

MAINTENANCE MANUAL
FOR 378-500 MHz
PERSONAL TWO-WAY FM RADIO COMBINATION

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INTRODUCTION

The recommended troubleshooting procedure, as illustrated in Figure 1, is to isolate the fault to a specific section of the M-RK Personal radio; the radio section; the logic section or the battery pack. Then further localize the fault to a specific stage of the suspected section. The last step is to isolate and identify the defective component.

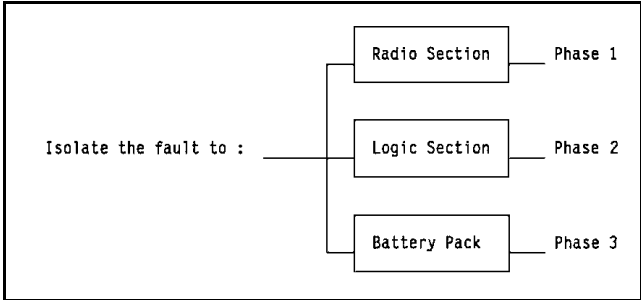


Figure 1 - Recommended Troubleshooting Procedure

The following list of test equipment is recommended when servicing or troubleshooting the M-RK Personal Radio.

Recommended Test Equipment :

- Audio Analyzer
- Digital Voltmeter
- DC Power Supply
- Multimeter
- Oscilloscope

Servicing Setup

The servicing setup is shown in Figures 2 thru 5. This illustrates the test boxes, cables, etc. required when the M-RK needs to be disassembled for troubleshooting or servicing.

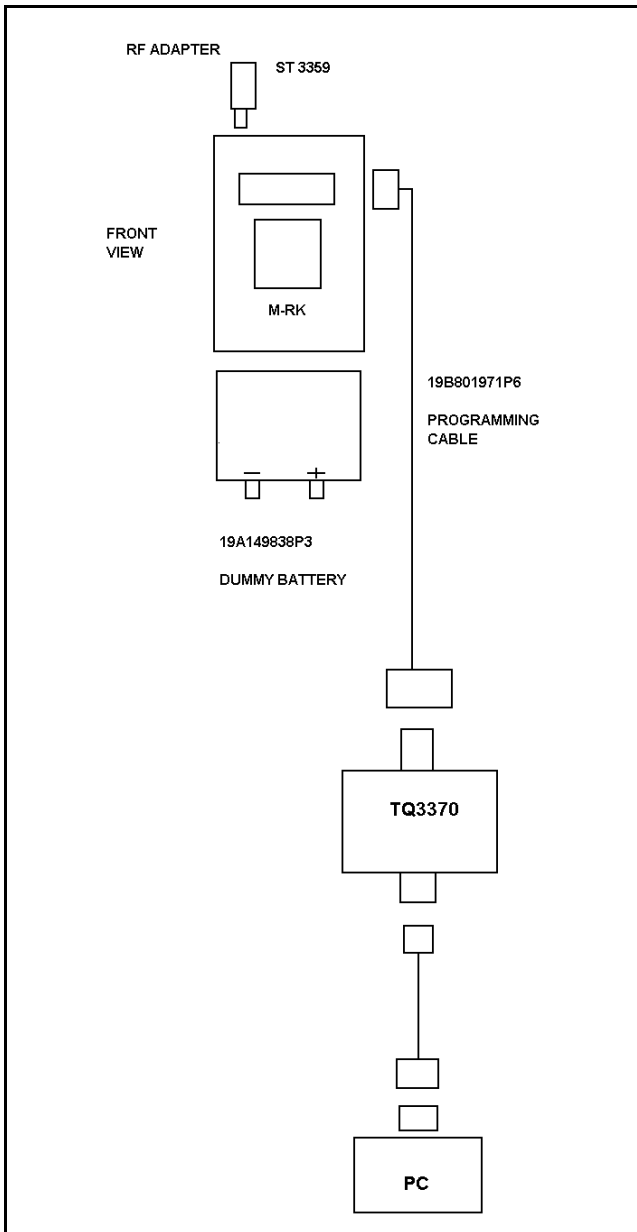


Figure 2 - M-RK Programming Mode

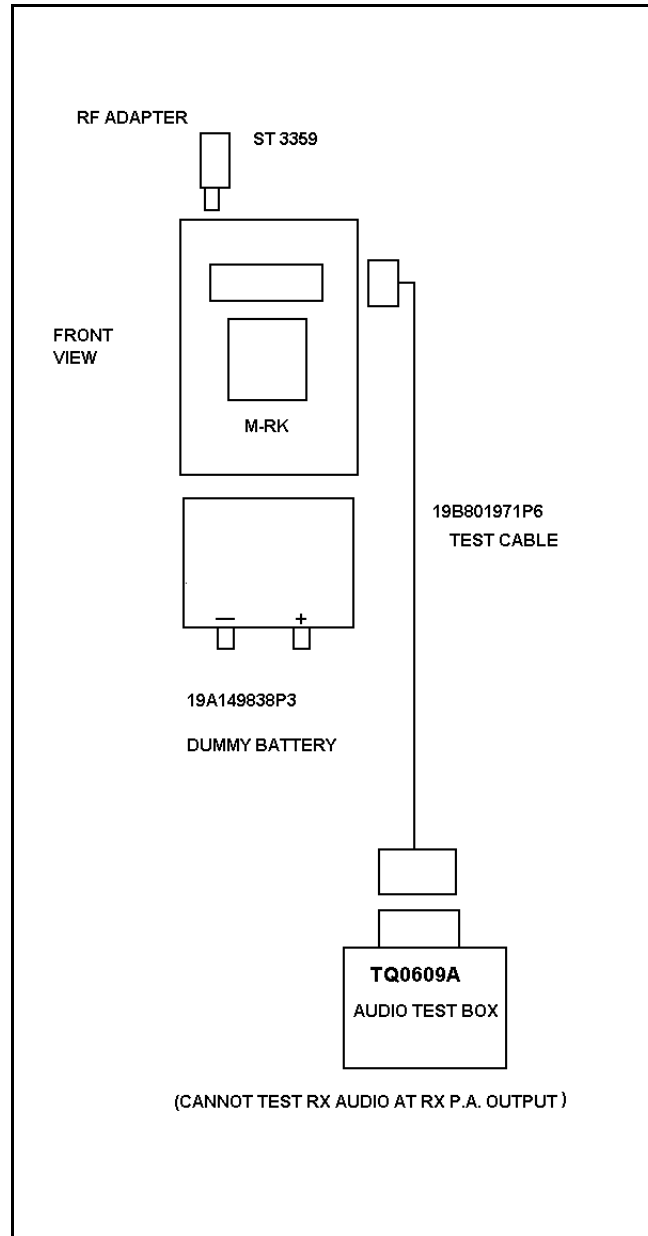


Figure 3 - Normal M-RK Test Mode

Maintenance/Warranty

1. Repair and Return is available at Authorized Service Centers (ASC) or at Ericsson Inc., in Lynchburg, VA.
2. Board level Repair and Return is recommended. Servicing to component level is not recommended.
3. Parts and components available through Service Parts are shown and listed in LBI-38746. When ordering replacement parts, please add the prefix "K19/" to the listed part number.
4. Standard warranty (3 months labor, 12 months parts) applies. Option PKCSIP extends labor warranty to 12 months.

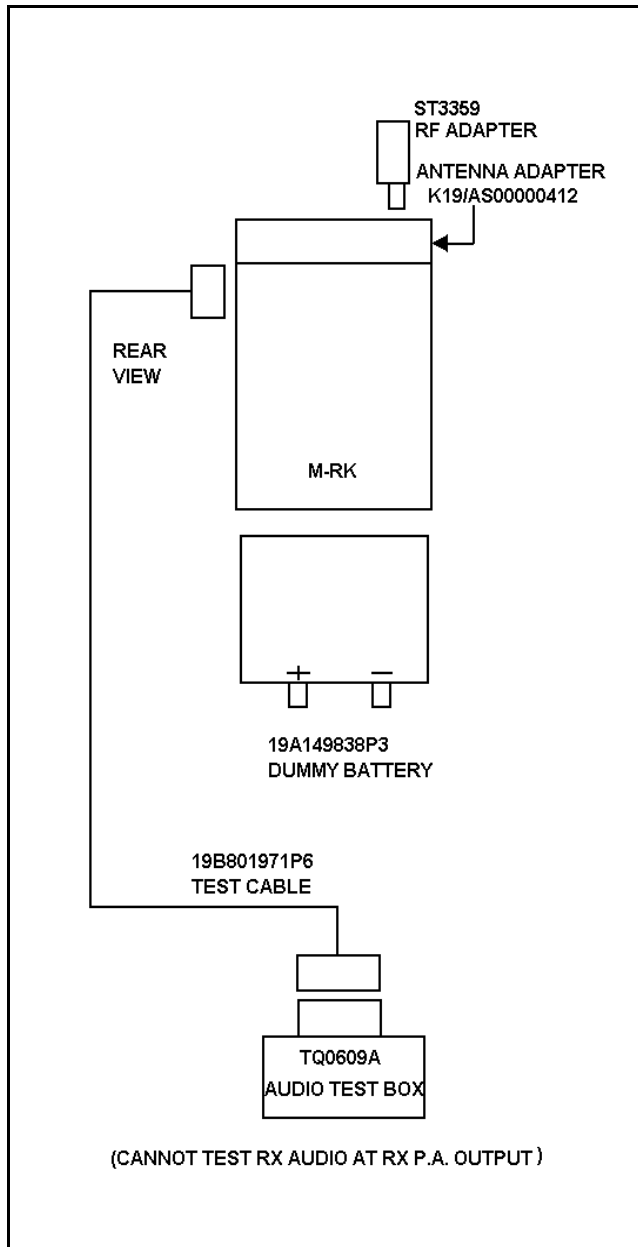


Figure 4 - M-RK Test Mode
(Rear Cover Removed)

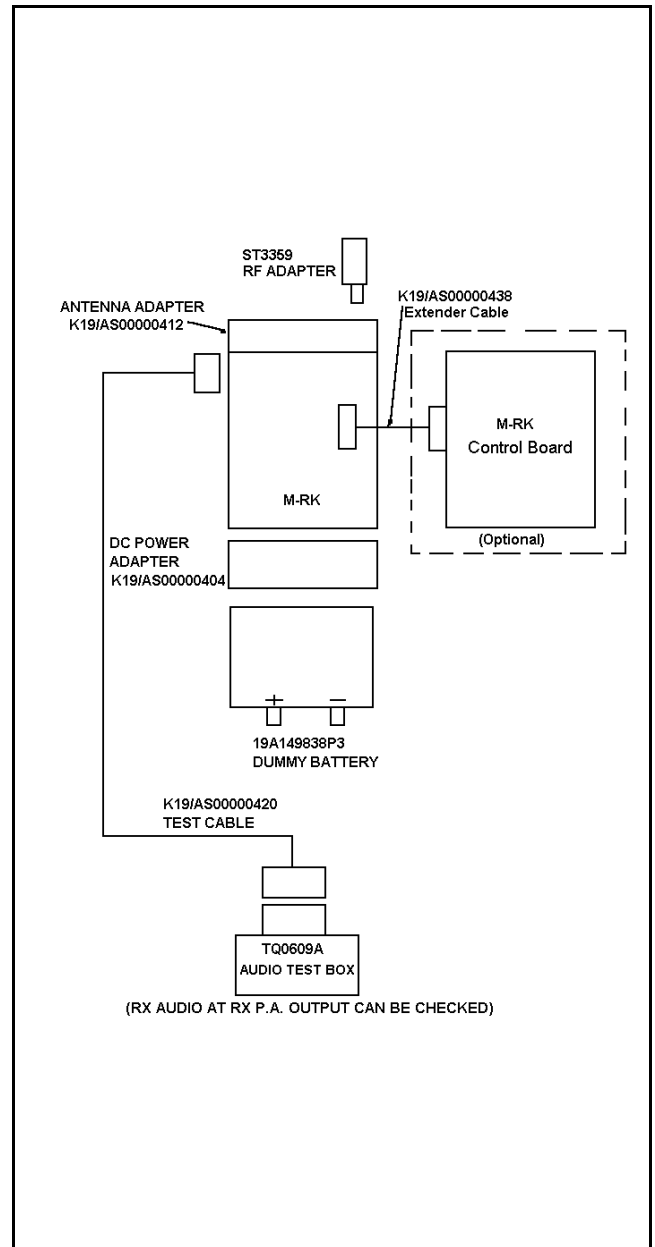


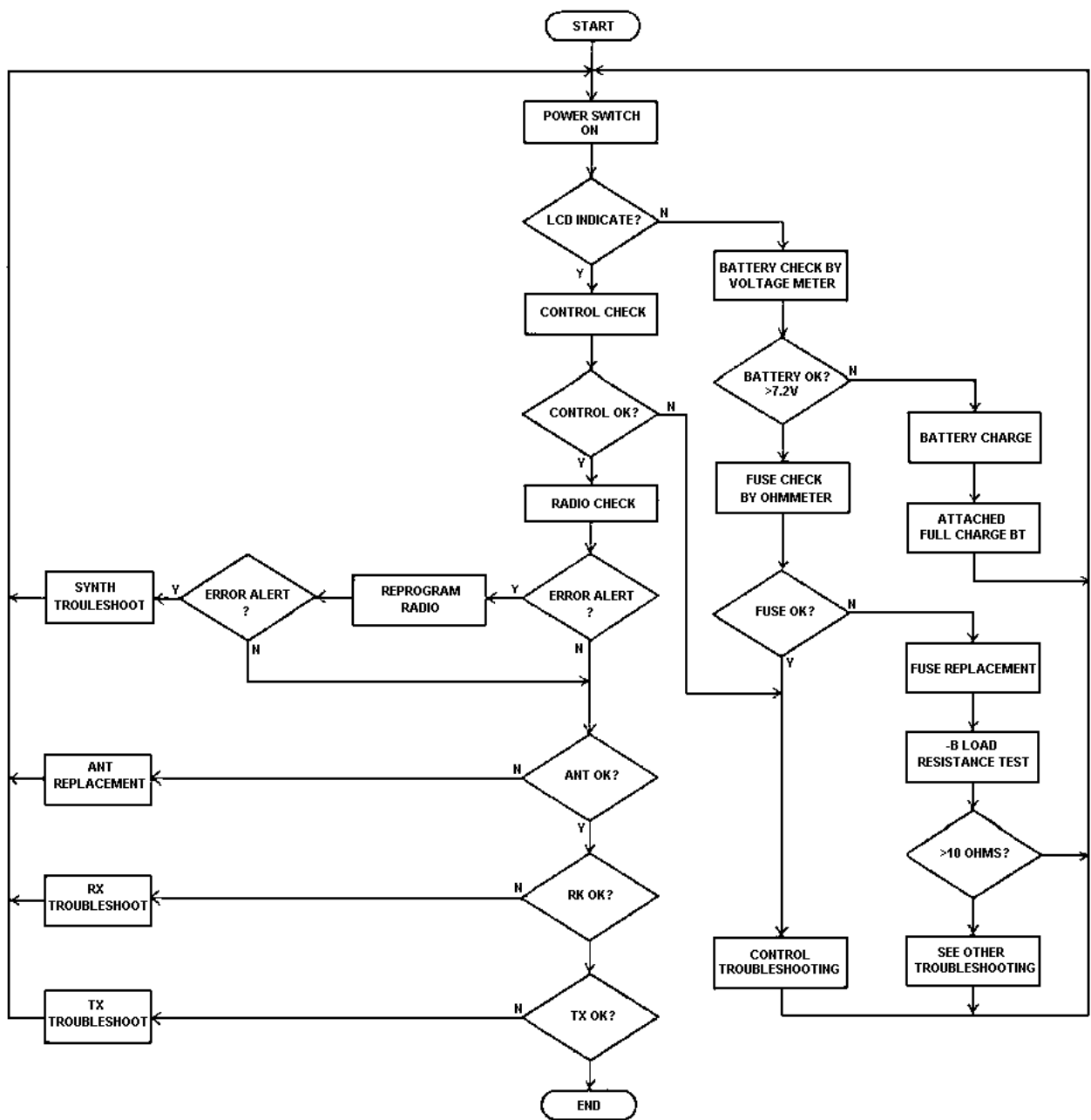
Figure 5 - M-RK Test Mode
(Front & Rear Covers Removed)

PHASE 1 : RADIO SECTION TROUBLESHOOTING

Functional Troubleshooting

Once the fault has been isolated to the radio section, the next step is to further isolate the fault to a specific stage of the radio section; Frequency Synthesizer (SYN), Receive (RX) and Transmit (TX). The flowchart (See Page 2) will assist in isolating the fault to a specific stage of the radio section.

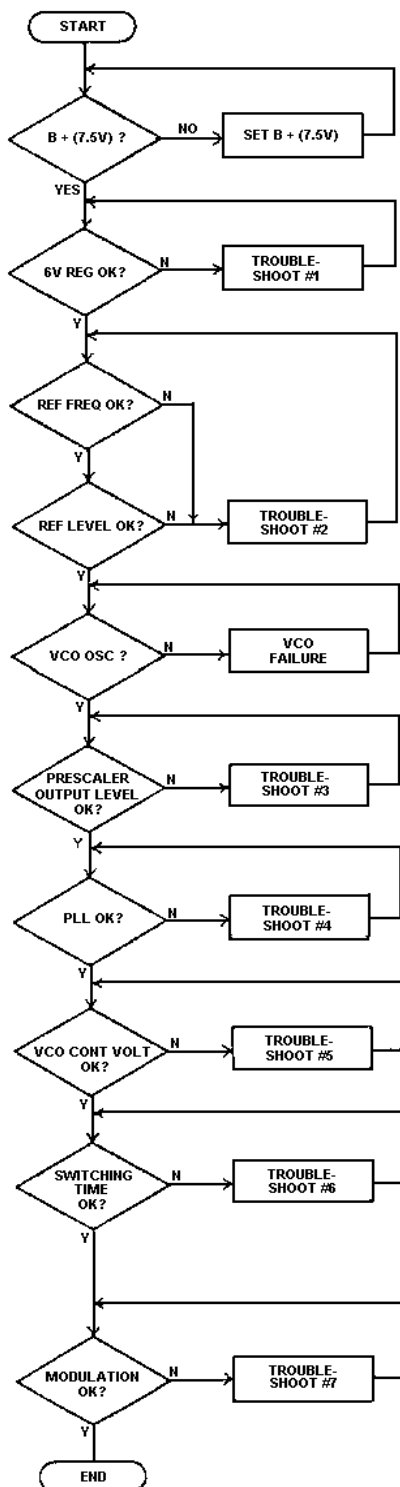
Functional Troubleshooting Flowchart:



SYNTHESIZER

The following flowchart can be used to isolate a defective stage in the synthesizer circuit.

Synthesizer Flowchart:



Troubleshooting for the Synthesizer :

1. 6.0 Volt Regulator

The 6.0 volt regulator consists of regulator U6 and transistor Q105. If a fault is found with the regulated 6.0 volt output line, trace the fault source along this line back to the regulator. A typical current flowing is 30 mA. Typical voltages for the synthesizer are shown in Table 1 or 2.

Any repair should be made so that the current and voltage at each assembly and component agrees with the typical value.

2. Reference Oscillator VCTCXO (Z1)

The reference oscillator is contained in one assembly. Typical data, when the reference oscillator is working properly, is shown in Table 3.

3. Prescaler Output Level

VCO U5 has an output level of about 0 dBm. Part of the VCO output is applied to the input of buffer amplifier transistor Q101 through a capacitor. After amplification, the output is applied to the input of the Prescaler, which is operating under 128/129 modulus control. A typical prescaler output level is 1 volt p-p, which is applied to the input of the PLL.

When checking the prescaler, refer to the typical value on Table 1 or 2.

4. Phase-Lock-Loop (U2)

- Check for approximately 1 to 2 volts p-p reference signal input at Pin 2 of U2.
- Check that the reference signal frequency is 13.2 MHz (12.8 MHz, switchable) and that frequency stability is ± 5 PPM. (± 2 PPM, switchable).
- Measure the input from the prescaler at Pin 10 of U2 and verify approximately 1 volt p-p input level.
- Verify that approximately 5 volts p-p (V_{SS} - V_{CC}) control pulse is present at Pin 8 of prescaler control U2.

