

VHF MARINE RADIO TELEPHONE

IC-M12

MAINTENANCE MANUAL

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SECTION 1 SPECIFICATIONS

GENERAL

Number of Semiconductors	Transistors	41
	FET	3
	IC	5
	Diodes	15 (not including diodes on the matrix board)
Number of Channels		12 programmable channels
	Operation	Simplex, Semi-duplex
Channel Spacing		25KHz
Frequency Stability		0.0005 Percent
Usable Temperature		-20 Degrees C to 60 Degrees C (-4 Degrees F to 140 Degrees F)
Antenna Impedance		50 ohms unbalanced
Power Supply Requirement		DC 8.4V; with attendant power pack IC-CM3, DC 6 to 12V negative ground is acceptable
Current Drain at 8.4V	Transmitting	
	At 1 watt output	Approx. 350mA
	Receiving	
	At max audio output	Approx. 130mA
	Squelched	Approx. 25mA
Dimensions		116.5mm(H) x 65mm(W) x 45mm(D) without power pack Attendant power pack, IC-CM3: 49mm(H) x 65mm(W) x 35mm(D)
Weight		510g including power pack, IC-CM3 and flexible antenna

RECEIVER

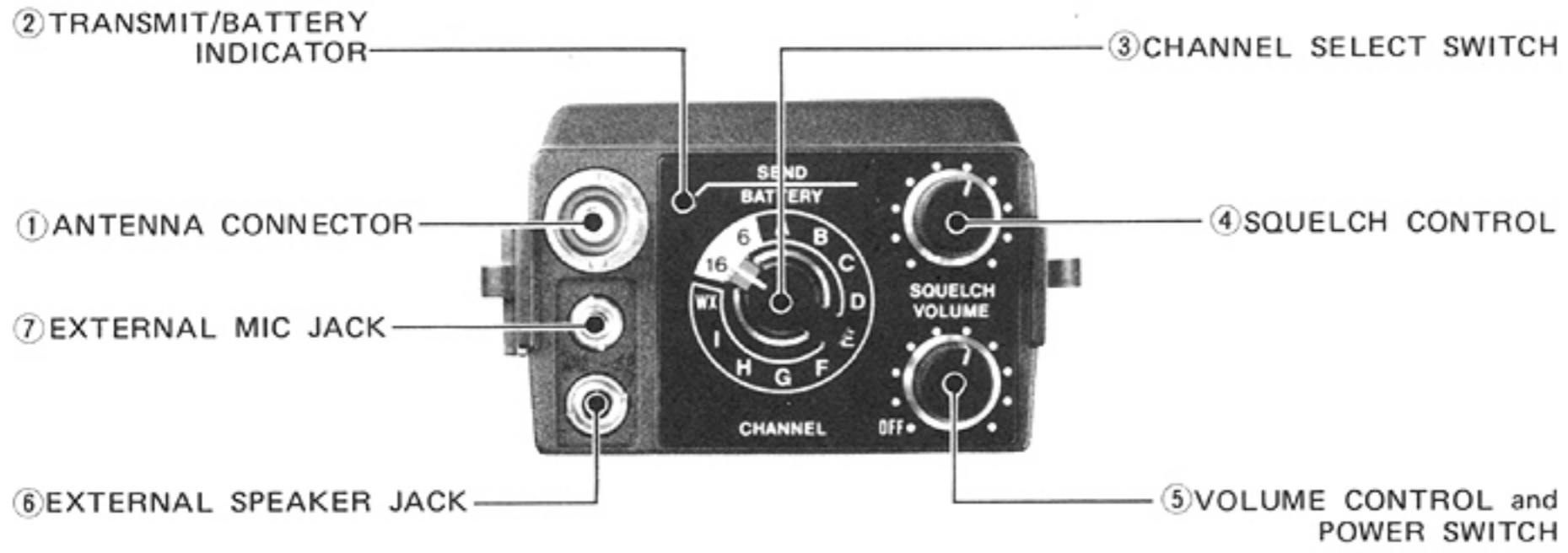
Frequency Range	156.3 ~ 157.425MHz and 160.875 ~ 162.550MHz
Receiving System	Double-conversion superheterodyne
Modulation Acceptance	16F ₃ ±7.5KHz
Intermediate Frequency	1st: 10.695MHz 2nd: 455KHz
Sensitivity	Less than 0.5μV for 20dB noise quieting Less than 0.4μV for 12dB SINAD
Squelch Sensitivity	Less than 0.4μV
Spurious Response Rejection Ratio	More than 50dB
Selectivity	More than 65dB at adjacent channel
Intermodulation Rejection Ratio	More than 60dB
Audio Output Power	More than 300mW at 10% distortion
Audio Output Impedance	8 ohms

TRANSMITTER

Frequency Range	156.3 ~ 157.425MHz
Output Power	1 Watt
Emission Mode	16F ₃
Modulation System	Variable reactance frequency modulation
Max. Frequency Deviation	±5KHz
Spurious Emission	More than 57dB below carrier
Microphone	Built-in electret condenser microphone Optional speaker-microphone (IC-CM9) can be used

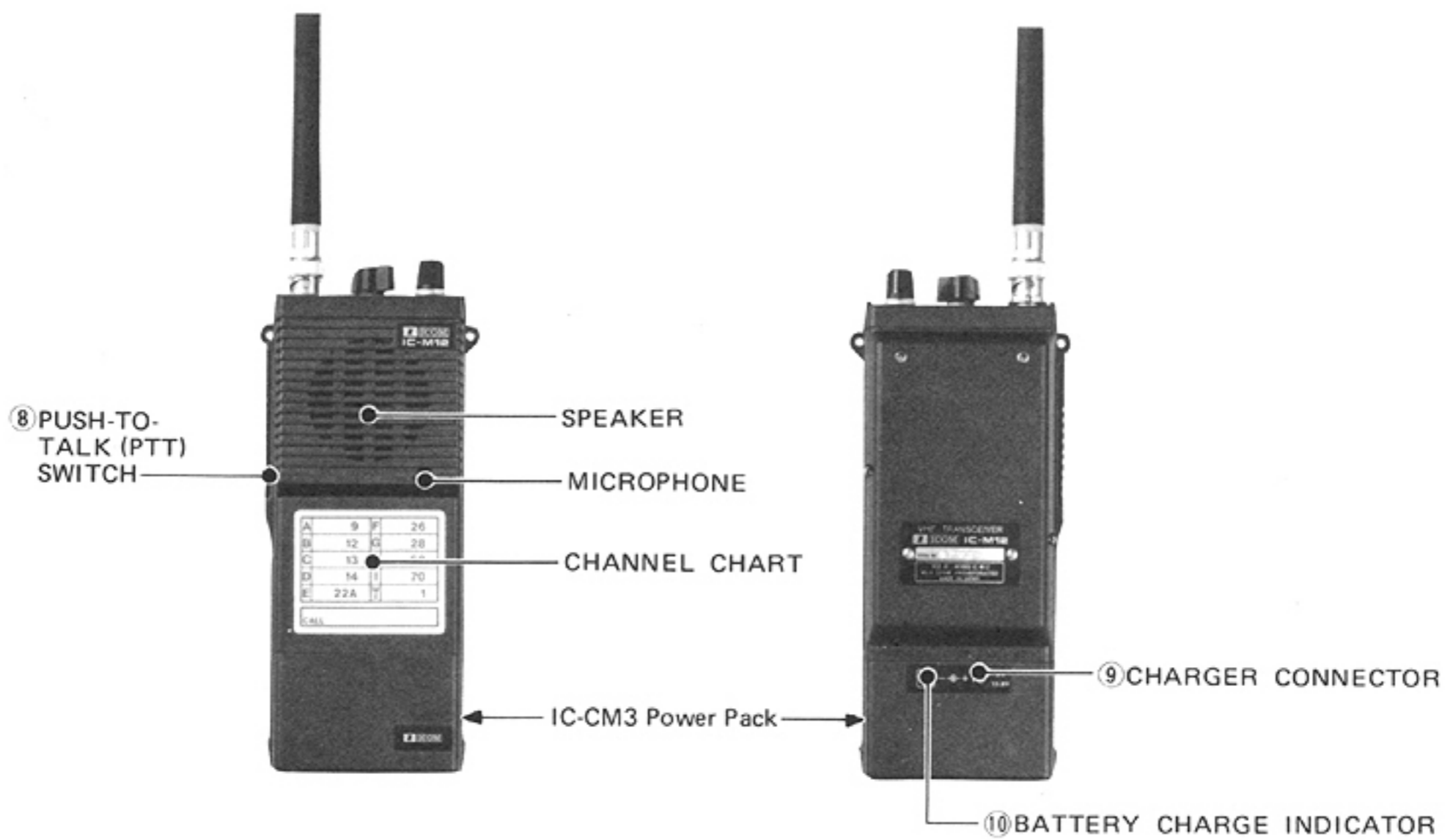
SECTION 2 OPERATING CONTROLS

TOP PANEL



FRONT PANEL

REAR PANEL



① **ANTENNA CONNECTOR**

Connect the supplied flexible antenna. An external antenna can be used, using a BNC connector.

② **TRANSMIT/BATTERY INDICATOR**

Illuminates in the transmit mode. Also indicates the battery condition; during transmission. The voltage of Nickel-Cadmium batteries drops rapidly just before they are exhausted, so when this indicator goes out, be sure to immediately stop using it, and charge the batteries again.

③ **CHANNEL SELECT SWITCH**

Selects one of the programmed channels.

④ **SQUELCH CONTROL**

Sets the squelch threshold level. To turn OFF the squelch function, rotate this control completely counterclockwise. To set the threshold level higher, rotate the control clockwise.

⑤ **VOLUME CONTROL and POWER SWITCH**

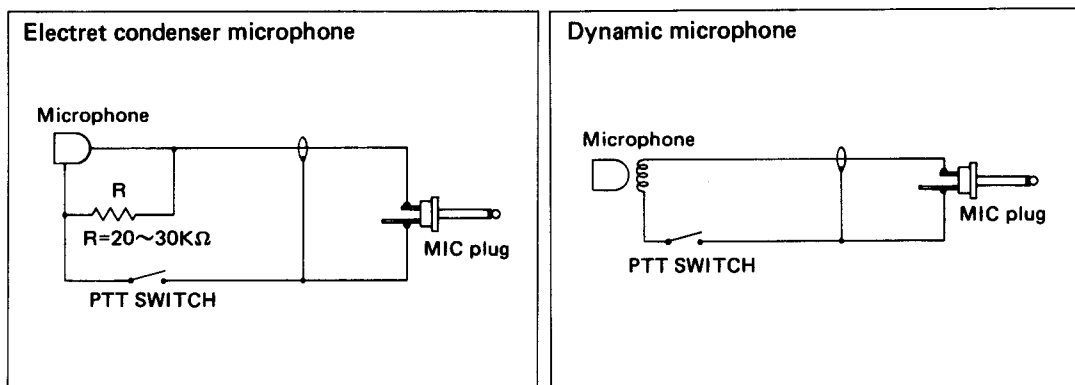
When the control is turned completely counterclockwise, the power is OFF. By turning the control clockwise beyond the "click", the unit is turned ON and the audio level increases by further rotating it clockwise.

⑥ **EXTERNAL SPEAKER JACK**

When an external speaker (or an earphone) is used, connect it to this jack. Use a speaker with an impedance of 8 ohms. When the external speaker is connected the built-in speaker does not function.

⑦ **EXTERNAL MIC JACK**

When an external microphone is used, connect it to this jack. See the schematic for the proper hookup. When the external microphone is connected the built-in microphone does not function. The IC-CM9 optional speaker-microphone can also be used.



⑧ **PUSH TO TALK (PTT) SWITCH**

For transmission, press this switch and talk into the microphone with normal voice. The internal microphone is of the electret-condenser type and provides good pickup for all voice levels.

⑨ **CHARGER CONNECTOR**

Connects to the output plug of the wall charger CM-25U/E or other 12V DC power source.

⑩ **BATTERY CHARGE INDICATOR**

Lights during battery charging.

SECTION 3 CIRCUIT DESCRIPTION

3 - 1 RECEIVER CIRCUITS

3 - 1 - 1 ANTENNA SWITCHING CIRCUIT

Signals from the antenna connector are fed to the antenna switching circuit through Chebyshev low-pass filter consisting of L229, L230, C295, C297 and C298 in the PLL board.

The antenna switching circuit employs a quarter wave switching circuit.

In the receive mode, switching diodes, D216 and D217 are turned OFF, and they make isolation against the transmitter circuit and matching circuit, and the incoming signals are fed to the RF amplifier.

3 - 1 - 2 RF AMPLIFIER AND FIRST MIXER

The signals from the switching circuit are fed to the cascode amplifier Q101 and Q102.

The amplified signals are fed to the gate of the first mixer Q103 through the band-pass filter L102 ~ L104, which reduces interference and intermodulation from out of the band signals.

To the source of Q103, a 145MHz signal is supplied from the PLL circuit to convert the RF signals into 10.695MHz first IF signals.

The first IF signals are taken from the drain of Q103 and fed to the IF circuit.

3 - 1 - 3 IF CIRCUIT

The first IF signals from Q103 are fed to the matched pair crystal filter F1101, then IF amplifiers Q104 and Q105.

The amplified signals are fed to IC101. IC101 is composed of the second local oscillator, second mixer, limiter amplifier, quadrature detector and active filter circuits.

The second local oscillator oscillates 10.240MHz with X101, and is fed to the second mixer with the first IF signals to convert into 455KHz second IF signals. The second IF signals are put out from Pin 3, and fed to external ceramic filter F1102 which has excellent selectivity, then fed to IC101 (Pin 5) again to amplify and detect.

The detected AF signals are put out from Pin 9.

3 - 1 - 4 AF AND SQUELCH CIRCUITS

The detected AF signals are put 6dB/Octave de-emphasis by integral circuit consisting of R117 and C126, and fed to AF power amplifier IC102 through the VOLUME control R1, to obtain enough power to drive the speaker.

Noise components put out from Pin 9 of IC101 are fed to IC101 (Pin 10) again through the SQUELCH control R2, which controls the squelch threshold level, filtered about 20KHz signal (noise) and put out from Pin 11.

This signal (noise) is rectified by Q113, integrated by R135, R136 and C136, and turns Q114 ON and turns OFF the regulator for AF power amplifier consisting of D103, Q115 and Q116.

This reduces the current drain of the set, in the standby condition. When a signal is received, noise is suppressed by the signal and turns Q114 OFF and the regulator is turned ON and supplies regulated voltage to the AF power amplifier, and incoming signal can be heard from the speaker.

In the transmit mode, a voltage is applied to Q114 and turns it ON, and turns the regulator OFF the same as in the standby condition.

3 - 2 TRANSMITTER CIRCUITS

3 - 2 - 1 MIC AMPLIFIER CIRCUIT

Audio signals from the microphone are fed to the limiter amplifier, consisting of Q125 ~ Q128, which has 6dB/Octave response between 300Hz and 3KHz.

The output of the limiter amplifier is similar to rectangular waves and includes harmonics. These harmonics are eliminated by the low-pass filter Q129, which cuts 3KHz or higher. Filtered signals are fed to the VCO in the PLL board to make modulation.

3 - 2 - 2 MULTIPLIER AND DRIVER CIRCUITS

The VCO oscillates a half of a transmitting frequency, thus the multiplier Q208 and Q209, multiplies it two times to obtain 156MHz transmitting frequency.

This 156MHz is fed to amplifiers Q211 and Q212 through band-pass filter L219, L220 and L221, L222 to obtain 200 milliwatts pure 156MHz signal. While switching from receive to transmit, Q210 is turned ON by the charged voltage of C269, until the charged voltage has been discharged, and this function cuts the bias voltage of Q211 ~ Q213.

This prevents transmission of unwanted signals.

3 - 2 - 3 POWER AMPLIFIER CIRCUIT

The output signals from Q212 is fed to the power amplifier Q213, and amplified to 1 watt. In the transmit mode, D216 and D217 are turned ON, and D217 makes L228 have high-impedance and D216 feeds the signals to the antenna through the low-pass filter.

3 - 3 PLL CIRCUITS

3 - 3 - 1 LOCAL OSCILLATOR CIRCUIT

The crystal oscillator Q206 oscillates 34.82625MHz with X202 for receive, 37.500MHz with X203 for simplex transmit, 36.350MHz with X204 for duplex transmit, and the signal at two times this frequency is taken from the collector of Q207, and fed to the mixer of the PLL circuit.

In the receive mode, R+5V is applied to D210 through R223, L211 and R227, and D210 is turned ON and selects X202.

In the simplex transmit mode, T+5V is applied to D211 through R224, L212 and R228, and D211 is turned ON and selects X203.

In the duplex transmit mode, T+5V is applied to D212 through R225, L213 and R229, and D212 is turned ON and selects X204.

3 - 3 - 2 MIXER, LOW-PASS FILTER AND AMPLIFIER CIRCUITS

The output signals from the local oscillator circuit and the VCO signals fed through buffer amplifiers Q202 and Q203 are mixed by the mixer Q204. The output signals are fed to the low-pass filter to filter out only the signals below 7MHz, then fed to Q205 to be amplified to proper drive level (more than 3Vp-p) of the programmable divider IC201.

3 - 3 - 3 PROGRAMMABLE DIVIDER CIRCUIT

The input signals at Pin 2 of IC201 are divided by the BCD input signals from the matrix board at Pin 3 ~ 14.

The programmable divider is also called the 1/N counter and the BCD value is N. The relationship between the operating frequency and the divide number N is:

$$N \text{ (divide number of programmable divider)} = (\text{Receive frequency (MHz)} - 150) / 0.0125$$

3-3-4 REFERENCE FREQUENCY GENERATOR CIRCUIT

Reference frequency generator IC203 consists of a crystal oscillator and a highspeed divider. X201 oscillates at 6.40MHz, which is divided by 1024. The 6.25KHz reference frequency is fed to phase detector IC202. This 6.25KHz reference frequency decides the variation step of the PLL output frequency.

3-3-5 PHASE DETECTOR AND LOOP FILTER CIRCUITS

Digital phase detector, IC202, detects the phase difference of the pulse signals of the 6.25KHz reference frequency and the output signal of the programmable divider, and proportionately puts out pulse signals at Pin 3, which becomes high impedance when the PLL is locked.

Pin 4 is for detecting the lock failures and changes to ground level according to the phase difference of the two pulse signals. When the lock fails, the pulse signal from Pin 4 is integrated by R202 and C215. When the integrated voltage exceeds the junction voltage of Q214's base, Q214 is turned ON and then Q107 in the MAIN boards is turned ON.

The collector of Q107 is connected to the base of Q108, so the base voltage of Q108 becomes ground level, and Q108 and Q106 are shut off to prevent transmitting unwanted signals.

The loop filter, consisting of R204, R205, R206, C213 and C214, converts the pulse signal from Pin 3 into a DC voltage and decides the response time of the whole loop.

The output signals are fed to tuning diode D203 of the VCO circuit as the control voltage for the VCO frequency set.

3-3-6 VCO CIRCUIT

The VCO (Voltage-Controlled Oscillator) is a Colpitts circuit using Q201, and oscillates in 70MHz range.

The oscillator frequency is controlled by a DC voltage which is supplied from the loop filter to varactor diode D203.

In the receive mode, R+5V is applied to D204's anode through L201, and D204 is turned ON and shunts C220. Thus the free-run frequency of the VCO is lowered.

In the transmit mode, T+5V is applied to D204's cathode through D205 and L202, D204 is turned OFF, and C220 is inserted in the oscillator circuit in series. Thus the free-run frequency of the VCO is increased. In the same time, the VCO signal is frequency modulated by the audio signals from the microphone which are applied to the gate of Q201 and varies Q201's mutual conductance.

3-4 OTHER CIRCUITRY

3-4-1 POWER SUPPLY CIRCUIT

The regulated 5V is supplied to the main circuits, so that the set operates under a stable condition with as low power voltage as possible.

The power supply voltage is fed to the AF power amplifier through the squelch switching circuit and to the 5V regulator consisting of Q117 ~ Q120 and zener diode D104. This regulated 5V is supplied to the PLL circuit.

In the transmit mode, the base of Q123 is grounded through R155, the microphone and the PTT switch, and Q123 is turned ON. Thus Q106 and Q108 are turned ON and T+5V is actuated, and supplied to the transmitter circuit. At the same time, T+5V turns Q112 ON, and the power supply voltage is applied to the MIC amplifier circuit through Q112.

In the receive mode, Q123 is turned OFF and the bias voltage of Q109 ON. Thus the R+5V is actuated and supplied to the PLL board to switch the local oscillator crystal and the driver transistors of the transmitter circuit.

At the same time, R+5V turns ON the voltage boost circuit consisting of Q110 and Q111, and +6V is supplied to the receiver circuit.

3 - 4 - 2 LED INDICATOR CIRCUIT

This LED is lit in the transmit mode, but when the power supply voltage becomes less than 5.5V, it will not be lit.

The power supply voltage is divided by R148 and R149, and applied to the base of Q121. The emitter of Q121 is connected to the regulated 5V source. When the power supply voltage is more than 5.5V, Q121 is turned OFF, Q122 is turned ON and T+5V is applied to the LED through Q122 and R150, and LED is lit.

3 - 4 - 3 DIODE MATRIX BOARD

The set incorporates a diode matrix board to determine its operation frequencies, and twelve channels can be programmed into the board.

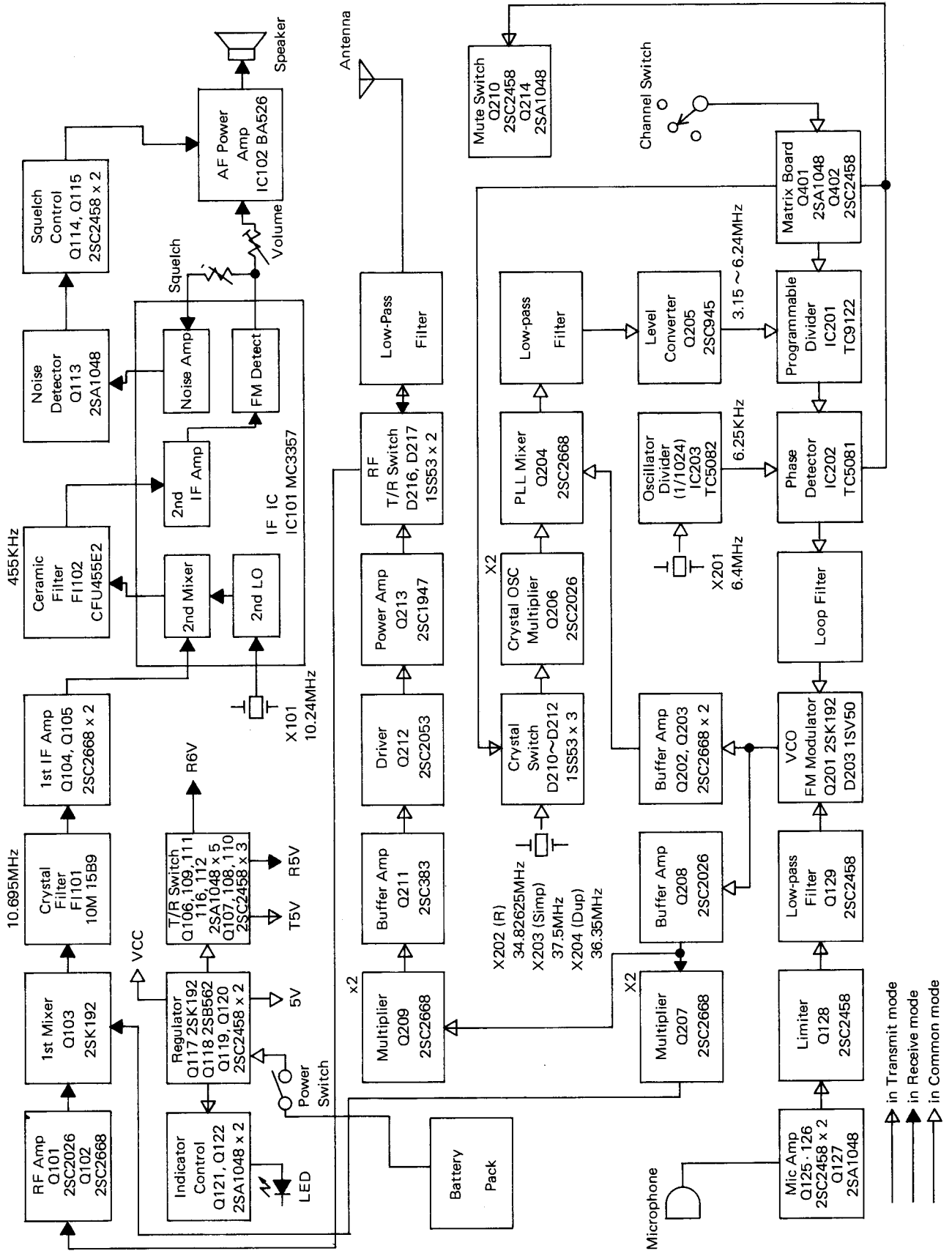
+5V is applied to a channel line, one of 16,6, A ~ I and WX, through the channel select switch, and it is converted to BCD codes by diodes programmed into the board, then fed to IC201 to determine an operation frequency (channel).

In addition, the channel selected has two options of the duplex transmit and receive only functions.

The duplex transmit function is provided by inserting a diode into the duplex line on the board. At this time, T+5V is applied to the base of Q402, and turns Q402 and Q401 ON. Thus T+5V is applied to D212 and selects X204, and the transmitting frequency becomes 4.6MHz below the receiving frequency.

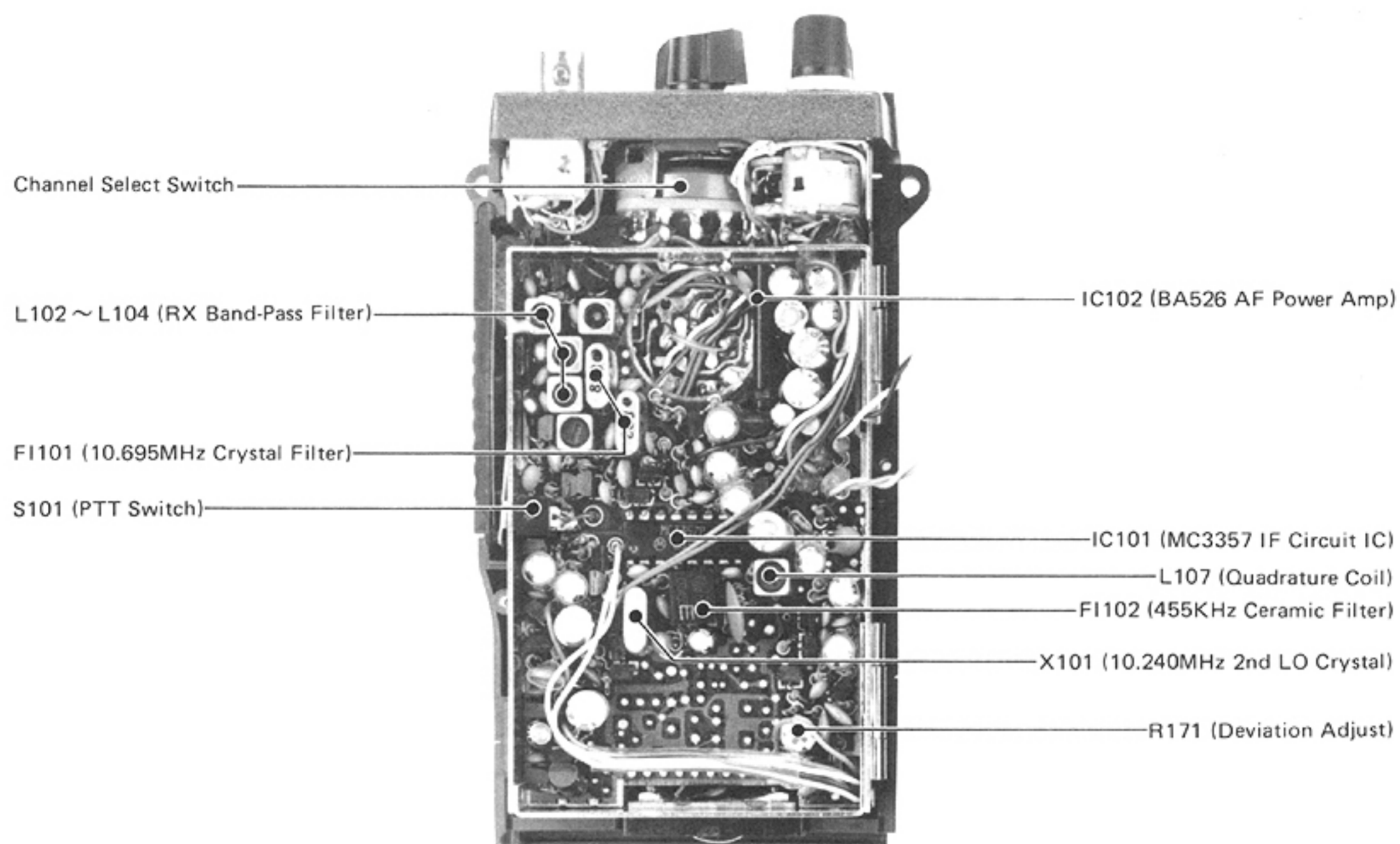
The receive only function is provided by inserting a diode into the receive only line. At this time, a voltage is applied to the base of Q107 on the MAIN board through R404, and it turns Q107 ON and Q106 OFF. Thus, the set does not turn to the transmit mode, even if the PTT switch is depressed.

