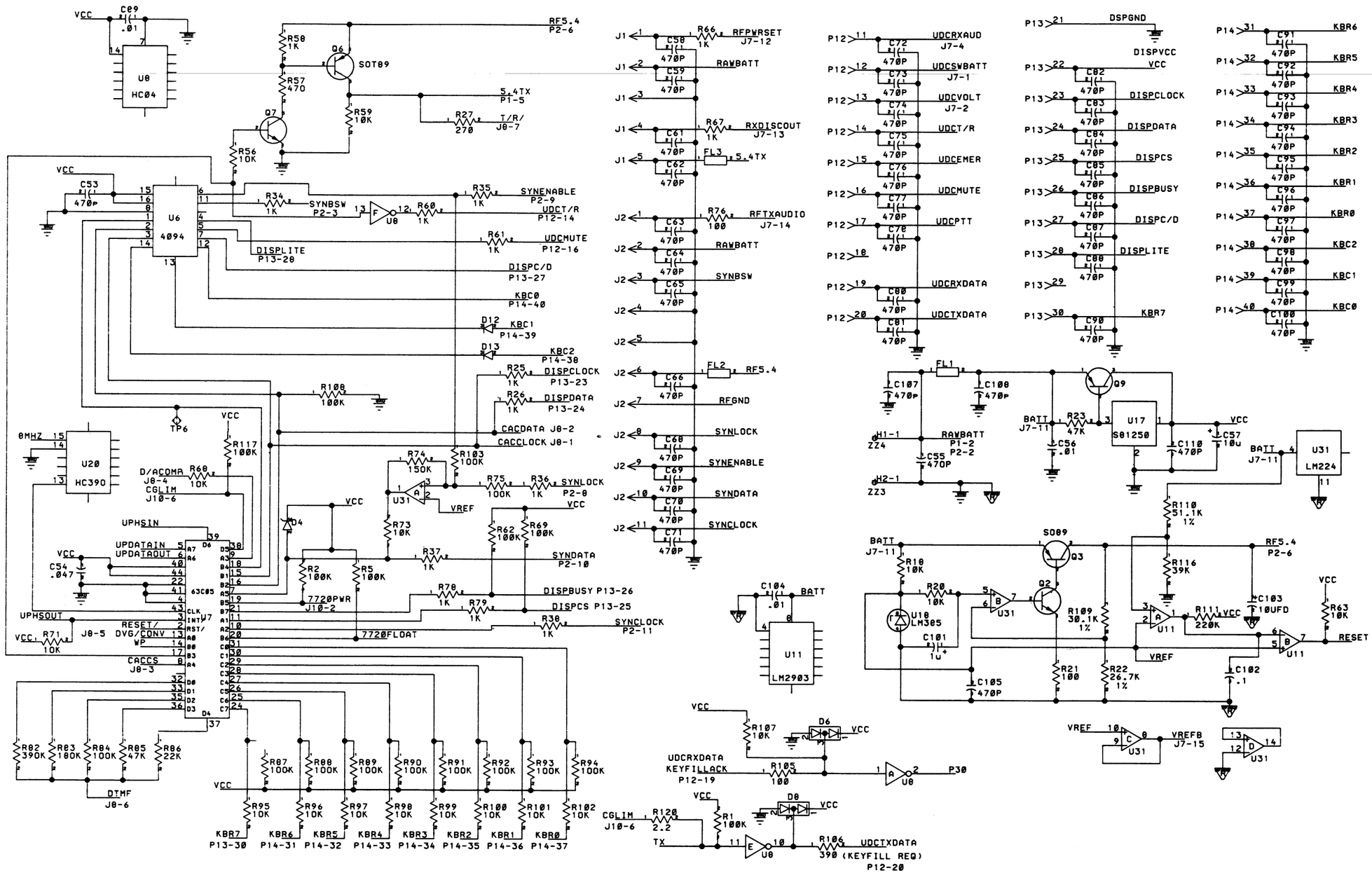


DIGITAL BOARD
Issue 1



VOICE GUARD MODULE
Digital Board
Issue 1

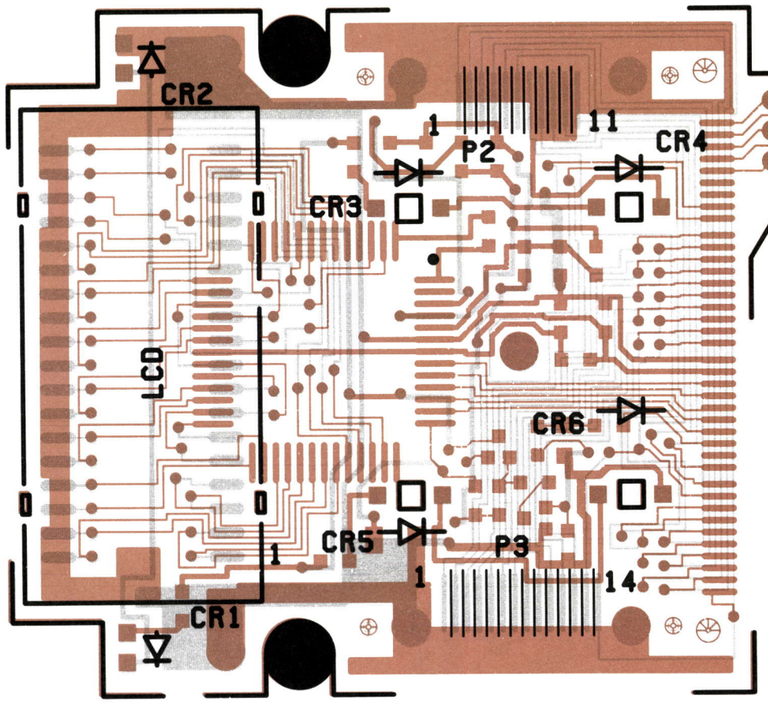
(19D438326, Sheet 1, Rev. 1)

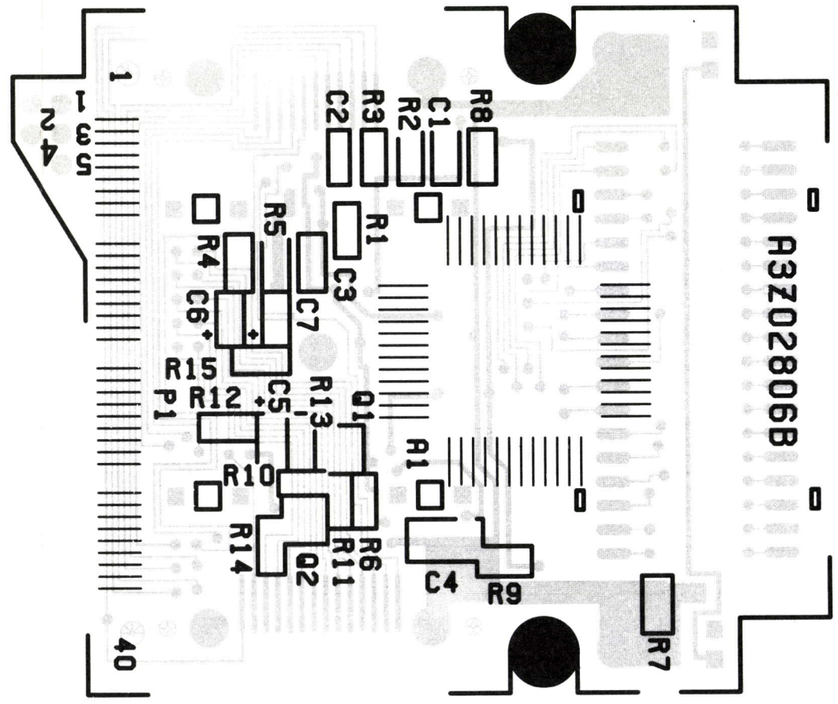


19D438236 Sh. 2, Rev. 1

COMPONENT SIDE

SOLDER SIDE

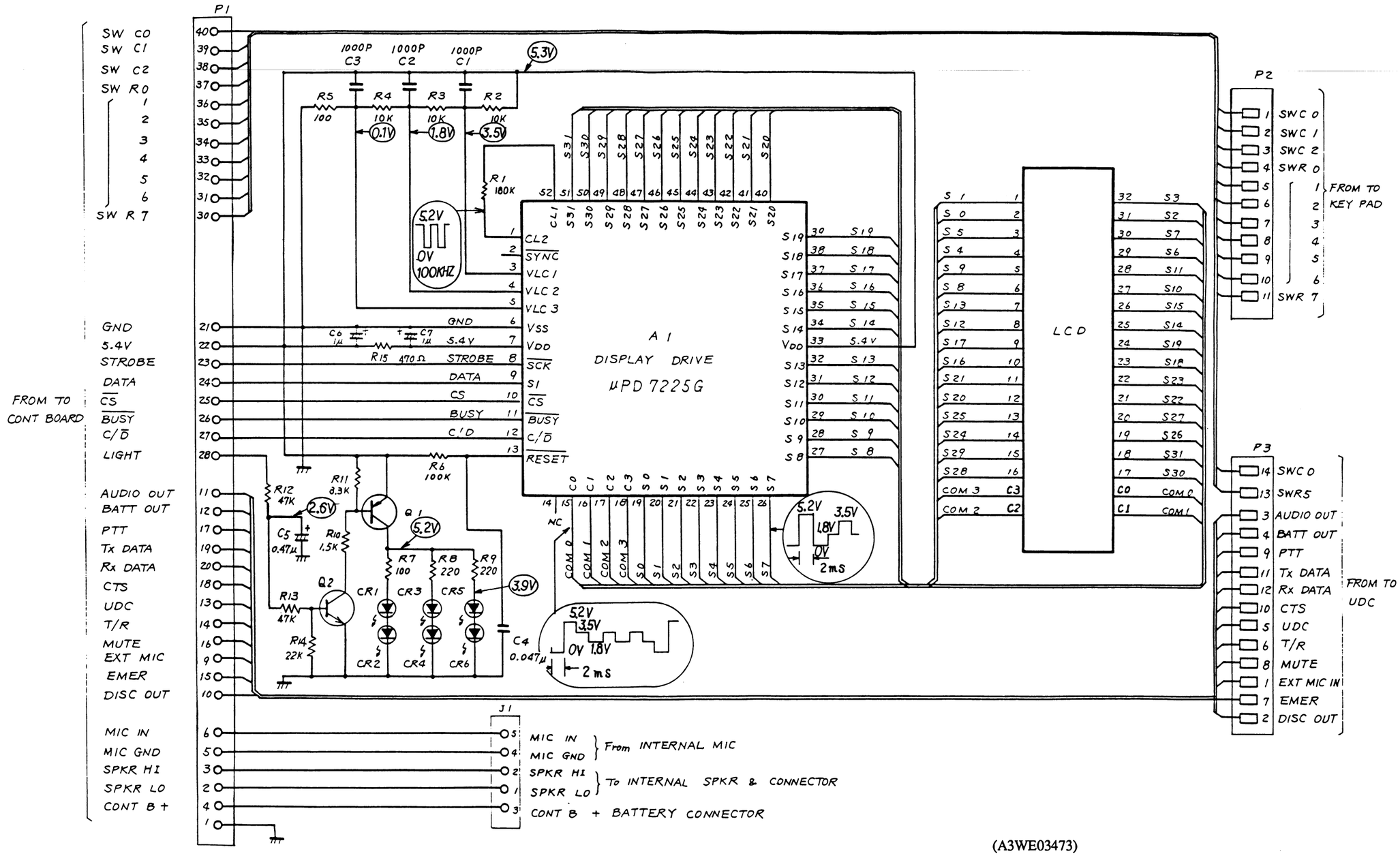




(A3Z02806B)

