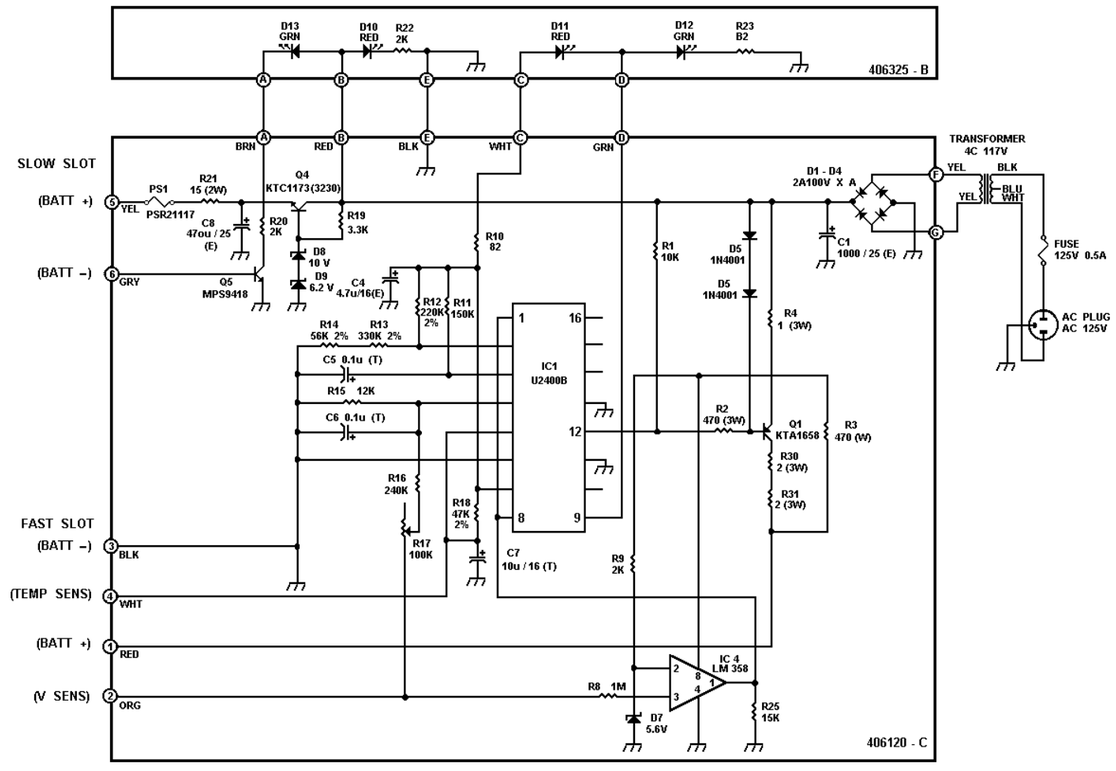
Mobile Communications



Monogram ***Series***

450-470 MHz PORTABLE RADIO
MODEL MGP 450

RAPID DESK CHARGER
MGCH3K

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

Printed in U.S.A.

Maintenance Manual

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SPECIFICATIONS*

GENERAL

	FCC	DOC
Radio Identification	F3JSP2850	287-194-149P
Frequency Range	450 - 470 MHz	
Channel Spacing and Stability	25 kHz ± 0.0005%	
Number of RX/TX Channels	10 Maximum	
Microphone Impedance	1.5k Ohm	
Speaker Impedance	8 Ohm	
Battery	Rechargeable Nickel-Cadmium Battery, 10.8 V DC 600 mAh MGPA5A 1200 mAh MGPA5C	
Operating Voltage Range	10.8 nominal	
Current Drain		
Standby		
(Battery Save On)	45 mA	
(Battery Save Off)	80 mA	
Receive	210 mA	
Transmit (5 W)	1200 mA	
Battery Life (5-5-90% duty cycle)		
Typically:		
600 mAh (344A4506P1)	7 hrs at 5 W (save on), 5 hrs at 5 W (save off).	
1200 mAh (344A4506P3)	14 hrs at 5 W (save on), 10 hrs at 5 W (save off).	
Environmental	Designed to meet EIA	
Temperature Range	-30°C to +60°C	
Relative Humidity	90% at 40°C Non-condensing	
Dimensions (in mm)		
Radio	99(H) x 64(W) x 36(D)	
600 mAh MGPA5A Battery	59(H) x 64(W) x 36(D)	
1200 mAh MGPA5C Battery	94(H) x 64(W) x 36(D)	
Weight		
Radio	270 gm	
600 mAh (344A4506P1) Battery	230 gm	
1200 mAh (344A4506P3) Battery	300 gm	

TRANSMITTER

Output Power	Variable 1W or 5W nominal
RF Load Stability	Unconditional
RF Power Stability	+2 dB - 3 dB of nominal power
Operational Bandwidth	8 MHz

Spurious emissions	
Conducted	-60 dBc maximum
Radiated	-60 dBc maximum
Adjacent Channel Noise Power	-70 dB
Audio Frequency Response	+1, -4-5 dB 300-3000 Hz
Audio Distortion	< 5%
Modulation Limiting	5 kHz 300-3000 Hz
Microphone Sensitivity	> 90 dB S.P.L.
FM Hum and Noise (Unsquelched)	< 45 dB
Carrier Attack Time	< 100 ms
RECEIVER	
Sensitivity	12 dB SINAD: 0.25 µV (TYPICAL) 20 dB: 0.5 µV
Modulation Acceptance Bandwidth	7.0 kHz
Adjacent Channel Signal Selectivity	-70 dB
Spurious Response Rejection	-70 dBc
Squelch Blocking	> 5 kHz
Intermodulation Rejection	≥ 70 db
Maximum Audio Power Output	0.5 W
AF Distortion	< 5.0%
Frequency Response	-2, +8 dB 1000 Hz reference 6 dB/octave de-emphasized 300 Hz - 3000 Hz.
Hum and Noise (Unsquelched)	45 dB
Conducted Spurious Emission	-53 dBm
Operational Bandwidth	7 MHz (3 dB)

* These specifications are intended primarily for use during servicing. Refer to the appropriate Specification Sheet for complete specifications.

DESCRIPTION

The MONOGRAM Series Personal radio is small, light-weight, yet ruggedly constructed two way FM radio operating on the 450-470 MHz frequency band. This multichannel radio offers both simplex and semi-duplex operation 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 the most in flexibility, capability, and adaptability to various system configurations. Up to 10 channels are offered with tone and digital Channel Guard programmable on a per channel basis.

OPTIONS AND ACCESSORIES

MGNC3P	Antenna, 450-470 MHz (19B802560P1)
MGAE1V	Speaker/Microphone (344A4209P30)
MGHC5L	Leather Case Assembly (use with 600 mAh battery)
MGHC5M	Leather Case Assembly (use with 1200 mAh battery)
MGPA5B	600 mAh Battery, Nickel-Cadmium battery (344A4506P1)
MGPA5C	1200 mAh Battery, Nickel-Cadmium battery (344A4506P3)
MGC3HJ	Standard Desk Charger (344A4209P20)
MGC3HK	Rapid Multicharger (344A4209P21)

PROGRAMMABLE FEATURES

All programmable functions are controlled by the micro-controller. The microcontroller reads specific channel information from an Electronically Erasable Programmable Read Only Memory (EEPROM). Refer to the programming manual provided with the programming adaptor kit for programming instructions.

Except for the time-out-timer, the following features are programmable on a per channel basis:

- Time-out-timer
- Channel transmit frequencies
- Channel receive frequencies
- Channel Guard frequencies - tone or digital
- Transmit only channels
- Receive only channels

Other programmable features:

- Tx Delay
- Channel busy lockout
- Battery saver
- Monitor inhibit

CTCSS OR DCS

Allows users to hear only messages intended for them and blocks out all other communications (unless monitor button is pressed) using a sub-audible tone. DCS operates in a similar manner but uses a digitally generated signal.

- CTCSS Non-Standard Tone Hi/Low Settings: There are a maximum of two Non-Standard Tone settings on the radios with 49.0 Hz being the lowest setting and 260.0 Hz being the highest setting.

TRANSMIT TIME-OUT-TIMER

The transmit time-out-timer limits the time a user may continuously transmit. When the PTT switch is released another transmission may be initiated.

BUSY CHANNEL LOCK-OUT

Busy Channel Lock-Out is used to prevent the radio from being keyed on a busy channel. If the PTT switch is pressed while a carrier is present, as indicated by the Busy LED and/or Call LED being lit, the transmit function is disabled and an audible alarm will sound. When the BUSY LED is off (no carrier is being received) the transmit function is enabled. This option can be disabled by enabling the Marked Idle feature.

MARKED IDLE

This is a Busy Channel Lock-Out override. With the proper tone present the Lock-Out will be disable.

Single Unit, Single
Rate Pedestal Charger
MGCH3J

Dual Unit, Dual Rate
"Smart" 1 Hour Desktop Charger
MGCH3K

Slide-on 500 mAh Standard
Capacity Battery
MGPA5B

1200 mAh High Capacity
Battery
MGPA5C

Speaker/Microphone
Has rotating detent clip
for fastening to pocket
or lapel.
MGAE1V

Deluxe All Leather Case
with metal riveted
construction and slide
on metal swivel for use
with standard capacity
battery.
MGHC5L

Deluxe All Leather Case for
use with high capacity battery
MGHC5M

Antenna
MGNC3N-VHF

Antenna
MGNC3P-UHF

PC Programming
TQ 3375

PC Programming Cable
TQ 3376

Figure 1 - Options And Accessories

TX DELAY

This option is used to eliminate Squelch Tail.

POWER SAVE MODE

The Power Save Feature is a battery saver feature, following are the three options:

On Time: This is the time that the battery save mode is enabled and the Receiver is asleep. (Suggested setting 400 mS)

Off Time: This is the time that the battery save mode is enabled and the Receiver is awake. (Suggested setting 150 mS)

Delay Time: This is the time it takes to resume the Power Save Mode after the carrier drops out. (Suggest setting 5 Seconds)

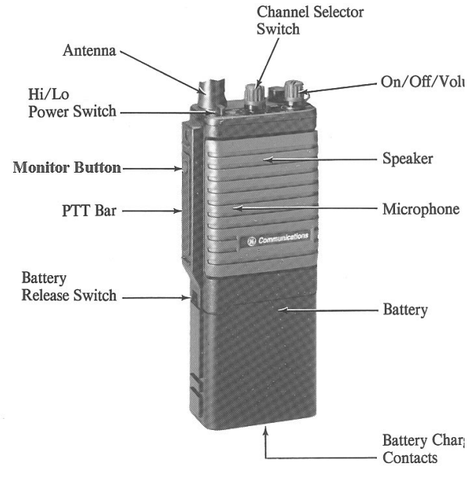
CONTROLS AND INDICATORS

Operating controls, indicators, accessories socket and antenna connections are all located on the top panel. The monitor and PTT buttons are located on the left hand side of the radio chassis. Figure 1 shows their location.

The radio battery pack securely latches in place at the bottom of the radio and is locked in position by the battery release switch.

CONTROLS

ANTENNA RECEPTACLE:	Attaches the antenna to the radio, 1/4 inch in UNEF socket
ACCESSORY JACK:	Multipurpose 6-way jack, used with optional speaker microphone or VOX unit. May also be used for an external 8 ohm speaker or earphone and programming.



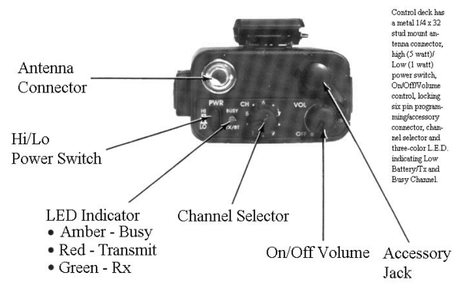


Figure 2 - Controls And Indicators

ON/OFF/VOLUME	Located on the control panel, used to turn the radio on or off and to adjust the listening level.
CHANNEL SELECTOR SWITCH	Rotary switch, used to select one of up to 10 preprogrammed channels
HI-LO POWER BUTTON	Selects either 1 or 5 watts RF power output.
MONITOR BUTTON	When pressed, it unsquelches the receiver to allow the user to monitor the selected channel.
PTT BAR	Pressing the PTT bar keys the transmitter and activates the radio Channel Guard encoder.
BATTERY	Slide on battery pack. A 600 mAh or a 1200 mAh battery is used to power the radio.
SPEAKER	Located behind the grille
MICROPHONE	Note the location of the microphone. To transmit clear messages, hold the microphone about two inches away from your mouth and speak in a normal voice.
BATTERY CHARGE CONTACTS	Charging contacts provided for pedestal slow charger or desktop quick charger.

INDICATORS

BUSY/TX/BT:	TX/BT: Red LED- ON when the transmitter is keyed (Normal transmission). NOTE: This LED dims or goes out when the battery voltage is low. BUSY: Amber LED- ON when the selected channel is busy. Green LED- ON when a properly encoded signal is received on the selected channel.

ALERT TONES

A series of audible alert tones are sounded to indicate the operating status of the radio.

Upon initial power-up, a quick four tone alert indicates the self test of the microprocessor functions has been successfully completed. Single tones are sounded when any of the following conditions exist:

- An attempt to transmit on a channel set for "receive only".
- An attempt to transmit on a channel that is already busy (if the "Busy Channel Lockout option has been programmed for operation).
- Transmitting time exceeds the preprogrammed time allowed by the "Time-Out-Timer (Dealer programmed).

NOTE

In some radios, a VCO out-of-lock indication is given while switching between channels. The out-of-lock indication is indicated by the top panel LED flashing and 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 this problem is to program all unused channels with a receive frequency. (Although the radio is only 10 channels, it is possible to program up to 16 channels into the radio. All 16 should be programmed. The programmer is capable of doing this).

OPERATION

RADIO ON/OFF

Each time the radio is powered up, an automatic self-check is executed and, upon satisfactory completion, a quick four tone alert is sounded.

Turn the radio **ON** by rotating the VOLume control fully clockwise (to the right) until you hear a click and the "Self-Test" alert tone.

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. Adjust the VOLume control to the desired listening level with the ON/OFF VOLume control. Unsquelch the radio by pressing the monitor switch on the side of the radio. When the radio is unsquelched, adjust the VOLume control to the desired level.

NOTE

When Channel Guard is programmed, only calls with the radio's specified code will be heard. In normal operation the speaker will remain quiet until the correct Channel guard code is received. The status indicator will glow green, the loudspeaker will open and the call will be heard.

TO TRANSMIT A MESSAGE

WARNING

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

1. Before making a call always monitor the channel. The status indicator glows yellow when the channel is busy. If the status indicator glows yellow and you cannot hear who is transmitting because they are using a different DCS or CTCSS tone you may listen to the channel by pressing the Monitor Button.
2. If a message is being received, transmit only after the incoming message has been received.
3. Press and hold the PTT switch, the status indicator glows red to indicate the transmitter is operating.
4. Place the microphone 2.5 cm to 10 cm from the mouth and speak clearly in a normal tone of voice.
5. Release the PTT switch to listen.
6. Turn the radio off by rotating the on/off/VOLume control fully counterclockwise.

NOTE

- When making a call on channels programmed for Channel Guard, only calls with that channels specific tone or code will be heard. In normal operation the speaker will remain quiet until the correct tone or code is received. The status indicator will glow green, the loudspeaker will open and the call will be heard.
- A red transmit indicator (TX/BT BUSY) will be on continuously while the PTT bar is pressed, indicating the radio is transmitting.
- If the TX/BT/BUSY indicator is dimly lit or fades rapidly, it is an indication that the battery should be replaced or recharged.
- When CTCSS and DCS is programmed, only calls with the radio's specified code will be heard. In normal operation the speaker will remain quiet until the correct CTCSS or DCS code is received. The status indicator will glow green, the loudspeaker will open and the call will be heard.
- When the Transmit Time Out Timer is programmed, transmission is disabled after a preset period of time. An audible alert will be heard at the end of the period.
- When the Busy Channel lock-out function is programmed and the system is busy, the transmitter is disabled. If the PTT button is pressed, an audible alert will sound and the yellow status indicator will blink off and then on.

CIRCUIT ANALYSIS

The radio consists of two main printed circuit boards: an RF board and a control board. The RF board contains the transmitter and receiver circuits, the synthesizer, and automatic power control. The control board contains the microcontroller and associated digital circuits and microphone audio circuits.

TRANSMITTER

The transmitter consists of the following:

- microphone audio circuit
- transmitter and harmonic filter
- automatic power control
- frequency synthesizer.

Microphone Audio Circuit

The audio signals from the microphone (CON 406, connection 2) or the external microphone (through CON 151, connection 1) are amplified, pre-emphasized, and limited by IC404 and associated components.

The AF microphone signal is applied to pin 5 of IC405B to produce an amplified and pre-emphasized audio signal. The signal is limited by IC404C and applied through VR402 (and the DCS AF signals from Q409 through VR401 when present) to a low-pass filter IC404A and IC404B.

The low-pass filter rejects frequencies above 3 kHz (outside the voice spectrum). The filtered signal is applied to the VCO (within the frequency synthesizer circuit) through the analog switch IC402B, CON 401 (connection 15) and flexible printed circuit board 1, (connection 14). RV402 is used to adjust voice deviation.

Transmitter And Harmonic Filter

The power amplifier contains transistors Q1-Q3, inductors L3-L9 and capacitors C74 thru C86. When operating in the transmit mode diode D6 is forward biased, enabling the RF signal to pass to input buffer Q3. The buffered RF signal is amplified by Q2. The output from Q3 is impedance matched to Q2 by inductor L6 and capacitors C83 thru C86. Q1 is the power amplifier. Diode D5 is reversed biased, inhibiting the TX signal through the receiver stage. The amplifier RF signal passes through the stripline coupler and is fed to the harmonic low-pass filter, consisting of inductors L1 thru L3, and then to the antenna connector (ANT).

The stripline coupler provides a sample of the RF signal to the automatic power control.

Automatic Power Control

The automatic power control circuit contains the stripline coupler, diode D3 and variable resistor VR2, two transistors Q8 and Q11. Q8 and Q9 form a differential amplifier. The RF signal present in the coupler is rectified by D2, to produce a DC voltage that is passed to the base of Q9 thru VR2. A portion of the voltage TX 8.5V is applied to the base of Q8 through voltage divider R7/R8. The difference signal at the collector of Q9 is passed to Q10 and Q11 to produce a constant power output to antenna connector ANT. VR2 is used to adjust the RF power level.

Frequency Synthesizer Circuit

With data received from EEPROM IC408, the frequency synthesizer circuit controls and produces the RF carrier frequency for the transmitter during transmit and the local oscillator frequency for the receiver. The frequency synthesizer circuit consists of the following:

- Voltage Controlled Oscillator Module
- Loop Filter
- PLL Frequency Synthesizer
- Dual Modulus Prescaler

Voltage Controlled Oscillator (VCO) Module: The VCO produces the transmit carrier frequency and the receive local oscillator frequency. The module also includes a power line filter.

Transistor Q301 is configured as a power supply ripple filter. The VCO consists of transistors Q302, varactors D301 and D302 and trim capacitor TC301. These components form a Colpitts oscillator. D301 and D302 produce a change in frequency with a change in DC voltage and are controlled by the phase detector signal present at the anodes of D301 and D302. The local oscillator signal at the emitter of Q302 is applied to amplifier Q303. The amplified signal from Q303 drives VCO output buffers Q304 and Q305.

When D6 is forward biased, carrier frequencies at the collector of Q304 pass to the transmitter stage and harmonic filter. When D7 is forward biased local oscillator frequencies at the collector of Q304 are passed to the first mixer and the first IF amplifier circuit. RX and TX oscillator frequencies are passed to the dual modulus prescaler. TC301 is used for PLL alignment.

