ICOM

SERVICE MANUAL

VHF TRANSCEIVER

IC-H6

Icom Inc.

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SECTION 1 SPECIFICATIONS

GENERAL

Number of Semiconductors	Transistors 43 FET 3 IC 5 Diodes 15 (not including diodes on the matrix board)
Number of Channels	6 programmable channels (Transmit and Receive frequencies are programmable independently for each channel) Operation; Simplex, Semi-duplex
Channel Spacing	25KHz (5KHz increments frequencies are programmable)
Frequency Stability	0.001 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 7 to 12V negative ground is acceptable
Current Drain at 8.4V	Transmitting At 2.5 watts output Approx. 700mA 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

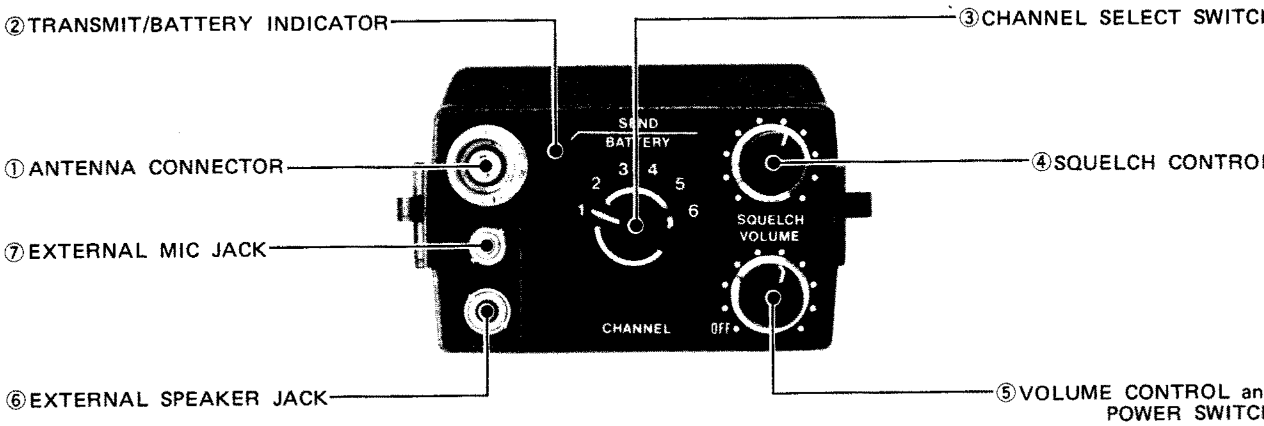
Frequency Range	Specified 2MHz segment (5MHz with reduced specification) within; 150.005 ~ 155.000MHz 155.005 ~ 160.000MHz 160.005 ~ 165.000MHz 165.000 ~ 170.000MHz
Receiving System	Double-conversion superheterodyne
Modulation Acceptance	$16F_3$ ±7.5KHz (F3E 16K0)
Intermediate Frequency	1st: 16.9MHz 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 60dB
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

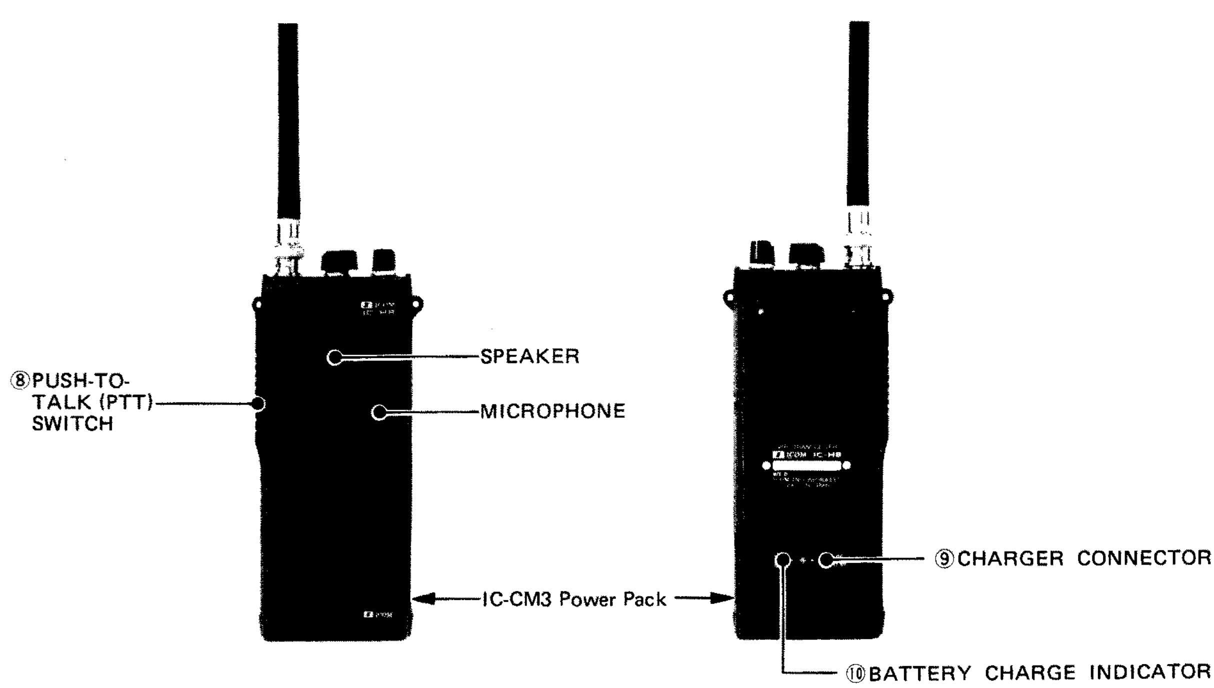
Frequency Range	Specified 2MHz segment (5MHz with reduced specification)
Output Power	2.5 Watts (4 watts with 10.8V battery pack IC-CM5)
Emission Mode	$16F_3$ (F3E 16K0)
Modulation System	Variable reactance frequency modulation
Max. Frequency Deviation	±5KHz
Spurious Emission	More than 60dB below carrier
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.

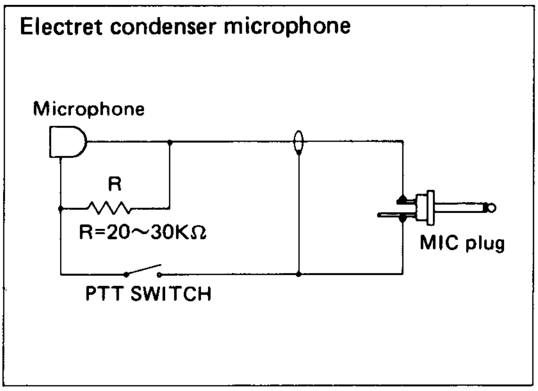
③ **CHANNEL SELECT SWITCH**
Selects one of the programmed channels.

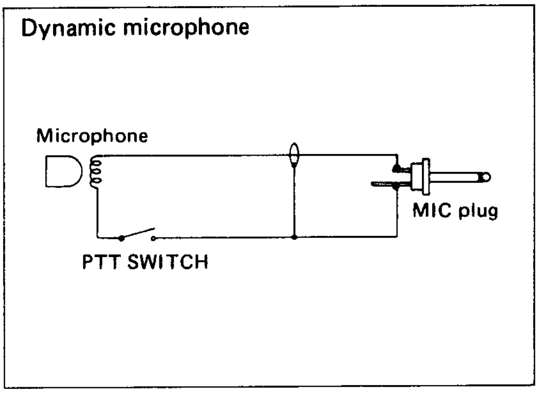
④ **SQUELCH CONTROL**
Sets the squelch threshold level. To turn OFF the squelch function, rotate this control completely counterclockwise. To set the threshold level higher, rotate the control clockwise.

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 quater 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 140MHz signal* is supplied from the PLL circuit to convert the RF signals into 16.9MHz first IF signals. (*This frequency differs depending on the version, and it can be calculated by formula; "Receive frequency" – 16.9MHz.)

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 FI101, 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 16.445MHz 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 FI102 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* signal 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.
(*This frequency differs depending on the version.)

3-2-3 POWER AMPLIFIER CIRCUIT

The output signals from Q212 is fed to the power amplifier Q213, and amplified to 2.5 watts.
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 35.77625MHz* with X202 for receive, 40.00125MHz* with X203 for 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.
(*These frequencies differ depending on the version.)

In the receive mode, R+6V is applied to D210 through R223, L211 and R227, and D210 is turned ON and selects X202.

In the transmit mode, T+6V is applied to D211 through R224, L212 and R228, and D211 is turned ON and selects X203.

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:

$$N \text{ (divide number of programmable divider)} = \frac{\text{Receive (or Transmit) Frequency (MHz)} - \text{Local Osc Frequency (MHz)}}{0.005} - 1000$$

3-3-4 REFERENCE FREQUENCY GENERATOR CIRCUIT

Reference frequency generator IC203 consists of a crystal oscillator and a highspeed divider. X201 oscillates at 5.12MHz, which is divided by 2048. The 2.5KHz reference frequency is fed to phase detector IC202. This 2.5KHz 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 2.5KHz 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 Oscilator) is a Colpitts circuit using Q201, and oscillates in 70 ~ 80MHz 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+6V 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+6V 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 6V 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 6V regulator consisting of Q117 ~ Q120 and zener diode D104. This regulated 6V 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+6V is actuated, and supplied to the transmitter circuit. At the same time, T+6V 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+6V 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+6V 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 7V, 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 6V source. When the power supply voltage is more than 7V, Q121 is turned OFF, Q122 is turned ON and T+6V is applied to the LED through Q122 and R150, and the LED is lit.

3-4-3 DIODE MATRIX BOARD

The set incorporates a diode matrix board to determine its operation frequencies, and six channels each can be programmed into the board for transmit and receive.

+6V is applied to each channel line, one of receive channels 1 ~ 6 and transmit channel 1 ~ 6, 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.

When duplex transmit function is required, calculate each N value for transmit frequency and receive frequency and program diodes into the board independently.

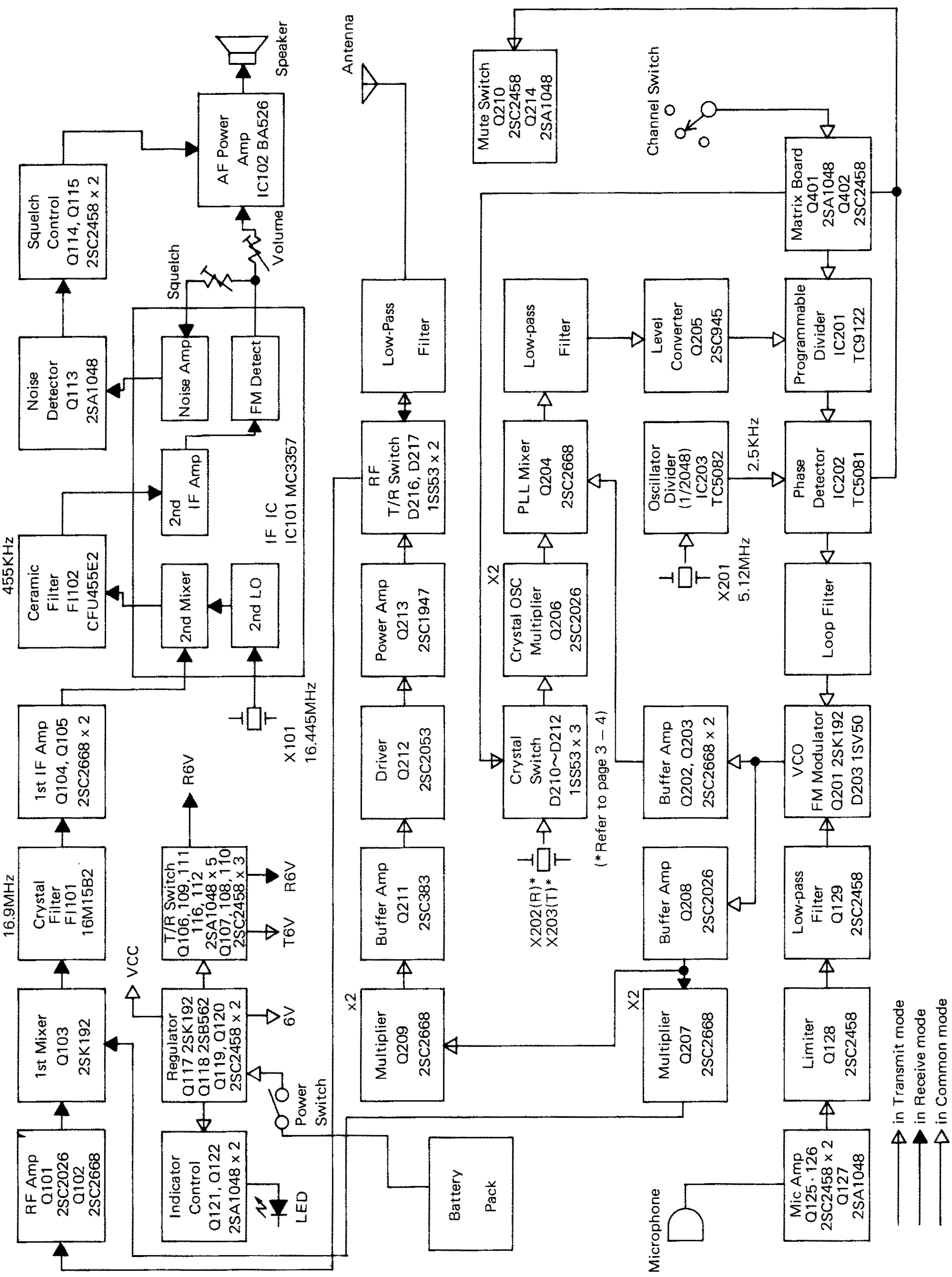
The receive only function is provided for channel 2 ~ Channel 6 by inserting a diode into the receive only line. At this time, a voltage is applied to the base of Q107 on the MAIN board through R404, and it turns Q107 ON and Q106 OFF. Thus, the set does not turn to the transmit mode, even if the PTT switch is depressed.

Crystal Frequency Chart

Operating Frequency Range	Crystal Frequency (MHz)		Local Oscillator Frequency (MHz)
	X202 (Receive)	X203 (Transmit)	
150.005 ~ 155.000MHz	32.02625	36.25125	145.005
155.005 ~ 160.000MHz	33.27625	37.50125	150.005
160.005 ~ 165.000MHz	34.52625	38.75125	155.005
165.005 ~ 170.000MHz	35.77625	40.00125	160.005

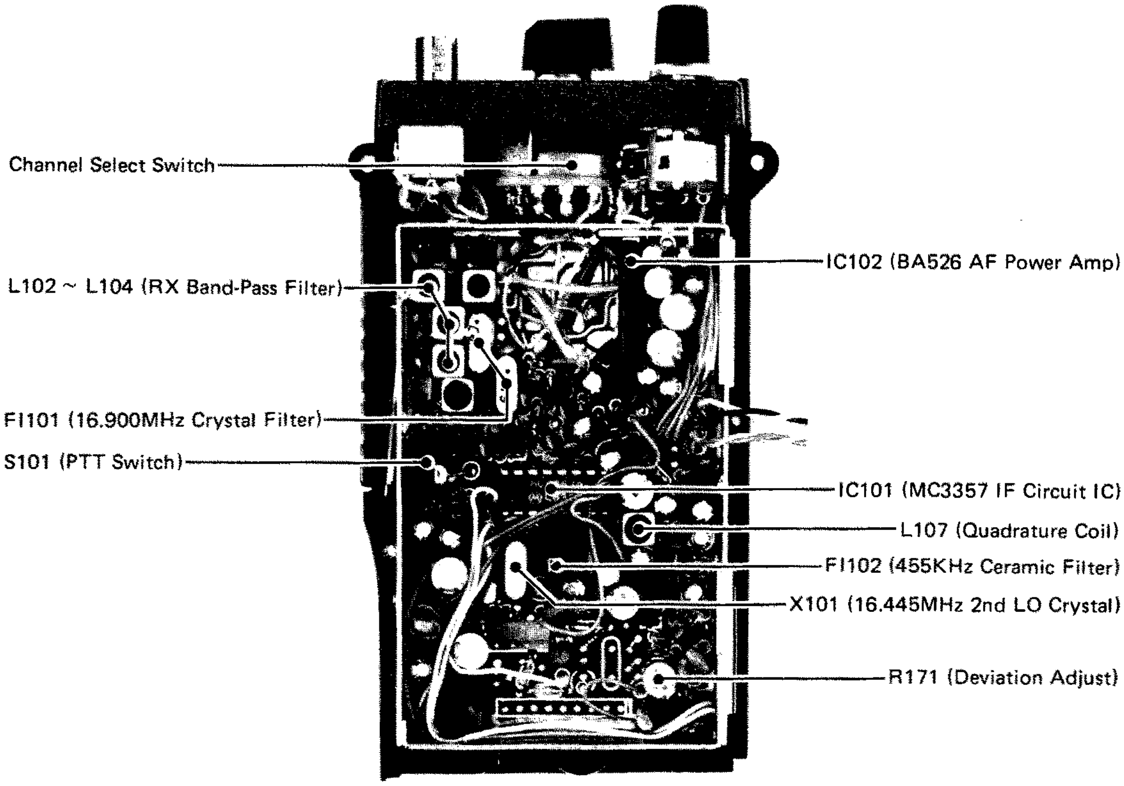
NOTE: The local oscillator frequency for calculation N value is the four times of the crystal frequency.

