MAINTENANCE MANUAL

M-PA UHF SERVICE SECTION

TABLE OF CONTENTS

INTRODUCTION

This document outlines maintenance procedures for the M-PA UHF personal radio.

In order to perform the following alignments, tests and many troubleshooting checks, programming of the radio is a necessary step. Further programming information can be found in the M-PA Programming Manual TQ-3339/4339.

STANDARD RF TESTS

This section outlines standard RF tests and how they relate to the M-PA radio. These tests are based on standards published by the Electronic Industries Association (EIA) for transmitter and receiver operation. Information is presented which will help determine if the radio is operating properly, and if not, isolate the faulty section.

TRANSMITTER

Power Output

The rated RF power output of the M-PA UHF radio is 5 watts in the high power mode. The unit has a per channel programmable range of 1 to 5 watts. A 10 watt RF wattmeter is ideal for making this measurement. If an RF wattmeter is not available, be sure to terminate the radio output with a 50 ohm load before transmitting. It is advisable to make several checks at different power levels to insure the logic/control circuits and the transmitter circuits are functioning properly. Note that the power levels may be changed only through the PC programmer. Also note that the tracking data parameters affect these programmed levels; see the Tracking Data section in this manual for further details.

If the M-PA power checks are good, every stage in the RF chain from the VCO to the Power Controller can be considered good. Most synthesizer and logic circuits are probably functioning properly since these circuits directly control the VCO and Power Controller modules.

Frequency and Stability

Program the M-PA for a frequency in the middle of the frequency split (given in Table 1) and measure the output frequency. The frequency must be within the specifications set forth in the alignment section (Table 2).

It is a good idea to take frequency readings on the high and low extremes of the frequency split to ensure that the transmitter and frequency synthesizer are functioning properly.

There are two main causes for frequency error. They are: (1) long term drift, and (2) environmental effects. Drift can be compensated by the following frequency adjustment procedures covered in the alignment section. Before any adjustments are made, make sure the radio is operating within the specified temperature limits.

Use care when making adjustments as a correction at one temperature could impose an out-of-tolerance condition at another temperature. If the proper frequency tolerance at all temperatures cannot be attained, some component (probably the Reference Oscillator module) is at fault. The frequency should be stable to within 0.00025%.

Modulation

These tests provide information regarding the condition of the modulator/modulation limiter circuits, modulation adjustments, and audio gain. All of the audio tests are conducted using an audio injection frequency of 1 kHz. This signal can be induced through the external mic option on the UDC. A deviation monitor is used to measure the Maximum Deviation, Deviation Symmetry, and Audio Sensitivity. A distortion analyzer must be used in order to make the Audio Distortion reading.

Maximum Deviation

The audio signal should be 110 mV rms at the UDC microphone audio input. This will drive the modulation limiting circuits into heavy limiting. The deviation should not be greater than ±4.5 kHz (adjust for 4.3 kHz ±200 Hz). It can be compensated using the PC Programmer by adjusting the modulation tracking data. See TQ - 3339/4339 for detailed instructions. If the deviation cannot be correctly set using the tracking parameter, it may be necessary to adjust R18 and/or R19 on the RF Board. Details on these adjustments can be found in the Alignment and Tests section in this manual.

Deviation Symmetry

Deviation Symmetry is the difference between the two deviation peaks (upper and lower). The maximum allowable asymmetry is 500 Hz. A lack of symmetry can becaused by faulty oscillators (reference oscillator or VCO), maladjusted R18, R19, faulty limiters or distortion in the audio stages.

If problems are encountered with symmetry, use a lower audio level to produce an output well below the deviation limits. If symmetry improves, check the modulation limiting circuits. If symmetry does not improve, check the modulating circuits (the reference oscillator or the VCO). The audio stages are the least suspect, but would still generate asymmetry if faulty.

Audio Sensitivity

A transmitter audio sensitivity test will verify the proper gain of the audio stages and proper operation of the modulator circuits. The audio generator is set for 1 kHz and applied to the external mic input of the UDC. The output of the generator is then varied from zero upwards to 60% of the maximum deviation. The output of the audio generator should be between 7 and 15 mV.

Failure to pass the sensitivity test indicates troubleshooting in the audio circuits. A low audio sensitivity implies low audio gain and causes low average modulation. A sensitivity that is too high can create microphone background noise and excessive limiting.

Audio Distortion

This test examines the amount of distortion present in the transmitter system. The audio generator should be set at 1 kHz and at a level well below the 1imiting point. A distortion analyzer is used to measure the amount of distortion present. The distortion reading should be less than 3%.

If distortion is greater than 3 %, troubleshoot the microphone and audio stages first. The modulator circuits also contribute to the distortion reading. A Symmetry test will reveal a distortion problem in the modulator/oscillators.

RECEIVER

12 dB SINAD Sensitivity

The measured 12 dB SINAD Sensitivity for the M-PA receive circuitry should be ≤ -116 dBm. If the results of the receiver test are within this specification, proper operation of the following receiver functions is verified:

- RF and IF gain
- Mixer and injection chain performance
- Selectivity is not too narrow or too wide

Modulation Acceptance Bandwidth

This test is a follow-up to the 12 dB SINAD test. Increase the RF signal generator level by 6 dB. Increase RF deviation until a 12 dB SINAD is measured. The Modulation Acceptance Bandwidth can then be read off the RF signal generator deviation calibration. It should be greater than or equal to 6.5 kHz.

20 dB Quieting Sensitivity

This test confirms that the receiver gain is normal. It is useful in narrowing down possible faults when the unit has failed the 12 dB SINAD test. To measure the 20 dB quieting use the following procedure:

With the volume control at 25% and the RF signal at 0 uV and no modulation, increase the RF signal generator's RF output while observing an audio voltmeter on the audio output of the receiver. When the audio voltmeter reading decreases 20 dB (receiver quieting), read the 20 dB Quieting Sensitivity in uV from the RF signal generator.

Squelch Sensitivities

Critical Squelch Sensitivity is the signal level that unsquelches the receiver when the squelch has been set just high enough to quiet the noise. This level should be about 8 dB less than the 20 dB Quieting Sensitivity.

Maximum Squelch Sensitivity measures the level of RF signal needed to unsquelch the receiver when the squelch control is set to maximum. This reading is generally 6 dB more than the 20 dB Quieting Sensitivity.

In the M-PA unit, the squelch opening point is programmed on a per channel basis via the PC Programmer. Tracking data also affects this level.

Audio Distortion

This test is performed with an RF injection frequency at a level of -50 dBm. This test will not verify gain and with such a high input an almost "dead" receiver can pass the distortion test. The test does verify the following circuit characteristics:

- Discriminator circuit is functioning properly
- Normal audio gain exists
- Audio distortion will not influence the 12 dB SINAD sensitivity test results.

The audio distortion reading should be ≤ 5%.

ALIGNMENT AND TESTS

This section includes the alignment procedures for the M-PA's UHF RF Board located in the Rear Cover Assembly. Several test procedures are also presented which will help isolate an RF or control circuit problem if it exists. See the Troubleshooting section for further service details.

The control circuits in the Front Cover Assembly contain no adjustments and therefore no alignment procedures are necessary. See the Troubleshooting section for test information if a problem is suspected in the control circuits.

These procedures must be performed in the order presented to insure proper radio operation. Maintenance Manual LBI-38383 contains the detailed Outline and Schematic diagrams of the UHF RF Board and LBI-38384 contains similar data on the control circuits.

TEST EQUIPMENT

General

- RF Signal Generator (HP 8640 or equivalent)
- Audio Distortion Analyzer (HP 331A or equivalent average responding meter with VU characteristics)
- RF wattmeter (10 watt capability)
- Oscilloscope with X1 probe
- Audio Oscillator
- Frequency Counter (Racal-Dana 9919 or equivalent)
- Modulation Analyzer (HP 8901B or equivalent)

NOTE

A Communications Service Monitor may combine most or all of the above equipment into one test unit

- DC Power Supply (7.5 volts, 3 amperes minimum)
- Digital Voltmeter
- Tuning Tool 19B801640P1
- Tuning Tool 19B219079P1
- ST3559P2 RF Antenna Adapter
- RF Connector K19/A4WX01566
- Dummy Battery K19/A4WX01543
- TQ-0609 Test Box
- RF/Logic Extender Cable K19/A4WX01544

Programming

- TQ-3339/4339 Programming Manual and Software
- TQ-3310 Serial Programming Kit
- TQ-3311 Programming Cable
- IBM PC compatible computer

SET-UP PROCEDURE

(1) Separate the front and rear covers and connect the RF/Logic Extender cable between the RF Board and the Logic Board. (See Figure 1) Be extremely careful when working with these delicate connectors.

(2) Slide the Dummy Battery onto the front cover and connect the audio output leads to the distortion analyzer. Place the Dummy Battery ON/OFF switch in the OFF position to direct the speaker audio to the distortion analyzer. Connect the PC Programmer to the UDC.

(3) Set the power supply to 7.5 ±0.1 volts and connect the Dummy Battery supply leads to the power supply.

(4) Program the M-PA with FREQ #1, #2 and #3 from Table 1 using the PC programming option. To fully test the transmitter circuits, program a channel pair for each frequency, one at high transmitter power and one at low transmitter power. This will result in a total of six programmed channels. It may be desirable to program more frequencies into the unit. Operation of the PC programmer can be found in TQ-3339/4339, M-PA Programming Manual.

Table 1 - Test Frequencies (MHz)

RF BOARD	FREQ #1	FREQ #2	FREQ #3
19D902282G1	403.025	413.025	422.975
19D902282G6	450.125	460.025	469.975
19D902282G3	470.025	481.025	491.975
19D902282G8	492.025	503.025	513.975

NOTE

LBI-38203 contains detailed information on the TQ-0609 Test Box.

(5) Remove power from the radio and replace the PC programming cable with the TQ-0609 Test Box.

(6) Connect the radio to the wattmeter using the RF Antenna Adapter or the RF Connector. Couple a small amount of the RF signal to the frequency counter.

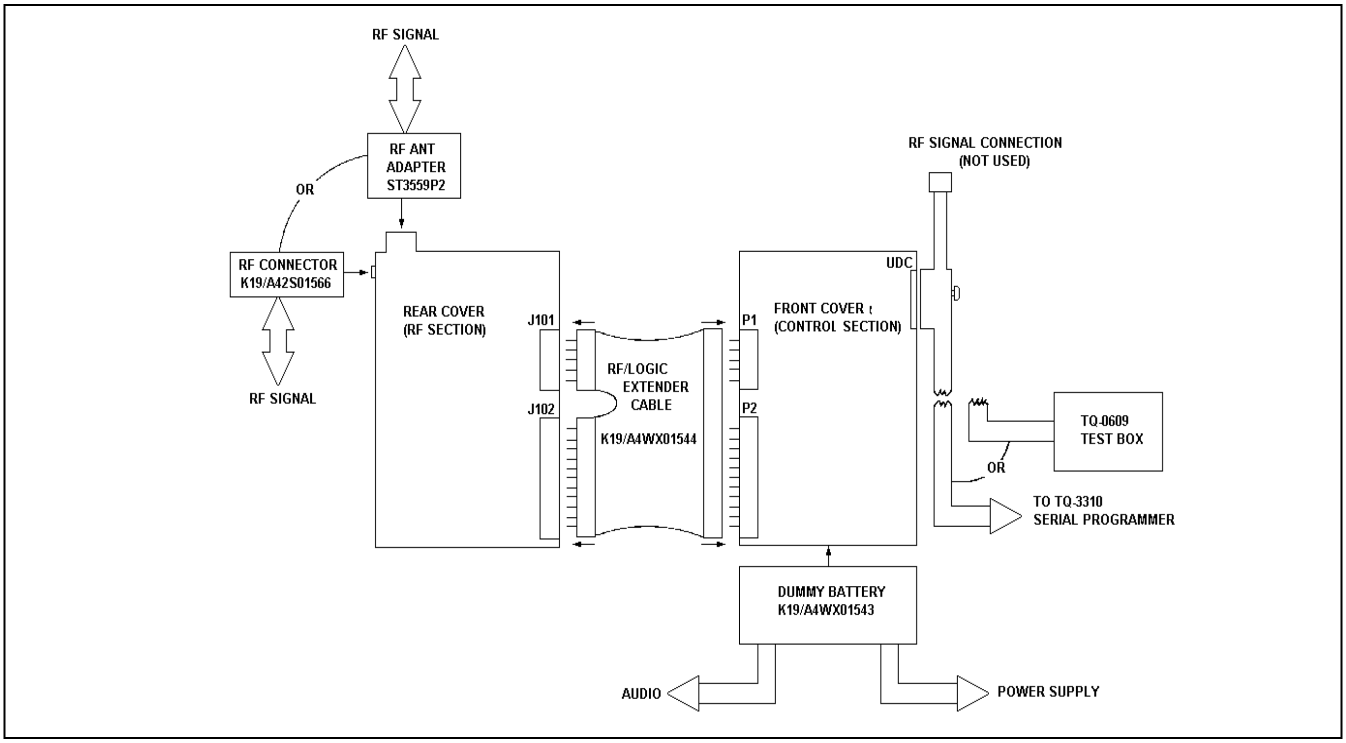


Figure 1 - M-PA Alignment and Test Set-Up

REFERENCE OSCILLATOR AND TRANSMITTER

(1) On the TQ-0609 Test Box, select UDC switch position 6 and apply power to the radio. This enables the M-PA control circuits for an external microphone and its internal speaker amplifier.

(2) Channel the unit to FREQ #2 (high power) and key the transmitter using the TQ-0609.

(3) Monitor the transmitter frequency and adjust U3 (a small trimmer hole is located on top of module) to obtain a frequency reading within specifications listed in Table 2.

Table 2 - Frequency Error Specifications

RF BOARD	FREQUENCY SPLIT	MAXIMUM ERROR
19D902282G1	403-440 MHz	±248 Hz
19D902282G6	440-470 MHz	±276 Hz
19D902282G3	470-492 MHz	±288 Hz
19D902282G8	492-514 MHz	±302 Hz

NOTE

The following alignment of the modulation pots, R18 and R19, should only be necessary if changes in the tracking data values will not compensate the deviation levels to within specifications. See the Tracking Data section in this manual for further details.

The below procedure balances and "coarse aligns" the VCO and Reference Oscillator deviation. The Audio Processor will perform the "fine level adjustment" of the transmitter deviation via the tracking values.

(4) To align R18 and R19, it will be necessary to modify the RF/Logic Extender cable as follows:

- Add two 10K ohm resistors in series from the 5.4 Vdc line (J102 pin 6) to ground (J102 pin 7).
- Break the connection at the TX AUDIO input (J102 pin 1).
- Bias the TX AUDIO input of the RF Board to 2.7 volts by connecting the junction of the 10K resistors to J102 pin 1.

(5) Using a 100 uF (or greater) capacitor, couple a 1 kHz, 600 mV rms audio signal into the TX AUDIO input.

(6) Key the transmitter and adjust the VCO Modulation, R19, for a deviation of 5.0 kHz ±100 Hz.

(7) Remove the sine wave signal, and apply a 20 Hz, 1 volt peak-to-peak square wave. Set the modulation analyzer as follows:

- No High-pass Filters
- 20 kHz Low-pass Filter

(8) Key the transmitter and monitor the demodulated output from the modulation analyzer. Adjust Modulation Balance, R18, for minimum peak-to-peak deviation or best square wave response.

RECEIVER

(1) Remove the Rear Cover Assembly shield and channel the unit to FREQ #2 (See Table 1).

(2) Set the RF signal generator to the on channel receive frequency at a level of -20 dBm with no modulation. Apply this signal to the RF Connector.

(3) Connect the frequency counter to U6 pin 5 and measure the IF signal. Use an appropriate high impedance probe (or amplifier).

