



ICOM

SERVICE MANUAL

FM TRANSCEIVERS

220MHz

IC-38A

430MHz

IC-48A/E

ICOM INCORPORATED

FOREWORD

This service manual contains information relative to the theoretical, physical, mechanical, and electrical characteristics of the **IC-38A** and **IC-48A/E** — versatile new FM mobile transceivers from ICOM.



The picture shows the IC-38A version.

ASSISTANCE

The **IC-38A** was designed for use exclusively in the United States. There are three separate versions of the **IC-48A/E** which are referred to in this manual by the assigned version numbers listed below. If you require assistance or information regarding the operation and capabilities of the **IC-38A** or **IC-48A/E**, please contact your nearest authorized ICOM Dealer or ICOM Service Center.

- #01 IC-48A U.S.A. version
- #02 IC-48A Australia version
- #03 IC-48E Europe version

Please supply all of the following information for each part when ordering from your dealer or ICOM Service Center (Refer to the schematic diagram).

1. Equipment model and serial number (i.e., IC-48A, 02054)
2. Part number and name (i.e., IC3, FM IF IC)
3. Manufacturer's number (i.e., MC3357P)
4. P.C. Board name and number (i.e., RX UNIT B-1157E)
5. Quantity required (i.e., 1)

TABLE OF CONTENTS

SECTION 1	SPECIFICATIONS	1 - 1
SECTION 2	OUTSIDE AND INSIDE VIEWS	2 - 1 ~ 3
2 - 1	FRONT PANEL	2 - 1
2 - 2	LCD READOUT	2 - 1
2 - 3	REAR PANEL	2 - 1
2 - 4	MAIN UNIT	2 - 2
2 - 5	RX UNIT	2 - 3
SECTION 3	BLOCK DIAGRAMS	3 - 1 ~ 2
3 - 1	(IC-38A)	3 - 1
3 - 2	(IC-48A/E)	3 - 2
SECTION 4	IC-48A/E CIRCUIT DESCRIPTION	4 - 1 ~ 4
4 - 1	RECEIVER CIRCUITS	4 - 1
4 - 2	TRANSMITTER CIRCUITS	4 - 2
4 - 3	PLL CIRCUITS	4 - 2
4 - 4	LOGIC CIRCUITS	4 - 2
SECTION 5	DISASSEMBLY AND ASSEMBLY DIAGRAMS	5 - 1 ~ 7
5 - 1	FRONT PANEL DISASSEMBLY	5 - 1
5 - 2	IC-38A FRAME DISASSEMBLY	5 - 2
5 - 3	IC-48A/E FRAME DISASSEMBLY	5 - 3
5 - 4	IC-38A MAIN UNIT CONNECTOR ASSEMBLY	5 - 4
5 - 5	IC-48A/E MAIN UNIT CONNECTOR ASSEMBLY	5 - 5
5 - 6	IC-38A RX UNIT CONNECTOR ASSEMBLY	5 - 6
5 - 7	IC-48A/E RX UNIT CONNECTOR ASSEMBLY	5 - 7
SECTION 6	MAINTENANCE AND ADJUSTMENT	6 - 1 ~ 12
6 - 1	PREPARATION BEFORE SERVICING	6 - 1
6 - 2	IC-38A PLL ADJUSTMENT	6 - 1
6 - 3	IC-38A TRANSMITTER ADJUSTMENT	6 - 3
6 - 4	IC-38A RECEIVER ADJUSTMENT	6 - 5
6 - 5	IC-48A/E PLL ADJUSTMENT	6 - 7
6 - 6	IC-48A/E TRANSMITTER ADJUSTMENT	6 - 9
6 - 7	IC-48A/E RECEIVER ADJUSTMENT	6 - 11
SECTION 7	BOARD LAYOUTS	7 - 1 ~ 7
7 - 1	EF UNIT (IC-38A)	7 - 1
7 - 2	EF UNIT (IC-48A/E)	7 - 1
7 - 3	MAIN UNIT (IC-38A)	7 - 3
7 - 4	MAIN UNIT (IC-48A/E)	7 - 4
7 - 5	RX UNIT (IC-38A)	7 - 5
7 - 6	RX UNIT (IC-48A/E)	7 - 6
7 - 7	VCO UNIT (IC-38A)	7 - 7
7 - 8	VCO UNIT (IC-48A/E)	7 - 7

SECTION 8	VOLTAGE/CIRCUIT DIAGRAMS	8 - 1 ~ 8
8 - 1	EF UNIT WIRING DIAGRAM (IC-38A AND IC-48A/E)	8 - 1
8 - 2	UNIT INTERCONNECTIONS DIAGRAM (IC-48A/E)	8 - 2
8 - 3	IC-38A EF UNIT	8 - 3
8 - 4	IC-48A/E EF UNIT	8 - 4
8 - 5	IC-38A MAIN UNIT	8 - 5
8 - 6	IC-48A/E MAIN UNIT	8 - 6
8 - 7	IC-38A RX UNIT	8 - 7
8 - 8	IC-48A/E RX UNIT	8 - 8
SECTION 9	IC PIN CONNECTIONS	9 - 1 ~ 4
9 - 1	IC-38A LINEAR ICs	9 - 1
9 - 2	IC-38A LOGIC ICs	9 - 2
9 - 3	IC-48A/E LINEAR ICs	9 - 3
9 - 4	IC-48A/E LOGIC ICs	9 - 4
SECTION 10	IC-38A PARTS LIST	10 - 1 ~ 7
10 - 1	EF UNIT	10 - 1
10 - 2	MAIN UNIT	10 - 2
10 - 3	RX UNIT	10 - 5
10 - 4	VCO UNIT	10 - 7
SECTION 11	IC-48A/E PARTS LIST	11 - 1 ~ 7
11 - 1	EF UNIT	11 - 1
11 - 2	MAIN UNIT	11 - 2
11 - 3	RX UNIT	11 - 5
11 - 4	VCO UNIT	11 - 7
SECTION 12	OPTIONAL UNITS	12 - 1 ~ 6
12 - 1	UT-28, UT-29 OPTIONS	12 - 1
12 - 2	UT-28, UT-29 BOARD LAYOUTS	12 - 2
12 - 3	UT-28, UT-29 PARTS LIST	12 - 3
12 - 4	UT-28, VOLTAGE/CIRCUIT DIAGRAM	12 - 4
12 - 5	UT-29 VOLTAGE/CIRCUIT DIAGRAM	12 - 5
12 - 6	OTHER OPTIONAL UNITS	12 - 6
SECTION 13	SCHEMATIC DIAGRAM	SEPARATE

SECTION 1 SPECIFICATIONS

■ GENERAL

Frequency coverage	: IC-38A 220~225MHz IC-48A U.S.A. version 440~450MHz IC-48A Australia, IC-48E versions 430~440MHz
Frequency resolution	: IC-38A 5, 10, 15, 20 or 25kHz (programmable) IC-48A U.S.A., Australia versions 5, 10, 15, 20 or 25kHz (programmable) IC-48E 12.5 or 25kHz (programmable)
Memory channels	: 21 channels
Usable temperature range	: -10°C~+60°C (+14°F~+140°F)
Power supply requirement	: 13.8V DC±15% (negative ground) AC power supply is available for AC operation.
Current drain (at 13.8V DC)	: Transmit
(IC-38A)	HIGH (25W) Approx. 6.5A LOW (5W) Approx. 3.0A Receive Max. audio output Approx. 800mA Squelched Approx. 450mA
(IC-48A/E)	: Transmit HIGH (25W) Maximum 7.5A LOW (5W) Approx. 3.5A Receive Max. audio output Approx. 800mA Squelched Approx. 450mA
Antenna impedance	: 50Ω unbalanced
Dimensions	: 140(140)mm(W) × 50(50)mm(H) × 155(171)mm(D) Bracketed values include projections
Weight	: 1.2kg

■ TRANSMITTER

Output power	: HIGH 25W LOW 5W
Emission mode	: F3 (F2, when optional UT-28 is operating)
Modulation system	: Variable reactance frequency modulation
Max. frequency deviation	: ±5.0kHz
Spurious emissions	: More than 60dB below carrier output power
Microphone	: 600Ω electret condenser with Push-To-Talk and scanning switches (The IC-48E version includes a 1750Hz TONE CALL SWITCH).

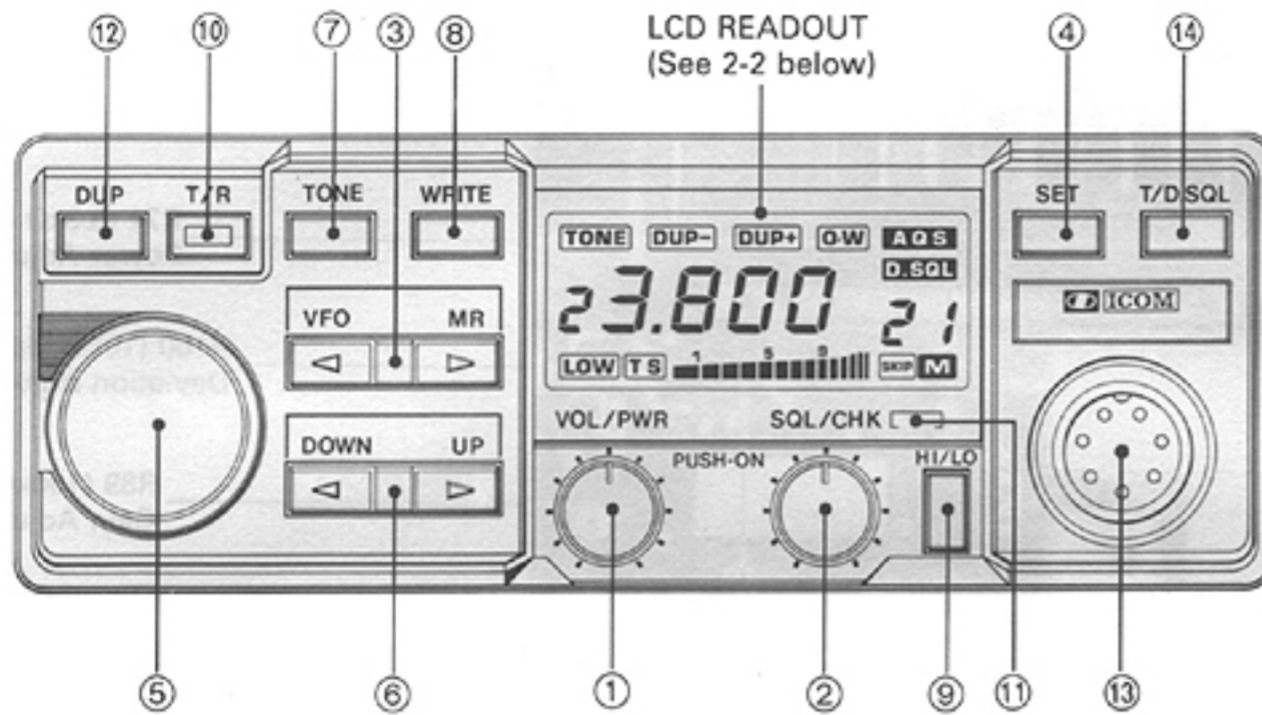
■ RECEIVER

Receive system	: Double-conversion superheterodyne
Modulation acceptance	: FM
Intermediate frequencies	: IC-38A 1st 17.2MHz 2nd 455kHz IC-48A/E 1st 23.15MHz 2nd 455kHz
Selectivity	: More than 12.5kHz at -6dB Less than 25.0kHz at -60dB
Sensitivity	: Less than 0.18μV for 12dB SINAD
Audio output	: More than 2.4W at 10% distortion with an 8Ω load
Audio output impedance	: 4~8Ω

All stated specifications are approximate and subject to change without notice or obligation.

SECTION 2 OUTSIDE AND INSIDE VIEWS

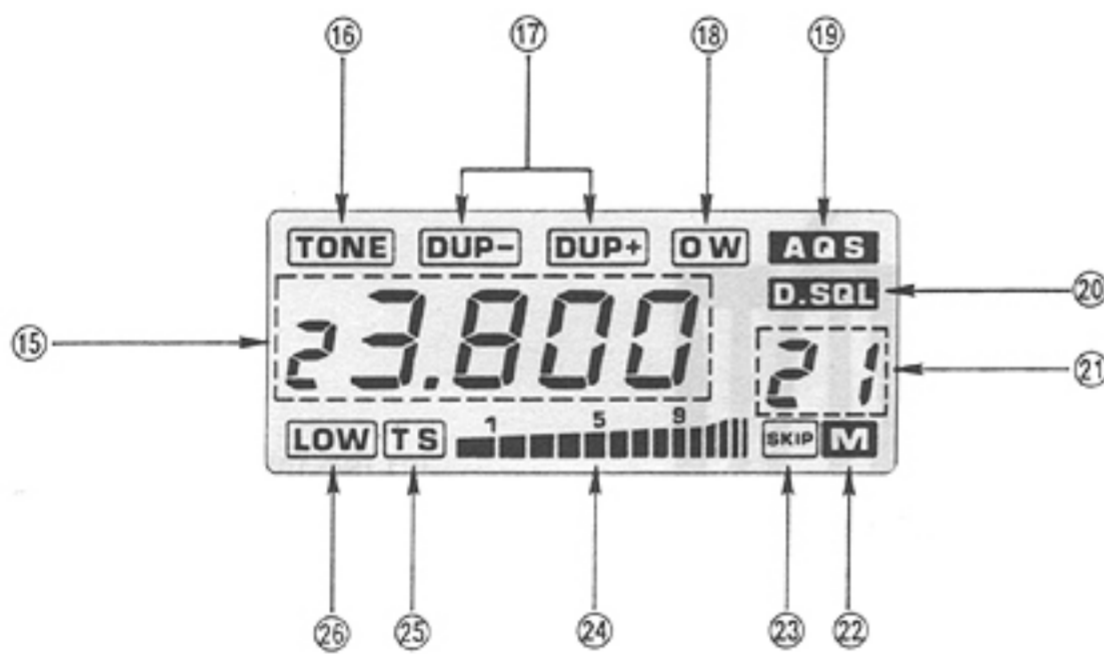
2 - 1 FRONT PANEL



NOTE: The following diagrams show the IC-38A.

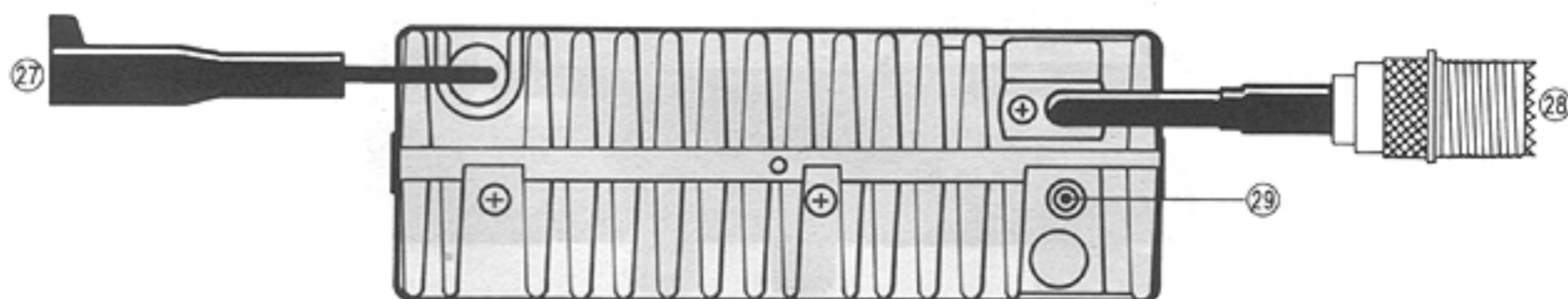
- | | |
|---|--|
| ① VOLUME CONTROL/POWER SWITCH [VOL/PWR] | ⑧ WRITE SWITCH [WRITE] |
| ② SQUELCH CONTROL/CHECK SWITCH [SQL/CHK] | ⑨ HIGH/LOW SWITCH [HI/LO] |
| ③ VFO/MEMORY READ SWITCH [VFO/MR] | ⑩ TRANSMIT/RECEIVE INDICATOR [T/R] |
| ④ SET SWITCH [SET] | ⑪ DISPLAY DIMMER SENSOR |
| ⑤ TUNING CONTROL | ⑫ DUPLEX SWITCH [DUP] |
| ⑥ DOWN/UP SWITCH [DOWN/UP] | ⑬ MIC CONNECTOR |
| ⑦ TONE SWITCH [TONE] (IC-38A, IC-48A U.S.A. version)
CALL SWITCH [CALL] (All IC-48 versions except U.S.A.) | ⑭ TONE SQUELCH SWITCH, DIGITAL SQUELCH SWITCH [T/D. SQL] |

2 - 2 LCD READOUT



- | |
|--|
| ⑮ FREQUENCY INDICATOR |
| ⑯ SUBAUDIBLE TONE INDICATOR "TONE" |
| ⑰ DUPLEX MODE INDICATORS "DUP-, DUP+" |
| ⑱ OFFSET WRITE INDICATOR "OW" |
| ⑲ GROUP CODE INDICATOR "AQS" |
| ⑳ SQUELCH SYSTEM INDICATOR "D. SQL" |
| ㉑ MEMORY CHANNEL NUMBER |
| ㉒ MEMORY MODE INDICATOR "M" |
| ㉓ MEMORY CHANNEL SKIP INDICATOR "SKIP" |
| ㉔ "S/R/F" INDICATOR |
| ㉕ TUNING STEP INDICATOR "TS" |
| ㉖ OUTPUT POWER INDICATOR "LOW" |

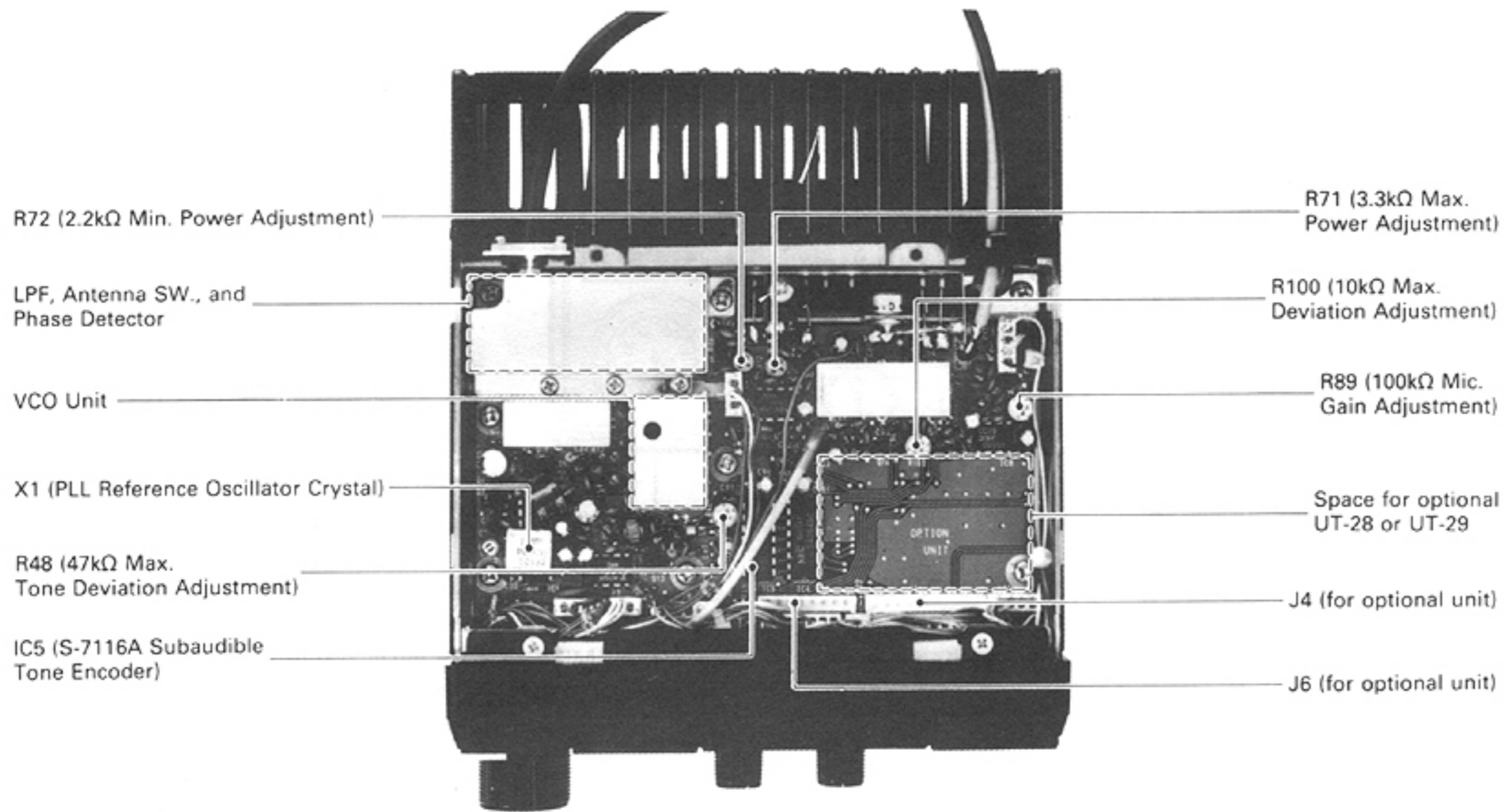
2 - 3 REAR PANEL



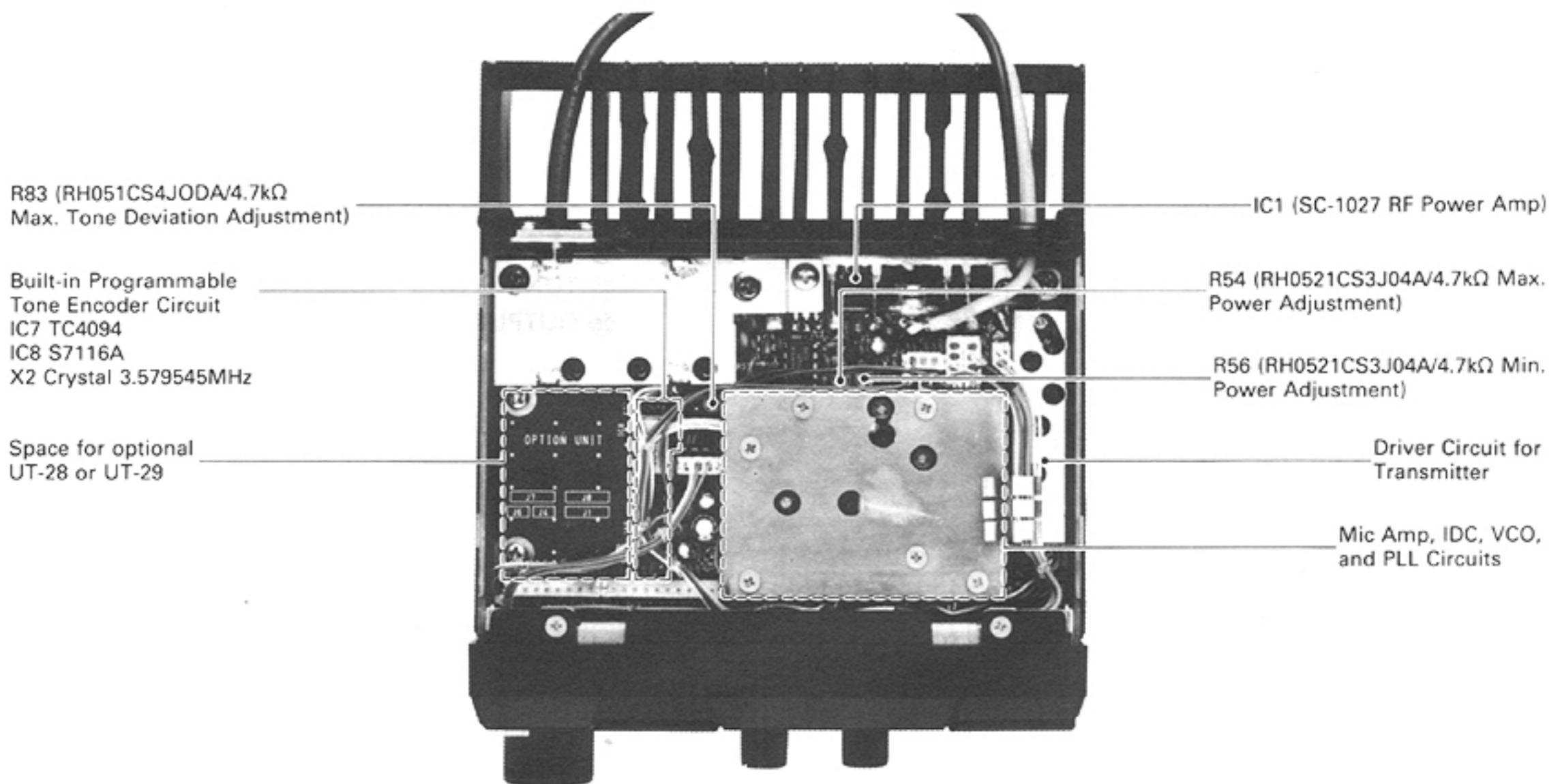
- | |
|-------------------------|
| ⑳ POWER CONNECTOR |
| ㉑ ANTENNA CONNECTOR |
| ㉒ EXTERNAL SPEAKER JACK |

2 - 4 MAIN UNIT

(IC-38A)

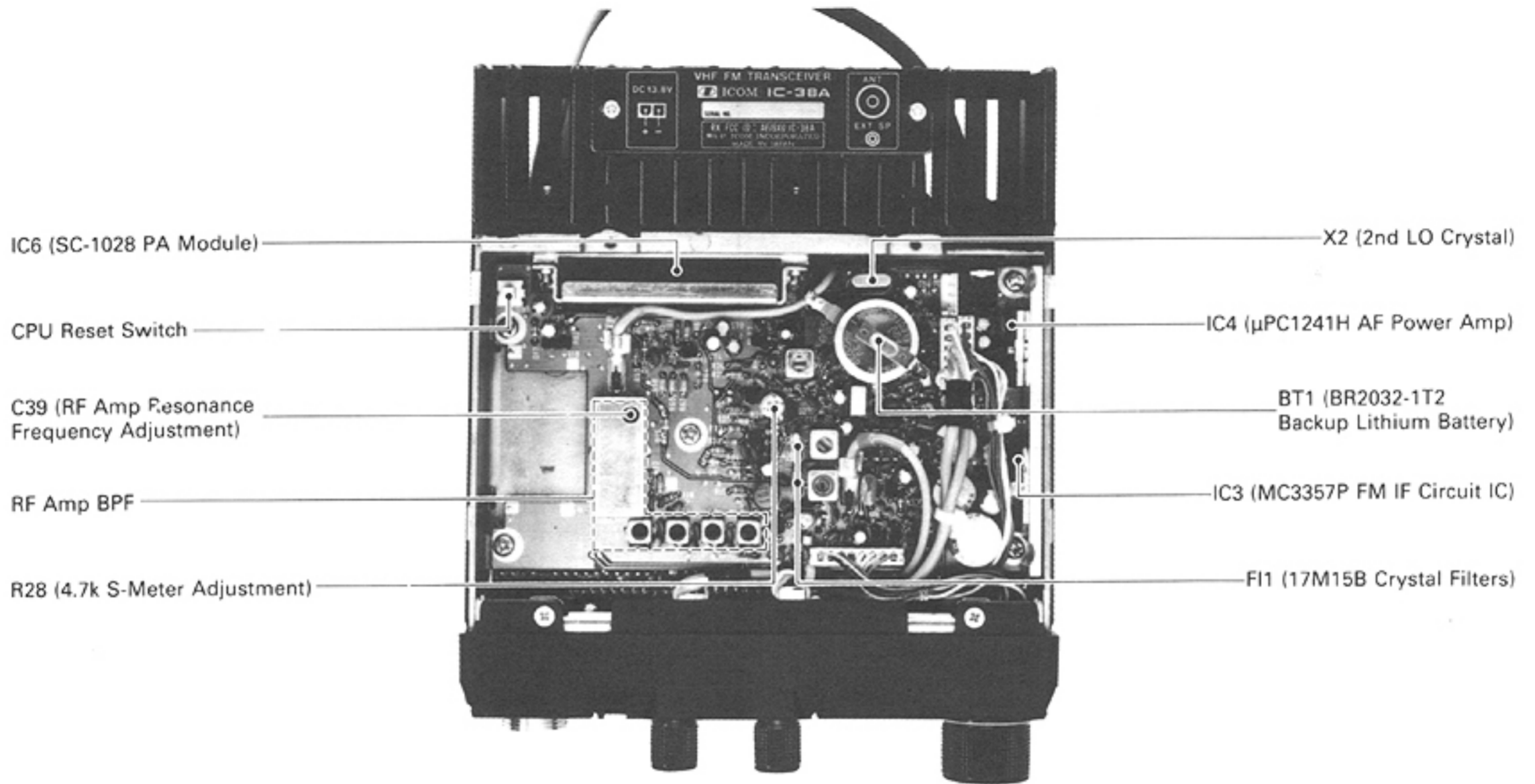


(IC-48A/E)

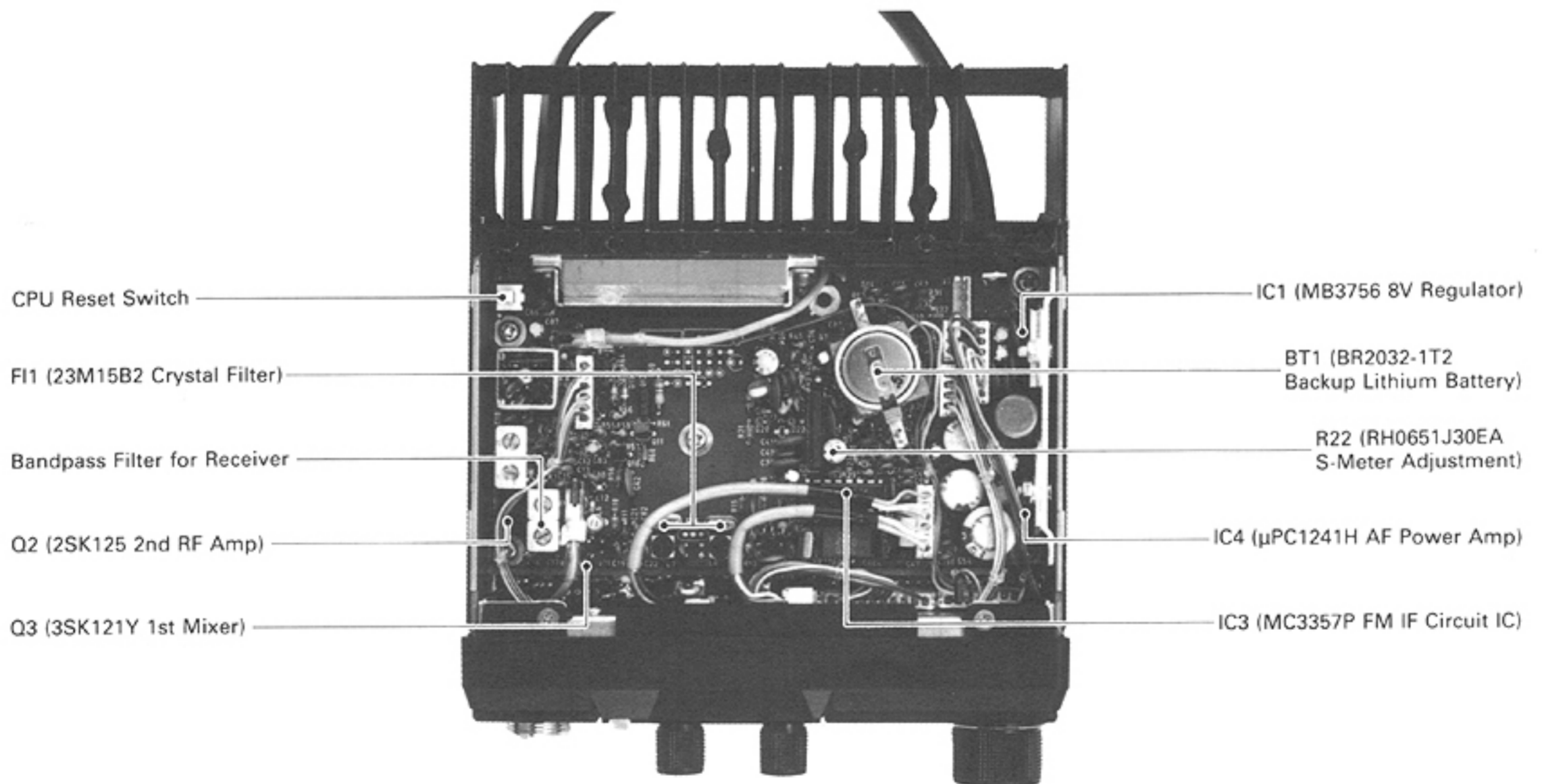


2 - 5 RX UNIT

(IC-38A)



(IC-48A/E)



SECTION 4 IC-48A/E CIRCUIT DESCRIPTION

4 - 1 RECEIVER CIRCUITS

4 - 1 - 1 LOW-PASS FILTER AND ANTENNA SWITCHING CIRCUITS

Incoming signals from the antenna connector are fed to a low-pass filter consisting of C33 ~ C39, C104, L11 and L12 on the MAIN UNIT and then are applied to an antenna switching circuit consisting of D6 and D7. D6 and D7 turn OFF when the transceiver is in receive mode.

4 - 1 - 2 RF CIRCUIT

Signals from the antenna switching circuit are fed to Q1 (the 1st RF amplifier on the RX UNIT) through a low-pass filter consisting of L1, C2, and C3.

Signals amplified by Q1 are fed to bandpass filter L3 (a helical resonator), to eliminate unwanted out-of-frequency signals. The signals are then fed to Q2, the 2nd RF amplifier.

Signals amplified by Q2 are fed to bandpass filter L5 (a helical resonator), to obtain good selectivity.

4 - 1 - 3 IF CIRCUIT

Signals from L5 are fed to the 1st mixer (Q3) and are mixed with a 1st LO signal from the MAIN UNIT. They are then converted into 1st IF signals (23.15MHz). The 1st LO signal is fed into Q3 on the RX UNIT by applying R8V to D1 via R4 on the MAIN UNIT.

1st IF signals from Q3 are applied to crystal filter F11 which accepts the object signals and eliminates any unwanted signals.

1st IF signals passed through F11 are fed to a matching circuit consisting of L8, C24 and C25, and are amplified by Q4, the 1st IF amplifier. D1 and D2 are limiters that limit strong signals. Amplified 1st IF signals are fed to IC3 and mixed with a 2nd LO signal to obtain 2nd IF signals (455kHz). 2nd LO signals are generated by an oscillator circuit in IC3 and crystal X2.

2nd IF signals from IC3 are fed to ceramic filter F12 to eliminate unwanted signals and are amplified by a limiter amplifier in IC3 to eliminate amplitude modulation components in the signal. Amplified 2nd IF signals are fed to an FM detector circuit in IC3 using quadrature detection to obtain audio signals. This IF circuit is a non-adjustment circuit using a phase-delay element with ceramic discriminator X1.

4 - 1 - 4 S/R/F INDICATOR CIRCUIT

In receive mode, a portion of 2nd IF signals from IC3 (pin 5) on the RX UNIT pass through C43 and are level adjusted by R22 and amplified by IC2 (the S-INDICATOR amplifier). 2nd IF signals are then fed to D3 and D4 where they are rectified, obtaining DC signals for the S-INDICATOR. The

DC signals drive the S/R/F INDICATOR on the LCD READ-OUT. In transmit mode, S-INDICATOR signals from the MAIN UNIT drive the S/R/F INDICATOR.

4 - 1 - 5 AUTOMATIC DIMMER CIRCUIT

This circuit consists of Q10, Q11, and Q12 on the RX UNIT and R3, a photo sensor (Cds) on the EF UNIT. R3 alters the collector current of Q10 according to brightness. The current drives Q11 and Q12. The charge of C83 continuously changes the brightness of the LCD READOUT.

4 - 1 - 6 AF CIRCUITS

Audio signals from IC3 on the RX UNIT are amplified by a noise amplifier circuit in IC3 via the SQUELCH CONTROL on the front panel. A noise detector circuit consisting of D7 and D8 detects noise components. The noise components are fed to the SQUELCH CONTROL, Q6. Q6 generates the AF MUTE signal when no signal is received. The AF MUTE signal is applied to AF amp Q7 and AF amp mute Q15. This signal controls Q7 and Q15 which emit no audio output nor noise output when no signal is received.

Audio signals from IC3 are amplified by AF amp Q7 and are fed to low-pass filter Q8, before being applied to AF amp IC4 via Q9 (the AF mute for D.SQL), Q15 (the AF amp mute), and the VOLUME CONTROL on the front panel. The signals are amplified by IC4 and drive the internal or external speaker.

Q15 functions as a muting circuit to block audio signals to IC4. An AF MUTE signal is generated when the squelch closes or the transceiver is in transmit mode.

If switches on the front panel are pushed, a phase oscillator using Q5 is activated by a signal from the CPU. At this time, Q16 turns Q9 OFF, Q9 mutes audio signals from Q8, Q15 is activated, and only a beep sound is emitted from the speaker.

4 - 1 - 7 CPU RESET CIRCUIT

The CPU reset circuit consists of S1 and Q13. If the CPU should malfunction, push the RESET SWITCH to reset the CPU. At this time, the CPU is initialized. (See page 2 – 3 for the RESET SWITCH location on the RX UNIT.) Q14 prevents the transceiver from reverting to transmit mode when the CPU is reset. The reset function operates only when the transceiver is ON.

4 - 1 - 8 VOLTAGE REGULATOR CIRCUITS

The 13.8V line which passes through the POWER SWITCH on the front panel is applied to IC1 on the RX UNIT and IC9 on the MAIN UNIT. IC1 is a voltage regulator that supplies a constant 8V, R8V during receiving, and T8V during transmitting. IC9 supplies a constant 5V.

4 - 2 TRANSMITTER CIRCUITS

4 - 2 - 1 MIC AMPLIFIER CIRCUIT

Audio signals from the microphone are fed into Q4, the first mic amplifier circuit on the MAIN UNIT. After passing through this circuit, the signals are fed into limiter amplifier circuit IC2(a). This circuit has preemphasis characteristics between 300Hz and 3kHz with 6dB/octave.

Output signals from the limiter amplifier pass through Q5 (the mic mute circuit), and are fed into IC2(b), an active low-pass filter circuit. The rectangular waveform of the limiter amplifier output contains many harmonics. Harmonics which are 3kHz or higher are eliminated by low-pass filter IC2(b).

These filtered signals are applied to Q2 in the VCO circuit to modulate the frequency and produce FM signals. R43 is a variable resistor for adjusting deviation.

4 - 2 - 2 BUFFER AND DRIVE CIRCUITS

Signals generated in the VCO circuit are buffered at Q9. After passing through Q9, signals are then fed to pre-driver amplifier Q2 through the T/R switching circuit, D1, and D2. Driver amplifier Q3 amplifies the signal fed by Q2 to a suitable level for the power amplifier.

4 - 2 - 3 POWER AMPLIFIER CIRCUIT

Output signals from driver amplifier Q3 on the MAIN UNIT are fed into power amplifier module IC1. The maximum output power of IC1 is approximately 30W. These output signals from IC1 are applied to the antenna connector through an antenna switch circuit consisting of D6, D7, and a low-pass filter consisting of C30, C33, and L8.

4 - 2 - 4 ALC (Automatic Level Control) and RF POWER METER CIRCUITS

The output voltage of the ALC detector circuit (L6, C23 ~ C25, D4, D5, and C27 ~ C29) is a minimum value when the antenna impedance is matched at 50Ω. However, when the antenna impedance is in a mismatched condition, the detector voltage becomes higher than it would be if the antenna were matched. The detector voltage is applied to the APC amplifier circuit, IC3(a) (pin 2). Output of IC3(a) (pin 1) controls Q7 bias voltage, which in turn controls the total gain of the power amplifier (IC1) through Q6. R54 is the HIGH power adjustment point and R56 is the LOW power adjustment point. Both variable resistors control the gain of APC amplifier IC3(a).

The detector voltage is also used for the RF INDICATOR. This voltage is applied to pin 5 of IC3(b), is amplified, and then is applied to IC2, the S/RF INDICATOR detector circuit on the EF UNIT.

4 - 3 PLL CIRCUITS

4 - 3 - 1 DUAL MODULUS PRESCALER

The PLL is designed in a way that allows the desired frequency to be generated directly by the VCO, adopting a dual modulus prescaler system. The PLL consists of prescaler IC4 and PLL IC5. The CPU feeds N-data to IC5 to determine the operating frequency.

N-data is determined by dividing the desired frequency by the reference frequency. The desired frequency is the transmit frequency in the transmit mode and the first local oscillator frequency in the receive mode.

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

A reference frequency of 5kHz (#01, #02) or 6.25kHz (#03) is acquired by X1 and the divider inside IC5. A signal from the VCO that is buffer-amplified at Q10 is fed into IC4 and IC5 and phase detected, resulting in lock voltages being applied to varactor diode D1, which controls the VCO frequency. Due to a no-multiplying mixing circuitry, the circuit constitution is simple and reduces spuriousness.

4 - 3 - 2 LOOP FILTER CIRCUIT

Output from IC5 (pin 11) is applied to D1 on the VCO UNIT via an active loop filter (Q14 and Q15).

In transmit mode, the PLL time constant switching circuit (Q18 and Q19) reduces the resistance of R74 and shortens PLL lock-up time.

When the PLL is in an unlocked condition, Q13 and Q17 turn OFF Q2 on the MAIN UNIT to prevent unwanted transmitting.

4 - 3 - 3 VCO CIRCUIT

The VCO, Q2, employs a Colpitts Oscillator Circuit. The free-run frequency of the VCO is controlled by T8V. Q1 receives 8V when the transceiver is in receive mode. D2 then turns ON and D1, C2, C3, and C5 ~ C7 are connected in parallel. In transmit mode, D2 turns OFF and D1, C2, C3, and C5 ~ C7 are connected in series. Thus, the free-run frequency of the VFO increases in receive mode. Audio signals from IC2(b) are fed to D3 to produce FM signals.

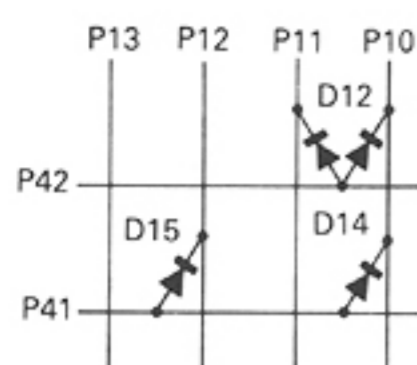
4 - 4 LOGIC CIRCUITS

Logic circuits are installed in the EF UNIT. The EF UNIT is located behind the front panel and controls receiver and transmitter sections as well as all switch functions on the front panel.

The EF UNIT includes a one-chip microcomputer CPU, μPD7514G. This chip contains a 4-bit parallel processing ALU, a ROM, RAM, I/O ports, 8-bit serial interface, 8-bit programmable timer/event counter, and LCD controller/driver. It operates as an independent unit.

Following are matrix configurations for the various IC-48A/E versions. CPU descriptions for all functions related to the

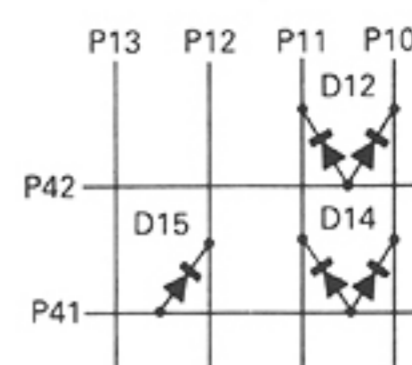
controls and switches on the front panel of the IC-48A/E are also listed below.



IC-48A (U.S.A.)