SECTION 4 BLOCK DIAGRAM

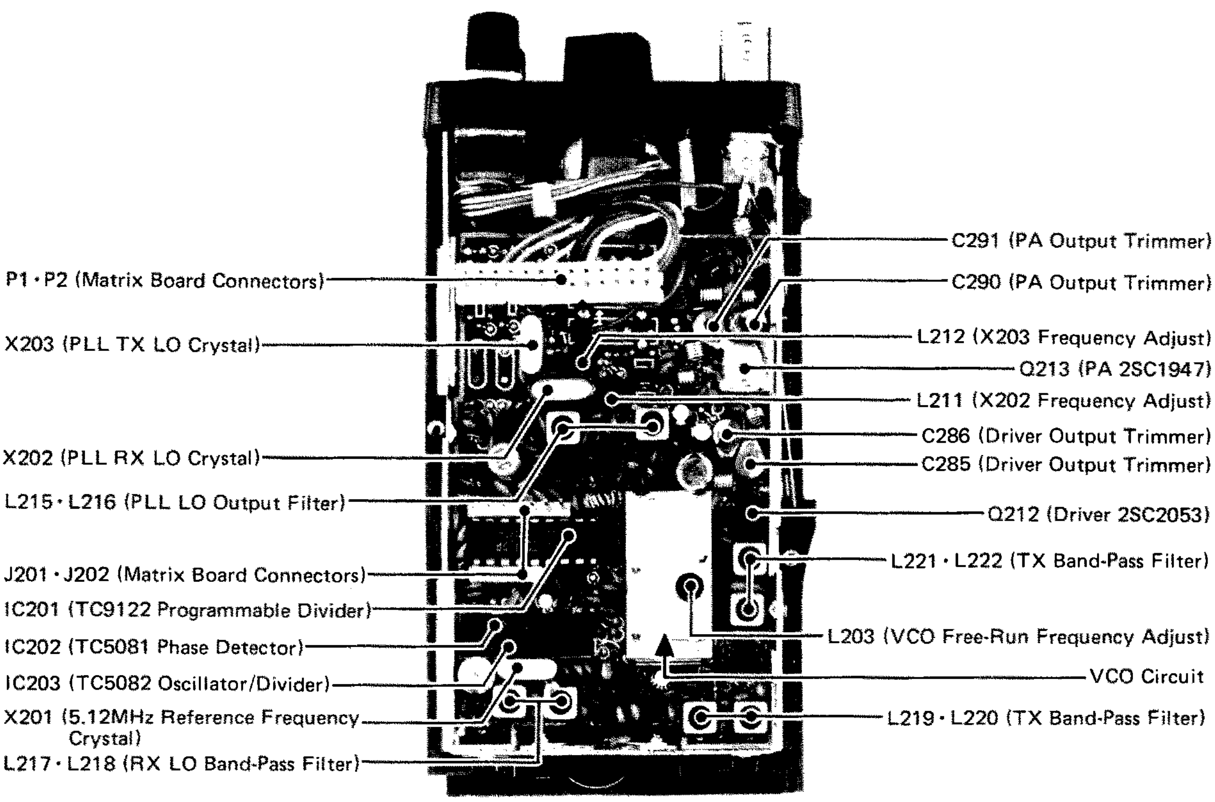


SECTION 5 INSIDE VIEWS

MAIN UNIT



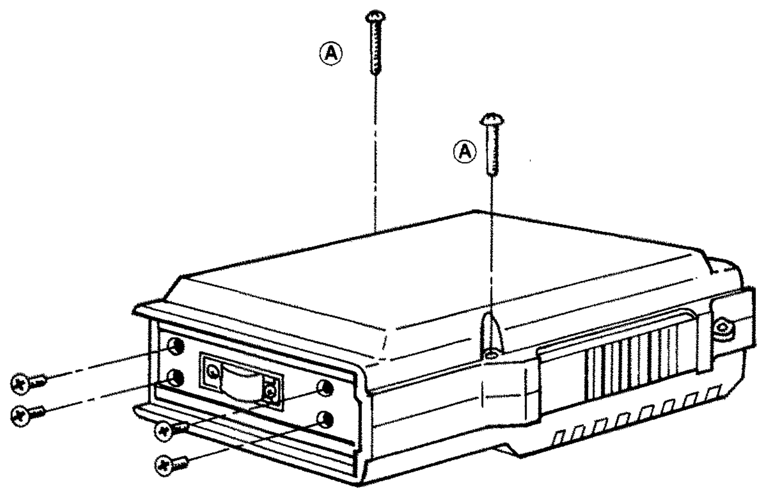
PLL UNIT



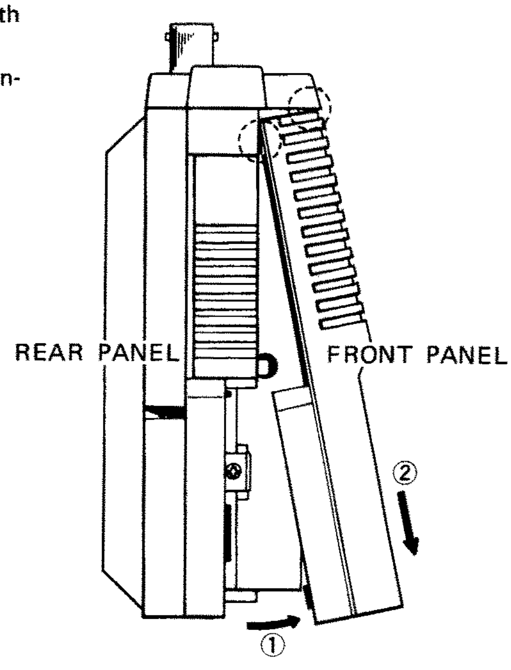
SECTION 6 MECHANICAL PARTS AND DISASSEMBLY

6-1 DISASSEMBLY OF THE CASES

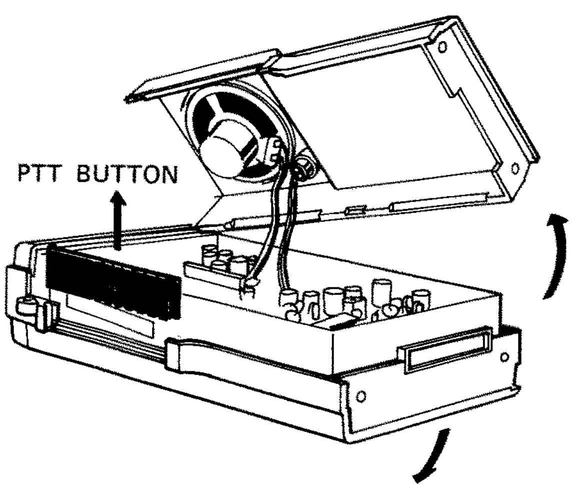
1. Turn the power switch off and remove the power pack.
2. Remove two screws Ⓐ on the rear panel and four screws on the bottom as shown in the figure.



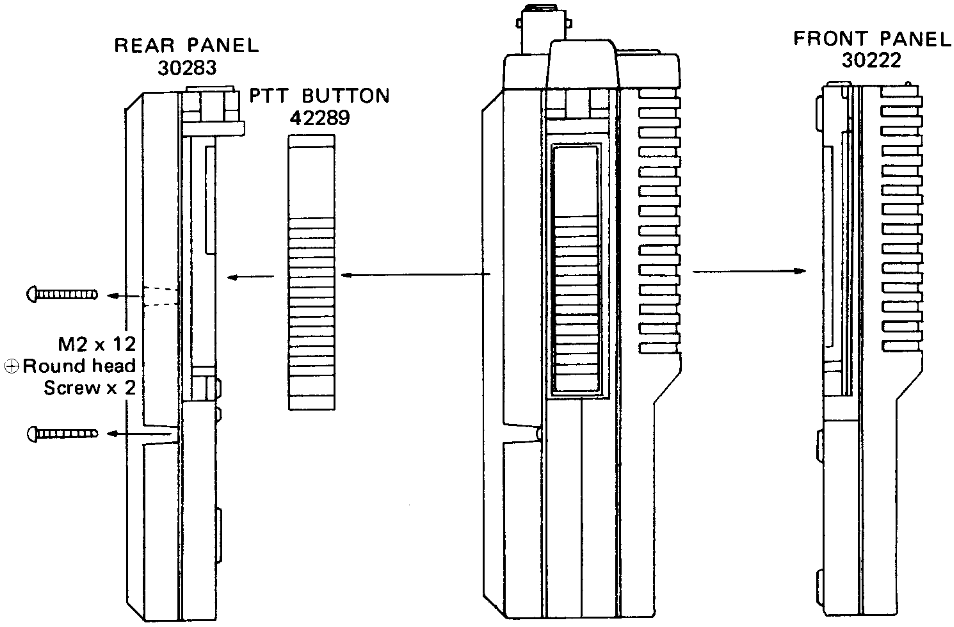
3. Remove the front panel as shown in the figure. At this time, be sure not to damage the engaged parts at the top (circled with dotted lines).
   ① open the bottom slightly and ② slide the front panel downwards.



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

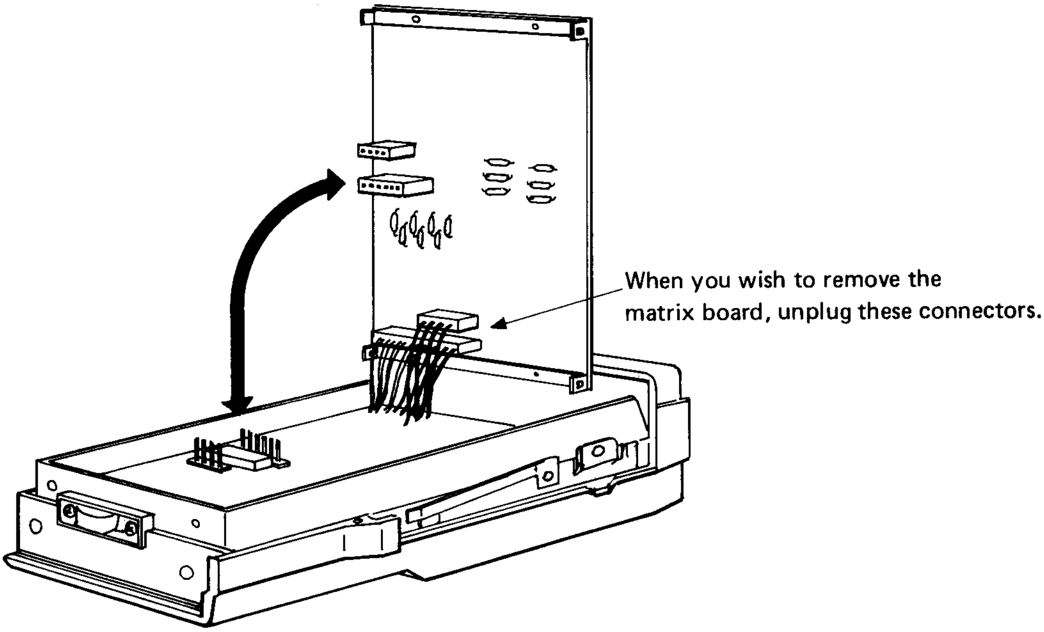


6 - 2 DISASSEMBLY OF UNITS

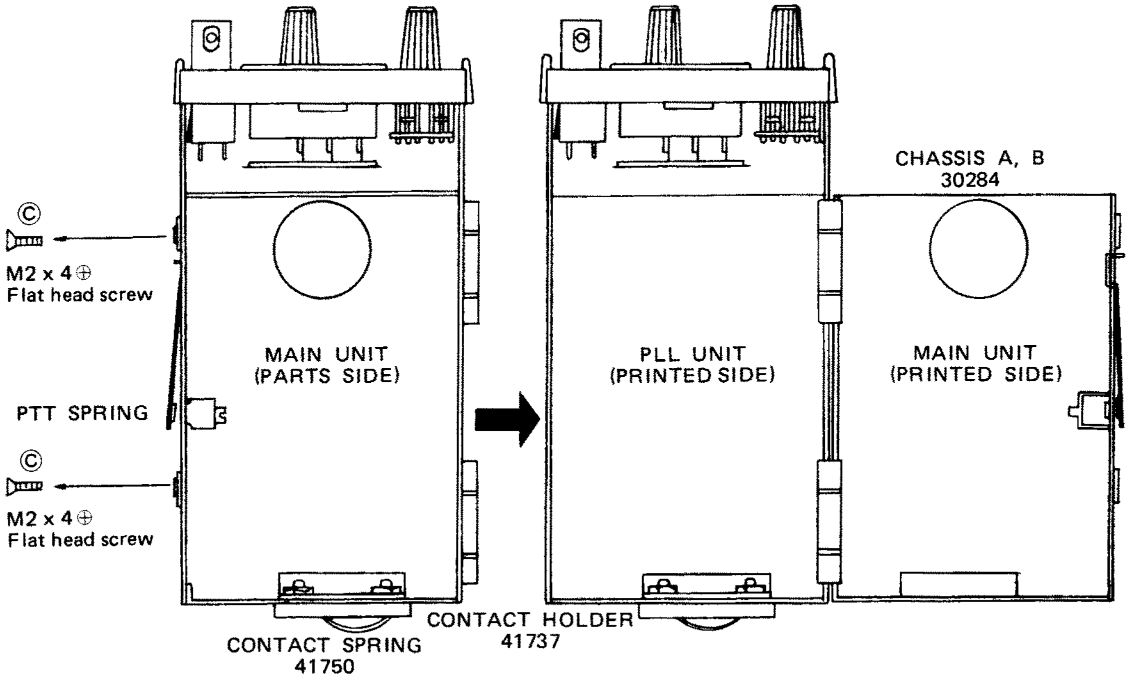


1. When you wish to program some operation frequencies (channels), remove the rear panel, then unplug the connectors between the matrix board and PLL board, and tilt the matrix board as shown in the figure.

   When you wish to remove the matrix board from the set, unplug the two connectors located on the front side end of the board.

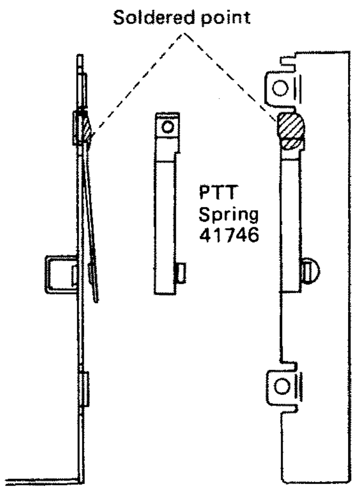


To see the printed sides of the PC boards, open the chassis by removing two screws Ⓒ located above and below the PTT spring.

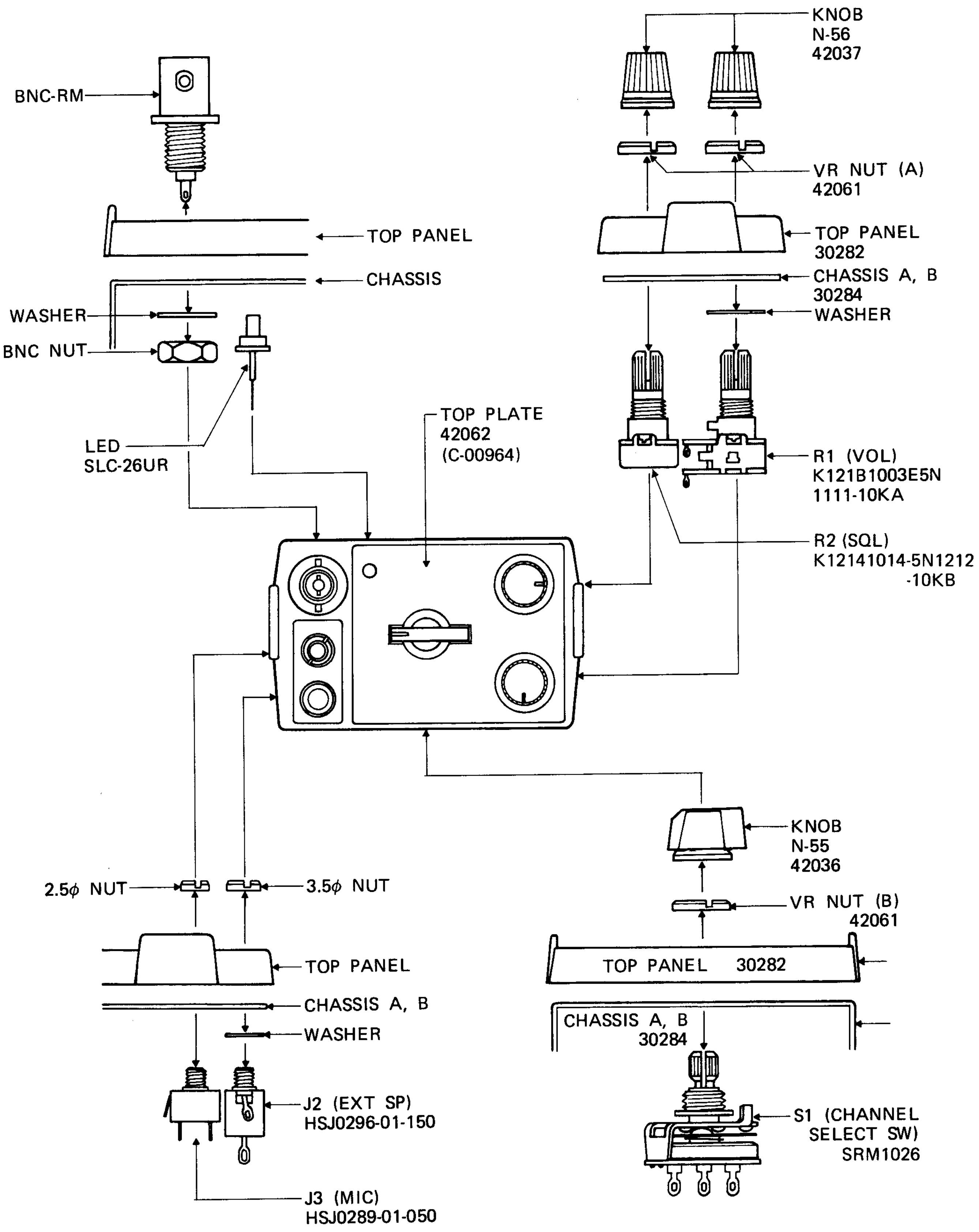


6-3 PTT SPRING ASSEMBLY (HOW TO REPLACE PTT SPRING)

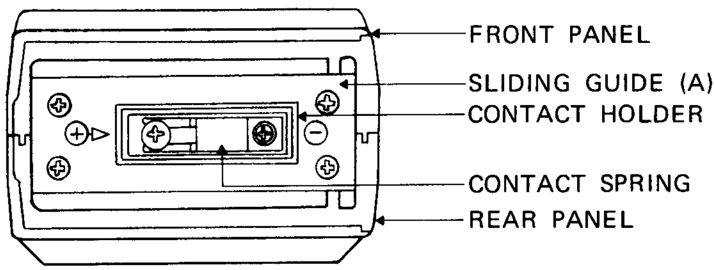
1. The PTT spring is soldered at its top as shown in the figure.
2. Remove the old spring by heating the soldered point.
3. Solder the hole at the top of the new spring.
4. Make sure that the new spring is soldered on parallel to the chassis.



6-4 TOP PANEL CONSTRUCTION

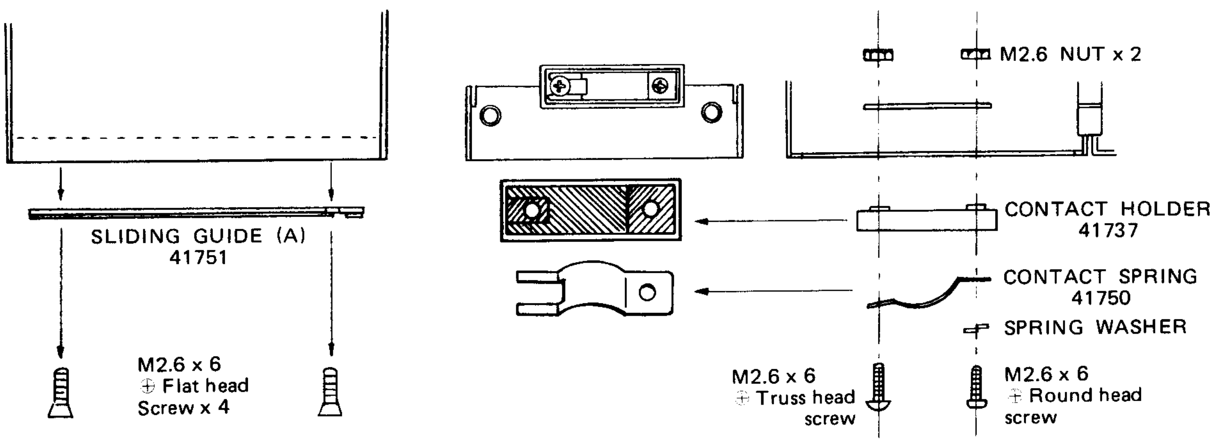


6-5 UNIT BOTTOM ASSEMBLY (BOTTOM VIEW)



(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.



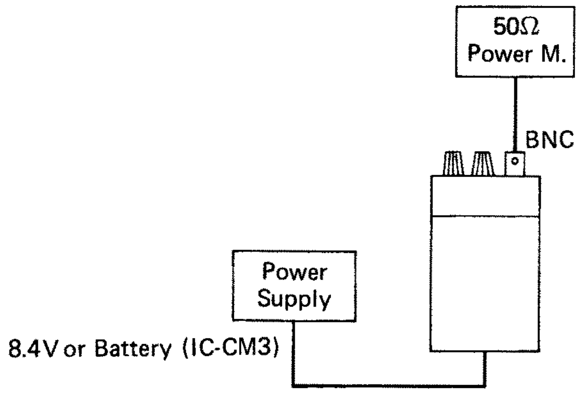
SECTION 7 MAINTENANCE AND ADJUSTMENT

7-1 MEASURING INSTRUMENTS REQUIRED FOR ADJUSTMENT

(1) FREQUENCY COUNTER	FREQUENCY RANGE	0.1 - 180MHz
	ACCURACY	BETTER THAN ±1 ppm
	SENSITIVITY	100mV or BETTER
(2) SIGNAL GENERATOR	FREQUENCY RANGE	0.1MHz - 180MHz
	OUTPUT VOLTAGE	−20 - 90dB (0dB = 1μV)
(3) MULTIMETER	50KΩ/Volt or better	
(4) AC MILLIVOLTMETER	MEASURING RANGE	10mV - 2V
(5) RF VOLTMETER	FREQUENCY RANGE	0.1 - 180MHz
	MEASURING RANGE	0.01 - 10V
(6) RF WATTMETER (Terminated Type)	MEASURING RANGE	5 ~ 10 Watts
	FREQUENCY RANGE	140 - 180MHz
	IMPEDANCE	50 OHMS
	SWR	LESS THAN 1.1
(7) AF OSCILLATOR	OUTPUT FREQUENCY	200 - 3000Hz
	OUTPUT VOLTAGE	0 - 200mV
	DISTORTION	LESS THAN 0.1%
(8) OSCILLOSCOPE	FREQUENCY RANGE	DC – 15MHz
	MEASURING RANGE	0.01 – 10V
(9) FM DEVIATION METER	FREQUENCY RANGE	140 ~ 180MHz
	MEASURING RANGE	0 ~ ±10KHz
(10) DIRECTIONAL COUPLER	FREQUENCY RANGE	140 ~ 180MHz
(11) AMPERMETER	MEASURING RANGE	0 ~ 1.5A DC
(12) DUMMY LOAD OR EXTERNAL SPEAKER	IMPEDANCE	8 OHMS
(13) VOLTAGE REGULATED POWER SUPPLY	OUTPUT VOLTAGE	5 ~ 11V DC (adjustable)
	CAPACITY	1.5A 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 Set to any programmed channel and key the transmitter. Observe the RF power OUTPUT.