(4) Adjust the signal generator level to achieve accurate counting of the IF signal. The RF signal generator should be set to a level of 10 dB above the lowest level which gives accurate counting.

(5) Adjust T1 in the RF module for 455.000 kHz on the counter. Adjust to within ±90 Hz. Disconnect the probe.

(6) Modulate the signal generator with a 1 kHz tone at 3 kHz deviation.

(7) Adjust T2 for maximum audio level at the discriminator output (J101 pin 4).

(8) Connect the audio distortion analyzer to the speaker load (from Dummy Battery).

(9) With the RF signal generator set to the corresponding carrier frequency and modulated with a 1 kHz tone at 3 kHz deviation, measure the 12 dB SINAD Sensitivity. This reading should be ≤ -116 dBm.

(10) Increase the signal level from the signal generator to -50 dBm.

(11) Check audio distortion. This reading should be ≤5%.

(12) Measure the discriminator output of the RF Board (J101 pin 4). Audio amplitude should be between 105 mV and 140 mV rms.

(13) Repeat the 12 dB SINAD Sensitivity check (Step 9) for FREQ #1 and FREQ #3. Readings should be ≤ 116 dBm.

TRACKING DATA

Tracking data establishes individual radio parameters. The four tracking data parameters include high RF power, low RF power, modulation level and receiver squelch opening. This data is programmed into the EEPROM at the factory after the Front and Rear covers are "married". The PC Programmer allows alteration of this data if necessary.

The Tracking Data should not normally be altered; however, it may be necessary to adjust some values after replacing modules or other components which will obsolete the programmed values. See TQ-3339/4339 Programming Manual (Maintenance section) for further information on altering tracking data. The factory settings are listed in Table 3.

Differences in the Audio Processor circuitry, the power supply regulators, the transmitter and receiver circuitry will affect these parameters from unit to unit.

Digital values stored for the PWR SET analog output voltage are one example of tracking information. As no two transmitter stages are exactly matched, the PWR SET dc voltage will be slightly different with any two radios to produce the same power output. The tracking data allows the microprocessor to tailor the PWR SET line per channel for the RF stage differences.

Table 3 - Tracking Data Parameters with Factory Settings

PARAMETER	FACTORY SETTING
High Power	5.0 - 5.2 watts
Low Power	4.2 - 4.4 watts
Modulation	4.2 - 4.4 kHz
Squelch Opening	8 - 10 dB SINAD

FIELD RF RETUNING PROCEDURES

These field RF retuning procedures will be necessary if the factory tuned 20 - 22 MHz operating band does not meet needed requirements. For example, the factory tuned 450 - 470 MHz band can be retuned to cover the 440 - 460 MHz band. Factory tuned RF bands are listed in Table 1 of this manual and on the specification page. Synthesizer and receiver circuits must be retuned when the operating band is moved. Note that if the radio is retuned, the frequency range limits of the RF Board cannot be exceeded. Perform the procedures in the order presented.

SET-UP PROCEDURE

(1) Program the radio with the low, middle and high-side retune channels in the desired operating frequency band. The low and high-side channels should 20 - 22 MHz apart and the middle channel should be centered between the two. Do not exceed the frequency range limits for the RF Board.

(2) Separate the Front and Rear Cover Assemblies and connect the RF/Logic Extender cable between the RF Board and the Control Board.

SYNTHESIZER RETUNING

(1) Set the radio to the middle retune channel. Monitor the VCO tuning voltage at TP1 (A5 pin 3) with a dc voltmeter. Adjust the RX VCO coil for a reading of 2.5 Vdc. See Figure 2.

(2) Set the radio to the lowest retune channel. The monitored voltage should be greater than I.0 Vdc.

(3) Set the radio to the highest retune channel. The monitored voltage should be less than 4.0 Vdc.

(4) If the lowest and highest retune channels push the VCO tuning voltage measured at TP1 outside of the specified limits, slightly readjust the RX VCO coil to center the low and high retune channel tuning voltages within or around this 1.0 - 4.0 Vdc window.

(5) Repeat steps 1 - 4 for the TX VCO coil with the following exceptions: The radio must be keyed when adjustments are made to the TX VCO coil. Also, connect an appropriate RF load to the antenna before keying.

(6) Turn the radio off and connect the PC Programmer to the radio. Power the radio back up. Using the PC Programmer, set the modulation Tracking Data value to OD (hex).

(7) Set the radio to the middle retune channel.

(8) Couple a modulation analyzer (with a monitoring oscilloscope) to the RF output of the radio. Set the modulation analyzer's filters as follows: no high-pass filters and 20 kHz low-pass filter. The modulation analyzer should have an almost dc response. If it does not, an alternative is to use a second M-PA monitoring the transmit frequency and monitor the discriminator output from the RF Board with a dc coupled oscilloscope. The monitoring point is J101 pin 4.

(9) Apply a 110 mV rms, 1 kHz tone to the TQ-3370's modulation input. Key the radio from the TQ-3370 and adjust RI9 on the RF Board for a deviation of ±4.3 kHz.

(10) Modify the RF/Logic Extender cable so a low-frequency signal can be injected directly into the RF Board. This modification procedure is outlined in the TRANSMITTER ALIGNMENT section of this manual.

(11) Using a 100 uF (or greater) capacitor, couple 20 Hz, 1.0 Vp-p square wave signal into TX AUDIO (J102 pin1).

(12) Key the radio and monitor the demodulated output from the modulation analyzer. Adjust R18 (modulation balance pot) for a good square wave response.

RECEIVER RETUNING

Retuning the UHF M-PA receiver involves retuning the two (2) helical filters at the input and output of RF Amplifier module A6. There are three (3) different procedures that can be used to retune the receiver. The most accurate method involves the use of a network analyzer. If a network analyzer is not available, a spectrum analyzer and signal generator can be used, but with less accurate results. Finally, the receiver can be retuned with some compromise in receiver performance using a best quieting (SINAD) tuning technique.

Network Analyzer Method

(1) Remove the solder mask on the solder side of the RF Board at the thin run between the output of FL4 and the input of A6 (A6 pin 1). Cut this run.

(2) Solder the center conductor of a small 50-ohm coax cable to FL4's output at the cut run. Solder the coax shield near FL4.

(3) Terminate the radio's antenna with a 50-ohm load.

(4) Connect the other end of the coax to the network analyzer and tune FL4 (all three sections) for best return loss over the desired receive frequency range.

(5) Un-solder the coax cable from the output of FL4 and solder it to the input of A6. Ground the shield near A6.

(6) With the network analyzer's output at -30 dBm or lower, adjust FL1 (all three sections) for best return loss over the desired receive frequency range. The receiver must be powered-up during this adjustment.

(7) With a small jumper, reconnect the output of FL4 to the input of A6. Test the radio over the new frequency range.

Spectrum Analyzer And Best Quieting Methods

This procedure involves retuning the receiver's helical filters at the low, middle and high-side frequencies. The same frequencies used to retune the VCO can be used.

The preferred method is to connect a small 50-ohm coax to the output of IF crystal filter FL2, ground, and connect this cable to a spectrum analyzer tuned to 45 MHz and set to 2 dB/division.

A less desirable alternative using the same tuning sequence can be achieved by varying the signal generator's level and tuning for best quieting (SINAD). No coax cable connections are required using this procedure.

(1) Remove the input and output (outer) tuning cores from FLI and FL4 (four cores total).

(2) Set the radio and signal generator to the low-side receive frequency.

(3) Set the signal generator's level to -30 dBm. If tuning by quieting, set the generator's level for a high receiver noise level.

(4) Alternately tune the center cores of FL1 and FL4 for maximum IF signal. If tuning by quieting, tune for sensitivity and reduce the generator's level as the receiver becomes more sensitive.

(5) Set the radio and signal generator to the high-side receive frequency.

(6) Reinstall the input tuning cores into FL1 and FL4. Alternately adjust these cores for maximum signal or best quieting.

(7) Set the radio and signal generator to the middle receive frequency.

(8) Reinstall the output tuning cores into FL1 and FL4. Alternately adjust these cores for maximum signal or best quieting.

(9) Under certain circumstances, best tuning may be achieved when certain tuning cores are not reinstalled. This is acceptable. Also, any excessively loose core should be secured with a drop of adhesive.

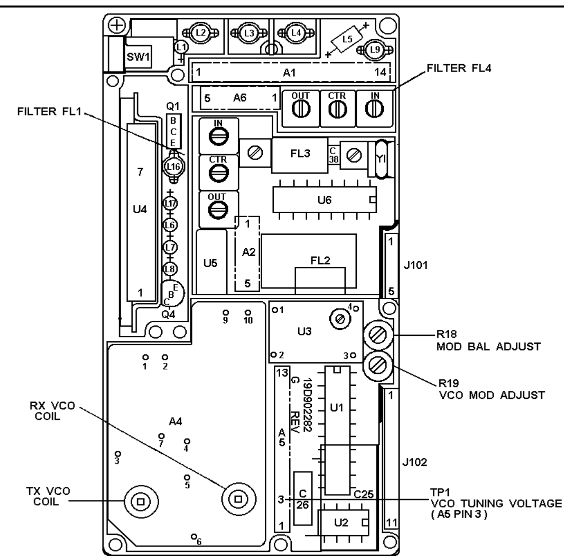


Figure 2 - RF Board 19D902282 Returning Areas (Component Side View)

TROUBLESHOOTING

Troubleshooting a problem with the M-PA involves determining whether the problem is with the RF circuits, the control circuits, a battery problem or an antenna problem. The following procedures are designed to quickly lead the service technician to the point of trouble.

The test set-up should be identical to the set up used in the Alignment and Tests section in this manual. See the Alignment and Tests section for further details on test equipment needed and test set-up required.

GENERAL

Table 4 lists various problems and suggestions for the most likely problem areas. These procedures can be performed before the unit is disassembled to lead the technician to the suspected problem.

TABLE 4 - GENERAL M-PA TROUBLESHOOTING

SYMPTOM	POSSIBLE CAUSES	ACTION
Completely inoperative (No audio sound or LCD indication).	1. Dead battery. 2. Fuse blown. 3. Control circuit problem.	Charge or replace battery. Check radio fuse. Troubleshoot Front Cover Assembly.
At power-up radio displays:		
a. "SYN LOCK"	1. Unit is not programmed. 2. Synthesizer is not locked.	Program radio - See TQ-3339/4339. Check LOCK DETECT line.
b. "LOW BAT"	1. Low battery. 2. INT or EXT PTT enabled (stick mic) 3. PTT Circuit failure.	Charge battery. Check UDC, PTT lines and switches. Troubleshoot Front Cover Assembly.
Display indication OK, receiver inoperative or weak.	1. Squelch levels programmed too high. 2. Channel Guard or Type 99 Enabled. 3. Defective antenna. 4. RF Board problem.	Reprogram squelch level(s). Press Monitor button to open squelch. See Operators Manual Replace antenna. Troubleshoot Rear Cover Assembly.
Display indication OK, transmitter inoperative or low range.	1. Power levels programmed low. 2. Weak battery - Note "BAT" flag. 3. Defective antenna. 4. RF Board problem.	Reprogram unit. Charge or replace battery. Replace antenna. Troubleshoot Rear Cover Assembly.
Display in error.	1. Incorrect programming. 2. Defective LCD circuits.	Reprogram radio - See TQ-3339/4339. Troubleshoot LCD and control circuits.

TRANSMITTER

Power sources and regulated power supplies should be one of the first areas to check before troubleshooting any transmitter problem. The external 7.5 volt supply, whether it be a battery or a bench power supply, is especially critical when troubleshooting a personal radio.

If the transmitter frequency can not be aligned to within specifications but it stays locked across the band, suspect a defective Reference Oscillator module. The oscillator should have an output of 13.2 MHz. Measure this output with no modulation applied to the unit. This module can also cause modulation problems. Check the audio input for proper signals before replacing the module.

If the synthesizer is not locked (on or near frequency) during an attempted transmission, the microprocessor circuits should not enable a transmission. This can be checked by measuring the LOCK DETECT, TX 5.4V and PWR SET lines. When the synthesizer is unlocked, the LOCK DETECT line will be low or pulsing low.

If the transmitter power out is found to be incorrect and the output of the VCO is OK, check the PWR SET and TX 5.4V lines. Also check supply voltages at the Power Amplifier and Power Controller. If these voltages check good, start signal tracing the RF signal path until the faulty component or module is isolated.

If the transmitter passes the maximum deviation test, it can be assumed that the entire audio chain is working. If the equipment fails, the problem can lie anywhere between the microphone input to the modulator circuitry of the VCO. Tracking data may need to be altered if the deviation is not within specifications. If changes in the modulation tracking data parameter will not correct a deviation problem, potentiometers R18 and R19 may need adjustment. These are the modulation adjustment controls and deviation can be changed by the adjustment of these potentiometers.

If correct deviation cannot be obtained through adjustment of the tracking data or the potentiometers, monitor the TX AUDIO level into the RF Board. A 1 kHz 600 mV signal here (on a dc bias voltage of 2.7 volts as set by U2C on the Control Board) should produce a deviation of 5.0 kHz. See the modulation tests in the Alignment and Test section.

If symmetry is OK, modulator distortion is acceptable at full deviation and at lower levels. If the unit fails the test, check the modulator (VCO), modulation limiter circuits or the audio circuits.

If audio sensitivity is correct the microphone, ampifiers and limiters are probably OK. Regeneration from an open decoupling capacitor or a stage gain too high may make the unit appear to be too sensitive.

Transmitter distortion problems point specifically to the audio circuits.

RECEIVER

The first test that should be performed on the receiver requires no test equipment. If receiver noise is heard when the monitor button is pressed, it can be assumed that ≈75% of the receiver circuitry is good. Noise generated in the front end (VCO, mixer), amplified by the IF stages, demodulated by the discriminator and amplified by the audio circuits implies this circuitry is probably functioning properly. The control circuits are also squelching the audio via the audio processor. The VCO may not be locked on frequency due to a failure in the synthesizer.

If there is no receiver noise at all suspect the frequency synthesizer. Check the VCO output with a frequency counter. If improper operation is suspected, check the DATA, STROBE, ENABLE and LOCK DETECT lines at the synthesizer chip for proper signals from and to the microprocessor. See the Control Circuit section for details.

An audio distortion test will verify that the receiver will develop full rated audio output. If the audio power is less than the rated value, check the output of the discriminator. An RF input modulated at 1 kHz, ± 3 kHz deviation should produce 100 mV rms at the discriminator output (J101 pin 4). If the discriminator output is good, signal trace between the discriminator and the speaker to isolate the fault. See the Control Circuit troubleshooting section for further details.

If the measured distortion exceeds the rated specification check the discriminator and audio stages. Signal tracing with an oscilloscope proves very useful in locating the trouble areas.

Failure of a modulation acceptance test indicates a receiver selectivity problem in the IF stages. If the receiver passes this test the bandwidth may be assumed to be within specs. A bandwidth that is too wide will cause unnecessary noise, detracting from the receiver quieting. If the bandwidth is too narrow, squelching could occur at the modulation peaks.

A squelch circuit problem (assuming good signal and/or noise is being generated at the front end) indicates a problem with the Audio Processor chip or programming of this feature. Troubleshooting should begin at the discriminator output. Signal trace through the noise filters and amplifiers. Check the operation of the noise rectifier to be sure the noise is being converted into the proper dc voltage (U1 pin 56).

Note that the tracking data parameter for squelch opening will influence the squelch point.

See the Control Circuit troubleshooting section for further details on receiver audio failures.

CONTROL CIRCUITS

Since the M-PA radio is a microprocessor controlled unit, a control circuit problem should be investigated using procedures similar to troubleshooting any computer. The correct operation of all of the audio paths (transmitter, receiver, tone generation, etc.) as well as the RF circuits depend on proper operation of the processors. User inputs (volume, channel, PTT, UDC, etc.) and outputs (LCD, audio, etc.) also depend on the proper operation of the microprocessors. Control circuit signal tracing will require an oscilloscope to monitor the digital and audio signals.