Loop Filter: A loop filter consisting of transistors Q18 and Q19, resistors R42 thru R47 and capacitors C7 and C101 thru C112 filter the phase detector output from IC1-6 to remove any reference frequency harmonics. It is then applied to the voltage controlled oscillator module.

PLL Frequency Synthesizer: The PLL frequency synthesizer (IC1) contains an oscillator for the reference crystal, a reference divider, a programmable divider, a phase/frequency comparator, an out of lock detector and a prescaler controller.

Reference oscillator IC1 along with a 12.8 MHz Crystal X1, varactor diode D13, and thermistors TH1, TH2 and TH3 produce a temperature compensated 12.8 MHz reference signal at pin IC1-18.

IC1 has two dividers, a data programmable divider and a hardwired programmable reference divider. Pins 1, 2 and 20 are all connected to the +8V supply to divide the reference frequencies by 2048. The prescaler divided output frequency at pin IC1-10 is further divided by the programmable divider. The 12.8 MHz frequency at pin 18 is the reference divider to produce a reference frequency of 6.25 kHz respectively. The programmable divided frequency (Fv) and the reference frequency (Fr) are fed to the phase detector.

The phase detector (pin 6) produces negative pulses when Fv<Fr positive pulses when Fv> Fr. When Fv = Fr and phase is the same, the phase detector presents a high impedance at pin 6. The signal at pin 6 is applied to the VCO through the loop filter.

The out of lock detector produces a high logic level when Fr and Fv are in the same phase and frequency, or low logic level pulses when the loop is out of lock at IC1-9. The signals at IC1-9 are buffered by Q17 and then integrated by R53 and C46. The product of the integrating circuit is fed to flexible PCB 1, connector 8.

The prescaler controller through pin 8 sets the prescaler to divide by 128 or 129.

Dual Modulus Prescaler

Dual modulus prescaler IC2 divides the VCO frequency by 128 or 129 with signals received from the PLL frequency synthesizer. A low logic level received at pin 6 of IC2 will divide the VCO frequency at pin 1 by 128. A high logic level received at pin 6 of IC2 will divide the VCO frequency at pin 1 by 129. The divided VCO frequency is passed to the PLL frequency synthesizer through pin 4.

RECEIVER

The Receiver uses dual conversion superheterodyning techniques and consists of:

- RF Amplifier,
- First Mixer and First IF Amplifier,
- Second Mixer, Second IF Amplifier and FM Detector,
- Receiver Audio
- Mute (Squelch).

RF Amplifier

The receiver RF amplifier contains helical resonators FL1 thru FL3 and Q13. FL1 and Fl2 are configured as 2-pole bandpass filters. The RF signal passes through the tuned circuit FL1, RF amplifier Q13 and FL2 enabling the RF signal at the operating frequency to pass to the first mixer.

First Mixer And First IF Amplifier

FET Q12 Transistor Q16, crystal filter XF1, helical resonator FL3 and coil T4 form the First Mixer and First IF Amplifier. The VCO local oscillator signal is filtered by FL3. Q12 produces a difference frequency of 21.4 MHz at the drain connection, from the filtered RF signal at the gate connection and then filtered by the VCO local oscillator signal at the source connection. The 21.4 MHz difference frequency is filtered by the crystal filter XF1. The tuned circuit T4 and associated components provide matching of the crystal filter to insure good passband response and selectivity. The IF signal is amplified by Q16 and passed to the second mixer, second IF, and FM detector.

Second Mixer, Second IF, And FM Detector

A single conversion FM receiver integrated chip, IC3, contains the second mixer, second IF, and FM detector functions. The second local oscillator frequency is determined by the crystal X2 (20.945MHz) connected to IC3-1. The IF signal is received at IC3-16 through coupling capacitor C6. The second IF frequency of 455 kHz is produced when the 1st IF frequency is applied to the mixer through pin 16. The output of the second mixer through pin 3 is applied to a 455 kHz bandpass filter, CF1. The output of CF1 is passed to a high gain IF amplifier (limiter) at IC2-5. The amplified signal is coupled to the adjustable quadrature detector T5. The audio output is produced at IC3-9 and applied to the receiver audio circuit and the mute (squelch) circuit.

Receiver Audio Circuit

The receiver audio circuit comprises a low pass filter and an audio amplifier on the RX/TX printed circuit board, and a high pass filter and de-emphasis circuit on the control printed circuit board.

The low pass filter is configured from coil L12, capacitor C64 and resistor R39. AF signals from IC3-9 are filtered by the low-pass filter to remove any components of the 455 kHz IF signal. The filtered signal at flexible PCB 1, connection 14 is passed to the high pass filter on the control printed circuit board through flexible CON 402, connection 15.

DCS and CTCSS signals from the recovered audio are removed by the high pass filter. The high pass filter is an 8-pole active filter that comprises IC410 and associated components. The de-emphasis is provided by resistor R451 and capacitor C471. The de-emphasized audio signal is fed to the audio amplifier on the RX/TX printed circuit board through the flexible PCB 1. The microcontroller controls the audio signal to the audio amplifier. When Q408 is on, the audio signal to the audio amplifier is disabled. When Q408 is off, the audio signal to the audio amplifier is enabled.

IC4 is the audio amplifier. The audio signal at flexible PCB 1, connection 12 is passed to IC4-3 through variable resistor VR3 located on the front panel. The gain of the amplifier is set by resistor R27 and C99. The amplified audio signal at IC4-5 is applied to the internal speaker by flexible PCB 1, (connection 9), CON 406 (connection 1) and CON 404 (connection 8). The external speaker connection is through the 6-way connector.

Mute (Squelch) Circuit

The squelch circuit switches off the audio power amplifier in the absence of audio signals. The squelch circuit comprises a 25 kHz pass band filter, squelch control VR201 and a noise detector circuit.

The audio signal from IC3-9 is filtered by the 25 kHz bandpass filter formed by L13, L14, C104 and C105. The noise in the IF pass band is accepted; frequencies in the voice frequency band are rejected. Any noise present at the output of the filter is applied to the noise detect circuit.

The noise detect circuit in conjunction with IC3 consists of transistors Q201 and Q202, thermistor TH201 and diode D205. Any noise signal present is applied to pin 2 of the SQ board from IC3-11. The signal is amplified by Q201, rectified by D201 then buffered by Q202. The buffered signal is applied to VR201 for adjustment of squelch sensitivity and applied through R149 to the squelch trigger at IC3-12.

When noise is present, the voltage at IC3-12 exceeds 0.7 V, the squelch trigger output is 0 V (logic 0), muting the receiver audio circuit. When no noise is present, the voltage at IC3-12 is less than 0.7 V and IC3-13 is at 5V (logic 1), unmuting the receiver audio circuit. Resistor R119 is used to provide hysteresis of 3 to 6 dB.

MICROCONTROLLER

Microcontroller, IC409, is a Zilog based Z86C10 with 4k-byte ROM and 128k-byte RAM. It has a clock frequency of 11.1552 MHz derived from crystal X401 which is connected between pins 30 and 31. The microcontroller, in conjunction with control signals from the switches on the top panel, controls the frequency synthesizer circuit from data stored in the EEPROM, the control and indicator circuit, the Channel Guard circuit, and the power save circuit.

Table 1 identifies the microcontroller interface signals.

Table 1 - Microcontroller Signal Descriptions

SIGNAL NAME	ENABLE STATE	DESCRIPTION/FUNCTION
LOW BATT	L	BATTERY LOW DETECTOR
MONITOR	L	MONITOR SWITCH DETECTOR
PTT	L	PTT SWITCH DETECTOR
CALL	H	CALL DETECTOR
BUSY	L	SQUELCH DETECTOR
L/D	H	LOCK DETECTOR
TXLED	H	RED LED CONTROLLER
CALL LED	H	GREEN LED CONTROLLER
386 EN	H	386 MUTE CONTROLLER
TXEN	L	TX ENABLE CONTROLLER
P/S	H	POWER SAVING CONTROLLER

Table 1 - Microcontroller Signal Descriptions (Cont.)

SIGNAL NAME	ENABLE STATE	DESCRIPTION/FUNCTION
R/E	H	PLL SELECTOR (MC 145156)
E/E	H	EEPROM SELECTOR (93C46)
E/E	H	EEPROM SELECTOR (93C46)
XS/E	H	X-SW SELECTOR (MC 142100)
1	DATA	EEPROM CLK/X-SW A/TONE A/CH SW A(1)
2	DATA	X-SWB/TONE B/CHANNEL SW B(2)
4	DATA	EEPROM D1/X-SW D/CH SW C(4)/PLL CLOCK
8	DATA	X-SW C/TONE C/CH SW D(8)
D	DATA	EEPROM DO/X-SW DATA/PLL DATA
CALLDET	INTERUPT	CALL DETECTOR INTERRUPT
I/O EN	L	I/O CONTROL SELECTOR (74HC368)
CLOCK	CLK	FILTERING CLOCK GENERATOR (MF 6-100)

Receive And Transmit Switching Circuit

The receive and transmit switching circuit in conjunction with microcontroller IC409 consists of transistors Q4, Q5 Q401, diode D9 and IC402. They are configured so that when a switch in the receiver circuit is closed the transmitter circuit is off.

When the PTT switch (SW-402) on flexible PCB 9 is pressed, the PTT input at IC409-43 is held low, causing transmit enable pin (TX EN) of IC409 to go low (0 V) and power save pin (P/S) to go high (+5V). TX EN is connected to Q401, IC402 on the control printed circuit board, and TX switching transistor Q4 and D9 on the RF printed circuit board.

Analog switch IC402A is disabled and Q401 is forward biased, applying +5V to IC404 and analog switch IC402B. This enables the microphone audio circuit. The transmit enable signal is passed to Q4 through CON401, connection 7 and flexible PCB 1, connection 6.

CTCSS/DCS Tone Encode And Decode Circuits

The CTCSS/DCS (tone/digital) encode and decode circuits, in conjunction with IC409, comprise an addressable 4 x 4 cross point switch (IC406) and a 6th order switched capacitor lowpass filter IC407). IC407 has two internal general purpose op-amps. When programmed the circuit is used to control the audio muting function of the radio. Table 2 details the 4 x 4 cross point switch input/output descriptions. The cross point switching is detailed in Table 3.

When the CTCSS/DCS decoding circuit IC406 is enabled, CTCSS/DCS signals present at CON402, connection 15 are passed to IC407-8 (FIL IN) through R4 (IC406-11), C3 (IC406-12) and capacitor C436. The clock frequency is used to set the cut-off frequency to filter out the CTCSS/DCS tone frequency. The filtered tone frequency at IC407-3 is passed to the input of an internal amplifier through pin 13. During CTCSS decoding operation the filtered tone frequency at Pin 3 (IC407) is passed to the CTCSS filter through the coupling cap C455 to IC412-3. The CTCSS signal is then output from IC421-1 through coupling cap C454 to IC407-13. The output of the internal amplifier (IC407-2) is fed to inverter input IC411-12. The inverted output IC411-11 is applied to the CALL pin and CALL DET pin 2B of the microcontroller. The signal is filtered and matched with a pre-programmed frequency and if successful the TX LED and BUSY LED output lines are set a +5V. The green LED on the front panel is turned on and the receiver audio circuit is enabled. For DCS, R2 of IC406 and C4 are added to improve low pass filtering.

Table 2 - Switch Input And Output Description

NAME	PIN NO	Input/Output	DESCRIPTIONS
R1	15	Output	To Modulation Circuits
R2	14	Input	From Filter Output
R3	10	Input	From Tone Generator
R4	11	Input	From Signal Receive Circuits
C1	9	Output	To Warning Tone Indication Circuits
C2	1	Output	To TCXO
C3	12	Output	To Filter Input
C4	13	Output	To DCS (or CTCSS Tone Coupling)

Table 3 - 4X4 Cross Point Switching

FUNCTION	MODE	I/O
CTCSS	Receive	R4.C3
	Transmit	R1.C2
		R3.C3
		R2.C2
DCS	Receive	R4.C3
		R2.C4
	Transmit	R1.C2
		R2.C2
		R3.C3
WARNING		R3.C1
SELF CHECK		R3.C3

During TX mode the CTCSS/CDS tone encoding circuit generates the tone squelch digital signal and produces a 3-bit parallel word at pins 18 (1), 19 (2) and 21 (8) of the microcontroller. The 3-bit digital signal is converted to an analog signal by resistors R421-424. RV403 is used to adjust signal deviation. The analog signal is passed to digital filter IC407-8 through pin 10 and 14 of 4 x 4 cross switch IC406. The filtered output at IC407-3 is connected to IC406-14 and fed to pin 1 (CTCSS) and pin 15 (DCS). The CTCSS signal at IC406-1 is passed to the VCO module through R46 and Flexi PCB 1, connector 16. The DCS signal at IC406-15 is passed to Q409, RV401 and IC404 A and B. RV401 is used to adjust DCS distortion. IC404 A and B form a low pass filter. The output is passed to the VCO module through Flexi PCB 1, connector 15.

Control And Indicator Circuits

External PTT Control Circuit - When the external microphone is connected at the adaptor socket (pin 4) on the top panel circuit board, the CONT control line on the control printed circuit board is at logic 0, switching IC401A off to disable the internal microphone. The CONT control line is also connected to the junction of R416 and C478 at IC405. IC405D is a voltage comparator with R416 DC. When PTT is pressed, IC405D-13 goes below 2V and output 14 goes high (+5V), turning on Q402. The PTT control line is pulled low, enabling the radio transmitter through D401.

Channel Select Circuit - One of 10 channels may be selected using the channel switch (CH) on the top panel. The channel switch encodes the channel number selected into a 4-bit binary word. Periodically the microcontroller enables IC411-1. The 4-bit binary word from the RF printed circuit board is passed through the 4-bit inverting buffer to the microcontroller data I/O lines 1, 2, L1, and 8 through the control printed circuit board, the flexible PCB2 and then to IC411. IC411 inverts the binary word. The inverted binary word is then decoded by the microcontroller, enabling the appropriate RX or TX frequency and associated data to be selected from the EEPROM.

Data present at the I/O lines is compared with previously sampled data. If a difference in data is detected, the microcontroller enables EEPROM IC408 and selects the RX or TX frequency datacontrolling the frequency synthesizer circuit for the channel selected.

Battery Low Indicator Circuit - Should the battery voltage drop below 8.86 Vdc, IC405B (voltage comparator) turns on Q403. The microcontroller then enables the red LED indicator and at the same time disables the transmitter. The battery must be replaced or recharged before continuing operation.

I/O Control Circuit - IC403 and IC411 are input/output buffers to isolate noise and are enabled by the microcontroller. IC411 is a tri-state 2-bit and 4-bit inverting buffer. The 4-bit output is enabled when pin 1 is at logic 0 (0 V). The 2-bit output is enabled when pin 15 is at logic 0 (0 V). IC403 is a non-inverting TTL to CMOS level shifter and output buffer supplying data to the RX/TX printed circuit board.

EEPROM

Rx/Tx channels, CTCSS, DCS as well as other data from the programmer are stored in the EEPROM. The data stored is retained during power outages and when the power is off. This is a non-volatile memory. The EEPROM may have information re-programmed or erased. IC408 is an EEPROM with 1024 bit (8 x 128) capacity. Data are written and read serially.

SERVICE SECTION

The Service Section contains information designed to assist you in rapidly identifying any problem areas and in tuning and adjusting the radio for optimum performance. A diagnostic section is included to help you, through the use of indicators and tones, to learn the current operating status of the radio.

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 the 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 when cleaning the radio. They may damage the radio housing.

DIAGNOSTIC ANALYSIS

An analysis of the status indicators and audible tones are provided in Table 4.

ELECTROSTATIC DEVICES

CMOS 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 is equipped with 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 being used 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 a standard soldering iron.

REMOVAL AND REPLACEMENT

NOTE

When disassembling or reassembling the radio, refer to the Parts Breakdown drawings and Parts List for assistance.

Table 4 - Status Indictors And Audible Tones

STATUS	DESCRIPTION	LED COLOR	AUDIBLE TONE
NORMAL	Power on ready		Melody
	Busy	Yellow	N/A
	Correct Call	Green	N/A
	Transmit	Red	N/A
	Busy Lock	Yellow, Flashing	Single Tone
WARNING		Time Out Timer	Single Tone
	Battery Low	Red, Flashing	N/A
ERROR	EEPROM Error	Red, Flashing	Single Tone Continuous
	PLL Error	Red, Flashing	Double Tone Continuous
	Filtering Error	Red, Flashing	Triple Tone Continuous

ANTENNA REMOVAL AND RE-INSTALLATION (See Figure 3)

A high quality molded antenna is supplied to match the operating frequency band of each radio. Should an antenna of the wrong frequency band be installed, the performance of the radio will be severely limited.

1. To remove the antenna, turn the antenna counter-clockwise until removed.

2. To install the antenna, thread the antenna clockwise until it is firmly seated. Do not overtighten.

BATTERY REMOVAL AND INSTALLATION (Figure 3)

To remove the battery:

1. Holding the radio chassis in one hand, press and hold the battery release catch.

2. Using the other hand, slide the battery away from the battery release catch and off the battery guide rail.

To replace the battery:

1. With the slides of the battery positioned in line with the radio battery rail guides, slide the battery into position until a click is heard.

BELT CLIP REMOVAL AND INSTALLATION (See Figure 3)

1. With the battery removed, install the top of the belt clip bracket into the top recess on the back of the radio.

2. Push the bottom of the belt clip bracket into the bottom recess.

3. Install the Battery.

4. To remove the belt clip reverse the above procedure.

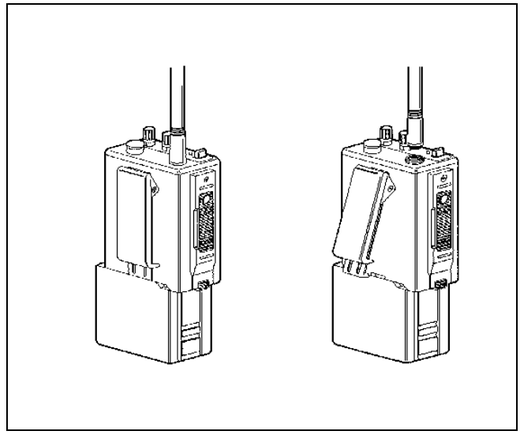


Figure 3 - Antenna Battery And Belt Clip Installation

BEZEL REMOVAL AND REPLACEMENT

To remove the bezel:

1. Remove the battery.

2. Using a phillips head screw driver (No. O) remove the two screws located on the battery rail guide.

3. Holding the bezel firmly with thumb and forefinger, gently apply pressure towards the top panel and lift the bezel from the radio chassis.

4. Unplug the speaker and microphone lead from the connector on the control printed circuit board.

To replace the bezel:

1. Ensure all gasket rubbers are in position and not broken.

2. Place the lip at the top end of the bezel into the gasket recess of the top panel.

3. Press the bezel firmly into position.

4. Using a phillips head screw driver (No. 0) replace the two screws located on the battery rail guide.

MICROPHONE AND SPEAKER REMOVAL AND REPLACEMENT

To remove the microphone and speaker:

1. Remove the bezel.

2. Unscrew the two speaker mounting screws.

3. Gently press the rubber microphone holder from the microphone slot on the bezel.

4. Remove the speaker and microphone.

To replace the speaker and microphone, reverse the procedures above.

CONTROL PRINTED CIRCUIT BOARD REMOVAL AND REPLACEMENT

To remove the printed circuit board:

1. Remove the bezel.

2. Disconnect the three flexible PCB's from the appropriate connectors.

3. Remove the three PCB mounting screws.

4. Gently lift the control board from the radio chassis.

To replace the PCB, reverse the procedures given in steps 2 to 4.

PCB SHIELD PLATE REMOVAL AND REPLACEMENT

1. Remove the bezel and the control PCB.

2. Using a small phillips head screw driver remove the screw located on the square black insulating pad and the screw fixing the PCB shield to the top panel PCB.

