ICOM

SERVICE MANUAL

VHF MARINE RADIOTELEPHONE

IC-M5

Icom Inc.

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SECTION 1 SPECIFICATIONS

GENERAL

Number of Channels	: *All U.S.A. and International channels 10 Weather plus Auxiliary Priority channels Operation Simplex, Semi-duplex
Channel Spacing	: 25kHz
Frequency Stability	: 0.0005 Percent
Usable Temperature Range	: −20°C to +60°C (−4°F to +140°F)
Antenna Impedance	: 50 ohms unbalanced
Power Supply Requirement	: ICOM battery pack (CM-2 ~ CM-12) 12 ~ 15V DC for the EXTERNAL DC POWER JACK Negative ground
Current Drain at 13.2V	: Transmitting At 5 watts output — Approx. 1.25A Receiving At max audio output — Approx. 140mA Squelched — Approx. 35mA
Dimensions (with CM-7)	: 65(W) x 198(H) x 35(D) mm 2.6(W) x 7.8(H) x 1.4(D) in (projections not included)
Weight (with CM-7)	: 590g (1.3 lb)

RECEIVER

Frequency Range	: 156.025 ~ 157.425MHz and 160.625 ~ 163.275MHz
Receiving System	: Double-conversion superheterodyne
Modulation Acceptance	: ± 7.5kHz
Intermediate Frequency	: 1st 16.9MHz 2nd 455kHz
Sensitivity	: Less than 0.3μV for 20dB noise quieting Less than 0.25μV for 12dB SINAD
Squelch Sensitivity	: Less than 0.1μV
Spurious Response Rejection Ratio	: More than 60dB
Selectivity	: More than 65dB at adjacent channel
Intermodulation Rejection Ratio	: More than 60dB
Audio Output Power	: More than 500mW at 10% distortion
Audio Output Impedance	: 8 ohms

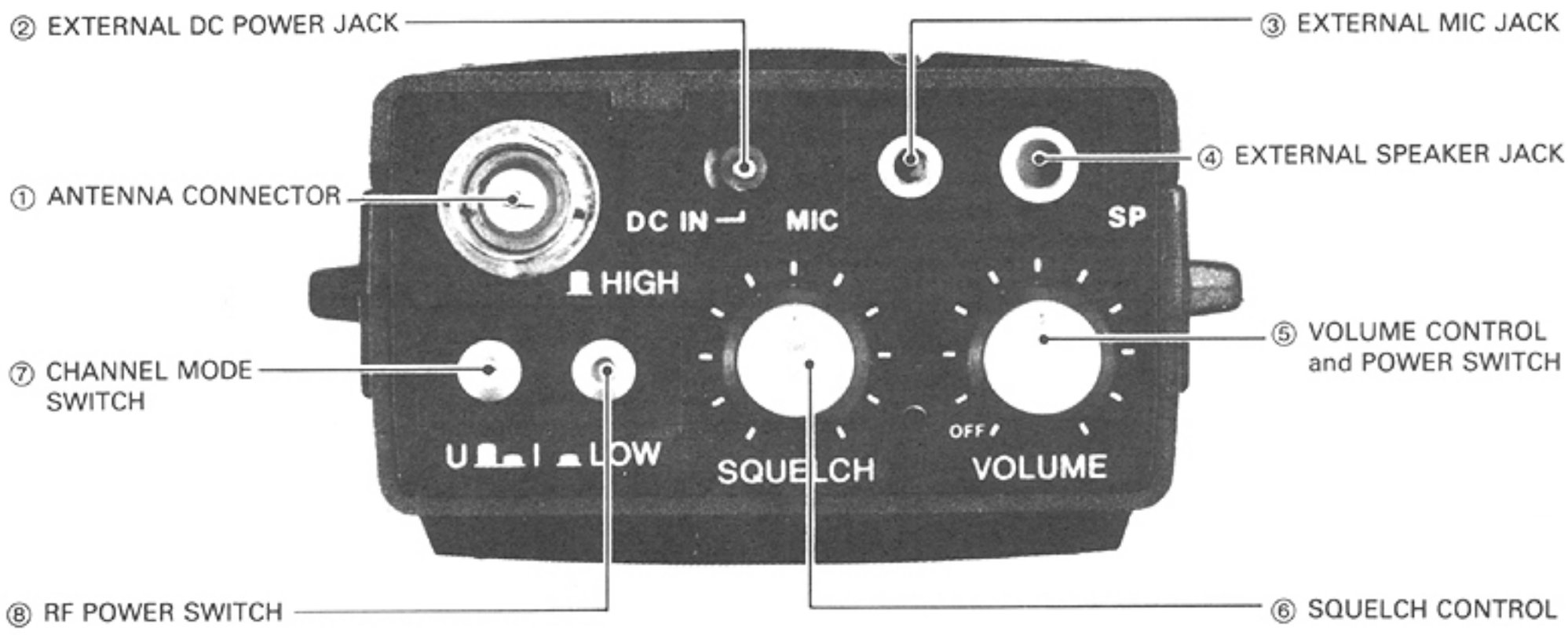
TRANSMITTER

Frequency Range	: 156.025 ~ 157.425MHz
Output Power	: High: 5 watts, Low: 1 watt (with CM-7) High: 2.5 watts, Low: 1 watt (with CM-3 or CM-8)
Emission Mode	: 16K0G3E, 16K0F3E
Modulation System	: Variable reactance frequency modulation
Max. Frequency Deviation	: ±5kHz
Spurious Emission	: More than 60dB below carrier
Microphone	: Built-in electret condenser microphone

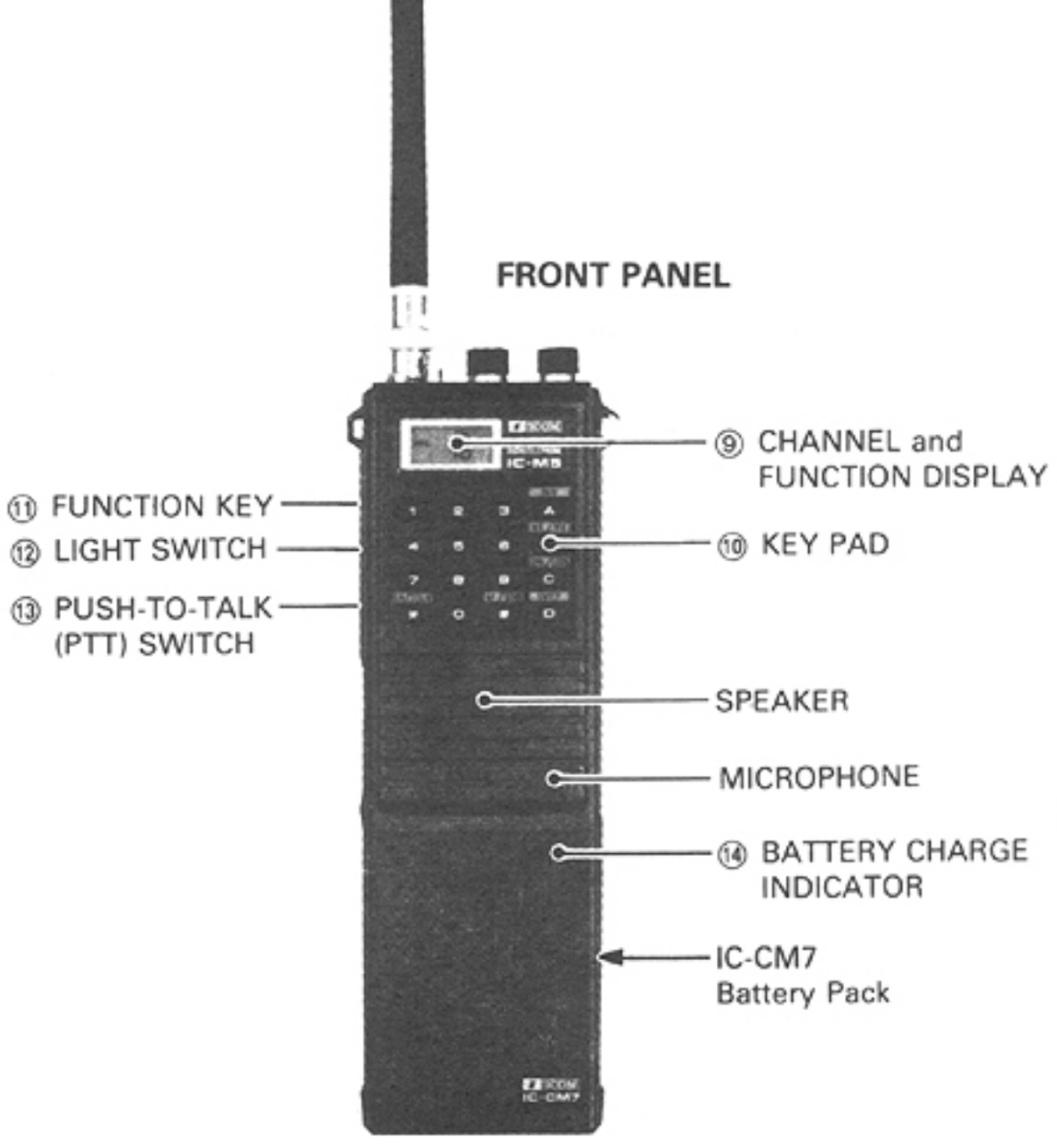
*NOTE: All versions of the IC-M5 radio will not tune this entire range. See Section 2 for the exact channels in each version.

SECTION 2 OPERATING CONTROLS

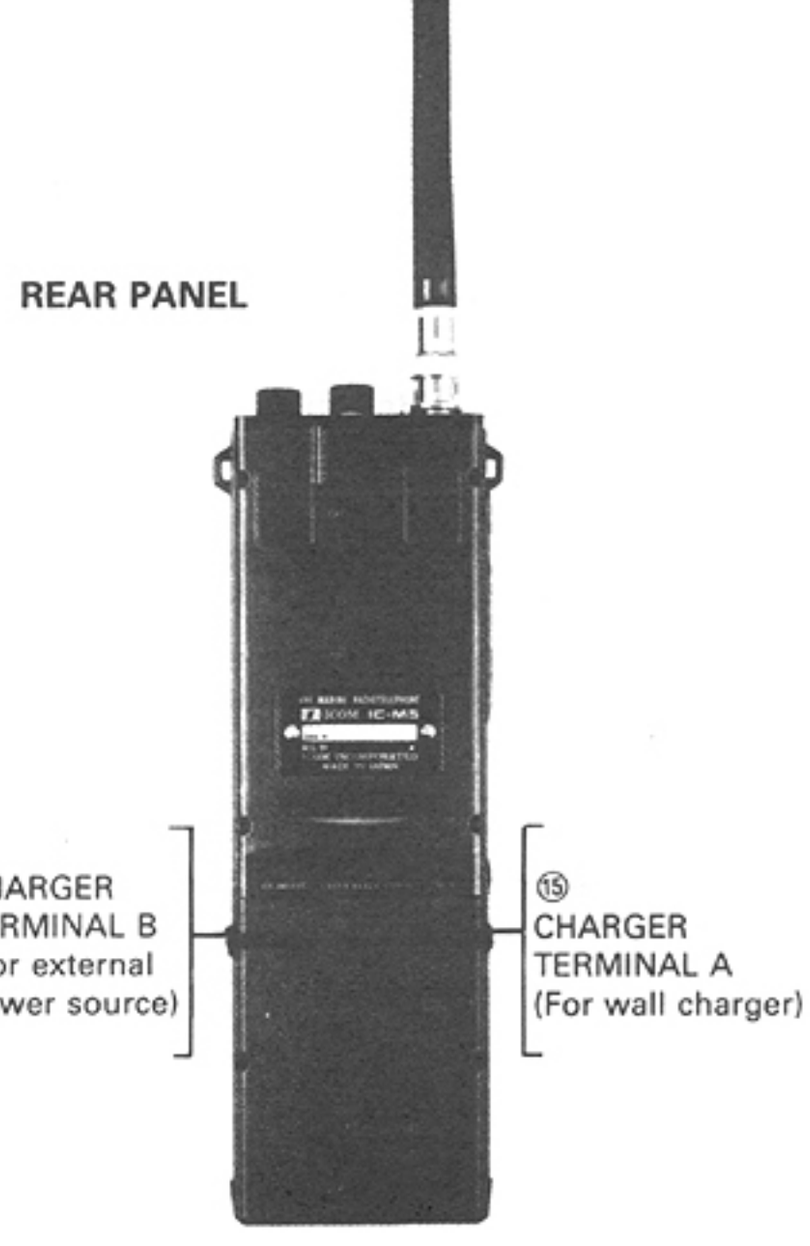
TOP PANEL



FRONT PANEL



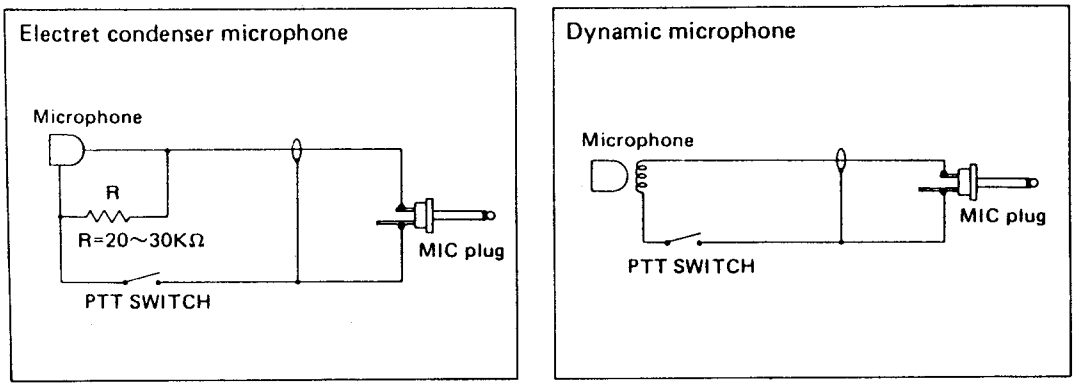
REAR PANEL



1. **ANTENNA CONNECTOR**
Connect the supplied flexible antenna or an external antenna. The feedline from an external antenna must have a BNC connector.

2. **EXTERNAL DC POWER JACK**
Connect a voltage regulated DC power supply with an output of 12 ~ 15 volts when using external power. Inserting a power plug into this jack disables the attached power pack. (NOTE: The battery pack will charge at a rate equal to 1/10 of the battery capacity when using the IC-CM7 or at about 45mA.

3. **EXTERNAL MIC JACK**
Connect an external microphone when required. Refer to the schematic below. The built-in microphone does not operate when the external microphone is connected. Use the optional speaker-microphone IC-CM9 or headset HS-10. Accessories for the HS-10 are the VOX unit HS-10SA or PTT switch box HS-10SB.



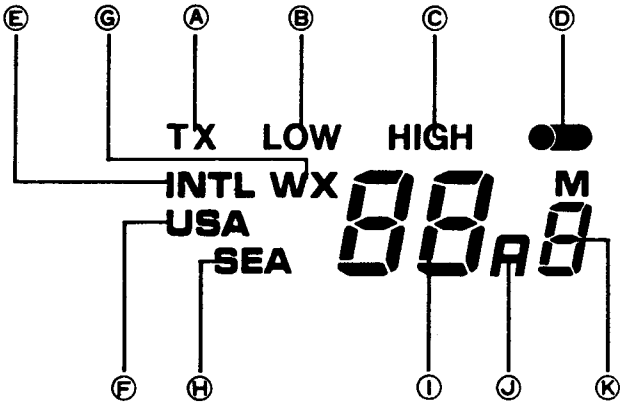
4. **EXTERNAL SPEAKER JACK**
Connect an external speaker or earphone when required. Use a speaker with 8 ohms impedance. The built-in speaker does not operate when an external speaker is connected.

5. **VOLUME CONTROL and POWER SWITCH**
Rotate completely counterclockwise to turn power OFF. Turn clockwise beyond the "click" to turn power ON. Rotating the control further clockwise increases the audio level.

6. **SQUELCH CONTROL**
Sets the squelch threshold level. Turn completely counterclockwise to disable the squelch circuit. Rotate clockwise to increase the threshold level.

7. **CHANNEL MODE SWITCH**
Switches the transceiver between the International or U.S.A. (or domestic) channel allocations.

8. **RF POWER SWITCH**
Switches the transmit output power between the HIGH and LOW levels. Power out is 5 watts at 13.2 volts in the HIGH position and 1 watt at any other acceptable voltage in the LOW position.



9. CHANNEL and FUNCTION DISPLAY

Displays the operating channel and status of the radio.

A: TRANSMIT INDICATOR: Displays "TX" when the set is in the transmit mode.

B: LOW POWER INDICATOR: Displays "LOW" when the set is in the low output power (1W) mode.

C: HIGH POWER INDICATOR: Displays "HIGH" when the set is in the high output power (5W) mode.

D: BATTERY CONDITION/SCAN INDICATOR: Displays this symbol just before the battery is exhausted. Stop using the set and recharge the battery pack or replace the pack with a charged one when the symbol appears. The symbol blinks when the set is in the scan mode.

E: INTERNATIONAL MODE INDICATOR: Displays "INTL" when the International mode is selected.

F: U.S.A. MODE INDICATOR: Displays "U.S.A." when the U.S.A. mode is selected.

G: WEATHER CHANNEL INDICATOR: Displays "WX" when a weather channel is selected.

H: SEA (DUAL WATCH) INDICATOR: Displays "SEA" when the SEA (dual watch) function is turned ON.

I: CHANNEL DISPLAY: Displays the operating channel number with 2 digits.

J: U.S.A. CHANNEL INDICATOR: Displays "A" when a U.S.A. mode channel is selected.

K: MEMORY CHANNEL DISPLAY: Displays the letter "M" and the memory channel number when a memory channel is selected. Displays the letter "L" instead of the memory channel number when the keyboard lock function is enabled.

10. KEY PAD

The key pad has 16 keys consisting of ten numerical and six code keys. Some keys have dual functions.

The primary functions are available by pushing one key. The ten numerical keys set digits on the display corresponding to the digits on the keys. The other keys enable the functions stated above the keys on a gray colored background.

Pushing a key while the "FUNC" key on the side of the set is depressed enables the secondary functions. Keys with secondary functions have those functions printed above the key on an olive colored background.

KEY	PRIMARY FUNCTION		SECONDARY FUNCTION	
	SYMBOL	FUNCTION	SYMBOL	FUNCTION
1	1	Inputs the digit 1.	—	—
2	2	Inputs the digit 2.	—	—
3	3	Inputs the digit 3.	—	—
4	4	Inputs the digit 4.	—	—
5	5	Inputs the digit 5.	—	—
6	6	Inputs the digit 6.	—	—
7	7	Inputs the digit 7.	—	—
8	8	Inputs the digit 8.	—	—
9	9	Inputs the digit 9.	—	—
0	0	Inputs the digit 0.	—	—
*	DN	Decreases the operating channel number, or operating memory channel number.	SEA W	Sets the SEA (dual watch) function. Push the A, B, or C key or the FUNC key to disable the SEA function.
#	UP	Increases the operating channel number or operating memory channel number.	SCAN	Starts the all channel scan when the set is in the DIAL mode, or the memory channel scan when in the memory channel mode. Push the A, B, or C keys to stop the scan.
A	CH 16	Sets the radio to Channel 16.	—	—
B	WX	Sets the radio in the weather channel mode. Push the key, and then a desired channel number 0 to 9.	MR	Sets the radio in the memory channel mode. Push the key, and then a desired channel number 0 to 9.
C	DIAL	Sets the radio in the dial mode. Push this key followed by desired channel number keys and ENTER to select a channel.	LOCK	Locks the key pad to prevent accidental key entry. To clear this function, push the key again while depressing the FUNC key.
D	ENTER	Inputs a selected channel number into the radio, or writes the selected channel into a memory channel.	—	—

11. FUNCTION KEY
Select the secondary function of each key by depressing this key.

12. LIGHT SWITCH
The CHANNEL and FUNCTION DISPLAY illuminates while this switch is depressed.

13. PUSH-TO-TALK (PTT) SWITCH
Press this switch and speak into the microphone with a normal voice to transmit. The internal microphone is a sensitive electret-condenser type.

14. BATTERY CHARGE INDICATOR
Lights during battery charging.

15. CHARGER TERMINAL A
Mates with the output plug from the supplied wall charger CM-16U/E or other suitable power source.

16. CHARGER TERMINAL B
Mates with the output plug from an external 13.8 volt DC power source.

CHANNEL FREQUENCIES

American Version #01

Channel No.	Frequency (MHz)		Transmitter RF Power
	Transmitter	Receiver	
01	156.050	160.650	5W & 1W
01A	156.050	156.050	5W & 1W
02	156.100	160.700	5W & 1W
02A	156.100	156.100	5W & 1W
03	156.150	160.750	5W & 1W
03A	156.150	156.150	5W & 1W
04	156.200	160.800	5W & 1W
04A	156.200	156.200	5W & 1W
05	156.250	160.850	5W & 1W
05A	156.250	156.250	5W & 1W
06	156.300	156.300	5W & 1W
07	156.350	160.950	5W & 1W
07A	156.350	156.350	5W & 1W
08	156.400	156.400	5W & 1W
09	156.450	156.450	5W & 1W
10	156.500	156.500	5W & 1W
11	156.550	156.550	5W & 1W
12	156.600	156.600	5W & 1W
13	156.650	156.650	5W & 1W
14	156.700	156.700	5W & 1W
15	156.750	156.750	1W only
16	156.800	156.800	5W & 1W
17	156.850	156.850	1W only
18	156.900	161.500	5W & 1W
18A	156.900	156.900	5W & 1W
19	156.950	161.550	5W & 1W
19A	156.950	156.950	5W & 1W
20	157.000	161.600	5W & 1W
20A	157.000	157.000	5W & 1W
21	157.050	161.650	5W & 1W
21A	157.050	157.050	5W & 1W
22	157.100	161.700	5W & 1W
22A	157.100	157.100	5W & 1W
23	157.150	161.750	5W & 1W
23A	157.150	157.150	5W & 1W
24	157.200	161.800	5W & 1W
25	157.250	161.850	5W & 1W
26	157.300	161.900	5W & 1W
27	157.350	161.950	5W & 1W
28	157.400	162.000	5W & 1W
60	156.025	160.625	5W & 1W
60A	156.025	156.025	5W & 1W
61	156.075	160.675	5W & 1W
61A	156.075	156.075	5W & 1W
62	156.125	160.725	5W & 1W
62A	156.125	156.125	5W & 1W
63	156.175	160.775	5W & 1W
63A	156.175	156.175	5W & 1W
64	156.225	160.825	5W & 1W

Channel No.	Frequency (MHz)		Transmitter RF Power
	Transmitter	Receiver	
64A	156.225	156.225	5W & 1W
65	156.275	160.875	5W & 1W
65A	156.275	156.275	5W & 1W
66	156.325	160.925	5W & 1W
66A	156.325	156.325	5W & 1W
67	156.375	156.375	5W & 1W
68	156.425	156.425	5W & 1W
69	156.475	156.475	5W & 1W
70	156.525	156.525	5W & 1W
71	156.575	156.575	5W & 1W
72	156.625	156.625	5W & 1W
73	156.675	156.675	5W & 1W
74	156.725	156.725	5W & 1W
75	—	—	Guard
76	—	—	Guard
77	156.875	156.875	5W & 1W
78	156.925	161.525	5W & 1W
78A	156.925	156.925	5W & 1W
79	156.975	161.575	5W & 1W
79A	156.975	156.975	5W & 1W
80	157.025	161.625	5W & 1W
80A	157.025	157.025	5W & 1W
81	157.075	161.675	5W & 1W
81A	157.075	157.075	5W & 1W
82	157.125	161.725	5W & 1W
82A	157.125	157.125	5W & 1W
83	157.175	161.775	5W & 1W
83A	157.175	157.175	5W & 1W
84	157.225	161.825	5W & 1W
84A	157.225	157.225	5W & 1W
85	157.275	161.875	5W & 1W
85A	157.275	157.275	5W & 1W
86	157.325	161.925	5W & 1W
86A	157.325	157.325	5W & 1W
87	157.375	161.975	5W & 1W
87A	157.375	157.375	5W & 1W
88	157.425	162.025	5W & 1W
88A	157.425	157.425	5W & 1W
WX 1	—	162.550	RX. only
WX 2	—	162.400	RX. only
WX 3	—	161.650	RX. only
WX 4	—	162.475	RX. only
WX 5	—	162.425	RX. only
WX 6	—	162.500	RX. only
WX 7	—	162.525	RX. only
WX 8	—	162.450	RX. only
WX 9	—	161.775	RX. only
WX 0	—	163.275	RX. only

CHANNEL FREQUENCIES

International Version #02

Channel No.	Frequency (MHz)		Transmitter RF Power
	Transmitter	Receiver	
01	156.050	160.650	5W & 1W
02	156.100	160.700	5W & 1W
03	156.150	160.750	5W & 1W
04	156.200	160.800	5W & 1W
05	156.250	160.850	5W & 1W
06	156.300	156.300	5W & 1W
07	156.350	160.950	5W & 1W
08	156.400	156.400	5W & 1W
09	156.450	156.450	5W & 1W
10	156.500	156.500	5W & 1W
11	156.550	156.550	5W & 1W
12	156.600	156.600	5W & 1W
13	156.650	156.650	5W & 1W
14	156.700	156.700	5W & 1W
15	156.750	156.750	1W only
16	156.800	156.800	5W & 1W
17	156.850	156.850	1W only
18	156.900	161.500	5W & 1W
19	156.950	161.550	5W & 1W
20	157.000	161.600	5W & 1W
21	157.050	161.650	5W & 1W
22	157.100	161.700	5W & 1W
23	157.150	161.750	5W & 1W
24	157.200	161.800	5W & 1W
25	157.250	161.850	5W & 1W
26	157.300	161.900	5W & 1W
27	157.350	161.950	5W & 1W
28	157.400	162.000	5W & 1W
60	156.025	160.625	5W & 1W
61	156.075	160.675	5W & 1W
62	156.125	160.725	5W & 1W
63	156.175	160.775	5W & 1W
64	156.225	160.825	5W & 1W
65	156.275	160.875	5W & 1W

Channel No.	Frequency (MHz)		Transmitter RF Power
	Transmitter	Receiver	
66	156.325	160.925	5W & 1W
67	156.375	156.375	5W & 1W
68	156.425	156.425	5W & 1W
69	156.475	156.475	5W & 1W
70	156.525	156.525	5W & 1W
71	156.575	156.575	5W & 1W
72	156.625	156.625	5W & 1W
73	156.675	156.675	5W & 1W
74	156.725	156.725	5W & 1W
75	—	—	Guard
76	—	—	Guard
77	156.875	156.875	5W & 1W
78	156.925	161.525	5W & 1W
79	156.975	161.575	5W & 1W
80	157.025	161.625	5W & 1W
81	157.075	161.675	5W & 1W
82	157.125	161.725	5W & 1W
83	157.175	161.775	5W & 1W
84	157.225	161.825	5W & 1W
85	157.275	161.875	5W & 1W
86	157.325	161.925	5W & 1W
87	157.375	161.975	5W & 1W
88	157.425	162.025	5W & 1W
WX 1	—	162.550	RX. only
WX 2	—	162.400	RX. only
WX 3	—	161.650	RX. only
WX 4	—	162.475	RX. only
WX 5	—	162.425	RX. only
WX 6	—	162.500	RX. only
WX 7	—	162.525	RX. only
WX 8	—	162.450	RX. only
WX 9	—	161.775	RX. only
WX 0	—	163.275	RX. only

CHANNEL FREQUENCIES

British Version #03

Channel No.	Frequency (MHz)		Transmitter RF Power
	Transmitter	Receiver	
01	156.050	160.650	5W & 1W
02	156.100	160.700	5W & 1W
03	156.150	160.750	5W & 1W
04	156.200	160.800	5W & 1W
05	156.250	160.850	5W & 1W
06	156.300	156.300	5W & 1W
07	156.350	160.950	5W & 1W
08	156.400	156.400	5W & 1W
09	156.450	156.450	5W & 1W
10	156.500	156.500	5W & 1W
11	156.550	156.550	5W & 1W
12	156.600	156.600	5W & 1W
13	156.650	156.650	5W & 1W
14	156.700	156.700	5W & 1W
15	156.750	156.750	1W only
16	156.800	156.800	5W & 1W
17	156.850	156.850	1W only
18	156.900	161.500	5W & 1W
19	156.950	161.550	5W & 1W
20	157.000	161.600	5W & 1W
21	157.050	161.650	5W & 1W
22	157.100	161.700	5W & 1W
23	157.150	161.750	5W & 1W
24	157.200	161.800	5W & 1W
25	157.250	161.850	5W & 1W
26	157.300	161.900	5W & 1W
27	157.350	161.950	5W & 1W
28	157.400	162.000	5W & 1W
37A	157.850	157.850	5W & 1W

Channel No.	Frequency (MHz)		Transmitter RF Power
	Transmitter	Receiver	
60	156.025	160.625	5W & 1W
61	156.075	160.675	5W & 1W
62	156.125	160.725	5W & 1W
63	156.175	160.775	5W & 1W
64	156.225	160.825	5W & 1W
65	156.275	160.875	5W & 1W
66	156.325	160.925	5W & 1W
67	156.375	156.375	5W & 1W
68	156.425	156.425	5W & 1W
69	156.475	156.475	5W & 1W
70	156.525	156.525	5W & 1W
71	156.575	156.575	5W & 1W
72	156.625	156.625	5W & 1W
73	156.675	156.675	5W & 1W
74	156.725	156.725	5W & 1W
75	—	—	Guard
76	—	—	Guard
77	156.875	156.875	5W & 1W
78	156.925	161.525	5W & 1W
79	156.975	161.575	5W & 1W
80	157.025	161.625	5W & 1W
81	157.075	161.675	5W & 1W
82	157.125	161.725	5W & 1W
83	157.175	161.775	5W & 1W
84	157.225	161.825	5W & 1W
85	157.275	161.875	5W & 1W
86	157.325	161.925	5W & 1W
87	157.375	161.975	5W & 1W
88	157.425	162.025	5W & 1W

CHANNEL FREQUENCIES

Dutch Version #04

Channel No.	Frequency (MHz)		Transmitter RF Power
	Transmitter	Receiver	
01	156.050	160.650	1W only
02	156.100	160.700	1W only
03	156.150	160.750	1W only
04	156.200	160.800	1W only
05	156.250	160.850	1W only
06	156.300	156.300	1W only
07	156.350	160.950	1W only
08	156.400	156.400	1W only
09	156.450	156.450	1W only
10	156.500	156.500	1W only
11	156.550	156.550	1W only
12	156.600	156.600	1W only
13	156.650	156.650	1W only
14	156.700	156.700	1W only
15	156.750	156.750	1W only
16	156.800	156.800	5W & 1W
17	156.850	156.850	1W only
18	156.900	161.500	1W only
19	156.950	161.550	1W only
20	157.000	161.600	1W only
21	157.050	161.650	1W only
22	157.100	161.700	1W only
23	157.150	161.750	5W & 1W
24	157.200	161.800	5W & 1W
25	157.250	161.850	5W & 1W
26	157.300	161.900	5W & 1W
27	157.350	161.950	5W & 1W
28	157.400	162.000	5W & 1W

Channel No.	Frequency (MHz)		Transmitter RF Power
	Transmitter	Receiver	
60	156.025	160.625	1W only
61	156.075	160.675	1W only
62	156.125	160.725	1W only
63	156.175	160.775	1W only
64	156.225	160.825	1W only
65	156.275	160.875	1W only
66	156.325	160.925	1W only
67	156.375	156.375	1W only
68	156.425	156.425	1W only
69	156.475	156.475	1W only
70	156.525	156.525	1W only
71	156.575	156.575	1W only
72	156.625	156.625	1W only
73	156.675	156.675	1W only
74	156.725	156.725	1W only
75	—	—	Guard
76	—	—	Guard
77	156.875	156.875	1W only
78	156.925	161.525	1W only
79	156.975	161.575	1W only
80	157.025	161.625	1W only
81	157.075	161.675	1W only
82	157.125	161.725	5W & 1W
83	157.175	161.775	5W & 1W
84	157.225	161.825	5W & 1W
85	157.275	161.875	5W & 1W
86	157.325	161.925	5W & 1W
87	157.375	161.975	5W & 1W
88	157.425	162.025	5W & 1W

SECTION 3 CIRCUIT DESCRIPTION

3 - 1 RECEIVER CIRCUITS

3 - 1 - 1 Antenna Switching Circuit

The signals enter the antenna switching circuit from the antenna connector via a Chebyshev low-pass filter. L213, L214, C258, C260, C262, C264 and C265 on the PLL board form the filter.