Table 1 - Synthesizer Portion Typical Voltages - UHF

No.	Test Points	Voltage (V)	Remarks
1	U1 (1)	3.0	
2	U1 (2)	5.3	
3	U1 (3)	0 (GND)	
4	U1 (4)	1.2p-p	V _L : 3.2, V _H : 4.4
5	U1 (5)	0 (GND)	
6	U1 (6)	4.8p-p	V _L : 0.6, V _H : 5.4
7	U1 (7)	—	
8	U1 (8)	3.0	
9	U2 (1)	4.4	
10	U2 (2)	1.6p-p	V _L : 1.6, V _H : 3.2
11	U2 (5) (19)	5.6	
12	U2 (6) (17)	0.9(RX), 1.0(Tx)	at low end frequency
13	U2 (8)	4.8p-p	V _L : 0.6, V _H : 5.4
14	U2 (9)	5.5	
15	U2 (10)	1.2p-p	V _L : 1.8, V _H : 3.0
16	U2 (11)	0	
17	U2 (12)	0	
18	U2 (13)	0	
19	U2 (15)	1.6o-p(Rx), 1.7o-p(Tx)	at low end frequency
20	U2 (18)	0.2p-p	V _L :1.6,V _H :1.8(Rx), V _L :1.8,V _H :2.0(Tx),
21	U2 (20)	4.2	
22	Z1 (3)	5.2	
23	U4 (1)	1.1(Rx), 1.3 (Tx)	at low end frequency
24	U4 (2)	0.9(Rx), 1.0 (Tx)	
25	U4 (3)	0.9 (Rx), 1.0(Tx)	at low end frequency
26	U4 (4) (5)	0 (GND)	
27	U4 (6)	0 (GND)	
28	U4 (7)	—	
29	U4 (8)	7.4	
30	U3 (9) (10)	1.1(Rx), 1.3(Tx)	at low end frequency (Hi impedance)
31	U3 (8) (11)	1.1(Rx), 1.3(Tx)	at low end frequency
32	U3 (6) (12)	0	

No.	Test Points	Voltage (V)	Remarks
33	U3 (5) (13)	0 (GND)	
34	U3 (7)	0 (GND)	
35	U3 (2) (3)	0 (GND)	
36	U3 (1) (4)	0 (GND)	
37	U3 (14)	6.0	
38	U5 (1)	0.1 (Rx), 3.9(Tx)	
39	U5 (3)	0	
40	U5 (4)	5.2	
41	U5 (5)	0	
42	U5 (7)	5.0(Rx), 0.2(Tx)	
43	U5 (10)	5.1	
44	U5 (12)	1.1(Rx), 1.3(Tx)	at low end frequency (Hi impedance)
45	U5 (2) (6) (8) (9) (11) (13) (14)	0 (GND)	
46	Q101 Base	1.4	
47	Q101 Emitter	0.6	
48	Q101 Collector	6.0	
49	Q102 (1)	5.0 (Rx), 0.2(Tx)	
50	Q102 (2) (3)	0.1(Rx), 3.9(Tx)	
51	Q102 (4)	5.0 (Rx), 0(Tx)	
52	Q103 (5) (6)	0 (GND)	
53	Q103 Base	1.2	
54	Q103 Emitter	0.6	
55	Q103 Collector	6.7	
56	Q105 (1)	0 (GND)	
57	Q105 (2)	7.5	
58	Q105 (3)	0	
59	Q106 Base	5.8	
60	Q106 Emitter	5.2	
61	Q106 Collector	6.0	
62	Q107 Base	7.4	
63	Q107 Emitter	6.8	
64	Q107 Collector	7.5	

Table 2 - Synthesizer Portion Typical Voltages - UHF Switchable

No.	Test Points	Voltage(V)	Remarks
1	U1 (1)	3.0	
2	U1 (2)	5.3	
3	U1 (3)	0 (GND)	
4	U1 (4)	1.2p-p	VL : 3.2, VH : 4.4
5	U1 (5)	0 (GND)	
6	U1 (6)	4.8p-p	VL : 0.6, VH : 5.4
7	U1 (7)		
8	U1 (8)	3.0	
9	U2 (1)	4.4	
10	U2 (2)	1.6p-p	VL : 1.6, VH : 3.2
11	U2 (5)(19)	5.6	
12	U2 (6)(17)	0.9(RX), 1.0(Tx)	at Low end frequency
13	U2 (8)	4.8p-p	VL : 0.6, VH : 5.4
14	U2 (9)	5.5	
15	U2 (10)	1.2p-p	VL : 1.8, VH : 3.0
16	U2 (11)	0	
17	U2 (12)	0	
18	U2 (13)	0	
19	U2 (15)	1.6o-p (RX), 1.7o-p (Tx)	at Low end frequency
20	U2 (18)	0.2p-p	VL : 1.6, VH : 1.8 (Rx), VL : 1.8, VH : 2.0 (Tx)
21	U2 (20)	4.2	
22	Z1 (3)	5.2	
23	U4 (1)	2.5 (Rx), 2.5 (Tx)	at Low end frequency
24	U4 (2)	2.5 (Rx), 2.5 (Tx)	at Low end frequency
25	U4 (3)	2.5 (Rx), 2.5 (Tx)	at Low end frequency
26	U4 (4)	0 (GND)	
27	U4 (5)	0.8	
28	U4 (6)	0.8	
29	U4 (7)	1.1	
30	U4 (8)	7.4	
31	U3 (8) (10)	1.1 (Rx), 1.3 (Tx)	at Low end frequency (Hi impedance)
32	U3 (9) (11)	1.1 (Rx), 1.3 (Tx)	at Low end frequency
33	U3 (6) (12)	0	
34	U3 (3) (4)	2.5 (25kHz), 2.5 (12.5kHz)	

No.	Test Points	Voltage(V)	Remarks
35	U3 (5)	0 (25kHz), 5.0 (12.5kHz)	
36	U3 (2)	0 (GND)	
37	U3 (1)	0 (GND)	
38	U3 (14)	6.0	
39	U5 (1)	0.1(Rx), 3.9 (Tx)	
40	U5 (3)	0	
41	U5 (4)	5.2	
42	U5 (5)	0	
43	U5 (7)	5.0 (Rx), 0.2 (Tx)	
44	U5 (10)	5.1	
45	U5 (12)	1.1 (Rx), 1.3 (Tx)	at Low end frequency (Hi impedance)
46	U5 (2) (6) (8) (9) (11) (13) (14)	0 (GND)	
47	Q101 Base	1.0	
48	Q101 Emitter	0.6	
49	Q101 Collector	6.0	
50	Q102 (6)	5.0 (Rx), 0.2 (Tx)	
51	Q102 (1) (4)	0.1 (Rx), 3.9 (Tx)	
52	Q102 (3)	5.0 (Rx), 0 (Tx)	
53	Q103 (2)	0 (GND)	
54	Q103 Base	1.2	
55	Q103 Emitter	0.6	
56	Q103 Collector	6.7	
57	Q105 (2)	0 (GND)	
58	Q105 (3)	7.5	
59	Q105 (4)	0	
60	Q105 (6)	7.5(Rx), 0 (Tx)	
61	Q105 (1)	0 (Rx), 5.0 (Tx)	
62	Q106 Base	5.8	
63	Q106 Emitter	5.2	
64	Q106 Collector	6.0	
65	Q107 Base	7.4	
66	Q107 Emitter	6.8	
67	Q107 Collector	7.5	

- e. Cause the PLL to unlock. Then check for the presence of approximately 5 volts p-p (V_{ss}-V_{cc}) PD and FD pulse outputs at Pin 6 and Pin 17 of U2 respectively. Also check for approximately 6 volts p-p (V_{ss}+B) at Pin 1 of U4. If the pulse output is absent or shifted to either the V_{ss} or the V_{cc} side, the PLL may fail to lock over a certain section of the frequency range or the entire range. If this fault occurs, the possible trouble source is ramp resistor R111, ramp capacitor C131 or hold capacitor C132.
- f. Verify that the local voltages at the test points listed on Table 1 agree with the typical values also listed on Table 1 or 2.
- g. Verify that the CLOCK, DATA, ENABLE and WIDE/NARROW signals coming from the Control Board are at the proper level and the proper duration (refer to Figure 6).

If the CLOCK and DATA are improper, the PLL operation will become erratic. If the duration of the W/N pulse is shorter than 10 milliseconds, which is the minimum value, the PLL may fail to lock.

NOTE

If parts other than those specified in the parts list are used in the associated circuit of the PLL, the switching time may be affected. Whenever any parts are replaced in the associated circuit, check the switching time.

Table 3 - Typical Data For The Reference Oscillator

Item	Typical Value	Remarks
Supply Voltage	5.3 Vdc	
Current Drain	1.5 to 1.8 mA	
Output Frequency	13.2 MHz 12.8 MHz (Switchable)	5 PPM 2 PPM
Output Level	1 to 2 Vp-p	

- 5. VCO Control Voltage
 - a. VCO Control Voltage should be
 - Approximately 1 volt or more at the lowest channel of any band.
 - Approximately 4.5 volts or less at the highest channel of any band.

Verify the VCO control voltage at the testpoint TPPD using a high impedance oscilloscope.

6. Switching Time

The channel frequency must be locked within 10 milliseconds, which is the duration of the Wide/Narrow pulse. That is, the switching time is restricted by the Wide/Narrow pulse.

- a. Switching time is largely influenced by the leakage current characteristics of C133 and C152. Be sure to use parts having the ratings specified when replacing these parts. Also, if moisture collects on the printed wire board, the insulation resistance of the board may be lowered, also affecting the switching time.
- b. The channel switching sequence and the action of the related functions are shown in Figure 7.

7. Modulation Degree vs Modulation flatness :

The M-RK equipment can be modulated with audio beginning with 10 Hz. For this reason, the same modulation signal is applied to both VCO and VCTCXO in phase. The modulation signal of low frequencies below 10 to 30 Hz, modulates the VCTCXO output whereas the high frequency signals modulate the VCO. Modulation characteristics can be adjusted using modulation adjust controls R120 and R121 as follows :

NOTES

1. Modulation flatness is to be adjusted with the radio section only. This means that the TX MOD signal which exits the control board at P1-2B must be disconnected from where it normally enters the radio board at J1-2B. Using an external audio signal generator, inject an audio signal into the radio board at J1-2B. The recommended method would be to use Extender Cable K19/AS00000438 to separate the control board from the radio board, open-circuit the wire that connects P1-2B to J1-2B, and inject the audio signal directly into J1-2B.
2. For this adjustment, select the center channel.

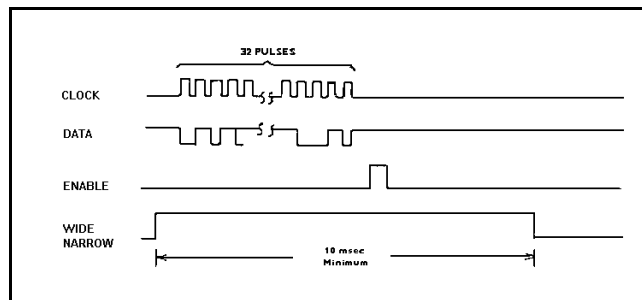


Figure 6 - Clock, Data, Enable, and Wide/Narrow Signals

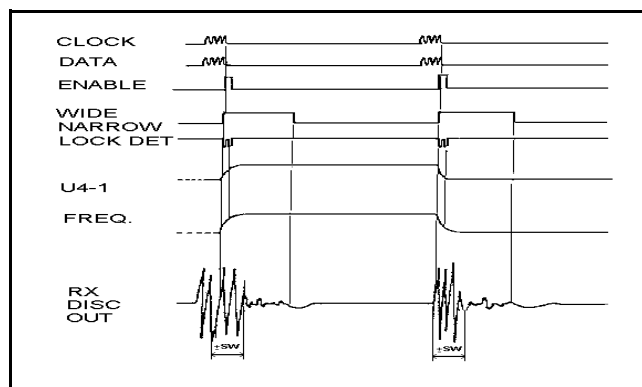


Figure 7 - Channel Switching Sequence

1. Apply a 0.45 Vrms signal at 1 kHz to the radio board TX MOD input at J1-2B and adjust R121 for ± 3 kHz deviation.
2. Change the signal frequency to 10 Hz. Adjust R120 for ± 3 kHz deviation.
3. Change the signal to a 10 Hz rectangular waveform signal. Then, the demodulated output from the modulation analyzer should look like Figure 8. If the level adjustments under step 1 and 2 are out of balance, the rectangular waveform will be distorted (refer to Figure 8).

NOTE

For this test, the modulation analyzer must have low frequency response to less than 1 Hz.

4. Change the carrier frequency to the highest channel of the band and then to the lowest channel. Check the modulation flatness each time (refer to Figure 9).

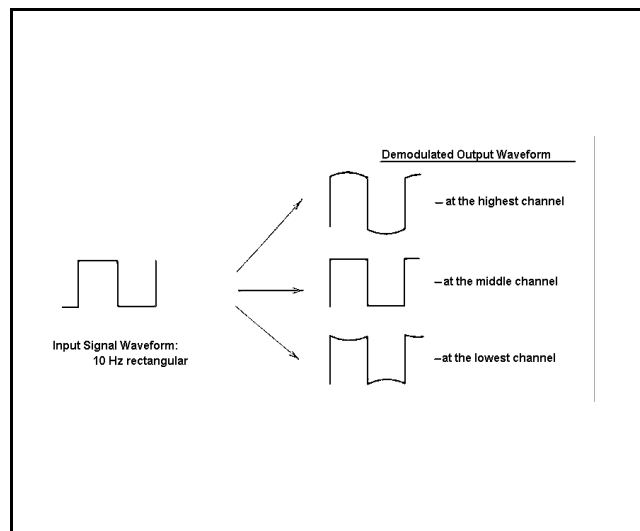


Figure 8 - Typical Rectangular Waveform of Demodulated Output

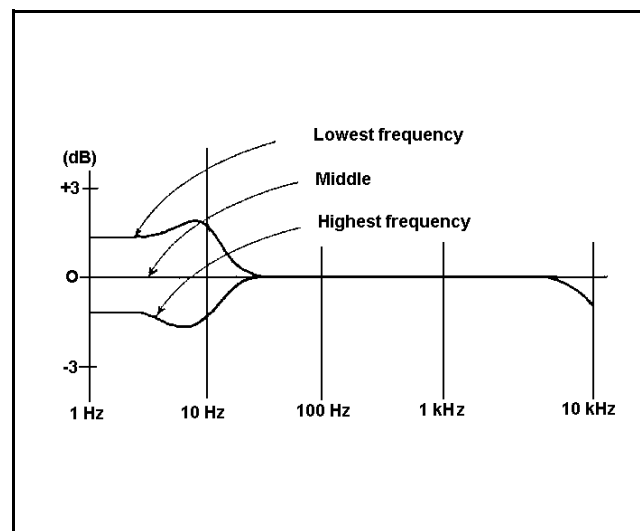


Figure 9 - Typical Modulation Frequency Characteristics

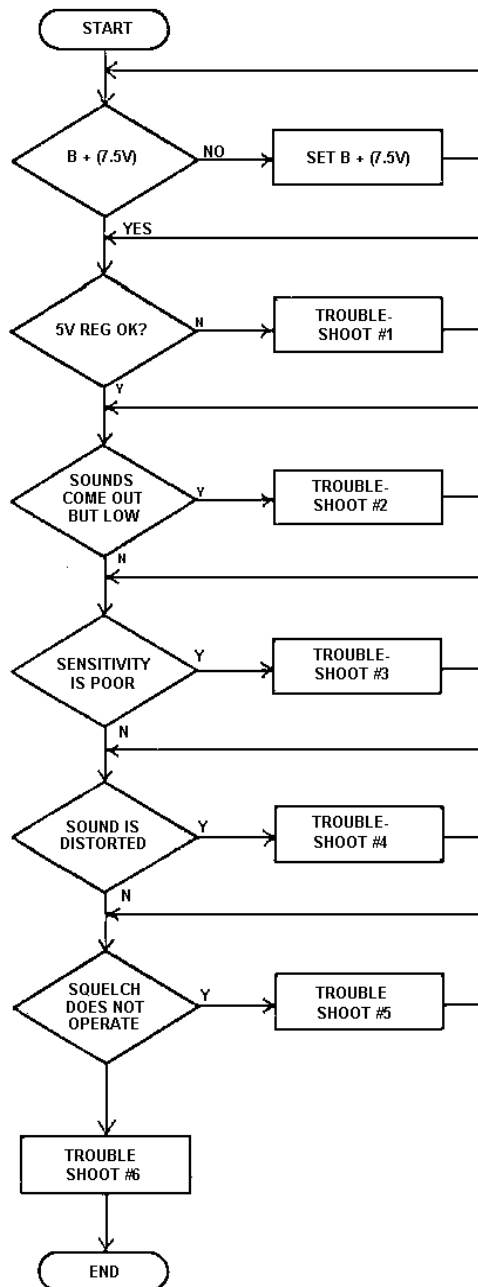
If a large level difference is found between the modulation characteristics at 10 Hz and those at 100 Hz when the carrier frequency is changed from the highest to the lowest, the problem is with the VCO modulation characteristics.

When the waveform of the demodulated output is distorted for a modulation frequency of 10 Hz or lower, the problem is with the VCTCXO. If the distortion is substantial, the carrier frequency may be affected by modulation.

Receive

The following flowchart can be used to isolate a defective stage in the receive circuit.

Flowchart:



Troubleshooting for the Receiver :

1. Measure the voltage of U10 input and output. If the voltage of U10 input is 7.5 V and the voltage of U10 output is not 5 +0.2V, U10 (voltage regulator) is probably no good.
2. If sound comes out of the receiver, but the volume does not increase, the problem may be due to either the Radio section or the Logic section.
 - a. Radio Section : Check the output signal for about 317 mVp-p at the audio terminal of the RX section (J1 Pin 3B) when a standard modulated signal (1 kHz at 3.0 kHz frequency deviation) of 0.5mVrms (-53 dBm) is supplied at the antenna terminal or UDC RF Connector. If the signal level at the audio terminal of the Rx is substantially low after return R312, IC U11 is suspected to be defective.
 - b. Control Board : The receive RF signal comes into P1, Pin 3B. The signal is then applied through a 14dB amplifier, 300-3000Hz BPF, de-emphasis and a 44 dB volume level control. The signal is then amplified by SPK amplifier U11 to drive the speaker. Typical levels needed to obtain a 1 kHz, 0.5 watt receive rated audio output are shown in Figure 10.
3. When receive sensitivity is poor, refer to the radio section Schematic Diagram and typical voltages shown on Table 4 or 5. The receive section consists of low noise amplifier Q301, local oscillator amplifier Q103, If amplifier Q302 and second If circuit IC U11.
 - a. Level Diagram: A frequency Relationship Diagram is shown in Figure 11 and a Typical Level Diagram is shown in Figure 12.
 - b. Adjustments :
 - (1) C318 is provided for the adjustment of the second local oscillator.
 - (2) When the desired channel frequency with standard modulation is applied to the antenna terminal, adjust C323 for maximum output at RX Audio.

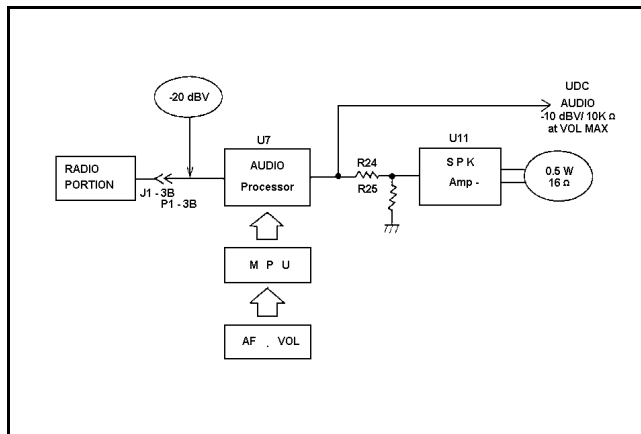


Figure 10 - Receive Audio Output

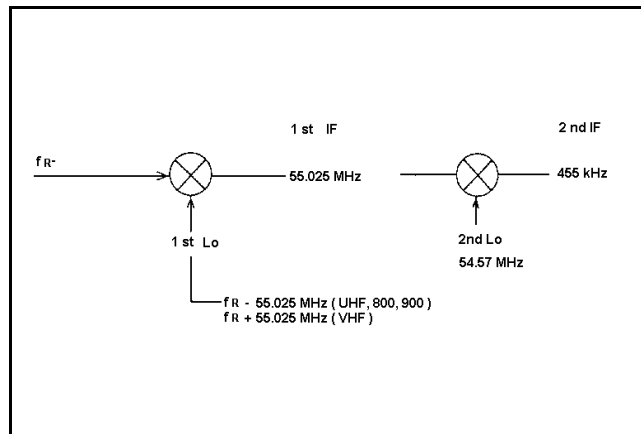


Figure 11 - Frequency Relationship Diagram

- (3) Adjustment of L304 and L306
 - (a) Adjust L304 and L306 in this order to obtain the best SINAD sensitivity.
 - (b) Next, adjust L304 and L306 in this order to obtain the minimum distortion of RX Audio Output when receiving a standard modulated signal at 0.5mVrms.
 - (c) If there is more than half a turn difference in the settings of L304 and L306 in the adjustments steps a. and b. above, a defective L304, L306 or the matching circuit is likely.

- c. Receiver first Local Oscillator Level : Local input level to Z2 is designed to be +7 dBm/50 ohms. Generally the input level is +6 to +8 dBm. If local input level is 3 dBm or less, sensitivity, intermodulation and If/2 spurious will be degraded.
- d. If the receive sensitivity changes by more than 5 dB across the band a circuit defect associated with FL301 and FL302 is likely.

Band	Receive Band
VHF	24 MHz
UHF	30 MHz
800 MHz	18 MHz
900 MHz	6 MHz

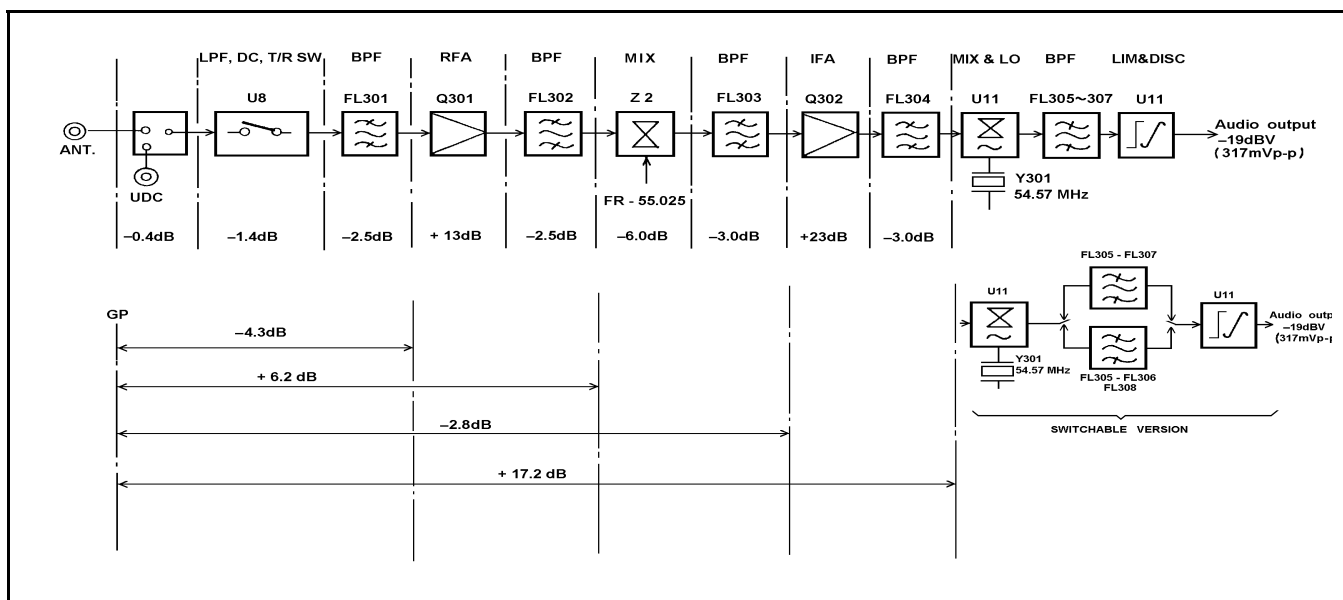


Figure 12 - Typical Level Diagram

Table 4 - Receive Section Typical Voltages

No.	Test Points	Voltage (V)	Remarks
1	Q301 Base	1.5	
2	Q301 Emitter	0.8	
3	Q301 Collector	5.8	
4	Q302 Base	1.2	
5	Q302 Emitter	0.4	
6	Q302 Collector	4.0	
7	U10 (1)	0 (GND)	
8	U10 (2)	7.4	
9	U10 (3)	5.0	
10	U11 (1) (13) (20)	0 (GND)	
11	U11 (2)	3.0	
12	U11 (3)	3.0	
13	U11 (4)	3.0	
14	U11 (5)	2.4	
15	U11 (6)	3.3	
16	U11 (7)	3.2	
17	U11 (8)	3.2	
18	U11 (9)	2.6	