3. Gently lift the PCB shield from the radio chassis.

To replace and fit a PCB shield plate, reverse the procedures given in steps 2 and 3 above.

RF BOARD REMOVAL AND REPLACEMENT

1. Remove the bezel, control board, and PCB shield plate.

2. Remove the four hexagonal mounting pillars.

3. Unsolder the lead of the fuse connected to the positive terminal of the battery connector.

4. Locate and remove the three TX transistor heatsink securing screws inside the radio chassis.

5. On the outside of the radio chassis remove the securing screw by the monitor and PTT switches and the securing screw on the opposite side.

6. Holding the top panel gently pull the radio chassis away from the top panel.

To replace the RF board, reverse the procedures given in steps 2 to 6.

DAUGHTER BOARD REMOVAL AND REPLACEMENT

The daughter boards are small printed circuit boards that are soldered onto the main printed circuit boards. To remove the control or TX/RX daughter board proceed as follows:

1. Remove the control or RF board as required.

2. Unsolder the daughter board on the solder side of the appropriate printed circuit board.

To replace a daughter board:

1. Ensure that the control or RF printed circuit board are mechanically clean.

2. Insert the daughter board in the required position on the control or RF board and be sure that it is properly seated.

3. Solder the daughter board into position.

NOTE

To avoid damage to the main PCB soldering must be accomplished quickly.

SMD COMPONENT REMOVAL AND REPLACEMENT

When removing and replacing the SMD components follow the procedure given below using a soldering iron and a solder sucker.

To Remove 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.

To Replace 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 printed circuit board pads to set the component in position.

CAUTION

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

Avoid prolong application of heat to the pads of the replacement SMD 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.

PERFORMANCE TEST AND ALIGNMENT

TEST EQUIPMENT REQUIRED

Either of the following test equipment lists may be used for test and alignment.

Discrete Test Equipment List

1. Volt, Ohm and Amp Meter, AVO 8
2. Power Meter, Bird 43
3. Power Supply, Farnell LS30-10
4. Oscilloscope, 20 MHz dual beam (HAMEG HM203_5)
5. Frequency Counter, Farnell 600 MHz
6. AF Signal Generator
7. RF Signal Generator, Marconi 2018A
8. Sinadder
9. Modulation Meter
10. Power Meter
11. Spectrum Analyzer (optional)
12. Coupler
13. 1/4 UNEF to BNC Adaptor, Part No. 344A4209P42

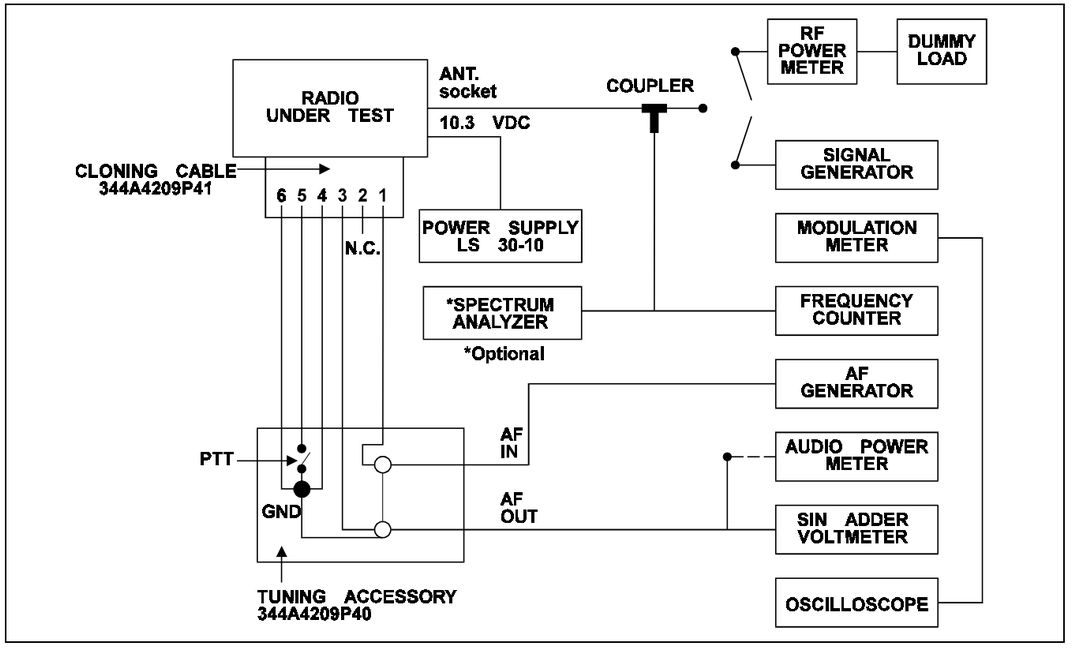


Figure 4 - Discrete List Text Equipment Setup

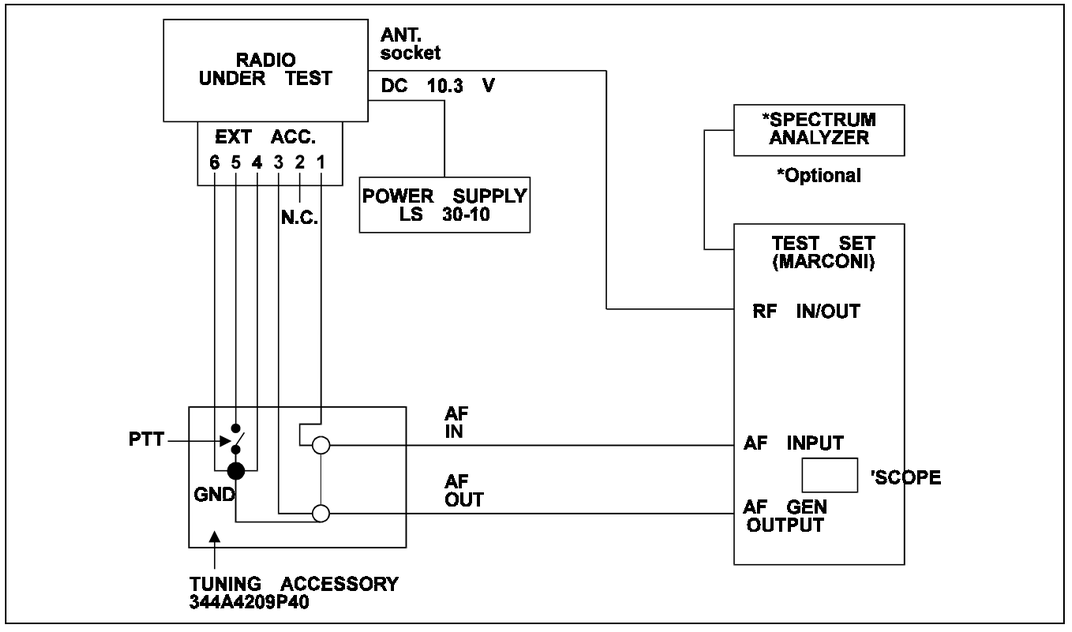


Figure 5 - Test Set Setup

Test Set Equipment List

1. Test Set, Marconi TF 2955
2. Volt Ohm and Amp Meter, AVO 8
3. Power Supply, Farnell LS30-10

Test Equipment Setup

Refer to Figure 4, Discrete List or Figure 5, Test Set.

1. Connect power supply as shown with the positive lead of the power supply connected to the 10.8V terminal and the negative lead to the radio chassis.
2. Connect the audio and PTT connections to the 6-pin accessories socket on the top panel as indicated below.

   Pin 1 - Transmitter audio microphone load, 600 ohm impedance

   2 - Not used

   3- Receiver audio speaker load, 8 Ohm impedance

   4,6- Ground

   5 - PTT

3. Set the modulation level of the signal generator for 3.0 kHz deviation for 25 kHz channel spacing.

If a component has been changed to provide different channel spacing or operating frequency be sure the associated components in the receiver and transmitter have also been changed. Refer to the Parts List to identify the correct components.

EEPROM Program Verification

Be sure the EEPROM has been programmed to customer specifications, otherwise use a test EEPROM programmed with the low, center and high RX/TX frequencies for that split prior to aligning the radio.

When Channel Guard checks are required use the CG frequencies listed below for test operation.

Lowest RX/TX frequency channel	67.0 Hz CTCSS
Middle RX/TX frequency channel	DCS Code 072
Highest RX/TX frequency channel	250.3 Hz CTCSS

Channel Guard tones and codes are given in Tables 5 and 6.

Table 5 - Standard CTCSS Tones

No.	Freq. (Hz)	No.	Freq. (Hz)	No.	Freq. (Hz)	No.	Freq. (Hz)
01	67.0	11	97.4	21	136.5	31	192.8
02	71.9	12	100.0	22	141.3	32	203.5
03	74.4	13	103.5	23	146.2	33	210.7
04	77.0	14	107.2	24	151.4	34	218.1
05	79.7	15	110.9	25	156.7	35	225.7
06	82.5	16	114.8	26	162.2	36	233.6
07	85.4	17	118.8	27	167.9	37	241.8
08	88.5	18	123.0	28	173.8	38	250.3
09	91.5	19	127.3	29	179.9		
10	94.8	20	131.8	30	186.2		

Table 6 - Standard DCS Codes

No.	Code	No.	Code	No.	Code	No.	Code
1	023	21	134	41	306	61	503
02	025	22	143	42	311	62	506
03	026	23	152	43	315	63	516
04	031	24	155	44	321	64	532
05	032	25	516	45	343	65	546
06	043	26	162	46	346	66	567
07	047	27	165	27	251	67	607
08	051	28	172	28	364	68	612
09	054	29	174	49	365	69	624
10	065	30	205	50	371	70	627
11	071	31	223	51	411	71	631
12	072	32	226	52	412	72	632
13	073	33	243	53	413	73	654
14	174	34	244	54	423	74	662

Table 6 - Standard DCS Codes (Con't)

No.	Code	No.	Code	No.	Code	No.	Code
15	114	35	245	55	431	75	664
16	115	36	251	56	432	76	703
17	116	37	261	57	445	77	713
18	125	38	263	58	464	78	723
19	131	39	265	59	465	79	731
20	132	40	271	60	466	80	732
						81	734
						82	743
						83	754

TRANSMITTER PERFORMANCE TESTS

POWER OUTPUT

1. Set the power supply voltage to 10.8 Vdc. Monitor the power supply voltage during transmit.
2. Press the PTT switch and record the output power. The nominal outputs are 1 or 5 Watts.
3. Reduce the power supply voltage to 8.86 Vdc and verify check that the power output is above 65% of the recorded output power.
4. Release the PTT switch.

PEAK DEVIATION

1. Using the channel switch on the radio select the channel with lowest frequency.
2. Connect the oscilloscope to the deviation meter, refer to Figure 4.
3. Set the audio signal generator to 1 kHz at 3 kHz deviation.
4. Press the PTT switch and observe the oscilloscope display for a noise free 1 kHz audio tone.
5. Set the audio signal generator output level to 3 kHz deviation and sweep from 300 Hz to 3 kHz. Record the peak deviation.
6. Check the peak deviation. It should be less than 5 kHz.
7. Release the PTT switch.
8. Select the channel with the highest TX frequency and repeat steps 3-7.

NOTE

It may be necessary to notch the fundamental signal during this test.

SPECTRUM TEST

1. Connect a spectrum analyzer and RF power meter to the antenna (ANT) socket, refer to Figure 4.
2. Press the PTT switch. Observe the output on the spectrum analyzer.
3. All spurious signals and harmonics should be below -36 dBm.
4. Release the PTT switch.

RECEIVER PERFORMANCE TESTS

SENSITIVITY

The SINAD or noise quieting sensitivity performance test may be used to test the sensitivity of the receiver.

SINAD Sensitivity

1. Connect the RF signal generator to the coupler as shown in Figure 4.
2. Set the RF signal generator to the receive frequency of the selected channel.
3. Connect the leads of the SINAD meter to the speaker through the adaptor socket on the top panel.
4. Press the monitor socket and set the volume control to mid-range.
5. Set the deviation for 3 kHz.
6. Set the audio generator to 1 kHz.

7. Adjust the RF signal generator level until the SINAD meter reads 12 dB.

8. Check that the signal generator RF level is less than 0.28 µV EMF.

Noise Quieting Sensitivity

1. Disconnect the signal generator from the radio.

2. Set the radio power meter to volts and connect the audio power meter to the speaker terminals.

3. Press and hold the monitor button.

4. Connect the signal generator to the radio

5. Adjust the VOLume control to obtain a noise reading of 1 Vrms.

6. Set the deviation to 3 kHz..

7. Set the audio generator to 1 kHz.

8. Adjust the RF level of the signal generator RF level for a noise reading on the meter of 0.1 Vrms. This is the 20 dB noise quieting point. Check that the RF level is less than 0.5 µV EMF.

Squelch Sensitivity

1. Set the RF signal generator to the receive frequency for the selected channel.

2. Set the deviation to 3 kHz.

3. Set the AF generator to 1 kHz.

4. Set the RF signal generator to 20 dB or 2.0 µV and verify that an audible tone is heard.

5. Switch off the RF signal generator and verify that no audio is heard (received).

AUDIO OUTPUT

1. Set the RF signal generator to 1 mV EMF and the deviation to 3 kHz.

2. Set the audio generator to 1 kHz.

3. Set the power voltmeter to ac volts.

4. Connect the power voltmeter to the accessories socket.

5. Adjust the volume control of the radio under test to fully clockwise.

6. The meter should indicate 2.0 V or greater, the power meter should read 500 mW or greater.

ALIGNMENT PROCEDURES

When performing the transmitter and receiver alignment prcedures, refer to Figure 6 for location of test points and adjustment controls.

PLL ALIGNMENT

NOTE

If the Phase Lock Loop (PLL) is out of lock, an audible warning will be heard and the red LED on the top panel will flash.

1. Connect an RF power meter to the ANT socket.

2. Using the channel switch, select channel with the lowest receive frequency.

NOTE

If the power save format is programmed and the squelch is closed (muted), there will be a periodic voltage change at TP1 unless step 3 below is performed. If the power mode has not been selected in programming, it is not necessary to perform step 3.

3. Adjust VR201 to unmute the squelch.

4. Connect a DC voltmeter to test point 1 (TP1), accessed through the hole in the VCO cover.

5. Adjust TC301 for 1.4 (0.05) volts at TP1.

NOTE

The receiver operational bandwidth is typically 10 MHz. There may be some degradation in actual receiver performance if a bandwidth of more than 10 MHz is used.

6. Using the channel switch, select channel with the highest transmit frequency.

NOTE

Any transmit frequency between 450 MHz and 470 MHz can be programmed and used, however the highest transmit frequency can typically be only 8 MHz above the lowest receive frequency.

7. Press the PTT switch to transmit.

8. At TP1 measure and check that the voltage is 6.0 volts or less. If the voltage is above, 6.0 volts the VCO may not lock because the frequency is programmed too high above the lowest receive frequency.

9. Set the PTT switch to receive.

10. If step 3 was performed, readjust the squelch setting.

AUTOMATIC POWER ADJUSTMENT

NOTE

Transmit periods longer than five minutes are to be avoided.

1. Using the channel switch, select the center receive frequency channel.

2. Press the PTT switch.

3. Adjust VR2 to provide rated transmit power.

4. Release the PTT switch.

DIGITAL CHANNEL GUARD MODULATION ADJUSTMENT

1. Connect the test equipment to the radio as shown in Figure 4.

2. Using the channel switch select the DCS coded frequency channel.

3. Press the PTT switch and observe the demodulated waveform on the oscilloscope. Compare with Figure 6.

4. If necessary adjust RV403 to achieve the waveform.

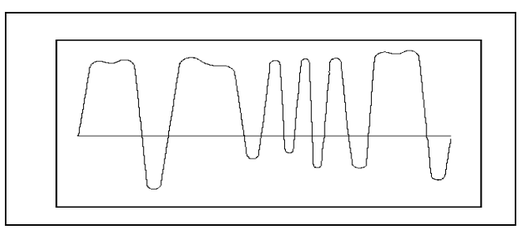


Figure 6 - Demodulated DCS Waveform

MODULATION DEVIATION ADJUSTMENT

1. Connect a power meter and a coupler to the radio as shown in Figure 4.

2. Connect an audio generator as shown in Figure 4.

3. Set the audio output level to 60 mV and the audio frequency to 1 kHz.

4. Using the channel switch, select the highest transmit channel without Channel Guard.

5. Press and hold the PTT switch.

6. Adjust RV402 for maximum system deviation.

7. Release the PTT switch.

8. Using the channel switch, select the lowest transmit channel without Channel Guard.

9. Press and hold the PTT switch.

10. Measure the deviation and verify that it is below peak system deviation. If the deviation is greater than the peak system deviation adjust RV402 to peak system deviation.

11. Select channel showing the highest deviation, sweep the audio frequency between 300 Hz and 3 kHz. Adjust RV2 to ensure deviation is below peak system deviation at all frequencies.

12. Disconnect the audio generator and set the PTT switch to the off position.

CTCSS/DCS DEVIATION ADJUSTMENT

1. Connect a power meter and modulation meter to the radio as shown in Figure 4.

2. Using the channel switch select a transmit channel with Channel Guard.

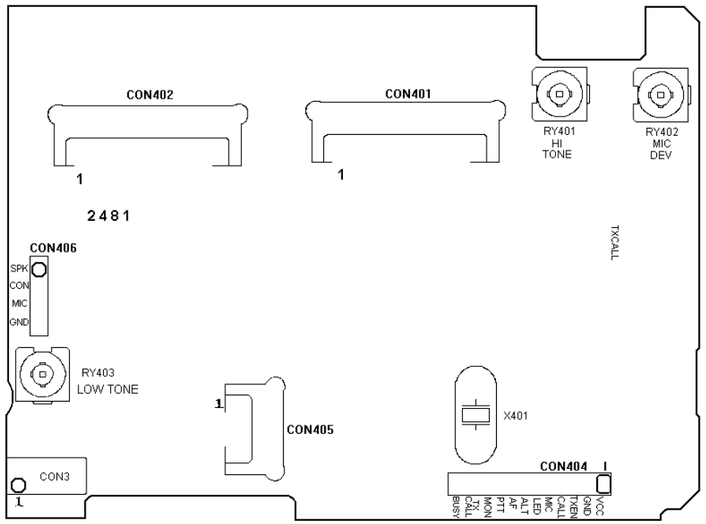
3. Press the PTT switch.