The antenna switch employs a quarter wave switching circuit.

Switching diodes D208 and D209 turn OFF when in the receive mode. They provide isolation from both the transmitter and matching circuits. The incoming signals pass to the RF amplifier through a PI low-pass filter consisting of C256, C259 and L212 on the PLL board.

3 - 1 - 2 RF Amplifier Circuit

The signals from the switching circuit feed to Q206 through L205. The amplified output passes to the gate of the first mixer Q205 via the band-pass filter formed by L202, L203 and L204. This filter reduces interference from out-of-band signals.

The PLL circuit supplies a 139MHz signal to the source of Q205 to convert the RF signal into the 16.9MHz first IF.

The first IF then passes to the IF circuit from the drain of Q205 through L201.

3 - 1 - 3 The First Local Oscillator Circuit

The VCO Q211 generates the 139MHz signal. This signal passes through buffer amplifier Q208 and switching diode D203 to the source of Q205.

3 - 1 - 4 IF Amplifier Circuit

The first IF signal from Q205 feeds into the matched-pair crystal filter FI202. This filter further reduces any interference and intermodulation. The filter output passes to IF amplifiers Q203 and Q204.

IC201 receives the amplified IF signal. The second local oscillator, second mixer, limiter amplifier and quadrature detector are all within IC201.

X202 provides the 16.445MHz second local oscillator frequency. This frequency and the first IF mix to produce the 455kHz second IF. The second IF exits IC201 at pin 3 and passes to a highly selective external ceramic filter FI201. The filter output feeds back into IC201 pin 5 to the limiter amplifier. The quadrature detector within IC201 processes the amplified signal and passes the output to pin 7 of the IC. The signal loops through the ceramic resonator X201 and again re-enters IC201 at pin 8. The detected AF signal exits from IC201 pin 9.

3 - 1 - 5 AF Circuit

R127 and C117 form an integrating circuit to provide 6dB/octave de-emphasis for the detected AF signal. The de-emphasized output passes to the AF amplifier Q105 on the MAIN board. The output from Q105 then passes through the VOLUME control R132 to the Q116 base.

Q116 and Q122 compose the AF power amplifier circuits. Q116 and Q117 act as a differential amplifier which offers stability and good frequency response by using R152 and R149 for negative feedback. The power amplifier is a complementary SEPP circuit with Darlington pairs Q119/Q120 and Q121/Q122. The AF output is greater than 500 milliwatts into an 8 ohm speaker.

D106 and Q106 are a voltage regulator which limits the audio output power and stabilizes the bias levels when the source voltage is more than 10 volts.

3 - 1 - 6 Squelch Circuit

Noise components output from IC201 pin 9 feed through C116 and the SQUELCH control R126 to the active filter IC101B. The SQUELCH control varies the squelch threshold level. IC101B amplifies the 20kHz noise components and D103 rectifies the result. R119, R120, C111 and C112 integrate the output from D103 to produce a DC voltage. This voltage passes through the two inverters IC103A and IC103B to turn AF amplifier Q105 ON and OFF.

The output voltage from D103 is HIGH when no signal is received. This forces IC103A pin 2 HIGH, which turns Q105 OFF and cuts off the AF output.

When transmitting, D105 passes a HIGH level voltage to IC103B pin 9 which forces IC103A pin 2 HIGH. This again turns Q105 OFF and disables the AF output.

3 - 2 TRANSMITTER CIRCUITS

3 - 2 - 1 Mic Amplifier Circuit

MIC 1 and MIC 2 audio signals feed into the microphone and limiter amplifiers consisting of Q101, Q102, Q103 and Q104. These amplifiers have a 6dB/octave pre-emphasis response between 300 and 3000Hz.

The rectangular waveform from the output of the limiter amplifier contains many harmonics. Splatter filter IC101A attenuates the harmonic components higher than 3kHz. The filtered output modulates the VCO on the PLL board.

3 - 2 - 2 Multiplier and Driver Circuits

The VCO Q211 oscillates at the transmit frequency of 156MHz. This signal feeds to buffer amplifier Q208 and then to amplifiers Q209 and Q210 via D204. Q209 and Q210 raise the power to 150 milliwatts to drive the PA amplifier.

The output of Q210 may be regulated by a voltage from the APC circuit. This will be explained in detail later.

3 - 2 - 3 Power Amplifier Circuit

IC204 is a compact power module that operates at 5 watts output with only a 150 milliwatt input in the range 150 to 160MHz. Pin 1 of the IC receives the input signal from Q210. The output passes from pin 4 to the antenna connector through L210, D208, C257 and a low-pass filter. L213, L214, C258, C260, C262, C264 and C265 form the filter.

Q215, D208 and D209 turn ON when in the transmit mode. L212 and C256 become a parallel resonant circuit at this time. The high impedance thus protects the receive circuits from the RF output.

Q207 controls the bias voltages of Q209, Q210 and IC204 to prevent unwanted emissions while switching from receive to transmit. This bias control is also useful if the PLL unlocks for any reason.

3 - 2 - 4 APC and Power Set Circuits

L210, C248, C250 to C254, D206 and D207 are an antenna mismatch detector. Voltage detected by D206 and D207 is minimum when the antenna impedance is close to 50 ohms. The voltage rises as the impedance varies from the ideal value.

Q216 and Q217 compose a differential amplifier. R239 and R240 mix the detected voltages from D206 and D207. The mixed voltage feeds to the Q216 base. The Q217 base receives a bias voltage determined by R265, R266 and R267.

When a mismatch occurs in the final output stage, the Q216 base voltage is higher than the Q217 base voltage. The Q216 collector current and Q214 base current reduce, as does the Q214 collector current. Q213 and Q210 base and collector currents, respectively, also drop.

As a result, the Q210 output power decreases which lowers the input to IC204 until the Q216 base voltage reaches the same value as the Q217 base voltage.

R267 determines the "HIGH" value of output power. The series combination of R268 and R269 are connected in parallel with R265 when the RF power switch is placed in the "LOW" position. R269 then adjusts the low output power.

3 - 3 PLL (PHASE LOCKED LOOP) CIRCUITS

The VCO generates the desired frequency directly through use of a dual modulus pre-scaler system. In the transmit mode, the VCO operates at the actual transmit frequency; whereas in the receive mode, it operates at the first local oscillator frequency.

The pre-scaler IC202 and the PLL IC IC203 form the PLL. The MPU feeds "divide by N" DATA to these circuits to determine the operating frequency.

The N-DATA is the ratio of the desired frequency and the reference frequency. The oscillator divider within IC203 divides the 12.8MHz output from X203 to provide the reference frequency of 25kHz.

$$N = \frac{\text{Desired frequency}}{\text{Reference frequency}}$$

where Desired frequency is: a) Tx, or
b) Rx 1st L.O. frequency.
Reference frequency is: 25kHz

IC202 receives the VCO output after it passes through buffer amplifier Q208. IC202 and IC203 together divide the signal by N times, phase detect the result and output the detected signal at IC203 pin 11.

The output signal feeds to varactor diodes D211 and D212 in the VCO circuit via the loop filter to control the VCO frequency.

Overall, the PLL is a simple, spurious-free circuit since it uses no multiplying nor mixing stages.

3 - 3 - 1 Dual Modulus Pre-scaler

IC202 is a dual modulus pre-scaler which divides the signal generated by the VCO by a factor of 64 or 65.

IC203 is a CMOS LSI circuit used as a frequency synthesizer in the PLL. It incorporates a 6 bit binary swallow-counter, an 11 bit binary programmable counter, a phase comparator, a charge pump and a frequency divider for the reference frequency.

Oscillator Q212 with crystal unit X203 produce a 12.8MHz master frequency which IC203 divides by 512 to produce the 25kHz reference frequency. The master frequency enters IC203 at pin 17 and the divided output exits pin 16 which is looped back into pin 8 of the same IC.

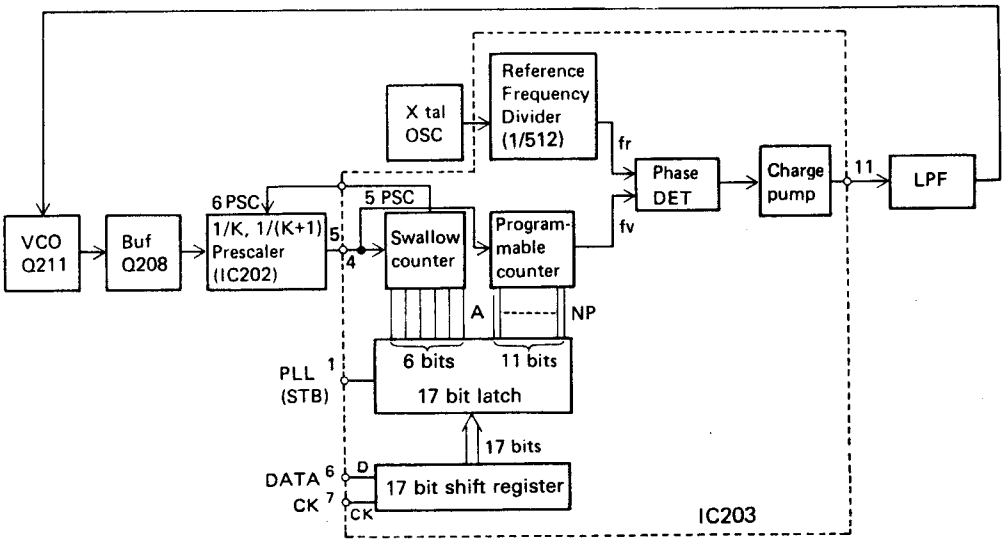


Fig. 3-1 Dual Modulus Pre-scaler System

3 - 3 - 2 Unlock Detector Circuit

IC203 pin 10 becomes LOW when the PLL unlocks. This signal passes to IC102A pins 8 and 9, through the R254 and C283 time constant circuit. IC102A pin 10 also becomes LOW which transfers to the MPU to disable the transmitter.

3 - 3 - 3 Loop Filter, VCO, Modulation Circuits

The output from IC203 pin 11 determines the PLL characteristics through a lag-lead loop filter consisting of R252, R253 and C282. This output also controls varactor diodes D211 and D212 by using the R249 and C273 integrating circuit.

The VCO Q211 employs C275, C276 and D214 in a Clapp oscillator circuit. D214 switches ON in the receive mode when TS5 is 0 volts and RS5 is 5 volts. This condition shorts C275 and C276 such that the receive VCO frequency is shifted lower than the transmit frequency. In this way, oscillator stability is maintained over a wide frequency range.

The frequency shift turns OFF in the transmit mode since TS5 is 5 volts and RS5 is 0 volts. This condition forces D214 OFF. C275 and C276 are then in series with L218, and the VCO free-run frequency is higher. Modulation applied to the anode varies the capacitance between the D214 terminals. The result is frequency modulation.

R243 sets the deviation by changing the modulation level.

3 - 4 POWER SUPPLY CIRCUITS

3 - 4 - 1 Internal/External Power Switching Circuit

RL101 is OFF when using a battery and the power switch connects directly to the battery pack. Attaching a 10 to 16 volt power source to the external power terminal (DC IN) turns RL101 ON. The power switch then connects to the external power source.

Wrong polarity of the external power reverse biases D117. This prevents RL101 from operating which protects the transceiver from damage.

3 - 4 - 2 Voltage Regulator Circuits

A CMOS three-terminal regulator IC104 maintains a constant 5 volt output with any input voltage from 5.1 to 16 volts.

R165 and C138 eliminate noise components from the output of IC104. The filtered voltage feeds into the Q129, Q130 current amplifier circuit.

The Q129 and Q130 complementary arrangement produces a high current amplification factor. The Q130 base voltage is nearly equal to the IC104 output voltage. Also, the Q129 collector voltage is approximately 5 volts. The temperature coefficient of the D114 junction is very similar to the Q130 Vbe temperature factor. The regulator output is, therefore, stable under varying temperature conditions.

The regulated 5V, at the Q129 collector passes to common circuits through Q114 and Q115 current amplifiers. Transmit/receive switching circuits Q108 and Q109 also receive the regulated output.

In the receive mode, the LOW level from IC102C pin 3 turns Q108 ON to feed RS5 and R+5 through the Q110 and Q111 current amplifiers. Q109 is OFF at this time.

In the transmit mode, the HIGH level from IC102C pin 3 forces IC103E pin 4 LOW which turns Q108 OFF and Q109 ON. Q109 feeds TS5 and T+5 through current amplifiers Q112 and Q113.

3 - 4 - 3 Power Source Circuit for the MPU

The MPU requires many memory elements to store frequencies, memory channels, etc. Removal of the MPU power source erases this information normally. Therefore, the memory unit has an internal lithium battery as backup for when the power source fails or is removed.

A new battery will maintain the memories for about four years.

3 - 4 - 4 VOX Power Source Circuit

This ia a current limited voltage supply which powers the external VOX unit HS-10SA. A 5 milliampere maximum current drain is acceptable.

Since the voltage drop at R271 is small in the case of a normal load current, approximately 5 volts feeds to the VOX unit. A load current increase causes an increase of th R271 voltage drop. The current limiting begins when the R271 voltage plus Q218 Vbe equals the R272 plus D216 voltages.

3 - 4 - 5 Low Voltage Detector Circuit

IC105B and R168 through R171 form the low voltage detector.

R168 and R169 divide the regulated 5 volts to provide about 1.03 volts to IC105B pin 6. Similarly, R170 and R171 divide the Vcc voltage to provide 1.03 volts to IC105B pin 5 when Vcc is about 5.6 volts.

If Vcc is greater than 5.6 volts, the IC105B pin 5 voltage is higher than the pin 6 voltage. This condition produces a HIGH level at pin 7.

If Vcc is less than 5.6 volts, the IC105B pin 5 voltage is less than the pin 6 voltage. This condition produces a LOW level at pin 7.

The IC105B pin 7 voltage passes to the MPU which sets the BATTERY CONDITION indicator to the appropriate state.

3 - 5 LOGIC CIRCUITS

The major component is a single-chip microcomputer IC401 which includes a 2kB ROM, a 128 word pattern ROM, a 160 bit RAM and a circuit to drive the LCD (liquid crystal display).

The following is a summary of the operation of the MPU.

3 - 5 - 1 D1 (Pin 79) MUTE

This is an output port which is HIGH for approximately 60 milliseconds when changing from receive to transmit.

3 - 5 - 2 D2 (Pin 80) CK

This pin feeds out clock pulses for serial data which transfers synchronously with N-data for the PLL.

Shift registers convert these serial data into parallel data. The shift registers shift the data at each leading edge of the clock pulses.

3 - 5 - 3 D3 (Pin 1) DATA

This is an output port for the serial PLL N-data.

The serial transfer begins with the most significant bit (MSB) and ends with the least significant bit (LSB). The data transfer in binary code.

For example, the N-data for 156MHz are 156/0.025 = 6240. This number in hexadecimal is 1860.

3 - 5 - 4 D4 (Pin 2) STROBE

This is an output port for a pulse which latches the N data after these data transfer to the PLL.

The PLL IC receives the data on the rising edge, and latches the data on the falling edge of the pulse.

3 - 5 - 5 D5 (Pin 3) RX MUTE

This is an output port used while the radio is in the SEA (dual watch) mode.

The D5 port outputs an approximately 5 millisecond pulse beginning 1 millisecond before the N data is sent. This signal mutes the pop noise of the squelch caused by a frequency change.

3 - 5 - 6 D6 (Pin 4) BEEP

This is an output port for a 40 millisecond HIGH pulse after a key is pressed. The pulse controls the BEEP tone oscillator on the MAIN unit.

3 - 5 - 7 D7 (Pin 5) HALT CONT

This is an output port for a short LOW pulse to store the MPU program execution address when the user turns the set off. This address is used again when the set is turned on.

3 - 5 - 8 D8 (Pin 6) BEEP CONT

This is an active LOW input port which the MPU pulls up. When the port is LOW, a HIGH level is output from the D0 port.

3 - 5 - 9 D9 (Pin 7) HI/LOW CONT

This is an active LOW input port which the MPU pulls up.

When this port is LOW, D0 outputs a HIGH level. When D9 is HIGH, D0 outputs a LOW level.

3 - 5 - 10 D10 (Pin 8) UNLOCK

This is an input port which the MPU pulls up. A LOW causes the MPU to make the D1 port LOW. Also, the LCD flashes to indicate the PLL is unlocked.

3 - 5 - 11 D11 (Pin 9) SEND

This is an input port which the MPU pulls up. A LOW input selects the transmit mode and inhibits any input from KEY entry. The MPU passes out frequency control data and determines whether to generate a MUTE signal at each leading and trailing edge.

3 - 5 - 12 D12 (Pin 10) SQL

This is an active LOW input port which the MPU pulls up. It provides the scan stop signal for the SEA and other modes.

3 - 5 - 13 D13 (Pin 11) TX DISPLAY

This ia an active LOW input port which the MPU pulls up. It causes an output pulse for the "TX" indication on the LCD display.

3 - 5 - 14 D14 (Pin 12) FUNCTION

This ia an input port which the MPU pulls up. It becomes LOW when the function key is pressed, and the secondary functions of the keypad become operational.

3 - 5 - 15 D15 (Pin 13) INHIBIT

This is an input port which the MPU pulls up. The port informs the MPU of the inhibited channel status when this type of channel is accessed. The accessed channel is not accepted nor displayed.

3 - 5 - 16 R0 ~ R3 (Pins 14 ~ 17) KEY RETURN

This is an input port consisting of four lines. R410 to R413 pull up each line respectively. The lines are active LOW and they determine which key has been pushed.

3 - 5 - 17 R10 (Pin 66) WX/MEMO

This is an active LOW input port which the MPU pulls up.

When this port is HIGH, the WX channels are functional. When the port is LOW, the MEMORY is functional and channels can be memorized.

3 - 5 - 18 R11 (Pin 67) HOLLAND

This is an active LOW input port which the MPU pulls up. The Dutch version of the radio is operational when this port is LOW.

3 - 5 - 19 R12 (Pin 68) INTL 1/2

This is an active LOW input port which the MPU pulls up. The International version (INTL 2) is operational when this port is LOW.

3 - 5 - 20 R13 (Pin 69) U/D STOP

This is an active LOW input port which the MPU pulls up. The scan does not activate when this port is LOW level. At this time, the channel shifts one step at a time.

3 - 5 - 21 R21 (Pin 71) PRV

This is an input port which the MPU pulls up. It is used when a memory channel is used to store a private channel.

3 - 5 - 22 R22 (Pin 72) POWER C.W.

This is an input port which the MPU pulls up. This port accepts the MPU HIGH/LOW output power information for a selected channel.

If the switch inside the unit is set to LOW, the HIGH/LOW switch on the top panel has no effect. The output power is LOW on all channels in this case.

3 - 5 - 23 R23 (Pin 73) INTL/USA

This ia an input port which the MPU pulls up.

The International version is operational when the port is LOW level, and the U.S.A. version is activated when the port is HIGH level.

3 - 5 - 24 COL 1 to COL 4 (Pins 74 ~ 77)

These are output ports and they are open drain. The ports turn on in order to transfer signals to the rows of the 10 key circuit.

3 - 5 - 25 INT 0 (Pin 64) POWER DOWN

This is an input port which R405 and R406 pull up outside the MPU.

The port is active LOW. The MPU follows a backup procedure when the radio is turned off or the power supply voltage drops. It sets the HALF CONT terminal HIGH and the MPU rests in the HALT state.

3 - 5 - 26 INT 1 (Pin 65) BAT

This is an input port which the MPU pulls up. It is active LOW. The terminal becomes LOW when the battery voltage drops to the recharge level. The LCD displays the low battery indicator.

3 - 5 - 27 RESET (Pin 18)

This is an MPU reset terminal which R415 pulls down.

The terminal is active HIGH. S102 (Reset switch) resets the MPU if pressed while the power switch is ON.

3 - 5 - 28 COM 1 — SEG 1 to 32

These are output terminals for driving the LCD display.

3 - 5 - 29 OSC 1 ~ OSC 2 (Pins 20, 21)

These are terminals for the MPU clock oscillator. R409 sets the clock frequency to about 200kHz.

3 - 6 OTHER CIRCUITS

3 - 6 - 1 Lamp Circuit

The components of the lamp circuit are Q131, D115, D116, R172, R173 and DS401. The circuit provides a constant current supply to maintain the LCD illumination regardless of a variation in Vcc.

Current flows into R173 when S104 is ON. The Q131 base voltage is approximately Vcc minus 1.2 volts due to the D115/D116 drops. Therefore, the Q131 emitter voltage is Vcc minus 0.6 volt. This condition maintains a constant voltage difference across R172 which means DS401 receives a steady current even if Vcc changes.

3 - 6 - 2 Beep Circuit

This is a phase shift oscillator consisting of IC103F, R155, R156, R157, C131, C132 and C134. The circuit begins oscillating when a HIGH voltage appears at the cathode of D113. The frequency is about 2500Hz.

3 - 6 - 3 Transmit/Receive Switching Circuit

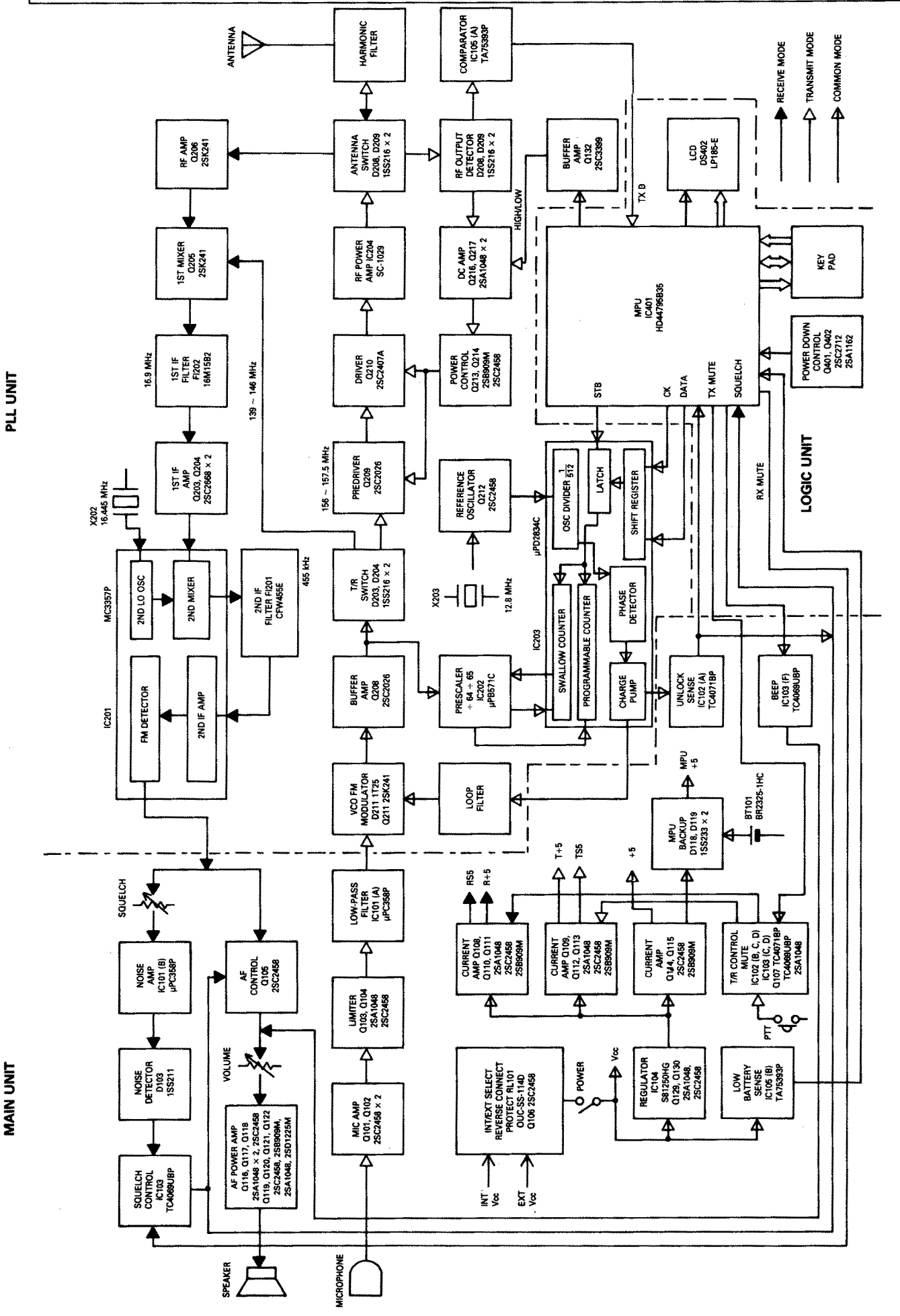
Pushing S101 turns Q107 ON. Both IC103C pin 13 and IC102C pin 1 are HIGH at this time. This causes IC102C pin 3 to go HIGH also. Q108 turns OFF and Q109 turns ON. T+5 and TS5 lines are 5 volts whereas R+5 and RS5 are 0 volts each. Since IC103C pin 12 is LOW, the MPU receives a signal through D107 that the transceiver is in the transmit mode.

IC102B pin 4 is LOW about 20 milliseconds after pushing S101 due to the R138 and C122 time constant. The MUTE signal from the MPU remains HIGH for about 60 milliseconds. Therefore, IC102D pin 11 is LOW about 60 milliseconds after pushing S101. Q207 turns ON and the radio transmits.

Q107 turns OFF on release of S101. IC103C pin 13 and IC102C pin 1 are LOW at the same time.

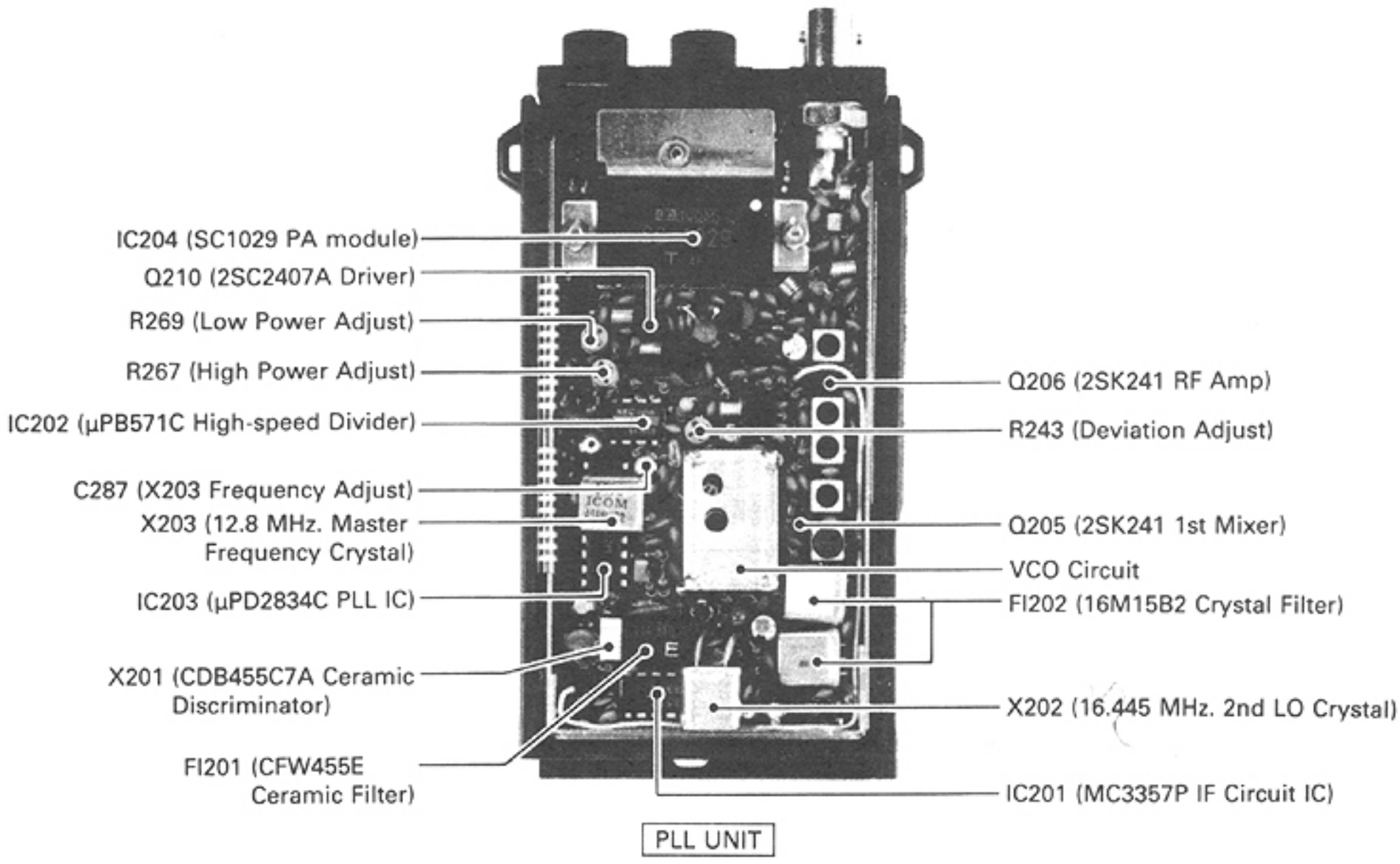
IC102C pin 3 is LOW about 20 milliseconds later, again caused by the R138 and C122 time constant. Q108 turns ON and Q109 turns OFF. Thus, the R+5 and RS5 lines are 5 volts and the T+5 and TS5 lines are 0 volts. IC103C pin 12 is HIGH which indicates to the MPU that the radio is in the receive mode. IC102D pin 11 is HIGH almost simultaneously to turn Q207 OFF.