No.	Test Points	Voltage (V)	Remarks
19	U11 (10)	3.3	
20	U11 (11)	0.9	
21	U11 (12)	0.6	2.2 (-53dBm)
22	U11 (14)	0.7	
23	U11 (15)	0.7	
24	U11 (16)	—	
25	U11 (17)	—	
26	U11 (18)	—	
27	U11 (19)	4.1	
28	U11 (21)	1.1	
29	U11 (22)	4.1	
30	U11 (23)	3.4	
31	U11 (24)	3.9	
32	U12 (1)	0.9	
33	U12 (2)	0.9	
34	U12 (3)	0 (GND)	
35	U12 (4)	5.0	
36	U12 (5)	5.0	

Table 5 - Receive Section Typical Voltages - UHF Switchable

No.	Test Points	Voltage (V)	Remarks
1	Q301 Base	1.5	
2	Q301 Emitter	0.8	
3	Q301 Collector	5.8	
4	Q302 Base	1.2	
5	Q302 Emitter	0.4	
6	Q302 Collector	4.0	
7	U10 (1)	0 (GND)	
8	U10 (2)	7.4	
9	U10 (3)	5.0	
10	U11 (14) (15)	0 (GND)	
11	U11 (1)	4.1	
12	U11 (2)	3.5	
13	U11 (3)	3.1	
14	U11 (4)	4.2	
15	U11 (5)	3.8	
16	U11 (6)	3.8	
17	U11 (7)	0.7	
18	U11 (8)	0.7	
19	U11 (9)	0.7	
20	U11 (10)	4.1	
21	U11 (11)	3.3	
22	U11 (12)	0.4	(-53dBm)
23	U11 (13)	0	
24	U11 (16)	1.0	
25	U12 (1)	0.8	
26	U12 (2)	0.8 (25kHz), 0.8 (12.5kHz)	
27	U12 (3)	5.0 (25kHz), 0 (12.5kHz)	

No.	Test Points	Voltage (V)	Remarks
28	U12 (4)	0 (GND)	
29	U12 (5)	0.7 (25kHz), 0.6 (12.5kHz)	
30	U12 (6)	0.7 (25kHz), 0.7 (12.5kHz)	
31	U12 (7)	5.0 (Rx), 0 (Tx)	
32	U12 (8)	5.0	
33	U13 (1) (2) (5) (6)	0	
34	U13 (3)	0 (25kHz), 5.0 (12.5kHz)	
35	U13 (4)	0 (GND)	
36	U13 (7)	0 (25kHz), 5.0 (12.5kHz)	
37	U13 (8)	5.0	
38	U14 (1) (2) (5) (6)	0	
39	U14 (3)	0 (25kHz), 5.0 (12.5kHz)	
40	U14 (4)	0 (GND)	
41	U14 (7)	0 (25kHz), 5.0 (12.5kHz)	
42	U14 (8)	5.0	
43	U15 (1)	5.0	
44	U15 (2)	5.0	
45	U15 (3)	5.0 (25kHz), 0 (12.5kHz)	
46	U15 (4)	0 (GND)	
47	U15 (5)	0 (25kHz), 5.0 (12.5kHz)	
48	U15 (6) (7)	0	
49	U15 (8)	5.0	

4. If distortion in the received signal is substantially high, try to perform checks with the Radio and Control Board individually.
 - a. Check the Local Oscillator frequency. Check the frequency after connecting a frequency counter through a 1 pF capacitor to the collector of Q103. The frequency relation at various stages is shown in Figure 12. If a frequency error is 5 PPM (UHF)(2 PPM switchable) or more in the temperature range of 20° to 25°C, adjust the frequency of VCTCXO (Z1). The frequency of VCTCXO is 13.2 MHz (12.8 MHz for switchable).
 - b. Check the Usable Band Width. Usable band width is generally ± 2.5 kHz (less in 12.5 kHz mode) or more of the desired receiving frequency. If the \pm balance is greatly different, the received signal may be distorted. This time, the problem is probably caused by FL303, FL304, FL305, FL306, FL307 (FL308, switchable) or its associated components.
 - c. Distortion Check : When the radio receives a standard modulated signal, the audio output at the Audio terminal J1-3B (PI-3B) is about 317mVp-p. At this point, the distortion will be about 5%. This is because the receiver discriminator output is connected to the RX Audio terminal and de-emphasis and BP Filtering has not, at this point, been provided. Because considerable noise is contained from low audio frequencies to high audio frequencies, use test equipment with a high input impedance (100K ohms) for the distortion measurement.
 - d. The signal from the Radio Board is applied to the Control Board at P1-3B and then to the speaker through U7 and U11. Check distortion at each point.
 - e. Even if there are no electrical problems with the audio circuits on the Control Board, the speaker itself may cause distortion mechanically. The voice coil may rub or the diaphragm may be damaged or touching another part of the radio.
5. Noise Squelch does not operate :

A part of receiver discriminator output is applied to the Control Board through J1-3B (P1-3B).

 - a. The operation of squelch is controlled by Audio Processor U7 on the Control Board.
 - b. The squelch operation level is set in the channel data E²PROM. Refer to E²PROM Programming.
6. Other Problems and Cautions :
 - a. A polyimide flex circuit is used at the LED flex Assy (M-RK I) and LCD/KB Flex Assy (M-RK II/SCAN). If Flex Assembly is repeatedly disassembled for maintenance, the flex circuit can be damaged. Accordingly, keep disassembly of the Logic Section at a minimum.

Transmit Circuit

The following flowchart can be used to isolate a defective stage in the transmit circuit. Also, refer to Table 6 or 7.

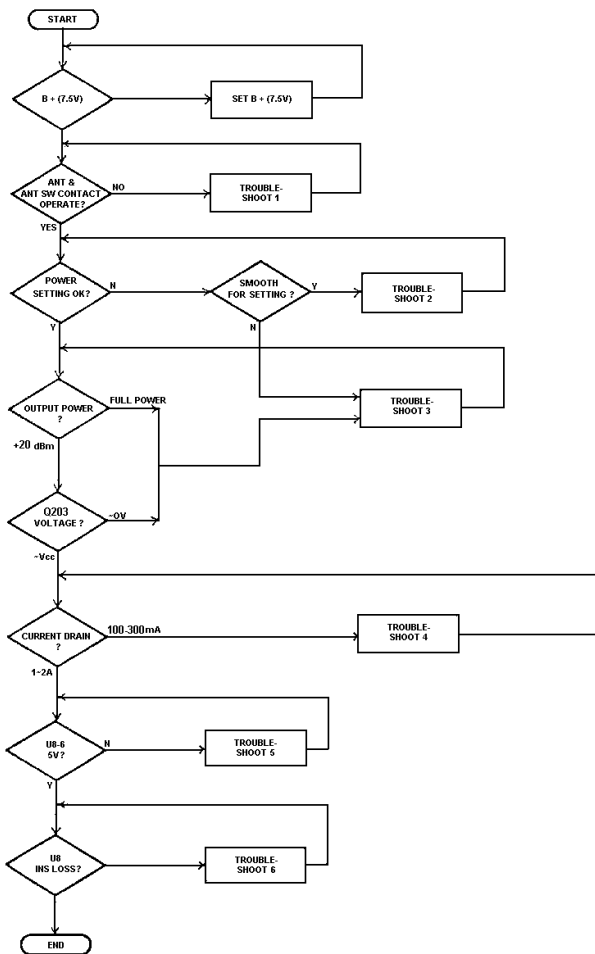
Flowchart: (Shown on page 15)

Troubleshooting for the Transmit Circuit :

1. Troubleshooting the Antenna Switch: Antenna Switch P1 (and J2) is a mechanical switch used to switch the RF signal between the antenna and the UDC RF connector J1. Periodically it is necessary to check that the antenna, the UDC RF Connector and RF Test Adapter (Coaxial Connector) are tightened securely. If the Antenna Switch does not contact properly even through the antenna and connectors are tightened securely, the contact of Antenna Switch may be defective.

As prescribed in the preventive maintenance section of the applicable maintenance manual, periodically clean the contact of the Antenna Switch by blowing compressed air on it. Otherwise, dust and dirt will collect on the contact and result in contact failure.
2. Check RF Output : If the transmit circuit can be set for the rated output, the transmit circuit is working properly.

Transmit Flowchart:

Checking

1. When the rated power output cannot be obtained smoothly, check U8.
2. If the rated power output cannot be obtained, check transistor Q203.

3. Transistor Q203 Voltage Check : When the collector voltage of transistor Q203 is about 0 volts, Q203, Q204 or U9 is probably defective.
- 4 a. If the current drain of the battery is in range of 100 to 300 milliamperes, verify that the voltage on Pin 3 of U7 is 7.3 volts. If 7.3 volts is not present at this point, the problem is with the D-PTT line (Q201, Q202). Check to see if there is an open- or a short- circuit on other lines on the Vcc line.
 - b. If 7.3 volts is present at the above pins, check that voltage at collector of Q104 . If so, then check the output level of U5 (VCOT0).
 - c. When the output of U5 is around 0 dBm, the problem is Q104. When the output level is -5 dBm or lower, the VCO in the synthesizer circuit is probably defective. Try the troubleshooting procedure for the Synthesizer to verify the trouble with the VCO.
5. Checking Voltage at U8 : Under normal conditions, the voltage at the Pin 6 of U8 is 5 volts. If 5 volts is not present at this point, refer to troubleshoot 4.
6. Checking the U8 (LPF.DC.T/R SW) Insertion Loss: If an increase in the insertion loss of the U8 is suspected, the problem is U8.

Table 6 - Typical Transmit Voltages - UHF

No.	Test Points	Voltage (V)	Remarks
1	U7 (1)	—	
2	U7 (2)	0 (Rx), 7.3 (Tx)	Changed by power level
3	U7 (3)	0 (Rx), 5.5 (Tx)	
4	U7 (4)	0 (Rx), 7.3 (Tx)	
5	U7 (5) (6)	7.4	
6	U7 (7)	—	
7	U8 (2)	—	
8	U8 (4)	0 (Rx), 2.5 (Tx)	Changed by power level
9	U8 (6)	0 (Rx), 5.0 (Tx)	
10	U8 (8)	0 (Rx), 1.6 (Tx)	
11	U8 (13)	—	
12	U8 (1) (3) (5) (7) (9) (11) (12) (14)	0 (GND)	
13	Q104 Base	0 (Rx), 1.3 (Tx)	
14	Q104 Emitter	0 (Rx), 0.6 (Tx)	
15	Q104 Collector	0 (Rx), 6.7 (Tx)	
16	Q201 (1)	7.5 (Rx), 0 (Tx)	
17	Q201 (2)	0 (Rx), 5.0 (Tx)	
18	Q201 (3)	5.0 (Rx), 0 (Tx)	
19	Q201 (4)	0 (Rx), 5.0 (Tx)	

No.	Test Points	Voltage (V)	Remarks
20	Q201 (5)	0 (GND)	
21	Q201 (6)	0 (GND)	
22	Q202 (1)	7.5 (Rx), 0 (Tx)	
23	Q202 (2)	0 (Rx), 7.3 (Tx)	
24	Q202 (3)	7.4	
26	Q203 Base	7.5 (Rx), 6.8 (Tx)	
27	Q203 Emitter	7.4	
28	Q203 Collector	0 (Rx), 5.5 (Tx)	Changed by power level
29	Q204 Base	0 (Rx), 2.1 (Tx)	Changed by power level
30	Q204 Emitter	0 (Rx), 1.5 (Tx)	Changed by power level
31	Q204 Collector	7.5 (Rx), 6.8 (Tx)	Changed by power level
32	Q205 (1)	5.0	
33	Q205 (2)	5.0 (Rx), 0 (Tx)	
34	Q205 (3)	0 (Rx), 5.0 (Tx)	
35	U9 (5)	3.6 (Rx), 1.9 (Tx)	Changed by power level
36	U9 (6)	0 (Rx), 1.9 (Tx)	Changed by power level
37	U9 (7)	0 (Rx), 2.1 (Tx)	Changed by power level
38	U9 (8)	0 (Rx), 4.9 (Tx)	
39	U9 (2) (3) (4)	0 (GND)	

Table 7 - Typical Transmit Voltages - UHF Switchables

No.	Test Points	Voltage (V)	Remarks
1	U7 (1)	—	
2	U7 (2)	0 (Rx), 7.3 (Tx)	Changed by power level
3	U7 (3)	0 (Rx), 5.5 (Tx)	
4	U7 (4)	0 (Rx), 7.3 (Tx)	
5	U7 (5) (6)	7.4	
6	U7 (7)	—	
7	U8 (2)	—	
8	U8 (4)	0 (Rx), 2.5 (Tx)	Changed by power level
9	U8 (6)	0 (Rx), 5.0 (Tx)	
10	U8 (8)	0 (Rx), 1.6 (Tx)	
11	U8 (13)	—	
12	U8 (1) (3) (5) (7) (9) (11) (12) (14)	0 (GND)	
13	Q104 Base	0 (Rx), 1.3 (Tx)	
14	Q104 Emitter	0 (Rx), 0.6 (Tx)	
15	Q104 Collector	0 (Rx), 6.7 (Tx)	
16	Q202 (1)	7.5 (Rx), 0 (Tx)	
17	Q202 (2)	0 (Rx), 7.3 (Tx)	
18	Q202 (3)	7.5	
19	Q205 (1)	0 (GND)	
20	Q205 (2)	0 (Rx), 5.0 (Tx)	
21	Q205 (3)	0 (Rx), 5.0 (Tx)	

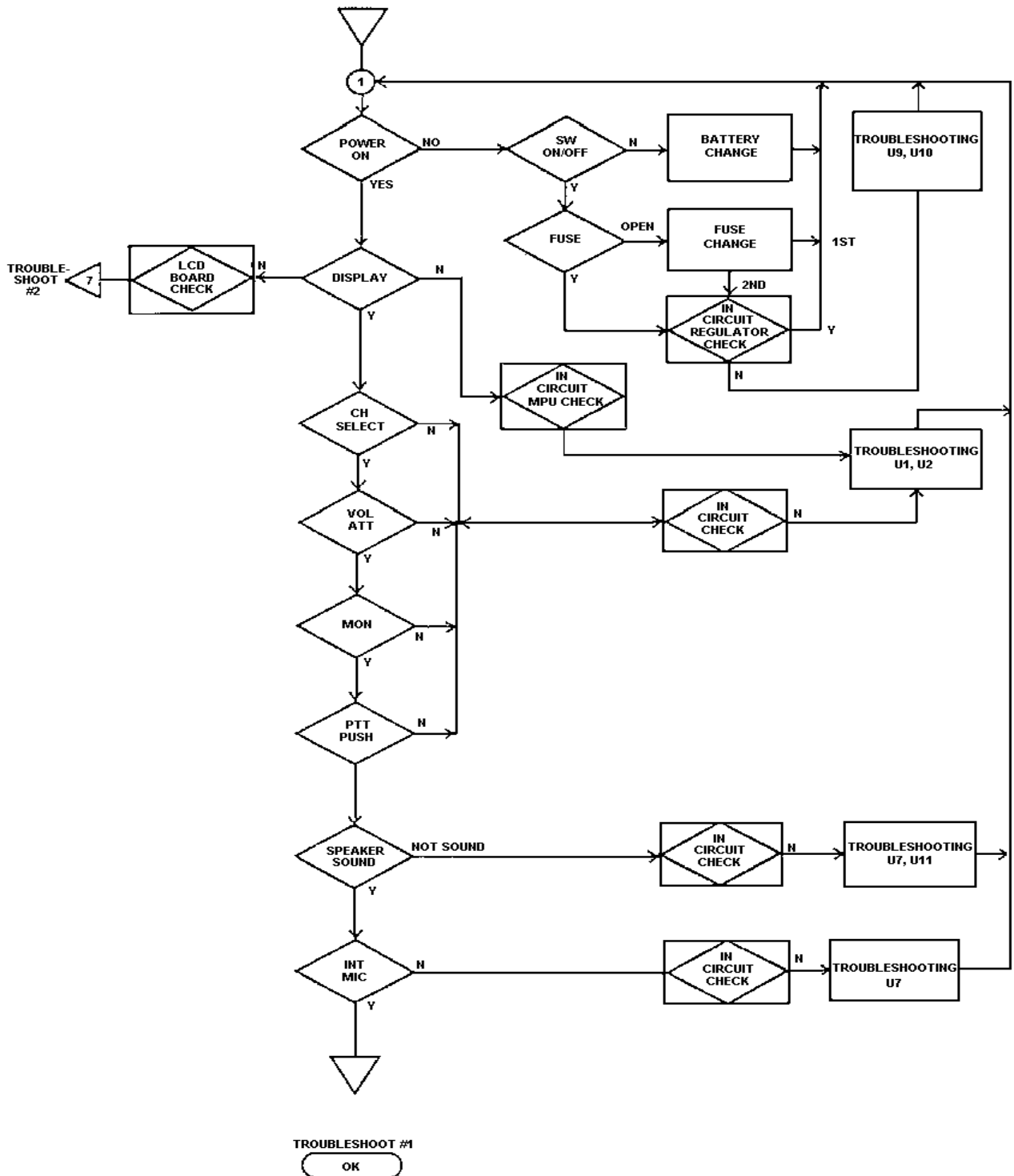
No.	Test Points	Voltage (V)	Remarks
22	Q205 (4)	5.0	
23	Q205 (2) (6)	5.0 (Rx), 0 (Tx)	
24	Q108 (1)	0 (GND)	
25	Q108 (2)	0 (Rx), 5.0 (Tx)	
26	Q108 (3)	0 (Rx), 7.3 (Tx)	
27	Q108 (4)	7.5	
28	Q108 (5) (6)	7.5 (Rx), 0 (Tx)	
29	Q203 Base	7.5 (Rx), 6.8 (Tx)	
30	Q203 Emitter	7.4	
31	Q203 Collector	0 (Rx), 5.5 (Tx)	Changed by power level
32	Q204 Base	0 (Rx), 2.1 (Tx)	Changed by power level
33	Q204 Emitter	0 (Rx), 1.5 (Tx)	Changed by power level
34	Q204 Collector	7.5 (Rx), 6.8 (Tx)	Changed by power level
35	Q205 (1)	5.0	
36	Q205 (2)	5.0 (Rx), 0 (Tx)	
37	Q205 (3)	0 (Rx), 5.0 (Tx)	
38	U9 (5)	3.6 (Rx), 1.9 (Tx)	Changed by power level
39	U9 (6)	0 (Rx), 1.9 (Tx)	Changed by power level
40	U9 (7)	0 (Rx), 2.1 (Tx)	Changed by power level
41	U9 (8)	0 (Rx), 4.9 (Tx)	
42	U9 (2) (3) (4)	0 (GND)	

PHASE 2 : LOGIC SECTION TROUBLESHOOTING

Major Troubleshooting : (Display and Switch Action)

The flowchart (Display and Switch Action) can be used to isolate any defective stage located on the Control and the LCD/KB Flex Assembly.(M-RK II/SCAN).

Flowchart (Internal Display and Switch Action)

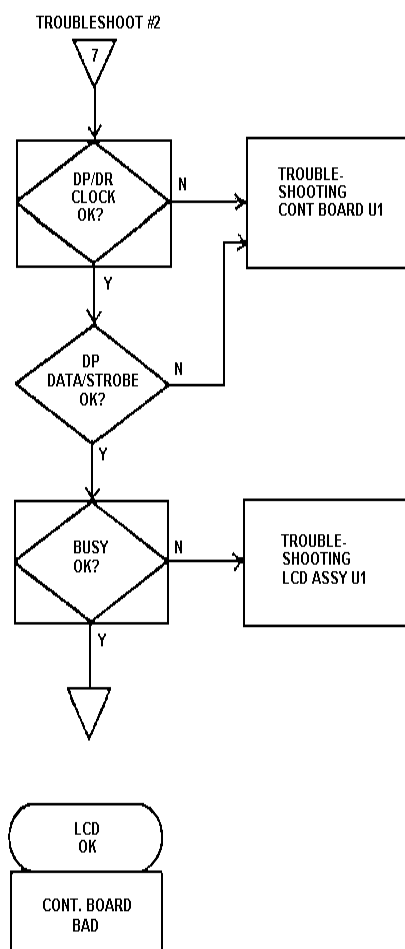


Functional Troubleshooting : (External Input and Output Action)

The flowchart (External Input and Output Action) can be used to externally function test the Control Board through the UDC.

LCD/KB Flex Assembly (M-RK II/SCAN) : The flowchart (LCD/KB Flex Assembly) can be used to isolate any defective stage located on the LCD/KB Flex Assembly.

Flowchart (LCD/KB Flex Assembly)



Troubleshooting for Logic Section

1. This troubleshooting should be made with the Control Board isolated from the Radio Board.
2. If the result is OK at Step 1, the E²PROM data (Channel No.) is displayed when power is ON. In the unlocked state of the Phase-Lock-Loop (PLL) UN-LOCK display is turned on and off at PTT.
3. If the result is OK at Step 2, the display should flicker in the unlocked state.
4. Step 3 indicated that the various switches are actuated in the sequence determined with the E²PROM data.
5. At Step 4, with 1 kHz, -19 dBV signal applied to RXDISC terminal, check for 0.5 watt/16 ohm output to be present at the AUDIO OUT terminal.