4. Adjust RV403 for 10% of maximum system deviation (500 to 750 Hz).

5. Using the oscilloscope check that the positive and negative peak deviations are equal.

6. If necessary adjust RV401 to obtain equal and opposite peak deviations.

7. Release the PTT switch and disconnect the deviation meter.



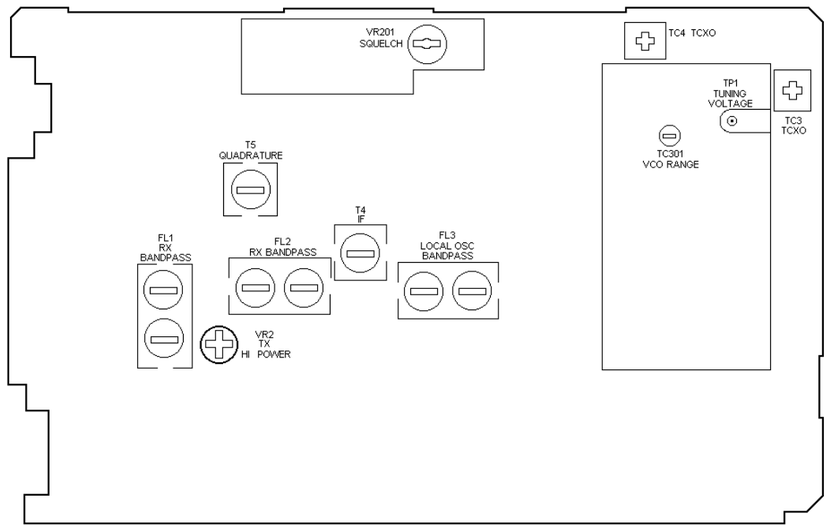


Figure 7 - Location Alignment Test And Adjustments

RECEIVER ALIGNMENT

RF TUNING

1. Connect to the radio an RF signal generator to the ANT socket through an adaptor and a SINAD meter to the accessories socket as shown in Figure 4.
2. On the TX/RX printed circuit board adjust VR201 fully counter clockwise position.
3. Adjust the VOLume control to the mid position.
4. Using the channel switch select the center frequency channel.
5. Set the RF signal generator to the receive channel frequency and set to 60% deviation.
6. Set the audio frequency to 1 kHz.
7. Adjust the RF output voltage level of the RF signal generator until the 1 kHz signal is audible. Note the RF output voltage level and the SINAD reading.
8. Adjust FL3 to for an improvement in SINAD.
9. Adjust the RF output voltage level of the RF signal generator while keeping the SINAD meter readings between 12 and 20 dB.
10. Adjust FL2 for an improvement in SINAD.
11. Adjust the RF output voltage level of the RF signal generator while keeping the SINAD meter readings between 12 and 20 dB.
12. Adjust FL1 and check for an RF voltage signal level of 0.5 µVpd and a SINAD meter reading of between 12 and 20 dB.
13. If the readings in step 11 are not as stated, adjust the RF output voltage level of the RF signal generator to a achieve SINAD meter reading between 12 and 20 dB.
14. Adjust T4 and check for an RF voltage signal level of 0.25 µVpd and a SINAD meter reading between 12 and 20 dB. Check the upper and lower sensitivities.
15. If the readings in step 14 are not as stated, adjust the RF output voltage level of the RF signal generator to achieve a SINAD meter reading between 12 and 20 dB.
16. If the SINAD meter reading is below 12 dB, repeat steps 7 to 16. Otherwise, reset VR201 to the required operating position.

DISCRIMINATOR TUNING

1. Set the RF level to 10 mVpd.
2. Adjust T5 for maximum audio output and observe the oscilloscope for sinewave distortion.
3. Adjust T4 for minimum distortion, normally less than 3%.
4. Disconnect the test equipment.

SQUELCH ADJUSTMENT

1. Set the RF signal generator to the receiver frequency with 60% deviation. Set audio signal to 1 kHz.
2. Adjust the RF output level of the RF signal generator until the 1 kHz signal is audible.
3. Adjust the RF signal to the level desired for squelch sensitivity. Monitor SINAD, usually 12 dB.
4. On the TX/RX board, adjust VR201 until the squelch is just unmuted (open).
5. Turn the RF generator off.
6. Press and release the monitor button and check that the audio output may be muted/unmuted.
7. Disconnect the test equipment.

PROGRAMMING THE RADIO

Refer to programming manual TQ3375 when programming the radio. Programming cable TQ3376 is required to interconnect the radio and PC programmer.

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 allow 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 placing into service. The battery should be replaced if the charge state is in doubt.

If the rechargeable battery is only 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 Desk Charger 344A420P21, separately or while attached to the radio.

MONOGRAM BATTERY CHARGER 344A4209P21

The charger operates from a 110/120V AC power source and should be installed with a suitable 3 ampere fused plug. The unit is capable of continuous operation. However, the unit should be disconnected from the power source when not in use. To operate the Dual Desk Charger, plug the charger into the power source and check that the POWER indicator (red) lights.

Rear Charge Slot

Insert battery or radio with battery into the Rear Charge Slot, observing correct polarity. The FAST LED (green) will begin to flash and fast charge begins according to the amount of charge in the battery. (In the case of a fully discharged battery, the initial charge is executed during the first minute. The FAST and SLOW LED's will not be illuminated. After the initial charge, the battery mode will change to fast charge).

In the fast charge mode, the MGHC5L battery will take approximately 1 hour to fully charge and the MGHC5M battery will take approximately 2 hours, depending on the initial charge of the battery.

CAUTION

If the charge indicator does not light, check to see that the battery has been inserted properly.

Do not charge the battery when battery temperature is below 10°C or 40°C. Usable life of the battery may be reduced.

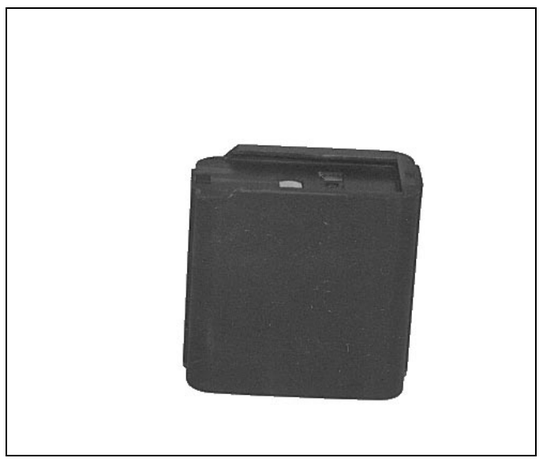
Do not use the charger if it is wet or damaged in any way.

Do not toss batteries in a fire; they may explode.

If the initial charge on the battery is over 95%, then the fast charge mode will turn to a "trickle-charge" mode. In the "trickle-charge" mode, the battery will be maintained at full charge, provided the radio is turned off. The SLOW LED (red) is turned on continuously, and may turn off momentarily every 34 seconds by the "trickle-charging" current. If the battery is charged to 100% of its capacity, the FAST LED will turn off and the SLOW LED will turn on.

Front Charge Slot

Insert battery or radio with battery into Front Charge Slot, observing correct polarity. The SLOW LED (green) will be illuminated, and a charging current of approximately 50mA is provided to the battery. In the slow charge mode, the MGHC5L battery will take approximately 14 hours to fully charge, and the MGHC5M battery will take approximately 20 hours.



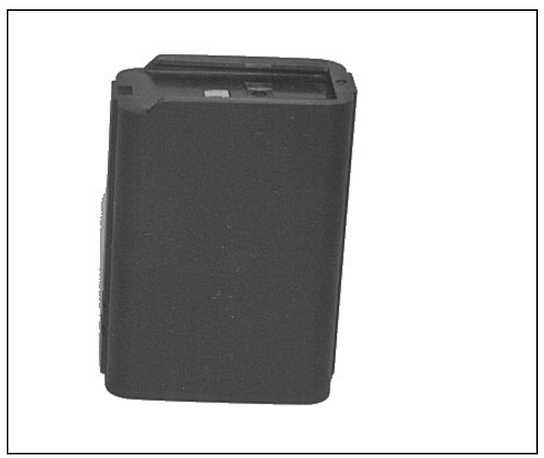


Figure 8 - Batteries

NOTE

On occasion when charging a new battery or a battery which has been out of use for a few months, the charger will prematurely switch to the trickle charge before the battery has been fully charged. If this happens, allow the battery to continue trickle-charging overnight. Then remove and reinsert the battery and observe that the battery goes through a normal rapid charge before putting it into service.

Table 7- Battery Charging Times

BATTERY CAPACITY	CHARGE TIME(hours)	
	FAST	SLOW
600mAh	1	10-14
1200mAh	2	20-24

RECHARGABLE BATTERY PACK DISPOSAL

Ni-Cd

Under specific state laws, it may be illegal to dispose of rechargeable battery packs and/or products powered by rechargeable batteries except in accordance with specific procedures. Special collection systems are in place in certain sites. Call Toll Free 1-800-822-9362 for specific procedures for returning rechargeable batteries in your state.

Figure 9 - Battery Charger

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

Printed in U.S.A.

NOTE: When ordering parts for your Monogram radio, precede all parts numbers with the prefix R29/.

SYMBOL	PART NO.	DESCRIPTION
C1	130-171-1	CER MONO 0.001µF:GRM42-6COG102J100V.
C2	130-184-4	CER MONO 0.001µF:GRM40X7R102K50.
C3	133-010-4	CER MONO 30 pF:GRM40COG300J50V.
C5	130-184-4	CER MONO 0.001µF:GRM40X7R102K50.
C6	130-184-4	CER MONO 0.001µF:GRM40X7R102K50.
C7	130-A17-6	CER MONO 0.001µF:GRM40COG102J50-500PT.
C8	130-184-4	CER MONO 0.001µF:GRM40X7R102K50.
C9	130-184-4	CER MONO 0.001µF:GRM40X7R102K50.
C11	130-172-2	CER MONO GRM40X7R103K50VM6305-500PT.
C12	130-172-2	CER MONO GRM40X7R103K50VM6305-500PT.
C13	130-172-2	CER MONO GRM40X7R103K50VM6305-500PT.
C14	130-172-2	CER MONO GRM40X7R103K50VM6305-500PT.
C16	130-172-2	CER MONO GRM40X7R103K50VM6305-500PT.
C17	130-172-2	CER MONO GRM40X7R103K50VM6305-500PT.
C18	130-172-2	CER MONO GRM40X7R103K50VM6305-500PT.
C19	130-172-2	CER MONO GRM40X7R103K50VM6305-500PT.
C20	130-234-5	CER MONO GRM40X7R223J50VM6305-500PT.
C20	130-331-9	CER MONO 0.039µF:GRM40X7R393J25.
C21	130-331-9	CER MONO 0.039µF:GRM40X7R393J25.
C23	130-175-5	CER MONO 0.01:GRM40X7R103J50.
C24	130-175-5	CER MONO 0.01:GRM40X7R103J50.
C25	130-175-5	CER MONO 0.01:GRM40X7R103J50.
C26	130-175-5	CER MONO 0.01:GRM40X7R103J50.
C28	130-175-5	CER MONO 0.01:GRM40X7R103J50.
C29	130-175-5	CER MONO 0.01:GRM40X7R103J50.
C30	130-175-5	CER MONO 0.01:GRM40X7R103J50.
C31	130-175-5	CER MONO 0.01:GRM40X7R103J50.
C32	130-175-5	CER MONO 0.01:GRM40X7R103J50.
C33	132-220-2	CER MONO 220pF:GRM40COG221J50.
C34	132-220-2	CER MONO 220pF:GRM40COG221J50.
C35	130-184-4	CER MONO 0.001µF:GRM40X7R102K50.
C37	130-184-4	CER MONO 0.001µF:GRM40X7R102K50.
C38	130-184-4	CER MONO 0.001µF:GRM40X7R102K50.
C39	130-184-4	CER MONO 0.001µF:GRM40X7R102K50.
C40	132-026-4	CER MONO 2pF:GRM42-6COG020C200V.
C42	130-185-5	CER MONO 0.1µF:GRM40Y5V104Z25.
C43	130-185-5	CER MONO 0.1µF:GRM40Y5V104Z25.
C44	130-185-5	CER MONO 0.1µF:GRM40Y5V104Z25.
C45	130-185-5	CER MONO 0.1µF:GRM40Y5V104Z25.
C46	130-185-5	CER MONO 0.1µF:GRM40Y5V104Z25.
C47	130-185-5	CER MONO 0.1µF:GRM40Y5V104Z25.
C48	132-220-2	CER MONO 220pF:GRM40COG221J50.
C49	132-220-2	CER MONO 220pF:GRM40COG221J50.
C50	134-302-2	CER MONO 43pF:GRM42-6COG436J200.
C51	132-220-2	CER MONO 220pF:GRM40COG221J50.
C52	132-220-2	CER MONO 220pF:GRM40COG221J50.
C53	132-220-2	CER MONO 220pF:GRM40COG221J50.
C54	132-220-2	CER MONO 220pF:GRM40COG221J50.
C55	132-220-2	CER MONO 220pF:GRM40COG221J50.
C56	132-220-2	CER MONO 220pF:GRM40COG221J50.
C57	132-220-2	CER MONO 220pF:GRM40COG221J50.
C58	132-220-2	CER MONO 220pF:GRM40COG221J50.
C59	132-220-2	CER MONO 220pF:GRM40COG221J50.
C60	132-220-2	CER MONO 220pF:GRM40COG221J50.
C61	132-220-2	CER MONO 220pF:GRM40COG221J50.
C62	132-220-2	CER MONO 220pF:GRM40COG221J50.
C63	132-220-2	CER MONO 220pF:GRM40COG221J50.
C64	132-220-2	CER MONO 220pF:GRM40COG221J50.
C65	132-220-2	CER MONO 220pF:GRM40COG221J50.
C66	131-813-3	CER MONO 18pF:GRM40COG180J50.
C67	136-007-7	CER MONO 6pF:GRM40COG060D50.
C68	134-722-1	CER MONO 47pF:GRM40COG470J50.
C69	132-407-5	CER MONO 24pF:GRM40COG240J50.
C70	13A-001-1	CER MONO 1pF:GRM42-6COG010C200V.
C71	131-106-8	CER MONO 11pF:GRM42-6COG110J2.
C72	131-029-2	CER MONO 10pF:GRM42-6COG0100D200V.
C73	13A-001-1	CER MONO 1pF:GRM42-6COG010C200V.
C74	132-026-4	CER MONO 2pF:GRM42-6COG020C200V.
C75	131-011-5	CERAMIC 10pF 50WV:D "NPO".
C76	134-302-2	CER MONO 33pF:GRM42-6COG330J200V.
C77	134-302-2	CER MONO 33pF:GRM42-6COG330J200V.
C78	131-029-2	CER MONO 10pF:GRM42-6COG010C200V.
C79	132-021-9	CER MONO 20pF: GRM40COG200J20.
C80	131-103-5	CER MONO 11pF:GRM40COG110J50.
C81	130-220-2	CER MONO 220pF:GRM40COG221J50.
C82	132-171-1	CER MONO 0.001µF:GRM42-6COG102J100V.
C83	132-011-0	CER MONO 2pF:GRM40COG020C50.
C84	136-010-4Z	CER MONO 5pF:GRM40COG0C50.
C85	139-101-3	CER MONO 91pF:GRM40COG910J50V.
C86	134-007-7Z	CER MONO 4pF:GRM40COG040C50.
C87	139-101-3	CER MONO 91pF:GRM40COG910J50V.
C88	139-101-3	CER MONO 91pF:GRM40COG910J50V.
C89	141-001-9	TANTALUM: 1.0µF 16WV:DA1C010M.
C90	131-103-5	CER MONO 11pF:GRM40COG110J50.
C91	133-925-1	CER MONO 390pF:GRM40COG391J50-500PT.
C92	101-042-4	ELECTROLYTIC 10µF 16WV:DN1C100MIS.
C93	136-816-5	CER MONO 68pF:GRM40COG80J50.
C94	101-007-3	CAPACITOR ELECT 1.0µF 50V SRA(M):4X7.
C95	138-004-4	CER MONO 8pF:GRM40COG080D50.
C96	104-739-6	CAPACITOR ELECT 47µF 16V SRA:(M):6.3X7.
C97	132-220-2	CER MONO 220pF:GRM40COG221J50.
C98	102-275-3	CAPACITOR ELECT 220µF 10WV:6.3X7.5.
C99	141-003-1	TANTALUM 10µF 16WV:DN1C100MIS.
C100	101-043-5	CAPACTOR ELECT 10µF 16V SRA(M):4X7.
C101	136-816-5	CER MONO 68pF:GRM40COG680J50.
C102	133-911-8	CER MONO 39pF:GRM40COG390J50.
C103	131-208-7	CER MONO 12pF:GRM40COG120J50.
C104	130-172-2	CER MONO GRM40X7R103K50VM6305-500PT.
C105	130-330-8	CER MONO 0.033µF:GRM40X7R333J50.
C106	132-012-1	CER MONO 20pF:GRM40COG200J50.
C107	133-321-5	CER MONO GRM40COG3R3C40VM6305-500PT.
C108	141-003-1	TANTALUM 10µF 16WV:DN1C100MIS.
C109	141-003-1	TANTALUM 10µF 16WV:DN1C100MIS.
C110	140-101-1	TANTALUM 0.1µF 16WV:DA1CORIM.
C111	140-101-1	TANTALUM 0.1µF 16WV:DA1CORIM.
C112	141-014-1	TANTALUM CHIP 1µF 16WV:TCM1C010AS#R.
C113	141-003-1	TANTALUM 10µF 16WV:DN1C100MIS.
C114	135-613-9	CER MONO 56pF:GRM40COG560J50.
C115	133-010-4	CER MONO 30pF:GRM40COG300J50V.
C116	131-027-0	CER MONO GRM40COG101J50V:M6305-500PT.
C117	141-001-9	TANTALUM 1.0µF 16WV:DA1C010M.
C118	141-003-1	TANTALUM 10µF 16WV:DN1C100MIS.
C119	101-043-5	CAPACITOR ELECT 10µF 16V SRA(M):4X7.
C120	141-001-9	TANTALUM 1.0µF 16WV:DA1C010M.
C121	130-425-1	CER MONO 0.047µF:GRM40X7R473J25.
C122	141-003-1	TANTALUM 10µF 16WV:DN1C100MIS.
C130	132-011-0	CER MONOI 2pF: GR40COG020C50.
C148	101-050-1	CAPACITOR ELECT 100µF 10V SRA(M):6.3X7.
C149	144-723-3	TANTALUM CHIP 47µF:293D476X0006C2T.
C150	130-184-4	CER MONO 0.001µF:GRM40X7R102K50.
C158	134-722-1	CER MONO 47pF:GRM40COG470J50.
C159	134-722-1	CER MONO 47pF:GRM40COG470J50.
C160	134-722-1	CER MONO 47pF:GRM40COG470J50.
C161	134-722-1	CER MONO 47pF:GRM40COG470J50.
C162	134-722-1	CER MONO 47pF:GRM40COG470J50.
C163	102-275-3	CAPACITOR ELECT 220µF 10WV:6.3X7.5.
C164	134-722-1	CER MONO 47pF:GRM40COG470J50.
C165	134-722-1	CER MONO 47pF:GRM40COG470J50.
C167	134-722-1	CER MONO 47pF:GRM40COG470J50.
C168	134-722-1	CER MONO 47pF:GRM40COG470J50.
C169	134-722-1	CER MONO 47pF:GRM40COG470J50.
C170	134-722-1	CER MONO 47pF:GRM40COG470J50.
C171	134-722-1	CER MONO 47pF:GRM40COG470J50.
C201	130-184-4	CER MONO 0.001µF:GRM40X7R102K50.
C202	141-003-1	TANTALUM 10µF 16WV:DN1C100MIS.
C203	130-172-2	CER MONO GRM40X7R103K50VM6305-500PT.
C204	130-185-5	CER MONO 0.1µF:GRM40Y5V104Z25.
C205	134-726-3	CER MONO 470pF:GRM40COG471J50.
C206	130-305-6	CER MONO 0.033µF:GRM40X7R333K50.
C207	140-101-1	TANTALUM 0.1µF 16WV:DA1CORIM.
C208	130-185-5	CER MONO 0.1µF:GRM40Y5V104Z25.
C300	132-220-2	CER MONO 220pF:GRM40COG221J50.
C301	132-220-2	CER MONO 220pF:GRM40COG221J50.
C302	131-208-7	CER MONO 12pF:GRM40COG120J50.
C304	139-003-8	CER MONO 9pF:GRM40COG090C50V.
C305	131-038-0	CER MONO 10pF:GRM40COG100F50.
C306	130-184-4	CER MONO 0.001µF:GRM40X7R102K50.
C307	139-101-3	CER MONO 91pF:GRM40COG910J50V.
C308	131-038-0	CER MONO 10pF:GRM40COG100F50.
C310	138-004-4	CER MONO 8pF:GRM40COG080D50.
C312	131-030-2	CER MONO 1pF:GRM40COG10C50.
C313	132-220-2	CER MONO 220pF:GRM40COG221J50.
C314	130-172-2	CER MONO GRM40X7R103K50VM6305-500PT.
C317	132-227-9	CER MONO GRM40COG2R2C50VM6305-500PT.
C318	130-172-2	CER MONO GRM40X7R103K50VM6305-500PT.
C319	133-321-5	CER MONO GRM40COG3R3C50VM6305-500PT.
C320	131-030-2	CER MONO 1pF:GRM40COG010C50.
C321	130-184-4	CER MONO 0.001µF:GRM40X7R102K50.
C322	130-184-4	CER MONO 0.001µF:GRM40X7R102K50.
C323	136-007-7	CER MONO 6pF:GRM40COG060D50.
C324	130-504-9	CER MONO 0.5pF:GRM40COG0R5C50V.
C325	131-030-2	CER MONO 1pF:GRM40COG010C50.
C326	136-816-5	CER MONO 68pF:GRM40COG680J50.
C327	136-816-5	CER MONO 68pF:GRM40COG680J50.
C328	132-220-2	CER MONO 220pF:GRM40COG221J50.
C330	130-184-4	CER MONO 0.001µF:GRM40X7R102K50.
C331	130-184-4	CER MONO 0.001µF:GRM40X7R102K50.
C334	142-223-8	TANTAL CHIP 2.2µF:293D225X0016B2T.
C401	130-172-2	CER MONO GRM40X7R103K50VM6305-500PT.
C402	130-172-2	CER MONO GRM40X7R103K50VM6305-500PT.
C403	130-172-2	CER MONO GRM40X7R103K50VM6305-500PT.
C404	130-175-5	CER MONO 0.01µF:GRM40X7R103J50.
C405	130-172-2	CER MONO GRM40X7R103K50VM6305-500PT.
C406	130-172-2	CER MONO GRM40X7R103K50VM6305-500PT.
C407	130-172-2	CER MONO GRM40X7R103K50VM6305-500PT.
C408	130-172-2	CER MONO GRM40X7R103K50VM6305-500PT.
C409	130-175-5	CER MONO 0.01µF:GRM40X7R103J50.
C410	134-722-1	CER MONO 47pF:GRM40COG470J50.
C411	134-722-1	CER MONO 47pF:GRM40COG470J50.
C412	134-722-1	CER MONO 47pF:GRM40COG470J50.
C413	134-722-1	CER MONO 47pF:GRM40COG470J50.
C414	134-722-1	CER MONO 47pF:GRM40COG470J50.
C415	130-185-5	CER MONO 0.1µF:GRM40Y5V104Z25.
C416	134-722-1	CER MONO 47pF:GRM40COG470J50.
C417	134-722-1	CER MONO 47pF:GRM40COG470J50.
C418	134-722-1	CER MONO 47pF:GRM40COG470J50.
C419	134-722-1	CER MONO 47pF:GRM40COG470J50.
C420	134-722-1	CER MONO 47pF:GRM40COG470J50.
C421	134-722-1	CER MONO 47pF:GRM40COG470J50.
C422	130-172-2	CER MONO GRM40X7R103K50VM6305-500PT.
C424	130-185-5	CER MONO 0.1µF:GRM40Y5V104Z25.
C425	134-726-3	CER MONO 470pF:GRM40COG471J50.
C426	130-175-5	CER MONO 0.01µF:GRM40X7R103J50.
C427	130-175-5	CER MONO 0.01µF:GRM40X7R103J50.
C428	132-220-2	CER MONO 220pF:GRM40COG221J50.
C429	134-726-3	CER MONO 470pF:GRM40COG471J50.
C430	141-046-0	TANTALUM CHIP 10µF:293D106X0010B2T.
C431	141-046-0	TANTALUM CHIP 10µF:293D106X0010B2T.
C432	130-234-5	CER MONO 0.002µF:GRM40X7R223J25.
C433	141-046-0	TANTALUM CHIP 10µF:293D106X0010B2T.
C434	141-046-0	TANTALUM CHIP 10µF:293D106X0010B2T.
C435	999-062-1	TANTALUM CHIP 0.47µF:293D335X0010A2T.
C436	130-185-5	CER MONO 0.1µF:GRM40Y5V104Z25.
C437	141-046-0	TANTALUM CHIP 10µF:293D106X0010B2T.
C438	141-046-0	TANTALUM CHIP 10µF:293D106X0010B2T.
C439	134-706-3	CER MONO 470pF:GRM40COG471J50.
C440	141-046-0	TANTALUM CHIP 10µF:293D106X0010B2T.
C441	130-A22-0	CER MONO 0.0018µF:GRM40X7R182K50.
C442	130-234-5	CER MONO GRM40X7R223J50V M6305-500PT.
C443	130-428-4	CER MONO 0.0047µF:GRM40X7R472J50.
C444	130-513-7	CER MONO 0.0056µF:GRM40X7R562K50.
C445	130-173-3	CER MONO 0.1µF:GRM42-6X7R104K25.
C446	135-613-9	CER MONO 56pF:GRM40COG560J50.
C447	130-234-5	CER MONO GRM40X7R223J50V M6305-500PT.
C448	134-722-1	CER MONO 47pF:GRM40COG470J50.
C449	130-234-5	CER MONO GRM40X7R223J50V M630.