As the Control Board contains the microprocessors and the majority of the audio circuits, troubleshooting should normally start here. The following outline will help lead the service technician to a problem with the Control Board or other associated control circuits.

NOTE

Logic 1	=	high	=	greater than 4.5 volts
Logic 0	=	low	=	less than 0.5 volts

__Completely Inoperative Unit__

1. Check power supplies, clock and reset logic

Power supplies should be the first area to check in the event of a completely inoperative control section. The supply formed by U6B, Q11 and Q10 supplies 5.4 volts to the Audio Processor. Integrated circuit U6D along with Q17 and Q16 powers the processors with 5.0 volts. A problem with both of these supplies could indicate a defective 2.5 volt reference IC U7. The 2.7 volt reference output from U4B should also be present.

The 4 MHz microprocessors’ clock, developed from the Audio Processor and Y1, should be the next suspected area. This clock can be monitored at U1 pin 42 with a frequency counter or an oscilloscope.

Check the reset line at U3 pin 7. It should be greater than 4.5 Vdc with 7.5 Vdc applied to the unit.

Lower the battery supply voltage until the reset line transitions low (less than 0.5 Vdc). This should occur at a supply voltage of 5.6 to 6.0 Vdc.

Raise the supply voltage and verify that the reset line returns high. There should be a .1 to .3 volt hysteresis.

2. Check Keypad/Display Scanning

Verify that DISP BUSY (J4-8) is high. If not, suspect the LCD controller U1 or pullup resistor R59.

Approximately every 20 mS, four pulse bursts should be present on the control lines to the keypad. (See Figure 3) These are the pulses loading a byte into shift register U2 and reading U1 on the Keypad Flex. Trigger a scope from the falling SR ENA pulse or from the falling CLOCK pulse to view these waveforms. Processor U14 should be suspected if a problem exists with these signals. Also check the interprocessor communication (Step 3 below) if a problem exists. A contact closure should be seen on the DATA IN line as a low going pulse on the first three pulse sets.

DATA IN should be high except during a contact closure on the first three pulse sets. On the fourth set, the pattern will be dependent on the position of the channel control knob S1.

For further troubleshooting procedures related to Keypad specific problems, see the information at the end of this Troubleshooting section.

3. Check Inter-processor Communication

The following analysis of inter-processor communication deals with the G4 (and later) processor software. The Master Out-Slave In (MOSI), the Master In-Slave Out (MISO) and the Serial Clock (SCK) lines are bi-directional lines between both processors. Each processor has a Slave Select (SS) input line which is controlled by an output bit from the other processor.

At power-up, the SS input (pin 37) of both processors should go to logic 1. Personality processor U10 should then set the SS input of I/O processor U14 to logic 0 for initialization. Initialization includes the transfer of a series of bytes to U14. During the initial transfers, U10 drives the clock line, SCK, and sends data on the MOSI line. All transfers require at least response from U14 on the MISO. A handshake occurs at the end of each byte consisting of U14 setting U10's SS input to logic 0, U10 returning U14's SS input to logic 1 followed by U14 returning U10's SS input to logic 1. Refer to Figure 4.

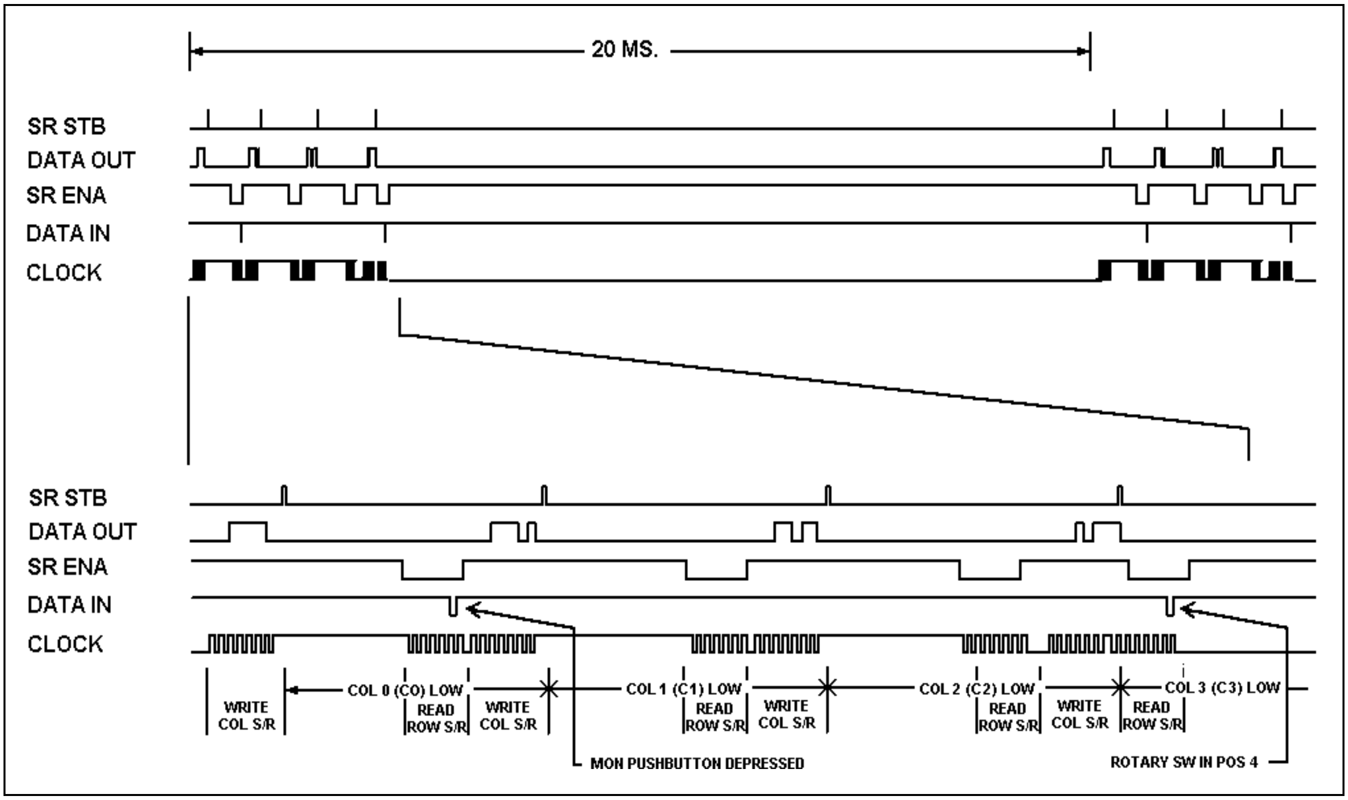


Figure 3 - Keypad/Display Scanning Waveforms

Either processor may initiate a transfer by setting the other processor's SS input to logic 0 and supplying SCK and data on MOSI.

If U10 does not set U14's SS input to logic 0, or supply SCK or data on MOSI at power-up, U10 is probably defective, or missing Vcc, clock, etc.

If U10 does set SS low and supply an initial burst of SCK and data on MOSI but U14 never lowers U10's SS input, U14 is probably defective, or missing Vcc, etc. In this case, the board will lock-up with U14's SS input at logic 0 and U10's SS input at logic 1.

If U14 receives the byte and starts a handshake which is not recognized by U10, the board will lockup with both SS inputs at logic 0.

Some U10 to U14 data transfers require data responses from U14. If the MOSI or MISO lines are defective, U10 will continue to clock SCK so that a response can be returned. If there is initial activity on MOSI but not on MISO, assume that the MISO input of U14 is defective, or that the MISO line is shorted. If there is no activity on MOSI, assume U10 is defective or the line is shorted. If there is activity on both lines, assume that the MISO input of U10 is defective.

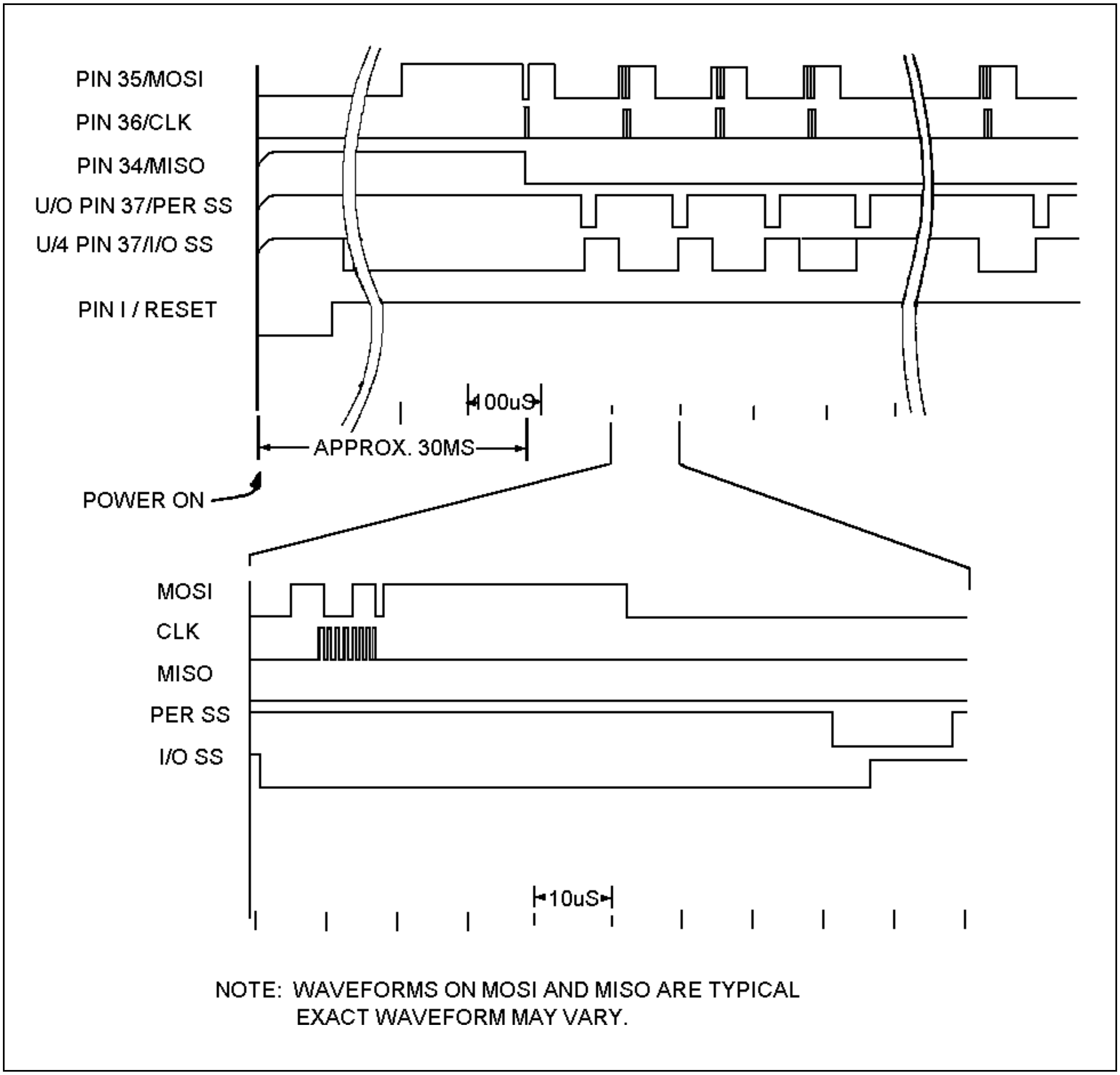


Figure 4 - Inter-processor Communication (G4 and later software)

Synthesizer Lock Failure

Failure of synthesizer locking can be caused by a problem on the RF or the Control Board. The following checks deal with problems associated with the Control Board.

If a channel name appears alternately with “SYN LOCK” on the display, the personality may be incorrect. If an unlocked condition occurs only in transmit mode, check TX 5.4V from the Control Board.

Check RF 5.4V (P2 pin 6) on the Control Board. If incorrect, suspect Q13, Q14, or U6C on the Control Board.

Check LOCK DETECT (P2 pin 8). If high and the unit is on frequency with the control circuits not recognizing the locked condition, check U4D. If LOCK DETECT is low or pulsing low, check the synthesizer loading as in step below.

Check for activity at SYN ENABLE, SYN DATA, and SYN CLOCK. If absent, suspect U14 or one of the series resistors.

Read the radio personality with the PC programmer. If correct, assume the problem is in the RF section. If incorrect, reprogram the unit. If reprogramming restores proper operation, suspect the EEPROM write delay circuit Q18. If reprogramming does not restore operation, suspect U10 or U11.

Radio Will Not Program

The Control Board must first recognize the programming resistor (short to ground at UDC pin 9) with the PC Interface connected. It should then supply greater than 6.5 Vdc battery power (current limited by Q7) to the PC Interface via UDC pin 4.

a. Attempt to reprogram the unit with the externalPC Interface power adapter; if successful, suspect transistors Q6 - Q9 or the UDC PWR output from U14 pin 27. If the UDC PWR output is low, continue with the step below.

b. Less than 0.5 Vdc should be on U1 pin 58 with the PC Interface connected to enable programming mode. If incorrect suspect R24, R25 or the UDC Flex. Most of the A/D conversion circuitry is operational if the volume control and low battery detector is functional.

If “PGM MODE” appears in the radio display, the serial data from the radio may not be reaching the programmer.

Attempt to read the radio repeatedly and check for a short serial data burst (RX DATA) at the following points:

1. U10 pin 33 (signal origin)

2. Inverter U12C pins 5 and 6.

3. Control Board J1 pin 7.

4. Check UDC Flex continuity from P1 pin 7 to UDC J101 pin 7. The short data burst should be present at the UDC pin.

To check the TX DATA input line, connect the PC Interface and computer and proceed as follows:

a. Check for logic 0 at TX DATA (J1 pin 5). Pulses should be seen here when a radio read is attempted. Suspect the UDC flex if the pulses are not present.

b. Check for logic 1 at TX DATA (U10 pin 32). Pulses should be seen when a radio read is attempted. Suspect U12B, R131, R132, D9. If the pulses are present on U10, suspect U10 or A/D converter circuits of U1; the Control Board may not be recognizing program mode.

Transmit Audio Failure

Transmit audio problems can often be isolated to a circuit section by the symptoms.

For an internal microphone failure with external microphone operating, check microphone, mic flex connection and amp U2A.

a. Check for 2.2 Vdc microphone bias at J1 pin 14.

b. Average speech into the front cover should produce 10-30 mV rms at J1 pin 14. If bias voltage is present and the audio signal is not, suspect the flex or the microphone.

c. Signal level at U2 pin 1 should be 7 to 10 times greater than the mic audio. Diode D1 begins limiting at about 350 mV rms output.

For an external microphone failure with internal microphone operating, check UDC flex and amp U2B.

a. Check for 2.6 Vdc microphone bias at UDC pin 12 and J1 pin 12. (2.2 Vdc with the external microphone attached). If this bias voltage is incorrect, suspect resistor R6.

b. Connect an external microphone and check the audio level at J1 pin 12. Average speech in the microphone should produce 10-30 mV here. Signal on U2 pin 7 should be 7 to 10 times greater than the EXT MIC audio.

If both microphone inputs are not functioning apply a 10 mV, 1 kHz tone to the UDC EXT MIC input using the TQ-0609 Test Box. Select switch position 6 (external mic) on the Test Box and key the radio. Typical signal levels with radio keyed are:

U2 pin	7	80 mV rms
U1 pin	18	70 mV rms
U1 pin	19	20 mV rms
U1 pin	26	800 mV rms (No Channel Guard)
U2 pin	8	560 mV rms (No Channel Guard)

Receive Audio Failure

Verify that discriminator audio from the RF section is present at P1 pin 4. Typical signal level is 100 mV rms for 1 kHz tone, 3 kHz deviation.