IC-48E (EUROPE)



IC-48A (AUSTRALIA)

4 - 4 - 1 CPU PORT ALLOCATIONS

PORT NUMBER	DESCRIPTION
P00	Interrupt input. Processor enters STOP mode.
P01	Outputs serial CK signals for PLL, tone encoder and optional UT-28 or UT-29.
P02	Outputs serial DATA signals for PLL, tone encoder and optional UT-28 or UT-29.
P03	No function.
P10 ~ P13	Input ports for the matrix circuit. Refer to page 4 - 4 for explanation of the matrix circuit.
P20	Output port for a strobe signal of the PLL N-data.
P21	Output port for a strobe signal of the built-in CTCSS encoder N-data.
P22	No function.
P30	This port becomes "HIGH" when a beep sound is emitted.
P31	This port becomes "LOW" for the SEND line when the transceiver is in the transmit mode.
P32	This port becomes "HIGH" when low power output is selected.
P33	This port becomes "HIGH" when the Digital Code Squelch is turned ON.
P40	This port is for LCD control and becomes "HIGH" when the transceiver is turned OFF.
P41 ~ P53	These ports are for matrix output.
P60	This is a data input port for the S-INDICATOR and RF-INDICATOR. Refer to SECTION 4 - 4 - 3 for further information.
P61	This port outputs the RESET signal for the sub-CPU, and becomes "HIGH" for about 40μsec when the transceiver is initialized.
P62	This port becomes "HIGH" if the operating frequency is out of band.
P63	This port becomes "HIGH" when AQS commands are sent to the sub-CPU in the AQS system.
P70	No function.
P71 ~ P73	These are data output ports for the S-INDICATOR and RF-INDICATOR. Refer to SECTION 4-4-3 for further information.
INT1	This is an input port for the Data Transmit Ready signal during communication with the sub-CPU for the AQS system, and is also an input port for the Group Number Verification signal when port P33 is "HIGH".

4 - 4 - 2 MATRIX PORT ALLOCATIONS

PORT NUMBER	DESCRIPTION
P41 ↔ P10 ~ P13	This flow sets a bandwidth.
P42 ↔ P10	This flow sets the IF shift direction in receive mode. When the flow is activated, the IF shift selects (-) direction.
P42 ↔ P11	This flow sets the IF frequency. When the flow is activated, the IF frequency is selected at 17.2MHz for IC-38A and 23.15MHz for IC-48AE.
P42 ↔ P12	No function.
P43 ↔ P10	This flow activates the [SET] SWITCH function.
P43 ↔ P11	These are squelch signal ports. When the SQLS line becomes "HIGH", Q4 is switched ON.
P43 ↔ P12	These are input ports for the microphone UP/DOWN clock (CK) signals. Q3 is switched ON while either the UP or DOWN SWITCH on the microphone is pushed.
P43 ↔ P13	These are input ports for the microphone UP/DOWN signals. Q5 is switched ON while the UP SWITCH on the microphone is pushed.
P50 ↔ P10	These are input ports for the [TONE] SWITCH.
P50 ↔ P11	These are input ports for the [VFO] SWITCH, and change the mode from memory mode to VFO mode.
P50 ↔ P12	These are input ports for the [MR] SWITCH, and change modes from the VFO mode to memory mode.
P51 ↔ P10, P11	These are input ports for the UP/DOWN signals on the TUNING CONTROL.
P51 ↔ P12, P13	These are input ports for the [DOWN/UP] SWITCH.
P52 ↔ P10	These are input ports for the [HI/LO] SWITCH. They control output power when the transceiver is in LOW and switch the front panel "LOW" indicator ON or OFF.
P52 ↔ P11	This flow creates the transmit condition. When the [PTT] SWITCH is pushed the SEND line becomes "HIGH" when this matrix flow is activated.
P52 ↔ P12	These are input ports for the [DUP] SWITCH.
P53 ↔ P13	These are input ports for the [WRITE] SWITCH.
P53 ↔ P10	No function.
P53 ↔ P11	When the optional UT-28 is installed, this matrix flow is activated and the SEL1 line becomes "LOW", switching Q10 ON.
P53 ↔ P12	When the optional UT-29 is installed, this matrix flow is activated and the SEL2 line becomes "LOW", switching Q13 ON.
P53 ↔ P13	These are input ports for the [T/D.SQL] SWITCH.

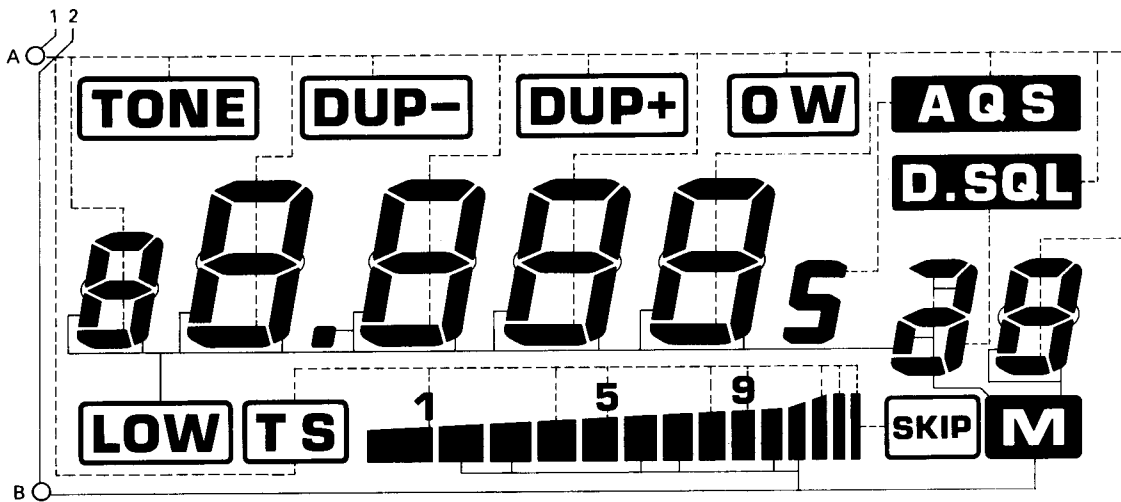
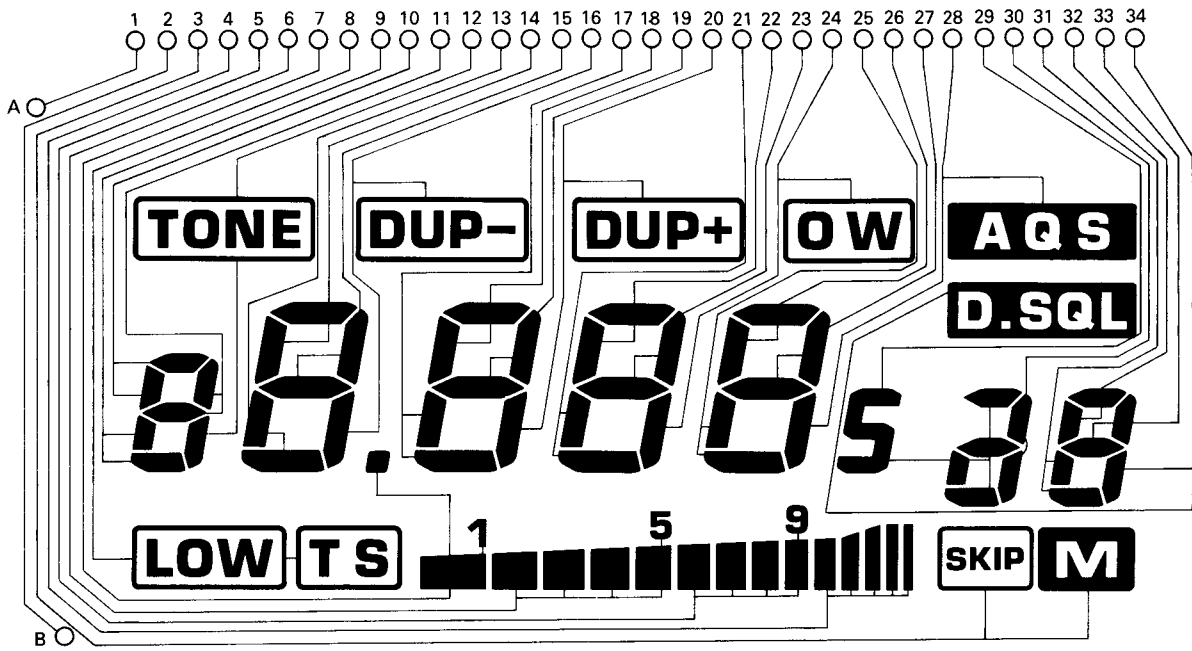
4 - 4 - 3 S-INDICATOR AND RF-INDICATOR

S/RF signals from ports P71 ~ P73 are fed to R14 ~ R17 which are used for digital/analog (D/A) conversion. The output voltage of the D/A converter is compared with a reference voltage of the S/RF at IC2, a comparator IC chip. If the reference voltage is higher than the voltage of the D/A converter, IC2 outputs "HIGH" level voltage. If the reference voltage is lower, IC2 outputs "LOW" level voltage. The output signal of IC2 is fed to port P60.

When transmitting, P71 and P72 output "HIGH", P73 outputs "LOW", and P60 outputs "HIGH". If the high power output is selected, all ports from P71 ~ P73 are "HIGH" and the bar indicator appears at S-7. If low power output is selected, the bar indicator appears at S-3. When P60 is "LOW", the bar indicator does not appear on the LCD READOUT.

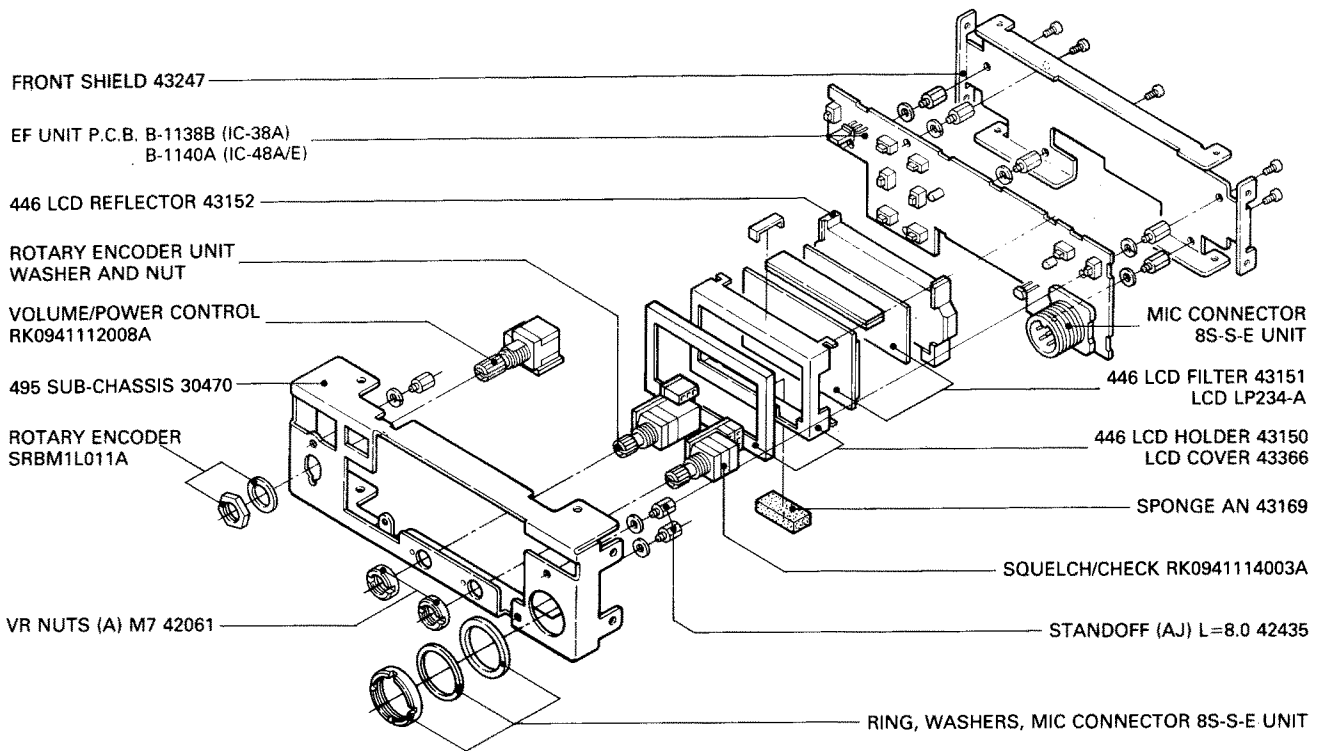
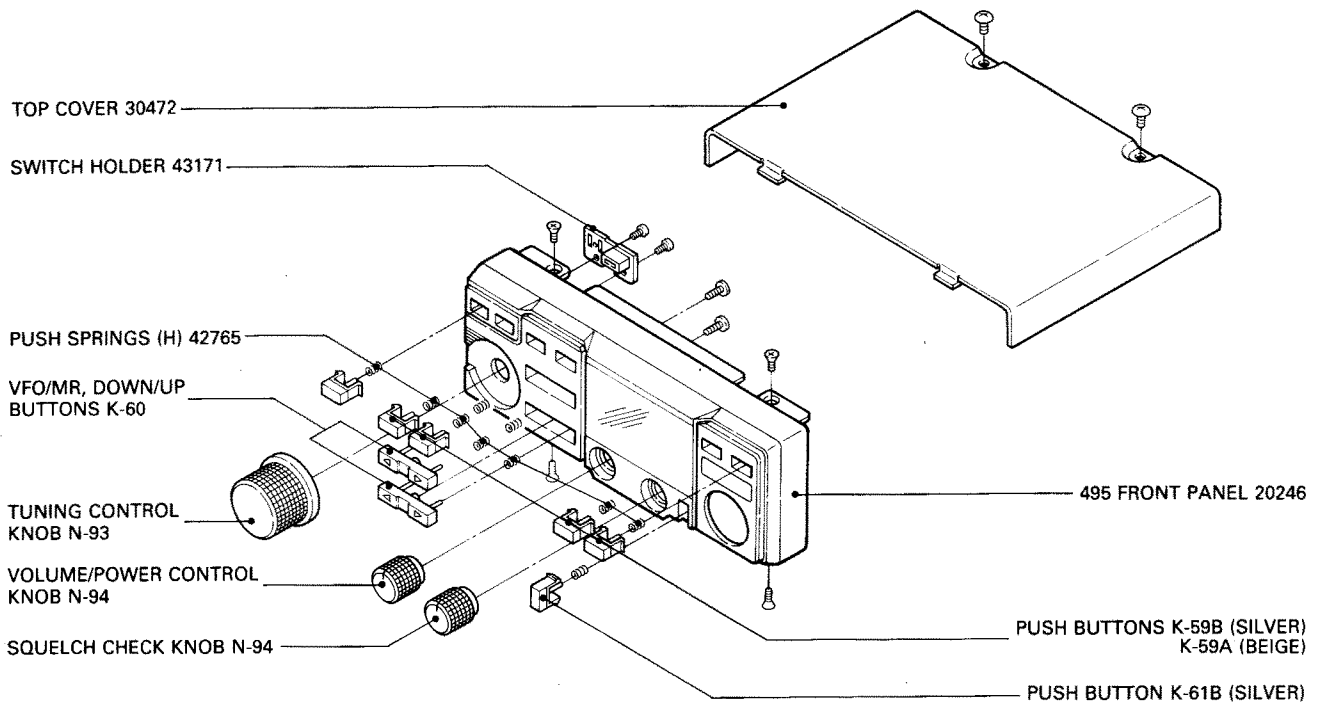
P73	P72	P71	NO. OF BARS
L	L	L	S-0
L	L	H	S-1
L	H	L	S-3
L	H	H	S-5
H	L	L	S-7
H	L	H	S-9
H	H	L	S-11
H	H	H	S-14

■ LCD READOUT

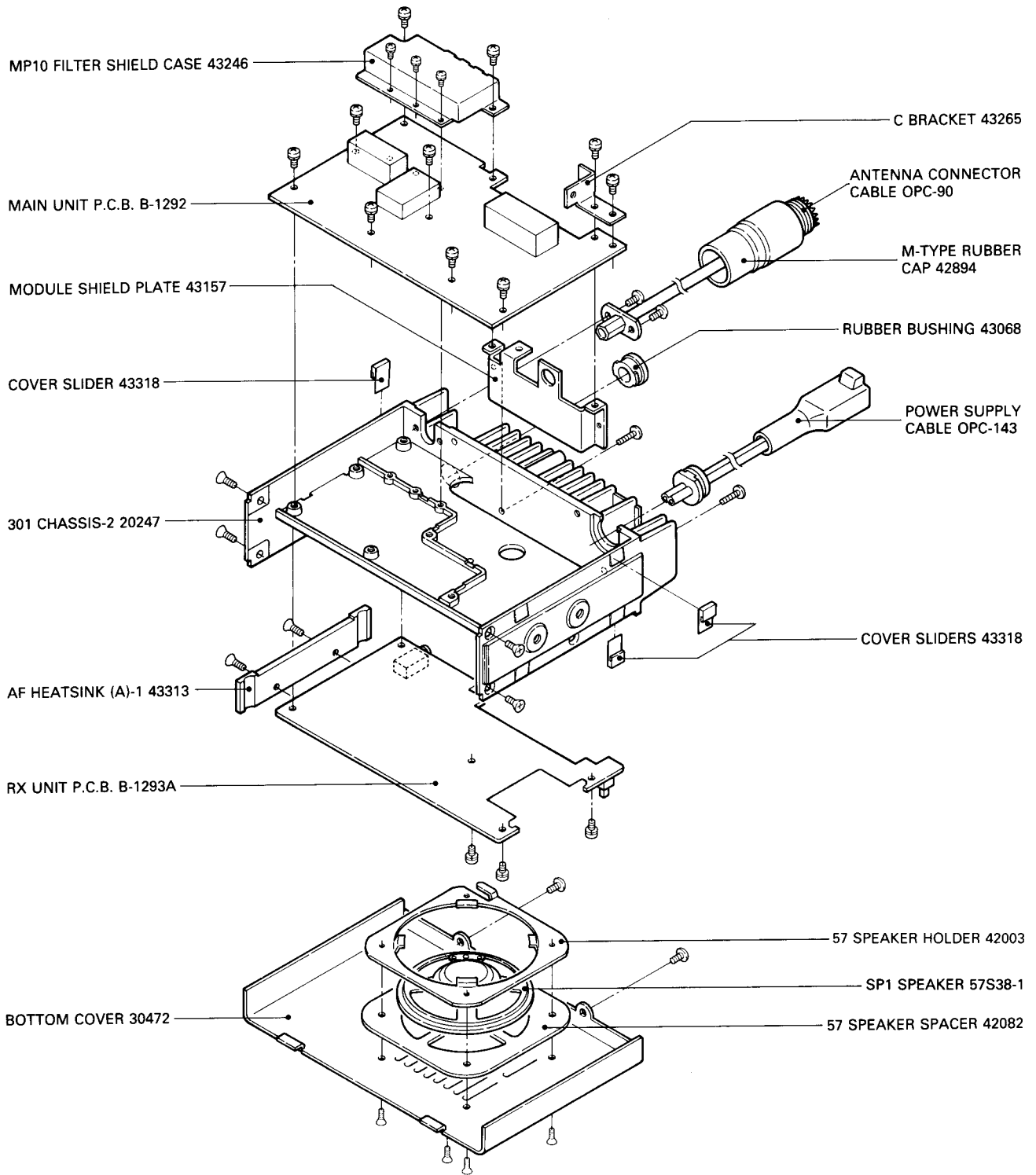


SECTION 5 DISASSEMBLY AND ASSEMBLY DIAGRAMS

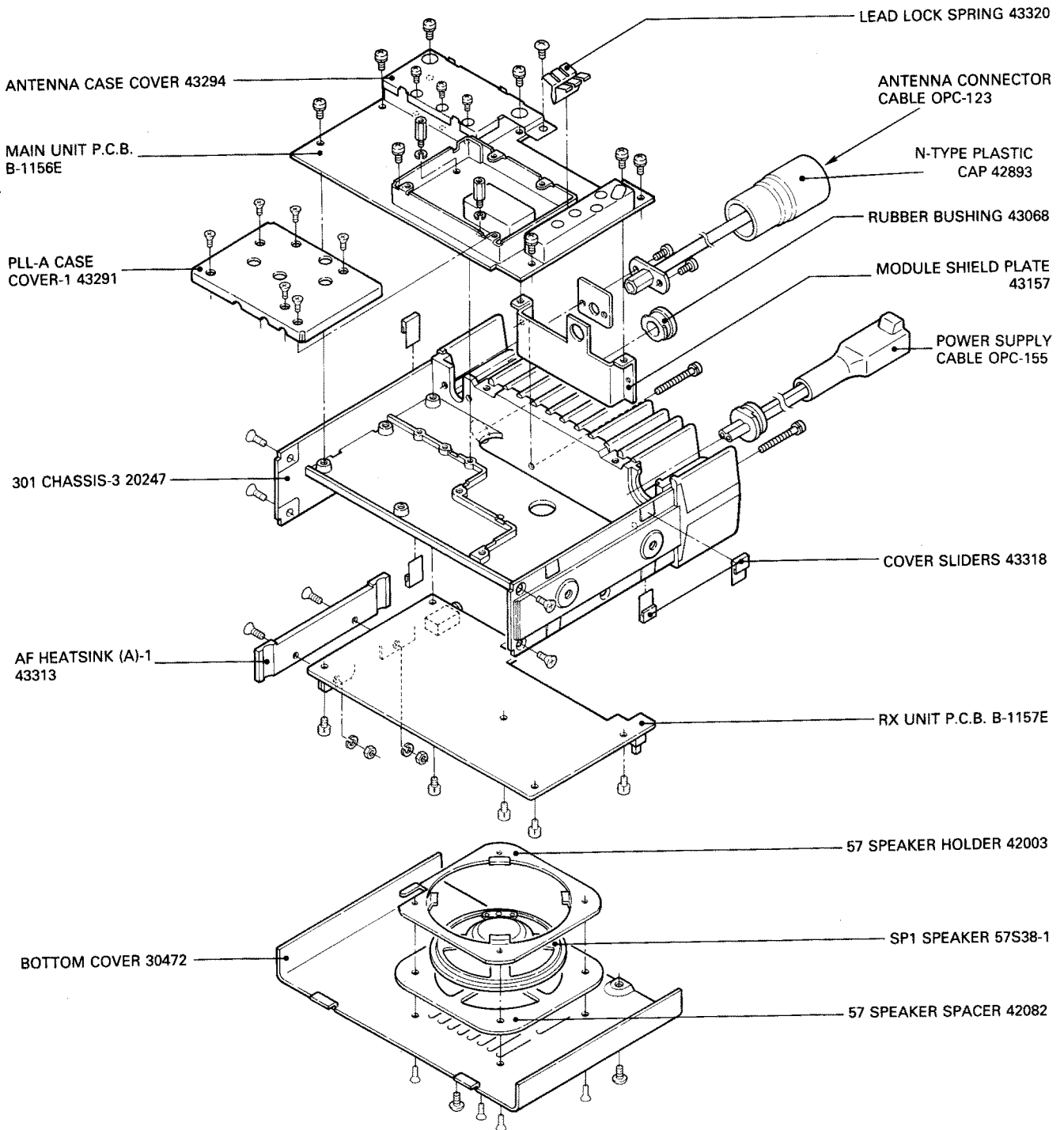
5 - 1 FRONT PANEL DISASSEMBLY



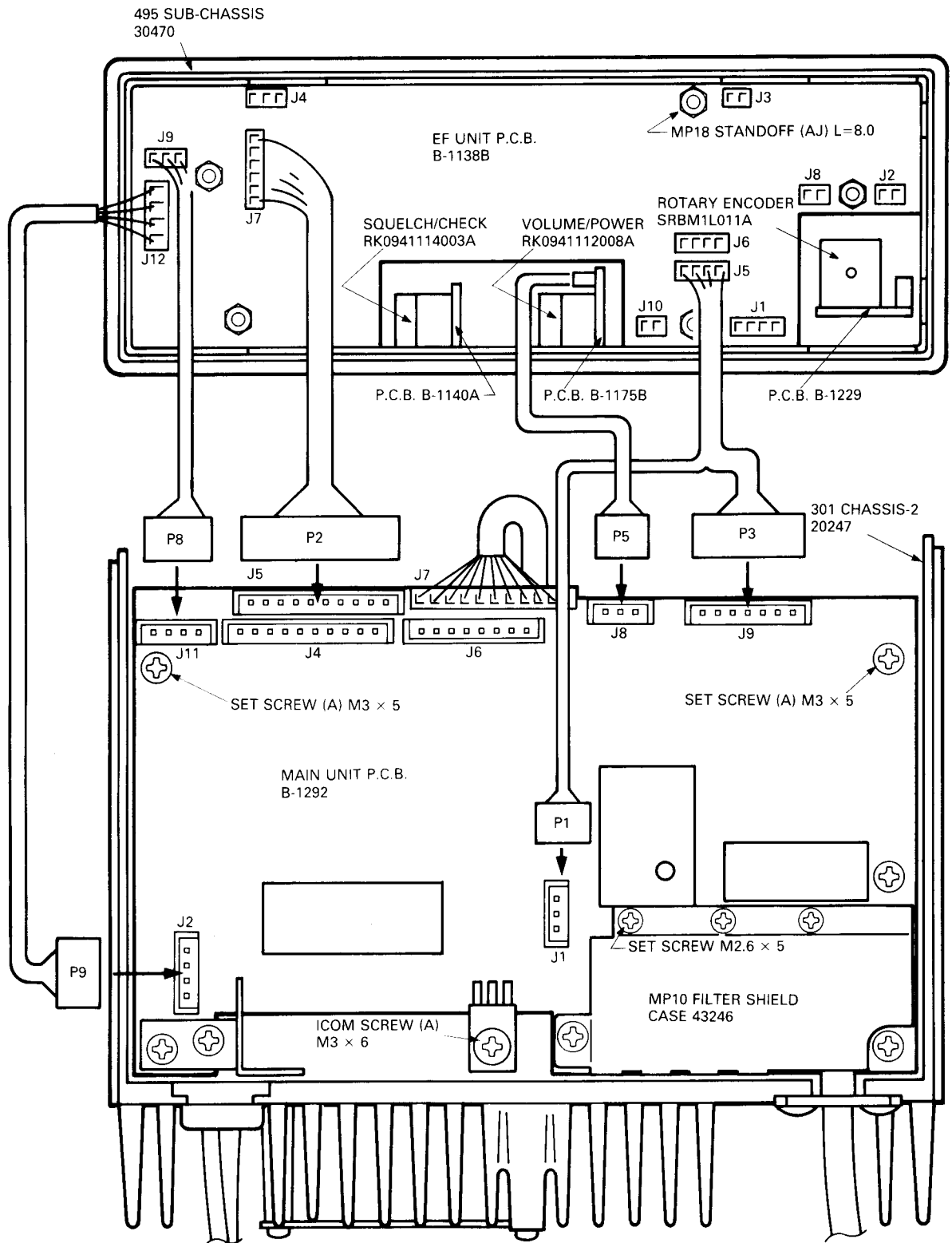
5 - 2 IC-38A FRAME DISASSEMBLY



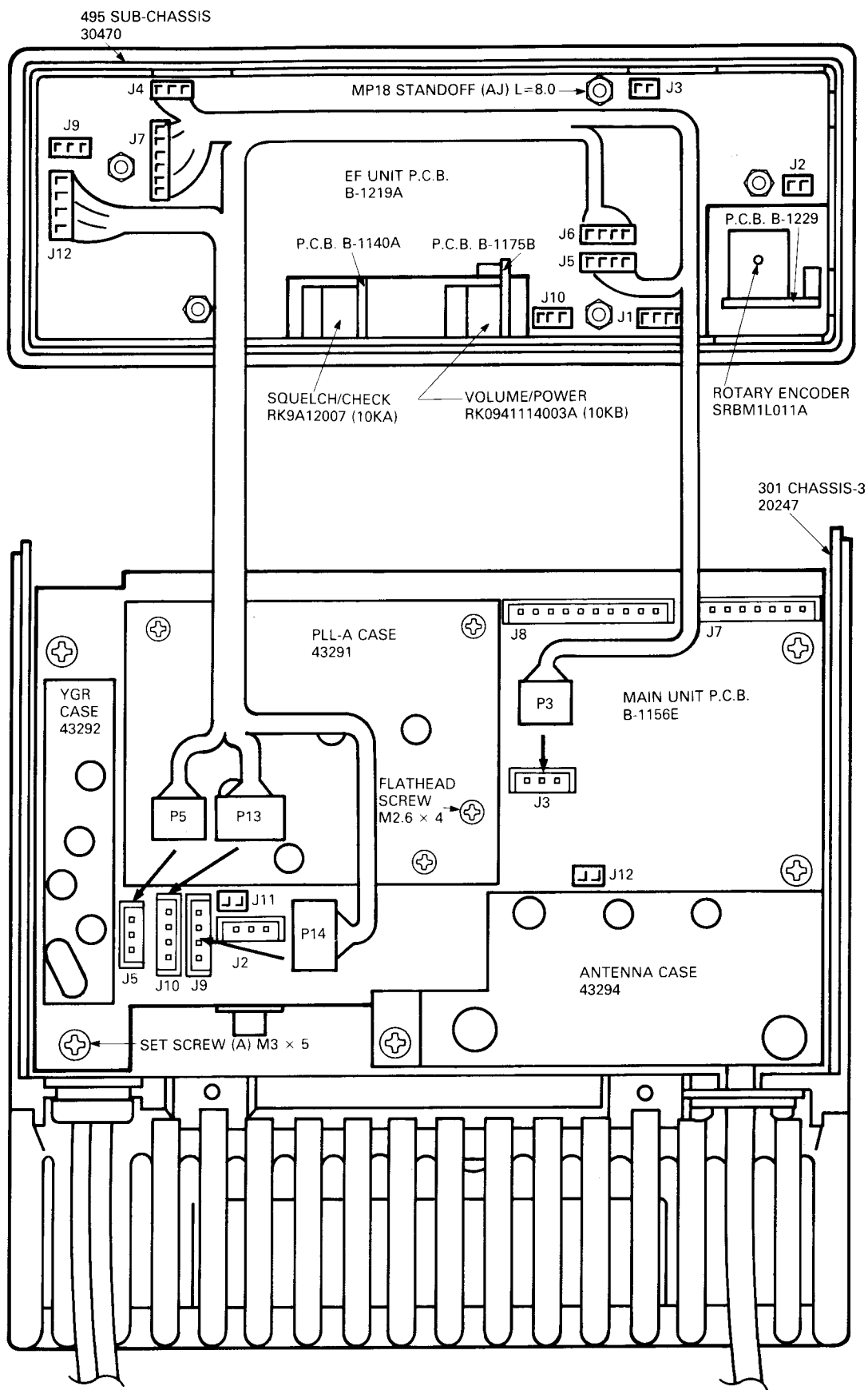
5 - 3 IC-48A/E FRAME DISASSEMBLY



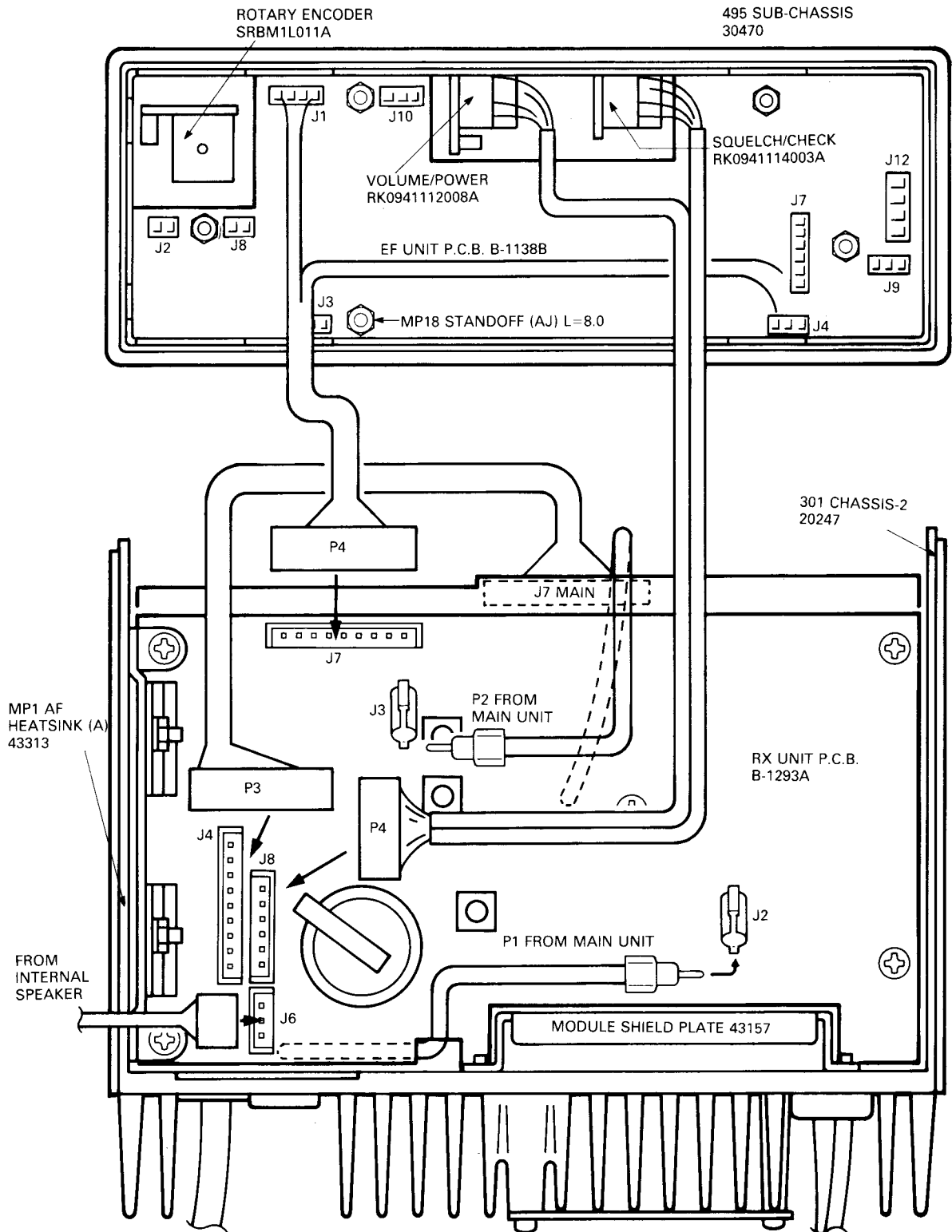
5 - 4 IC-38A MAIN UNIT CONNECTOR ASSEMBLY



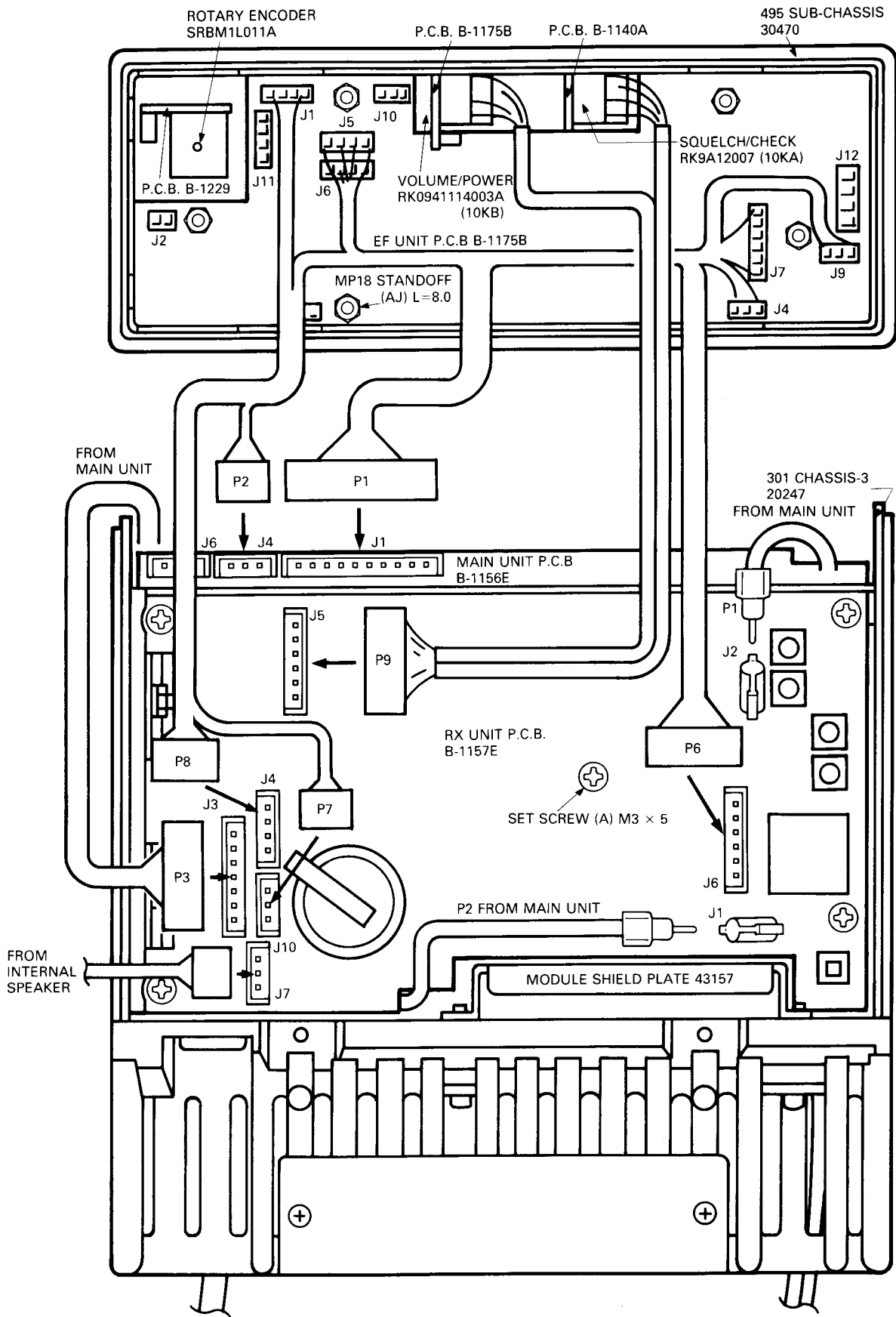
5 - 5 IC-48A/E MAIN UNIT CONNECTOR ASSEMBLY



5 - 6 IC-38A RX UNIT CONNECTOR ASSEMBLY



5 - 7 IC-48A/E RX UNIT CONNECTOR ASSEMBLY



SECTION 6 MAINTENANCE AND ADJUSTMENT

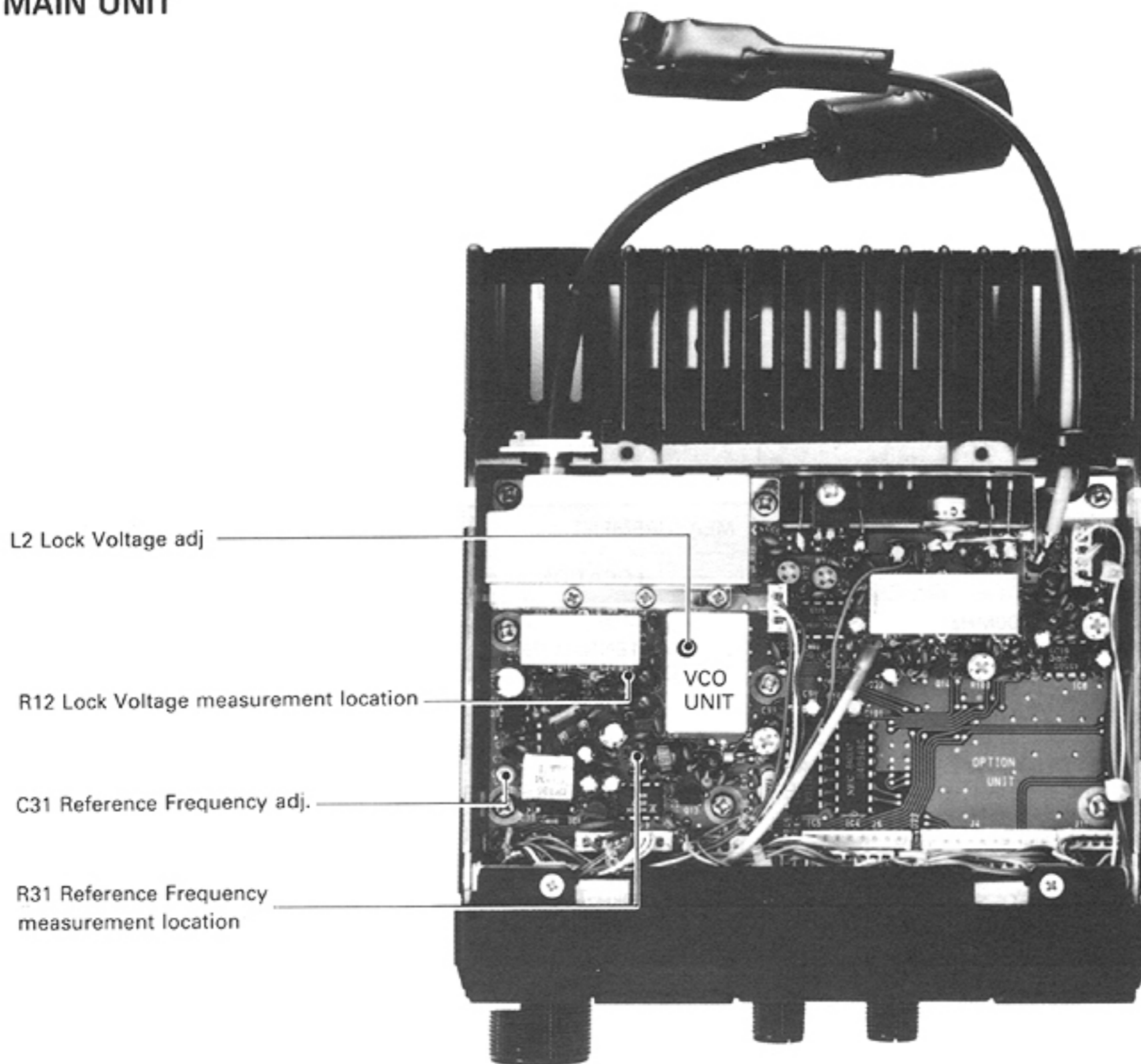
6 - 1 PREPARATION BEFORE SERVICING

1. Detach the power cord and turn OFF the VOLUME CONTROL/POWER SWITCH before performing any work on the transceiver.
2. Do not short circuit components while making adjustments.
3. Use an insulated tuning tool for all adjustments. Be sure to use the correct tools and test equipment.
4. Do not force any of the variable components. Turn them slowly and smoothly.
5. Follow the instructions exactly. If an indicated result is not obtained, repeat the instruction until the correct result is obtained.
6. Check the condition of connectors, solder joints and screws when adjustments are complete. Confirm that components do not touch each other.
7. Attach a 13.8 volt DC external power source to the power supply connector. Be sure to check the polarity.
8. For transmission problems, attach a dummy load to the antenna connector. For reception problems, attach an antenna connector. DO NOT transmit into the signal generator.
9. Recheck for the suspected malfunction with the VOLUME CONTROL/POWER SWITCH ON.
10. Check the defective circuit. Measure the DC voltages of the collector, base and emitter of each transistor.

