Mobile Communications

Monogram *Series*
Portable Radio
Model MHP 300 30-50 MHz

Maintenance Manual

Ericsson GE Mobile Communications Inc.
Mountain View Road • Lynchburg, Virginia 24502

Printed in U.S.A.

LBI-38998

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SPECIFICATIONS*

GENERAL

	FCC	DOC
Radio Identification		
30-35 MHz	F3JSP5050B	287 194 1001P
35-42 MHz	F3JSP5050C	287 194 1001P
42-50 MHz	F3JSP5050D	287 194 1001P
Frequency Range	30-50 MHz	
Number of Channels	6 TX/RX	
Impedance		
Antenna	50 ohms unbalanced	
Speaker	8 ohms	
Microphone	1.5k ohms	
Microphone Sensitivity	> 90 dB S.P.L.	
Power (battery)	Rechargeable Nickel-Cadmium, 10.8 Vdc nominal (600 mA)	
Input Voltage	10.8 Vdc	
Current Drain (maximum)		
Standby	40 mA.	
Receive	180 mA @ 500 mA audio output	
Transmit	0.3 A. @ 5 watts	
Weight		
Radio (with battery)	18 oz.	
Environmental		
Temperature Range	-30º C To +60º C (-22º F to 140º F)	
Relative Humidity	0% @ 40º C Non-condensing	
Dimensions (mm)		
Radio	5.6" X 2.8" X 1.9" (143 mm x 70 mm x 48 mm)	

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SPECIFICATIONS* (CONT'D)

TRANSMITTER

Allowable spread	2.0 MHz (with degradation)
RF Output Power	5 watts minimum
Frequency Stability	±0.002%
FM Hum & Noise	<45 dB
Spurious Emissions	
Conducted	60 dBc
Radiated	60 dBc
Audio Distortion	<3%
AF Response	+1, -4.5 dB 300-3000 Hz
Modulation Limiting	5 kHz 300-3000 Hz
Channel Spacing	20 kHz
Carrier Attack Time	<100 ms

RECEIVER

Allowable spread	2.0 MHz (with degradation)
Sensitivity	
12 dB SINAD	0.25 µV
20 dB	0.5 µV
Adjacent Channel Selectivity	-70 dB
Intermodulation Rejection	-70 Db
Spurious Response Rejection	-70 dB
Frequency Stability	±0.002%
Channel Spacing	20 kHz
Modulation Acceptance Bandwidth	7.5 kHz
Squelch Blocking	> 5 kHz
Hum and Noise (unsquelched)	45 dB
Conducted Spurious	70 dB min
Frequency Response	+2 to -8 dB 1000 Hz reference 6 dB octave de-emphasized 300 Hz to 3000 Hz.
Audio Power Output	0.5 watts minimum
Audio Distortion	< 3%

ACCESSORIES

Dual Rate Charger	(3 hr & 14 hr)
Input	120 Vac, 60 Hz, 18 W.
Output	11 Vdc, 200 mA

*These specifications are intended primarily for use by the service technician. Refer to the appropriate Specification Sheet for complete information.

DESCRIPTION

The Ericsson GE Monogram Series Personal radio is small, lightweight, yet ruggedly constructed 5 watt two way FM radio operating on the 30-50 MHz frequency band. This multichannel radio offers both simplex and semi-duplex operations with a wide range of options and accessories available.

Advanced state-of-the-art technology is used in the design and manufacture of this synthesized radio to provide flexibility, capability, and adaptability. Up to six channels are available with CTCSS tones (optional) programmable on a per channel basis to satisfy customer requirements.

This unit is packaged in a durable Noryl housing for industrial use. The 600 mAh NI-CAD battery pack, in combination with the efficient TX power amp and low stand-by current maximizes the in-service time. Batteries are recharged in single or multiple drop-in chargers or a wall charger that plugs into the top panel external charge jack.

Channel frequency coding information is stored in a plug-in EEPROM (Electrically Erasable Programmable Read Only Memory) that requires no battery backup to retain data. The EEPROM data is dealer programmable using the MHTS3R programmer. Programming new channels is accomplished by reprogramming or replacing the EEPROM (Some minor tune-up may be required).

A plug-in interface circuit board facilitates customizing the radio's performance by the addition of optional accessories. CTCSS is offered as a simple plug-in circuit board. Individual channel CTCSS tones are programmable to provide any combination of tones in transmit or receive modes. Sub audible CTCSS tones allow users to hear only the messages intended for them and, unless the monitor button is pressed, blocks out all other communications

OPTIONS AND ACCESSORIES

MHNC3R	Antenna, 30-35 MHz (349A9730P11)
MHNC3S	Antenna, 35-42 MHz (349A9730P12)
MHNC3S	Antenna, 42-50 MHz (349A9730P13)
MHAE3J	Speaker/Microphone (349A9730P21)
MHHC5W	Leather Case Assembly (use with 600 mAh battery) (349A9730P28)
MHPA5P	600 mAh Battery, Nickel-Cadmium battery (344A9730P22)
MHCH3V	Standard Dual Rate Charger (349A9730P25)
MHCH3W	Rapid Multicharger (344A209P21) Wall Charger (349A9730P24) Belt Clip (349A9730P23)
MHTS3R	Radio Programmer (349A9730P30) (LBI-39008)

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PROGRAMMABLE FUNCTIONS

All programmable functions are controlled by the microcontroller. The microcontroller reads specific channel information from an EEPROM. Refer to the programming manual provided with the programmer for instructions. The following features are programmable on a per channel basis:

- Channel transmit frequencies
- Channel receive frequencies
- CTCSS tone frequencies (per channel basis) Transmit/Receive
- Transmit only channels
- Receive only channels

CONTROLS AND INDICATORS

Operating controls, indicators, accessory jacks and antenna receptacle are located on the top panel. The monitor and PTT buttons are located on the left hand side of the radio chassis. The microphone is behind the grill on the front of the radio. The battery is internal to the case assembly. Figure 1 shows the location of the controls and indicators.

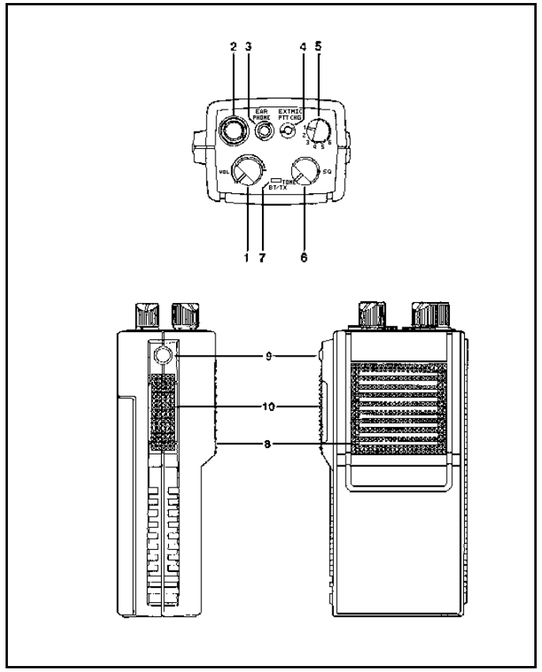

Figure 1 - Location of Controls And Indicators

CONTROLS

1. VOLume Control — Turns the radio on and off and adjusts the volume level.

2. Antenna Receptacle — Connects the antenna to the radio, 1/4 inch UNEF socket.

3. EARPHONE Jack — For use with optional Speaker Microphone or Vox unit. May be used with an external 8 ohm speaker or an earphone.

4. EXT MIC/ PTT/CH — For use with optional Speaker Microphone or Vox unit. This jack is also used to charge the battery pack (using the wall charger supplied with the portable). NOTE: If the optional Speaker Microphone is attached, unplug it and insert the wall charger plug into this jack. Then connect the charger to an ac outlet Be Sure The Radio Is Turned Off. Full charge will take about 14 hours.

5. Channel Selector Switch — Rotary switch, used to select one of up to 6 preprogrammed channels.

6. SQuelch Control — The squelch control will silence the receiver when no signal is being received. Rotate the squelch control to the tone (detent) position when tone coded options are installed.

8. Microphone — Located behind the speaker grille. To transmit clear messages, speak about two inches away from the microphone in a normal voice level.

9. Monitor Button — Located above the PTT bar. This is a squelch defeat switch. When pressed, it unsquelches the receiver to allow the user to monitor the selected channel.

10. PTT Bar — Pressing the PTT bar keys the transmitter and activates the radio CTCSS encoder When released, the radio operates in the "receive" mode.

INDICATORS

7. BT/TX — Red LED - ON when the transmitter is keyed. The LED dims or goes out when the battery voltage is low. Recharge or replace the battery to restore optimum performance.

ALERT TONES

PLL Unlock — A repeated double beep tone (1000 Hz) sounds when the PLL becomes unlocked. It may also indicate an unprogrammed channel.

RADIO ON/OFF

1. Turn the radio ON by rotating the VOLume control fully clockwise (to the right) until you hear a click.

2. Turn the radio OFF by rotating the VOLume control fully counterclockwise until you hear a click and feel the switch enter the detente position.

TO RECEIVE MESSAGES

1. Turn the radio ON and set the channel selector switch to the desired channel.

2. Unsquelch the radio by pressing the monitor switch on the side of the radio and adjust the VOLume control for the desired listening level.

NOTE

When CTCSS is programmed, only calls coded with the radio's assigned code are heard. In normal operation the speaker is muted until the correct CTCSS code is received. The receiver opens and the call is heard.

NOTES

When making a call on channels programmed with CTCSS , only calls with that channel's programmed tone are heard. In normal operation the speaker will remain quiet until the correct tone is received.

The RED TX indicator is "on" continuously when the PTT bar is pressed, indicating the radio transmitter is keyed.

Recharge or replace the battery if the TX/BT indicator is dimly lit or fades rapidly.

CAUTION

Operating the transmitter without a proper antenna installed may result in permanent damage to the radio.

TO TRANSMIT A MESSAGE

1. Before making a call always press the monitor button to be sure the channel is not in use. Do not key the transmitter while a message is being received.

2. Press and hold the PTT switch. The status indicator glows red to indicate the transmitter is keyed.

3. Place the microphone 2.5 to 10 cm from the mouth and speak clearly in a normal voice.

4. Release the PTT switch to listen.

5. Turn the radio off by rotating the on/off VOLume control fully counterclockwise.

CIRCUIT ANALYSIS

The radio contains three printed circuit boards (PCB): Main, VCO, and Top Panel. The Main PCB contains the transmitter, receiver, and synthesizer circuitry excluding the VCO (located on a separate PCB). The Top Panel PCB accommodates the user interface functions: channel selector switch, volume control, squelch control, accessory jacks, antenna connector, and transmit/battery indicator.

Functionally, the radio transceiver is divided into five areas consisting of the Microprocessor/Control, Frequency Synthesizer, Transmitter, Receiver, and Voltage Regulators and Power Distribution. A block diagram is shown in Figure 2.

MICROPROCESSOR CONTROL

Microprocessor U10 performs the various policing and control functions required to ensure the radio is set to perform as desired by the operator's inputs. An internally masked program determines the sequence and timing of these control functions. The following discussion describes the various control functions that U9 performs.

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Radio In Transmit Or Receive Mode

The microprocessor monitors the synthesizer unlock line. If the synthesizer is not locked, U10 will alert the operator by outputting a repeating 1 kHz double-beep on U10-6. This tone frequency is applied it to the input of the audio amp U8. U8 is unmuted at this time by a low at U8-8.

Should the state of the PTT input to pin 2 of U10 change states, the microprocessor will immediately examine the channel selection inputs (U10, pins 23, 24, 25, and 26) and direct the loading of the appropriate channel data from the EEPROM to the synthesizer. Through a basic error detection scheme, U10 will alert the operator if the EEPROM data is incorrect by outputting repeated 1 kHz tone bursts on U10-1 and applying it to the input of audio amp U8. U8 is unmuted by a low at pin 7.

Radio In Receive Mode

The microprocessor monitors the channel select lines. If a change is detected, U10 loads new channel data. It also monitors the state of the squelch control line (U10-20) and decode control line (U10-19). If both control lines are high, U10 unmutes the audio amp by setting U10-7 low. If either control line goes low, U10 mutes the audio amp by setting U10-7 high.

The microprocessor also examines the state of the PTM (Push-To-Monitor) input at pin U10-18. If the PTM input goes low, U10 unmutes the audio amp regardless of the state of the decode or squelch inputs.

Radio In Tx Mode

Does not allow the radio to be powered up in TX mode. If this is attempted, U10 outputs the synthesizer unlock alert to the operator (repeated double beeps of 1 kHz tone).

Does not allow the radio to be powered up in TX mode. If this is attempted, U10 outputs the synthesizer unlock alert to the operator as described above under "Radio In Transmit or Receive Mode".

Does not allow channel changing. If the operator changes the selected channel while in TX mode, U10 ignores the change request until the PTT bar is released.

FREQUENCY SYNTHESIZER

The frequency synthesizer utilizes a type-2 third order phase locked loop (PLL) circuit to generate the required frequencies for the transmit and receive modes. The PLL is based on a multifunction integrated circuit (U5). When used in conjunction with a low pass filter, voltage controlled oscillator (VCO), and prescaler, (the IC containing the circuitry for all the remaining functions required) it operates as a PLL frequency synthesizer.

The basic principle of the PLL system is to phase lock the desired frequency to a single stable frequency reference. A frequency of 5 kHz is used as the system reference since it represents the smallest incremental change in the PLL's output frequency coinciding with the frequency assignments of every 5 kHz within the frequency band allocation.

The 5 kHz reference is derived from crystal oscillator Q16. The crystal oscillator operates at its fundamental frequency of 10.245 MHz but is digitally divided in the PLL IC to generate the 5 kHz reference.

Since the TX VCO, RX VCO, and RX second LO injection frequency are all referenced to the crystal oscillator, the overall frequency stability is directly controlled by the stability of the crystal oscillator.

The output frequency of the VCO is divided by dual modulus prescaler U6 with divide values of 32 and 33. The dual modulus prescaler allows the relatively low frequency programmable divider in U5 to be used as a high frequency divider to provide system resolution (frequency step size). The programmable dividers internal to U5 are loaded by microprocessor U10 with the channel data contained in the EEPROM. The channel data determines the overall divide ratio such that when the desired channel frequency is divided by this ratio, the resultant frequency is 5 kHz.

The output from the programmable divider and the 5 kHz reference derived from the crystal oscillator are the two inputs to a phase comparator internal to U5. The doubled-ended outputs from the phase comparator are both normally high when the inputs are in frequency and phase coherence. When the input frequency from the programmable divider is greater than the 5 kHz reference or the phase is leading the V output, U5-19, pulses low. Conversely, if the input frequency is less than the reference or the is phase lagging, the R output, U5-20, pulses low.

These outputs are filtered and combined through the low pass filter composed of U4A and associated components. The low pass filter's cutoff frequency is normally 20 Hz, but for large channel frequency excursions, the diode pairs of CR5 and CR6 effectively switch the filter's cutoff to approximately 60 Hz and thereby speed up the loop's response. This provides essentially the same lock-up time for any frequency change within the radio's operational frequency band.