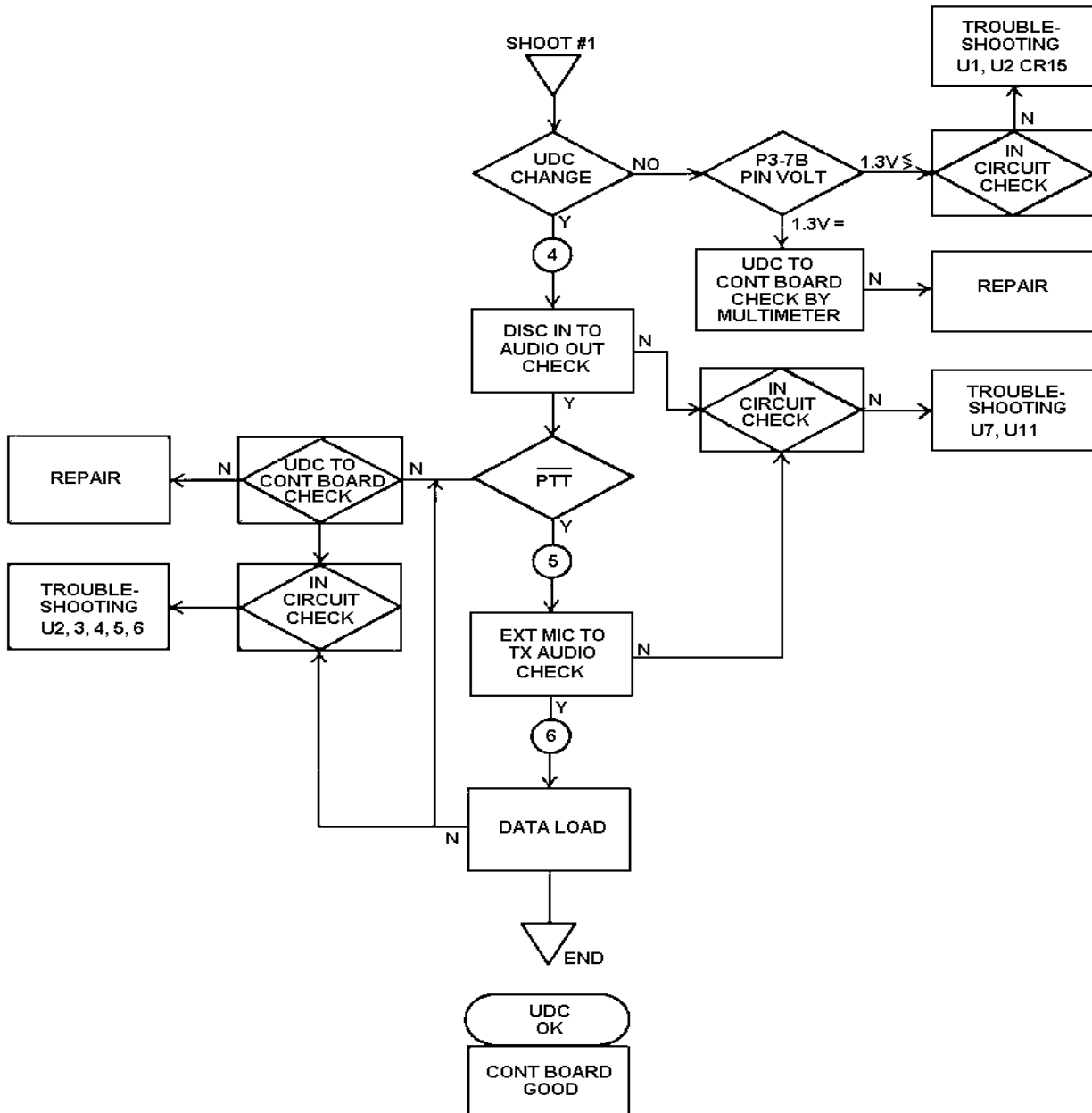
It should also be noted that when the initial VOL ATT setting is not at 0.5 watt/16 ohm, operate the AF, VOL (R8) for a volume level of 0.5 watt.

6. At Step 5, when the PTT line is grounded, the radio set is switched to the TRANSMIT mode. Then the PTT button on the side of the radio should be released.

When the transmit mode is verified, apply 1 kHz, -40 dBV signal to the EXT MIC terminal from the Audio Analyzer. Check that a -7dBV +2 dB signal appears at the TX AUDIO terminal (Pin 2B of P1). Take note that the output at TX AUDIO is not subjected to limiting and without Channel Guard.

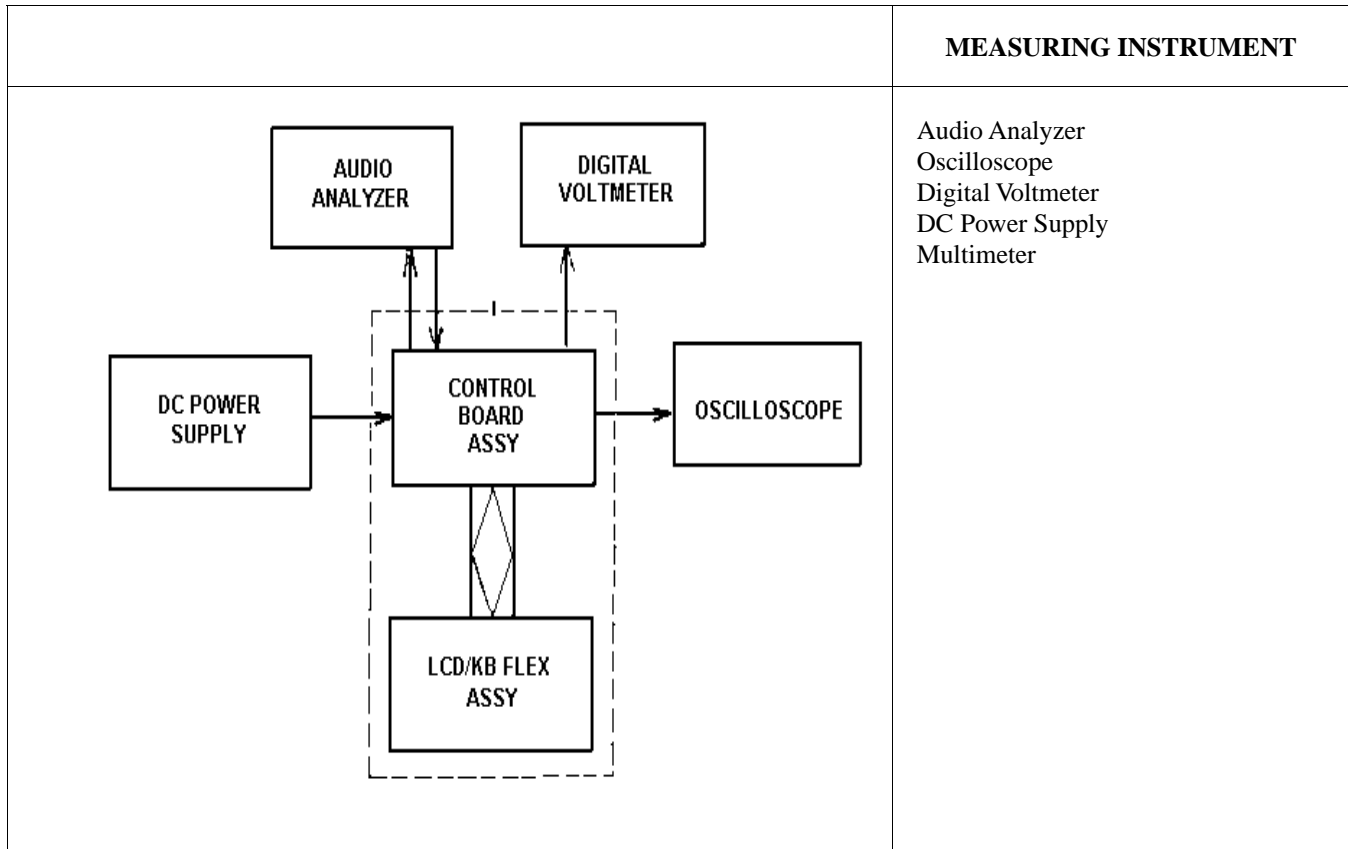
7. At Step 6, generate an arbitrary radio data with a data loader and try to load the data in the E²PROM. Check that data is loaded properly.
8. To perform an internal microphone (INT MIC) test, press and hold the PTT button and speak into the internal microphone. Check that an audio signal appears at Pin 2B of P1 (TX AUDIO terminal).

Flowchart: (External Input and Output Action)

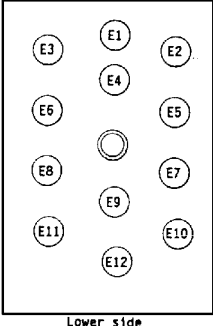


Logic Section Check List :

		MEASURING INSTRUMENT						
<pre> graph LR DC[DC POWER SUPPLY] --> CB[CONTROL BOARD ASSY] CB --> DV[DIGITAL VOLTMETER] CB --- LF[LCD/KB FLEX ASSY] FC[FREQUENCY COUNTER] -.-> 100pF CB </pre>		Digital Voltmeter DC Power Supply Frequency Counter						
ITEM	TEST PROCEDURE							
1. Preliminary 1-1 Voltage Check	There are two regulated supply lines. Conduct voltage check at each check point as under. <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Check Point</th> <th>Rated Voltage</th> </tr> </thead> <tbody> <tr> <td>U9 - Pin 1</td> <td>5.0 V \pm0.2 V for Control</td> </tr> <tr> <td>U10 - Pin 3</td> <td>5.0 V \pm0.2 V for Audio</td> </tr> </tbody> </table>		Check Point	Rated Voltage	U9 - Pin 1	5.0 V \pm 0.2 V for Control	U10 - Pin 3	5.0 V \pm 0.2 V for Audio
Check Point	Rated Voltage							
U9 - Pin 1	5.0 V \pm 0.2 V for Control							
U10 - Pin 3	5.0 V \pm 0.2 V for Audio							
1-2 Battery Out Check	Check that the voltage of Battery or DC Power Supply is present at P1-1B, P2-14B and P2-15b.							
1-3 Oscillator Frequency Check	Check Crystal "Y1" (IC U2-Pin 69) with frequency counter. The frequency should be within 9.8304 MHz \pm 300 Hz. Check Crystal.							



ITEM	TEST PROCEDURE	
<p>2. Preliminary 2-1 LED FLEX (M-RK I) 2-1 LCD/KB FLEX (M-RK II/SCAN)</p>	<p>1. Check LED or LCD/KB FLEX by turning power supply on.</p> <p>Insert connector (J1) on LED or LCD/KB FLEX into P2 on Control Board. Then turn power on and check that the data from Control Board is displayed in the LED or LCD/KB FLEX.</p>	
<p>3. SW Check and UDC Check</p>	<p>2-a. Operation for each switch, check whether each SW is operated or not by multimeter.</p> <p>Check List</p>	
	SW-Name	Connector Pin No. to be checked
	<p>AF. VOL PTT MON OPT EMR</p>	<p>J1 —</p> <div style="border-left: 1px solid black; border-right: 1px solid black; padding: 5px; display: inline-block;"> <p>4B 1A 11A/13B 12A/13B 12B/13B</p> </div> <p>LCD/KB Flex Assembly.</p>

ITEM	TEST PROCEDURE																								
	<p>2-b UDC Check.</p> <p>Check List</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>Pin No. to be checked</p> <table style="margin: auto;"> <tr><td style="border-right: 1px solid black; padding: 2px 5px;">1A</td><td style="padding: 2px 5px;">- E3</td></tr> <tr><td style="border-right: 1px solid black; padding: 2px 5px;">1B</td><td style="padding: 2px 5px;">- E2</td></tr> <tr><td style="border-right: 1px solid black; padding: 2px 5px;">2A</td><td style="padding: 2px 5px;">- E1</td></tr> <tr><td style="border-right: 1px solid black; padding: 2px 5px;">2B</td><td style="padding: 2px 5px;">- E6</td></tr> <tr><td style="border-right: 1px solid black; padding: 2px 5px;">3B</td><td style="padding: 2px 5px;">- E4</td></tr> <tr><td style="border-right: 1px solid black; padding: 2px 5px;">4B</td><td style="padding: 2px 5px;">- E5</td></tr> <tr><td style="border-right: 1px solid black; padding: 2px 5px;">5B</td><td style="padding: 2px 5px;">- E7</td></tr> <tr><td style="border-right: 1px solid black; padding: 2px 5px;">6B</td><td style="padding: 2px 5px;">- E10</td></tr> <tr><td style="border-right: 1px solid black; padding: 2px 5px;">7A</td><td style="padding: 2px 5px;">- E12</td></tr> <tr><td style="border-right: 1px solid black; padding: 2px 5px;">7B</td><td style="padding: 2px 5px;">- E8</td></tr> <tr><td style="border-right: 1px solid black; padding: 2px 5px;">8A</td><td style="padding: 2px 5px;">- E11</td></tr> <tr><td style="border-right: 1px solid black; padding: 2px 5px;">8B</td><td style="padding: 2px 5px;">- E9</td></tr> </table> </div> <div style="text-align: center;"> <p>UDC SIDE VIEW</p> <p>Upper side</p>  <p>Lower side</p> </div> </div> <p style="text-align: center;">UDC Flex</p>	1A	- E3	1B	- E2	2A	- E1	2B	- E6	3B	- E4	4B	- E5	5B	- E7	6B	- E10	7A	- E12	7B	- E8	8A	- E11	8B	- E9
1A	- E3																								
1B	- E2																								
2A	- E1																								
2B	- E6																								
3B	- E4																								
4B	- E5																								
5B	- E7																								
6B	- E10																								
7A	- E12																								
7B	- E8																								
8A	- E11																								
8B	- E9																								
<p>4. RX S/N Measurement</p>	<p>Set Audio Analyzer for 1 kHz, -19 dBv output. Apply this 1 kHz signal to RX DISC P1 Pin 3B. Turn AF. VOL. to get Maximum output and check that the level at RX DISC of P3 PIN 8B (-10 dBV or more) on Oscilloscope.</p> <p>Adjust CAL control on AUDIO Analyzer for "0". Turn 1 kHz signal off. Check that noise level is -45 dB or less. (-39 dB in 12.5 kHz mode).</p>																								
<p>5. RX Frequency Response</p>	<p>Set Audio Analyzer for 1 kHz, -30 dBV output. Apply this 1 kHz signal to RX DISC P1 PIN 3B. Check that the level at RX DISC of P3 PIN 8B is -19 dBV on Levelmeter and Oscilloscope. Adjust CAL control on Audio Analyzer for "0" to turn 1 kHz signal off. Change the OSC frequency from 210 Hz to 3 kHz. Plot AUDIO OUT level on a graph. Check that the level from 500 Hz to 2.5 kHz is in the range of +1 dB to -3 dB from -6 dB/octave.</p>																								

ITEM	TEST PROCEDURE
6. RX Audio Distortion Measurement	<p>Set Audio Analyzer for 1 kHz. Apply this 1 kHz Measurement signal to RX DISC P1 PIN 3B. Adjust until Levelmeter and Oscilloscope show that the P3 PIN 8B is -10 dBV.</p> <p>Check that Audio Analyzer distortion meter shows 5% or less at this time.</p> <p>Alternatively it is permitted to use SPEAKER AUDIO OUT as the check point.</p>
7. CG Opening Level Measurement	<p>Set Audio Analyzer for 67 Hz to 210.7 Hz. Apply this 67 Hz signal to RX DISC P1 PIN 3B. Decrease the level of Audio Analyzer until the squelch opens. Check that the opening level is about -38dBV.</p> <p>NOTE : Use the channel with CG tone in this test.</p>
8. SQ Operation	<p>Set Audio Analyzer for 10 kHz. Apply this 10 kHz signal to RX DISC P1 PIN 3B.</p> <p>Check the output voltage for U2 Pin 59 on Control Board and plot the level on a graph. It is permitted that only the opening level and the closing level of squelch are checked.</p>
9. TX S/N Measurement	<p>On Test Set, set PTT switch to PTT and check that the Unit goes into transmit mode. Set Audio Analyzer to 1 kHz -40dBV. Apply this 1 kHz signal to EXT MIC Terminal of Test Set. There should be about -7 dBV signal at TX AUDIO OUT at P1 PIN 2B. Adjust CAL control on Analyzer to null. Then turn the Analyzer output off. The S/N ratio should be 40 dB or better.</p>
10. TX Distortion Measurement	<p>Under the same test condition as with S/N measurement, measure distortion with the Audio Analyzer. The distortion should be less than 3%.</p>
11. TX Frequency Response	<p>Set Audio Analyzer for 1 kHz, -50 dBV. Apply this 1 kHz signal to EXT MIC Terminal of Test Set. Check that -17dBV signal is present at TX AUDIO OUT at P1 2B. Adjust CAL control on Audio Analyzer for null indication. Turn off the 1 kHz signal from Analyzer. Then change the output frequency of OSC 210 Hz to 3 kHz. Plot the changes in the output signal level on a graph. Check that the frequency response curve is within +1, -3 dB from 6 dB/octave over a 500 to 2.5 kHz.</p>
12. Measurement of CG Encode	<p>Set PTT Switch to Off on Test Set. Select that Level and Distortion channel for which SIG appears on the LCD. Change PTT Switch to PTT side. Check that either 67 Hz to 210.7 Hz CG waveform is present at TX AUDIO OUT using an oscilloscope. Measure the CG signal level (-19 dBV is reference level). Check that the distortion in the CG waveform is less than 5%.</p>
13. Power Set Action	<p>With the PTT Switch in the PTT Position, check with digital voltmeter that 2.0 to 4.0 V is present at PIN 2A of PI.</p>
14. Syn. Clock, Syn. Data, Syn. Enable and Syn. Wide/Narrow Output	<p>Using an Oscilloscope, check that Enable signal is present at PIN 7B of PI, Data at PIN 8A, Clock at PIN 8B and Wide/Narrow at PIN 6A. In this test LOCK/UNLOCK Switch should be in the UNLOCK position.</p>

M-RK LOGIC SECTION TEST DATA

TEST DATA
 TEST CONDITION
 TEST ASSY

TEMP
 HUMIDITY
 CONTROL BOARD
 LED FLEX (MRK I)
 LCD/KB FLEX (MRK II/SCAN)

C
 %

NO.	TEST ITEM	STANDARD VALUE	TEST VALUE
1-1	REGULATORS	5.0 V \pm 0.2V	V
1-2	BATTERY OUT	7.5 V	V
1-3	OSCILLATORS	9.8304 MHz \pm 300 kHz	MHz
2-1	LED OR LCD CHECK		GOOD/NG
3	SWITCH CHECK		GOOD/NG
3	UDC CHECK		GOOD/NG
	DATA LOAD		LOAD OK/NG
4	RX SIG/NOISE	> 45 dB	dB
5	RX FREQ RESPONSE	0.5 K - 2.5 kHz +1 dB -3dB	GOOD/NG
6	RX DISTORTION	< 5%	%
7	RX CG OPENING LEVEL	TYPICAL : -38dBv	dBV
8	SQ OPERATION		GOOD/NG
9	TX SIG/NOISE	> 40 dB	dB
10	TX DISTORTION	< 3%	%
11	TX FREQ RESPONSE	0.5 K - 2.5 kHz + 1 dB -3dB	GOOD/NG
12	TX CG ENCODE LEVEL	TYPICAL : -19 dBV	- dBV
12	TX CG DISTORTION	< 5%	%
13	POWER SET	2.0 V - 4.0V	V
14	SYN WIDE/NARROW CLOCK DATA ENABLE OUT		GOOD/NG

TRACKING DATA

Tracking data is information stored in radio personality E²PROM that sets various transmit parameters to ensure proper performance over the band. If the RF Board in the radio is replaced, this tracking data may need to be changed.

If tracking data is supplied with the replacement RF Board, use the radio personality programmer to edit the personality E²PROM and enter the new tracking data. If tracking data was not supplied with the RF Board, retain the original data stored in E²PROM.

If original tracking data is lost, new tracking data can be generated by using the MAINTENANCE section of EDACS3 PC Programming software. Generate a personality using the tracking data frequencies listed in Table 8.

TABLE 8 - TRACKING DATA FREQUENCIES

	L	LM	M	MH	H
VHF 136-160 MHz	136.0000	142.0000	148.0000	154.0000	160.0000
VHF 150-174 MHz	150.0000	156.0000	162.0000	168.0000	174.0000
UHF 403-430 MHz	403.0000	409.7500	416.5000	423.2500	430.0000
UHF 440-470 MHz	440.0000	447.5000	455.0000	462.5000	470.0000
UHF 470-500 MHz	470.0000	477.5000	485.0000	492.5000	500.0000
800 MHz	806.0000	810.5000	815.0000	819.5000	824.0000
	851.0000	855.5000	860.0000	864.5000	869.0000
900 MHz	896.0000	897.5000	899.0000	900.5000	902.0000
	935.0000	936.5000	938.0000	939.5000	941.0000

MAINTAINING WEATHERPROOF INTEGRITY

The following maintenance procedure is required in order to assure that the radio housing will continue to meet the weatherproof features as designed.

1. Replace key pads which become damaged or torn.
2. Check the "O" ring at base of the antenna when the antenna is removed. Check the housing seal around flanges of the Rear Assy. when the radio unit is opened. Avoid pinching or abrading seals when assembling. Use a light coating of Silicone Grease (GE #623 Clear Silicone Protector, or equivalent) on sealing surfaces of "O" rings to provide lubrication and to increase surface tension for waterproofing.

NOTE

The antenna must be assembled securely to the top of the radio. Tighten to within two (2) to three (3) inch-pounds torque (40 in-ounces).

ERROR CODES

This section lists all the M-RK radio errors and warnings. Each error code in the list includes an explanation of what went wrong and what action to take to correct the problem. The error codes are divided into three different categories:

1. Fatal Operational Error Codes - These are errors that are displayed during the radio normal operation or on the radio power-up (Fatal System Errors). These errors will cause the radio to reset.
2. Non-Fatal Operational Error Codes - These are errors that are displayed during the radio normal operation or on the radio power-up. The radio will not reset.
3. Radio Programming Errors - These are errors that are displayed on the radio or the programming PC display during radio programming.

Group 1 through 4 M-RK software

Fatal System Errors

Fatal system errors will cause the radio to stop operating until the problem is corrected. The error code will be displayed until the problem is corrected. The errors are displayed on the radio display as follows:

FSE=xxxx y yyyyyy

Where: xxxx is the error code and y yyyyyy is the error address

All Other Software Groups M-RK

System Errors

Fatal system errors will cause the radio to display an error message/code and then reset the radio to its starting operation. The reset condition will remain until the fatal error(s) is corrected.

Non-Fatal errors are displayed for a short period (about 2 seconds) then normal radio operation will resume.

The errors are displayed on the radio as follows:

message ERR=xxxx

Where: xxxx is the error code and the message is one of the messages listed

FATAL ERRORS	
<u>ERROR MESSAGE</u>	<u>DESCRIPTION</u>
HARDWARE	ROM errors
SOFTWARE	General software failure
TRACKING	Tracking data fatal error
NO LOCK	Synthesizer not locking
FREQDATA	Frequency data fatal error
PERSDATA	Personality errors

NON-FATAL ERRORS	
<u>ERROR MESSAGE</u>	<u>DESCRIPTION</u>
UNKNOWN	
FEAT ERR	Feature encryption error
DSP ERR	DSP error

ROM Fatal Systems Errors

ROM fatal errors may be corrected by cycling the radio power (turn it off then on). When the power cycle does not correct the problem the radio must be serviced.