SECTION 4 BLOCK DIAGRAM

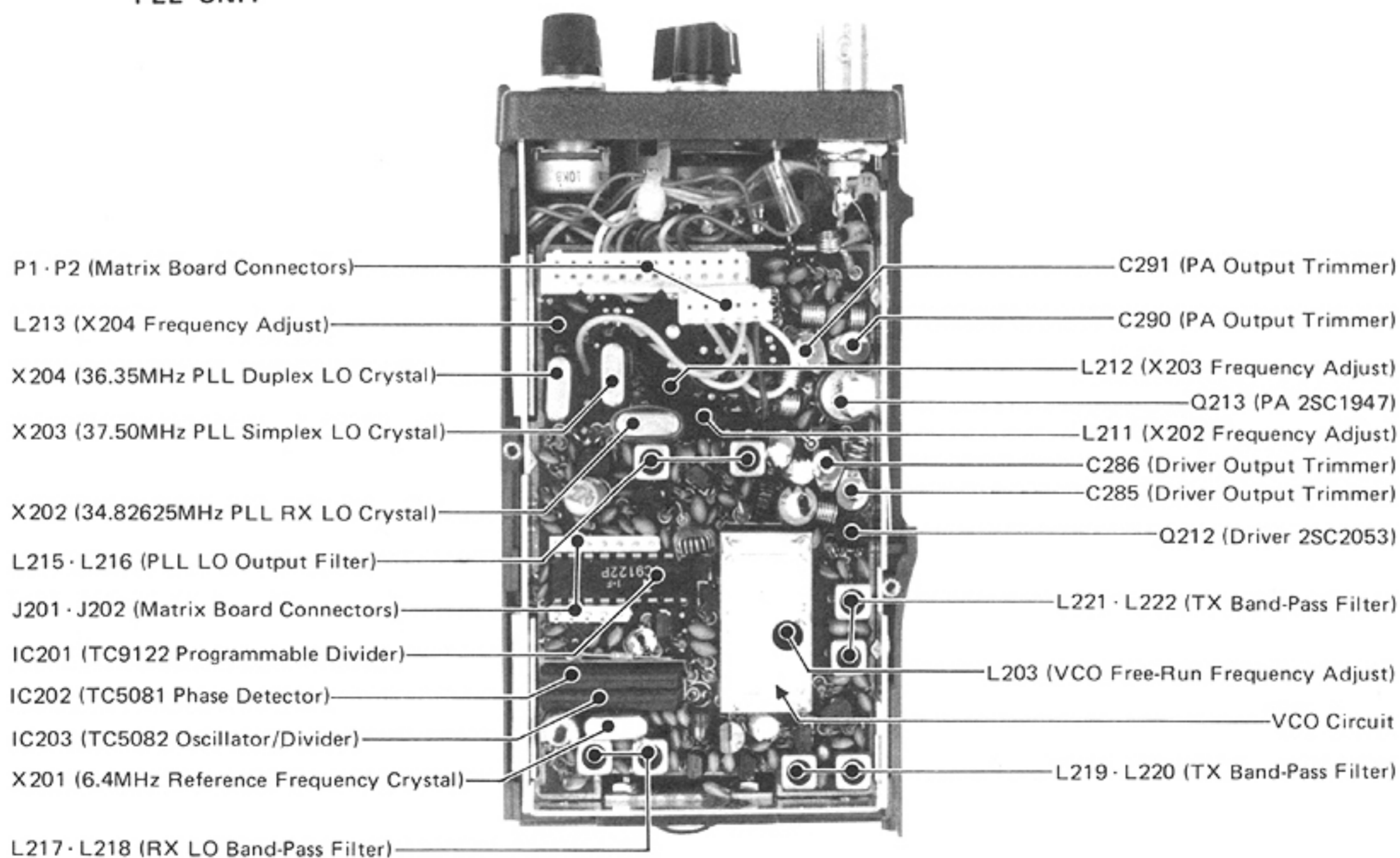


SECTION 5 INSIDE VIEWS

MAIN UNIT



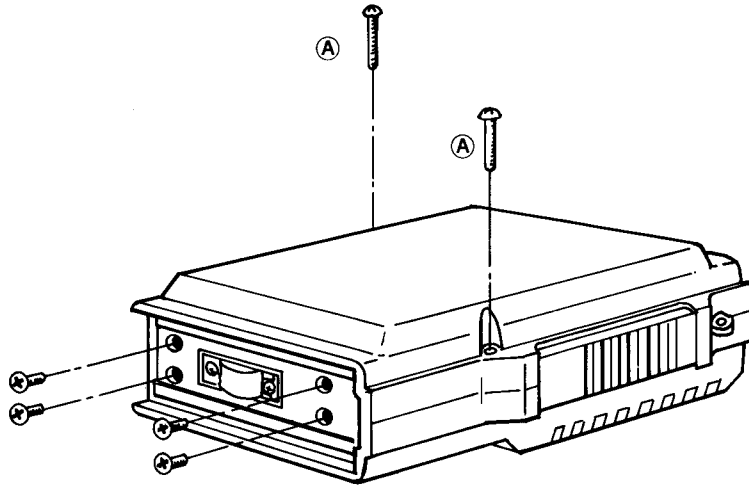
PLL UNIT



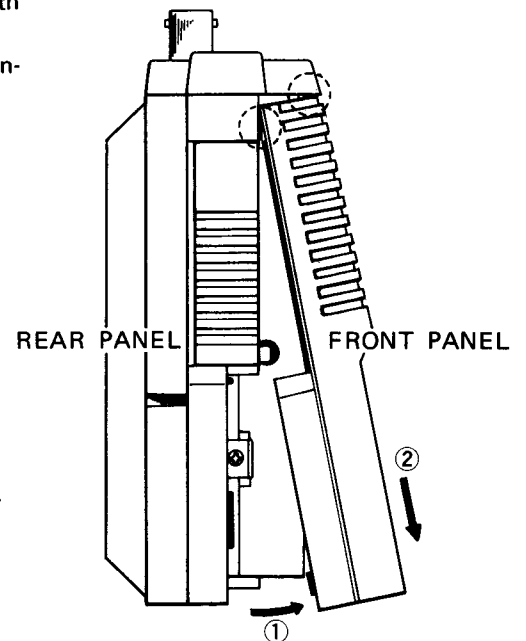
SECTION 6 MECHANICAL PARTS AND DISASSEMBLY

6 - 1 DISASSEMBLY OF THE CASES

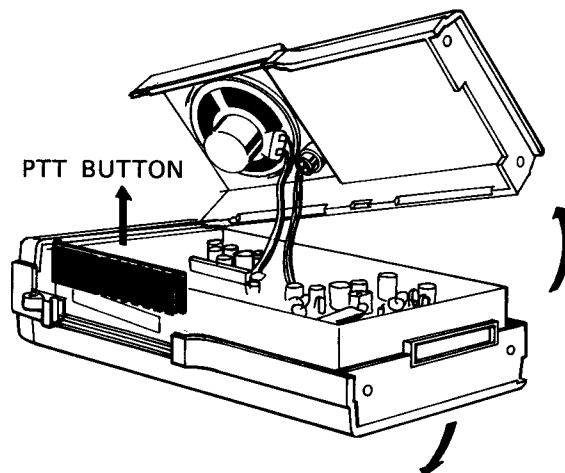
1. Turn the power switch off and remove the power pack.
2. Remove two screws (A) on the rear panel and four screws on the bottom as shown in the figure.



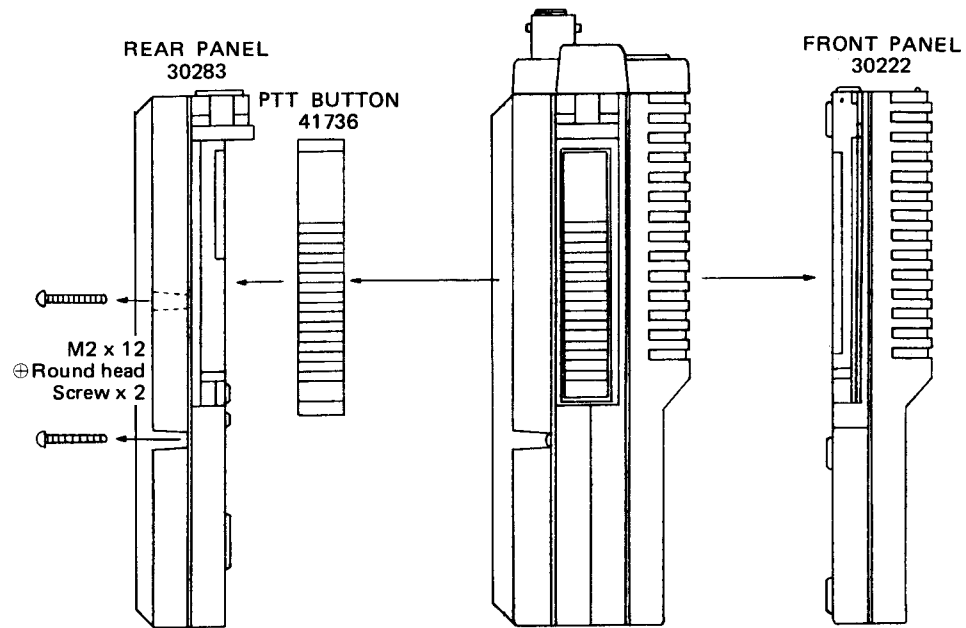
3. Remove the front panel as shown in the figure. At this time, be sure not to damage the engaged parts at the top (circled with dotted lines).
① open the bottom slightly and ② slide the front panel downwards.



4. Slide the PTT Button upward, and then remove the rear panel.

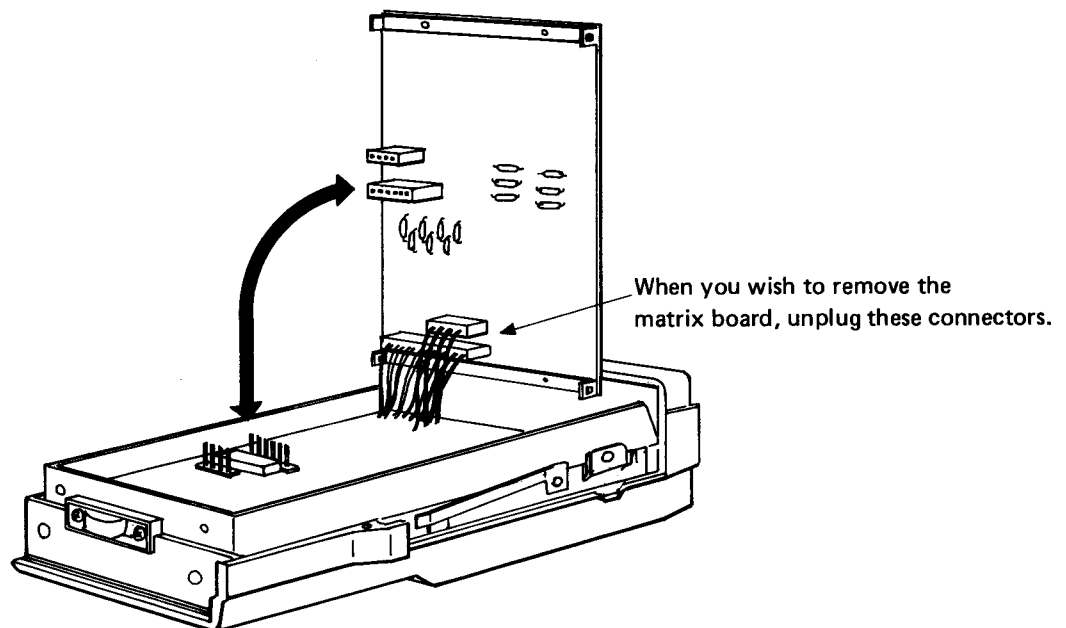


6 - 2 DISASSEMBLY OF UNITS

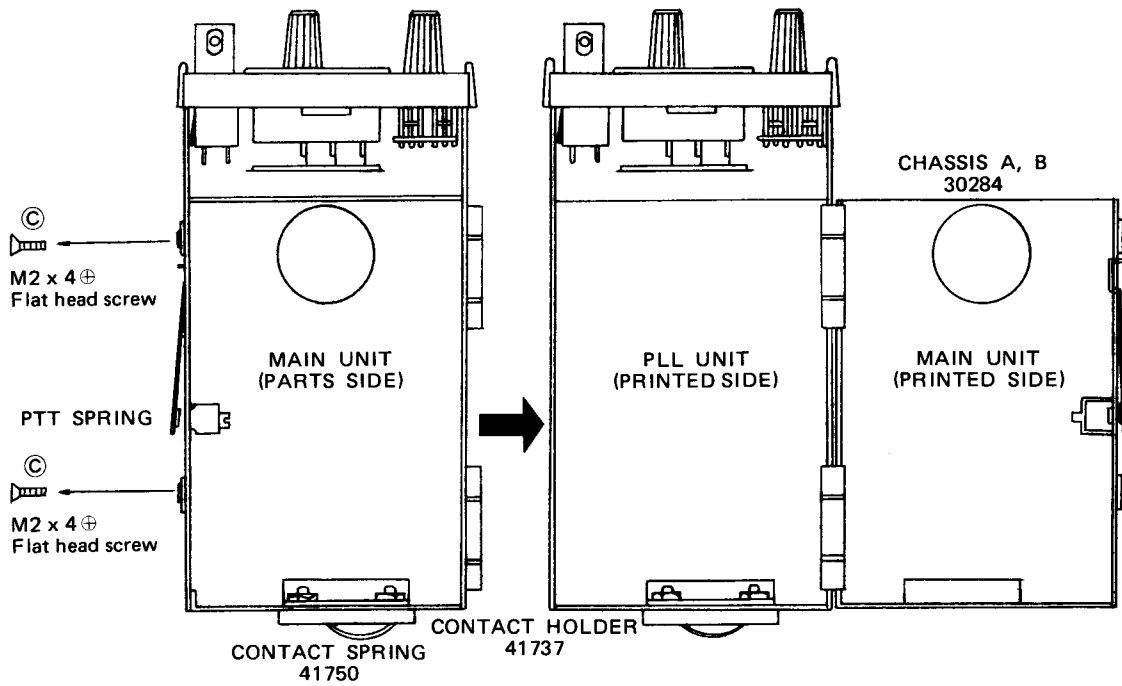


1. When you wish to program some operation frequencies (channels), remove the rear panel, then unplug the connectors between the matrix board and PLL board, and tilt the matrix board as shown in the figure.

When you wish to remove the matrix board from the set, unplug the two connectors located on the front side end of the board. (Some version has one more wiring on the foil side, so resolder it too.)

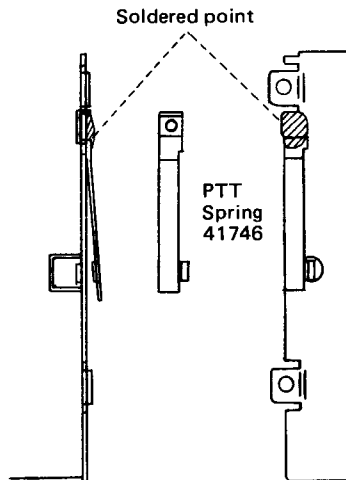


To see the printed sides of the PC boards, open the chassis by removing two screws © located above and below the PTT spring.

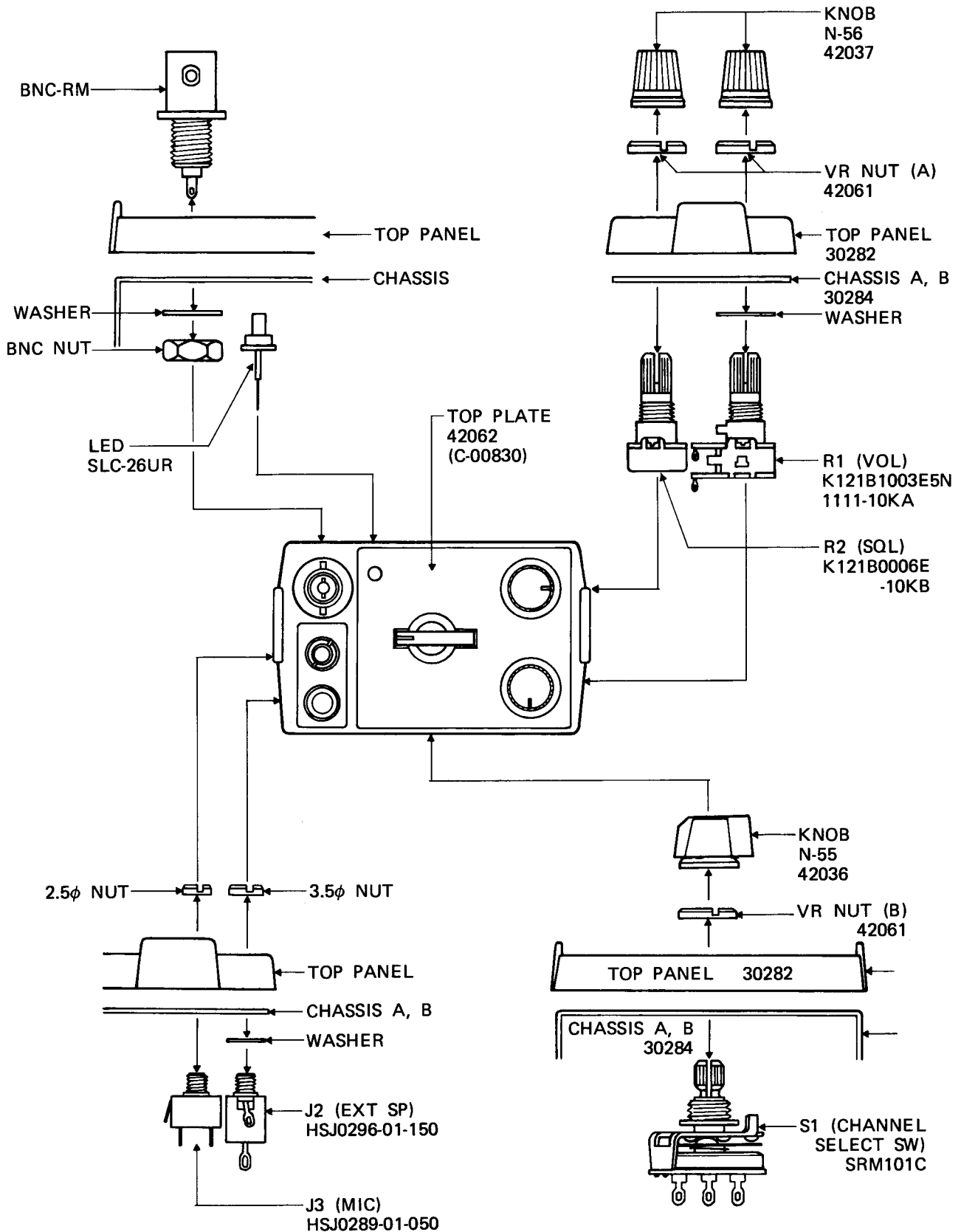


6 - 3 PTT SPRING ASSEMBLY (HOW TO REPLACE PTT SPRING)

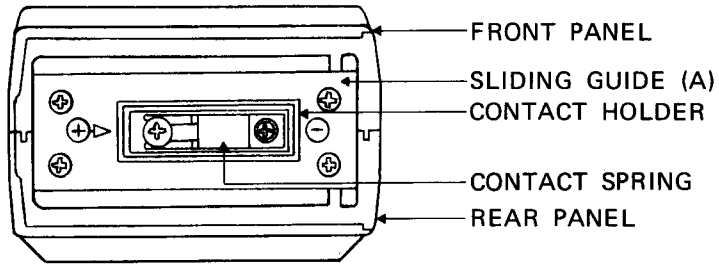
1. The PTT spring is soldered at its top as shown in the figure.
2. Remove the old spring by heating the soldered point.
3. Solder the hole at the top of the new spring.
4. Make sure that the new spring is soldered on parallel to the chassis.



6-4 TOP PANEL CONSTRUCTION

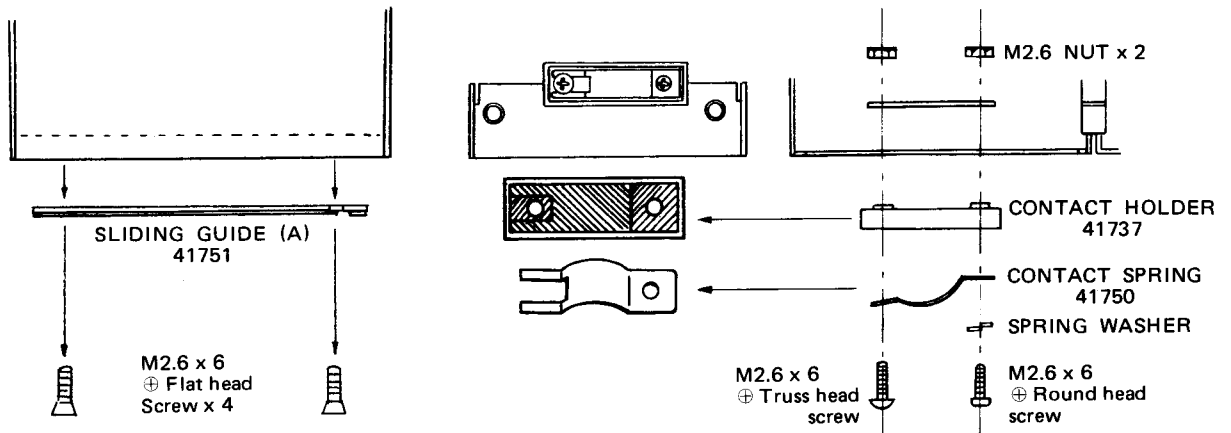


**6 - 5 UNIT BOTTOM ASSEMBLY
(BOTTOM VIEW)**



(HOW TO REPLACE CONTACT SPRING)

1. Remove the sliding guide by removing the four screws as shown.
2. Remove the contact spring by removing the two screws as shown.
3. Set the new contact spring so that the split of the spring is on the positive side and the other end on the negative side.
4. Tighten the two screws.



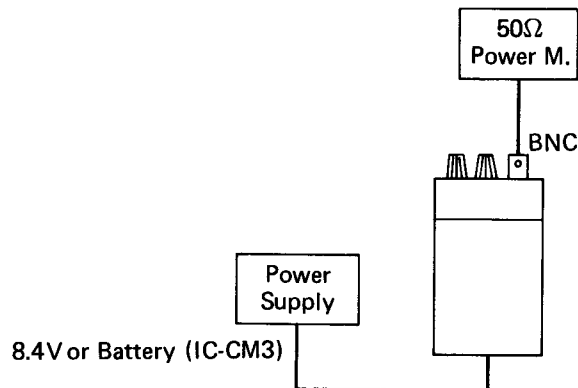
SECTION 7 MAINTENANCE AND ADJUSTMENT

7 - 1 MEASURING INSTRUMENTS REQUIRED FOR ADJUSTMENT

(1) FREQUENCY COUNTER	FREQUENCY RANGE ACCURACY SENSITIVITY	0.1 - 170MHz BETTER THAN ± 1 ppm 100mV or BETTER
(2) SIGNAL GENERATOR	FREQUENCY RANGE OUTPUT VOLTAGE	0.1MHz - 170MHz -20 - 90dB (0dB = 1 μ V)
(3) MULTIMETER	50K Ω /Volt or better	
(4) AC MILLIVOLTMETER	MEASURING RANGE	10mV - 2V
(5) RF VOLTMETER	FREQUENCY RANGE MEASURING RANGE	0.1 - 170MHz 0.01 - 10V
(6) RF WATTMETER (Terminated Type)	MEASURING RANGE FREQUENCY RANGE IMPEDANCE SWR	5 Watts 140 - 170MHz 50 OHMS LESS THAN 1.1
(7) AF OSCILLATOR	OUTPUT FREQUENCY OUTPUT VOLTAGE DISTORTION	200 - 3000Hz 0 - 200mV LESS THAN 0.1%
(8) OSCILLOSCOPE	FREQUENCY RANGE MEASURING RANGE	DC - 10MHz 0.01 - 10V
(9) FM DEVIATION METER	FREQUENCY RANGE MEASURING RANGE	140 ~ 170MHz 0 ~ ± 10 KHz
(10) DIRECTIONAL COUPLER	FREQUENCY RANGE	140 ~ 170MHz
(11) AMPERMETER	MEASURING RANGE	0 ~ 1A DC
(12) DUMMY LOAD OR EXTERNAL SPEAKER	IMPEDANCE	8 OHMS
(13) VOLTAGE REGULATED POWER SUPPLY	OUTPUT VOLTAGE CAPACITY	5 ~ 11V DC (adjustable) 1A OR MORE

7 - 2 PRELIMINARY CHECKS

7 - 2 - 1 TRANSMITTER OUTPUT CHECKS

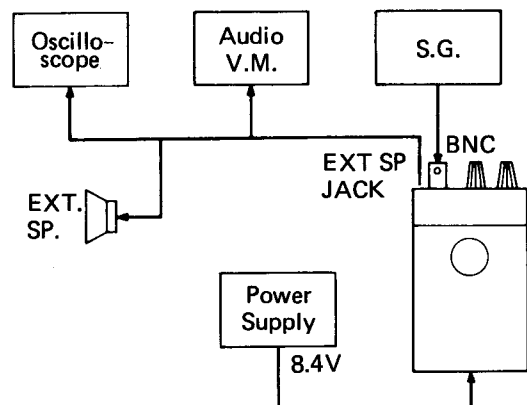


1. Connect a 50 ohms RF wattmeter to the ANT connector.
2. Setting the IC-M12 to any programmed channel and key the transmitter. Observe the RF power OUTPUT.
3. Power output should be 1.0 watt at rated input voltage.

7 - 2 - 2 RECEIVER CHECKS

Make all checks at 8.4V DC

1. Settings of controls and switches
Power switch ON
Squelch Control Minimum position
Frequency Any programmed channel



2. Connect an AF voltmeter to the SP jack and set the SQL control fully counterclockwise.
3. Connect the RF output of a VHF signal generator to the ANT connector.
4. Adjust the VOL control and the AF voltmeter range.
Adjust the VOL control for a full scale reading on the AF voltmeter. Don't change the VOL control setting after this adjustment.
5. Set the signal generator to the receiving frequency and adjust the output level of the signal generator until the AF voltmeter shows a 20dB decrease in reading.
6. The signal generator output voltage at this point is the 20dB quieting sensitivity.

7 - 3 PREPARATION AND PROCEDURE BEFORE SERVICING

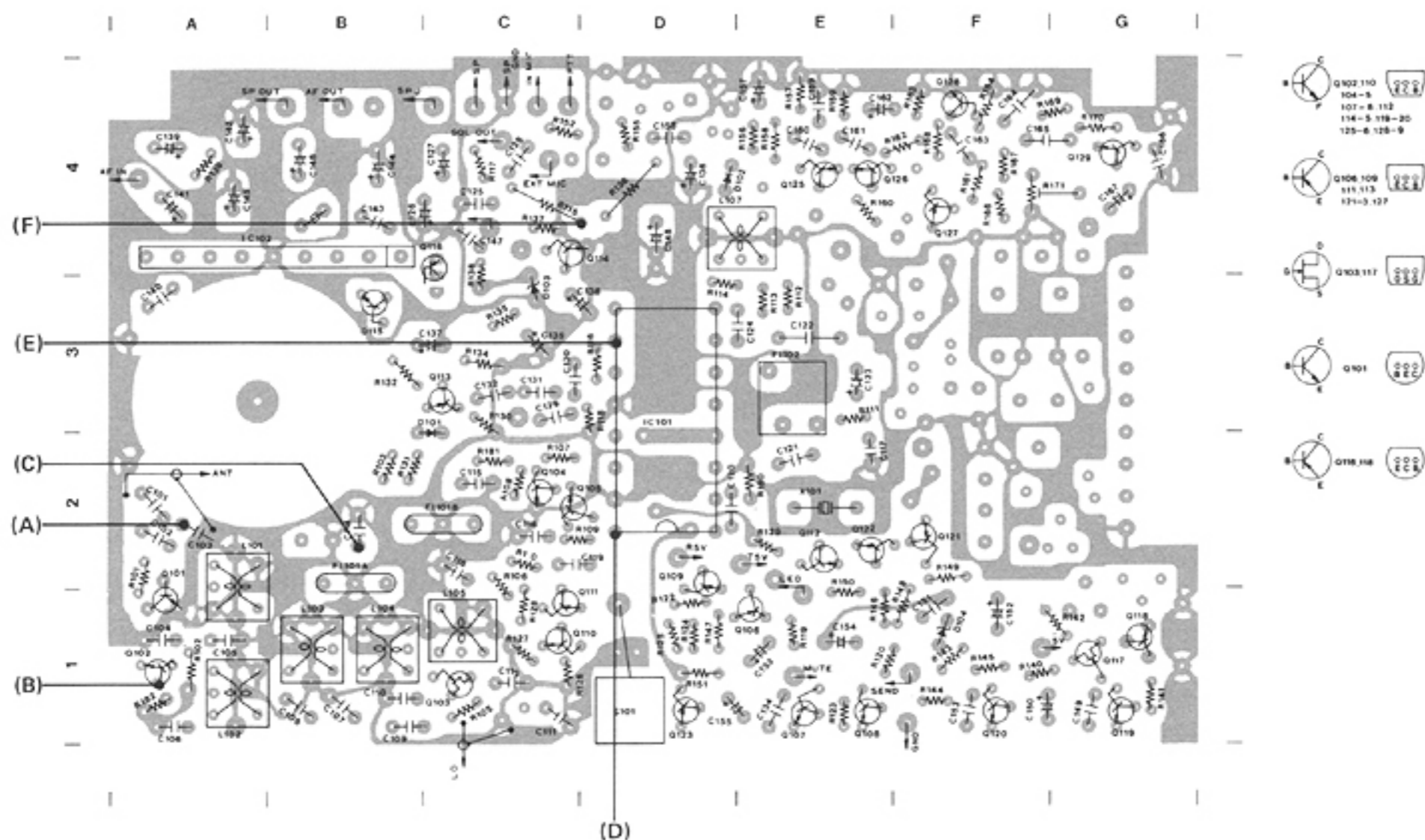
1. Confirm defective operation and check to make sure setup or external sources are not the cause of the problem.
2. Proper tools and measuring instruments are required for repair and adjustment. Don't try to repair or modify without them.