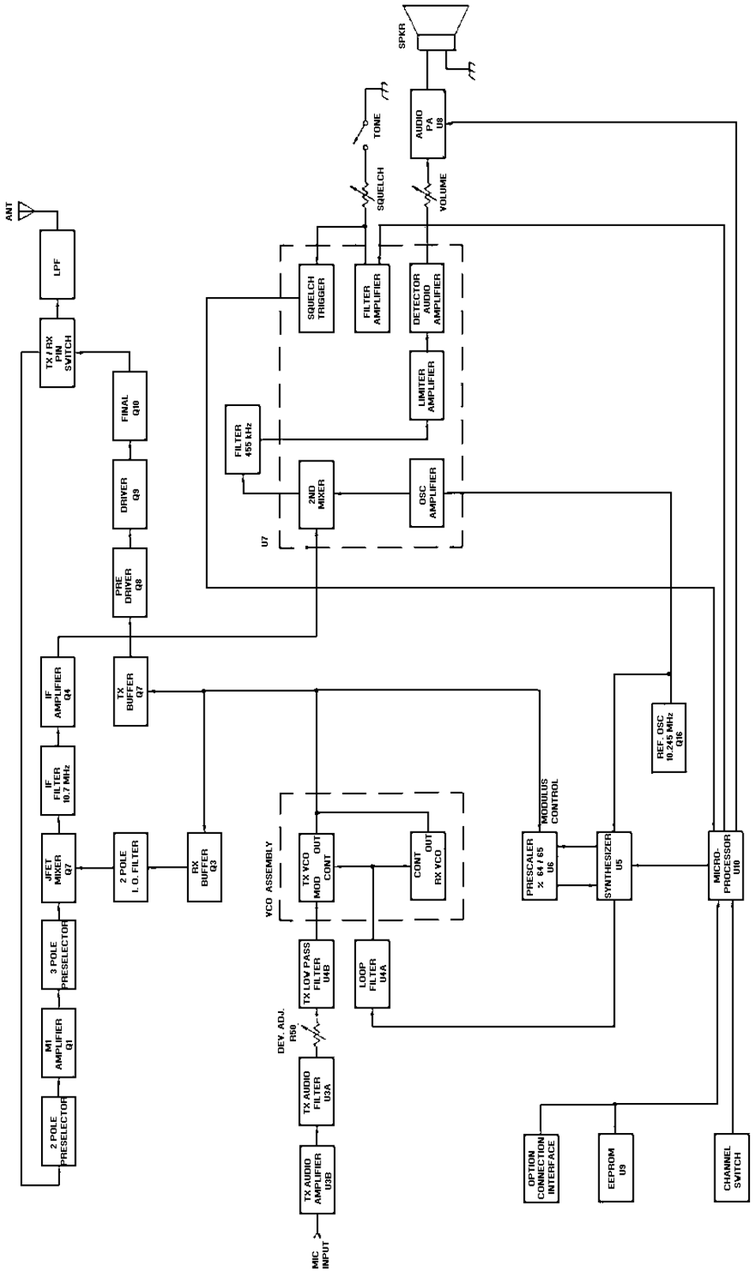

Figure 2 - 30-50 MHz Synthesized Radio Block Diagram

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The output from the low pass filter is connected directly to the VCO tuning varactor and is composed of a DC voltage with a small AC signal (error voltage) riding on the DC. The level of the DC voltage coarse tunes the VCO to the correct frequency and the error voltage acts as a continuous fine tune to maintain phase tracking with the 5 kHz reference.

A lock detect circuit consisting of Q15 and its associated components is provided as an indication to the microprocessor of the operational state of the PLL. The lock output from synthesizer U5-9 is a series of negative going pulses where the individual pulse width is a direct measure of the closeness of frequency and/or phase coherence of the VCO to the 5 kHz reference. R67 and C78 form an integrator with the time constant selected so that Q15 will turn off whenever the pulse widths appearing at U5-9 narrow to the width that represents the VCO being within the allowable frequency tolerance of programmed output frequency.

As the PLL achieves lock, the transition between Q15 conducting (out-of-lock indication) and turning off (valid lock indication) typically results in a short period where Q15 will be rapidly turning on and off. R66 and C77 are provided to filter out this "chatter" so that the indication to the microprocessor (U10-21) is a steady lock or unlock condition.

Transmit/Receive VCO'S

The synthesized radio uses two VCO's to generate the transmit channel frequencies and the receiver's first LO injection frequency. Both oscillators use the same Colpitts topology with the receiver oscillator offset in frequency by the 10.7 MHz, the first IF. The receive VCO consists of Q201 and associated circuitry and the transmit VCO consists of Q202 and associated circuitry. Refer to the VCO schematic diagram.

The oscillators are both grounded gate JFET designs that are varactor controlled to be DC voltage tuneable through a range of approximately 7 MHz. The VCO frequencies are set by monitoring the VCO Test Point on the VCO board, setting the channel selector for the center programmed frequency, and adjusting the appropriate capacitor (C205 receive & C212 transmit) for 4.5 ± 0.1 Vdc. The test point is located near the center of the board just above R206. The TX VCO has a second varactor tapped into the oscillator tank circuit of Q202 to allow direct FM modulation.

The transmit or receive VCO is enabled by switching the 8 Vdc supply to the appropriate oscillator depending on whether the radio is operating in the transmit or receive mode. The active oscillator is determined by the presence of 8 Vdc at pin 1 (transmit) or pin 2 (receive) of the VCO board.

TRANSMITTER

The transmitter operates in a frequency range of 30 to 50 MHz and delivers 5 watts RF output power to the antenna. The operating frequencies are established by preprogramming the radio and may be programmed by the dealer using the MHTS3R Radio Programmer. The transmitter consists of the microphone audio circuit, power amplifier, harmonic filter, automatic power control, and frequency synthesizer.

When the PTT bar is pressed the transmitter is keyed, the microphone audio circuitry is powered up via Q11, and Q12 is turned on. The open collector output of Q12 represents the radio's PTT function and switches the receiver VCO off and the transmit VCO on via Q13 and Q14. Q12 also provides a request to transmit signal, via J1-1 to the microprocessor at U10-2. The microprocessor then directs the transmit channel codes be loaded into synthesizer U5 from the information stored in EEPROM U9. Once the synthesizer loop has achieved lock with the selected transmit frequency, the synthesizer, via Q15, signals microprocessor U10-21 with a logic low. The microprocessor then outputs a logic high (TX ENABLE) on pin 8 to turn on power control transistor Q5 and enable the transmitter power amplifier circuits through dc power switch Q6.

To initiate transmit operation a positive base voltage from the microprocessor must first turn on power control transistor Q5. When Q5 is turned on its collector drops low, enabling it to:

- Complete the current path to illuminate the TX LED, CR302.
- Provide base current to turn on dc switching transistor Q6, providing dc power to the power amplifier circuits, RF pre-driver Q7 and drivers Q8 and Q9 respectively.

Microphone Audio Circuit

The Monogram radio operates using direct frequency modulation by applying the modulating signals to a modulation varactor diode that is lightly coupled to the transmit VCO tank circuit. Deviation limiting and occupied bandwidth are controlled by an instantaneous peak limiter and audio low pass filter respectively.

Voice modulation may be applied either through the internal electret microphone (MP301) or externally by an optional speaker/mic through J301. The internal electret is enabled by pressing the hand-held PTT switch. If the external speaker/mic is used, the external PTT switch controls the radio and the internal mic remains disabled.

DC bias for the microphone is supplied through R30 when the PTT bar is pressed. The resulting current through R30 causes Q11 to turn on supplying 8 Vdc to the op-amp pair of U3 and also to Q12 through R33. Q12 is turned on. The open collector output of Q12 represents the radio's PTT function. The active low PTT output from Q12 switches Q14 off, removing the receiver VCO voltage causing it to be disabled and also switches Q13 on, applying 8V to the transmitter VCO, enabling it.

The audio frequencies from the microphone are amplified and filtered by the active two-pole high pass filter consisting of U3B and its associated components. The filter operates with a cutoff frequency of 270 Hz and provides approximately 17 dB of voltage gain. The amplified output from U3B is passed through a 6 dB/octave pre-emphasis network composed of C61 and R43 to the input of limiting amplifier U3A. U3A has a voltage gain of approximately 40 dB at 1 kHz. This amplifier is driven into limiting to provide peak clipping. Deviation symmetry while in limiting is set by the reference voltage divider of R42 and R46, supplying U3. The combined gain of U3A and U3B establishes the microphone sensitivity and is optimized to provide the best trade off between maximum deviation with low distortion versus the tendency to pick up background noise.

The limited output of U3A is coupled through a resistive divider network consisting of R48, R49, and R50, option connector J1, and coupling capacitor C71 to the input of an active 3-pole low pass filter. The filter, consisting of U4 B and associated components has a cutoff frequency of 3 kHz to roll off the harmonics of the clipped signal and therefore establish the spectral distribution of the modulated RF signal. The output of this LPF is coupled directly to the modulating varactor diode in the transmit VCO.

The connection point in the transmit audio path is at option connector J1. This provides a summing point for the accessories that modulate the transmitter, such as, CTCSS encoding, DTMF encoding, etc. Resistors R48 and R49, besides being part of the voltage divider to reduce the amplitude of the modulating signal to a level compatible with the input of the LPF, provide for minimal loading of the signal sources to be summed.

Power Amplifier And Harmonic Filter

RF transistors Q7 - Q1O are the active devices in the transmit power chain and are controlled by the microprocessor through power control transistor Q5 and dc power switch Q6.

Transmitter pre-amp Q7 is located within the synthesizer shield to prevent stray RF pickup from transmitted high power RF fields. It therefore acts as a buffer to isolate the transmit VCO from the subsequent transmitter power stages. This isolation minimizes VCO pulling by controlling the load changes seen by the transmit VCO.

Q7 is biased Class "A" by resistive divider R53-R54 and emitter resistor R56. The emitter resistor provides ac and dc degeneration for amplifier stability. The collector output is dc shunt fed by L18 and has approximately 12 dB of power gain. C70 and L18 form an impedance matching "L" network that drives a 50 ohm RF pad consisting of R57- R59. The padded RF output is then applied to the emitter of amplifier Q8.

Q8 is also biased Class "A" by resistive divider R21-R22 and collector resistor R24. The output of Q8 is then matched into the base of Q9 by an "L" network composed of L9 and C33.

The last two stages, Q9 and Q10, are biased Class "C". These stages are driven into saturation to provide RF power stability (flatness) over the extremes of operating temperature and voltage. Another "L" network consisting of L11 and C34 is utilized to form a broad band impedance matching network between the collector of Q9 and the base of Q10. Driver transistor Q9 supplies sufficient RF power to saturate power amplifier Q10.

Dc to the collector of Q9 is shunt fed by parallel circuit L13-R28 that acts as a low Q RF choke to the RF output power. The amplifier output is matched to 50 ohms by a "T" network consisting of L14, C41, C42, and L15. RF power then passes through pin diode CR3, coupling capacitor C43, and an elliptic Low Pass Filter (LPF) to reach the antenna. The LPF is a 50 ohm input-output design to reject harmonics. Together, the "T" network and the LPF pass the carrier with low loss while effectively suppressing harmonics. C42 is adjustable to provide 5 watts to the antenna output.

Receiver Protection Circuit

During transmit, the receiver protection circuit, L17, is active. The protection circuit consists of "T" network L17, L16, and C44 terminated by pin diode CR2, which is turned on, and parallel capacitors C39 and C40. The capacitors and CR2 act as an RF short at the receiver input to protect it from transmitted energy. The loading presented to the transmitter consists of a parallel resonant circuit composed of L16 and C44. The impedance of this circuit is high with respect to 50 ohms, therefore, transmitter power loss is minimal within the usable bandwidth of the transmitter.

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RECEIVER

The FM receiver is a dual conversion superheterodyne with a first IF of 10.7 MHz and a second IF of 455 kHz. The low band radio uses high side injection for the 1st LO injection.

The received signal from antenna jack J303 passes through an elliptic LPF (Low Pass Filter) and through coupling capacitor C43 to the receiver protection circuit. In the receive mode, both pin diodes, CR2 and CR3, are off, disabling the receive input protection scheme. With the pin diodes off, circuit components L16, L17 and C44 form a broadly tuned low-loss BPF that connects the elliptic LPF to the receive input stage.

Receiver Input Stage Q1

Receiver input stage Q1 is a low noise bipolar amplifier. The preselector band pass filter on it's input is a double-tuned (L1 and L2) filter featuring low insertion loss and an approximate bandwidth of 2 MHz. The preselector is coupled to the input of RF amplifier Q1. The output from Q1 is loaded by a triple pole RF band pass filter is tuned by inductors L3, L4, and L5. Receiver noise figure is established primarily by the preselector insertion loss while the image and other out-of-band spurious responses are determined by the stopband attenuation of both the preselector and output band pass filters. The output from the triple-tuned RF filter is coupled through C13 and C15 to the mixer input.

JFET Mixer Q2

Mixer Q2 is a JFET transistor that provides excellent intermodulation characteristics for the receiver. Capacitor C13 matches the impedance of the RF filter output to the lower impedance FET source while C15 acts as a shorting path for the RF signal. Resistor R6 provides dc self-bias for the mixer operating point and L6 provides the required dc return for JFET current without loading the RF signal.

The LO is injected into the gate of Q2 through a wide band tuned circuit to enhance receiver performance. The LO signal is generated by the synthesizer receive VCO and is ac coupled through C65 to the source input of buffer Q3. Q3 is a grounded gate JFET amplifier whose output load is the tuned mixer gate circuit. The tuned circuit consists of inductors L7 and L8 resonating with capacitors C18, C16, and C17. The gate LO injection controls mixer FET conduction to provide mixing of the RF frequency on the source and the LO frequency on the gate. The drain output transformer T1 is tuned to 10.7 MHz to select the difference frequency while rejecting other mixer outputs. T1 also performs an impedance transformation to match the output impedance of the mixer to the input impedance of crystal filter pair, FL1 and FL2.

Crystal Filters FL1 And FL2

Filters FL1 and FL2 are two-pole monolithic crystal filters having a center frequency of 10.7 MHz. Together the two filters yield four poles of IF selectivity with a bandwidth of 15 kHz to attenuate undesired 1st mixer products and establish 2nd image rejection. The filters are connected in cascade with C22 optimized for minimum ripple within the 15 kHz IF bandwidth. IF transformer T2 is used to match the impedance of the filter output termination to the input of IF pre-amplifier Q4.

The function of Q4 is to provide first IF system gain to minimize contributions to the receiver noise figure by subsequent stages. Q4 is an RC coupled amplifier whose output appears at collector resistor R13. This output is coupled through C25 to the mixer input of integrated circuit U7.

Mixer/IF Ampl/FM Detector/Noise Squelch

Multipurpose IC U7 incorporates a mixer, IF amplifer, FM detector, and noise squelch functions within a single package. This package contains the active circuit devices that are linked by external components to complete the circuits within the IC.

The initial stage of U7 is a mixer to down convert the 10.7 MHz frequency to 455 kHz. Pin 16 is the mixer input and pin 1 is the LO injection from the 10.245 MHz REF OSC Q16. The mixer output is taken from pin 3 of U7 and is fed through ceramic filter FL3 to select the difference frequency of 455 kHz. FL3 provides second IF selectivity and improves adjacent channel rejection. The output of FL3 is returned to pin 5 of U7 as the input to a limiting 455 kHz IF amplifier.

The 455 kHz IF amplifier provides AM rejection and high gain at the low IF frequency. The limiting output is fed to a quadrature detector circuit. The quadrature circuit consists of an internal capacitor plus external coil L19 to develop the 90 degree phase shifted signal required by the detector. The quadrature detector recovers the FM modulation from the IF signal and provides an amplified audio output at U7-9.