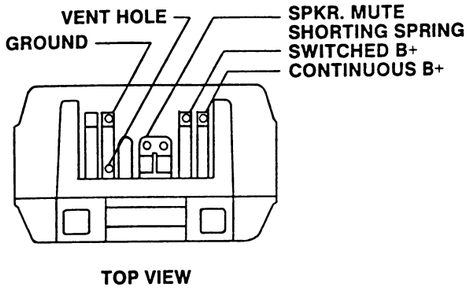
RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

LCD BOARD
Issue 1

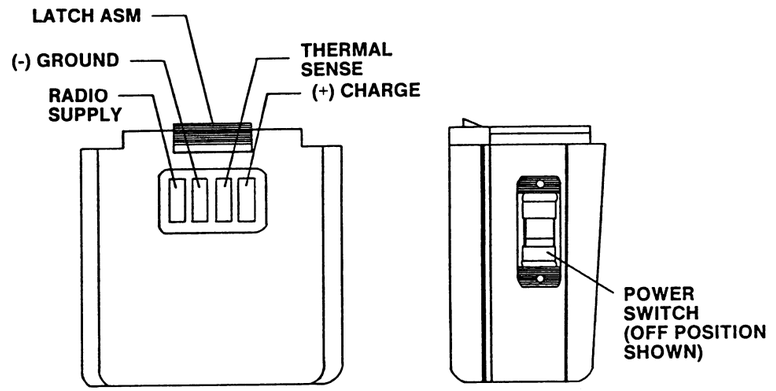


(A3WE03473)

LCD BOARD
Issue 1

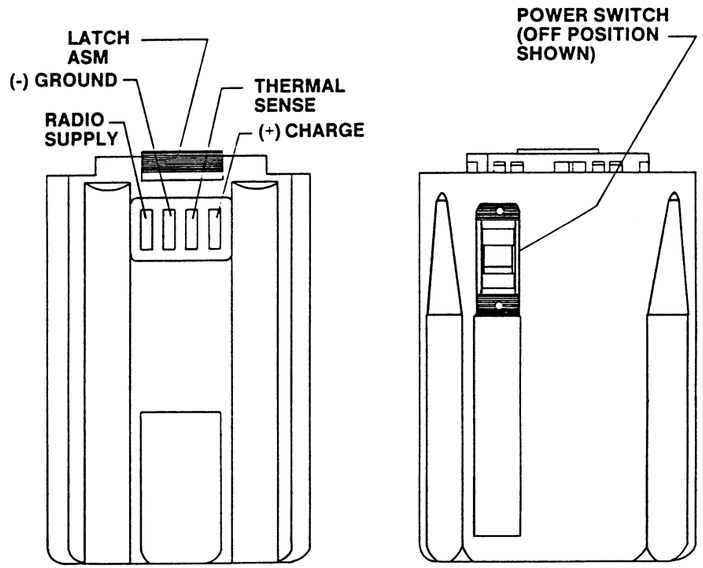


TOP VIEW



REAR VIEW SIDE VIEW

19A704850P5
(STANDARD CAPACITY)



REAR VIEW FRONT VIEW

19A704860P5
(HIGH CAPACITY)

RC-5784

Standard And High Capacity
Battery Packs
Issue 1

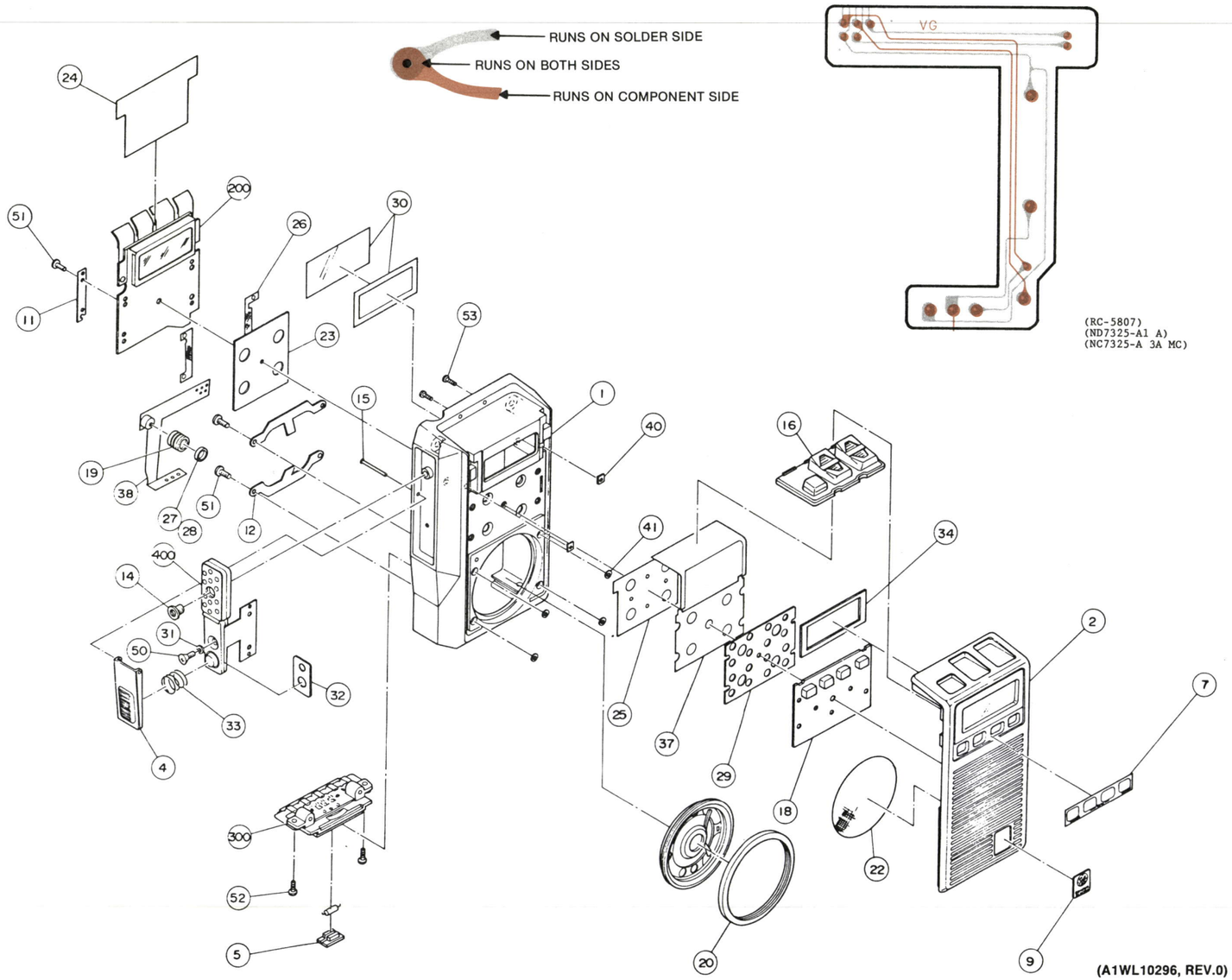
PARTS LIST

LBI-31972
M-PD VOICE GUARD
RADIO CHASSIS

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - - LCD BOARD - - - - - - - - - - -
	K19/A4WE04140	LCD (with CA1)
		- - - - - - - - - - FLEXIBLE BOARD - - - - - - - - -
CA1	K19/A3WL09327	LCD
CA2	K19/A3WL09236	Key Board
CA3	K19/A3WL09248	UDC
CA4	K19/A3WL09259	SPKR/MIC
		- - - - - - - - - - - CAPACITORS - - - - - - - - - - -
C1 thru C6	K19/2CAK013127	Ceramic chip: 1000 pF
		- - - - - - - - - - - - FUSES - - - - - - - - - - - -
F1	K19/2DDB010043	275005 (5A)
		- - - - - - - - - - - - SOCKETS - - - - - - - - - - -
J1	K19/	SL-101-T-102
J2	K19/	SL-101-T-102
		- - - - - - - - - - - MICROPHONE - - - - - - - - - -
MIC	K19/2SAA006109	EM-78
		- - - - - - - - - - - PINHEADER - - - - - - - - - - -
P1	K19/2PDA023150	68908-006P
		- - - - - - - - - - - SPEAKER - - - - - - - - - - -
SPKR	K19/2SDA001286	VS-50W-24ohm 0.5W