SYMBOL	PART NO.	DESCRIPTION
C450	141-036-1	TANTAL CHIP 1µF:293D105X0016A2T.
C451	134-706-3	CER MONO 220pF:GRM40COG221J50.
C454	141-014-1	TANTALUM CHIP 1µF 16WV:TCMK010AS#R.
C455	143-312-0	TANTALUM CHIP 3.3µF.
C456	134-722-1	CER MONO 47pF:GRM40COG470J50.
C457	130-185-5	CER MONO 0.1µF:GRM40Y5V104Z25.
C458	130-173-3	CER MONO 0.1µF:GRM42-6X7R104K25.
C460	131-511-0	CER MONO 15pF:GRM40COG150J50.
C461	131-511-0	CER MONO 15pF:GRM40COG150J50.
C462	130-425-1	CER MONO 0.047µF:GRM40X7R473J25.
C463	130-425-1	CER MONO 0.047µF:GRM40X7R473J25.
C464	130-425-1	CER MONO 0.047µF:GRM40X7R473J25.
C465	130-425-1	CER MONO 0.047µF:GRM40X7R473J25.
C466	130-425-1	CER MONO 0.047µF:GRM40X7R473J25.
C467	130-425-1	CER MONO 0.047µF:GRM40X7R473J25.
C468	130-425-1	CER MONO 0.047µF:GRM40X7R473J25.
C469	130-425-1	CER MONO 0.047µF:GRM40X7R473J25.
C470	141-036-1	TANTAL CHIP 1µF:293D105X0016A2T.
C471	130-173-3	CER MONO 0.1µF:GRM42-6X7R104K25.
C472	130-185-5	CER MONO 0.1µF:GRM40Y5V104Z25.
C473	130-185-5	CER MONO 0.1µF:GRM40Y5V104Z25.
C474	130-305-6	CER MONO 0.033µF:GRM40X7R333K.
C475	130-305-6	CER MONO 0.033µF:GRM40X7R333K.
C476	130-305-6	CER MONO 0.033µF:GRM40X7R333K.
C477	130-305-6	CER MONO 0.033µF:GRM40X7R333K.
C478	130-220-2	CER MONO 220pF:GRM40COG221J50.
C601	130-185-2	CER MONO 0.1:GRM40Y5V109725.
C602	134-722-1	CER MONO 47pF:GRM40COG470J50.
C603	132-220-2	CER MONO 220pF:GRM40COG221J50.
C604	130-184-4	CER MONO 0.001µF:GRM40X7R102K50.
C605	130-185-5	CER MONO 0.1µF:GRM40Y5V104Z25.
C700	130-176-6	CER MONO 0.1µF:GRM40X7R104J50.
CF1	270-009-2	FILTER CERAMIC CFW455E.
CON401	421-619-5	CONNECTOR 00-6200-167-012-800:ZIF.
CON402	421-619-5	CONNECTOR 00-6200-167-012-800:ZIF.
CON3	422-689-3	TDH CONNECTOR TDH2-8SG.
CON404	422-746-1	MOLEX 14PIN FEMALE.
CON405	421-618-4	CONNECTOR 00-6200-057-012-800:ZIF.
CON406	422-470-1	MOLEX 4 PIN CONNECTOR.
CON153	421-648-1	CONNECTOR HR10A-7R-6SB.
CON151	422-367-2	HEADER PIN CONNECTORGDH2-6DBC.
CON152	422-709-8	HEADER PIN FEMALE 6 PIN.
CON201	422-083-5	4PIN HEADER (SQUELCH PCB).
CON9	504-916	4P HOUSING ASSY.
D1	245-013-1	DIODE 1N 4001 (1A50V).
D2	245-013-1	DIODE 1N 4001 (1A50V).
D3	243-026-3	DIODE SILICON SCHOTT1SS97.
D4	243-012-0	DIODE MMBV3401.
D5	243-012-0	DIODE MMBV3401.
D6	243-012-0	DIODE MMBV3401.
D7	243-012-0	DIODE MMBV3401.
D8	243-051-5	DIODE SI KDS184S.
D9	243-051-5	DIODE SI KDS184S.
D10	243-024-1	DIODE SI MMBD2835 (A3).
D13	243-054-8	DIODE SI TUNING BB619A.

SYMBOL	PART NO.	DESCRIPTION
D153	251-148-1	LED LAMP SCF33G2TT.
D201	244-003-7	DIODE GE OA90.
D202	244-003-7	DIODE GE OA90.
D204	243-028-5	DIODE SI MBAV99-LT1.
D301	243-050-4	DIODE VARACTOR 1SV153.
D302	243-050-4	DIODE VARACTOR 1SV153.
D401	243-051-5	DIODE SI KDS 184
D402	243-063-6	DIODE SWITCHING KDS181S.
D403	243-052-6	DIODE SI KDS 193.
FB1	320-536-5	CORE BEAD 56 59065-4B.
FB2	320-536-5	CORE BEAD 56 59065-4B.
FB3	320-536-5	CORE BEAD 56 59065-4B.
FB4	320-536-5	CORE BEAD 56 59065-4B.
FB5	320-536-5	CORE BEAD 56 59065-4B.
FL1	320-877-5	COIL HELICAL 460MHZ 2 POLE.
FL2	320-893-9	COIL HELICAL 460MHZ 2 POLE:F367 PN-K5005A.
FL3	320-592-7	COIL HELICAL 440MHZ 2 POLE.
FUSE	280-089-7	FUSE MICRO MS2(125V 2A SLOW).
IC1	223-319-2	I.C MC145156DW2.
IC2	223-313-6	I.C MC12022BD(S008).
IC3	231-081-9	I.C LM3361AM.
IC4	231-008-4	I.C LM386(803-N-3).
IC5	223-418-8	I.C MC147808.
IC6	223-119-8	I.C 78L05.
IC402	223-224-9	I.C MC14066BD:SO14.
IC403	223-320-2	I.C MC14504BD.
IC404	231-082-0	I.C LM2902M.
IC405	231-082-0	I.C LM2902M.
IC406	223-378-5	I.C MC142100DW.
IC407	231-073-3	I.C MF6CWM-100.
IC408	229-401-2	I.C CAT93C46J.
IC409	229-451-7	I.C Z86101ZFEC R562.
IC410	231-082-0	I.C LM2902M.
IC411	229-357-6	I.C GD74HC368DT.
IC412	229-456-2	I.C LTC1059CS.
L1	310-549-6	COIL SPRING 2.8X0.6%X1(1/2T)R.
L2	310-618-5	COIL SPRING 3.6DIAX0.6DIAX1.5T: (R).
L3	310-619-6	COIL SPRING 2.8DIAX0.6DIAX1.5T: (L).
L4	310-551-7	COIL SPRING 2.4X0.4&X6(1/2T) R.
L5	310-551-7	COIL SPRING 2.4X0.4&X6(1/2T) R.
L6	310-550-6	COIL SPRING 2.4X0.4&X4(1/2T) R.
L7	310-615-2	COIL SPRING 1.8DIAX0.4DIAX1.5T: (L).
L8	310-616-3	COIL SPRING 1.8DIAX0.4DIAX2.5T: (L).
L9	310-615-2	COIL SPRING 1.8DIAX0.4DIAX1.5T: (L).
L10	310-381-0	COIL AXIAL 1MH:LAL03TB102K.
L12	310-381-0	COIL AXIAL 1MH:LAL03TB102K.
L13	310-381-0	COIL AXIAL 1MH:LAL03TB102K.
L14	310-381-0	COIL AXIAL 1MH:LAL03TB102K.
L15	310-381-0	COIL AXIAL 1MH:LAL03TB102K.
L16	310-218-7	COIL AXIAL 1µH:LAL0.3X7TX1K.
L17	310-380-9	COIL AXIAL 100µH:LAL03TB101K.
L18	310-380-9	COIL AXIAL 100µH:LAL03TB101K.
L19	310-399-7	COIL AXIAL 0.68µH:LAL02TBR68M.
L20	310-399-7	COIL AXIAL 0.68µH:LAL02TBR68M.
L21	310-399-7	COIL AXIAL 0.68µH:LAL02TBR68M.

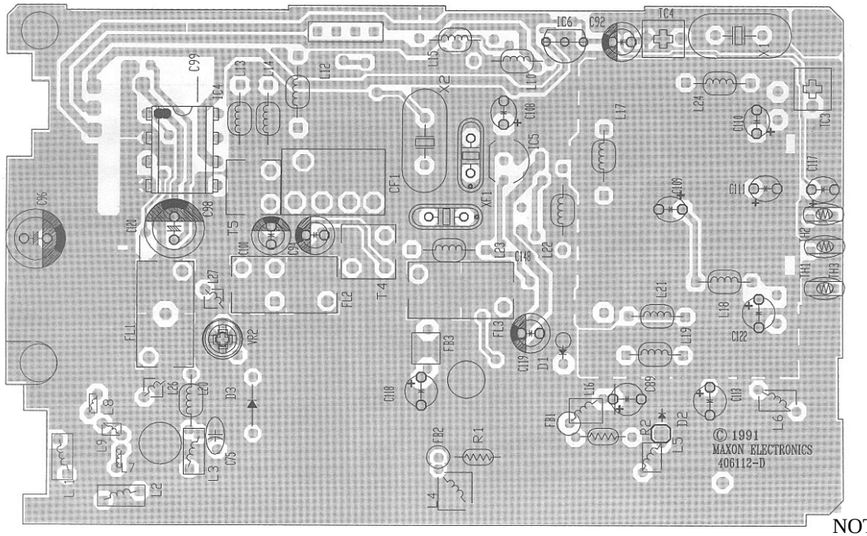
SYMBOL	PART NO.	DESCRIPTION
L23	310-380-9	COIL AXIAL 100µH:LAL03TB101K.
L24	310-289-1	COIL AXIAL 2.2µH:LAL03TB2R2M.
L26	310-617-4	COIL SPRING 1.8DIAX0.4DIAX4.5T: (R).
L27	310-614-1	COIL SPRING 1.2DIAX0.4DIAX4.5T: (R).
L401	310-293-4	1 µH COIL.
Q1	203-046-9	TRANSISTOR SRF1886.
Q2	203-055-7	TRANSISTOR MRF581.
Q3	200-003-5	TRANSISTOR BFR92A REEL.
Q4	218-042-4	TRANSISTOR KSR2101 (T).
Q5	218-042-4	TRANSISTOR KSR2101 (T).
Q6	218-042-4	TRANSISTOR KSR2101 (T).
Q7	218-042-4	TRANSISTOR KSR2101 (T).
Q8	200-001-3	TRANSISTOR BC848C SOT-23.
Q9	200-001-3	TRANSISTOR BC848C SOT-23.
Q10	200-001-3	TRANSISTOR BC848C SOT-23.
Q11	203-111-4	TRANSISTOR BCX-18.
Q12	203-116-9	TRANSISTOR MMBFJ310 SOT-23.
Q13	200-003-5	TRANSISTOR BFR92A REEL.
Q14	200-002-4	TRANSISTOR BC858B SOT-23.
Q15	218-038-0	TRANSISTOR KSR1102T.
Q16	203-096-4	TRANSISTOR MMBC1321Q4.
Q17	200-013-4	TRANSISTOR BCX17.
Q18	200-013-4	TRANSISTOR BCX17.
Q19	200-013-3	TRANSISTOR BC848C SOT-23.
Q20	218-042-4	TRANSISTOR KSR2101 (T).
Q21	202-097-0	TRANSISTOR KTN2369S.
Q201	200-001-3	TRANSISTOR BC848C SOT-23.
Q202	200-001-3	TRANSISTOR BC848C SOT-23.
Q301	200-001-3	TRANSISTOR BC848C SOT-23.
Q302	203-104-8	TRANSISTOR MRF5711.
Q303	200-003-5	TRANSISTOR BFR92A REEL.
Q304	200-003-5	TRANSISTOR BFR92A REEL.
Q305	203-096-4	TRANSISTOR MMBC1321Q4.
Q401	202-092-5	BRT KRA110S PK.
Q402	202-085-8	BRT KRC101S ND.
Q403	202-095-8	BRT KRC104S ND.
Q404	202-095-8	BRT KRC104S ND.
Q405	202-095-8	BRT KRC104S ND.
Q406	202-090-3	BRT KRA103S PC.
Q407	202-090-3	BRT KRA103S PC.
Q408	202-096-9	BRT KRC110S NK.
Q409	202-113-1	TRANSISTOR KTC 3875.
Q410	202-095-8	BRT KRC104S ND.
Q411	202-095-8	BRT KRC104S ND.
Q412	207-006-1	TRANSISTOR FET.
Q413	209-029-8	BRT KRC 104S ND.
Q500	209-029-4	TRANSISTOR IRFD120.
R1	009-220-7	RESISTOR METALFILM 22 OHM 1/4W ±5%.
R2	002-272-9Z	RESISTOR METALFILM 2.7K OHM 1/8W ±5%.
R3	060-220-0	RESISTOR CHIP 220 OHM 1/10W ±5%.
R4	060-122-5	RESISTOR CHIP 1.2K OHM 1/10W ±5%.
R5	060-103-8	RESISTOR CHIP 10K OHM 1/10W ±5%.
R6	060-471-0	RESISTOR CHIP 470 OHM 1/10W ±5%.
R7	060-223-3	RESISTOR CHIP 22K OHM 1/10W ±5%.
R8	060-272-7	RESISTOR CHIP 2.7K OHM 1/10W ±5%.