The recovered audio signal is directed through an RC circuit (R84-C98) that attenuates the 455 kHz IF while preserving audio and noise frequencies within the bandwidth of the receiver. From U7-9, the audio branches in two directions. R84 and C99 couple the signal to a squelch-controlled audio output stage U8 while R83 passes the higher frequency noise spectrum to a BPF noise amplifier.

Since FM receivers noise quiet during reception, channel noise is typically utilized to mute audio until the receiver signal to noise ratio becomes acceptable. To perform this task, receiver noise is bandpassed, rectified, and used as a noise threshold control for muting the output audio amplifier.

The squelch noise amplifier is a MFB (multiple feedback bandpass) design with its input at U7-10 and output at U7-11. In this bandpass amplifier, resistors R82, R83, and R80 in conjunction with capacitors C95 and C96 are the essential components that determine the gain and center frequency.

C97, in conjunction with R82, is a high pass filter to reject voice components.

The output of the noise amplifier is converted to a dc level representing the average receiver noise by voltage doubling detector CR7. The detector output load consists of the series/parallel combination of R76, R77, and RT1 in parallel with C91 to smooth the variations in noise

levels. The rectified dc operates the squelch input at U7-12. An operator controlled dc voltage is summed with the rectified noise output to allow the user to control the squelch point.

U7-12 is the input to an internal switching circuit configured to provide approximately 50 mV of hysteresis on the switch trigger point. Additional external hysteresis is provided by loading the dc voltage summed with the noise detector output through R78 to ground provided by U7-14.

Hysteresis or positive feedback effectively performs two useful functions. First, it increases switching speed due to regeneration and further, it shifts the threshold point slightly to eliminate squelch chatter.

When a positive dc signal (caused by the detected RX noise during low RF signal conditions) greater than 0.7 Vdc is applied to U7- 12, the switching circuit outputs at U7-13 (Scan) and U7-14 (Mute) change states. U7-14 reflects an open circuit condition effectively providing the previously mentioned external hysteresis by removing the load on the input by R78. The SCAN output at pin 13 goes low and represents a request for microprocessor U10 to mute the audio output stage. U10 responds by outputting a logic high at U10-7 to mute audio amplifier U8.

Audio Amplifier, U8

Audio amplifier U8 is the final receiver stage; the stage that provides power amplification and mutes the audio. A positive dc level at U8-8 mutes the amplifier. The input audio to U8 is controlled by the volume control. The volume control input is either the received output (noise and signal) or a pulsating 1.0 kHz alarm indicating synthesizer unlock.

Basically, U8 is a power op amp with the input coupled through C100 to non-inverting (+) input pin 1. Input resistor R87, returned to voltage divider R88-89, sets the dc reference for the amplifier operating point. R90, returned to the same reference divider, is a speaker pop eliminator. Negative feedback components C108, R92, R91, and C107 determine the amplifier gain and its frequency response. The parallel combination of R92-C108 forms a de-emphasis circuit that attenuates audio at 6 dB per octave rate at frequencies above the cutoff frequency. C107 in conjunction R91, causes low frequency roll-off.

Processed audio output is coupled through C109 to internal speaker SP301 or to an external speaker via jack J302. RC circuit R93-C110 prevents high frequency oscillations by severely loading the amplifier at the very high frequencies. R94 is resistive speaker loading to suppress speaker resonances.

SERVICE SECTION

The Service Section contains information to assist you in identifying problem areas and in tuning and adjusting the radio for optimum performance. Care of the radio, Removal and Replacement Procedures, Radio Alignment, Performance Tests and Antenna Tuning procedures are included.

Verify that the user's operating configuration is programmed into the EEPROM and the transmit and receive sections of the radio are adjusted for optimum performance. If new frequencies be programmed into the radio, that are outside the current bandwidth or frequency sensitive components replaced, realign the radio and verify proper operation by doing the Performance Tests. If the optional Channel Guard tone encoder/decoder is installed and the radio programmed for Channel Guard operation, the Channel Guard deviation and noise squelch must also be adjusted prior to returning the radio to service.

The alignment and performance checks can be very helpful in localizing a problem when trouble shooting the radio. If any frequency sensitive components are replaced, the performance checks should be run to verify proper operation and, if indicated, the realignment may be required. If alignment is required, run the performance procedures again to assure proper operation.

Voltage charts, located on the service outlines, are provided for both the component and solder side of the main PCB.

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In some radios, a VCO out-of-lock indication is given while switching between channels or when an unprogrammed channel is selected. The unlock indication is recognized by repeated two short beeps sounded from the speaker. This in no way inhibits or restricts the operation of the radio and lasts for only a very short time. A solution to the unprogrammed channel problem is to program all unused channels with a receive frequency. Refer to the programmer instruction manual.

CARE OF EQUIPMENT

1. Keep the exterior of the radio clean. Use a soft damp cloth.

2. To ensure efficient power transfer from battery to radio, wipe the contacts of the battery and radio to remove dirt or grease. Use a soft dry cloth.

3. When the accessories connector is not in use, cover the connector with a protective dust cap to prevent the build up of dust or water particles.

CAUTION

Do not carry or hold the radio by the antenna.

Do not use chemical cleaners, aerosol sprays or petroleum based products. They may damage the radio housing.

RADIO IDENTIFICATION

The Monogram Series Portable operates on one of three frequency splits:

Freq. Split	Model
30-35 MHz	344A9730P11
35-42 MHz	344A9730P12
42-50 MHz	344A9730P13

ELECTROSTATIC DEVICES

CAUTION

Integrated Circuit devices used in this equipment can be destroyed by static discharges. Before handling one of these devices, the service person should discharge himself by touching the case of a bench test instrument that has a 3-prong power cord connected to an outlet with a known good earth ground. When soldering or desoldering a CMOS device, the soldering iron should also have a 3-prong power cord connected to an outlet with a known good earth ground. A battery operated soldering iron may be used in place of the regular soldering iron.

REMOVAL AND REPLACEMENT

Antenna Removal And Replacement

A high quality molded antenna is supplied to match the operating frequency split of each radio. Each antenna must be tuned for the frequency split for which it will be operating. Should an antenna, tuned to the wrong frequency split be installed, the performance of the radio will be degraded.

1. To remove the antenna, turn the antenna counterclockwise.

2. To install the antenna, turn the antenna clockwise until it is firmly seated. do not over tighten.

Battery Removal and Replacement

1. To remove the battery, use a screwdriver or coin to unlatch the back cover screw, located at the bottom of the rear cover. Rotate the screw counterclockwise to release.

2. Pull up on the cloth strap attached to the battery and remove the battery.

3. To replace the battery, insert it in compartment so the contacts mate and replace battery cover.

Main PCB & Option Interface Board Removal and Replacement

1. Remove the battery as instructed above

2. Using a posi drive screw driver, remove the four machine screws from the bottom cover (battery compartment) and separate the bottom from the radio assembly and unplug the Option Interface board.

3. On each side of the radio near the top, remove the two posi drive screws securing the bottom cover casting to the top panel casting. One of these screws is located just above the monitor switch.

4. Hold the radio with the battery compartment facing up and the thumbs positioned on the side of the radio (on the front cover and the metal casting), separate the front cover from the metal casting.

5. Unplug the option interface or Channel Guard board located just below the top panel.

6. Remove the two retaining screws securing the main PCB to the top panel.

7. Unsolder the connections to the volume control, squelch control, and the BT/RX indicator.

8. Unsolder the ten remaining wires, including the antenna wire, that interconnect the main PCB and the top panel PCB.

9. Disconnect the 3-pin PTT/monitor connector form the main PCB and remove board.

10. Reassemble the radio in reverse order.

Condenser Mic & Speaker Removal And Replacement

Condenser Microphone

1. Separate the radio covers by performing steps 1-4 of Main PCB board removal above.

2. Unsolder the gray and brown microphone wires from the main PCB and remove the microphone.

3. Reassemble radio in reverse order.

Speaker

1. Separate radio covers by performing steps 1-4 of Main PCB board removal above.

2. Unsolder the black and white speaker wires from the top panel PCB (located near top center) and remove the speaker.

3. Reassemble radio in reverse order.

Top Panel Removal and Replacement

1. Remove the main PCB and speaker as described above.

2. To remove the top panel PCB board unsolder all connections to the top panel controls and accessory jacks.

3. Reassemble the radio in reverse order.

PTT and Monitor Switch Removal And Replacement

1. Separate radio covers by performing steps 1-4 of Main PCB board removal above.

2. Unplug the 3-pin connector used to interconnect the PTT and monitor controls to the main PCB.

3. Remove the retaining screw securing the PTT bar to the metal casting.

4. Unsolder controls as necessary.

5. Reassemble the radio in reverse order.

WARNING

Any repairs or adjustments should be made by a qualified service technician or an authorized service center.

SMD Component Removal & Replacement

When removing and replacing the surface mounted components, SMD, follow the procedures given below using a soldering iron and a solder sucker.

Removing SMD components

1. Unsolder the component by heating one pad and using a solder sucker to remove the solder. Then apply heat to the other pad and lift the component from the board.

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Replacing SMD Components

With the PCB appropriately held in the best position for repair:

1. Ensure that all excess solder and old glue is removed from the board and the pads on the printed circuit board and component solder pads are mechanically clean.

2. Centrally locate the component between the printed circuit board pads.

3. Using the soldering iron apply sufficient heat to the SMD component pads and the corresponding PCB pads to set the component in position.

EEPROM PROGRAMMING

CAUTION

Do not allow the soldering iron to come in contact with the body of the replacement SMD component.

Avoid prolonged application of heat to the pads of the replacement component. Damage to the component may result.

Do not use SMD components that do not accept solder properly. They may not function as required or the working life of the component may be reduced due to chemical contamination.

Before alignment, the radio must be programmed to the user's transmit and receive frequencies as well as the optional Channel Guard tone frequencies. This programmed information is stored in a plug-in EEPROM inside the radio unit. Refer to the Programmers Manual to program the EEPROM with the operating information. The following procedure is used for removing and re-installing the EEPROM.

1. Use a screwdriver or coin to unlatch the back cover screw, located on the bottom of the back cover of the radio. Remove the battery cover. Rotate latch screw counterclockwise to release.

2. Remove the battery pack and the insulating material from the battery compartment.

3. Locate and remove the four screws in the battery compartment securing the front and rear covers.

4. Remove the two top screws from the metal casting on either side of the radio. One screw secures the top of the PTT bar.

5. With the battery compartment facing up, snap the case halves apart.

6. Locate and carefully remove the optional Channel Guard printed circuit board (see Figure 3 for location).

7. Locate and carefully remove the EEPROM.

8 Program the EEPROM to the user's operating configuration.

9. Carefully re-install the EEPROM and reassemble the radio in the reverse order.

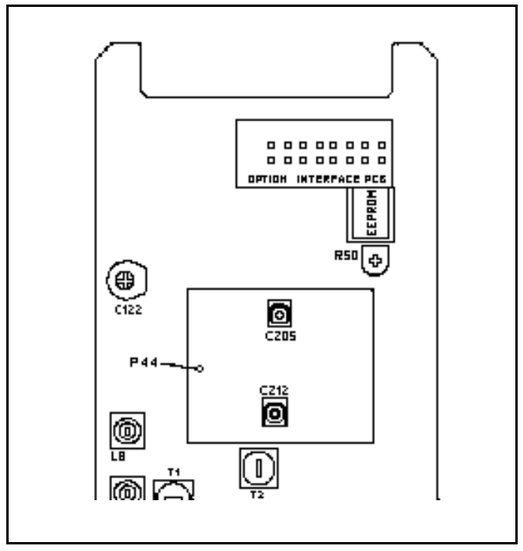

Figure 3 - EEPROM Removal

Table 1 - Transistor Voltage Chart

Component Side

TRANSISTOR	MODE	E	B	C
Q1	TX	0.00	0.00	0.00
	RX	0.00	0.76	5.36
	SQ	0.00	0.76	5.36
Q3 FET	TX	8.0 S	7.2 B	7.93 D
	RX	8.0 S	7.72 B	0.85 D
	SQ	8.0 S	7.72 B	0.85 D
Q6	TX	10.6	9.8	10.5
	RX	10.8	10.8	0.00
	SQ	10.8	10.8	0.00
Q9	TX	0.00	0.00	10.3
	RX	0.00	0.00	0.00
	SQ	0.00	0.00	0.00
Q10	TX	0.00	0.00	10.4
	RX	0.00	0.00	10.82
	SQ	0.00	0.00	10.82
Q12	TX	0.00	0.8	0.15
	RX	0.00	0.00	0.76
	SQ	0.00	0.00	0.76
Q13	TX	8.0	7.0	8.0
	RX	8.0	7.95	1.8
	SQ	8.0	7.95	1.8
Q14	TX	7.94	8.0	0.00
	RX	8.0	7.2	7.95
	SQ	8.0	7.2	7.95

Chip Component Side

TRANSISTOR	MODE	E	B	C
Q2	TX	0.00 S	0.00 G	0.00 D
	RX	2.4 S	0.00 G	7.42 D
	SQ	2.4 S	0.00 G	7.42 D
Q4	TX	0.00	0.00	0.00
	RX	0.18	0.89	3.9
	SQ	0.18	0.89	3.9
Q5	TX	0.16	0.96	0.16
	RX	7.6	0.09	10.8
	SQ	7.6	0.09	10.8
Q7	TX	1.23	1.93	7.9
	RX	0.00	0.28	0.85
	SQ	0.00	0.28	0.85
Q8	TX	0.00	0.52	6.25
	RX	0.00	0.00	0.00
	SQ	0.00	0.00	0.00
Q11	TX	8.0	7.3	7.9
	RX	8.0	8.0	0.00
	SQ	8.0	8.0	0.00
Q16	TX	4.5	5.0	7.9
	RX	4.5	5.0	0.00
	SQ	4.5	5.0	0.00

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Table 2 - IC Voltage Chart

IC	TRANSMIT	RECEIVE	SQUELCH
U1-1	8.0	8.0	8.0
U1-2	0.00	0.00	0.00
U1-3	10.8	10.8	10.8
U2-1	5.0	5.0	5.0
U2-2	0.00	0.00	0.00
U2-3	10.8	10.8	10.8
U3-1	3.38	0.00	0.00
U3-2	3.4	0.00	0.00
U3-3	3.38	0.00	0.00
U3-5	3.38	0.00	0.00
U3-6	3.38	0.00	0.00
U3-7	3.38	0.00	0.00
U4-5	4.31	0.47	0.47
U4-6	4.34	0.47	0.47
U4-7	4.34	0.47	0.47
U7-3	0.00	7.64	7.64
U7-4	0.00	7.94	7.94
U7-5	0.00	7.5	7.5
U7-8	0.00	7.95	7.95
U7-10	0.00	0.72	0.72
U7-11	0.00	1.29	1.29
U7-12	0.00	*	*
U7-13	0.00	7.36	0.00
U7-14	0.00	0.00	*
U8-1	5.1	5.3	5.3
U8-2	5.2	5.4	5.4
U8-4	4.9	5.3	5.2
U8-8	5.0	0.00	5.0
U10-1	4.63	4.63	4.63
U10-2	0.19	7.57	7.57
U10-7	5.0	0.00	5.0
U10-8	4.75	0.00	0.00
U10-16	0.00	0.00	0.00
U10-20	0.00	5.72	0.00
U10-21	0.00	0.00	0.00
U10-28	5.09	5.09	5.09

* See IC pinout information

TRANSMITTER ALIGNMENT

Test Equipment Required

The following test equipment, or equivalent, is required for proper alignment of the low band portable radio. See Figure 4 for the Test Equipment Setup Diagram.