If squelch does not function, check circuits associated with U5B and Q1.

There should be a dc voltage on U1 pin 4 between 2.7 Vdc and 5.4 Vdc (proportional to receiver noise). Typical squelch circuit values (assuming 220 mV rms squelch noise at the discriminator output) are as follows:

		No RF Signal	Strong RF Signal (no modulation)
U5 pin	7	650 mV rms	0 V rms
U1 pin	3	230 mV rms	0 V rms
U1 pin	56	3.7 Vdc	2.7 Vdc
U1 pin	55	4.3 Vdc	2.7 Vdc

If the above voltages check good, check squelch tracking data using PC Programmer. Higher numbers should make squelch open at lower signal levels, and lower numbers shou1d make squelch open at higher signal levels. Typical squelch tracking data values are 90 to C0 hex. Values below 78 shou1d always squelch the radio and values above E0 should always unsquelch the radio. If the radio does not operate as described, suspect C9, C10 or the Audio Processor IC.

Typical audio levels with the volume control fully clockwise and 100 mV rms, 1 kHz tone from the discriminator are:

U5 pin	7	330	mV rms
U1 pin	18	320	mV rms
U1 pin	19	85	mV rms
U1 pin	27	520	mV rms
U5 pin	1	180	mV rms

The volume control operates by digitizing the dc voltage from the volume potentiometer wiper and varying the digital attenuator in the Audio Processor.

a. Check the dc voltage at J4 pin 9. It should be near 0 volts with the volume control fully counterclockwise and near 5.4 volts with the control fully clockwise. If not, check the volume control and Keypad Flex.

b. The volume control wiper voltage should also be present at U1 pin 59. If not, suspect J4 or R27. If there is a problem with volume control and the varying voltage is present at U1, there may be a problem in the Audio Processor.

Keypad Failure

Verify proper operation of the shift registers U1 and U2 on the Keypad Flex. See the procedure in the previous Keypad/Display Scanning section.

Verify that the 4 column outputs (C0-C3) of U2 are being sequentially set to logic 0. If not, verify that CLOCK, DATA OUT and SR STB are present. Replace Keypad IC U2 if serial signals are good and the column outputs are not.

Check the 8 row inputs (R0-R7) of U1. Each should be logic 1 except when a switch is closed on that row and the column output for that switch is strobed low by U2. See the chart on the Keypad Schematic. Note that R0-R3 may have low going pulses on them during a column 3 strobe; the particular row strobed will be dependent on the setting of the rotary switch. If a row is always logic 0, suspect a defective pullup resistor (R1-R8) or a defective U1. If a row is always logic 1 (when appropriate switch is closed), check series resistor (R9-R16) and flex patterns.

If U1 inputs appear correct, check U1 control signal CLOCK and SR ENA. If these appear correct, replace U1.

COMPONENT REPLACEMENT

CHIP COMPONENTS

Chip components should always be replaced using a temperature controlled soldering system. The soldering tools may be either a temperature controlled soldering iron or a temperature controlled hot-air soldering station. Ericsson recommends the use of a hot-air system for the removal of components on the multi-layer boards utilized throughout the M-PA radio. With either soldering system, a temperature of 700°F (371°C) should be maintained.

The below procedure outlines the removal and replacement of chip components. If a hot-air soldering system is employed, see the manufacture's operating instructions for detailed information on the use of your system.

CAUTION

Avoid applying heat to the body of any chip component when using standard soldering methods. Heat should be applied only to the metallized terminals of the components. Hot-air systems do not damage the components since the heat is quickly and evenly distributed to the external surface of the component.

CAUTION

As the M-PA contains many static sensitive components, observe static handling precautions during any service procedure.

CHIP COMPONENT REMOVAL

(1) Grip the component with tweezers or small needlenose pliers.

(2) A1ternately heat the metallized terminal ends of the chip component with the soldering iron. If a hot-air system is used, direct the heat to the terminals of the component. Use extreme care with the soldering equipment to prevent damage to the printed wire board (PWB) and the surrounding components.

(3) When the solder on all terminals is liquefied, gently remove the component. Excessive force may cause the PWB pads to separate from the board if all solder is not completely liquefied.

(4) It may be necessary to remove excess solder using a vacuum de-soldering tool or Solderwick®. Again, use great care when de-soldering or soldering on the printed wire boards. It may also be necessary to remove the epoxy adhesive that was under the chip component and any flux on the printed wire board.

CHIP COMPONENT REPLACEMENT

(1) "Tin" one terminal end on the new component and on the corresponding pad of the PWB. Use as little solder as possible.

(2) Place the component on the PWB pads, observing proper orientation for capacitors, diodes, transistors, etc.

(3) Simultaneously touch the "tinned" terminal end and the "tinned" pad with the soldering iron. Slightly press the component down on the board as the solder is liquefied. Solder all component terminals as necessary. Do not apply heat for an excessive length of time and do not use excessive solder.

With a hot-air system, apply hot air until all "tinned" areas are melted and the component is seated in place. It may be necessary to slightly press the component down on the board. Touchup the soldered connections with a standard soldering iron if needed. Do not use excessive solder.

(4) Allow the component and the board to cool and then remove all flux from the area using alcohol or another Ericsson approved flux remover.

CAUTION

Some chemicals may damage the internal and external plastic and rubber parts of the M-PA unit.

SURFACE MOUNTED INTEGRATED CIRCUIT REPLACEMENT

Soldering and de-soldering techniques of the surface mounted IC's are similar to the above outlined procedures for the surface mounted chip components. Use extreme care and observe static precautions when removing or replacing the defective (or suspect) IC's. This will prevent any damage to the printed wire board or the surrounding circuitry.

Replacement of the surface mounted IC's is best completed using a hot-air soldering system. The IC's can easily be removed and installed using the hot-air system. See the manufacturers instructions for complete details on tip selection and other operating instructions unique to your system.

If a hot-air system is not available, the service technician may wish to clip the pins near the body of the defective IC and remove it. The pins can then be removed from the PWB with a standard soldering iron and tweezers, and the new IC installed following the above Chip Component Replacement procedures. It may not be necessary to "tin" all (or any) of the IC pins before the installation process.

MODULE REPLACEMENT

The modules, all of which are located on the RF Board, are very reliable devices. Before replacing any of the modules, check the associated circuitry thoroughly to insure there is not a problem elsewhere. If replacement is necessary, follow the below procedures.

All of the component lead holes on the RF Board for the modules are plated through from the top to the bottom of the board. This allows for easy removal and replacement of the modules as long as appropriate soldering techniques are observed. Always observe static precautions when handling the board during module replacement.

To remove the PA or the VCO module, it is first necessary to remove the hardware which supports the modules.

Two Torx®, pan head screws and a support bracket secure the PA module to the component side eggcrate casting.

Two Torx®, pan head screws secure the VCO module to the RF Board. The two screws that secure the VCO module can be found on the chip component side of the board.

To remove a module, position the RF Board in a work vice (face down, chip components up) and remove the solder from the plated-through points at the appropriate pins. If a hot-air system is employed, use an appropriate tip that will localize the heat on the pins and not on surrounding chip components. Solderwick® or a vacuum desoldering iron will also remove the solder if a hot-air station is not available. When all solder has been removed or liquefied, the module should drop out of the eggcrate casting.

To install a module, clean any solder from the plated-through holes and clean all flux from the board. Next, install the replacement module making sure that all pins align in the proper holes on the RF Board. Re-solder the pins to the board. Clean the flux from the board using an approved solvent and clip any excess lead length.

WEATHERPROOF INTEGRITY

The M-PA radio is designed to meet the MIL-810-D specifications for blowing rain. All internal circuitry of the M-PA is protected from water entry by seals.

Rear Cover Assembly seals include the Front/Rear Cover Assembly gasket and the antenna insert gasket. Front Cover Assembly seals include the speaker/microphone seal, the battery plate seal, the LCD gasket and the control knob seals.

These seals should be inspected during any disassembly/ reassembly process for cracks and tears. A defective seal warrants replacement See the Mechanical Parts breakdown drawings and the Parts Lists for details on locations and part numbers for these seals. When installing a new seal, make sure it is seated properly before reassembly.

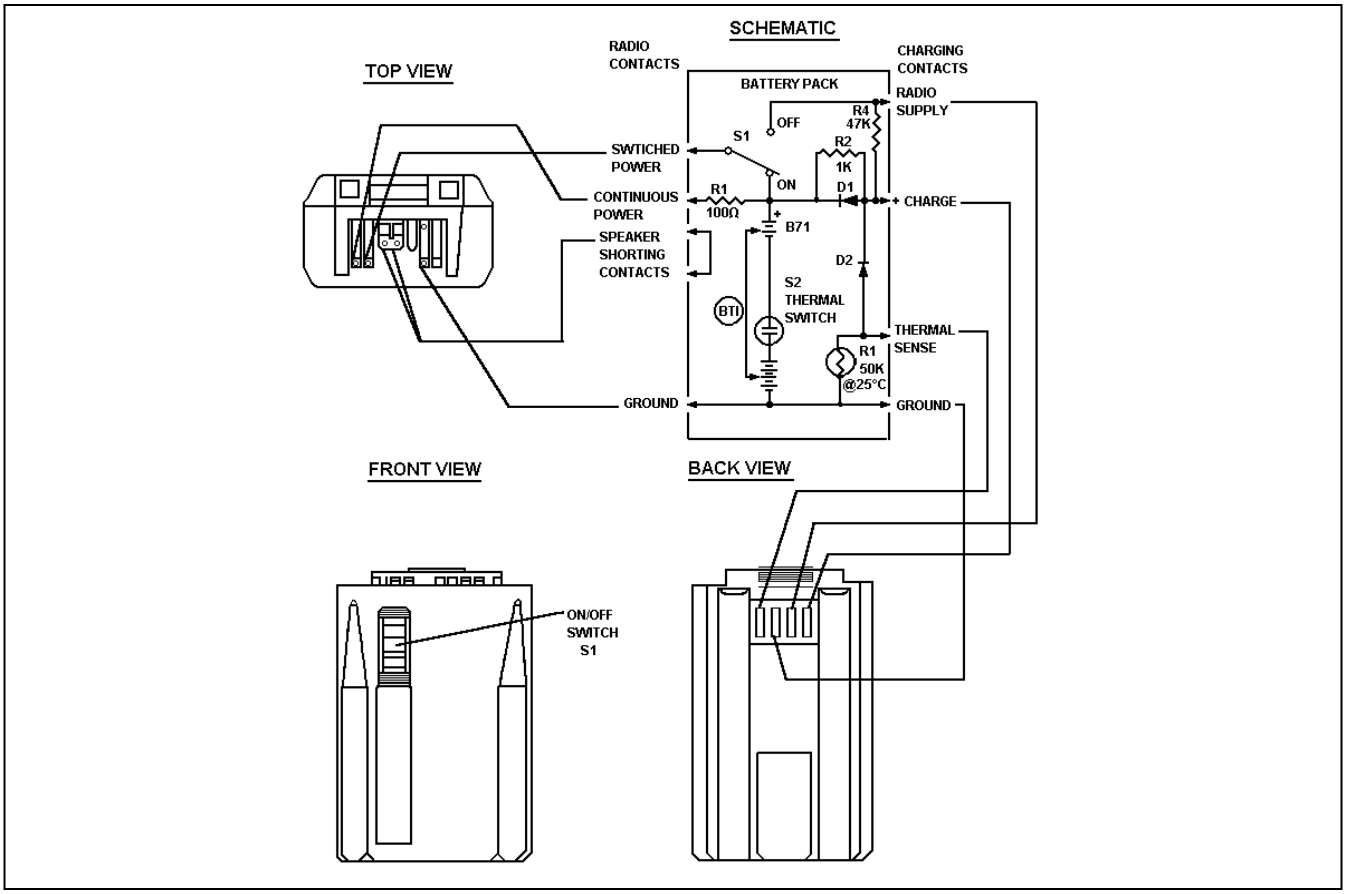


Figure 5 - Typical Battery Pack

BATTERY PACKS

Nickel-cadmium battery packs available for use with the personal radio include standard, medium, high, and extra high capacity. All of the packs are factory sealed and are not field serviceable other than properly charging, and cleaning the contacts.

Radio contacts located on the top of the pack include switched power, ground, the speaker enabling contacts and a continuous power contact. Four charging contacts are located on the rear side of the battery pack. These four contacts provide connections to the slip-in type chargers or vehicular chargers/repeaters while the battery pack is still connected to the unit. These battery charging contacts are diode protected from external shorts.

Chargers are available with nominal charge times of 1 (rapid) and 14 (standard) hours. Combinations include single (1) and multi (5) position, standard and rapid charge units. The chargers utilize an internal thermistor in the battery pack to sense temperature and automatically control charge rate of the battery. This allows for a maximum charge rate without overheating the battery. All battery packs can be charged in less than 1 1/2 hours with the rapid type chargers. Nominal full charge time in a standard charger is 14 hours. Figure 5 outlines a typical battery pack.

CHARGING THE BATTERY PACKS

After receiving a new battery pack from the factory, it should be fully charged before it is placed into service. This also applies to batteries that have been stored for long periods. For specific instructions for the particular charger, refer to the applicable charger's Operating Manual.

A fully charged battery pack should provide an open terminal voltage greater than 7.5 Vdc (typically 9 Vdc). A fully discharged battery pack should be no less than 6 Vdc. When the battery pack drops below 6.8 Vdc the radio will warn the operator with an alert tone.

Nickel-cadmium batteries can develop a condition of reduced capacity sometimes called "Memory Effect". This condition can occur when a battery is continuously charged for long periods of time or when a regularly performed duty cycle allows the battery to expend only a limited portion of its capacity.

If the battery pack is seldom used and left on a continuous charge for long periods, it may develop reduced capacity. On the first discharge cycle, the capacity may be significantly lowered, reducing useful service hours.

Any nickel-cadmium battery pack showing signs of reduced capacity should be checked before being replaced. If reduced capacity is in fact a problem, the following procedure may restore capacity:

(1) Discharge the battery pack at a normal discharge rate until the output voltage is approximately 1 Volt per cell. This equals 6 Volts output for the battery packs. Refer to Figure 6. Note the flatness of the discharge curve from 0% - 90%. Experience shows discharging below the "knee" is not necessary.

(2) Complete a full charge cycle using an Ericsson charger.

(3) Repeat steps 1 and 2. Performing this deep cycle at least twice should be sufficient to restore battery pack capacity.

NOTE

This procedure is easily completed using Discharger Analyzer 19B801506P9 and Rapid Multi-Charger 19B801506P16 or P18.

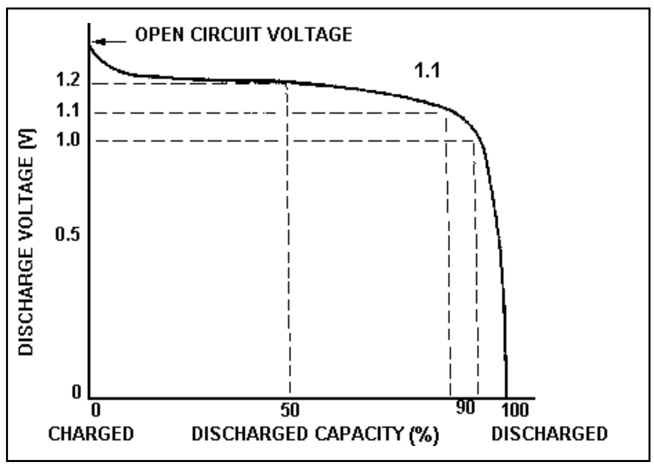


Figure 6 - Typical Cell Discharge Curve

CONTROL KNOB STOP PLATE

A stop plate is located under the Control Knob. This plate can be repositioned, if desired, to limit the number of unique Control Knob positions. The stop plate is factory placed for 15 positions unless 16 unique factory programmed positions are ordered.