SYMBOL	PART NO.	DESCRIPTION
R10	060-393-3	RESISTOR CHIP 39K OHM 1/10W ±5%.
R11	060-223-3	RESISTOR CHIP 22K OHM 1/10W ±5%.
R12	060-102-7	RESISTOR CHIP 1K OHM 1/10W ±5%.
R13	060-222-2	RESISTOR CHIP 2.2K OHM 1/10W ±5%.
R14	060-103-8Z	RESISTOR CHIP 10K OHM 1/10W ±5%.
R15	060-101-6Z	RESISTOR CHIP 100 OHM 1/10W ±5%.
R16	060-471-0	RESISTOR CHIP 470 OHM 1/10W ±5%.
R17	060-103-8	RESISTOR CHIP 10K OHM 1/10W ±5%.
R18	060-102-7	RESISTOR CHIP 1K OHM 1/10W ±5%.
R19	060-122-5	RESISTOR CHIP 1.2K OHM 1/10W ±5%.
R20	060-101-6	RESISTOR CHIP 100 OHM 1/10W ±5%.
R21	060-390-8	RESISTOR CHIP 39 OHM 1/10W ±5%.
R22	060-822-4	RESISTOR CHIP 8.2K OHM 1/10W ±5%.
R23	060-122-5	RESISTOR CHIP 1.2K OHM 1/10W ±5%.
R24	060-473-2	RESISTOR CHIP 47K OHM 1/10W ±5%.
R25	060-474-3	RESISTOR CHIP 470K OHM 1/10W ±5%.
R26	060-104-9	RESISTOR CHIP 100K OHM 1/10W ±5%.
R27	060-471-0	RESISTOR CHIP 470 OHM 1/10W ±5%.
R28	060-563-0	RESISTOR CHIP 56K OHM 1/10W ±5%.
R29	060-224-4	RESISTOR CHIP 220K OHM 1/10W ±5%.
R30	060-101-6	RESISTOR CHIP 100 OHM 1/10W ±5%.
R31	060-332-8	RESISTOR CHIP 3.3K OHM 1/10W ±5%.
R32	060-474-3	RESISTOR CHIP 470K OHM 1/10W ±5%.
R33	060-471-0	RESISTOR CHIP 470 OHM 1/10W ±5%.
R34	060-471-0	RESISTOR CHIP 470 OHM 1/10W ±5%.
R35	060-393-3	RESISTOR CHIP 39K OHM 1/10W ±5%.
R36	060-393-3	RESISTOR CHIP 39K OHM 1/10W ±5%.
R37	060-471-0	RESISTOR CHIP 470 OHM 1/10W ±5%.
R38	060-103-8	RESISTOR CHIP 10K OHM 1/10W ±5%.
R39	060-272-7	RESISTOR CHIP 2.7K OHM 1/10W ±5%.
R40	060-000-8	RESISTOR CHIP 0 OHM 1/10W ±5%.
R41	060-222-2	RESISTOR CHIP 2.2K OHM 1/10W ±5%.
R42	060-392-2	RESISTOR CHIP 3.9K OHM 1/10W ±5%.
R42	060-472-1	RESISTOR CHIP 4.7K OHM 1/10W ±5%.
R43	060-122-5	RESISTOR CHIP 1.2K OHM 1/10W ±5%.
R44	060-122-5	RESISTOR CHIP 1.2K OHM 1/10W ±5%.
R45	060-102-7	RESISTOR CHIP 1K OHM 1/10W ±5%.
R46	060-102-7	RESISTOR CHIP 1K OHM 1/10W ±5%.
R47	060-153-3	RESISTOR CHIP 15K OHM 1/10W ±5%.
R49	060-154-4	RESISTOR CHIP 150K OHM 1/10W ±5%.
R50	060-392-2	RESISTOR CHIP 3.9K OHM 1/10W ±5%.
R51	060-682-4	RESISTOR CHIP 6.8K OHM 1/10W ±5%.
R53	060-103-8Z	RESISTOR CHIP 10K OHM 1/10W ±5%.
R54	060-123-6	RESISTOR CHIP 12K OHM 1/10W ±5%.
R55	060-332-8	RESISTOR CHIP 3.3K OHM 1/10W ±5%.
R56	060-122-5	RESISTOR CHIP 1.2K OHM 1/10W ±5%.
R57	060-223-3	RESISTOR CHIP 22K OHM 1/10W ±5%.
R58	060-473-2	RESISTOR CHIP 47K OHM 1/10W ±5%.
R59	060-102-7	RESISTOR CHIP 1K OHM 1/10W ±5%.
R60	060-101-6	RESISTOR CHIP 100 OHM 1/10W ±5%.
R61	060-181-8	RESISTOR CHIP 180 OHM 1/10W ±5%.
R99	060-222-2	RESISTOR CHIP 2.2K OHM 1/10W ±5%.
R149	060-152-2	RESISTOR CHIP 1.5K OHM 1/10W ±5%.

SYMBOL	PART NO.	DESCRIPTION
R156	060-223-3	RESISTOR CHIP 22K OHM 1/10W ±5%.
R157	060-101-6	RESISTOR CHIP 100 OHM 1/10W ±5%.
R158	060-101-6	RESISTOR CHIP 100 OHM 1/10W ±5%.
R201	060-123-6	RESISTOR CHIP 12K OHM 1/10W ±5%.
R202	060-471-0	RESISTOR CHIP 470 OHM 1/10W ±5%.
R203	060-393-3	RESISTOR CHIP 39K OHM 1/10W ±5%.
R204	060-332-8	RESISTOR CHIP 3.3K OHM 1/10W ±5%.
R205	060-272-7	RESISTOR CHIP 2.7K OHM 1/10W ±5%.
R206	060-563-0	RESISTOR CHIP 56K OHM 1/10W ±5%.
R207	060-563-0	RESISTOR CHIP 56K OHM 1/10W ±5%.
R208	060-272-7	RESISTOR CHIP 2.7K OHM 1/10W ±5%.
R209	060-272-7	RESISTOR CHIP 2.7K OHM 1/10W ±5%.
R210	060-223-3	RESISTOR CHIP 22K OHM 1/10W ±5%.
R211	060-223-3	RESISTOR CHIP 22K OHM 1/10W ±5%.
R212	060-153-3	RESISTOR CHIP 15K OHM 1/10W ±5%.
R213	060-223-3	RESISTOR CHIP 22K OHM 1/10W ±5%.
R301	060-100-5	RESISTOR CHIP 10 OHM 1/10W ±5%.
R302	060-562-9	RESISTOR CHIP 5.6K OHM 1/10W ±5%.
R303	060-182-9	RESISTOR CHIP 1.8K OHM 1/10W ±5%.
R304	060-221-1	RESISTOR CHIP 220 OHM 1/10W ±5%.
R305	060-182-9	RESISTOR CHIP 1.8K OHM 1/10W ±5%.
R306	060-221-1	RESISTOR CHIP 220 OHM 1/10W ±5%.
R307	060-123-6	RESISTOR CHIP 12K OHM 1/10W ±5%.
R308	060-220-0	RESISTOR CHIP 22 OHM 1/10W ±5%.
R309	060-182-9	RESISTOR CHIP 1.8K OHM 1/10W ±5%.
R310	060-220-0	RESISTOR CHIP 22 OHM 1/10W ±5%.
R311	060-683-5	RESISTOR CHIP 68K OHM 1/10W ±5%.
R312	060-220-0	RESISTOR CHIP 22 OHM 1/10W ±5%.
R313	060-823-5	RESISTOR CHIP 82K OHM 1/10W ±5%.
R401	060-103-8Z	RESISTOR CHIP 10K OHM 1/10W ±5%.
R402	060-822-4	RESISTOR CHIP 8.2K OHM 1/10W ±5%.
R403	060-682-4	RESISTOR CHIP 6.8K OHM 1/10W ±5%.
R404	060-153-3	RESISTOR CHIP 15K OHM 1/10W ±5%.
R405	060-104-9	RESISTOR CHIP 100K OHM 1/10W ±5%.
R406	060-103-8Z	RESISTOR CHIP 10K OHM 1/10W ±5%.
R407	060-333-9	REISTOR CHIP 33K OHM 1/10W ±5%.
R408	060-203-5	RESISTOR CHIP 20K OHM 1/10W ±5%.
R409	060-184-1	RESISTOR CHIP 180K OHM 1/10W ±5%.
R410	060-222-2	RESISTOR CHIP 2.2K OHM 1/10W ±5%.
R411	060-124-6	RESISTOR CHIP 120K OHM 1/10W ±5%.
R412	060-153-3	RESISTOR CHIP 15K OHM 1/10W ±5%.
R413	060-473-2	RESISTOR CHIP 47K OHM 1/10W ±5%.
R414	060-103-8Z	RESISTOR CHIP 10K OHM 1/10W ±5%.
R415	060-103-8Z	RESISTOR CHIP 10K OHM 1/10W ±5%.
R416	060-222-2	RESISTOR CHIP 2.2K OHM 1/10W ±5%.
R417	060-103-8Z	RESISTOR CHIP 10K OHM 1/10W ±5%.
R418	060-561-8	RESISTOR CHIP 560 OHM 1/10W ±5%.
R419	060-124-6	RESISTOR CHIP 120K OHM 1/10W ±5%.
R420	060-334-0	RESISTOR CHIP 330K OHM 1/10W ±5%.
R421	060-473-2	RESISTOR CHIP 47K OHM 1/10W ±5%.
R422	060-393-3	RESISTOR CHIP 39K OHM 1/10W ±5%.
R423	006-203-5	RESISTOR CHIP 20K OHM 1/10W ±5%.
R424	060-103-8Z	RESISTOR CHIP 10K OHM 1/10W ±5%.

SYMBOL	PART NO.	DESCRIPTION
R426	060-103-8Z	RESISTOR CHIP 10K OHM 1/10W ±5%.
R427	060-104-9Z	RESISTOR CHIP 100K OHM 1/10W ±5%.
R428	060-103-8Z	RESISTOR CHIP 10K OHM 1/10W ±5%.
R429	060-393-3	RESISTOR CHIP 39K OHM 1/10W ±5%.
R430	060-472-1	RESISTOR CHIP 4.7K OHM 1/10W ±5%.
R431	060-473-2	RESISTOR CHIP 47K OHM 1/10W ±5%.
R432	999-127-4	RESISTOR CHIP 620K OHM 1/10W ±5%.
R433	060-473-2	RESISTOR CHIP 47K OHM 1/10W ±5%.
R434	060-473-2	RESISTOR CHIP 47K OHM 1/10W ±5%.
R435	060-153-3	RESISTOR CHIP 15K OHM 1/10W ±5%.
R436	060-222-2	RESISTOR CHIP 2.2K OHM 1/10W ±5%.
R437	060-222-2	RESISTOR CHIP 2.2K OHM 1/10W ±5%.
R438	060-473-2	RESISTOR CHIP 47K OHM 1/10W ±5%.
R439	060-272-7	RESISTOR CHIP 2.7K OHM 1/10W ±5%.
R440	060-472-1	RESISTOR CHIP 4.7K OHM 1/10W ±5%.
R441	060-222-2	RESISTOR CHIP 2.2K OHM 1/10W ±5%.
R442	060-223-3	RESISTOR CHIP 22K OHM 1/10W ±5%.
R443	060-152-2	RESISTOR CHIP 1.5K OHM 1/10W ±5%.
R444	060-563-0	RESISTOR CHIP 56K OHM 1/10W ±5%.
R445	060-123-6	RESISTOR CHIP 12K OHM 1/10W ±5%.
R446	060-681-3	RESISTOR CHIP 680 OHM 1/10W ±5%.
R447	060-184-1	RESISTOR CHIP 180K OHM 1/10W ±5%.
R448	060-153-3	RESISTOR CHIP 15K OHM 1/10W ±5%.
R449	060-103-8Z	RESISTOR CHIP 10K OHM 1/10W ±5%.
R450	060-153-3	RESISTOR CHIP 15K OHM 1/10W ±5%.
R451	060-103-8Z	RESISTOR CHIP 10K OHM 1/10W ±5%.
R452	060-102-7	RESISTOR CHIP 1K OHM 1/10W ±5%.
R453	060-102-7	RESISTOR CHIP 1K OHM 1/10W ±5%.
R454	060-473-2	RESISTOR CHIP 47K OHM 1/10W ±5%.
R455	060-473-2	RESISTOR CHIP 47K OHM 1/10W ±5%.
R456	060-473-2	RESISTOR CHIP 47K OHM 1/10W ±5%.
R457	060-473-2	RESISTOR CHIP 47K OHM 1/10W ±5%.
R458	060-473-2	RESISTOR CHIP 47K OHM 1/10W ±5%.
R459	060-473-2	RESISTOR CHIP 47K OHM 1/10W ±5%.
R460	060-683-5	RESISTOR CHIP 68K OHM 1/10W ±5%.
R461	161-105-0Z	1M OHM 1/10W ±5%.
R462	002-474-5	RESISTOR CHIP 470K OHM 1/8W ±5%.
R463	060-474-3	RESISTOR CHIP 470K OHM 1/8W ±5%.
R464	060-473-2	RESISTOR CHIP 47K OHM 1/8W ±5%.
R465	060-184-1	RESISTOR CHIP 180K OHM 1/10W ±5%.
R466	060-184-1	RESISTOR CHIP 180K OHM 1/10W ±5%.
R467	060-472-1	RESISTOR CHIP 4.7K OHM 1/10W ±5%.
R468	060-473-2	RESISTOR CHIP 47K OHM 1/8W ±5%
R469	060-103-8Z	RESISTOR CHIP 10K OHM 1/10W ±5%.
R470	060-472-1	RESISTOR CHIP 4.7K OHM 1/10W ±5%.
R471	060-103-8Z	RESISTOR CHIP 10K OHM 1/10W ±5%.
R472	060-223-3	RESISTOR CHIP 22K OHM 1/10W ±5%.
R473	060-105-0Z	RESISTOR CHIP 1M OHM 1/8W ±5%.
R474	060-104-9Z	RESISTOR CHIP 100K OHM 1/10W ±5%.
R475	060-272-7	RESISTOR CHIP 2.7K OHM 1/10W ±5%.
R476	060-123-6	RESISTOR CHIP 12K OHM 1/10W ±5%.
R477	060-682-4	RESISTOR CHIP 6.8K OHM 1/10W ±5%.
R478	060-103-8Z	RESISTOR CHIP 10K OHM 1/10W ±5%.

SYMBOL	PART NO.	DESCRIPTION
R480	060-103-8Z	RESISTOR CHIP 10K OHM 1/10W ±5%.
R481	060-222-2	RESISTOR CHIP 2.2K OHM 1/10W ±5%.
R482	060-473-2	RESISTOR CHIP 47K OHM 1/10W ±5%.
R700	060-474-3	RESISTOR CHIP 470K OHM 1/10W ±5%.
RV401	480-044-8	TRIMMER POT.METER NRV630HF01 B100K.
RV402	480-045-9	TRIMMER POT.METER NRV630HF01 B20K.
RV403	480-051-4	POTENTIOMETER NRV630HF01 B50KOHM.
SW151	432-063-7	SW PUSH SPPH221BP011.
SW152	430-048-7	SW DIP ROTAR. DIGITALKDR-10.
T4	320-905-7	COIL 1FT 21.4MHZ:25KHZ.
T5	320-232-2	COIL 455KHZ DETECTOR.
TC301	171-501-3	CAPACITOR TRIMMER TSW-3-P-180.
TC3	176-014-5	CAPACITOR TRIMMER 6pF:ECR-LA006A52V.
TC4	176-014-5	CAPACITOR TRIMMER 6pF:ECR-LA006A52V.
TH1	099-303-6	THERMISTOR 30K OHM ±15%:KTD5-330.
TH2	098-252-8	THERMISTOR 2.5K OHM ±15%:KTD5-225.
TH201	097-103-3	THERMISTOR 10K OHM ±10%:YTD5-310.
TH3	097-102-1	THERMISTOR 1K OHM ±15%:KTD5-210.
VR2	072-103-1	RESISTOR SEMIFIXED 10KB:RH0621C100138.
VR201	480-045-9	TRIMMER POT.METER NRV630HF01 B20K.
VR3	450-514-7	VR 20KAV12M4-1(6X5)PVBS(SJ)12R-15.
X1	261-394-2	CRYSTAL NC-18C 12.800MHZ(S1-1060-0510).
X2	262-052-7	CRYSTAL (NR-18T) 20.945MHZ 15PPM.
X401	262-006-6	CRYSTAL HC49/S 11.155200MHZ.
XF1	271-002-0	FILTER CRYSTAL 21M 15BU.



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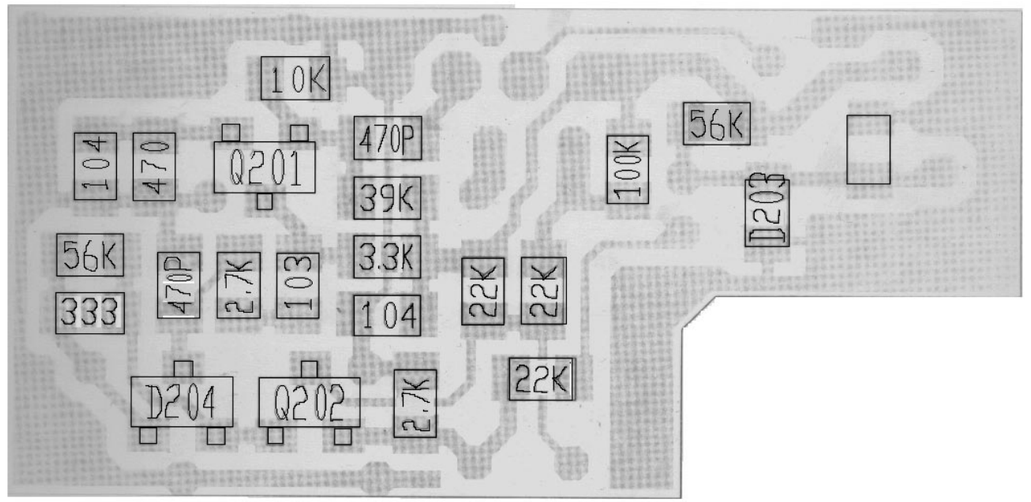
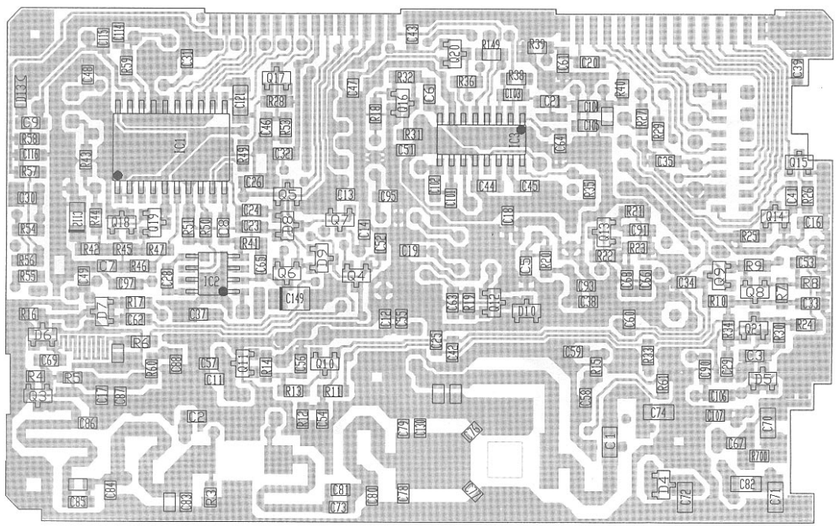
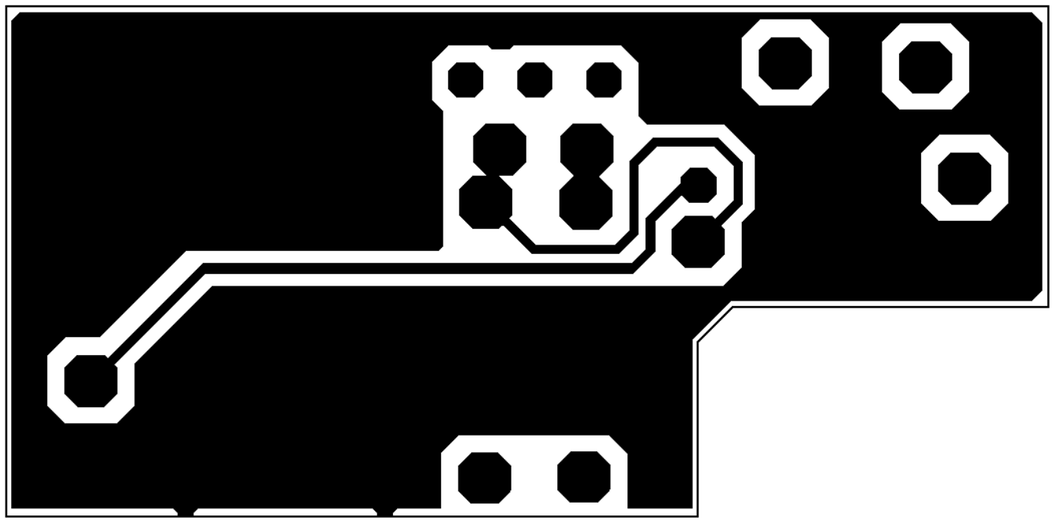