1. RF watt meter
2. Regulated power supply 16 volts, adjustable; with a minimum capacity of 3 amperes.
3. FM Communications Monitor
4. EEPROM Programmer (MHTS3R)
5. SINAD meter
6. Oscilloscope
7. AC/DC voltmeter with a minimum of 1 megohm input impedance
8. Antenna Adaptor (R29/4207999), 1/4 UNEF to BNC.
9. Field Strength Meter

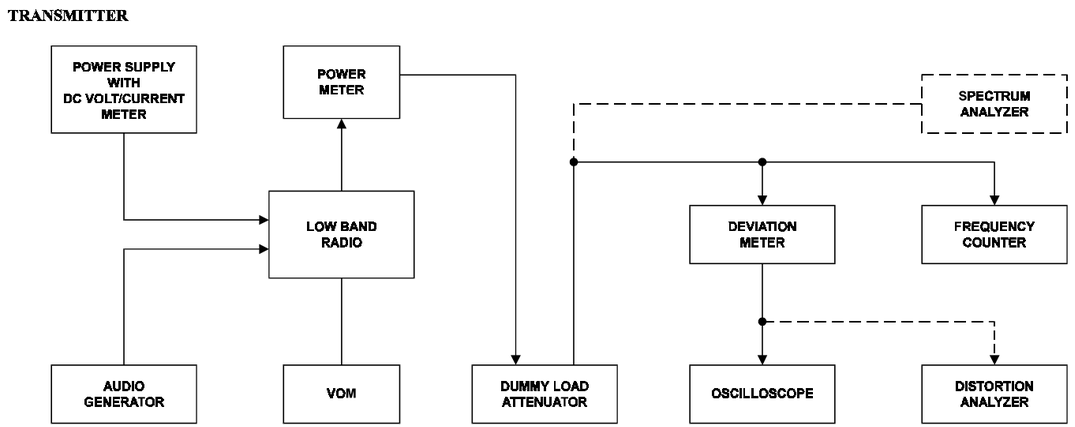

Figure 4 - Test Equipment Setup Diagra

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Pre-Alignment Notes

1. The transmit frequencies should be within a 2 MHz range.
2. The receive frequencies should be within a 2 MHz range.
3. There is no constraint on the relationship between the transmit frequencies and the receive frequencies except that they lie within the limits of the radio band (i.e., 30-35, 35-42 or 42-50 MHz).

Antenna Tuning

Refer to Figure 5 for tuning capacitor settings for the various frequencies. To tune the antenna perform the following steps

1. Remove slotted set screw from coil cover of antenna to uncover the tuning capacitor.
2. Select the radio channel that represents the center of the frequencies programmed.
3. Hold the radio upright and press the PTT bar to key the transmitter on the selected channel.
4. With a field strength meter in the same polarization plane as the radio antenna, use a non-conductive tuning tool to adjust the tuning capacitor for maximum field strength.
5. After tuning, carefully re-install the set screw into the coil cover until it is flush with the outside of the cover. **DO NOT OVER TIGHTEN**.

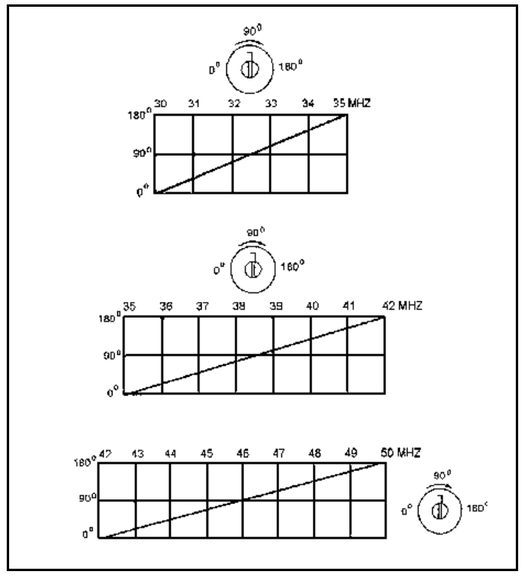

Figure 5 - Antenna Tuning Capacitor Settings Vs Frequencies

Alignment Procedure.

NOTE

Be sure the radio is programmed to customer specifications, otherwise use a test EEPROM programmed with low, center, and high Tx/Rx frequencies for the split being used prior to aligning the radio. When Channel Guard is required use the CG frequencies listed below for test operation.

Low Tx/Rx channel - 67.0 Hz
Center Tx/Rx channel - 151.4 Hz
High TxRx channel - 250.3 Hz

CAUTION

To avoid damage to the radio, observe proper power supply polarity.

- Connect the power supply to the battery terminals of the radio (battery removed). As you proceed with the alignment procedure, ensure that the power supply voltage remains at 10.8 Vdc measured at the radio, not the power supply. Refer to Figure 6 for location of adjustment and tuning controls.
- Connect an RF Wattmeter (5 watt scale) and Power Attenuator/dummy load to the antenna jack using an antenna adapter, 1/4 x 32 x 3/16 thread to BNC, part number R29/4207999.

3. Select the middle programmed transmit channel. Key the transmitter and adjust C212 on the VCO PCB for 4.5 ± 0.1 Vdc at the control voltage test point on the VCO PCB.
4. Select a programmed mid-frequency transmit channel. Connect a frequency counter to the output of the power attenuator. Key the transmitter and adjust C122 for the correct channel frequency with a maximum error of ± 100 Hz.
5. Key the transmitter and adjust C41 for maximum RF output power. Switch the radio between the lowest and highest transmit frequencies and adjust C41 to obtain the smallest power output variation across the transmit frequency range.
6. Connect an audio generator with a source impedance of 600 ohms or less to the external microphone jack J301 on the top panel.

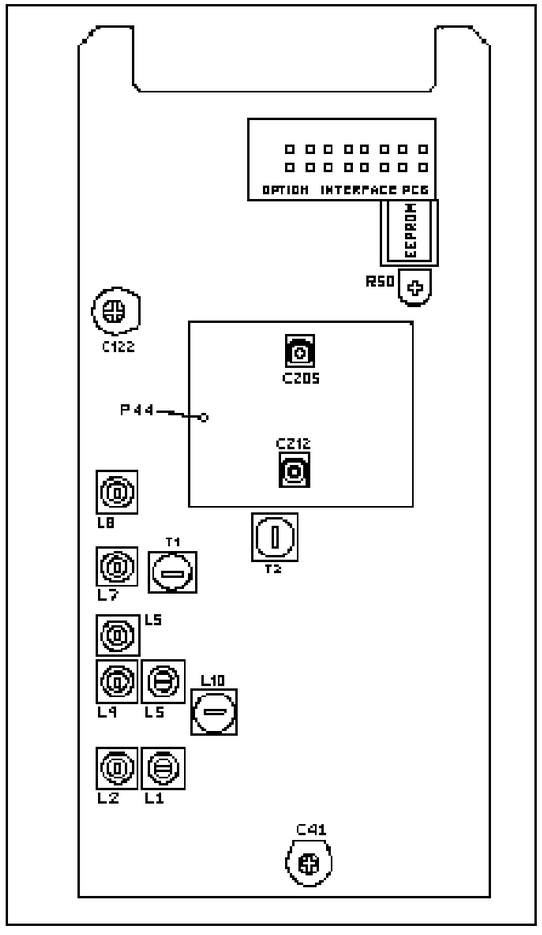

Figure 6 - Location of Controls and Adjustments.

7. Set the audio frequency to 1 kHz at an output level of 300 mVrms. Key the transmitter and adjust R50 for ±4.5 kHz deviation. Maintain the input from 300 Hz to 3 kHz and readjust R50 if necessary to ensure that the deviation does not exceed ± 5.0 kHz.
8. Check all programmed transmit channels and readjust R50, if necessary, to ensure that the deviation does not exceed ± 5.0 kHz on any channel.

TRANSMITTER PERFORMANCE TESTS

Power Output

Power output should be in excess of 5 watts with a power supply input voltage of 11 volts and total dc current of 1.5 ampere or less. Reducing the supply voltage to 9 volts should produce a minimum power output of 2.5 watts.

Audio Response

Connect an audio generator to the EXT MIC jack. Set the output for 1 kHz modulation and press the PTT switch. Adjust the generator output level to produce 1 kHz of deviation on the deviation meter. Reset the generator modulation to 500 Hz. The deviation should be approximately 500 Hz. Set the generator modulation to 2 kHz. The deviation should now be approximately 2 kHz.

Limiting Test

Adjust the audio generator output level for 1 kHz deviation with 3 kHz modulation. Increase the generator output by 20 dB and sweep the frequency band from 300 to 3000 Hz. The deviation should not exceed ± 5 kHz. at any frequency within this band.

Splatter Filter Test

With the test equipment set up for the Limiting Test, note the reading of the ac vtvm connected across the audio output of the deviation meter at 3 kHz deviation. Set the audio generator to 6 kHz. The ac vtvm reading should decrease more than 18 dB.

Spectrum Test

With the input attenuator of the spectrum analyzer protected by 40 to 60 dB of attenuation, all spurious and harmonics should be down more than 60 dB.

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Antenna Test

Reassemble the radio and install a fully-charged battery pack. Insert the radio into its case. Connect a properly trimmed (to frequency) flexible antenna to the antenna connector on the top panel. Key to transmit and check the frequency, deviation and spectral purity. All should be the same as tested with the 50 ohm dummy load.

RECEIVER ALIGNMENT

1. Select the middle programmed receive channel and adjust C205 on the VCO PCB for 4.5 ± 0.1 Vdc at the VCO control voltage test point on the VCO PCB.

2. Turn the Squelch control fully counter-clockwise without switching into the tone (detent) position.

3. Connect an oscilloscope (and distortion analyzer if available) across the speaker terminals

4. Select a programmed mid-frequency channel. Connect an RF signal generator or communications monitor to the antenna jack. Set the RF frequency to the correct channel frequency. The generator should be set for 3 kHz with 1 kHz modulation. The RF output level should be 1 mV.

5. Adjust the discriminator coil (L19) for maximum sine wave amplitude at the speaker terminals. Adjust the VOLume control if necessary to avoid clipping. If a sine wave is not visible (only noise), proceed with step 8 and return to this step.

6. Adjust T1, T2, and L19 for lowest audio distortion at the speaker terminals as observed on the oscilloscope or distortion analyzer.

7. Connect a SINAD meter across the speaker terminals. Adjust the VOLume control to the proper level for the SINAD meter and the signal generator output level to produce 12 dB SINAD on the SINAD meter.

8. Adjust L1, L2, L3, L4, L5, L7, L8, and T1 for the best sensitivity, readjusting the RF signal generator level as necessary to keep the SINAD meter reading near 12 dB.

9. Repeat step 8 at the lowest and highest programmed receive channels, if necessary, to give the best sensitivity across the entire receive band.

RECEIVER PERFORMANCE TESTS

SINAD Sensitivity

Adjust the signal generator output for 12 dB SINAD. The signal generator output should be less than 0.28 µV.

Noise Quieting Sensitivity

With the signal generator disconnected from the radio and the squelch open, adjust the VOLume control to obtain a noise reading of 1 V rms. Couple the signal generator to radio with no modulation and adjust the RF output so that a noise reading of 0.1 V rms is obtained. This is the 20 dB quieting point. The signal generator output level should be 0.5 µV maximum.

Squelch Sensitivity

With the signal generator set for the 1 kHz modulation, 3 kHz deviation and the RF attenuator at minimum, adjust the squelch control to its threshold. The squelch should open as the output of the signal generator is increased to 0.20 µV. Set the squelch control to its maximum clockwise position. Increase the RF attenuator setting until the squelch opens. The point of opening should be 10 to 20 dB greater than for the 0.20 µV attenuator setting.

Audio Output

With the generator set at 1000 µV RF output, adjust the radio's volume control to display a clean sinewave on the oscilloscope just below the point at which clipping occurs. The ac vtvm connected across the speaker leads should read 2V (500 mW at 1 kHz into an 8 ohm load). The distortion analyzer should display less than 10% THD.

Standby Current

Squelch the receiver and connect a VOM (0-100 mA range) in series with one of the supply leads. The meter reading should be less than 40 mA at a supply voltage of 11 volts.

SERVICING THE BATTERY

BATTERY CHARGING AND CARE

To insure peak performance from your radio, the battery pack must be fully charged. Proper care and charging will provide maximum performance and life of your battery pack.

New batteries or batteries that have been stored for a long period of time, should be fully charged before being installed in a radio. The battery should be recharged or replaced if the charge state is in doubt.

If the charging battery is sparingly or seldom used and is left on continuous charge for one or two months at a time, it could experience reduced capacity. This would severely reduce the life of the battery between charges.

The rechargeable nickel-cadmium battery packs may be recharged using the MONOGRAM Dual Rate Charger 344A9730P25 (LBI-39009), separately or with the radio inserted. The battery should be recharged when the charge state is in doubt. To recharge a battery insert the battery pack (or radio) into the charger.

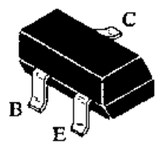
DUAL RATE CHARGER

The charger operates from a 110/120 Vac source and should be installed with a 150 mA 125 Vac fuse inserted in the charger fuse holder. The unit is capable of continuous operation; however, it should be disconnected from the power source when not in use. To operate the Dual Rate Charger, plug the charger into the power source and insert the battery or radio into the appropriate section of the charger. When the radio is inserted into the charger (rear section), it initially operates on fast charge until the battery is fully charged and then reverts to "slow" charge to maintain full battery capacity. The battery will charge fully in about 3 hours. When the battery (only) is inserted into the front section of the charger, the battery is charged at the slow rate and will be fully charged in about 14 hours. The appropriate fast or slow charge indicator will light indicating the rate at which the battery is being charged.

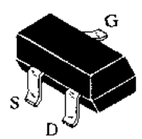
CAUTION

- If the charge indicator does not light, check to see that the battery has been inserted properly.
- Do not charge the battery when the battery temperature is below 10ºC or above 40ºC (50ºF or 104ºF). Usable life of the battery may be reduced.
- Do not use the charger if it is wet or damaged in any way.
- Do not toss batteries into a fire; they may explode.