MODIFICATION PROCEDURE

Follow the below procedure if repositioning of the stop plate is desired.

(1) Remove the Control Knob using an M1.5 hex wrench.

(2) Lift the stop plate using small needle-nose pliers.

(3) Reposition the stop plate by aligning the raised bar to the channel marking one number higher than the number of positions required. For example, if 8 unique positions are required, align the bar to the "9". See Figure 6. If 16 positions are required, do not reinstall the stop plate.

(4) Replace the Control Knob and torque the set screw to 3 lb./in. The set screw must align on the flat area of the switch shaft. Test for proper operation.

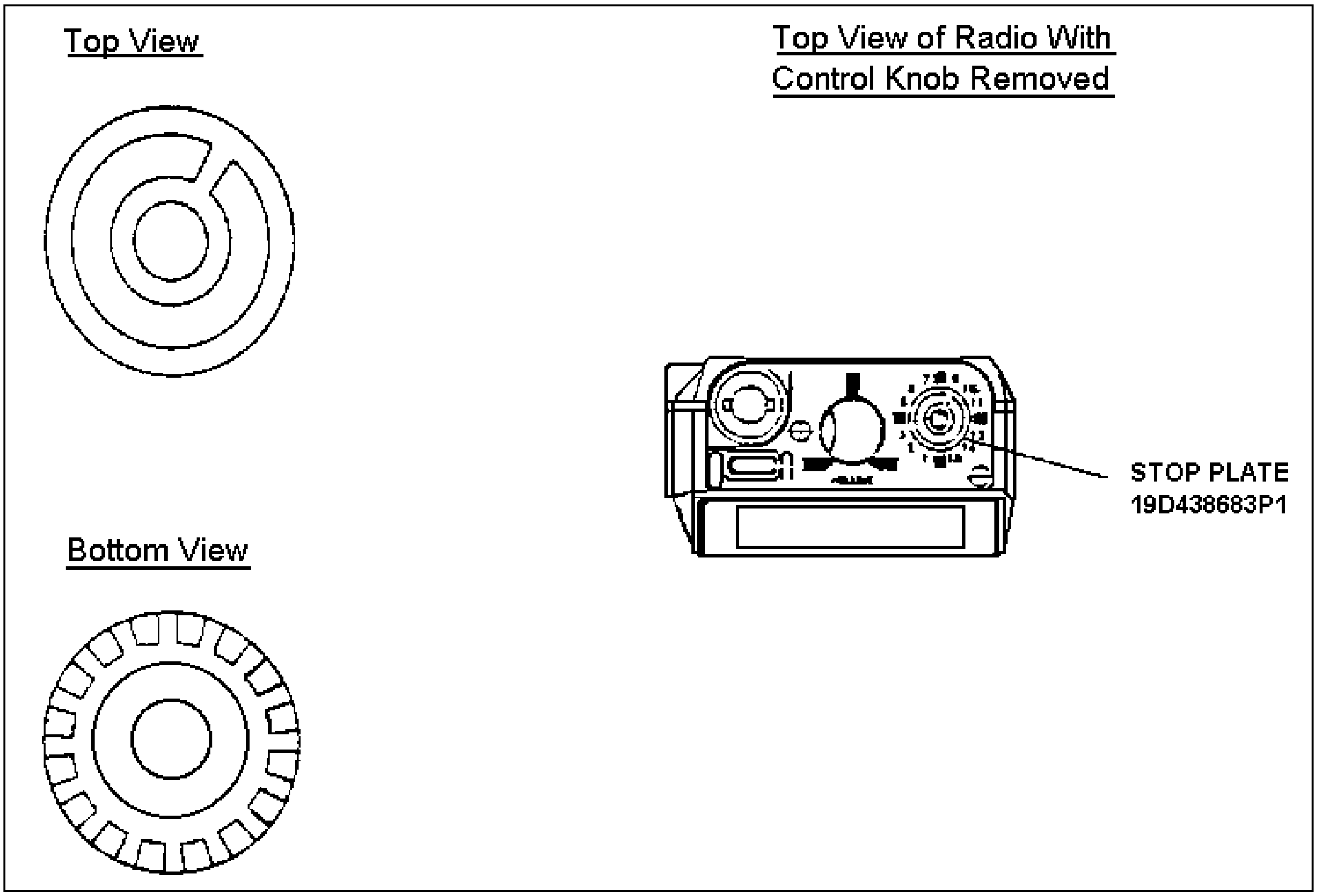
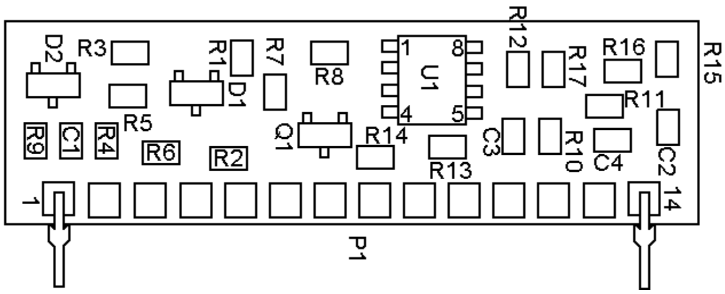
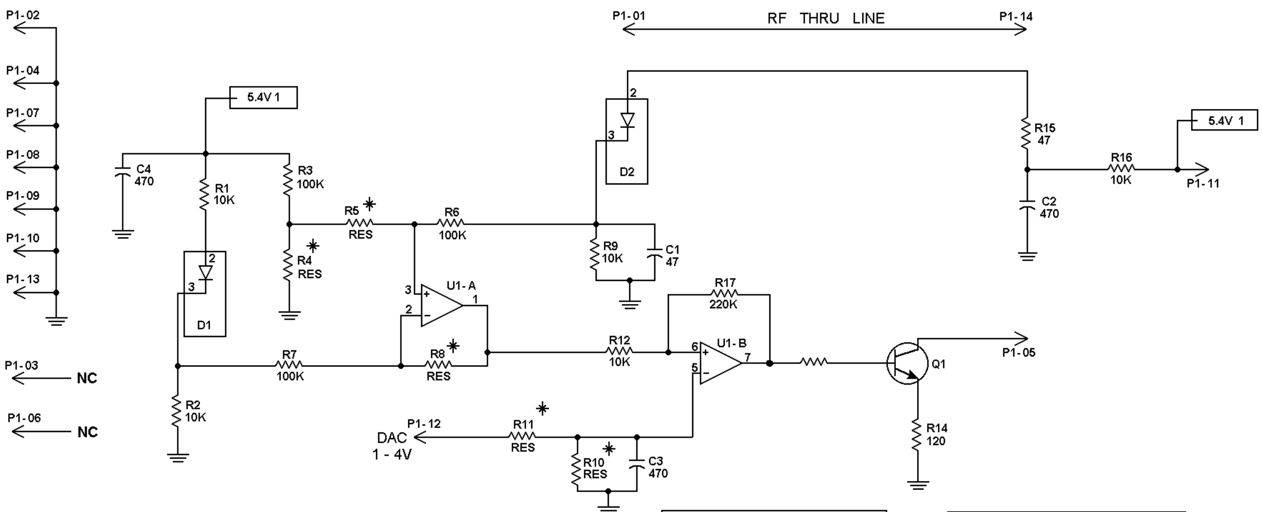


Figure 7 - Control Knob Stop Plate 19D438683P1



(19C337063, Rev. 2)



POWER AND GROUND CONNECTIONS		
DEVISE	5.4V	GROUND
U1	PIN 8	PIN 4

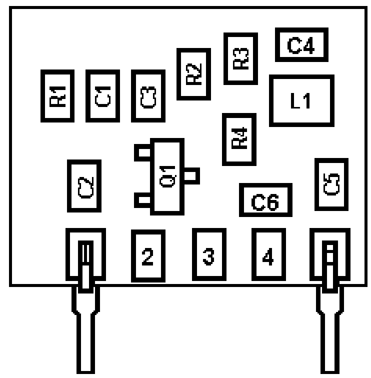
FREQUENCY DEPENDENT PARTS		
PART	G1 VHF	G3 UHF
R4	10K	4.7K
R5	100K	68K
R8	100K	68K
R10	10K	22K
R11	10K	6.8K

ALL RESISTORS ARE 1/8 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY MULTIPLIER K OR M. CAPACITOR VALUES IN F UNLESS FOLLOWED BY MULTIPLIER U, N, OR P INDUCTANCE VALUES IN H UNLESS FOLLOWED BY MULTIPLIER M OR U.

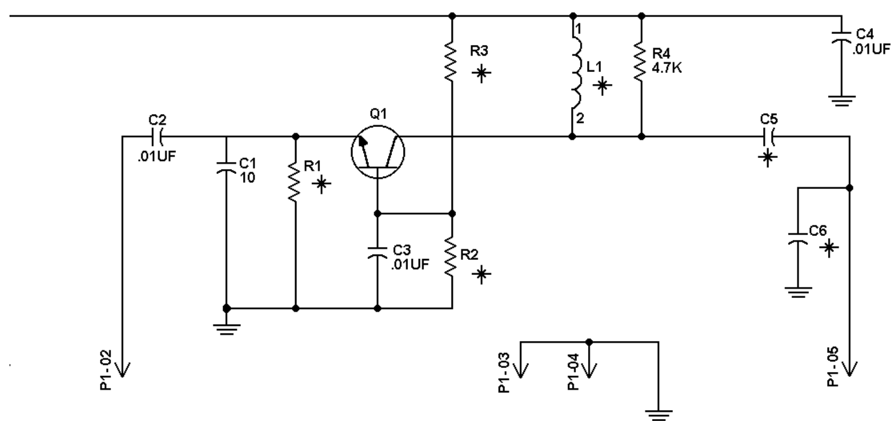
THIS SCHEMATIC DIAG. APPLIES TO	
MODEL NO.	REV. LETTER

(19C337315, Rev. 1)

RF BOARD
POWER CONTROLLER A1
19C337063G3



(19C336876, Rev. 1)



BAND SPLIT PARTS

PART	GROUP 1 45MHZ	GROUP 3 21.4MHZ
C5	13P	16P
C6	56P	27P
L1	1U	3.3U
R1	390 OHM	820 OHM
R2	22K	27K
R3	27K	8.2K

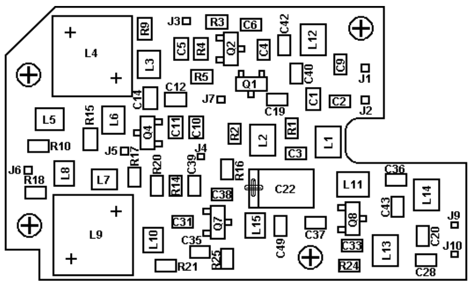
* FREQUENCY SENSITIVE PART - SEE CHART

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K = 1000 OHMS OR MEG = 1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF-MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH=MILLIHENRYS OR H=HENRYS.

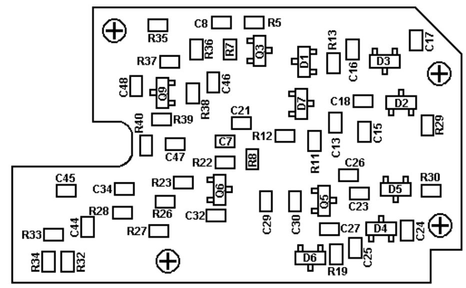
THIS SCHEMATIC DIAG. APPLIES TO	
MODEL NO.	REV. LETTER

(19C337062, Rev. 1)

RF BOARD
IF AMPLIFIER A2
19C336876G1

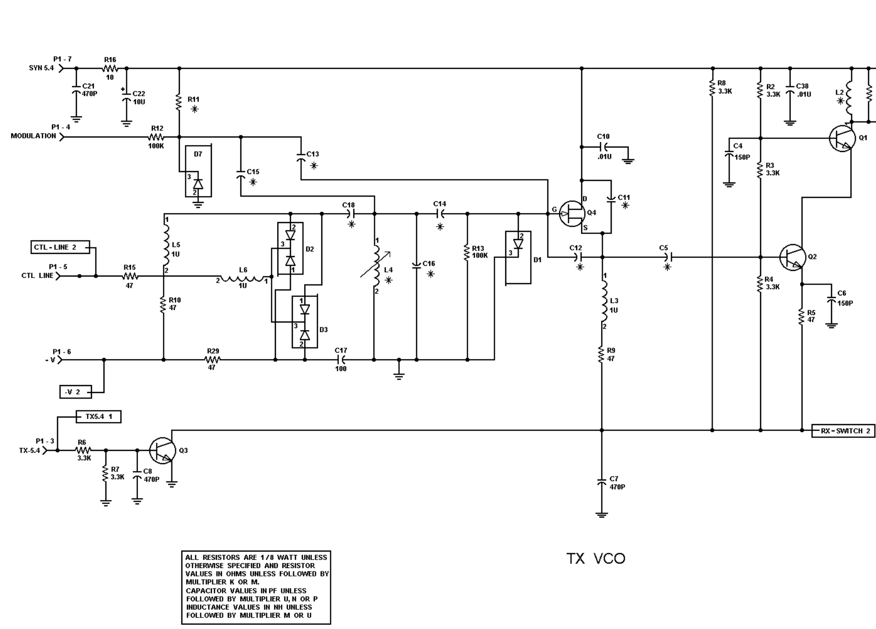


COMPONENT SIDE



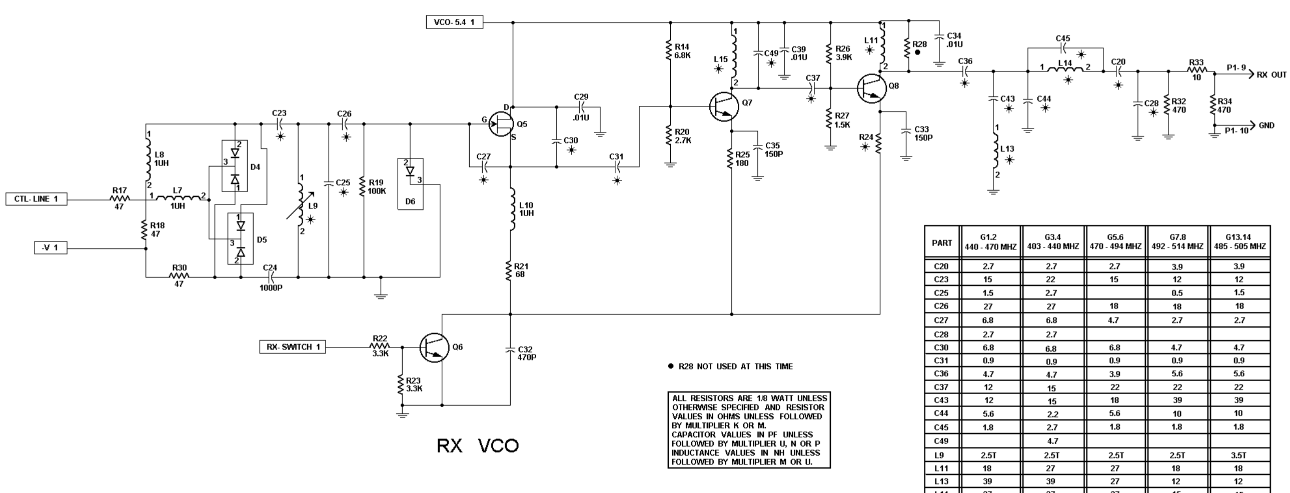
SOLDER SIDE

(19D438605, Sh. 1, Rev. 2)