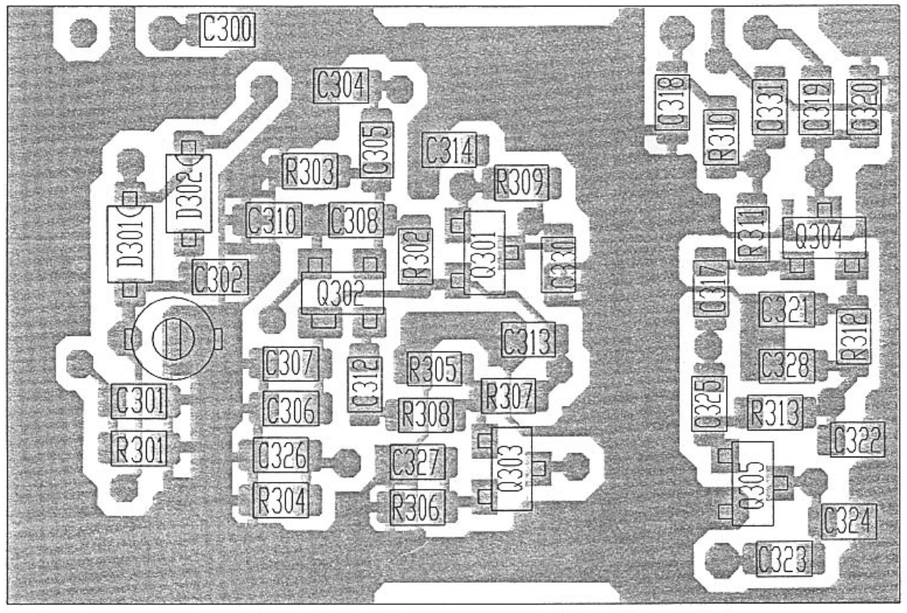


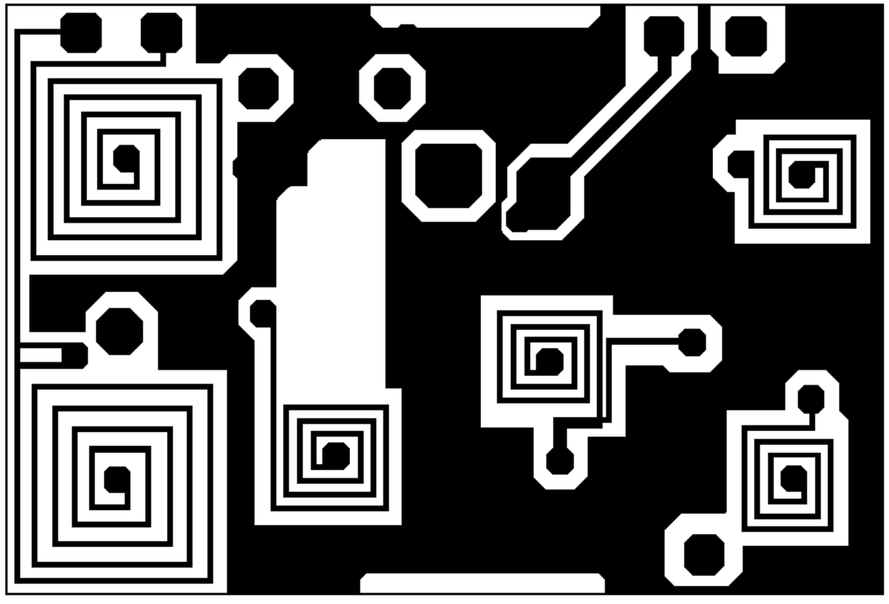
CAUTION
OBSERVE PRECAUTIONS FOR HANDLING ELECTROSTATIC SENSITIVE DEVICES



MONOGRAM PORTABLE
RF BOARD
406112-D

MONOGRAM PORTABLE
SQUELCH BOARD
4161917B





MONOGRAM PORTABLE
VCO BOARD
416914-B

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CAUTION
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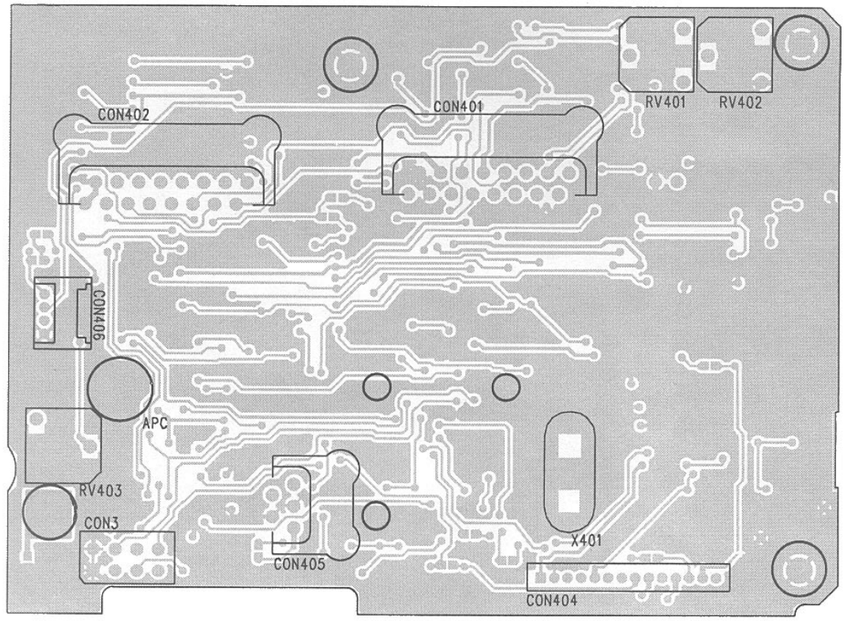
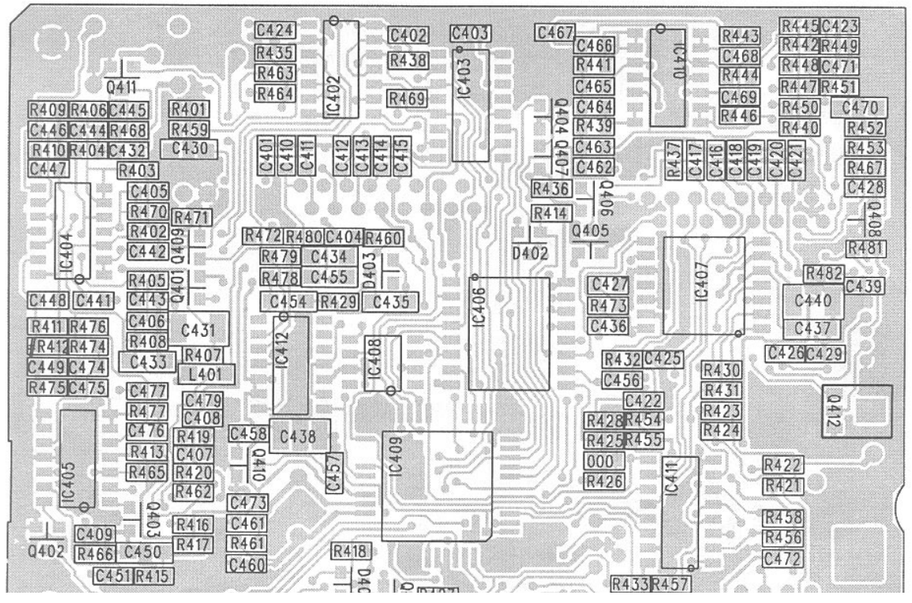
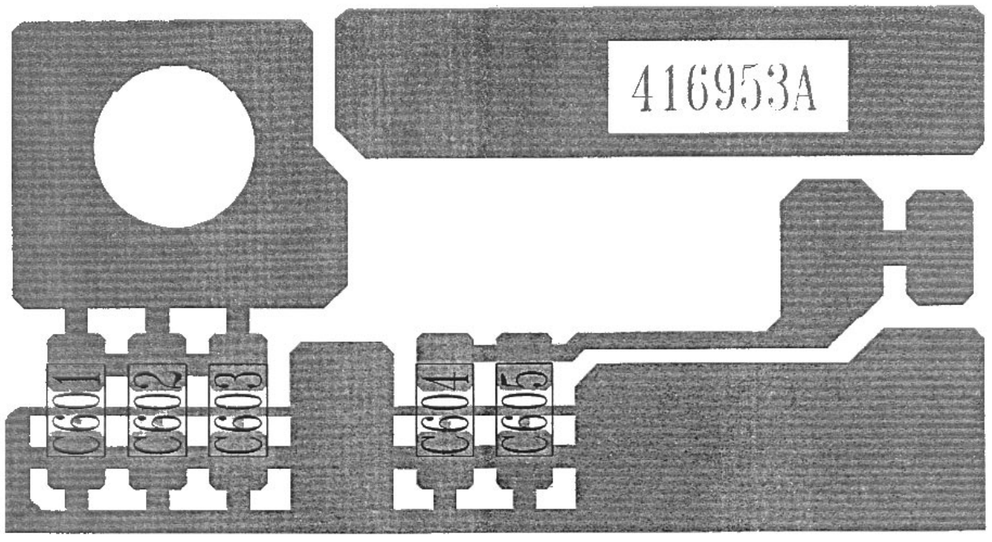
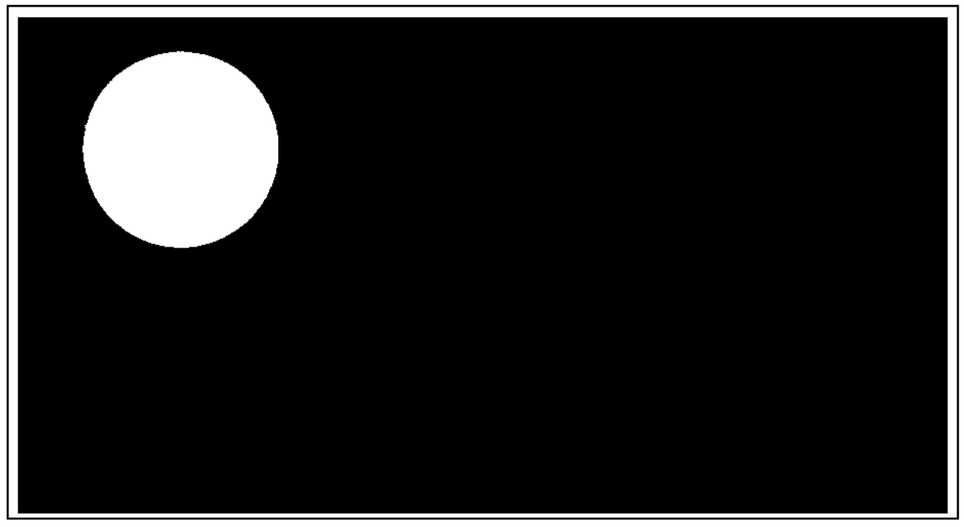
ELECTROSTATIC SENSITIVE DEVICES





MONOGRAM PORTABLE
CONTROL BOARD
406115-H





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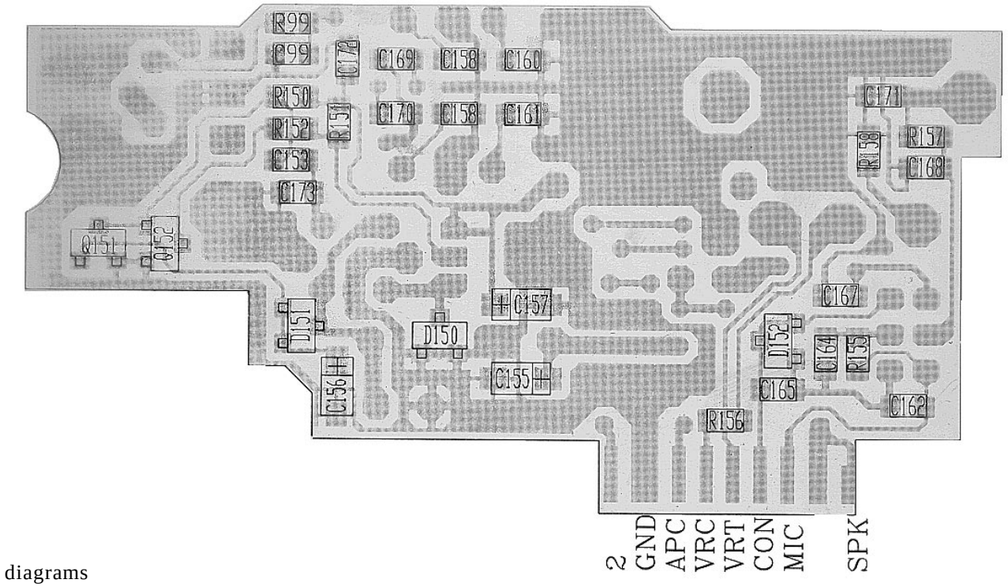

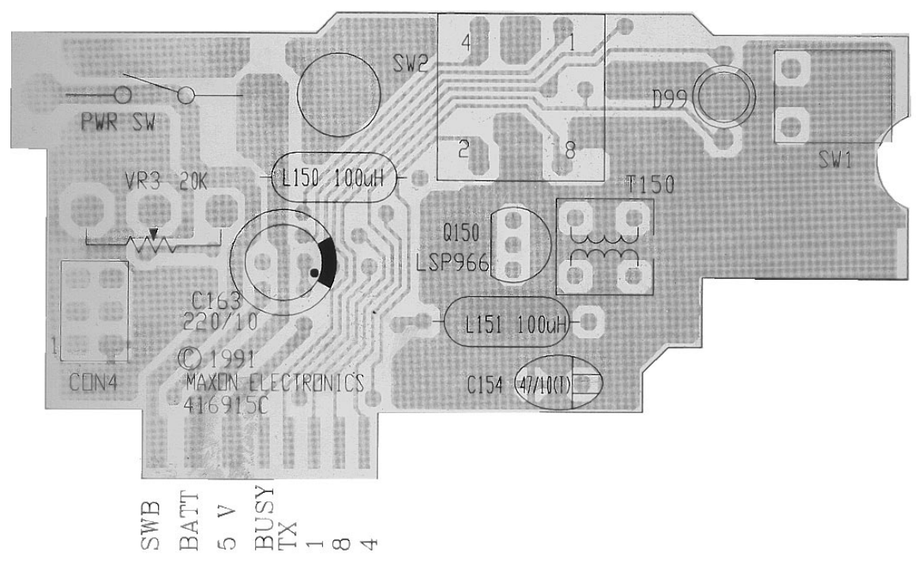

CAUTION
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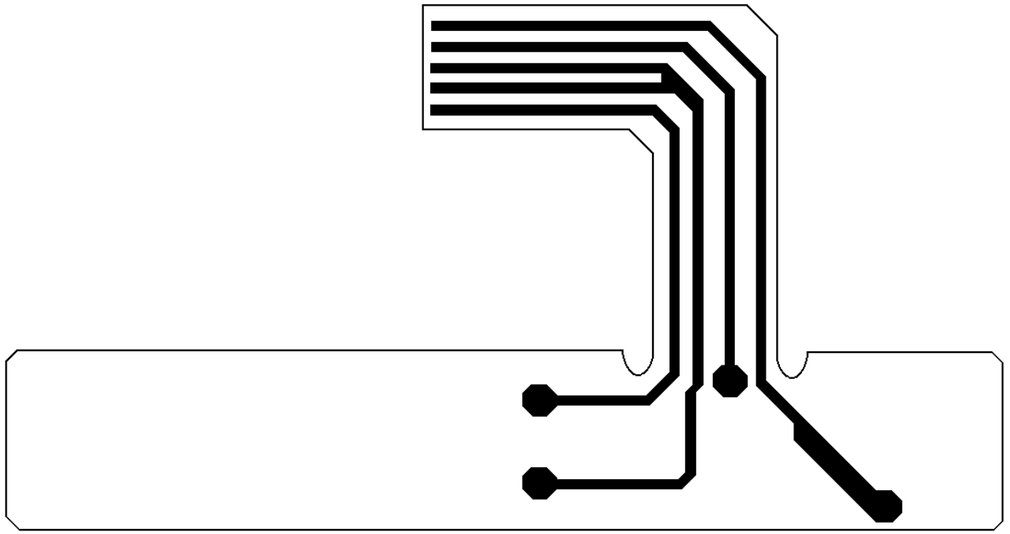
MONOGRAM PORTABLE
BATTERY TERMINAL
416953-A