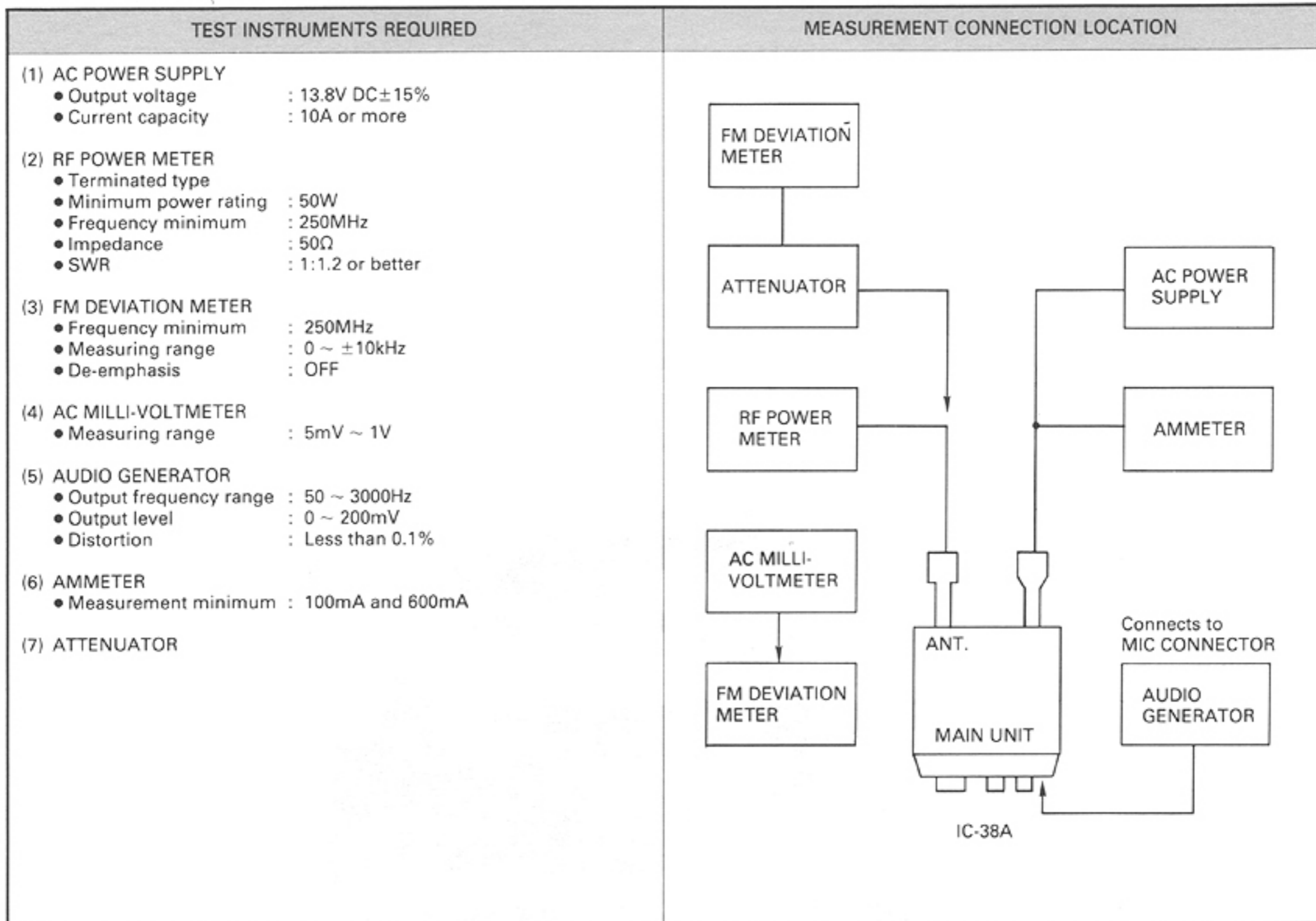
6 - 2 IC-38A PLL ADJUSTMENT

TEST INSTRUMENTS REQUIRED			MEASUREMENT CONNECTION LOCATION				
(1) AC POWER SUPPLY • Output voltage : 13.8V DC \pm 15% • Current capacity : 10A or more (2) FREQUENCY COUNTER • Frequency range : 0.1 ~ 250MHz • Accuracy : 1ppm or better • Sensitivity : 100mV or better (3) VOLTMETER • Input impedance : 50 Ω /V DC or better							
ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT			VALUE	ADJUSTMENT POINT	
		UNIT	LOCATION	UNIT		ADJUST	
LOCK VOLTAGE	1 • Frequency display: 220.000MHz	MAIN	Connect a voltmeter to R12.	4.0V	VCO	L2	
	2 • Frequency display: 215.000MHz • Receive mode					Verify	
	3 • Frequency display: 230.000MHz • Transmit mode					Verify	
REFERENCE FREQUENCY	1 • Frequency display: 220.000MHz • Receive mode	MAIN	Connect a frequency counter to R31.	202.800MHz	MAIN	C31	

MAIN UNIT





6 - 3 IC-38A TRANSMITTER ADJUSTMENT

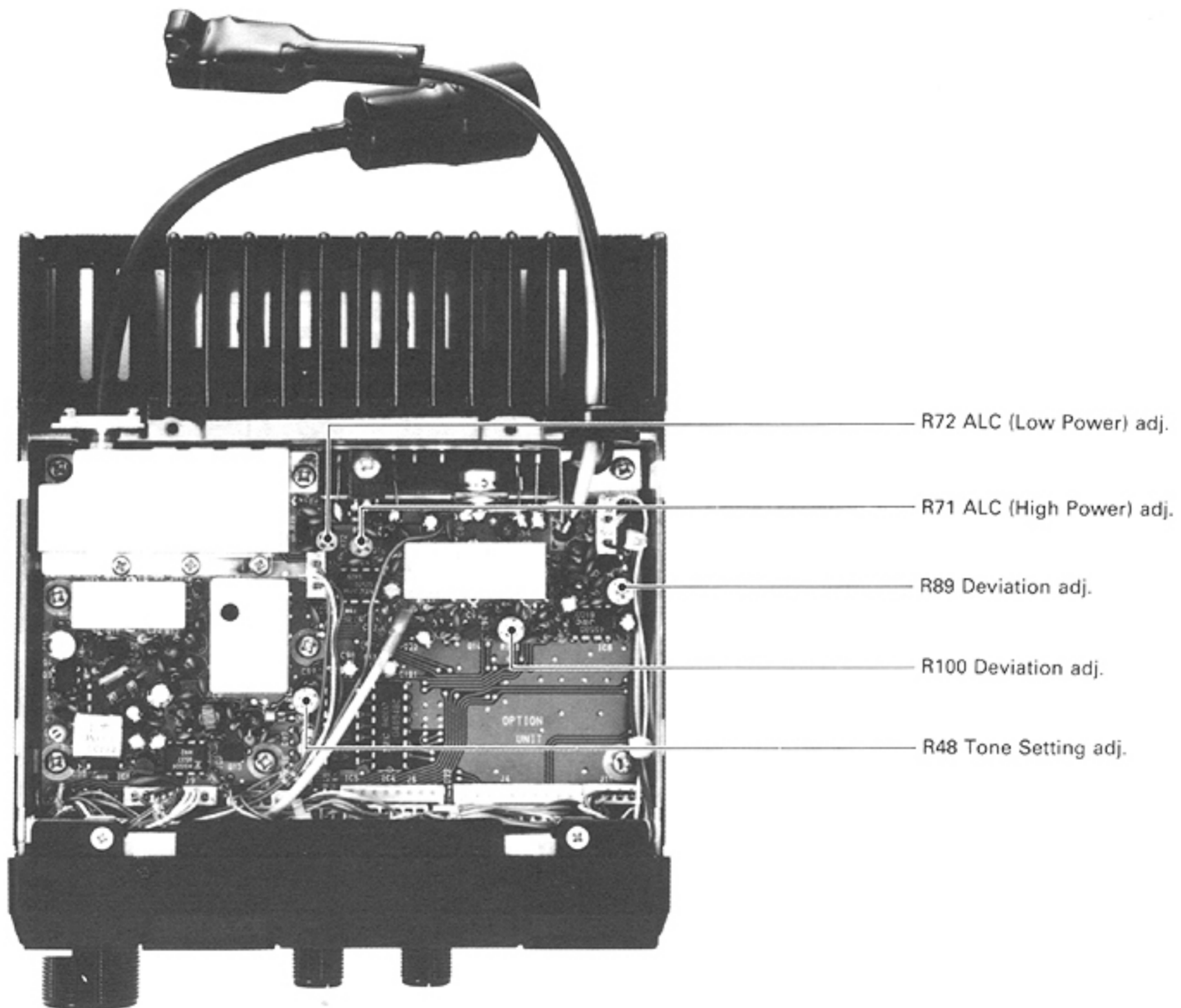


ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT	
		UNIT	LOCATION		UNIT	ADJUST
ALC (Automatic Level Control) Ⓐ HIGH POWER	1	REAR PANEL	Connect an RF power meter to the ANTENNA CONNECTOR.	25W	MAIN	R71
	2			5W		R72
DEVIATION	1	REAR PANEL	Connect a deviation meter to the ANTENNA CONNECTOR through an attenuator. Deviation meter HPF: 50Hz LPF: 20kHz		MAIN	
	2			±4.8kHz		R100
	3			±3.5kHz		R89
TONE SETTING	1	REAR PANEL	Connect a deviation meter to the ANTENNA CONNECTOR through an attenuator. Deviation meter HPF: OFF LPF: 20kHz	±0.75kHz	MAIN	R48
	2			±0.5 ~ ±1kHz		Verify
S/N RATIO Ⓐ Step 1	1	REAR PANEL	Connect an AC milli-voltmeter to the deviation meter. Deviation meter HPF: 50Hz LPF: 20kHz	Record the reading. (Step 1)		
	2			Record the reading. (Step 2)		
NOTE: Verify that the recorded ratio is greater than 40dB (See Steps 1 and 2).						

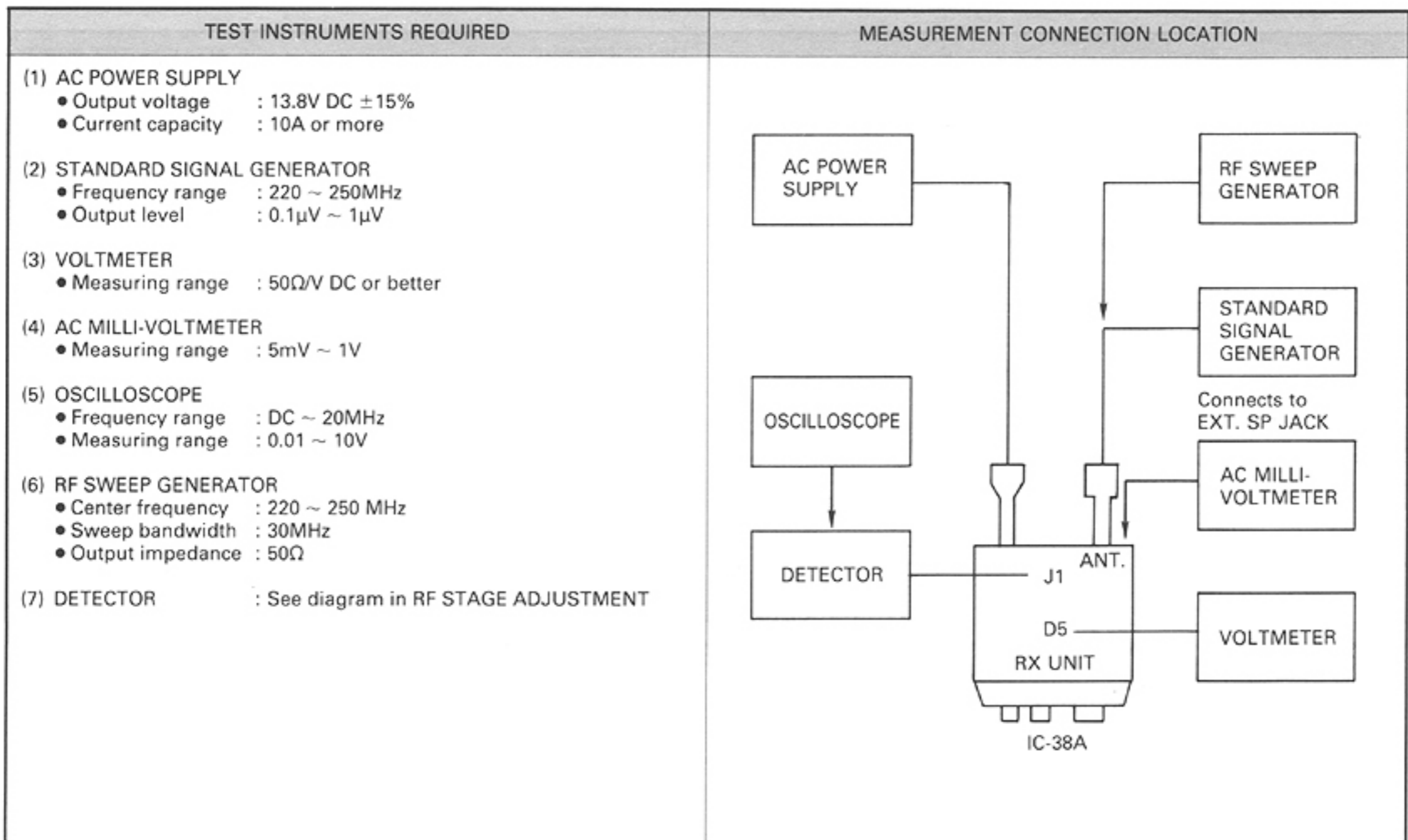
IC-38A TRANSMITTER ADJUSTMENT

ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT	
		UNIT	LOCATION		UNIT	ADJUST
TRANSMIT CURRENT	1 • Frequency display: 223.000MHz • HIGH/LOW POWER: HIGH (25W) • Transmit mode	REAR PANEL	Connect an ammeter between the power supply and the transceiver.	Less than 6.5A	MAIN	Verify
	2 • HIGH/LOW POWER: LOW (5W)					Less than 3.0A
RF LEVEL INDICATOR	1 • Frequency display: 223.000MHz • HIGH/LOW POWER: HIGH (25W) • Transmit mode	DISPLAY	 <p>RF LEVEL INDICATOR: Full scale</p>	Full scale		Verify
	2 • HIGH/LOW POWER: LOW (5W)					 <p>RF LEVEL INDICATOR: S-5</p>

MAIN UNIT

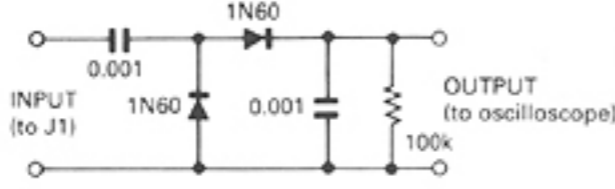



6 - 4 IC-38A RECEIVER ADJUSTMENT

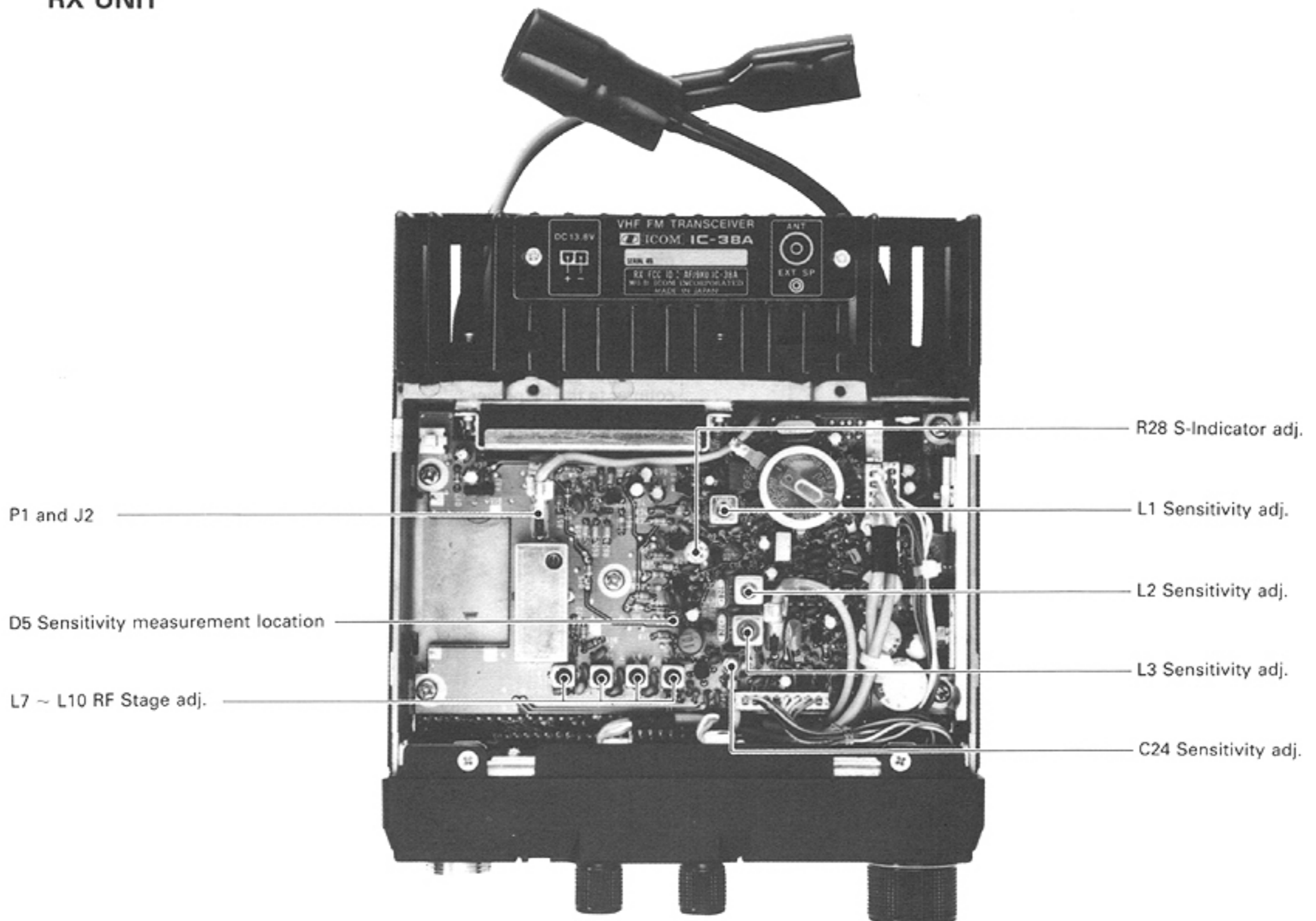


ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT	
		UNIT	LOCATION		UNIT	ADJUST
SENSITIVITY	<p>1</p> <ul style="list-style-type: none"> • Frequency display: 223.000MHz • Turn R28 completely CW. • Apply an RF signal to the ANTENNA CONNECTOR. Level : 1μV (-107dBm) Deviation : \pm3.5kHz Modulation : 1kHz <p>NOTE: Verify that the sensitivity in all bands is below 0.18μV (-122dBm) for 12dB SINAD.</p>	RX	Connect a voltmeter to the cathode of D5.	Maximum value	RX	C24, L3 L2, L1
S-INDICATOR	<p>1</p> <ul style="list-style-type: none"> • Frequency display: 223.000MHz • Apply an RF signal to the ANTENNA CONNECTOR. Level : 1μV (-107dBm) Deviation : \pm3.5kHz Modulation : 1kHz 	DISPLAY	<p>S-INDICATOR: S-3</p>	S-3	RX	R28
	<p>2</p> <ul style="list-style-type: none"> • Apply an RF signal to the ANTENNA CONNECTOR. Level : 5.0μV (-93dBm) Deviation : \pm3.5kHz Modulation : 1kHz 		<p>S-INDICATOR: Full scale</p>	Full scale		Verify
SQUELCH	<p>1</p> <ul style="list-style-type: none"> • Frequency display: 223.000MHz • Apply an RF signal to ANTENNA CONNECTOR. Level : 0.11μV (-126dBm) Deviation : \pm3.5kHz Modulation : 1kHz • Adjust SQUELCH CONTROL to threshold point 			SQUELCH opens		Verify
	<p>2</p> <ul style="list-style-type: none"> • Apply an RF signal to the ANTENNA CONNECTOR. Level : 0.5μV (-113dBm) Deviation : \pm3.5kHz Modulation : 1kHz • Turn SQUELCH CONTROL to maximum CW 			SQUELCH opens		Verify

IC-38A RECEIVER ADJUSTMENT

ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT	
		UNIT	LOCATION		UNIT	ADJUST
AF OUTPUT POWER	1 <ul style="list-style-type: none"> Apply an RF signal to the ANTENNA CONNECTOR. Level : 10μV (-87dBm) Deviation : \pm3.5kHz Modulation : 1kHz Turn AF VOLUME CONTROL to maximum CW. 	REAR PANEL	Connect an AC milli-volt-meter to the transceiver EXTERNAL SPEAKER JACK using an 8 Ω load.	More than 4.4V at 10% distortion.		Verify
RF STAGE	NOTE: The Bandpass Filter unit in the RF stage has been thoroughly adjusted prior to leaving the factory. The following should be regarded as reference material.					
	1 <ul style="list-style-type: none"> Unplug P1 from J2 on the RX UNIT. Apply an RF sweep generator to the ANTENNA CONNECTOR. Frequency range : 150 ~ 320MHz Output level : 2.2mV (-20dBm) <p>Detector circuit:</p> 	RX	Connect an oscilloscope to J1 on the RX UNIT through the detector circuit as described at left below.		RX	L7 ~ L10
						

RX UNIT



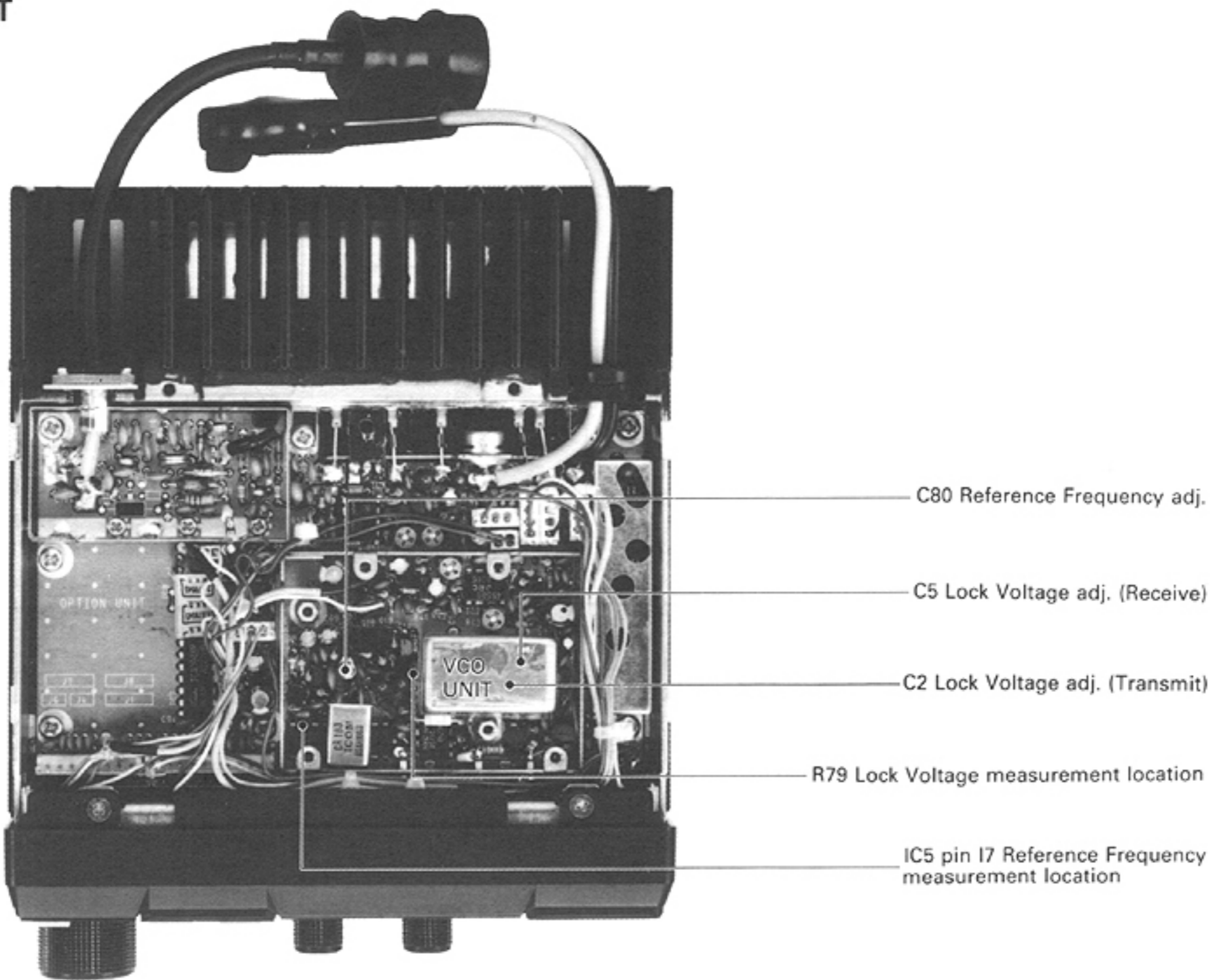
6 - 5 IC-48A/E PLL ADJUSTMENT

NOTE: Bracketed figures indicate the IC-48E version.

TEST INSTRUMENTS REQUIRED	MEASUREMENT CONNECTION LOCATION
<p>(1) AC POWER SUPPLY</p> <ul style="list-style-type: none"> • Output voltage : 13.8V DC \pm 15% • Current capacity : 10A or more <p>(2) VOLTMETER</p> <ul style="list-style-type: none"> • Input impedance : 50Ω/V DC or better <p>(3) FREQUENCY COUNTER</p> <ul style="list-style-type: none"> • Frequency range : 0.1 ~ 470MHz • Accuracy : 1ppm or better • Sensitivity : 100mV or better <p>(4) RF POWER METER</p> <ul style="list-style-type: none"> • Terminated type • Minimum power rating : 50W • Frequency minimum : 500MHz • Impedance : 50Ω • SWR : 1:1.2 or better <p>(5) OSCILLOSCOPE</p> <ul style="list-style-type: none"> • Frequency range : DC ~ 20MHz • Measuring range : 0.01 ~ 10V 	

ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT	
		UNIT	LOCATION		UNIT	ADJUST
LOCK VOLTAGE	1 • Frequency display: 440.000MHz (430.000MHz)	MAIN	Connect a voltmeter to R79. Connect an RF power meter to the ANTENNA CONNECTOR.	2.0V 2.5V 4.5 ~ 6.0V	VCO	C5 C2 Verify
	2 • Receive mode					
	3 • Transmit mode					
	4 • Frequency display: 449.995MHz (439.975MHz) • Transmit and receive mode					
REFERENCE FREQUENCY	1 • Frequency display: 445.000MHz (435.000MHz)	MAIN	Connect an oscilloscope to pin 17 on IC5. Connect an RF power meter to the ANTENNA CONNECTOR. Loosely couple a frequency counter to the RF power meter.	More than 3Vp-p 445.000MHz (435.000MHz)	MAIN	Verify C80
	2 • Frequency display: 445.000MHz (435.000MHz) • Transmit mode					

MAIN UNIT



6 - 6 IC-48A/E TRANSMITTER ADJUSTMENT

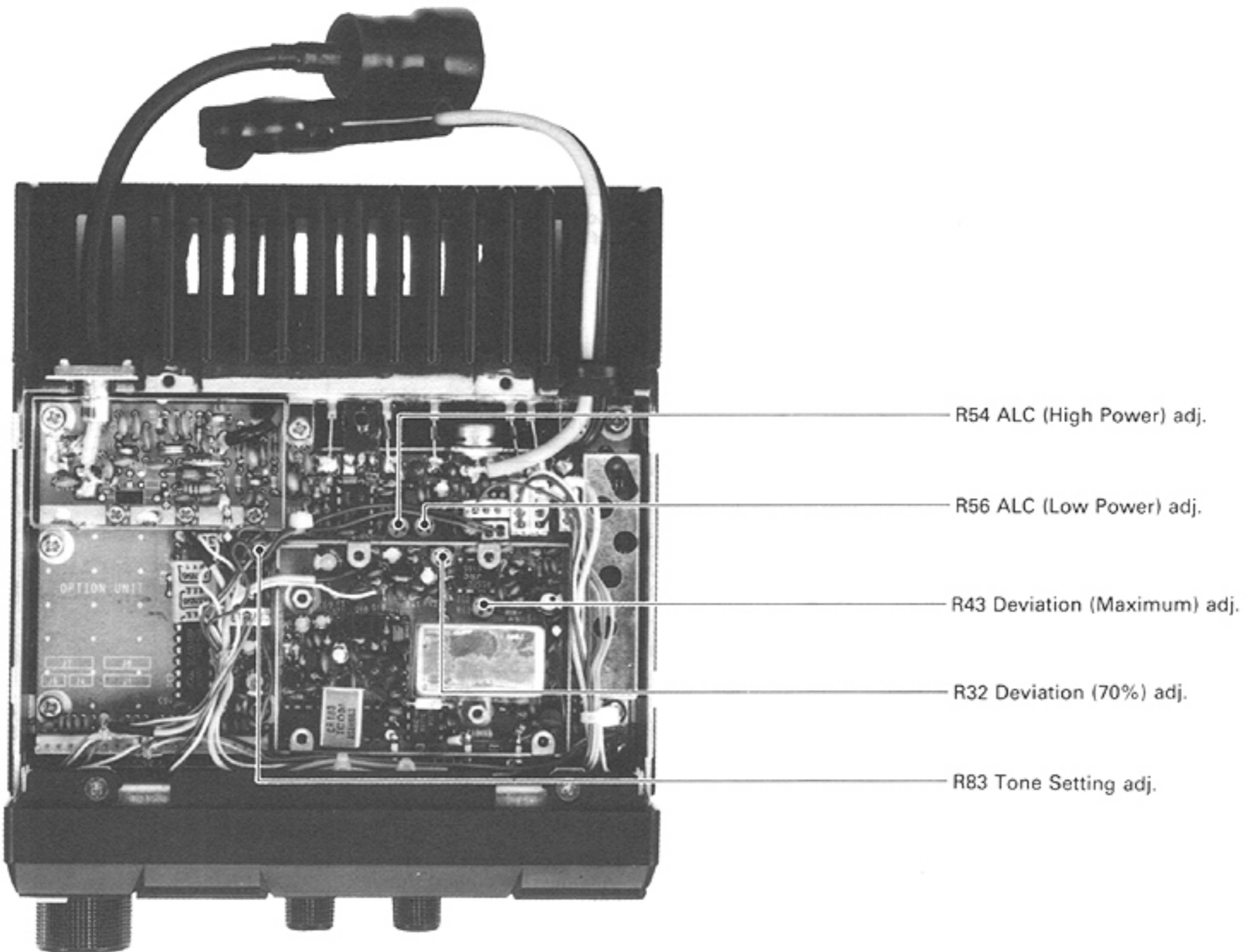
TEST INSTRUMENTS REQUIRED	MEASUREMENT CONNECTION LOCATION
<p>(1) AC POWER SUPPLY</p> <ul style="list-style-type: none"> • Output voltage : 13.8V DC \pm15% • Current capacity : 10A or more <p>(2) RF POWER METER</p> <ul style="list-style-type: none"> • Terminated type • Minimum power rating : 50W • Frequency minimum : 500MHz • Input impedance : 50Ω • SWR : 1:1.2 or better <p>(3) FM DEVIATION METER</p> <ul style="list-style-type: none"> • Frequency minimum : 500MHz • Measuring range : 0 ~ \pm10kHz • De-emphasis : OFF <p>(4) AUDIO GENERATOR</p> <ul style="list-style-type: none"> • Output frequency range : 50 ~ 3000Hz • Output level : 0 ~ 200mV • Distortion : Less than 0.1% <p>(5) AMMETER</p> <ul style="list-style-type: none"> • Measurement minimum : 100mA and 600mA <p>(6) AC MILLI-VOLTMETER</p> <ul style="list-style-type: none"> • Measuring range : 50mV ~ 1V <p>(7) ATTENUATOR</p>	

ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT	
		UNIT	LOCATION		UNIT	ADJUST
ALC (Automatic Level Control) Ⓐ HIGH POWER	1	REAR PANEL	Connect an RF power meter to the ANTENNA CONNECTOR.	25W	MAIN	R54
	2			5W		R56
RF LEVEL INDICATOR	1	DISPLAY	<p>RF LEVEL INDICATOR: Full scale.</p>	Full scale		Verify
	2			<p>RF LEVEL INDICATOR: S-5</p>		S-5
TRANSMIT CURRENT	1	REAR PANEL	Connect an ammeter between the power supply and the transceiver.	Less than 7.5A		Verify
	2			Less than 3.5A		Verify
DEVIATION Ⓐ MAXIMUM	1	REAR PANEL	Connect a deviation meter to the ANTENNA CONNECTOR through an attenuator. Deviation meter HPF: 50Hz LPF: 20kHz	\pm 4.8kHz	MAIN	R43
	2			\pm 3.5kHz		R32

IC-48A/E TRANSMITTER ADJUSTMENT

ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT	
		UNIT	LOCATION		UNIT	ADJUST
TONE SETTING	1 <ul style="list-style-type: none"> • Frequency display: 445.000MHz (435.000MHz) • Tone function: ON • Tone number: 38 • Apply no signal to the MIC CONNECTOR • Transmit mode 	REAR PANEL	Connect a deviation meter to the ANTENNA CONNECTOR through an attenuator.	±0.75kHz	MAIN	R83
	2 <ul style="list-style-type: none"> • Tone number: 01 					±0.5 ~ ±1kHz
S/N RATIO ⓐ Step 1	1 <ul style="list-style-type: none"> • Frequency display: 445.000MHz (435.000MHz) • Apply a 1kHz 6.5mV AF signal to the MIC CONNECTOR. • Transmit mode 	REAR PANEL	Connect an AC milli-volt-meter to the deviation meter.	Record the reading. (Step 1)		
	ⓑ Step 2			2 <ul style="list-style-type: none"> • Apply no signal to the MIC CONNECTOR 	Record the reading. (Step 2)	
NOTE: Verify that the recorded ratio is greater than 40dB (See Steps 1 and 2).						

MAIN UNIT

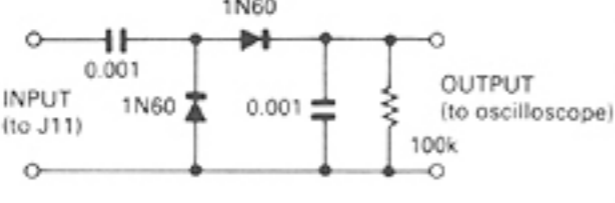

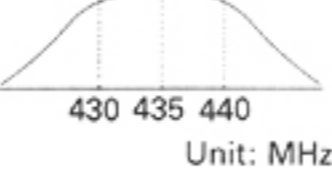


6 - 7 IC-48A/E RECEIVER ADJUSTMENT

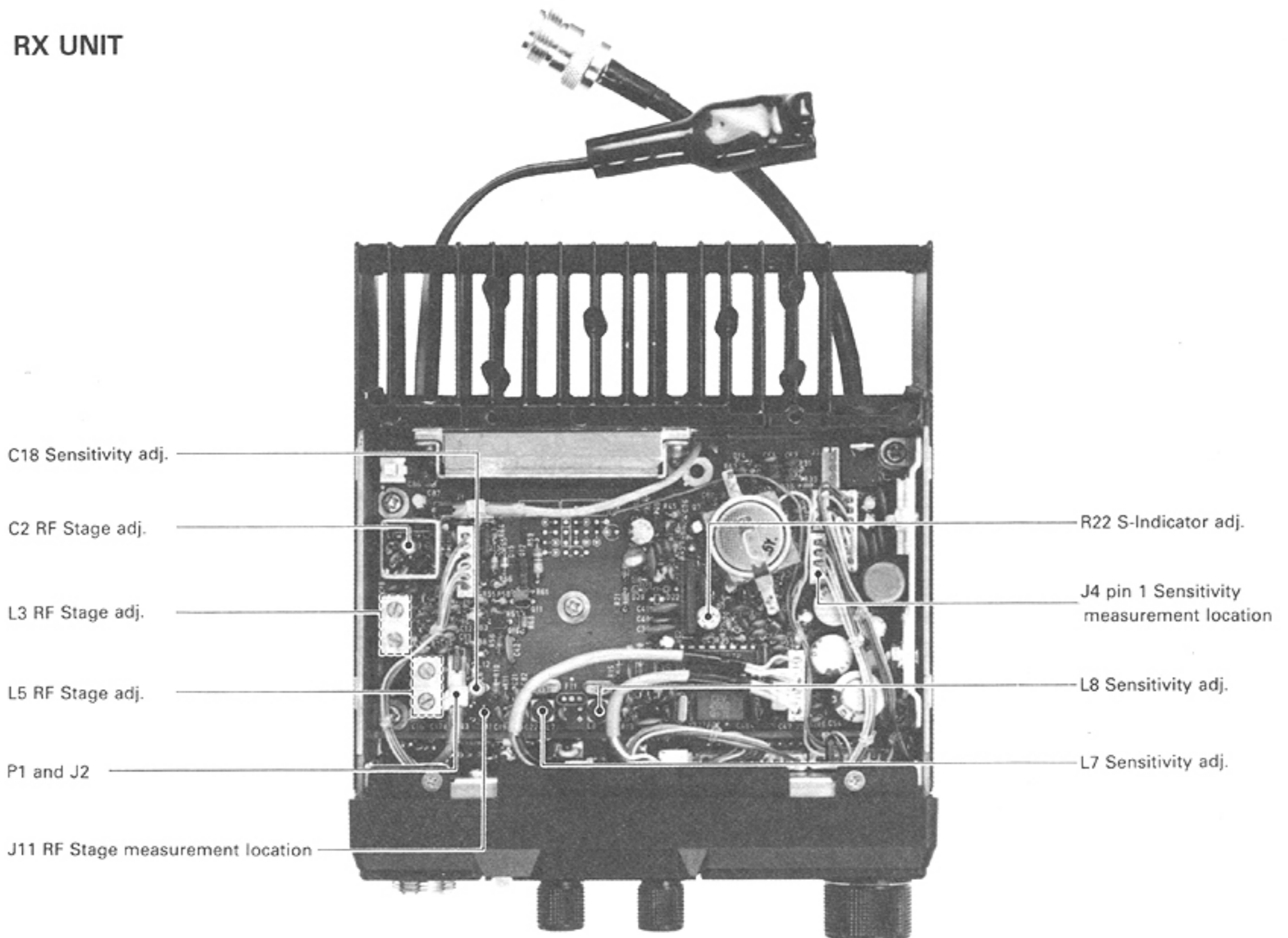
TEST INSTRUMENTS REQUIRED	MEASUREMENT CONNECTION LOCATION
<p>(1) AC POWER SUPPLY</p> <ul style="list-style-type: none"> Output voltage : 13.8V DC ± 15% Current capacity : 10A or more <p>(2) STANDARD SIGNAL GENERATOR</p> <ul style="list-style-type: none"> Frequency range : 430 ~ 450MHz Output level : 0.1μV ~ 32mV <p>(3) AC MILLI-VOLTMETER</p> <ul style="list-style-type: none"> Measuring range : 5mV ~ 1V <p>(4) VOLTMETER</p> <ul style="list-style-type: none"> Input impedance : 50kΩ/V DC or better <p>(5) OSCILLOSCOPE</p> <ul style="list-style-type: none"> Frequency range : DC ~ 20MHz Measuring range : 0.01 ~ 10V <p>(6) RF SWEEP GENERATOR</p> <ul style="list-style-type: none"> Center frequency : 430 ~ 450MHz Sweep bandwidth : ±20MHz Output impedance : 50Ω <p>(7) DETECTOR : See diagram in RF STAGE ADJUSTMENT</p>	

ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT	
		UNIT	LOCATION		UNIT	ADJUST
SENSITIVITY	<p>1</p> <ul style="list-style-type: none"> Frequency display: 445.000MHz (435.000MHz) Turn R22 completely CCW. Apply an RF signal to the ANTENNA CONNECTOR. Level : 1μV (-107dBm) Deviation : ±3.5kHz Modulation : 1kHz <p>NOTE: Verify that the sensitivity in all bands is below 0.18μV (-122dBm) for 12dB SINAD.</p>	RX	Connect a voltmeter to pin 1 of J4.	Maximum value	RX	C18, L7, L8
S-INDICATOR	<p>1</p> <ul style="list-style-type: none"> Frequency display: 445.000MHz (435.000MHz) Apply an RF signal to the ANTENNA CONNECTOR. Level : 1μV (-107dBm) Deviation : ±3.5kHz Modulation : 1kHz 	DISPLAY	<p>S-INDICATOR: S-3</p>	S-3	RX	R22
	<p>2</p> <ul style="list-style-type: none"> Apply an RF signal to the ANTENNA CONNECTOR. Level : 10μV (-87dBm) Deviation : ±3.5kHz Modulation : 1kHz 		<p>S-INDICATOR: Full scale</p>	Full scale		Verify
SQUELCH	<p>1</p> <ul style="list-style-type: none"> Frequency display: 445.000MHz (435.000MHz) Apply an RF signal to ANTENNA CONNECTOR Level : 0.11μV (-126dBm) Deviation : ±3.5kHz Modulation : 1kHz Adjust SQUELCH CONTROL to threshold point. 		Connect a standard signal generator to the ANTENNA CONNECTOR.	SQUELCH opens		Verify
	<p>2</p> <ul style="list-style-type: none"> Apply an RF signal to the ANTENNA CONNECTOR. Level : 0.2μV (-121dBm) Deviation : ±3.5kHz Modulation : 1kHz Turn SQUELCH CONTROL to maximum CW. 			SQUELCH does not open.		Verify

IC-48A/E RECEIVER ADJUSTMENT

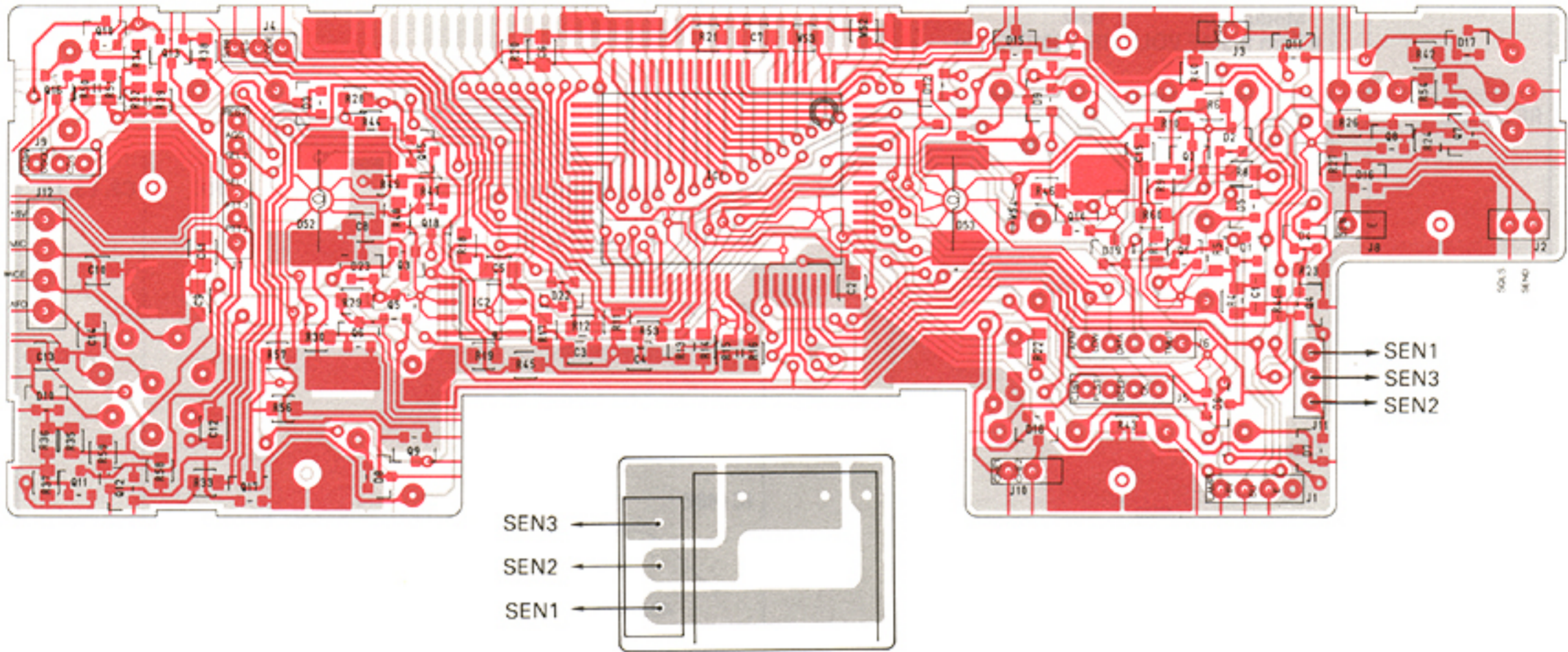
ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT	
		UNIT	LOCATION		UNIT	ADJUST
AF OUTPUT POWER	1 <ul style="list-style-type: none"> • Frequency display: 445.000MHz (435.000MHz) • Apply an RF signal to the ANTENNA CONNECTOR. Level : 10μV (-87dBm) Deviation : \pm3.5kHz Modulation : 1kHz • Turn the AF VOLUME CONTROL to maximum CW. 	REAR PANEL	Connect a standard signal generator to the ANTENNA CONNECTOR. Connect an AC milli-volt-meter to the transceiver EXTERNAL SPEAKER JACK using an 8 Ω load.	More than 4.4V at 10% distortion.		Verify
RF STAGE	NOTE: The Bandpass Filter unit in the RF stage has been thoroughly adjusted prior to leaving the factory. The following should be regarded as reference material.					
	1 <ul style="list-style-type: none"> • Unplug P1 from J2 on the RX UNIT. • Apply an RF sweep generator to the ANTENNA CONNECTOR. Frequency range: 350 ~ 550MHz Output level: 2.2mV (-20dBm) <p>Detector Circuit:</p> 	RX	Connect an oscilloscope to J11 on the RX UNIT through the detector circuit as described at left below. IC-48A  IC-48E 		RX	C2, L3, L5