PART	G1,2 440 - 470 MHZ	G3, 4 403 - 440 MHZ	G5, 6 470 - 494 MHZ	G7, 8 492 - 514 MHZ	G9, 10 378 - 413 MHZ	G11, 12 440 - 470 MHZ	G13, 14 485 - 505 MHZ
C1	15	22	22	28	22	22	28
C2	1.8	3.9	3.9	1.8	3.9	1.0	1.8
C5	4.7	4.7	4.7	4.7	4.7	4.7	4.7
C9		2.2			2.2	2.2	
C11	6.8	6.8	6.8	6.8	6.8	6.8	6.8
C12	6.8	6.8	6.8	6.8	6.8	6.8	6.8
C13	0.9		0.9	0.5		0.9	0.5
C14	47	47	47	47	47	47	47
C15	0.9	0.9	0.9	0.9	0.9	0.9	0.9
C16	5.6	10	2.2	0.9	5.6	5.6	10
C18	33	47	27	22	47	33	33
C19	1.8	1.8	1.5	1.5	1.8	1.5	1.5
C40	8.2	2.2	2.2	2.7	2.2	0.7	2.7
C42	1.5	1.5	1.8	2.2	1.5	1.2	2.2
C46	100	150	22	22	150	100	22
C48	100	150	150	150	150	100	150
L1	27NH	27NH	22NH	22NH	27NH	27NH	22NH
L2	27NH	27NH	22NH	22NH	27NH	27NH	22NH
L12	27NH	27NH	22NH	18NH	27NH	39NH	18NH
R1	470	470	470	470	470	270	470
R11	6.8K	33K	6.8K	6.8K	33K	6.8K	6.8K
R35	100	100	100	100	100	100	120
R36	68	68	68	68	68	68	47
R37	100	100	100	100	100	100	120
L4	1.5T	1.5T	1.5T	1.5T	1.5T	1.5T	3.5T

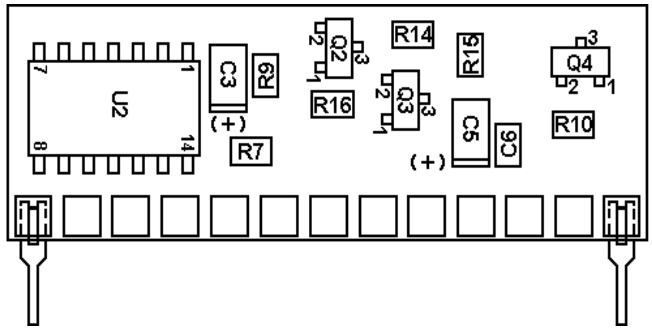
(19D438604, Sh. 1, Rev. B)



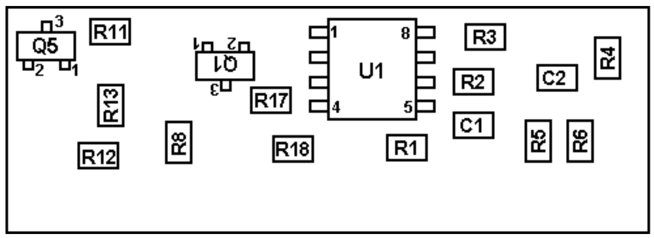
PART	G1.2 440 - 470 MHZ	G3.4 403 - 440 MHZ	G5.6 470 - 494 MHZ	G7.8 492 - 514 MHZ	G13.14 485 - 505 MHZ
C20	2.7	2.7	2.7	3.9	3.9
C23	15	22	15	12	12
C25	1.5	2.7		0.5	1.5
C26	27	27	18	18	18
C27	6.8	6.8	4.7	2.7	2.7
C28	2.7	2.7			
C30	6.8	6.8	6.8	4.7	4.7
C31	0.9	0.9	0.9	0.9	0.9
C36	4.7	4.7	3.9	5.6	5.6
C37	12	15	22	22	22
C43	12	15	18	39	39
C44	5.6	2.2	5.6	10	10
C45	1.8	2.7	1.8	1.8	1.8
C49		4.7			
L9	2.5T	2.5T	2.5T	2.5T	3.5T
L11	18	27	27	18	18
L13	39	39	27	12	12
L14	27	27	27	15	15
L15	47	68	47	47	47

RF BOARD
VCO A4
19D438605G1

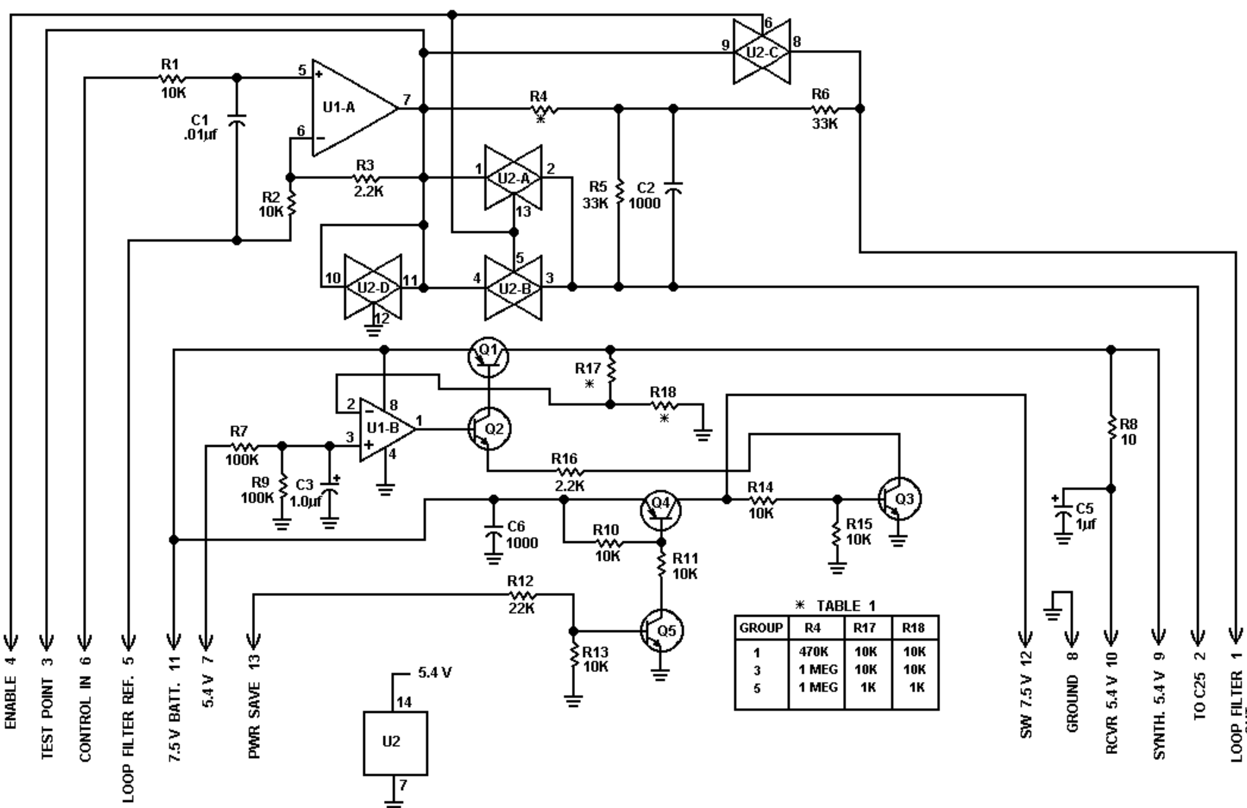
(19D438604, Sh. 2, Rev. 4)



(19C336915, Sh. 1, Rev. 0)



(19C336915, Sh. 2, Rev. 0)

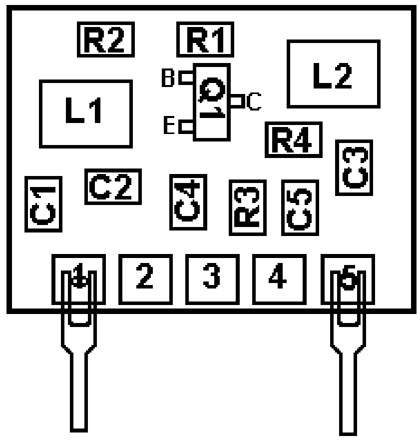


* TABLE 1

GROUP	R4	R17	R18
1	470K	10K	10K
3	1 MEG	10K	10K
5	1 MEG	1K	1K

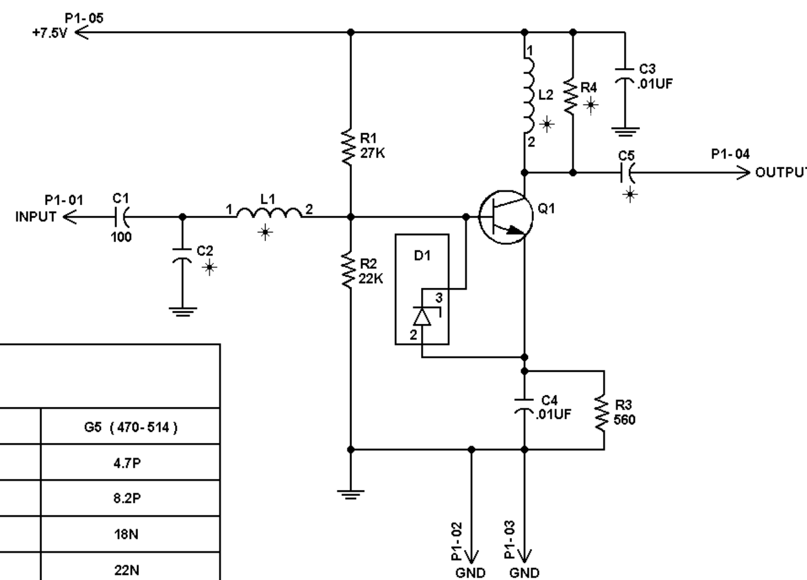
(19C336917, Rev. 4)

RF BOARD
PLL FILTER AND REGULATOR A5
19C336915G3



(19B235081, Sh. 1, Rev. 3)

ALL RESISTORS ARE 1/8 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY MULTIPLIER K OR M.
CAPACITOR VALUES IN F UNLESS FOLLOWED BY MULTIPLIER U, N OR P
INDUCTANCE VALUES IN H UNLESS FOLLOWED BY MULTIPLIER M OR U.

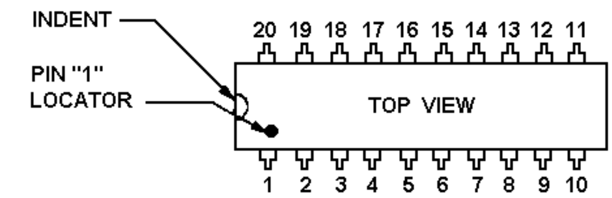


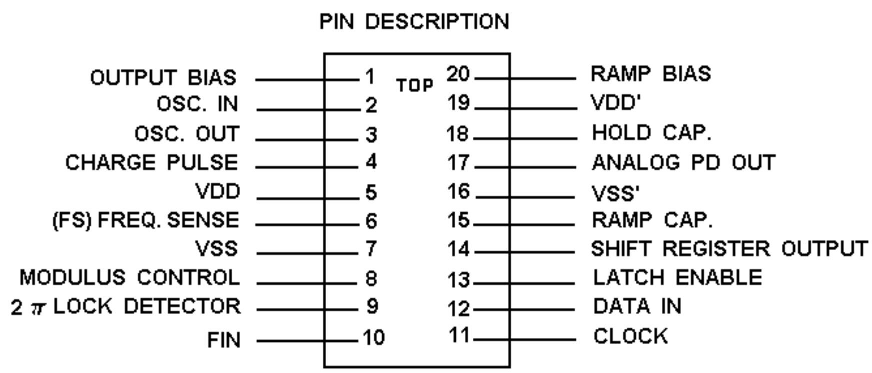
CHARTS FOR SPLITS			
COMPONENT	G1 (440-470)	G3 (403-440)	G5 (470-514)
C2	5.6P	4.7P	4.7P
C5	10P	12P	8.2P
L1	18N	22N	18N
L2	22N	27N	22N
R4	100	68	100

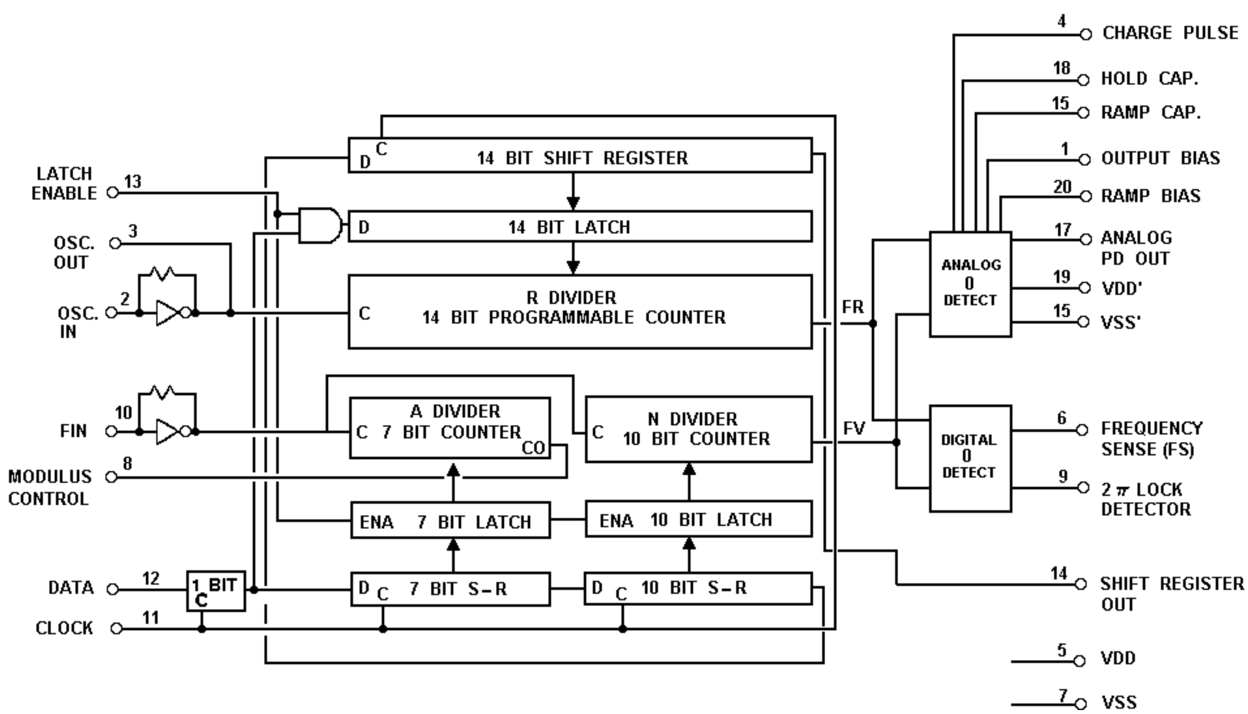
✳ SEE SPLIT CHART

(19C337073, Rev. 2)

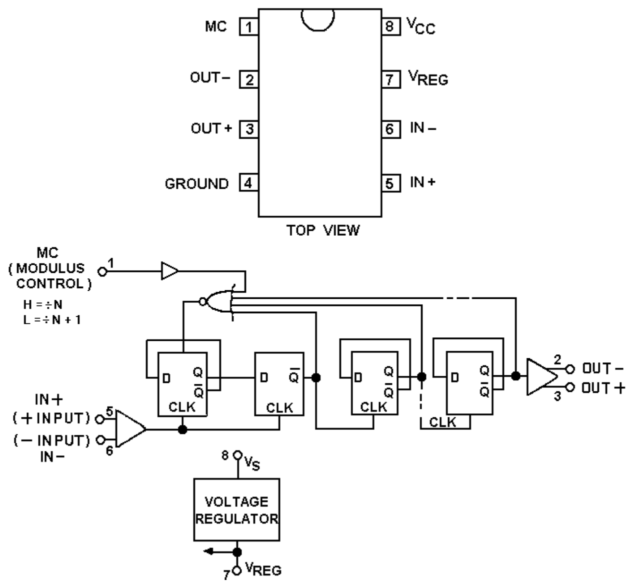
RF BOARD
RF AMPLIFIER A6
19B235081G1



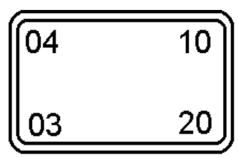




RF BOARD
SYNTHESIZER U1
19B800902P4



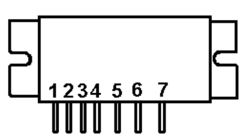
RF BOARD
PRESCALER U2
19A704287P2



PIN CONNECTIONS

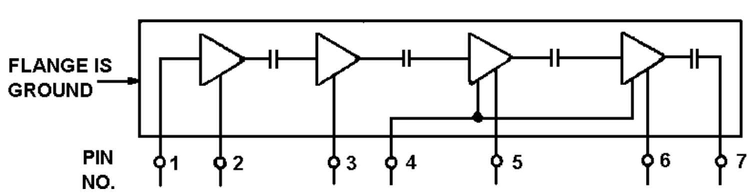
1. COMMON & CASE
2. OUTPUT
3. + Vcc
4. MODULATION