SECTION 4 BLOCK DIAGRAM



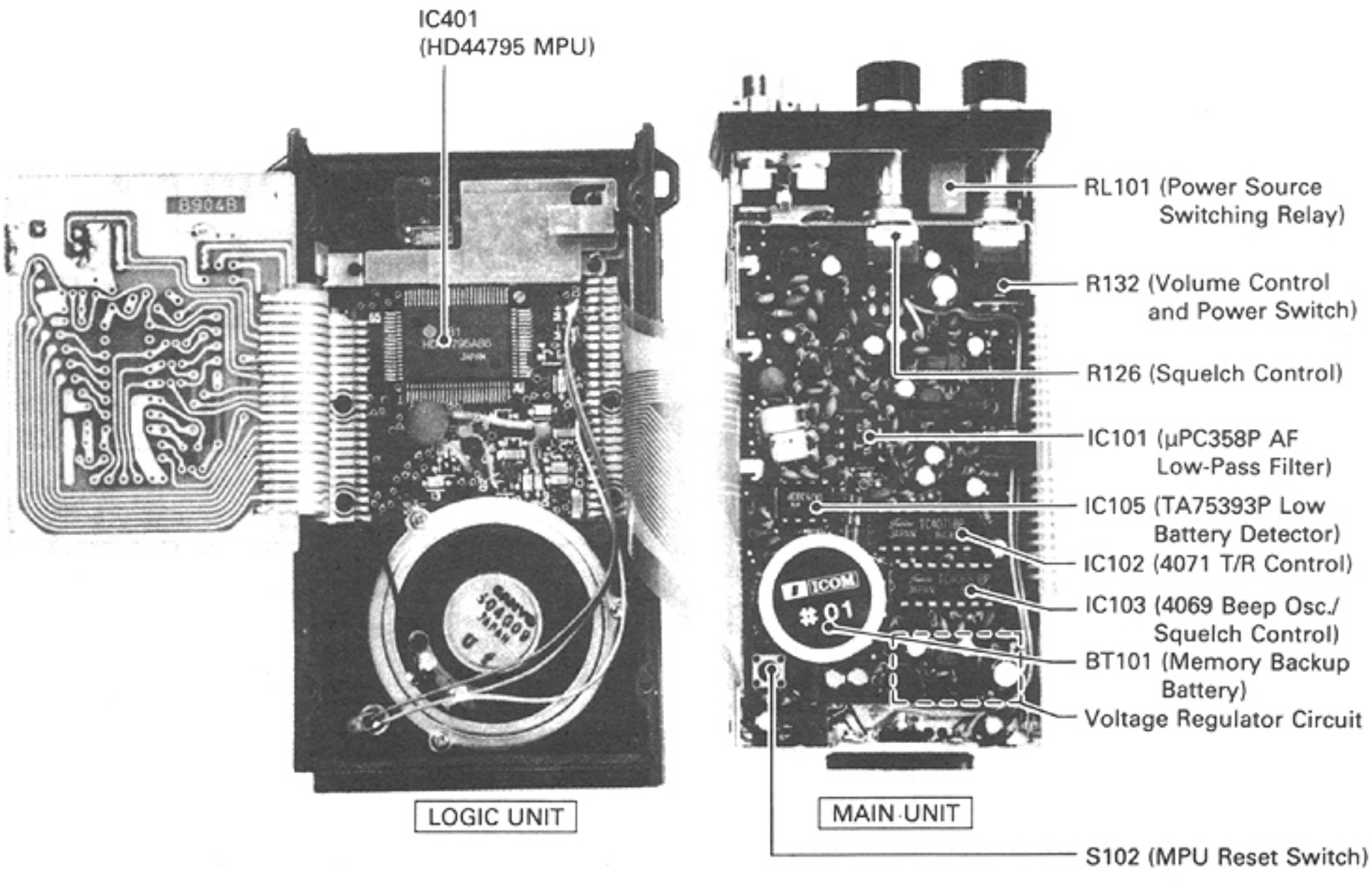
SECTION 5 INSIDE VIEWS

REAR SIDE



PLL UNIT

FRONT SIDE



LOGIC UNIT

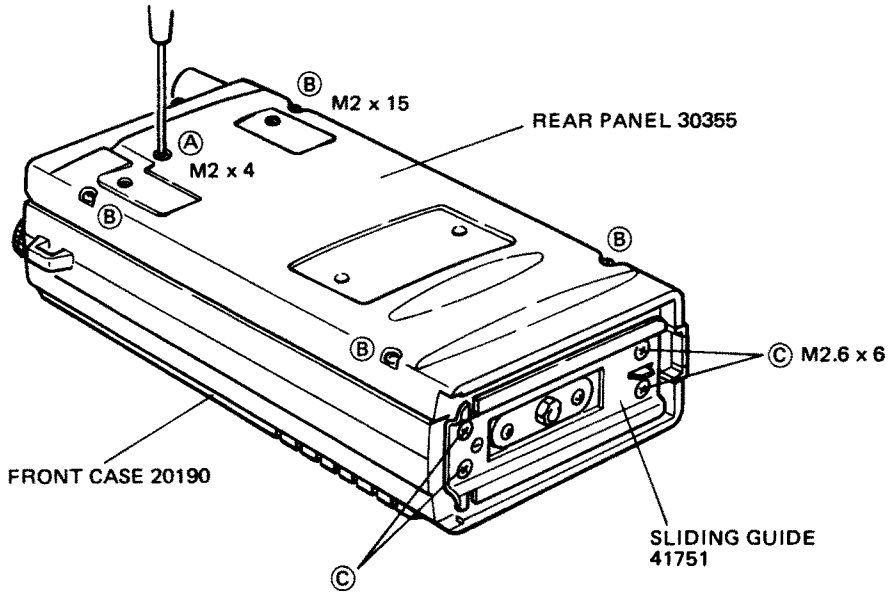
MAIN UNIT

SECTION 6 MECHANICAL PARTS AND DISASSEMBLY

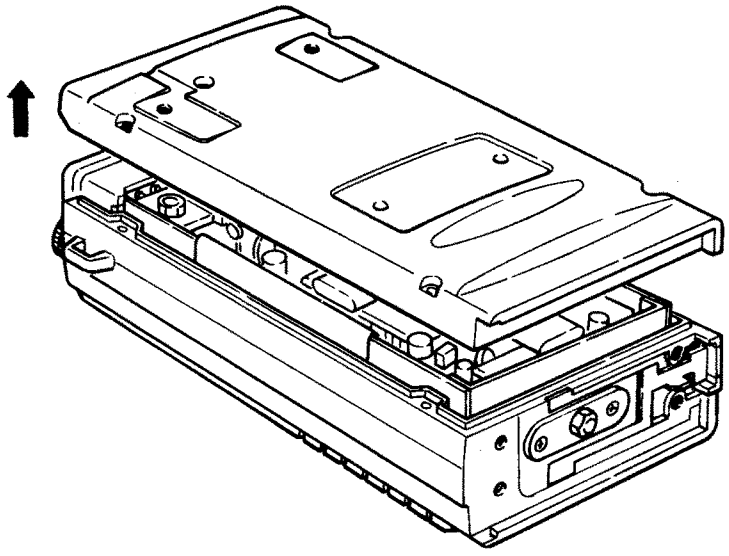
6 - 1 DISASSEMBLY OF THE CASE

1. Turn the power switch off and remove the power pack.

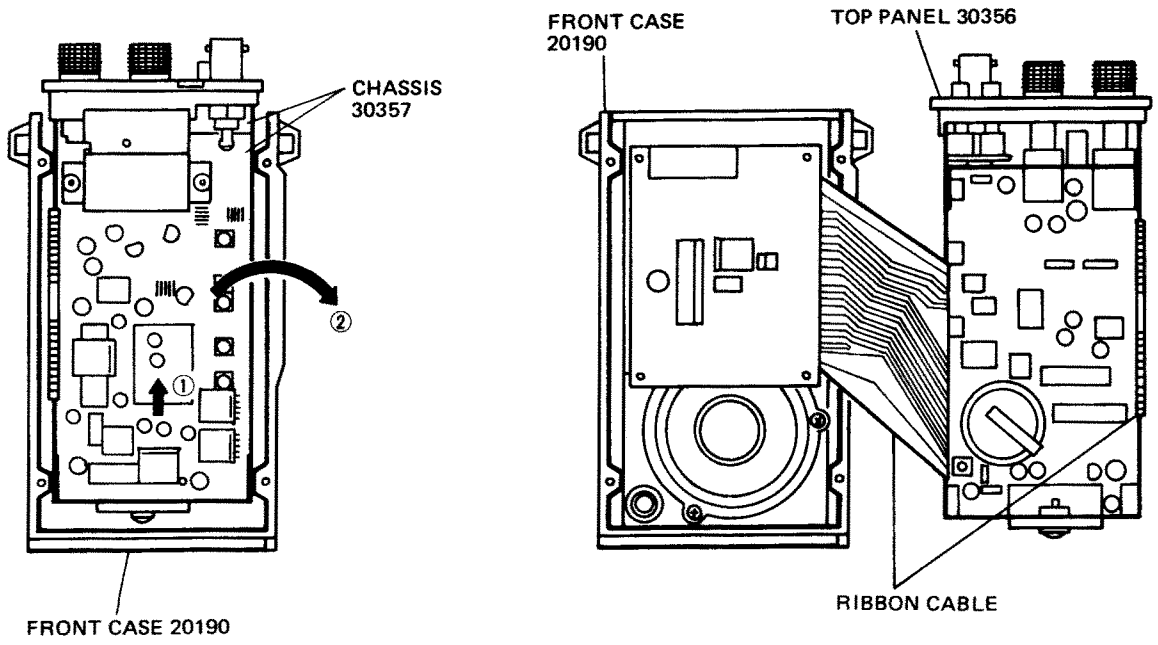
2. Remove screw Ⓐ and four screws Ⓑ on the rear panel, and four screws Ⓒ on the bottom as shown in the figure.



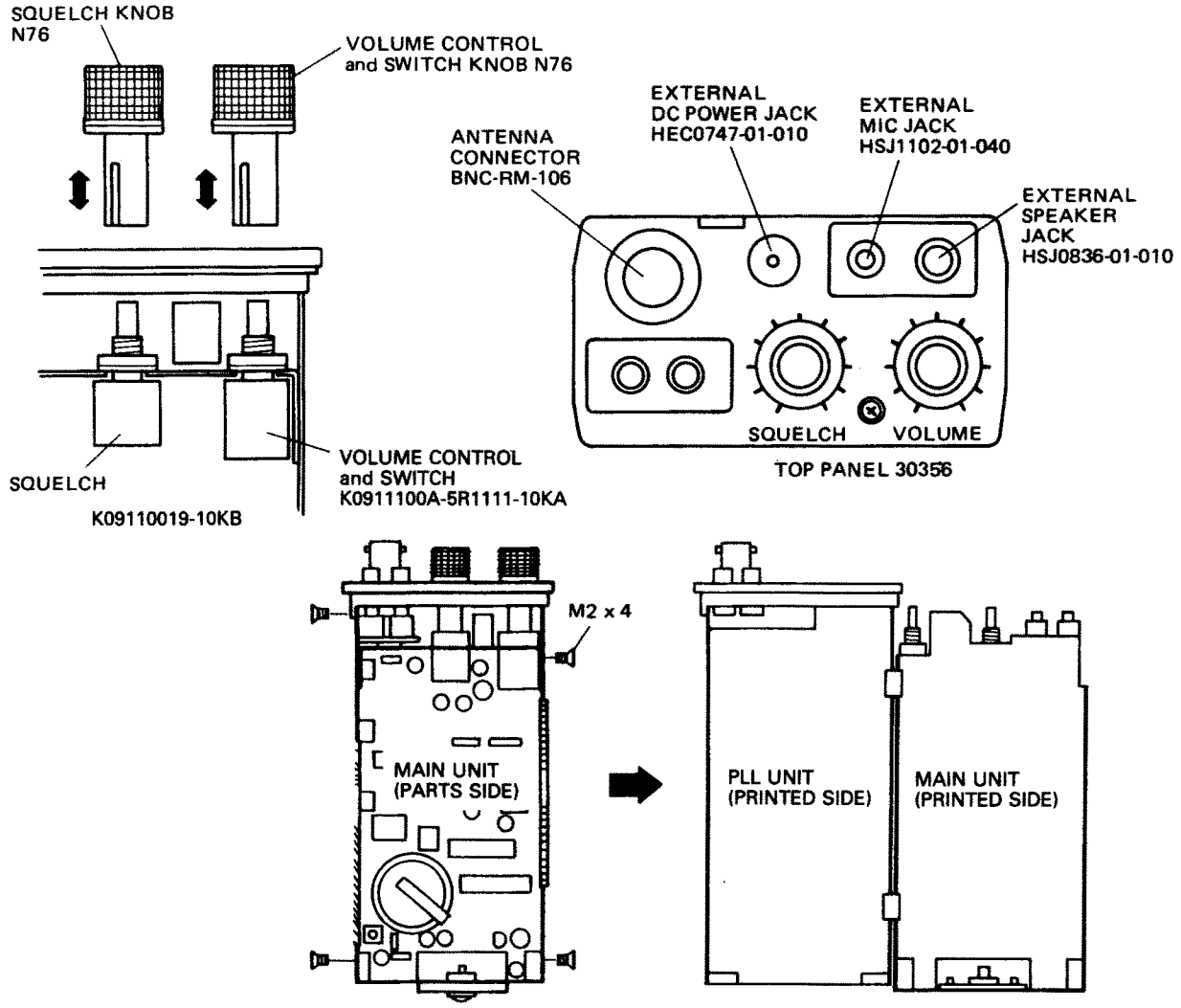
3. Remove the rear panel as shown in the figure.



4. Slide the inner frame upward slightly as shown in the figure, and lift the frame away from the front cover. At this time, be sure not to damage the ribbon cable.



5. To see the printed sides of the MAIN and PLL boards, remove the SQUELCH and VOLUME CONTROL and POWER SWITCH knobs. Remove the four screws on the sides of the inner frame.



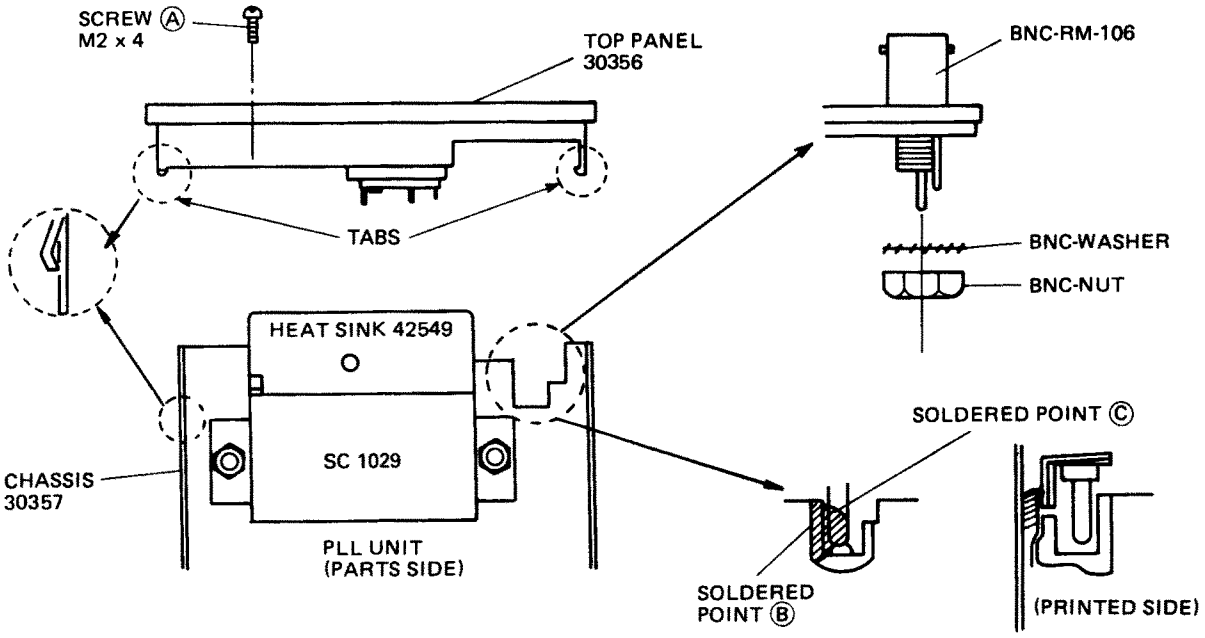
6 - 2 DISASSEMBLY OF THE TOP PANEL

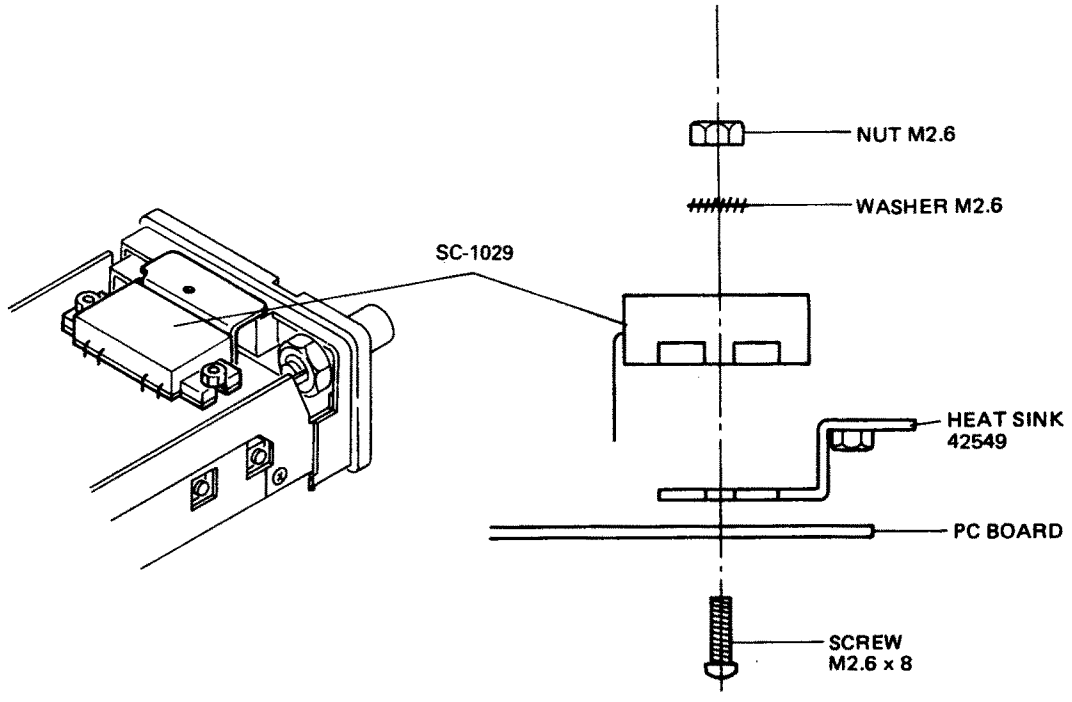
Remove screw Ⓐ.

1. Remove the BNC-NUT and the BNC-WASHER.

2. Remove the BNC-RM by desoldering point Ⓑ on the parts side and point Ⓒ on the printed side of the PLL board.

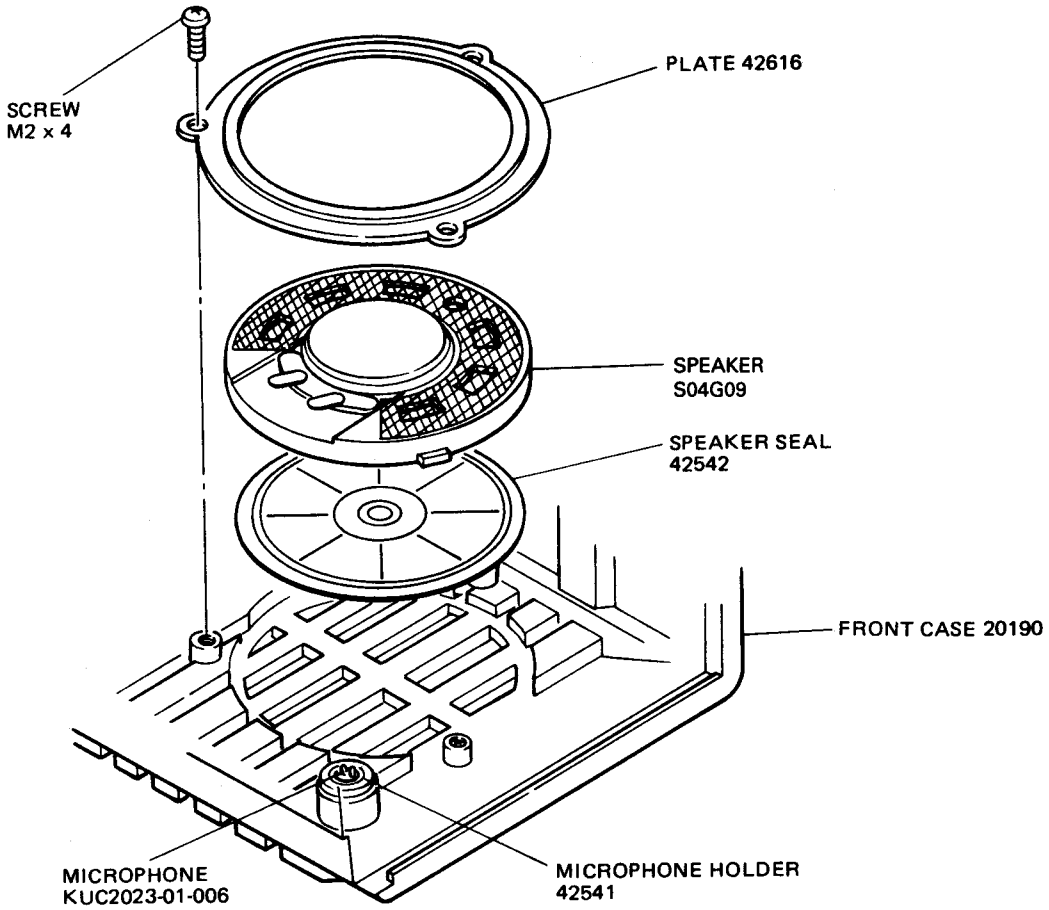
3. Remove the TOP PANEL by slightly prying outward on both sides of the TOP PANEL. See the diagram below. Take care not to break the tabs.





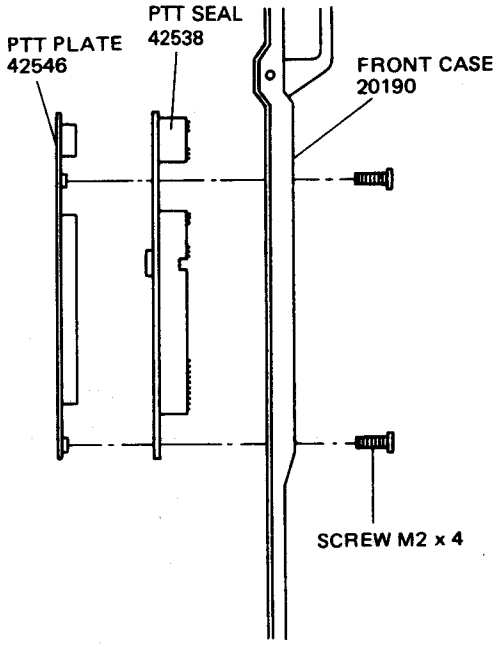
6 - 3 SPEAKER/MICROPHONE ASSEMBLY

(HOW TO REPLACE THE SPEAKER/MICROPHONE)

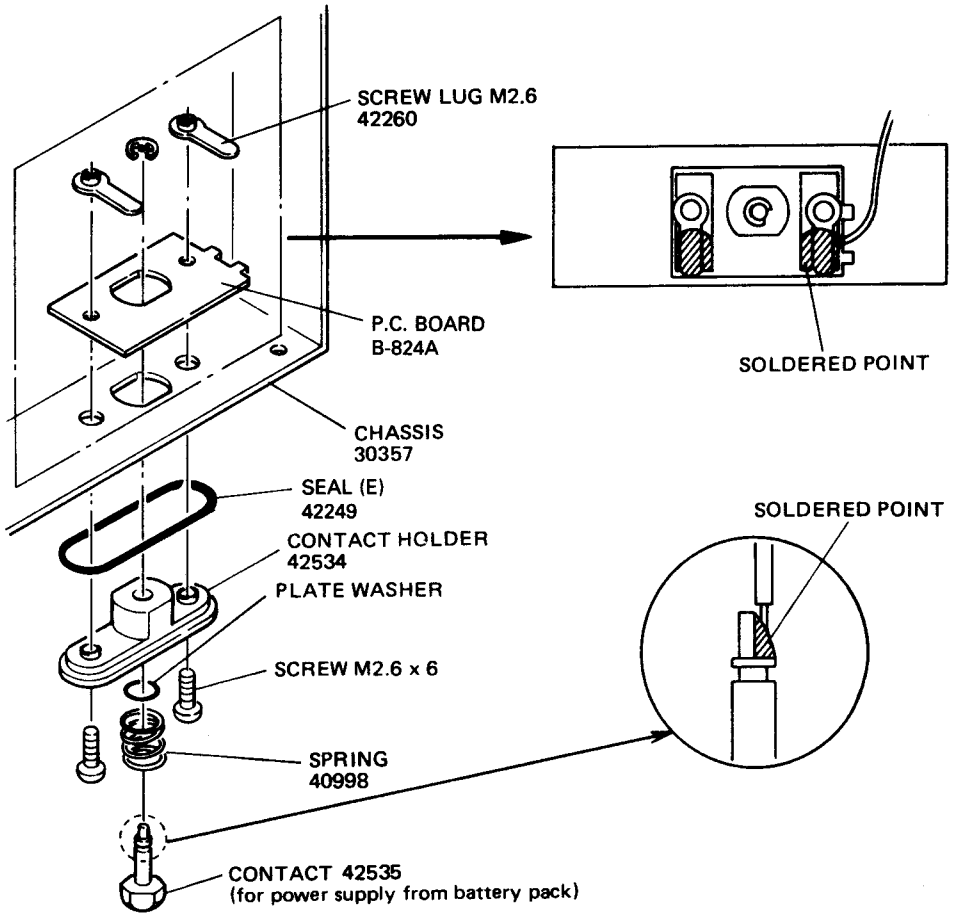


6 - 4 PTT SPRING ASSEMBLY

(HOW TO REPLACE PTT SPRING)



6 - 5 UNIT BOTTOM ASSEMBLY

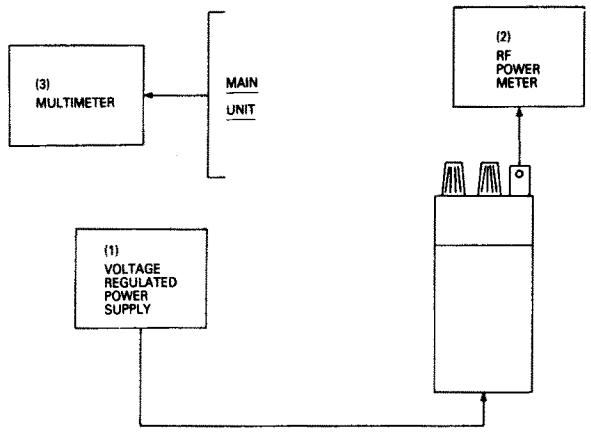


SECTION 7 MAINTENANCE AND ADJUSTMENT

7 - 1 PREPARATION BEFORE SERVICING

1. Detach the power cord and turn off the power switch before performing any work on the radio.
2. Do not short circuit components while making adjustments.
3. Use an insulated tuning tool for all adjustments.
4. Do not force any of the variable components. Tune them slowly and smoothly.
5. Follow the instructions exactly. If an indicated result is not obtained, repeat the instruction until the correct result is obtained.
6. Check the condition of connectors, solder joints and screws when adjustments are complete. Confirm that components do not touch each other.
7. There are several versions of this radio. Adjustment procedures and results may differ for each version. Be certain to follow the correct procedure for the radio you have.
8. Confirm defective operation of the radio first when checking an out-of-service unit. Verify that external sources do not cause the problem.
9. Use the correct tools and test equipment.
10. Remove the transceiver case as shown on Page 6-1.
    NOTE: Do not damage the flexible printed circuit when removing the case.
11. Remove the four screws to open the hinged chassis as shown on Page 6-2.
12. Attach an 8.0 ~ 14.0 volt DC external power source to the battery clip or screw. Be sure to check the polarity.
13. For transmission problems, attach a dummy load to the antenna connector. For reception problems, attach an antenna or signal generator to the antenna connector. Do not transmit into the signal generator.
14. Recheck for the suspected malfunction with the power switch on.
15. Check the defective circuit. Measure the DC voltages of the collector, base and emitter of each transistor.
16. It is convenient to short circuit an accessory mic connector plug and insert it into the microphone jack when troubleshooting the transmitter.