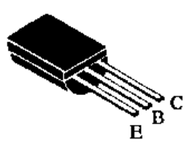
Q1 - R29/200-003-5
Q4, Q7, Q8, Q16 - R29/203-109-3
Q5 ,Q12 - R29/218-018-2
Q11, Q13, Q14, Q15 - R29/18-017-1



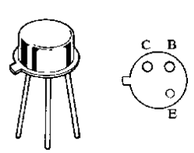
Q2, Q3, Q201, Q202 - R29/203-116-9



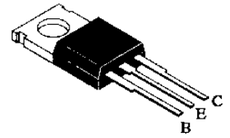
Q6 - R29/203-054-6



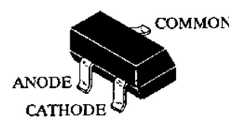
Q9 - R29/203-176-3



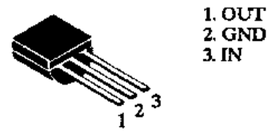
Q10 - R29/203-043-6



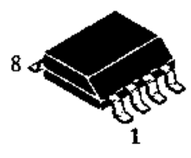
CR5-CR7 - R29/249-006-5



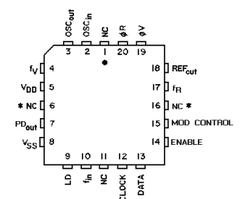
U1 - 8-VOLT REGULATOR
R29/229-358-7
U2 - 5-VOLT REGULATOR
R29/223-119-8



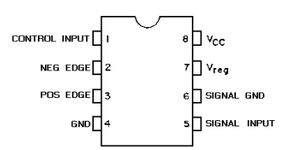
U3, U4 - DUAL OP AMP
R29/231-124-2



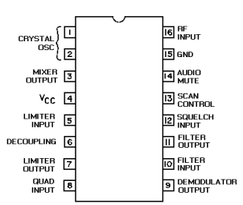
U5 - SYNTHESIZER
R29/223-145-1



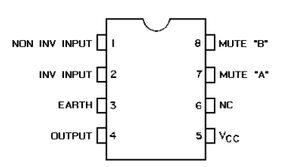
U6 - DUAL MODULUS PRESCALER
R29/223-403-4



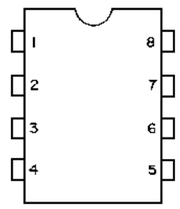
U7 - IF AMPL/FM DET/NOISE SQ.
R29/223-116-5



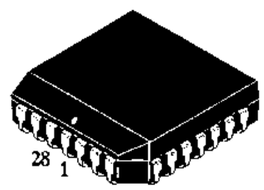
U8 - AUDIO AMPLIFIER
R29/229-080-5



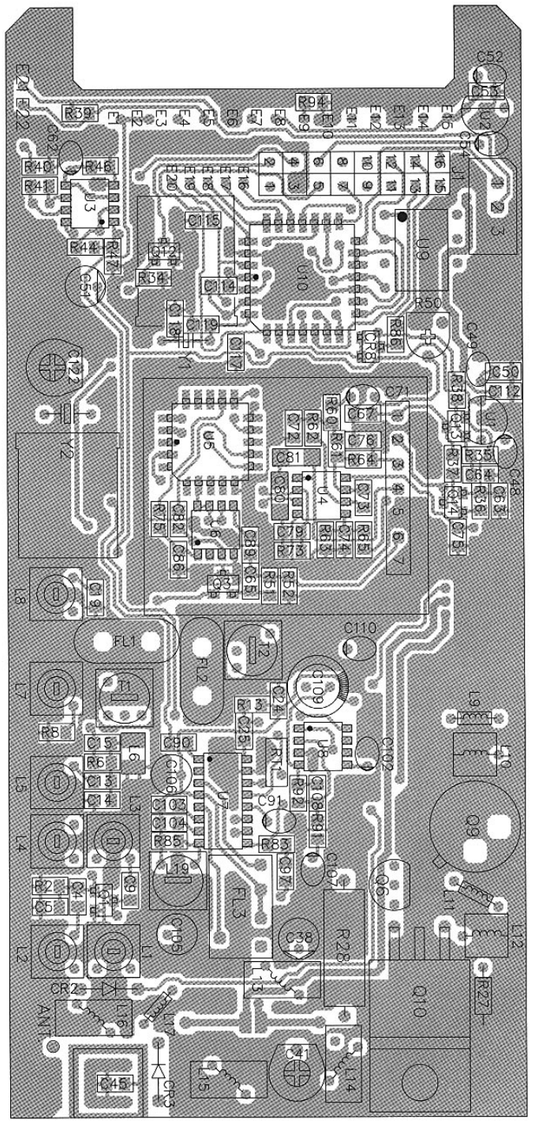
U9 - EEPROM
R29/229-063-0



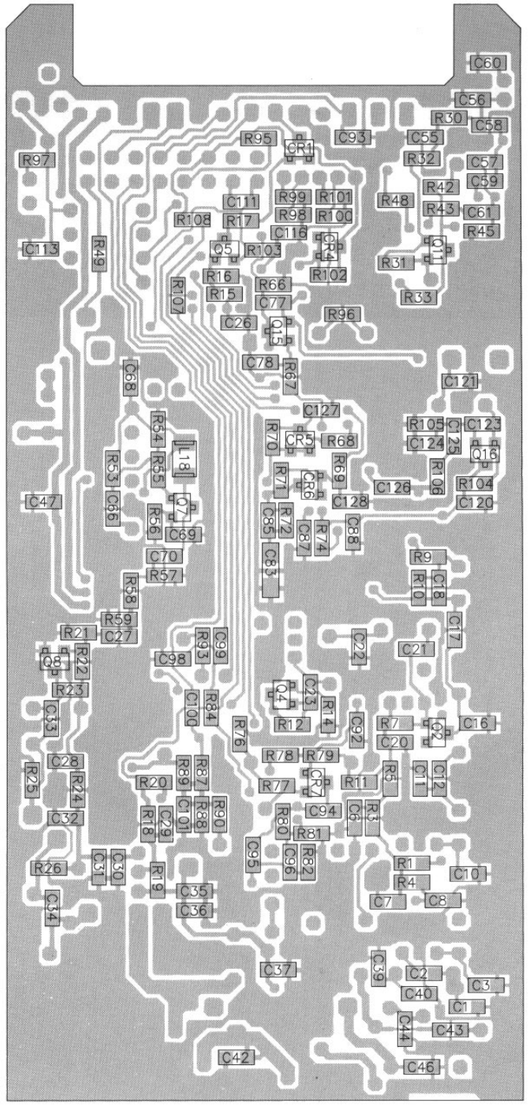
U10 - MICROPROCESSOR CONTROLLER



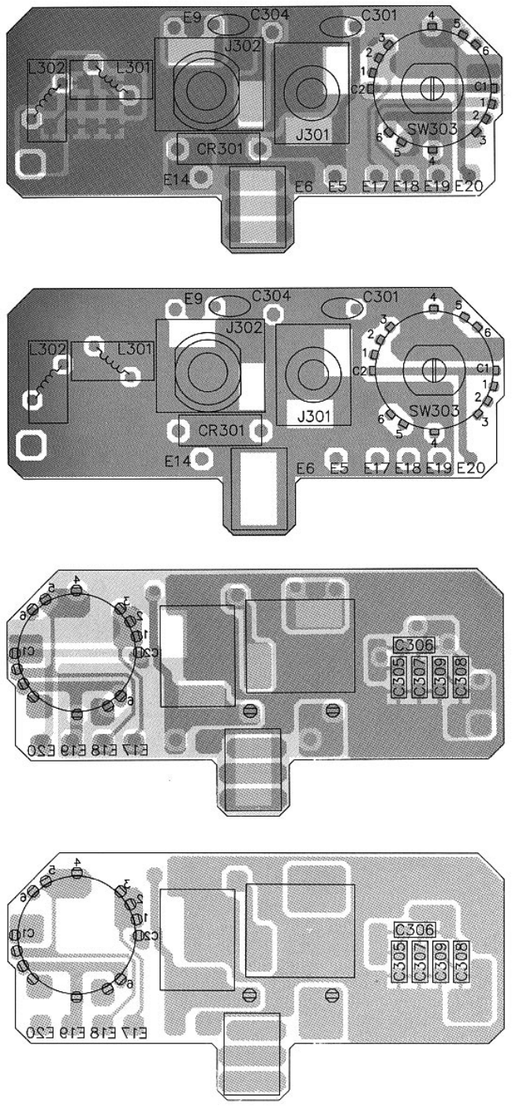
COMPONENT SIDE



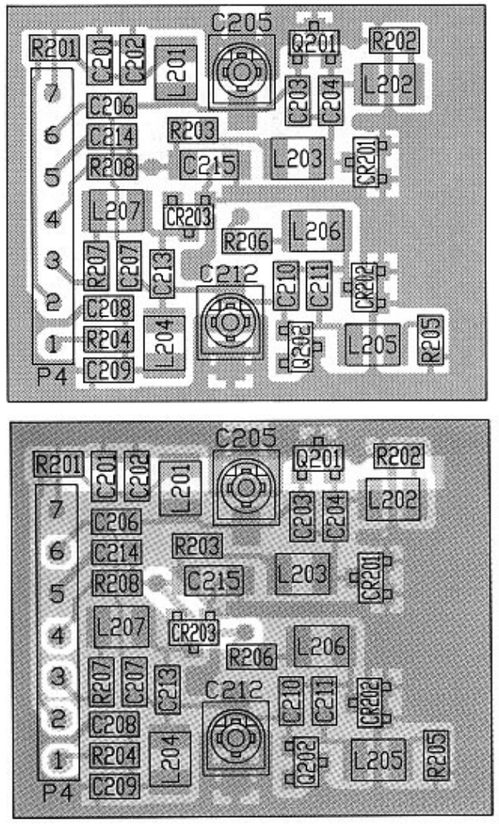
SOLDER SIDE



TOP PANEL PCB

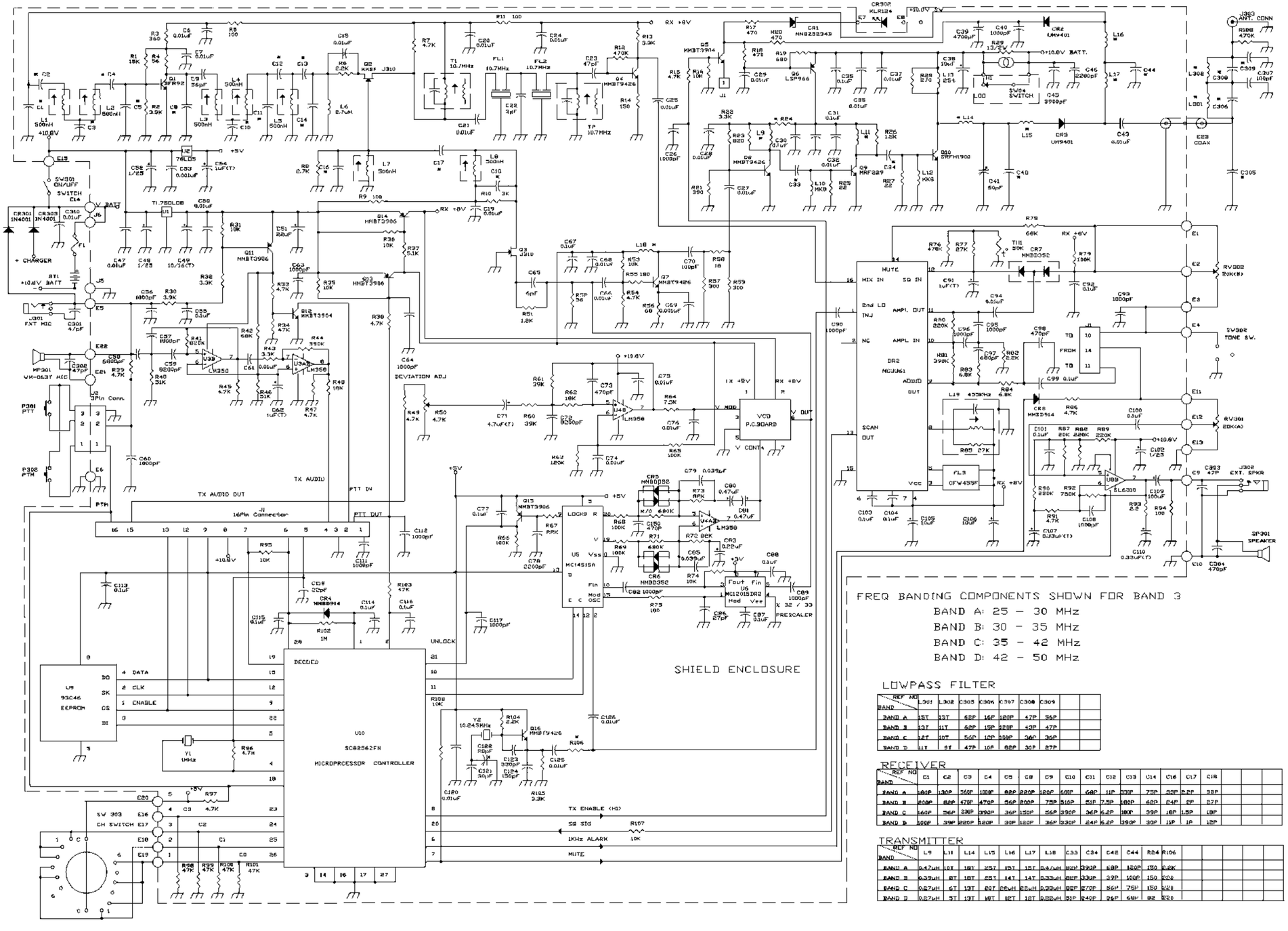


VCO PCB



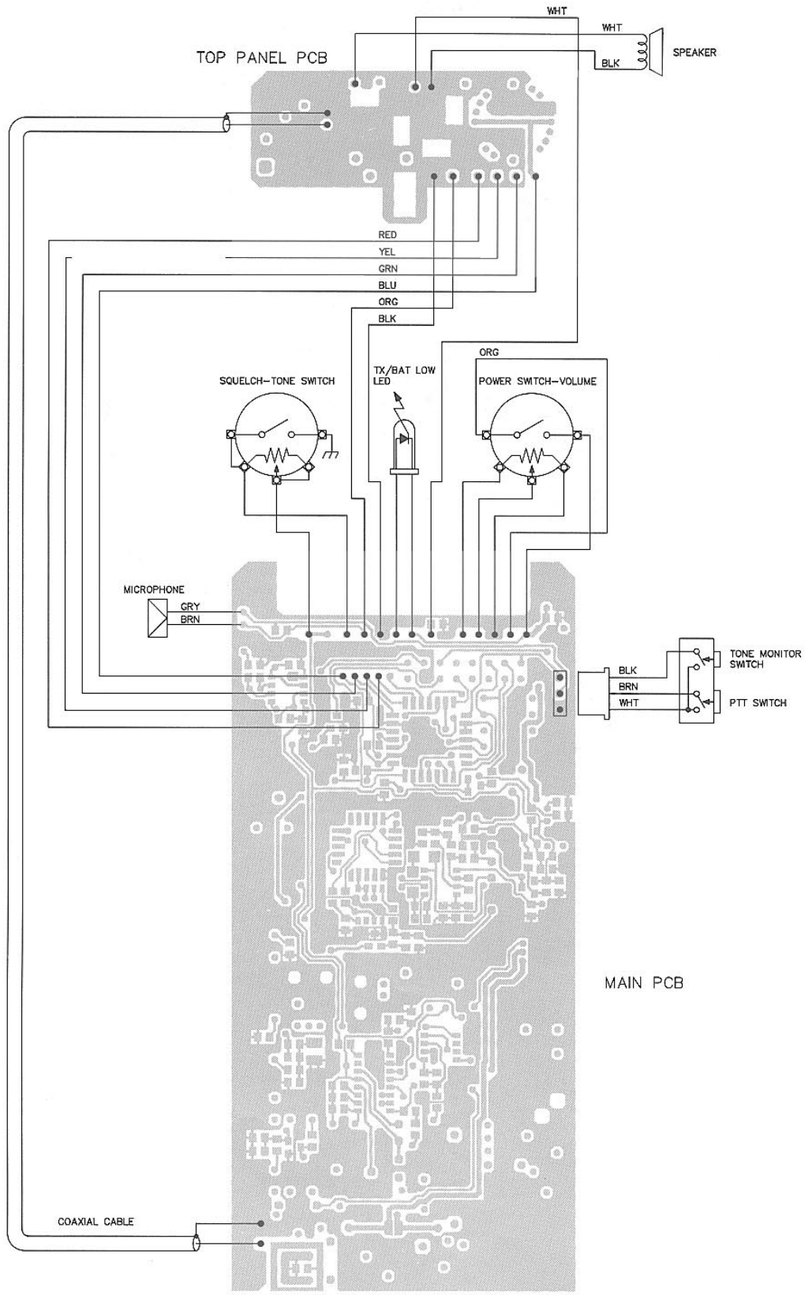
Main Printed Circuit Board

(R29/404-049-A)