<u>ERROR NAME</u>	<u>MESSAGE</u>	<u>CODE</u>	<u>DESCRIPTION</u>
FATAL_SYS_TRAP	HARDWARE	0	Fatal system error trap number.
FATAL_NMI_ERROR	HARDWARE	1	NMI occurred outside of sleep.
FATAL_RAM_ERROR	HARDWARE	2	8K RAM test error.
FATAL_ROM_CHKSUM	HARDWARE	3	32K ROM checksum test error.
FATAL_FLSH_CHKSUM	HARDWARE	4	Flash checksum test error.
FATAL_ASIC_LOAD	HARDWARE	10	ASIC driver failed initialization.
FATAL_ICP_LOAD	HARDWARE	11	ICP driver failed initialization.
FATAL_ASP_LOAD	HARDWARE	12	ASP driver failed initialization.
FATAL_EE_LOAD	HARDWARE	13	EEPROM driver failed initialization.
FATAL_ICP_PORTINIT	HARDWARE	14	ICP digital I/O initialization failed.
FATAL_INTOUT_LOAD	HARDWARE	15	Standard input/output driver failed initialization.
FATAL_INTIN_LOAD	HARDWARE	16	Standard input driver failed initialization.
FATAL_RADIO_LOAD	HARDWARE	17	RADIO driver failed initialization.
FATAL_MODEM_LOAD	HARDWARE	18	MODEM driver failed initialization.
FATAL_EXTIO_LOAD	HARDWARE	19	External I/O driver failed initialization.
FATAL_SCI_LOAD	HARDWARE	20	Serial communication interface driver failed initialization.
FATAL_ICP_CHKSUM	HARDWARE	21	ICP prom checksum.
FATAL_ADI_NOACK	HARDWARE	30	ADI did not respond to command.
FATAL_ADI_QUNDERFLOW	HARDWARE	31	ADI Rx circular queue underflowed.
FATAL_LCD_NOACK	HARDWARE	40	LCD did not acknowledge message.
FATAL_LCD_HARD_FAIL	HARDWARE	41	LCD hardware is invalid.
FATAL_SCI_NOHEAP	HARDWARE	50	Serial communication interface out of heap (RAM memory) space.
FATAL_ICP_NOACK	HARDWARE	60	ICP did not acknowledge message.
FATAL_EXTIO_ICPFAIL	HARDWARE	70	ICP failed in a fork.
FATAL_RADIO_ASPWRT	HARDWARE	80	Radio driver could not write to ASP.
FATAL_ROM_NOHEAP	HARDWARE	90	Software memory error - ROM task.
FATAL_BL_NOHEAP	HARDWARE	91	Software memory error - Boot loader.
FATAL_BL_SCI_ATTACH	HARDWARE	92	Boot loader could not attach to SCI.

Operational Software Non-Fatal System Errors

<u>ERROR NAME</u>	<u>MESSAGE</u>	<u>CODE</u>	<u>DESCRIPTION</u>
PIFEAT_SNR_ERROR	FEAT ERR	550	Feature encryption - Can not read radio ROM serial number.
PIFEAT_READ_ERROR	FEAT ERR	551	Personality feature encryption read failure or data not available.
PIFEAT_CRC_ERROR	FEAT ERR	552	Decryption failure. Personality feature encryption CRC failure.
RI_DSPDOWN_NOATTEMPT	DSP ERR	850	DSP not found.
AEGIS_ADIDOWN_NOTFOUND	DSP ERR	851	DSP file not found.
AEGIS_ADIDOWN_CRCFAIL	DSP ERR	852	DSP file is corrupted.
AEGIS_ADIDOWN_ENCERR	DSP ERR	853	Radio feature encryption does not match DSP file.
AEGIS_ADIDOWN_PMFFAIL	DSP ERR	854	DSP file is corrupted or hardware failure. Re-program radio or power cycle the radio.
AEGIS_ADIDOWN_DMFAIL	DSP ERR	855	DSP file is corrupted or hardware failure. Re-program radio or power cycle radio.
AEGIS_ADIDOWN_BIOSERR	DSP ERR	856	Hardware failure.
AEGIS_KEYLOAD_NOBANKS	DSP ERR	860	Personality did not assign banks for the keys.
AEGIS_PVT_NONE	FEAT ERR	870	Private is not feature encrypted.

Operational Software Fatal System Errors

<u>ERROR NAME</u>	<u>MESSAGE</u>	<u>CODE</u>	<u>DESCRIPTION</u>
RADC_PITD_ERROR	TRACKING	200	Personality tracking data error. Re-program the tracking data.
RADC_PIHW_ERROR	PERSDATA	201	Personality hardware data error. Re-program the personality.
RADC_FREQ_ERROR	FREQDATA	202	Personality frequency data error. Re-program the personality.
RADC_PITD_MALLOE_ERROR	SOFTWARE	203	Personality tracking data malloc error. Re-program the tracking data.
RADC_PITD_CKSUM_ERROR	SOFTWARE	204	Personality tracking data checksum error. Re-program the tracking data.
DACS_NO_LOCK	NO LOCK	300	Synthesizer did not lock or became unlocked. Check the frequencies in the PC programmer and re-program the radio personality.
DACS_MODEM_FATAL_ERROR	SOFTWARE	301	Unable to correctly configure the modem for EDACS operation. Re-program the personality.
DACS_RADC_FAILURE	SOFTWARE	302	Power cycle the radio.
DACS_MODEM_RXOVR	SOFTWARE	304	Hardware Modem overflow. Power cycle the radio.
DACS_MODEM_RXAVR	SOFTWARE	305	Power cycle the radio.
CONV_RADC_ERROR	SOFTWARE	400	Error calling RADC function. Power cycle the radio.
CONV_NOLOCK_ERROR	NO LOCK	401	Synthesizer became unlocked. check the frequencies in the PC programmer and re-program the radio personality.
CONV_PUT_UIMSG_ERROR	SOFTWARE	402	UI message buffer not enabled. Power cycle the radio.
CONV_MODEM_RXOVR	SOFTWARE	403	Conventional DIGV modem overflow.
CONV_MODEM_RXAVR	SOFTWARE	404	Conventional DIGV modem underflow.
CONV_MODEM_FATAL_ERROR	SOFTWARE	405	Unable to correctly configure the modem for conventional DIGV operation.
CONV_PERS_ERROR	PERSDATA	407	Conventional personality error.
PI_NOPERS_ERROR	PERSDATA	500	Personality data is not present. Program the personality.
PI_CRC_ERROR	PERSDATA	501	Flash personality CRC did not match EEPROM. Re-program the personality.
PI_DESC_CRC_ERROR	PERSDATA	502	Crucial personality data has incorrect CRC. Re-program the personality.
PI_MALLOE_ERROR	SOFTWARE	503	Could not allocate memory to store crucial personality data.
UI_FATAL_DEVICE_ERROR	PERSDATA	600	Input/Output device error.
UI_FATAL_SWTO_MALLOE_ERROR	SOFTWARE	601	Software memory error.
UI_FATAL_SWTO_MAX_ERROR	SOFTWARE	602	Software error, power cycle the radio.
UI_FATAL_WINDOW_MAX_ERROR	SOFTWARE	603	Too many open windows.
UI_FATAL_WINDOW_MALLOE_ERROR	SOFTWARE	604	Software memory error.
UI_FATAL_MESSAGE_INVPARM	SOFTWARE	605	Invalid parameter to UI_PUT_MESSAGE(). software error, report how error was encountered.
UI_FATAL_RI_MSGBUF_FULL	SOFTWARE	606	UI Task message buffer full error. Software error, report how error was encountered.
UI_FATAL_RISYS_MSGBUF_FULL	SOFTWARE	607	Radio Interface System (EDACS/CONV) task message buffer full.
UI_FATAL_CI_MSGBUF_FULL	SOFTWARE	608	CI Task message buffer full.
UI_FATAL_DEVICE_NOTSUPPORTED	PERSDATA	609	I/O device type (from personality) not supported.
UI_FATAL_AUXIO_MALLOE_ERROR	SOFTWARE	610	Software memory error.
UI_FATAL_NET_DEVICE_ERROR	SOFTWARE	611	Network I/O device error.
UI_FATAL_INVALID_CUID	SOFTWARE	612	CU ID is invalid or CU not connected. Insure that CU ID is CUA and DUAL is disabled in personality.
UI_FATAL_NO TONE_DATA	SOFTWARE	613	No tone data is available in personality.
UI_FATAL_U110_MSGBUF_FULL	SOFTWARE	614	UI I/O BBOS message buffer full.
AEGIS_ADI_OVERFLOW	SOFTWARE	801	ADI Transmit event not serviced in time and buffer has overflown.
AEGIS_RXBUF_MALLOE_ERROR	SOFTWARE	802	No memory available.
AEGIS_KEYLOAD_MALLOE_ERROR	SOFTWARE	803	No Keyloader table memory available.
AEGIS_KEYLOAD_ERROR	SOFTWARE	804	General Keyload error has occurred.
AEGIS_DATAMEM_MALLOE_ERROR	SOFTWARE	805	No memory is allocated for data.
AEGIS_KEYLOAD_NOTABL	SOFTWARE	806	No key table was found in EEPROM.

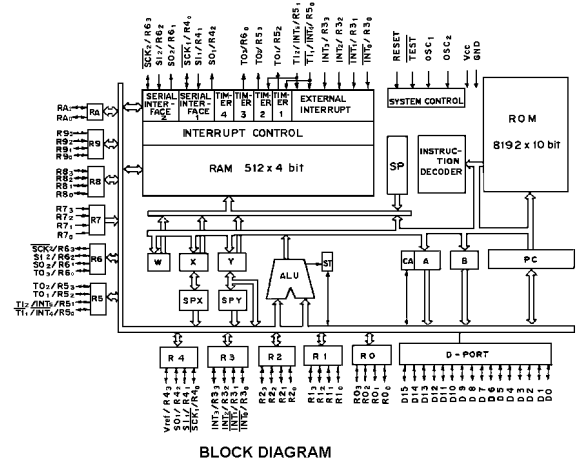
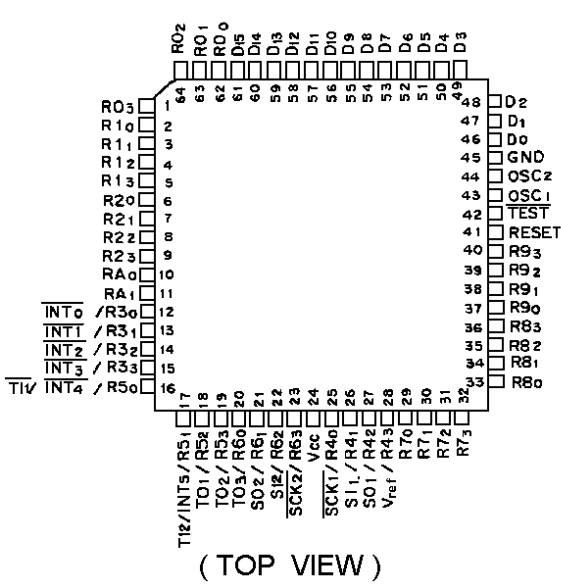
Radio Programming Errors

Programming errors are divided into three categories:

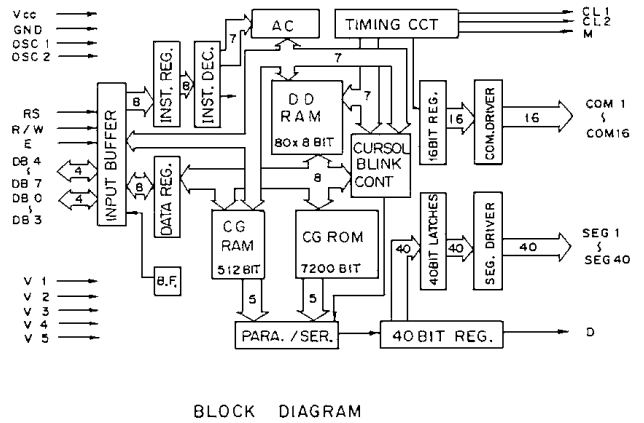
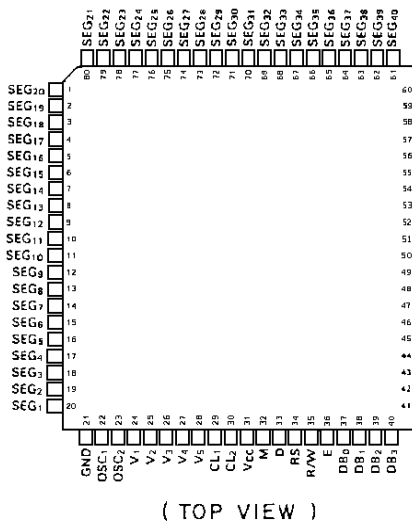
1. Protocol Errors - These are errors produced by the low level communication routines.
2. Radio Errors - These are errors that are returned from the radio ROM or operating software.
3. PC Errors - These are errors that are produced by the PC Programming software.

MESSAGE	CODE	DESCRIPTION
Successful	0	Command was performed successfully.
Protocol - Canceled by receiver	5	x328 protocol received a cancel. The radio detected a cancel command.
Protocol - Canceled by sender	6	x 328 protocol transmitted cancel. The radio is canceling the read command.
Protocol - Terminate transmission	7	x328 protocol received an end of transmission.
Protocol - Transmit error	8	x328 protocol could not transmit. Reliable communication can not be established. It could be the radio or PC hardware problems (programming cable, interface box, or radio hardware).
Protocol - Protocol initialization error	9	x328 protocol not initialized or failed to initialize.
Radio - Programmed successfully	10	Radio responded with a success. Radio acknowledged successful programming.
Radio - Comport configuration failed	11	Radio could not configure its comport (hardware failure).
Radio - Flash erase failed	12	Radio failed to erase the flash memory. The radio flash memory part is unusable or it can not detect the 12 volts power. Check the programming box and cables.
Radio - Flash write failed	13	Radio failed in writing to the flash memory. Retry the programming process (hardware failure).
Radio - Flash code CRC did not match	14	Flash code not programmed correctly. CRC did not match. The operating software will not execute. Re-program the radio.
Radio - Canceled by receiver	15	The radio operating software received a cancel command.
Radio - Canceled by sender	16	
Radio - End of transmission received	17	The radio software received or sent an end of transmission.
Radio - Transmit error	18	Radio could not transmit the required data. Check all hardware connections and try programming again.
Radio - Invalid command	19	Radio did not understand the received command.
Radio - No application code	20	No application code is loaded, the radio can not accept personality commands. Re-program the operating software (flash code) and re-program the personality.
Radio - Application code error	21	The radio application code failed to perform the command.
Radio - EEPROM programming error	22	Could not program the radio EEPROM part.
Radio - Baud rate has changed	23	The radio acknowledged a successful baud communication baud rate change.
PC - Cannot allocate memory	50	The PC programming software could not allocate adequate memory space to perform the function.
PC - Cannot open data file	51	The specified file (code or personality) could not be opened (file does not exist or has access protection).
PC - Cannot read data file	52	The specified file (code or personality) could not be read.
PC - Cannot write to file	53	The specified file (code or personality) could not be written.
PC - File not found	54	The specified file (code or personality) in not found in the current directory.
PC - File is larger than radio memory	55	The radio flash part size is unknown or the operating software file size is larger than the radio's flash memory size.
PC - Incorrect Tracking Data RF band split	57	Incorrect Tracking Data RF band split.
PC - Incorrect Tracking Data version	58	Incorrect Tracking Data version.
PC - Tracking Data checksum error	59	Tracking Data checksum error.
PC- Time-out, radio not responding	60	Radio is not connected or not turned on or the selected PC comport number is invalid.
PC - Comport configuration error	61	Comport configuration error, can not set comport.
PC - Abort, message canceled	62	Aborted by operator, message canceled.
PC - Requested personality data does not exist	63	The personality table does not exist (Tracking or Encryption table).

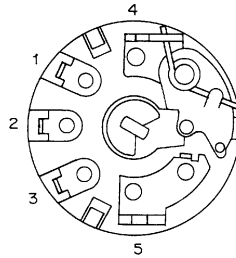
LCD/KB FLEX BOARD
MICRO PROCESSOR (U1)



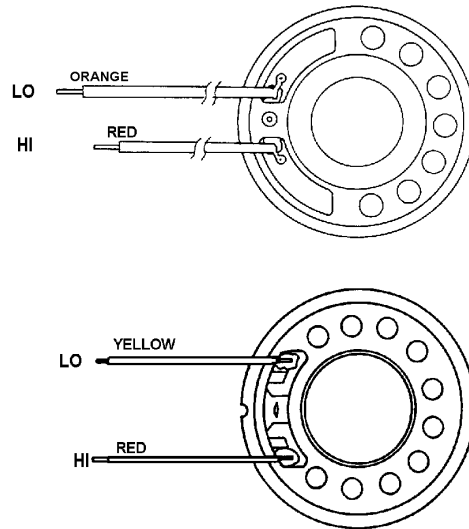
LCD / KB FLEX BOARD
LCD DRIVER (U2)



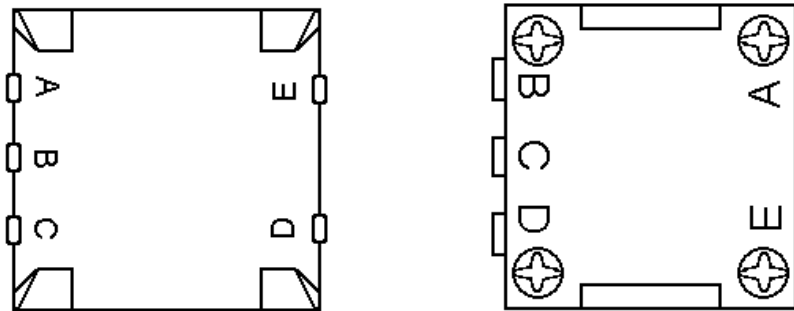
LCD / KB FLEX
LED FLEX
AF VOLUME W/SWITCH (R8)



SPEAKER (LS12)

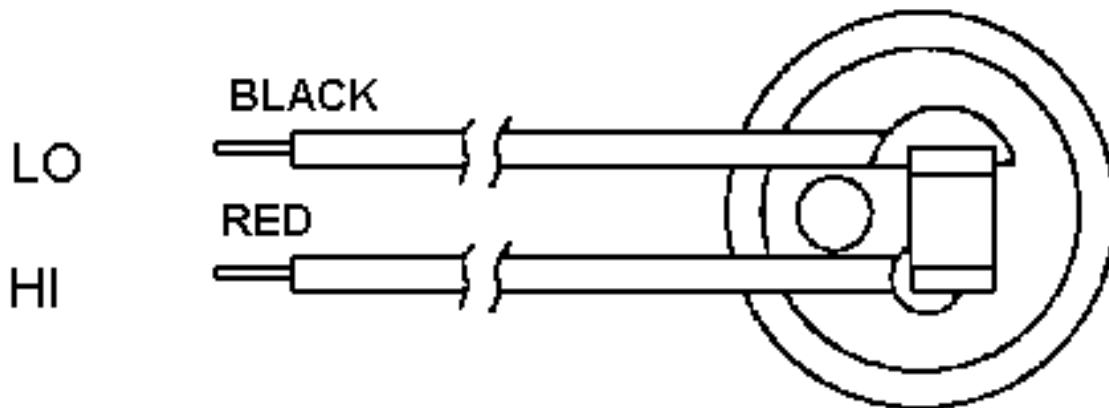


ROTARY SWITCH
(S1)

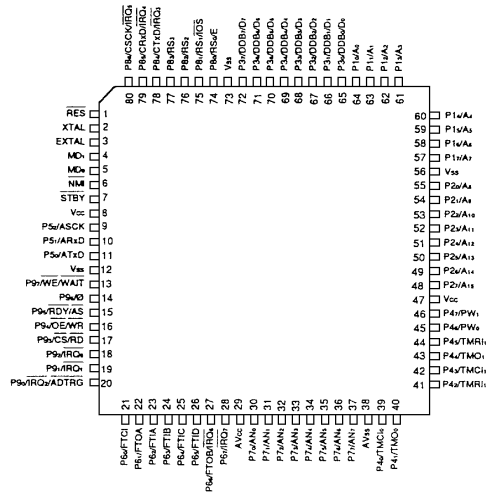


LED FLEX FROM ASSY REV. A
LCD/KB FLEX FROM ASSY REV. C

MICROPHONE W/ CAPACITOR
(MK1) (C9)

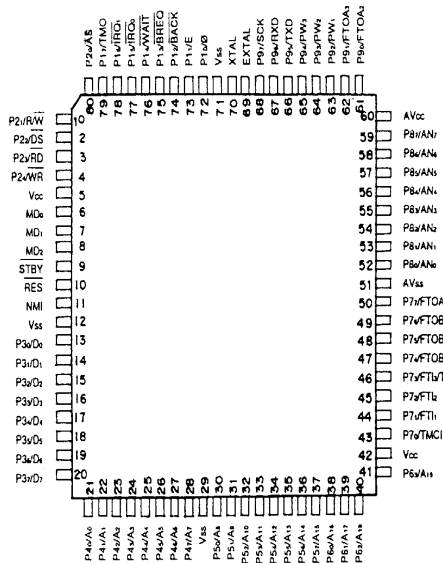


CONTROL BOARD
MICRO PROCESSOR (U1)

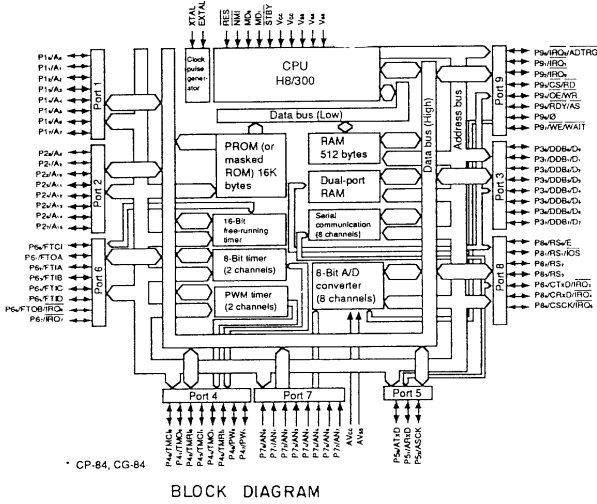


(TOP VIEW)

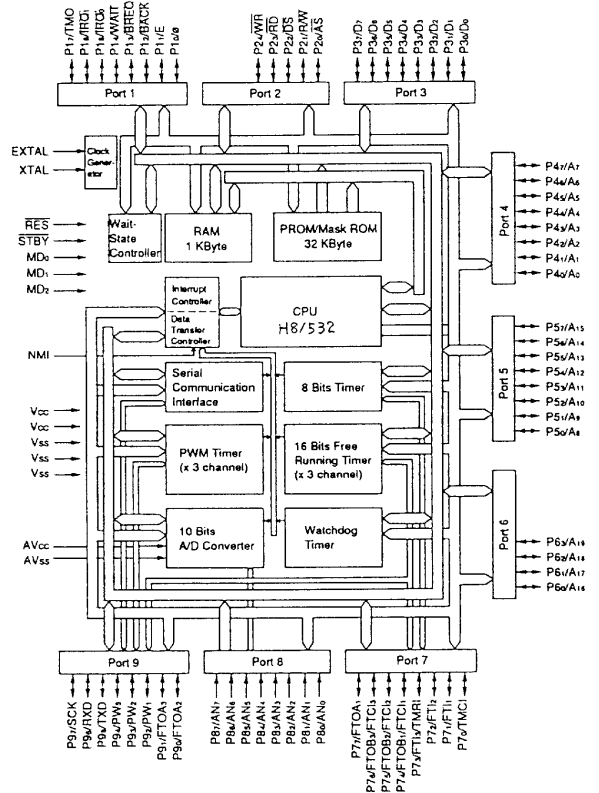
CONTROL BOARD
MICRO PROCESSOR (U2)