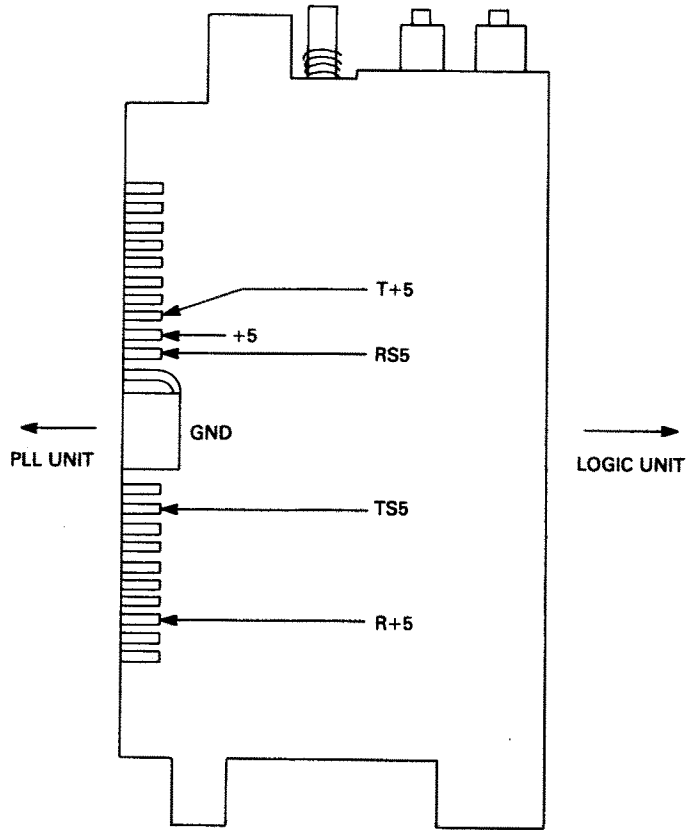
7 - 2 POWER SUPPLY CHECKS

INSTRUMENTS REQUIRED	CONNECTIONS
(1) VOLTAGE REGULATED POWER SUPPLY OR ATTENDANT POWER PACK • OUTPUT VOLTAGE : DC 13.2 V • CURRENT CAPACITY : 1A (2) RF POWER METER (TERMINATED TYPE) • MEASURING RANGE : 5W • FREQUENCY RANGE : 140 ~ 170MHz • IMPEDANCE : 50 OHMS • SWR : LESS THAN 1:1 (3) MULTIMETER • INPUT IMPEDANCE : 50 KOHMS/VOLT OR BETTER	

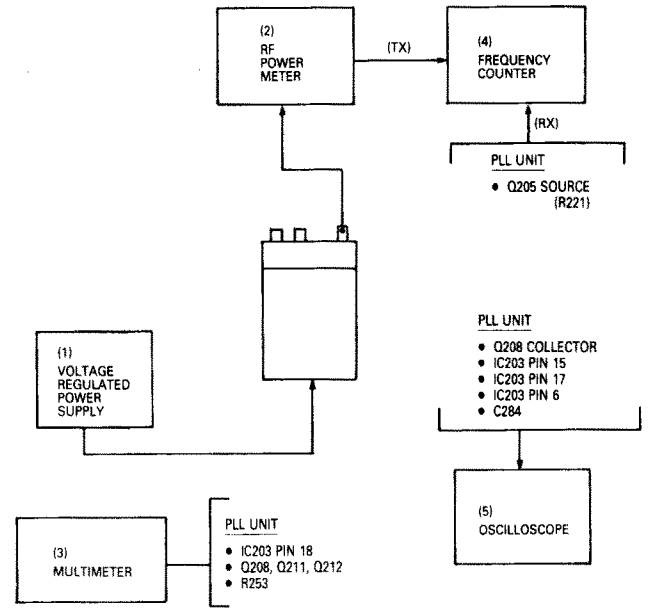
ADJUSTMENT		ADJUSTMENT CONDITIONS	UNIT	MEASUREMENT LOCATION	VALUE	UNIT	ADJUST
+5	1	• Receive mode	MAIN	• See diagram	5V		Verify voltage
R+5	1	• Receive mode	MAIN	• See diagram	5V		Verify voltage
RS5	1	• Receive mode	MAIN	• See diagram	5V		Verify voltage
T+5	1	• Transmit mode	MAIN	• See diagram	5V		Verify voltage
TS5	1	• Transmit mode	MAIN	• See diagram	5V		Verify voltage

MAIN UNIT

(PRINTED CIRCUIT SIDE)



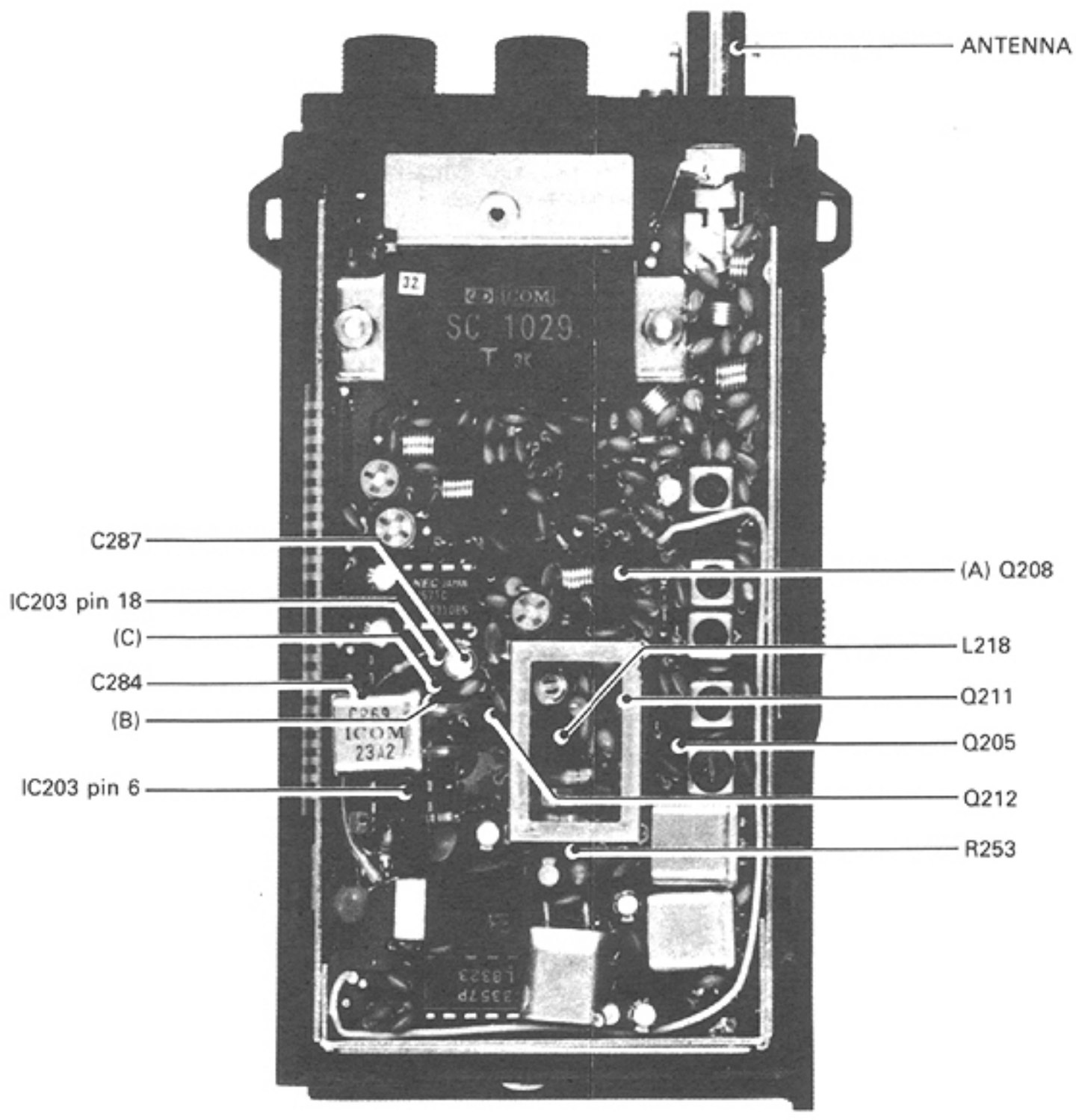
7 - 3 PLL ADJUSTMENT

INSTRUMENTS REQUIRED	CONNECTIONS
(1) VOLTAGE REGULATED POWER SUPPLY OR ATTENDANT POWER PACK • OUTPUT VOLTAGE : DC13.2 V • CURRENT CAPACITY : 1A (2) RF POWER METER (TERMINATED TYPE) • MEASURING RANGE : 5W • FREQUENCY RANGE : 140 ~ 170MHz • IMPEDANCE : 50 OHMS • SWR : LESS THAN 1:1 (3) MULTIMETER • INPUT IMPEDANCE : 50KOHMS/VOLT OR BETTER (4) FREQUENCY COUNTER • FREQUENCY RANGE : 0.1 ~ 170MHz • ACCURACY : BETTER THAN ±1 PPM • SENSITIVITY : 100mV OR BETTER (5) OSCILLOSCOPE • FREQUENCY RANGE : DC-20MHz • MEASURING RANGE : 0.01 ~ 10V	

ADJUSTMENT		ADJUSTMENT CONDITIONS	UNIT	MEASUREMENT LOCATION	VALUE	UNIT	ADJUST
PRELIMINARY	1	• Check for a PLL lock failure. • Unstable or no waveform indicates lock failure.	PLL	• Connect the oscilloscope to point A. (Q208 collector)	Verify waveform is present		
	2	• Check the divided reference frequency.		• Connect the oscilloscope to point B. (IC203 pin 15)	25kHz 5Vpp squarewave		
	3	• Perform this step if a squarewave is not observed above.		• Connect the multimeter to IC203 pin 18. (DC 10V range)	5V		
	4	• Check the master oscillator frequency.		• Connect the oscilloscope to point C. (IC203 pin 17)	12.8MHz waveform		
	5	• Check the transistor voltages.		• Connect the multimeter to Q208, Q211, and Q212.	See voltage diagram Section 9.		
	6	• Check the DATA signal. • Perform this step if the TX/RX frequency is different from the display.		• Connect the oscilloscope to IC203 pin 6.	•		
PLL LOCK	1	• The PLL is normally locked with a voltage range of 0 to 5 volts. • CHANNEL SELECTOR: CH 16. • Receive mode.	PLL	• Connect the oscilloscope to C284. • Connect the multimeter to R253.	1.5V DC	PLL	L218
	2	• CHANNEL SELECTOR: CH 26.			Less than 3.5V DC		
	NOTE: If the PLL does not lock, check the voltages on RS5, TS5, R+5, T+5 and +5 lines. Refer to Section 7-2. Also, check the PLL L.O. and reference frequency. Refer to the PRELIMINARY section above.						

ADJUSTMENT		ADJUSTMENT CONDITIONS	UNIT	MEASUREMENT LOCATION	VALUE	UNIT	ADJUST
REFERENCE FREQUENCY OSCILLATOR	1	• Set this oscillator accurately since it determines both transmit and receive frequencies. • CHANNEL SELECTOR: CH 16. • Receive mode.	PLL	• Connect the frequency counter through a capacitor to the Q205 source (R221).	139.9MHz ±400Hz	PLL	C287
	2	• Transmit mode.		• Connect the power meter to the ANTENNA CONNECTOR. • Couple the frequency counter loosely to the power meter.	156.8MHz ±400Hz		

PLL UNIT



7 - 4 TRANSMITTER ADJUSTMENT

INSTRUMENTS REQUIRED

(1) VOLTAGE REGULATED POWER SUPPLY OR ATTENDANT POWER PACK
- OUTPUT VOLTAGE : DC 13.2 V
- CURRENT CAPACITY : 1A

(2) RF POWER METER (TERMINATED TYPE)
- MEASURING RANGE : 5W
- FREQUENCY RANGE : 140 ~ 170MHz
- IMPEDANCE : 50 OHMS
- SWR : LESS THAN 1:1

(3) MULTIMETER
- INPUT IMPEDANCE : 50KOHMS/VOLT OR BETTER

(4) OSCILLOSCOPE
- FREQUENCY RANGE : DC-20MHz
- MEASURING RANGE : 0.01 ~ 10V

(5) RF VOLTMETER
- FREQUENCY RANGE : 0.1 ~ 170MHz
- MEASURING RANGE : 0.01 ~ 10V

(6) AF OSCILLATOR
- OUTPUT FREQUENCY : 200 ~ 3000Hz
- OUTPUT VOLTAGE : 0 ~ 200mV
- DISTORTION : LESS THAN 0.1%

(7) AMMETER
- MEASURING RANGE : 0 ~ 1A DC

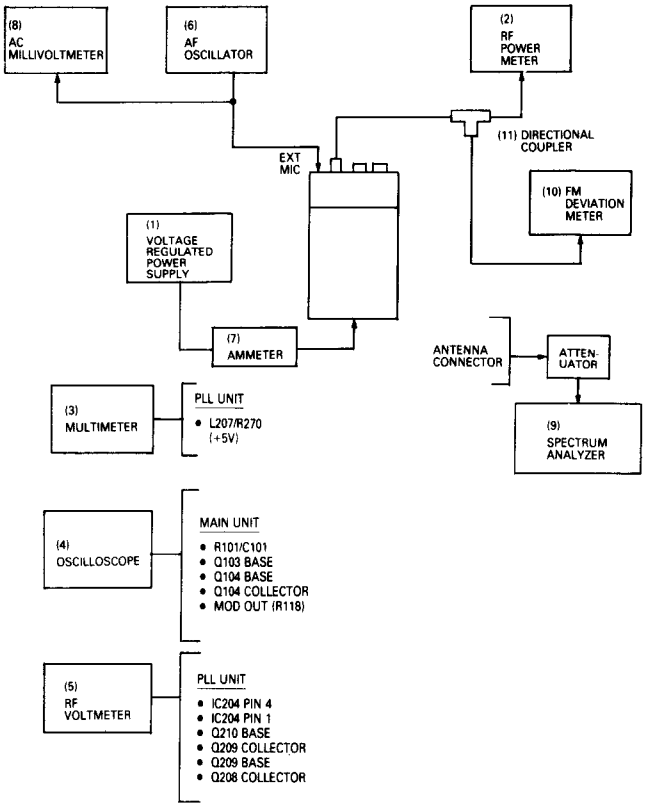
(8) AC MILLIVOLTMETER
- MEASURING RANGE : 10mV ~ 2V

(9) SPECTRUM ANALYZER
- FREQUENCY RANGE : 0.1 ~ 170MHz

(10) FM DEVIATION METER
- FREQUENCY RANGE : 140 ~ 170MHz
- MEASURING RANGE : 0 ~ ±10kHz
- EQUIPPED FILTERS : 50Hz HIGH PASS
  20kHz LOW PASS

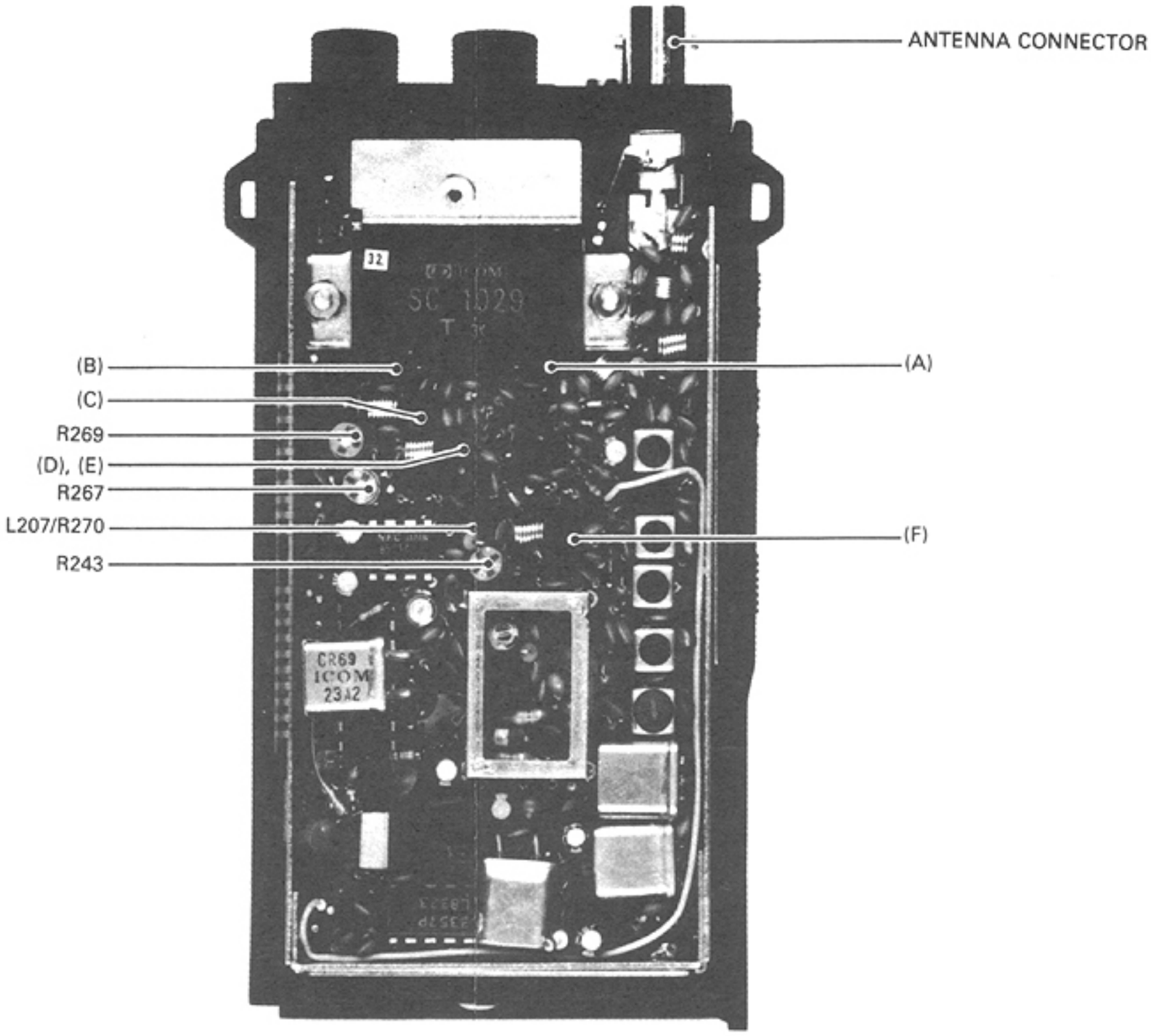
(11) DIRECTIONAL COUPLER
- FREQUENCY RANGE : 140 ~ 170MHz

CONNECTIONS

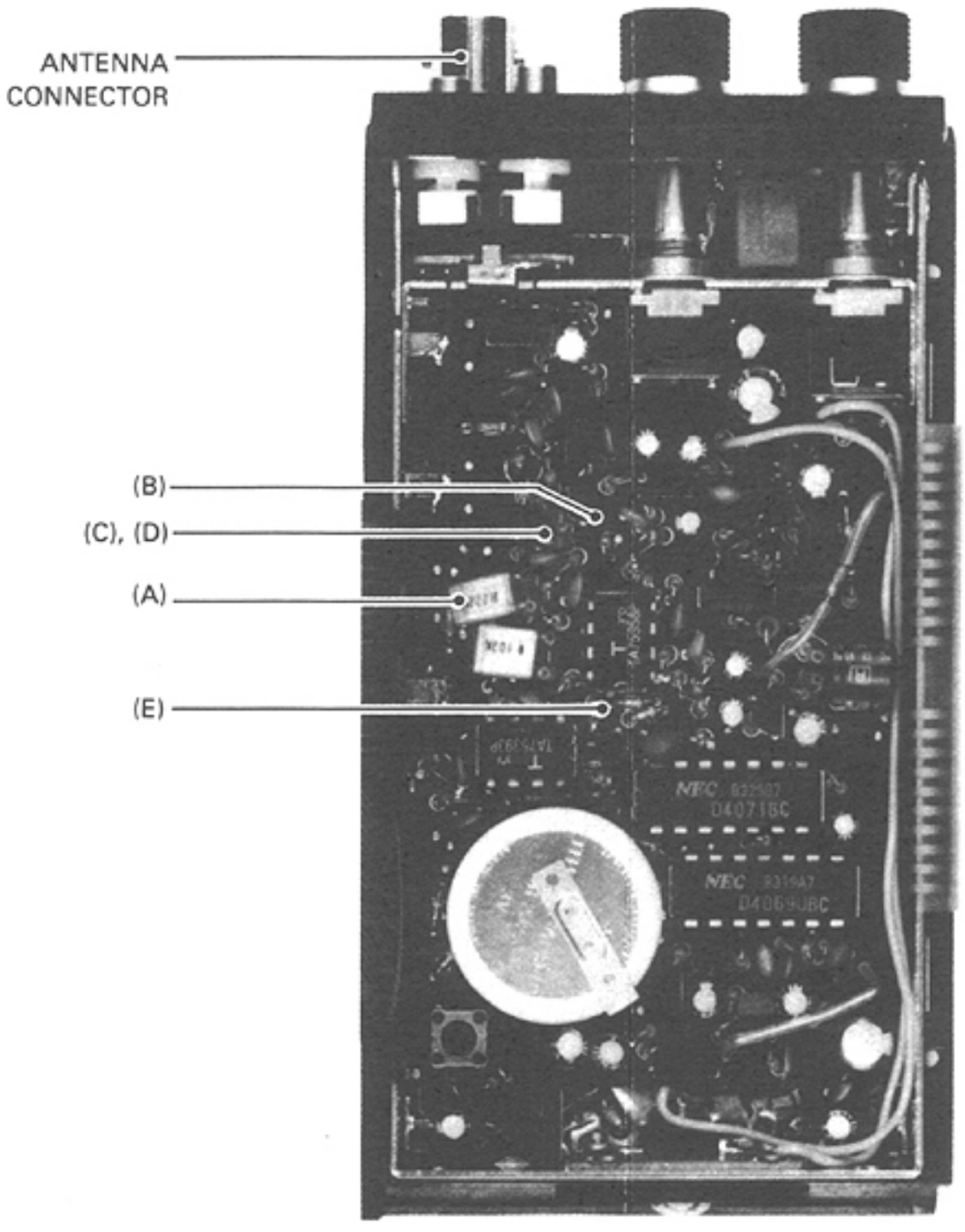


ADJUSTMENT		ADJUSTMENT CONDITIONS	UNIT	MEASUREMENT LOCATION	VALUE	UNIT	ADJUST
PRELIMINARY	1	• Check the RF output power. • RF POWER switch: HIGH. • Transmit mode.		• Connect the RF power meter to the ANTENNA CONNECTOR.	5W		
	2	• RF POWER switch: LOW. • Transmit mode.			1W		
	3	• Check the main points in the transmission path. • Transmit mode.	PLL	• Connect the RF voltmeter to: (A) IC204 pin 4, (B) IC204 pin 1, (C) Q210 base, (D) Q209 collector, (E) Q209 base, (F) Q208 collector.	Verify RF is present		
	4	• If the output power is low, check the regulated power supply voltage. • Do not adjust the coils.		• Connect the multimeter to the +5V bus. (L207/R270 junction — DC 10V range)	5V		
	NOTE: It is not possible to measure the DC voltage accurately with a multimeter when RF is present.						
	5	• Check the main audio voltages. • Transmit mode.	MAIN	• Connect a 1kHz 40mV signal to the EXT MIC connector. • Connect the oscilloscope to: (A) R101/C101 junction, (B) Q103 base, (C) Q104 base, (D) Q104 collector, (E) Mod out (R118).	Verify AF is present		

PLL UNIT

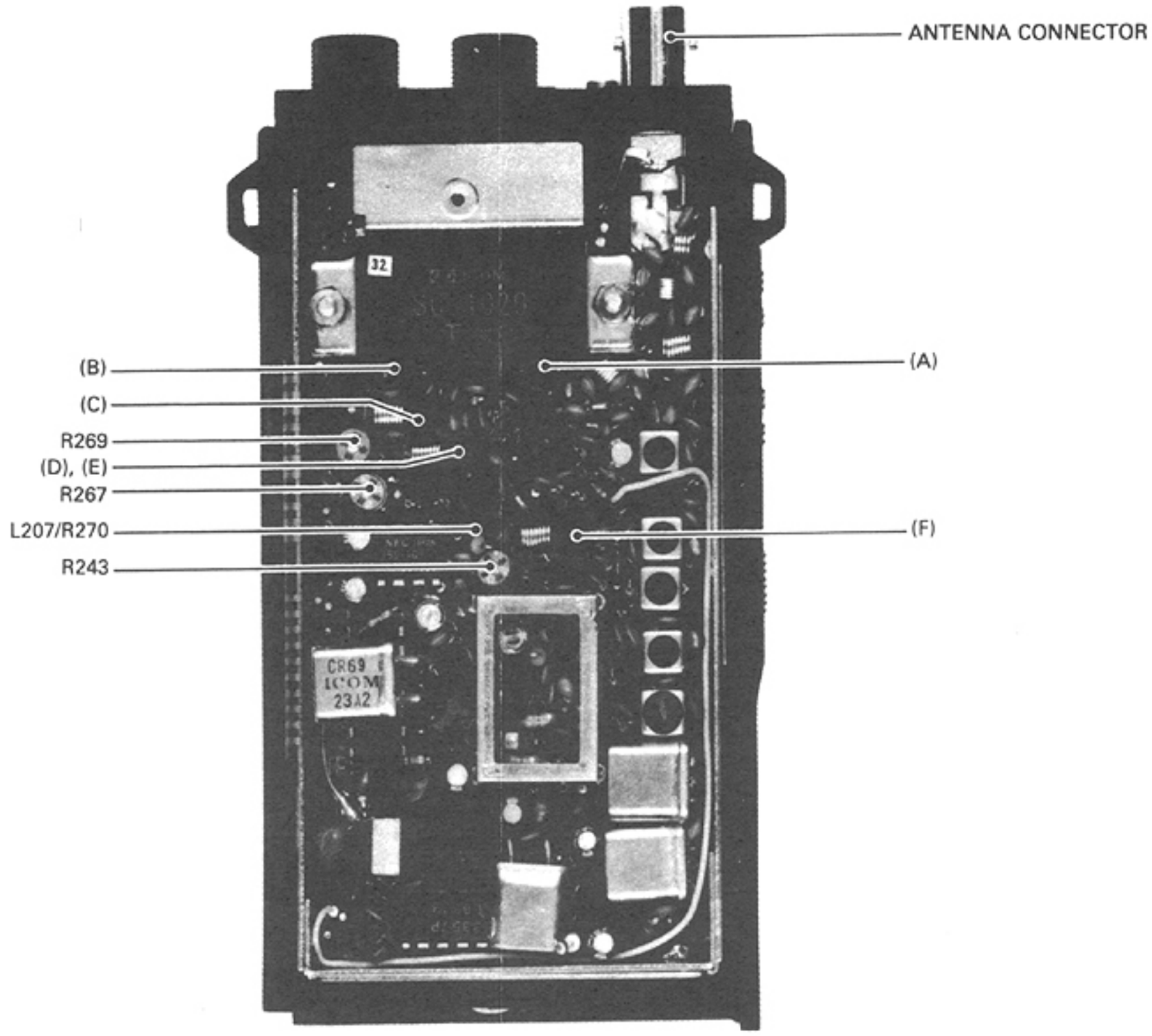


MAIN UNIT

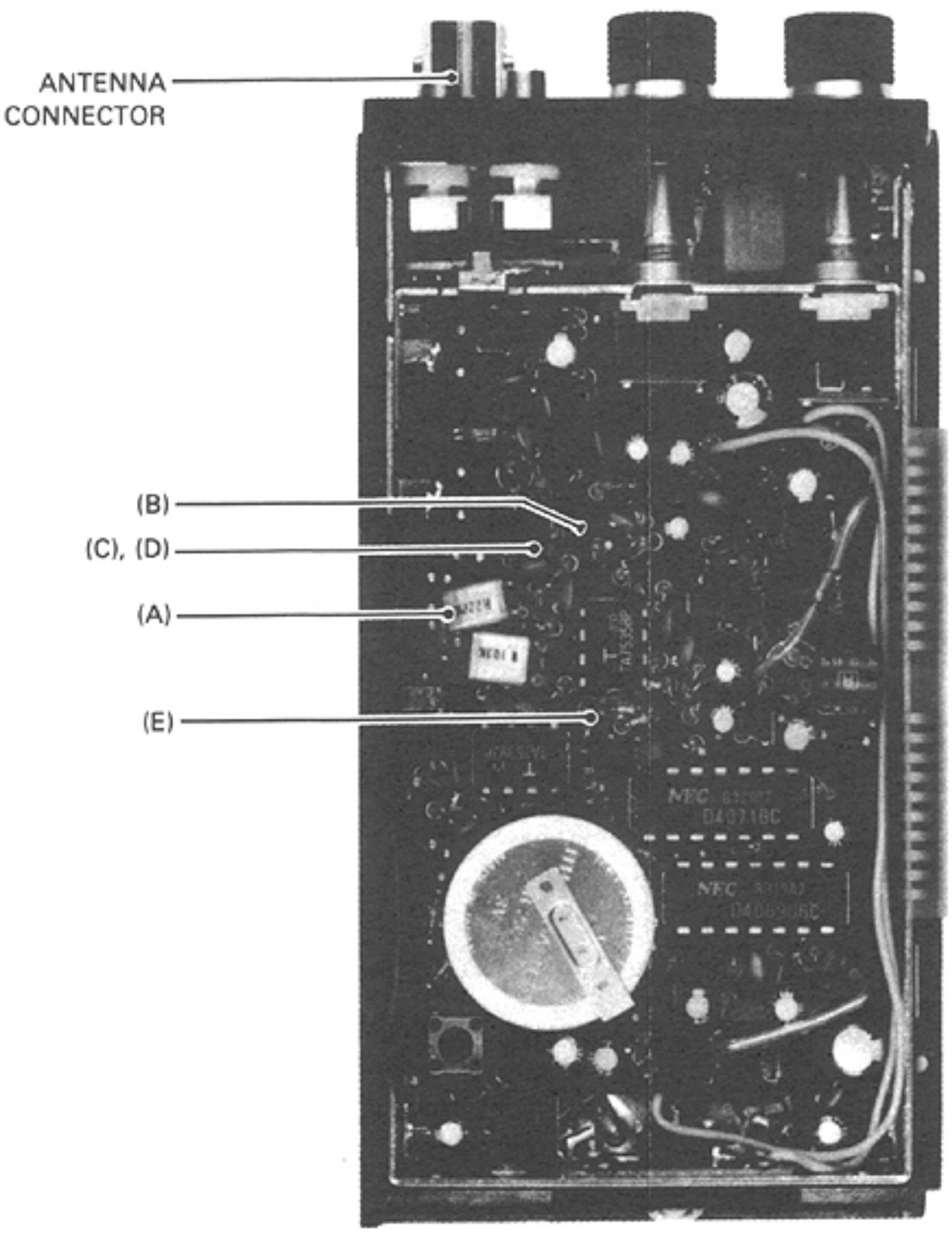


ADJUSTMENT		ADJUSTMENT CONDITIONS	UNIT	MEASUREMENT LOCATION	VALUE	UNIT	ADJUST
OUTPUT POWER	1	• RF POWER switch: HIGH. • CHANNEL SELECTOR: CH 16. • Transmit mode.		• Connect the RF power meter to the ANTENNA CONNECTOR.			
	2	• Set the HIGH RF output power. • Transmit mode.			5W @13.2V 2.5W @8.4V	PLL	R267
	3	• Set the LOW RF output power. • Transmit mode.			1W		R269
	4	• Verify current drain and power are within limits at the band edges.		• Connect the ammeter in series between the power supply and the radio.	Less than: 1.45A @5W 1.25A @2.5W 0.55A @1W		
DEVIATION	1	• Adjust the transmit deviation. • CHANNEL SELECTOR: CH 16. • RF POWER switch: HIGH. • Deviation meter deemphasis: OFF • Transmit mode.		• Connect a 1kHz 170mV signal to the EXT MIC jack. • Connect the RF power meter and the deviation meter to the ANTENNA CONNECTOR using a directional coupler.	5kHz deviation ±10%	PLL	R243
MODULATION SENSITIVITY	2	• Check the modulation sensitivity.		• Adjust the AF oscillator to 1kHz 17mV ±3dB.	3.5kHz deviation		
S/N RATIO	3	• Check the transmit signal-to-noise ratio. • No audio input. • Transmit mode.		• Remove the oscillator signal. • Connect the millivoltmeter to the deviation meter output.	Record the reading		
	4	• Transmit mode.		• Connect a 1kHz 40mV signal to the EXT MIC jack. • Connect the millivoltmeter to the deviation meter output.	Record the reading		
	NOTE: The ratio of the readings take in steps 3 and 4 must be greater than 40dB.						
SPURIOUS EMISSIONS	1	• Measure the spurious signals. • Transmit mode.		• Connect the spectrum analyzer to the ANTENNA CONNECTOR using a suitable attenuator. • Adjust the attenuator until the noise level just appears.	Greater than 60dB below the fundamental frequency level.		