3. Remove the transceiver case as shown on Page 6 - 1. Use a screw driver that fits the screw.
4. To open the hinge chassis remove the two screws as shown on Page 6 - 2.
5. Attach an 8.0 ~ 11.0V DC external power source to the battery clip or screw. Be sure to check the polarity.
6. In the case of a transmission problem, a dummy load should be connected to the antenna connector. In the case of a receiving problem, an antenna or signal generator is connected to the antenna connector. Be careful not to transmit into the signal generator.
7. Recheck for the suspected malfunction with the power switch on.
8. Check the defective circuit and measure the DC voltages of the collector, base and emitter of each transistor.
9. When checking a transmission problem, it is convenient to short circuit an accessory mic connector plug and insert it, turning on the transmitter.

7 - 4 HOW TO CHECK

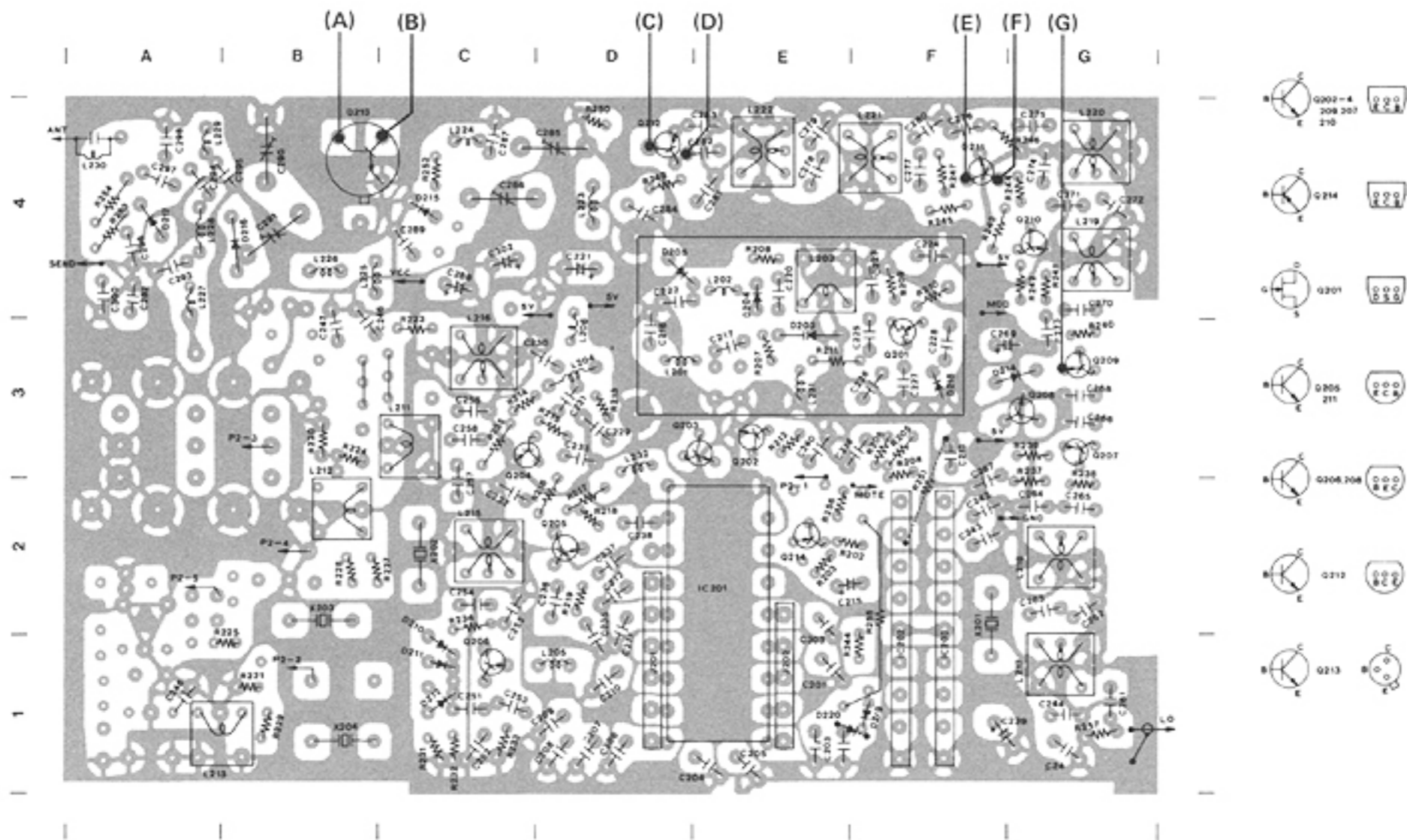
7 - 4 - 1 RECEIVE

1. Check the frequency of P.L.L. unit when you are unable to receive with a strong signal present and noise present when turning up the AF volume.
2. When no noise is present at the speaker, check audio frequency amplifier or 5V regulator first.
3. Inject RF through a $0.01\mu\text{F}$ capacitor from an FM signal generator modulated with 1KHz audio modulation (FM), to points (A) through (D) in order, check for receiver output.
 - (A) = Selected channel frequency
 - (B) = Selected channel frequency
 - (C) = 10.695MHz
 - (D) = 10.695MHz
4. Check (E) and (F) with an oscilloscope, for demodulated output in the audio frequency range.



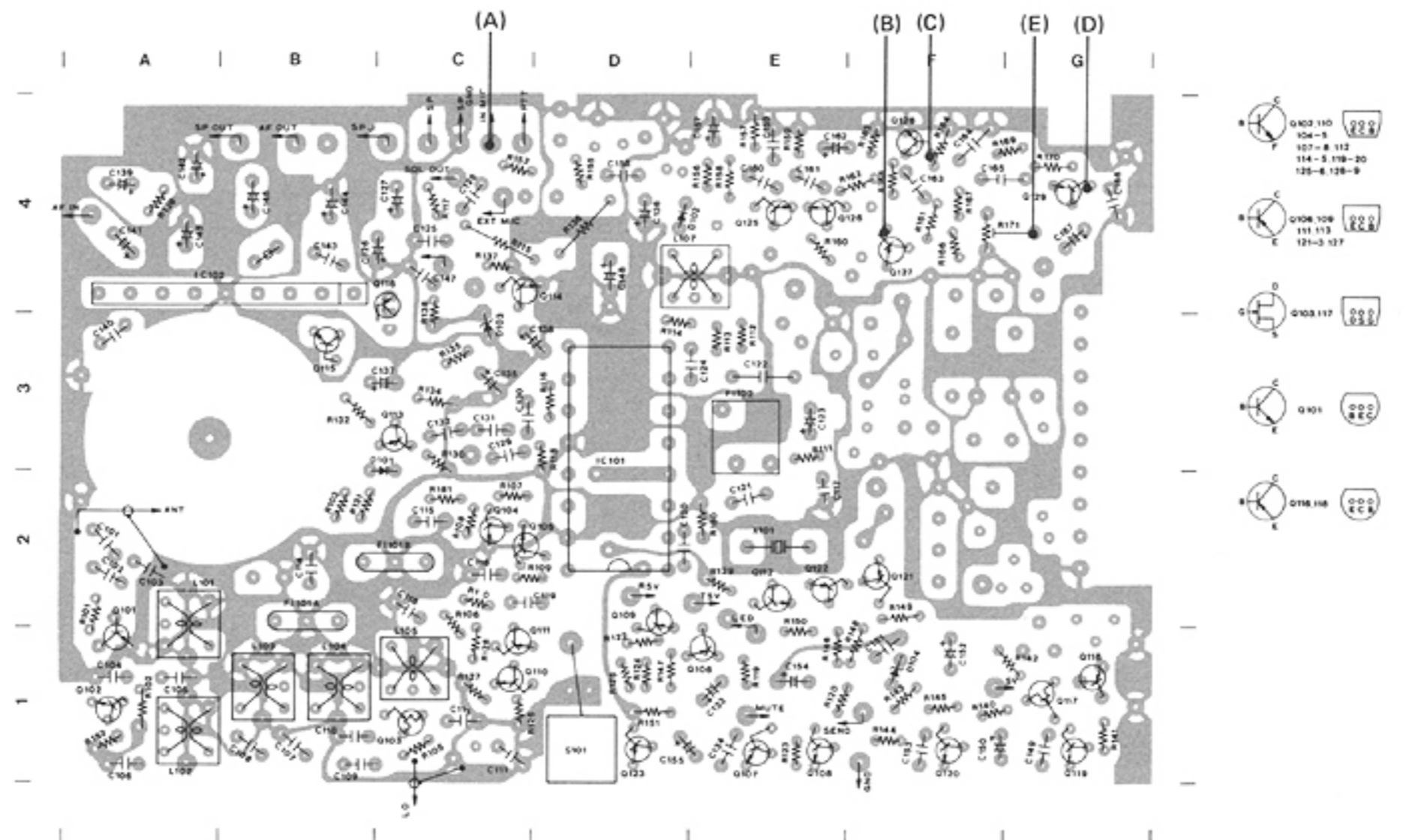
7-4-2 TRANSMITTER

1. Check (A) through (G) in order with RF voltmeter.
2. When the transmitter output is low, check regulated power supply voltage first, do not turn coil trimmers.
3. When transmission is normal, RF is present and it is not possible to measure the DC voltage accurately with a voltmeter.



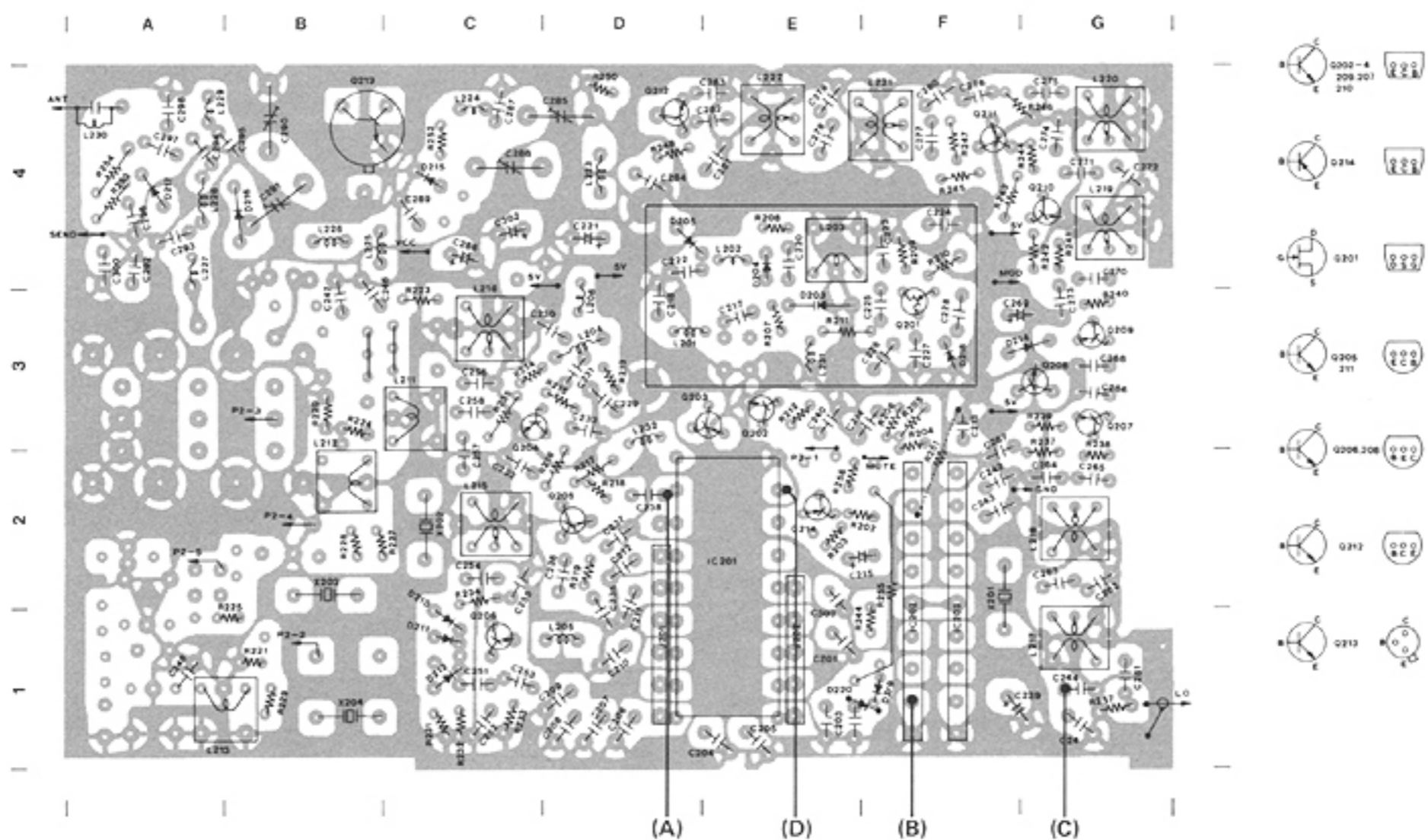
7-4-3 MODULATION

1. Put a signal into the EXT MIC connector (1KHz 40mV) with an AF oscillator or an external mic.
2. Check the AF voltages (A) through (E) in order with an oscilloscope.



7-4-4 P.L.L.

1. Check (A) with an oscilloscope. A lock failure is indicated by an instability or absence of the wave form. Check as follows:
2. Check the Frequency of the master oscillator (6.40MHz). If a 6.25KHz 5Vp-p squarewave is not observed at (B), measure DC voltage on Pin 5 of IC203 if no oscillation.
3. Wave measure the output of (C) and (D) with an oscilloscope.
4. Measure DC voltage of Q201, Q202, Q203, Q204 and Q205.
5. If the transmit or receive frequency differs from the programmed frequency, check the voltage of A1 to C4 on the IC201 (BCD control lines from matrix board).



CH	Frequency (MHz)		Matrix N	Conditions of IC201 input (Pin 3 ~ 15)												
	Transmit	Receive		A ₁	A ₂	A ₃	A ₄	B ₁	B ₂	B ₃	B ₄	C ₁	C ₂	C ₃	C ₄	D ₁
6	156.300	156.300	504	L	L	H	L	L	L	L	L	H	L	H	L	L
7	156.350	160.950	76	L	H	H	L	H	H	H	L	L	L	L	H	L
7A	156.350	156.350	508	L	L	L	H	L	L	L	L	H	L	H	L	L
8	156.400	156.400	512	L	H	L	L	H	L	L	L	H	L	H	L	L
9	156.450	156.450	516	L	H	H	L	H	L	L	L	H	L	H	L	L
10	156.500	156.500	520	L	L	L	L	L	H	L	L	H	L	H	L	L
11	156.550	156.550	524	L	L	H	L	L	H	L	L	H	L	H	L	L
12	156.600	156.600	528	L	L	L	H	L	H	L	L	H	L	H	L	L
13	156.650	156.650	532	L	H	L	L	H	H	L	L	H	L	H	L	L
14	156.700	156.700	536	L	H	H	L	H	H	L	L	H	L	H	L	L
15	156.750	156.750	540	L	L	L	L	L	L	H	L	H	L	H	L	L

H = 5V L = 0V

CH	Frequency (MHz)		Matrix N	Conditions of IC201 input (Pin 3 ~ 15)												
	Transmit	Receive		A ₁	A ₂	A ₃	A ₄	B ₁	B ₂	B ₃	B ₄	C ₁	C ₂	C ₃	C ₄	D ₁
16	156.800	156.800	544	L	L	H	L	L	L	H	L	H	L	H	L	L
17	156.850	156.850	548	L	L	L	H	L	L	H	L	H	L	H	L	L
18	156.900	161.500	120	L	L	L	L	L	H	L	L	H	L	L	H	L
18A	156.900	156.900	552	L	H	L	L	H	L	H	L	H	L	H	L	L
19	156.950	161.550	124	L	L	H	L	L	H	L	L	H	L	L	H	L
19A	156.950	156.950	556	L	H	H	L	H	L	H	L	H	L	H	L	L
20	157.000	161.600	128	L	L	L	H	L	H	L	L	H	L	L	H	L
21	157.050	161.650	132	L	H	L	L	H	H	L	L	H	L	L	H	L
21A	157.050	157.050	564	L	L	H	L	L	H	H	L	H	L	H	L	L
22	157.100	161.700	136	L	H	H	L	H	H	L	L	H	L	L	H	L
22A	157.100	157.100	568	L	L	L	H	L	H	H	L	H	L	H	L	L
23	157.150	161.750	140	L	L	L	L	L	L	H	L	H	L	L	H	L
23A	157.150	157.150	572	L	H	L	L	H	H	H	L	H	L	H	L	L
24	157.200	161.800	144	L	L	H	L	L	L	H	L	H	L	L	H	L
25	157.250	161.850	148	L	L	L	H	L	L	H	L	H	L	L	H	L
26	157.300	161.900	152	L	H	L	L	H	L	H	L	H	L	L	H	L
27	157.350	161.950	156	L	H	H	L	H	L	H	L	H	L	L	H	L
28	157.400	162.000	160	L	L	L	L	L	H	H	L	H	L	L	H	L
65	156.275	160.875	70	L	L	L	L	H	H	H	L	L	L	L	H	L
65A	156.275	156.275	502	L	H	L	L	L	L	L	L	H	L	H	L	L
66	156.325	160.925	74	L	L	H	L	H	H	H	L	L	L	L	H	L
66A	156.325	156.325	506	L	H	H	L	L	L	L	L	H	L	H	L	L
67	156.375	156.375	510	L	L	L	L	H	L	L	L	H	L	H	L	L
68	156.425	156.425	514	L	L	H	L	H	L	L	L	H	L	H	L	L
69	156.475	156.475	518	L	L	L	H	H	L	L	L	H	L	H	L	L
70	156.525	156.525	522	L	H	L	L	L	H	L	L	H	L	H	L	L
71	156.575	156.575	526	L	H	H	L	L	H	L	L	H	L	H	L	L
72	156.625	156.625	530	L	L	L	L	H	H	L	L	H	L	H	L	L
73	156.675	156.675	534	L	L	H	L	H	H	L	L	H	L	H	L	L
74	156.725	156.725	538	L	L	L	H	H	H	L	L	H	L	H	L	L
77	156.875	156.875	550	L	L	L	L	H	L	H	L	H	L	H	L	L
78	156.925	161.525	122	L	H	L	L	L	H	L	L	H	L	L	H	L
78A	156.925	156.925	554	L	L	H	L	H	L	H	L	H	L	H	L	L
79	156.975	161.575	126	L	H	H	L	L	H	L	L	H	L	L	H	L
79A	156.975	156.975	558	L	L	L	H	H	L	H	L	H	L	H	L	L
80	157.025	161.625	130	L	L	L	L	H	H	L	L	H	L	L	H	L
80A	157.025	157.025	562	L	H	L	L	L	H	H	L	H	L	H	L	L

H = 5V L = 0V

CH	Frequency (MHz)		Matrix N	Conditions of IC201 input (Pin 3 ~ 15)												
	Transmit	Receive		A ₁	A ₂	A ₃	A ₄	B ₁	B ₂	B ₃	B ₄	C ₁	C ₂	C ₃	C ₄	D ₁
81	157.075	161.675	134	L	L	H	L	H	H	L	L	H	L	L	H	L
81A	157.075	157.075	566	L	H	H	L	L	H	H	L	H	L	H	L	L
82	157.125	161.725	138	L	L	L	H	H	H	L	L	H	L	L	H	L
83	157.175	161.775	142	L	H	L	L	L	L	H	L	H	L	L	H	L
83A	157.175	157.175	574	L	L	H	L	H	H	H	L	H	L	H	L	L
84	157.225	161.825	146	L	H	H	L	L	L	H	L	H	L	H	L	L
85	157.275	161.875	150	L	L	L	L	H	L	H	L	H	L	L	H	L
86	157.325	161.925	154	L	L	H	L	H	L	H	L	H	L	L	H	L
87	157.375	161.975	158	L	L	L	H	H	L	H	L	H	L	L	H	L
88	157.425	162.025	162	L	H	L	L	L	H	H	L	H	L	L	H	L
WX1	—	162.550	1004*	L	L	H	L	L	L	L	L	L	L	L	L	H
WX2	—	162.400	192	L	H	L	L	H	L	L	H	H	L	L	H	L
WX3	—	162.475	198	L	L	L	H	H	L	L	H	H	L	L	H	L
WX4	—	161.650	132	L	H	L	L	H	H	L	L	H	L	L	H	L

H = 5V L = 0V

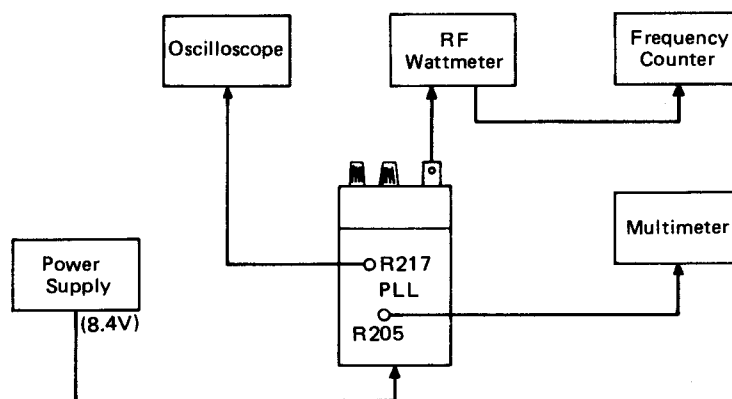
* WX1 needs another wiring. Refer to the BOARD LAYOUT of the MATRIX UNIT (Version U.S.A.).

7 - 5 BASIC ALIGNMENT PROCEDURE

7 - 5 - 1 P.L.L. CIRCUIT

A. Lock Adjustment

1. Connect the measuring instrument and set the control knobs as follows:
 - Connect an oscilloscope (10MHz band width) to R217.
 - Connect voltmeter between R205 and ground.
 - Set the channel selects switch at "16" (CH16).



2. Procedure

When the circuit is operating normally, adjust coil L203. The P.L.L. will lock.

- Adjust the coil of L203, and the voltage of R205 varies between 0 ~ 5V, and P.L.L. should lock.
- Adjust L203 for 1V after lock.

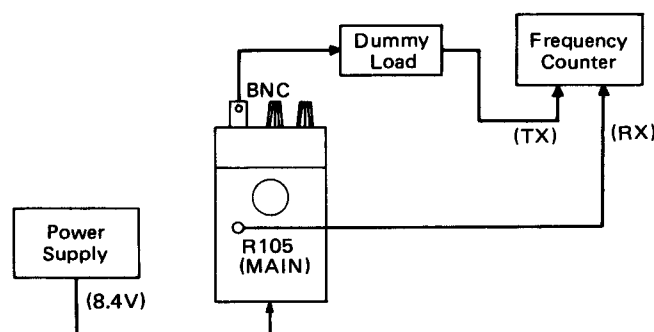
Next, in Receive adjust L216 for maximum voltage (P-P value) on the oscilloscope and then during transmission adjust L215 to maximum. Set the channel select switch at CH26, and repeat adjustment of L215, L216 several times. After that, confirm the following voltage of R205 (both transmission and receiving) $1V \pm 0.3V$ at CH16, and that the voltage of R217 (both transmission and receiving) is over 2Vp-p (over operating range of the radio). If the P.L.L. won't lock, check these voltages: R+5V, T+5V, 5V constant, and the P.L.L. LO and reference frequency oscillator for oscillation.

B. Reference Frequency Oscillator Check

1. Connect a counter through a capacitor to Pin 1 of IC203.
2. Confirm frequency is: $6.400MHz \pm 250Hz$.

C. P.L.L. LO Frequency Adjustment

1. Connection of the measuring instruments and the setting of knob.
 - When adjusting the receiving frequency, connect the counter to R105 of the MAIN unit through a capacitor. After power adjustment, loosely couple the set to a counter with capability of more than 170MHz (with dummy load connected), so that the transmitting frequency can be obtained.



2. Set the channel select switch at CH16.
 - In the receive mode, adjust L211 for 146.105MHz.
 - In the transmit mode, adjust L212 for 156.800MHz.
 - Set the channel at CH26, and adjust L213 for 157.300MHz.
 - Then check again, because these adjustments interact.
3. Confirmation

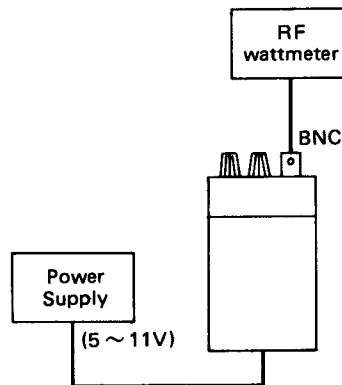
Check each frequency:
All frequencies should be within $\pm 500\text{Hz}$.

7 - 5 - 2 TRANSMISSION

A. Power Adjustment

1. Connection of measuring instruments and setting of the knobs.
 - Connect ANT to 50 ohm power meter.
 - Connect a voltmeter and variable power supply to the set.
 - CAUTION:** Applying over 10.8V can damage the P.A. transistor.
 - Set the channel select switch at CH16.
2. Procedure
 - Adjust L219 through L222 and C285, C286, C290 and C291 for maximum power output while pushing PTT switch.
 - If the total current drain exceeds 500mA, adjust C291 to set the current at 500mA, and repeat above procedures.
3. Confirmation

More than 1.0W output, less than 500mA current drain.
No abnormality in operation should be found if the supply voltage is varied from 5.5V to 10.8V.



B. Modulation Adjustment

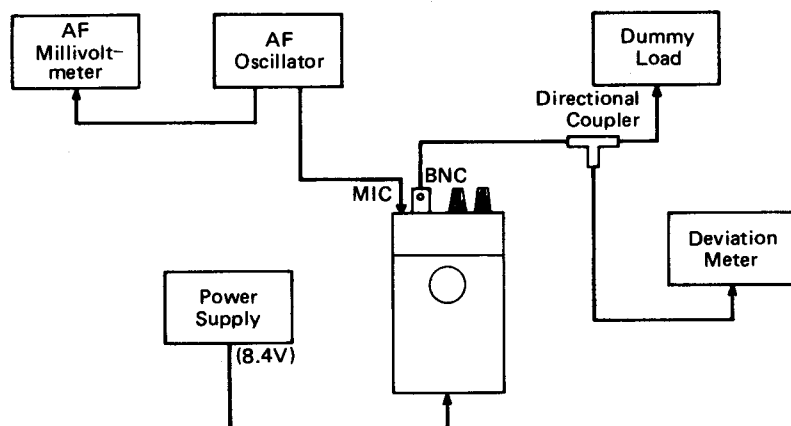
1. Connecting the measuring instrument and the settings of the controls.

Connect ANT Connector to a deviation meter with a directional coupler or attenuator.

Deviation meter filter shall be a High Pass Filter 50Hz, L.P.F. 20KHz. De-emphasis OFF.

 - Set the channel select switch at CH16.
 - Connect an AF oscillator, with AF millivoltmeter in parallel, to the mic input.
2. Procedure

Mic input shall be 1KHz 120mV RMS. During transmit, adjust R171 on the main unit for 4.5KHz deviation.



3. Modulation check

Maximum deviation: With 1KHz 120mV shall be 4.5KHz \pm 10%.

Modulation sensitivity: Mic input voltage 12mV \pm 3dB at 1KHz. Deviation should be 3.5KHz.

S/N Ratio:

Connect the output of the deviation meter to a millivoltmeter. With no audio input to the mic input, take the voltmeter reading. Now insert 1KHz 40mV audio into the mic connector. Take the voltmeter reading. The ratio should be greater than 40dB.

C. Spurious Transmission

Connect spectrum analyzer with appropriate attenuation. Confirm nearby random spurious signals below fundamental frequency less than -60 dB.

Measure the harmonic wave output, adjust RF-ATT until noise level just appears.

Should be less than -60 dB below the fundamental frequency.

7 - 5 - 3 RECEIVER

A. LO Output Adjustment

- Set the channel select switch at CH16. Adjust L217 and L218 for maximum output on an RF voltmeter attached to R105 in the main unit.
- Then set the channel select switch at CH26 and adjust L217 and L218 with the same procedure.
- Repeat above procedures to obtain the same reading on the RF voltmeter on either CH16 or CH26. The output voltage should be about 200mV.

B. RF IF DET Coil Adjustment.

1. The connecting point of measuring instrument and the setting of the knob.

- Set the channel select switch at CH16.
- Connect antenna to signal generator.
- Connect SP terminal to EXT SP and AF millivoltmeter.

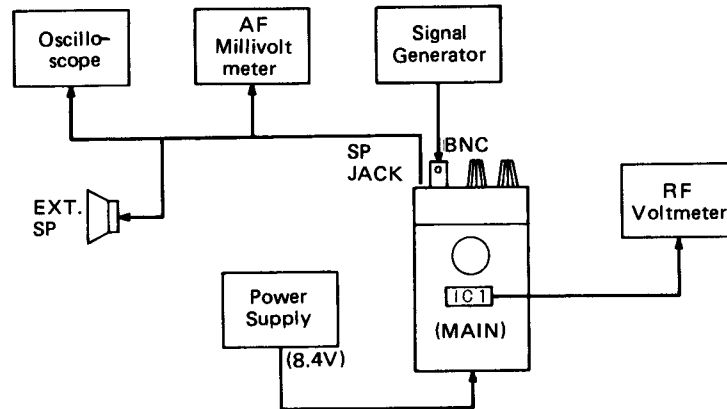
2. Procedure

Set RF voltage meter (minimum range) to Pin 16 on IC101 in the IF, adjust L101 through L105 maximum output while setting the input from the signal generator as low as possible. Then vary the input frequency from the signal generator \pm 10KHz. Check if rippling (change in output level) occurs. If ripple is over 3dB, readjust L105.

Set signal generator output to -80 dBm to -90 dBm and deviation to 3.5KHz. Set signal generator frequency to speaker output maximum. After that, adjust L107 for maximum output.

3. Confirmation

Sensitivity should be less than -8 dB μ (0.4 μ V) for 20dB quieting.



C. 2nd LO Frequency Check

Connect a 10.24MHz amplifier to the counter, check the frequency of X101 (2nd OSC) with a loose couple. It should be: 10.240MHz \pm 400Hz.