RX UNIT

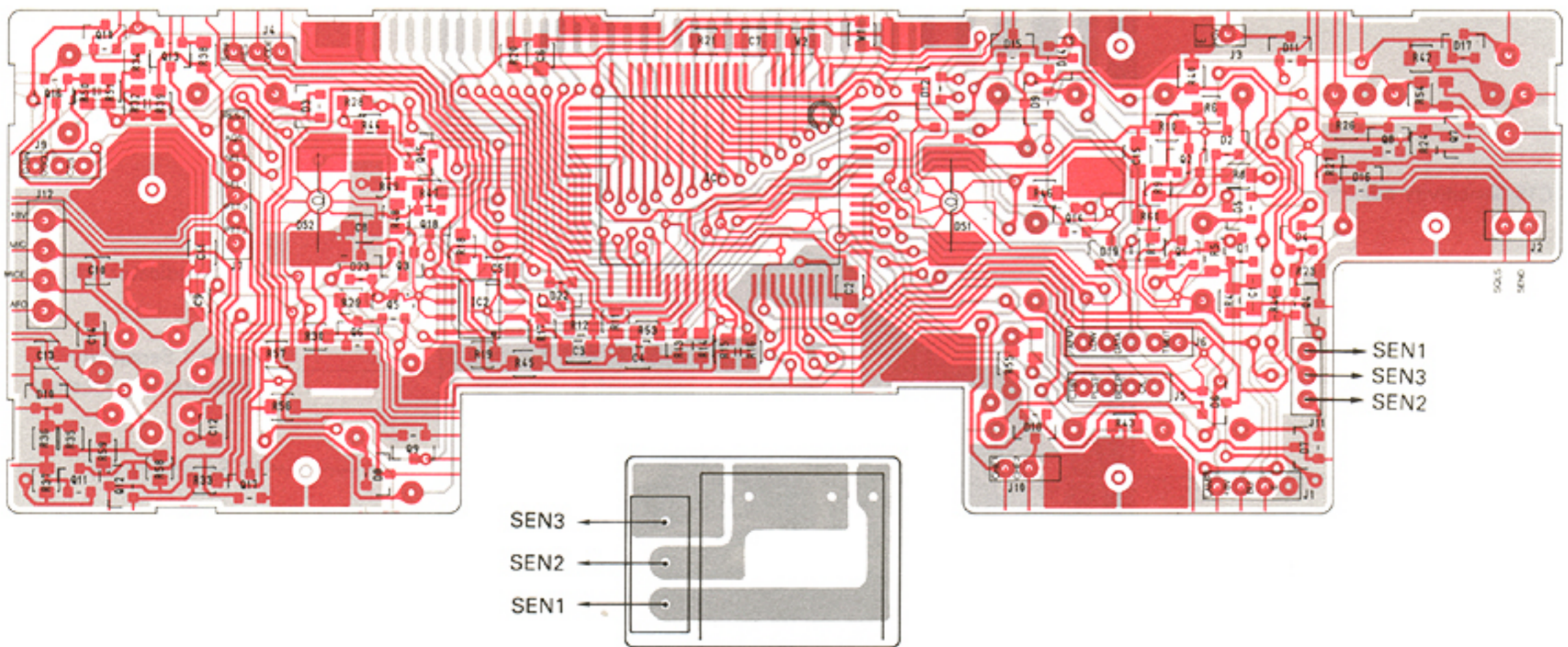


SECTION 7 BOARD LAYOUTS

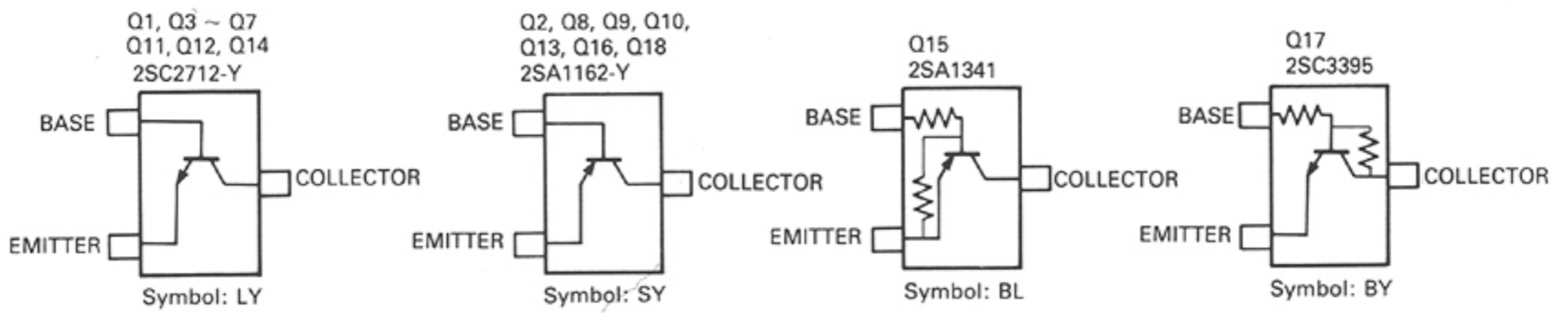
7 - 1 EF UNIT (IC-38A)



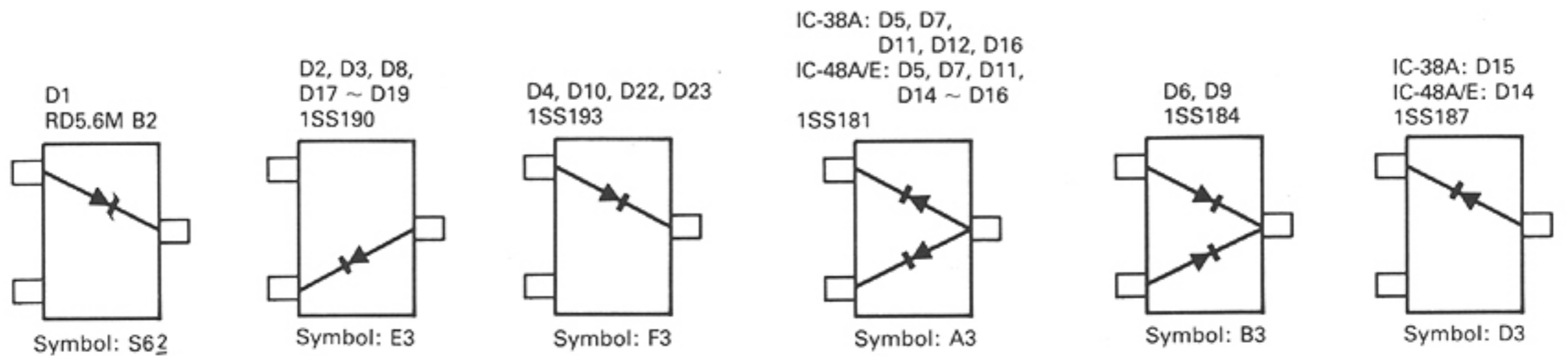
7 - 2 EF UNIT (IC-48A/E)



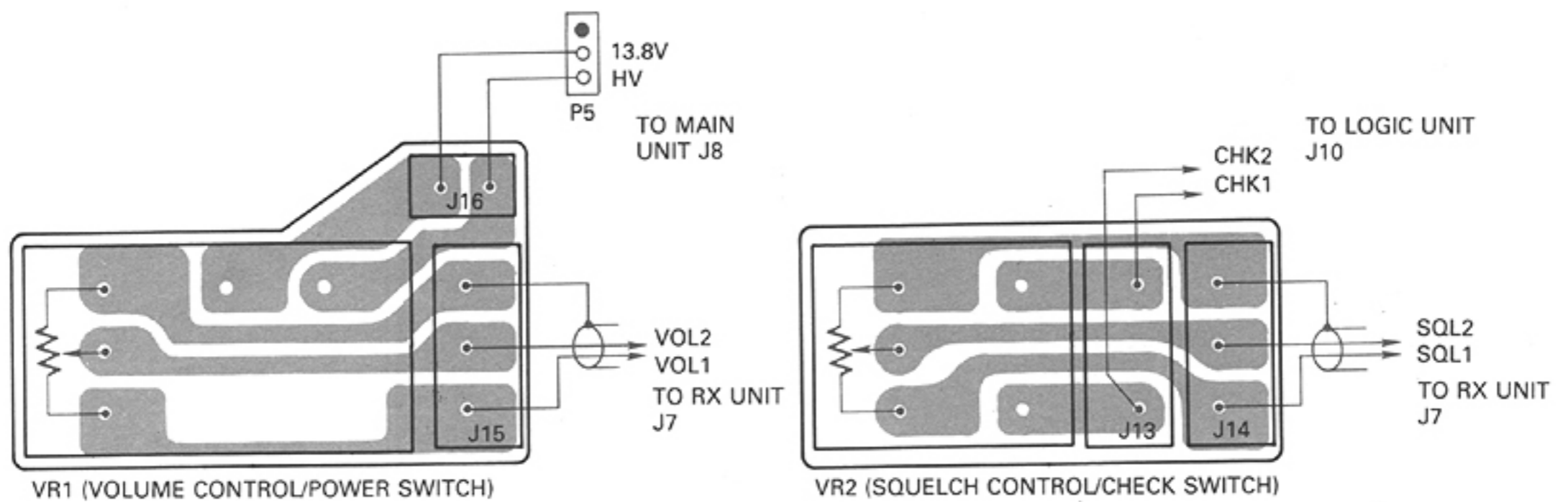
■ TRANSISTORS



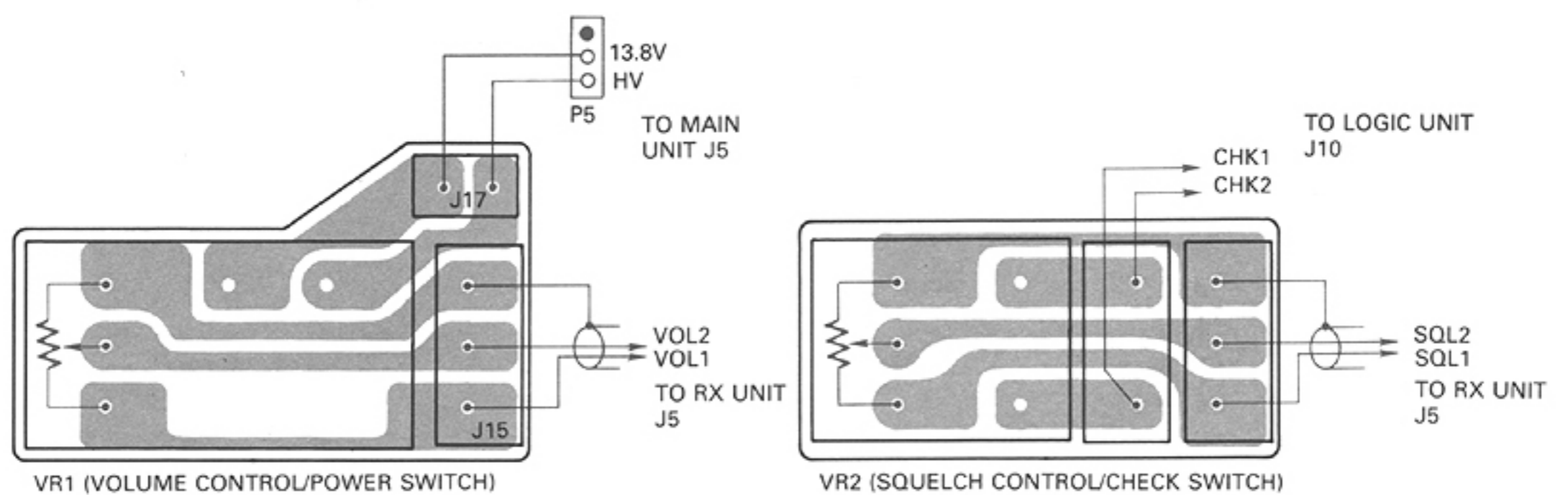
■ DIODES



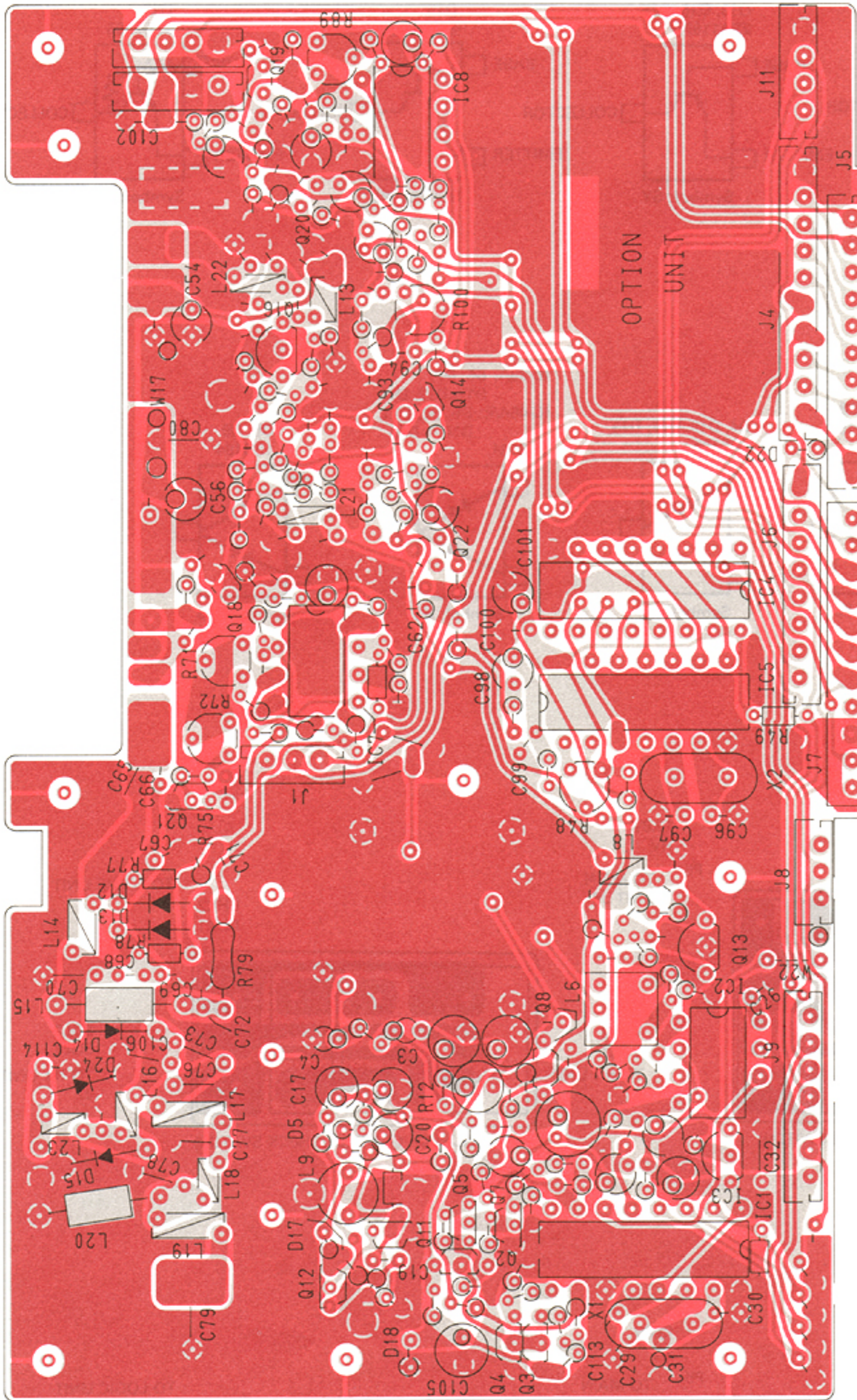
IC-38A



IC-48A/E



7 - 3 MAIN UNIT (IC-38A)



Q2, Q5
2SK184-Y (FET)



Q3, Q12
2SA1048-GR



Q4, Q7, Q8, Q11,
Q14, Q18, Q22
2SC2458-GR



Q19
2SC2458L



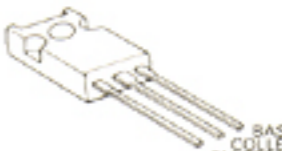
Q13
2SC2026



Q16
2SC2407



Q17
2SA1359-Y



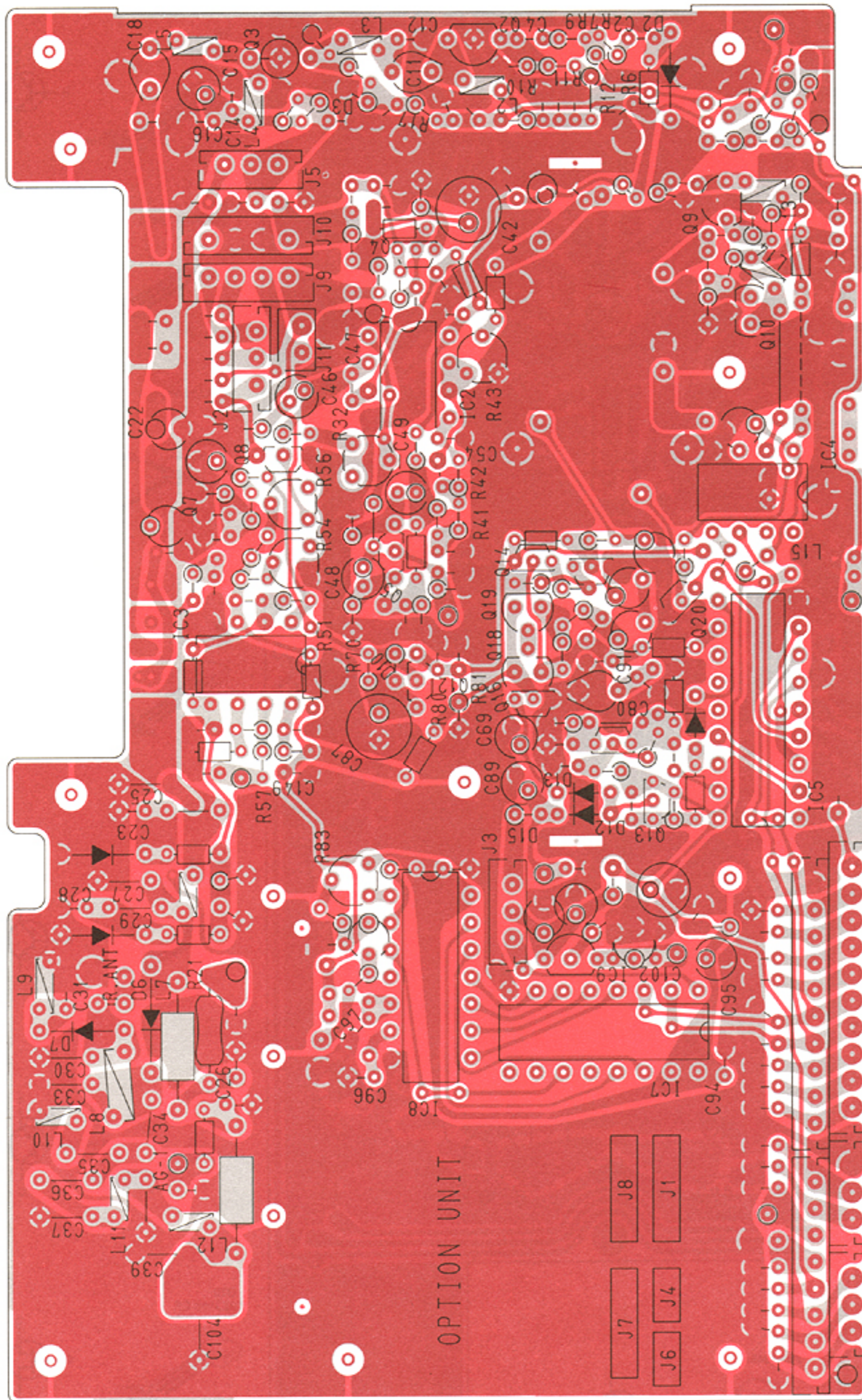
Q20
2SJ105-GR



Q21
2SC3399

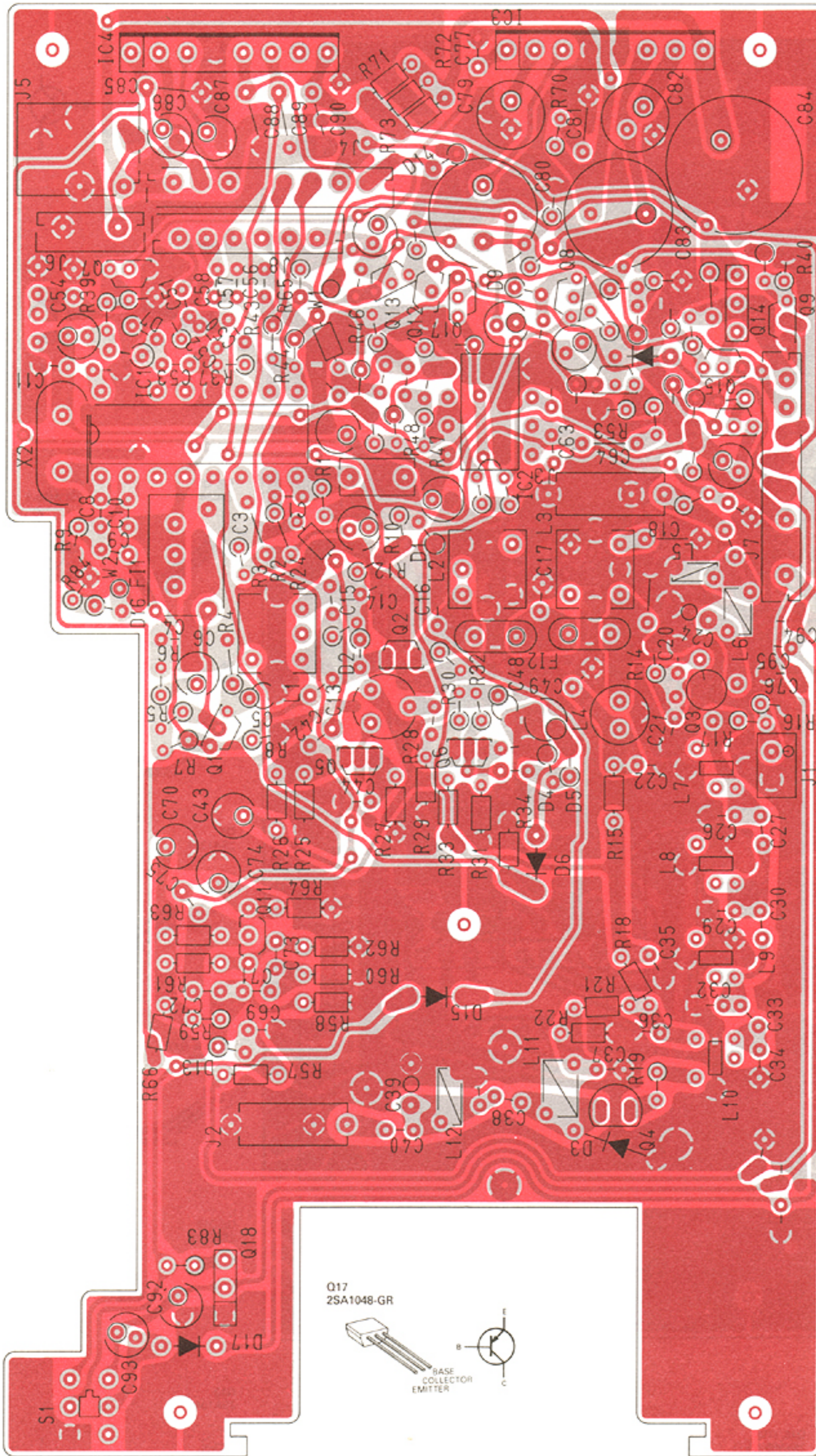


7 - 4 MAIN UNIT (IC-48A/E)



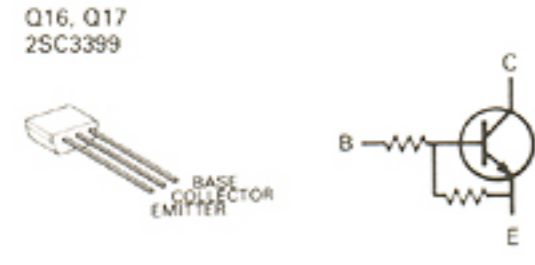
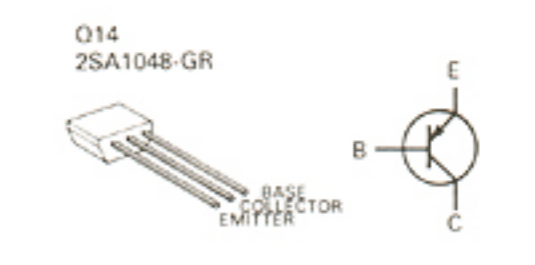
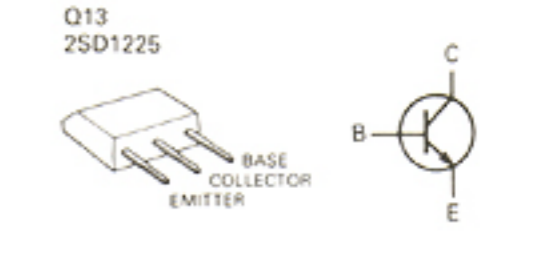
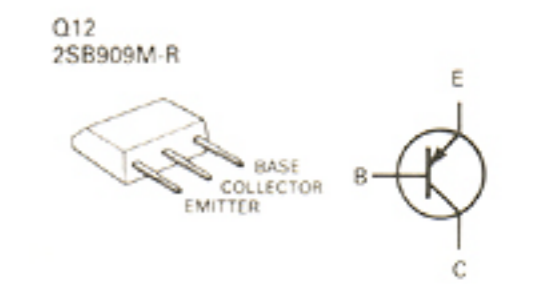
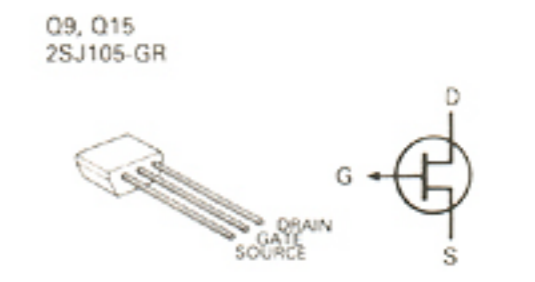
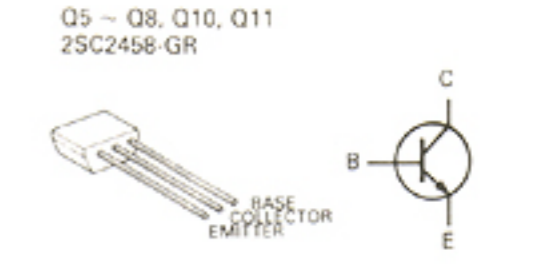
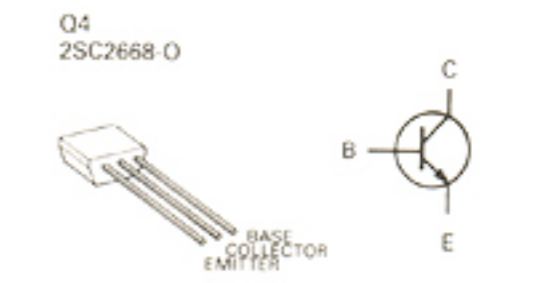
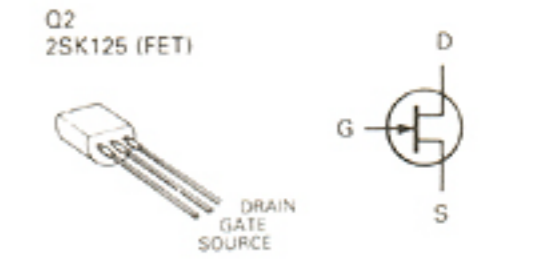
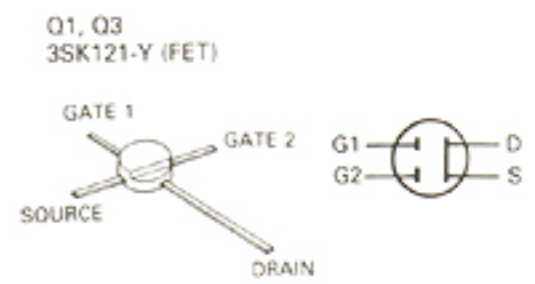
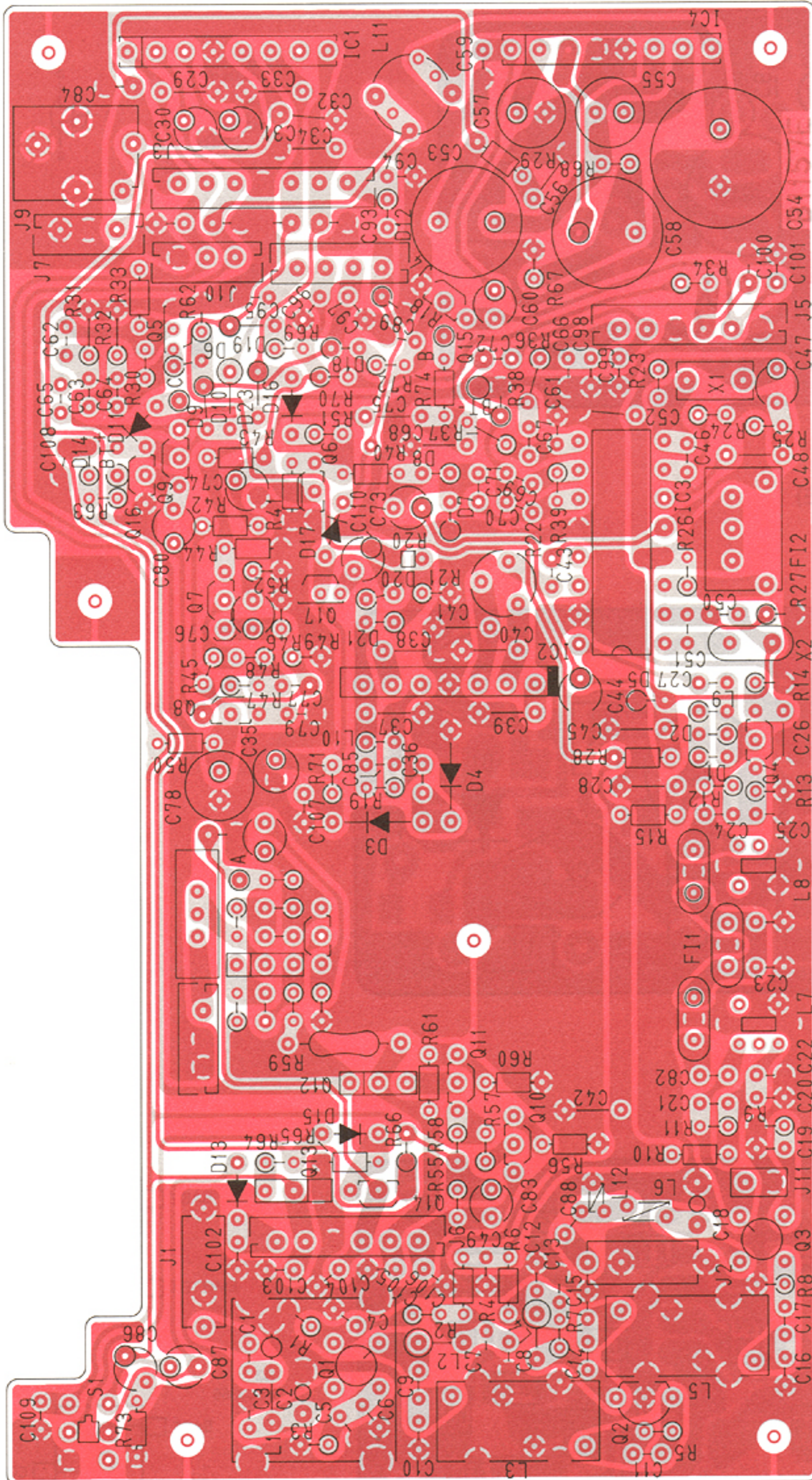
- Q2**
 2SC2570-A
- Q3**
 TRF559
- Q4, Q15**
 2SC2458L-G
Q7, Q12
 2SC2458-GR
Q11
 2SC2458-Y
- Q5**
 2SJ105-GR
- Q6**
 2SA1359
- Q8, Q16, Q17**
 2SC3399
- Q9, Q10**
 2SC2026
- Q13**
 2SA1048-Y
- Q14**
 2SK184-Y (FET)
- Q18, Q19**
 2SK583 (FET)
- Q20**
 2SC3402

7 - 5 RX UNIT (IC-38A)

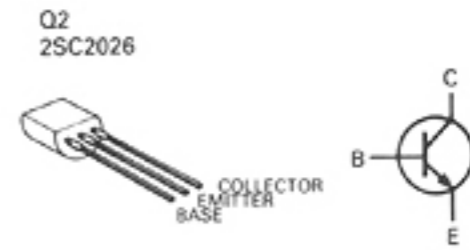
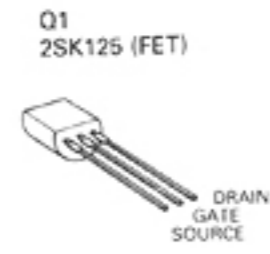
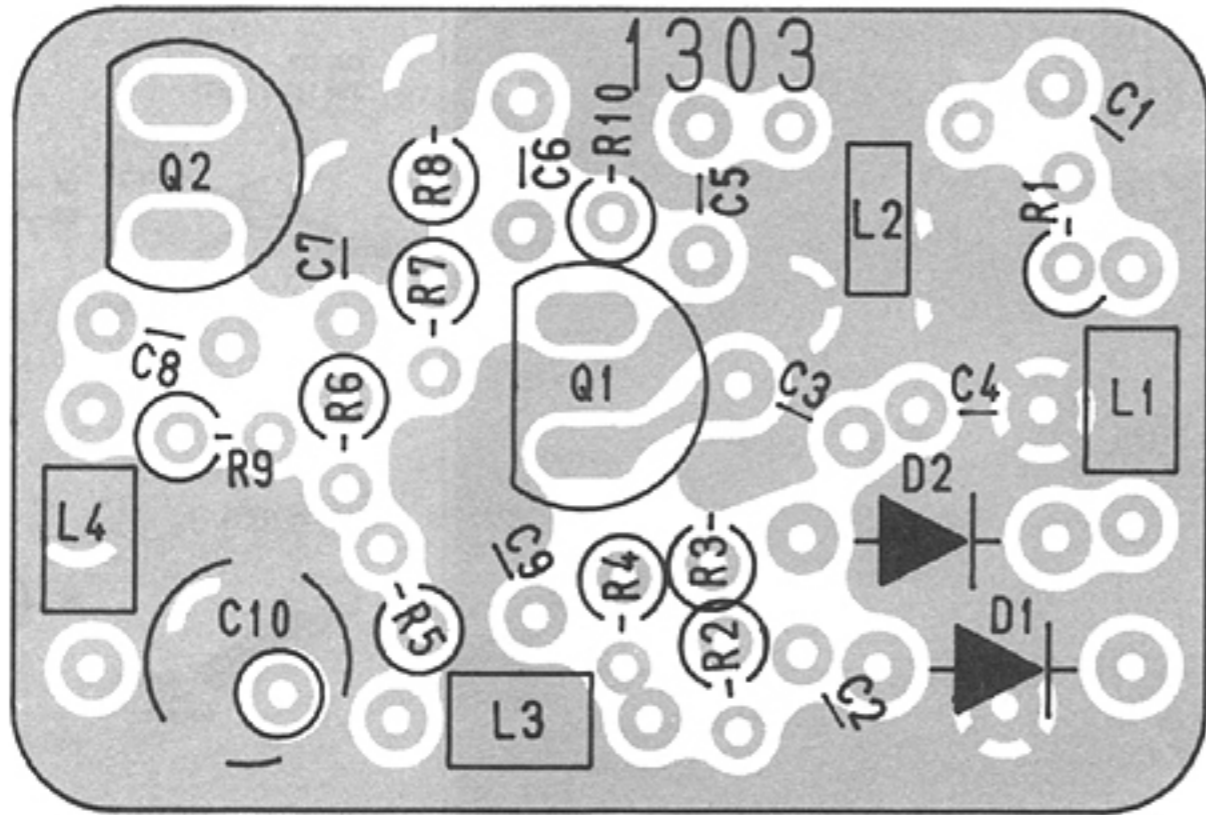


- Q1**
2SC2668-O
- Q2**
2SK241-Y (FET)
- Q3**
3SK121-Y (FET)
- Q4**
2SC3355
- Q5 - Q7, Q9, Q11, Q15, Q16**
2SC2458-GR
- Q8**
2SA1348
- Q10**
2SJ105-GR
- Q12, Q13**
2SC3399
- Q14**
2SB909M-R
- Q18**
2SD1225M-R

7 - 6 RX UNIT (IC-48A/E)

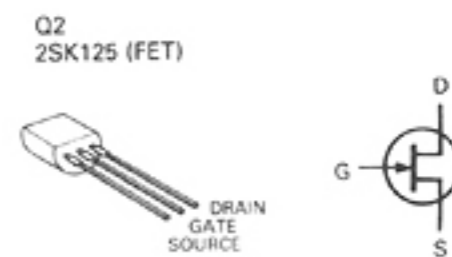
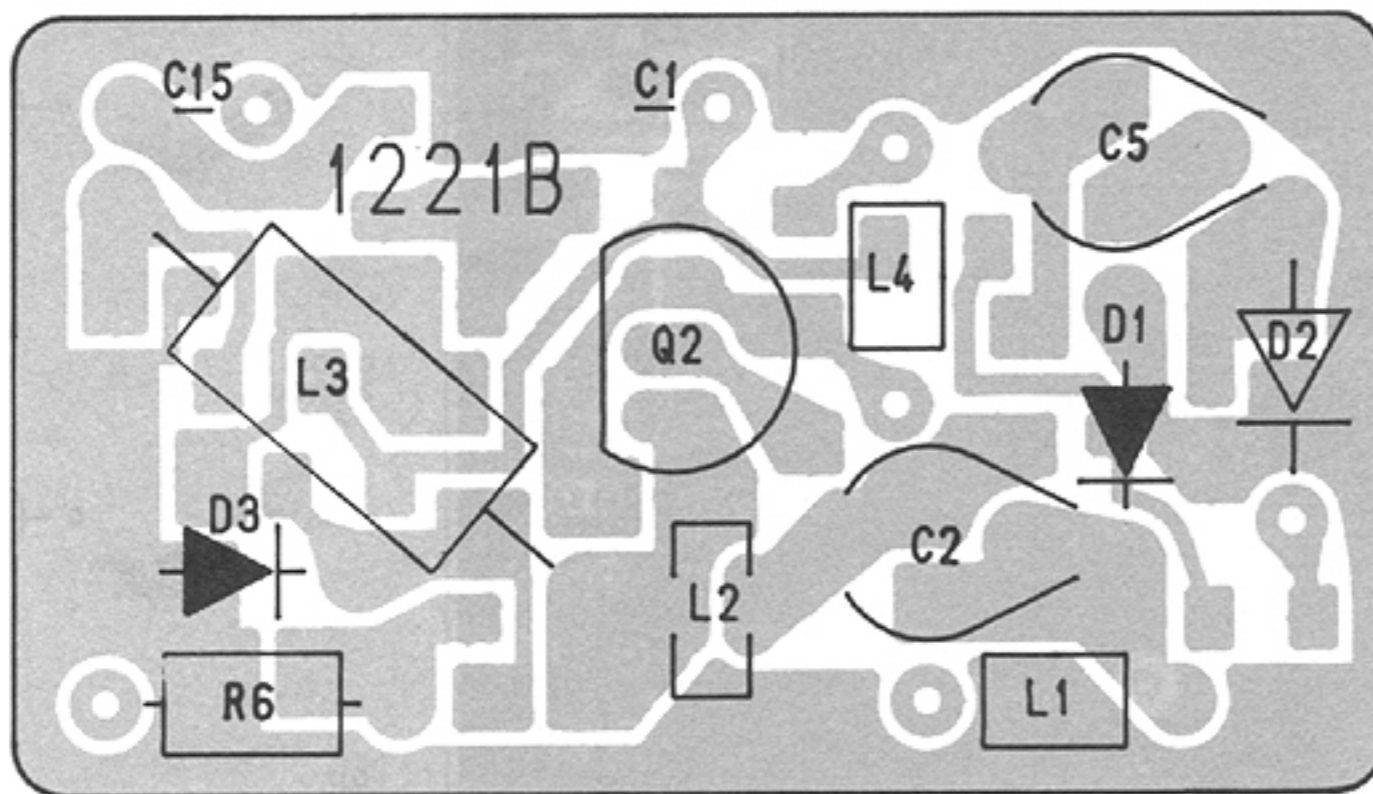


7 - 7 VCO UNIT (IC-38A)