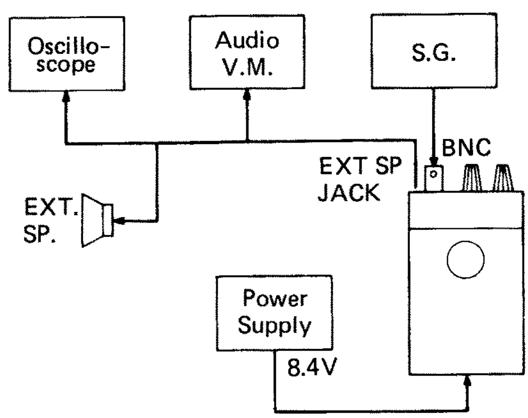
3. Power output should be 2.5 ~ 3.0 watts at rated input (power supply) voltage.

7-2-2 RECEIVER CHECKS

Make all checks at 8.4V DC

1. Settings of controls and switches

Power switch	ON
Squelch Control	Fully counterclockwise
Frequency	Any programmed channel



2. Connect an AF voltmeter to the EXT 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

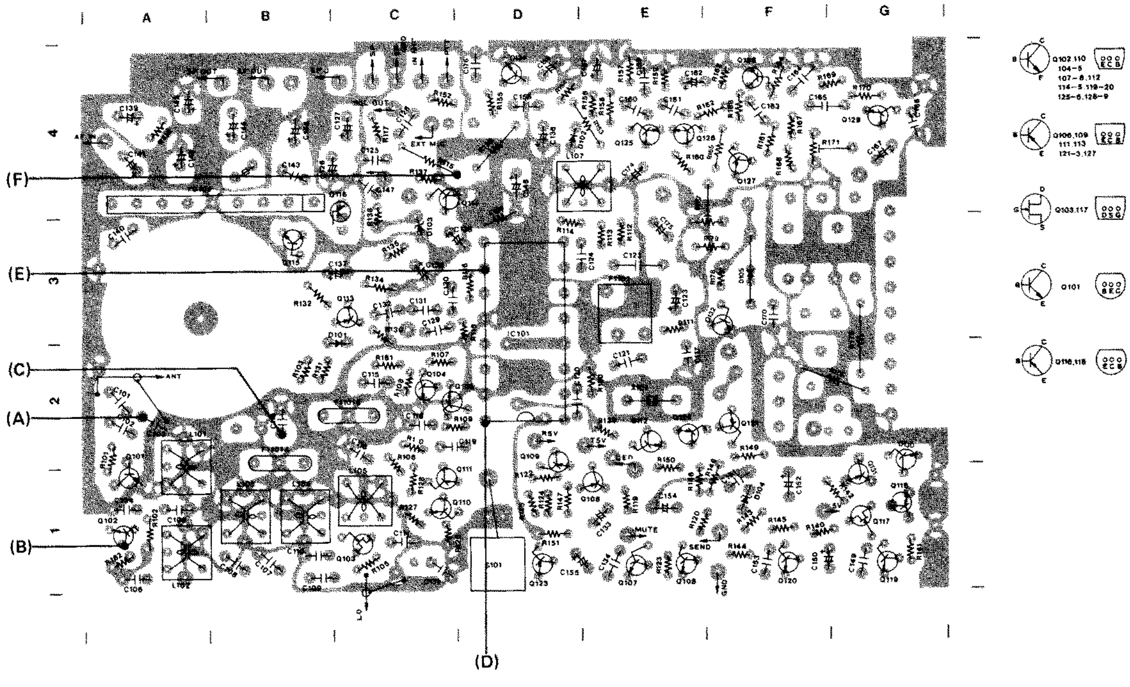
7 - 4 - 1 RECEIVE

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 6V regulator first.

3. Inject RF through a 0.01μF 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) = 16.900MHz
   (D) = 16.900MHz

4. Check (E) and (F) with an oscilloscope, for demodulated output in the audio frequency range.

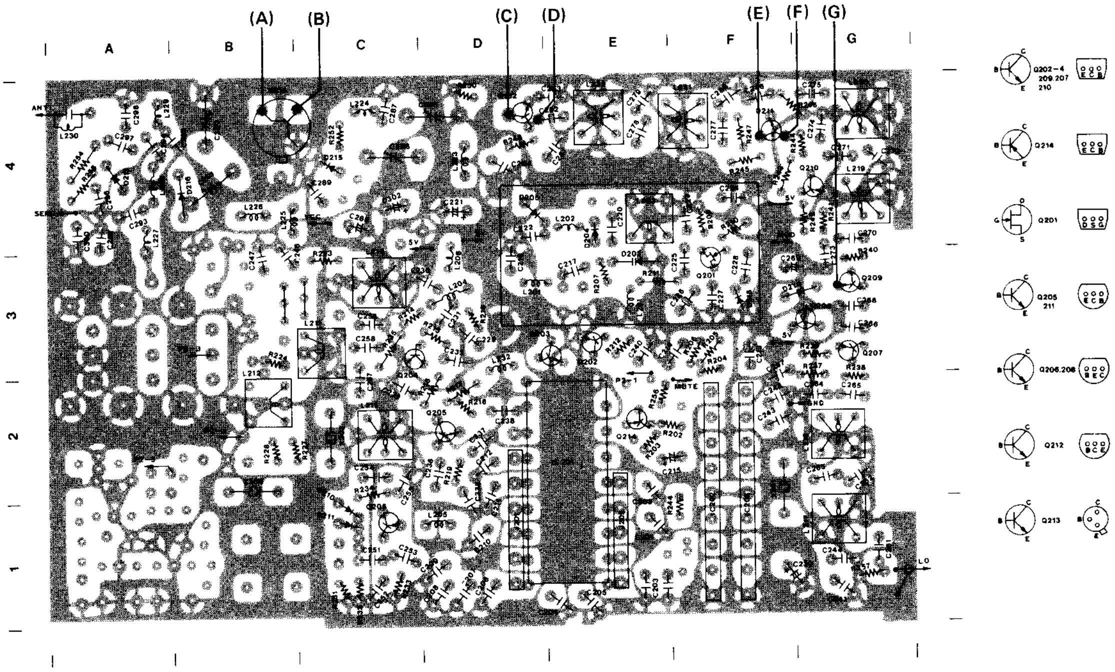


7-4-2 TRANSMITTER

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.

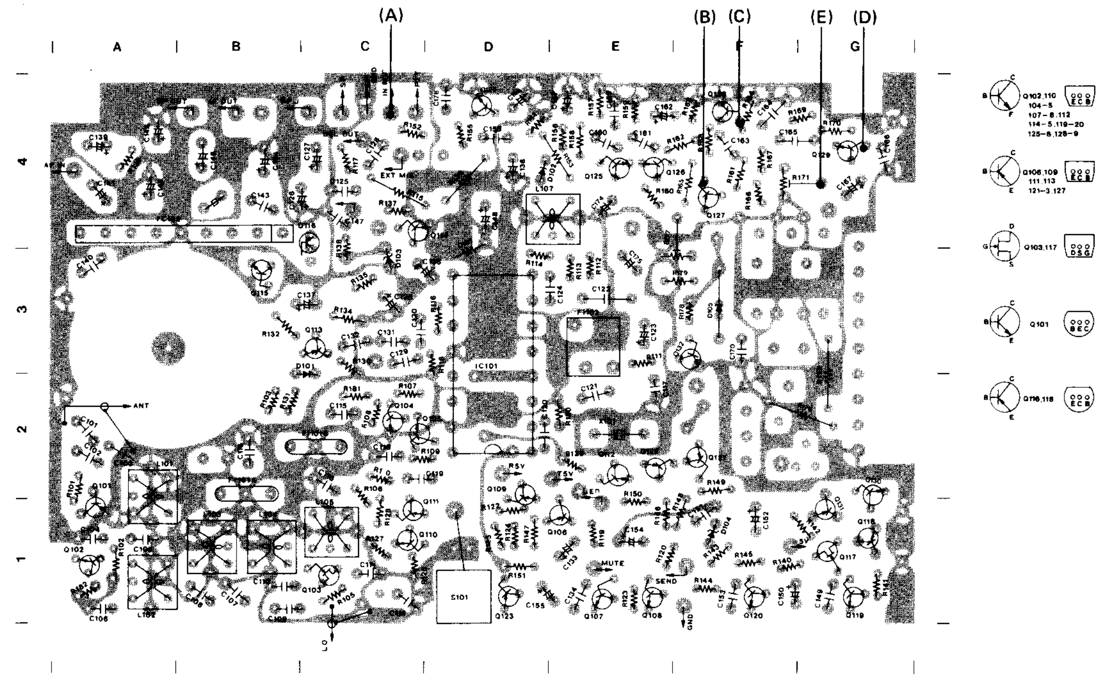
3. When transmission is normal, RF is present and it is not possible to measure the DC voltage accurately with a voltmeter.



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.

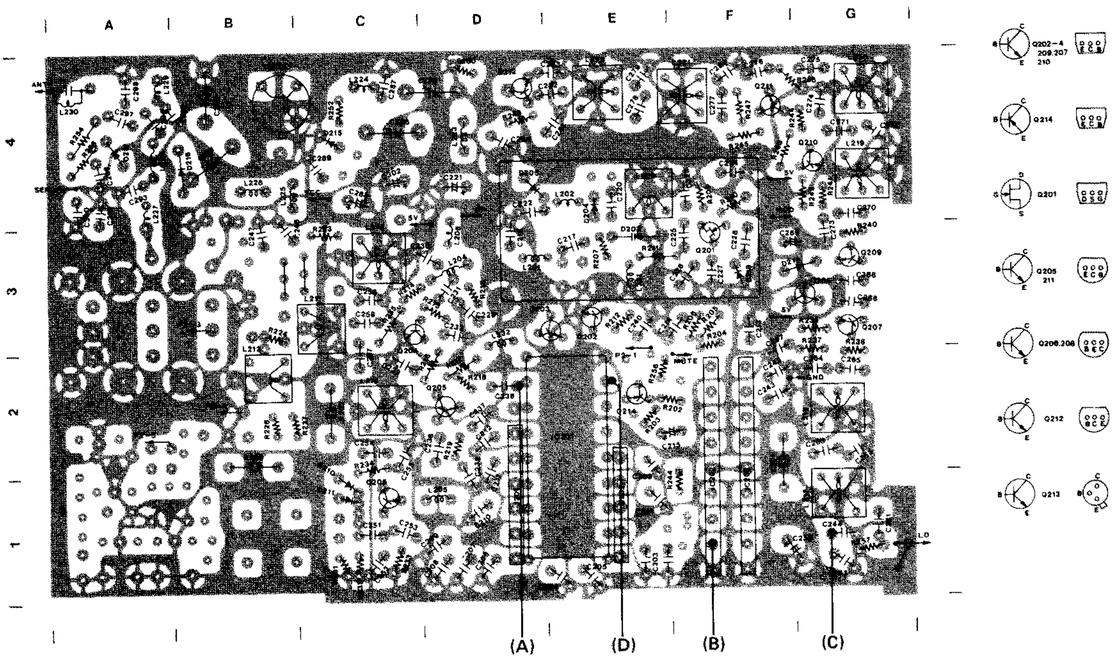
1. Check (A) with an oscilloscope. A lock failure is indicated by an instability or absence of the wave form. Check as follows:

2. Check the Frequency of the master oscillator (5.12MHz). If a 2.5KHz 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).

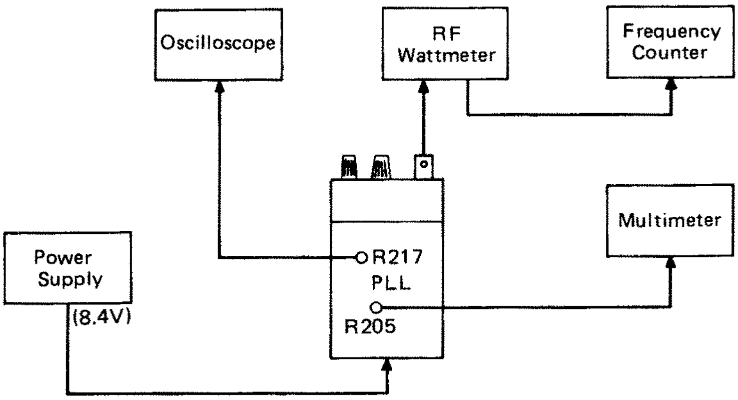


7-5 BASIC ALIGNMENT PROCEDURE

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 (15MHz band width) to R217.
   - Connect voltmeter between R205 and ground.
   - Set the channel select switch at a programmed channel (center frequency of the operating frequency range is recommended).



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 ~ 6V, and P.L.L. should lock.
   - Adjust L203 for 3V after lock.

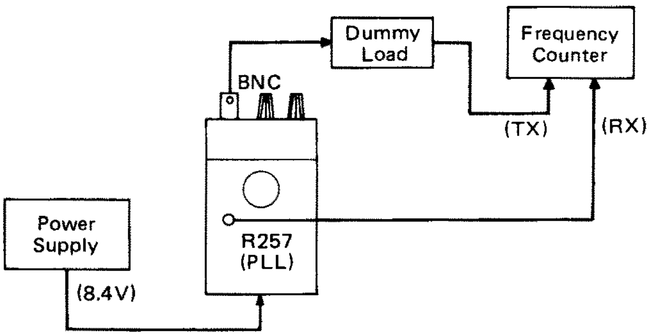
   Next, in Receive adjust L216 for maximum voltage (P-P value) on the oscilloscope and then during transmission adjust L215 to maximum. Set the channel select switch at a high edge channel, and repeat adjustment of L215, L216 several times. After that, confirm the following voltage of R205 (both transmission and receiving)about 2V at a low edge channel and 4V at a high edge channel, 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+6V, T+6V, 6V constant, and the P.L.L. LO and reference frequency oscillator for oscillation.

B. Reference Frequency Oscillator Check

1. Connect a frequency counter through a capacitor to Pin 1 of IC203.
2. Confirm frequency is: 5.120MHz ±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 frequency counter to R257 through a capacitor. After power adjustment, loosely couple the set to a frequency counter with capability of more than 180MHz (with dummy load connected), so that the transmitting frequency can be obtained.



2. Set the channel select switch at a programmed channel.
   - In the receive mode, adjust L211 for the programmed receiving frequency minus 16.9MHz.
   - In the transmit mode, adjust L212 for the programmed transmitting frequency.
   - Then check again, because these adjustments interact.

3. Confirmation
   Check each frequency:
   All frequencies should be within ±500Hz.

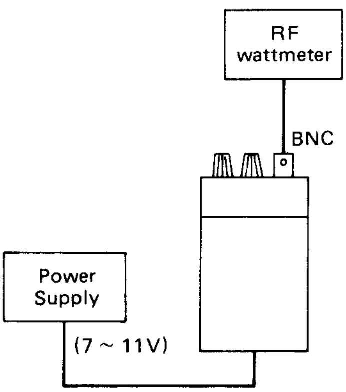
7-5-2 TRANSMISSION

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 12V can damage the P.A. transistor.
   - Set the channel select switch at a programmed channel.

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 1000mA, adjust C291 to set the current at 1000mA, and repeat above procedures.

3. Confirmation
   More than 2.5W output, less than 1000mA current drain.
   No abnormality in operation should be found if the supply voltage is varied from 7.0V to 10.8V.



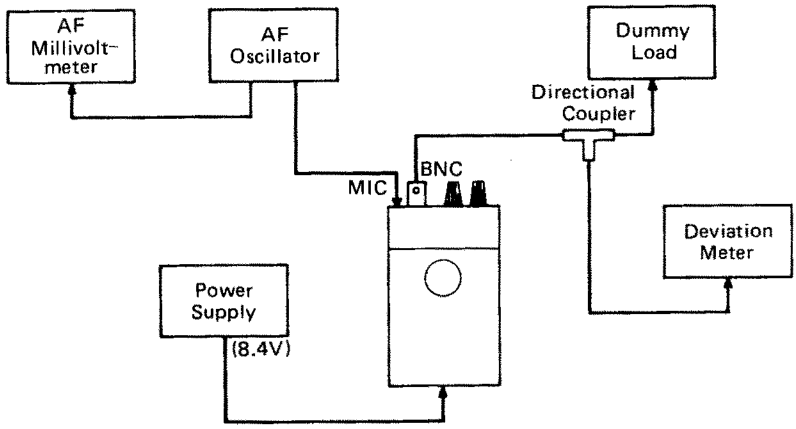
B. Modulation Adjustment

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

   Connect a deviation meter to the ANT Connector 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 a programmed channel.
   - 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 ±10%.

Modulation sensitivity: Mic input voltage 12mV ±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 apply 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 −60dB.

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

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

7-5-3 RECEIVER

A. LO Output Adjustment

- Set the channel select switch at a programmed channel (center frequency of the frequency range is recommended). Adjust L217 and L218 for maximum output on an RF voltmeter attached to R257.
- Then set the channel select switch at a high edge frequency channel and adjust L217 and L218 with the same procedure.
- Repeat above procedures to obtain the same reading on the RF voltmeter on either channel. 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 a programmed channel.
   - Connect a signal generator to the antenna connector.
   - Connect an external speaker and AF millivoltmeter to the EXT SP terminal.

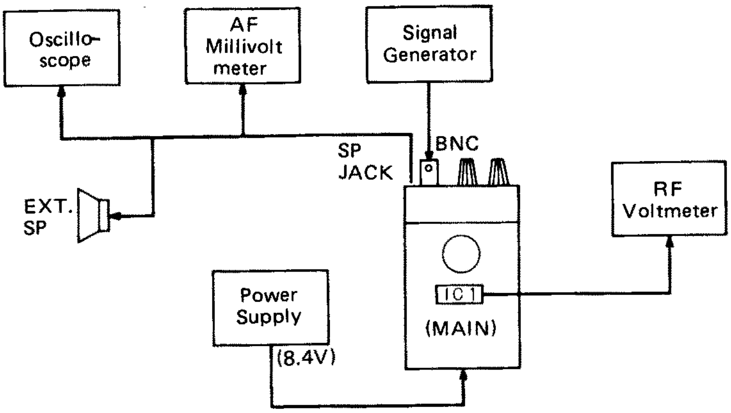
2. Procedure

   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 ±10KHz. Check if rippling (change in output level) occurs. If ripple is over 3dB, readjust L105.

   Set signal generator output to −80dBm to −90dBm 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 −8dBμ (0.4μV) for 20dB quieting.



C. 2nd LO Frequency Check

Connect a 16.9MHz amplifier to the frequency counter, check the frequency of X101 (2nd OSC) with a loose couple. It should be: 16.900MHz ±400Hz.