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

PART 38



ILLUSTRATED MECHANICAL PARTS
Front Cover Assembly
Issue 1

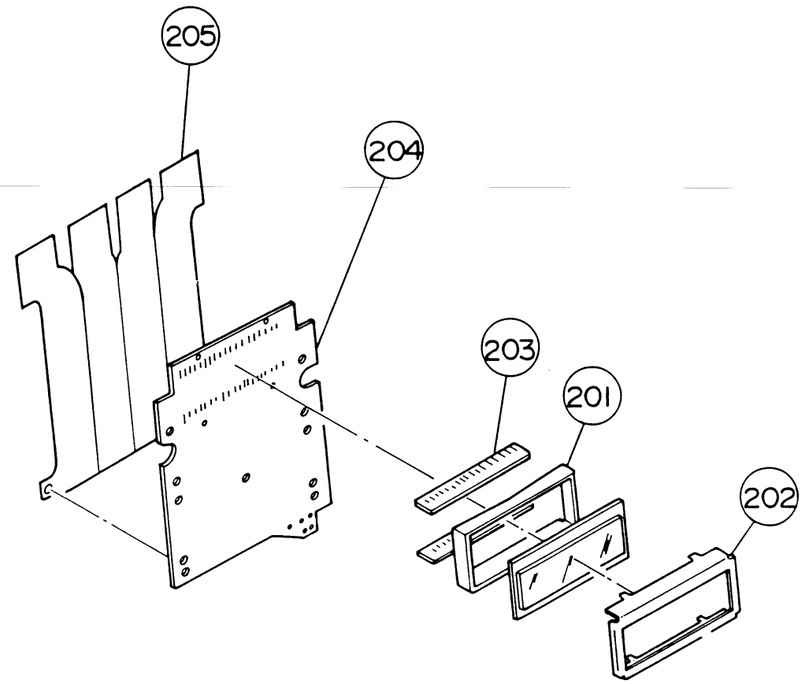
PARTS LIST

MECHANICAL PARTS
FOR
FRONT COVER ASSEMBLY
K19/A4WE04128
(REFER TO RC-5726)
ISSUE 1

SYMBOL	GE PART NO.	DESCRIPTION
	K19/A4WE04128	FRONT ASSEMBLY
1	K19/A1WL09114	Front cover
2	K19/A1WL09176	Front Escutcheon (SCAN) w/Window (K19/A3WL07574)
3		NOT USED
4	K19/A3WL07575	PTT Lever
5	K19/A3WL07577	Fuse Cover
6		NOT USED
7	K19/A4WL08954	Key Pad Name Plate (SCAN)
8		NOT USED
9	K19/A4WL07721	Nameplate (GE)
10		NOT USED
11	K19/A4WL07892	Plate
12	K19/A4WL09668	SPKR Mounting Bracket
13		NOT USED
14	K19/A4WL07605	UDC Nut
15	K19/A4WL07434	Pivot Pin
16	K19/A2WL09247	Top Switch Pad
17		NOT USED
18	K19/A3WL08854P2	4 Key Pad
19	K19/A4WL07594P2	Mic Gasket
20	K19/A4WL07910	SPKR Gasket
21		NOT USED
22	K19/A4WL09455	SPKR Dust Screen
23	K19/A4WL07606	Insulator (LCD BD.)
24	K19/A4WL08445	LCD Sheet
25	K29/A4WL08088	Adhesion Sheet
26	K19/A4WL08409	Rubber Sheet
27	K19/A4WL08385	MIC Film
28	K19/A4WL09037	Adhesion Ring
29	K19/A4WL07909	Front Sheet
30	K19/A4WL08437	Window Sheet
31	K19/A4WL08802	Nylon Washer
32	K19/A4WL09662	PTT Spacer
33	K19/A4WL09422	Coil Spring
34	K19/A4WL08673	Window Gasket
35		NOT USED
36		NOT USED
37	K19/A3WL09236	Top Flex Circuit
38	K19/A3WL09259	SPKR/MIC Flex Circuit
39		NOT USED
40	K19/A4WL09206	Rubber Spacer
41	K19/A4WL09169	Rubber Washer
42		NOT USED
43		NOT USED
44		NOT USED
45		NOT USED
46		NOT USED
47		NOT USED
48		NOT USED
49		NOT USED
50	K19/A4WL08827P1	Flat Head Screw, M2.6 x 4
51	K19/A4WL08828P2	Pan Head Tapping Screw, M2 x 6
52	K19/A4WL08828P3	Pan Head Tapping Screw, M2 x 10
53	K19/A4WL08828P4	Pan Head Tapping Screw, M1.6 x 4
54		NOT USED
55		NOT USED
56		NOT USED
57		NOT USED
58		NOT USED
59		NOT USED
60		NOT USED

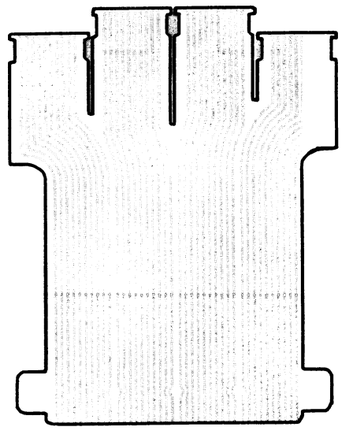
SYMBOL	GE PART NO.	DESCRIPTION
		LCD BOARD SUB ASSEMBLY (REFER TO RC-5727)
200	K19/A4WE04140	LCD BOARD SUB ASSEMBLY
201	K19/A3WL07601	Light Diffuser
202	K19/A3WL07614	LCD Frame
203	K19/A4WL07665	Zebra Contacts
204	K19/A3WL07895	LCD P.W. Board
205	K19/A3WL09327	LCD-Cont Flex. Circuit
		BASE PLATE SUB ASSEMBLY (REFER TO RC-5728)
300	K19/A3WL08781	BASE PLATE SUB ASSEMBLY
301	K19/A2WL07573	Base Plate
302		NOT USED
303	K19/A4WL07611	Battery Connector Springs
304	K19/A4WL07608	SPKR/MUTE Contacts
305	K19/A4WL07610	Contact Lug
306	K19/A4WL08007	Contact Lug B
307	K19/A4WL08629	Contact Lug C
308	K19/A4WL08630	Base Contact
309	K19/A4WL08628	Base Shield Spring
310	K19/A3WL08672	Base P.W. Board
311		NOT USED
312		NOT USED
313		NOT USED
314	K19/A4WL08827P2	Pan Head Screw
315		NOT USED
316		NOT USED
317		NOT USED
		UDC PTT SUB ASSEMBLY (REFER TO RC-5729)
400	K19/A3WL10279	UDC PTT SUB ASSEMBLY
401	K19/A3LW07576	UDC PTT Plate
402	K19/A4LW07604	UDC Contacts
403	K19/A3LW07580	PTT Switch Pad
404	K19/A3LW09248	UDC PTT Flex. Circuit

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES



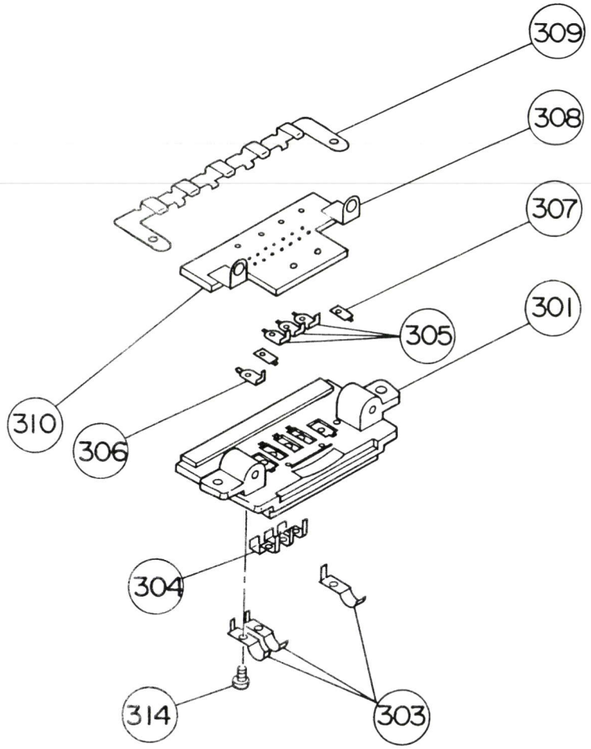
(A4WL10476, REV.0)
RC-5727

PART 205



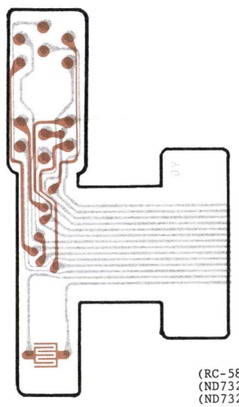
(RC-5808)
(ND7324-A1A:0)

ILLUSTRATED MECHANICAL PARTS
Front Cover Assembly
Issue

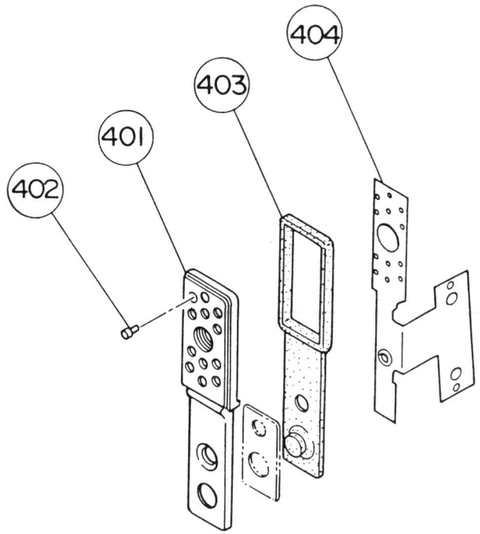


(A4WL10298, REV.0)
RC-5728

PART 404



(RC-5806)
(ND7328-A2B)
(ND7328-A3B)