D. Receiver Spurious Response

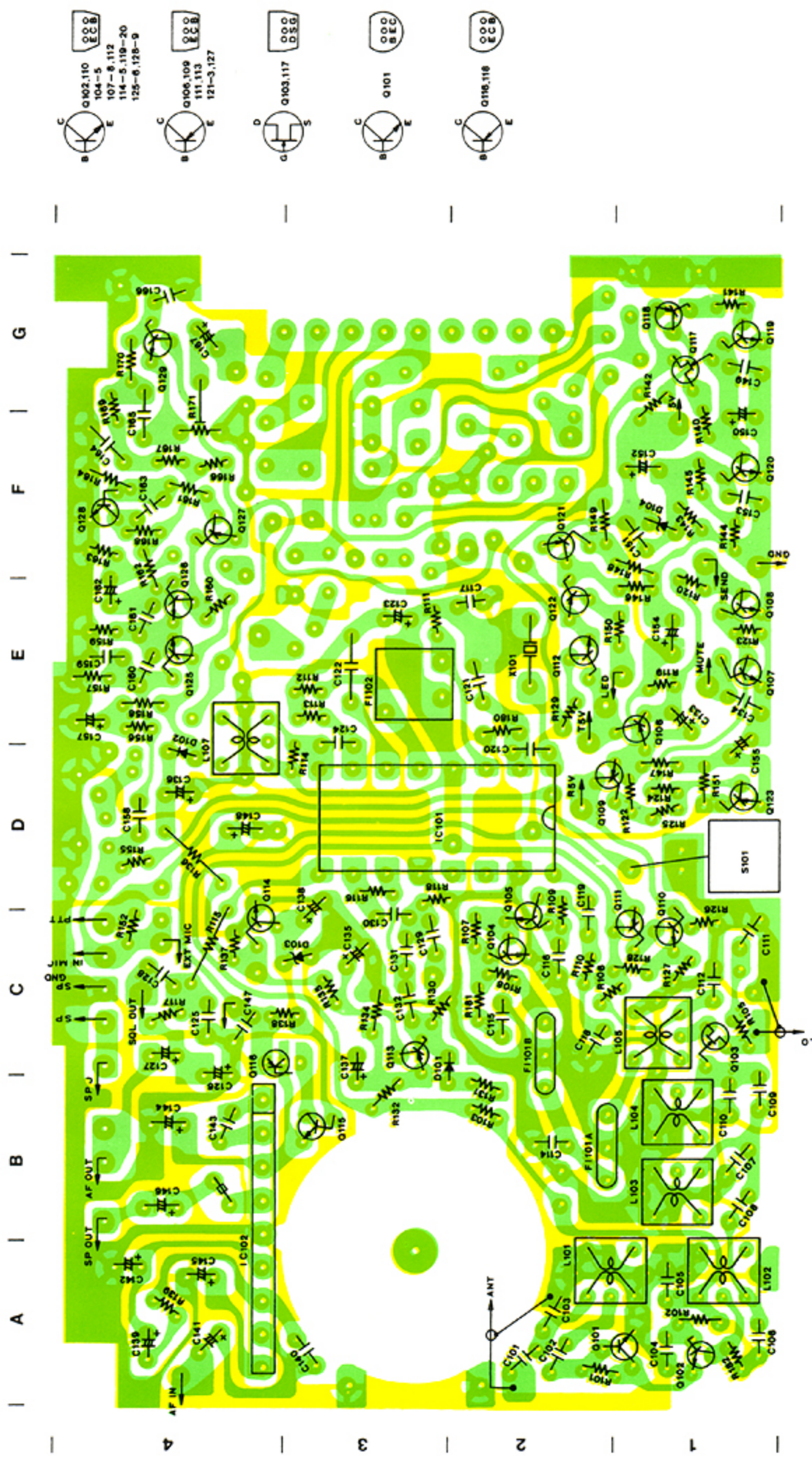
Connect a speaker and millivoltmeter to the EXT SP. Connect a 50 ohm dummy load to the antenna terminal. All receiver spurious should be suppressed less than 3dB, over entire frequency range.

E. Receive Audio Output

Connect to the EXT SP connector a millivoltmeter, oscilloscope, and a distortion meter. To the ANT terminal connect the signal generator and set the signal generator to -80 to -90 dBm and deviation to 3.5KHz. Turn up AF VOL control. Read the millivoltmeter when the distortion is 10%.

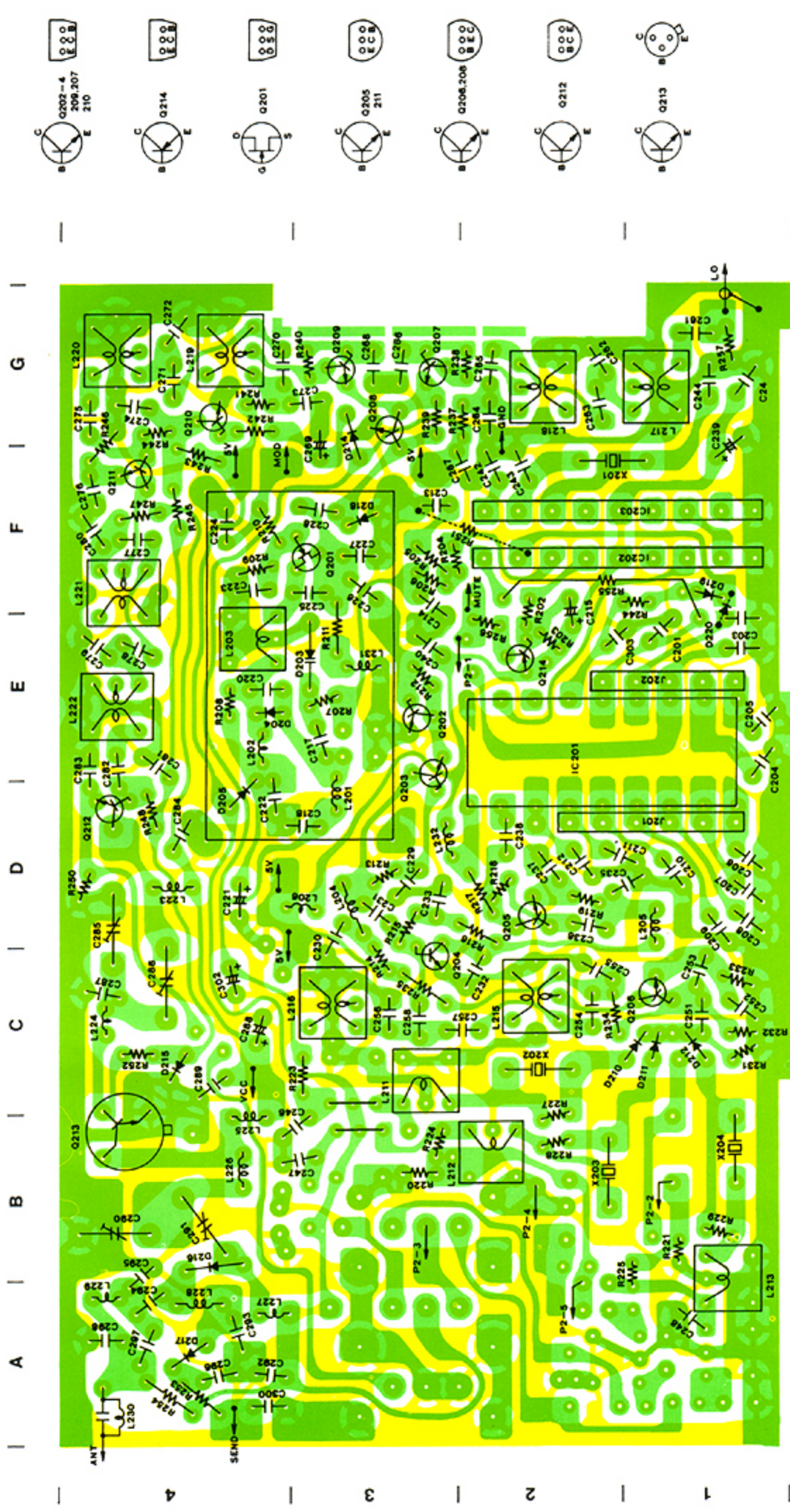
BOARD LAYOUT

MAIN UNIT



BOARD LAYOUT

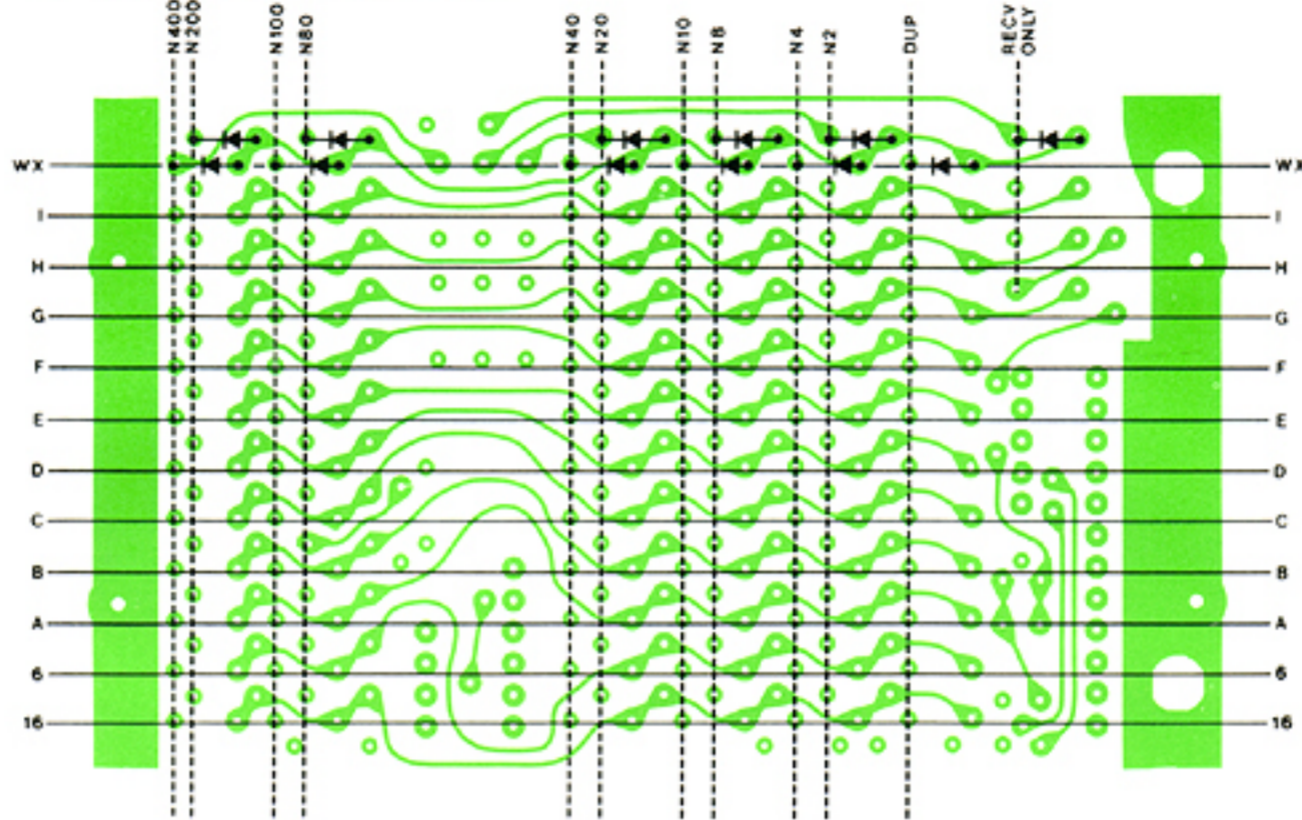
PLL UNIT



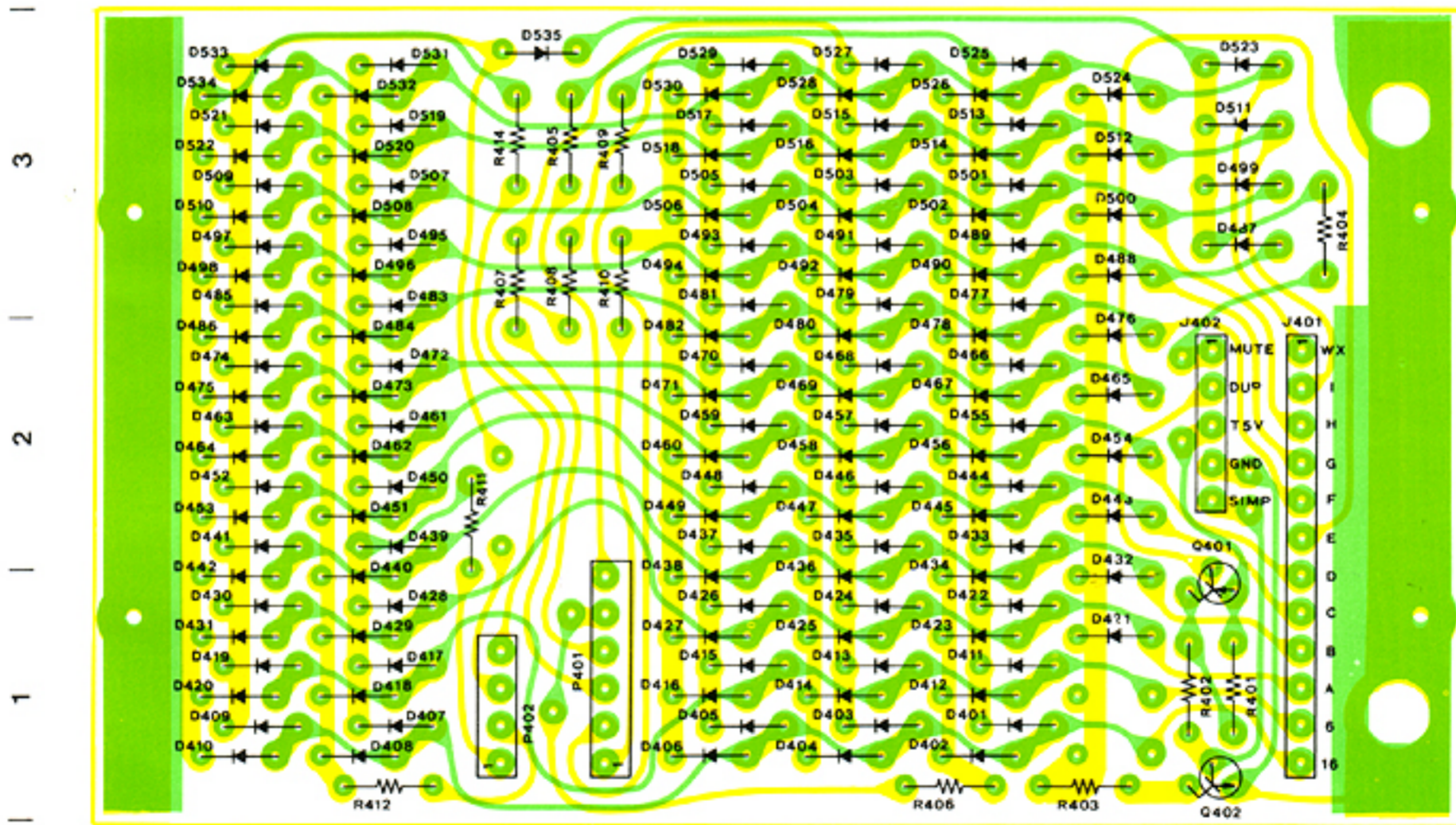
BOARD LAYOUT

MATRIX UNIT

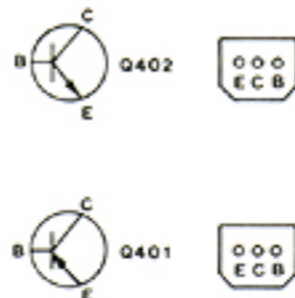
■ MATRIX LAYOUT



A | B | C | D | E



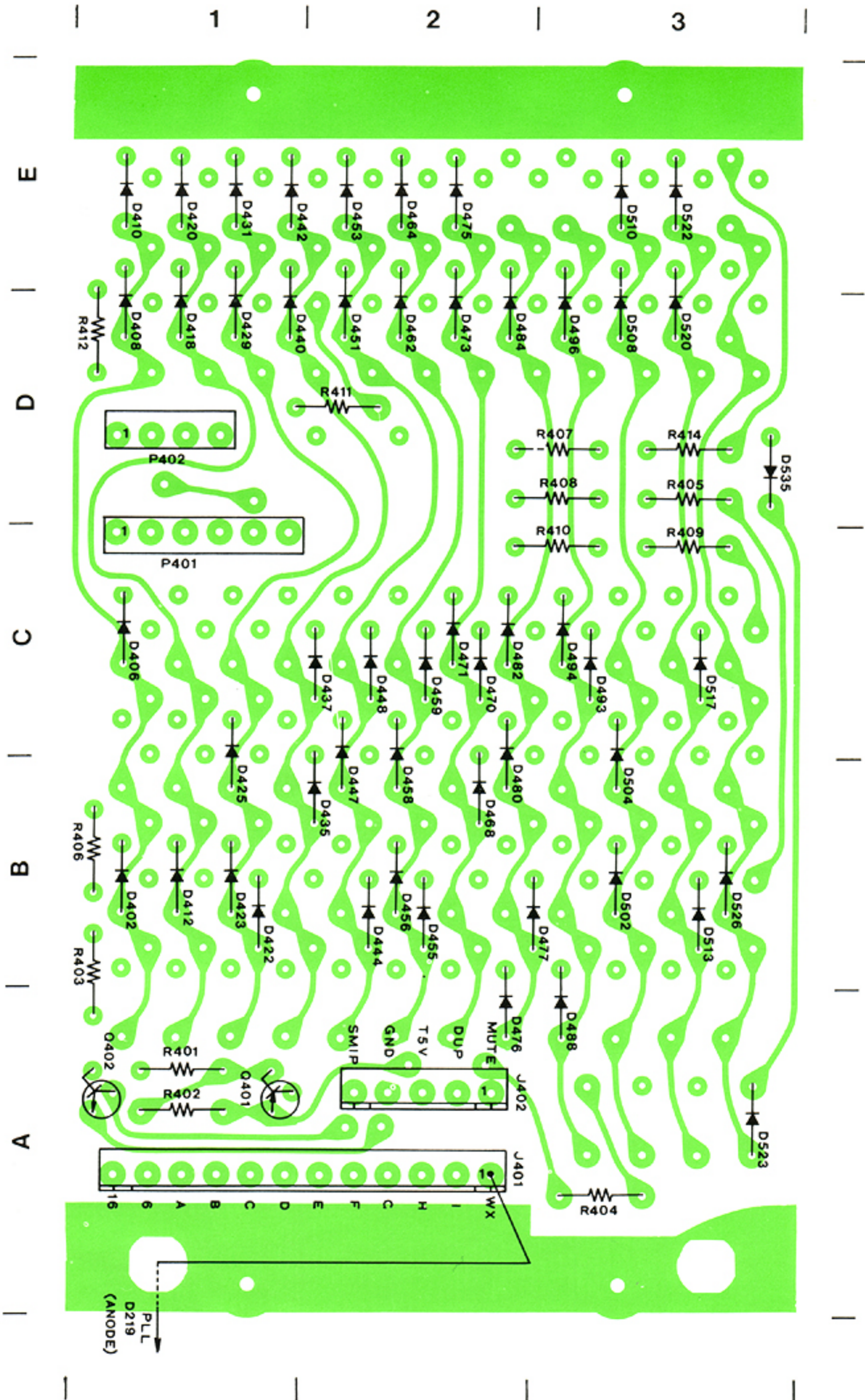
3
2
1



BOARD LAYOUT

MATRIX UNIT

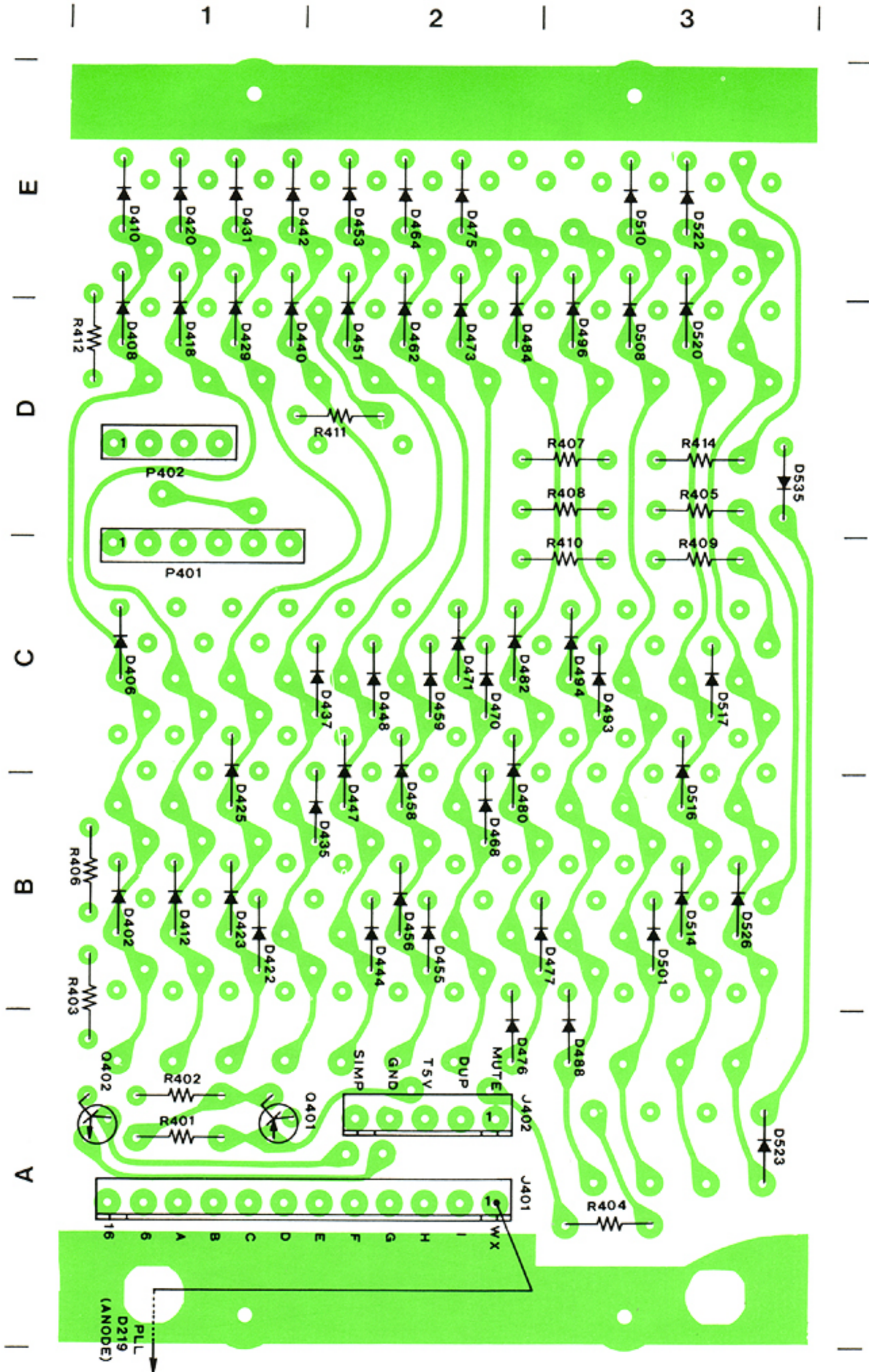
■ Version USA (A)



BOARD LAYOUT

MATRIX UNIT

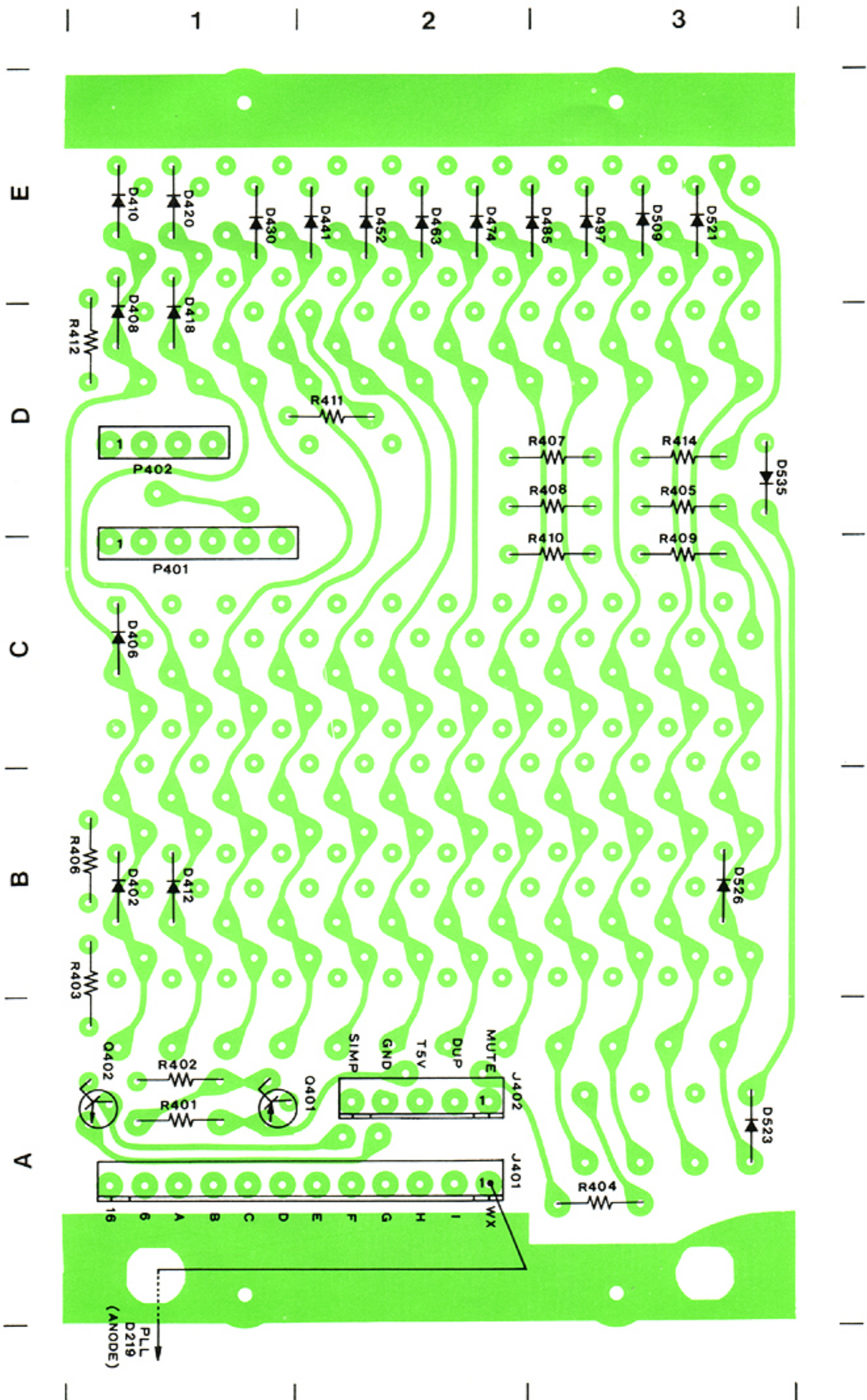
■ Version USA (B)



BOARD LAYOUT

MATRIX UNIT

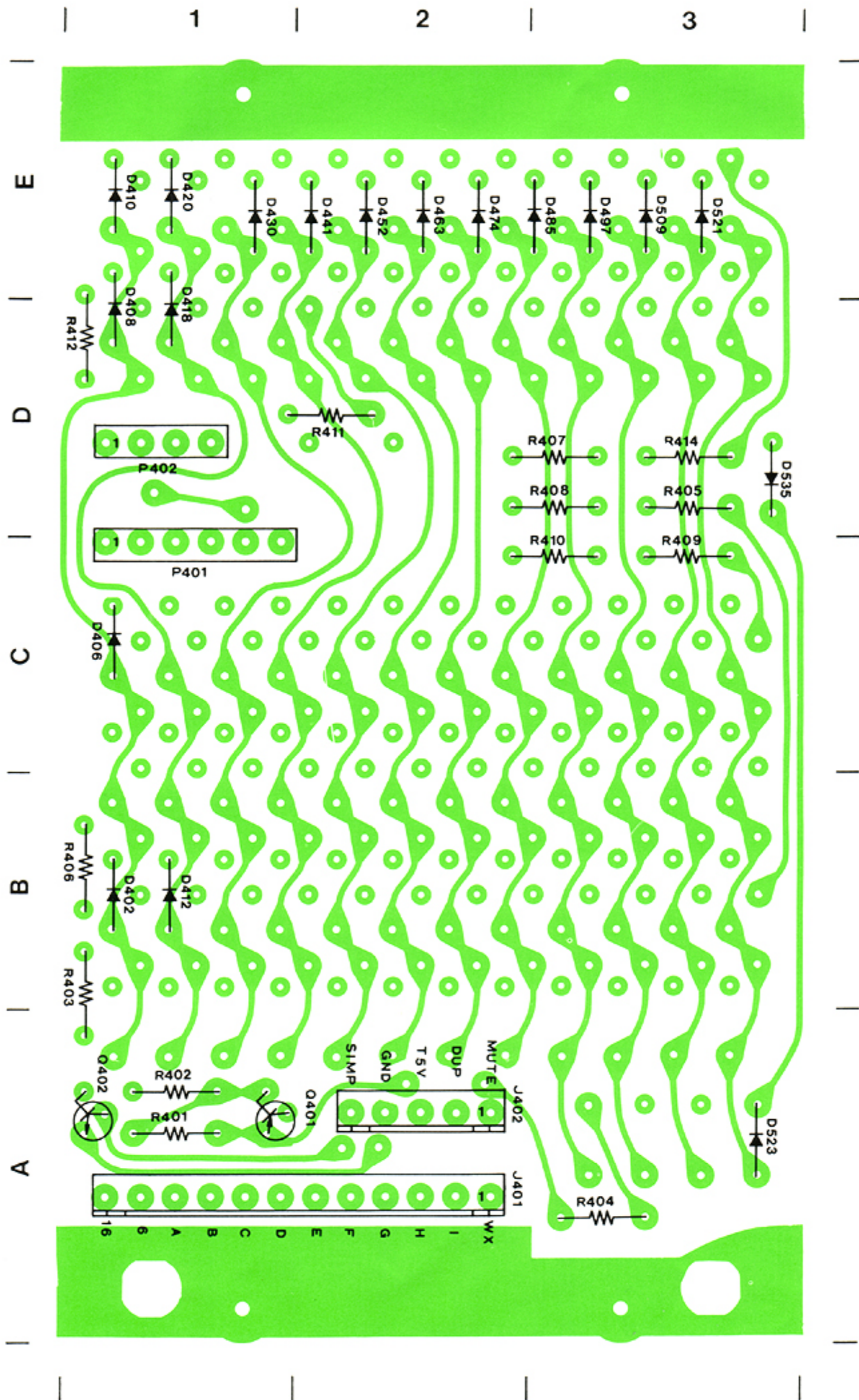
■ Version USA (C)