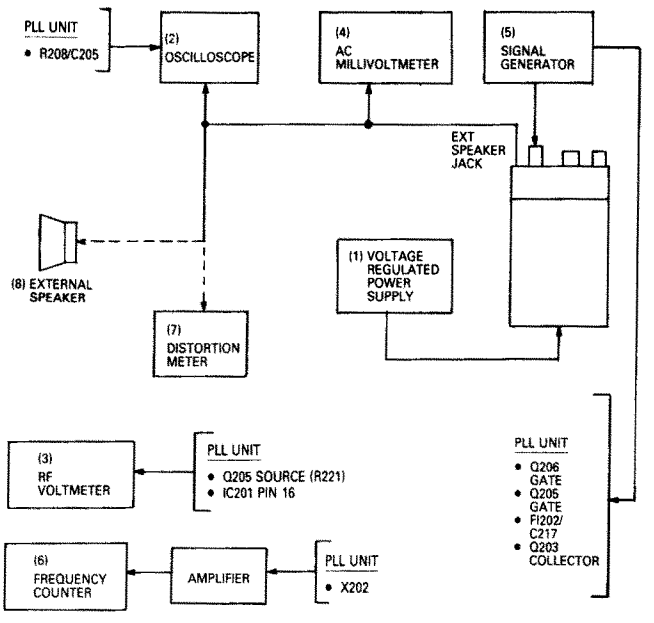
PLL UNIT



MAIN UNIT



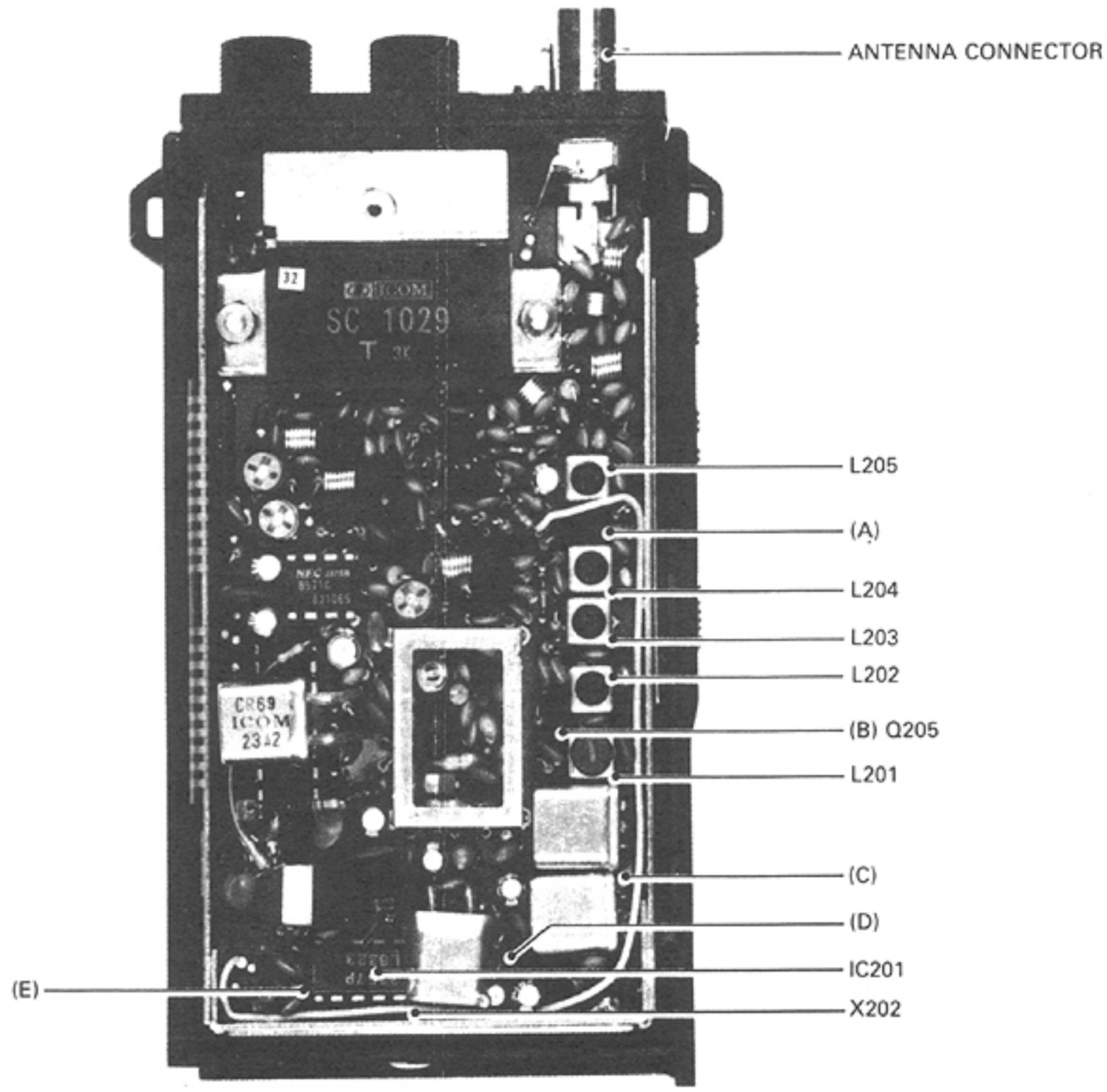
7 - 5 RECEIVER ADJUSTMENT

INSTRUMENTS REQUIRED	CONNECTIONS
(1) VOLTAGE REGULATED POWER SUPPLY OR ATTENDANT POWER PACK • OUTPUT VOLTAGE : DC 13.2V • CURRENT CAPACITY : 1A (2) OSCILLOSCOPE • FREQUENCY RANGE : DC-20MHz • MEASURING RANGE : 0.01 ~ 10V (3) RF VOLTMETER • FREQUENCY RANGE : 0.1 ~ 170MHz • MEASURING RANGE : 0.01 ~ 10V (4) AC MILLIVOLTMETER • MEASURING RANGE : 10mV ~ 2V (5) SIGNAL GENERATOR • FREQUENCY RANGE : 0.1 ~ 170MHz • OUTPUT VOLTAGE : −20 to +90 dB (0dB = 1μV) (6) FREQUENCY COUNTER • FREQUENCY RANGE : 0.1 ~ 170MHz • ACCURACY : BETTER THAN ±1 PPM (7) DISTORTION METER (8) EXTERNAL SPEAKER • IMPEDANCE : 8 OHMS	

ADJUSTMENT		ADJUSTMENT CONDITIONS	UNIT	MEASUREMENT LOCATION	VALUE	UNIT	ADJUST
PRELIMINARY	1	• Check the 20dB noise quieting. • CHANNEL SELECTOR: CH 16. • SQUELCH: CCW. • No audio input to the ANTENNA CONNECTOR from the signal generator.		• Connect the AC millivoltmeter and an external speaker to the EXT SPEAKER jack.	Full Scale		VOLUME
	NOTE: Do not readjust the VOLUME after this step.						
	2	• Set the signal generator to 156.8MHz		• Connect the signal generator to the ANTENNA CONNECTOR.	20dB decrease in level.		Generator level.
	NOTE: The signal generator output voltage is the 20dB quieting sensitivity.						
	3	• Confirm the PLL works correctly.		• See Section 7-3 PLL PRELIMINARY			
	4	• Check the receive path continuity. • Set the oscillator for an FM test signal with 1kHz modulation. • Inject the test signal through a 0.01μF capacitor into test points (A) through (D): (A) Q206 gate — inject 156.8MHz, (B) Q205 gate — inject 156.8MHz, (C) FI202/C217 junction — inject 16.9MHz, (D) Q203 collector — inject 16.9 MHz.	PLL	• Monitor receiver speaker. • Connect the oscilloscope to test point (E): (E) DET bus (R208/C205 junction)	Check for an AF output.		
LOCAL OSCILLATOR OUTPUT	1	• CHANNEL SELECTOR: CH 16.	PLL	• Connect the RF voltmeter to the Q205 source (R221).	About 180mV		

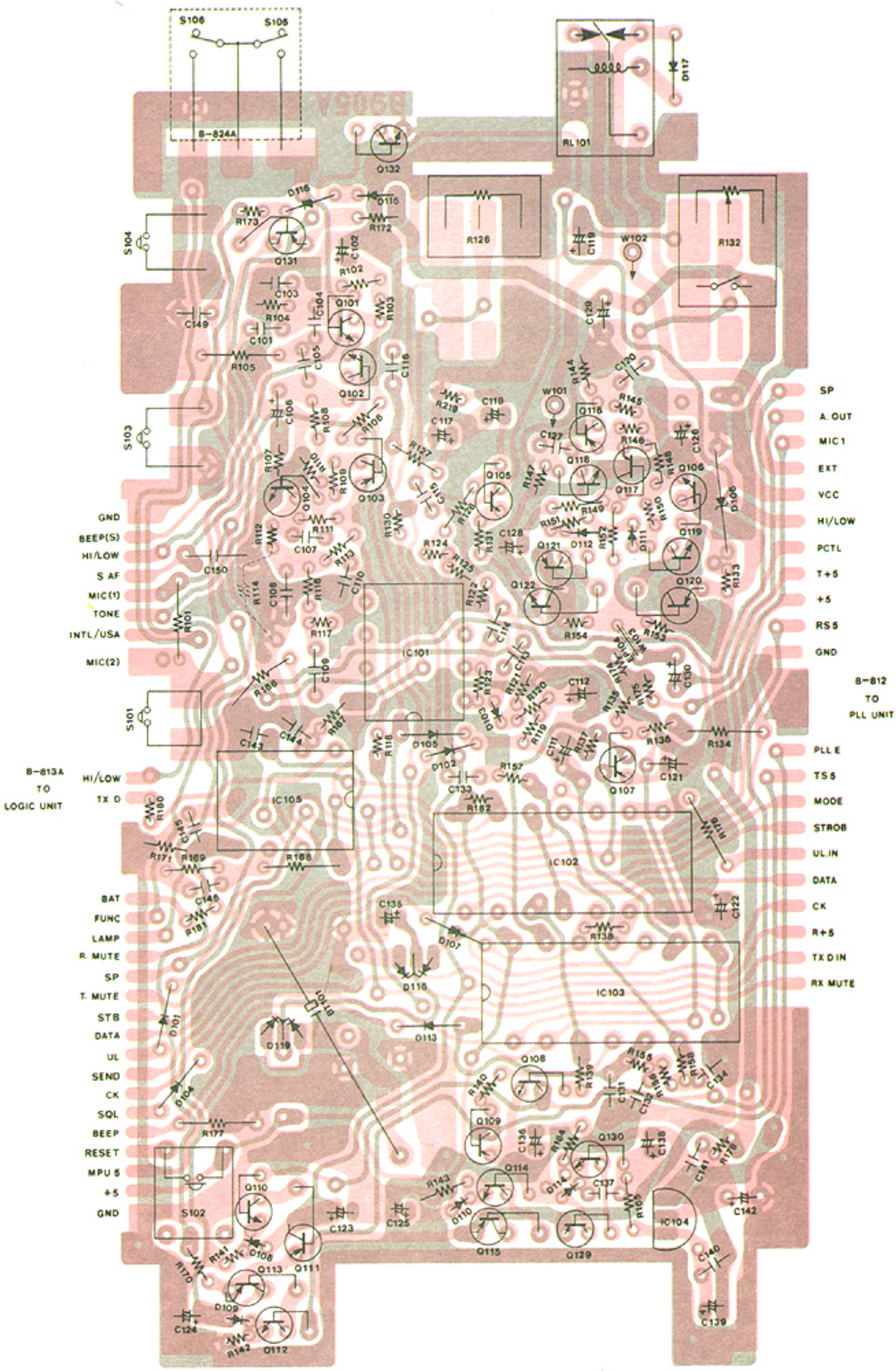
ADJUSTMENT		ADJUSTMENT CONDITIONS	UNIT	MEASUREMENT LOCATION	VALUE	UNIT	ADJUST
RF/IF STAGES	1	• Set the signal generator to 156.8MHz • Reduce the generator output so the voltmeter reads just above the noise.	PLL	• Connect the RF voltmeter to IC201 pin 16. • Connect the signal generator to the ANTENNA CONNECTOR.	Maximum RF voltmeter reading	PLL	L201 ~ L205
	2	• Vary the generator by ±10kHz. • Check for ripple on the RF voltmeter.			Ripple must be less than 3dB.		L201
	NOTE: Final settings should produce 20 dB quieting for a −10dBμ (0.3μV) signal. See Section 7-5 RECEIVER ADJUSTMENT/ PRELIMINARY for the method of measuring the 20dB quieting level.						
2ND LOCAL OSCILLATOR FREQUENCY	1	• Use an amplifier between the counter and the test point.	PLL	• Loosely couple the frequency counter to X202 (2nd OSC).	16.445 MHz ± 500Hz		
RECEIVER SPURIOUS RESPONSE	1	• Measure the spurious frequencies across the band.		• Connect the AC millivoltmeter and an external speaker to the EXT SPEAKER jack.	Less than 3dB noise suppression by any spurious		
RECEIVER AUDIO OUTPUT	1	• Set the signal generator to 20 to 30dBμ (−80 to −90dBm) with 3.5kHz deviation. • Increase the VOLUME for 10% distortion of the AF signal.		• Connect the signal generator to the ANTENNA CONNECTOR. • Connect the oscilloscope, distortion meter and AC millivoltmeter in parallel with the EXT SPEAKER jack.		2V RMS minimum.	VOLUME

PLL UNIT

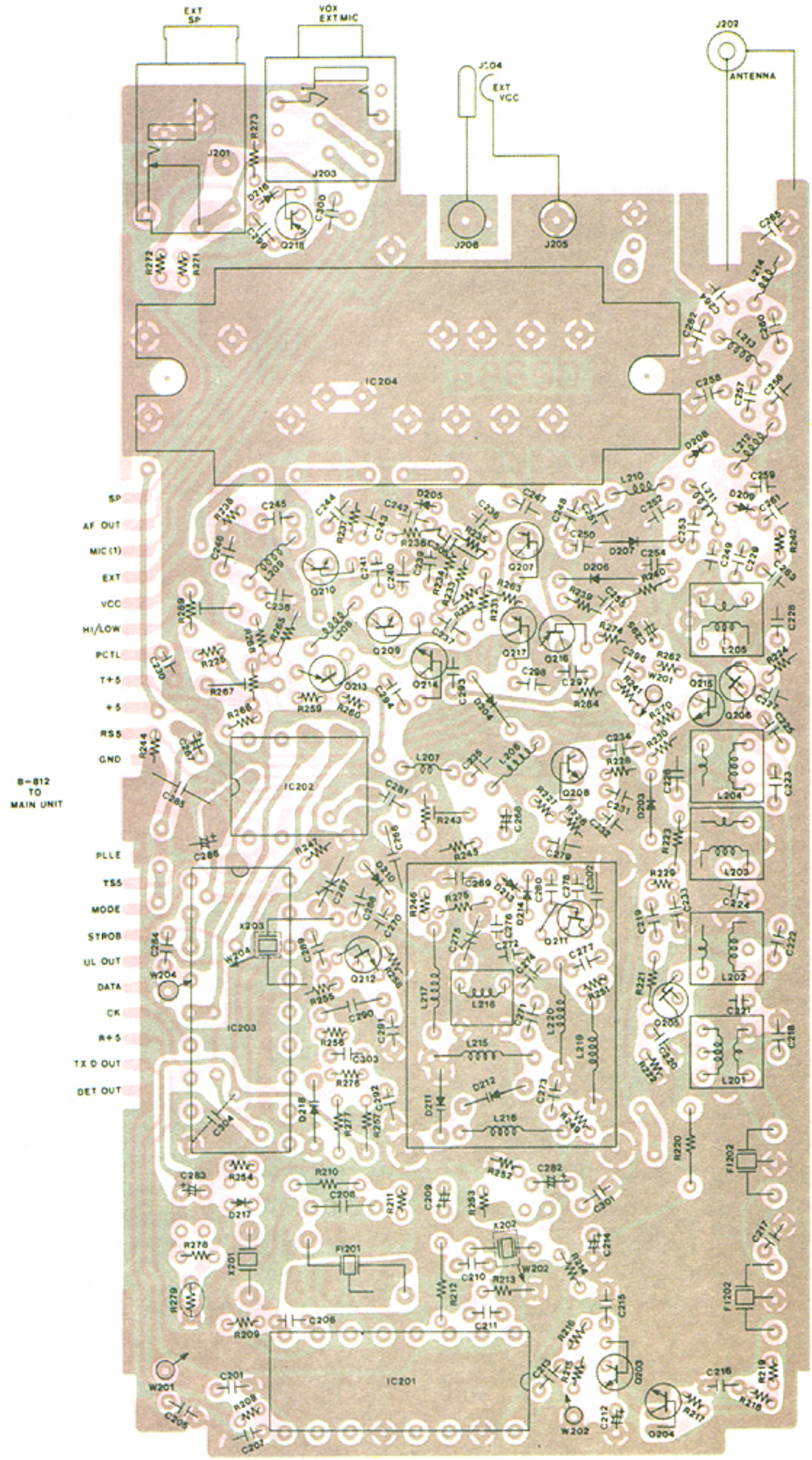


SECTION 8 BOARD LAYOUTS

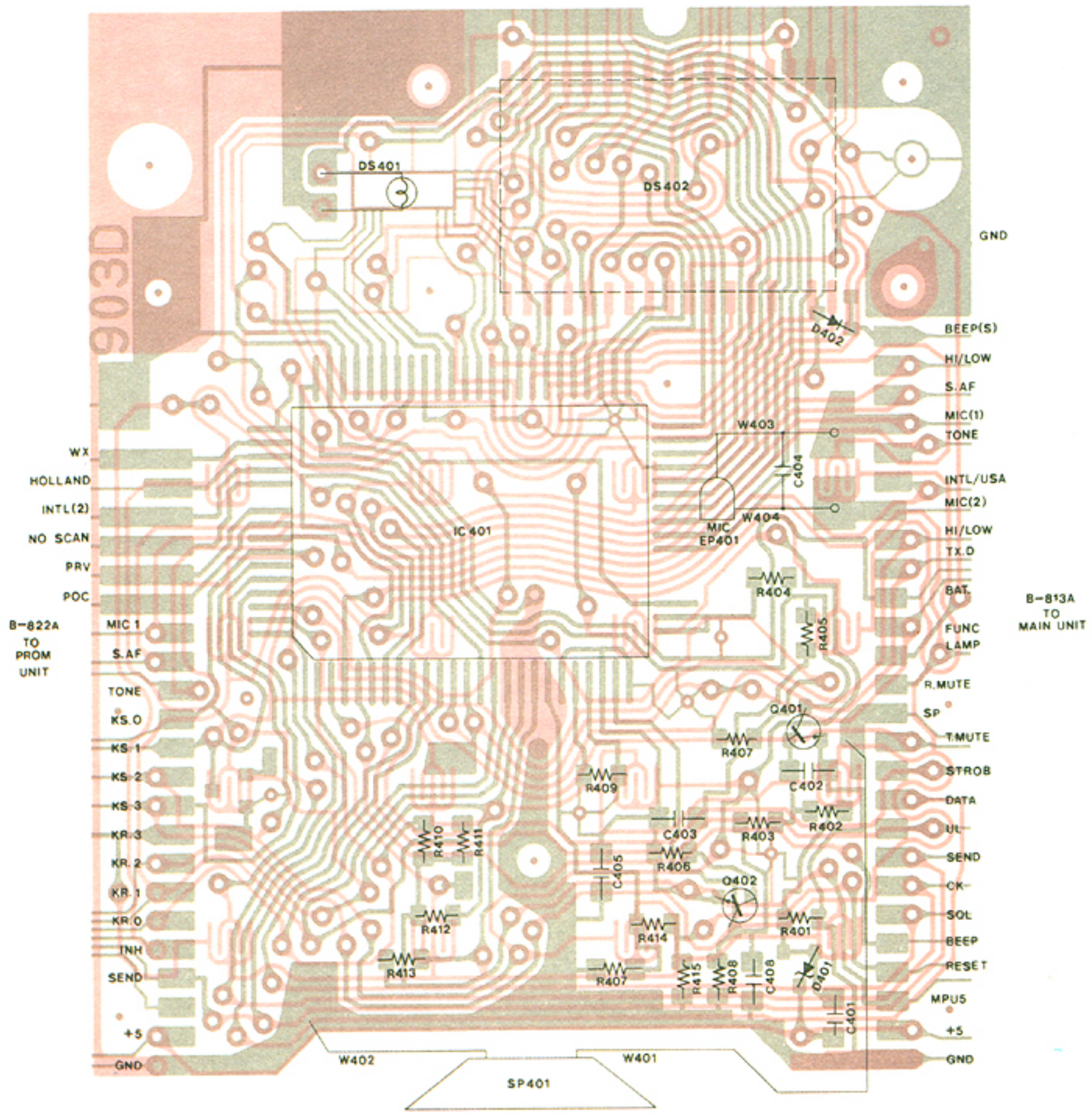
MAIN UNIT



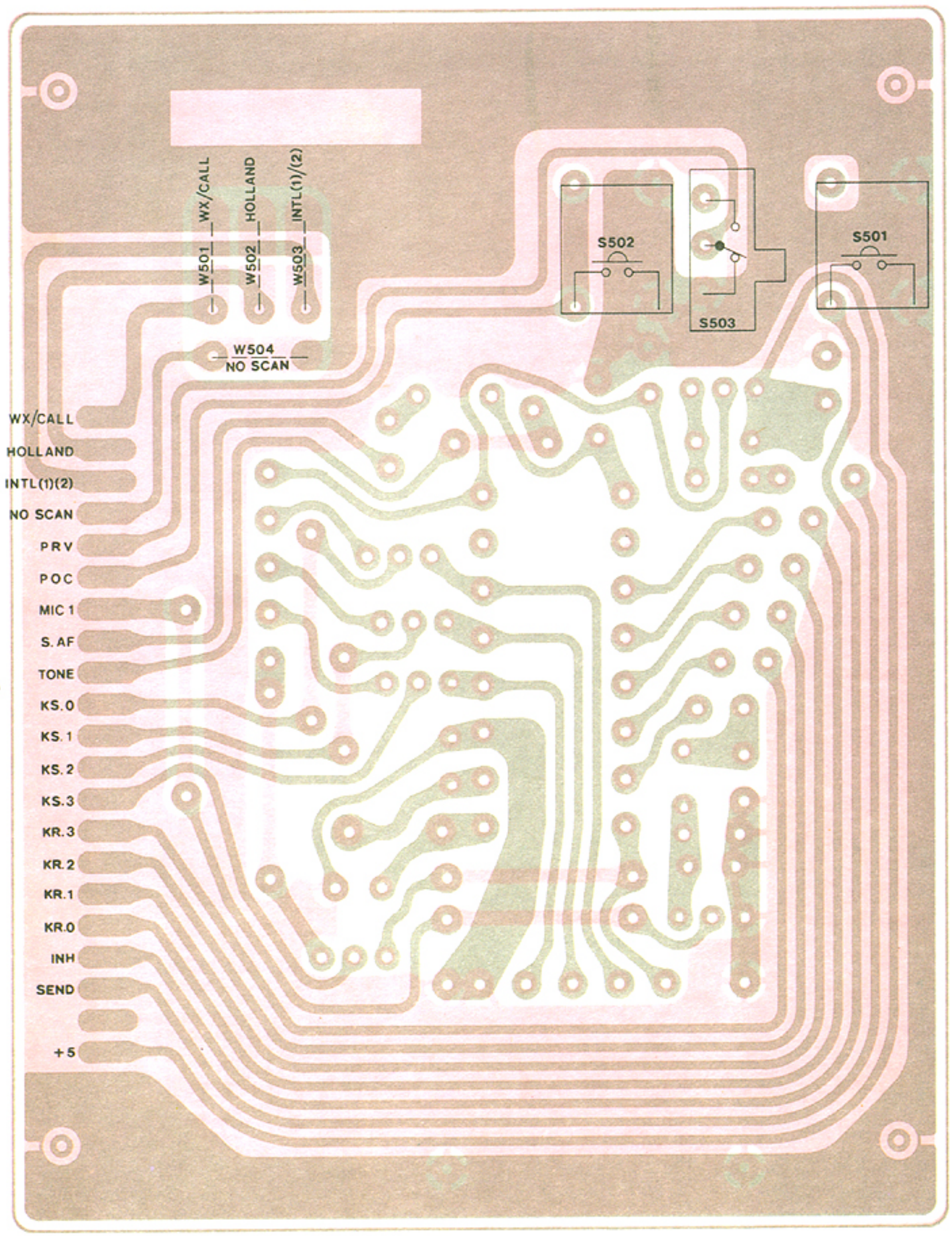
PLL UNIT


EXT SP
VOX EXT MIC
J202
ANTENNA
J204
EXT VCC
J201
J203
J206
J205
IC204
IC202
IC203
IC201
SP
AF OUT
MIC (1)
EXT
VCC
HI/LOW
PCTL
T+5
+5
RS5
GND
PLLE
TS5
MODE
STROB
UL OUT
DATA
CK
R+5
TX D OUT
DET OUT
8-812 TO MAIN UNIT

LOGIC UNIT

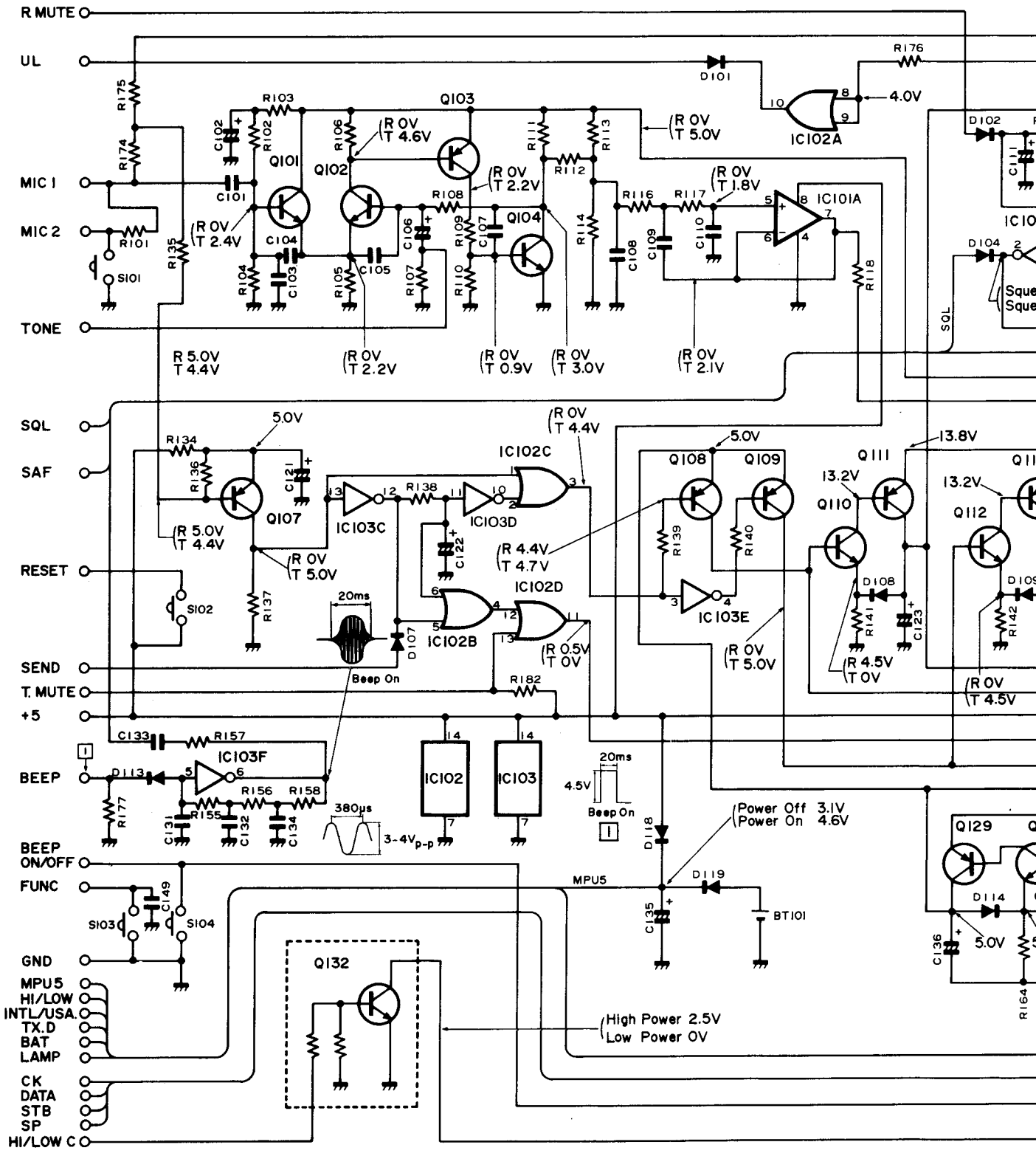

903D
DS401
DS402
GND
D402
BEEP(S)
HI/LOW
S.AF
MIC(1)
TONE
W403
C404
INTL/USA
MIC(2)
HI/LOW
TX.D
BAT.
FUNC LAMP
R.MUTE
SP
T.MUTE
STROB
DATA
UL
SEND
CK
SQL
BEEP
RESET
MPU5
+5
GND
B-813A TO MAIN UNIT
W404
MIC EP401
IC401
R404
R405
Q401
R407
C402
R409
C403
R403
R402
R410
R411
C405
R406
Q402
R412
R414
R401
R413
R407
R415
R408
C408
D401
C401
W402
W401
SP401
WX
HOLLAND
INTL(2)
NO SCAN
PRV
POC
B-822A TO PROM UNIT
MIC 1
S.AF
TONE
KS.0
KS.1
KS.2
KS.3
KR.3
KR.2
KR.1
KR.0
INH
SEND
+5
GND