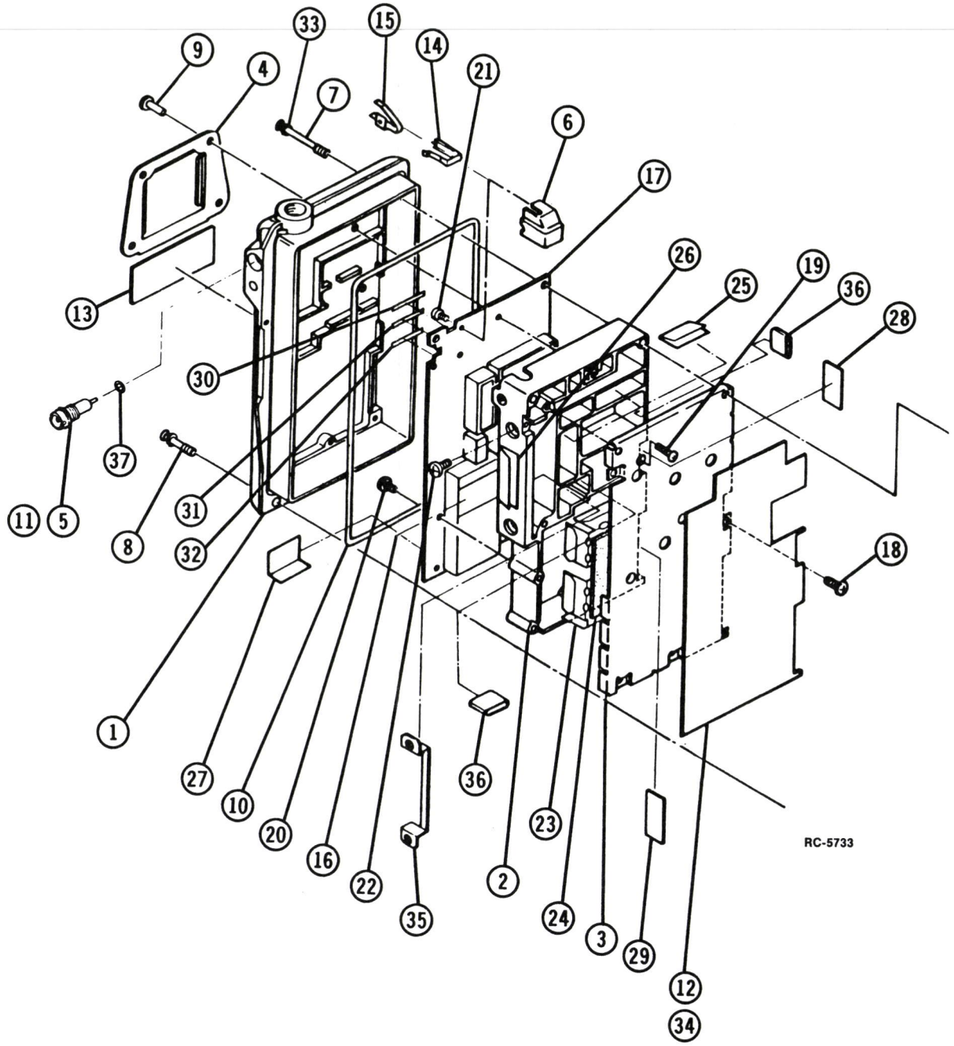
(A4WL10297, REV.0)
RC-5729

PARTS LIST

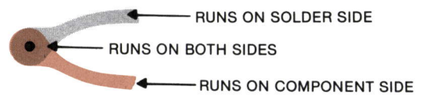
M-PD UHF RF SECTION
19B801509P5-12
MECHANICAL PARTS
(REFER TO RC-5733)
ISSUE 1

SYMBOL	GE PART NO.	DESCRIPTION
1	K19/A1WL07561	Rear Cover
2	K19/A1WL07570P2	EGG Crate
3	K19/A2WL07512	Tx/Rx Shield Cover
4	K19/A3WL07509	Receptacle Plate
5	K19/A4WL08826	RF Connector
6	K19/A3WL07654	Antenna Switch Housing
7	K19/A4WL07499P2	Captive Screws
8	K19/A4WL07499P1	Captive Screws
9	K19/A4WL07694	Rivets
10	K19/A4WL08383	Housing Gasket
11	K19/A4WL07880	RF Connector Gasket
12	K19/A3WL07513	Insulator
13	K19/A4WL08694	Label
14	K19/A4WL07655	ANT Switch Spring B
15	K19/A4WL07656	ANT Switch Spring A
16	K19/A4WL07727	Shield Plate
17	K19/A3WL08693	Tx/Rx P.W. Board
18	K19/A4WL08827P3	Pan Head Screw with SW, M2 x 4
19	K19/A4WL08827P6	Pan Head Screw with SW, M2 x 15
20	K19/A4WL08827P7	Pan Head Screw, M2 x 4
21	K19/A4WL08828P1	Pan Head Tapping Screw, M2 x 4
22	K19/A4WL08827P8	Pan Head Screw with SW, M2.6 x 6
23	K19/A4WL07595	Shield Cover
24	K19/A4WL08494	VCO Rubber
25	K19/A4WL08829	RF Spring A
26	K19/A4WL08830	RF Spring B
27	K19/A4WL08832	RF Shield Plate, (Used 800 MHz only)
28	K19/A4WL08495P1	Connector Spacer A
29	K19/A4WL08495P2	Connector Spacer B
30	K19/A4WL08831P1	RF PWB Contact A
31	K19/A4WL08831P2	RF PWB Contact B
32	K19/A4WL08831P3	RF PWB Contact C
33	K19/A4WL08802	Nylon Washer
34	K19/A4WL08698	Tracking Data Label
35	K19/A4WL07663	Power Pack Bracket
36	K19/A4ZL05484	Crystal Protection Tube
37	K19/A4WL08848	RF Connector Washer

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.