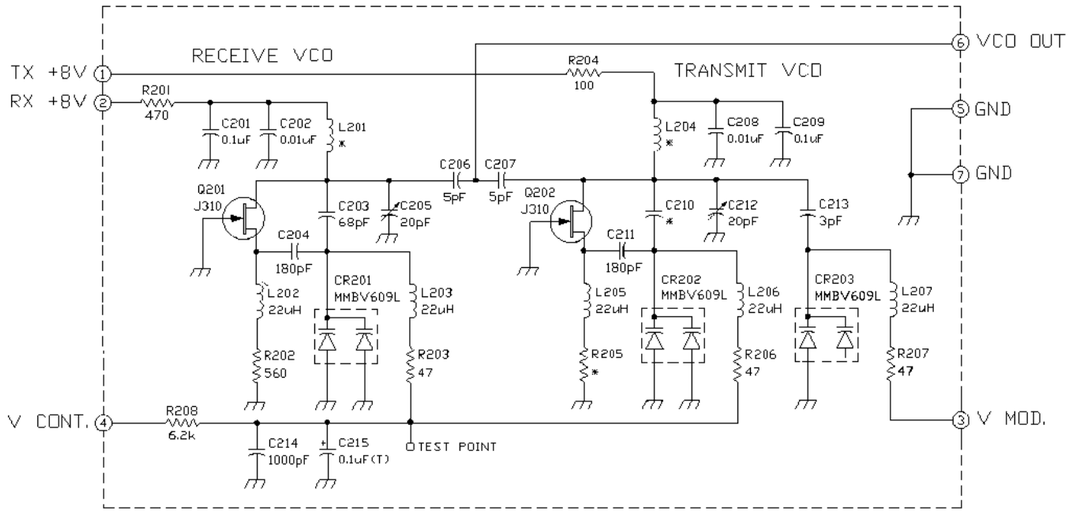


Main PCB (30 - 50 MHz)

Main Board/Top Panel



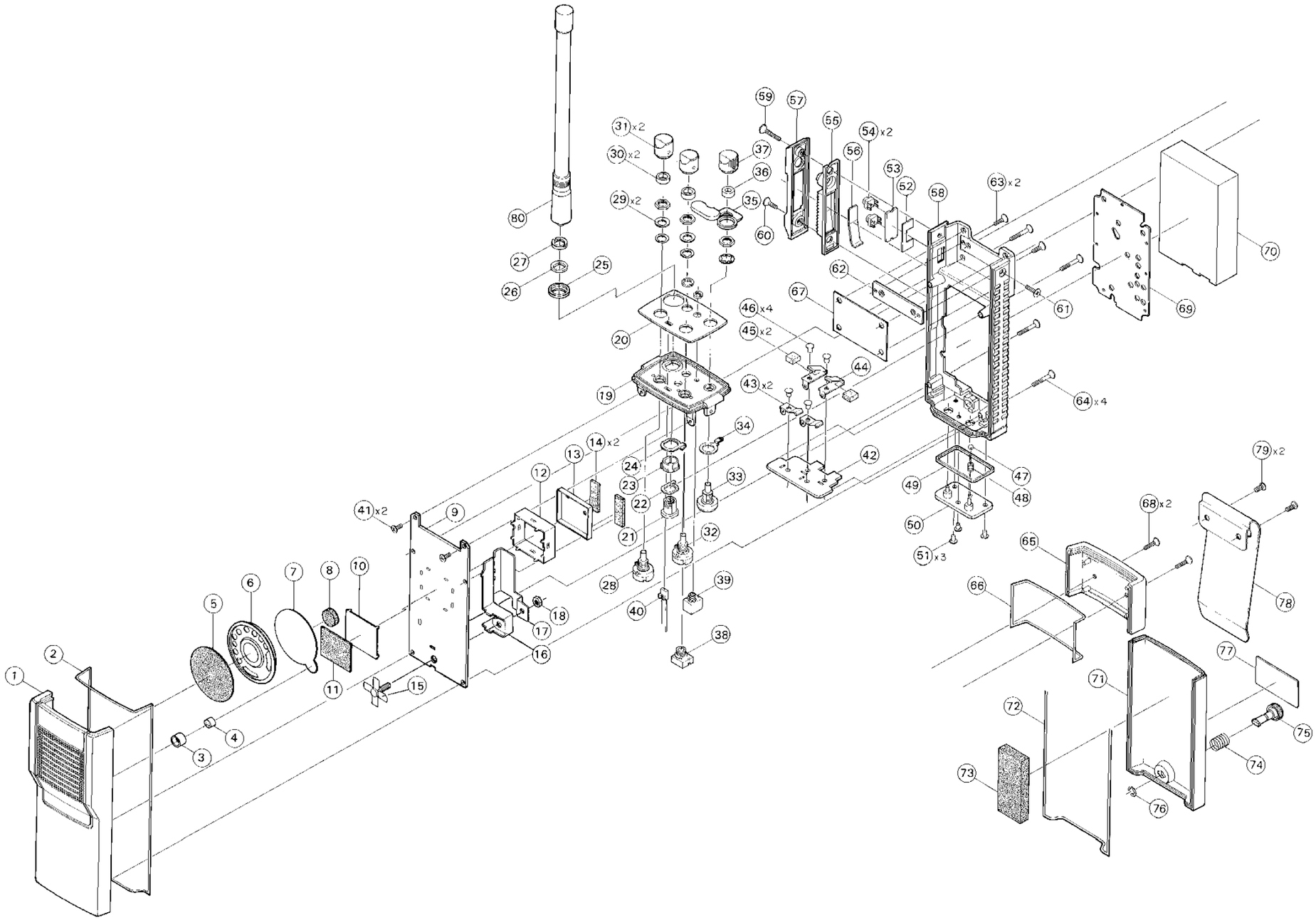
VCO



BAND	RX FREQ.(MHz)	TX FREQ.(MHz)	*R205	*C210	*L201	*L204
1	35.7-40.7	25-30	390	91pF	390nH	680nH
2	40.7-45.7	30-35	470	91pF	270nH	470nH
3	45.7-52.7	35-42	470	100pF	220nH	330nH
4	52.7-60.7	42-50	560	91pF	180nH	220nH

Top Panel & VCO PCB

R29/406-977-A



Radio Assembly, Exploded View

ınect Diagram
VCO Diagram

MONOGRAM Series Personal Radio
MPG 300

SYMBOL	PART NO.	DESCRIPTION
1	R29/718-088-AA	Cover Upper Assembly, Lexan 141-2032
2	R29/891-370	Gasket, Sili (Rubber/blk) (Included in cover upper assembly)
3	R29/850-924	Bushing MIC (Included in cover upper assembly)
4	R29/999-113-7	Condenser MIC assembly
5	R29/906-070	Felt (ø40 x t0.2 blk) (Included in cover upper asesembly)
6	R29/420-167-8	Speaker (45-8B-03 400 Hz)
7		Insulation Plate (Fiber Sticker)
8	R29/892-111	Rubber sponge sticker (Sticker blk)
9		Main PCB
10		Shield Plate
11	R29/894-592	Cushon, (Rubber sponge sticker)
12		Shield Case
13		Shield cover
14	R29/894-557	Cushon, (Rubber sponge sticker)
15	R29/203-043-6	Transistor
16		Heat Sink
17		Top Panel Assembly
18	R29/650-047	Nut
19	R29/718-075	Top Panel (Included in top panel assembly)
20	R29/795-083	Overlay (Included in top panel assembly)
21	R29/732-535	Holder (Ant) (Included in top panel assembly)
22		Washer (Ant) (Included in top panel assembly)
23	R29/852-761	Bushing (Ant P.C. Blk) (Included in top panel assembly)
24		Washer (ground) (Included in top panel assembly)
25	R29/8520765	Ring (Ant mtg) (Included in top panel assembly)
26	R29/905-481	Washer (P.C. clear) (Included in top panel assembly)
27	R29/650-295	Nut (Ant) (Included in top panel assembly)
28	R29/450-517-0	V12M4-1 (6x5) S (SJ) 12R-B20K VR (Squelch) (Included in top panel assembly)
29	R29/660-770	Washer (BSBM) (Included in top panel assembly)
30	R29/851-990	Bushing (CR-Blk) (Included in top panel assembly)
31	R29/821-470	Control Knob (Included in top panel assembly)
32	R29/450-516-9	V12M4-1 (6x5) S (SJ) 12R-150A20K VR (Volume) (Included in top panel assembly)
33	R29/430-029-0	JRE2-6 Rotary Sw. (Channel Select) (Included in top panel assembly)
34		Lug Terminal (Included in top panel assembly)
35	R29/894-514	Rubber Cap (Blk) (Included in top panel assembly)
36		Bushing (NEPO. Blk) (Included in top panel assembly)
37	R29/825-630	Knob (Channel) (Included in top panel assembly)
38	R29/420-717-5	Connector Jack (HCY3505 w/nut) (Included in top panel assembly)
39	R29/420-718-5	Connector Jack (HCY2505 w/nut) (Included in top panel assembly)
40	R29/251-016-7	L.E.D. Lamp (SLB) (Included in top panel assembly)
41	R29/611-230	(+) Machinea Screw
42		P.C.B. Battery (Included in Battery Contact Assembly)
43	R29/880-540	Spring Terminal (Included in Battery Contact Assembly)
44	R29/880-530	Spring battery (Included in Battery Contact Assembly)
45	R29/894-535	Cushon, (Sponge Sticker) (Included in Battery Contact Assembly)
46		Rivet (Terminal) (Included in Battery Contact Assembly)
47	R29/750-447	Ball Bearing (Included in frame assembly)
48	R29/881-481	Spring (Included in frame assembly)
49		Gasket (Spacer/rubber Blk) (Included in frame assembly)
50		Spacer (Battery terminal) (Included in frame assembly)
51		(+) Machine screw (B.H.) (Included in frame assembly)
52	R29/906-192	Installation Plate (Mylar sticker) (Included in PTT assembly)
53		P.C.B.PTT (Included in PTT assembly)
54	R29/434-007-0	Touch S.W. (SKHHAR 018A) (Included in PTT assembly)
55	R29/894-502	Gasket (PTT rubber Blk) (Included in PTT assembly)
56	R29/881-481	Spring (PTT rubber mtg.) (Included in PTT assembly)
57	R29/732-720	Holder, PTT (Included in PTT assembly)
58	R29/718-070-A	Frame (Included in frame assembly)
59	R29/613-761	(+) Machine screw (F.H.) Blk
60	R29/613-570	(+) Machine screw (F.H.) Blk
61	R29/613-217	(+) Machine screw (F.H.) Blk (Included in frame assembly)
62	R29/732-731	Holder Frame mtg)
63		(+) Machine screw (F.H.) 2.6 x 4 (Included in frame assembly)
64		(+) Machine screw (F.H.) 2.6 x 15
65	R29/718-087	Cover Bottom
66	R29/891-370	Gasket (Sili rubber Blk)
67	R29/903-680	Insulation Plate (Fiber sticker)
68	R29/613-192	(+) Machine screw (F.H.) Blk
69		Shield plate (Included in frame assembly)
70		Cover battery assembly
71	R29/718-090-A	Cover battery (Included in cover battery assembly)
72	R29/891-370	Gasket (Sili rubber Blk) (Included in cover battery assembly)
73		Cushion (Sponge sicker gray) (Included in cover battery assembly)
74	R29/881-462	Spring (locking) (Included in cover battery assembly)
75	R29/852-932	Shaft, locking (Included in cover battery assembly)
76	R29/665-110	"E" Ring, locking (Included in cover battery assembly)
77	R29/959-670-BA	Name Plate
78	R29/721-821-B	Belt Loop
79	R29/613-590	(+) Maching screw (B.H.)
80		Option Antenna
81	R29/958-671-A	Clear overlay for nameplate (Not shown) Frame Assembly