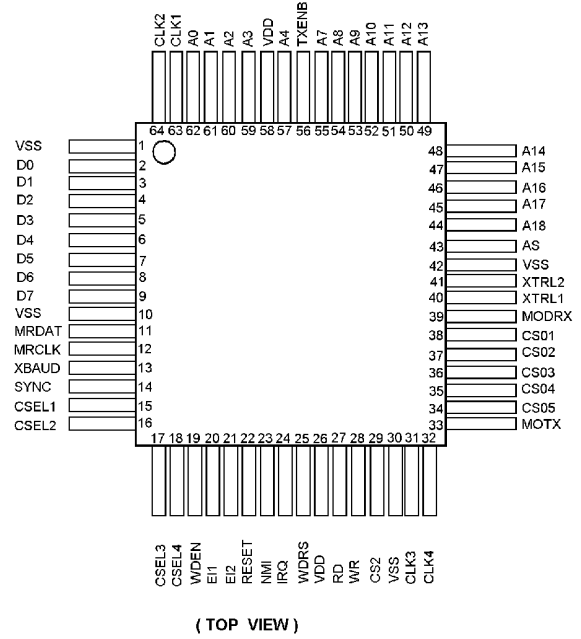
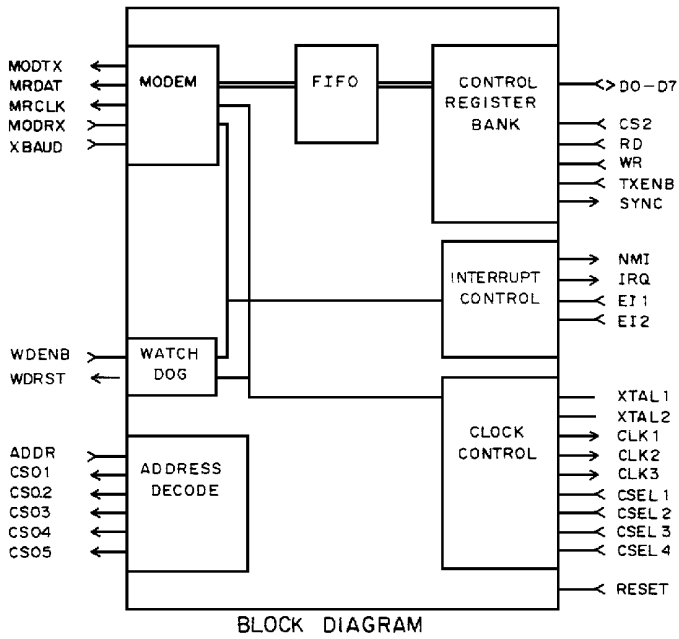
(TOP VIEW)



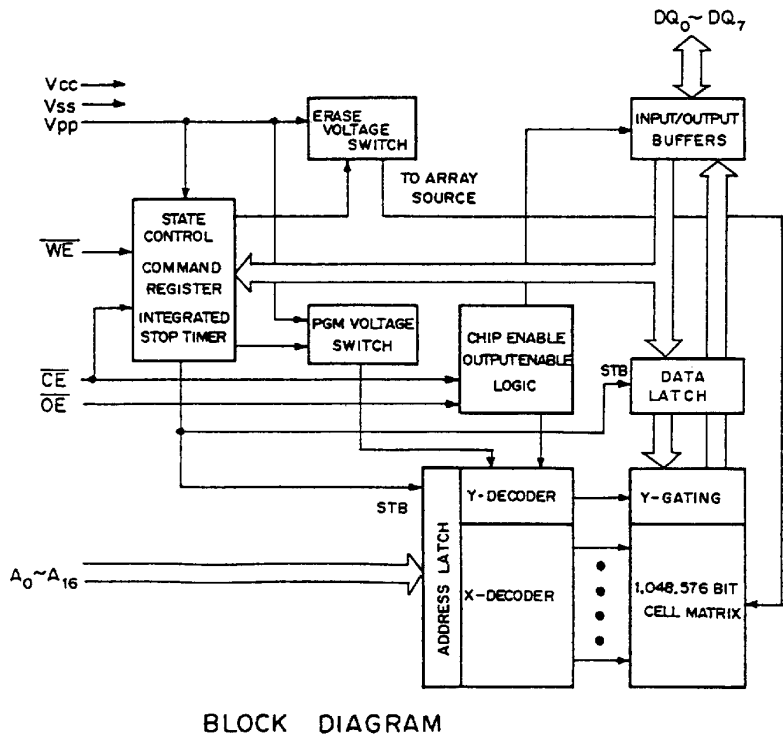
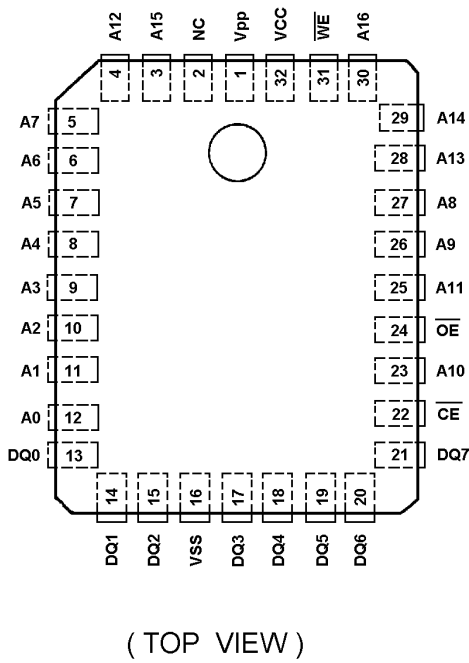
BLOCK DIAGRAM



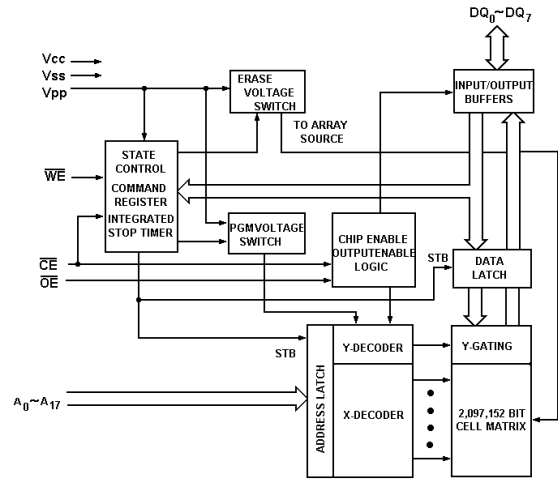
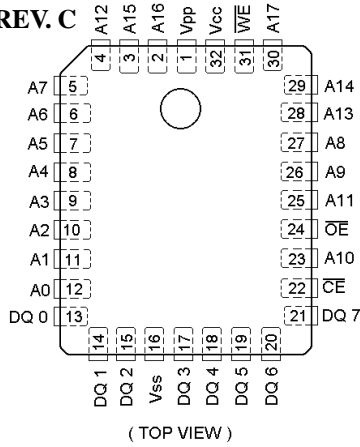
CONTROL BOARD
DIGITAL SIGNAL PROCESSOR (U3)



CONTROL BOARD
FLASH E²PROM (U4)

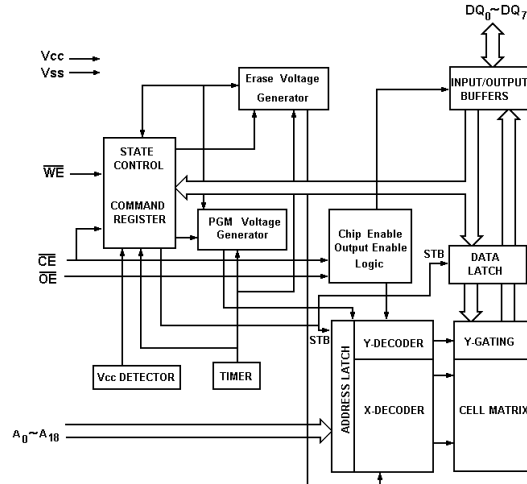
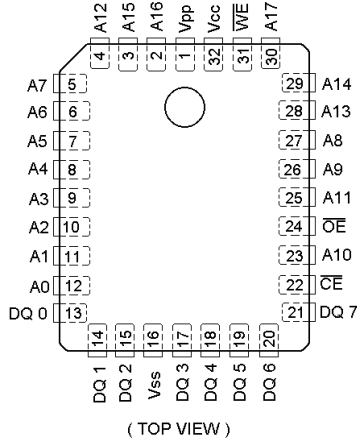


**CONTROL BOARD (AEGIS)
FLASH E²PROM (U4)
28F020
FROM ASSY REV. C**



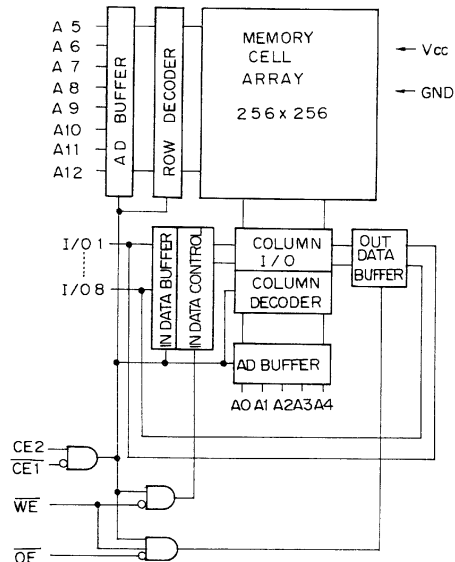
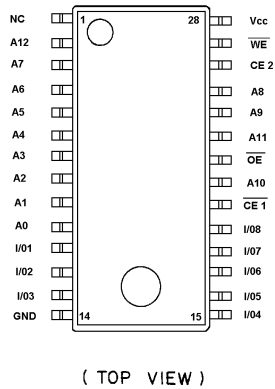
BLOCK DIAGRAM

**CONTROL BOARD (AEGIS)
FLASH E²PROM (U4)
29F040**



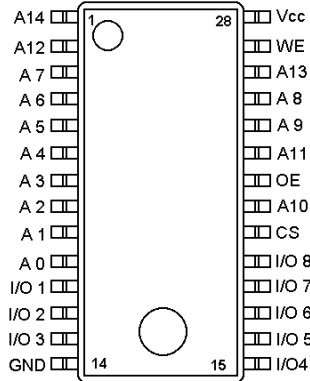
BLOCK DIAGRAM

**CONTROL BOARD
CMOS SRAM (U5)**

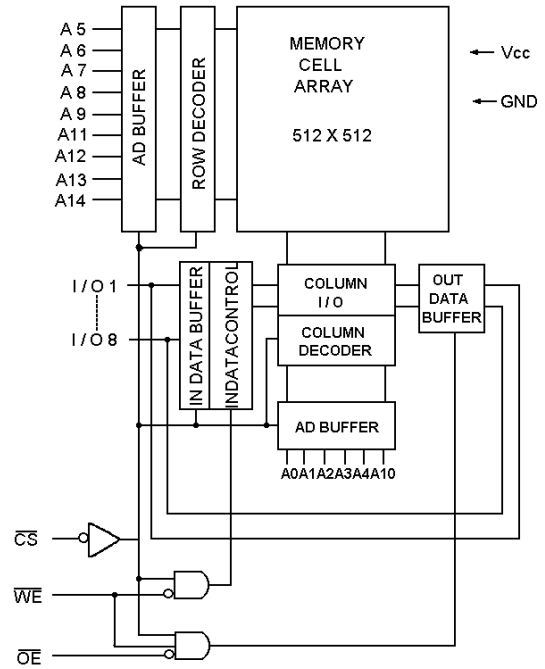


BLOCK DIAGRAM

**CONTROL BOARD
CMOS SRAM U5
FROM ASSY REV. D**

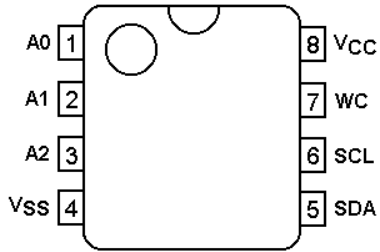


(TOP VIEW)



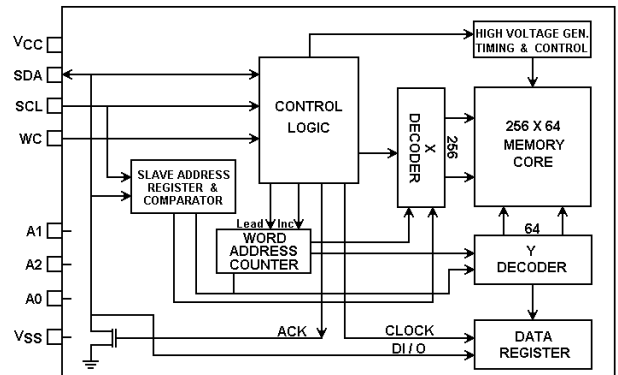
BLOCK DIAGRAM

**CONTROL BOARD (AEGIS)
E²PROM (U6)
FROM ASSY REV. E**



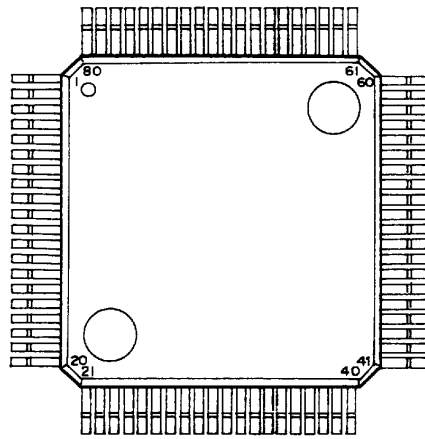
(TOP VIEW)

- A0 - A2 Address Inputs
- SDA Serial Data
- SCL Serial Clock
- WC Write Control
- Vss Ground
- Vcc Supply Voltage



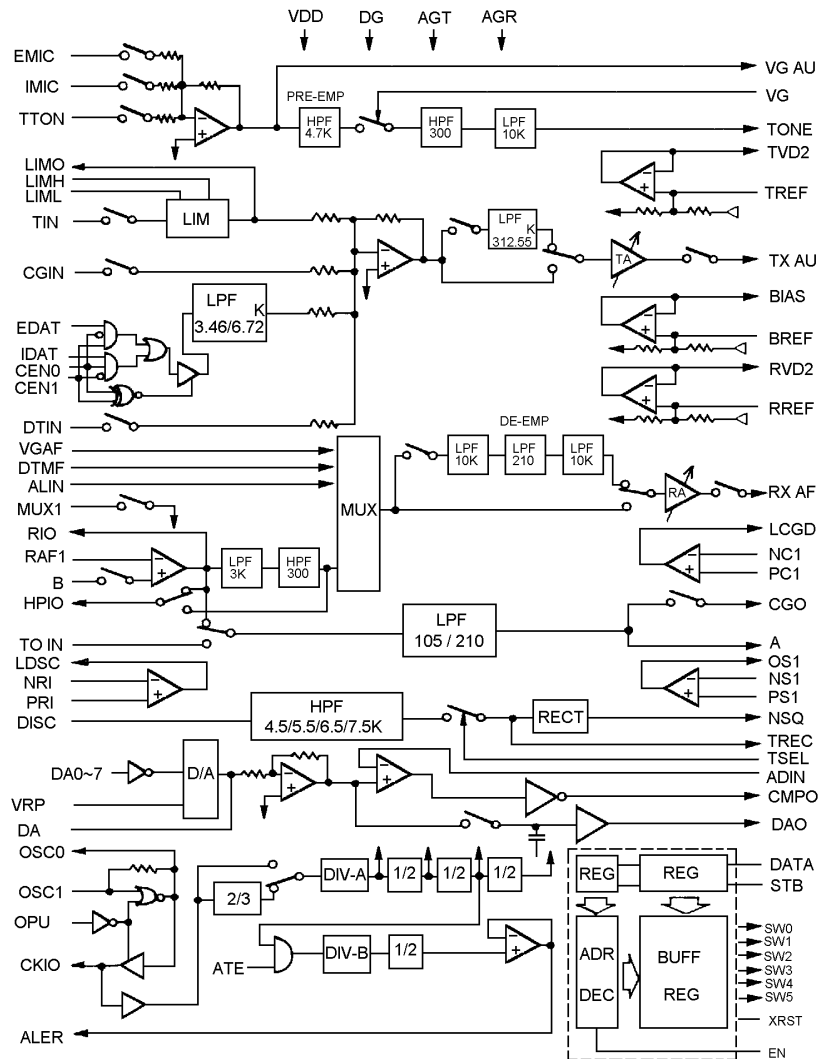
BLOCK DIAGRAM

CONTROL BOARD
AUDIO PROCESSOR (U7)



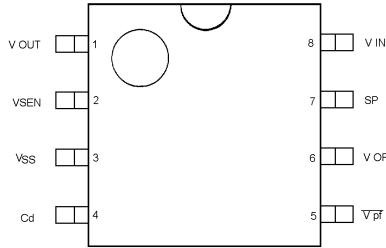
No	IO	name	No	IO	name	No	IO	name	No	IO	name
1	-	NC	21	O	LDSC	41	G	AGR	61	-	NC
2	I	OPU	22	O	LCGO	42	AO	MUX1	62	G	AGT
3	G	DG	23	O	CMPO	43	AO	R10	63	AO	TVD2
4	I	OSCI	24	-	NC	44	AI	RAFI	64	AO	TREF
5	O	OSCO	25	I	TSEL	45	AO	HP10	65	AO	BIAS
6	IO	CKIO	26	VD	VDD	46	AI	VRP	66	AO	BREF
7	G	DG	27	AO	RXAF	47	AO	DA	67	AO	LIMH
8	VD	VDD	28	AI	VGAF	48	AO	DAO	68	AO	LIML
9	I	XRST	29	AI	DTMF	49	AI	ADIN	69	AO	LIMO
10	I	EN	30	AI	ALIN	50	AI	DISC	70	AO	TONE
11	I	STB	31	AI	NR1	51	IO	TREC	71	-	NC
12	I	DATA	32	AI	PR1	52	AO	NSQ	72	AO	VG AU
13	O	SW5	33	-	NC	53	AO	OS1	73	AI	EMIC
14	O	SW4	34	AI	NC1	54	AI	NS1	74	AI	IMIC
15	O	SW3	35	AI	PC1	55	AI	PS1	75	AI	TTON
16	O	SW2	36	AO	A	56	-	NC	76	AO	ALER
17	O	SW1	37	AO	CGO	57	AI	TIN	77	VD	VDD
18	O	SW0	38	AI	TOIN	58	AI	CGIN	78	I	VG
19	VD	VDD	39	AO	RREF	59	AI	DTIN	79	I	EDAT
20	G	DG	40	AO	RVD2	60	AO	TXAU	80	I	IDAT

(TOP VIEW)

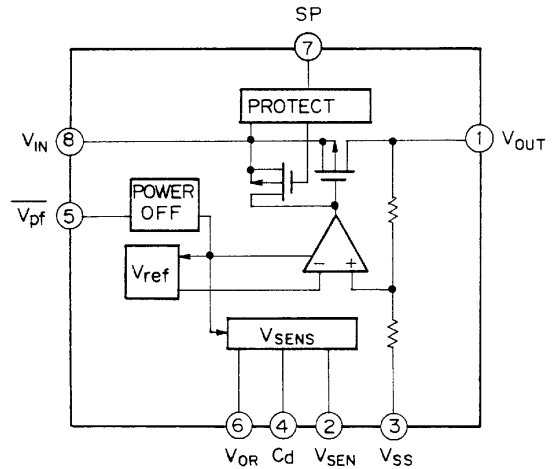


BLOCK DIAGRAM

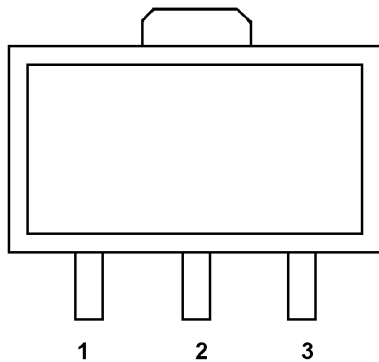
**CONTROL BOARD
VOLTAGE REGULATOR (U9)**



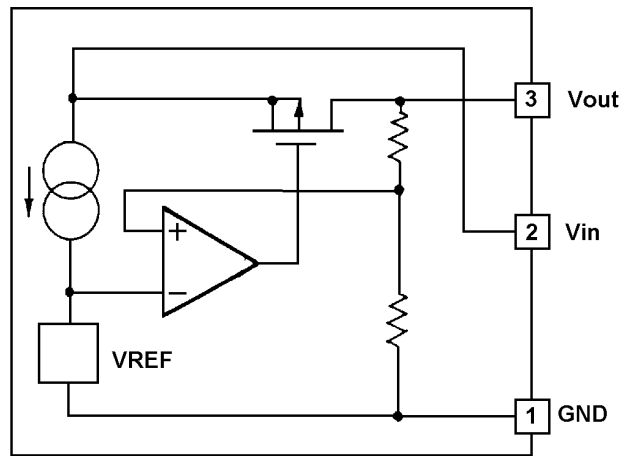
(TOP VIEW)



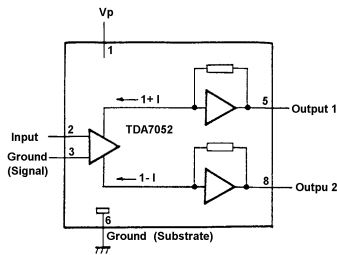
**CONTROL / RF BOARD
VOLTAGE REGULATOR (U10)**



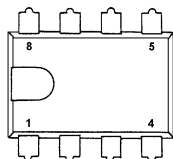
(TOP VIEW)



**CONTROL BOARD
INTEGRATED CIRCUIT /
AF POWER AMPLIFIER (U11)**

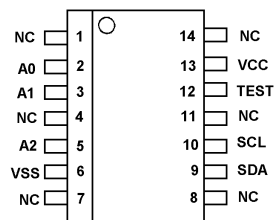


BLOCK DIAGRAM



(TOP VIEW)