RC-5733



ILLUSTRATED PARTS BREAKDOWN
RF SECTION
Issue 1

PARTS LIST

PARTS LIST

UHF M-PD
PERSONAL RADIO
A4WE03712
ISSUE 2

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - - -
A101	K19/2ABD004124	Prescaler MC12018L
A102	K19/2AAJ004062	PLL MC145159P1
A103	K19/2YBA106090	VCTCXO A4WX01328-2.5 ppm
	K19/2YBA106082	VCTCXO A4WX01328-5 ppm
A104	K19/2AAB004243	OP AMP UPC1251BG
A105	K19/2ABC039105	Analog Switch UPD4066BG
A106	K19/200KLH3553	VCO A4WX01392 #4.1.1 KLH3553, 403-440 MHz
	K19/200KLH3554	VCO A4WE01392 #4.1.2 KLH3554, 440-470 MHz
	K19/200KLH3555	VCO A4WE01392 #4.1.3 KLH3555, 470-512 MHz
A201	K19/200KLH2590	Gain Hybrid KLH2590
A202	K19/2AAA013120	PA Pack A4WX01422-2L, 403-440 MHz
	K19/2AAA013138	PA Pack A4WX01422-2M, 440-470 MHz
	K19/2AAA013146	PA Pack A4WX01422-2H, 470-512 MHz
A203	K19/200KLH8514	PWR-Cont KLH9514
A301	K19/2EDG002010	Mixer UST-1L A4WX01375
A302	K19/2AAJ008089	IF HA12442V
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C102	K19/2CAK009208	Ceramic chip 1000 pF ±10% 50V
C103	K19/2CAK009257	Ceramic chip 10 pF ±0.5 pF 50V
C104	K19/2CAK009208	Ceramic chip 1000 pF ±10% 50V
C105	K19/2CCF004086	Tantalum 1 uF 16V
C106	K19/2CAK009208	Ceramic chip 1000 pF ±10% 50V
C107	K19/2CAK009216	Ceramic chip 0.01 uF ±10% 50V
C108	K19/2CAK009190	Ceramic chip 330 pF ±5% 50V
C109	K19/2CAK009216	Ceramic chip 0.01 uF ±10% 50V
C110	K19/2CAK009331	Ceramic chip 4700 pF ±10% 50V
C111	K19/2CAK009182	Ceramic chip 100 pF ±5% 50V
C112	K19/2CBB034121	Electrolytic 22 uF 16V
C113	K19/2CAK009216	Ceramic chip 0.01 uF ±10% 50V
C114	K19/2CDA055016	MET POLY-PROP Film 0.56 uF 50V
C116	K19/2CAK009323	Ceramic chip 3300 pF ±10% 50V
C117	K19/2CAK009034	Ceramic chip 3 pF ±0.25 pF 50V, 403-440 MHz
	K19/2CAK009026	Ceramic chip 2 pF ±0.25 pF 50V, 440-512 MHz
C118	K19/2CAK009034	Ceramic chip 3 pF ±0.25 pF 50V, 403-440 MHz
	K19/2CAK009026	Ceramic chip 2 pF ±0.25 pF 50V, 440-512 MHz
C119	K19/2CAK009216	Ceramic chip 0.01 uF ±10% 50V
C120 and C121	K19/2CAK009182	Ceramic chip 100 pF ±5% 50V
C122 and C123	K19/2CAK009216	Ceramic chip 0.01 uF ±10% 50V
C124	K19/2CCF004086	Tantalum 1 uF 16V
C125	K19/2CBB062171	Electrolytic 100 uF 25V
C126 and C127	K19/2CAK009216	Ceramic chip 0.01 uF ±10% 50V
C128	K19/2CCF004086	Tantalum 1 uF 16V
C129 and C130	K19/2CAK009208	Ceramic chip 1000 pF ±10% 50V
C131	K19/2CCF004086	Tantalum 1 uF 16V
C132	K19/2CAK009208	Ceramic chip 1000 pF ±10% 50V
C133	K19/2CCF004086	Tantalum 1 uF 16V
C134	K19/2CBB034121	Electrolytic 22 uF 16V
C135	K19/2CAK009216	Ceramic chip 0.01 uF ±10% 50V
C136	K19/2CAK009059	Ceramic chip 5 pF ±0.25 pF 50V
C137	K19/2CAK009026	Ceramic chip variable 0 pF-10 pF (2 pF ±0.25 pF)
C138	K19/2CCF004086	Tantalum 1 uF 16V
C139	K19/2CAK009026	Ceramic chip 2 pF ±0.25 pF 50V, 403-440 MHz
C201	K19/2CAK009216	Ceramic chip 0.01 uF ±10% 50V
C202 and C203	K19/2CCF004086	Tantalum 1 uF 16V
C204	K19/2CAK009034	Ceramic chip 3 pF ±0.25 pF 50V, 403-440 MHz
C205	K19/2CAK009208	Ceramic chip 1000 pF ±10% 50V
C206	K19/2CCB026018	Tantalum 10 uF 16V
C207 and C208	K19/2CAK009208	Ceramic chip 1000 pF ±10% 50V
C209	K19/2CCB026018	Tantalum 10 uF 16V
C210 and C211	K19/2CAK009208	Ceramic chip 1000 pF ±10% 50V
C212	K19/2CAK009059	Ceramic chip 5 pF ±0.25 pF 50V, 403-440 MHz
	K19/2CAK009281	Ceramic chip 6 pF ±0.25 pF 50V, 440-470 MHz
	K19/2CAK009299	Ceramic chip 7 pF ±0.25 pF 50V, 470-512 MHz
C213-1	K19/2CAK009034	Ceramic chip 3 pF ±0.25 pF 50V
C213-2	K19/2CAK009240	Ceramic chip 0.5 pF 50V, 440-470 MHz
C214 and C215	K19/2CAK009307	Ceramic chip 8 pF ±0.5 pF 50V
C216	K19/2CAK009034	Ceramic chip 3 pF ±0.25 pF 50V
C217	K19/2CAK009208	Ceramic chip 1000 pF +10% 50V
C218	K19/2CAK009042	Ceramic chip 4 pF ±0.25 pF 50V, 403-440 MHZ
	K19/2CAK009059	Ceramic chip 5 pF ±0.25 pF 50V, 440-470 MHz
	K19/2CAK009059	Ceramic chip 5 pF ±0.25 pF 50V, 470-512 MHz
C219	K19/2CAK009018	Ceramic chip 1 pF ±0.25 pF 50V, 403-440 MHz
	K19/2CAK009018	Ceramic chip 1 pF ±0.25 pF 50V, 470-512 MHz
C220 and C221	K19/2CAK009208	Ceramic chip 1000 pF +10% 50V
C222	K19/2CAK009042	Ceramic chip 4 pF ±0.25 pF 50V
C223	K19/2CAK009349	Ceramic chip 1.5 pF ±0.25 pF 50V
C224	K19/2CAK009042	Ceramic chip 4 pF ±0.25 pF 50V
C225	K19/2CAK009208	Ceramic chip 1000 pF ±10% 50V
C228	K19/2CCF004086	Tantalum 1 uF 16V
C301	K19/2CAK009208	Ceramic chip 1000 pF ±10% 50V
C302	K19/2CCF004086	Tantalum 1 uF 16V
C303	K19/2CAK009182	Ceramic chip 100 pF ±5% 50V
C304	K19/2CAK009042	Ceramic chip 4 pF ±0.25 pF 50V
C306	K19/2CAK009166	Ceramic chip 47 pF ±5% 50V
C308	K19/2CAK009109	Ceramic chip 12 pF ±5% 50V
C309	K19/2CAK009034	Ceramic chip 3 pF ±0.25 pF 50V
C310 and C311	K19/2CAK009216	Ceramic chip 0.01 uF ±10% 50V
C312	K19/2CAK009109	Ceramic chip 12 pF ±5% 50V
C313	K19/2CAK009034	Ceramic chip 3 pF ±0.25 pF 50V
C314	K19/2CAL039216	Ceramic chip 0.01 uF ±10% 50V
C315	K19/2CAK009216	Ceramic chip 0.01 uF ±10% 50V
C316	K19/2CAK009125	Ceramic chip 15 pF ±5% 50V
C317 and C318	K19/2CCF004086	Tantalum 1 uF 16V
C319	K19/2CAK009190	Ceramic chip 330 pF ±5% 50V
C320	K19/2CAK009166	Ceramic chip 47 pF ±5% 50V
C321	K19/2CAK009208	Ceramic chip 1000 pF +10% 50V
C322	K19/2CCF004086	Tantalum 1 uF 16V
C324	K19/2CAK009281	Ceramic chip 6 pF ±0.25 pF 50V, 403-440 MHz
	K19/2CAK009281	Ceramic chip 6 pF ±0.25 pF 50V, 440-470 MHz
	K19/2CAK009042	Ceramic chip 4 pF ±0.25 pF 50V, 470-512 MHz
C325	K19/2CAK009257	Ceramic chip 10 pF ±0.25 pF 50V
C330	K19/2CCF004086	Tantalum 1 uF 16V
C331	K19/2CAK009158	Ceramic chip 33 pF +5% 50V
C332	K19/2CAK009216	Ceramic chip 0.01 uF ±10% 50V
C333 thru C336	K19/2CAK009182	Ceramic chip 100 pF ±5% 50V
C337 and C338	K19/2CAK009208	Ceramic chip 1000 pF ±10% 50V
C339	K19/2CAK009182	Ceramic chip 100 pF ±5% 50V
C340	K19/2CAK009257	Ceramic chip 10 pF ±0.25 pF 50V
C341 and C342	K19/2CCF004086	Tantalum 1 uF 50V
C343	K19/2CAK009208	Ceramic chip 1000 pF ±10% 50V
		- - - - - - - - - - DIODES - - - - - - - - - -
CR101	K19/2QBE005024	DAP202KT-96
CR201 thru CR203	K19/2QBA009079	MMBV3401
CR301	K19/2QBA006166	1S2075K
CR302	K19/2QBA012024	MA57
		- - - - - - - - - - FILTERS - - - - - - - - - -
FL301	K19/2FBD001505	A3FX01902 (#1) #2 (#3), 403-440 MHz
	K19/2FBD001539	A3FX01902 (#4) #5, 440-470 MHz
	K19/2FBD001554	A3FX01902 (#6) #7 (#8), 470-512 MHz
FL302	K19/2FBD001505	A3FX01902 (#1) #2 (#3), 403-440 MHz
	K19/2FBD001539	A3FX01902 (#4) #5, 440-470 MHz
	K19/2FBD001554	A3FX01902 (#6) #7 (#8), 470-512 MHz
FL303	K19/2FAA103041	A4WX01306
FL304	K19/2FAA103058	A4WX01307
FL305	K19/2FAD001242	CFX455E
		- - - - - - - - - - JACKS - - - - - - - - - -
J101	K19/2PDA023036	69775-005
J102	K19/2PDA023044	69775-011
		- - - - - - - - - - COILS - - - - - - - - - -
L101	K19/2EDE001022	A4WX01365
L102	K19/2LAB024199	A4FX01878 #10, 403-440 MHz
	K19/2LAB024173	A4FX01878 #8, 440-470 MHz
	K19/2LAB024165	A4FX01878 #7, 470-512 MHz
L103 and L104	K19/2EDE001022	A4WX01365
L105	K19/2LAD001096	NL322522T-022M
L201	K19/2LAA001743	LAL02KRR47M

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

SYMBOL	GE PART NO.	DESCRIPTION
L202	K19/2A4W208763	3 2T R1 +1.5MM, 403-440 MHz
	K19/2A4W208762	440-470 MHz
	K19/2A4W208762	470-512 MHz
L203	K19/2A4W207904	
L204	K19/2A4W208762	
L205	K19/2A4W207904	
L206	K19/2LAA001743	LAL02KRR47M
L301	K19/2LAB024140	A4FX01878 #5
L302	K19/2EDF001022	A4WX01365
L305	K19/2LAD001062	MLF3216D1R0K
L306	K19/2LAD001062	MLF3216D1R0K
L307	K19/2LAD001021	MLF3216DR68K
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q101	K19/2QAD004020	2SC3356R22
Q102	K19/2QAD004087	2SB624BV3
Q103 thru Q105	K19/2QAD004046	2SD596DV3
Q106	K19/2QAD004020	2SC3356R22
Q201	K19/2QAD004053	2SD999
Q202	K19/2QAB015077	2SB1169
Q301 thru Q303	K19/2QAD004020	2SC3356R22
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R104	K19/2RGC003110	Square chip 1/16W 1K ohms ±5%
R105	K19/2RGC003342	Square chip 1/16W 47 ohms ±5%
R106	K19/2RGC003243	Square chip 1/16W 150K ohms ±5%
R107	K19/2RGC003060	Square chip 1/16W 220 ohms ±5%
R108	K19/2RGC003227	Square chip 1/16W 100K ohms ±5%
R109	K19/2RGC003219	Square chip 1/16W 47K ohms ±5%
R110	K19/2RGC003110	Square chip 1/16W 1K ohms ±5%
R111	K19/2RGC003151	Square chip 1/16W 4.7K ohms ±5%
R112	K19/2RGC003177	Square chip 1/16W 10K ohms ±5%
R113	K19/2RGC003276	Square chip 1/16W 470K ohms ±5%
R114	K19/2RGC003060	Square chip 1/16W 220 ohms ±5%
R115	K19/2RGC003185	Square chip 1/16W 15K ohms ±5%
R116 and R117	K19/2RFB003253	Variable GF04W 10K ohms
R118 thru R120	K19/2RGC003219	Square chip 1/16W 47K ohms ±5%
R121	K19/2RGC003177	Square chip 1/16W 10K ohms ±5%
R122	K19/2RGC003425	Square chip 1/16W 1.5K ohms +5%
R123 and R124	K19/2RGC003219	Square chip 1/16W 47K ohms ±5%
R125	K19/2RGC003151	Square chip 1/16W 4.7K ohms ±5%
R126	K19/2RGC003110	Square chip 1/16W 1K ohms ±5%
R127 and R128	K19/2RGC003219	Square chip 1/16W 47K ohms ±5%
R129	K19/2RGC003383	Square chip 1/16W 4.7 ohms ±5%
R130	K19/2RGC003342	Square chip 1/16W 47 ohms ±5%
R131	K19/2RGC003045	Square chip 1/16W 150 ohms ±5%
R132	K19/2RGC003037	Square chip variable 1/16W 100 ohms ±5%
R201	K19/2RGC003375	Square chip 1/16W 15 ohms ±5%
R202 and R203	K19/2RGC003086	Square chip 1/16W 330 ohms ±5%