D. Receiver Spurious Response

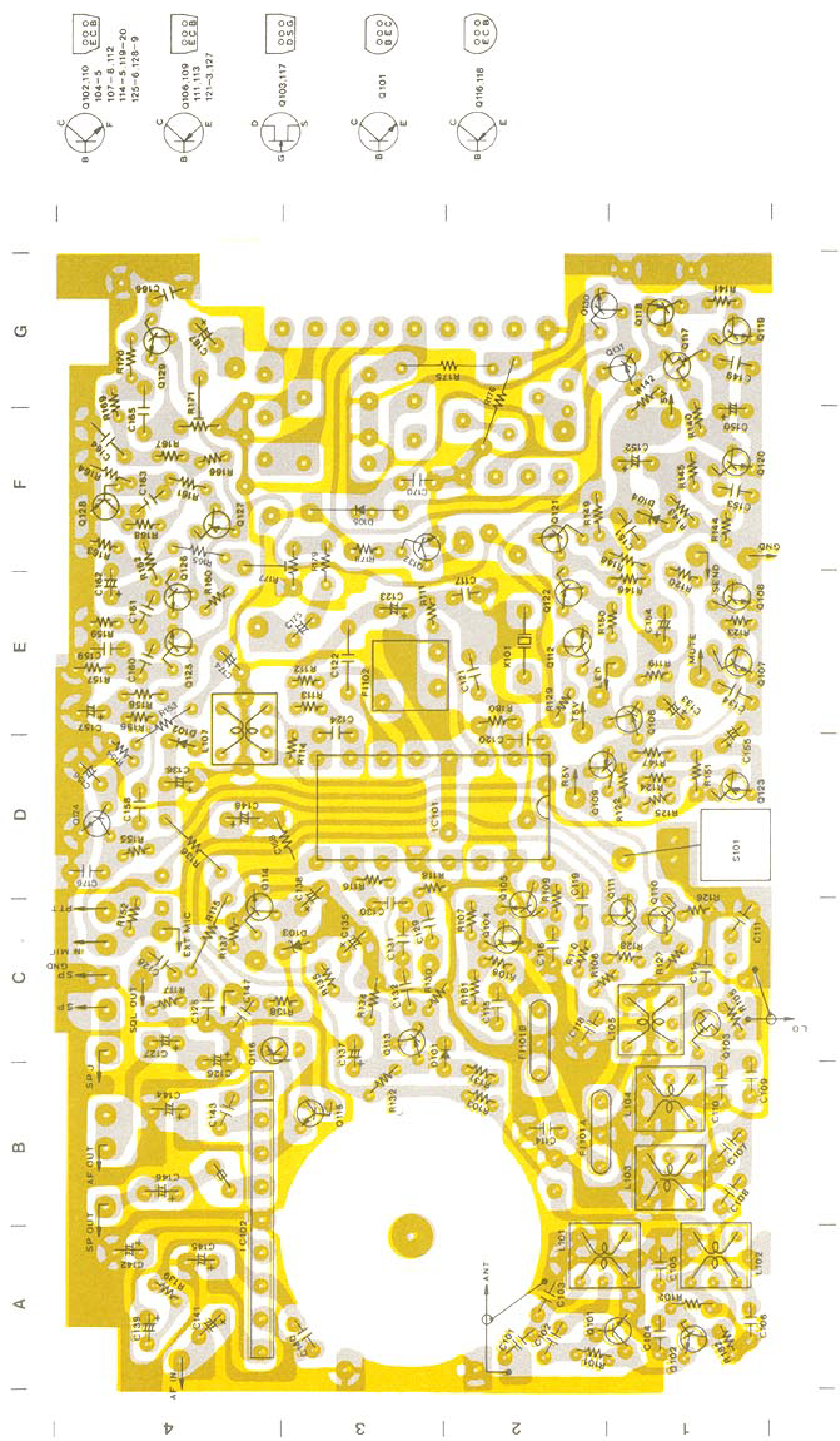
Connect a speaker and millivoltmeter to the EXT SP. Connect a 50 ohm dummy load to the antenna terminal. All receiver spurious should be supressed less than 3dB, over entire frequency range.

E. Receive Audio Output

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

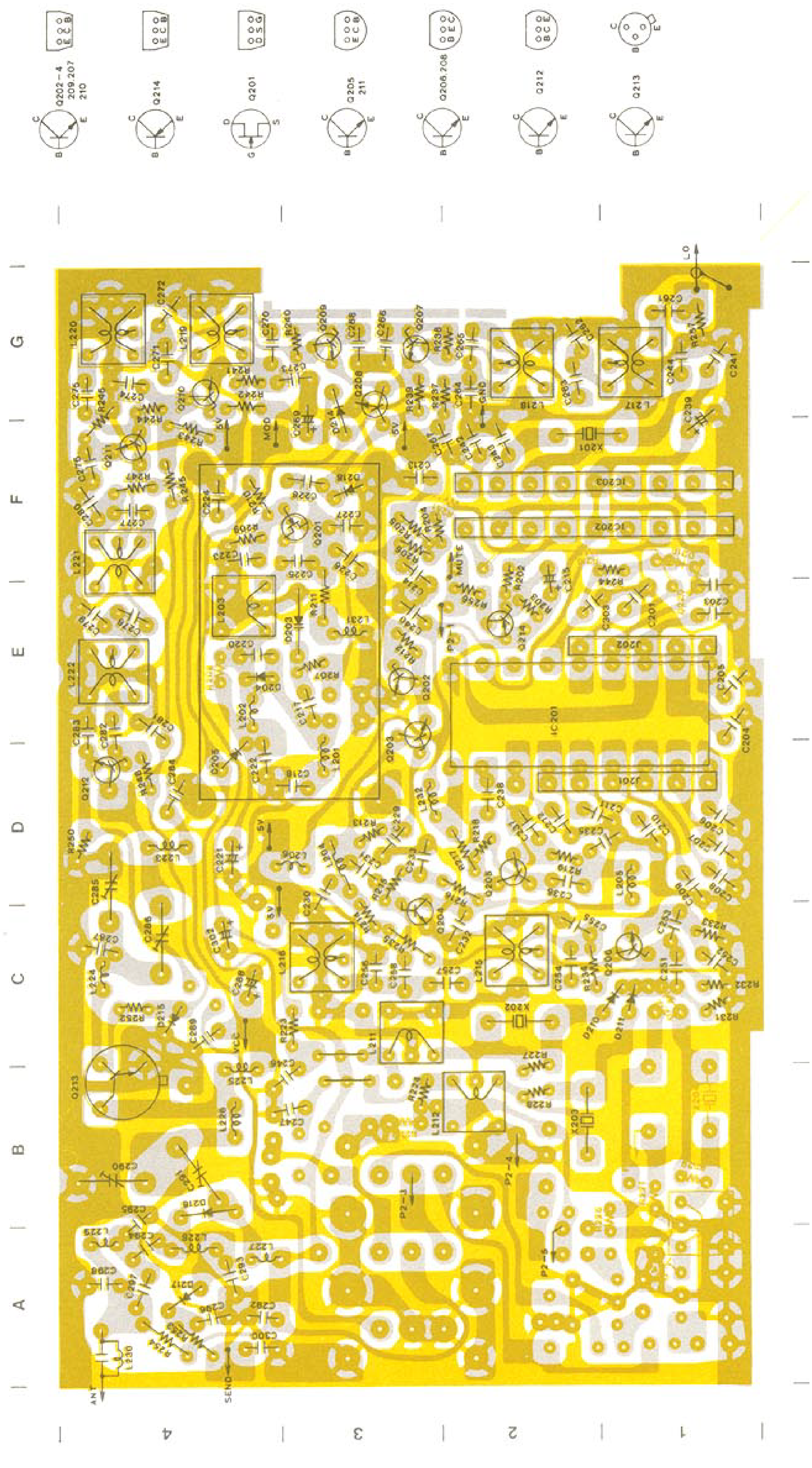
BOARD LAYOUT

MAIN UNIT



BOARD LAYOUT

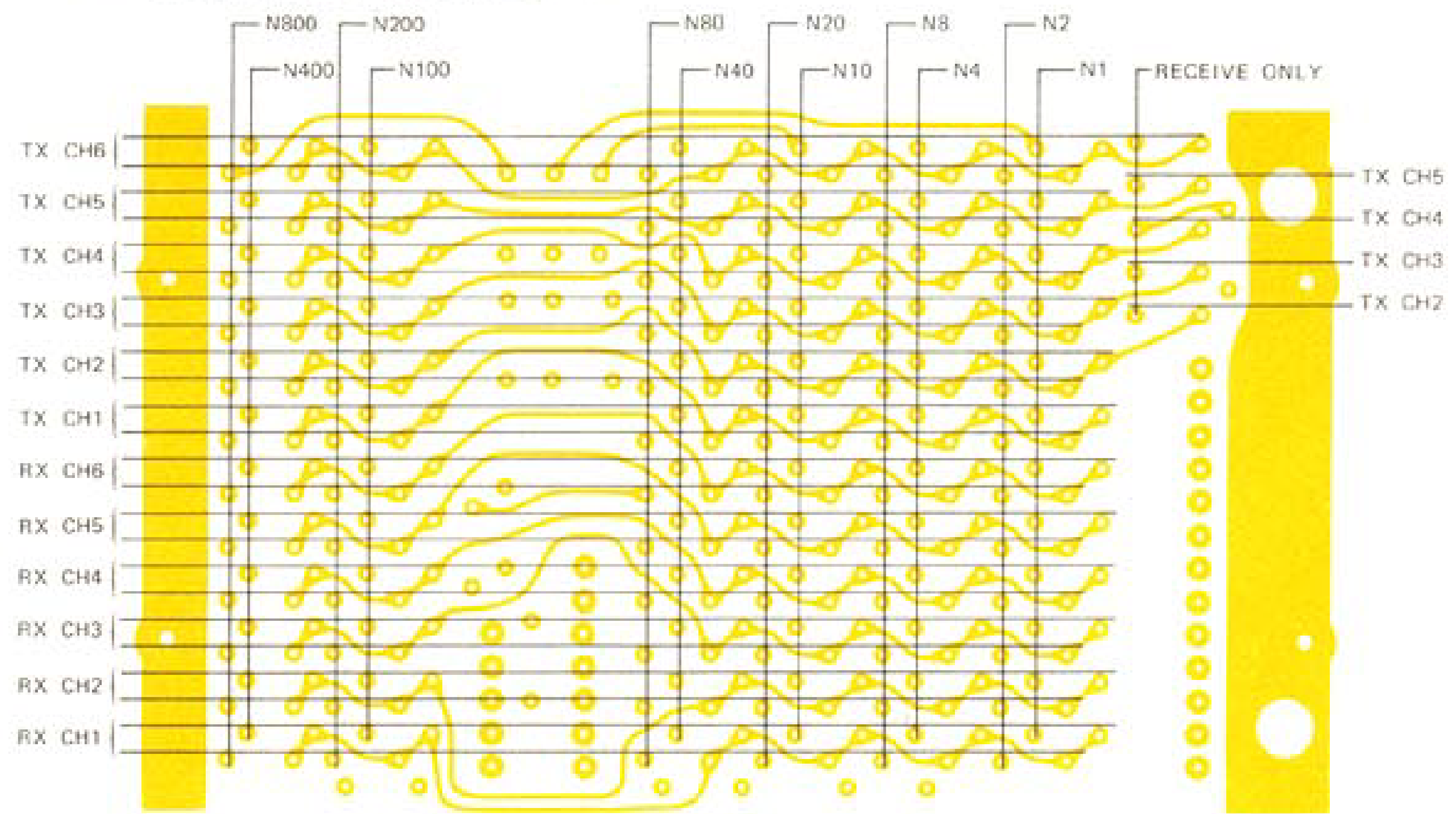
PLL UNIT

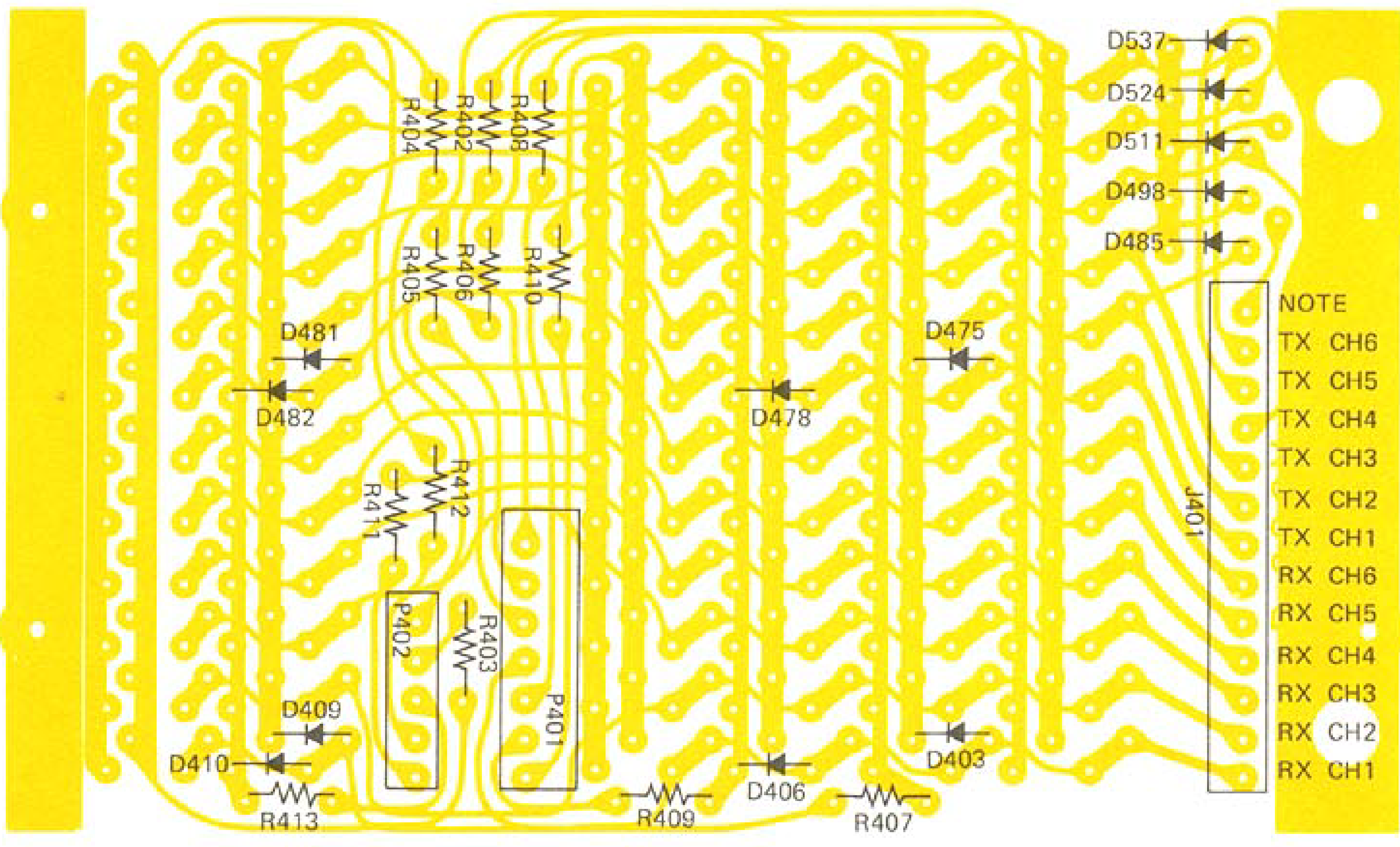


BOARD LAYOUT

MATRIX UNIT

■ MATRIX LAYOUT





SECTION 9 VOLTAGE CHARTS

TRANSISTORS VOLTAGE CHART

● **Measuring instrument is a 50KΩ/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	0.8	1.2	GND	RF Amp
	Q102	0	0	0	1.9	5.8	1.2	RF Amp
	Q103	0	0	0	0	6.0	1.4	1st Mixer
	Q104	0	0	GND	0.7	0.9	GND	1st IF Amp
	Q105	0	0	0	1.5	2.8	0.9	1st IF Amp
	Q106	5.2/6.0	5.9/0	6.0	6.0	0	6.0	T/R Switch Locked/Unlocked
	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	6.0	GND	T/R Switch
	Q109	5.8	0	6.0	5.3	6.0	6.0	T/R Switch
	Q110	0	8.1	0.4	6.0	7.7	5.4	T/R Switch
	Q111	8.1	0	8.4	7.7	6.2	8.4	T/R Switch
	Q112	5.9/0	8.0/8.4	5.2/0	0	8.4	0	T/R Switch Locked/Unlocked
	Q113	0	0.6	0	4.2	0 ~ 1.2	3.2 ~ 3.7	Noise Detector SQL CLOSED/SQL OPENED
	Q114	0.6	0	GND	0.6/0	0 /8.0	GND	Squelch Control Closed/Opened
	Q115	0	8.0	0	0 /8.0	8.0	0 /7.4	Squelch Control
	Q116	8.0	0	8.4	8.0	0 /7.4	8.4	T/R Switch SQL Closed/Opened
	Q117	0.6	8.4	1.7	0.6	8.4	1.7	Regulator
	Q118	7.7	6.0	8.4	7.7	6.0	8.4	Regulator
	Q119	0.6	6.0	GND	0.6	7.4	GND	Regulator
	Q120	0.6	0.6	GND	0.6	0.6	GND	
	Q121	6.4	4.5	6.0	6.4	0	6.0	Indicator Control
	Q122	4.5	5.1/0	5.2/0	0	0	0	Indicator Control Locked/Unlocked
	Q123	4.6	5.2	5.2	6.0	1.6	6.0	T/R Switch
	Q125	3.0	5.2	2.6	0	0	0	Mic Amp
	Q126	3.2	5.1	2.6	0	0	0	Mic Amp
	Q127	5.1	2.0	5.2	0	0	0	Mic Amp
	Q128	0.3	2.4	GND	0	0	GND	Limiter
	Q129	2.4	5.2	3.1	0	0	0	Low Pass Filter
PLL	Q201	0	5.2	0.6	0	5.2	0.6	VCO, FM Mod.
	Q202	0.6	1.0	GND	0.6	1.0	GND	Buffer Amp
	Q203	1.6	3.4	1.0	1.6	3.4	1.0	Buffer Amp
	Q204	0.7	0.8	GND	0.7	0.8	GND	PLL Mixer
	Q205	1.8	3.4	1.3	1.8	3.4	1.3	Level Converter
	Q206	2.2	5.9	1.8	2.2	5.9	1.8	Multiplier
	Q207	0	0	1.2	1.6	5.8	1.0	Multiplier
	Q208	0.5	1.2	GND	0.5	1.0	GND	Buffer Amp
	Q209	1.7	5.6	1.2	0	0	1.0	Multiplier
	Q210	−0.6~0	1.5	GND	0.7	0	GND	T/R Switch
	Q211	1.4	8.0	0.6	0	8.4	0	Buffer Amp
	Q212	0.6	8.4	0.2	0	8.4	0	Driver
	Q213	0.5	8.4	GND	0	8.4	GND	Power Amp
	Q214	5.9/5.4	0 /6.0	6.0	5.9/5.4	0 /6.0	6.0	Lock Failure Mute Locked/Unlocked

IC'S VOLTAGE CHART

● **Measuring instrument is a 50KΩ/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	6.0	2.0	*	*	*	*	*	*	*	*	*	*	*	*	*	0	0	GND	
PLL	IC202	0	3.0	1~5	6.0	6.0	0	0	3.0	GND										
PLL	IC203	1.4	2.5	2.5	–	6.0	3.0	–	–	GND										

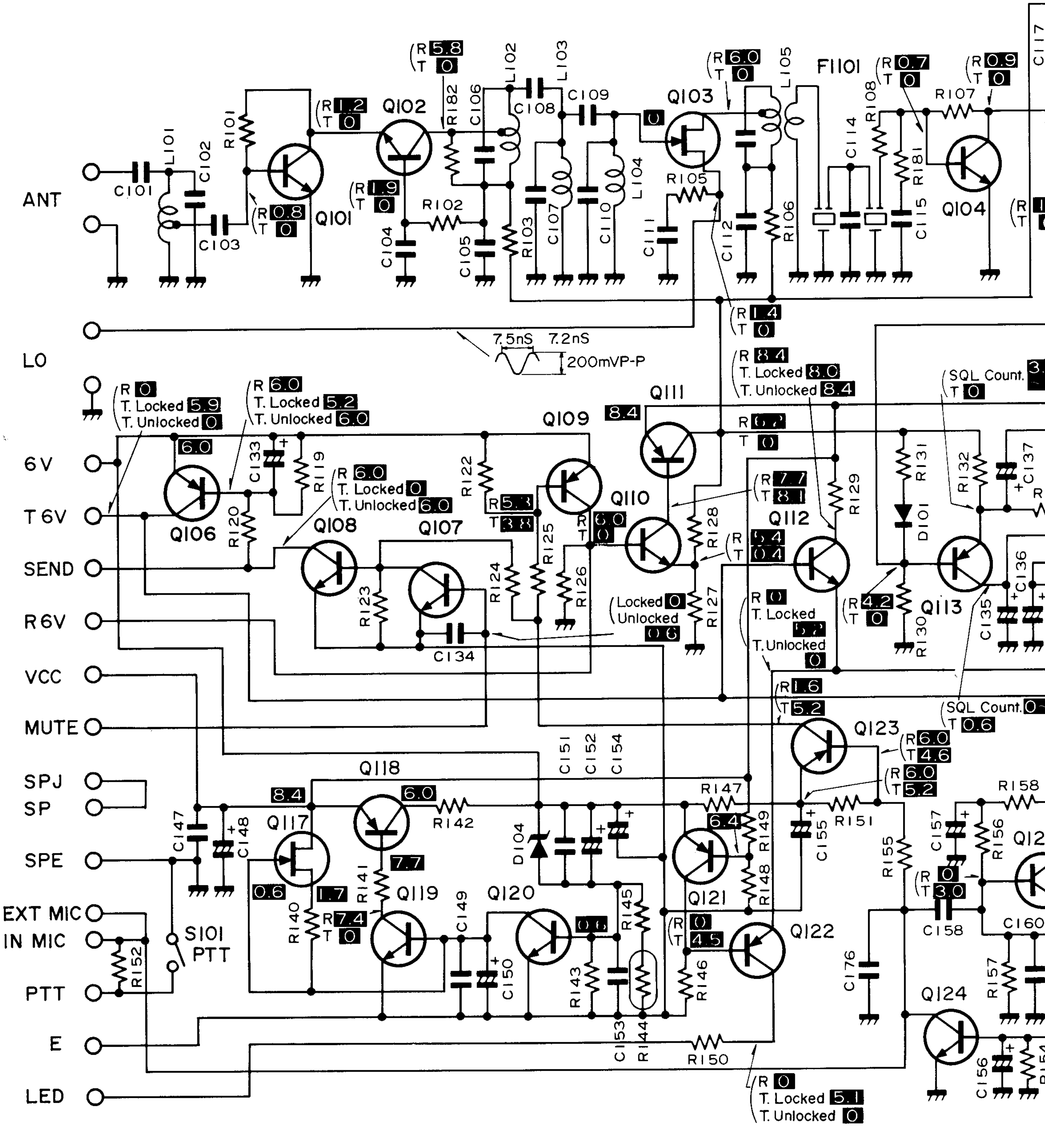
* 6.0V or 0V depending on the diode matrix programming.