RF BOARD
REFERENCE OSCILLATOR U3
19B801351P15

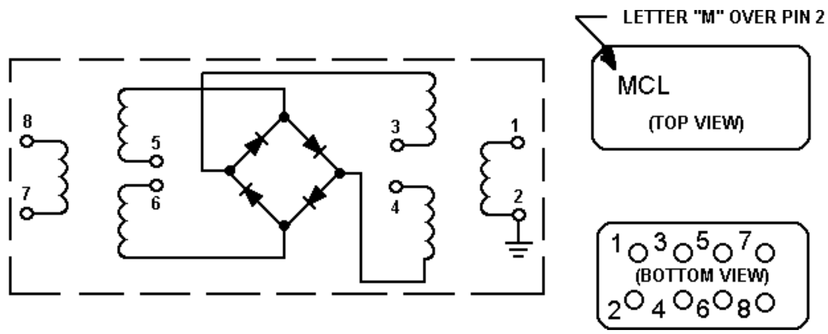


PIN FUNCTION

1. RF INPUT
2. VS1
3. VCONT
4. VS2
5. VS3
6. VS4
7. RF OUTPUT

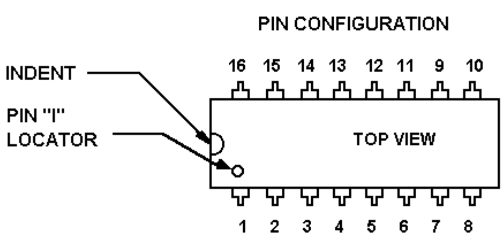


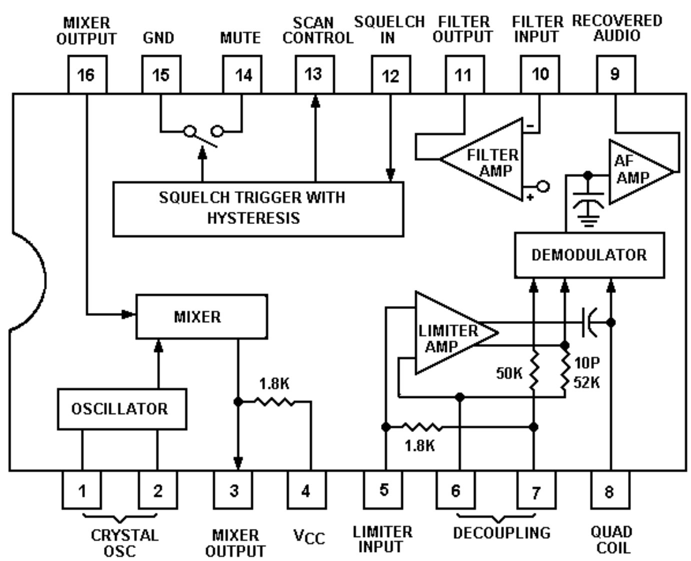
RF BOARD
POWER AMPLIFIER U4
19A705419P2



PIN	FUNCTION
1	RF INPUT
2	GROUND (Case)
3	IF OUTPUT
4	IF OUTPUT
5	GROUND
6	GROUND
7	GROUND
8	LO INPUT

RF BOARD
MIXER U5
19A705706P2



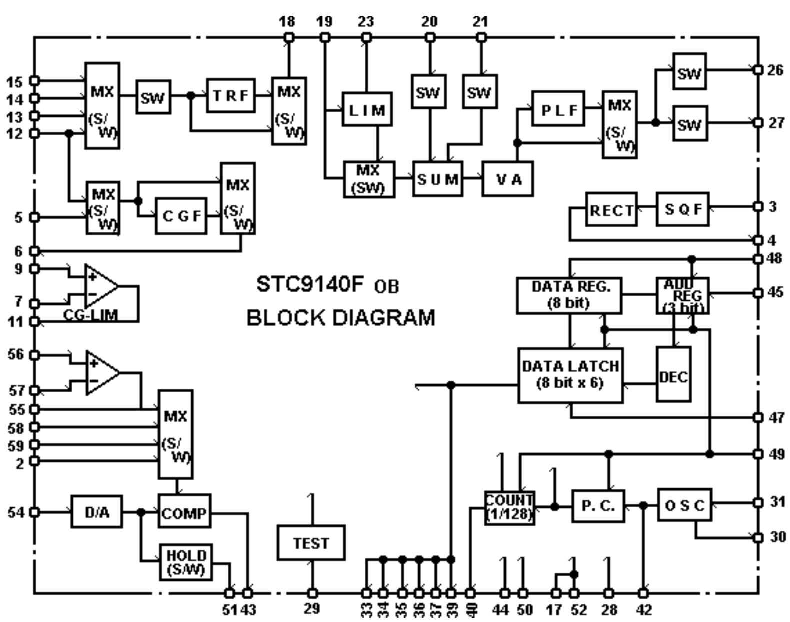


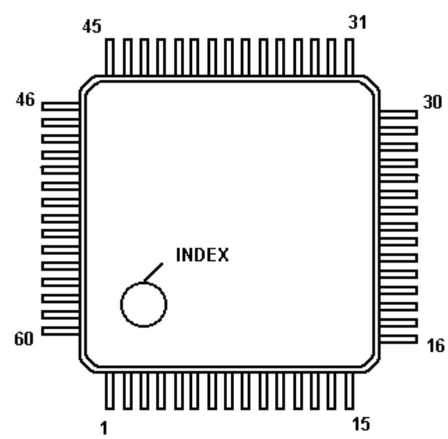
BLOCK DIAGRAM

RF BOARD
OSC/MIXER/IF/DET U6
19A704619P1

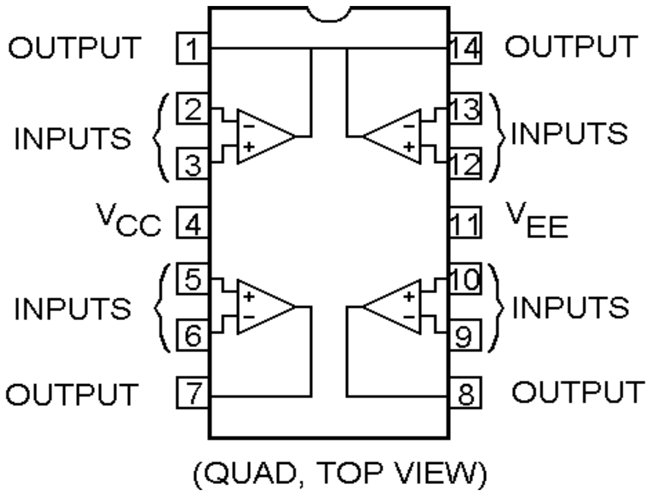
PIN CONFIGURATION

PIN NO.	NAME (FUNCTION)	PIN NO.	NAME (FUNCTION)	PIN NO.	NAME (FUNCTION)	PIN NO.	NAME (FUNCTION)
1	N.C.	16	N.C.	31	XG	46	N.C.
2	COMP D IN	17	GND	32	N.C.	47	ENABLE
3	SQL AUD IN	18	COUPLING OUT	33	SW0	48	STROBE
4	SQL AUD OUT	19	COUPLING IN	34	SW1	49	RESET
5	CG TONE IN	20	TONE A IN	35	SW2	50	V_{SSA}
6	CG ENC OUT	21	TONE B IN	36	SW3	51	D/A OUT
7	CG LIM (-) IN	22	N.C.	37	SW4	52	GND
8	N.C.	23	AUD LIM OUT	38	N.C.	53	N.C.
9	CG LIM (+) IN	24	N.C.	39	SW5	54	V_{REF}
10	N.C.	25	N.C.	40	1 KHz OUT	55	COMP A OUT
11	CG LIM OUT	26	TX AUD OUT	41	N.C.	56	COMP A (+) IN
12	REC AUD IN	27	RX AUD OUT	42	OSC OUT	57	COMP A (-) IN
13	EXT MIC IN	28	V_{DD}	43	COMP OUT	58	COMP B IN
14	INT MIC IN	29	TEST	44	V_{SSA}	59	COMP C IN
15	TONE C IN	30	X_D	45	DATA	60	N.C.

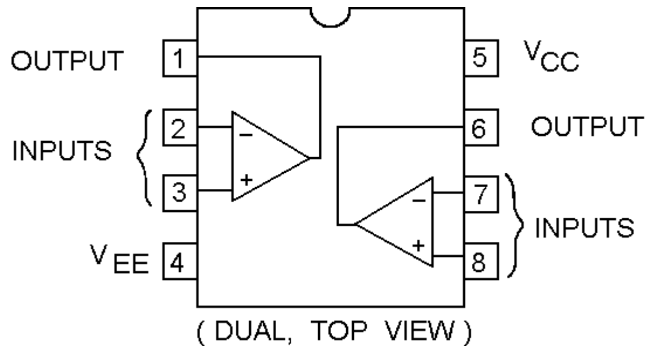




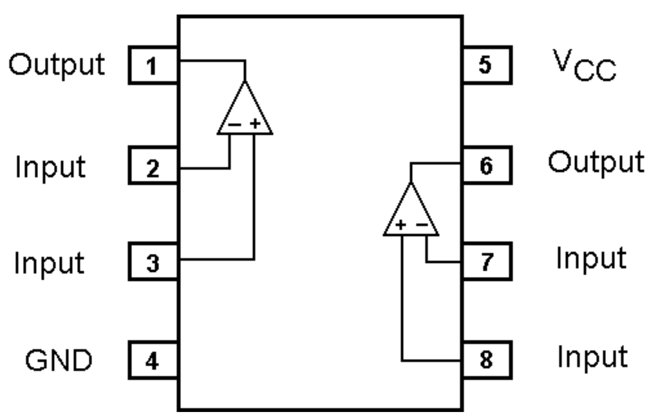
CONTROL BOARD
AUDIO PROCESSOR U1
19A705851P1



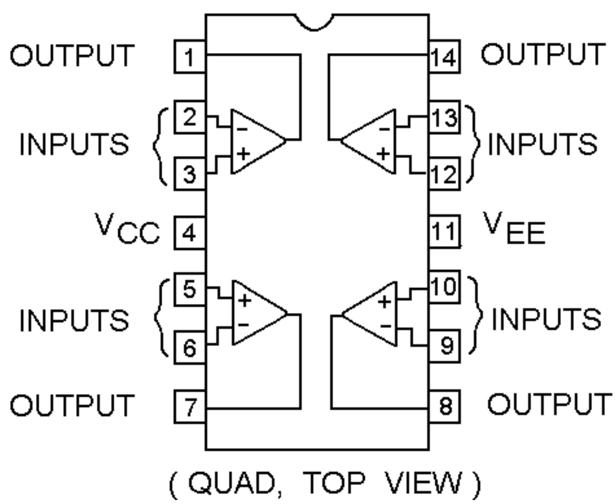
CONTROL BOARD
QUAD JFET OP AMP U2, U4
19A705798P2



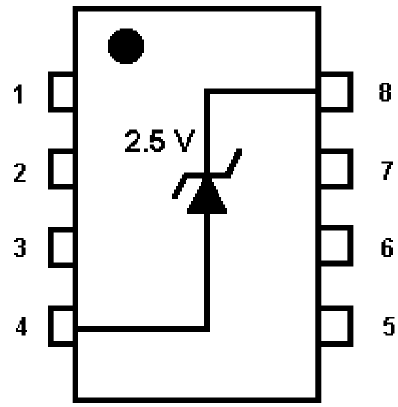
CONTROL BOARD
DUAL JFET OP AMP U5
19A705798P1



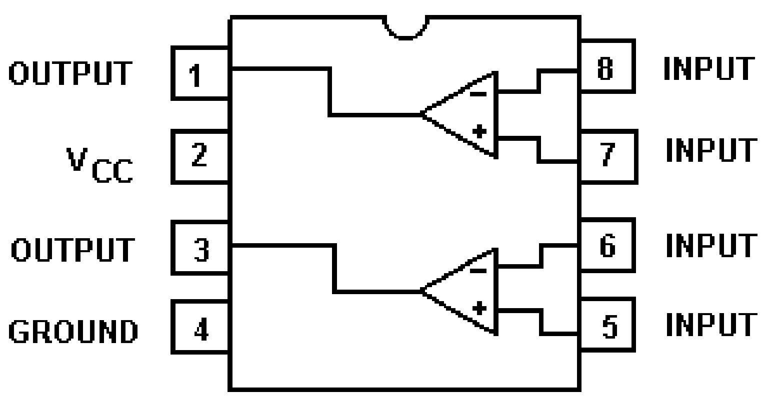
CONTROL BOARD
DUAL COMPARATOR U3, U8
19A704125P2



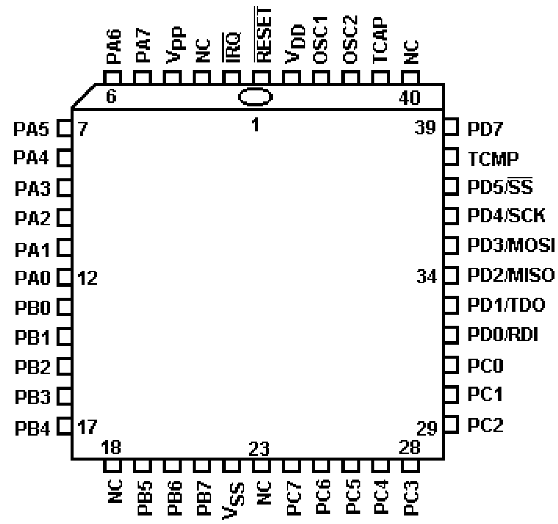
CONTROL BOARD
QUAD OP AMP U6
19A702293P1