SYMBOL	GE PART NO.	DESCRIPTION
R205	K19/2RGC003326	Square chip 1/16W 10 ohms ±5%
R206 and R207	K19/2RGC003094	Square chip 1/16W 470 ohms ±5%
R208 and R209	K19/2RGC003037	Square chip 1/16W 100 ohms ±5%
R210	K19/2RFB003253	Variable GF04W 10K ohms
R301	K19/2RGC003037	Square chip 1/16W 100 ohms ±5%
R302 and R303	K19/2RGC003243	Square chip 1/16W 150K ohms ±5%
R305	K19/2RGC003045	Square chip 1/16W 150 ohms ±5%
R306	K19/2RGC003177	Square chip 1/16W 10K ohms ±5%
R307	K19/2RGC003243	Square chip 1/16W 150K ohms ±5%
R308	K19/2RGC003045	Square chip 1/16W 150 ohms ±5%
R310	K19/2RGC003144	Square chip 1/16W 3.3K ohms ±5%
R311	K19/2RGC003201	Square chip 1/16W 33K ohms ±5%
E312	K19/2RGC003177	Square chip 1/16W 10K ohms ±5%
R313	K19/2RGC003110	Square chip 1/16W 1K ohms ±5%
R321	K19/2RFB003261	Variable GF04W 100K ohms
R322	K19/2RGC003193	Square chip 1/16W 22K ohms ±5%
		- - - - - - - - - - TRANSFORMERS - - - - - - - - - -
T301 and T302	K19/2LAB014893	A4WX01333
T303	K19/2LAB014901	A4WX01334
T304	K19/2LAB014919	A4WX01335
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S101	K19/2A3W207654	Antenna Switch
		- - - - - - - - - - THERMISTORS - - - - - - - - - -
TH301	K19/2QBD016139	NTCDS3018-3HG103HC
		- - - - - - - - - - CRYSTALS - - - - - - - - - -
Y301	K19/2YAA181657	44.545 MHz A4WX01304

PARTS LIST

VOICE GUARD MODULE
19C85160G1 & 2

ISSUE 1

SYMBOL	GE PART NO.	DESCRIPTION
A1	19D901386G1	ANALOG BOARD
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C100	19A702052P22	Ceramic: 0.047 uF ±10%, 50 VDCW.
C101	19A700058P18	Ceramic: .022 uF, 50 VDCW.
C102	19A702052P8	Ceramic: 3300 pF ±10%, 50 VDCW.
C103	19A705205P2	Tantalum, EIA STD. Dry Solid: sim to Sprague 293D.
C105	19A705205P6	Tantalum, EIA STD. Dry Solid: sim to Sprague 293D.
C106	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C107 and C108	19A702052P26	Ceramic: 0.1 uF ±10%, 50 VDCW.
C109	19A705205P2	Tantalum, EIA STD. Dry Solid: sim to Sprague 293D.
C110 and C111	19A702061P33	Ceramic: 27 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C112	19A705205P2	Tantalum, EIA STD. Dry Solid: sim to Sprague 293D.
C113	19A702052P8	Ceramic: 3300 pF ±10%, 50 VDCW.
C114	19A705205P12	Tantalum, EIA STD. Dry Solid: sim to Sprague 293D.
C115	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C116	19A702052P26	Ceramic: 0.1 uF ±10%, 50 VDCW.
C117 and C118	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C119	19A702061P99	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C120	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C121	19A702052P26	Ceramic: 0.1 uF ±10%, 50 VDCW.
C122	19A705205P6	Tantalum, EIA STD. Dry Solid: sim to Sprague 293D.
C123	19A705205P2	Tantalum, EIA STD. Dry Solid: sim to Sprague 293D.
C124	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C127	19A702052P6	Ceramic: 1500 pF ±10%, 50 VDCW.
C128	19A702061P61	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C129	19A700058P118	Ceramic: 0.047 uF ±10%, 50 VDCW.
C130	19A702052P22	Ceramic: 0.047 uF ±10%, 50 VDCW.
C131	19A702061P99	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C132	19A705205P2	Tantalum, EIA STD. Dry Solid: sim to Sprague 293D.
C133	19A702052P26	Ceramic: 0.1 uF ±10%, 50 VDCW.
C134	19A702061P75	Ceramic: 390 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C135	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C136 and C137	19A702052P22	Ceramic: 0.047 uF ±10%, 50 VDCW.
C138	19A702061P99	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

SYMBOL	GE PART NO.	DESCRIPTION
C139 thru C141	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C151 thru C158	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C159 and C160	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C161 thru C166	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C170	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C178 thru C181	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C182	19A705205P6	Tantalum, EIA STD. Dry Solid: sim to Sprague 293D.
C183 and C184	19A702052P26	Ceramic: 0.1 uF ±10%, 50 VDCW.
C185 and C186	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C187 aand C188	19A702052P26	Ceramic: 0.1 uF ±10%, 50 VDCW.
C189 and C190	19A705205P6	Tantalum, EIA STD. Dry Solid: sim to Sprague 293D.
C191	19A705205P2	Tantalum, EIA STD. Dry Solid: sim to Sprague 293D.
C192	19A705205P6	Tantalum, EIA STD. Dry Solid: sim to Sprague 293D.
C195	19A705205P2	Tantalum, EIA STD. Dry Solid: sim to Sprague 293D.
C196 and C197	19A705205P111	Tantalum, EIA STD. Dry Solid: sim to Sprague 293D.
C198	19A705205P2	Tantalum, EIA STD. Dry Solid: sim to Sprague 293D.
C199	19A705205P6	Tantalum, EIA STD. Dry Solid: sim to Sprague 293D.
C200	19A700058P16	Ceramic: .015 uF ±10%, 50 VDCW.
C201 thru C203	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C204	19A702061P33	Ceramic: 27 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C206	19A702052P22	Ceramic: 0.047 uF ±10%, 50 VDCW.
C207	19A702052P108	Ceramic: 0.01 uF ±10%, 50 VDCW.
C208	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
		- - - - - - - - - - - - DIODES - - - - - - - - - - - -
D101		Diode; sim to Siemons BAS16.
D102	19A134587P2	Silicon, fast recovery: 100 mW; sim to Amperex BAV 70 Series.
D103	19A703561P2	Silicon, fast recovery (2 diodes in series).
D104	19A700053P2	Silicon, fast recovery (2 diodes in series).
D105		Diode; sim to Siemons BAS40-4 Schottky.
D106	19A700053P2	Silicon, fast recovery (2 diodes in series).
D107 and D108		Diode; sim to Siemons BAS40-04 Schottky
		- - - - - - - - - - - - JACKS - - - - - - - - - - - -
J7	19B801235P10	Terminal Strip: 15 positions, sim to Samtec BBL-115-G-E.
J8	19B801235P6	Terminal Strip: 7 positions, sim to Samtec BBL-107-G-E.
J10	19B801235P8	Terminal Strip: 9 positions, sim to Samtec BBL-109-G-E.

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - - - PLUGS - - - - - - - - - - - -
P11	19A705135P1	Connector: 10 positions, sim to JST 10FM-SG.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q100	19A700076P2	Silicon, NPN.
Q101	19A134577P1	Transistor, PNP: sim to Amperex BCX51.
Q102	19A700076P2	Silicon, NPN.
Q103	19A134577P1	Transistor, PNP: sim to Amperex BCX51.
Q104		Transistor; sim to Motorola BCX-17 PNP
Q105		Transistor; sim to Motorola BCX-19 NPN
Q106	19A700076P2	Silicon, NPN.
Q107	19A700059P2	Silicon, PNP.
Q108 and Q109	19A700076P2	Silicon, NPN.
Q110 and Q111	19A134577P1	Transistor, PNP: sim to Amperex BCX51.
Q112	19A700076P2	Silicon, NPN.
Q113		Transistor; sim to Motorola BCX-17 PNP.
Q114		Transistor; sim to Motorola BCX-19 NPN.
Q115 thru Q119	19A700059P2	Silicon, PNP.
Q120 thru Q123	19A700076P2	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R100	19B801251P103	Metal film: 10K ohm ±5%, 150 VDCW.
R101	19B801251P335	Metal film: 3.3M ohm ±5%, 150 VDCW.
R102 and R103	19B801251P104	Metal film: 100K ohm ±5%, 150 VDCW.
R104	19B801251P103	Metal film: 10K ohm ±5%, 150 VDCW.
R105	19B801251P222	Composition: 2.2K ohms ±5%, 150 VDCW, 1/8 w.
R106	19A702931P356	Metal film: 37.4K ohms ±1%, 200 VDCW, 1/8 w.
R107	19A702931P393	Metal film: 90.9K ohms ±1%, 200 VDCW, 1/8 w.
R108	19B801251P103	Metal film: 10K ohm ±5%, 150 VDCW.
R109	19B801251P104	Metal film: 100K ohm ±5%, 150 VDCW.
R110	19B801251P223	Metal film: 22K ohm ±5%, 150 VDCW.
R111	19A702931P401	Metal film: 100K ohms ±1%, 200 VDCW, 1/8 w.
R112	19A702931P365	Metal film: 46.4K ohms ±1%, 200 VDCW, 1/8 w.
R113	19A702931P301	Metal film: 10K ohms ±1%, 200 VDCW, 1/8 w.
R114	19B801251P104	Metal film: 100K ohm ±5%, 150 VDCW.
R115 and R116	19A702931P401	Metal film: 100K ohms ±1%, 200 VDCW, 1/8 w.
R117	19B801251P474	Metal film: 470K ohm ±5%, 150 VDCW.
R118	19B801251P103	Metal film: 10K ohm ±5%, 150 VDCW.
R119	19A702931P293	Metal film: 9090 ohms ±1%, 200 VDCW, 1/8 w.
R120 thru R123	19B801251P100	Metal film: 10 ohm ±5%, 150 VDCW.
R124 thru R127	19B801251P103	Metal film: 10K ohm ±5%, 150 VDCW.
R128	19B801251P472	Metal film: 4.7K ohm ±5%, 150 VDCW.
R129	19B801251P104	Metal film: 100K ohm ±5%, 150 VDCW.
R130	19B801251P224	Metal film: 220K ohm ±5%, 150 VDCW.
R131	19B801251P104	Metal film: 100K ohm ±5%, 150 VDCW.
R132	19A702931P365	Metal film: 46.4K ohms ±1%, 200 VDCW, 1/8 w.