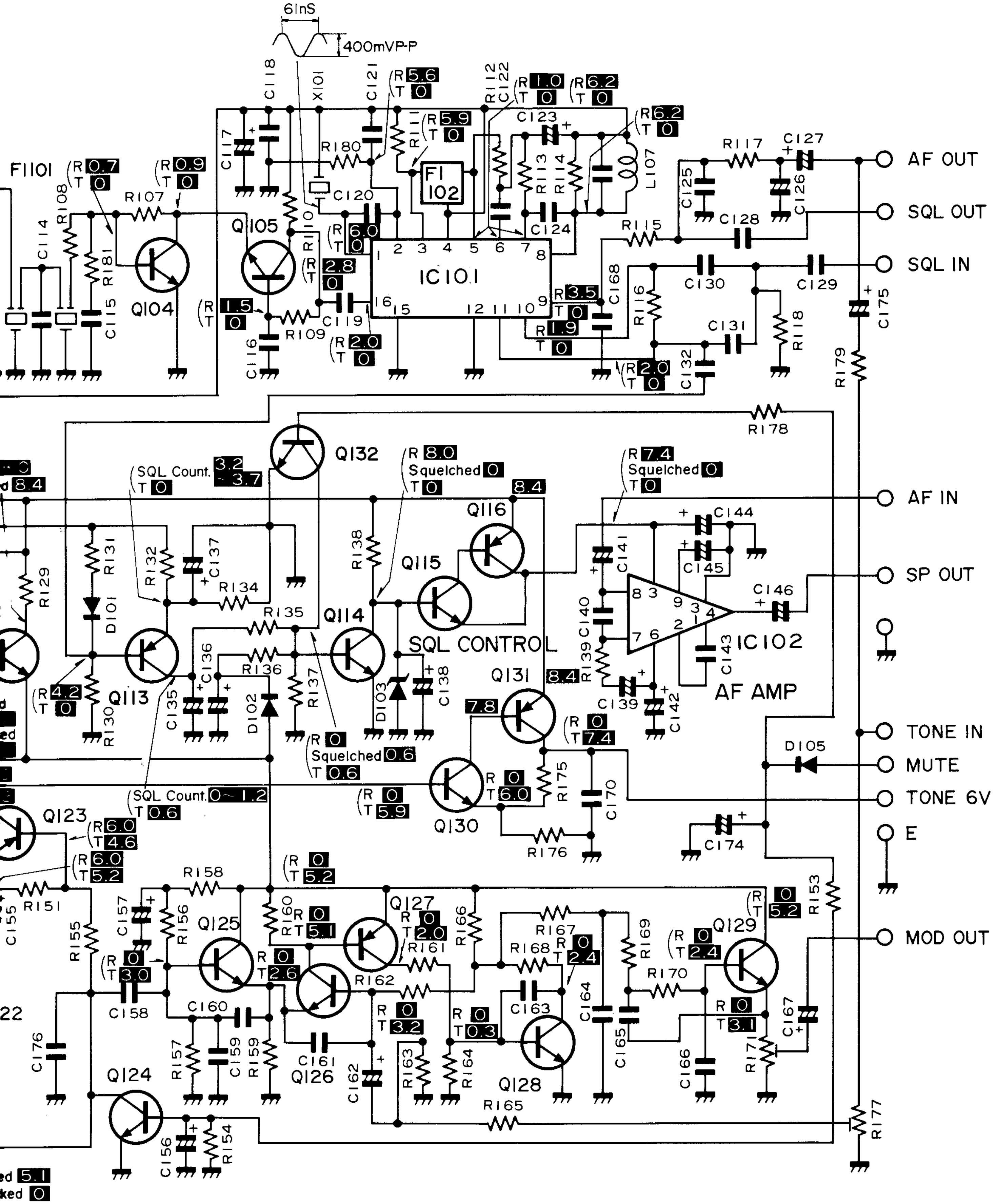
IN RECEIVE MODE

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	6.0	5.6	5.9	6.2	1.0	1.0	1.0	6.2	3.5	1.9	2.0	GND	5.6	0	GND	2.0			
MAIN	IC102	5.9	3.9	7.4	3.3	GND	3.3	3.3	3.1	7.4										SQL OPEN
PLL	IC201	6.0	2.0	*	*	*	*	*	*	*	*	*	*	*	*	*	0	0	GND	
PLL	IC202	0	3.0	1~5	6.0	6.0	0	0	3.0	GND										
PLL	IC203	1.4	2.5	2.5	–	6.0	3.0	–	–	GND										

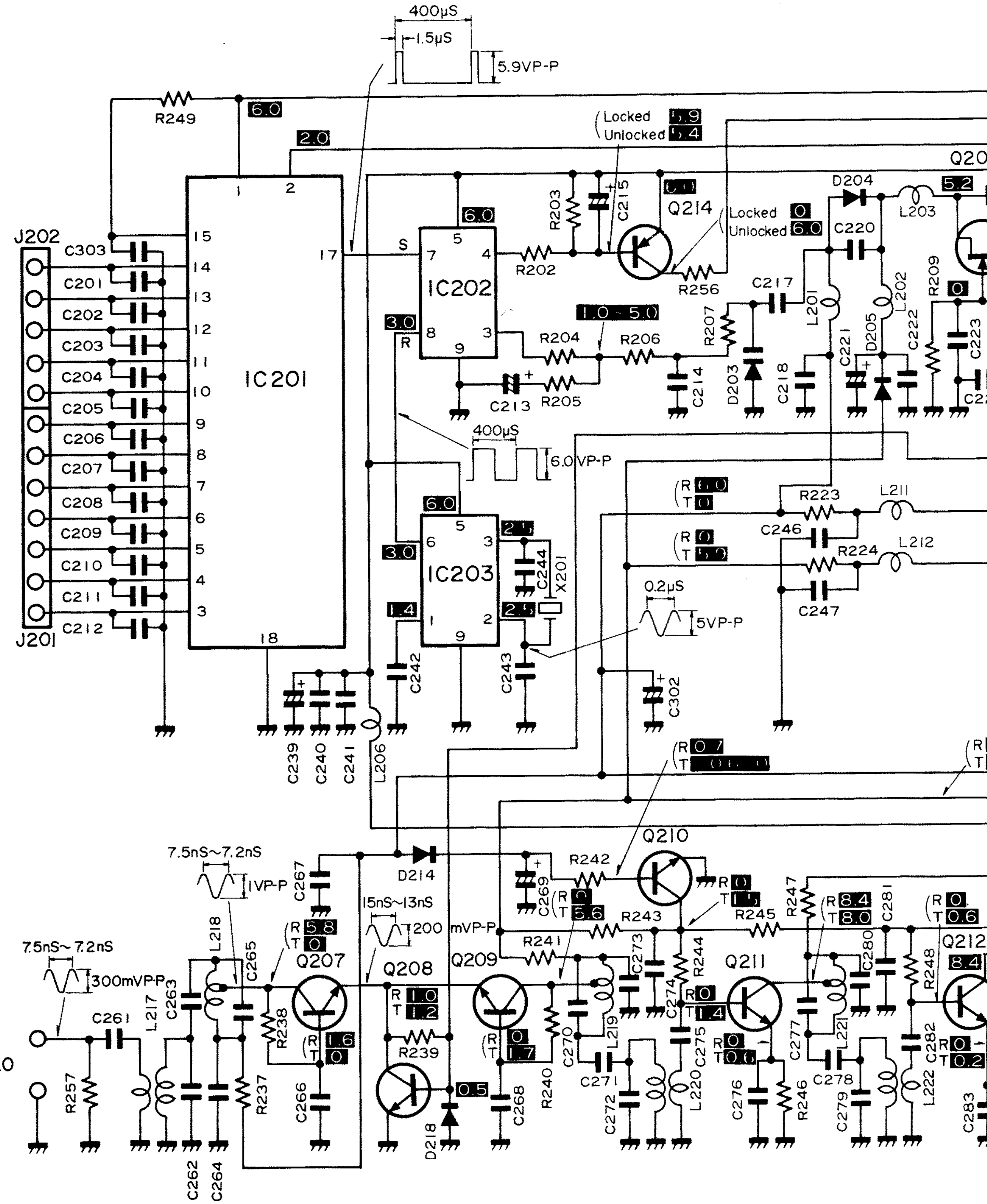
* 6.0V or 0V depending on the diode matrix programming.

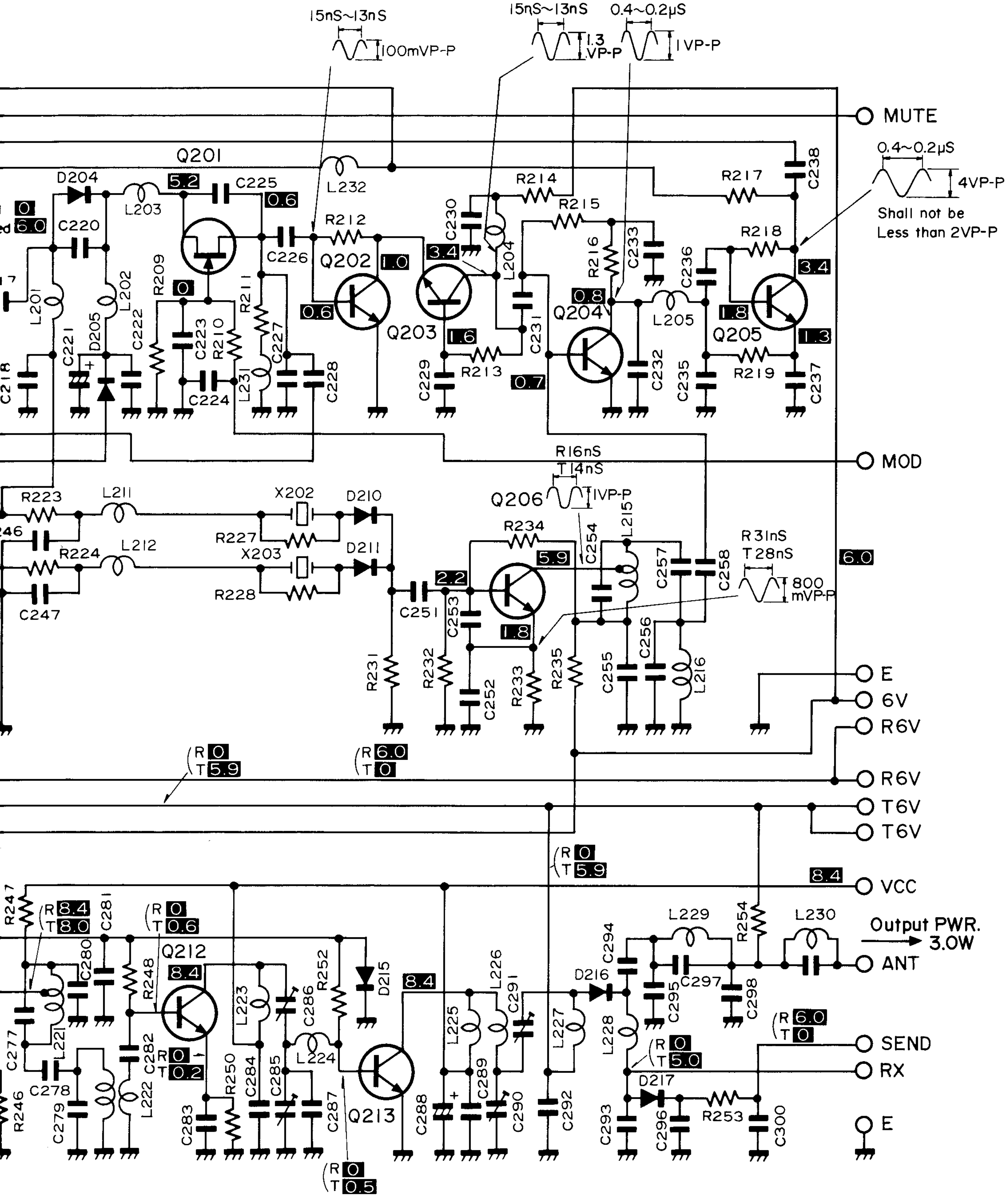
MAIN UNIT


ANT
LO
6V
T 6V
SEND
R6V
VCC
MUTE
SPJ
SP
SPE
EXT MIC
IN MIC
PTT
E
LED
Q101
Q102
Q103
Q104
Q106
Q107
Q108
Q109
Q110
Q111
Q112
Q113
Q117
Q118
Q119
Q120
Q121
Q122
Q123
Q124
FI101
S101 PTT
D101
D104
L101
L102
L103
L104
L105
C101
C102
C103
C104
C105
C106
C107
C108
C109
C110
C111
C112
C114
C115
C117
C133
C134
C135
C136
C137
C147
C148
C149
C150
C151
C152
C153
C154
C155
C156
C157
C158
C160
C176
R101
R102
R103
R105
R106
R107
R108
R119
R120
R122
R123
R124
R125
R126
R127
R128
R129
R130
R131
R132
R140
R141
R142
R143
R144
R145
R146
R147
R148
R149
R150
R151
R152
R155
R156
R157
R158
R181
R182
7.5nS 7.2nS
200mVP-P
R 5.8
T 0
R 1.2
T 0
R 1.9
T 0
R 0.8
T 0
R 6.0
T 0
R 0.7
T 0
R 0.9
T 0
R 1.4
T 0
R 8.4
T. Locked 8.0
T. Unlocked 8.4
R 0
T. Locked 5.9
T. Unlocked 0
R 6.0
T. Locked 5.2
T. Unlocked 6.0
R 6.0
T. Locked 0
T. Unlocked 6.0
R 5.3
T 3.8
R 6.0
T 0
R 7.7
T 8.1
R 5.4
T 0.4
R 4.2
T 0
Locked 0
Unlocked 0.6
R 0
T. Locked 5.2
T. Unlocked 0
SQL Count.
T 0
R 1.6
T 5.2
SQL Count.
T 0.6
R 6.0
T 4.6
R 6.0
T 5.2
R 0
T 3.0
R 7.4
T 0
R 0
T 4.5
R 0
T. Locked 5.1
T. Unlocked 0
8.4
6.0
0.6
1.7
7.7
6.4


61nS
400mVP-P
FI101
FI 102
IC101
IC102
AF AMP
SQL CONTROL
Q104
Q105
Q113
Q114
Q115
Q116
Q123
Q124
Q125
Q126
Q127
Q128
Q129
Q130
Q131
Q132
SQL Count.
Squelched
AF OUT
SQL OUT
SQL IN
AF IN
SP OUT
TONE IN
MUTE
TONE 6V
E
MOD OUT

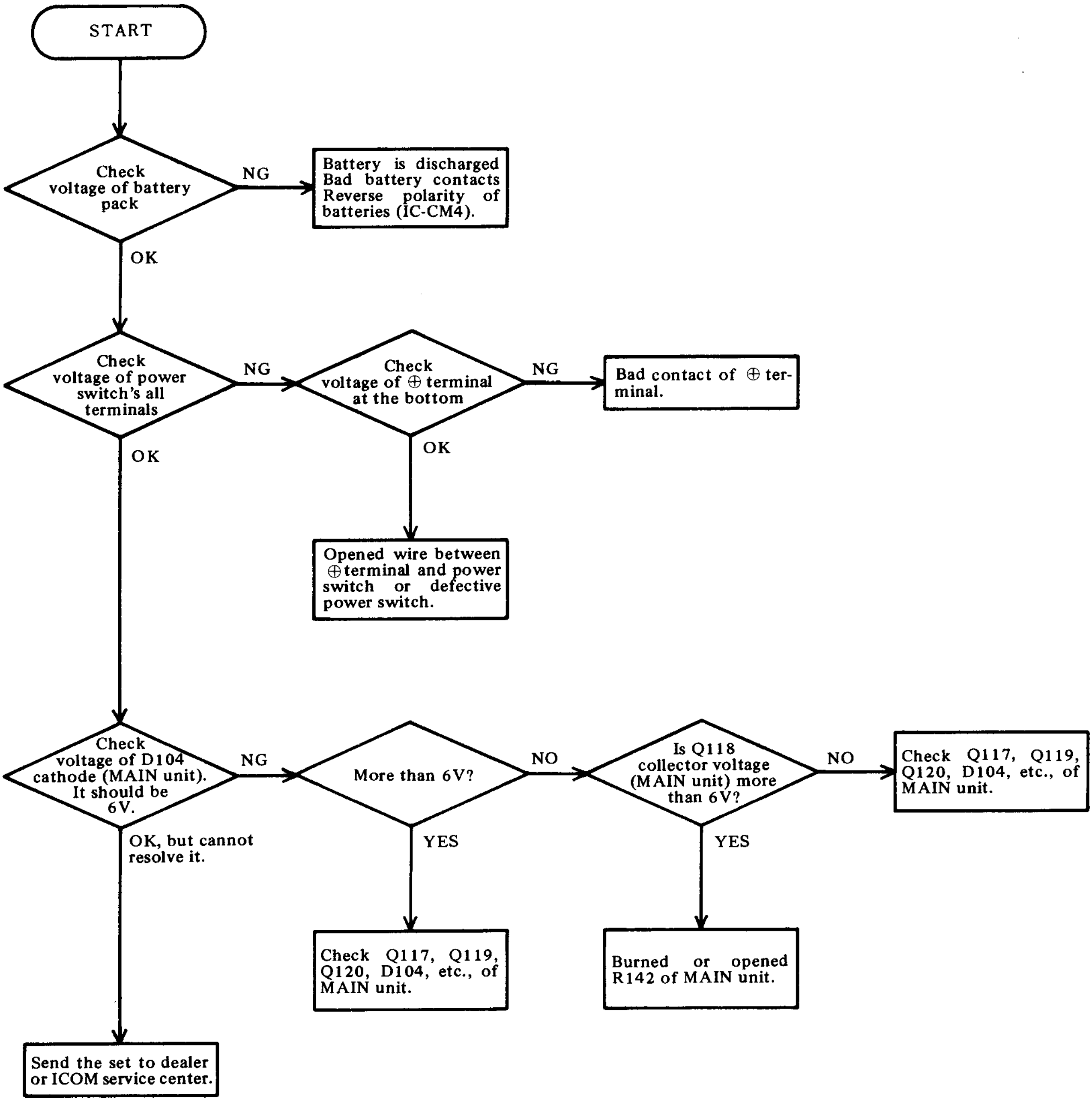
PLL UNIT


400μS
1.5μS
5.9VP-P
R249
6.0
2.0
Locked
Unlocked
Q214
Locked 0
Unlocked 6.0
D204
L203
5.2
C220
C215
R203
R202
R256
C217
R207
L201
L202
R209
0
1.0~5.0
R204
R206
C214
D203
C218
C221
D205
C222
C223
C213
R205
J202
C303
C201
C202
C203
C204
C205
C206
C207
C208
C209
C210
C211
C212
J201
IC201
IC202
IC203
6.0
3.0
1.4
400μS
6.0VP-P
C244
X201
C242
C243
C239
C240
C241
L206
C302
0.2μS
5VP-P
R223
L211
C246
R224
L212
C247
7.5nS~7.2nS
1VP-P
15nS~13nS
200 mVP-P
7.5nS~7.2nS
300mVP-P
C267
D214
C269
R242
Q210
R243
R245
R247
C281
Q212
8.4
R 5.8
T 0
Q207
Q208
Q209
L218
C265
L217
C263
C261
R238
R 1.0
T 1.2
R 1.6
T 0
R239
R 0
T 1.7
R241
C273
R244
Q211
R 0
T 1.4
R 8.4
T 8.0
C280
R248
C270
L219
C274
C275
C277
L221
C282
R 0
T 0.6
C271
C278
L222
C272
L220
C276
R246
C279
C283
0.5
C268
R240
C266
R237
R257
D218
LO
C262
C264