PARTS LIST
MAIN PRINTED CIRCUIT BOARD
R29/406-049-A

Note, when ordering parts the prefix "R29/" must precede all part numbers

SYMBOL	PART NO.	DESCRIPTION
C1	131-811-1Z	Capacitor, Ceramic 180 pF, COG (Band A)
C1		Capacitor, Ceramic 220 pF, COG (Band B)
C1		Capacitor, Ceramic 160 pF, COG (Band C)
C1	131-027-0Z	Capacitor, Ceramic 100 pF, COG (Band D)
C2		Capacitor, Ceramic 130 pF, COG (Band A)
C2	138-210-3	Capacitor, Ceramic 82 pF, COG (Band B)
C2	135-613-9Z	Capacitor, Ceramic 56 pF, COG (Band C)
C2		Capacitor, Ceramic 39 pF, COG (Band D)
C3		Capacitor, Ceramic 560 pF, COG (Band A)
C3	134-761-4Z	Capacitor, Ceramic 470 pF, COG (Band B)
C3		Capacitor, Ceramic 330 pF, COG (Band C)
C3		Capacitor, Ceramic 220 pF, COG (Band D)
C4	130-A17-6Z	Capacitor, Ceramic 1000 pF, COG (Band A)
C4	134-726-3	Capacitor, Ceramic 470 pF, COG (Band B)
C4	133-925-1Z	Capacitor, Ceramic 390 pF, COG (Band C)
C4		Capacitor, Ceramic 120 pF, COG (Band D)
C5	138-210-3	Capacitor, Ceramic 82 pF, COG (Band A)
C5		Capacitor, Ceramic 56 pF, COG (Band B)
C5		Capacitor, Ceramic 36 pF, COG (Band C)
C5	133-010-4Z	Capacitor, Ceramic 30 pF, COG (Band D)
C6	130-172-2Z	Capacitor, Ceramic .01 µF, X7R
C7	130-172-2Z	Capacitor, Ceramic .01 µF, X7R
C8	132-220-2Z	Capacitor, Ceramic 220 pF, COG (Band A)
C8		Capacitor, Ceramic 200 pF, COG (Band B)
C8	131-529-7Z	Capacitor, Ceramic 150 pF, COG (Band C)
C8	131-107-9Z	Capacitor, Ceramic 120 pF, COG (Band D)
C9	131-211-9	Capacitor, Ceramic 120 pF, COG (Band A)
C9	137-504-4Z	Capacitor, Ceramic 75 pF, COG (Band B)
C9	135-613-9Z	Capacitor, Ceramic 56 pF, COG (Band C)
C9		Capacitor, Ceramic 36 pF, COG (Band D)
C10	136-811-6Z	Capacitor, Ceramic 680 pF, COG (Band A)
C10		Capacitor, Ceramic 510 pF, COG (Band B)
C10	133-925-1Z	Capacitor, Ceramic 390 pF, COG (Band C)
C10		Capacitor, Ceramic 330 pF, COG (Band D)
C11	136-811	Capacitor, Ceramic 68 pF, COG (Band A)
C11	135-103-5Z	Capacitor, Ceramic 51 pF, COG (Band B)
C11		Capacitor, Ceramic 36 pF, COG (Band C)
C11	132-407-5Z	Capacitor, Ceramic 24 pF, COG (Band D)
C12		Capacitor, Ceramic 11 pF, COG (Band A)
C12		Capacitor, Ceramic 7.5 pF, COG (Band B)
C12		Capacitor, Ceramic 6.2 pF, COG (Band C & D)
C13		Capacitor, Ceramic 330 pF, COG (Band A)
C13	131-811-1Z	Capacitor, Ceramic 180 pF, COG (Band B)
C13	131-811-1Z	Capacitor, Ceramic 180 pF, COG (Band C)
C13	133-925-1Z	Capacitor, Ceramic 390 pF, COG (Band D)
C14	137-504-4Z	Capacitor, Ceramic 75 pF, COG (Band A)
C14		Capacitor, Ceramic 62 pF, COG (Band B)
C14	133-932-7	Capacitor, Ceramic 39 pF, COG (Band C)
C14	133-010-4Z	Capacitor, Ceramic 30 pF, COG (Band D)
C15	130-172-2Z	Capacitor, Ceramic .01 µF, X7R
C16	133-306-2Z	Capacitor, Ceramic 33 pF, COG (Band A)
C16	132-407-5Z	Capacitor, Ceramic 24 pF, COG (Band B)
C16		Capacitor, Ceramic 18 pF, COG (Band C)
C16		Capacitor, Ceramic 11 pF, COG (Band D)
C17	132-247-7	Capacitor, Ceramic 2.2 pF, COG (Band A)
C17	132-011-0Z	Capacitor, Ceramic 2 pF, COG (Band B)
C17	131-559-4Z	Capacitor, Ceramic 1.5 pF, COG (Band C)
C17	131-030-2Z	Capacitor, Ceramic 1 pF, COG (Band D)
C18	133-306-2Z	Capacitor, Ceramic 33 pF, COG (Band A)
C18	132-714-2Z	Capacitor, Ceramic 27 pF, COG (Band B)
C18		Capacitor, Ceramic 18 pF, COG (Band C)
C18	131-208-7Z	Capacitor, Ceramic 12 pF, COG (Band D)
C19	130-172-2Z	Capacitor, Ceramic .01 µF, X7R
C20	130-172-2Z	Capacitor, Ceramic .01 µF, X7R
C21	130-172-2Z	Capacitor, Ceramic .01 µF, X7R
C22	133-014-8Z	Capacitor, Ceramic 3 pF, COG
C23	134-722-1Z	Capacitor, Ceramic 47 pF, COG
C24	130-172-2Z	Capacitor, Ceramic .01 µF, X7R
C25	130-172-2Z	Capacitor, Ceramic .01 µF, X7R
C26	130-A17-6Z	Capacitor, Ceramic .001 µF, X7R
C27	130-172-2Z	Capacitor, Ceramic .01 µF, X7R
C28	130-172-2Z	Capacitor, Ceramic .01 µF, X7R
C29	130-172-2Z	Capacitor, Ceramic .01 µF, X7R
C30		Capacitor, Ceramic .1 µF, Y5V
C31		Capacitor, Ceramic .1 µF, Y5V
C32	130-172-2Z	Capacitor, Ceramic .01 µF, X7R
C33	138-210-3	Capacitor, Ceramic 82 pF, COG (Band A, B & C)
C33	135-103-5Z	Capacitor, Ceramic 51 pF, COG (Band D)
C34A	133-925-1Z	Capacitor, Ceramic 390 pF
C34	133-339-2Z	Capacitor, Ceramic 330 pF, COG (Band A & B)
C34	132-710-8Z	Capacitor, Ceramic 270 pF, COG (Band C)
C34	132-411-8	Capacitor, Ceramic 240 pF, COG (Band D)
C35	130-170-0Z	Capacitor, Ceramic .1 µF, Y5V
C36	130-172-2Z	Capacitor, Ceramic .01 µF, X7R
C37	130-172-2Z	Capacitor, Ceramic .01 µF, X7R
C38	101-043-5	Capacitor, Electrolytic 10 µF, 16V
C39	130-719-7Z	Capacitor, Ceramic 4700 pF, X7R
C40	130-A17-6Z	Capacitor, Ceramic .001 µF, X7R
C41	175-007-2	Capacitor, Trimmer 50 pF,
C42	136-816-5Z	Capacitor, Ceramic 68 pF, COG (Band A)
C42		Capacitor, Ceramic 39 pF, COG (Band B)
C42	135-613-9Z	Capacitor, Ceramic 56 pF, COG (Band C)
C42		Capacitor, Ceramic 36 pF, COG (Band D)
C43	130-172-2Z	Capacitor, Ceramic .01 µF, X7R
C44		Capacitor, Ceramic 120 pF, COG (Band A)
C44	139-101-3	Capacitor, Ceramic 100 pF, COG (Band B)
C44	137-504-4Z	Capacitor, Ceramic 75 pF, COG (Band C)
C44	136-816-5Z	Capacitor, Ceramic 68 pF, COG (Band D)
C45		Capacitor, Ceramic 3900 pF, X7R
C46	130-239-0Z	Capacitor, Ceramic 2200 pF, X7R
C47	130-172-2Z	Capacitor, Ceramic .01 µF, X7R
C48		Capacitor, Tantalum 1 µF, 16V
C49	141-004-2	Capacitor, Tamtalum 10 µF, 16V
C50	130-172-2Z	Capacitor, Ceramic .01 µF, X7R
C51	102-246-7	Capacitor, Electrolytic 22 µF, 16V
C52		Capacitor, Tantalum 1 µF, 16V
C53	130-A17-6Z	Capacitor, Ceramic .001 µF, X7R
C54	141-027-3Z	Capacitor, Tantalum 1 µF, 16V
C55		Capacitor, Ceramic .1 µF, Y5V
C56	130-A17-6Z	Capacitor, Ceramic .001 µF, X7R
C57	130-A17-6Z	Capacitor, Ceramic .001 µF, X7R
C58	130-602-4Z	Capacitor, Ceramic 6800 pF, X7R
C59	130-804-0	Capacitor, Ceramic 8200 pF, X7R
C60	130-A17-6Z	Capacitor, Ceramic .001 µF, X7R
C61	130-172-2Z	Capacitor, Ceramic .01 µF, X7R
C62	141-008-6Z	Capacitor, Tantalum 1 µF, 16V
C63	130-A17-6Z	Capacitor, Ceramic .001 µF, X7R
C64	130-A17-6Z	Capacitor, Ceramic .001 µF, X7R
C65		Capacitor, Ceramic 6 pF, COG

SYMBOL	PART NO.	DESCRIPTION
C66	130-172-2Z	Capacitor, Ceramic .01 µF, X7R
C67		Capacitor, Ceramic .1 µF, Y5V
C68	130-172-2Z	Capacitor, Ceramic .01 µF, X7R
C69	130-A17-6Z	Capacitor, Ceramic .001 µF, X7R
C70	131-027-0Z	Capacitor, Ceramic 100 pF
C71	144-702-4Z	Capacitor, Tantalum 4.7 µF, 16V
C72	130-804-0	Capacitor, Ceramic 8200 pF, X7R
C73	134-761-4Z	Capacitor, Ceramic 470 pF, COG
C74	130-172-2Z	Capacitor, Ceramic .01 µF, X7R
C75	130-172-2Z	Capacitor, Ceramic .01 µF, X7R
C76	130-172-2Z	Capacitor, Ceramic .01 µF, X7R
C77		Capacitor, Ceramic .1 µF, Y5V
C78	130-239-0Z	Capacitor, Ceramic 2200 pF, X7R
C79		Capacitor, Ceramic .039 µF, X7R
C80		Capacitor, Tantalum .47 µF
C81		Capacitor, Tantalum .47 µF
C82	130-A17-6Z	Capacitor, Ceramic .001 µF, X7R
C83	140-204-1Z	Capacitor, Tantalum .22 µF
C84		NOT USED
C85		Capacitor, Ceramic .039 µF, X7R
C86	132-714-2Z	Capacitor, Ceramic 27 pF, COG
C87		Capacitor, Ceramic .1 µF, Y5V
C88		Capacitor, Ceramic .1 µF, Y5V
C89	130-A17-6Z	Capacitor, Ceramic .001 µF, X7R
C90	130-A17-6Z	Capacitor, Ceramic .001 µF, X7R
C91	141-027-3Z	Capacitor, Tantalum 1 µF, 16V
C92		Capacitor, Ceramic .1 µF, Y5V
C93	130-A17-6Z	Capacitor, Ceramic .001 µF, X7R
C94	130-172-2Z	Capacitor, Ceramic .01 µF, X7R
C95	130-A17-6Z	Capacitor, Ceramic .001 µF, X7R
C96	130-A17-6Z	Capacitor, Ceramic .001 µF, X7R
C97	136-811-6Z	Capacitor, Ceramic 680 pF, COG
C98	134-761-4Z	Capacitor, Ceramic 470 pF, COG
C99		Capacitor, Ceramic .1 µF, Y5V
C100		Capacitor, Ceramic .1 µF, Y5V
C101		Capacitor, Ceramic .1 µF, Y5V
C102		Capacitor, Tantalnm 1 µF, 16V
C103		Capacitor, Ceramic .1 µF, Y5V
C104		Capacitor, Ceramic .1 µF, Y5V
C105	141-012-9Z	Capacitor, Electrolytic 10 µF, 16V
C106	101-043-5	Capacitor, Electrolytic 10 µF, 16V
C107	143-302-1Z	Capacitor, Tantalum .33 µF, 16V
C108	130-A17-6Z	Capacitor, Ceramic .001 µF, X7R
C109	101-093-0	Capacitor, Electrolytic 100 µF, 16V
C110	143-302-1Z	Capacitor, Tantalum .33 µF, 16V
C111	130-A17-6Z	Capacitor, Ceramic .001 µF, X7R
C112	130-A17-6Z	Capacitor, Ceramic .001 µF, X7R
C113		Capacitor, Ceramic .1 µF, Y5V
C114		Capacitor, Ceramic .1 µF, Y5V
C115		Capacitor, Ceramic .1 µF, Y5V
C116		Capacitor, Ceramic .1 µF, Y5V
C117	130-A17-6Z	Capacitor, Ceramic .001 µF, X7R
C118	132-216-9Z	Capacitor, Ceramic 22 pF, COG
C119	132-216-9Z	Capacitor, Ceramic 22 pF, COG
C120	130-172-2Z	Capacitor, Ceramic .01 µF, X7R
C121	133-010-4Z	Capacitor, Ceramic 30 pF
C122	172-017-8	Capacitor, Trimmer 20 pF
C123		Capacitor, Ceramic 330 pF, COG
C124	131-529-7Z	Capacitor, Ceramic 150 pF, COG
C125	130-172-2Z	Capacitor, Ceramic .01 µF, X7R
C126	130-172-2Z	Capacitor, Ceramic .01 µF, X7R

SYMBOL	PART NO.	DESCRIPTION
C127-C200		NOT USED
C201		Capacitor, Ceramic .1 µF, Y5V
C202	130-172-2Z	Capacitor, Ceramic .01 µF, X7R
C203	136-816-5Z	Capacitor, Ceramic 68 pF, COG
C204	131-811-1Z	Capacitor, Ceramic 180 pF, COG
C205		Capacitor, Trimmer 20 pF
C206	135-010-4Z	Capacitor, Ceramic 5 pF, COG
C207	135-010-4Z	Capacitor, Ceramic 5 pF, COG
C208	130-172-2Z	Capacitor, Ceramic .01 µF, X7R
C209		Capacitor, Ceramic .1 µF, Y5V
C210	131-027-0Z	Capacitor, Ceramic 91 pF, COG (Bands A,B,D)
C210	131-052-2	Capacitor, Ceramic 100pF, COG (Band C)
C211	131-811-1	Capacitor, Ceramic 180 pF, COG
C212		Capacitor, Trimmer 20 pF
C213	133-014-8Z	Capacitor, Ceramic 3 pF, X7R
C214	130-A17-6Z	Capacitor, Ceramic .001 µF, X7R
C215		Capacitor, Tantalum .1 µF, (T)
C216-C300		NOT USED
C301	134-722-1Z	Capacitor, Ceramic 47 pF, COG
C302	134-761-4Z	Capacitor, Ceramic 470 pF, COG
C303	134-722-1Z	Capacitor, Ceramic 47 pF, COG
C304		Capacitor, Ceramic 470 pF, COG
C305		Capacitor, Ceramic 62 pF. COG (Band A & B)
C305	135-613--9Z	Capacitor, Ceramic 56 pF. COG (Band C)
C305	134-722-1Z	Capacitor, Ceramic 47 pF. COG (Band D)
C306	131-511-0Z	Capacitor, Ceramic 16 pF. COG (Band A)
C306	131-511-0Z	Capacitor, Ceramic 16 pF. COG (Band B)
C306	131-208-7Z	Capacitor, Ceramic 12 pF. COG (Band C)
C306	131-039-1Z	Capacitor, Ceramic 10 pF. COG (Band D)
C307	131-107-9Z	Capacitor, Ceramic 120 pF. COG (Band A)
C307	131-107-9Z	Capacitor, Ceramic 120 pF. COG (Band B)
C307	131-027-0Z	Capacitor, Ceramic 100 pF. COG (Band C)
C307	138-210-3Z	Capacitor, Ceramic 82 pF. COG (Band D)
C308	134-722-1Z	Capacitor, Ceramic 47 pF, COG (Band A)
C308		Capacitor, Ceramic 43 pF, COG (Band B)
C308		Capacitor, Ceramic 36 pF, COG (Band C)
C308	133-010-4Z	Capacitor, Ceramic 30 pF, COG (Band D)
C309	135-613-9Z	Capacitor, Ceramic 56 pF, COG (Band A)
C309	134-722-1	Capacitor, Ceramic 47 pF, COG (Band B)
C309		Capacitor, Ceramic 36 pF, COG (Band C)
C309	132-714-2Z	Capacitor, Ceramic 27 pF, COG (Band D)
C310	130-188-8	Capacitor, Ceramic .01 µF, X7R
CR1		Diode, Zener MMBZ5234B-T1(8J)
CR2	243-016-4	Diode, Pin UM9401
CR3	243-016-4	Diode, Pin UM9401
CR4	243-052-6	Diode, Silicon MMBD914-LT1(5D)
CR5	249-006-5	Diode, Schottkey MMBD352-LT1(5G)
CR6	249-006-5	Diode, Schottkey MMBD352-LTI(5G)
CR7	249-006-5	Diode, Schottkey MMBD352-LTI(5G)
CR8	243-052-6	Diode, Silicon MMBD914-LTI(5D)
CR201		Diode, MMBV6O9L
CR202		Diode, MMBV609L
CR203		Diode, MMBV609L
CR301		Diode, 1N4001
CR302	251-016-7	Diode, LED Lamp (KLR124)
CR303		Diode, 1N4001
F1	280-089-7	Fuse, 3A
FL1		Filter, Crystal 10M15B
FL2		Filter, Crystal 10M15B
FL3	270-027-8Z	Filter, ceramic CFW455F
J1		TDH Connector TDH-16SG