SYMBOL	GE PART NO.	DESCRIPTION
R133	19B801251P100	Metal film: 10 ohm ±5%, 150 VDCW.
R134	19A702931P381	Metal film: 68.1K ohms ±1%, 200 VDCW, 1/8 w.
R135	19A702931P301	Metal film: 10K ohms ±1%, 200 VDCW, 1/8 w.
R136	19B801251P223	Metal film: 22K ohm ±5%, 150 VDCW.
R137	19A702931P422	Metal film: 165K ohms ±1%, 200 VDCW, 1/8 w.
R138	19B801251P103	Metal film: 10K ohm ±5%, 150 VDCW.
R139	19B801251P100	Metal film: 10 ohm ±5%, 150 VDCW.
R140	19A702931P310	Metal film: 12.4K ohms ±1%, 200 VDCW, 1/8 w.
R141	19B801251P104	Metal film: 100K ohm ±5%, 150 VDCW.
R142	19B801251P222	Composition: 2.2K ohms ±5%, 150 VDCW, 1/8 w.
R144 and R145	19A702931P401	Metal film: 100K ohms ±1%, 200 VDCW, 1/8 w.
R146	19A702931P327	Metal film: 18.7K ohms ±1%, 200 VDCW, 1/8 w.
R147	19B801251P184	Metal Film: 10K ohm ±5%, 150 VDCW.
R148	19B801251P103	Metal film: 10K ohm ±5%, 150 VDCW.
R149	19B801251P222	Composition: 2.2K ohms ±5%, 150 VDCW, 1/8 w.
R150	19A702931P347	Metal film: 30.1K ohms ±1%, 200 VDCW, 1/8 w.
R152 and R153	19B801251P104	Metal film: 100K ohm ±5%, 150 VDCW.
R154	19B801251P103	Metal film: 10K ohm ±5%, 150 VDCW.
R155	19B801251P334	Metal film: 330K ohm ±5%, 150 VDCW.
R156	19B801251P103	Metal film: 10K ohm ±5%, 150 VDCW.
R157	19B801251P474	Metal film. 470K ohm ±5%, 150 VDCW.
R158	19B801251P223	Metal film: 22K ohm ±5%, 150 VDCW.
R159 and R160	19B801251P222	Composition: 2.2K ohms ±5%, 150 VDCW, 1/8 w.
R161	19B801251P103	Metal film: 10K ohm ±5%, 150 VDCW.
R162 and R163	19B801251P2R2	Metal film: 2.2 ohm ±5%, 150 VDCW.
R164	19B801251P104	Metal film: 100K ohm ±5%, 150 VDCW.
R165	19A702931P351	Metal film: 33.K ohms ±1%, 200 VDCW, 1/8 w.
R166 and R167	19B801251P103	Metal film: 10K ohm ±5%, 150 VDCW.
R169	19B801251P103	Metal film: 10K ohm ±5%, 150 VDCW.
R170	19B801251P474	Metal film: 470K ohm ±5%, 150 VDCW.
R171	19B801251P222	Composition: 2.2K ohms ±5%, 150 VDCW, 1/8 w.
R172	19B801251P102	Metal film: 1K ohm ±5%, 150 VDCW.
R173	19B801251P472	Metal film: 4.7K ohm ±5%, 150 VDCW.
R174	19B801251P222	Composition: 2.2K ohms ±5%, 150 VDCW, 1/8 w.
R175	19B801251P103	Metal film: 10K ohm ±5%, 150 VDCW.
R176	19B801251P102	Metal film: 1K ohm ±5%, 150 VDCW.
R177	19B801251P683	Metal film: 68K ohm ±5%, 150 VDCW.
R178	19A702931P466	Metal film: 475K ohms ±1%, 200 VDCW, 1/8 w.
R179	19B801251P2R2	Metal film: 2.2 ohm ±5%, 150 VDCW.
R180 and R181	19A702931P342	Metal film: 26.7K ohms ±1%, 200 VDCW, 1/8 w.
R182	19B801251P100	Metal film: 10 ohm ±5%, 150 VDCW.
R183	19B801251P334	Metal film: 330K ohm ±5%, 150 VDCW.
R184	19B801251P223	Metal film: 22K ohm ±5%, 150 VDCW.
R185	19B801251P104	Metal film: 100K ohm ±5%, 150 VDCW.
R186	19B801251P103	Metal film: 10K ohm ±5%, 150 VDCW.
R187	19A702931P368	Metal film: 49.9K ohms ±1%, 200 VDCW, 1/8 w.
R188	19A702931P301	Metal film: 10K ohms ±1%, 200 VDCW, 1/8 w.
R189	19A702931P201	Metal film: 1000 ohms ±1%, 200 VDCW, 1/8 w.

SYMBOL	GE PART NO.	DESCRIPTION
R190 and R191	19B801251P222	Composition: 2.2K ohms ±5%, 150 VDCW, 1/8 w.
R192	19B801251P104	Metal film: 100K ohm ±5%, 150 VDCW.
R193	19B801251P102	Metal film: 1K ohm ±5%, 150 VDCW.
R194	19A702931P342	Metal film: 26.7K ohms ±1%, 200 VDCW, 1/8 w.
R195 and R196	19B801251P2R2	Metal film: 2.2 ohm ±5%, 150 VDCW.
R197 and R198	19B801251P102	Metal film: 1K ohm ±5%, 150 VDCW.
R199 thru R201	19B801251P103	Metal film: 10K ohm ±5%, 150 VDCW.
R202	19B801251P223	Metal film: 22K ohm ±5%, 150 VDCW.
R203	19B801251P473	Metal film: 47K ohm ±5%, 150 VDCW.
R204	19A702931P365	Metal film: 46.4K ohms ±1%, 200 VDCW, 1/8 w.
R205	19A702931P430	Metal film: 200K ohms ±1%, 200 VDCW, 1/8 w.
R207	19B801251P101	Metal film: 100 ohm ±5%, 150 VDCW.
R208	19B801251P103	Metal film: 10K ohm ±5%, 150 VDCW.
R209	19B801251P154	Metal film: 150K ohm ±5%, 150 VDCW.
R210	19B801251P100	Metal film: 10 ohm ±5%, 150 VDCW.
R211	19B801251P101	Metal film: 100 ohm ±5%, 150 VDCW.
R212	19B801251P103	Metal film: 10K ohm ±5%, 150 VDCW.
R213	19B801251P473	Metal film: 47K ohm ±5%, 150 VDCW.
R214	19A702931P336	Metal film: 23.2K ohms ±1%, 200 VDCW, 1/8 w.
R215	19B801251P	Resistor, Metal Film.
R216 and R217	19B801251P103	Metal film: 10K ohm ±5%, 150 VDCW.
R218	19A702931P368	Metal film: 49.9K ohms ±1%, 200 VDCW, 1/8 w.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - - -
U12		Integrated circuit; sim to Motorola LM258D.
U13		Integrated circuit; sim to Motorola LM224D.
U14		Integrated circuit; sim to SEIKO STC9140F.
U15		Integrated circuit; sim to SGS TDA2822M.
U27		Integrated circuit; sim to Motorola LM224D.
U28		Integrated circuit; sim to Motorola MC79L05ACD.
U29	19A702705P2	Digital, CMOS.
U30		Integrated circuit; sim to KANEMATSU S-8125OHG-RD-T1.
U32		Integrated circuit; sim to Motorola LM2903D.
U33		Integrated circuit; sim to Motorola LM258D.
		- - - - - - - - - - CRYSTALS - - - - - - - - - -
Y100	19A702511G27	Crystal, Quartz: 8.00 MHz.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19A705299P1	Spring.
	N330P603P22	Metal Eyelet.
A2	19D901378G1	DIGITAL BOARD
		- - - - - - - - - - BATTERIES - - - - - - - - - -
BT1	19B801255P1	Battery, sim to Sanyo CR1220-T4.
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C2	19A702052P22	Ceramic: 0.047 uF ±10%, 50 VDCW.

SYMBOL	GE PART NO.	DESCRIPTION
C3	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C4 and C5	19A702052P22	Ceramic: 0.047 uF ±10%, 50 VDCW.
C6 and C7	19A702061P33	Ceramic: 27 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C8	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C9	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C10 and C11	19A702052P22	Ceramic: 0.047 uF ±10%, 50 VDCW.
C13	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C14	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C15	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C16	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C17	19A702052P22	Ceramic: 0.047 uF ±10%, 50 VDCW.
C18	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C19 thru C22	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C24 thru C26	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C27	19A702052P26	Ceramic: 0.1 uF ±10%, 50 VDCW.
C29 thru C33	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C35 thru C49	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C50	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C51	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C53	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C54	19A702052P22	Ceramic: 0.047 uF ±10%, 50 VDCW.
C55	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C56	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C57	19A705205P6	Tantalum, EIA STD. Dry Solid: sim to Sprague 293D.
C58 and C59	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C61 thru C66	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C68 thru C78	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C79	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C80 thru C88	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C89	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C90 thru C100	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C101	19A705205P2	Tantalum, EIA STD. Dry Solid: sim to Sprague 293D.
C102	19A702052P26	Ceramic: 0.1 uF ±10%, 50 VDCW.
C103	19A705205P6	Tantalum, EIA STD. Dry Solid: sim to Sprague 293D
C104	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C105	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.

SYMBOL	GE PART NO.	DESCRIPTION
C106	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C107 thru C110	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
		- - - - - - - - - - DIODES - - - - - - - - - -
D3	19A700155P2	Silicon, fwd current: 100 mA, 35 VIP.
D4		Diode; sim to SIEMENS BAS40-04 Series SCHOTTKY.
D5		Diode; sim to SIEMENS BAS40-05 SHOTKY COM CATH.
D6		Diode; sim to SIEMENS BAS40-04 Series SCHOTTKY.
D8 thru D10		Diode; sim to SIEMENS BAS40-04 Series Schottky
D12 and D13	19A700155P2	Silicon, fwd current: 100 mA, 35 VIP.
		- - - - - - - - - - FILTERS - - - - - - - - - -
FL1 thru FL3	19A700103P1	Torroidal core.
		- - - - - - - - - - JACKS - - - - - - - - - -
J1	19A704852P202	Connector PWB: 5 circuits, sim to Dupont Berg 65646-105.
J2	19A704852P203	Connector PWB: 11 circuits, sim to Dupont Berg 65646-111.
J9	19B801451P1	Socket, Strip: 2 positions, SL-102-T-12.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P7	19B801451P7	Socket, Strip: 15 positions, sim to Samtec SL-115-T-11.
P8	19B801451P3	Socket, Strip: 7 positions, sim to Samtec SL-107-T-11.
P10	19B801451P5	Socket, Strip: 9 positions, sim to Samtec SL-109-T-11.
P12 thru P14	19A705135P1	Connector: 10 positions, sim to JST 10FM-SG.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q1 and Q2	19A700076P2	Silicon, NPN.
Q3	19A134577P1	Transistor, PNP: sim to Amperex BCX51.
Q4 and Q5	19A700076P2	Silicon, NPN.
Q6	19A134577P1	Transistor, PNP: sim to Amperex BCX51.
Q7	19A700076P2	Silicon, NPN.
Q9	19A134577P1	Transistor, PNP: sim to Amperex BCX51.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1 thru R6	19B801251P104	Metal film: 100K ohm ±5%, 150 VDCW.
R7 thru R14	19B801251P103	Metal film: 10K ohm ±5%, 150 VDCW.
R15	19B801251P472	Metal film: 4.7K ohm ±5%, 150 VDCW.
R16 thru R18	19B801251P103	Metal film: 10K ohm ±5%, 150 VDCW.
R20	19B801251P103	Metal film: 10K ohm ±5%, 150 VDCW.
R21	19B801251P101	Metal film: 100 ohm ±5%, 150 VDCW.
R22	19A702931P342	Metal film: 26.7K ohms ±1%, 200 VDCW, 1/8 w.
R23	19B801251P473	Metal film: 47K ohm ±5%, 150 VDCW.
R24	19B801251P105	Metal film: 1M ohm ±5%, 150 VDCW.