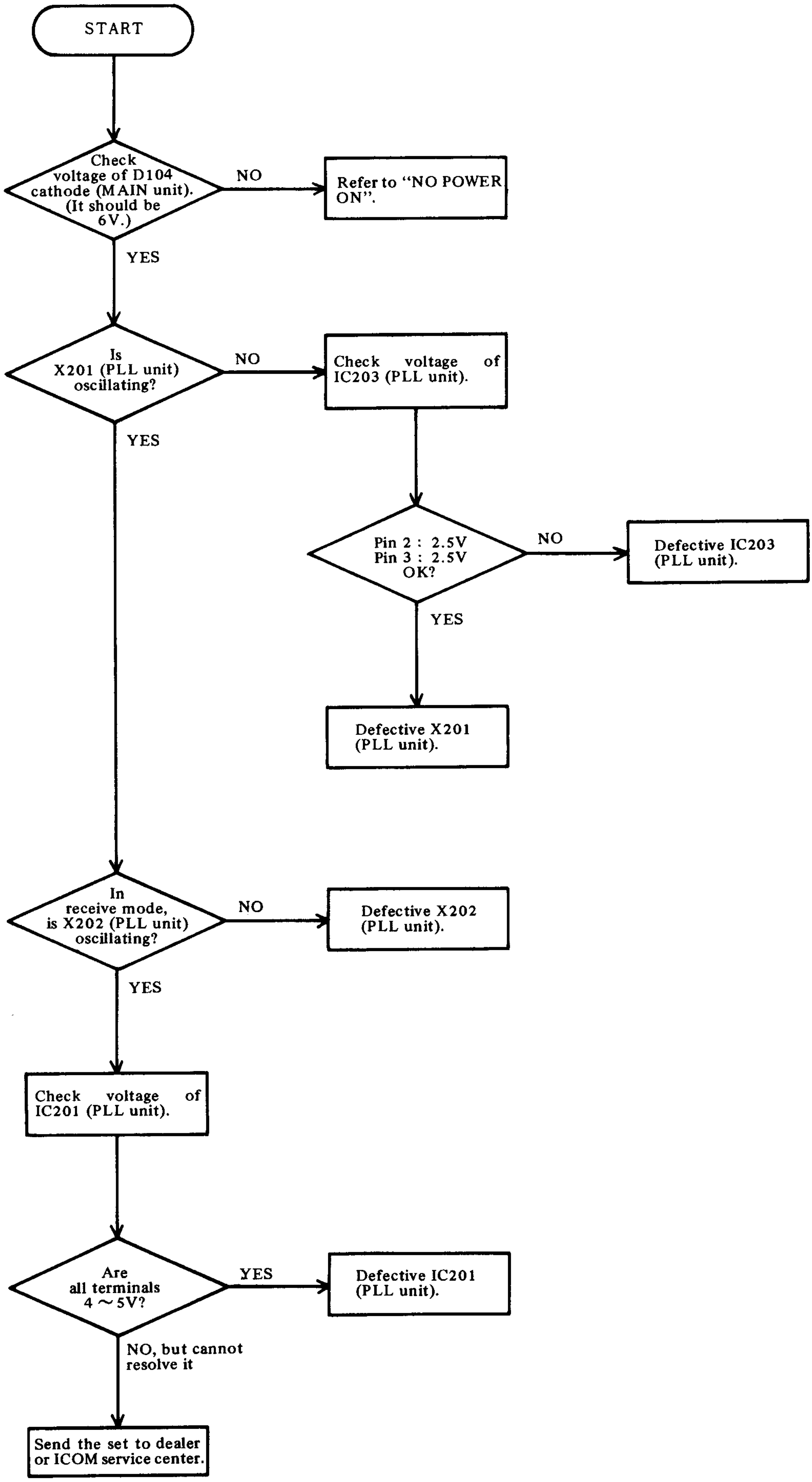


15nS~13nS
100mVP-P
15nS~13nS
1.3 VP-P
0.4~0.2μS
1VP-P
MUTE
0.4~0.2μS
4VP-P
Shall not be Less than 2VP-P
Q201
D204
C225
L232
R214
R217
C238
L203
R215
C220
R212
C230
R218
C226
Q202
L204
R216
C233
C236
R209
R211
C231
Q204
L205
Q205
L201
L202
C222
C223
R210
C227
Q203
C229
R213
C232
C235
R219
C237
D205
C221
C218
C224
L231
C228
MOD
R16nS
T14nS
Q206
1VP-P
R223
L211
X202
D210
R234
L215
R3InS
T28nS
C246
C254
C257
C258
R227
R224
L212
X203
D211
800 mVP-P
C247
R228
C251
C253
R231
R232
C252
R233
R235
C255
C256
L216
E
6V
R6V
R6V
T6V
T6V
VCC
R247
C281
L229
R254
L230
Output PWR. 3.0W
C280
Q212
C294
ANT
R248
D215
L226
D216
C297
C298
L223
C286
R252
C291
C295
L227
L228
C277
L221
C282
L225
L224
C278
C279
L222
R246
C283
R250
C284
C285
C287
Q213
C288
C289
C290
C292
D217
SEND
RX
R253
C293
C296
C300
E

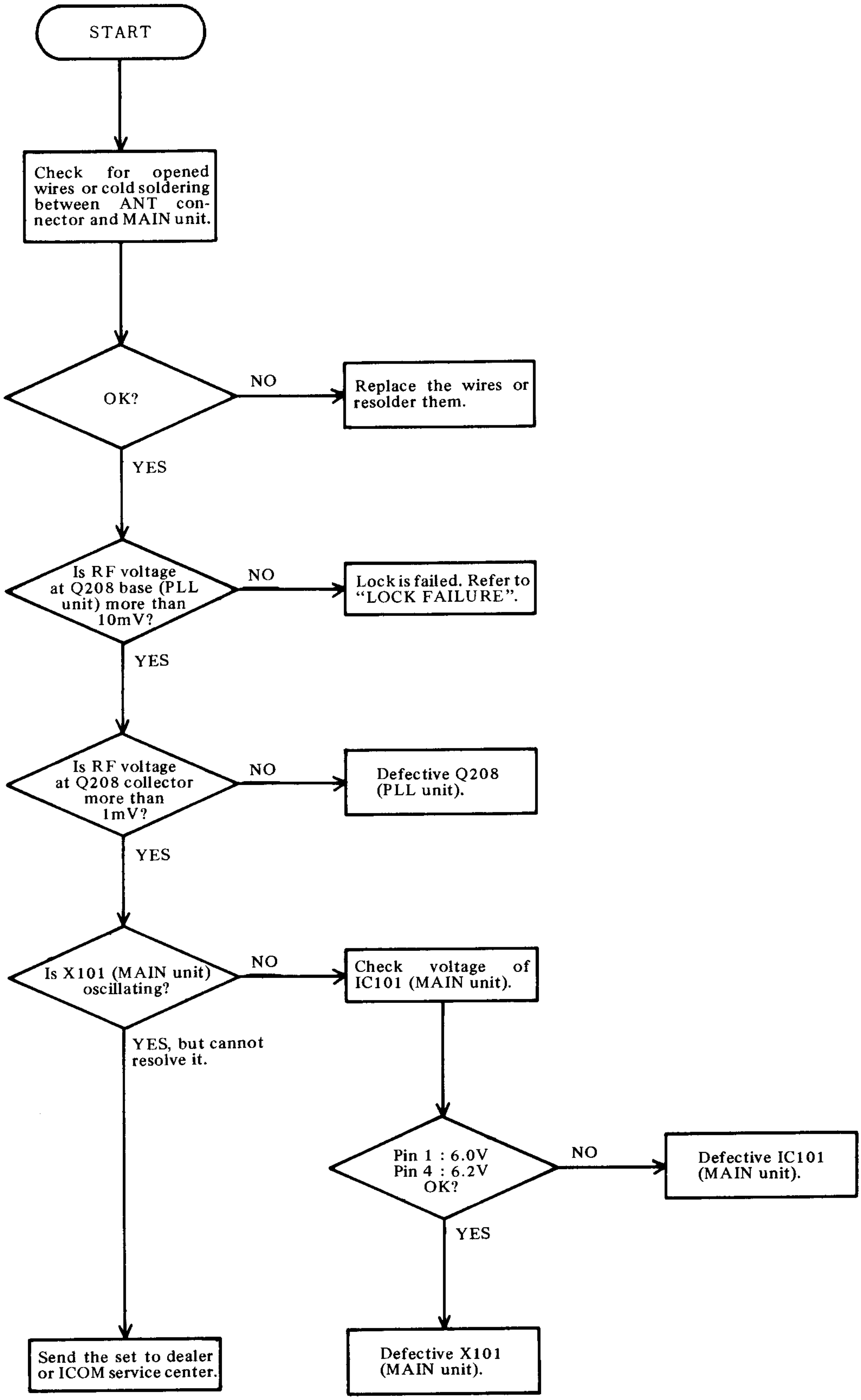
NO POWER ON


START
Check voltage of battery pack
NG
Battery is discharged Bad battery contacts Reverse polarity of batteries (IC-CM4).
OK
Check voltage of power switch's all terminals
NG
Check voltage of ⊕ terminal at the bottom
NG
Bad contact of ⊕ terminal.
OK
Opened wire between ⊕terminal and power switch or defective power switch.
OK
Check voltage of D104 cathode (MAIN unit). It should be 6V.
NG
More than 6V?
NO
Is Q118 collector voltage (MAIN unit) more than 6V?
NO
Check Q117, Q119, Q120, D104, etc., of MAIN unit.
YES
Check Q117, Q119, Q120, D104, etc., of MAIN unit.
YES
Burned or opened R142 of MAIN unit.
OK, but cannot resolve it.
Send the set to dealer or ICOM service center.

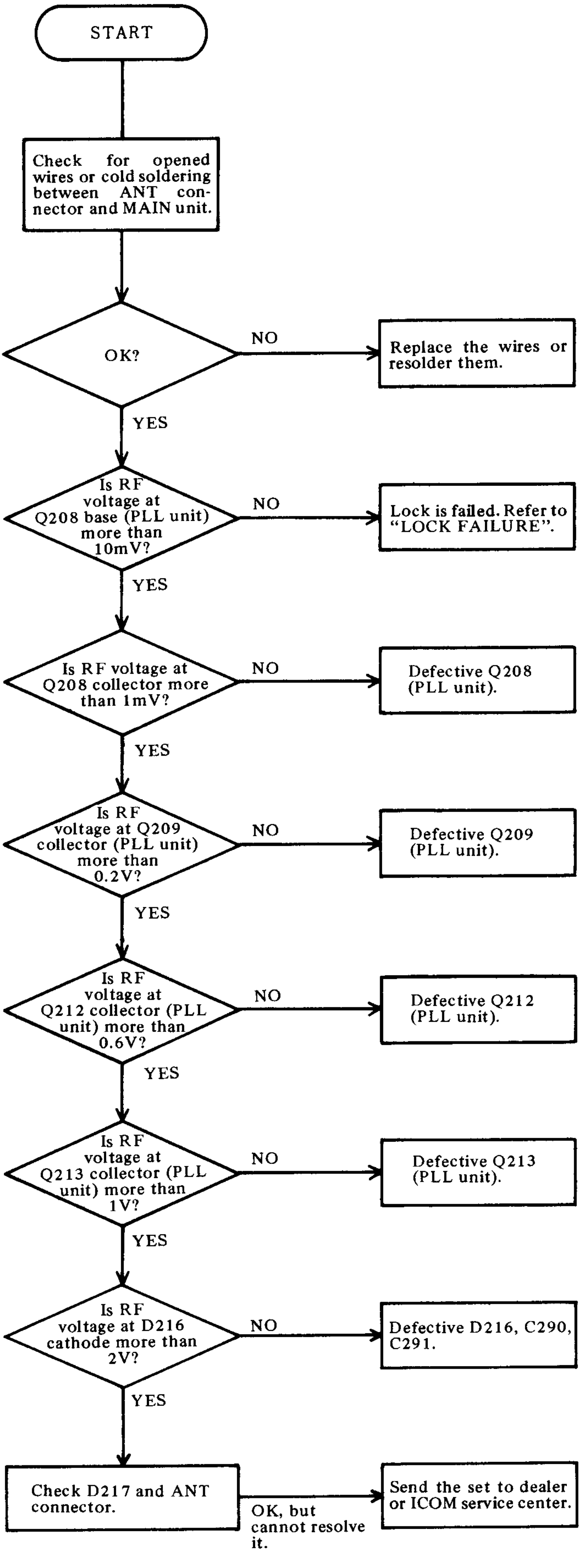
LOCK FAILURE



NO RECEPTION



NO TRANSMIT RF POWER

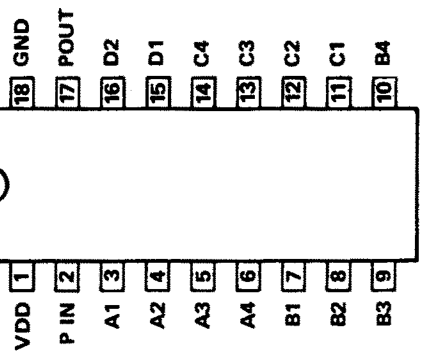


TC-9122P (BCD PROGRAMMABLE COUNTER)

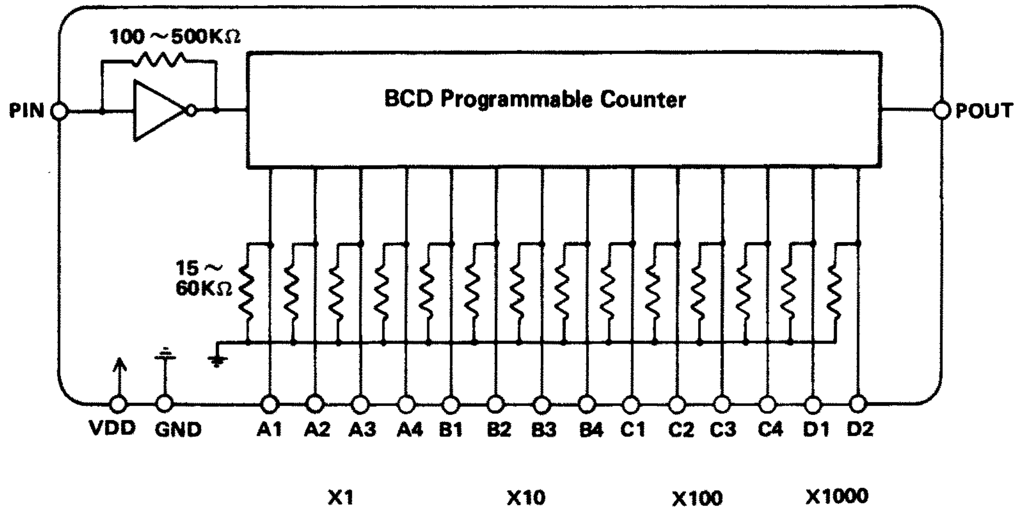
MAXIMUM RATINGS (Ta = 25°C)

SYMBOL	DESCRIPTION	RATINGS	UNIT
V_{DD}	Supply Voltage	10	V
V_{IN}	Input Voltage	$-0.3 \sim V_{DD} + 0.3$	V
T_{OPR}	Operating Temperature	$-30 \sim 75$	°C
T_{STR}	Storage Temperature	$-55 \sim 125$	°C

PIN CONNECTION



BLOCK DIAGRAM

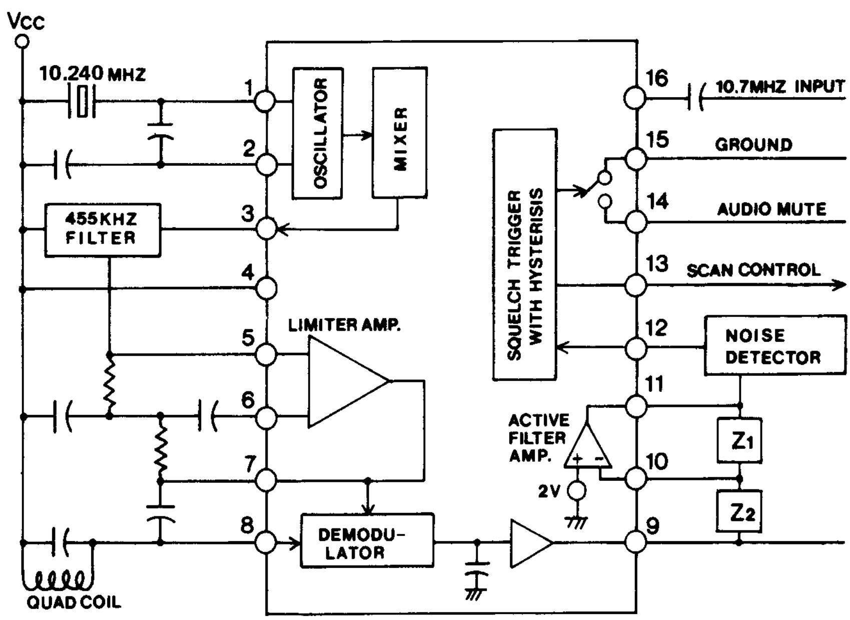


MC-3357 (LOW POWER FM IF)

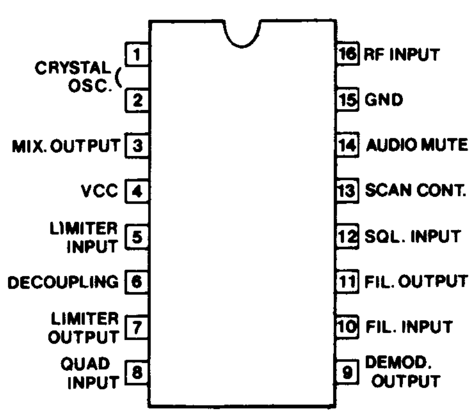
MAXIMUM RATINGS (Ta = 25°C)

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

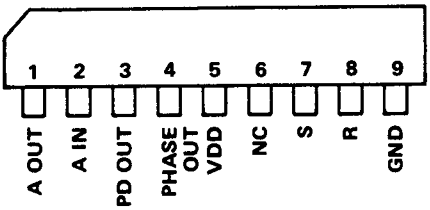


TC-5081 (PHASE COMPARATOR)

MAXIMUM RATINGS (Ta = 25°C)

SYMBOL	DESCRIPTION	RATINGS	UNIT
V_{DD}	Supply Voltage	10	V
V_{IN}	Input Voltage	–0.3 ~ V_{DD} +0.3	V
T_{OPR}	Operating Temperature	–30 ~ 75	°C
T_{STR}	Storage Temperature	–55 ~ 125	°C

PIN CONNECTION

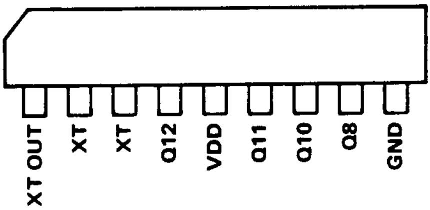


TC-5082 (OSCILLATOR AND 10 STAGE DIVIDER)

MAXIMUM RATINGS (Ta = 25°C)