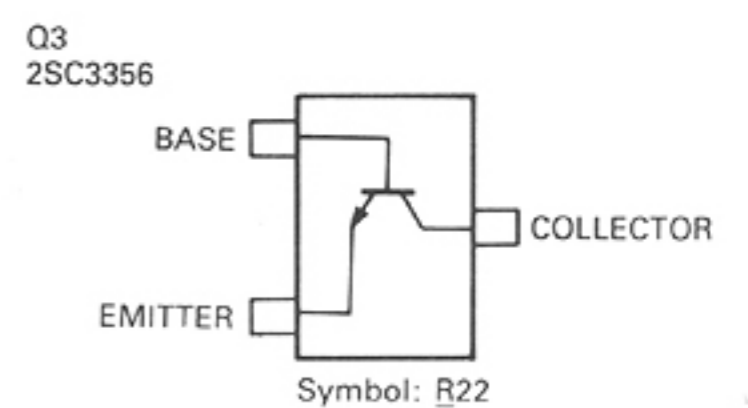
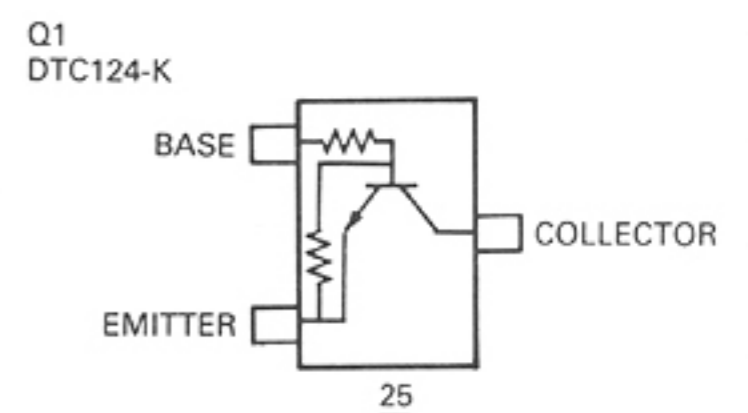
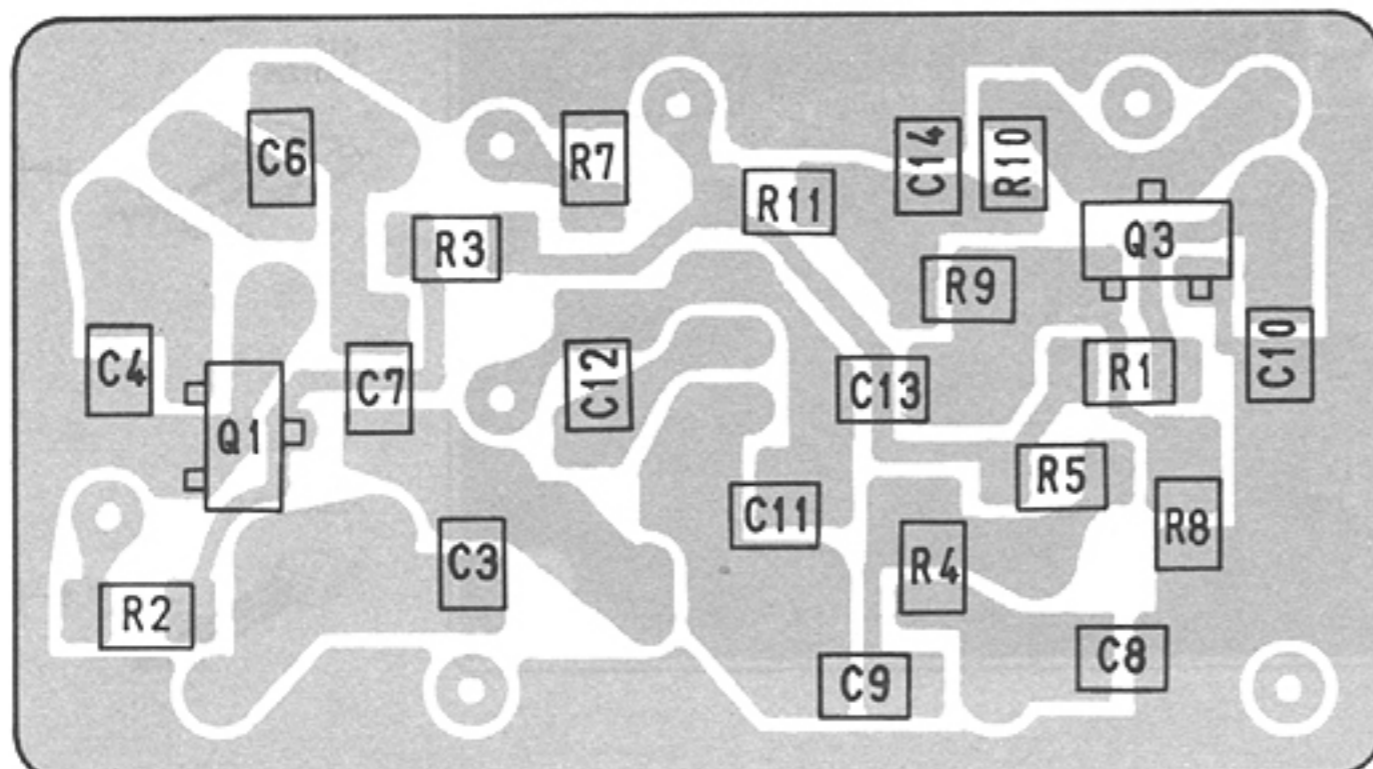


7 - 8 VCO UNIT (IC-48A/E)

(Top View)

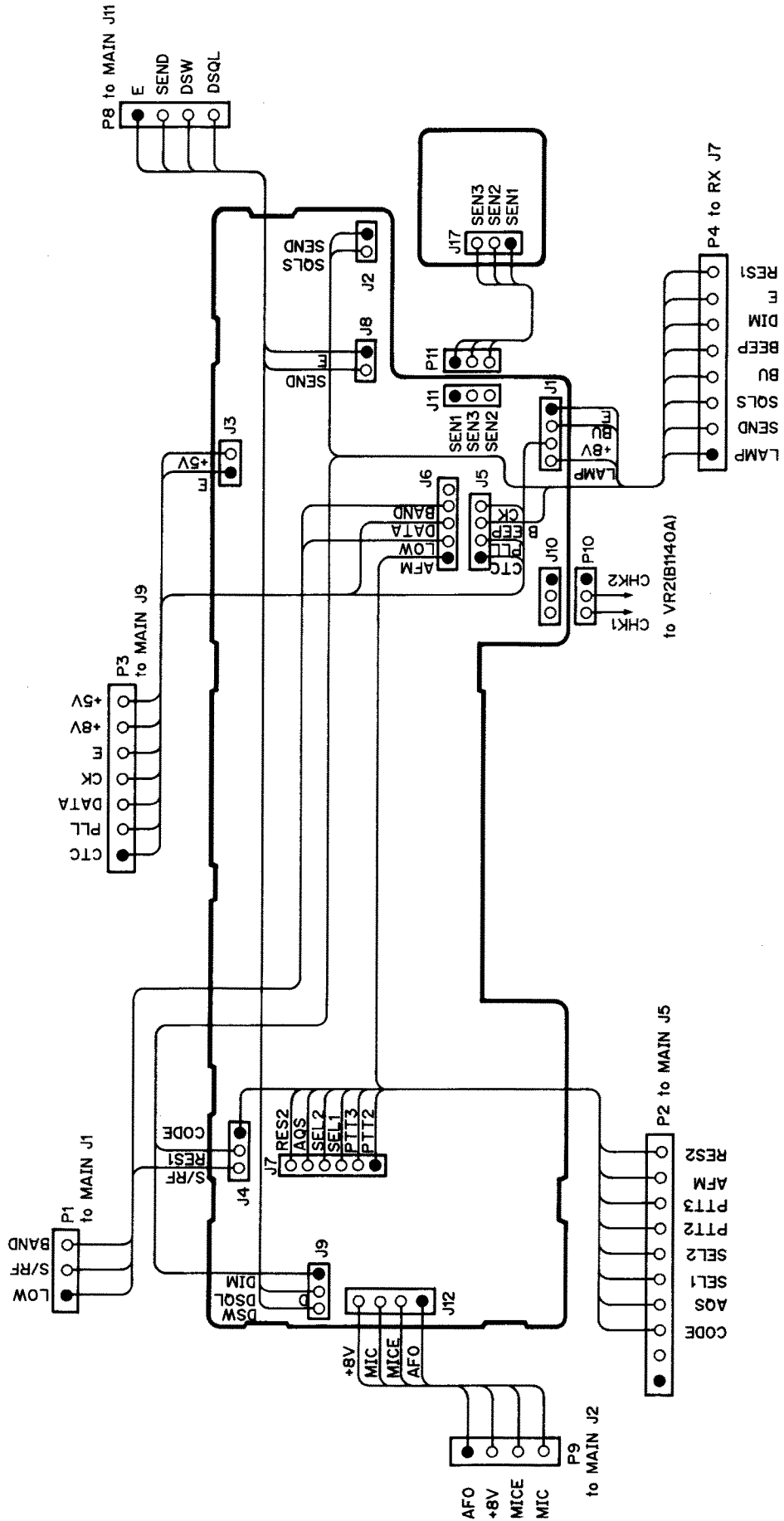


(Bottom View)

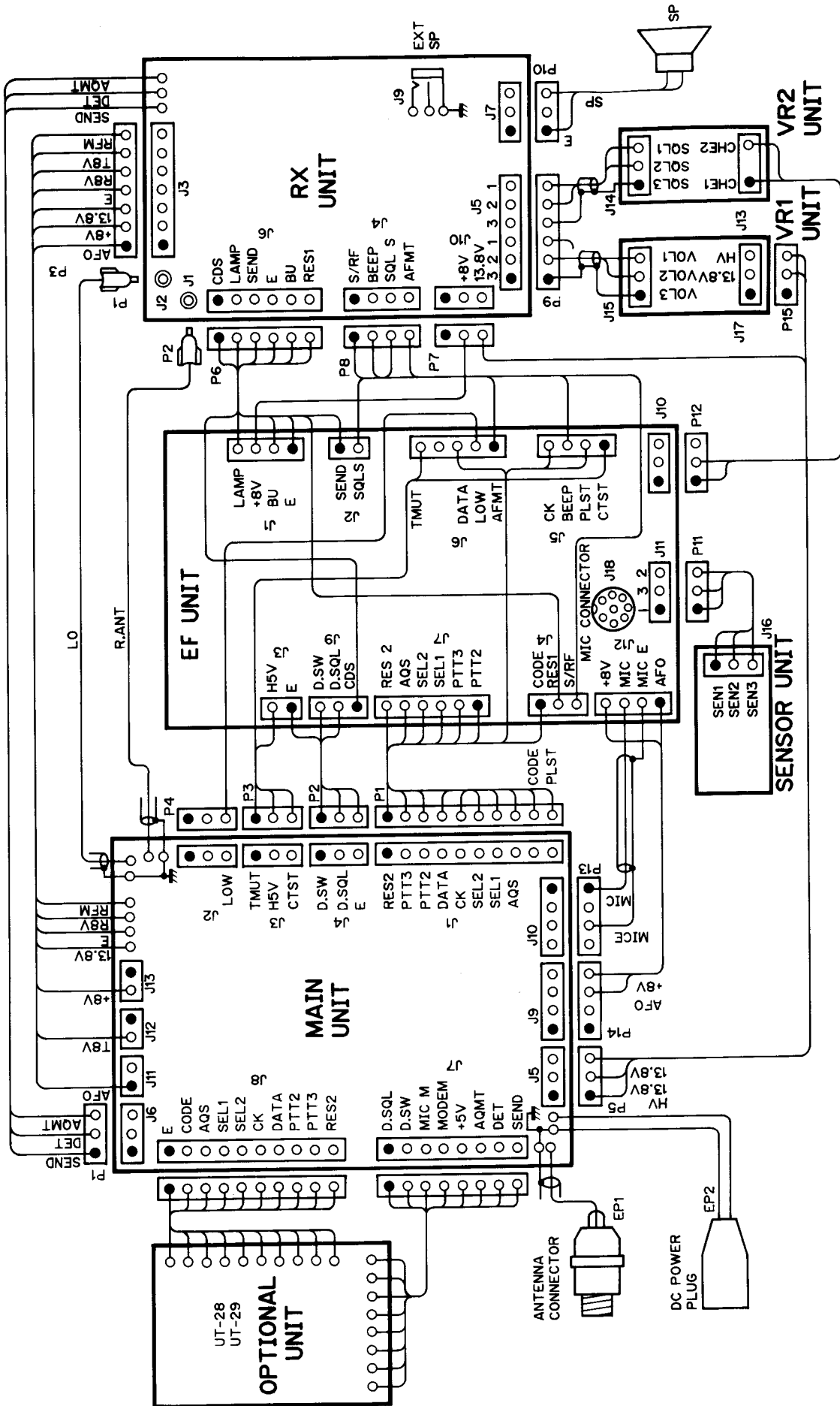


SECTION 8 VOLTAGE/CIRCUIT DIAGRAMS

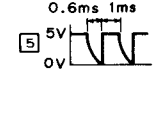
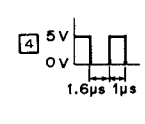
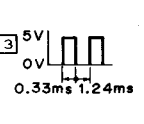
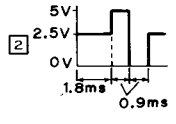
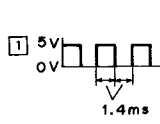
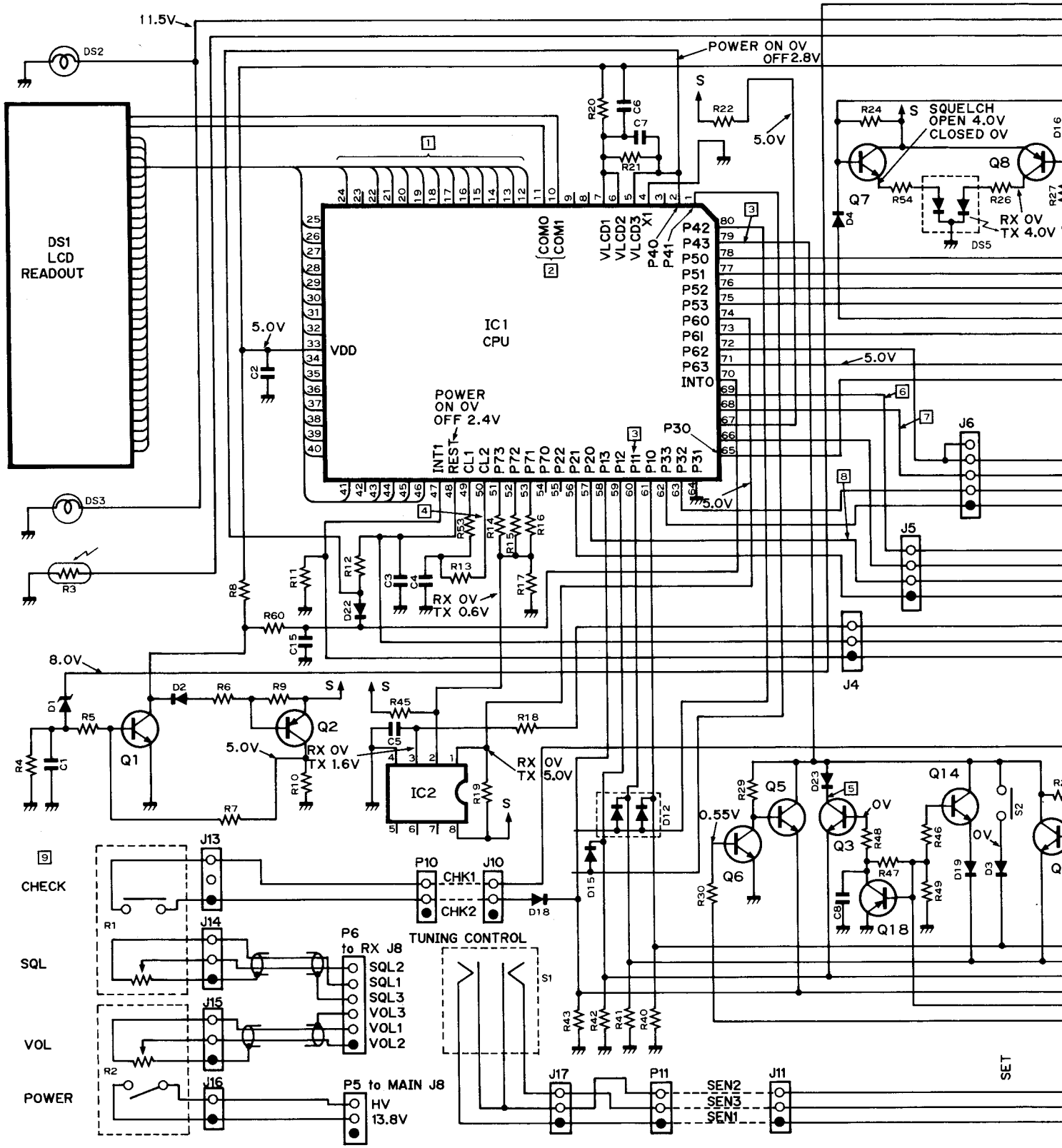
8 - 1 EF UNIT WIRING DIAGRAM (IC-38A AND IC-48A/E)



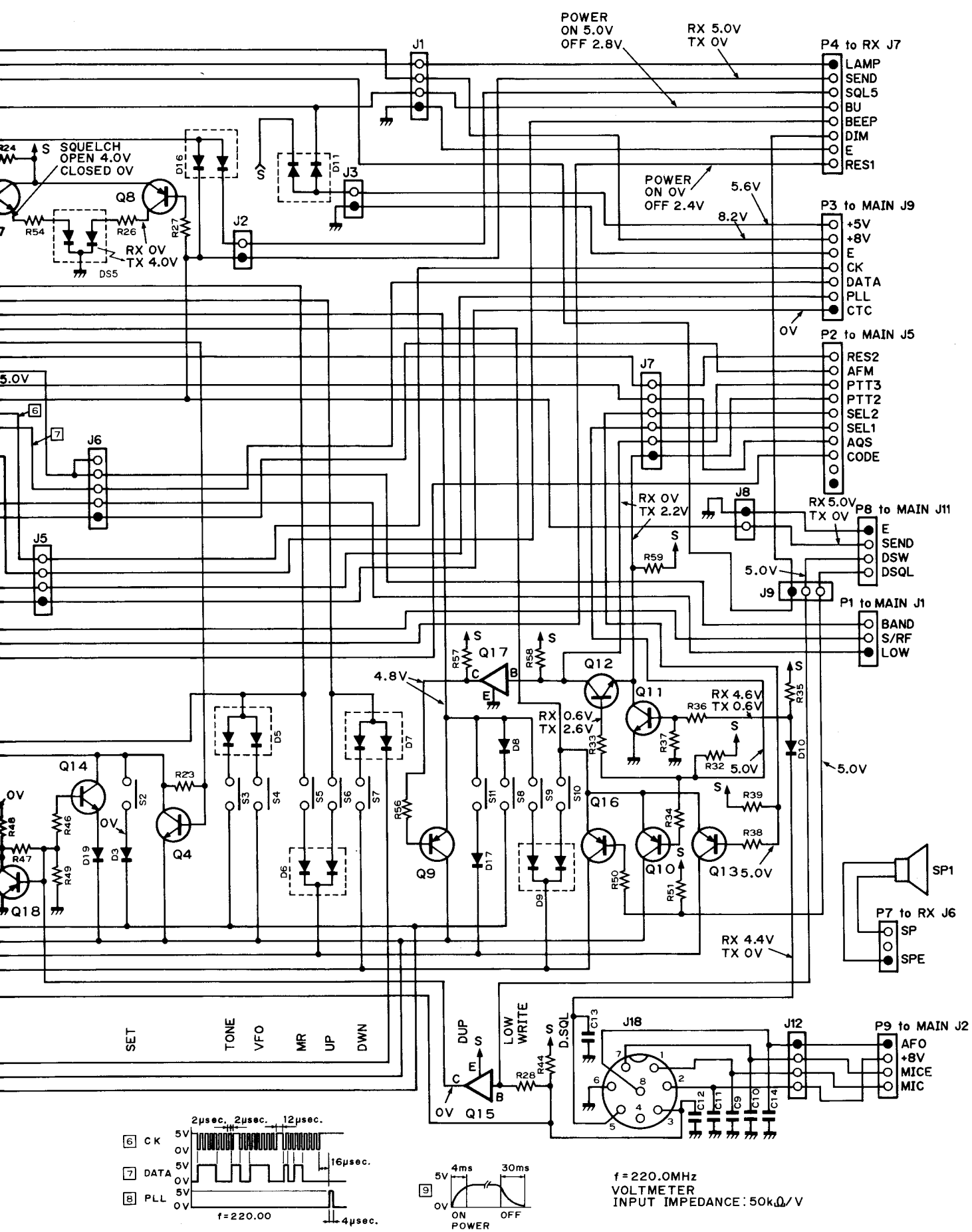
8 - 2 UNIT INTERCONNECTIONS DIAGRAM (IC-48A/E)



8 - 3 IC-38A EF UNIT



- 6 CK 5
- 0
- 7 DATA 5
- 0
- 8 PLL 5
- 0



POWER ON 5.0V
OFF 2.8V

RX 5.0V
TX 0V

POWER ON 0V
OFF 2.4V

- P4 to RX J7
- LAMP
 - SEND
 - SQL5
 - BU
 - BEEP
 - DIM
 - E
 - RES1

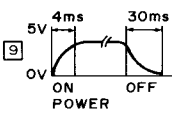
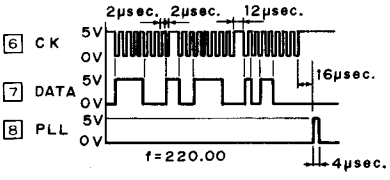
- P3 to MAIN J9
- +5V
 - +8V
 - E
 - CK
 - DATA
 - PLL
 - CTC

- P2 to MAIN J5
- RES2
 - AFM
 - PTT3
 - PTT2
 - SEL2
 - SEL1
 - AQS
 - CODE

- P8 to MAIN J11
- E
 - SEND
 - DSW
 - DSQ

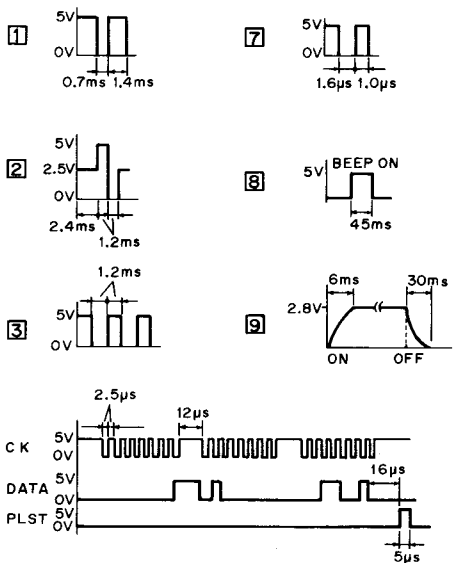
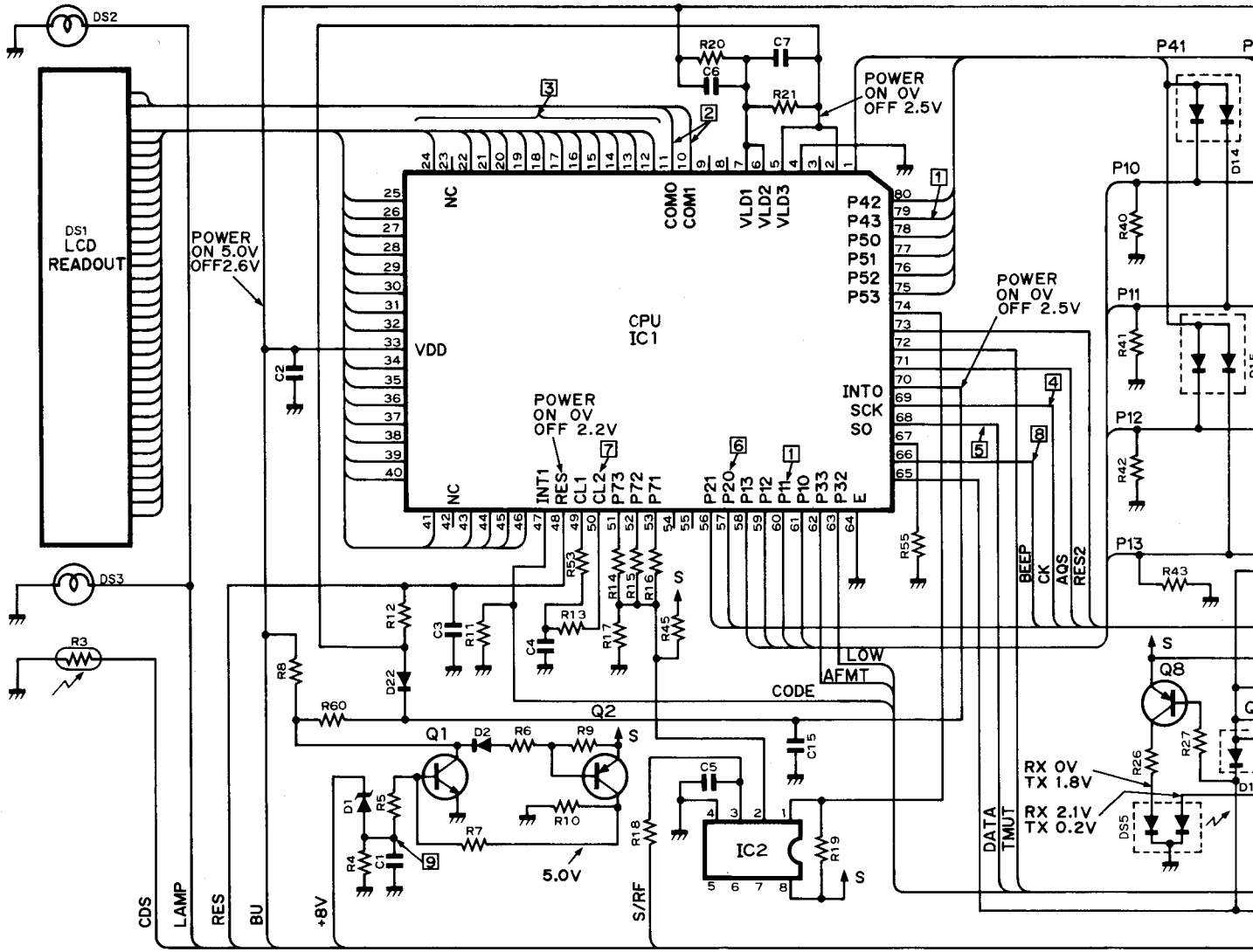
- P1 to MAIN J1
- BAND
 - S/RF
 - LOW

- P9 to MAIN J2
- AFO
 - +8V
 - MICE
 - MIC

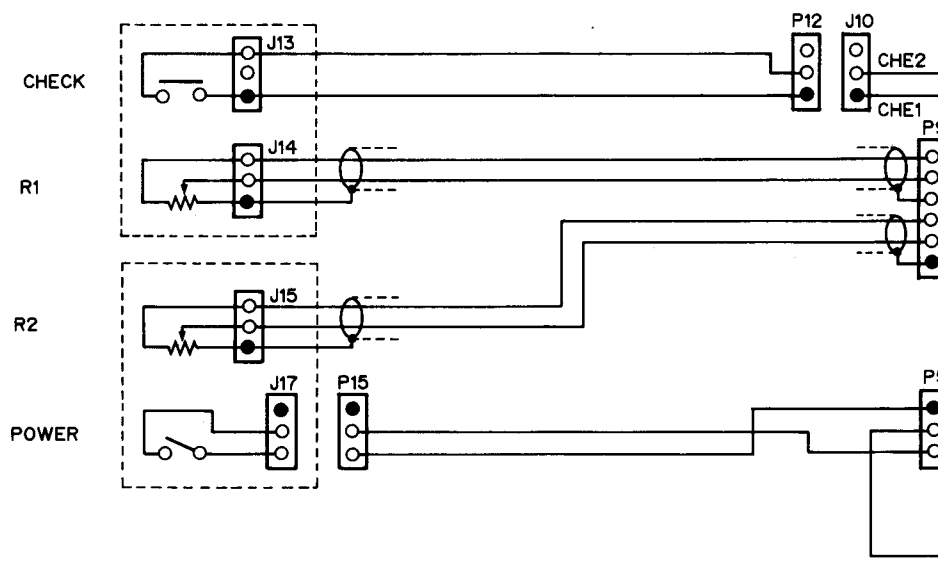


f = 220.0MHz
VOLT METER
INPUT IMPEDANCE: 50kΩ/V

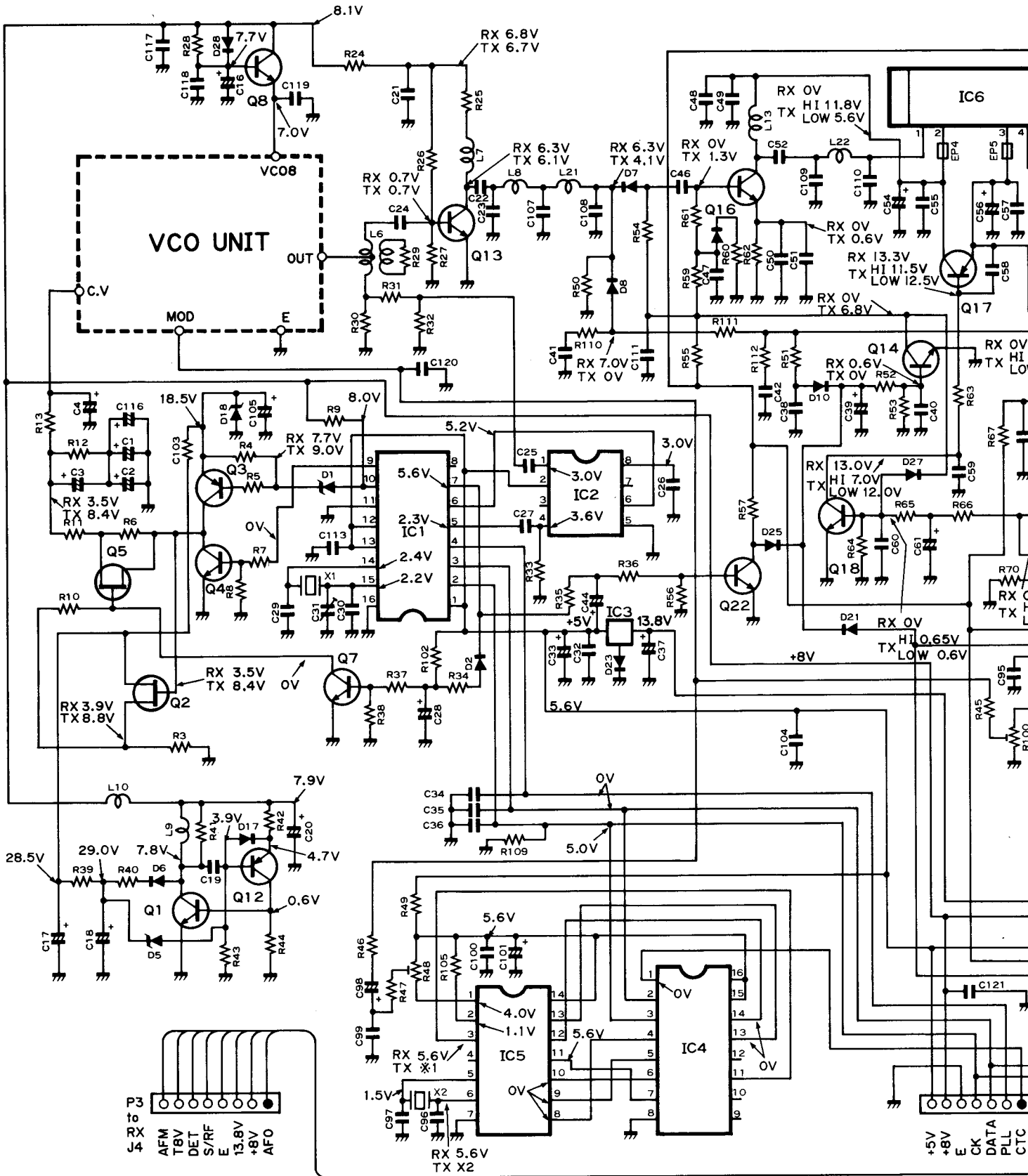
8 - 4 IC-48A/E EF UNIT



f = 433.0MHz
 VOLTMETER
 INPUT IMPEDANCE: 50kΩ/V

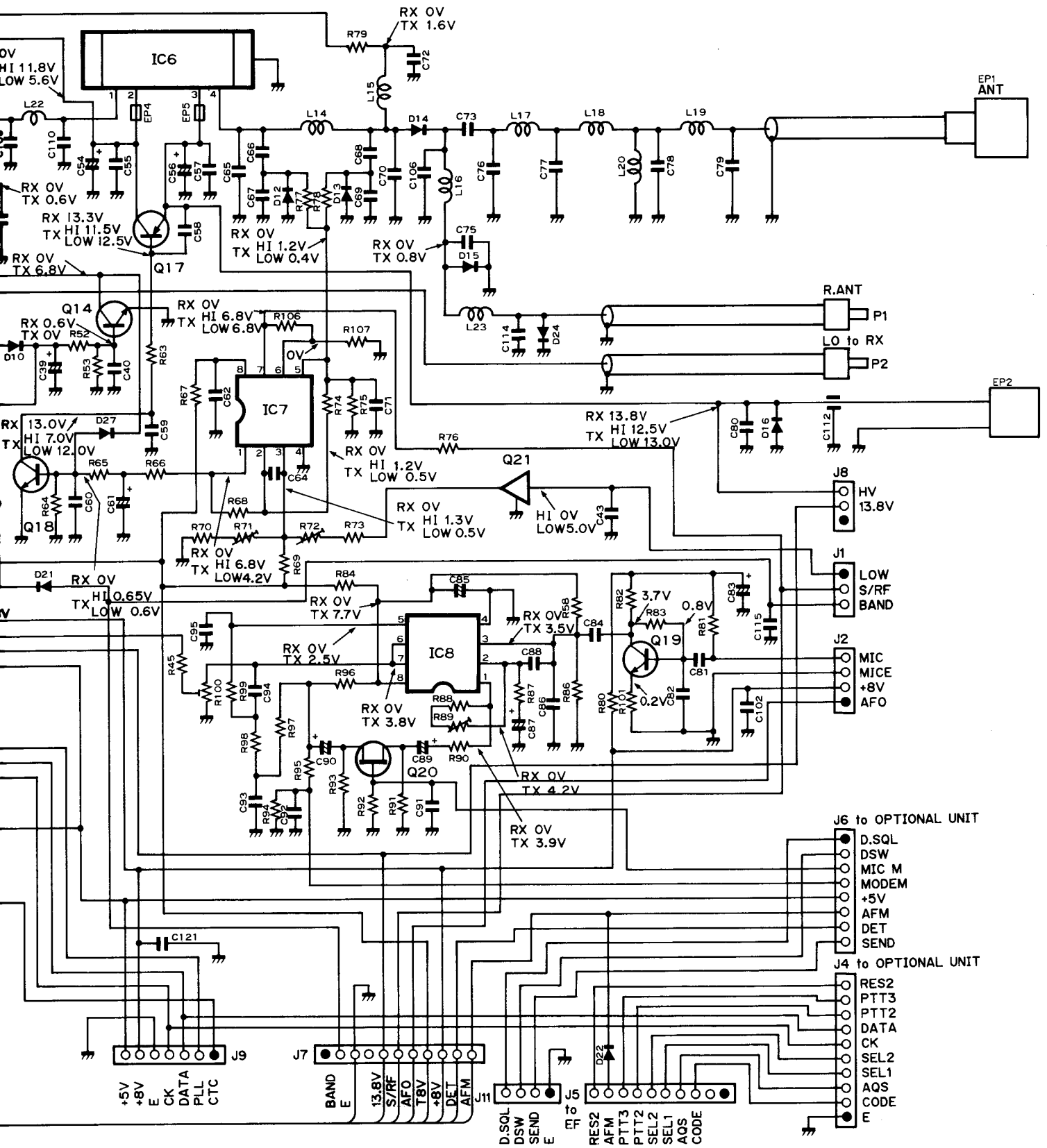


8 - 5 IC-38A MAIN UNIT

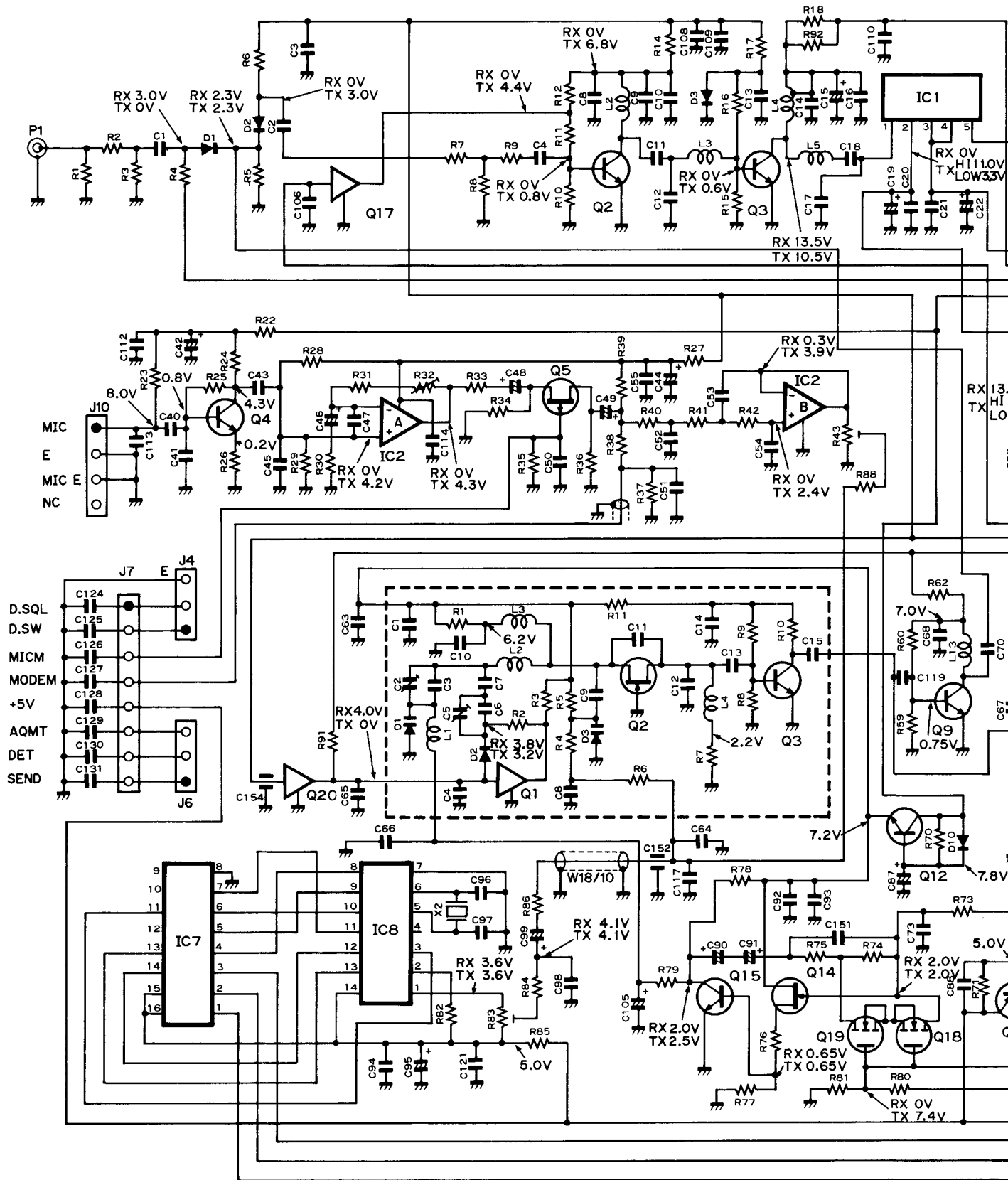


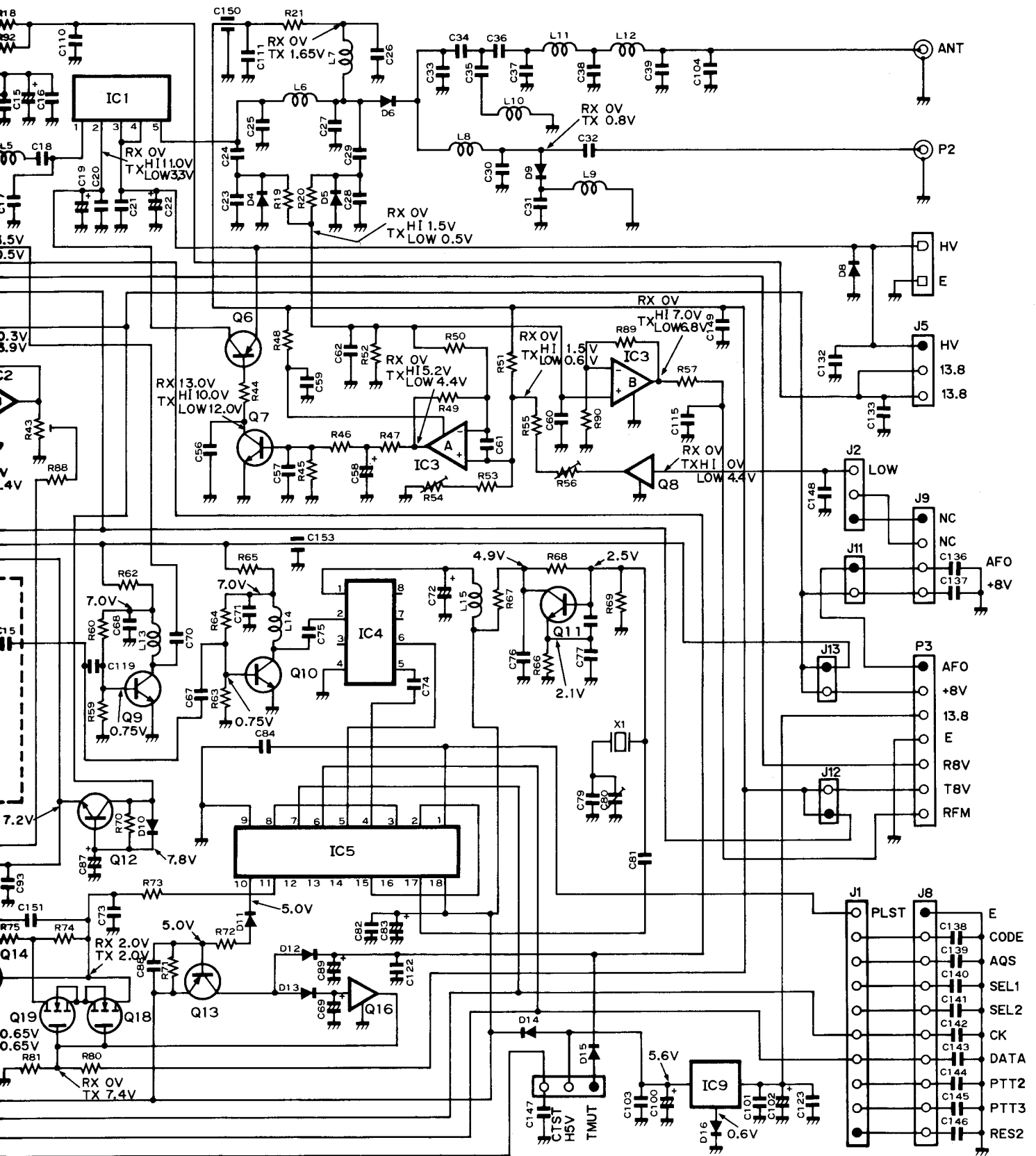
f = 220.0MHz
 VOLTMETER
 INPUT IMPEDANCE: 50kΩ/V