BOARD LAYOUT

MATRIX UNIT

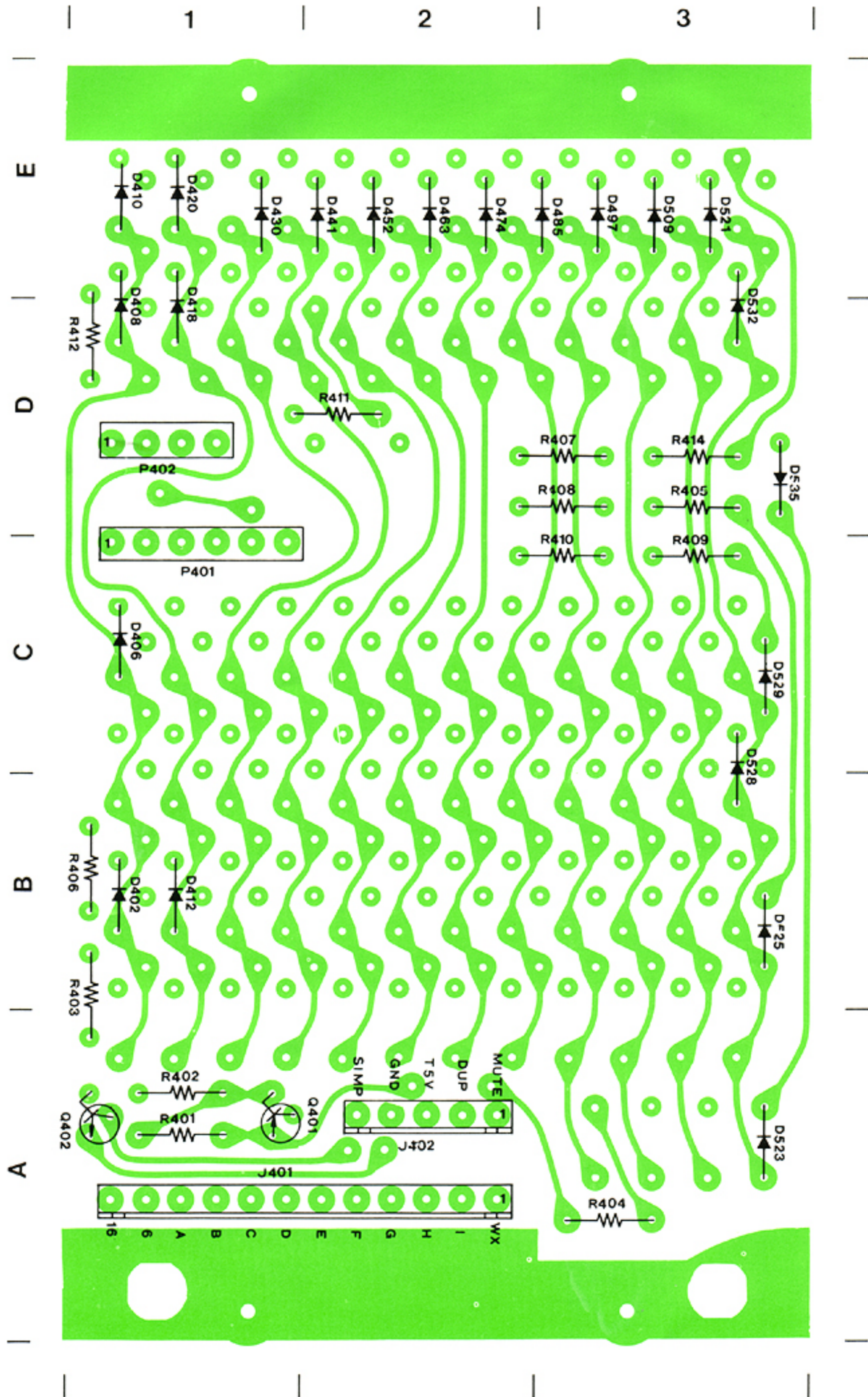
■ Version INTL



BOARD LAYOUT

MATRIX UNIT

■ Version CANADA



MATRIX POSITIONS TABLE

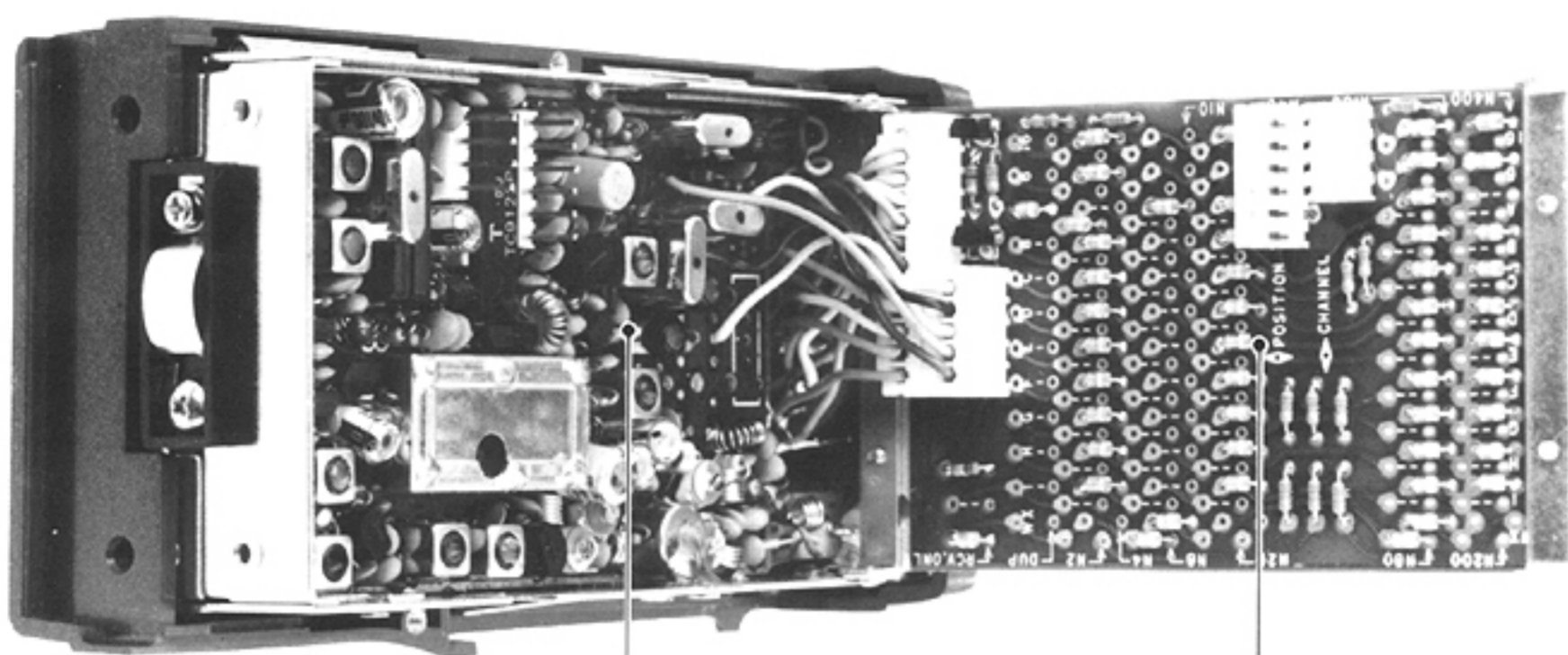
POSITION (P)													POSITION (P)												
CH	400	100	80	40	20	10	8	4	2	D	R	CH	400	100	80	40	20	10	8	4	2	D	R		
6	●	●							●			65				●	●	●					●		
7				●	●	●		●	●	●		65A	●	●								●			
7A	●	●							●			66				●	●	●				●	●		
8	●	●				●				●		66A	●	●							●	●			
9	●	●				●				●	●	67	●	●				●							
10	●	●				●						68	●	●				●			●				
11	●	●				●				●		69	●	●				●	●						
12	●	●				●			●			70	●	●			●					●			
13	●	●				●	●				●	71	●	●			●				●	●			
14	●	●				●	●			●	●	72	●	●			●	●							
15	●	●			●							73	●	●			●	●			●				
16	●	●			●					●		74	●	●			●	●	●						
17	●	●			●				●			77	●	●		●		●							
18		●			●						●	78	●			●					●	●			
18A	●	●			●					●		78A	●	●		●		●			●				
19		●			●				●	●		79	●			●				●	●	●			
19A	●	●			●				●	●		79A	●	●		●		●	●						
20		●			●				●		●	80	●			●	●						●		
21		●			●	●				●	●	80A	●	●		●	●					●			
21A	●	●			●	●				●		81	●			●	●				●		●		
22		●			●	●				●	●	81A	●	●		●	●				●	●			
22A	●	●			●	●			●			82	●			●	●	●					●		
23		●			●						●	83	●			●						●	●		
23A	●	●			●	●	●				●	83A	●	●		●	●	●				●			
24		●			●				●		●	84	●			●					●	●	●		
25		●			●				●		●	85	●			●		●					●		
26		●			●					●	●	86	●			●		●			●		●		
27		●			●				●	●	●	87	●			●		●	●				●		
28		●			●	●					●	88	●			●	●					●	●		
WX2		●	●			●				●		WX3	●	●			●	●					●		
WX4		●			●	●				●	●	WX1									●		●		

D : DUPLEX

R : RECEIVE ONLY

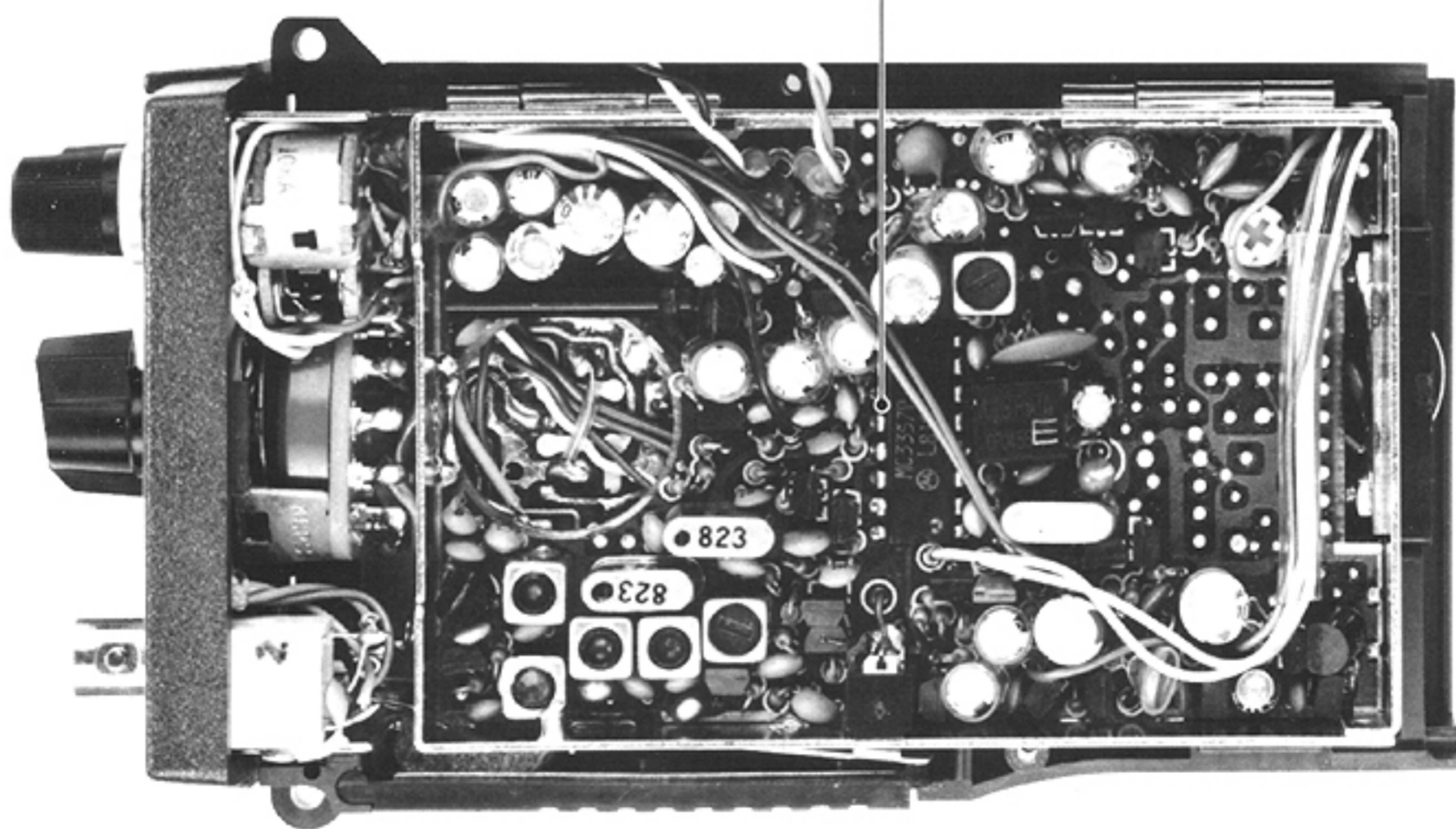
NOTE : WX1 NEEDS ANOTHER WIRING

UNIT LAYOUT



PLL UNIT

MATRIX UNIT



MAIN UNIT

SECTION 9 VOLTAGE CHARTS

TRANSISTORS VOLTAGE CHART

• Measuring instrument is a 50K Ω /V multimeter.

UNIT	NO.	TRANSMIT			RECEIVE			REMARKS
		BASE or GATE	COLLECTOR or DRAIN	EMITTER or SOURCE	BASE or GATE	COLLECTOR or DRAIN	EMITTER or SOURCE	
MAIN	Q101	0	0	GND	0.75	1.2	GND	RF Amp
	Q102	0	0	0	1.8	5.6	1.2	RF Amp
	Q103	0	0	0	0	5.9	0.9	1st Mixer
	Q104	0	0	GND	0.7	0.8	GND	1st IF Amp
	Q105	0	0	0	1.4	2.9	0.8	1st IF Amp
	Q106	4.1	4.8	4.9	4.8	0	4.9	T/R Switch
	Q107	0/0.6	0.7/0	GND	0/0.6	0.3/0	GND	T/R Switch Locked/Unlocked
	Q108	0.7	0	GND	0.3	4.8	GND	T/R Switch
	Q109	4.6	0	4.9	4.2	4.8	4.9	T/R Switch
	Q110	0	8.2	0	4.8	8.4	4.2	T/R Switch
	Q111	7.8	0	8.4	7.8	5.6	8.4	T/R Switch
	Q112	4.8	7.8	4.0	0	8.4	0	T/R Switch
	Q113	0	0.5	0	3.7	1.5/0	2.8/3.4	Noise Detector SQL CLOSED/SQL OPENED
	Q114	0.6	0	GND	0.6/0	0/7.8	GND	Squelch Control
	Q115	0	7.4	0	0/7.8	7.4	0/7.2	Squelch Control
	Q116	7.4	0	8.4	7.4	7.2/0	8.4	T/R Switch
	Q117	0.5	8.4	1.7	0.5	8.4	1.7	Regulator
	Q118	7.8	4.9	8.4	7.8	4.9	8.4	Regulator
	Q119	0.5	6.5	GND	0.5	7.5	GND	Regulator
	Q120	0.6	0.5	GND	0.6	0.5	GND	
	Q121	6.1	3.4	4.9	6.1	0	4.9	Indicator Control
	Q122	3.4	4.0	4.0	0	0	0	Indicator Control
	Q123	3.1	3.8	3.8	4.8	1.2	4.9	T/R Switch
	Q125	2.4	4.0	2.0	0	0	0	Mic Amp
	Q126	2.5	3.5	2.0	0	0	0	Mic Amp
	Q127	3.5	2.0	4.0	0	0	0	Mic Amp
	Q128	0.6	1.7	GND	0	0	GND	Limiter
	Q129	2.1	4.0	1.8	0	0	0	Low Pass Filter
	PLL	Q201	0	4.0	0.8	0	4.0	0.8
Q202		0.6	0.9	GND	0.6	0.9	GND	Buffer Amp
Q203		1.5	3.1	0.9	1.5	3.1	0.9	Buffer Amp
Q204		0.6	0.7	GND	0.6	0.7	GND	PLL Mixer
Q205		1.4	3.2	1.1	1.4	3.2	1.1	Level Converter
Q206		1.6	4.8	1.1	1.6	4.8	1.1	Multiplier
Q207		0	0	0.8	1.4	4.7	0.8	Multiplier
Q208		0.6	0.8	GND	0.6	0.8	GND	Buffer Amp
Q209		1.4	4.6	0.8	0	0	0.8	Multiplier
Q210		0	1.8	GND	0.6	0	GND	T/R Switch
Q211		1.1	7.9	0.5	0	8.4	0	Buffer Amp
Q212		0.6	8.4	0.4	0	8.4	0	Driver
Q213		0.6	8.4	GND	0	8.4	GND	Power Amp
Q214		4.5	0	4.9	4.5	0	4.9	Lock Failure Mute

IC'S VOLTAGE CHART

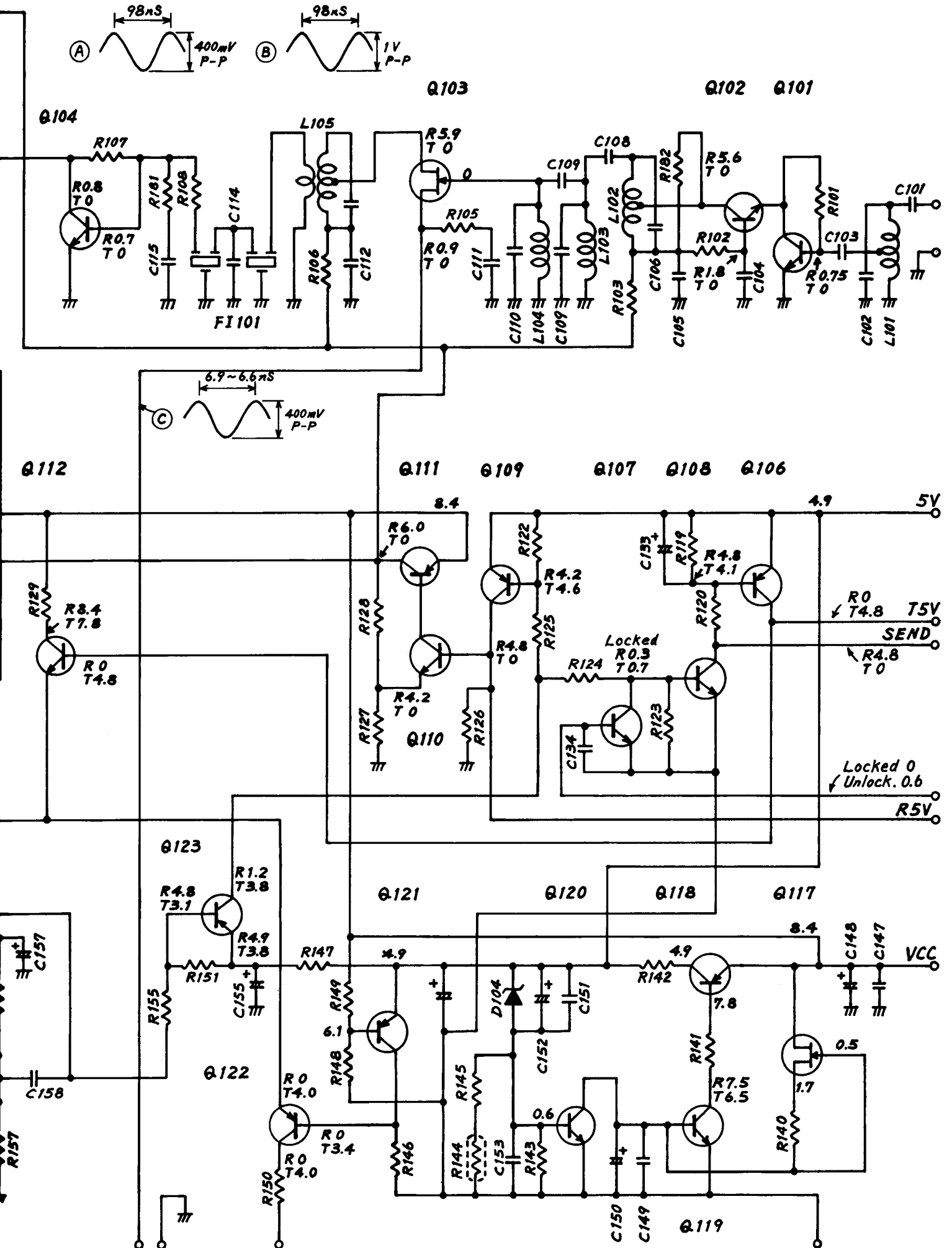
● Measuring instrument is a 50K Ω /V multimeter.

IN TRANSMIT MODE

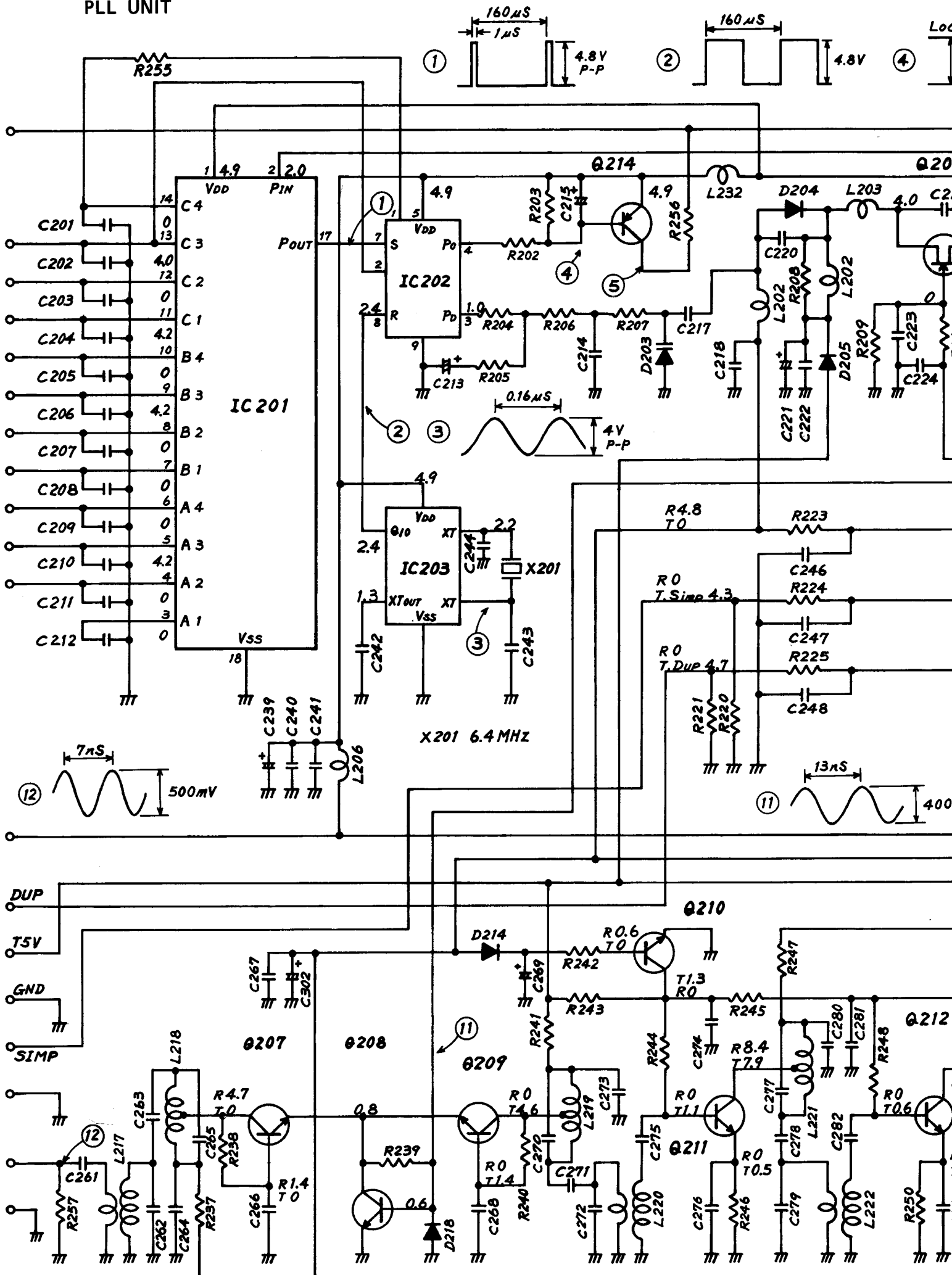
UNIT	IC No.	PIN No.																		REMARKS
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
MAIN	IC101	0	0	0	0	0	0	0	0	0	0	0	GND	0	0	GND	0			
MAIN	IC102	0	0	0	0	GND	0	0	0	0										
PLL	IC201	5.0	1.0	0	0	4.4	0	0	0	4.4	0	4.4	0	4.4	0	0	0	0	GND	f = 156.8MHz
PLL	IC202	0	4.0	1.0	4.9	4.9	0	0	2.4	GND										
PLL	IC203	0.9	1.4	1.8	0	4.9	0	2.4	2.4	GND										

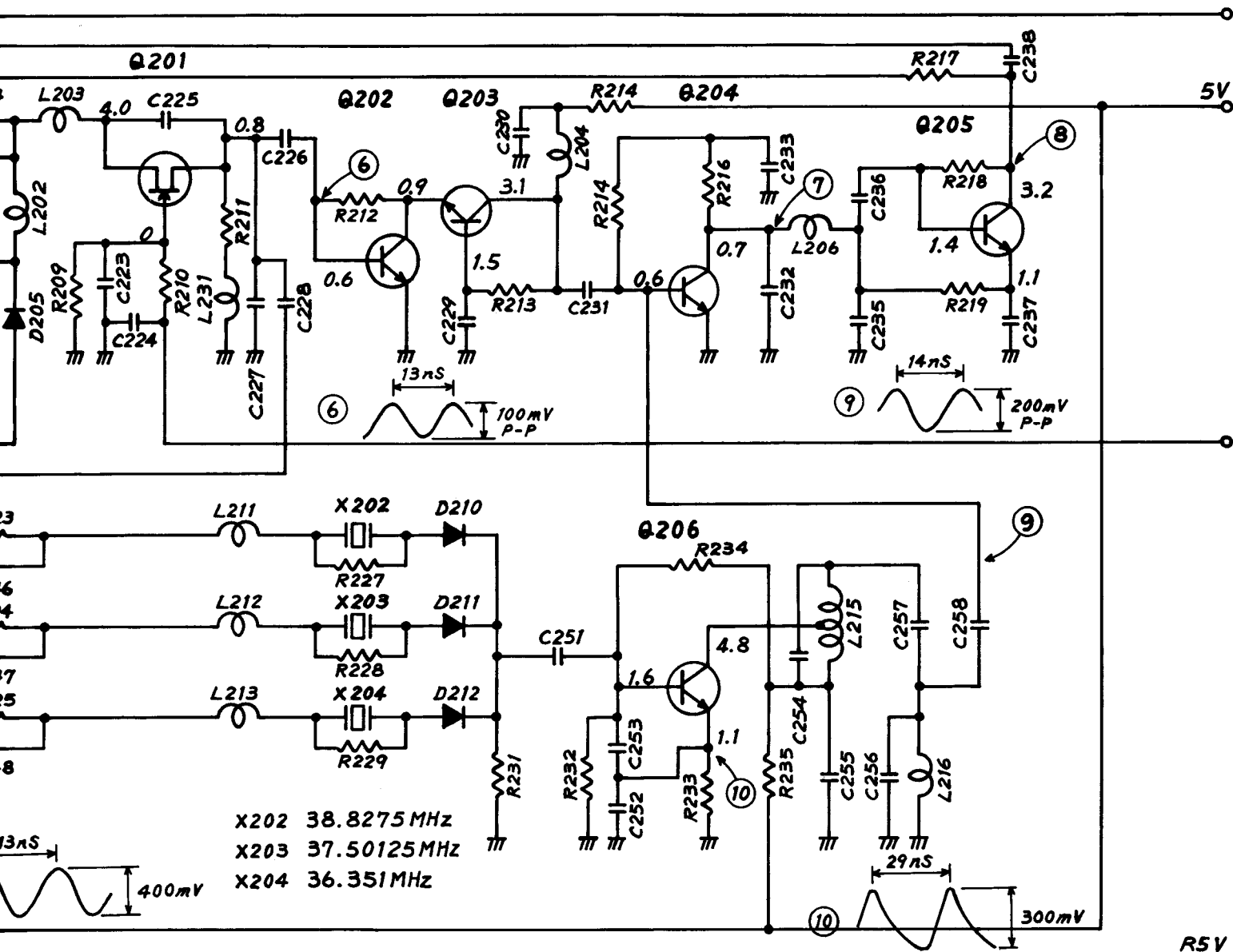
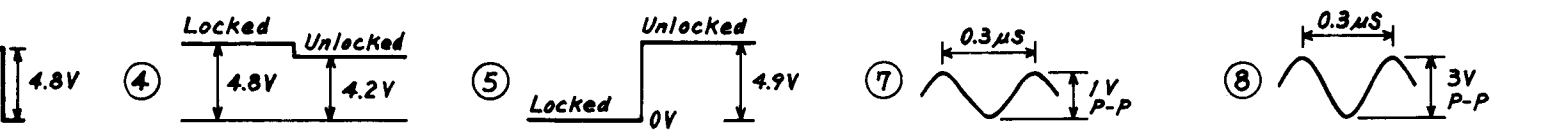
IN RECEIVE MODE