SYMBOL	DESCRIPTION	RATINGS	UNIT
V_{DD}	Supply Voltage	10	V
V_{IN}	Input Voltage	–0.3 ~ V_{DD} +0.3	V
T_{OPR}	Operating Temperature	–30 ~ 75	°C
T_{STR}	Storage Temperature	–55 ~ 125	°C

PIN CONNECTION

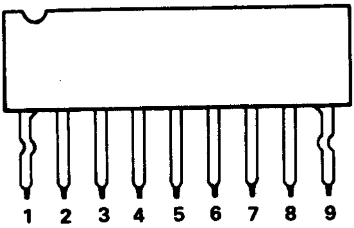


BA-526 (700mW AMPLIFIER)

MAXIMUM RATINGS (Ta = 25°C)

SYMBOL	DESCRIPTION	RATINGS	UNIT
V_{CC}	Supply Voltage	9	V
Pd	Permissible Dissipation	700	mW
T_{OPR}	Operating Temperature	–10 ~ +65	°C
T_{STG}	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	K12141014-5N1212-10KB	(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-13	
S1	Rotary Switch	SRM1026	
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
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
Q124	Transistor	2SC2458-GR	4D
Q125	Transistor	2SC2458-GR	4E
Q126	Transistor	2SC2458-GR	4E

[MAIN UNIT PARTS]

REF NO.	DESCRIPTION (PART NO)		BOARD LOCATION
Q127	Transistor	2SA1048-Y	4F
Q128	Transistor	2SC2458-GR	4F
Q129	Transistor	2SC2458-GR	4G
Q130	Transistor	2SC2458-GR	1G
Q131	Transistor	2SA1015-Y	1G
Q132	Transistor	2SC2458-GR	3F
D101	Diode	1S1555	2C
D102	Diode	1S1555	4D
D103	Zener Diode	WZ-081	3C
D104	Zener Diode	EZ-056A	1F
D105	Diode	1S1555	3F
FI101	Crystal Filter	16M15B2	1B-2C
FI102	Ceramic Filter	CFU455E2	3E
X101	Crystal	16.445MHz 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-221	1C
L107	Inductor	LS-158	4D
R101	Resistor	10KΩ -J ELR10	2A
R102	Resistor	100KΩ-J ELR10	1A
R103	Resistor	100Ω -J ELR10	2B
R105	Resistor	56Ω -J ELR10	1C
R106	Resistor	220Ω -J ELR10	1C
R107	Resistor	47KΩ -J ELR10	2C
R108	Resistor	1.2KΩ -J ELR10	2C
R109	Resistor	330KΩ-J ELR10	2C
R110	Resistor	10KΩ -J ELR10	2C
R111	Resistor	1.5KΩ -J ELR10	2E
R112	Resistor	1.5KΩ -J ELR10	3E
R113	Resistor	47KΩ -J ELR10	3E
R114	Resistor	22KΩ -J ELR10	3D
R115	Resistor	470Ω -J R10	4C
R116	Resistor	330KΩ-J ELR10	3D
R117	Resistor	4.7KΩ -J ELR10	4C
R118	Resistor	5.6KΩ -J ELR10	3D
R119	Resistor	1KΩ -J ELR10	1E
R120	Resistor	2.2KΩ -J ELR10	1E
R122	Resistor	3.3KΩ -J ELR10	1D
R123	Resistor	1KΩ -J ELR10	1E
R124	Resistor	3.3KΩ -J ELR10	1D
R125	Resistor	10KΩ -J ELR10	1D
R126	Resistor	10KΩ -J ELR10	1C
R127	Resistor	10KΩ -J ELR10	1C
R128	Resistor	1.5KΩ -J ELR10	1C
R129	Resistor	47Ω -J ELR10	2E
R130	Resistor	68KΩ -J ELR10	2C
R131	Resistor	22KΩ -J ELR10	2B
R132	Resistor	10KΩ -J ELR10	3B
R134	Resistor	15KΩ -J ELR10	3C
R135	Resistor	10KΩ -J ELR10	3C
R136	Resistor	47KΩ -J R10	4D
R137	Resistor	22KΩ -J ELR10	4C
R138	Resistor	22KΩ -J ELR10	3C

[MAIN UNIT PARTS]

REF NO.	DESCRIPTION (PART NO)	BOARD LOCATION
R139	Resistor 330Ω -J ELR10	4A
R140	Resistor 3.3KΩ -J ELR10	1F
R141	Resistor 4.7KΩ -J ELR10	1G
R142	Resistor 2.2Ω -J ELR10	1G
R143	Resistor 2.7KΩ -J ELR10	1F
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 47KΩ -J ELR10	2F
R150	Resistor 330Ω -J ELR10	1E
R151	Resistor 10KΩ -J ELR10	1D
R152	Resistor 33KΩ -J ELR10	4C
R153	Resistor 100KΩ-J ELR10	4E
R154	Resistor 150KΩ-J ELR10	4D
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
R165	Resistor 2.2KΩ -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	Resistor WHS512A 10KΩ	4G
R175	Resistor 3.9KΩ -J R10	2G
R176	Resistor 10KΩ -J R10	2G
R177	Trimmer H0651A 4.7KΩ	3F
R178	Resistor 47KΩ -J ELR10	3F
R179	Resistor 33KΩ -J ELR10	3F
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 1pF/50V	2A
C103	Ceramic 100pF/50V	2A
C104	Ceramic 470pF/50V	1A
C105	Ceramic 470pF/50V	1A
C106	Ceramic 7pF/50V	1A
C107	Ceramic 7pF/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 TBD05V	1C
C112	Barrier Lay 0.0047μF/50V TBD05V	1C
C114	Ceramic 5pF/50V	2B
C115	Ceramic 0.001μF/50V	2C
C116	Barrier Lay 0.0047μF/50V TBD05V	2C
C117	Tantalum 10μF/6.3V ECSF6E 10	2E
C118	Barrier Lay 0.0047μF/50V TBD05V	2C

[MAIN UNIT PARTS]

REF NO.	DESCRIPTION (PART NO)	BOARD LOCATION
C119	Ceramic 0.001μ/50V	2C
C120	Ceramic 22pF/50V	2D
C121	Ceramic 120pF/50V	2E
C122	Barrier Lay 0.1μF/16V	3E
C123	Electrolytic 0.1μF/50V MS7	3E
C124	Ceramic 10pF/50V	3E
C125	Barrier Lay 0.0033μF/50V TBD05V	4C
C126	Electrolytic 0.22μF/50V MS7	4C
C127	Electrolytic 0.22μF/50V MS7	4C
C128	Ceramic 0.001μF/50V	4C
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 MS7	1E
C134	Ceramic 470pF/50V	1E
C135	Electrolytic 1μF/50V MS7	3C
C136	Electrolytic 0.47μF/50V MS7	4D
C137	Electrolytic 1μF/50V MS7	3C
C138	Electrolytic 3.3μF/50V MS7	3D
C139	Electrolytic 10μF/16V MS7	4A
C140	Ceramic 0.001μF/50V	3A
C141	Electrolytic 0.47μF/50V MS7	4A
C142	Electrolytic 10μF/16V MS7	4A
C143	Ceramic 0.001μF/50V	4B
C144	Electrolytic 100μF/10V MS9	4B
C145	Electrolytic 47μF/10V MS9	4A
C146	Electrolytic 100μF/10V MS9	4B
C147	Ceramic 0.001μF/50V	4C
C148	Electrolytic 47μF/25V MS9	4D
C149	Ceramic 470pF/50V	1G
C150	Electrolytic 0.22μF/50V MS7	1F
C151	Ceramic 470pF/50V	1F
C152	Electrolytic 100μF/10V MS9	1F
C153	Ceramic 470pF/50V	1F
C154	Electrolytic 100μF/10V MS9	1E
C155	Electrolytic 10μF/16V MS7	1D
C156	Electrolytic 0.47μF/50V MS7	4D
C157	Electrolytic 10μF/16V MS7	4E
C158	Barrier Lay 0.01μF/50V TBD05V	4D
C159	Ceramic 470pF/50V	4E
C160	Ceramic 470pF/50V	4E
C161	Ceramic 470pF/50V	4E
C162	Electrolytic 1μF/50V MS7	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 MS7	4G
C168	Ceramic 0.001μF/50V	3D
C170	Barrier Lay 0.0047μF/50V TBD05V	3F
C174	Electrolytic 10μF/16V MS7	4E
C175	Electrolytic 0.47μF/50V MS7	3E
C176	Ceramic 470pF/50V	4D
S101	Switch TWN-0301	1D
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
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
D214	Diode 1S1555	3G
D215	Diode 1S1209	4C
D216	Diode 1SS53	4B
D217	Diode 1SS53	4A
D218	Diode 1S1555	3F
X201	Crystal 5.12000MHz HC-18/T	2F
X202	Crystal * HC-18/T	2C
X203	Crystal * HC-18/T	2B
	(*Refer to page 3 — 4)	
L201	Inductor LR-125	3D
L202	Inductor LR-79	4E
L203	Inductor LB-88	4E
L204	Inductor LW-20	3D
L205	Inductor 100 L4	1D
L206	Inductor LR-79	3D
L211	Inductor LB-91	3C
L212	Inductor LB-134	2B
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-126	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 47KΩ -J ELR10	2F
R203	Resistor 12KΩ -J ELR10	2E
R204	Resistor 1KΩ -J ELR10	3F

[PLL UNIT PARTS]

REF NO.	DESCRIPTION (PART NO)	BOARD LOCATION
R205	Resistor 470Ω -J R10	3F
R206	Resistor 100KΩ-J ELR10	3F
R207	Resistor 100KΩ-J ELR10	3E
R209	Resistor 220Ω -J ELR10	4F
R210	Resistor 22KΩ -J ELR10	4F
R211	Resistor 220Ω -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
R223	Resistor 2.2KΩ -J ELR10	3C
R224	Resistor 2.2KΩ -J ELR10	3B
R227	Resistor 2.2KΩ -J ELR10	2C
R228	Resistor 2.2KΩ -J ELR10	2B
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
R252	Resistor 22Ω -J ELR10	4C
R253	Resistor 330Ω -J ELR10	4A
R254	Resistor 15KΩ -J ELR10	4A
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 10μF/6.3V	3F
C214	Barrier Lay 0.01μF/50V TBD05V	3F
C215	Electrolytic 10μF/16V MS7	2F
C217	Ceramic 470pF/50V	3E
C218	Ceramic 470pF/50V	3D
C220	Ceramic 30pF/50V	4E
C221	Electrolytic 100μF/10V MS9	4D
C222	Ceramic 470pF/50V	4D

[PLL UNIT PARTS]

REF NO.	DESCRIPTION (PART NO)		BOARD LOCATION
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	0.001μF/50V	3D
C230	Ceramic	0.001μF/50V	3D
C231	Ceramic	8pF/50V	3D
C232	Ceramic	22pF/50V	2C
C233	Barrier Lay	0.0047μF/50V TBD05V	3D
C235	Ceramic	22pF/50V	1D
C236	Ceramic	0.001μF/50V	2D
C237	Barrier Lay	0.0047μF/50V TBD05V	2D
C238	Ceramic	0.001μF/50V	2D
C239	Electrolytic	100μF/10V MS9	1F
C240	Barrier Lay	0.0047μF/50V TBD05V	3E
C241	Ceramic	0.001μF/50V	1G
C242	Ceramic	15pF/50V	2F
C243	Ceramic	33pF/50V	2F
C244	Ceramic	33pF/50V	1G
C246	Ceramic	0.001μF/50V	3B
C247	Ceramic	0.001μF/50V	3B
C251	Ceramic	0.001μF/50V	1C
C252	Ceramic	56pF/50V	1C
C253	Ceramic	22pF/50V	1C
C254	Ceramic	47pF/50V	2C
C255	Ceramic	0.001μF/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	0.001μF/50V	2G
C265	Ceramic	10pF/50V	2G
C266	Ceramic	0.001μF/50V	3G
C267	Ceramic	470pF/50V	2F
C268	Ceramic	0.001μF/50V	3G
C269	Electrolytic	4.7μF/25V MS7	3G
C270	Ceramic	7pF/50V	4G
C271	Ceramic	0.35pF/50V	4G
C272	Ceramic	7pF/50V	4G
C273	Ceramic	0.001μF/50V	3G
C274	Ceramic	470pF/50V	4G
C275	Ceramic	47pF/50V	4G
C276	Ceramic	470pF/50V	4F
C277	Ceramic	6pF/50V	4F
C278	Ceramic	0.5pF/50V	4E
C279	Ceramic	6pF/50V	4E
C280	Ceramic	470pF/50V	4F
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	27pF/50V	4C
C288	Electrolytic	1μF/50V MS7	4C

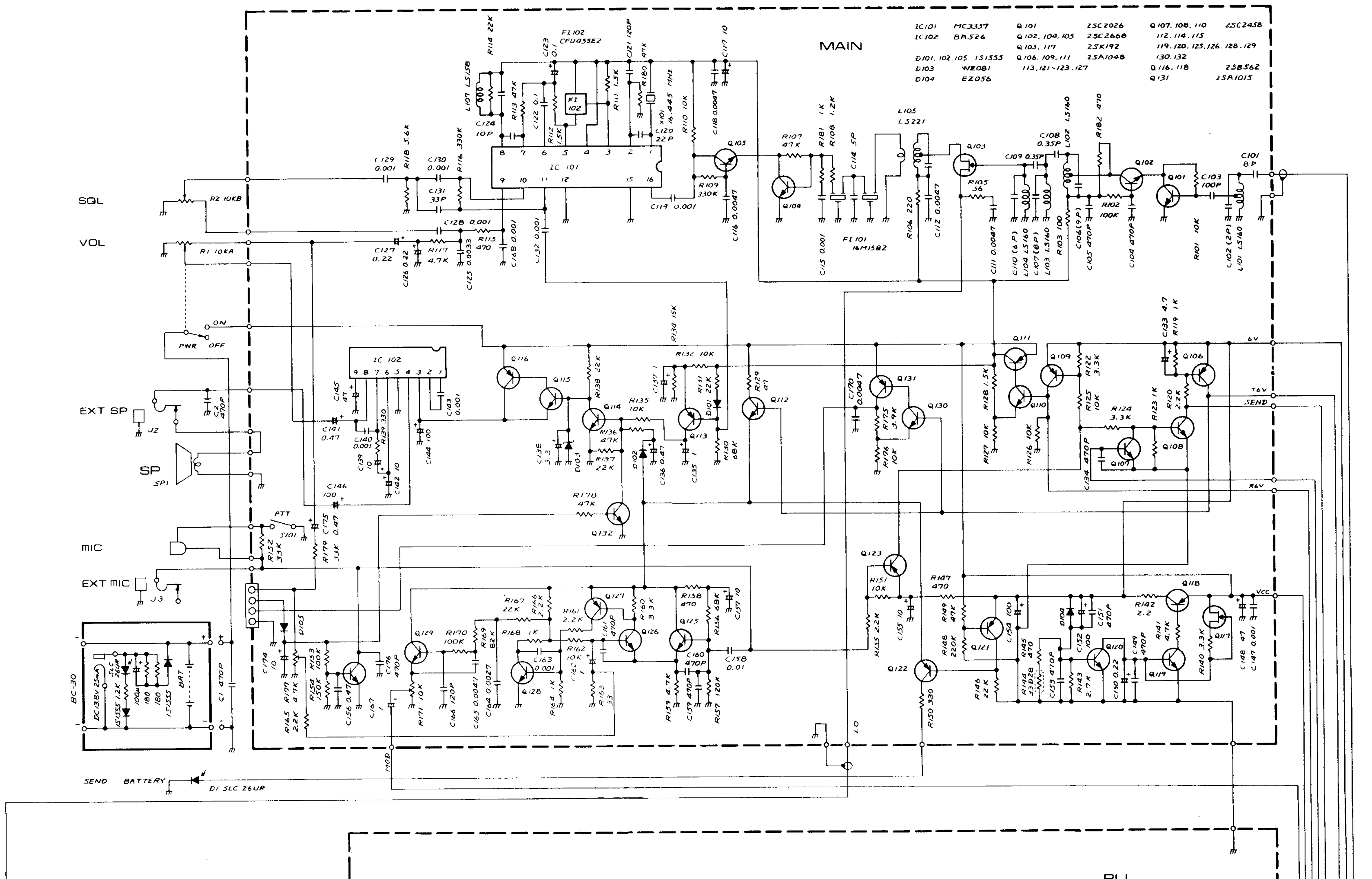
[PLL UNIT PARTS]

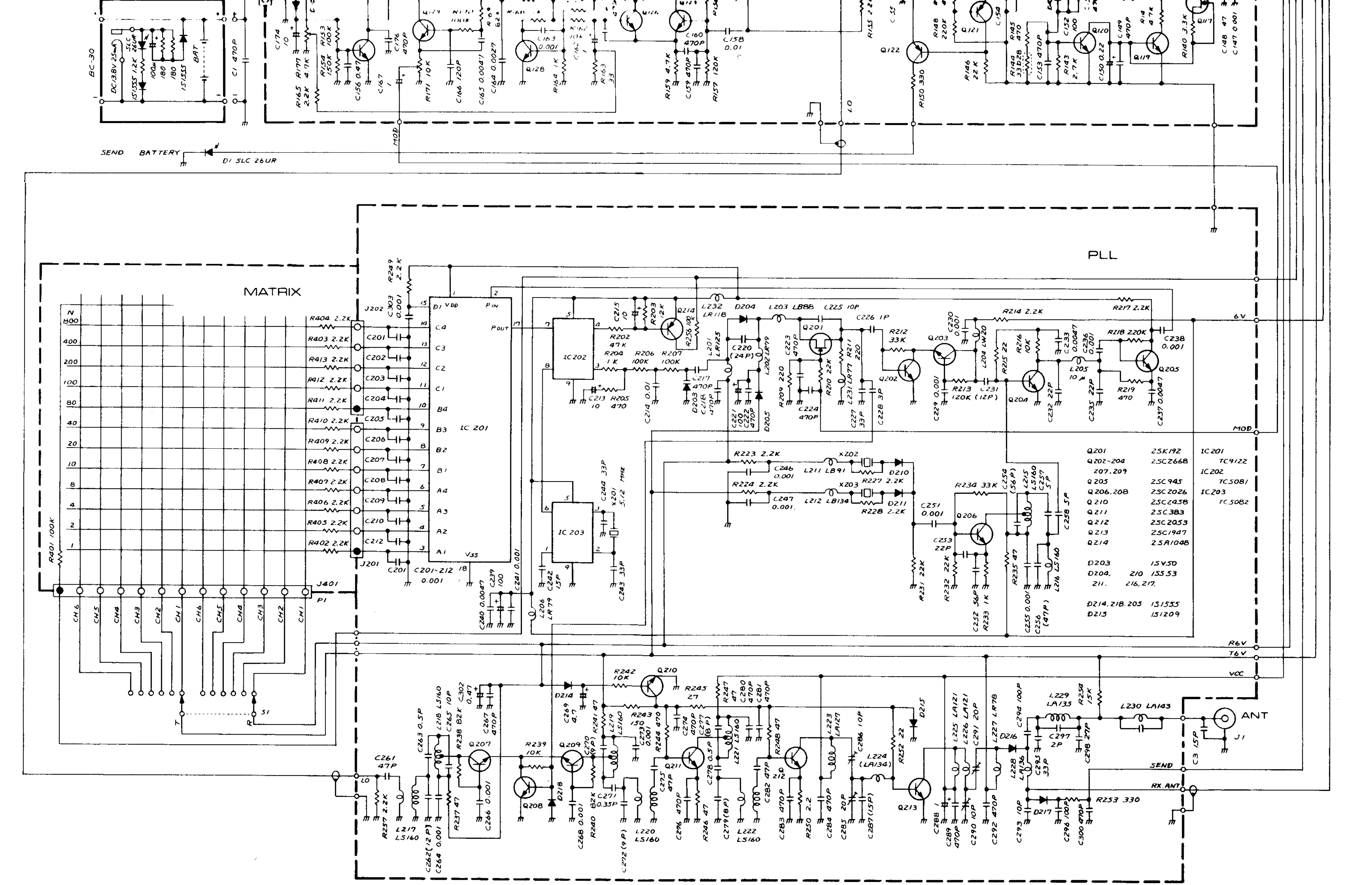
REF NO.	DESCRIPTION (PART NO)		BOARD LOCATION
C289	Ceramic	470pF/50V	4C
C290	Trimmer	10pF MCV50D1H100	4B
C291	Trimmer	20pF MCV50D1H200	4B
C292	Ceramic	470pF/50V	4A
C293	Ceramic	10pF/50V	4A
C294	Ceramic	100pF/50V	4A
C295	Ceramic	33pF/50V	4B
C296	Ceramic	100pF/50V	4A
C297	Ceramic	2pF/50V	4A
C298	Ceramic	27pF/50V	4A
C300	Ceramic	470pF/50V	4A
C302	Electrolytic	0.47μF/50V MS7	4C
C303	Ceramic	0.001μF/50V	2E
J201	Connector	SB7P-HVQ-22	1D
J202	Connector	SB5P-HVQ-22	1E
B201	P.C. Board	B-390D	
	Beads Core	DL-20P2.6-3-1.2H	