TONE	*1	*2
OFF	5.6V	5.6V
ON	OV	3.7V



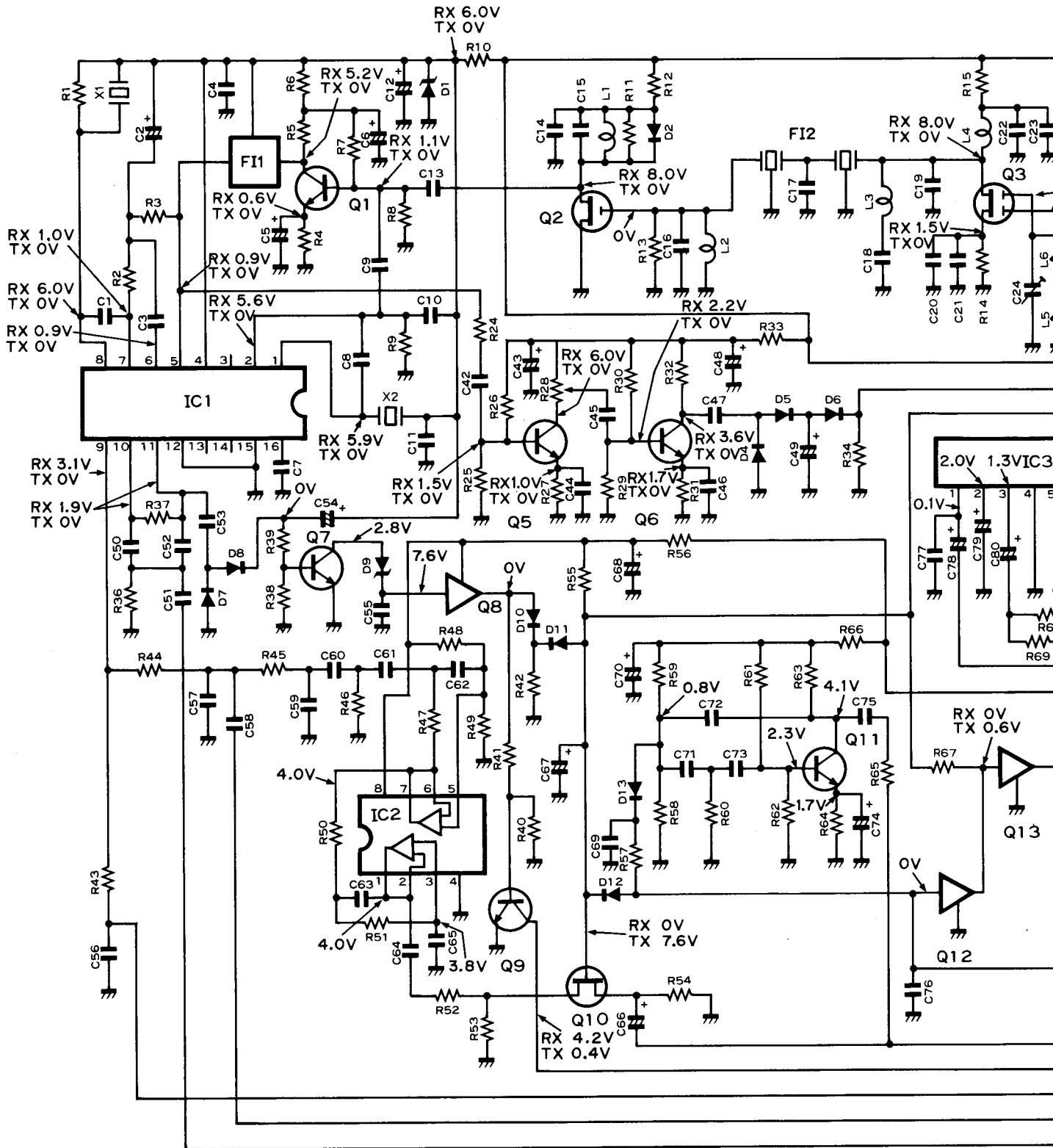
8 - 6 IC-48A/E MAIN UNIT



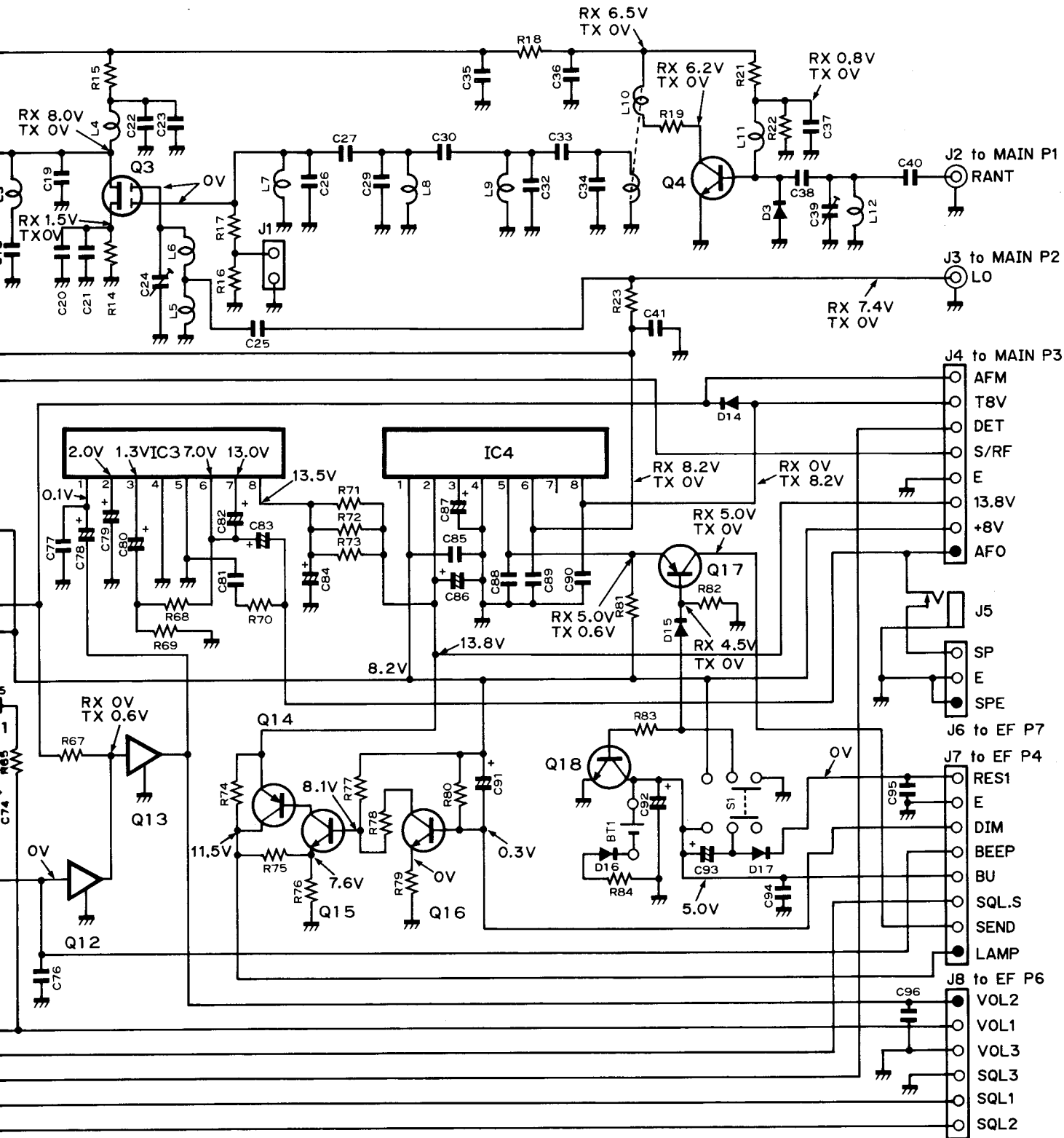


f = 433.0MHz
 VOLT METER
 INPUT IMPEDANCE: 50kΩ / V

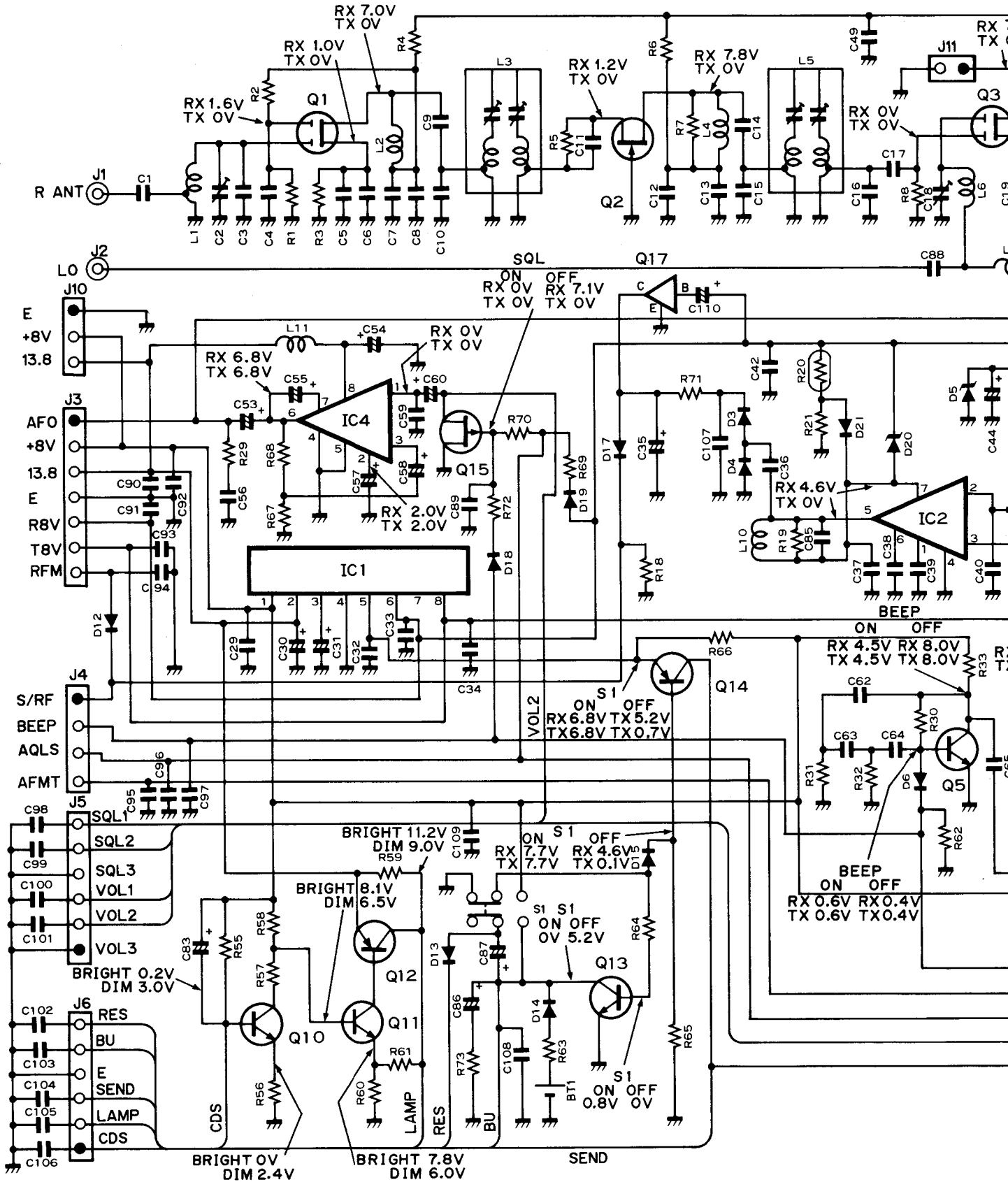
8 - 7 IC-38A RX UNIT



f=222.50MHz SQUELCH OPEN
 VOLTMETER
 INPUT IMPEDANCE: 50kΩ/V



8 - 8 IC-48A/E RX UNIT

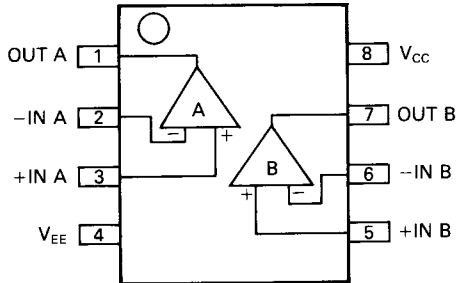


SECTION 9 IC PIN CONNECTIONS

9 - 1 IC-38A LINEAR ICs

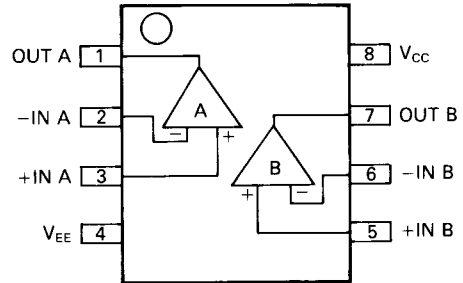
LA6393M (DUAL COMPARATOR)

(Top View)

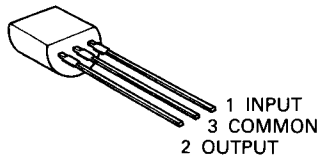


NJM4558D (DUAL LOW NOISE AMPLIFIER)

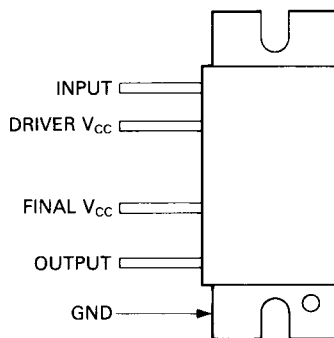
(Top View)



μA78L05 (POSITIVE VOLTAGE REGULATOR)

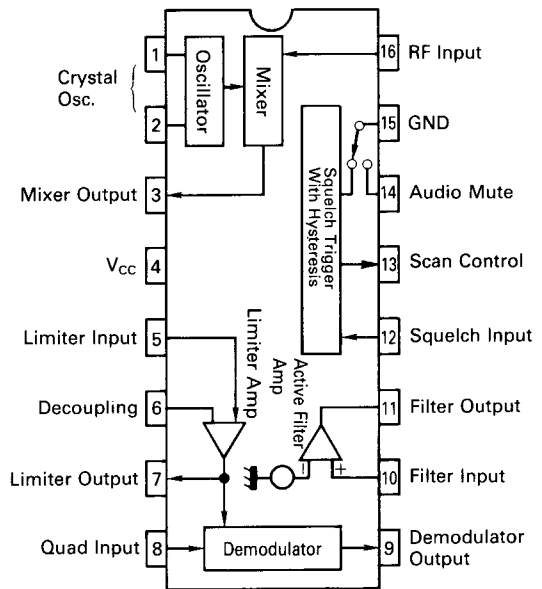


SC-1028 (220 ~ 225MHz 25W POWER MODULE)



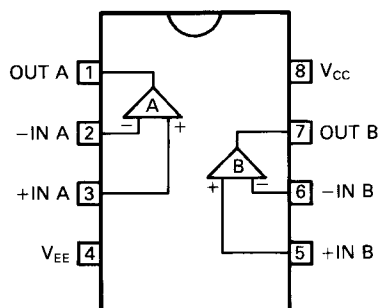
MC3357 (NARROW BAND FM IF)

(Top View)

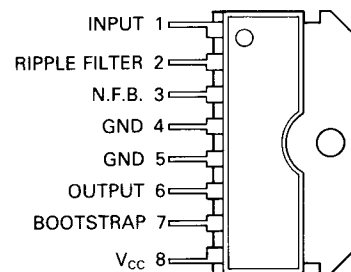


μPC358C (DUAL DRIVER)

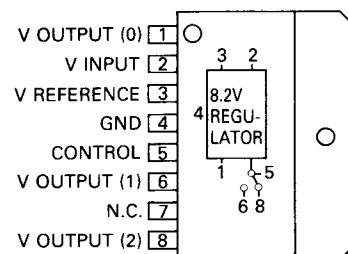
(Top View)



μPC1241H (AUDIO POWER AMPLIFIER)



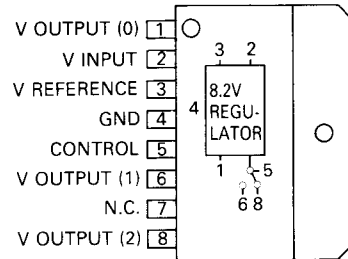
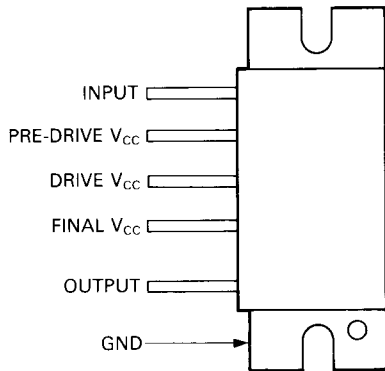
MB3756 (3-OUTPUT 8.2V VOLTAGE REGULATOR)



9 - 3 IC-48A/E LINEAR ICs

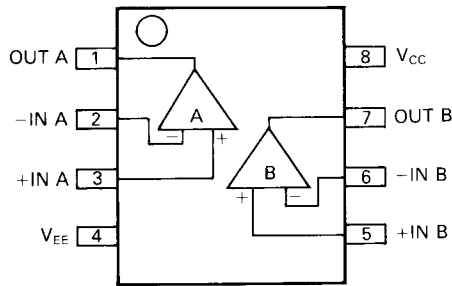
SC-1027 (430 ~ 450MHz 25W POWER MODULE)

MB3756 (3-OUTPUT 8.2V VOLTAGE REGULATOR)

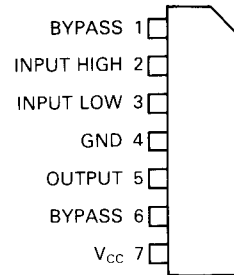


NJM4558 (DUAL NOISE LOW AMP)

(Top View)

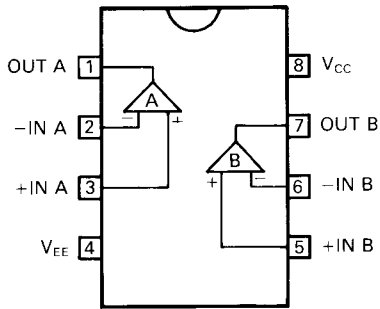


μ PC577H (FM-IF AMPLIFIER)



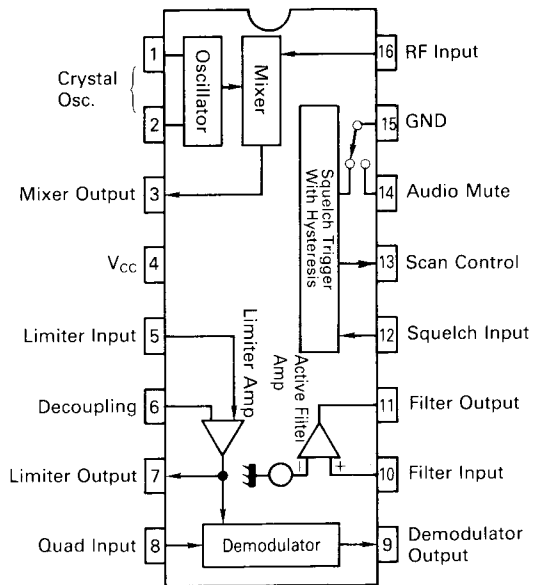
μ PC358C (DUAL DRIVER)

(Top View)

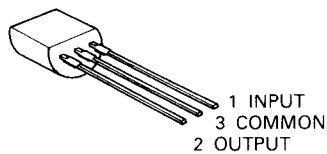


MC3357P (NARROW BAND FM IF)

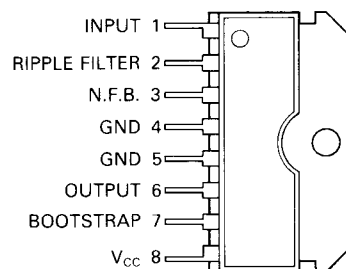
(Top View)



μ A78L05 (POSITIVE VOLTAGE REGULATOR)



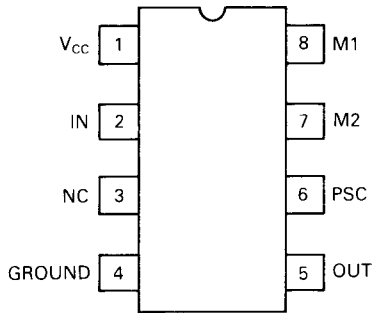
μ PC1241H (AUDIO POWER AMPLIFIER)



9 - 4 IC-48A/E LOGIC ICs

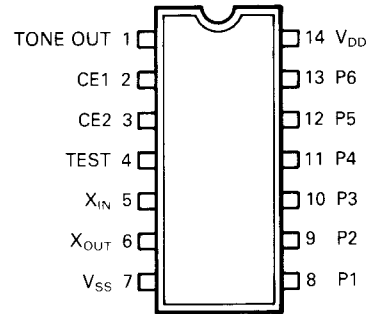
μPB571C (LOW POWER PRE-SCALER)

(Top View)



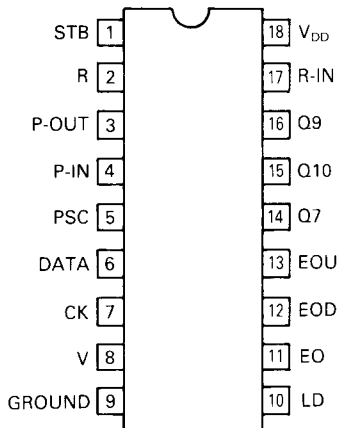
S7116A (TONE GENERATOR CMOS LSI)

(Top View)



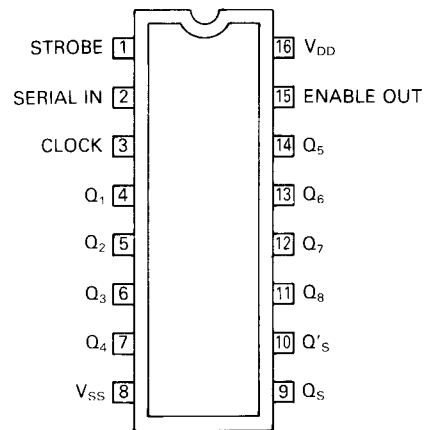
μPD2834C (PLL FREQUENCY SYNTHESIZER)

(Top View)



TC4094BP (8-STAGE AND STORE BUS REGISTER)

(Top View)



SECTION 10 IC-38A PARTS LIST

10 - 1 EF UNIT

REF. NO.	DESCRIPTION	TYPE (PART NO.)	
IC1	IC	μPD7514G-191-12	
IC2	IC	LA6393M	
Q1	Transistor	2SC2712-Y	
Q2	Transistor	2SA1162-Y	
Q3	Transistor	2SC2712-Y	
Q4	Transistor	2SC2712-Y	
Q5	Transistor	2SC2712-Y	
Q6	Transistor	2SC2712-Y	
Q7	Transistor	2SC2712-Y	
Q8	Transistor	2SA1162-Y	
Q9	Transistor	2SA1162-Y	
Q10	Transistor	2SA1162-Y	
Q11	Transistor	2SC2712-Y	
Q12	Transistor	2SC2712-Y	
Q13	Transistor	2SA1162-Y	
Q14	Transistor	2SC2712-Y	
Q15	Transistor	2SA1341	
Q16	Transistor	2SA1162-Y	
Q17	Transistor	2SC3395	
Q18	Transistor	2SA1162-Y	
D1	Zener	RD5.6M B2	
D2	Diode	1SS190	
D3	Diode	1SS190	
D4	Diode	1SS193	
D5	Diode	1SS181	
D6	Diode	1SS184	
D7	Diode	1SS181	
D8	Diode	1SS190	
D9	Diode	1SS184	
D10	Diode	1SS193	
D11	Diode	1SS181	
D12	Diode	1SS181	
D15	Diode	1SS187	
D16	Diode	1SS181	
D17	Diode	1SS190	
D18	Diode	1SS190	
D19	Diode	1SS190	
D22	Diode	1SS193	
D23	Diode	1SS193	
R1	Variable	RK0941114003A	10kB
R2	Variable	RK0941112008A	10kA
R3	Cds	MPY-43C79	
R4	Chip	10k	MCR10
R5	Chip	10k	MCR10
R6	Chip	220k	MCR10
R7	Chip	270k	MCR10
R8	Chip	10k	MCR10
R9	Chip	100k	MCR10
R10	Chip	10k	MCR10
R11	Chip	100k	MCR10
R12	Chip	1M	MCR10
R13	Chip	100k	MCR10
R14	Chip	47k	MCR10
R15	Chip	100k	MCR10
R16	Chip	220k	MCR10

EF UNIT

REF. NO.	DESCRIPTION	TYPE (PART NO.)	
R17	Chip	8.2k	MCR10
R18	Chip	100k	MCR10
R19	Chip	100k	MCR10
R20	Chip	270k	MCR10
R21	Chip	270k	MCR10
R22	Chip	100k	MCR10
R23	Chip	100k	MCR10
R24	Chip	3.3k	MCR10
R26	Chip	330	MCR10
R27	Chip	22k	MCR10
R28	Chip	100k	MCR10
R29	Chip	100k	MCR10
R30	Chip	100k	MCR10
R32	Chip	10k	MCR10
R33	Chip	470k	MCR10
R34	Chip	100k	MCR10
R35	Chip	2.2k	MCR10
R36	Chip	22k	MCR10
R37	Chip	10k	MCR10
R38	Chip	100k	MCR10
R39	Chip	100k	MCR10
R40	Chip	100k	MCR10
R41	Chip	100k	MCR10
R42	Chip	100k	MCR10
R43	Chip	100k	MCR10
R44	Chip	1k	MCR10
R45	Chip	220k	MCR10
R46	Chip	470k	MCR10
R47	Chip	220k	MCR10
R48	Chip	1M	MCR10
R49	Chip	10k	MCR10
R50	Chip	100k	MCR10
R51	Chip	100k	MCR10
R53	Chip	3.3k	MCR10
R54	Chip	150	MCR10
R56	Chip	100k	MCR10
R57	Chip	470k	MCR10
R58	Chip	100k	MCR10
R59	Chip	470k	MCR10
R60	Chip	56k	MCR10
C1	Monolithic	0.1	GRM40 F
C2	Monolithic	0.1	GRM40 F
C3	Monolithic	0.001	GRM40
C4	Monolithic	33P	GRM40
C5	Monolithic	0.01	GRM40 F
C6	Monolithic	0.01	GRM40 F
C7	Monolithic	0.01	GRM40 F
C8	Monolithic	0.1	GRM40 F
C9	Monolithic	0.001	GRM40
C10	Monolithic	0.001	GRM40
C11	Monolithic	0.001	GRM40
C12	Monolithic	0.001	GRM40
C13	Monolithic	0.001	GRM40
C14	Monolithic	0.001	GRM40
C15	Monolithic	0.1	GRM40 F
J1	Connector	5379-04	
J2	Connector	5379-02	

EF UNIT

REF. NO.	DESCRIPTION	TYPE (PART NO.)
J3	Connector	5379-02
J4	Connector	5379-03
J5	Connector	5379-04
J6	Connector	5379-05
J7	Connector	5379-06
J8	Connector	5379-02
J9	Connector	5379-03
J10	Connector	TXL-P03P-C1
J11	Connector	TXL-P03P-C1
J12	Connector	TLB-P04H-B1
J13	Connector	TLB-P03H-B1
J14	Connector	TLB-P03H-B1
J15	Connector	TLB-P03H-B1
J16	Connector	5379-02
J17	Connector	TLB-P03H-B1
J18	Connector	8S-S-E
P1	Connector	EHR-03
P2	Connector	EHR-10
P3	Connector	EHR-07
P4	Connector	EHR-08
P5	Connector	EHR-03
P6	Connector	EHR-06
P7	Connector	EHR-03
P8	Connector	EHR-04
P9	Connector	EHR-04
P10	Connector	TXL-P03H-A1
P11	Connector	TXL-P03H-A1
DS1	LCD	LP234-A
DS2	Lamp	HRS-7219A-G40
DS3	Lamp	HRS-7219A-G40
DS5	LED	GL9ND2
S1	Rotary Encoder	SRBM1L011A
S2	Switch	SKHLAB 064A
S3	Switch	SKHLAB 064A
S4	Switch	SKHLAB 064A
S5	Switch	SKHLAB 064A
S6	Switch	SKHLAB 064A
S7	Switch	SKHLAB 064A
S8	Switch	SKHLAB 064A
S9	Switch	SKHLAB 064A
S10	Switch	SKHLAB 064A
S11	Switch	SKHLAB 064A
SP1	Speaker	57S38-1
EP1	P.C. Board	B-1138B
EP2	P.C. Board	B-1140A
EP3	P.C. Board	B-1229
EP5	Rubber Conductor	SS-TYPE 48.5×5×8.5×3
EP6	P.C. Board	B-1175B

10 - 2 MAIN UNIT

REF. NO.	DESCRIPTION	TYPE (PART NO.)
IC1	IC	MB87001P-G
IC2	IC	MB504P-G
IC3	IC	μA78L05AWC
IC4	IC	μPD4094
IC5	IC	S-7116A
IC6	IC	SC-1028
IC7	IC	μPC358C
IC8	IC	NJM4558D
Q2	FET	2SK184-Y
Q3	Transistor	2SA1048-GR
Q4	Transistor	2SC2458-GR
Q5	FET	2SK184-Y
Q7	Transistor	2SC2458-GR
Q8	Transistor	2SC2458-GR
Q11	Transistor	2SC2458-GR
Q12	Transistor	2SA1048-GR
Q13	Transistor	2SC2026
Q14	Transistor	2SC2458-GR
Q16	Transistor	2SC2407
Q17	Transistor	2SA1359-Y
Q18	Transistor	2SC2458-GR
Q19	Transistor	2SC2458L-G
Q20	FET	2SJ105-GR
Q21	Transistor	2SC3399
Q22	Transistor	2SC2458-GR
D1	Zener	RD15E B2
D2	Diode	1S133
D5	Zener	RD30E B2
D6	Diode	1S953
D7	Diode	1S216
D8	Diode	1S216
D10	Diode	1S133
D11	Diode	1S553
D12	Diode	1S597
D13	Diode	1S597
D14	Diode	MI308
D15	Diode	MI308
D16	Diode	15CD11
D17	Diode	1S133
D18	Zener	RD20E B2
D21	Diode	1S133
D22	Diode	1S133
D23	Diode	1S133
D24	Diode	MI308
D25	Diode	1S133
D27	Diode	1S953
D28	Diode	1S133
X1	Crystal	CR106
X2	Crystal	RF4A3FAA
L6	Coil	LR-116
L7	Coil	LAL03NA 1R0M
L8	Coil	LA-234
L9	Coil	LW-30
L10	Coil	LAL03NA 102K
L13	Coil	LA-234
L14	Coil	LA-233
L15	Coil	LW-19
L16	Coil	LA-233
L17	Coil	LA-252
L18	Coil	LA-233

MAIN UNIT

REF. NO.	DESCRIPTION	TYPE (PART NO.)	
L19	Coil	LA-252	
L20	Coil	LW-19	
L21	Coil	LA-242	
L22	Coil	LA-242	
L23	Coil	LA-233	
R3	Resistor	470k	ELR20
R4	Resistor	470k	ELR20
R5	Resistor	27k	ELR20
R6	Resistor	4.7k	ELR20
R7	Resistor	47k	ELR20
R8	Resistor	100k	ELR20
R9	Resistor	10k	ELR20
R10	Resistor	2.2M	ELR20
R11	Resistor	100	ELR20
R12	Resistor	330	R20
R13	Resistor	6.8k	ELR20
R24	Resistor	100	ELR20
R25	Resistor	47	ELR20
R26	Resistor	4.7k	ELR20
R27	Resistor	680	ELR20
R28	Resistor	47k	ELR20
R29	Resistor	47	ELR20
R30	Resistor	270	ELR20
R31	Resistor	18	R20
R32	Resistor	270	ELR20
R33	Resistor	4.7k	ELR20
R34	Resistor	4.7k	ELR20
R35	Resistor	56k	ELR20
R36	Resistor	560k	ELR20
R37	Resistor	270k	ELR20
R38	Resistor	100k	ELR20
R39	Resistor	470	ELR20
R40	Resistor	470	ELR20
R41	Resistor	10k	R20
R42	Resistor	15k	ELR20
R43	Resistor	68k	ELR20
R44	Resistor	2.2k	ELR20
R45	Resistor	12k	ELR20
R46	Resistor	47k	ELR20
R47	Resistor	47k	ELR20
R48	Trimmer	RH0651CS4J25A	47k
R49	Resistor	10	R20
R50	Resistor	4.7k	ELR20
R51	Resistor	1k	ELR20
R52	Resistor	10k	ELR20
R53	Resistor	10k	ELR20
R54	Resistor	2.2k	ELR20
R55	Resistor	390	ELR20
R56	Resistor	150k	ELR20
R57	Resistor	10k	ELR20
R59	Resistor	3.3k	ELR20
R60	Resistor	330	ELR20
R61	Resistor	47	ELR20
R62	Resistor	10	ELR20
R63	Resistor	330	ELR20
R64	Resistor	10k	ELR20
R65	Resistor	47k	ELR20
R66	Resistor	10k	ELR20
R67	Resistor	100	ELR20
R68	Resistor	2.2M	ELR20
R69	Resistor	15k	ELR20
R70	Resistor	1.2k	ELR20
R71	Trimmer	RH0521CN3J04A	3.3k

MAIN UNIT

REF. NO.	DESCRIPTION	TYPE (PART NO.)	
R72	Trimmer	RHO521CJ3J05A	2.2k
R73	Resistor	390	ELR20
R74	Resistor	56k	ELR20
R75	Resistor	4.7k	ELR20
R76	Resistor	100k	R20
R77	Resistor	4.7k	R20
R78	Resistor	4.7k	R20
R79	Resistor	100	R50
R80	Resistor	100	ELR20
R81	Resistor	1k	ELR20
R82	Resistor	5.6k	ELR20
R83	Resistor	1.2M	ELR20
R84	Resistor	100	ELR20
R85	Resistor	220k	ELR20
R86	Resistor	270k	ELR20
R87	Resistor	100	ELR20
R88	Resistor	1.5k	ELR20
R89	Trimmer	RH0651C15J1UA	100k
R90	Resistor	56k	ELR
R91	Resistor	5.6k	ELR20
R92	Resistor	100k	ELR20
R93	Resistor	33k	ELR20
R94	Resistor	100k	ELR20
R95	Resistor	47k	ELR20
R96	Resistor	150k	ELR20
R97	Resistor	82k	ELR20
R98	Resistor	82k	ELR20
R99	Resistor	82k	ELR20
R100	Trimmer	RH0651C14J2WA	10k
R101	Resistor	330	ELR20
R102	Resistor	220k	ELR20
R103	Resistor	6.8k	ELR20
R105	Resistor	100k	ELR20
R106	Resistor	180k	ELR20
R107	Resistor	680	ELR20
R109	Resistor	47k	R20
R110	Resistor	68	ELR20
R111	Resistor	82	ELR20
R112	Resistor	68	ELR20
C1	Tantalum	DN1V	100M1S
C2	Tantalum	DN1V	100M1S
C3	Tantalum	1	35V DN
C4	Tantalum	0.1	35V DN
C16	Electrolytic	100	10V MS7
C17	Electrolytic	3.3	50V MS7
C18	Electrolytic	3.3	50V MS7
C19	Ceramic	100P	50V
C20	Electrolytic	10	16V MS7
C21	Ceramic	470P	50V
C22	Ceramic	0.001	50V
C23	Ceramic	6P	50V
C24	Ceramic	15P	50V
C25	Ceramic	0.001	50V
C26	Ceramic	0.001	50V
C27	Ceramic	0.001	50V
C28	Electrolytic	4.7	25V MS7
C29	Ceramic	39P	50V CH
C30	Ceramic	27P	50V CH
C31	Trimmer	ECR-GA020E30	20P
C32	Barrier Layer	0.1	16V
C33	Electrolytic	22	6.3V MS7
C34	Ceramic	470P	50V
C35	Ceramic	470P	50V

MAIN UNIT

REF. NO.	DESCRIPTION	TYPE (PART NO.)		
C36	Ceramic	470P	50V	
C37	Electrolytic	10	16V	MS7
C38	Ceramic	470P	50V	
C39	Electrolytic	4.7	25V	MS7
C40	Ceramic	470P	50V	
C41	Ceramic	470P	50V	
C42	Ceramic	470P	50V	
C43	Ceramic	0.001	50V	
C44	Electrolytic	100	10V	MS7
C46	Ceramic	33P	50V	
C47	Ceramic	470P	50V	
C48	Ceramic	470P	50V	
C49	Ceramic	0.001	50V	
C50	Ceramic	470P	50V	
C51	Ceramic	0.001	50V	
C52	Ceramic	15P	50V	
C54	Tantalum	DN1V	100M1S	
C55	Ceramic	0.001	50V	
C56	Electrolytic	10	16V	MS7
C57	Ceramic	0.001	50V	
C58	Ceramic	0.001	50V	
C59	Ceramic	0.001	50V	
C60	Ceramic	0.001	50V	
C61	Electrolytic	10	16V	MS7
C62	Ceramic	0.001	50V	
C64	Ceramic	0.001	50V	
C65	Ceramic	12P	500V	
C66	Ceramic	1.5P	50V	RH
C67	Ceramic	33P	50V	CH
C68	Ceramic	1.5P	50V	RH
C69	Ceramic	33P	50V	CH
C70	Ceramic	15P	500V	
C71	Ceramic	0.001	50V	
C72	Ceramic	0.001	50V	
C73	Ceramic	0.001	500V	
C75	Ceramic	22P	50V	
C76	Ceramic	8P	500V	
C77	Ceramic	15P	500V	
C78	Ceramic	15P	500V	
C79	Ceramic	12P	500V	
C80	Ceramic	220P	50V	
C81	Barrier Layer	0.01	25V	
C82	Ceramic	470P	50V	
C83	Tantalum	10	16V	DN
C84	Barrier Layer	0.01	25V	
C85	Electrolytic	4.7	25V	MS7
C86	Ceramic	470P	50V	
C87	Tantalum	0.22	35V	DN
C88	Ceramic	470P	50V	
C89	Electrolytic	1	50V	MS7
C90	Tantalum	1	35V	DN
C91	Barrier Layer	0.01	25V	
C92	Ceramic	470P	50V	
C93	Barrier Layer	0.001	25V	
C94	Barrier Layer	0.0022	25V	
C95	Ceramic	120P	50V	
C96	Ceramic	39P	50V	
C97	Ceramic	39P	50V	
C98	Electrolytic	0.1	50V	MS7
C99	Barrier Layer	0.01	25V	
C100	Ceramic	0.001	50V	
C101	Electrolytic	2.2	50V	MS7
C102	Ceramic	0.001	50V	
C104	Ceramic	470P	50V	

MAIN UNIT

REF. NO.	DESCRIPTION	TYPE (PART NO.)		
C105	Electrolytic	47	25V	MS9
C106	Ceramic	15P	500V	
C107	Ceramic	20P	50V	
C108	Ceramic	20P	50V	
C109	Ceramic	20P	50V	
C110	Ceramic	20P	50V	
C111	Ceramic	470P	50V	
C112	Feed Through	TF318-450E	102GMV50V	
C113	Ceramic	0.001	50V	
C114	Ceramic	15P	50V	
C115	Ceramic	470P	50V	
C116	Tantalum	DN1V	100M1S	
C117	Ceramic	120P	50V	
C118	Ceramic	120P	50V	
C119	Ceramic	120P	50V	
C120	Ceramic	150P	50V	
C121	Ceramic	120P	50V	
J1	Connector	B03B-EH-S		
J2	Connector	B04B-EH-S		
J4	Connector	B10B-EH-S		
J5	Connector	B10B-EH-S		
J6	Connector	B08B-EH-S		
J7	Connector	TLB-P11H-B1		
J8	Connector	B03B-EH-S		
J9	Connector	B07B-EH-S		
J11	Connector	B04B-EH-S		
P1	Connector	TMP-P01X-A1		
P2	Connector	TMP-P01X-A1		
P3	Connector	EHR-08		
EP3	P.C. Board	B-1292		
EP4	Ferrite Bead	DL2-OP2.6-3-1.2H		
EP5	Ferrite Bead	DL2-OP2.6-3-1.2H		

10 - 3 RX UNIT

RX UNIT

REF. NO.	DESCRIPTION	TYPE (PART NO.)		REF. NO.	DESCRIPTION	TYPE (PART NO.)	
IC1	IC	MC3357P		R4	Resistor	1k	ELR20
IC2	IC	NJM4558D		R5	Resistor	1.5k	ELR20
IC3	IC	μPC1241H		R6	Resistor	100	ELR20
IC4	IC	MB3756		R7	Resistor	56k	ELR20
Q1	Transistor	2SC2668-O		R8	Resistor	18k	ELR20
Q2	FET	2SK241-Y		R9	Resistor	22k	ELR20
Q3	FET	3SK121-Y		R10	Resistor	100	ELR20
Q4	Transistor	2SC3355		R11	Resistor	10k	ELR20
Q5	Transistor	2SC2458-GR		R12	Resistor	100	ELR20
Q6	Transistor	2SC2458-GR		R13	Resistor	2.2k	ELR20
Q7	Transistor	2SC2458-GR		R14	Resistor	470	ELR20
Q8	Transistor	2SA1348		R15	Resistor	100	R20
Q9	Transistor	2SC2458-GR		R16	Resistor	2.2k	ELR20
Q10	FET	2SJ105-GR		R17	Resistor	6.8k	ELR20
Q11	Transistor	2SC2458-GR		R18	Resistor	68	R20
Q12	Transistor	2SC3399		R19	Resistor	10	ELR20
Q13	Transistor	2SC3399		R21	Resistor	820	R20
Q14	Transistor	2SB909M-R		R22	Resistor	120	R20
Q15	Transistor	2SC2458-GR		R23	Resistor	470	ELR20
Q16	Transistor	2SC2458-GR		R24	Resistor	33k	R20
Q17	Transistor	2SA1048-GR		R25	Resistor	47k	R20
Q18	Transistor	2SD1225M-R		R26	Resistor	180k	R20
D1	Zener	RD6.2E B2		R27	Resistor	2.7k	R20
D2	Diode	1S953		R28	Trimmer	RH0651CS3J2KA	4.7k
D3	Diode	1S953		R29	Resistor	47k	R20
D4	Diode	1S953		R30	Resistor	100k	ELR20
D5	Diode	1S953		R31	Resistor	1k	R20
D6	Diode	1SS133		R32	Resistor	2.7k	ELR20
D7	Diode	1S953		R33	Resistor	100	R20
D8	Diode	1S953		R34	Resistor	12k	R20
D9	Zener	RD6.2E B2		R36	Resistor	5.6k	ELR20
D10	Diode	1SS133		R37	Resistor	330k	ELR20
D11	Diode	1SS133		R38	Resistor	100k	ELR20
D12	Diode	1SS133		R39	Resistor	100k	ELR20
D13	Diode	1Sd133		R40	Resistor	100k	ELR20
D14	Diode	1SS133		R41	Resistor	10k	ELR20
D15	Diode	1SS133		R42	Resistor	4.7k	ELR20
D16	Diode	1SS133		R43	Resistor	470	ELR20
D17	Diode	1SS133		R44	Resistor	470	ELR20
F1	Ceramic	CFV455E10		R45	Resistor	27k	R20
F2	Crystal	17M15B		R46	Resistor	27k	ELR20
X1	Discriminator	CDB455C7A		R47	Resistor	5.6k	ELR20
X2	Crystal	CR166		R48	Resistor	1.2M	ELR20
L1	Coil	LS-66		R49	Resistor	1.2M	ELR20
L2	Coil	LS-66		R50	Resistor	12k	ELR20
L3	Coil	LS-171		R51	Resistor	12k	ELR20
L4	Coil	S4	101K	R52	Resistor	2.7k	ELR20
L5	Coil	LA-232		R53	Resistor	4.7k	ELR20
L6	Coil	LA-234		R54	Resistor	10k	ELR20
L7	Coil	LS-182		R55	Resistor	100k	ELR20
L8	Coil	LS-182		R56	Resistor	100	ELR20
L9	Coil	LS-182		R57	Resistor	10k	R20
L10	Coil	LS-182		R58	Resistor	27k	R20
L11	Coil	LA-245		R59	Resistor	100k	ELR20
L12	Coil	LA-243		R60	Resistor	27k	R20
R1	Resistor	1.5k	ELR20	R61	Resistor	68k	R20
R2	Resistor	47k	ELR20	R62	Resistor	27k	R20
R3	Resistor	1.5k	ELR20	R63	Resistor	22k	R20
				R64	Resistor	10k	R20
				R65	Resistor	470k	ELR20
				R66	Resistor	100	R20
				R67	Resistor	220k	ELR20
				R68	Resistor	1k	ELR20
				R69	Resistor	3.3	ELR20

RX UNIT

REF. NO.	DESCRIPTION	TYPE (PART NO.)		
R70	Resistor	2.2	ELR20	
R71	Resistor	1	R20	
R72	Resistor	1	R20	
R73	Resistor	1	R20	
R74	Resistor	100	R50	
R75	Resistor	1.5k	ELR20	
R76	Resistor	2.7k	ELR20	
R77	Resistor	3.3k	ELR20	
R78	Resistor	8.2k	ELR20	
R79	Resistor	4.7k	ELR20	
R80	Resistor	220k	ELR20	
R81	Resistor	100k	ELR20	
R82	Resistor	100k	ELR20	
R83	Resistor	1.5k	ELR20	
R84	Resistor	220k	ELR20	
C1	Ceramic	82P	50V	
C2	Electrolytic	0.1	50V	MS7
C3	Barrier Layer	0.1	16V	
C4	Barrier Layer	0.01	25V	
C5	Tantalum	4.7	16V	DN
C6	Electrolytic	0.1	50V	MS7
C7	Ceramic	0.001	50V	
C8	Ceramic	100P	50V	
C9	Ceramic	5P	50V	
C10	Ceramic	39P	50V	
C11	Barrier Layer	0.01	25V	
C12	Electrolytic	4.7	25V	MS7
C13	Ceramic	0.001	50V	
C14	Barrier Layer	0.01	25V	
C15	Ceramic	27P	50V	
C16	Ceramic	39P	50V	
C17	Ceramic	3P	50V	
C18	Ceramic	47P	50V	CH
C19	Ceramic	82P	50V	CH
C20	Barrier Layer	0.01	25V	
C21	Ceramic	0.001	50V	
C22	Ceramic	0.001	50V	
C23	Barrier Layer	0.01	25V	
C24	Trimmer	ECR-GA010D30	10P	
C25	Ceramic	10P	50V	
C26	Ceramic	8P	50V	
C27	Ceramic	0.5P	50V	
C29	Ceramic	12P	50V	
C30	Ceramic	0.5P	50V	
C32	Ceramic	12P	50V	
C33	Ceramic	0.5P	50V	
C34	Ceramic	11P	50V	
C35	Ceramic	0.001	50V	
C36	Ceramic	0.001	50V	
C37	Ceramic	0.001	50V	
C38	Ceramic	3P	50V	
C39	Trimmer	ECR-GA006A30	6P	
C40	Ceramic	3P	50V	
C41	Ceramic	0.001	50V	
C42	Ceramic	100P	50V	
C43	Electrolytic	1	50V	MS7
C44	Barrier Layer	0.01	25V	
C45	Barrier Layer	0.01	25V	
C46	Barrier Layer	0.01	25V	
C47	Barrier Layer	0.01	25V	
C48	Tantalum	0.1	35V	DN
C49	Electrolytic	10	16V	MS7
C50	Barrier Layer	0.0015	25V	