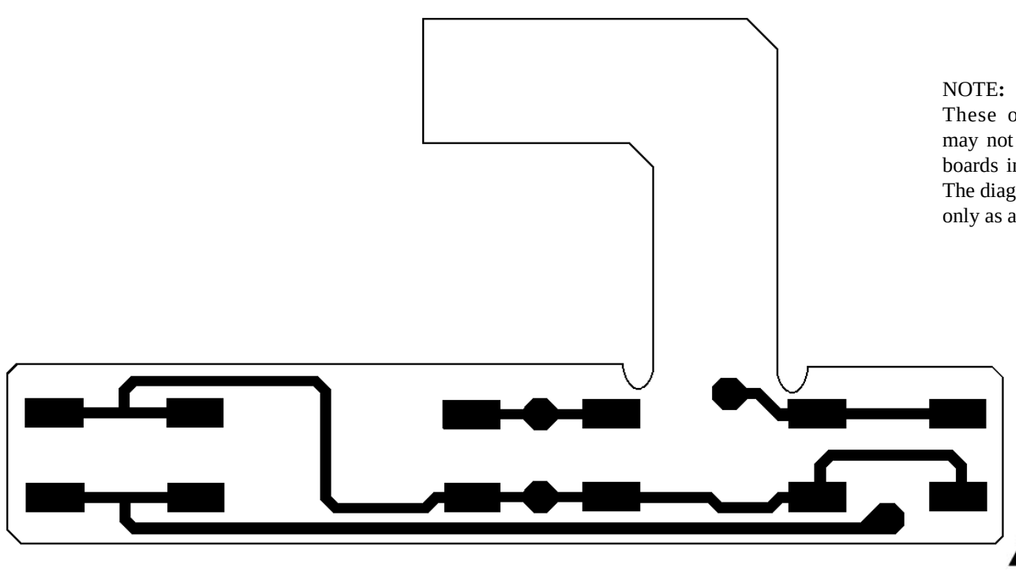
TOP PANEL
416915-C



PTT TALK
416954-A

FLEX PCB B 416916-B

FLEX PCB A 416909-C



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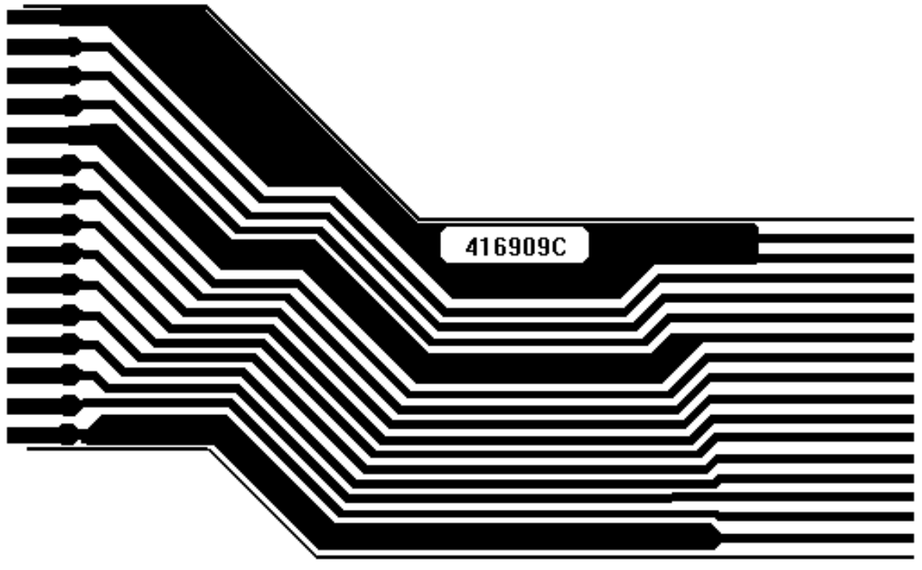
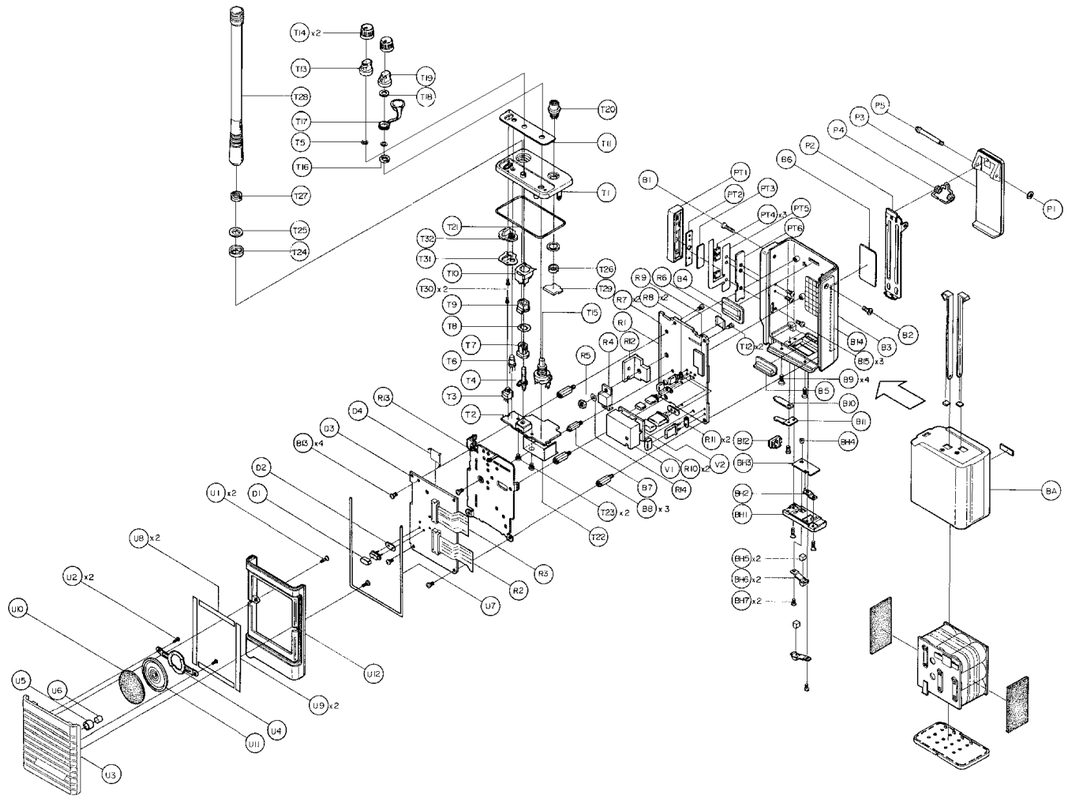


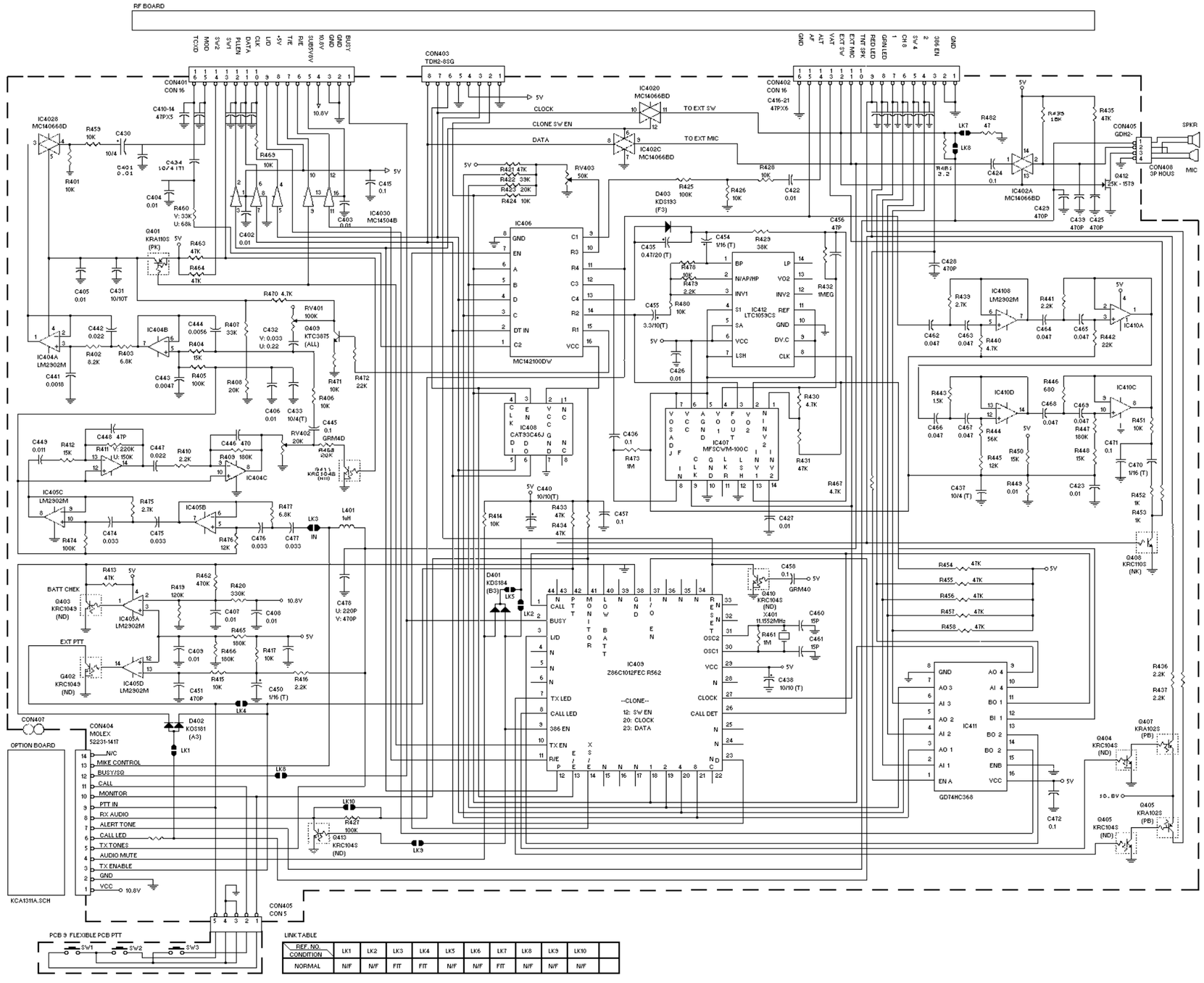
FLEX PCB BOARD
4161916-B
416909-C

NOTE: When ordering parts for your Monogram radio, precede all parts numbers with the prefix R29/.

SYMBOL	PART NO.	DESCRIPTION
B1	611379	Screw Machine (FH) M2.6x10.
B2	611380	Screw Machine (FH) M2.5x6.
B3	7181528A	Bottom Cover.
B4	894566	Protector "A" NBR.
B5	894567	Protector "B" NBR.
B6	959-647BA	Label Name AL Foil 34.7x17.8.
B7	852991A	Post 4.5x8.6 NI-PLT.
B8	852950	Post 4.5x13.1 NI-PLT.
B9	600727	Screw Machine (PH) #2-56x5.
B10	771885	Latch Plate.
B11	881476	Spring (Latch).
B12	825642	Latch (Batt. Lock).
B13	600747	Screw Machine (PH) #2-56x5.
B14	906406	Felt 80x20x0.2t PVC.
B15	600726	Screw Machine (PH) #2-56-7.
BH1		Holder Conductive Spray.
		Holder None. Spray.
BH2	752-515	Terminal(-) 0.6t NI-PLT.
BH3	416953B	Batt.PCB.
BH4	853042	Bushing SN-PLT.
BH5	894550	Cushion Hs50.
BH6	881477	Contact (Batt.) NI-PLT.
BH7	600725	Screw Machine (PH) #2-56x5.
D1	894785	Rubber Cap Sili.Hs50.
D2	894787	Rubber Holder Sili.Hz50.
D3	406-115H	Digital PCB.
D4	772013	Shield Plate STPEO.3t.
P1	665018	"E" Ring & 1.5 BLK.
P2	723670C	Bracket SUS304 Spray.
P3	752483C	Belt Clip Lexan 141-2032.
P4	881496	Spring SUS304-WPA.
P5	860110	Pin BSBM & 3.5x30 NI-PLT.
PT1		PTT Pad SILL. Hs45 BLK (3 BUTT.)
		PTT Pad SILL. Hz45 BLK (2 BUTT.)
PT2		In-Plate SUS304 0.2t (3 BUTT.)
		In-Plate SUS304 0.2t (2 BUTT.)
PT3		Te-Plate PVC 0.2t 22x6.5 (3 BUTT.)
		Te-Plate PVC 0.2t 22x6.5 (2 BUTT.)
PT4	4360300	Tact Switch.
PT5	406954A	Felx PCB.
PT6	772050	Plate PTT SPC 1t NI-PLT.
R1	406-112D	RF PCB.
R2	416909D	Flex PCB "B".
R3	416916D	Flex PCB "A".
R4	2030436	Transistor SRFH1900.
R5	650047	Nut UNC-NOB-32 Ni Plat.
R6		Shield Plate Spte 0.21.
R7	894785	Rubber Cap Hs50 Gray.
R8	894787	Rubber Holder Sili.
R9	416914B	SQ PCB.
R10	894786	Rubber Cap Hs50 Gray.
R11	894786	Rubber Holder Sili.
R12	761-705	ABL A5056E.
R13	771954A	Shield Plate SPTE 0.3t.
R14	662410	Washer (Spring) M4 Ni-Plat.
T1	702-349B	Top Panel ALDC 12 Spray.
T2	416915D	Interface PCB.
T3	4320637	Push SW SPPH221BP011.
T4	508159A	Stopper Ass'y (10CH).
	508130A	Stopper Ass'y (16CH).
T5	665060	"E" Ring & 2.5 Ni-PLT.
T6	2511481	LED Lamp SEF33G2TT.
T7	723 535	Holder (ANT) BSBM (1/4'-32).
T8	650-985	Washer (ANT) SPTE 0.3t.
T9	852761	Bushing (ANT) P.C Clear.
T10	771-952	Shield Plate Spte 0.25t.
T11	795-596	Overlay (10CH.) ALP 0.5t.
T12	617120	Screw Machine (PH) M1.7x4.
T13	825646-AA	Knob (CH.) AL A5056E BLK.
T14	830872	Cap Ne. Rubb. Hs70.
T15	450-514-7	Volume 20kav 12m4-1.
T16	650345	Nut BSBM M6xP 0.5 & 8.3.
T17	830992A	Dust Cap Nylon66 BLK.
T18	894547	"O" Ring Sili. & 6.6x & 4.8.
T19	825647-AA	Knob (Cont.) AL A5056E BLK.
T20	4216481	Connector HR10A-7R-65B.
T21	894549	Gasket Sili. Rubb. BLK Hs40.
T22	906381A	Insulator PVC 0.3t BLK.
T23	600747	Screw Machine (PH) #2-56x5.
T24	852765	Ring (ANT MTG) BSBM & 13.8.
T25	905481	Washer (ANT) & 8x & 11.5x1t.
T26	650344	Nut BSBM M8 x P0.5 & 10.
T27	650295	Nut (ANT) BSBM & 10.6 Ni-PLT.
T28	416-915D	Top Sub PCB.
T29	612287	Screw Machine (PH) M2x3 Zn-PLT.
T30	723688	Bracket SPTE 0.5t.
T31	894544	Key Pad SILL. RUBB. BLK. Hs40.
U1	621104	Screw Tapping (FH) 2.6x6-2S.
U2	621460	Screw Tapping (PH) M2.6x5-2S.
U3	831-121	Bezel Noryl Cone. Spray BLK.
	831117A	Bezel Noryl None. Spray BLK.
U4	723776	Bracket (SPK) SPC 0.8t.
U5	850924	Bushing Mic & 7.5x5.5 NBR.
U6	593-175	Mic Condenser WM063T.
U7	894600	Gasket Sili. Rubb. & 1 BLK.
U8	906214A	Double Tape 3M930 3x52.
U9	906215	Double Tape 3M4930 3x59.
U10	906369	Spk. Filter & 33.5x0.15t.
U11	4201124	Speaker T036S25A-000.
U12	718-154-B	Upper Cover AL DC12 Spray.
V1	771951	Shield Can BSP 0.4t.
V2	906316	Felt 0.5t BLK. Sticker.

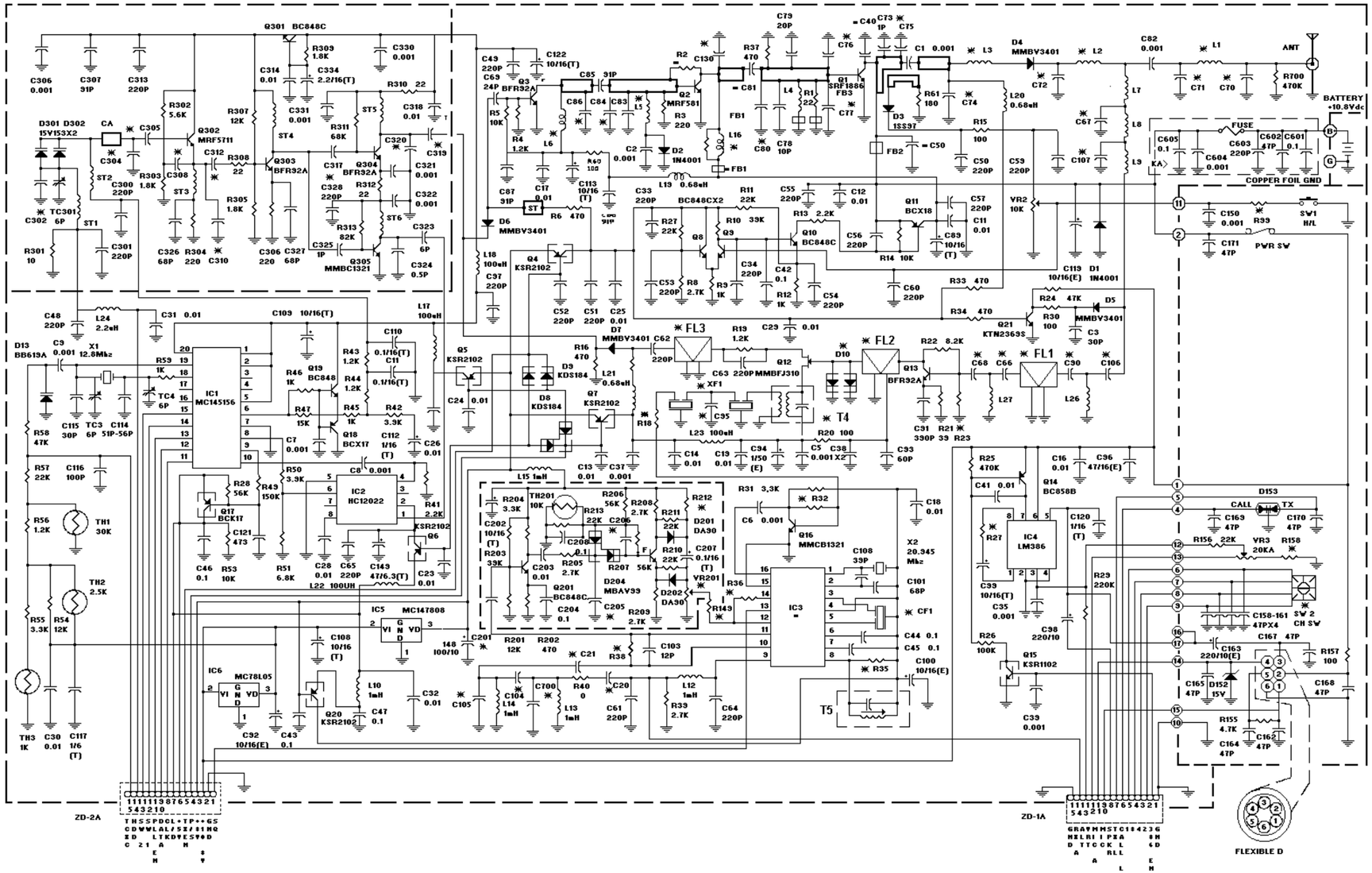


*COMPONENTS, ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES



REF. NO. / CONDITION	LK1	LK2	LK3	LK4	LK5	LK6	LK7	LK8	LK9	LK10	
NORMAL	N/F	N/F	F/T	F/T	N/F	N/F	F/T	N/F	N/F	N/F	

DIGITAL BOARD
406115-H



Ref. NO. / BAND OPTION	C70	C71	C72	C50	C74	C75	C76	C80	C83	C84	C67	C107	C106	C90	C66	C68	R23	L1	L2	L3	L6	L16	FB1	FL1	FL2	FL3	C302	C304	C305	C308	C310	C319	C312	C317	C320	C130	C77	C40	C81	R2
A BAND (400 - 420)	5P	10P	11P	51P	5P	10P N	51P	14P	2P	3P	5P	3.3P	24P	22P	10P	47P	1.5K	3.2X0.6 X1.5R	4.0X0.6 X1.5R	3.2X0.6 X1.5L	2.4X0.4 X4.5R	1nH	FB	320 7231	320 8395	320 9079	15P	10P	15P	15P	14P	3.3P	2P	4.7P	2P		51P		20P	
B BAND (420 - 440)	2P	13P	10P	51P	3P	10P N	39P	12P	2P	8P	5P	3.3P	24P	14P	22P	47P	1.5K	3.2X0.6 X1.5R	4.0X0.6 X1.5R	3.2X0.6 X1.5L	2.4X0.4 X4.5R	0.3X7 X1K	FB	320 3035	320 9002	320 7231	14P	14P	12P	11P	10P	3.3P	1P	3.3P	1P	2P	39P	6P	330P	820
C BAND (450 - 470)	1P	11P	10P	43P	2P	10P N	33P	11P	2P	5P	6P	3.3P	20P	11P	10P	47P	1.2K	2.8X0.6 X1.5R	3.6X0.6 X1.5R	2.8X0.6 X1.5L	2.4X0.4 X4.5R	0.3X7 X1K	FB	320 8775	320 8339	320 5927	12P	9P	10P	10P	8P	3.3P	1P	2.2P	1P		33P	2P	220P	2.7K
D BAND (470 - 490)	1P	12P	8P	51P	1P	10P N	43P	12P	8P	3P	4P	2.7P	20P	11P	10P	47P	1.2K	2.8X0.6 X1.5R	3.6X0.6 X1.5R	2.8X0.6 X1.5L	2.4X0.4 X4.5R	2.4X0.4 X6 5R	-	320 8775	320 8333	320 5927	12P	8P	9P	7P	7P	2P	1.5P	2P	1P		43P		20P	
E BAND (488 - 512)	1P	10P	7P	51P	1P	10P	33P	9P	2P	5P	3.3P	2P	15P	6P	24P	33P	1.5K	2.8X0.6 X1.5R	3.6X0.6 X1.5R	2.8X0.6 X1.5L	2.4X0.4 X6.5R	2.4X0.4 X6 5R	-	320 3024	320 3013	320 8775	10P	7P	8P	6P	6P	2P	1.5P	1P	1P		33P		20P	

RF BOARD
406112-H