[MATRIX UNIT PARTS]

REF NO.	DESCRIPTION (PART NO)			BOARD LOCATION
R401	Resistor	100KΩ-J	R10	1E
R402	Resistor	2.2KΩ -J	R10	1E
R403	Resistor	2.2KΩ -J	R10	1D
R404	Resistor	2.2KΩ -J	R10	3E
R405	Resistor	2.2KΩ -J	R10	3B
R406	Resistor	2.2KΩ -J	R10	1D
R407	Resistor	2.2KΩ -J	R10	3B
R408	Resistor	2.2KΩ -J	R10	3B
R409	Resistor	2.2KΩ -J	R10	3C
R410	Resistor	2.2KΩ -J	R10	3C
R411	Resistor	2.2KΩ -J	R10	2B
R412	Resistor	2.2KΩ -J	R10	1B
R414	Resistor	2.2KΩ -J	R10	3B
J401	Connector	B13B-XH		1E
P401	Connector	F7P-HVQ-K		1C
P402	Connector	F5P-HVQ-K		1B
B401	P.C. Board	B-638		

IC-H6 SCHEMATIC DIAGRAM





ICOM ICOM INCORPORATED

AC BATTERY CHARGER

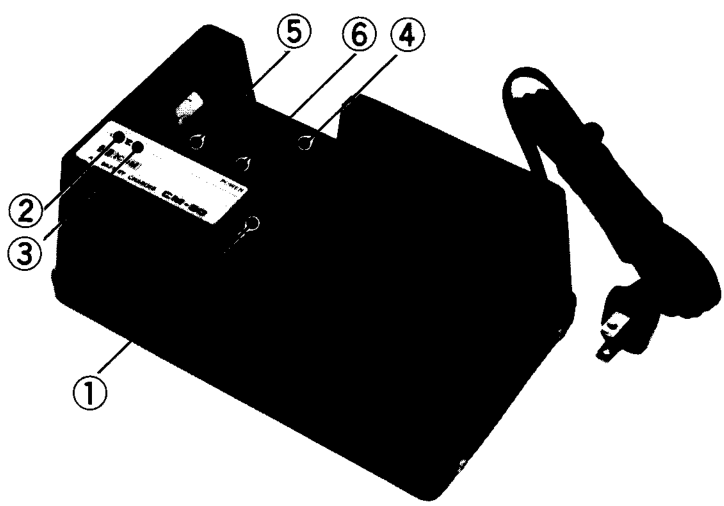
CM-30

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.

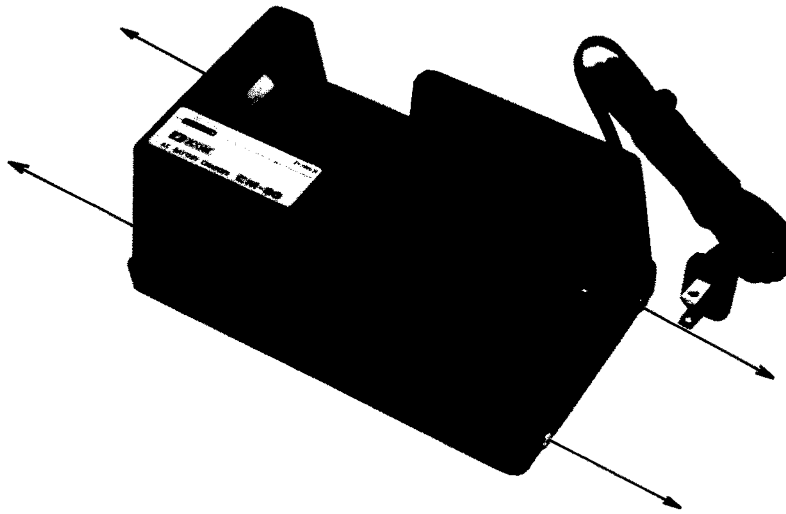
4. Insertion slot for battery packs.

5. Charging terminal
   Correspond to the terminals on the bottom of the battery packs.

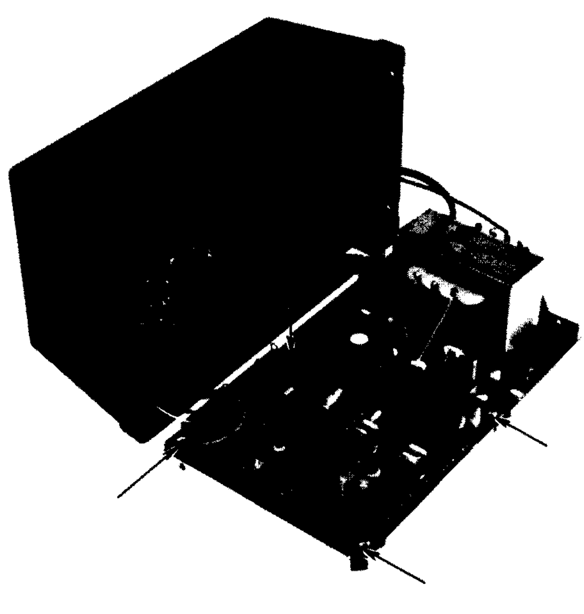
6. Microswitches.
   Since the current and capacity for each battery pack is different, these microswitches select the proper factors for each one.

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.



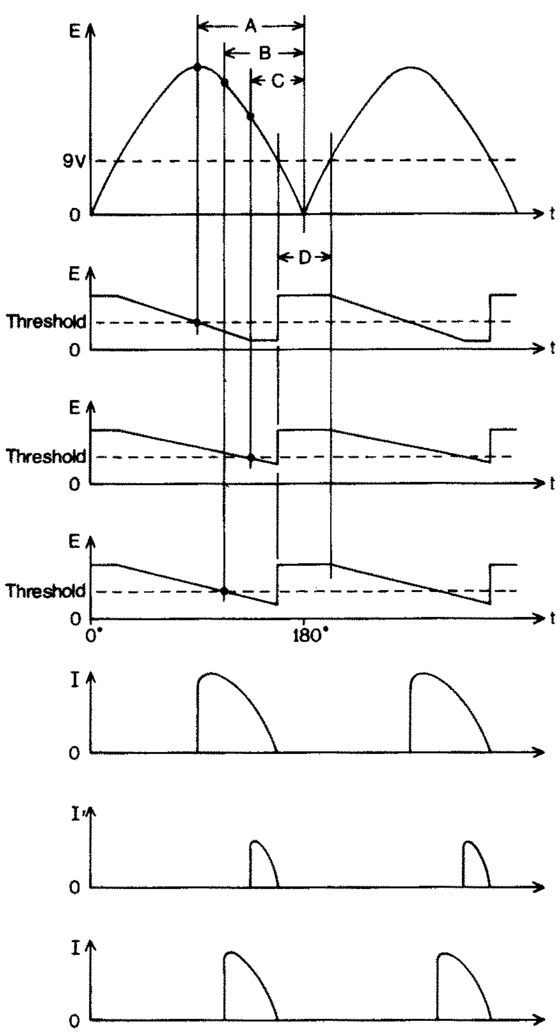
CIRCUIT DESCRIPTION

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.

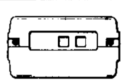
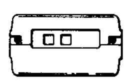
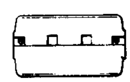
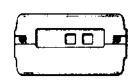
When the battery pack is fully charged, the built-in thermal switch in the pack is turned off and cuts off the ⊖ charging terminal. Thus, H level is applied to Pin 1 and 2 of IC2, Pin 5 of IC1 and the flip-flop is turned to reverse condition and Pin 4 of IC1 becomes L level. This puts out H level at 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.

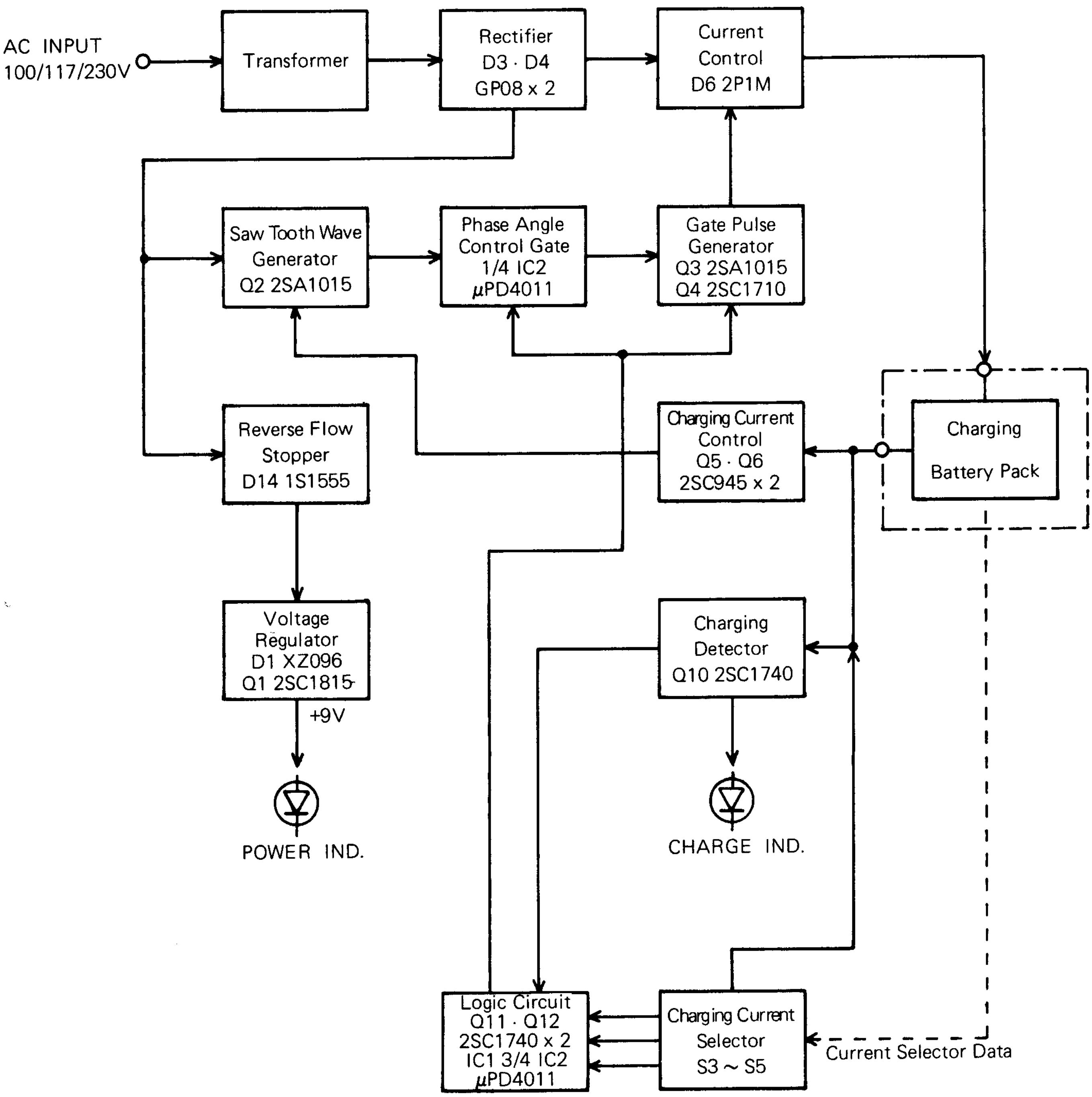
When charging IC-CM3, S3 is turned on and the charging current (25mA) flows through R37.
Pin 5 and 8 of IC1 are grounded through S5, Pin 10 of IC2 is L level and Q4 emitter is grounded through R10. Thus, the charging current flows until the battery pack is removed from the charger.

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.

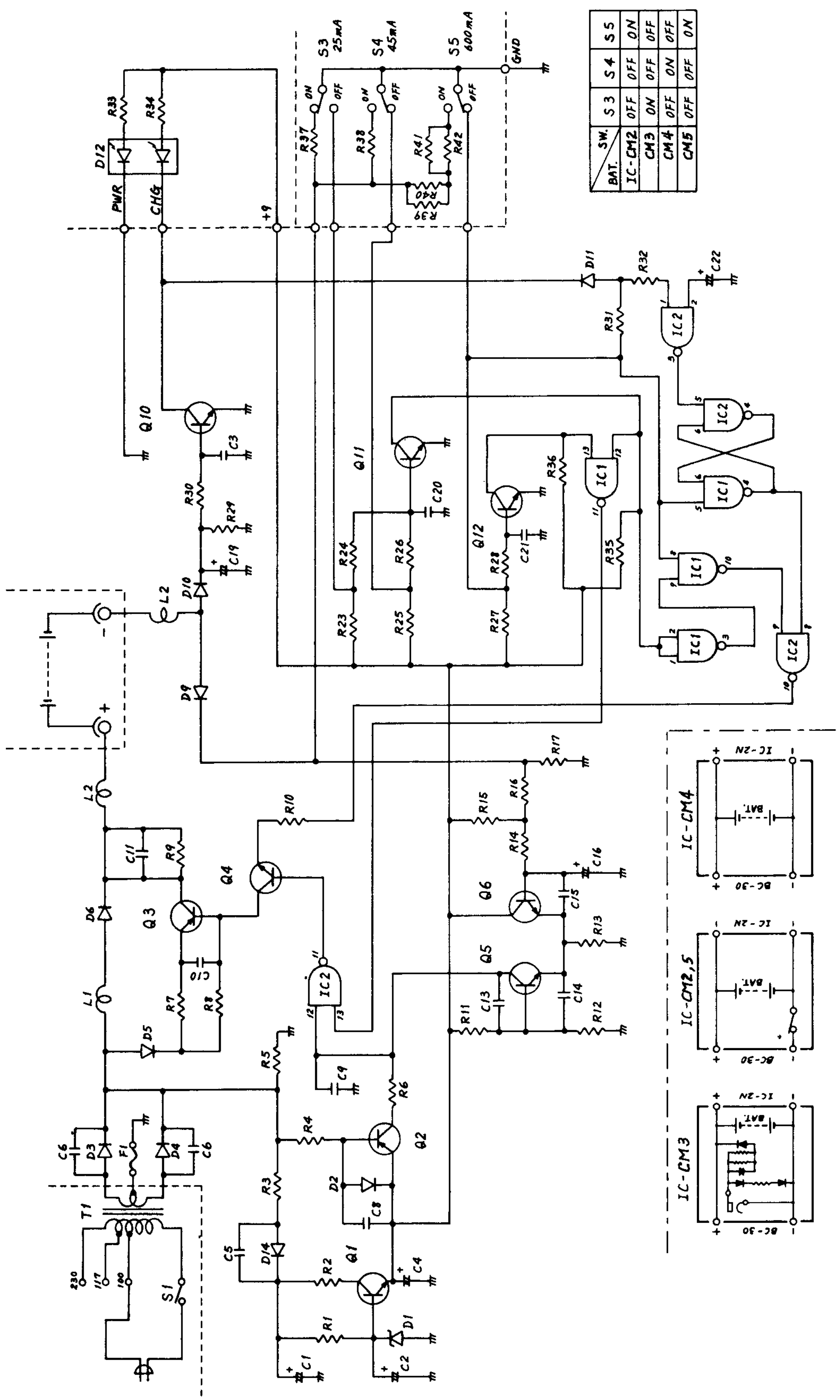
SPECIFICATIONS OF BATTERY PACKS

	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	O	X		X	O
Current Selector					
Height	39m/m	39m/m	49m/m	49m/m	60m/m
Battery Replace	X	X	O	O	X

BLOCK DIAGRAM



SCHEMTIC DIAGRAM



SW. / BAT.	S 3	S 4	S 5
IC-CM2	OFF	OFF	ON
CM3	ON	OFF	OFF
CM4	OFF	ON	OFF
CM5	OFF	OFF	ON

VOLTAGE CHART

TRANSISTOR

Note: Measuring instrument is a 50KΩ/V multimeter.

BATTERY	No connection			IC-CM3 (25mA)			IC-CM4 (45mA)			IC-CM2/CM5 (600mA)		
Tr. NO.	BASE	COLLE-CTOR	EMITTER	BASE	COLLE-CTOR	EMITTER	BASE	COLLE-CTOR	EMITTER	BASE	COLLE-CTOR	EMITTER
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		
IC1	IC μPD4011		
IC2	IC μPD4011		
Q1	Transistor	2SC1815-O, Y, GL, BL	
Q2	Transistor	2SA1015-Y	
Q3	Transistor	2SA1015-Y	
Q4	Transistor	2SC1740-Q, R, S, E	
Q5	Transistor	2SC945-P	
Q6	Transistor	2SC945-P	
Q10	Transistor	2SC1740-Q, R, S, E	
Q11	Transistor	2SC1740-Q, R, S, E	
Q12	Transistor	2SC1740-Q, R, S, E	
D1	Zener	XZ-096	
D2	Diode	1S1555	
D3	Diode	GP-08B	
D4	Diode	GP-08B	
D5	Diode	1S1555	
D6	SCR	2P1M	
D9	Diode	GP-08B	
D10	Diode	1S1555	
D11	Diode	1S1555	
D12	LED	LD-002R	
D14	Diode	1S1555	
L1	Choke	LW-16	
L2	Choke	LW-9	
L3	Choke	LW-9	
R1	Resistor	820	ELR25
R2	Resistor	220	ELR25
R3	Resistor	33	ELR25
R4	Resistor	22K	ELR25
R5	Resistor	2.2K	ELR25
R6	Resistor	3.3K	ELR25
R7	Resistor	1K	R25
R8	Resistor	10K	R25
R9	Resistor	1K	ELR25
R10	Resistor	47K	R25
R11	Resistor	22K	ELR25
R12	Resistor	2.7K	ELR25
R13	Resistor	1.5K	ELR25
R14	Resistor	22K	ELR25
R15	Resistor	15K	ELR25
R16	Resistor	680	ELR25
R17	Resistor	820	ELR25
R23	Resistor	10K	ELR25
R24	Resistor	100K	ELR25
R25	Resistor	10K	ELR25
R26	Resistor	100K	ELR25
R27	Resistor	10K	ELR25
R28	Resistor	100K	ELR25

REF. NO.	DESCRIPTION		
R29	Resistor	100K	R25
R30	Resistor	5.6K	R25
R31	Resistor	470K	R25
R32	Resistor	22K	R25
R33	Resistor	680	R25
R34	Resistor	680	R25
R35	Resistor	10K	ELR25
R36	Resistor	10K	ELR25
R37	Resistor	27	R25
R38	Resistor	15	R25
R39	Resistor	1	R25
R40	Resistor	1	R25
R41	Resistor	1	R25
R42	Resistor	1	R25
C1	Electrolytic	47μF/25V	
C2	Electrolytic	10μF/16V	
C3	Ceramic	470P	
C4	Electrolytic	100μF/10V	
C5	Ceramic	0.0047	
C6	Ceramic	0.0047	
C7	Ceramic	0.0047	
C8	Ceramic	470P	
C9	Barrier Lay	0.047	
C10	Ceramic	470P	
C11	Ceramic	470P	
C13	Ceramic	470P	
C14	Ceramic	470P	
C15	Ceramic	470P	
C16	Electrolytic	47μF	10V
C19	Electrolytic	22μ	16V
C20	Ceramic	470P	
C21	Ceramic	470P	
C22	Electrolytic	2.2μ	50V
S1	Switch	SDJ2S	
S3	Switch	D2MS	
S4	Switch	D2MS	
S5	Switch	D2MS	
	PC Board	B-439B	
	HEATSINK	41912	
	Fuse Holder	S-N5051	
	Fuse	2A	
T1	Transformer	TP-25	
	Power Cord	OPC-013	

Count on us!

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