RX UNIT

REF. NO.	DESCRIPTION	TYPE (PART NO.)		
C51	Barrier Layer	0.0015	25V	
C52	Ceramic	33P	50V	
C53	Barrier Layer	0.01	25V	
C54	Electrolytic	0.47	50V	MS7
C55	Ceramic	0.001	50V	
C56	Ceramic	0.001	50V	
C57	Ceramic	0.001	50V	
C58	Ceramic	0.001	50V	
C59	Barrier Layer	0.01	25V	
C60	Barrier Layer	0.01	25V	
C61	Barrier Layer	0.01	25V	
C62	Barrier Layer	0.01	25V	
C63	Barrier Layer	0.01	25V	
C64	Mylar	0.056	50V	
C65	Barrier Layer	0.0047	25V	
C66	Electrolytic	1	50V	MS7
C67	Electrolytic	4.7	25V	MS7
C68	Electrolytic	10	16V	MS7
C69	Barrier Layer	0.01	25V	
C70	Electrolytic	10	16V	MS7
C71	Ceramic	0.001	50V	
C72	Ceramic	0.001	50V	
C73	Ceramic	0.001	50V	
C74	Electrolytic	1	50V	MS7
C75	Ceramic	0.001	50V	
C76	Ceramic	0.001	50V	
C77	Ceramic	470P	50V	
C78	Electrolytic	0.1	50V	MS7
C79	Electrolytic	47	16V	MS9
C80	Electrolytic	220	16V	MS9
C81	Barrier Layer	0.1	16V	
C82	Electrolytic	47	16V	MS9
C83	Electrolytic	220	16V	MS9
C84	Electrolytic	470	16V	MS16
C85	Barrier Layer	0.1	16V	
C86	Electrolytic	10	16V	MS7
C87	Electrolytic	4.7	25V	MS7
C88	Barrier Layer	0.1	16V	
C89	Barrier Layer	0.1	16V	
C90	Barrier Layer	0.1	16V	
C91	Electrolytic	10	16V	MS7
C92	Electrolytic	4.7	25V	MS7
C93	Electrolytic	0.33	50V	MS7
C94	Ceramic	470P	50V	
C95	Ceramic	0.001	50V	
C96	Ceramic	0.001	50V	
J1	Connector	IMSA-9201B-2-02-T		
J2	Connector	TMP-J01X-A2		
J3	Connector	TMP-J01X-A2		
J4	Connector	B08B-EH-S		
J5	Connector	HSJ0836-001-010		
J6	Connector	B03B-EH-S		
J7	Connector	B08B-EH-S		
J8	Connector	B06B-EH-S		
S1	Switch	SPPH21127A		
BT1	Lithium Battery	BR2032-1T2		
EP1	P.C. Board	B-1293A		

10 - 4 VCO UNIT

REF. NO.	DESCRIPTION	TYPE (PART NO.)	
Q1	FET	2SK125	
Q2	Transistor	2SC2026	
D1	Varicap	1T25	
D2	Varicap	1SV50E	
L1	Coil	LAL02KR	1R0M
L2	Coil	LB-201	
L3	Coil	LAL02KR	1R0M
L4	Coil	LAL02KR	R56M
R1	Resistor	470	ELR20
R2	Resistor	2.7k	ELR20
R3	Resistor	470	ELR20
R4	Resistor	47	ELR20
R5	Resistor	47	ELR20
R6	Resistor	100	ELR20
R7	Resistor	4.7k	ELR20
R8	Resistor	680	ELR20
R9	Resistor	47	ELR20
R10	Resistor	220	ELR20
C1	Ceramic	470P	50V
C2	Ceramic	100P	50V
C3	Ceramic	120P	50V
C4	Ceramic	0.5P	50V
C5	Ceramic	120P	50V
C6	Ceramic	0.35P	50V
C7	Ceramic	100P	50V
C8	Ceramic	100P	50V
C9	Ceramic	100P	50V
C10	Electrolytic	33	10V MS5
EP1	P.C. Board	B-1303	

SECTION 11 IC-48A/E PARTS LIST

11 - 1 EF UNIT				EF UNIT			
REF. NO.	DESCRIPTION	TYPE (PART NO.)		REF. NO.	DESCRIPTION	TYPE (PART NO.)	
IC1	IC	μPD7514G-191-12		R15	Chip	100k	MCR10
IC2	IC	LA6393M		R16	Chip	220k	MCR10
Q1	Transistor	2SC2712-Y		R17	Chip	8.2k	MCR10
Q2	Transistor	2SA1162-Y		R18	Chip	100k	MCR10
Q3	Transistor	2SC2712-Y		R19	Chip	100k	MCR10
Q4	Transistor	2SC2712-Y		R20	Chip	270k	MCR10
Q5	Transistor	2SC2712-Y		R21	Chip	270k	MCR10
Q6	Transistor	2SC2712-Y		R23	Chip	100k	MCR10
Q7	Transistor	2SC2712-Y		R24	Chip	3.3k	MCR10
Q8	Transistor	2SA1162-Y		R26	Chip	330	MCR10
Q9	Transistor	2SA1162-Y		R27	Chip	22k	MCR10
Q10	Transistor	2SA1162-Y		R28	Chip	100k	MCR10
Q11	Transistor	2SC2712-Y		R29	Chip	100k	MCR10
Q12	Transistor	2SC2712-Y		R30	Chip	100k	MCR10
Q13	Transistor	2SA1162-Y		R32	Chip	10k	MCR10
Q14	Transistor	2SC2712-Y		R33	Chip	470k	MCR10
Q15	Transistor	2SA1341		R34	Chip	100k	MCR10
Q16	Transistor	2SA1162-Y		R35	Chip	2.2k	MCR20
Q17	Transistor	2SC3395		R36	Chip	22k	MCR10
Q18	Transistor	2SA1162-Y		R37	Chip	10k	MCR10
D1	Zener	RD5.6M B2		R38	Chip	100k	MCR10
D2	Diode	1SS190		R39	Chip	100k	MCR10
D3	Diode	1SS190		R40	Chip	100k	MCR10
D4	Diode	1SS193		R41	Chip	100k	MCR10
D5	Diode	1SS181		R42	Chip	100k	MCR10
D6	Diode	1SS184		R43	Chip	100k	MCR10
D7	Diode	1SS181		R44	Chip	1k	MCR10
D8	Diode	1SS190		R45	Chip	220k	MCR10
D9	Diode	1SS184		R46	Chip	470k	MCR10
D10	Diode	1SS193		R47	Chip	220k	MCR10
D11	Diode	1SS181		R48	Chip	1M	MCR10
D12	Diode	1SS181		R49	Chip	10k	MCR10
D14	Diode	1SS181	#02	R50	Chip	100k	MCR10
D14	Diode	1SS187	#01, #03	R51	Chip	100k	MCR10
D15	Diode	1SS181	#03	R53	Chip	3.3k	MCR10
D15	Diode	1SS181	#01, #02	R54	Chip	150	MCR10
D16	Diode	1SS181		R55	Chip	4.7k	MCR10
D17	Diode	1SS190		R56	Chip	100k	MCR10
D18	Diode	1SS190		R57	Chip	470k	MCR10
D19	Diode	1SS190		R58	Chip	100k	MCR10
D22	Diode	1SS193		R59	Chip	470k	MCR10
D23	Diode	1SS193		R60	Chip	56k	MCR10
R1	Variable	RK0941114003A	10kΩ	C1	Monolithic	0.1	GRM40 F
R2	Variable	RK9A12007	10kA	C2	Monolithic	0.1	GRM40 F
R3	Cds	MPY-43C79		C3	Monolithic	0.001	GRM40
R4	Chip	10k	MCR10	C4	Monolithic	33P	GRM40
R5	Chip	10k	MCR10	C5	Monolithic	0.01	GRM40 F
R6	Chip	220k	MCR10	C6	Monolithic	0.01	GRM40 F
R7	Chip	270k	MCR10	C7	Monolithic	0.01	GRM40 F
R8	Chip	10k	MCR10	C8	Monolithic	0.1	GRM40 F
R9	Chip	100k	MCR10	C9	Monolithic	0.001	GRM40
R10	Chip	10k	MCR10	C10	Monolithic	0.001	GRM40
R11	Chip	100k	MCR10	C11	Monolithic	0.001	GRM40
R12	Chip	1M	MCR10	C12	Monolithic	0.001	GRM40
R13	Chip	100k	MCR10	C13	Monolithic	0.001	GRM40
R14	Chip	47k	MCR10	C14	Monolithic	0.001	GRM40
				C15	Monolithic	0.1	GRM40 F

EF UNIT

11 - 2 MAIN UNIT

REF. NO.	DESCRIPTION	TYPE (PART NO.)	REF. NO.	DESCRIPTION	TYPE (PART NO.)
J1	Connector	5379-04	IC1	IC	SC-1027
J2	Connector	5379-02	IC2	IC	NJM4558D
J3	Connector	5379-02	IC3	IC	μPC358C
J4	Connector	5379-03	IC4	IC	μPB571C
J5	Connector	5379-04	IC5	IC	μPD2834C
J6	Connector	5379-05	IC7	IC	TC4094BP #01
J7	Connector	5379-06	IC8	IC	S7116A #01
J9	Connector	5379-03	IC9	IC	F78L05
J10	Connector	TXL-P03P-C1			
J11	Connector	TXL-P03P-C1	Q2	Transistor	2SC2570-A
J12	Connector	TLB-P04H-B1	Q3	Transistor	TRF559
J13	Connector	TLB-P03H-B1	Q4	Transistor	2SC2458L-G
J14	Connector	TLB-P03H-B1	Q5	FET	2SJ105-GR
J15	Connector	TLB-P03H-B1	Q6	Transistor	2SA1359
J16	Connector	TLB-P03H-B1	Q7	Transistor	2SC2458-GR
J17	Connector	TXL-P03P-C1	Q8	Transistor	2SC3399
J18	Connector	8S-S-E	Q9	Transistor	2SC2026
			Q10	Transistor	2SC2026
P1	Connector	EHR-10	Q11	Transistor	2SC2458-Y
P2	Connector	EHR-03	Q12	Transistor	2SC2458-GR
P3	Connector	EHR-03	Q13	Transistor	2SA1048-Y
P4	Connector	EHR-03	Q14	FET	2SK184-Y
P5	Connector	EHR-03	Q15	Transistor	2SC2458L-G
P6	Connector	EHR-06	Q16	Transistor	2SC3399
P7	Connector	EHR-03	Q17	Transistor	2SC3399
P8	Connector	EHR-04	Q18	FET	2SK583
P9	Connector	EHR-06	Q19	FET	2SK583
P10	Connector	EHR-03	Q20	Transistor	2SC3402
P11	Connector	TXL-P03H-A1			
P12	Connector	TXL-P03H-A1	D1	Diode	1SS216
P13	Connector	EHR-04	D2	Diode	1SS216
P14	Connector	EHR-04	D3	Diode	1SS133
P15	Connector	TXL-P03H-A1	D4	Diode	1SS97
			D5	Diode	1SS97
DS1	LCD	LP234-A	D6	Diode	MI407
DS2	Lamp	HRS-7219A-G40	D7	Diode	MI308
DS3	Lamp	HRS-7219A-G40	D8	Diode	15CD11
DS5	LED	GL9ND2	D10	Diode	1SS133
			D11	Diode	1SS133
S1	Rotary Encoder	SRBM1L011A	D12	Diode	1SS133
S2	Switch	SKHLAB 064A	D13	Diode	1SS133
S3	Switch	SKHLAB 064A	D14	Diode	1SS133
S4	Switch	SKHLAB 064A	D15	Diode	1SS133
S5	Switch	SKHLAB 064A	D16	Diode	1SS133
S6	Switch	SKHLAB 064A			
S7	Switch	SKHLAB 064A	X1	Crystal	CR184 #03
S8	Switch	SKHLAB 064A	X1	Crystal	CR183 #01, #02
S9	Switch	SKHLAB 064A	X2	Crystal	HC-43/U (3.6MHz) #01
S10	Switch	SKHLAB 064A			
S11	Switch	SKHLAB 064A	L2	Coil	LA-233
			L3	Coil	LA-232
SP1	Speaker	57S38-1	L4	Coil	LA-232
			L5	Coil	LA-232
EP1	P.C. Board	B-1219A	L6	Coil	LA-153 #02, #03
EP2	P.C. Board	B-1140A	L6	Coil	LA-232 #01
EP3	P.C. Board	B-1229	L7	Coil	LW-19
EP5	Rubber Conductor	SS-TYPE 48.5×8.5×3	L8	Coil	LA-252
EP6	P.C. Board	B-1175B	L9	Coil	LA-242
			L10	Coil	LA-232
			L11	Coil	LA-232
			L12	Coil	LA-181
			L13	Coil	LA-233
			L14	Coil	LA-233
			L15	Choke	LAL02NA 101K

MAIN UNIT

REF. NO.	DESCRIPTION	TYPE (PART NO.)	
R1	Resistor	150	ELR20
R2	Resistor	39	ELR20
R3	Resistor	150	ELR20
R4	Resistor	2.2k	ELR20
R5	Resistor	1k	ELR20
R6	Resistor	2.2k	R20
R7	Resistor	8.2	ELR20
R8	Resistor	150	ELR20
R9	Resistor	8.2	ELR20
R10	Resistor	1k	ELR20
R11	Resistor	3.3k	ELR20
R12	Resistor	2.2k	ELR20
R14	Resistor	56	ELR20
R15	Resistor	1k	ELR20
R16	Resistor	100	ELR20
R17	Resistor	1k	ELR20
R18	Resistor	47	ELR20
R19	Resistor	4.7k	R20
R20	Resistor	4.7k	R20
R21	Resistor	100	R50X
R22	Resistor	220	ELR20
R23	Resistor	1k	ELR20
R24	Resistor	5.6k	R20
R25	Resistor	1.2M	ELR20
R26	Resistor	330	ELR20
R27	Resistor	100	ELR20
R28	Resistor	220k	R20
R29	Resistor	270k	ELR20
R30	Resistor	100	ELR20
R31	Resistor	1.5k	ELR20
R32	Trimmer	RH0521C15J05A	100k
R33	Resistor	56k	ELR20
R34	Resistor	5.6k	ELR20
R35	Resistor	100k	ELR20
R36	Resistor	33k	ELR20
R37	Resistor	100k	ELR20
R38	Resistor	47k	R20
R39	Resistor	150k	ELR20
R40	Resistor	82k	ELR20
R41	Resistor	82k	ELR20
R42	Resistor	82k	ELR20
R43	Trimmer	RH0521C14J08A	10k
R44	Resistor	330	ELR20
R45	Resistor	10k	ELR20
R46	Resistor	47k	ELR20
R47	Resistor	10k	ELR20
R48	Resistor	100	ELR20
R49	Resistor	820k	ELR20
R50	Resistor	22k	R20
R51	Resistor	15k	R20
R52	Resistor	4.7k	ELR20
R53	Resistor	1.2k	ELR20
R54	Trimmer	RH0521CS3J04A	4.7k
R55	Resistor	390	ELR20
R56	Trimmer	RH0521CS3J04A	4.7k
R57	Resistor	4.7k	ELR20
R59	Resistor	1k	ELR20
R60	Resistor	6.8k	ELR20
R62	Resistor	100	ELR20
R63	Resistor	1k	ELR20
R64	Resistor	6.8k	ELR20
R65	Resistor	100	R20
R66	Resistor	2.2k	ELR20 #03
R66	Resistor	3.9k	ELR20 #01, #02

MAIN UNIT

REF. NO.	DESCRIPTION	TYPE (PART NO.)	
R67	Resistor	100	ELR20
R68	Resistor	100k	ELR20
R69	Resistor	100k	R20
R70	Resistor	4.7k	ELR20
R71	Resistor	10k	ELR20
R72	Resistor	1k	R20
R73	Resistor	1.5k	R20
R74	Resistor	2.7k	ELR20
R75	Resistor	470	ELR20
R76	Resistor	1.8k	ELR20
R77	Resistor	820	ELR20
R78	Resistor	1k	R20
R79	Resistor	22k	R20
R80	Resistor	1k	R20
R81	Resistor	10k	ELR20
R82	Resistor	10k	ELR20 #01
R83	Trimmer	RH0521CS4J0DA	47k #01
R84	Resistor	47k	ELR20 #01
R85	Resistor	100	ELR20 #01
R86	Resistor	56k	ELR20 #01
R88	Resistor	4.7k	R20
R89	Resistor	220k	ELR20
R90	Resistor	12k	R20
R91	Resistor	1k	ELR20
R92	Resistor	47	ELR20
C1	Ceramic	10P	50V
C2	Ceramic	6P	50V
C3	Ceramic	0.001	50V
C4	Ceramic	47P	50V
C8	Ceramic	0.001	50V
C9	Ceramic	0.001	50V
C10	Ceramic	0.001	50V
C11	Ceramic	3P	50V
C12	Ceramic	6P	50V
C13	Ceramic	470P	50V
C14	Ceramic	0.001	50V
C15	Electrolytic	10	16V MS7
C16	Ceramic	470P	50V
C17	Ceramic	1P	50V
C18	Ceramic	4P	50V
C19	Tantalum	DN1V100MIS	10 35V
C20	Ceramic	0.001	50V
C21	Ceramic	0.001	50V
C22	Tantalum	10	16V DN
C23	Ceramic	10P	50V
C24	Ceramic	0.5P	500V
C25	Ceramic	7P	500V
C26	Ceramic	47P	50V
C27	Ceramic	7P	500V
C28	Ceramic	10P	50V
C29	Ceramic	0.5P	500V
C30	Ceramic	5P	500V
C31	Ceramic	24P	50V
C32	Ceramic	20P	50V
C33	Ceramic	5P	500V
C34	Ceramic	10P	500V
C35	Ceramic	27P	500V
C36	Ceramic	10P	500V
C37	Ceramic	8P	500V
C38	Ceramic	10P	500V
C39	Ceramic	3P	500V
C40	Barrier Layer	0.01	25V
C41	Ceramic	470P	50V

MAIN UNIT

REF. NO.	DESCRIPTION	TYPE (PART NO.)		
C42	Electrolytic	100	10V	MS7
C43	Barrier Layer	0.01	25V	
C44	Electrolytic	4.7	16V	MS5 D=3
C45	Ceramic	470P	50V	
C46	Electrolytic	0.22	50V	MS7
C47	Ceramic	470P	50V	
C48	Electrolytic	1	50V	MS7
C49	Electrolytic	1	50V	MS7
C50	Barrier Layer	0.01	25V	
C51	Barrier Layer	0.0047	25V	
C52	Barrier Layer	0.001	25V	
C53	Barrier Layer	0.0022	25V	
C54	Ceramic	120P	50V	
C55	Ceramic	0.001	50V	
C56	Ceramic	0.001	50V	
C57	Ceramic	0.001	50V	
C58	Electrolytic	10	16V	MS7
C59	Ceramic	0.001	50V	
C60	Ceramic	47P	50V	
C61	Ceramic	0.001	50V	
C62	Ceramic	0.001	50V	
C63	Ceramic	47P	50V	
C64	Ceramic	47P	50V	
C65	Ceramic	47P	50V	
C66	Ceramic	47P	50V	
C67	Ceramic	2P	50V	
C68	Ceramic	0.001	50V	
C69	Electrolytic	4.7	25V	MS7
C70	Ceramic	6P	50V	
C71	Ceramic	0.001	50V	
C72	Tantalum	10	16V	DN
C73	Barrier Layer	0.01	25V	
C74	Ceramic	0.001	50V	
C75	Cylinder	UP125	SL	5R6
C76	Barrier Layer	0.01	25V	
C77	Ceramic	100P	50V	
C78	Ceramic	200P	50V	
C79	Ceramic	20P	50V	CH
C79	Ceramic	22P	50V	CH
C80	Trimmer	CV38D1001	10P	
C81	Ceramic	0.001	50V	
C82	Ceramic	0.001	50V	
C83	Electrolytic	100	10V	MS7
C84	Ceramic	47P	50V	
C87	Electrolytic	100	10V	MS7
C88	Monolithic	D33Y5V1E104Z21		
C89	Electrolytic	0.47	50V	MS7
C90	Tantalum	DNIA220MIS	22	10V
C91	Tantalum	10	16V	DN
C92	Ceramic	120P	50V	
C93	Ceramic	0.001	50V	
C94	Ceramic	0.001	50V	#01
C95	Electrolytic	10	16V	MS7 #01
C96	Ceramic	33P	50V	#01
C97	Ceramic	33P	50V	#01
C98	Barrier Layer	0.01	25V	#01
C99	Tantalum	0.1	35V	DN #01
C100	Electrolytic	22	6.3V	MS7
C101	Ceramic	0.001	50V	
C102	Tantalum	2.2	16V	DN
C103	Monolithic	S33Y5V1E104Z21		
C104	Ceramic	3P	500V	
C105	Tantalum	0.1	35V	DN
C106	Ceramic	0.001	50V	

MAIN UNIT

REF. NO.	DESCRIPTION	TYPE (PART NO.)	
C108	Ceramic	0.001	50V
C109	Ceramic	47P	50V
C110	Ceramic	47P	50V
C111	Ceramic	47P	50V
C112	Ceramic	47P	50V
C113	Ceramic	47P	50V
C114	Ceramic	47P	50V
C115	Ceramic	47P	50V
C117	Ceramic	47P	50V
C119	Ceramic	47P	50V
C121	Ceramic	47P	50V #01
C122	Ceramic	47P	50V
C123	Ceramic	47P	50V
C124	Ceramic	47P	50V
C125	Ceramic	47P	50V
C126	Ceramic	47P	50V
C127	Ceramic	47P	50V
C128	Ceramic	47P	50V
C129	Ceramic	47P	50V
C130	Ceramic	47P	50V
C131	Ceramic	47P	50V
C132	Ceramic	47P	50V
C133	Ceramic	47P	50V
C136	Ceramic	47P	50V
C137	Ceramic	47P	50V
C138	Ceramic	47P	50V
C139	Ceramic	47P	50V
C140	Ceramic	47P	50V
C141	Ceramic	47P	50V
C142	Ceramic	47P	50V
C143	Ceramic	47P	50V
C144	Ceramic	47P	50V
C145	Ceramic	47P	50V
C146	Ceramic	47P	50V
C147	Ceramic	47P	50V
C148	Ceramic	47P	50V
C149	Ceramic	47P	50V
C150	Feed Through	TF240-603-332	
C151	Barrier Layer	0.01	25V
C152	Feed Through	TF240-603-332	
C153	Feed Through	TF240-603-332	
C154	Feed Through	TF240-603-332	
J1	Connector	B10B-EH-S	
J2	Connector	B03B-EH-S	
J3	Connector	B03B-EH-S	
J4	Connector	B03B-EH-S	
J5	Connector	B03B-EH-S	
J6	Connector	B03B-EH-S	
J7	Connector	B08B-EH-S	
J8	Connector	B10B-EH-S	
J9	Connector	B04B-EH-S	
J10	Connector	B04B-EH-S	
J11	Connector	TLB-P02H-B1	
J12	Connector	5379-02	
J13	Connector	5379-02	
P1	Connector	TMP-P01X-A1	
P2	Connector	TMP-P01X-A1	
P3	Connector	EHR-07	
EP3	P.C. Board	B-1156E	
EP4	Ferrite Bead	DL2-OP2.6-3-1.2H	

11 - 3 RX UNIT

REF. NO.	DESCRIPTION	TYPE (PART NO.)
IC1	IC	MB3756
IC2	IC	μPC577H
IC3	IC	MC3357P
IC4	IC	μPC1241H
Q1	FET	3SK121-Y
Q2	FET	2SK125
Q3	FET	3SK121-Y
Q4	Transistor	2SC2668-O
Q5	Transistor	2SC2458-GR
Q6	Transistor	2SC2458-GR
Q7	Transistor	2SC2458-GR
Q8	Transistor	2SC2458-GR
Q9	FET	2SJ105-GR
Q10	Transistor	2SC2458-GR
Q11	Transistor	2SC2458-GR
Q12	Transistor	2SB909M-R
Q13	Transistor	2SD1225M-R
Q14	Transistor	2SA1048-GR
Q15	FET	2SJ105-GR
Q16	Transistor	2SC3399
Q17	Transistor	2SC3399
D1	Diode	1SS53
D2	Diode	1SS53
D3	Diode	1S953
D4	Diode	1S953
D5	Zener	RD6.2E B2
D6	Diode	1S953
D7	Diode	1S953
D8	Diode	1S953
D9	Diode	1SS53
D10	Diode	1SS53
D11	Diode	1SS133
D12	Diode	1SS53
D13	Diode	1SS133
D14	Diode	1SS53
D15	Diode	1SS133
D16	Diode	1SS133
D17	Diode	1SS133
D18	Diode	1SS53
D19	Diode	1SS53
D20	Diode	RD3.6E B2
D21	Diode	1SS53
D23	Diode	1SS53
FI1	Crystal	23M15B2
FI2	Ceramic	CFV455E10
X1	Discriminator	CDB455C7A
X2	Crystal	CR157
L1	Coil	LA-159
L2	Coil	LW-25
L3	Coil	7HW-252MX-1550 A
L4	Coil	LW-25
L5	Coil	7HW-252MX-1550 A
L6	Coil	LA-232
L7	Coil	LS-264
L8	Coil	LS-264
L9	Coil	LAL03NA 101K
L10	Coil	LAL03NA 121K
L11	Coil	LW-15
L12	Coil	LA-189

RX UNIT

REF. NO.	DESCRIPTION	TYPE (PART NO.)
R1	Resistor	33k ELR20
R2	Resistor	100k ELR20
R3	Resistor	82 ELR20
R4	Resistor	100 R20
R5	Resistor	47 ELR20
R6	Resistor	22 R20
R7	Resistor	1k ELR20
R8	Resistor	10k ELR20
R9	Resistor	470 ELR20
R10	Resistor	100 R20
R11	Resistor	2.7k ELR20
R12	Resistor	22k ELR20
R13	Resistor	4.7k ELR20
R14	Resistor	330 ELR20
R15	Resistor	100 R20
R18	Resistor	22k ELR20
R19	Resistor	4.7k ELR20
R20	Thermistor	23D29
R21	Resistor	560 ELR20
R22	Trimmer	RH0651CJ3JOCA
R23	Resistor	1.5k ELR20
R24	Resistor	47k ELR20
R25	Resistor	1.5k ELR20
R26	Resistor	1.5k ELR20
R27	Resistor	4.7k ELR20
R28	Resistor	100 R20
R29	Resistor	1 R20
R30	Resistor	1M ELR20
R31	Resistor	2.7k ELR20
R32	Resistor	2.7k ELR20
R33	Resistor	5.6k ELR20
R34	Resistor	82k ELR20
R36	Resistor	2.2k ELR20
R37	Resistor	22k ELR20
R38	Resistor	5.6k ELR20
R39	Resistor	390k ELR20
R40	Resistor	2.2k ELR20
R41	Resistor	47k R20
R42	Resistor	4.7k R20
R43	Resistor	150k R20
R44	Resistor	39k R20
R45	Resistor	4.7k ELR20
R46	Resistor	1k ELR20
R47	Resistor	15k ELR20
R48	Resistor	5.6k ELR20
R49	Resistor	5.6k ELR20
R50	Resistor	100 R20
R51	Resistor	47k ELR20
R52	Resistor	47 ELR20
R55	Resistor	220k ELR20
R56	Resistor	4.7k R20
R57	Resistor	8.2k ELR29
R58	Resistor	3.3k ELR20
R59	Resistor	100 R50X
R60	Resistor	2.7k R20
R61	Resistor	1.5k R20
R62	Resistor	10k ELR20
R63	Resistor	220k ELR20
R64	Resistor	1.5k ELR20
R65	Resistor	100k R20
R66	Resistor	100k ELR20
R67	Resistor	3.3 ELR20
R68	Resistor	1k ELR20
R69	Resistor	47k ELR20

RX UNIT

REF. NO.	DESCRIPTION	TYPE (PART NO.)	
R70	Resistor	47k	ELR20
R71	Resistor	22k	ELR20
R72	Resistor	10k	ELR20
R73	Resistor	560	R20
R74	Resistor	1	R20
C1	Ceramic	12P	50V
C2	Trimmer	ECR-GA006A30	6P
C3	Ceramic	3P	50V
C4	Ceramic	0.001	50V
C5	Ceramic	0.001	50V
C6	Ceramic	0.001	50V
C7	Ceramic	0.001	50V
C8	Ceramic	0.001	50V
C9	Ceramic	22P	50V
C10	Ceramic	3P	50V
C11	Ceramic	22P	50V
C12	Ceramic	0.001	50V
C13	Ceramic	0.001	50V
C14	Ceramic	22P	50V
C15	Ceramic	1P	50V
C16	Ceramic	3P	50V
C17	Ceramic	47P	50V
C18	Trimmer	ECR-GA006A30	6P
C19	Ceramic	0.001	50V
C20	Ceramic	0.001	50V
C21	Ceramic	39P	50V
C22	Ceramic	0.001	50V
C23	Ceramic	3P	50V
C24	Ceramic	120P	50V
C25	Ceramic	56P	50V
C26	Ceramic	0.0047	50V
C27	Ceramic	0.001	50V
C28	Ceramic	0.0047	50V
C29	Barrier Layer	0.1	16V
C30	Electrolytic	10	16V MS7
C31	Electrolytic	10	16V MS7
C32	Barrier Layer	0.1	16V
C33	Barrier Layer	0.1	16V
C34	Barrier Layer	0.1	16V
C35	Electrolytic	2.2	50V MS7
C36	Ceramic	0.001	50V
C37	Barrier Layer	0.1	16V
C38	Barrier Layer	0.1	16V
C39	Barrier Layer	0.1	16V
C40	Ceramic	150P	50V
C41	Barrier Layer	0.1	16V
C42	Ceramic	0.0047	50V
C43	Ceramic	20P	50V
C44	Electrolytic	10	16V MS7
C45	Ceramic	0.0047	50V
C46	Ceramic	82P	50V
C47	Tantalum	0.1	35V DN
C48	Barrier Layer	0.1	16V
C49	Ceramic	0.001	50V
C50	Ceramic	120P	50V
C51	Ceramic	68P	50V
C52	Ceramic	0.0047	50V
C53	Electrolytic	220	16V MS9
C54	Electrolytic	470	16V MS16
C55	Electrolytic	47	16V MS7
C56	Barrier Layer	0.1	16V
C57	Electrolytic	47	25V MS9
C58	Electrolytic	220	16V MS9

RX UNIT

REF. NO.	DESCRIPTION	TYPE (PART NO.)	
C59	Ceramic	0.001	50V
C60	Electrolytic	10	16V MS7
C61	Ceramic	0.001	50V
C62	Barrier Layer	0.0047	25V
C63	Barrier Layer	0.0047	25V
C64	Barrier Layer	0.0047	25V
C65	Ceramic	120P	50V
C66	Ceramic	0.001	50V
C67	Ceramic	0.001	50V
C68	Barrier Layer	0.047	25V
C69	Barrier Layer	0.0015	25V
C70	Ceramic	33P	50V
C71	Barrier Layer	0.01	25V
C72	Barrier Layer	0.0015	25V
C73	Electrolytic	4.7	25V MS5
C74	Electrolytic	10	16V MS5
C75	Ceramic	0.0047	50V
C76	Electrolytic	4.7	25V MS5
C77	Barrier Layer	0.01	25V
C78	Electrolytic	47	25V MS9
C79	Barrier Layer	0.01	25V
C80	Tantalum	0.1	35V DN
C82	Ceramic	0.001	50V
C83	Electrolytic	10	16V MS7
C84	Ceramic	0.001	50V
C85	Ceramic	0.001	50V
C86	Tantalum	DNIA220MIS	22 10V
C87	Electrolytic	0.33	50V MS7
C88	Ceramic	12P	50V
C89	Monolithic	D33Y5V1E104Z21	
C90	Ceramic	47P	50V
C91	Ceramic	47P	50V
C92	Ceramic	47P	50V
C93	Ceramic	47P	50V
C94	Ceramic	47P	50V
C95	Ceramic	47P	50V
C96	Ceramic	47P	50V
C97	Ceramic	47P	50V
C98	Ceramic	47P	50V
C99	Ceramic	47P	50V
C100	Ceramic	47P	50V
C101	Ceramic	47P	50V
C102	Ceramic	47P	50V
C103	Ceramic	47P	50V
C104	Ceramic	47P	50V
C105	Ceramic	47P	50V
C106	Ceramic	47P	50V
C107	Barrier Layer	0.01	25V
C108	Ceramic	47P	50V
C109	Ceramic	47P	50V
C110	Electrolytic	1	50V MS7
J1	Mini Pin	TMP-J01X-A2	
J2	Mini Pin	TMP-J01X-A2	
J3	Connector	B07B-EH-S	
J4	Connector	B04B-EH-S	
J5	Connector	B06B-EH-S	
J6	Connector	B06B-EH-S	
J7	Connector	B03B-EH-S	
J9	Connector	HSJ0836-01-010	
J10	Connector	B03B-EH-S	
J11	Connector	IMSA-9201B-1-02-T	
P1	Connector	EHR-03	

RX UNIT

REF. NO.	DESCRIPTION	TYPE (PART NO.)
S1	Switch	SPPH21127A
BT1	Lithium Battery	BR2032-1T2
EP1	P.C. Board	B-1157E

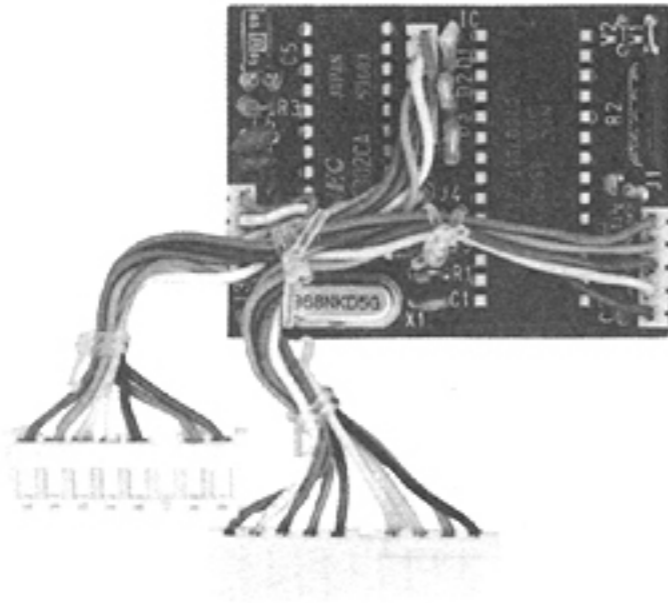
11 - 4 VCO UNIT

REF. NO.	DESCRIPTION	TYPE (PART NO.)
Q1	Transistor	DTC124-K
Q2	FET	2SK125
Q3	Transistor	2SC3356
D1	Varicap	1T25
D2	Diode	1SS216
D3	Varicap	1T25
L1	Choke	LAL02NA R33
L2	Coil	LA-134
L3	Choke	LW-17
L4	Choke	LAL02NA R33
R1	Resistor	100 MCR10
R2	Resistor	820 MCR10
R3	Resistor	47k MCR10
R4	Resistor	10k MCR10
R5	Resistor	47k MCR10
R6	Resistor	22k R20
R7	Resistor	220 MCR10
R8	Resistor	1k MCR10
R9	Resistor	6.8k MCR10
R10	Resistor	220 MCR10
R11	Resistor	100 MCR10
C1	Ceramic	470P 50V
C2	Trimmer	CV38A0301 3P
C3	Monolithic	7P 50V GRM40
C4	Monolithic	470P 50V GRM40
C5	Trimmer	CV38B0601 6P
C6	Monolithic	3P 50V GRM40
C7	Monolithic	12P 50V GRM40
C8	Monolithic	47P 50V GRM40
C9	Monolithic	1.5P 50V GRM40
C10	Monolithic	470P 50V GRM40
C11	Monolithic	8P 50V GRM40
C12	Monolithic	8P 50V GRM40
C13	Monolithic	0.5P 50V GRM40
C14	Monolithic	0.001 50V GRM40
C15	Ceramic	6P 50V
EP1	P.C. Board	B-1221B

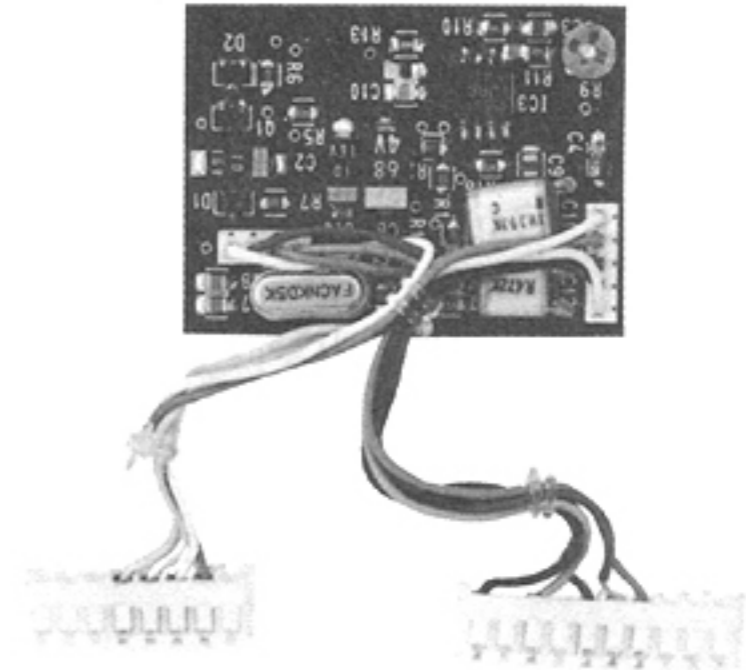
SECTION 12 OPTIONAL UNITS

12 - 1 UT-28, UT-29 OPTIONS

UT-28 DIGITAL CODE SQUELCH UNIT

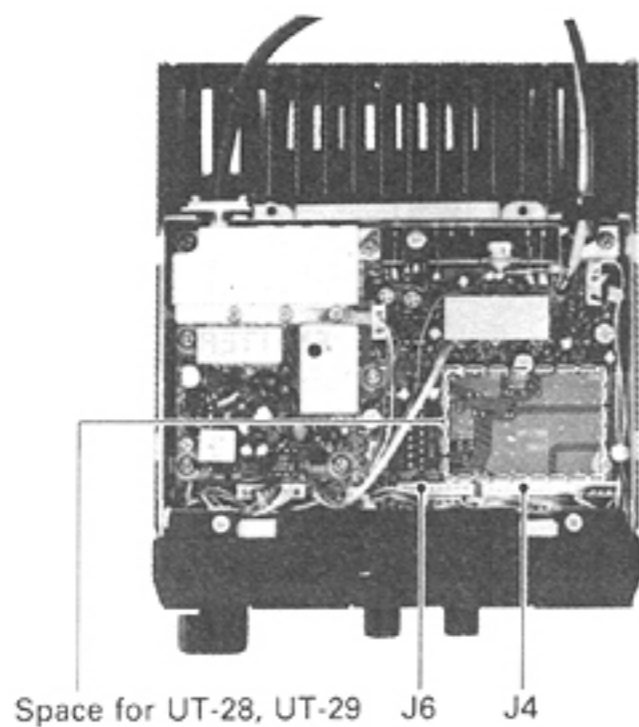


UT-29 TONE SQUELCH UNIT

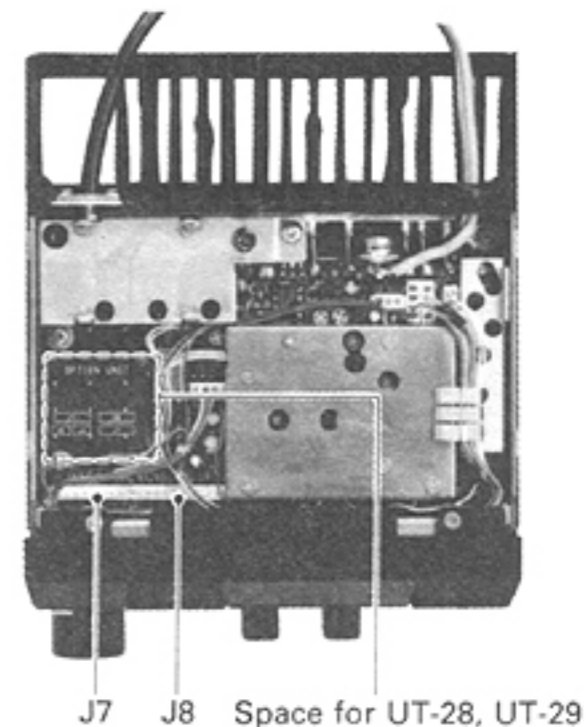


INSTALLATION PROCEDURE

IC-38A installation location on MAIN UNIT for UT-28 and UT-29.



IC-48A/E installation location on MAIN UNIT for UT-28 and UT-29.



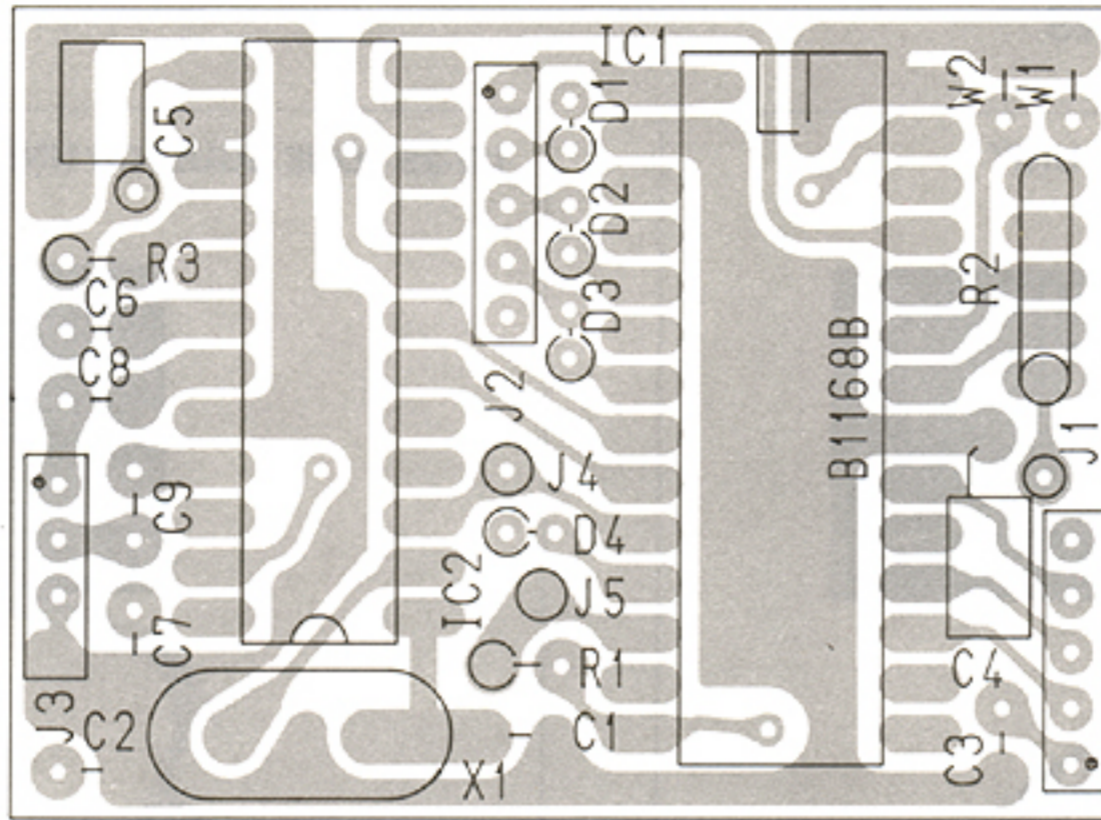
NOTE: Unplug the power cable before performing any work on the transceivers.