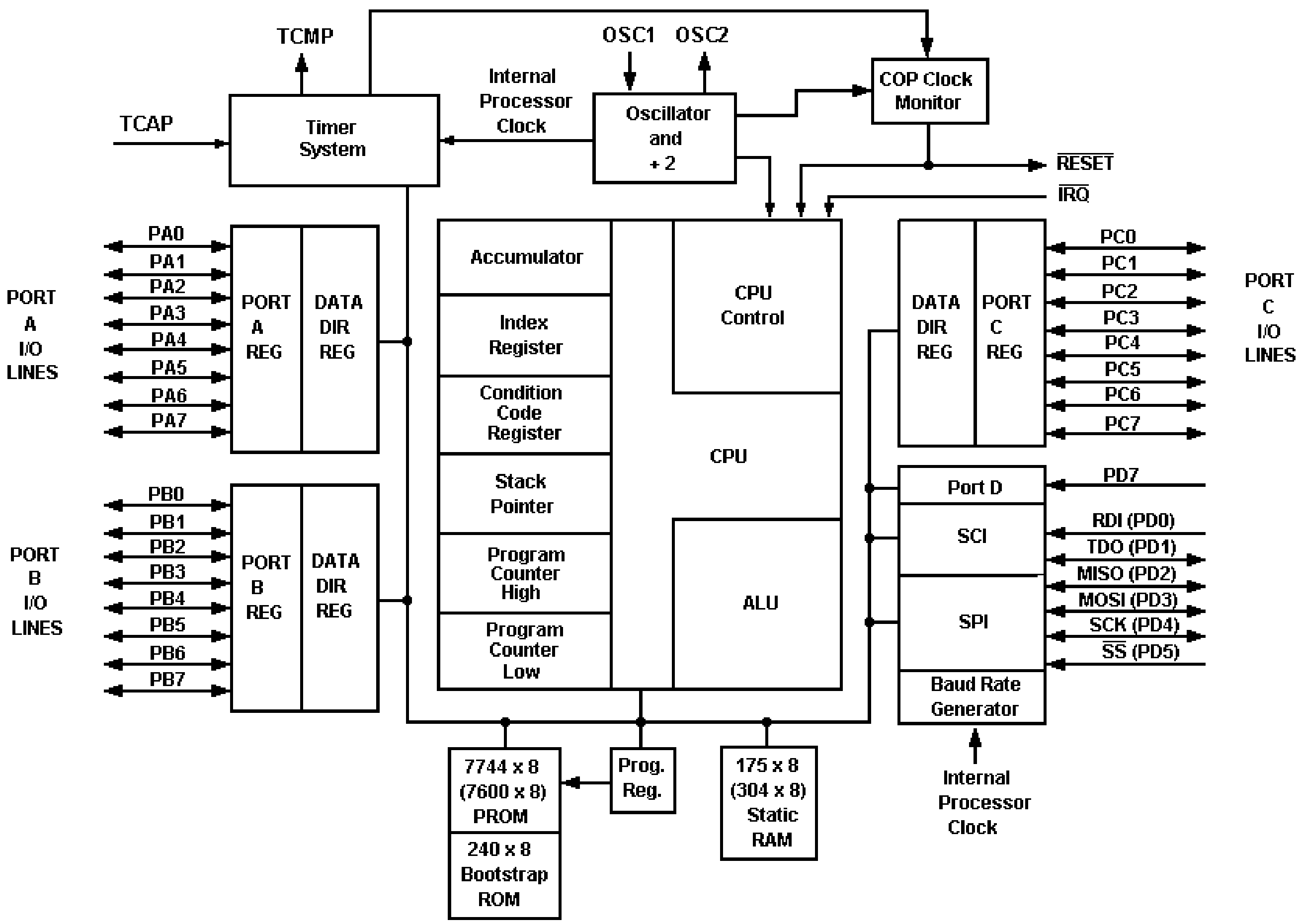
CONTROL BOARD
2.5 VOLT REFERENCE U7
19A149634P1



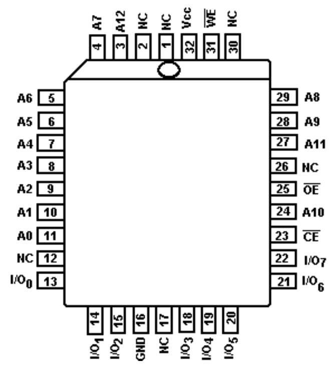
CONTROL BOARD
AUDIO AMPLIFIER
19A705452P2

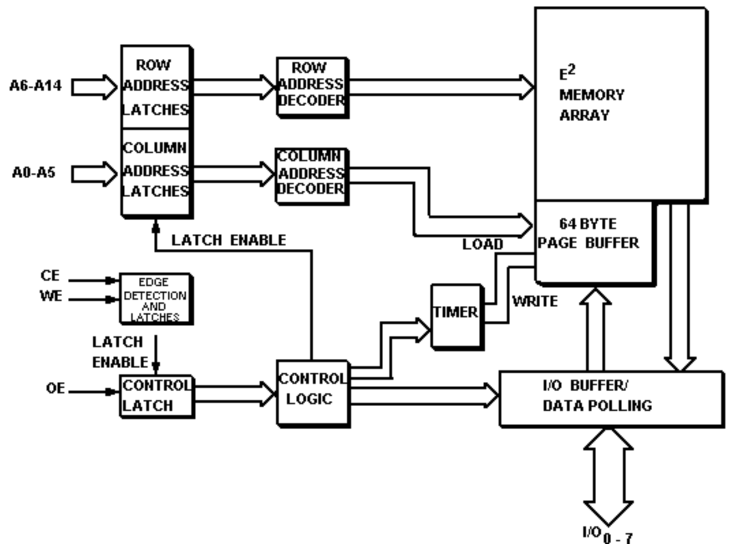


BLOCK DIAGRAM

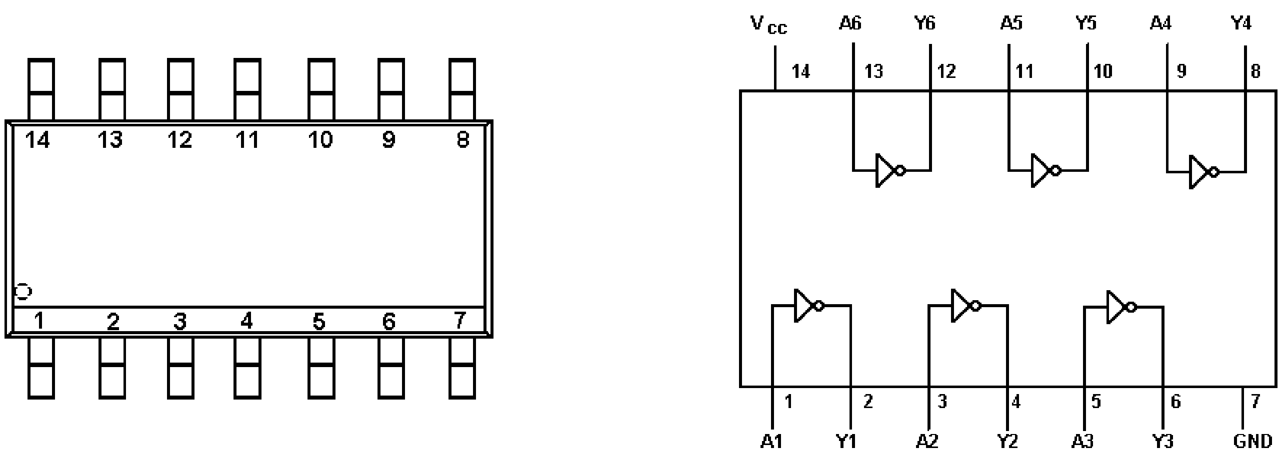


CONTROL BOARD
MICROPROCESSORS U10, U14
19A705949, 19A705950

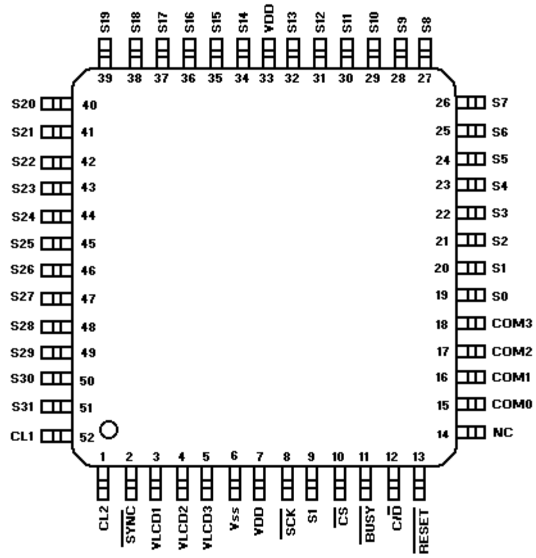


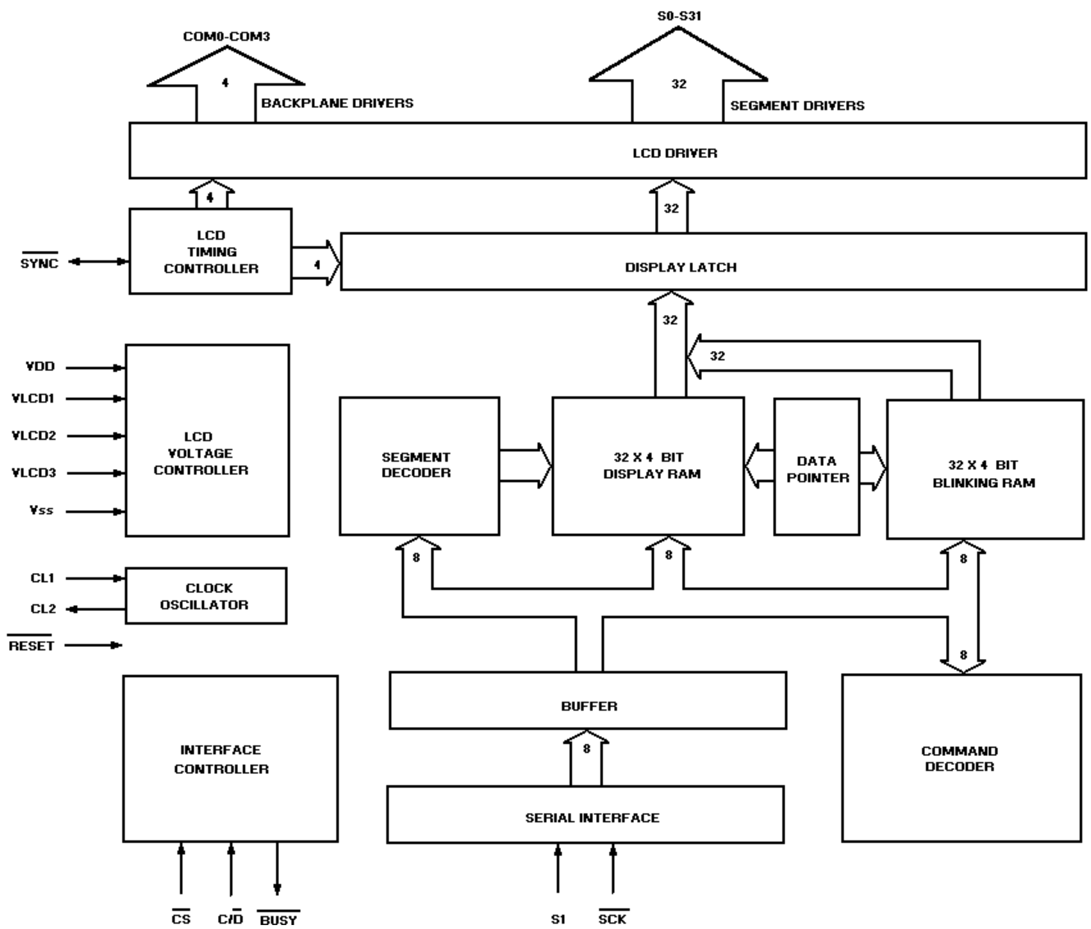


CONTROL BOARD
EEPROM U11
19A149755P1



CONTROL BOARD
HEX INVERTER U12
19A703483P104

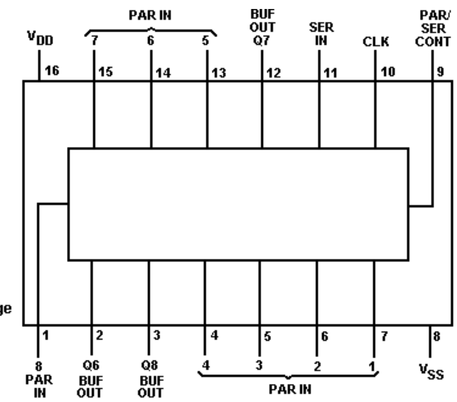


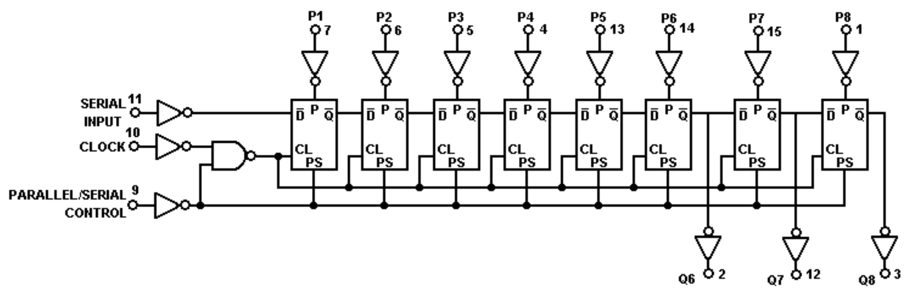


LCD BOARD
CONTROLLER/DRIVER U1
19A705799P1

CL*	Serial Input	Parallel/ Serial Control	PI 1	PI n	Q1 (Internal)	Qn	
X	X	1	0	0	0	0	
X	X	1	0	1	0	1	
X	X	1	1	0	1	0	
X	X	1	1	1	1	1	
_/‾	0	0	X	X	0	Q_{n-1}	
_/‾	1	0	X	X	1	Q_{n-1}	
‾_	X	0	X	X	Q1	Q_n	No Change

* Level change
X = Don't care case

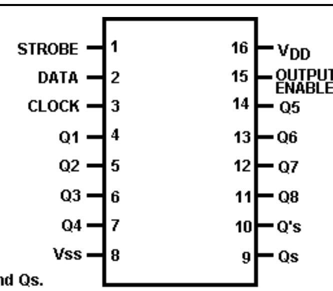


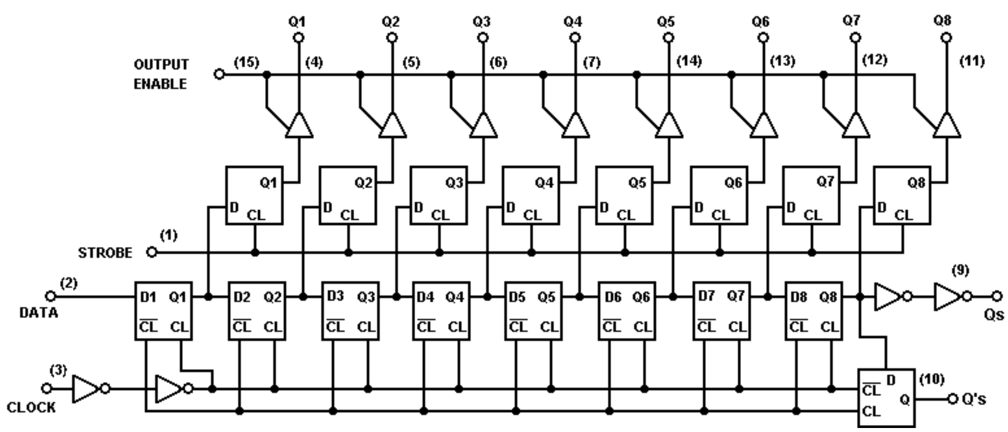


KEYPAD FLEX
SHIFT REGISTER U1
19A704423P2

Clock	Output Enable	Strobe	Data	Parallel Outputs		Serial Outputs	
				Q1	QN	Qs*	Q's
_/‾	0	X	X	Hi-Z	Hi-Z	Q7	No Chg.
‾_	0	X	X	Hi-Z	Hi-Z	No Chg.	Q7
_/‾	1	0	X	No Chg.	No Chg.	Q7	No Chg.
_/‾	1	1	0	0	QN−1	Q7	No Chg.
_/‾	1	1	1	1	QN−1	Q7	No Chg.
‾_	1	1	1	No Chg.	No Chg.	No Chg.	Q7

X = Don't Care
*At the positive clock edge, information in the 7th shift register stage is transferred to Q8 and Qs.





KEYPAD FLEX
SHIFT REGISTER U2
19A704423P3

(This page intentionally left blank)

Ericsson Inc.
Private Radio Systems
Mountain View Road
Lynchburg, Virginia 24502
1-800-528-7711 (Outside USA, 804-528-7711)

Printed in U.S.A.