UNIT	IC No.	PIN No.																		REMARKS
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
MAIN	IC101	4.2	5.0	5.3	5.6	0.9	0.9	1.1	5.6	2.9	2.0	2.1	GND	5.1	0	GND	2.0			
MAIN	IC102	5.9	3.9	7.2	3.3	GND	3.3	3.3	3.1	7.2										SQL OPEN
PLL	IC201	5.0	1.0	0	0	4.4	0	0	0	4.4	0	4.4	0	4.4	0	0	0	0	GND	f = 156.8MHz
PLL	IC202	0	4.0	1.0	4.9	4.9	0	0	2.4	GND										
PLL	IC203	0.9	1.4	1.8	0	4.9	0	2.4	2.4	GND										

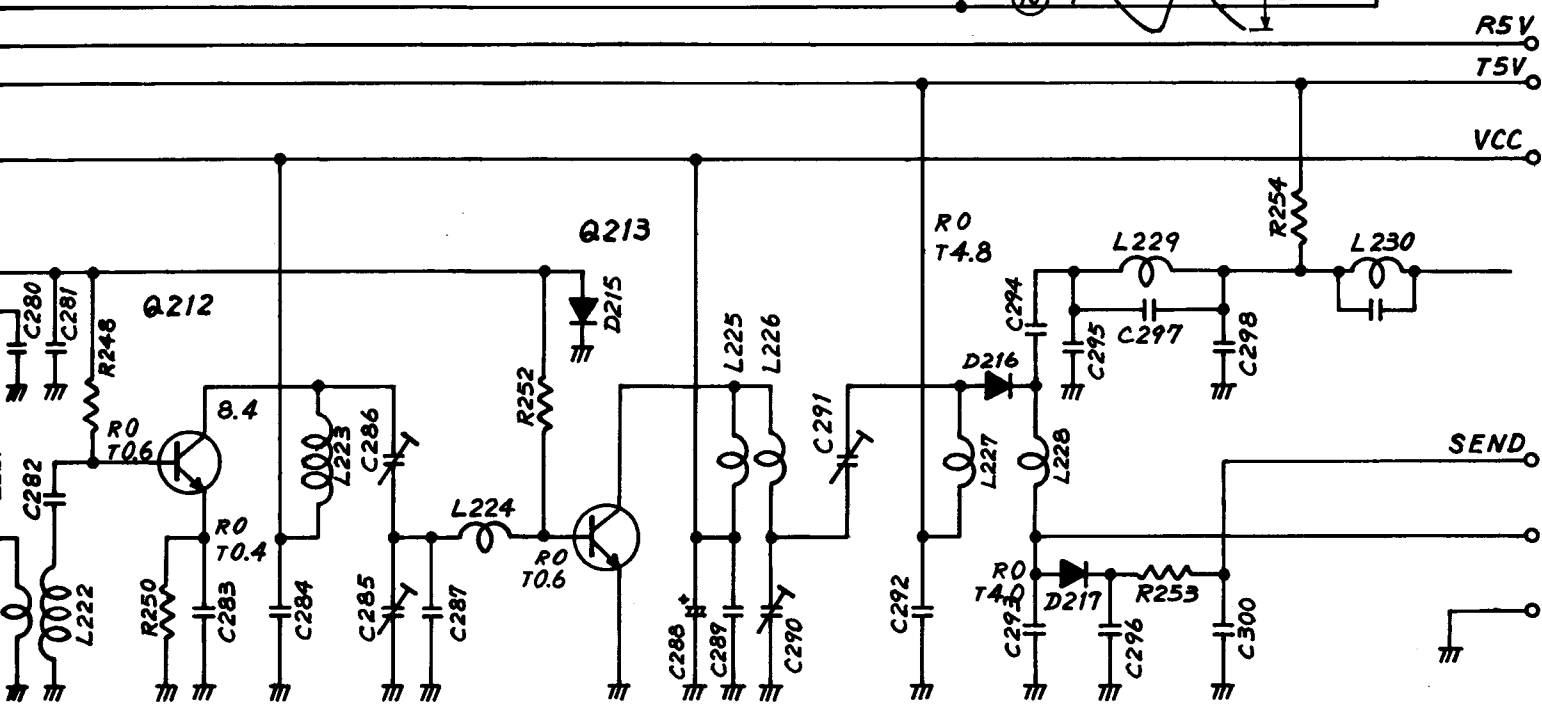


PLL UNIT



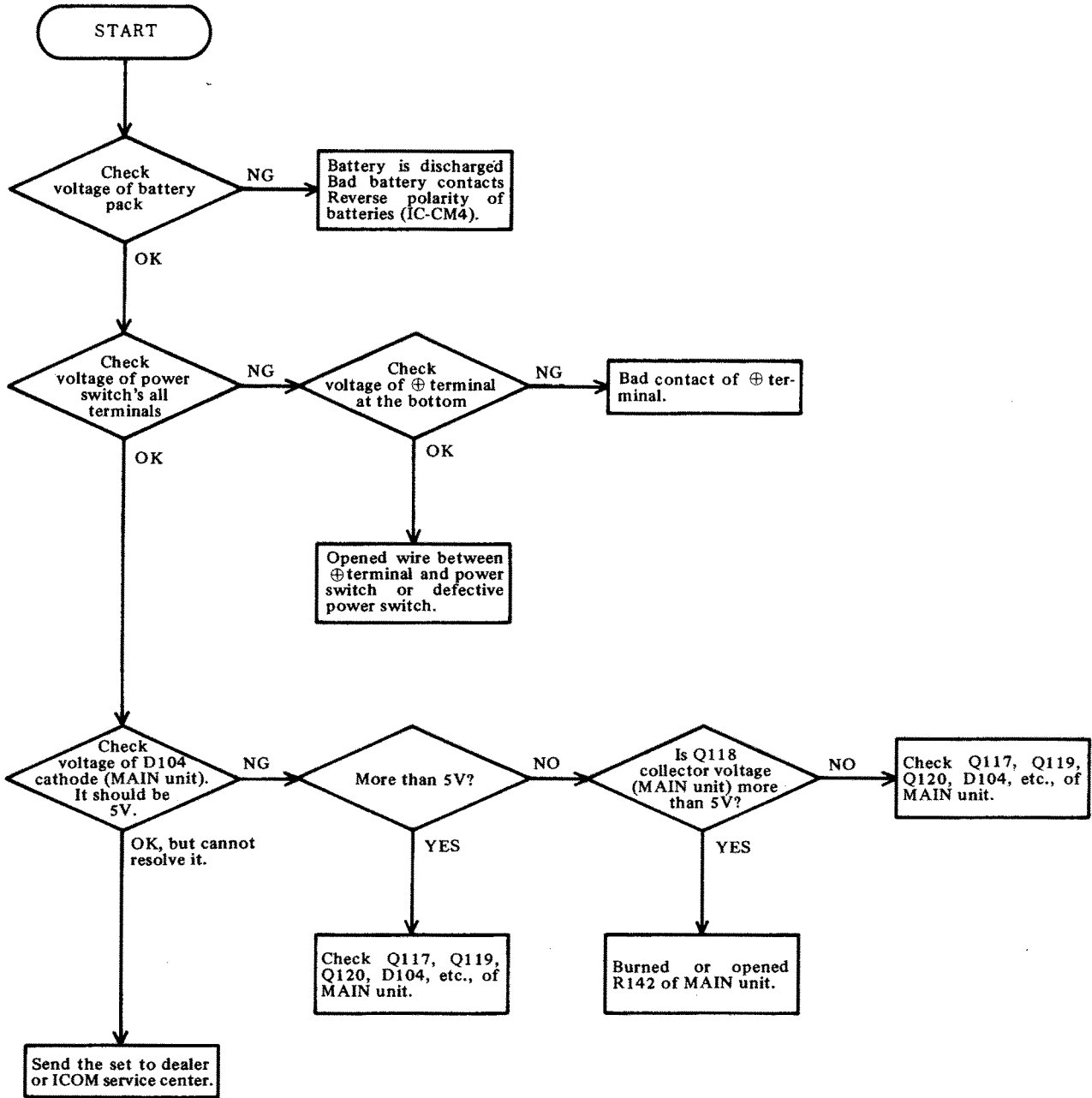


X202 38.8275 MHz
 X203 37.50125 MHz
 X204 36.351 MHz

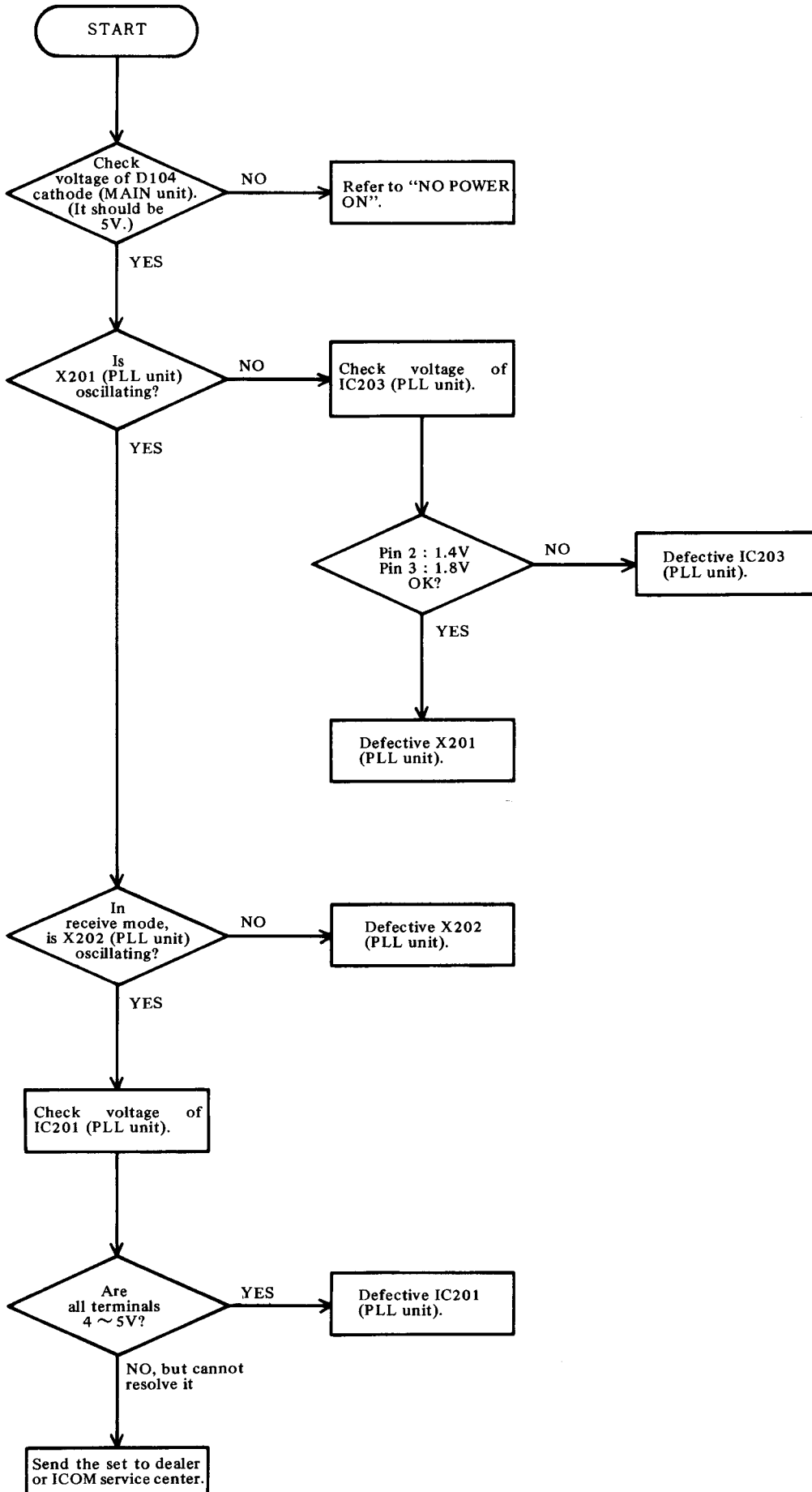


SECTION 10 TROUBLE SHOOTING

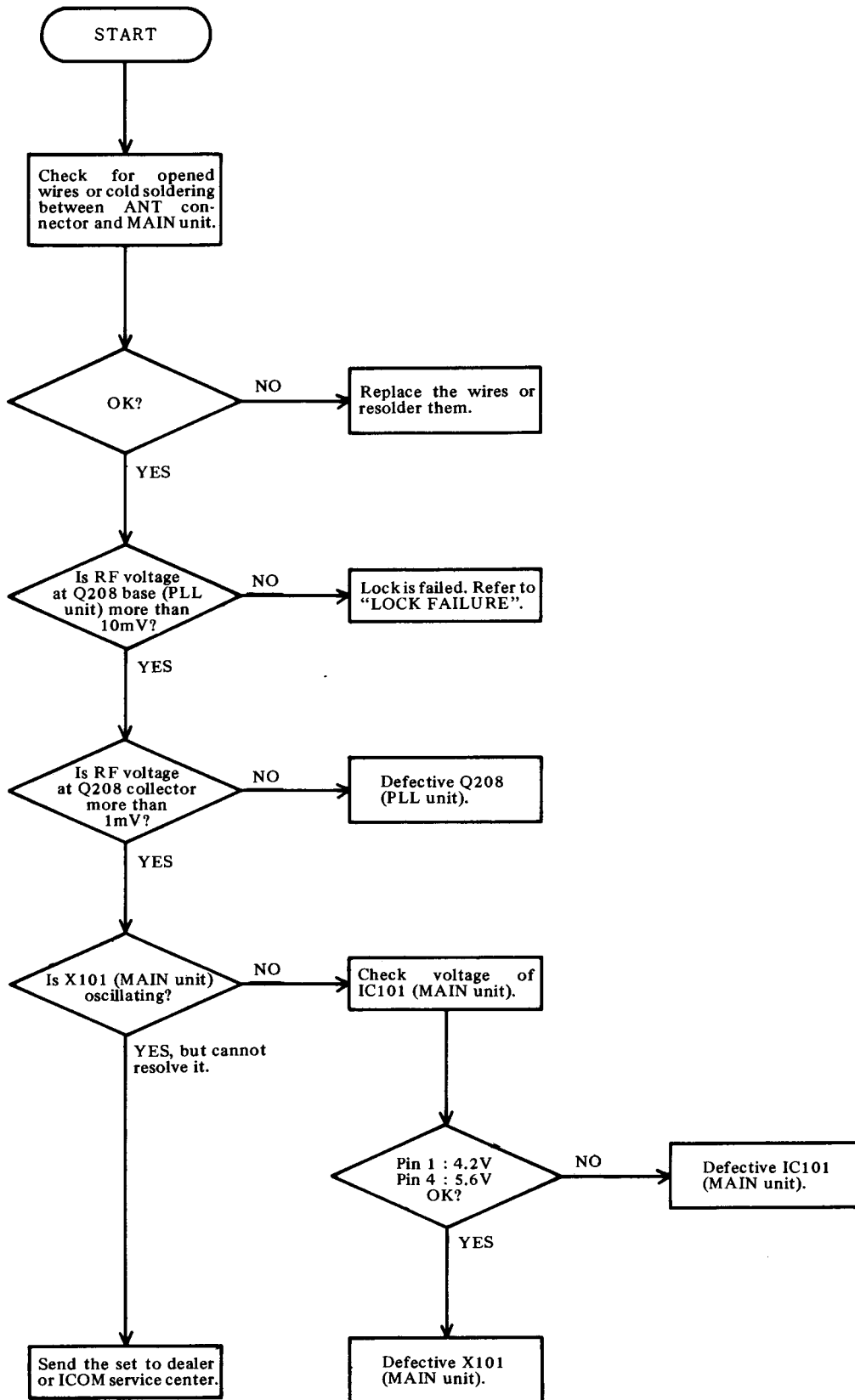
NO POWER ON



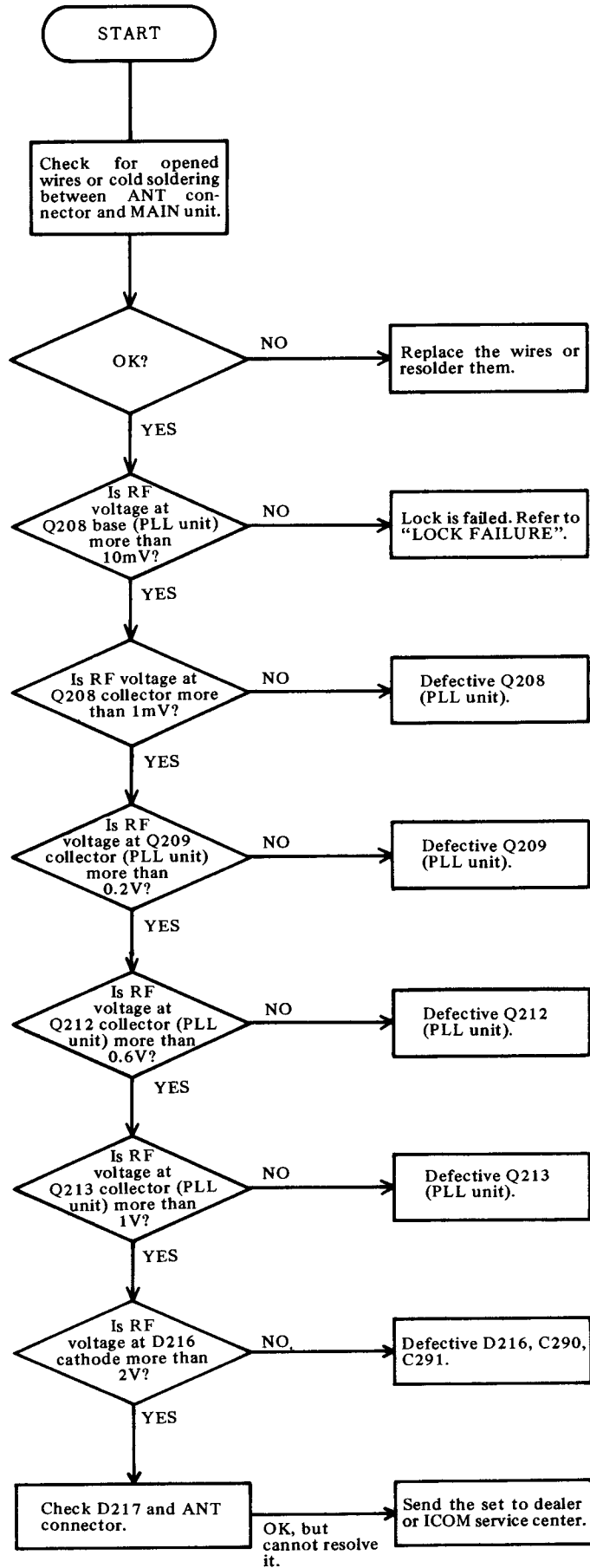
LOCK FAILURE



NO RECEPTION



NO TRANSMIT RF POWER



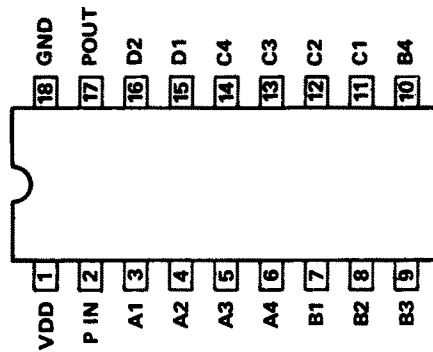
SECTION 11 IC SPECIFICATIONS

TC-9122P (BCD PROGRAMMABLE COUNTER)

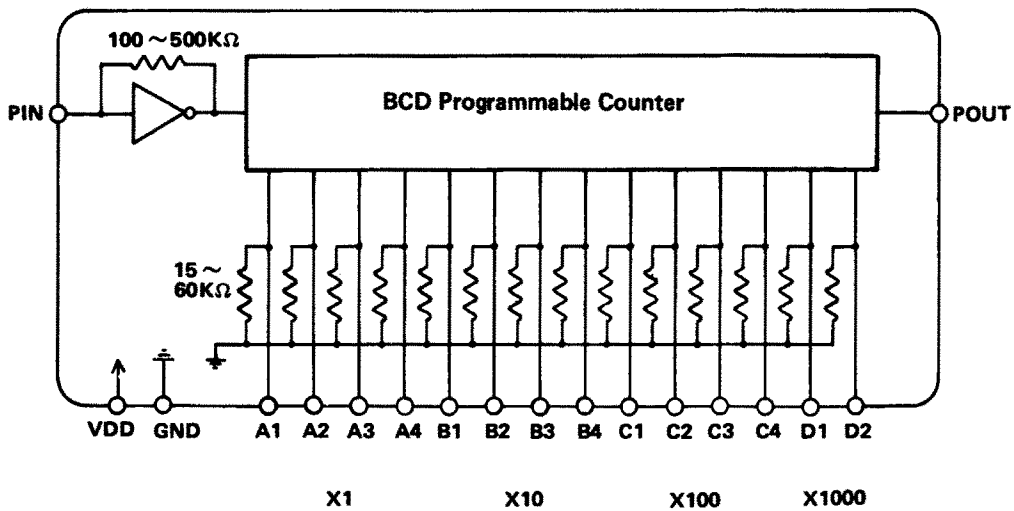
MAXIMUM RATINGS (Ta = 25°C)

SYMBOL	DESCRIPTION	RATINGS	UNIT
VDD	Supply Voltage	10	V
VIN	Input Voltage	-0.3 ~ VDD +0.3	V
TOPR	Operating Temperature	-30 ~ 75	°C
TSTR	Storage Temperature	-55 ~ 125	°C

PIN CONNECTION



BLOCK DIAGRAM

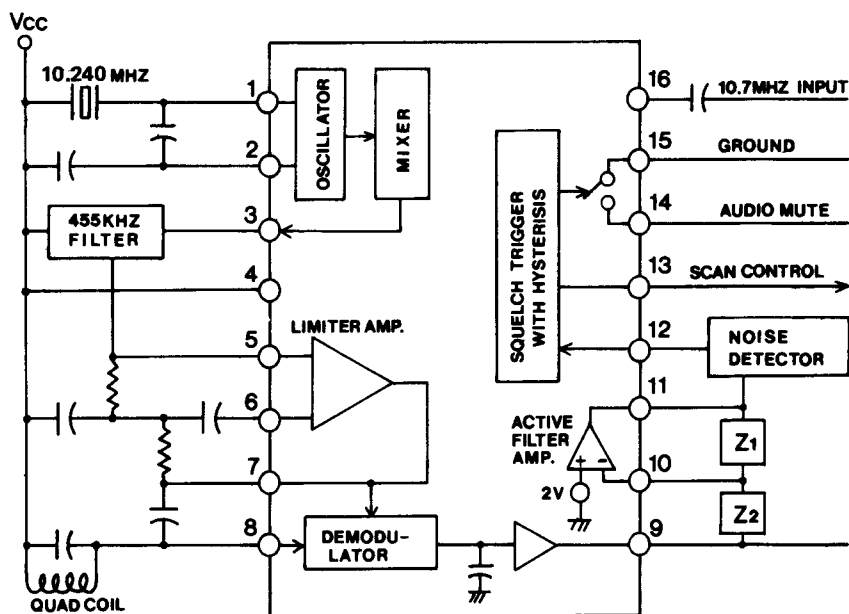


MC-3357 (LOW POWER FM IF)

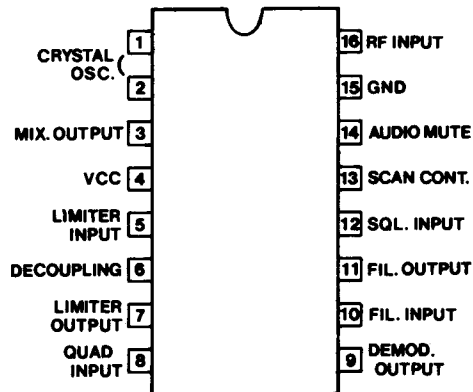
MAXIMUM RATINGS (Ta = 25°C)

SYMBOL	DESCRIPTION	RATINGS	UNIT
VCC	Supply Voltage (MAX)	12	VDC
VCC	Operating Supply Voltage	4 to 8	VDC
VIN	Input Voltage	1.0	VRMS
TOPR	Operating Temperature	-30 ~ +70	°C
TSTG	Storage Temperature	-65 ~ +150	°C

BLOCK DIAGRAM



PIN CONNECTION

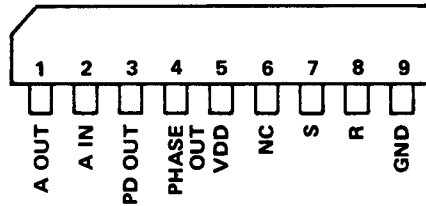


TC-5081 (PHASE COMPARATOR)

MAXIMUM RATINGS (Ta = 25°C)

SYMBOL	DESCRIPTION	RATINGS	UNIT
VDD	Supply Voltage	10	V
VIN	Input Voltage	-0.3 ~ VDD +0.3	V
TOPR	Operating Temperature	-30 ~ 75	°C
TSTR	Storage Temperature	-55 ~ 125	°C

PIN CONNECTION

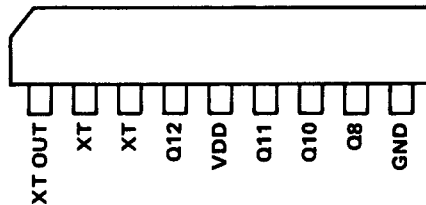


TC-5082 (OSCILLATOR AND 10 STAGE DIVIDER)

MAXIMUM RATINGS (Ta = 25°C)

SYMBOL	DESCRIPTION	RATINGS	UNIT
VDD	Supply Voltage	10	V
VIN	Input Voltage	-0.3 ~ VDD +0.3	V
TOPR	Operating Temperature	-30 ~ 75	°C
TSTR	Storage Temperature	-55 ~ 125	°C

PIN CONNECTION

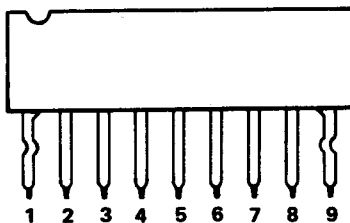


BA-526 (700mW AMPLIFIER)

MAXIMUM RATINGS (Ta = 25°C)

SYMBOL	DESCRIPTION	RATINGS	UNIT
VCC	Supply Voltage	9	V
Pd	Permissible Dissipation	700	mW
TOPR	Operating Temperature	-10 ~ +65	°C
TSTG	Storage Temperature	-30 ~ +125	°C

PIN CONNECTION



SECTION 12 PARTS LIST

[EF PARTS]

REF NO.	DESCRIPTION (PART NO)	BOARD LOCATION
D1	LED SLC-26UR	
R1	Variable Resistor K121B1003E5N 1111-10KA	(VOL)
R2	Variable Resistor K121B0006E -10KB	(SQL)
C1	Ceramic 470pF/50V	
C2	Ceramic 470pF/50V	
C3	Ceramic 15pF/50V	
J1	Connector BNC-RM	(ANT)
J2	Connector HSJ0296-01-150	(EXT SP)
J3	Connector HSJ0289-01-050	(MIC)
P1	Connector XHP-12	
P2	Connector XHP-5	
S1	Rotary Switch SRM101C	
SP1	Speaker 45P30S	
MC1	Microphone EM-80	
B1	P.C. Board B-415 (Contact Board)	

[MAIN UNIT PARTS]

REF NO.	DESCRIPTION (PART NO)	BOARD LOCATION
Q128	Transistor 2SC2458-GR	4F
Q129	Transistor 2SC2458-GR	4G
D101	Diode 1S1555	2C
D102	Diode 1S1555	4D
D103	Zener Diode WZ-081	3C
D104	Zener Diode YZ-045B	1F
F1101	Crystal Filter 10M15B9	1B-2C
F1102	Ceramic Filter CFU455E2	3E
X101	Crystal 10.240MHz HC-18/T	2E
L101	Inductor LS-160	2A
L102	Inductor LS-160	1A
L103	Inductor LS-160	1B
L104	Inductor LS-160	1B
L105	Inductor LS-159	1C
L107	Inductor LS-158	4D
R101	Resistor 10K Ω -J ELR10	2A
R102	Resistor 100K Ω -J ELR10	1A
R103	Resistor 100 Ω -J ELR10	2B
R105	Resistor 56 Ω -J ELR10	1C
R106	Resistor 220 Ω -J ELR10	1C
R107	Resistor 47K Ω -J ELR10	2C
R108	Resistor 2.7K Ω -J ELR10	2C
R109	Resistor 330K Ω -J ELR10	2C
R110	Resistor 10K Ω -J ELR10	2C
R111	Resistor 1.5K Ω -J ELR10	2E
R112	Resistor 1.5K Ω -J ELR10	3E
R113	Resistor 47K Ω -J ELR10	3E
R114	Resistor 22K Ω -J ELR10	3D
R115	Resistor 1K Ω -J R10	4C
R116	Resistor 330K Ω -J ELR10	3D
R117	Resistor 4.7K Ω -J ELR10	4C
R118	Resistor 5.6K Ω -J ELR10	3D
R119	Resistor 1K Ω -J ELR10	1E
R120	Resistor 2.2K Ω -J ELR10	1E
R122	Resistor 3.3K Ω -J ELR10	1D
R123	Resistor 1K Ω -J ELR10	1E
R124	Resistor 3.3K Ω -J ELR10	1D
R125	Resistor 10K Ω -J ELR10	1D
R126	Resistor 10K Ω -J ELR10	1C
R127	Resistor 10K Ω -J ELR10	1C
R128	Resistor 4.7K Ω -J ELR10	1C
R129	Resistor 47 Ω -J ELR10	2E
R130	Resistor 68K Ω -J ELR10	2C
R131	Resistor 22K Ω -J ELR10	2B
R132	Resistor 10K Ω -J ELR10	3B
R134	Resistor 15K Ω -J ELR10	3C
R135	Resistor 10K Ω -J ELR10	3C
R136	Resistor 47K Ω -J R10	4D
R137	Resistor 22K Ω -J ELR10	4C
R138	Resistor 22K Ω -J ELR10	3C
R139	Resistor 330 Ω -J ELR10	4A
R140	Resistor 3.3K Ω -J ELR10	1F
R141	Resistor 4.7K Ω -J ELR10	1G
R142	Resistor 2.2 Ω -J ELR10	1G
R143	Resistor 2.7K Ω -J ELR10	1F