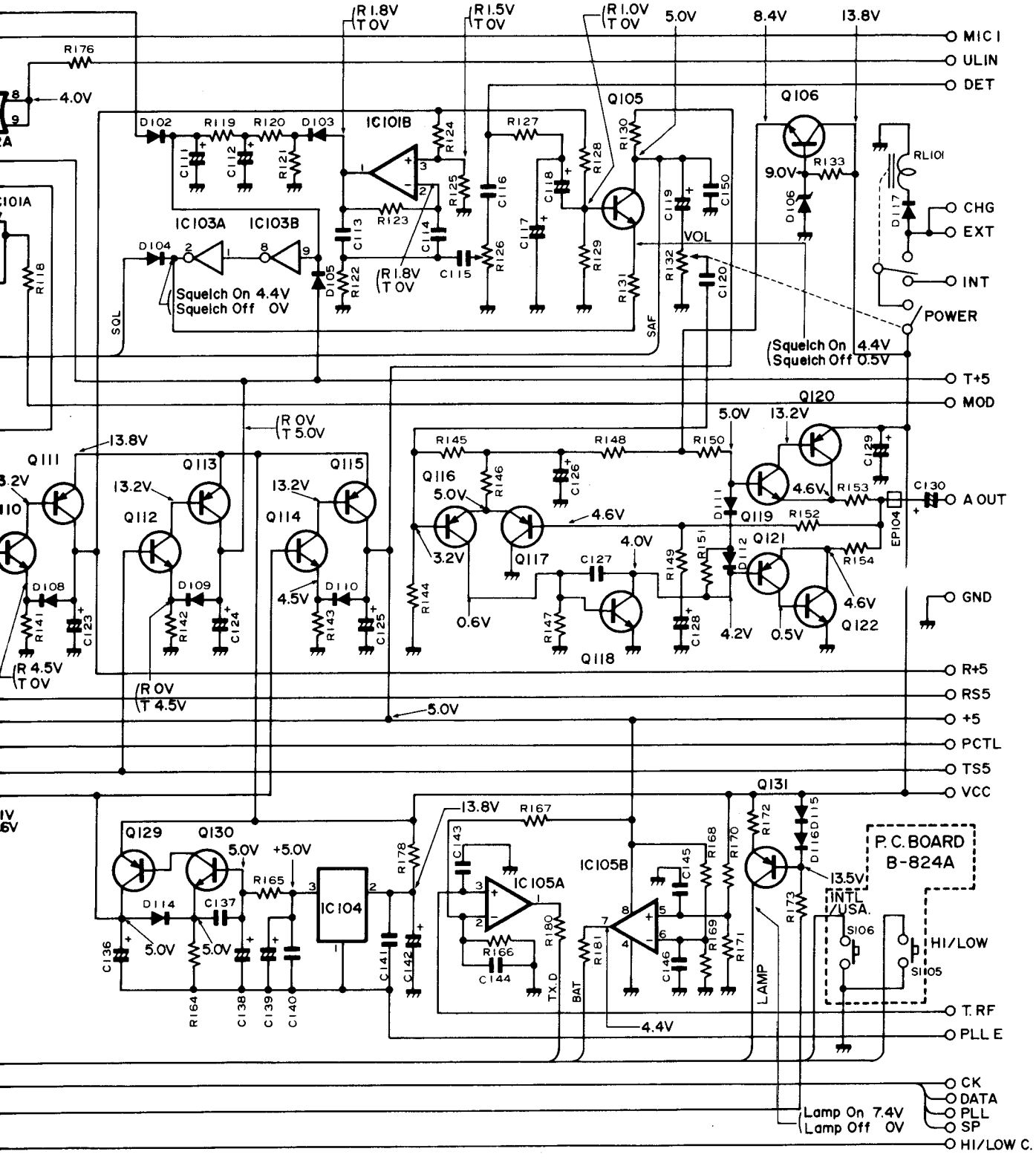
SW UNIT


W501 WX/CALL
W502 HOLLAND
W503 INTL(1)/(2)
W504 NO SCAN
S502
S503
S501
WX/CALL
HOLLAND
INTL(1)(2)
NO SCAN
PRV
POC
MIC 1
S. AF
TONE
KS. 0
KS. 1
KS. 2
KS. 3
KR. 3
KR. 2
KR. 1
KR. 0
INH
SEND
+5
B-822A TO LOGIC UNIT

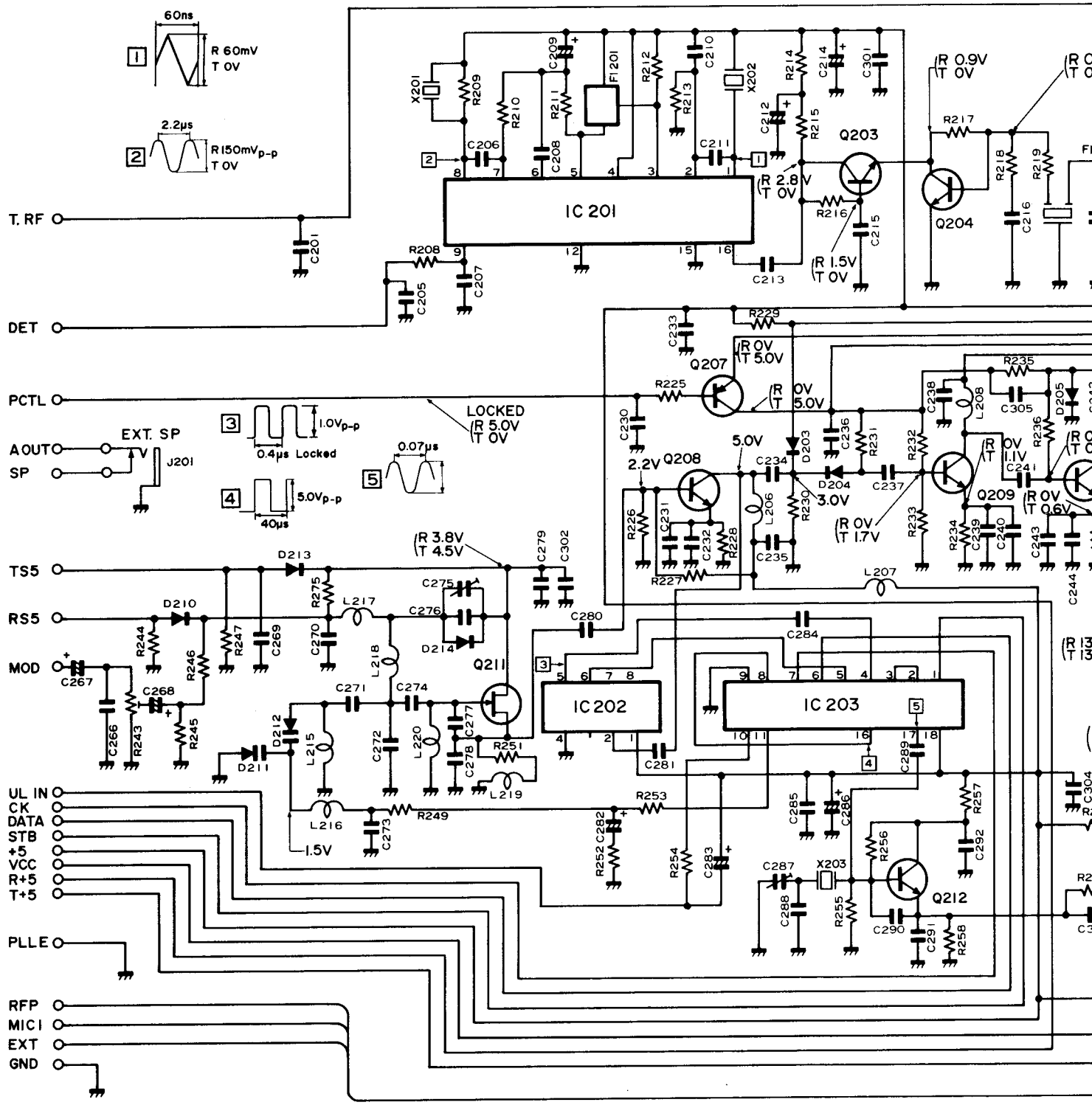
SECTION 9 VOLTAGE DIAGRAMS

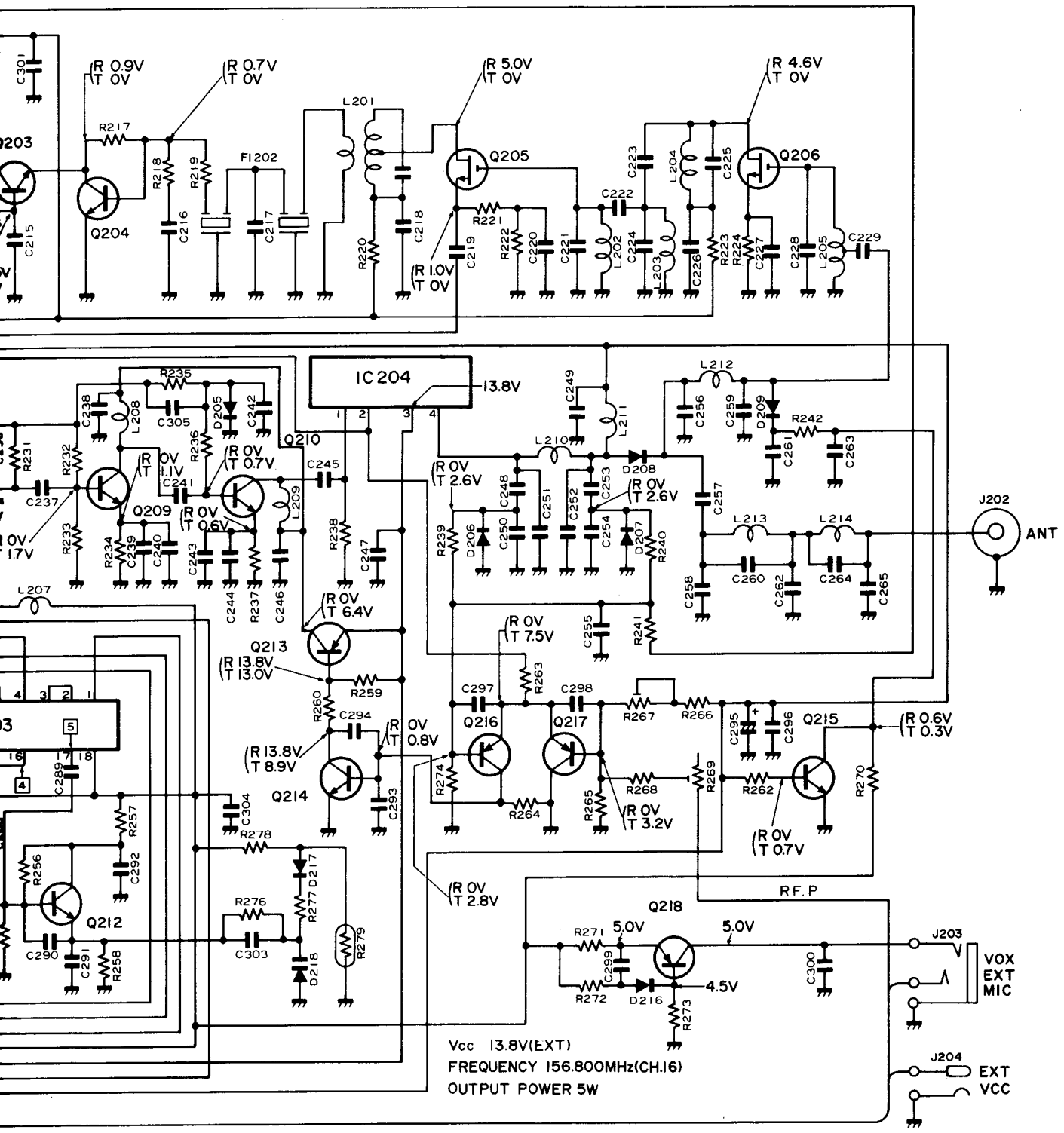
MAIN UNIT VOLTAGE DIAGRAM



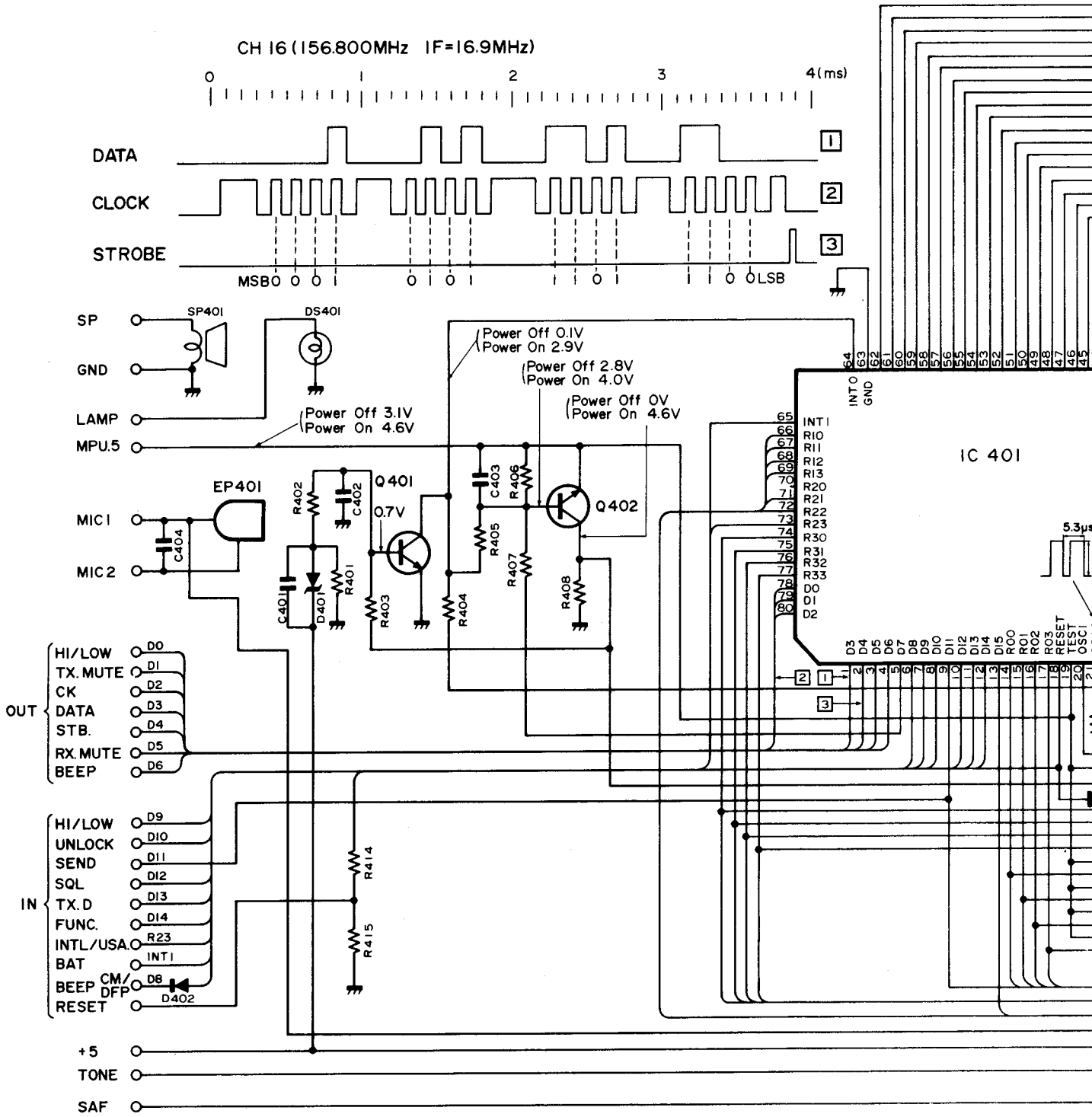

R1.8V T0V
R1.5V T0V
R1.0V T0V
5.0V
8.4V
13.8V
MIC I
ULIN
DET
Q105
Q106
IC101B
IC103A
IC103B
VOL
SAF
SQL
Squelch On 4.4V
Squelch Off 0V
Squelch On 4.4V
Squelch Off 0.5V
CHG
EXT
INT
POWER
RL101
T+5
MOD
Q120
A OUT
GND
R+5
RS5
+5
PCTL
TS5
VCC
Q131
P.C.BOARD
B-824A
INTL
/USA.
HI/LOW
T.RF
PLL E
CK
DATA
PLL
SP
HI/LOW C.
Lamp On 7.4V
Lamp Off 0V
IC104
IC105A
IC105B
LAMP
BAT
TX.D
4.4V

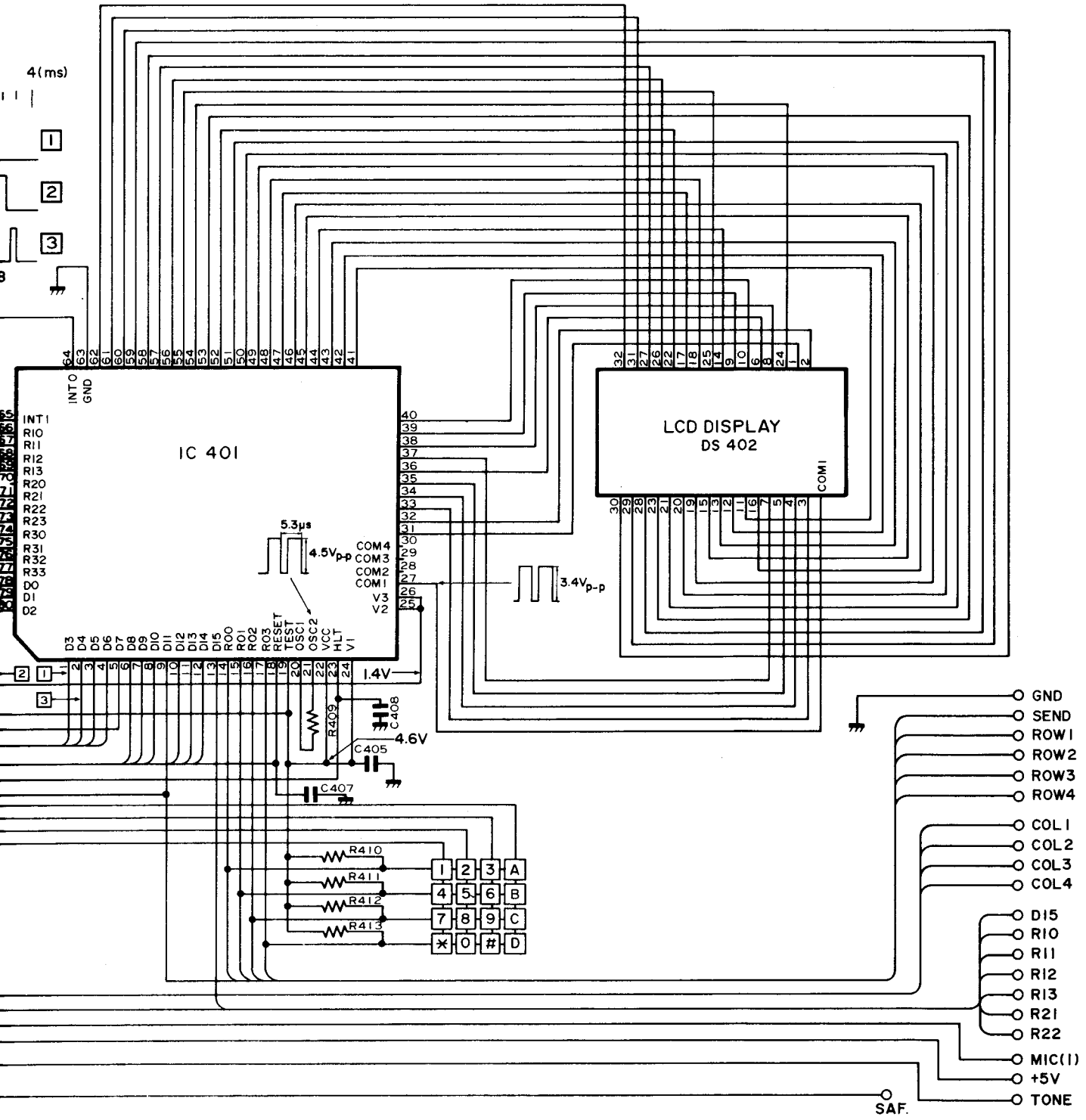
PLL UNIT VOLTAGE DIAGRAM




R 0.9V T 0V
R 0.7V T 0V
R 5.0V T 0V
R 4.6V T 0V
L201
R217
F1202
Q204
Q205
Q206
C222
R221
R 1.0V T 0V
IC 204
13.8V
Q210
Q209
L212
L210
D208
R242
J202
ANT
L207
R 0V T 6.4V
Q213
R 13.8V T 13.0V
R 13.8V T 8.9V
Q214
R 0V T 0.8V
R 0V T 2.6V
R 0V T 2.6V
R 0V T 7.5V
Q216
Q217
Q215
R 0.6V T 0.3V
R 0V T 3.2V
R 0V T 0.7V
R 0V T 2.8V
RF.P
Q218
5.0V
5.0V
4.5V
J203
VOX
EXT
MIC
J204
EXT
VCC
Vcc 13.8V(EXT)
FREQUENCY 156.800MHz(CH.16)
OUTPUT POWER 5W

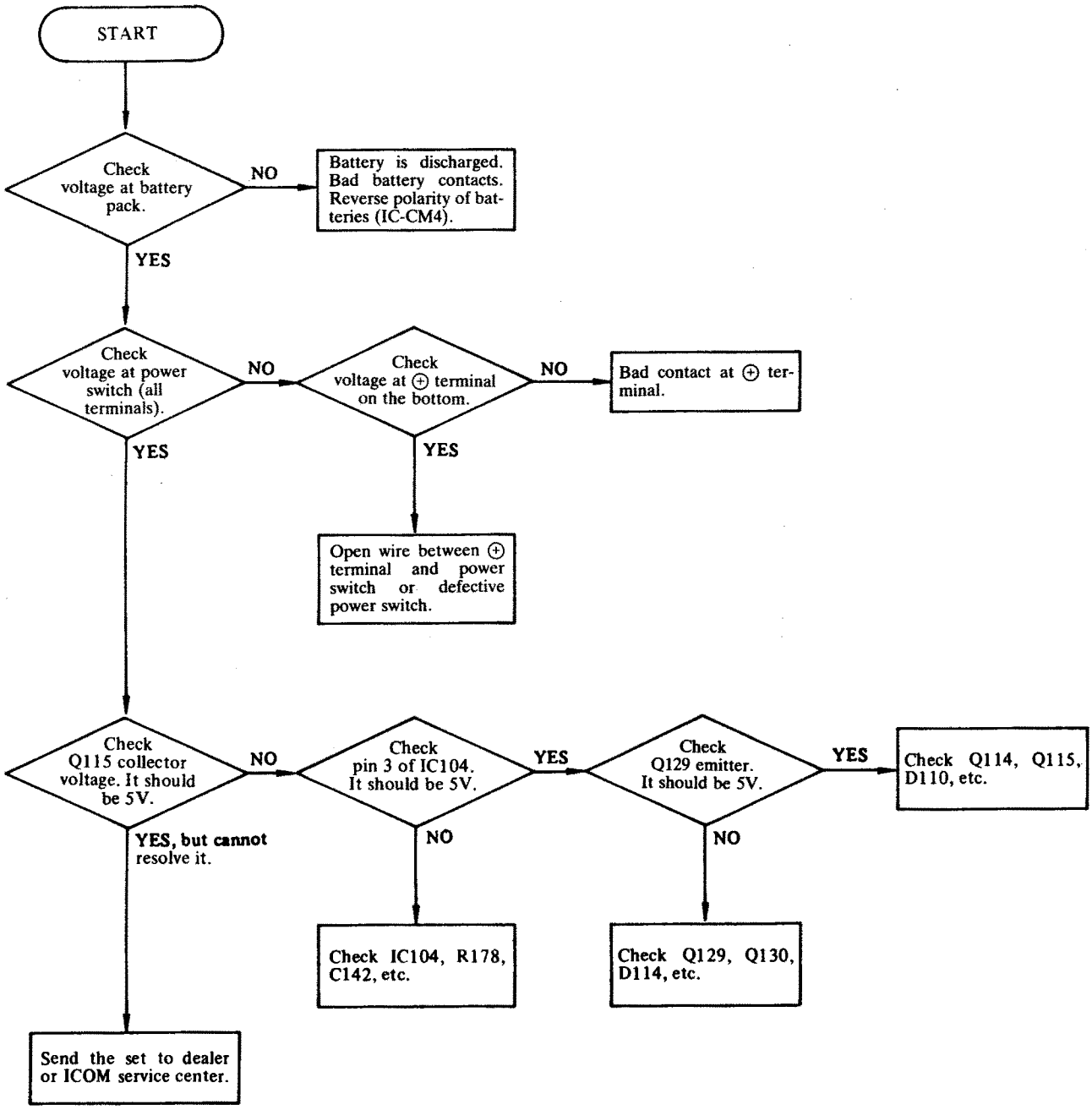
LOGIC UNIT VOLTAGE DIAGRAM



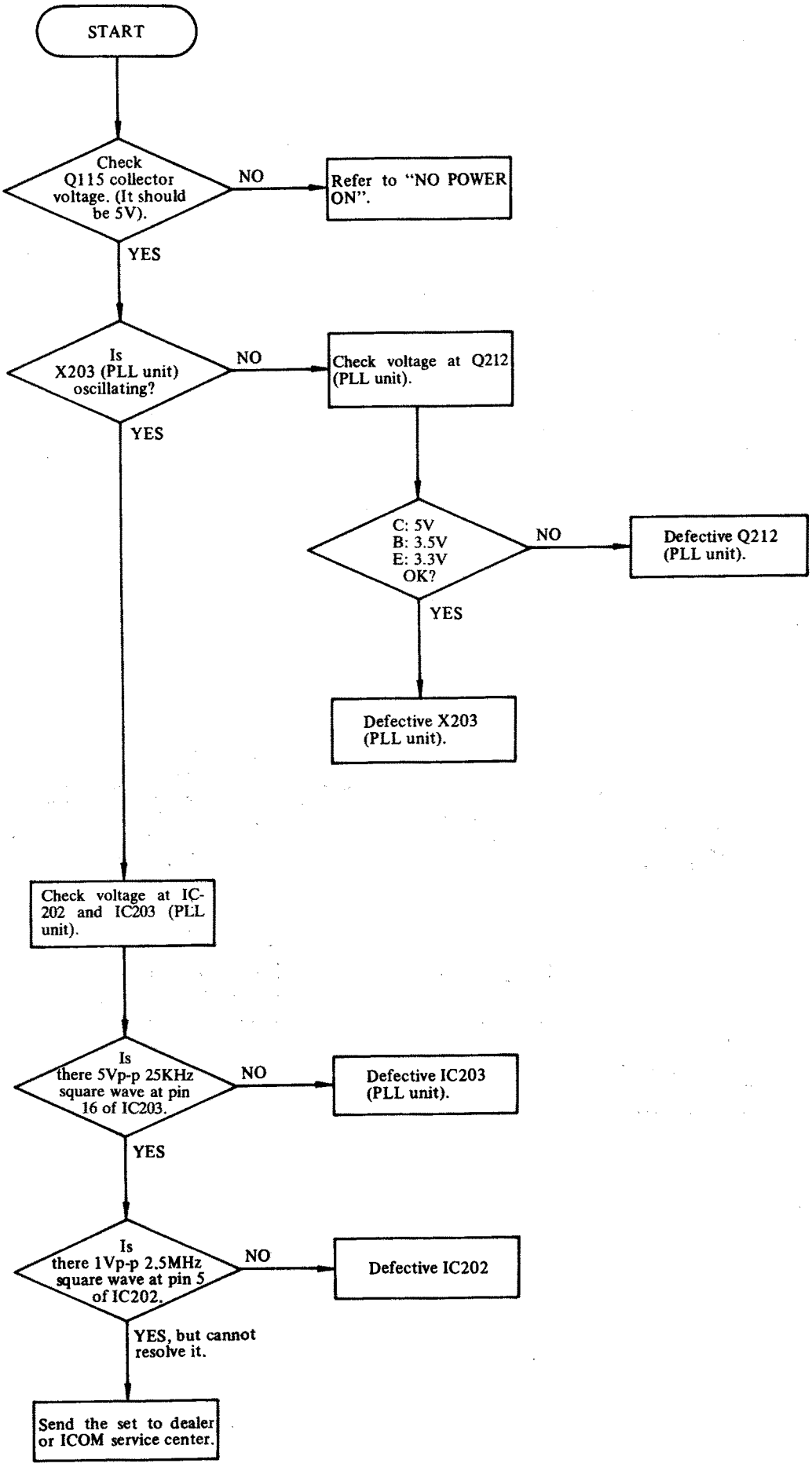

4(ms)
IC 401
INT0
GND
INT1
RI0
RI1
RI2
RI3
R20
R21
R22
R23
R30
R31
R32
R33
DO
DI
D2
D3
D4
D5
D6
D7
D8
D9
D10
D11
D12
D13
D14
D15
RO0
RO1
RO2
RO3
RESET
TEST
OSC1
OSC2
VCC
HLT
V1
V2
V3
COM1
COM2
COM3
COM4
5.3μs
4.5Vp-p
3.4Vp-p
1.4V
4.6V
R409
C408
C405
C407
R410
R411
R412
R413
LCD DISPLAY
DS 402
COM1
GND
SEND
ROW1
ROW2
ROW3
ROW4
COL1
COL2
COL3
COL4
D15
RI0
RI1
RI2
RI3
R21
R22
MIC(1)
+5V
TONE
SAF.