SYMBOL	GE PART NO.	DESCRIPTION
R25 and R26	19B801251P102	Metal film: 1K ohm ±5%, 150 VDCW.
R27	19B801251P271	Metal film: 270 ohm ±5%, 150 VDCW.
R28 and R29	19B801251P103	Metal film: 10K ohm ±5%, 150 VDCW.
R30	19B801251P472	Metal film: 4.7K ohm ±5%, 150 VDCW.
R31	19B801251P104	Metal film: 100K ohm ±5%, 150 VDCW.
R32	19B801251P824	Metal film: 820K ohm ±5%, 150 VDCW.
R33	19B801251P104	Metal film: 100K ohm ±5%, 150 VDCW.
R34 thru R38	19B801251P102	Metal film: 1K ohm ±5%, 150 VDCW.
R39 thru R43	19B801251P104	Metal film: 100K ohm ±5%, 150 VDCW.
R44	19A702931P330	Metal film: 20K ohms ±1%, 200 VDCW, 1/8 w.
R45 thru R55	19B801251P104	Metal film: 100K ohm ±5%, 150 VDCW.
R56	19B801251P103	Metal film: 10K ohm ±5%, 150 VDCW.
R57	19B801251P471	Composition: 470 ohms ±5%, 150 VDCW, 1/8 w.
R58	19B801251P102	Metal film: 1K ohm ±5%, 150 VDCW.
R59	19B801251P103	Metal film: 10K ohm ±5%, 150 VDCW.
R60 and R61	19B801251P102	Metal film: 1K ohm ±5%, 150 VDCW.
R62	19B801251P104	Metal film: 100K ohm ±5%, 150 VDCW.
R63	19B801251P103	Metal film: 10K ohm ±5%, 150 VDCW.
R64	19B801251P333	Metal film: 33K ohm ±5%, 150 VDCW.
R65	19B801251P103	Metal film: 10K ohm ±5%, 150 VDCW.
R66 and R67	19B801251P102	Metal film: 1K ohm ±5%, 150 VDCW.
R68	19B801251P103	Metal film: 10K ohm ±5%, 150 VDCW.
R69	19B801251P104	Metal film: 100K ohm ±5%, 150 VDCW.
R70 and R71	19B801251P103	Metal film: 10K ohm ±5%, 150 VDCW.
R72	19B801251P271	Metal film: 270 ohm ±5%, 150 VDCW.
R73	19B801251P103	Metal film: 10K ohm ±5%, 150 VDCW.
R74	19B801251P154	Metal film: 150K ohm ±5%, 150 VDCW.
R75	19B801251P104	Metal film: 100K ohm ±5%, 150 VDCW.
R76	19B801251P101	Metal film: 100 ohm ±5%, 150 VDCW.
R77	19B801251P103	Metal film: 10K ohm ±5%, 150 VDCW.
R78 and R79	19B801251P102	Metal film: 1K ohm ±5%, 150 VDCW.
R81	19B801251P101	Metal film: 100 ohm ±5%, 150 VDCW.
R82	19B801251P394	Metal film: 390K ohm ±5%, 150 VDCW.
R83	19B801251P184	Metal film: 180K ohm ±5%, 150 VDCW.
R84	19B801251P104	Metal film: 100K ohm ±5%, 150 VDCW.
R85	19B801251P473	Metal film: 47K ohm ±5%, 150 VDCW.
R86	19B801251P223	Metal film: 22K ohm ±5%, 150 VDCW.
R87 thru R94	19B801251P104	Metal film: 100K ohm ±5%, 150 VDCW.
R95 thru R102	19B801251P103	Metal film: 10K ohm ±5%, 150 VDCW.
R103	19B801251P104	Metal film: 100K ohm ±5%, 150 VDCW.
R104	19B801251P103	Metal film: 10K ohm ±5%, 150 VDCW.
R105	19B801251P101	Metal film: 100 ohm ±5%, 150 VDCW.
R106	19B801251P391	Metal film: 390 ohm ±5%, 150 VDCW.
R107	19B801251P103	Metal film: 10K ohm ±5%, 150 VDCW.
R108	19B801251P104	Metal film: 100K ohm ±5%, 150 VDCW.
R109	19A702931P347	Metal film: 30.1K ohms ±1%, 200 VDCW, 1/8 w.
R110	19A702931P369	Metal film: 51.1K ohms ±1%, 200 VDCW, 1/8 w.
R111	19B801251P224	Metal film: 220K ohm ±5%, 150 VDCW.
R113	19A702931P313	Metal film: 13.3K ohms ±1%, 200 VDCW, 1/8 w.
R114	19B801251P100	Metal film: 10 ohm ±5%, 150 VDCW.
R115	19B801251P104	Metal film: 100K ohm ±5%, 150 VDCW.
R116	19B801251P393	Metal film: 39K ohm ±5%, 150 VDCW.
R117	19B801251P104	Metal film: 100K ohm ±5%, 150 VDCW.
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S1	19A705164P1	Switch.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - - -
U1		Integrated circuit; sim to MATRA-HARRIS IS-80C31.
U2		Integrated circuit; sim to PANASONIC MN74HC573S
U3		Integrated circuit; sim to NEC UPD27C256-25-G
U4	19A704727P1	Integrated circuit, Mode 28 Hook.
U5		Integrated circuit; sim to RCA CD74HC393M.
U6		Integrated circuit; sim too Motorola MC14094BD.
U7		Integrated circuit; sim to HITACHI HD63705V0CP.
U8		Integrated circuit; sim to Motorola MC74HC04D.
U9		Integrated circuit; sim to Motorola MC74HC58D.
U10		Integrated circuit; sim to NEC UPD4464-20L-G
U11		Integrated circuit; sim to Motorola LM2903D.
U17		Integrated circuit; sim to KANEMATSU S-81250HG-RD-T1.
U18		Integrated circuit; sim to NATAIONAL LM385M-2.5
U19	19B801375P1	Chip, integrated circuit.
U20		Integrated circuit; sim to RCA CD74HC290M.
U21		Integrated circuit; sim to OKI MSM77C20JS.
U22		Integrated circuit; sim to NATIONAL TP3054J-X.
U23		Integrated circuit; sim to PANASONIC MN74HC245S.
U24		Integrated circuit; sim to Motorola MC74HC365D.
U25		Integrated circuit; sim to Motorola MC74HC04D.
U26		Integrated circuit; sim to RCA CD74HC138M.
U31		Integrated circuit; sim to Motorola LM224D QUAD OP-AMP.
		- - - - - - - - - - CRYSTALS - - - - - - - - - -
Y1	19A702511G26	Crystal, Quartz: 11.059 MHz.

PARTS LIST

M-PD LCD BOARD

A4WE03617
ISSUE 3

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - INTEGRATED CIRCUITS - - - - - - -
A1	K19/2ADC003107	uPD7225G
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C1 thru C3	K19/2CAK011196	Ceramic chip 1000 pF
C4	K19/2CAK005586	Ceramic chip 0.047 uF
C5	K19/2CCF004193	Tantalum 0.47 uF
C6 and C7	K19/2CCF004102	Tantalum 1 uF
		- - - - - - - - - - - - LED - - - - - - - - - - -
CR1 thru CR6	K19/2HAA010202	HLMP-6500
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q1	K19/2QAD001026	Silicon, 2SA1121SBTL
Q2	K19/2QAD001034	Silicon, 2SC2462LCTL
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	K19/2RGC001734	Square chip 1/10W 180 K ohm ±5%
R2 thru R4	K19/2RGC001627	Square chip 1/10W 10 K ohm ±5%
R5	K19/2RGC001528	Square chip 1/10W 100 ohm ±5%
R6	K19/2RGC001643	Square chip 1/10W 100 K ohm ±5%
R7	K19/2RGC001528	Square chip 1/10W 100 ohm ±5%
R8 and R9	K19/2RGC001544	Square chip 1/10W 220 ohm ±5%
R10	K19/2RGC001700	Square chip 1/10W 1.5 K ohm ±5%
R11	K19/2RGC001601	Square chip 1/10W 3.3 K ohm ±5%
R12 and R13	K19/2RGC001726	Square chip 1/10W 47 K ohm ±5%
R14	K19/2RGC001635	Square chip 1/10W 22 K ohm ±5%
R15	K19/2RGC001569	Square chip 1/10W 470 ohm ±5%
		- - - - - - - - - - LCD DISPLAY - - - - - - - - -
LCD	K19/2DCA005020	T164003A
		- - - - - - - - - - PINHEADER - - - - - - - - -
J1-1 thru J1-5	K19/2PDA023143	Minisert 76693-001

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

This addendum contains changes to the **CAUTION** in Step 6, page 21. The **CAUTION** should read:

When separating the two boards, be very careful not to bend or break the inter-board connector pins. To separate the two boards, alternately lift up each edge of the board until the pins on P7, P8, and P10 are pulled straight up out of their sockets as evenly as possible.