[MAIN UNIT PARTS]

REF NO.	DESCRIPTION (PART NO)	BOARD LOCATION
IC101	IC MC3357	2D
IC102	IC BA526	4A
Q101	Transistor 2SC2026	1A
Q102	Transistor 2SC2668-O	1A
Q103	FET 2SK192-Y	1C
Q104	Transistor 2SC2668-O	2C
Q105	Transistor 2SC2668-O	2C
Q106	Transistor 2SA1048-Y	1E
Q107	Transistor 2SC2458-GR	1E
Q108	Transistor 2SC2458-GR	1E
Q109	Transistor 2SA1048-Y	2D
Q110	Transistor 2SC2458-GR	1C
Q111	Transistor 2SA1048-Y	1C
Q112	Transistor 2SC2458-GR	2E
Q113	Transistor 2SA1048-Y	3C
Q114	Transistor 2SC2458-GR	4C
Q115	Transistor 2SC2458-GR	3B
Q116	Transistor 2SB562-C	4C
Q117	FET 2SK192-Y	1G
Q118	Transistor 2SB562-C	1G
Q119	Transistor 2SC2458-GR	1G
Q120	Transistor 2SC2458-GR	1F
Q121	Transistor 2SA1048-Y	2F
Q122	Transistor 2SA1048-Y	2E
Q123	Transistor 2SA1048-Y	1D
Q125	Transistor 2SC2458-GR	4E
Q126	Transistor 2SC2458-GR	4E
Q127	Transistor 2SA1048-Y	4F

[MAIN UNIT PARTS]

REF NO.	DESCRIPTION (PART NO)	BOARD LOCATION
R144	Thermistor 33D28	1F
R145	Resistor 470Ω -J ELR10	1F
R146	Resistor 22KΩ -J ELR10	1E
R147	Resistor 470Ω -J ELR10	1D
R148	Resistor 220KΩ-J ELR10	1F
R149	Resistor 56KΩ -J ELR10	2F
R150	Resistor 330Ω -J ELR10	1E
R151	Resistor 10KΩ -J ELR10	1D
R152	Resistor 33KΩ -J ELR10	4C
R155	Resistor 2.2KΩ -J ELR10	4D
R156	Resistor 68KΩ -J ELR10	4E
R157	Resistor 120KΩ-J ELR10	4E
R158	Resistor 470Ω -J ELR10	4E
R159	Resistor 4.7KΩ -J ELR10	4E
R160	Resistor 3.3KΩ -J ELR10	4E
R161	Resistor 2.2KΩ -J ELR10	4F
R162	Resistor 10KΩ -J ELR10	4F
R163	Resistor 33Ω -J ELR10	4F
R164	Resistor 1KΩ -J ELR10	4F
R166	Resistor 2.2KΩ -J ELR10	4F
R167	Resistor 22KΩ -J ELR10	4F
R168	Resistor 1KΩ -J ELR10	4F
R169	Resistor 82KΩ -J ELR10	4G
R170	Resistor 100KΩ-J ELR10	4G
R171	Trimmer WHS512A 10KΩ	4G
R180	Resistor 47KΩ -J ELR10	2E
R181	Resistor 1KΩ -J ELR10	2C
R182	Resistor 470Ω -J ELR10	1A
C101	Ceramic 8pF/50V	2A
C102	Ceramic 2pF/50V	2A
C103	Ceramic 100pF/50V	2A
C104	Ceramic 470pF/50V	1A
C105	Ceramic 470pF/50V	1A
C106	Ceramic 8pF/50V	1A
C107	Ceramic 8pF/50V	1B
C108	Ceramic 0.35pF/50V	1B
C109	Ceramic 0.35pF/50V	1B
C110	Ceramic 5pF/50V	1B
C111	Barrier Lay 0.0047μF/50V SS45X 1EM	1C
C112	Barrier Lay 0.0047μF/50V SS45X 1EM	1C
C114	Ceramic 4pF/50V	2B
C115	Ceramic 0.001μF/50V	2C
C116	Barrier Lay 0.0047μF/50V SS45X 1EM	2C
C117	Tantalum 10μF/6.3V ECSF6E 10	2E
C118	Barrier Lay 0.0047μF/50V SS45X 1EM	2C
C119	Ceramic 0.001μ/50V	2C
C120	Ceramic 47pF/50V	2D
C121	Ceramic 120pF/50V	2E
C122	Barrier Lay 0.1μF/12V	3E
C123	Electrolytic 0.1μF/50V AK	3E
C124	Ceramic 10pF/50V	3E
C125	Barrier Lay 0.0033μF/50V SS45X 1EM	4C
C126	Electrolytic 0.22μF/50V AK	4C
C127	Electrolytic 0.22μF/50V AK	4C
C128	Ceramic 0.001μF/50V	4C

[MAIN UNIT PARTS]

REF NO.	DESCRIPTION (PART NO)	BOARD LOCATION
C129	Ceramic 0.001μF/50V	3C
C130	Ceramic 0.001μF/50V	3C
C131	Ceramic 33pF/50V	3C
C132	Ceramic 0.001μF/50V	3C
C133	Electrolytic 4.7μF/35V RC2	1E
C134	Ceramic 470pF/50V	1E
C135	Electrolytic 1μF/50V RC2	3C
C136	Electrolytic 0.47μF/50VRC2	4D
C137	Electrolytic 1μF/50V RC2	3C
C138	Electrolytic 3.3μF/50V RC2	3D
C139	Electrolytic 10μF/16V RC2	4A
C140	Ceramic 0.001μF/50V	3A
C141	Electrolytic 0.47μF/50VRC2	4A
C142	Electrolytic 10μF/16V RC2	4A
C143	Ceramic 0.001μF/50V	4B
C144	Electrolytic 100μF/10V MS	4B
C145	Electrolytic 47μF/10V MS	4A
C146	Electrolytic 100μF/10V MS	4B
C147	Ceramic 0.001μF/50V	4C
C148	Electrolytic 47μF/25V MS	4D
C149	Ceramic 470pF/50V	1G
C150	Electrolytic 0.22μF/50V AK	1F
C151	Ceramic 470pF/50V	1F
C152	Electrolytic 100μF/10V MS	1F
C153	Ceramic 470pF/50V	1F
C154	Electrolytic 100μF/10V MS	1E
C155	Electrolytic 10μF/16V RC2	1D
C157	Electrolytic 10μF/16V RC2	4E
C158	Barrier Lay 0.01μF/50V SS45X 1EM	4D
C159	Ceramic 470pF/50V	4E
C160	Ceramic 470pF/50V	4E
C161	Ceramic 470pF/50V	4E
C162	Electrolytic 1μF/50V RC2	4E
C163	Ceramic 0.01μF/50V	4F
C164	Mylar 0.0027μF/50V	4F
C165	Mylar 0.0047μF/50V	4F
C166	Ceramic 120pF/50V	4G
C167	Electrolytic 1μF/50V RC2	4G
B101	P.C. Board B-391C Beads Core DL-20P2.6-3-1.2H	

[PLL UNIT PARTS]

REF NO.	DESCRIPTION (PART NO)	BOARD LOCATION
IC201	IC TC9122P	2E
IC202	IC TC5081P	1F
IC203	IC TC5082P-GL	1F
Q201	FET 2SK192-Y	3F
Q202	Transistor 2SC2668-O	3E
Q203	Transistor 2SC2668-O	3E
Q204	Transistor 2SC2668-O	3C
Q205	Transistor 2SC945-R	2D
Q206	Transistor 2SC2026	1C
Q207	Transistor 2SC2668-O	3G
Q208	Transistor 2SC2026	3G

[PLL UNIT PARTS]

REF NO.	DESCRIPTION (PART NO)	BOARD LOCATION
Q209	Transistor 2SC2668-O	3G
Q210	Transistor 2SC2458-GR	4G
Q211	Transistor 2SC383TM	4F
Q212	Transistor 2SC2053	4D
Q213	Transistor 2SC1947	4B
Q214	Transistor 2SA1048-Y	2E
D203	Varactor Diode 1SV50	3E
D204	Diode 1SS53	4E
D205	Diode 1SS53	4D
D210	Diode 1SS53	1C
D211	Diode 1SS53	1C
D212	Diode 1SS53	1C
D214	Diode 1S1555	3G
D215	Diode 1S1209	4C
D216	Diode 1SS53	4B
D217	Diode 1SS53	4A
D218	Diode 1S1555	3F
D219	Diode 1SS53	1F
D220	Diode 1SS53	1F
X201	Crystal 6.40000MHz HC-18/T	2F
X202	Crystal 34.82750MHz HC-18/T	2C
X203	Crystal 37.50125MHz HC-18/T	2B
X204	Crystal 36.35100MHz HC-18/T	1B
L201	Inductor LR-118	3D
L202	Inductor LR-77	4E
L203	Inductor LB-88	4E
L204	Inductor LW-20	3D
L205	Inductor 220 L4	1D
L206	Inductor LR-79	3D
L211	Inductor LB-92	3C
L212	Inductor LB-120	2B
L213	Inductor LB-120	1B
L215	Inductor LS-160	2C
L216	Inductor LS-160	3C
L217	Inductor LS-160	1G
L218	Inductor LS-160	2G
L219	Inductor LS-160	4G
L220	Inductor LS-160	4G
L221	Inductor LS-160	4F
L222	Inductor LS-160	4E
L223	Inductor LA-127	4D
L224	Inductor LA-134	4C
L225	Inductor LA-121	4B
L226	Inductor LA-121	4B
L227	Inductor LR-78	4A
L228	Inductor LA-136	4A
L229	Inductor LA-135	4A
L230	Inductor LA-143	4A
L231	Inductor LR-77	3E
L232	Inductor LR-118	3D
R202	Resistor 39KΩ -J ELR10	2F
R203	Resistor 12KΩ -J ELR10	2E
R204	Resistor 10KΩ -J ELR10	3F
R205	Resistor 470Ω -J R10	3F

[PLL UNIT PARTS]

REF NO.	DESCRIPTION (PART NO)	BOARD LOCATION
R206	Resistor 10KΩ -J ELR10	3F
R207	Resistor 100KΩ-J ELR10	3E
R208	Resistor 4.7KΩ -J ELR10	4E
R209	Resistor 220Ω -J ELR10	4F
R210	Resistor 22KΩ -J ELR10	4F
R211	Resistor 470Ω -J ELR10	3E
R212	Resistor 33KΩ -J ELR10	3E
R213	Resistor 120KΩ-J ELR10	3D
R214	Resistor 2.2KΩ -J ELR10	3C
R215	Resistor 22Ω -J ELR10	3D
R216	Resistor 10KΩ -J ELR10	2D
R217	Resistor 2.2KΩ -J R10	2D
R218	Resistor 220KΩ-J ELR10	2D
R219	Resistor 470Ω -J ELR10	2D
R220	Resistor 220KΩ-J ELR10	3B
R221	Resistor 220KΩ-J ELR10	1B
R223	Resistor 2.2KΩ -J ELR10	3C
R224	Resistor 2.2KΩ -J ELR10	3B
R225	Resistor 2.2KΩ -J ELR10	1B
R227	Resistor 2.2KΩ -J ELR10	2C
R228	Resistor 2.2KΩ -J ELR10	2B
R229	Resistor 2.2KΩ -J ELR10	1B
R231	Resistor 22KΩ -J ELR10	1C
R232	Resistor 22KΩ -J ELR10	1C
R233	Resistor 1KΩ -J ELR10	1C
R234	Resistor 33KΩ -J ELR10	2C
R235	Resistor 47Ω -J ELR10	3C
R237	Resistor 47Ω -J ELR10	2G
R238	Resistor 82KΩ -J ELR10	2G
R239	Resistor 10KΩ -J ELR10	3G
R240	Resistor 82KΩ -J ELR10	3G
R241	Resistor 47Ω -J ELR10	4G
R242	Resistor 10KΩ -J ELR10	4G
R243	Resistor 150Ω -J ELR10	4F
R244	Resistor 470Ω -J ELR10	4G
R245	Resistor 27Ω -J ELR10	4F
R246	Resistor 47Ω -J ELR10	4G
R247	Resistor 47Ω -J ELR10	4F
R248	Resistor 47Ω -J ELR10	4D
R249	Resistor 2.2KΩ -J ELR10	1F
R250	Resistor 27Ω -J ELR10	4D
R251	Resistor 47KΩ -J R10	2F
R252	Resistor 22Ω -J ELR10	4C
R253	Resistor 330Ω -J ELR10	4A
R254	Resistor 15KΩ -J ELR10	4A
R255	Resistor 2.2KΩ -J R10	2F
R256	Resistor 100KΩ-J ELR10	2E
R257	Resistor 2.2KΩ -J R10	1G
C201	Ceramic 0.001μF/50V	1E
C202	Ceramic 0.001μF/50V	1E
C203	Ceramic 0.001μF/50V	1E
C204	Ceramic 0.001μF/50V	1E
C205	Ceramic 0.001μF/50V	1E
C206	Ceramic 0.001μF/50V	1D
C207	Ceramic 0.001μF/50V	1D
C208	Ceramic 0.001μF/50V	1D
C209	Ceramic 0.001μF/50V	1D
C210	Ceramic 0.001μF/50V	1D
C211	Ceramic 0.001μF/50V	1D
C212	Ceramic 0.001μF/50V	2D
C213	Tantalum 2.2μF/16V	3F

[PLL UNIT PARTS]

REF NO.	DESCRIPTION (PART NO)	BOARD LOCATION
C214	Barrier Lay 0.01 μ F/50V SS45X 1EM	3F
C215	Electrolytic 22 μ F/10V MS9	2F
C217	Ceramic 470pF/50V	3E
C218	Ceramic 470pF/50V	3D
C220	Ceramic 51pF/50V	4E
C221	Electrolytic 100 μ F/10V MS	4D
C222	Ceramic 470pF/50V	4D
C223	Ceramic 470pF/50V	4F
C224	Ceramic 470pF/50V	4F
C225	Ceramic 10pF/50V UJ	3F
C226	Ceramic 1pF/50V	3F
C227	Ceramic 33pF/50V UJ	3F
C228	Ceramic 3pF/50V	3F
C229	Ceramic 0.001 μ F/50V	3D
C230	Ceramic 0.001 μ F/50V	3D
C231	Ceramic 12pF/50V	3D
C232	Ceramic 22pF/50V	2C
C233	Barrier Lay 0.0047 μ F/50V SS45X 1EM	3D
C235	Ceramic 22pF/50V	1D
C236	Ceramic 0.001 μ F/50V	2D
C237	Barrier Lay 0.0047 μ F/50V SS45X 1EM	2D
C238	Ceramic 0.001 μ F/50V	2D
C239	Electrolytic 100 μ F/10V MS	1F
C240	Barrier Lay 0.0047 μ F/50V	3E
C241	Ceramic 0.001 μ F/50V	1G
C242	Ceramic 15pF/50V	2F
C243	Ceramic 33pF/50V	2F
C244	Ceramic 33pF/50V	1G
C246	Ceramic 0.001 μ F/50V	3B
C247	Ceramic 0.001 μ F/50V	3B
C248	Ceramic 0.001 μ F/50V	1A
C251	Ceramic 0.001 μ F/50V	1C
C252	Ceramic 56pF/50V	1C
C253	Ceramic 22pF/50V	1C
C254	Ceramic 47pF/50V	2C
C255	Ceramic 0.001 μ F/50V	2C
C256	Ceramic 39pF/50V	3C
C257	Ceramic 5pF/50V	2C
C258	Ceramic 5pF/50V	3C
C261	Ceramic 47pF/50V	1G
C262	Ceramic 10pF/50V	2G
C263	Ceramic 0.5pF/50V	2G
C264	Ceramic 0.001 μ F/50V	2G
C265	Ceramic 10pF/50V	2G
C266	Ceramic 0.001 μ F/50V	3G
C267	Ceramic 470pF/50V	2F
C268	Ceramic 0.001 μ F/50V	3G
C269	Electrolytic 4.7 μ F/35V RC2	3G
C270	Ceramic 8pF/50V	4G
C271	Ceramic 0.35pF/50V	4G
C272	Ceramic 8pF/50V	4G
C273	Ceramic 0.001 μ F/50V	3G
C274	Ceramic 470pF/50V	4G
C275	Ceramic 47pF/50V	4G
C276	Ceramic 470pF/50V	4F
C277	Ceramic 8pF/50V	4F
C278	Ceramic 0.5pF/50V	4E
C279	Ceramic 8pF/50V	4E
C280	Ceramic 470pF/50V	4F

[PLL UNIT PARTS]

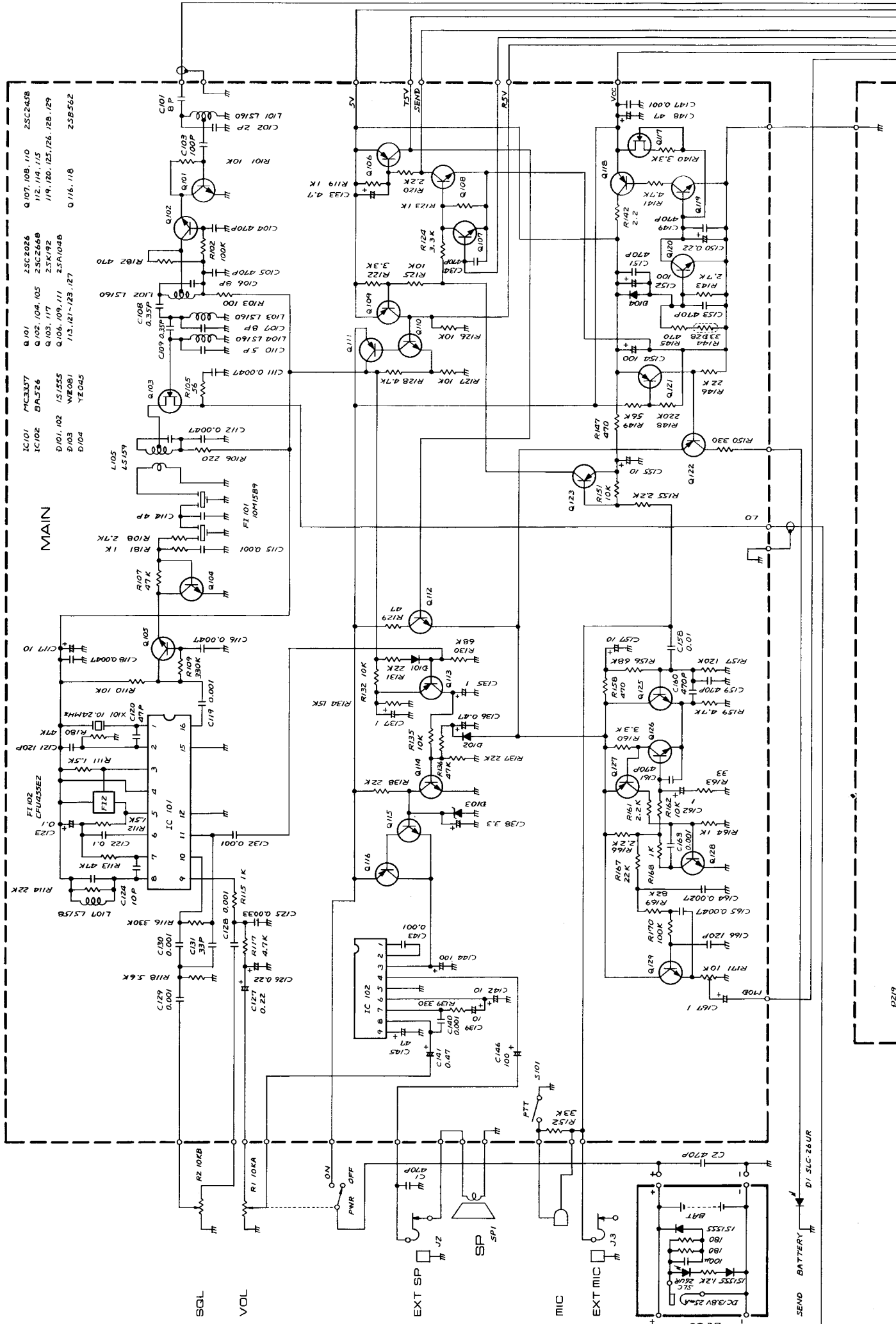
REF NO.	DESCRIPTION (PART NO)	BOARD LOCATION
C281	Ceramic 470pF/50V	4E
C282	Ceramic 47pF/50V	4E
C283	Ceramic 470pF/50V	4E
C284	Ceramic 470pF/50V	4D
C285	Trimmer 20pF MCV50D1H200	4D
C286	Trimmer 10pF MCV50D1H100	4C
C287	Ceramic 15pF/50V	4C
C288	Electrolytic 1 μ F/50V RC2	4C
C289	Ceramic 470pF/50V	4C
C290	Trimmer 10pF MCV50D1H100	4B
C291	Trimmer 20pF MCV50D1H200	4B
C292	Ceramic 470pF/50V	4A
C293	Ceramic 10pF/50V	4A
C294	Ceramic 100pF/50V	4A
C295	Ceramic 33pF/50V	4B
C296	Ceramic 100pF/50V	4A
C297	Ceramic 2pF/50V	4A
C298	Ceramic 27pF/50V	4A
C300	Ceramic 470pF/50V	4A
C302	Electrolytic 0.47 μ F/50V RC2	4C
C303	Ceramic 0.001pF/50V	2E
J201	Connector SB6P-HVQ-10	1D
J202	Connector SB4P-HVQ-10	1E
B201	P.C. Board B-390C	
	Beads Core DL-20P2.6-3-1.2H	

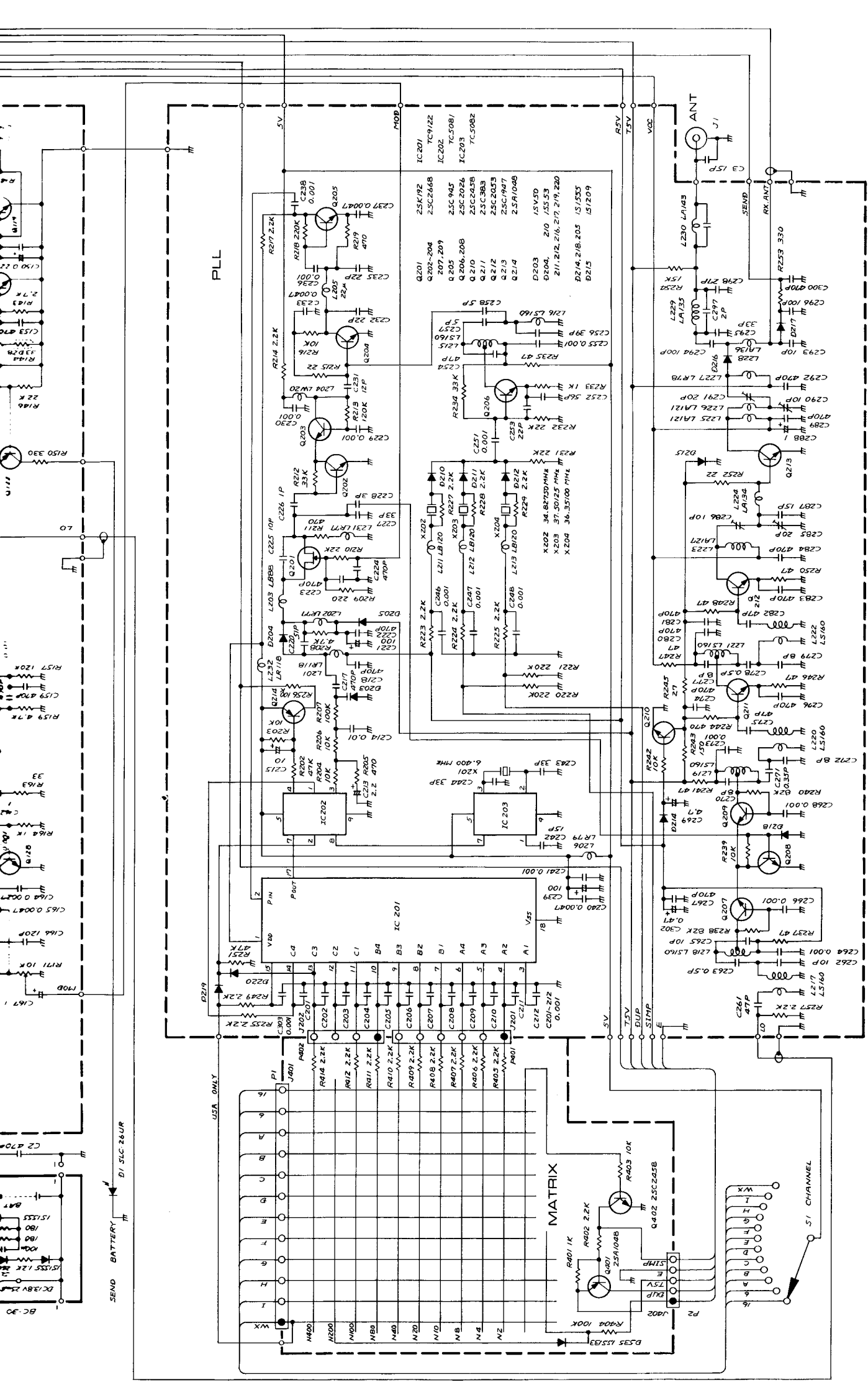
[MATRIX UNIT PARTS]

REF NO.	DESCRIPTION (PART NO)	BOARD LOCATION
Q401	Transistor 2SA1048-Y	1E
Q402	Transistor 2SC2458-GR	1E
R401	Resistor 1K Ω -J R10	1E
R402	Resistor 2.2K Ω -J R10	1E
R403	Resistor 10K Ω -J R10	1D
R404	Resistor 100K Ω -J R10	3E
R405	Resistor 2.2K Ω -J R10	3B
R406	Resistor 2.2K Ω -J R10	1D
R407	Resistor 2.2K Ω -J R10	3B
R408	Resistor 2.2K Ω -J R10	3B
R409	Resistor 2.2K Ω -J R10	3C
R410	Resistor 2.2K Ω -J R10	3C
R411	Resistor 2.2K Ω -J R10	2B
R412	Resistor 2.2K Ω -J R10	1B
R414	Resistor 2.2K Ω -J R10	3B
J401	Connector B12B-XH	1E
J402	Connector B05B-XH	2E
P401	Connector F6P-HVQ-K	1C
P402	Connector F4P-HVQ-K	1B
B401	P.C. Board B-537B	

IC-M12

SCHEMATIC DIAGRAM





Some components subject to change for an improvement without notice.