SECTION 10 TROUBLESHOOTING

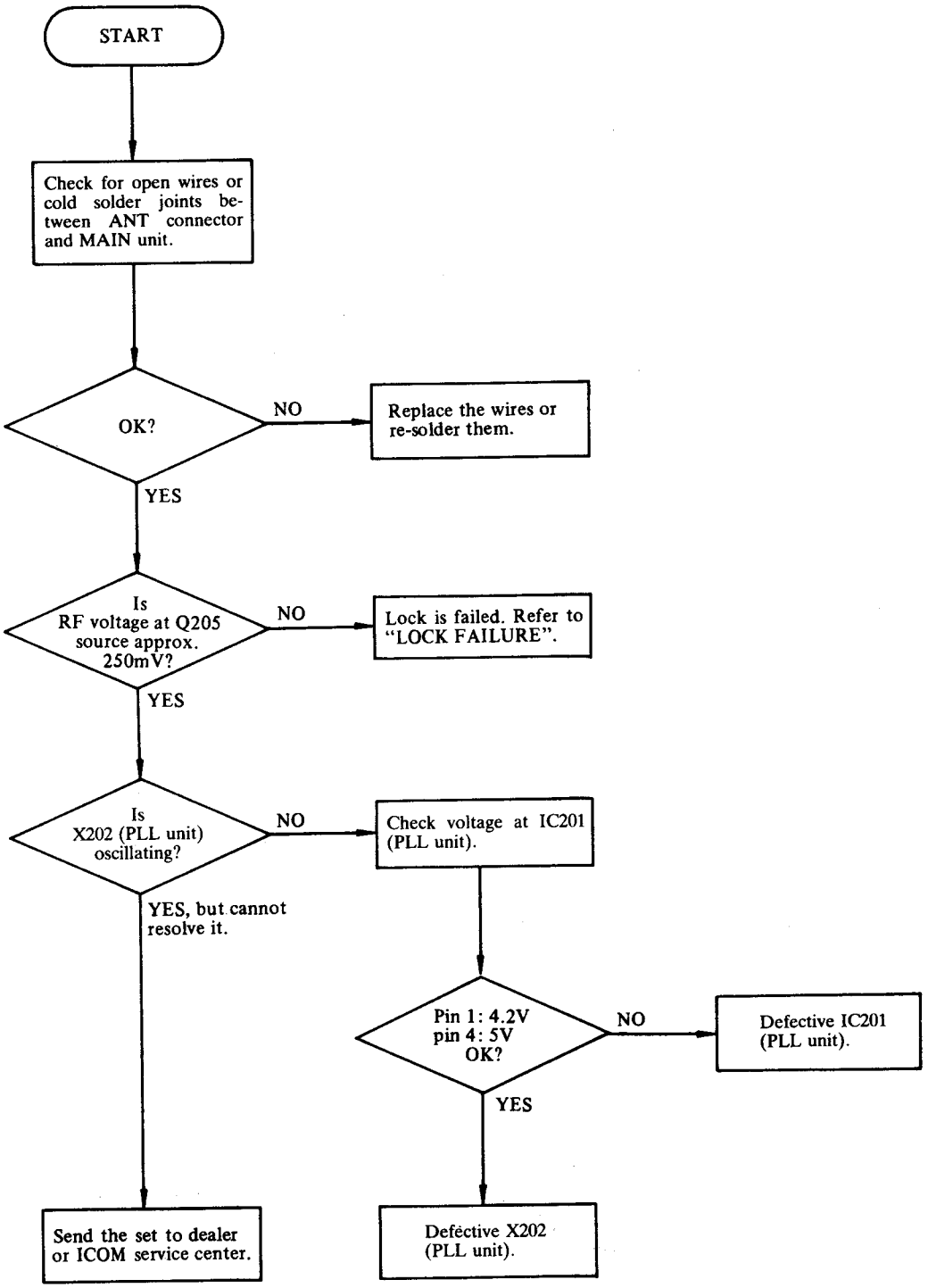
NO POWER ON



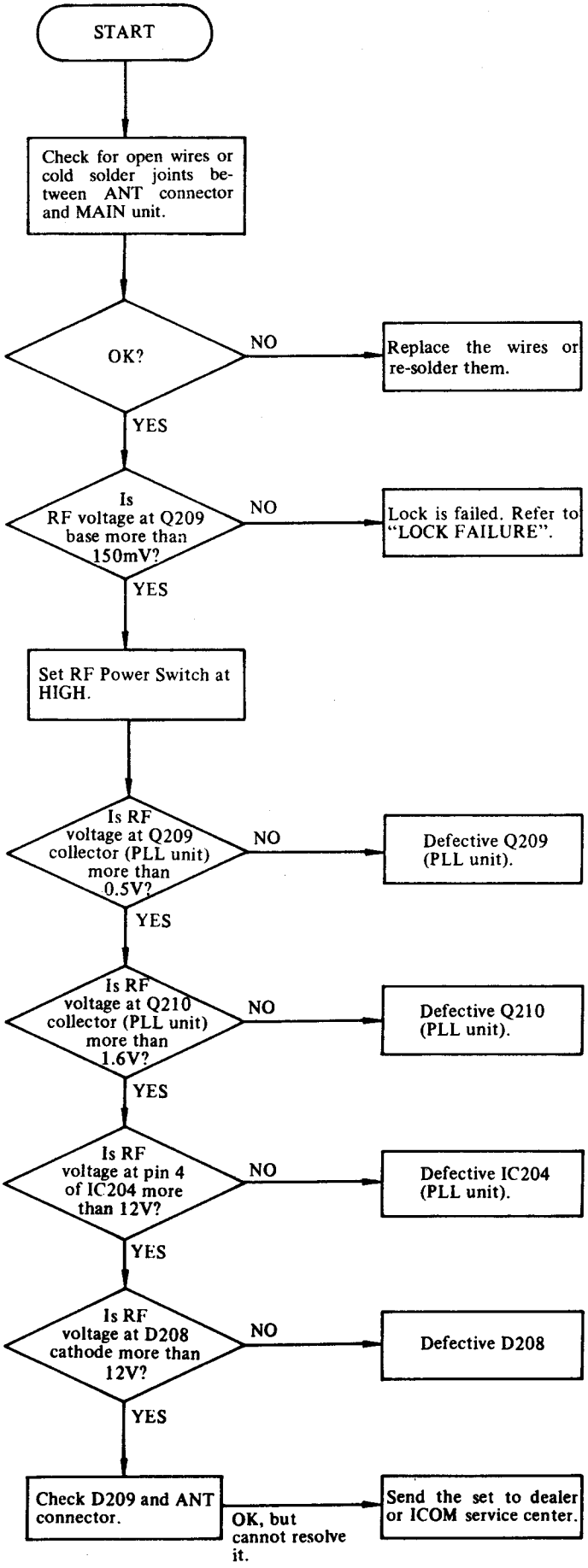
LOCK FAILURE



NO RECEPTION



NO TRANSMIT RF POWER



SECTION 11 IC SPECIFICATIONS

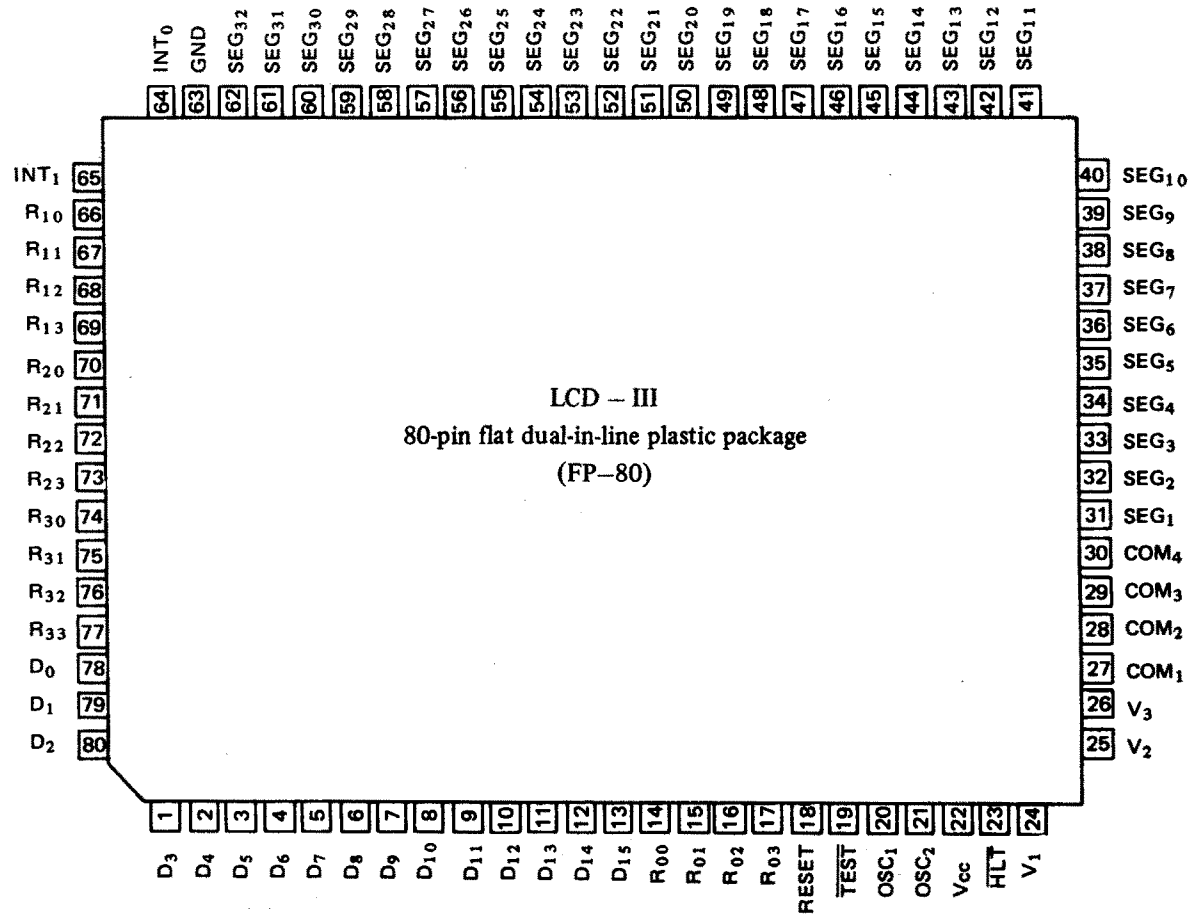
HD 44795 (MPU)

MAXIMUM RATINGS

SYMBOL	DESCRIPTION	RATINGS	UNIT	REMARKS
V_{CC}	Supply Voltage	$-0.3 \sim +7.0$	V	
V_{T1}	Lead Voltage (1)	$-0.3 \sim V_{CC}+0.3$	V	Note 1)
V_{T2}	Lead Voltage (2)	$-0.3 \sim +10.0$	V	Note 2)
$-\Sigma I_{O1}$	Maximum Output Current (1)	45	mA	
ΣI_{O2}	Maximum Output Current (2)	45	mA	
T_{OPR}	Operating Temperature	$-20 \sim +75$	°C	
T_{STG}	Storage Temperature	$-55 \sim +125$	°C	

Note 1): Use all pins except V_{I1}.
Note 2): Use open drain output pins and input and output pins.

PIN CONNECTION

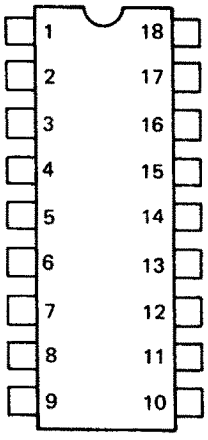


μPD 2834C (PLL FREQUENCY SYNTHESIZER)

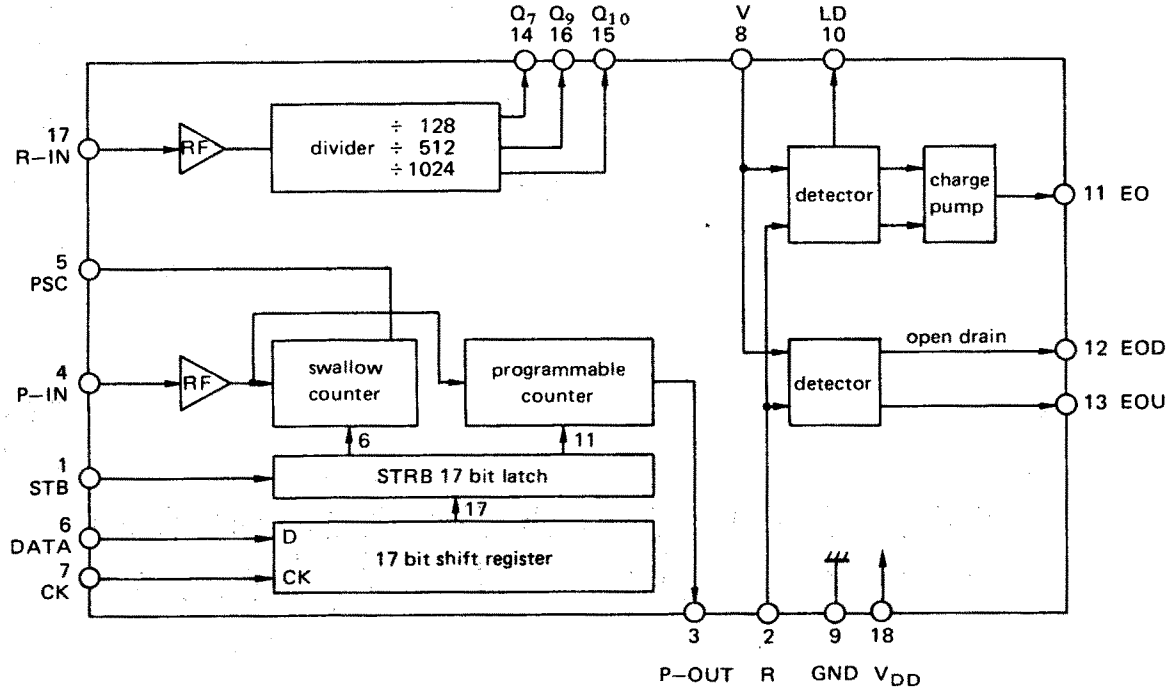
MAXIMUM RATINGS (Ta = 25°C)

SYMBOL	DESCRIPTION	RATINGS	UNIT	REMARKS
V_{DD}	Supply Voltage	$-0.3 \sim +7.0$	V	
V_{IN}	Input Voltage	$-0.5 \sim +V_{DD}+0.5$	V	
V_{OUT}	Output Voltage	$-0.5 \sim +V_{DD}+0.5$	V	
V_{OUT}	Output Voltage	$-0.5 \sim +V_{DD}+3.0$	V	EOU pins only
T_{OPR}	Operating Temperature	$-40 \sim +85$	°C	
T_{STR}	Storage Temperature	$-65 \sim +150$	°C	

PIN CONNECTION



BLOCK DIAGRAM

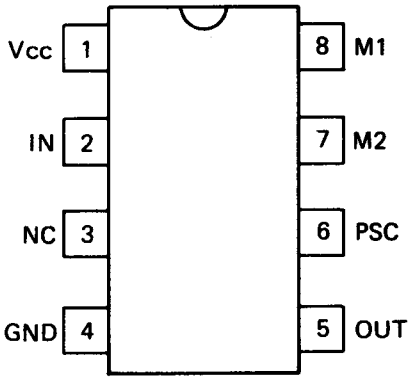


μPB571C (LOW POWER PRESCALER)

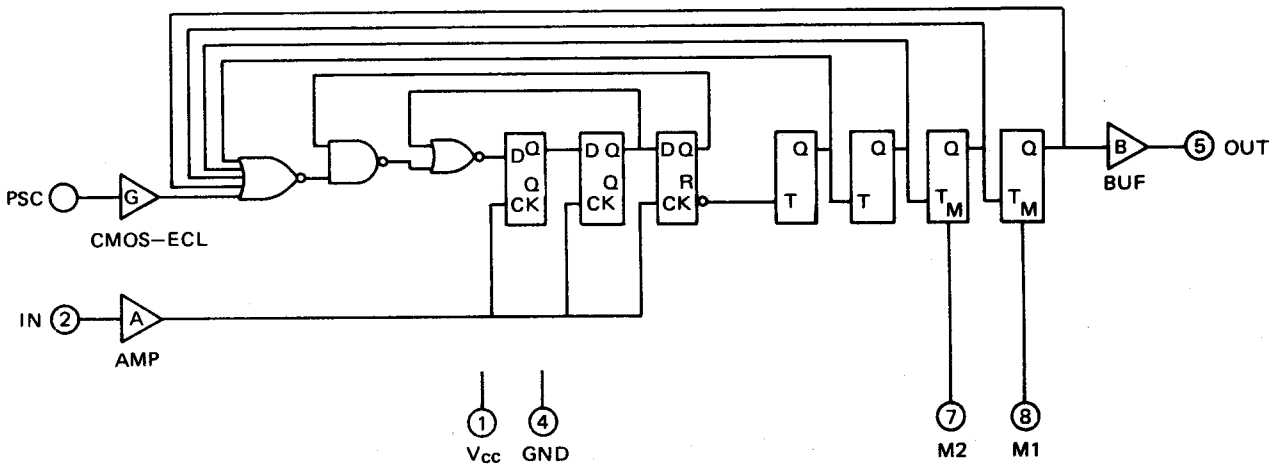
MAXIMUM RATINGS (ta = 25°C)

SYMBOL	DESCRIPTION	RATINGS	UNIT
V_{CC}	Supply Voltage (MAX)	− 0.5 ~ + 6.0	V
V_{IN}	Input Voltage	− 0.5 ~ + Vcc + 0.5	V
I_O	Output Current	− 10	mA
T_{STG}	Storage Temperature	− 55 ~ + 125	°C

PIN CONNECTION



BLOCK DIAGRAM



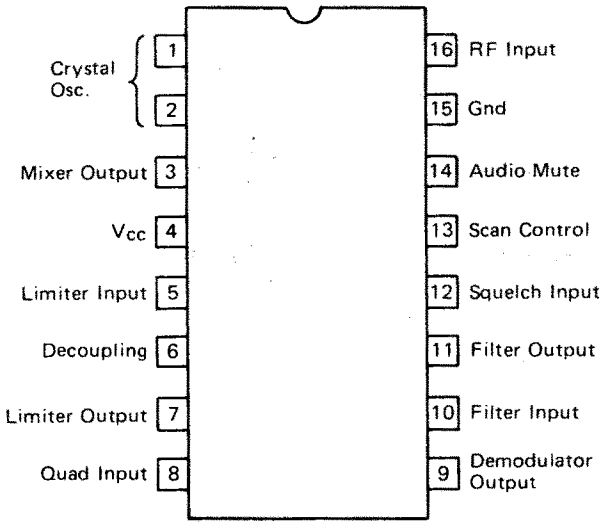
when M1 and M2 are Hi (V_{CC}), FF is equal to buffer.

MC3357 (LOW POWER FM IF)

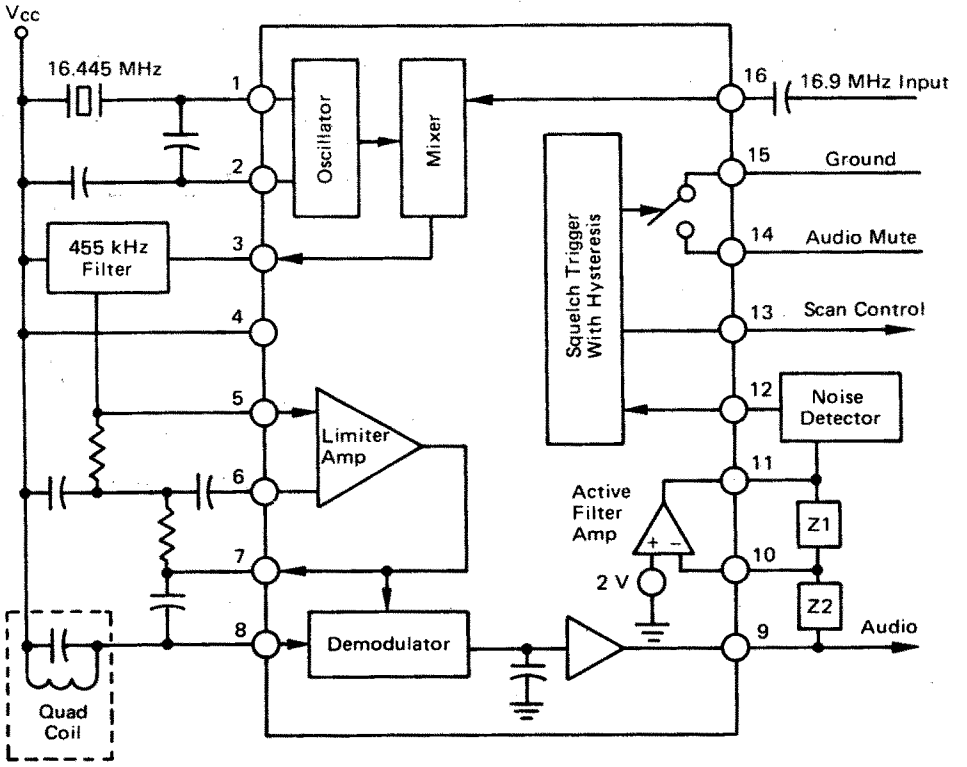
MAXIMUM RATINGS

SYMBOL	DESCRIPTION	RATINGS	UNIT
V_{CC} (max)	Power Supply Voltage	12	Vdc
V_{CC}	Operating Supply Voltage	4 or 8	Vdc
—	Detector Input Voltage	1.0	Vp-p
V_{16}	Input Voltage ($V_{CC} \geqslant 6.0$ Volts)	1.0	V_{RMS}
V_{14}	Mute Function	− 0.5 to 5.0	V_{pk}
T_J	Junction Temperature	150	°C
T_A	Operating Ambient Temperature Range	− 30 to + 70	°C
T_{STG}	Storage Temperature Range	− 65 to + 150	°C

PIN CONNECTION



BLOCK DIAGRAM

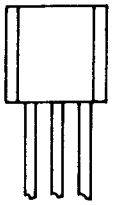


S-81250HG (C-MOS VOLTAGE REGULATOR)

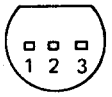
MAXIMUM RATINGS

SYMBOL	DESCRIPTION	RATINGS	UNIT
V_{IN}	Input Voltage	18	V
V_{OUT}	Output Current	100	mA
V_{OUT}	Output Voltage	Vin + 0.3 ~ Vss − 0.3	V
Pd	Permissible Dissipation	200	mW
T_{OPR}	Operating Temperature	− 20 ~ + 70	°C
T_{STG}	Storage Temperature	− 40 + 125	

PIN CONNECTION

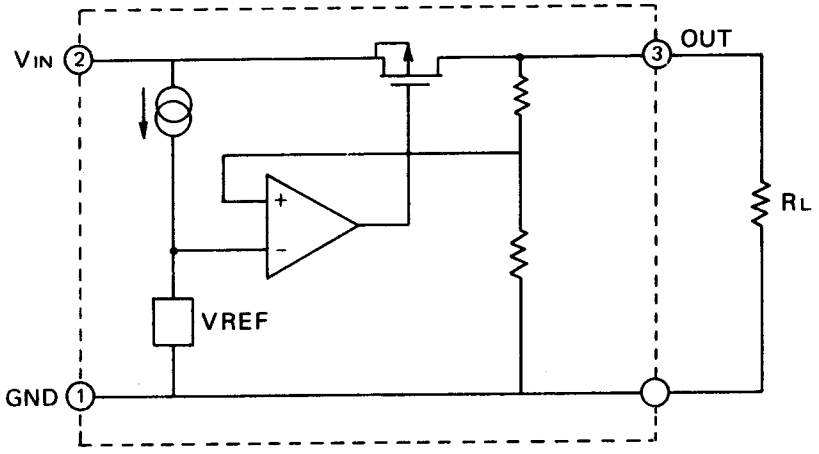


1 GND
2 V_{IN}
3 V_{OUT}



BOTTOM VIEW

BLOCK DIAGRAM

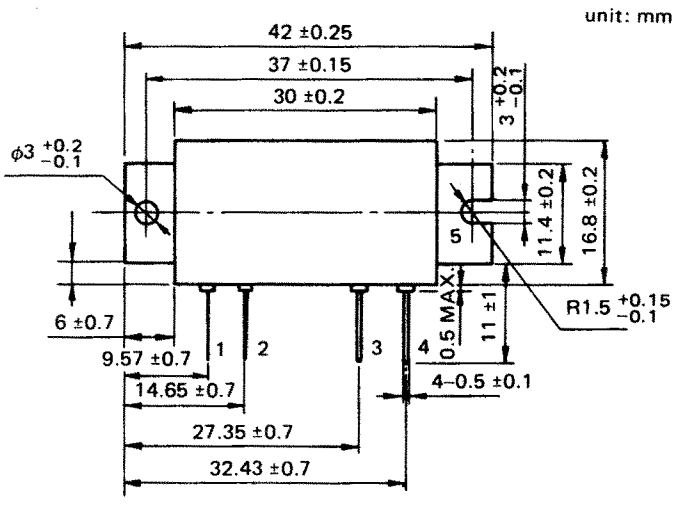


SC-1029 (VHF POWER AMPLIFIER MODULE)

MAXIMUM RATINGS

SYMBOL	DESCRIPTION	RATINGS	UNIT
V_{CC}	Supply Voltage	16	V
V_{BB}	Bias Voltage	6	V
P_i	Input Power	300	mW
$T_{C(OP)}$	Operating Temperature	− 30 ~ 100	°C
T_{STG}	Storage Temperature	− 40 ~ 110	°C

PIN CONNECTOR

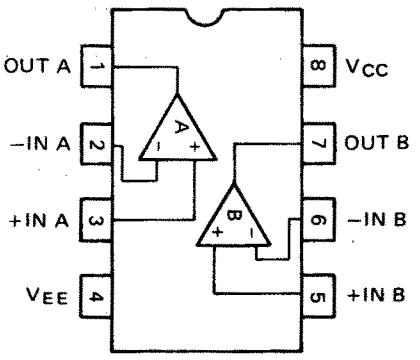


μPC358P (DUAL DRIVER)

MAXIMUM RATINGS (Ta = 25°C)

SYMBOL	DESCRIPTION	RATINGS	UNIT
V_{CC}, V_{EE}	Supply Voltage	± 18, 36	V
DV_{IN}	Drive Input Voltage	± 36	V
V_{IN}	Input Voltage	− 0.3 ~ 36	V
P_D	Permissible Dissipation	500	mV
T_{OPR}	Operating Temperature	− 40 ~ 85	°C
T_{STG}	Storage Temperature	− 55 ~ 125	°C

PIN CONNECTION

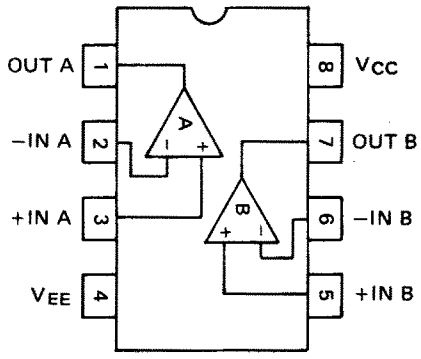


TA75393P (DUAL COMPARATOR)

MAXIMUM RATINGS (Ta = 25°C)

SYMBOL	DESCRIPTION	RATINGS	UNIT
V_{CC}	Supply Voltage	± 18 ~ 36	V
DV_{IN}	Drive Input Voltage	± 36	V
CMV_{IN}	Comparator Input Voltage	− 0.3 ~ V_{CC}	V
P_D	Permissible Dissipation	500	mW
T_{OPR}	Operating Temperature	− 40 ~ 85	°C
T_{STG}	Storage Temperature	− 55 ~ 125	°C

PIN CONNECTION

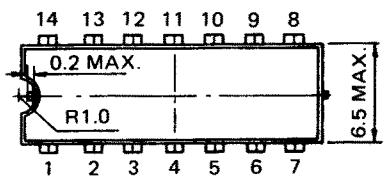


TC4069UBP (HEX INVERTER)

MAXIMUM RATINGS

SYMBOL	DESCRIPTION	RATINGS	UNIT
V_{DD}	Supply Voltage	V_{SS} − 0.5 ~ V_{SS} + 20	V
V_{IN}	Input Voltage	V_{SS} − 0.5 ~ V_{DD} + 0.5	V
V_{OUT}	Output Voltage	V_{SS} − 0.5 ~ V_{DD} + 0.5	V
I_{IN}	Input Current	± 10	mA
P_D	Permissible Dissipation	300	mW
T_{STG}	Strage Temperature	− 65 ~ 150	°C
T_{SOL}	Soldering Temperature and Time	260°C · 10 sec	

PIN CONNECTION



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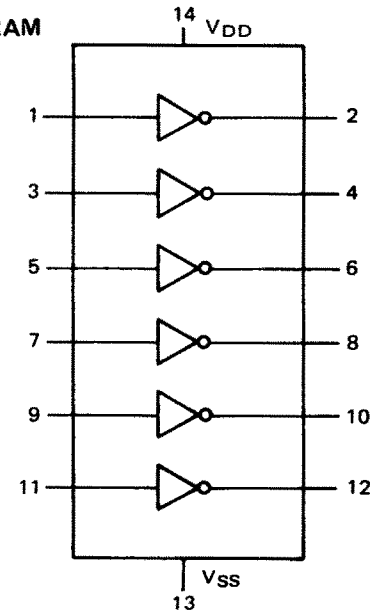
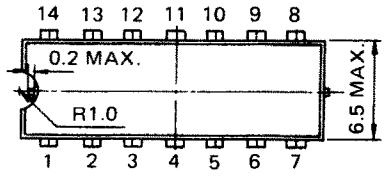


TC4071BP (QUAD 2-INPUT POSITIVE OR GATE)

MAXIMUM RATINGS

SYMBOL	DESCRIPTION	RATINGS	UNIT
V_{DD}	Supply Voltage	$V_{SS} - 0.5 \sim V_{SS} + 20$	V
V_{IN}	Input Voltage	$V_{SS} - 0.5 \sim V_{DD} + 0.5$	V
V_{OUT}	Output Voltage	$V_{SS} - 0.5 \sim V_{DD}$ ¼ 0.5	V
I_{IN}	Input Current	± 10	mA
P_D	Permissible Dissipation	300	mW
T_{STG}	Storage Temperature	− 65 ~ 150	°C
T_{SOL}	Soldering Temperature and Time	260°C · 10 sec	

PIN CONNECTION



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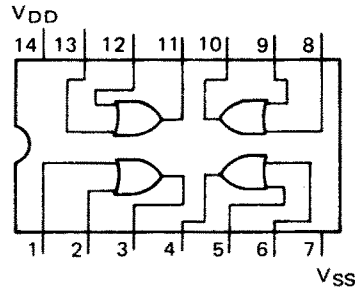


SECTION 12 PARTS LIST

[MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.	
IC101	IC	μPC358P	
IC102	IC	TC4071BP	
IC103	IC	TC4069UBP	
IC104	IC	S81250HG	
IC105	IC	TA75393P	
Q101	Transistor	2SC2458-GR	
Q102	Transistor	2SC2458-GR	
Q103	Transistor	2SA1048-GR	
Q104	Transistor	2SC2458-GR	
Q105	Transistor	2SC2458-GR	
Q106	Transistor	2SC2458-GR	
Q107	Transistor	2SA1048-GR	
Q108	Transistor	2SA1048-GR	
Q109	Transistor	2SA1048-GR	
Q110	Transistor	2SC2458-GR	
Q111	Transistor	2SB909M-R	
Q112	Transistor	2SC2458-GR	
Q113	Transistor	2SB909M-R	
Q114	Transistor	2SC2458-GR	
Q115	Transistor	2SB909M-R	
Q116	Transistor	2SA1048-GR	
Q117	Transistor	2SA1048-GR	
Q118	Transistor	2SC2458-GR	
Q119	Transistor	2SC2458-GR	
Q120	Transistor	2SB909M-R	
Q121	Transistor	2SA1048-GR	
Q122	Transistor	2SD1225M-R	
Q129	Transistor	2SA1048-GR	
Q130	Transistor	2SC2458-GR	
Q131	Transistor	2SB909M-R	
Q132	Transistor	2SC3399	
D101	Diode	1SS211	
D102	Diode	1SS211	
D103	Diode	1SS211	
D104	Diode	1SS211	
D105	Diode	1SS211	
D106	Zener	RD9.1EB3	
D107	Diode	1SS211	
D108	Diode	1SS211	
D109	Diode	1SS211	
D110	Diode	1SS211	
D111	Diode	1SS211	
D112	Diode	1SS211	
D113	Diode	1SS211	
D114	Diode	1SS211	
D115	Diode	1SS211	
D116	Diode	1SS211	
D117	Diode	1SS211	
D118	Diode	1SS233	
D119	Diode	1SS233	
R101	Resistor	33K	R10
R102	Resistor	120K	ELR10
R103	Resistor	470	ELR10
R104	Resistor	120K	ELR10
R105	Resistor	2.2K	R10

[MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.	
R106	Resistor	5.6K	ELR10
R107	Resistor	270	ELR10
R108	Resistor	470K	ELR10
R109	Resistor	2.2K	ELR10
R110	Resistor	1K	ELR10
R111	Resistor	3.3K	ELR10
R112	Resistor	100K	ELR10
R113	Resistor	220K	ELR10
R114	Resistor	82K	R10
R116	Resistor	39K	ELR10
R117	Resistor	39K	ELR10
R118	Resistor	12K	ELR10
R119	Resistor	150K	ELR10
R120	Resistor	1K	ELR10
R121	Resistor	100K	ELR10
R122	Resistor	5.6K	ELR10
R123	Resistor	1M	ELR10
R124	Resistor	330K	ELR10
R125	Resistor	180K	ELR10
R126	Variable	K09110019-10KB	
R127	Resistor	4.7K	ELR10
R128	Resistor	330K	ELR10
R129	Resistor	100K	ELR10
R130	Resistor	6.8K	ELR10
R131	Resistor	1.2K	ELR10
R132	Variable	K0911100A-5R1111-10KA	
R133	Resistor	22K	ELR10
R134	Resistor	470	R10
R135	Resistor	1.2K	ELR10
R136	Resistor	10K	ELR10
R137	Resistor	100K	ELR10
R138	Resistor	180K	ELR10
R139	Resistor	33K	ELR10
R140	Resistor	33K	ELR10
R141	Resistor	10K	ELR10
R142	Resistor	10K	ELR10
R143	Resistor	10K	ELR10
R144	Resistor	470K	ELR10
R145	Resistor	330K	ELR10
R146	Resistor	27K	ELR10
R147	Resistor	22K	ELR10
R148	Resistor	6.8K	ELR10
R149	Resistor	12K	ELR10
R150	Resistor	8.2K	ELR10
R151	Resistor	1.5K	ELR10
R152	Resistor	390K	ELR10
R153	Resistor	1	ELR10
R154	Resistor	1	ELR10
R155	Resistor	1M	ELR10
R156	Resistor	220K	ELR10
R157	Resistor	270K	ELR10
R158	Resistor	39K	ELR10
R164	Resistor	33K	ELR10
R165	Resistor	10K	ELR10
R166	Resistor	6.8K	R10
R167	Resistor	180K	ELR10
R168	Resistor	150K	R10
R169	Resistor	39K	ELR10

[MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.	
R170	Resistor	120K	ELR10
R171	Resistor	27K	ELR10
R172	Resistor	12	ELR10
R173	Resistor	5.6K	ELR10
R174	Resistor	1K	ELR10
R175	Resistor	1K	ELR10
R176	Resistor	100K	R10
R177	Resistor	470K	R10
R178	Resistor	470	ELR10
R180	Resistor	4.7K	ELR10
R181	Resistor	4.7K	ELR10
R182	Resistor	470K	ELR10
C101	Barrier Lay	UAT 05X103K	
C102	Electrolytic	10	16V RC3
C103	Ceramic	470P	50V
C104	Ceramic	470P	50V
C105	Ceramic	470P	50V
C106	Tantalum	0.1	35V
C107	Ceramic	0.001	50V
C108	Mylar	0.0022	50V
C109	Mylar	0.01	50V
C110	Ceramic	120P	50V
C111	Electrolytic	0.22	50V RC3
C112	Electrolytic	0.22	50V RC3
C113	Ceramic	10P	50V
C114	Ceramic	0.001	50V
C115	Ceramic	0.001	50V
C116	Ceramic	0.001	50V
C117	Electrolytic	0.22	50V RC3
C118	Electrolytic	0.22	50V RC3
C119	Electrolytic	1	50V RC3
C120	Barrier Lay	TBD 05X 103	
C121	Electrolytic	10	16V RC3
C122	Electrolytic	0.22	50V RC3
C123	Electrolytic	22	6.3V RC3
C124	Electrolytic	22	6.3V RC3
C125	Electrolytic	22	6.3V RC3
C126	Electrolytic	10	16V RC3
C127	Ceramic	100P	50V
C128	Electrolytic	0.22	50V RC3
C129	Electrolytic	47	25V MS7
C130	Electrolytic	100	10V MS7
C131	Ceramic	100P	50V
C132	Ceramic	470P	50V
C133	Barrier Lay	0.0033	50V
C134	Barrier Lay	0.0027	50V
C135	Electrolytic	47	6.3V RC3
C136	Electrolytic	22	6.3V RC3
C137	Ceramic	470P	50V
C138	Electrolytic	22	6.3V RC3
C139	Electrolytic	22	6.3V RC3
C140	Ceramic	470P	50V
C141	Ceramic	470P	50V
C142	Electrolytic	33	25V RC3
C143	Ceramic	0.001	50V
C144	Ceramic	0.001	50V
C145	Ceramic	0.001	50V
C146	Ceramic	0.001	50V
C149	Ceramic	470P	50V
C150	Barrier Lay	UAT06X183K	
RL101	Relay	OUC-SS-114D	

[MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.
S101	Switch	KHH 10906
S102	Switch	KHH 10906
S103	Switch	KHH 10906
S104	Switch	KHH 10906
S105	Switch	SPH 221B
S106	Switch	SPH 221B
BT101	Lithium Cell	BR2325-1HC
B101	P.C. Board	B-905A
B102	P.C. Board	B-824A
B103	F.P.C.	B-812
	Beads Core	DL20P2.6-3-1.2H

[PLL UNIT]

REF. NO.	DESCRIPTION	PART NO.
IC201	IC	MC 3357P
IC202	IC	μPB571C
IC203	IC	μPD2834C
IC204	IC	SC-1029
Q203	Transistor	2SC2668-O
Q204	Transistor	2SC2668-O
Q205	FET	2SK241-Y
Q206	FET	2SK241-Y
Q207	Transistor	2SB561-C
Q208	Transistor	2SC2026
Q209	Transistor	2SC2026
Q210	Transistor	2SC2407A
Q211	FET	2SK241-Y
Q212	Transistor	2SC2458-GR
Q213	Transistor	2SB909M-R
Q214	Transistor	2SC2458-GR
Q215	Transistor	2SC2458-GR
Q216	Transistor	2SA1048-GR
Q217	Transistor	2SA1048-GR
Q218	Transistor	2SA1048-GR
D203	Diode	1SS216
D204	Diode	1SS216
D205	Diode	1SS211
D206	Diode	1SS97
D207	Diode	1SS97
D208	Diode	1SS216
D209	Diode	1SS216
D210	Diode	1SS211
D211	Varactor Diode	1T25
D212	Varactor Diode	1T25
D213	Diode	1SS211
D214	Diode	1SS216
D216	Diode	1SS211
D217	Diode	1SS211
D218	Varactor Diode	1SV50E
FI201	Ceramic Filter	CFW455E
FI202	Crystal Filter	HC-18/T 16M15B2
X201	Discriminator	CDB455C7A
X202	Crystal	HC-18/T 16.445MHz
X203	Crystal	CR69 (12.8000MHz)

[PLL UNIT]

REF. NO.	DESCRIPTION	PART NO.
L201	Coil	LS262
L202	Coil	LS265
L203	Coil	LS265
L204	Coil	LS265
L205	Coil	LS265
L206	Coil	LA237
L207	Choke	LAL03NA221K
L208	Coil	LA237
L209	Coil	LA237
L210	Coil	LA235
L211	Choke	LAL03NA4R7K
L212	Coil	LA237
L213	Coil	LA235
L214	Coil	LA234
L215	Choke	LAL03NA4R7K
L216	Choke	LAL03NA2R2K
L217	Choke	LAL03NA2R2K
L218	Coil	LB164
L219	Choke	LAL03NA2R2K
L220	Choke	LAL03NA4R7K
R208	Resistor	470 ELR10
R209	Resistor	1.5K ELR10
R210	Resistor	47K R10
R211	Resistor	1.5K ELR10
R212	Resistor	1.5K R10
R213	Resistor	82K ELR10
R214	Resistor	2.2K ELR10
R215	Resistor	4.7K ELR10
R216	Resistor	330K ELR10
R217	Resistor	47K ELR10
R218	Resistor	1K ELR10
R219	Resistor	1.2K ELR10
R220	Resistor	100 R10
R221	Resistor	56 R10
R222	Resistor	2.2K ELR10
R223	Resistor	100 ELR10
R224	Resistor	18 ELR10
R225	Resistor	6.8K ELR10
R226	Resistor	4.7K ELR10
R227	Resistor	5.6K ELR10
R228	Resistor	470 ELR10
R229	Resistor	10K ELR10
R230	Resistor	22K ELR10
R231	Resistor	10K ELR10
R232	Resistor	1.2K ELR10
R233	Resistor	560 ELR10
R234	Resistor	68 ELR10
R235	Resistor	1K R10
R236	Resistor	100 R10
R237	Resistor	10 ELR10
R238	Resistor	220 ELR10
R239	Resistor	4.7K ELR10
R240	Resistor	4.7K ELR10
R241	Resistor	150K ELR10
R242	Resistor	330 ELR10
R243	Resistor	100K H0521A
R244	Resistor	220K ELR10
R245	Resistor	100K ELR10
R246	Resistor	47K ELR10
R247	Resistor	100K ELR10
R249	Resistor	15K ELR10
R251	Resistor	56 ELR10
R252	Resistor	120 ELR10

[PLL UNIT]

REF. NO.	DESCRIPTION	PART NO.
R253	Resistor	1K R10
R254	Resistor	82K ELR10
R255	Resistor	220K ELR10
R256	Resistor	47K ELR10
R257	Resistor	100 ELR10
R258	Resistor	5.6K ELR10
R259	Resistor	5.6K ELR10
R260	Resistor	15K ELR10
R262	Resistor	47K ELR10
R263	Resistor	120K ELR10
R264	Resistor	560K ELR10
R265	Resistor	22K ELR10
R266	Resistor	8.2K ELR10
R267	Trimmer	100K H0521A
R268	Resistor	3.9K ELR10
R269	Trimmer	2.2K H0521A
R270	Resistor	1M ELR10
R271	Resistor	27 ELR10
R272	Resistor	5.6K ELR10
R273	Resistor	47K ELR10
R274	Resistor	22K ELR10
R275	Resistor	220K ELR10
R276	Resistor	1M ELR10
R277	Resistor	10K ELR10
R278	Resistor	10K ELR10
R279	Thermistor	33D28
C201	Ceramic	0.001 50V B
C205	Barrier Lay	0.0033 50V
C206	Ceramic	82P 50V
C207	Ceramic	0.001 50V
C208	Barrier Lay	0.1 16V
C209	Electrolytic	0.1 50V RC2
C210	Ceramic	120P 50V
C211	Ceramic	22P 50V
C212	Electrolytic	1 50V RC2
C213	Ceramic	0.001 50V
C214	Electrolytic	10 16V RC2
C215	Barrier Lay	0.0047 50V
C216	Ceramic	0.001 50V
C217	Ceramic	5P 50V
C218	Barrier Lay	0.0047 50V
C219	Ceramic	10P 50V
C220	Barrier Lay	0.0047 50V
C221	Ceramic	10P 50V
C222	Ceramic	0.75P 50V
C223	Ceramic	0.75P 50V
C224	Ceramic	10P 50V
C225	Ceramic	10P 50V
C226	Ceramic	470P 50V
C227	Ceramic	470P 50V
C228	Ceramic	9P 50V
C229	Ceramic	7P 50V
C230	Ceramic	0.001 50V
C231	Ceramic	0.001 50V
C232	Ceramic	0.001 50V
C233	Ceramic	470P 50V
C234	Ceramic	22P 50V
C235	Ceramic	0.001 50V
C236	Ceramic	0.001 50V
C237	Ceramic	33P 50V
C238	Ceramic	0.001 50V
C239	Ceramic	0.001 50V
C240	Ceramic	0.001 50V

[PLL UNIT]

REF. NO.	DESCRIPTION	PART NO.		
C241	Ceramic	18P	50V	
C242	Ceramic	0.001	50V	
C243	Ceramic	0.001	50V	
C244	Ceramic	0.001	50V	
C245	Ceramic	22P	50V	
C246	Ceramic	0.001	50V	
C247	Ceramic	0.001	50V	
C248	Ceramic	0.75P	50V	
C249	Ceramic	470P	50V	
C250	Ceramic	2P	50V	
C251	Ceramic	20P	50V	
C252	Ceramic	20P	50V	
C253	Ceramic	0.75P	50V	
C254	Ceramic	2P	50V	
C255	Ceramic	470P	50V	
C256	Ceramic	15P	50V	
C257	Ceramic	0.001	50V	
C258	Ceramic	15P	50V	
C259	Ceramic	15P	50V	
C260	Ceramic	2P	50V	
C261	Ceramic	120P	50V	
C262	Ceramic	27P	50V	
C263	Ceramic	470P	50V	
C264	Ceramic	8P	50V	
C265	Ceramic	12P	50V	
C266	Mylar	0.0022	50V	
C267	Electrolytic	0.47	50V RC2	
C268	Electrolytic	0.1	50V RC2	
C269	Ceramic	470P	50V	
C270	Ceramic	470P	50V	
C271	Ceramic	47P	50V	
C272	Ceramic	3P	50V CH	
C273	Barrier Lay	TBD05X103		
C274	Ceramic	18P	50V	
C275	Trimmer	ECR. GA015E30		
C276	Ceramic	51P	50V	
C277	Ceramic	3P	50V	N750
C278	Ceramic	3P	50V	N750
C279	Ceramic	0.001	50V	
C280	Ceramic	1P	50V	
C281	Ceramic	4P	50V	
C282	Tantalum	10	6.3V	
C283	Electrolytic	1	50V RC2	
C284	Ceramic	0.001	50V	
C285	Barrier Lay	0.1	16V	
C286	Electrolytic	22	6.3V RC2	
C287	Trimmer	ECR. GA010D30		
C288	Ceramic	20P	50V	
C289	Ceramic	0.001	50V	
C290	Ceramic	220P	50V	
C291	Ceramic	68P	50V	
C292	Barrier Lay	TBD05X103		
C293	Ceramic	0.001	50V	
C294	Barrier Lay	0.0027	50V	
C295	Electrolytic	10	16V RC2	
C296	Ceramic	0.001	50V	
C297	Ceramic	0.001	50V	
C298	Ceramic	0.001	50V	
C299	Ceramic	0.001	50V	
C300	Ceramic	0.001	50V	
C301	Barrier Lay	0.0047	50V	
C302	Ceramic	0.001	50V	
C303	Ceramic	0.001	50V	
C304	Barrier Lay	0.1	16V	

[PLL UNIT]

REF. NO.	DESCRIPTION	PART NO.	
C305	Barrier Lay	0.03	50V
J201	Connector	HSJ0836-01-010	
J202	Connector	BNC-RM-106	
J203	Connector	HSJ1102-01-040	
J204	Connector	HEC0747-01-010	
J205	Connector	RT-01T-1.3A	
J206	Connector	RT-01T-1.3A	
B201	P.C. Board	B-869D	
B202	F.P.C.	B-880	
B203	F.P.C.	B-881	

[LOGIC UNIT]

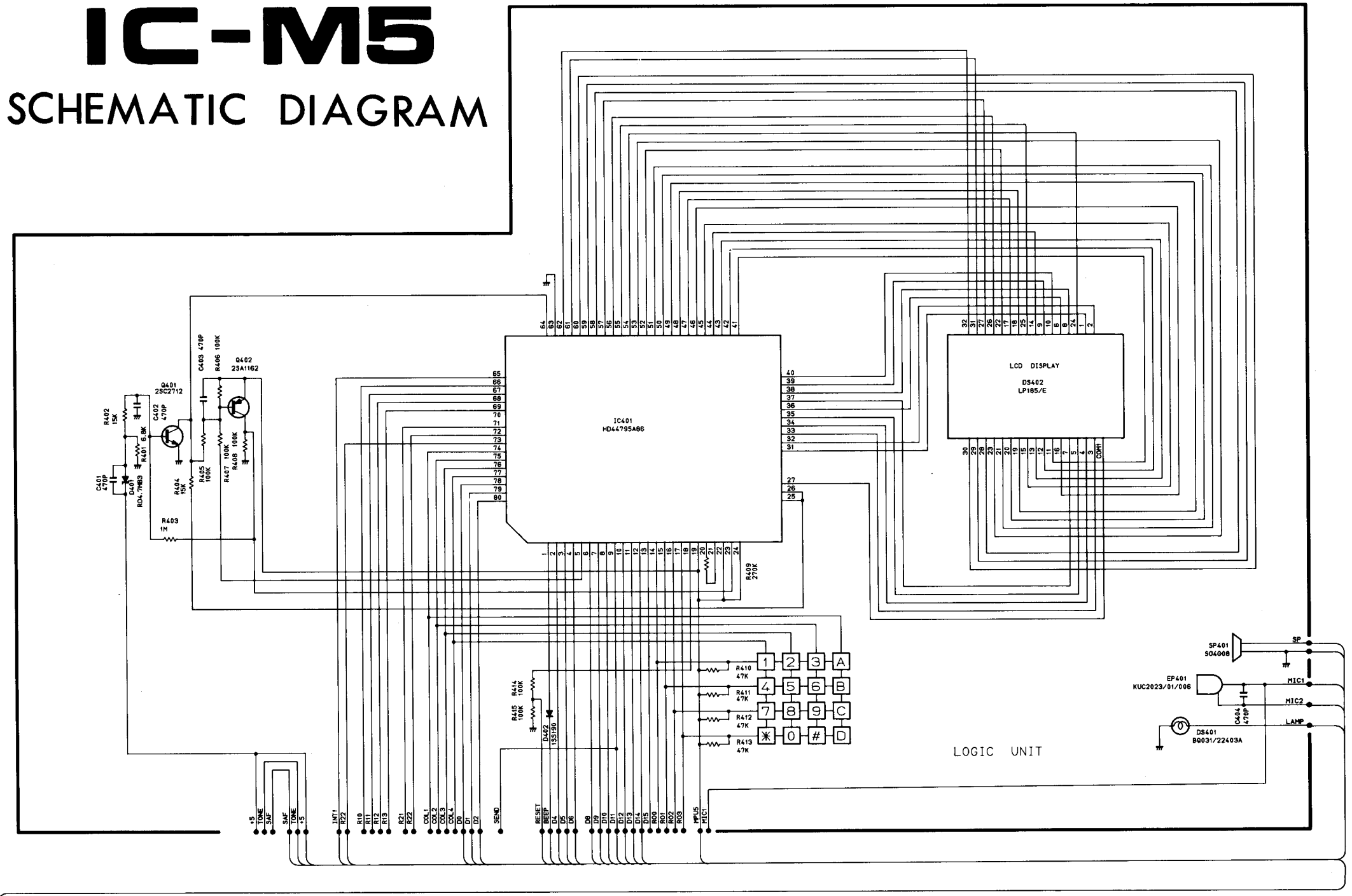
REF. NO.	DESCRIPTION	PART NO.		
IC401	IC	HD44795B35		
Q401	Transistor	2SC2712-Y		
Q402	Transistor	2SA1162-Y		
D401	Zener	RD4. 7MB3		
D402	Diode	1SS190		
R401	Resistor	6.8K	MCR10	
R402	Resistor	15K	MCR10	
R403	Resistor	1M	MCR10	
R404	Resistor	15K	MCR10	
R405	Resistor	100K	MCR10	
R406	Resistor	100K	MCR10	
R407	Resistor	100K	MCR10	
R408	Resistor	15K	MCR10	
R409	Resistor	270K	MCR10	
R410	Resistor	47K	MCR10	
R411	Resistor	47K	MCR10	
R412	Resistor	47K	MCR10	
R413	Resistor	47K	MCR10	
R414	Resistor	100K	MCR10	
R415	Resistor	100K	MCR10	
C401	Monolithic	470P	50V	GR40
C402	Monolithic	470P	50V	GR40
C403	Monolithic	470P	50V	GR40
C404	Ceramic	470P	50V	
C405	Monolithic	0.1	50V	GR40
C407	Monolithic	0.001	50V	GR40
C408	Monolithic	0.001	50V	GR40
DS401	Lamp	BQ031-22403A		
DS402	LCD	LP185-E		
SP401	Speaker	S04G09		
EP401	Microphone	KUC2023-01-006		
B401	P.C. Board	B-903D		
B402	F.P.C.	B-813A		
B403	F.P.C.	B-822A		

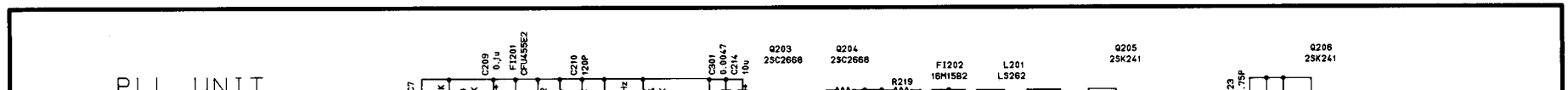
[SW UNIT]

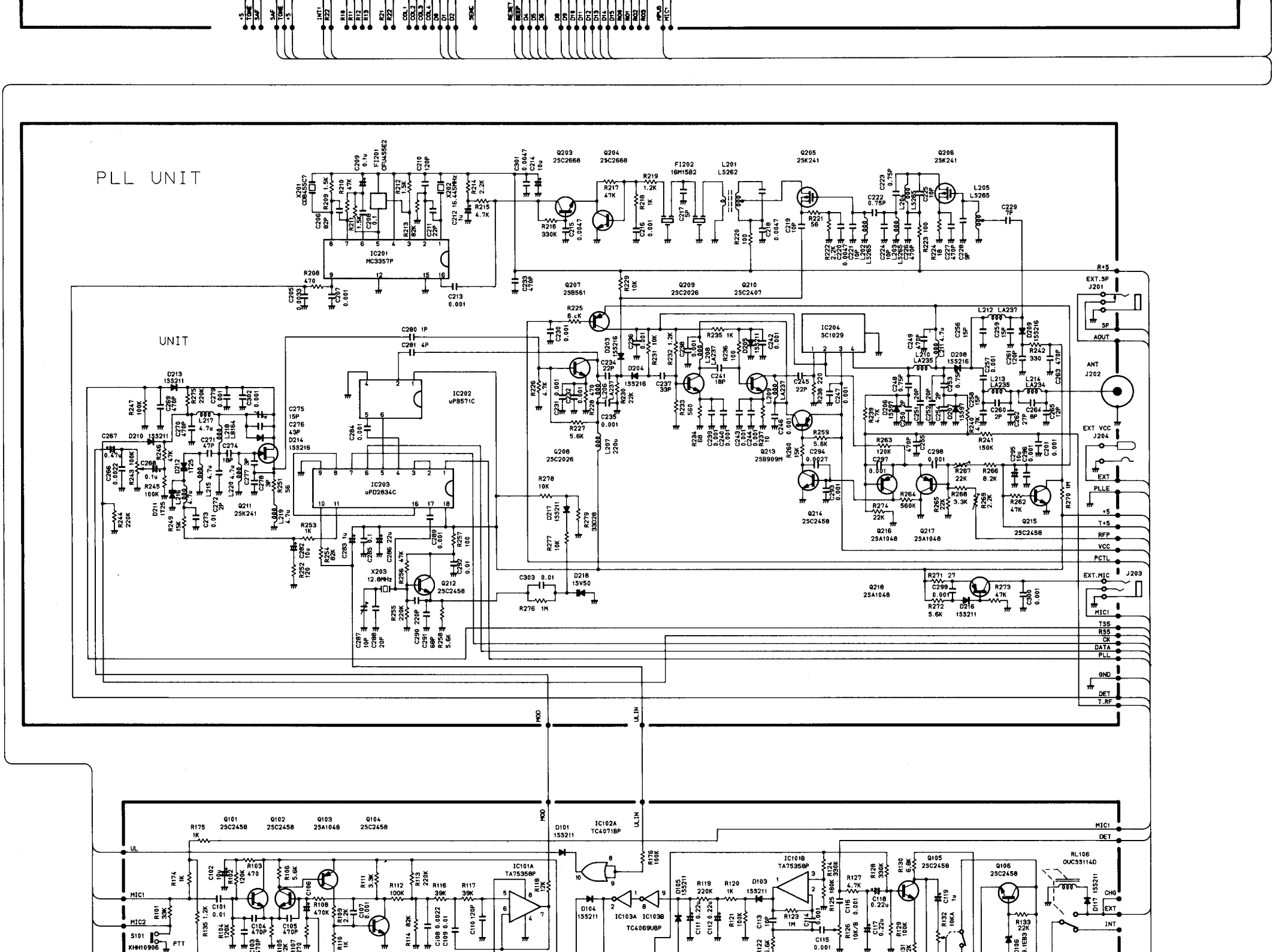
REF. NO.	DESCRIPTION	PART NO.
S501	Switch	KHH 10902
S502	Switch	KHH 10902
S503	Switch	SSS 212 (B)
B501	P.C. Board	B-904B

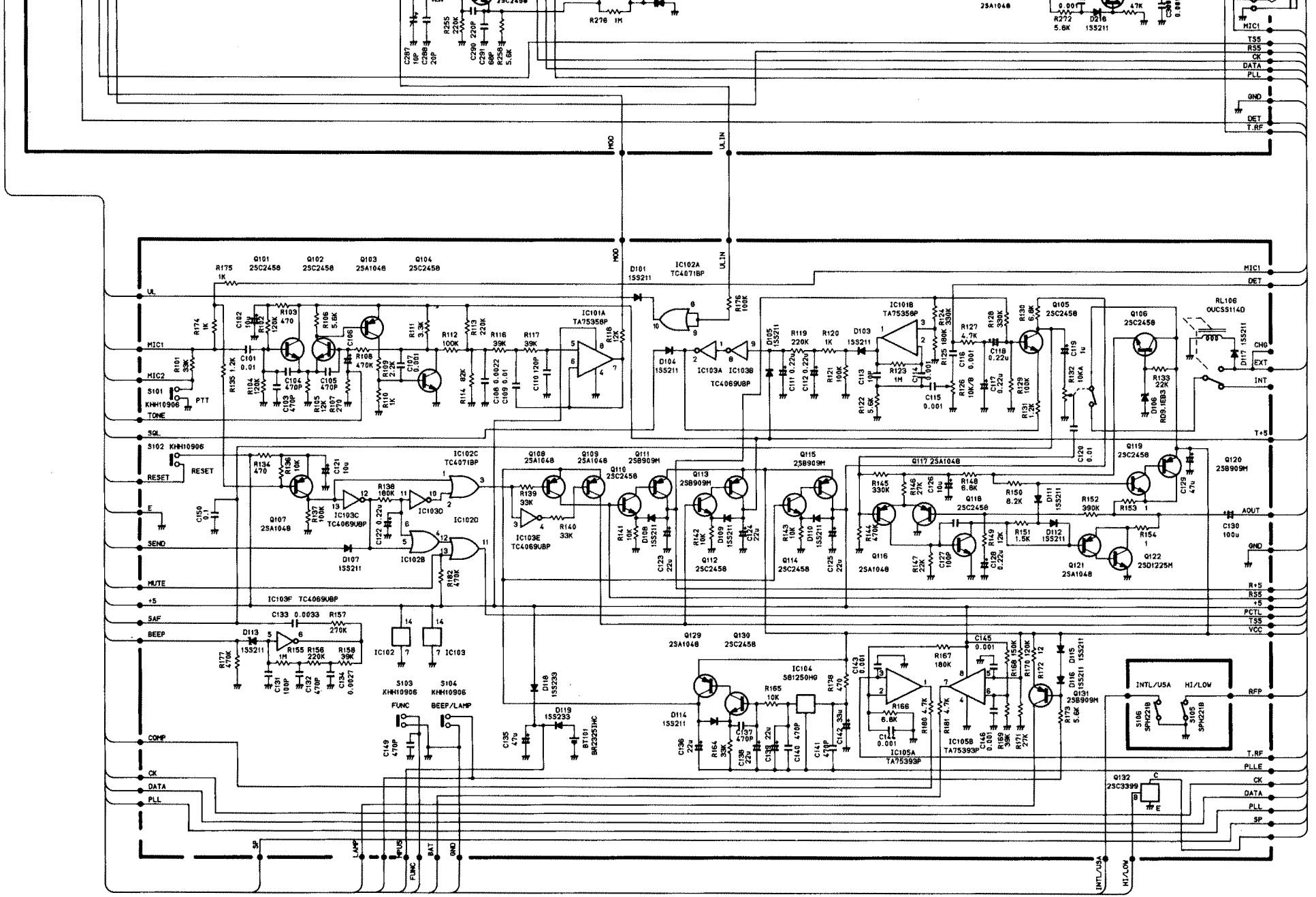
IC-M5

SCHEMATIC DIAGRAM






PLL UNIT
UNIT
IC201 MC3357P
IC202 uPB571C
IC203 uPD2834C
IC204 SC1029
IC102A TC4071BP
IC103A IC103B TC4069UBP
IC101A TA75358P
IC101B TA75358P
Q201 2SB561
Q202 2SC2026
Q203 2SC2668
Q204 2SC2668
Q205 2SK241
Q206 2SK241
Q207 2SB561
Q208 2SC2026
Q209 2SC2026
Q210 2SC2407
Q211 2SK241
Q212 2SC2458
Q213 2SB909M
Q214 2SC2458
Q215 2SC2458
Q216 2SA1048
Q217 2SA1048
Q218 2SA1048
Q101 2SC2458
Q102 2SC2458
Q103 2SA1048
Q104 2SC2458
Q105 2SC2458
Q106 2SC2458
F1201 CFU455E2
F1202 16M15B2
L201 LS262
X201 CR455C7
X202 16.455MHz
X203 12.8MHz
D101 1SS211
D103 1SS211
D104 1SS211
D105 1SS211
D201 1SS211
D202 1SS211
D203 1SS216
D204 1SS216
D205 1SS211
D206 1SS211
D207 1SS211
D208 1SS216
D209 1SS216
D210 1SS211
D211 1T25
D212 1T25
D213 1SS211
D214 1SS216
D215 1SS211
D216 1SS211
D217 1SS211
D218 15V50
RL106 OUC5S114D
S101 KHH10906
PTT
MIC2
MIC1
EXT.SP J201
SP
AOUT
ANT J202
EXT VCC J204
EXT
PLLE
+5
T+5
RFP
VCC
PCTL
EXT.MIC J203
MIC1
TSS
RSS
CK
DATA
PLL
GND
DET
T.RF
MOD
ULIN
UL
CHG
EXT
INT



ICOM ICOM INCORPORATED

Icom Inc.

6-9-16, Kamihigashi, Hirano-ku, Osaka 547, Japan
Phone: 06 793 5302
Fax : 06 793 0013
Telex : 05277822 ICOMTR J

Icom America Inc.

<Corporate Headquarters>
2380 116th Avenue N.E., Bellevue, WA 98004, U.S.A.
Phone : (206) 454-8155
Fax : (206) 454-1509
Telex : 152210 ICOM AMER BVUE

<Customer Service>
Phone : (206) 454-7619

<Regional Customer Service Centers>
18102 Sky Park South, Suite 52-B, Irvine, CA 92714, U.S.A.
Phone : (714) 852-8026
Fax : (714) 852-8716

1777 Phoenix Parkway, Suite 201, Atlanta, GA 30349, U.S.A.
Phone : (404) 991-6166
Fax : (404) 991-6327

Icom Canada

A Division of Icom America Inc.
3071 #5 Road, Unit 9, Richmond, B.C., V6X 2T4, Canada
Phone : (604) 273-7400
Fax : (604) 273-1900

Icom (Europe) GmbH

Communication Equipment
Himmelgeister Str. 100, 4000 Düsseldorf 1, F.R.G.
Phone : 0211 346047
Fax : 0211 333639
Telex : 8588082 ICOM D

Icom (Australia) Pty. Ltd.

A.C.N 006 092 575
7 Duke Street, Windsor, Victoria, 3181, Australia
Phone : 03 529 7582
Fax : 03 529 8485
Telex : AA 35521 ICOM AS

Icom (UK) Ltd.

Unit 9, Sea St., Herne Bay, Kent, CT6 8LD, U.K.
Phone : 0227 741741
Fax : 0227 741742
Telex : 965179 ICOM G

Icom France S.a

Zac de la Plaine, Rue Brindejonc des Moulinais
BP 5804, 31505 Toulouse Cedex, France
Phone : 61. 36. 03. 03 Fax : 61. 34. 05. 91
Telex : 521515 ICOM FRA

Count on us!

Icom Inc.
6-9-16, Kamihigashi, Hirano-ku, Osaka 547, Japan

A-1034T-S-①
Printed in Japan