SYMBOL	PART NO.	DESCRIPTION
J2	422-027-5	Molex Connector 5267-03A
J3	421-607-4	R. I. C. Socket DIS-8DR
J4	504-508	7 Pin IC Socket
J6	422-228-0	Interconnection Header Pin
J301	420-718-6	Jack Connector HCY2505 (MPS)
J302	420-717-5	Jack Connector w/nut HCY3505
J303	732-535	Antenna Stud Mount Connector
L1		Coil, 500 nH 12T
L2		Coil, 500 nH 12T
L3		Coil, 500 nH 12T
L4		Coil, 500 nH 12T
L5		Coil, 500 nH 12T
L6		Coil, Chip 2.7 uH
L7		Coil, 500 nH 12T
L8		Coil, 500 nH 12T
L9		Coil, .47 uH (Band A)
L9		Coil, .39 uH (Band B)
L9		Coil, .27 uH (Band C, D)
L10	310-085-3	Coil, Choke MK8
L11		Coil, 10T .125 ID #24 AWG (Band A)
L11		Coil, 8T .125 ID #24 AWG (Band B)
L11		Coil, 6T .125 ID #24 AWG (Band C)
L11		Coil, 5T .125 ID #24 AWG (Band D)
L12	10-085-3	Coil, Choke MK8
L13		Coil, 25T #28 AWG on T25-12 Core
L14		Coil, 18T #28 AWG on T25-12 Core (Band A,B)
L14		Coil, 13T #24 AWG on T25-12 Core (Band C,D)
L15		Coil, 25T #28 AWG on T25-12 Core (Band A,B)
L15		Coil, 20T #28 AWG on T25-12 Core (Band C)
L15		Coil, 18T #28 AWG on T25-12 Core (Band D)
L16		Coil, 15T #24 AWG on T25-12 Core (Band A)
L16		Coil, 14T #24 AWG on T25-12 Core (Band B)
L16		Coil, 13T #24 AWG on T25-12 Core (Band C)
L16		Coil, 12T #24 AWG on T25-12 Core (Band D)
L17		Coil, 15T #24 AWG on T25-12 Core (Band A)
L17		Coil, 14T #24 AWG on T25-12 Core (Band B)
L17		Coil, 13T #24 AWG on T25-12 Core (Band C)
L17		Coil, 12T #24 AWG on T25-12 Core (Band D)
L18		Coil, Chip .47 uH (Band A)
L18		Coil, Chip .33 uH (Band B & C)
L18	310-392-0	Coil, Chip .22 uH (Band D)
L19	320-232-2	Coil, 455 KHz Detector
L201		Coil, Chip 220 nH (Band A)
L201		Coil, Chip 220 nH (Band B)
L201	310-392-0	Coil, Chip 220 nH (Band C)
L201	310-647-1	Coil, Chip 220 nH (Band D)
L202	310-607-5	Coil, Chip 22 uH
L203	310-607-5	Coil, Chip 22 uH
L204		Coil, Chip 330 nH (Band A)
L204		Coil, Chip 330 nH (Band B)
L204		Coil, Chip 330 nH (Band C)
L204	310-392-0	Coil, Chip 220 nH (Band D)
L205	310-607-5	Coil, Chip 22 uH
L206	310-607-5	Coil, Chip 22 uH
L207	310-607-5	Coil, Chip 22 uH
L301		Coil, 15T #24 AWG on T25-12 Core (Band A)
L301		Coil, 13T #24 AWG on T25-12 Core (Band B)
L301		Coil, 12T #24 AWG on T25-12 Core (Band C)
L301		Coil, 11T #24 AWG on T25-12 Core (Band D)
L302		Coil, 13T #24 AWG on T25-12 Core (Band A)
L302		Coil, 11T #24 AWG on T25-12 Core (Band B)
L302		Coil, 10T #24 AWG on T25-12 Core (Band C)

SYMBOL	PART NO.	DESCRIPTION
L302		Coil, 9T #24 AWG on T25-12 Core (Band C)
P4	422-247-7	Interconnection Header Pin GDH-16DBC 4.7 mm
Q1	200-003-5	Transistor, BFR92A
Q2	203-116-9	Transistor, MMBFJ31O (6T)
Q3	203-116-9	Transistor, MMBFJ310 (6T)
Q4	203-109-3	Transistor, MMBR9426-LT1
Q5	218-018-2	Transistor, MMBT3904 (1A)
Q6	203-054-6	Transistor, L8P966
Q7	203-109-3	Transistor, MMBR9426-LT1
Q8	203-109-3	Transistor, MMBR9426-LT1
Q9	203-176-3	Transistor, MRF229
Q10	203-043-6	Transistor, SRFH1900
Q11	218-017-1	Transistor, MMBT3906 (2A)
Q12	218-018-2	Transistor, MMBT3904 (1A)
Q13	218-017-1	Transistor, MMBT3906 (2A)
Q14	218-017-1	Transistor, MMBT3906 (2A)
Q15	218-017-1	Transistor, MMBT3906 (2A)
Q16	203-109-3	Transistor, MMBR9426-LT1
Q201	203-116-9	Transistor, MMBFJ310 (6T)
Q202	203-116-9	Transistor, MMBFJ310 (6T)
R1	060-153-3Z	Resistor, Chip 15k ohm 1/10W 5%
R2	060-392-2Z	Resistor, Chip 3.9k ohm 1/10W 5%
R3		Resistor, Chip 360 ohm 1/10W 5%
R4	060-560-7Z	Resistor, Chip 56 ohm 1/10W 5%
R5	060-101-6Z	Resistor, Chip 100 ohm 1/10W 5%
R6	060-222-2Z	Resistor, Chip 2.2k ohm 1/10W 5%
R7	060-472-1Z	Resistor, Chip 4.7k ohm 1/10W 5%
R8	060-272-7Z	Resistor, Chip 2.7k ohm 1/10W 5%
R9	060-101-6Z	Resistor, Chip 100 ohm 1/10W 5%
R10	060-302-1Z	Resistor, Chip 3k ohm 1/10W 5%
R11	060-101-6Z	Resistor, Chip 100 ohm 1/10W 5%
R12	060-474-3Z	Resistor, Chip 470k ohm 1/10W 5%
R13	060-332-8Z	Resistor, Chip 3.3k ohm 1/10W 5%
R14	060-151-1Z	Resistor, Chip 150 ohm 1/10W 5%
R15	060-472-1Z	Resistor, Chip 4.7k ohm 1/10W 5%
R16	060-103-8Z	Resistor, Chip 10k ohm 1/10W 5%
R17	060-471-0Z	Resistor, Chip 470 ohm 1/10W 5%
R18	060-471-0Z	Resistor, Chip 470 ohm 1/10W 5%
R19	060-681-3Z	Resistor, Chip 680 ohm 1/10W 5%
R20	060-471-0Z	Resistor, Chip 470 ohm 1/10W 5%
R21	060-391-1Z	Resistor, Chip 390 ohm 1/10W 5%
R22	060-332-8Z	Resistor, Chip 3.3k ohm 1/10W 5%
R23	060-821-3Z	Resistor, Chip 820 ohm 1/10W 5%
R24	060-151-1Z	Resistor, Chip 150 ohm 1/10W 5% (Band A, B, C)
R24	060-820-2Z	Resistor, Chip 82 ohm 1/10W 5% (Band D)
R25	060-220-0Z	Resistor, Chip 22 ohm 1/10W 5%
R26	060-152-2Z	Resistor, Chip 1.5k ohm 1/10W 5%
R27	002-220-2Z	Resistor, Metal Film 22 ohm 1/8W:JS
R28		Resistor, Metal Film 270 ohm 1/2W 5%
R29		NOT USED
R30	060-392-2Z	Resistor, Metal Film 3.9k ohm 1/10W 5%
R31	060-103-8Z	Resistor, Chip 10k ohm 1/10W 5%
R32	060-332-8Z	Resistor, Chip 3.3k ohm 1/10W 5%
R33	060-472-1Z	Resistor, Chip 4.7k ohm 1/10W 5%
R34	060-473-2Z	Resistor, Chip 47k ohm 1/10W 5%
R35	060-103-8Z	Resistor, Chip 10k ohm 1/10W 5%
R36	060-103-8Z	Resistor, Chip 10k ohm 1/10W 5%
R37	060-512-4Z	Resistor, Chip 5.1k ohm 1/10W 5%
R38	060-472-1Z	Resistor, Chip 4.7k ohm 1/10W 5%
R39	060-472-1Z	Resistor, Chip 4.7k ohm 1/10W 5%
R40	060-513-5	Resistor, Chip 51k ohm 1/10W 5%
R41	060-824-6Z	Resistor, Chip 820k ohm 1/10W 5%

SYMBOL	PART NO.	DESCRIPTION
R42	060-683-5Z	Resistor, Chip 68k ohm 1/10W 5%
R43	060-332-8Z	Resistor, Chip 3.3k ohm 1/10W 5%
R44	060-394-4Z	Resistor, Chip 390k ohm 1/10W 5%
R45	060-472-1Z	Resistor, Chip 4.7k ohm 1/10W 5%
R46	060-513-5	Resistor, Chip 51k ohm 1/10W 5%
R47	060-472-1Z	Resistor, Chip 4.7k ohm 1/10W 5%
R48	060-183-0Z	Resistor, Chip 18k ohm 1/10W 5%
R49	060-472-1Z	Resistor, Chip 4.7k ohm 1/10W 5%
R50		Resistor, Semi-Fixed 4.7k ohm
R51	060-122-5Z	Resistor, Chip 1.2k ohm 1/10W 5%
R52	060-560-7Z	Resistor, Chip 56 ohm 1/10W 5%
R53	060-103-8Z	Resistor, Chip 10k ohm 1/10W 5%
R54	060-472-1Z	Resistor, Chip 4.7k ohm 1/10W 5%
R55	060-181-8Z	Resistor, Chip 180 ohm 1/10W 5%
R56	060-680-2Z	Resistor, Chip 68 ohm 1/10W 5%
R57	060-301-8Z	Resistor, Chip 300 ohm 1/10W 5%
R58		Resistor, Chip 18 ohm 1/10W 5%
R59	060-301-8Z	Resistor, Chip 300 ohm 1/10W 5%
R60	060-393-3Z	Resistor, Chip 39k ohm 1/10W 5%
R61	060-393-3Z	Resistor, Chip 39k ohm 1/10W 5%
R62	060-183-0Z	Resistor, Chip 18k ohm 1/10W 5%
R63	060-124-6Z	Resistor, Chip 120k ohm 1/10W 5%
R64	060-752-4Z	Resistor, Chip 7.5k ohm 1/10W 5%
R65	060-104-9Z	Resistor, Chip 100k ohm 1/10W 5%
R66	060-104-9Z	Resistor, Chip 100k ohm 1/10W 5%
R67	060-223-3Z	Resistor, Chip 22k ohm 1/10W 5%
R68	060-104-9Z	Resistor, Chip 100k ohm 1/10W 5%
R69	060-104-9Z	Resistor, Chip 100k ohm 1/10W 5%
R70		Resistor, Chip 680k ohm 1/10W 5%
R71		Resistor, Chip 680k ohm 1/10W 5%
R72	060-823-5Z	Resistor, Chip 82k ohm 1/10W 5%
R73	060-823-5Z	Resistor, Chip 82k ohm 1/10W 5%
R74	060-103-8Z	Resistor, Chip 10k ohm 1/10W 5%
R75	060-101-6Z	Resistor, Chip 100 ohm 1/10W 5%
R76	060-474-3Z	Resistor, Chip 470k ohm 1/10W 5%
R77	060-273-8Z	Resistor, Chip 27k ohm 1/10W 5%
R78	060-683-5Z	Resistor, Chip 68k ohm 1/10W 5%
R79	060-104-9Z	Resistor, Chip 100k ohm 1/10W 5%
R80	060-224-4Z	Resistor, Chip 220k ohm 1/10W 5%
R81	060-394-4Z	Resistor, Chip 390k ohm 1/10W 5%
R82	060-222-2Z	Resistor, Chip 2.2k ohm 1/10W 5%
R83	060-682-4Z	Resistor, Chip 6.8k ohm 1/10W 5%
R84	060-682-4Z	Resistor, Chip 6.8k ohm 1/10W 5%
R85	060-273-8Z	Resistor, Chip 27k ohm 1/10W 5%
R86	060-472-1Z	Resistor, Chip 4.7k ohm 1/10W 5%
R87	060-203-5Z	Resistor, Chip 20k ohm 1/10W 5%
R88	060-224-4Z	Resistor, Chip 220k ohm 1/10W 5%
R89	060-224-4Z	Resistor, Chip 220k ohm 1/10W 5%
R90	060-224-4Z	Resistor, Chip 220k ohm 1/10W 5%
R91	060-472-1Z	Resistor, Chip 4.7k ohm 1/10W 5%
R92	060-754-6Z	Resistor, Chip 750k ohm 1/10W 5%
R93	060-229-9Z	Resistor, Chip 2.2 ohm 1/10W 5%
R94	060-101-6Z	Resistor, Chip 100 ohm 1/10W 5%
R95	060-103-8Z	Resistor, Chip 10k ohm 1/10W 5%
R96	060-475-4Z	Resistor, Chip 4.7M ohm 1/10W 5%
R97	060-472-1Z	Resistor, Chip 4.7k ohm 1/10W 5%
R98	060-473-2Z	Resistor, Chip 47k ohm 1/10W 5%
R99	060-473-2Z	Resistor, Chip 47k ohm 1/10W 5%
R100	060-473-2Z	Resistor, Chip 47k ohm 1/10W 5%
R101	060-473-2Z	Resistor, Chip 47k ohm 1/10W 5%
R102	060-105-0Z	Resistor, Chip 1M ohm 1/10W 5%
R103	060-473-2Z	Resistor, Chip 47k ohm 1/10W 5%

SYMBOL	PART NO.	DESCRIPTION
R104	060-222-2Z	Resistor, Chip 2.2k ohm 1/10W 5%
R105	060-332-8Z	Resistor, Chip 3.3k ohm 1/10W 5%
R106	060-222-2	Resistor, Chip 2.2k ohm 1/10W 5% (Band A)
R106	060-221-1Z	Resistor, Chip 220 ohm 1/10W 5% (Band B, C, D)
R107	060-103-8Z	Resistor, Chip 10k ohm 1/10W 5%
R108	060-103-8Z	Resistor, Chip 10k ohm 1/10W 5%
R201	060-471-0Z	Resistor, Chip 470 ohm 1/10W 5%
R202	060-561-8Z	Resistor, Chip 560 ohm 1/10W 5%
R203	060-470-9Z	Resistor, Chip 47 ohm 1/10W 5%
R204	060-101-6Z	Resistor, Chip 100 ohm 1/10W 5%
R205	060-391-1Z	Resistor, Chip 390 ohm 1/10W 5% (Band A)
R205	060-471-0Z	Resistor, Chip 470 ohm 1/10W 5% (Band B,C)
R205	060-561-8Z	Resistor, Chip 560 ohm 1/10W 5% (Band D)
R206	060-470-9Z	Resistor, Chip 47 ohm 1/10W 5%
R207	060-470-9Z	Resistor, Chip 47 ohm 1/10W 5%
R208		Resistor, Chip 6.2k ohm 1/10W 5%
RT1	097-503-0	Thermistor, 50k ohm 15%
SW301	450-516-9	Resistor, Variable (VR) 20k (A)
SW302	450-517-0	Resistor, Variable (VR) 20k (B)
SW303	430-029-0	Switch, Rotary JRE2-6
SW304	435-003-1	Switch, Hi/Low (Not used)
T1	320-352-7	Coil, IFT 10.7 MHz
T2	320-352-7	Coil, IFT 10.7 MHz
U1		I. C., TL750L08, CLP
U2	223-119-8	I. C., 78L05
U3	231-064-4	I. C., LM358D
U4	231-064-4	I. C., LM358D
U5	223-145-1	I. C., MC145158BN
U6		I. C., MC12015D
U7	223-116-5	I. C., MC3361AD
U8	229-080-5	I. C., SL6310CMP
U9	229-318-1	I. C., EEPROM HY93C46
U10	223-125-3	I. C., Microprocessor SC82562FN
Y1	261-306-2	Crystal, 1 MHz
Y2	260-376-0	Crystal, 10.245 MHz