ICOM ICOM INCORPORATED



AC BATTERY CHARGER

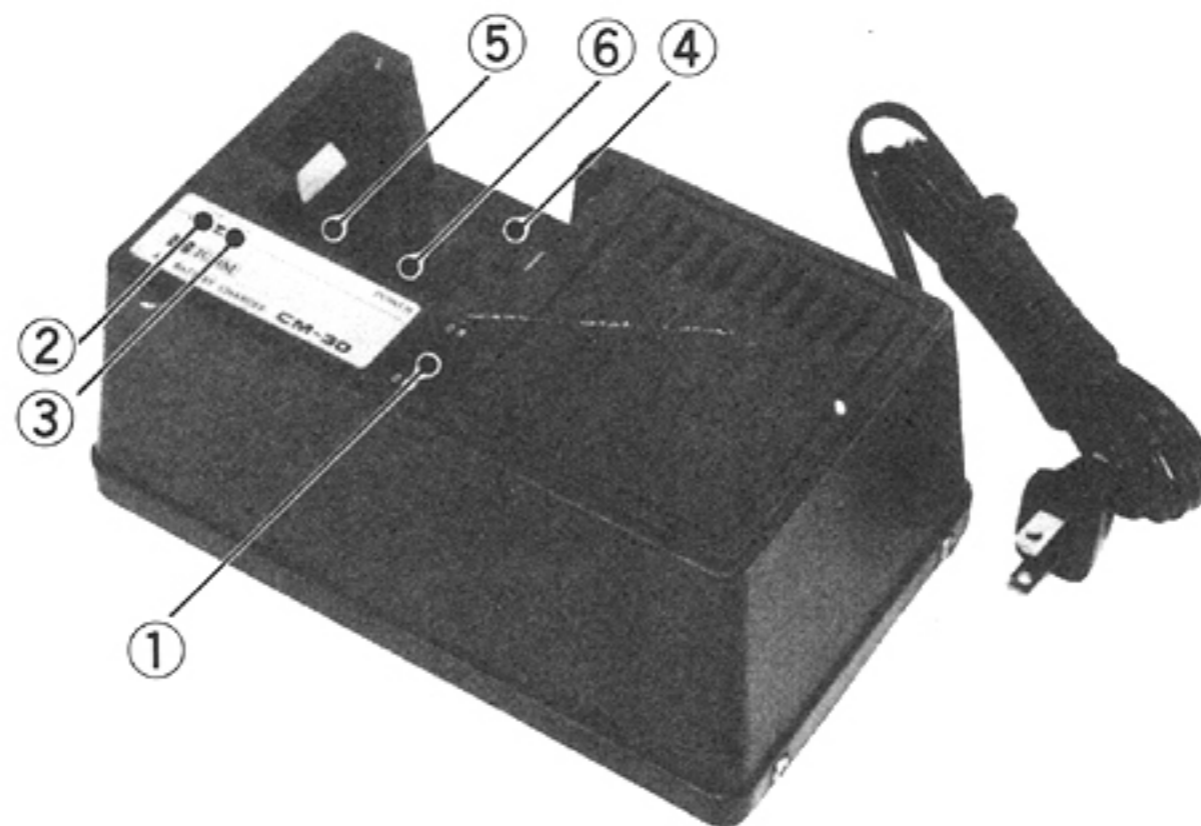
CM-30

MAINTENANCE MANUAL

SPECIFICATIONS

Applicable Battery Packs	IC-CM2, IC-CM3, IC-CM5 IC-CM4 (applies only with Nickel-Cadmium batteries inserted)
Number of Semiconductors	Transistor 9 IC 2 Diode 12
Power Supply Requirement	100/117/230V AC 50/60Hz (Input voltage can be selected by changing internal wiring.)
Charging Current	600mA for IC-CM2 and IC-CM5 25mA for IC-CM3 45mA for IC-CM4 (Nickel-Cadmium inserted)
Usable Temperature	0°C ~ +45°C for IC-CM3 and IC-CM4 +10°C ~ 40°C for IC-CM2 and IC-CM5
Dimensions	72mm(H) x 172mm(W) x 104mm(D)
Weight	Approx. 1.0kg

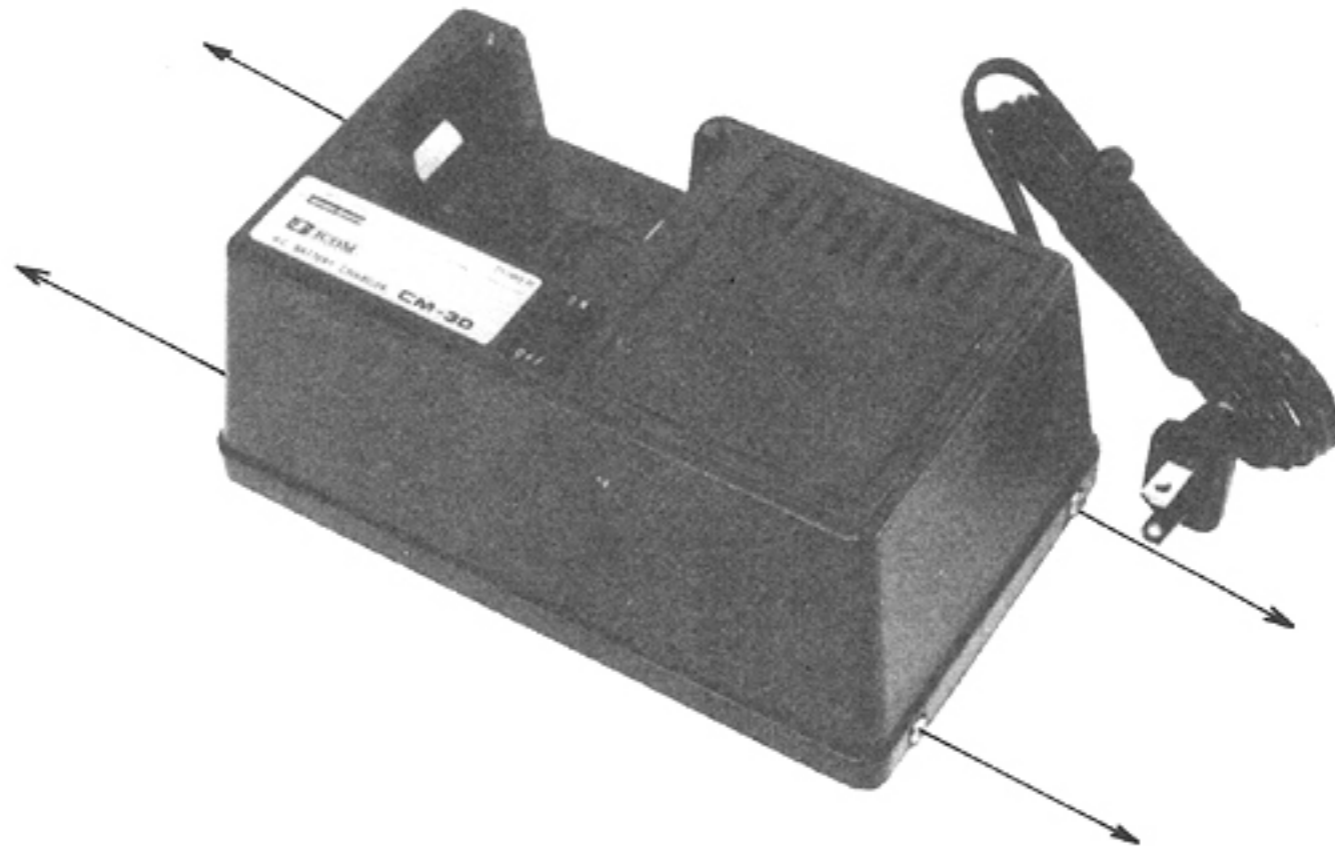
DESCRIPTION OF CONTROLS



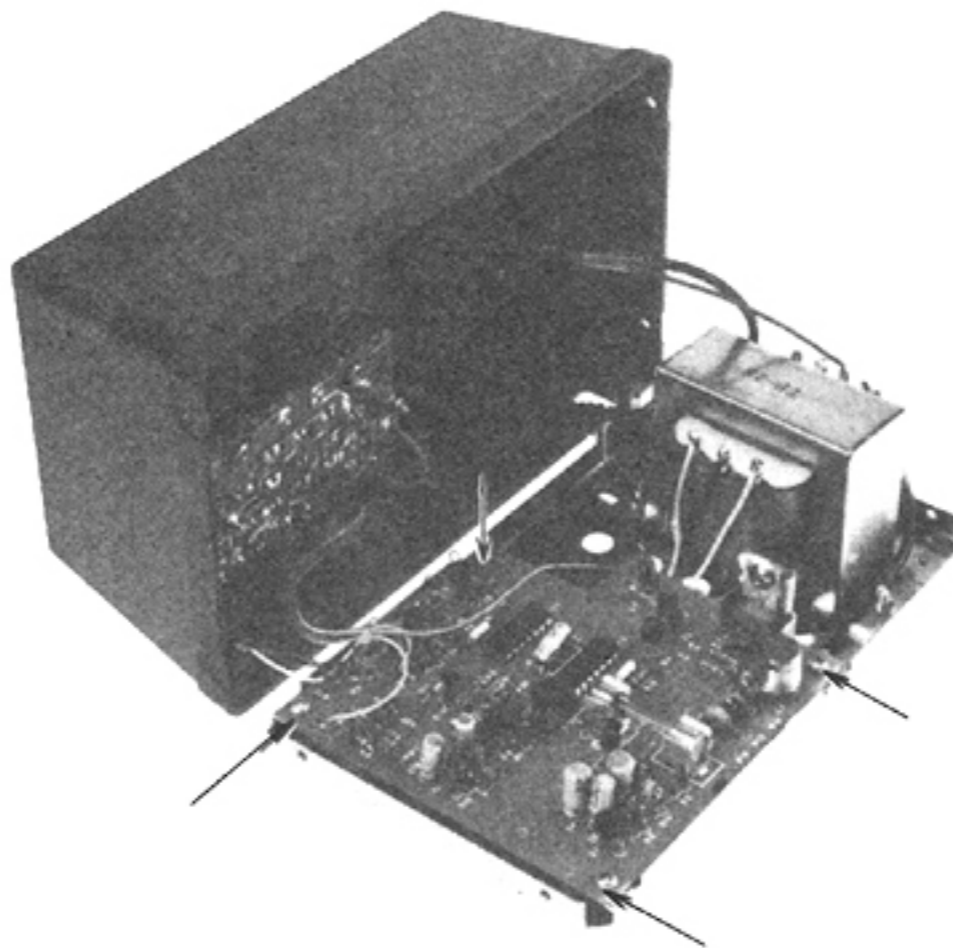
- 1. Power Switch**
When the charger is connected to a wall outlet, it turns the charger on.
- 2. Power Lamp**
Indicates power is on.
- 3. Charge lamp**
Indicates charging is underway, goes out then charging of rapid-charge packs is completed.
- 4. Insertion slot for battery packs.**
- 5. Charging terminal**
Correspond to the terminals on the bottom of the battery packs.
- 6. Microswitches.**
Since the current and capacity for each battery pack is different, these microswitches select the proper factors for each one.

DISASSEMBLING

1. Remove the four screws which have retained the cover of the unit as shown in the figure.



2. Remove the cover from the chassis with taking care to donot make damage to the internal wirings as shown. When you wish to remove the PC Board, remove the four screws at each end of the board as shown in the figure.



CIRCUIT DESCRIPTION

This charger provides proper charging current for various battery packs which is selected by charging current selector on the bottom of the battery pack.

Also a constant charging current is provided by controlling conducting phase angle of the SCR in the circuit. It keeps the current constant even if various battery packs which have different output voltage, has been used.

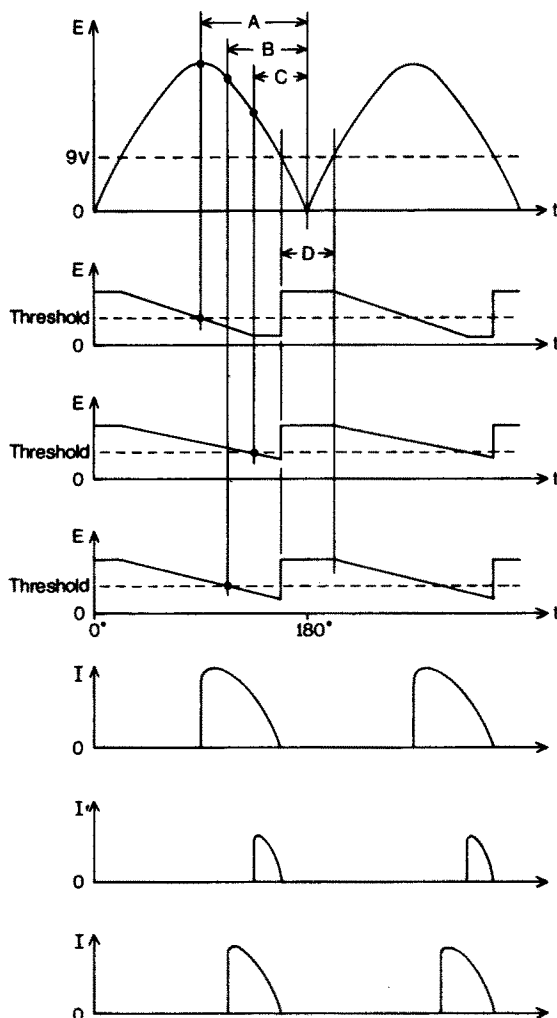
1. CONDUCTING ANGLE CONTROL CIRCUIT

A gate pulse is used to control the thyristor (SCR) in the circuit. This gate pulse is a part of a full-wave rectified wave and its phase angle is controlled by a saw tooth pulse which is synchronized to the full-wave rectified wave.

The pulse falltime of the saw tooth pulse is controlled by an actual charging current, and it decides the phase angle of the gate pulse of between 40 degrees and 160 degrees.

The saw tooth pulse generate circuit consists of Q2, Q5 and C9.

A full-wave rectified voltage is applied to the base of Q2 through R4 and turns Q2 on at near its base line (D portion in the figure), and charges C9 to +9V which from regulator Q1. When the rectified voltage exceeds +9V (out of D portion), Q2 is turned off and the charged voltage of C9 is discharged through Q5, and a saw tooth wave is generated across C9. This saw tooth pulse is fed to Pin 12 of IC2.



When the pulse voltage decreases less than gate's threshold voltage, Pin 11 of IC2 puts out H level voltage. This turns Q4 and Q3 on, and a portion of full-wave rectified voltage is fed to the gate of D6 SCR through Q3, and D6 is turned on.

When the SCR has been turned on, it holds this condition until the power source voltage becomes zero or its cathode is biased by reverse voltage. Thus, when the full-wave rectified voltage becomes less than +9V (D portion in the figure), the SCR will be turned off.

Rated charging current is decided by R37 ~ R42. R37 ~ R42 are selected by S3 ~ S5 which are turned on or off by a battery pack's charging current selector, and are in series with the charging battery.

A voltage across R37, R38 or R39 ~ R42 is integrated by R14 and C16, then fed to the base of Q6. Q5 and Q6 compose a differential amplifier. A reference voltage which is divided from +9V by R11 and R12, is applied to the base of Q5, thus the collector current of Q5 is varied by the base voltage of Q6, and controls discharging time of C9.

For example, when the charging current increases more than the specified charging current, Q6 collector current increases, Q5 collector current decreases, C9 discharging time becomes longer, the phase angle of D6 gate pulse delays (the pulse width becomes narrower), and the charging current decreases.

When the charging current decreases less than the specified charging current, the circuit functions the opposite way and keeps the charging current constant.

2. LOGIC CIRCUIT

The logic circuit is controlled by the charging current select switches S3 ~ S5, and the charging detector Q10.

When charging IC-CM2 or IC-CM5, S5 is turned on by the charging current selector on the battery pack.

The charging current (600mA) flows through R39 ~ R42, and a voltage across these resistors is applied to the base of Q10 and turns it on. Thus, a gate input Pin 1 and 2 of IC2 becomes L level, its output Pin 3 H level. This puts out H level at Pin 4 of IC1, output of a flip-flop consisting of a gate of IC1 and a gate of IC2. Also Pin 10 of IC1 puts out H level and Pin 10 of IC2 L level.

This grounds the emitter of Q4 through R10 and Pin 10 of IC2, and Q3 is turned on during Pin 11 of IC2 is H level and charges the battery pack.

When the battery pack is fully charged, the built-in thermal switch in the pack is turned off and cuts off the ⊖ charging terminal. Thus, H level is applied to Pin 1 and 2 of IC2, Pin 5 of IC1 and the flip-flop is turned to reverse condition and Pin 4 of IC1 becomes L level. This puts out H level at Pin 10 of IC2 and turns Q4 off, and any charging current does not flow even if the thermal switch has been turned on when the battery pack is cooled.

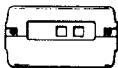


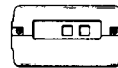
When the battery pack is removed from the charger, S5 is turned off and Pin 5 of IC1 is grounded through S5. This resets the flip-flop for another charging.

When charging IC-CM3, S3 is turned on and the charging current (25mA) flows through R37.

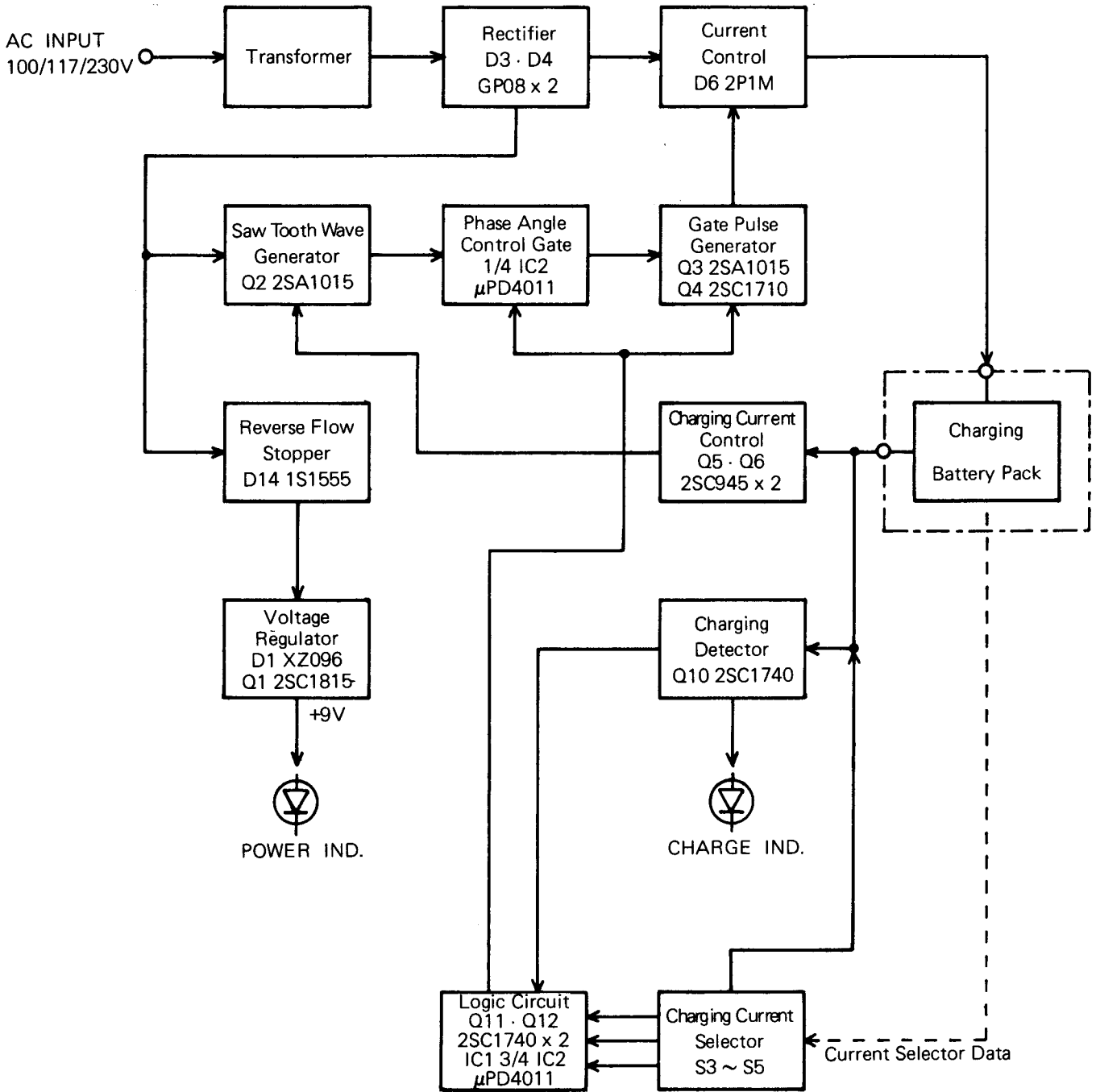
Pin 5 and 8 of IC1 are grounded through S5, Pin 10 of IC2 is L level and Q4 emitter is grounded through R10. Thus, the charging current flows until the battery pack is removed from the charger.

When charging IC-CM4 inserted nickel-cadmium batteries S4 is turned on and the charging current (45mA) flows through R38. The logic circuit works the same as charging IC-CM3.

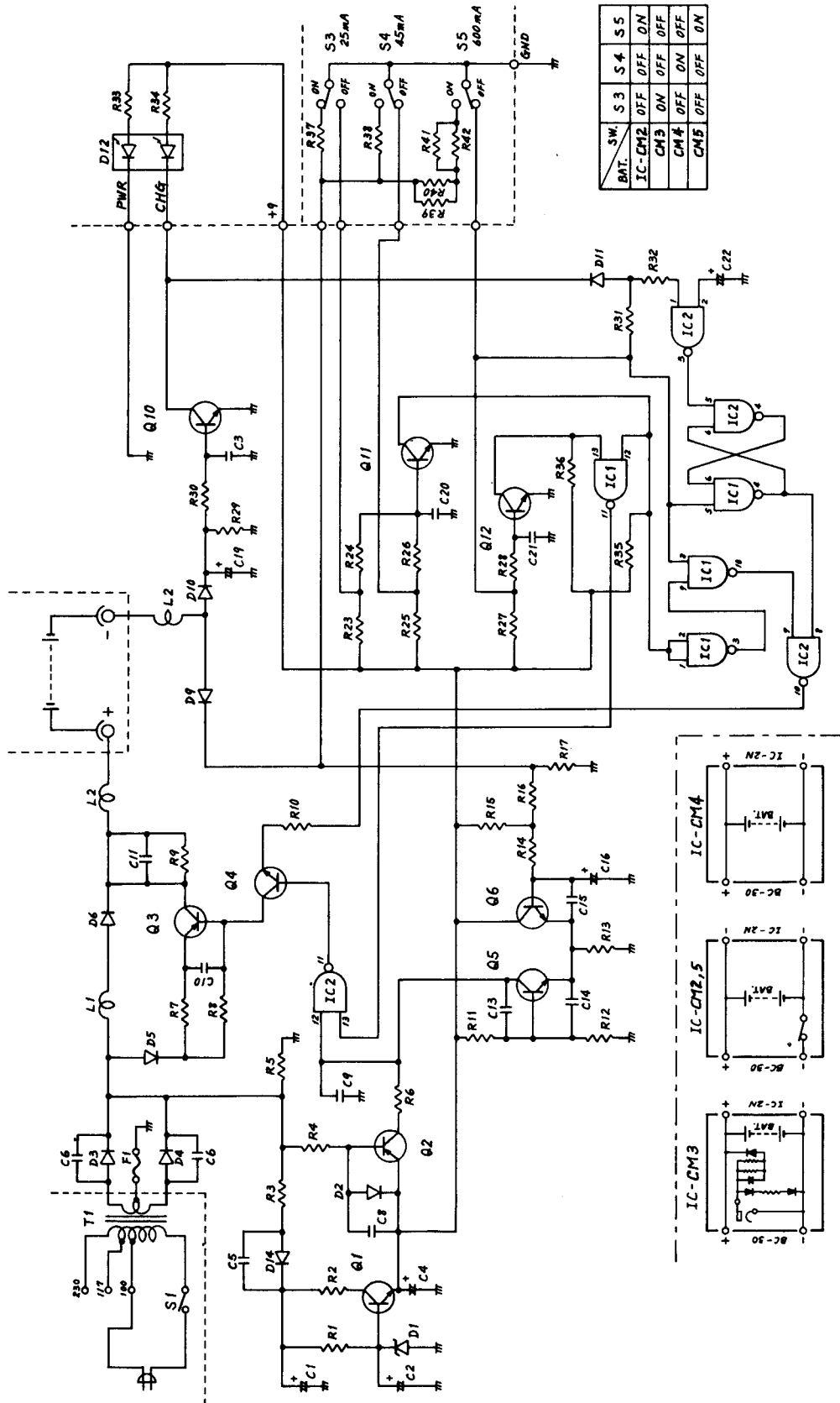
SPECIFICATIONS OF BATTERY PACKS

	IC-CM2	IC-CM3	IC-CM4	IC-CM4	IC-CM5
Cells [Capacity]	N-425A R (X 6) [400mAH]	N-250A A (X 7) [250mAH]	AA Size Alkaline (X 6)	AA Size Nickel- Cadmium (X 6)	N-425A R (X 9) [400mAH]
Voltage	7.2V	8.4V	9.0V	7.2V	10.8V
RF Output	1.0W	1.5W	1.5W	1.0W	2.3W
Charging	Rapid	Normal		Normal	Rapid
Charging Time	1 ~ 1.5H	15H		15H	1 ~ 1.5H
Suitable Charger	CM-30	CM-30 CM-25U IC-CM1		CM-30	CM-30
Charging Current	600mA	25mA		45mA	600mA
Ambient Temperature	+10°~+40°C	0°~+45°C		0°~+45°C	+10°~+40°C
Overcharge Protect	○	X		X	○
Current Selector					
Height	39m/m	39m/m	49m/m	49m/m	60m/m
Battery Replace	X	X	○	○	X

BLOCK DIAGRAM



SCHEMATIC DIAGRAM



VOLTAGE CHART

TRANSISTOR

Note: Measuring instrument is a 50K Ω /V multimeter.

BATTERY	No connection			IC-CM3 (25mA)			IC-CM4 (45mA)			IC-CM2/CM5 (600mA)		
Tr. NO.	BASE	COLLE- CTOR	EMI TTER	BASE	COLLE- CTOR	EMI TTER	BASE	COLLE- CTOR	EMI TTER	BASE	COLLE- CTOR	EMI TTER
Q 1	9.8	18.0	9.2	9.8	14.5	9.1	9.8	14.5	9.2	9.8	13.0/20.0	9.2
Q 2	9.4	2.9	9.2	9.4	6.2	9.1	9.4	6.2	9.2	9.4	5.2/4.4	9.2
Q 3	16.5	15.0	17.0	16.0	2.7	3.2	16.0	2.4	2.6	14.0	5.0/7.8	14.0
Q 4	9.1	16.5	8.5	1.75	16.0	1.65	1.6	16.0	1.7	3.6/4.8	14.0	3.3/4.4
Q 5	0.9	2.4	0.32	1.0	6.0	0.45	1.0	6.2	0.45	1.0	4.9/3.9	0.44/0.42
Q 6	0.7	9.2	0.32	1.05	9.1	0.45	1.0	9.2	0.45	1.0	9.1	0.44/0.42
Q10	0	7.6	GND	0.75	0.1	GND	0.74	0.1	GND	0.75	0.1	GND
Q11	0	9.0	GND	0.65	0.1	GND	0.65	0.1	GND	0	8.9	GND
Q12	0	9.0	GND	0	9.0	GND	0	9.0	GND	0.65	0.1	GND

IC

IC NO.	Condition	PIN NO.													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
IC1	—	9.0	9.0	0	9.0	0	0	GND	0	0	9.0	0	9.0	9.0	9.0
	25mA	0	0	9.0	9.0	0	0	GND	0	9.0	9.0	9.0	0	9.0	9.0
	45mA	0	0	9.0	9.0	0	0	GND	0	9.0	9.0	9.0	0	9.0	9.0
	600mA	9.0	9.0	0	9.0	9.0	0	GND	9.0	0	9.0	9.0	9.0	0	9.0
	CUT	9.0	9.0	0	0	9.0	9.0	GND	9.0	0	9.0	9.0	9.0	0	9.0
IC2	—	0	0	9.0	0	9.0	9.0	GND	9.0	9.0	0	9.0	2.5	0	9.0
	25mA	0	0	9.0	0	9.0	9.0	GND	9.0	9.0	0	*1.0	*6.0	9.0	9.0
	45mA	0	0	9.0	0	9.0	9.0	GND	9.0	9.0	0	*1.0	*5.0	9.0	9.0
	600mA	0.8	0.8	9.0	0	9.0	9.0	GND	9.0	9.0	0	*3.5	*5.0	9.0	9.0
	CUT	4.3	4.3	0	9.0	0	0	GND	0	9.0	9.0	6.0	4.2	9.0	9.0

*Will be varied by battery voltage and/or charging conditions.

PARTS LIST

REF. NO.	DESCRIPTION	REF. NO.	DESCRIPTION
IC1	IC μ PD4011	R29	Resistor 100K R25
IC2	IC μ PD4011	R30	Resistor 5.6K R25
Q1	Transistor 2SC1815-O, Y, GL, BL	R31	Resistor 470K R25
Q2	Transistor 2SA1015-Y	R32	Resistor 22K R25
Q3	Transistor 2SA1015-Y	R33	Resistor 680 R25
Q4	Transistor 2SC1740-Q, R, S, E	R34	Resistor 680 R25
Q5	Transistor 2SC945-P	R35	Resistor 10K ELR25
Q6	Transistor 2SC945-P	R36	Resistor 10K ELR25
Q10	Transistor 2SC1740-Q, R, S, E	R37	Resistor 27 R25
Q11	Transistor 2SC1740-Q, R, S, E	R38	Resistor 15 R25
Q12	Transistor 2SC1740-Q, R, S, E	R39	Resistor 1 R25
D1	Zener XZ-096	R40	Resistor 1 R25
D2	Diode 1S1555	R41	Resistor 1 R25
D3	Diode GP-08B	R42	Resistor 1 R25
D4	Diode GP-08B	C1	Electrolytic 47 μ F/25V
D5	Diode 1S1555	C2	Electrolytic 10 μ F/16V
D6	SCR 2P1M	C3	Ceramic 470P
D9	Diode GP-08B	C4	Electrolytic 100 μ F/10V
D10	Diode 1S1555	C5	Ceramic 0.0047
D11	Diode 1S1555	C6	Ceramic 0.0047
D12	LED LD-002R	C7	Ceramic 0.0047
D14	Diode 1S1555	C8	Ceramic 470P
L1	Choke LW-16	C9	Barrier Lay 0.047
L2	Choke LW-9	C10	Ceramic 470P
L3	Choke LW-9	C11	Ceramic 470P
R1	Resistor 820 ELR25	C13	Ceramic 470P
R2	Resistor 220 ELR25	C14	Ceramic 470P
R3	Resistor 33 ELR25	C15	Ceramic 470P
R4	Resistor 22K ELR25	C16	Electrolytic 47 μ F 10V
R5	Resistor 2.2K ELR25	C19	Electrolytic 22 μ 16V
R6	Resistor 3.3K ELR25	C20	Ceramic 470P
R7	Resistor 1K R25	C21	Ceramic 470P
R8	Resistor 10K R25	C22	Electrolytic 2.2 μ 50V
R9	Resistor 1K ELR25	S1	Switch SDJ2S
R10	Resistor 47K R25	S3	Switch D2MS
R11	Resistor 22K ELR25	S4	Switch D2MS
R12	Resistor 2.7K ELR25	S5	Switch D2MS
R13	Resistor 1.5K ELR25	PC Board	B-439B
R14	Resistor 22K ELR25	HEATSINK	41912
R15	Resistor 15K ELR25	Fuse Holder	S-N5051
R16	Resistor 680 ELR25	Fuse	2A
R17	Resistor 820 ELR25	T1	Transformer TP-25
R23	Resistor 10K ELR25	Power Cord	OPC-013
R24	Resistor 100K ELR25		
R25	Resistor 10K ELR25		
R26	Resistor 100K ELR25		
R27	Resistor 10K ELR25		
R28	Resistor 100K ELR25		