**CONTROL BOARD
E²PROM (U6)**

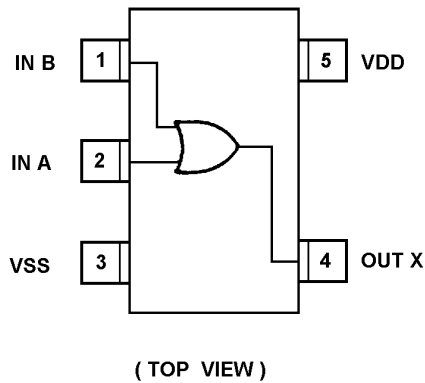


(TOP VIEW)

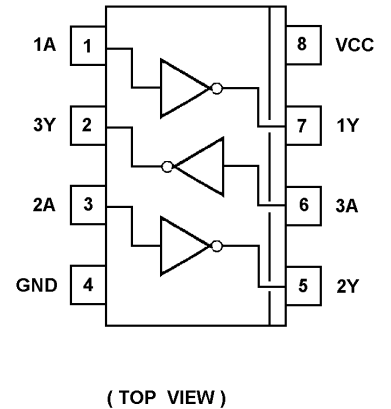
PIN NAMES

A0 - A2	Address Inputs
SDA	Serial Data
SCL	Serial Clock
TEST	Hold at Vss
VSS	Ground
VCC	+ 3.5V to + 6V
NC	No Connect

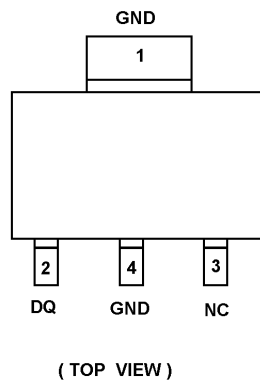
**CONTROL BOARD
2 INPUT OR GATE (U15)**



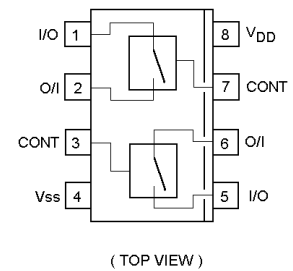
**CONTROL BOARD
3 INVERTERS (U12)
(U20) FROM ASSY REV. B
RF BOARD (W/N)
(U15)**



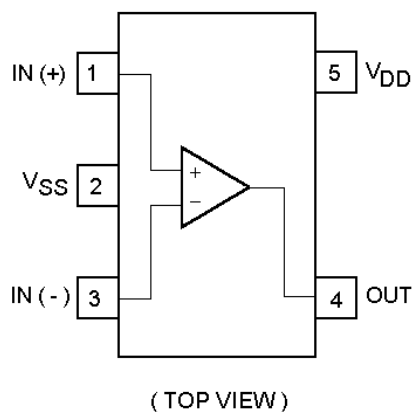
**CONTROL BOARD
SERIAL NUMBER (U16)**



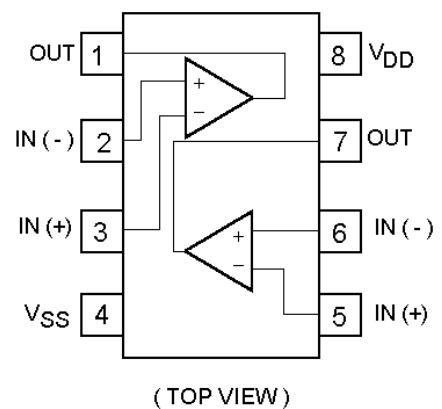
**CONTROL BOARD (AEGIS)
2 BI - LATERAL SWITCH (U19)
FROM ASSY REV. B
RF BOARD (W/N)
(U12)
(U13)
(U14)**



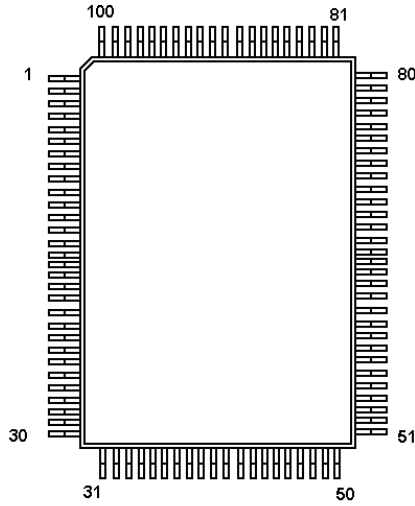
**CONTROL BOARD (AEGIS)
OP AMP (U18)**



**CONTROL BOARD (AEGIS)
OP AMP (U18)
FROM ASSY REV. B**

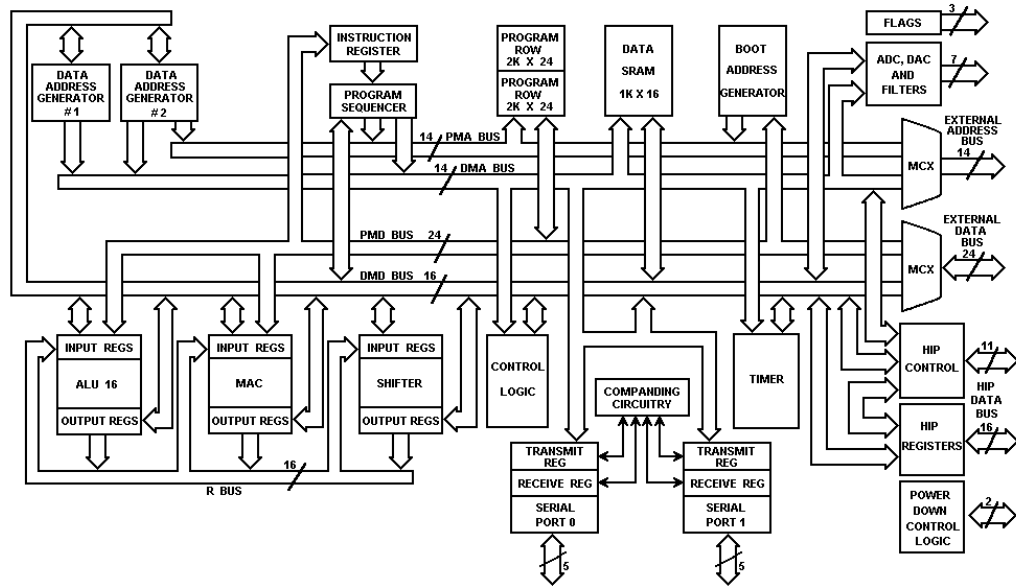


CONTROL BOARD (AEGIS)
ADSP (U17) FROM ASSY REV. B



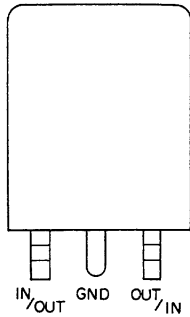
(TOP VIEW)

POFP NUMBER	PIN NAME	POFP NUMBER	PIN NAME	POFP NUMBER	PIN NAME	POFP NUMBER	PIN NAME
1	VDD	26	HA1	51	REF_FILT	76	D11
2	A4	27	HA0	52	VINAUX	77	D12
3	A5	28	HSEL	53	DECOUPLE	78	D13
4	A6	29	HWR/HDS	54	VINNORM	79	D14
5	A7	30	HRD/HRV	55	VCC	80	D15
6	A8	31	VDD	56	VREF	81	GND
7	A9	32	DT0	57	VOUTP	82	D16
8	A10	33	TFSO	58	VOUTN	83	D17
9	A11	34	RFSO	59	GND4	84	D18
10	A12	35	DRO	60	BMODE	85	D19
11	A13	36	SCLKO	61	PWD	86	D20
12	GND	37	GND	62	BR	87	D21
13	VDD	38	DT1/FO	63	BG	88	D22
14	XTAL	39	TFS1/RQ1	64	D0	89	D23
15	CLKIN	40	RFS1/RQ0	65	D1	90	VDD
16	CLKOUT	41	DR1/F1	66	D2	91	PMS
17	HD7	42	SCLK 1	67	D3	92	DMS
18	HD6	43	FLO	68	D4	93	BMS
19	HD5	44	HACK	69	D5	94	RD
20	HD4	45	HMD 1	70	D6	95	WR
21	HD3	46	HMD 0	71	D7	96	GND
22	HD2	47	IRQ 2	72	GND	97	A0
23	HD1	48	RESET	73	D8	98	A1
24	HD0	49	MMAP	74	D9	99	A2
25	HA2/ALE	50	GND4	75	D10	100	A3

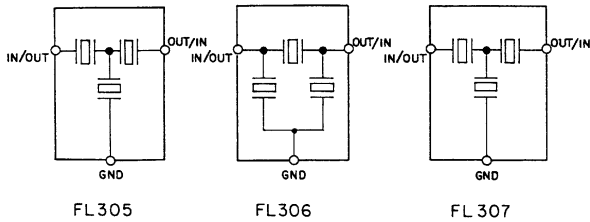


BLOCK DIAGRAM

**RF BOARD
BAND PASS FILTER
(FL305, FL306, FL307)**



(TOP VIEW)

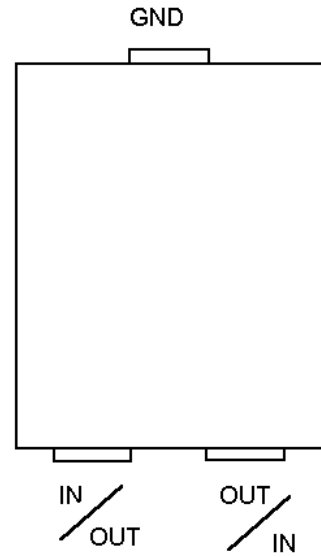


FL305

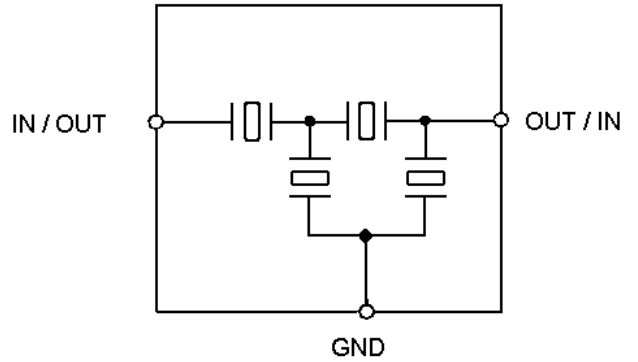
FL306

FL307

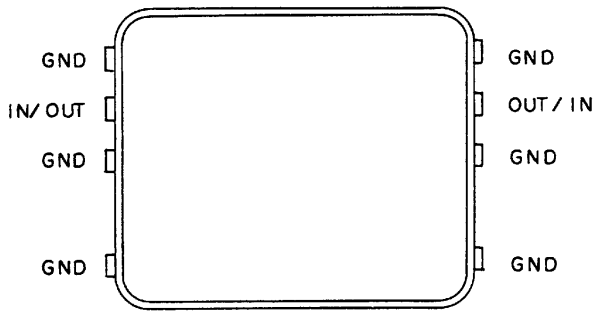
**RF BOARD
BAND PASS FILTER
(FL308)**



(TOP VIEW)

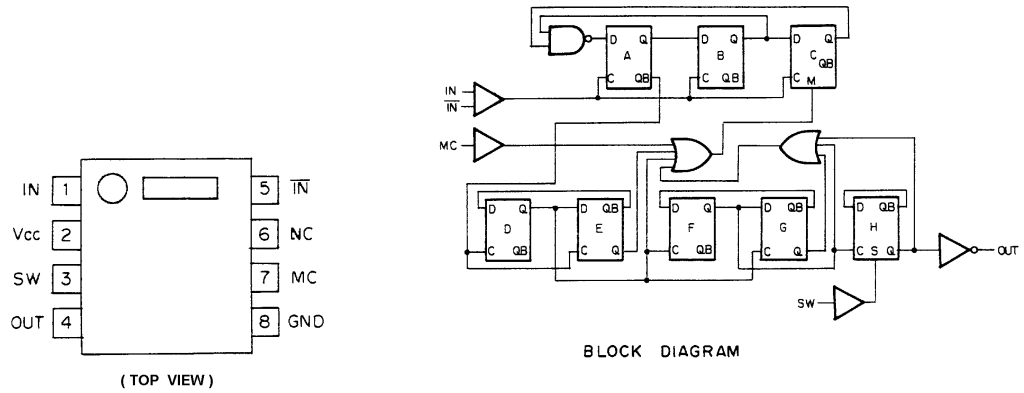


**RF BOARD
BAND PASS FILTER
(FL301, FL302)**

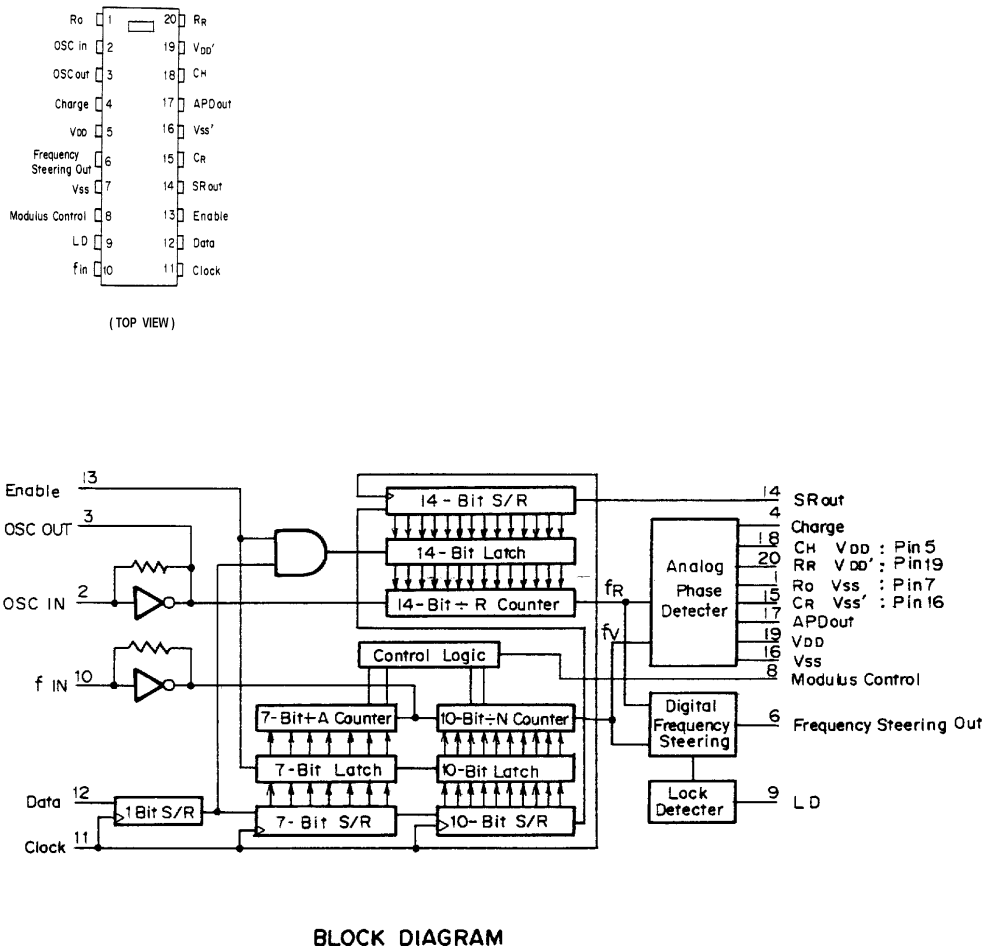


UHF (TOP VIEW)

RF BOARD
PRESCALER (U1)

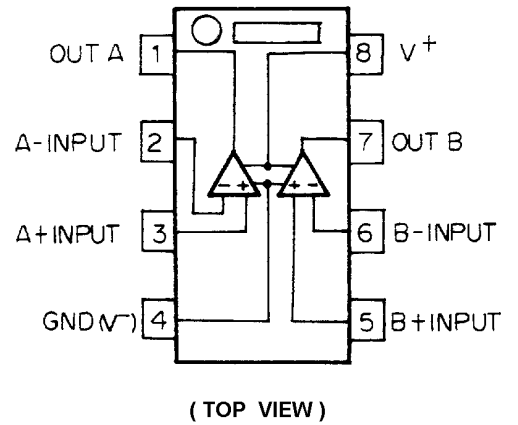
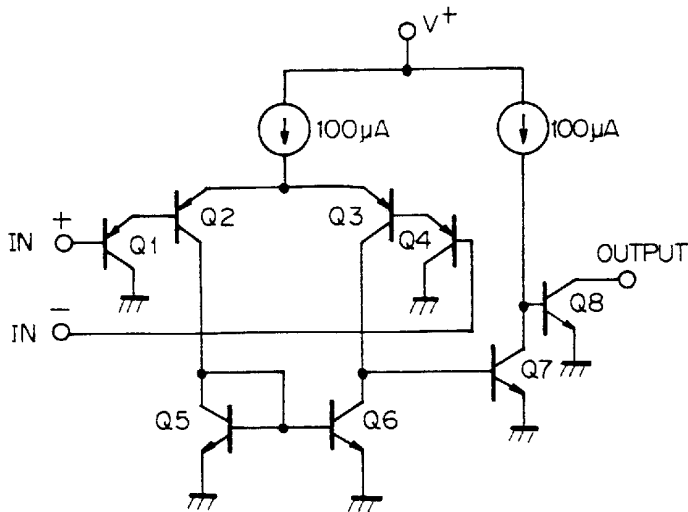


RF BOARD
PHASE LOCK LOOP (U2)

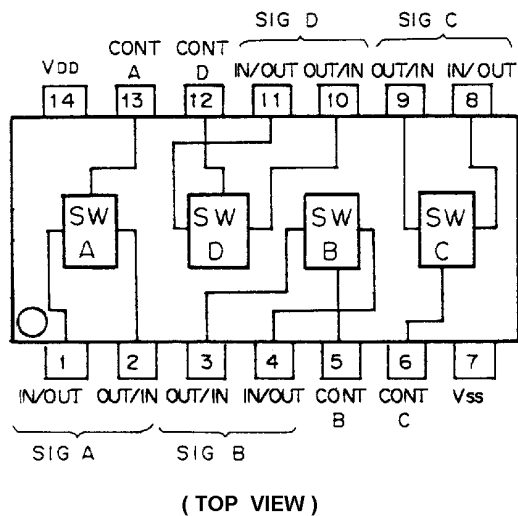


**RF BOARD
DUAL OP - AMPLIFIER
(U4, U9)**

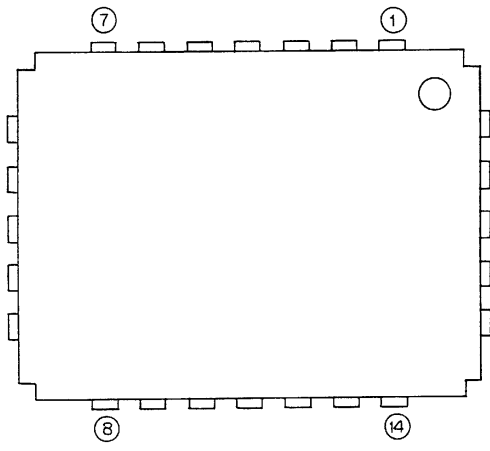
Equivalent Circuit (1/2 Circuit)



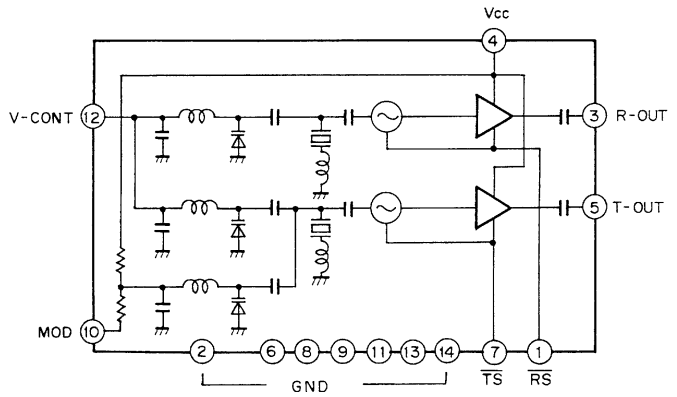
**RF BOARD
QUAD / BI - LATERAL SWITCH
(U3)**



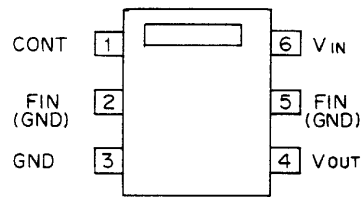
**RF BOARD
VCO MODULE (U5)**



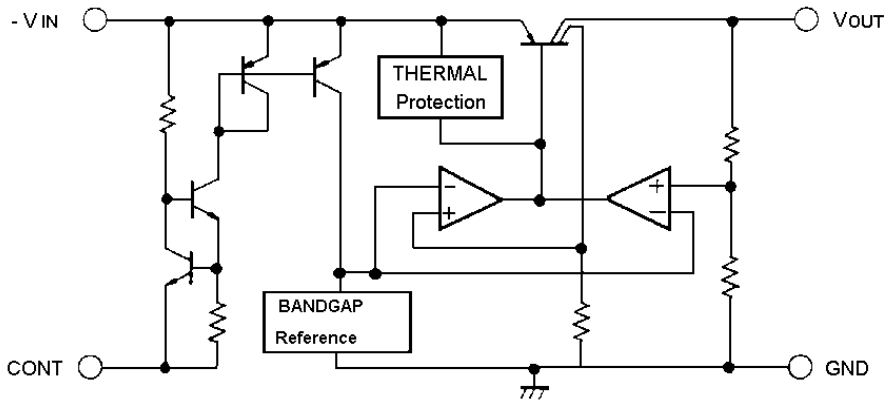
(TOP VIEW)



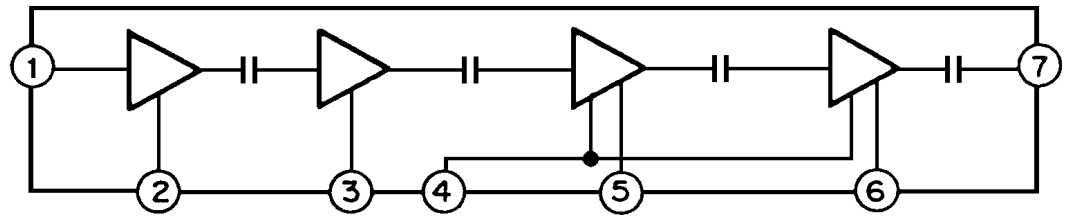
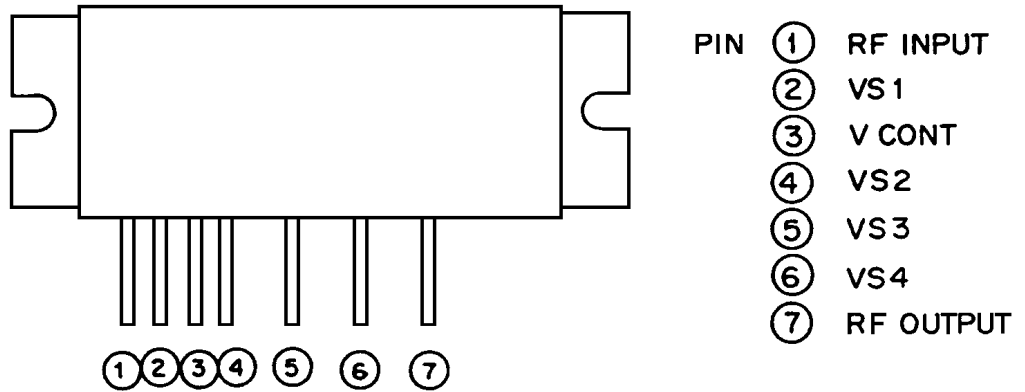
**RF BOARD
REGULATOR (U6)**



(TOP VIEW)

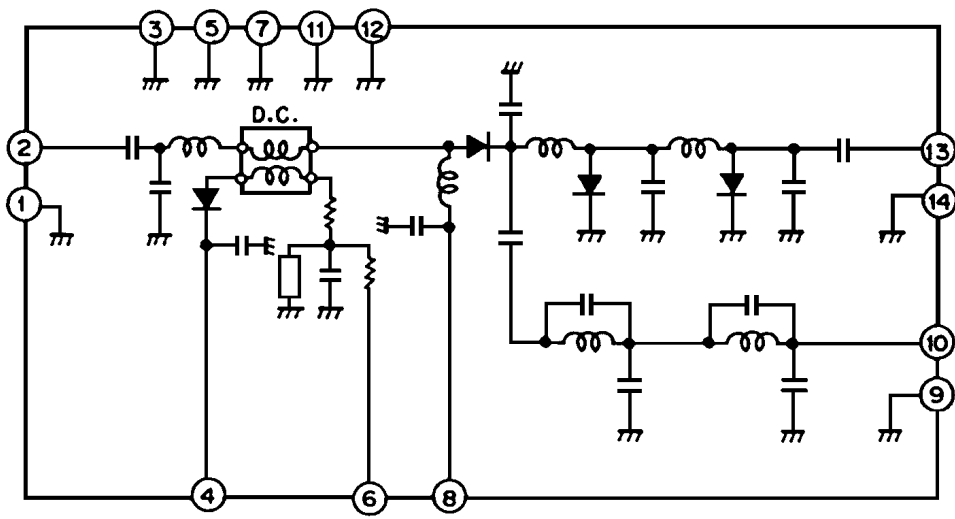
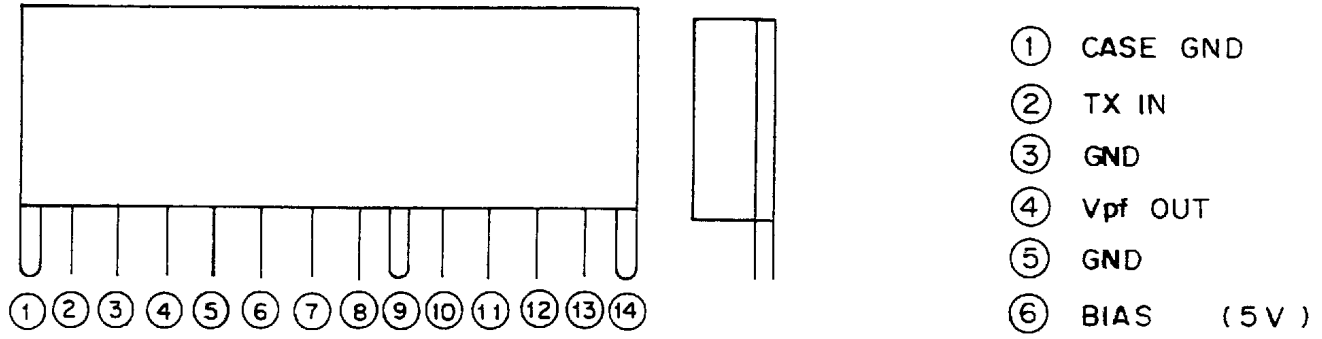


RF BOARD
POWER AMPLIFIER MODULE (U7)

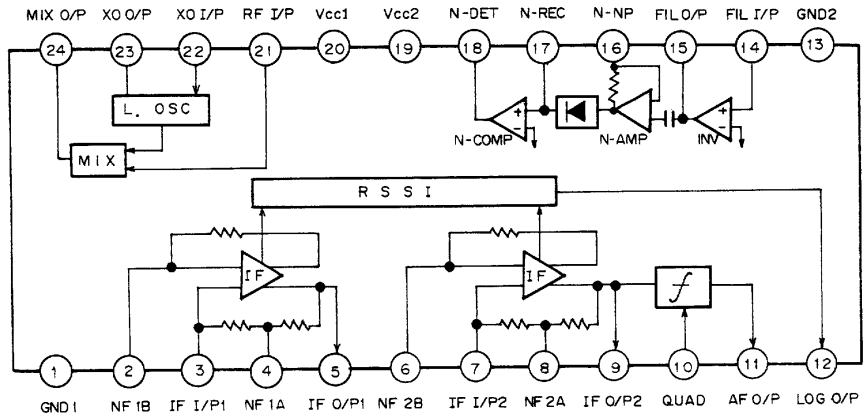
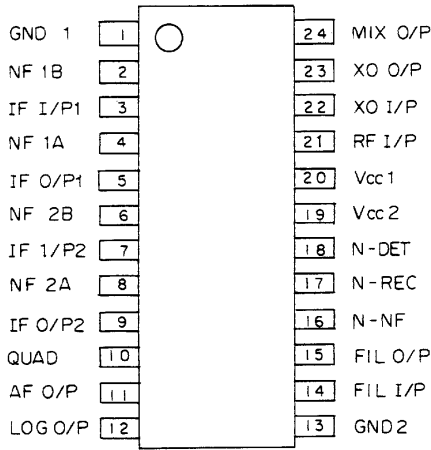


INTERNAL DIAGRAM

RF BOARD
LPF / DC / TR SWITCH MODULE (U8)

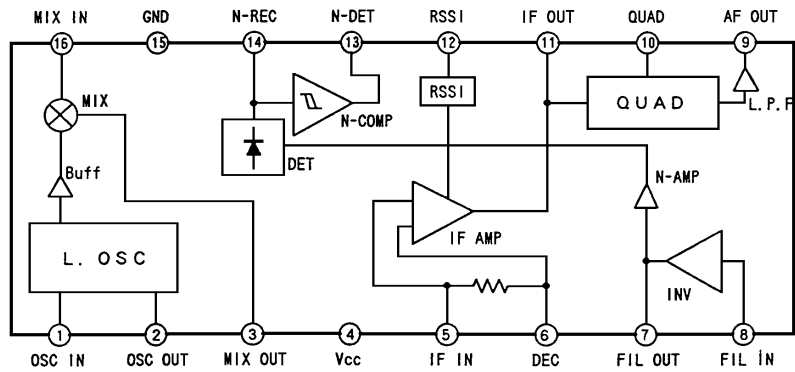
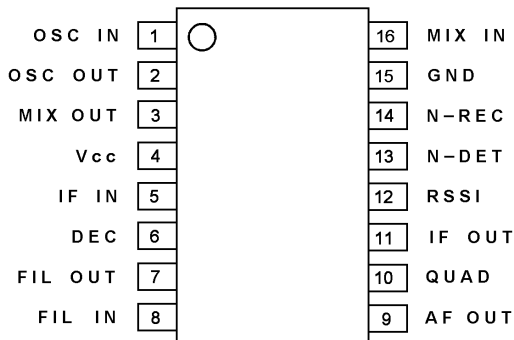


**RF BOARD
IF IC (U11)**



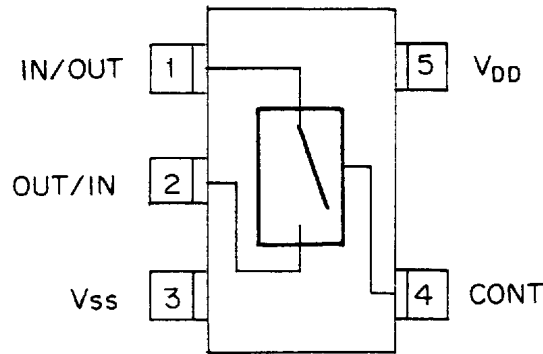
(TOP VIEW)

**RF BOARD (W/N)
IF IC (U11)**



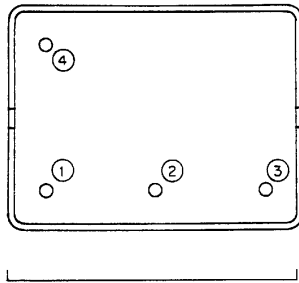
(TOP VIEW)

**RF BOARD
BI - LATERAL SWITCH (U12)**

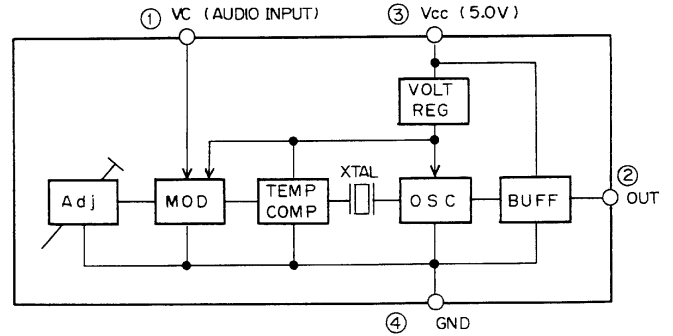


(TOP VIEW)

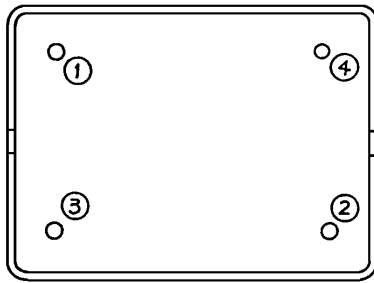
**RF BOARD
VC TCXO MODULE (Z1)**



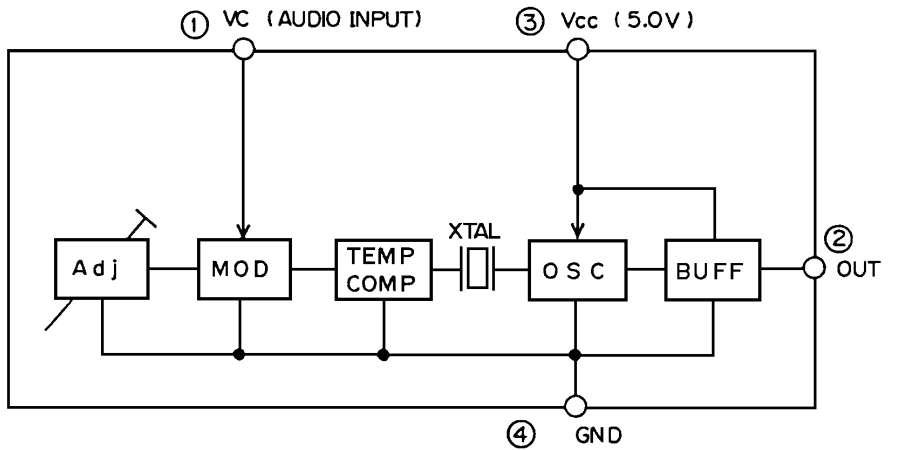
(BOTTOM VIEW)



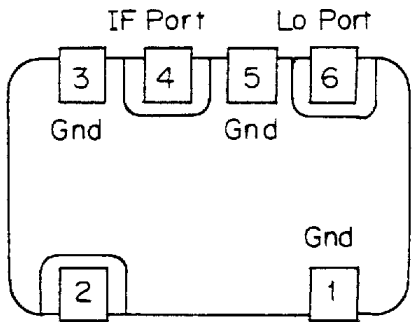
**RF BOARD (W/N)
VC TCXO MODULE (Z1)**



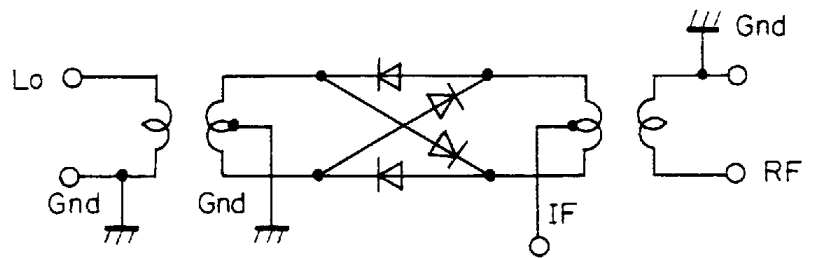
(BOTTOM VIEW)



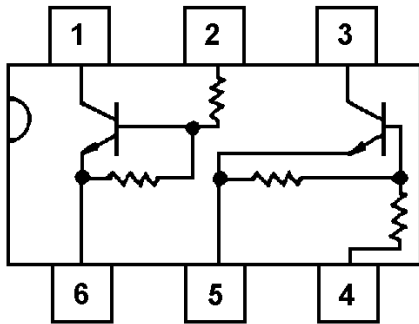
**RF BOARD
DOUBLE BALANCED DIODE MIXER (DBM) (Z2)**



(BOTTOM VIEW)

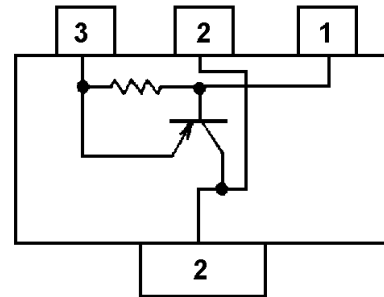


RF BOARD Q102, Q201
LED FLEX BOARD Q2



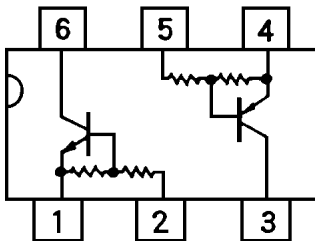
(TOP VIEW)

CONTROL BOARD
Q1, Q5, Q6



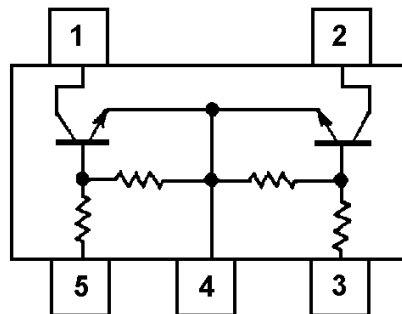
(TOP VIEW)

RF BOARD (W/N)
Q108, Q205



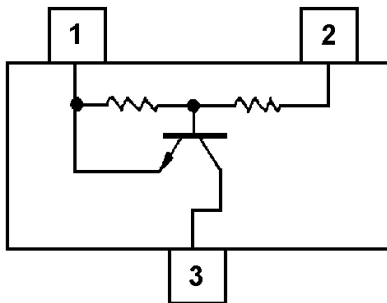
(TOP VIEW)

CONTROL BOARD Q3
LCD / KB FLEX BOARD Q5 ~ Q11
RF BOARD (W/N) Q102, Q105



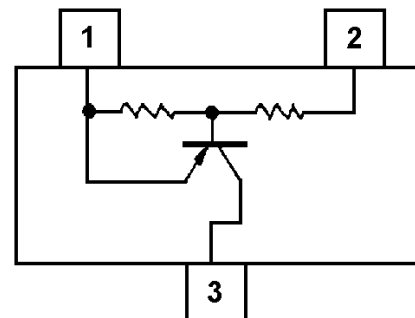
(TOP VIEW)

RF BOARD Q105
CONTROL BOARD Q8
LCD / KB FLEX BOARD Q4



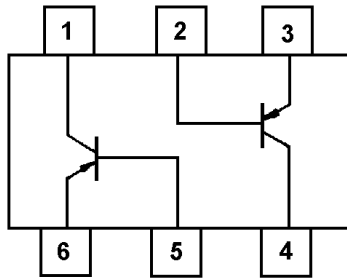
(TOP VIEW)

RF BOARD Q205
LCD / KB FLEX BOARD Q1, Q3
LED FLEX BOARD Q1



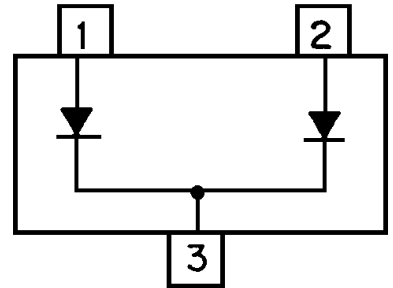
(TOP VIEW)

CONTROL BOARD
Q4, Q7



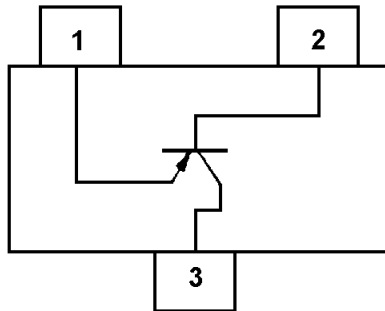
(TOP VIEW)

RF BOARD
CR101



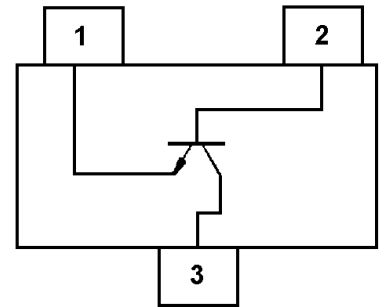
(TOP VIEW)

RF BOARD
Q203 (VHF, UHF)



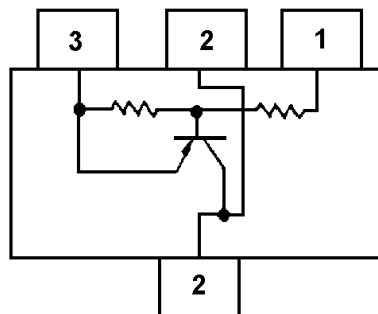
(TOP VIEW)

RF BOARD Q101, Q103, Q104, Q106, Q107, Q204,
Q301 (VHF, UHF), Q302,
CONTROL BOARD Q2
LCD / KB FLEX BOARD Q2



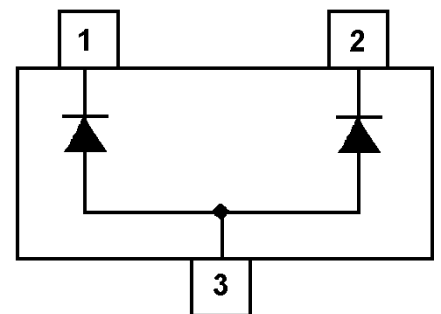
(TOP VIEW)

RF BOARD
Q202



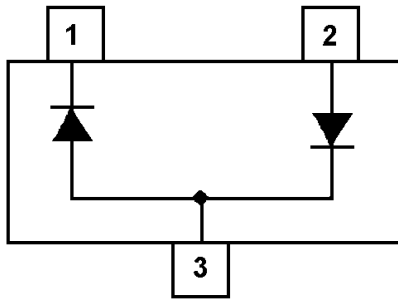
(TOP VIEW)

CONTROL BOARD
CR7 ~ 11, CR12



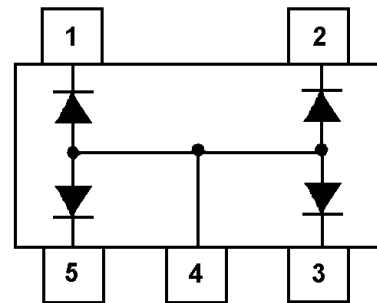
(TOP VIEW)

CONTROL BOARD
 CR1 ~ 6, CR13 ~ 15
 LCD / KB FLEX BOARD CR1



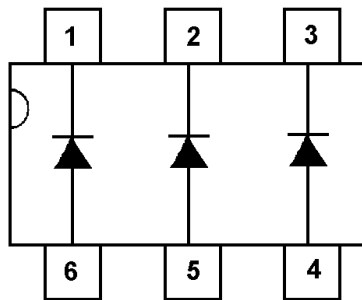
(TOP VIEW)

LCD / KB FLEX BOARD CR3
 LED FLEX BOARD CR3



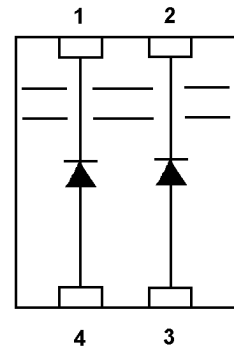
(TOP VIEW)

LCD / KB FLEX BOARD CR2, CR4
 LED FLEX BOARD CR4



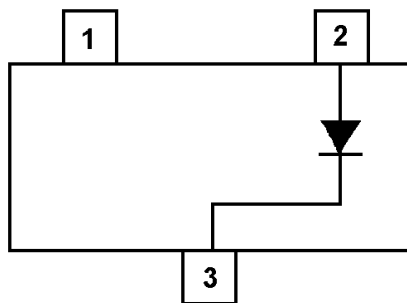
(TOP VIEW)

LED FLEX BOARD
 DS2, DS3



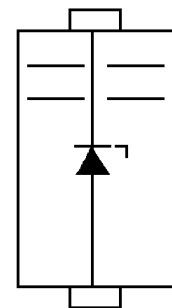
(TOP VIEW)

RF BOARD
 CR301
 CR202



(TOP VIEW)

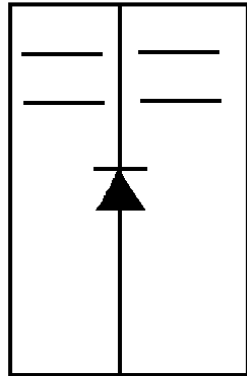
CONTROL BOARD
 CR16



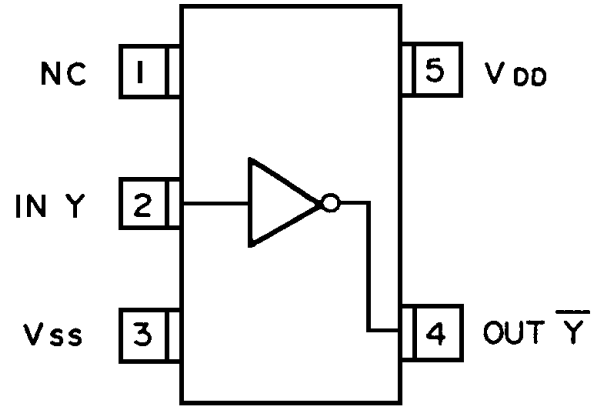
(TOP VIEW)

LCD / KB FLEX BOARD DS1 ~ 4
LED FLEX BOARD DS1

LCD / KB FLEX
U3



(TOP VIEW)



(TOP VIEW)