1. Unscrew the two cover screws on the rear panel and remove the top cover.
2. Connect the 10-pin and 8-pin plugs to J4 and J6 on the MAIN UNIT of the IC-38A or to J7 and J8 on the MAIN UNIT of the IC-48A/E.

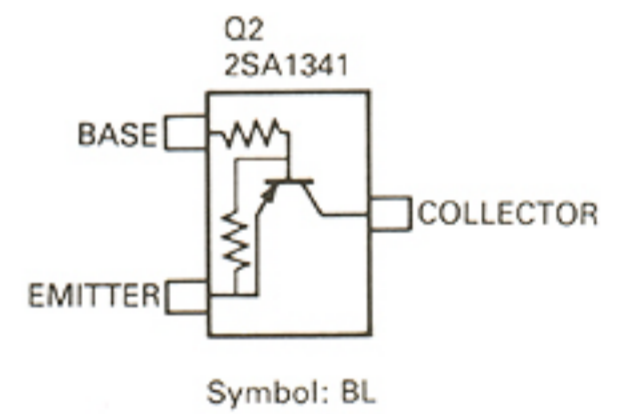
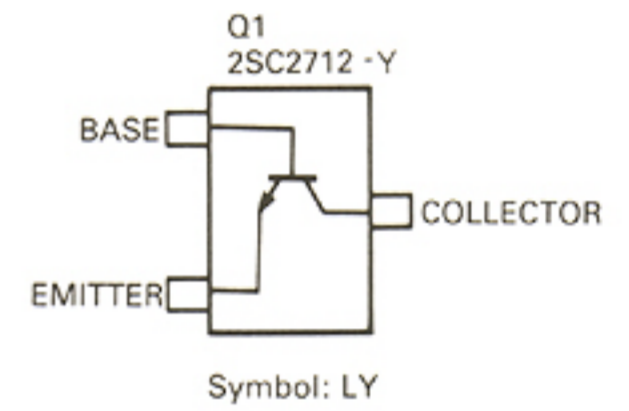
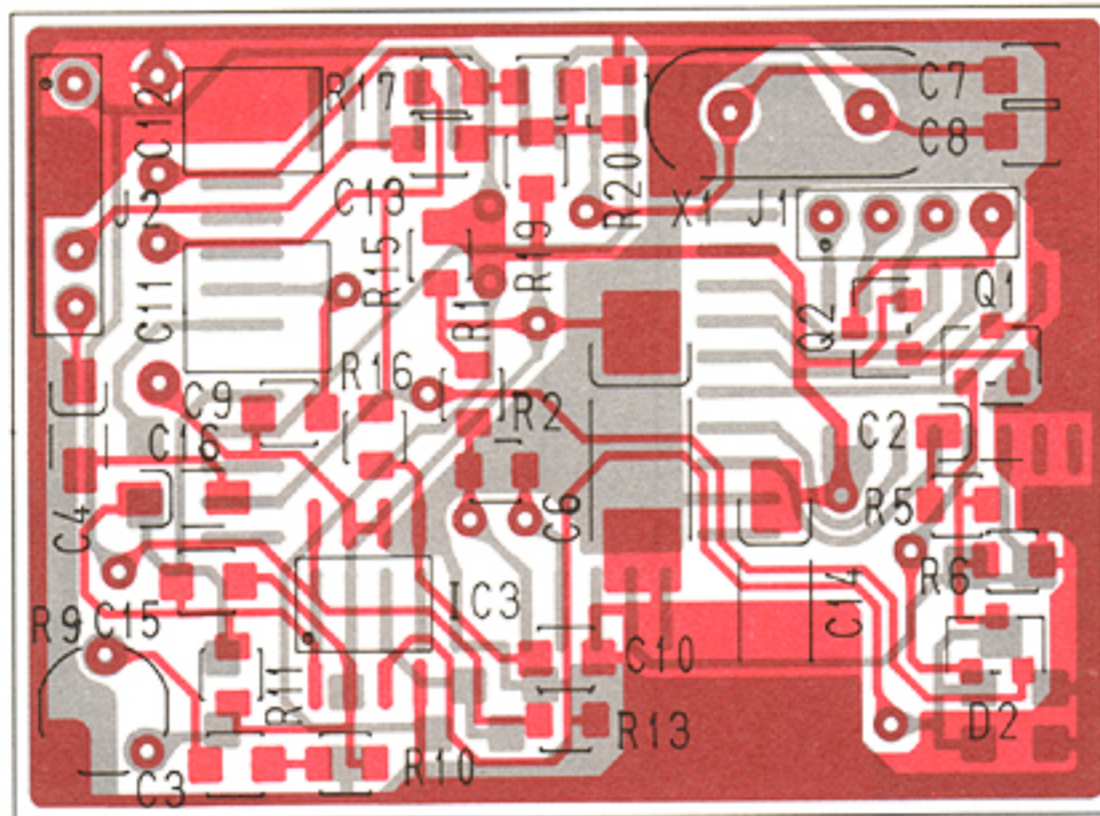
3. Install the unit in the spot shown in the photos above.
 - Adhesive tape is applied to the sponge on the back of the unit, so remove this in order to install the unit properly.
4. Re-attach the cover to the transceiver.

12 - 2 UT-28, UT-29 BOARD LAYOUTS

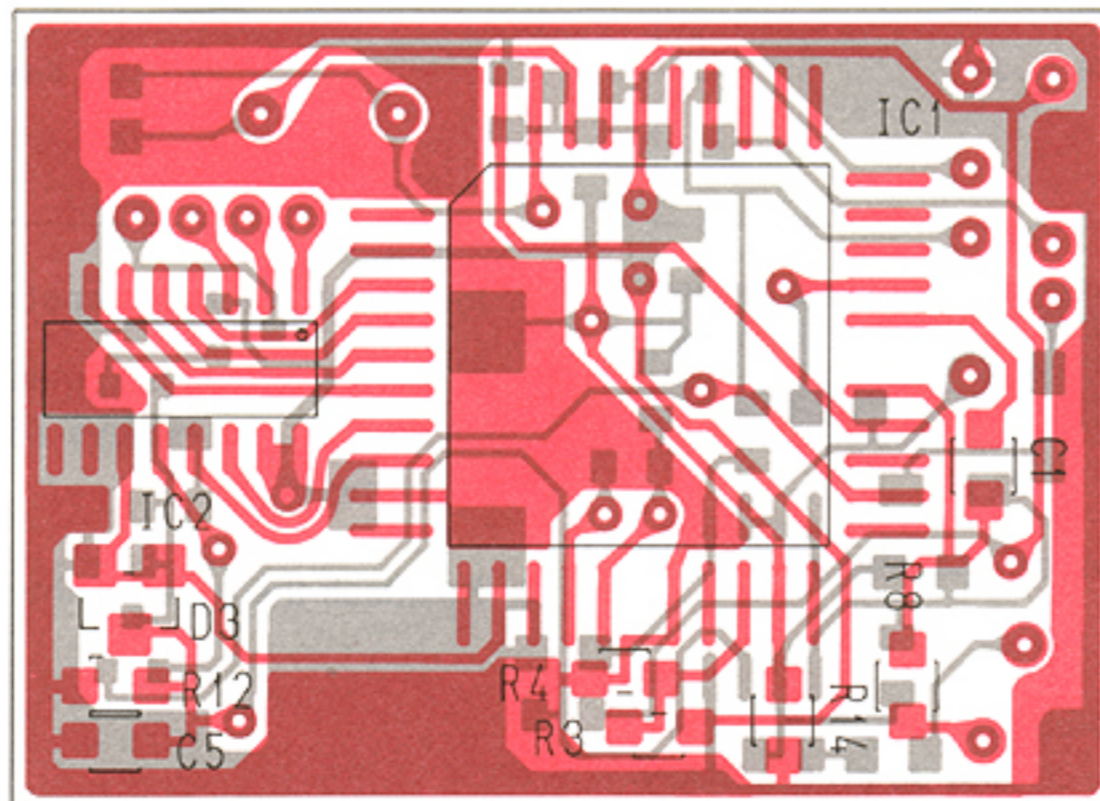
UT-28



UT-29
(Top View)



UT-29
(Bottom View)



12 - 3 UT-28, UT-29 PARTS LIST

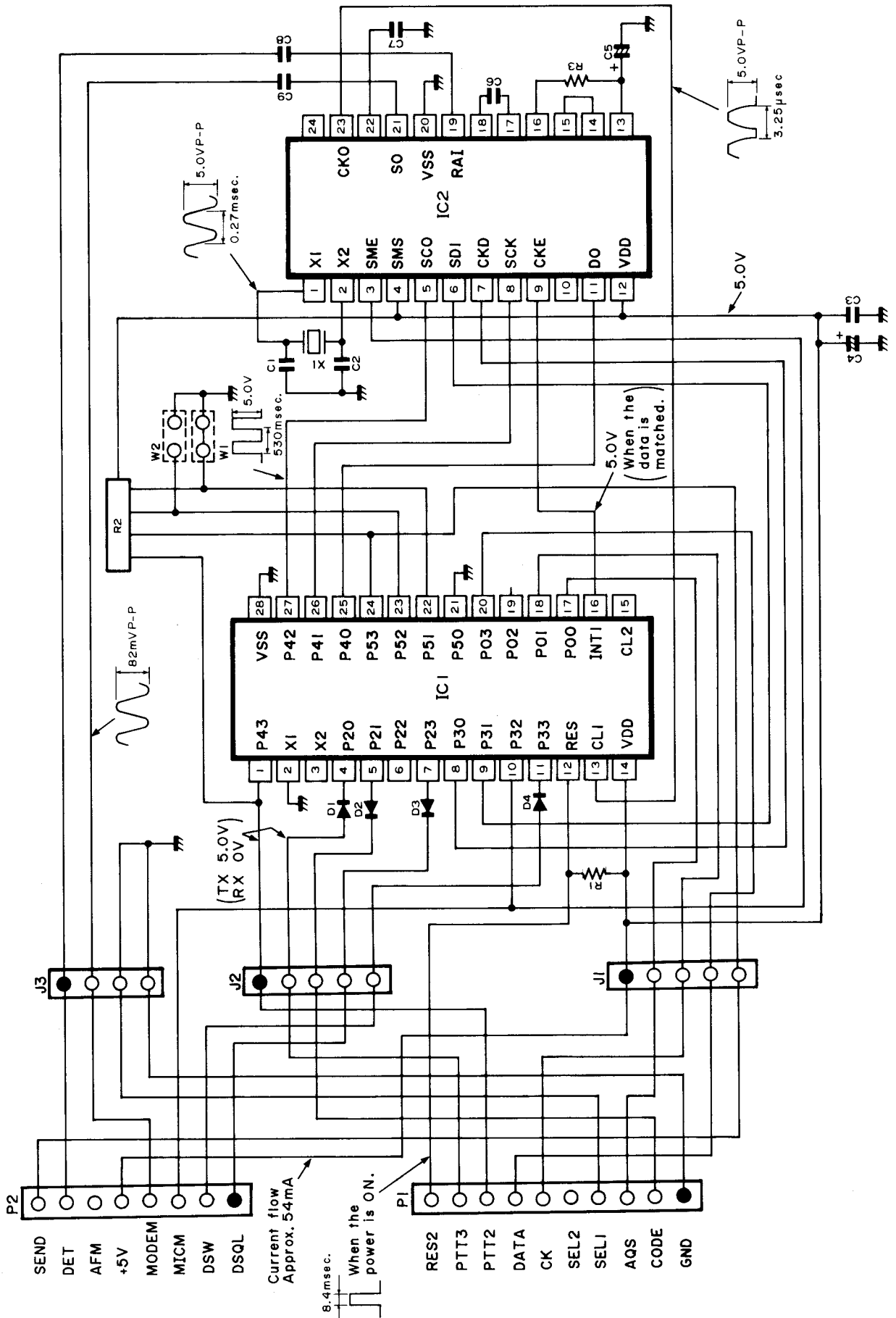
UT-28 DIGITAL SQUELCH UNIT

REF. NO.	DESCRIPTION	TYPE (PART NO.)	
IC1	IC	μPD7507SCT-217	
IC2	IC	μPD6302CA	
D1	Diode	1SS133	
D2	Diode	1SS133	
D3	Diode	1SS133	
D4	Diode	1SS133	
X1	Crystal	FABNKD00	
R1	Resistor	27k	ELR20
R2	Array	RNSA05S473J	
R3	Resistor	27k	ELR20
C1	Ceramic	33P	50V
C2	Ceramic	33P	50V
C3	Monolithic	D33Y5V1E104Z21	
C4	Electrolytic	4.7	25V MS5
C5	Electrolytic	4.7	25V MS5
C6	Barrier Layer	0.01	25V
C7	Monolithic	D33Y5V1E104Z21	
C8	Monolithic	D33Y5V1E104Z21	
C9	Monolithic	D33Y5V1E104Z21	
J1	Connector	PD09-05M	
J2	Connector	PD09-05M	
J3	Connector	PD09-04M	
P1	Connector	EHR-10	
P2	Connector	EHR-08	
EP1	P.C. Board	B-1168A	

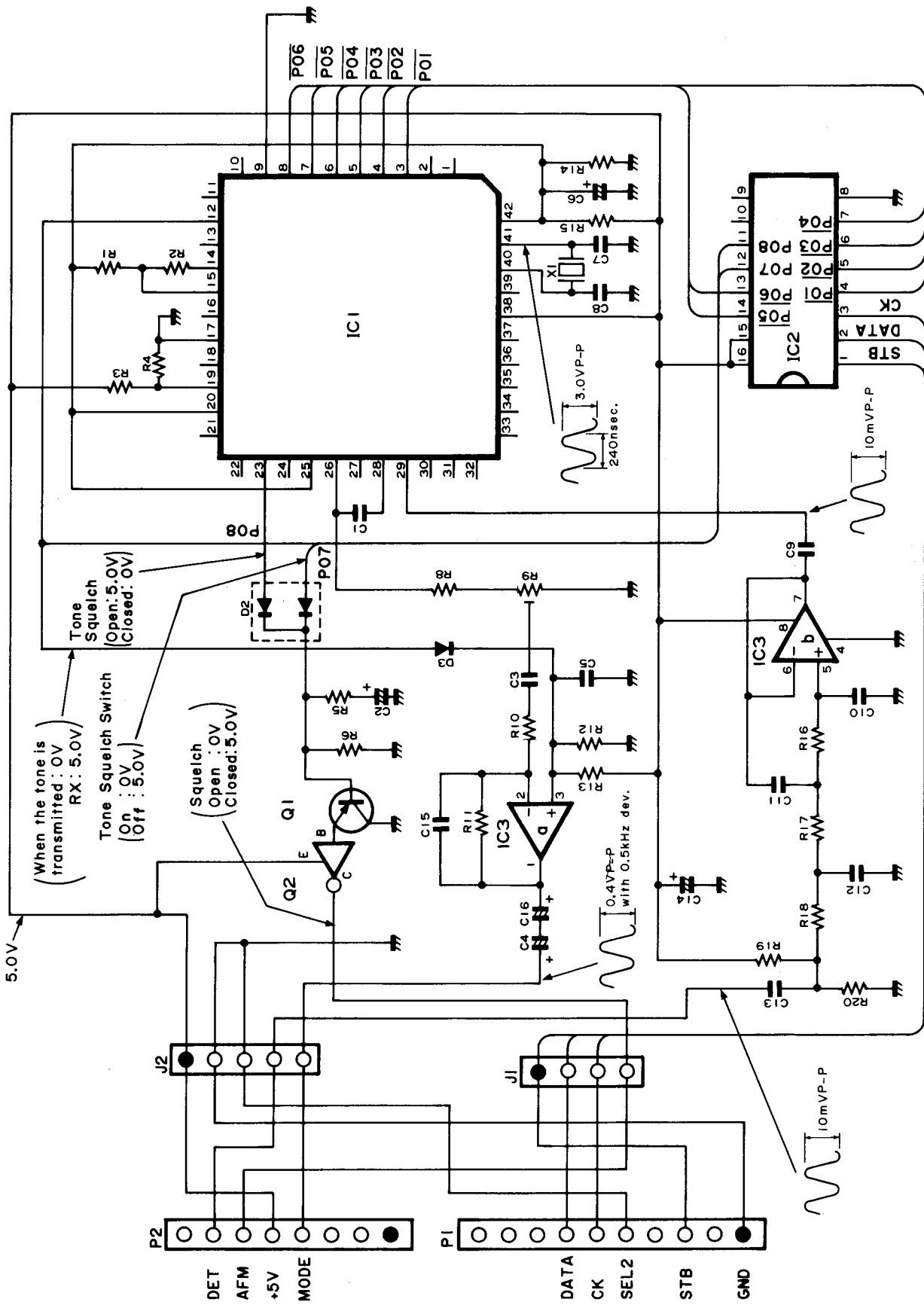
UT-29 TONE SQUELCH UNIT

REF. NO.	DESCRIPTION	TYPE (PART NO.)	
IC1	IC	MN6520	
IC2	IC	μPD4094BG	
IC3	IC	NJM4558M	
Q1	Transistor	2SC2712-Y	
Q2	Transistor	2SA1341	
D2	Diode	1SS184	
D3	Diode	1SS193	
X1	Crystal	4.194304M FACNKD00	
R1	Chip	2.2k	MCR10
R2	Chip	150k	MCR10
R3	Chip	10k	MCR10
R4	Chip	15k	MCR10
R5	Chip	10k	MCR10
R6	Chip	470k	MCR10
R8	Chip	4.7k	MCR10
R9	Trimmer	10k	RH0521C14J08A
R10	Chip	180k	MCR10
R11	Chip	820k	MCR10
R12	Chip	100k	MCR10
R13	Chip	100k	MCR10
R14	Chip	10k	MCR10
R15	Chip	10k	MCR10
R16	Chip	330k	MCR10
R17	Chip	330k	MCR10
R18	Chip	330k	MCR10
R19	Chip	1M	MCR10
R20	Chip	1M	MCR10
C1	Monolithic	0.1	GRM40 F
C2	Tantalum	1μ	SVA1C105M
C3	Monolithic	0.1	GRM40 F
C4	Tantalum	1μ	SVA1C105M
C5	Monolithic	0.1	GRM40 F
C6	Tantalum	68μ	SVD0G686M
C7	Monolithic	18P	GRM40
C8	Monolithic	18P	GRM40
C9	Monolithic	0.1	GRM40 F
C10	Monolithic	82P	GRM40
C11	Mylar	0.039	50V
C12	Mylar	0.0047	50V
C13	Monolithic	0.1	GRM40 F
C14	Tantalum	10μ	SVC1C106M
C15	Monolithic	270P	GRM40
C16	Tantalum	1μ	SVA1C105M
J1	Connector	PD09A-04M	
J2	Connector	PD09A-05M	
P1	Connector	EHR-10	
P2	Connector	EHR-08	
EP1	P.C. Board	B-1197A	

12 - 4 UT-28 VOLTAGE/CIRCUIT DIAGRAM



12 - 5 UT-29 VOLTAGE/CIRCUIT DIAGRAM

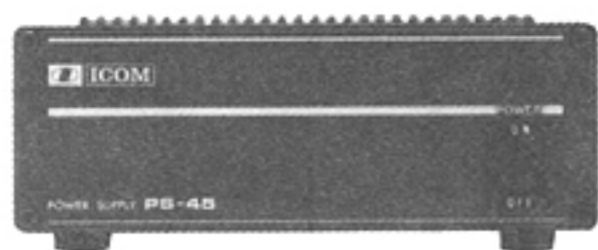


12 - 6 OTHER OPTIONAL UNITS

Part of the tremendous versatility of the IC-38A and IC-48A/E is their adaptability to base station use when not being used as mobile units.

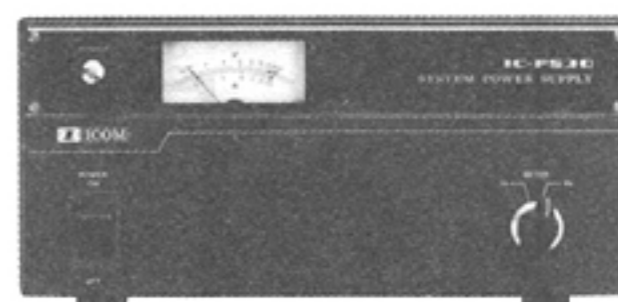
The following recommended options will help complement your new base station system.

PS-45 POWER SUPPLY



The OPC-102 INTERFACE CABLE for connecting the PS-45 to the transceivers must be purchased separately.

IC-PS30 AC POWER SUPPLY



SP-7 EXTERNAL SPEAKER

- Compact, easily installed in a variety of locations
- Adjustable, lightweight stand



SP-10 EXTERNAL SPEAKER

- Adjustable stand for multi-directional audio output
- Excellent also for mobile use



SM-8 DESK MICROPHONE

- Electret condenser type mic element
- UP/DOWN function switches
- Tone control
- HIGH/LOW mic output selectability



SM-10 COMPRESSOR/GRAPHIC EQUALIZER DESK TOP MICROPHONE

- Electret condenser mic element
- Compressor amplifier
- Tunable equalizer
- Level meter and Output level control
- UP/DOWN function switches



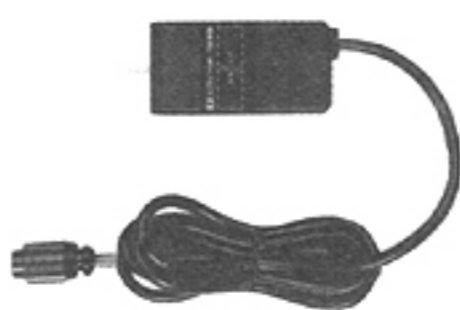
AND FOR MOBILE USE: HS-15 MOBILE FLEXIBLE MICROPHONE

- Uni-directional mic
- Flexible neck
- Light, convenient for driving ease



HS-15SB SWITCHBOX

- Connects to the HS-15

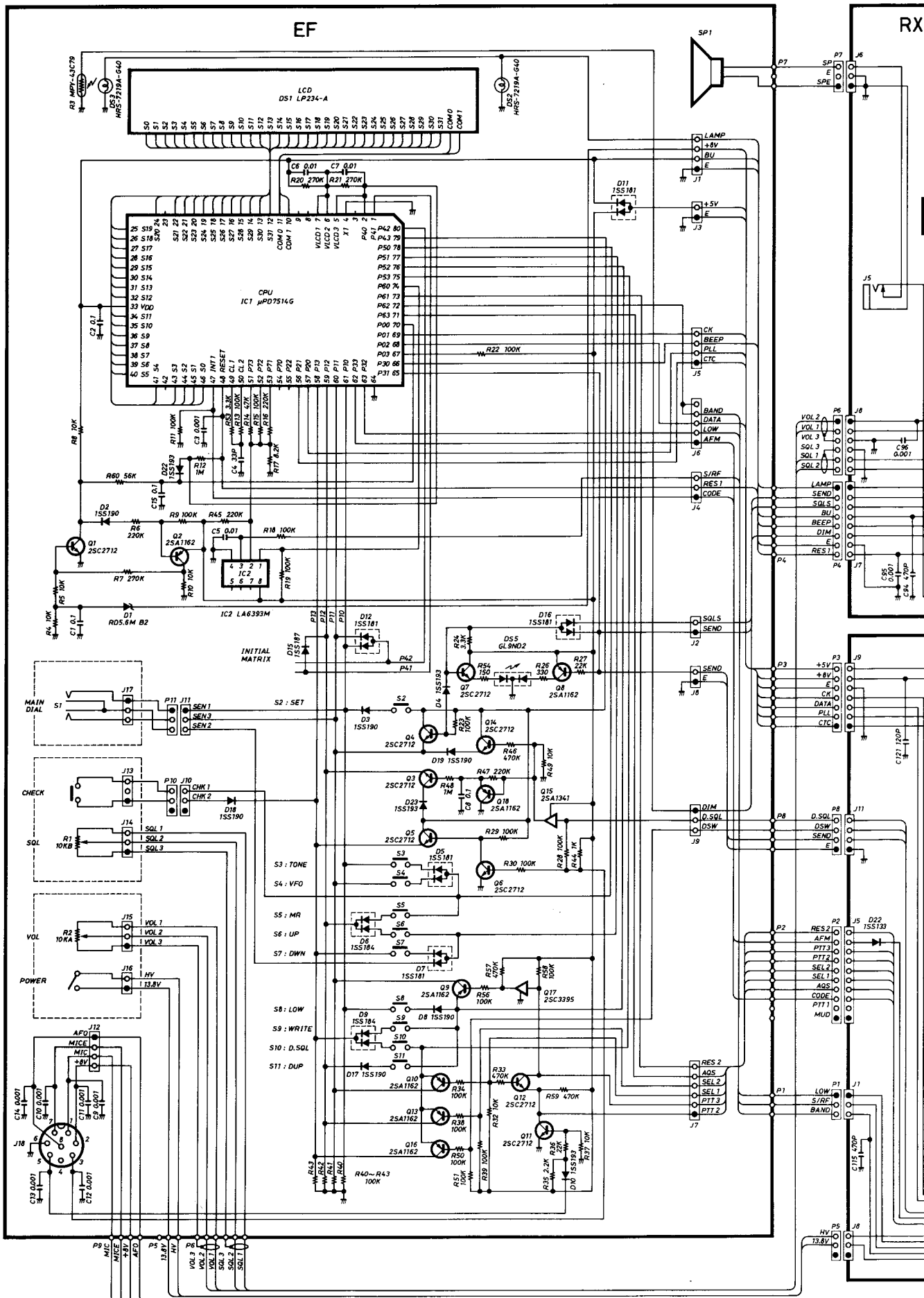


SP-8 EXTERNAL MOBILE SPEAKER

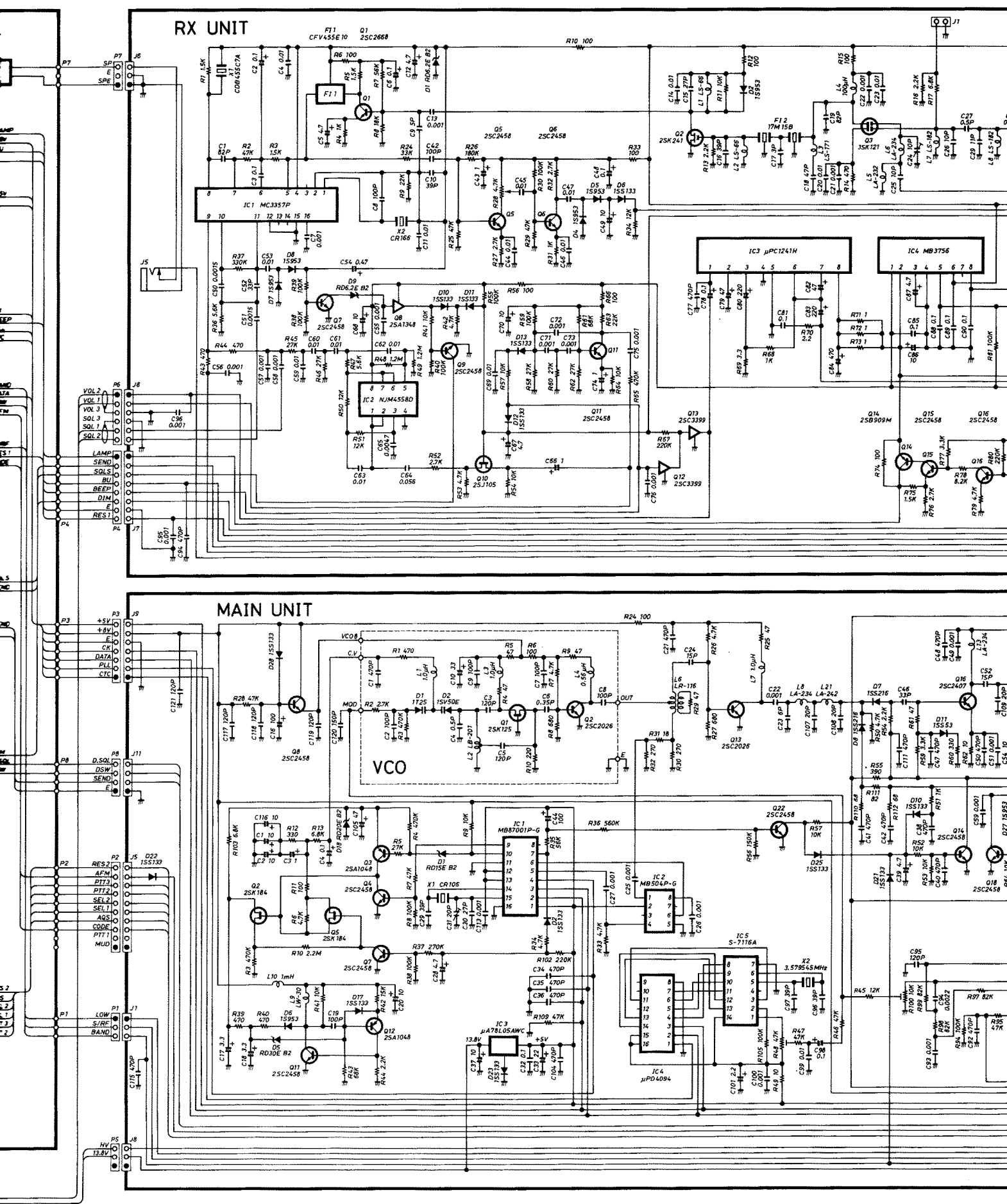
- Compact, easily attachable to your sun visor or dashboard

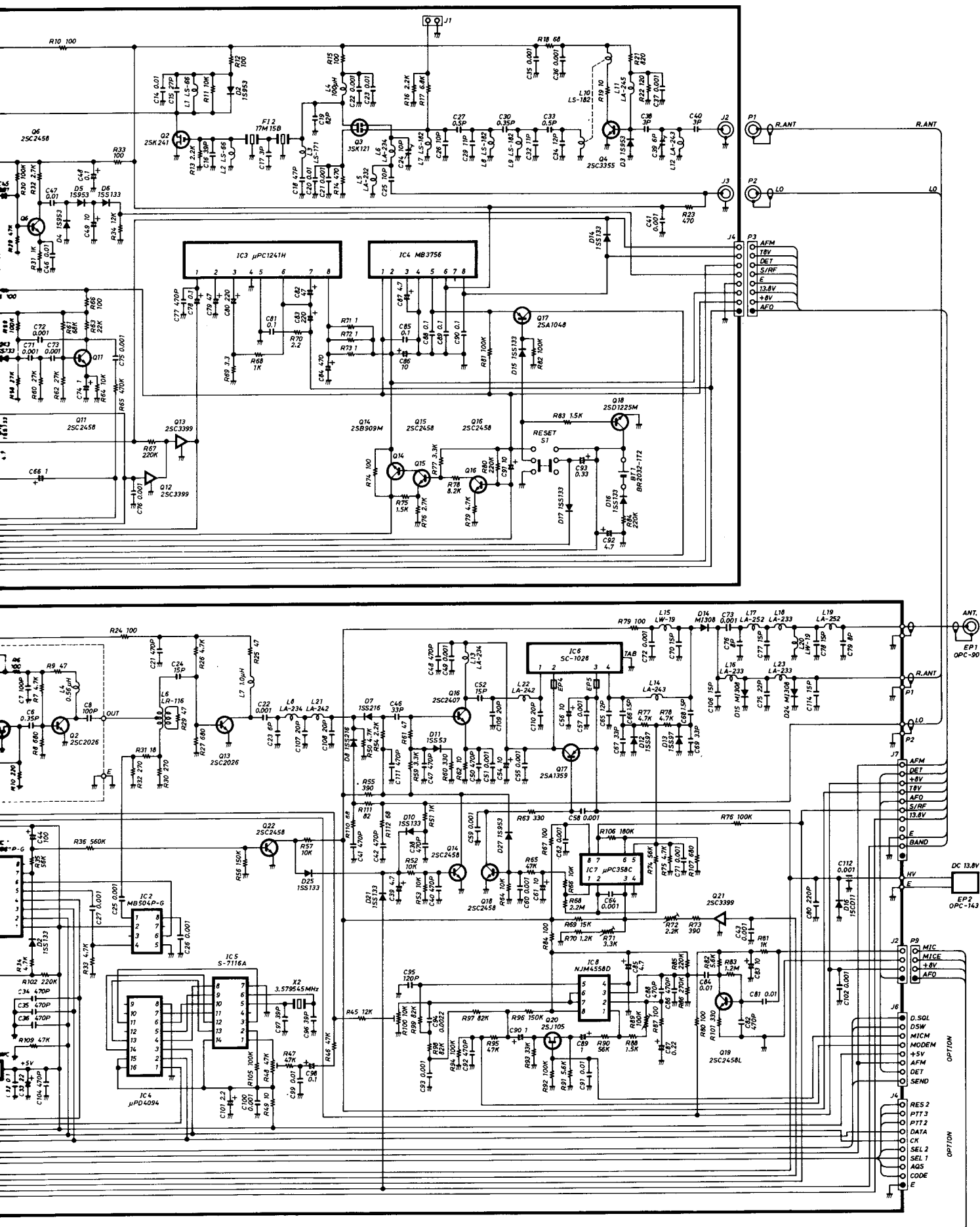


IC-38A SCHEMATIC DIAGRAM

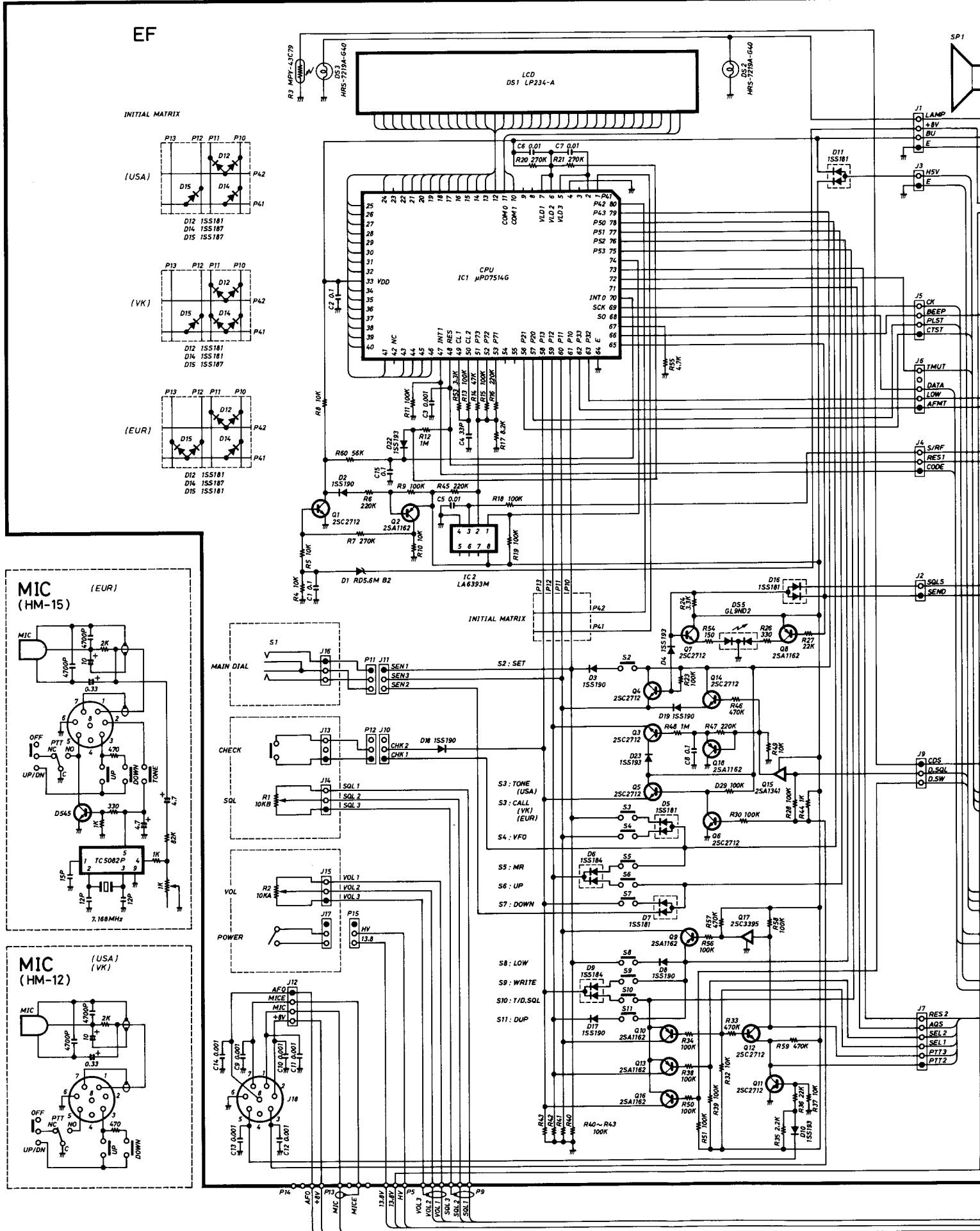


RAM

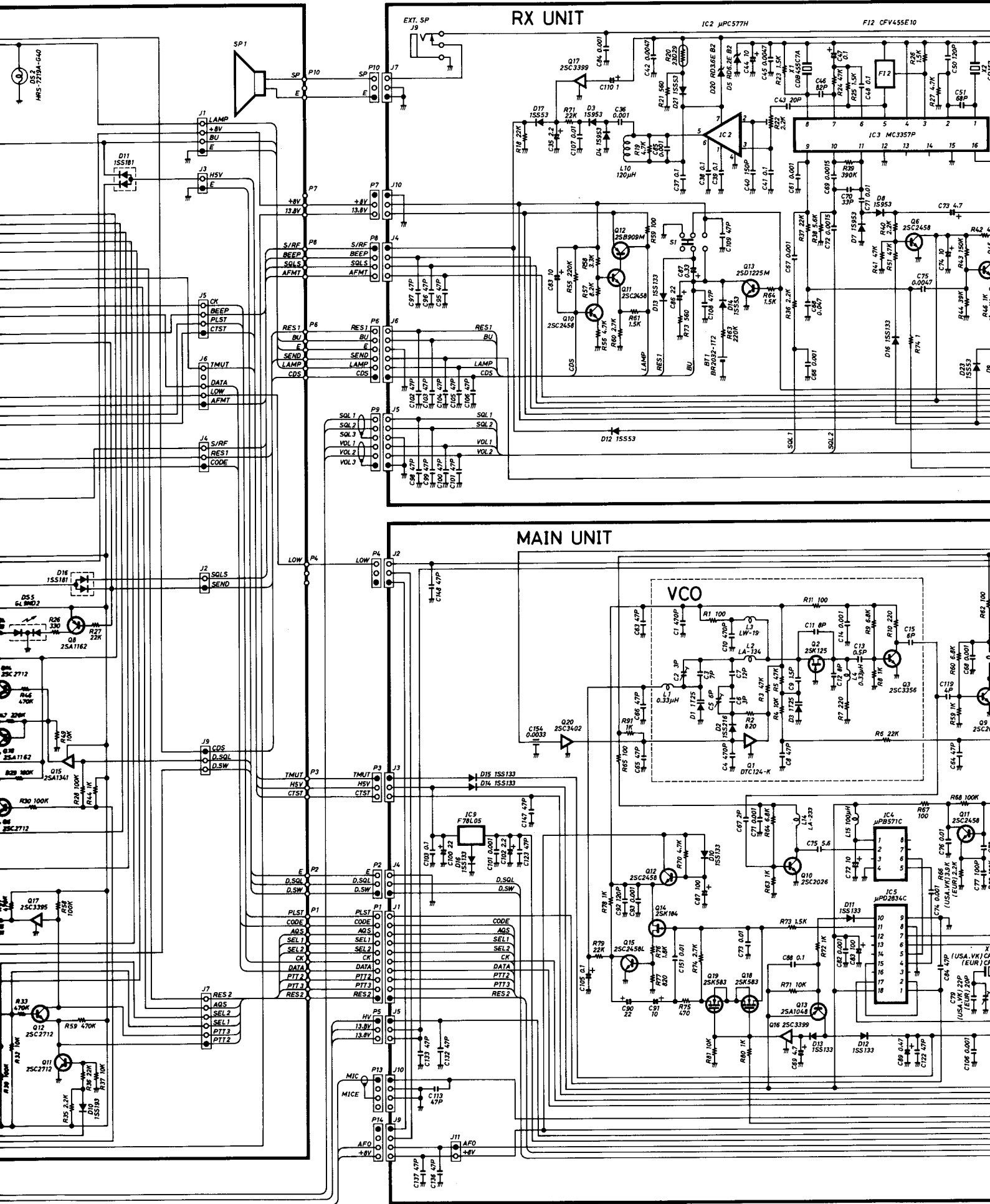


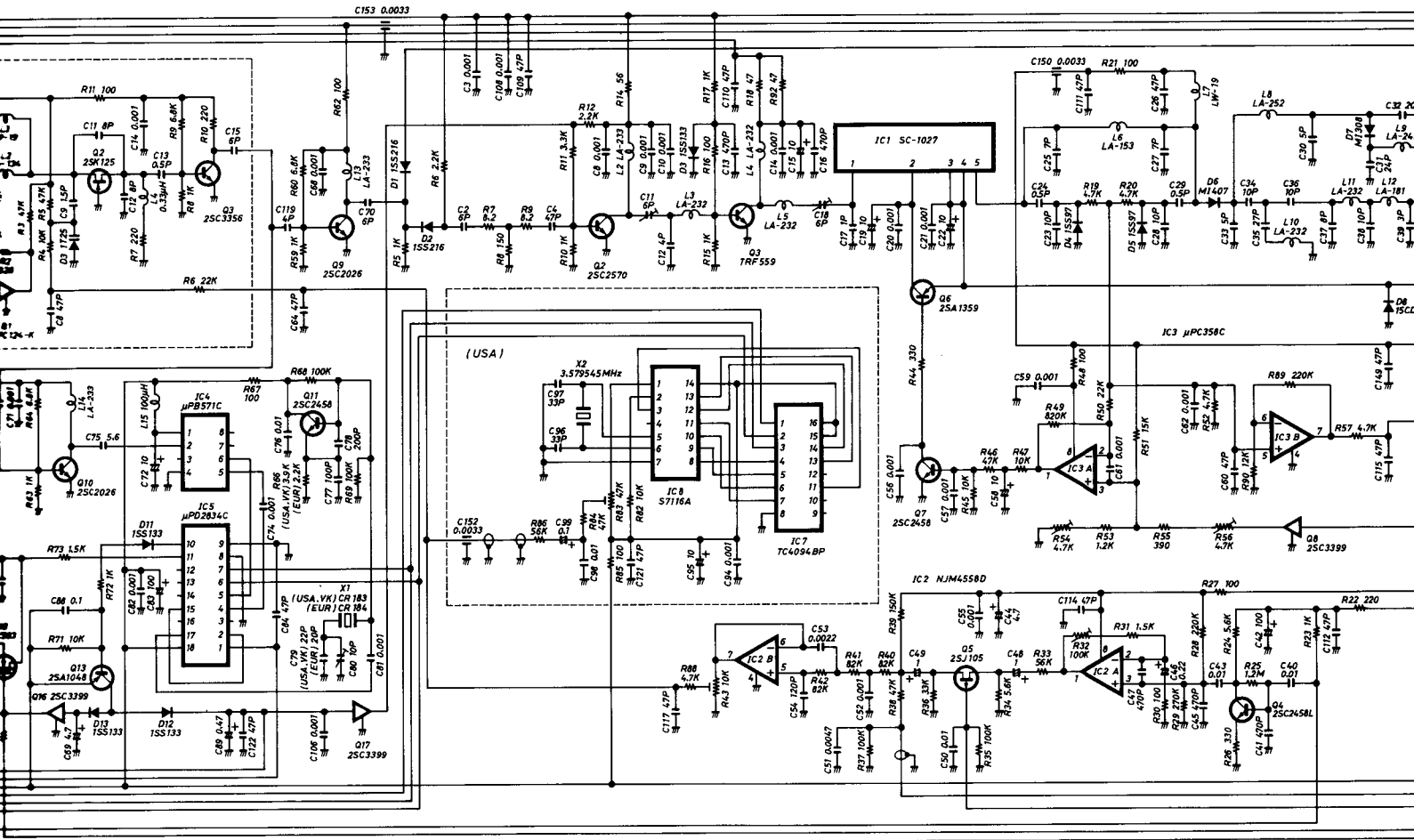
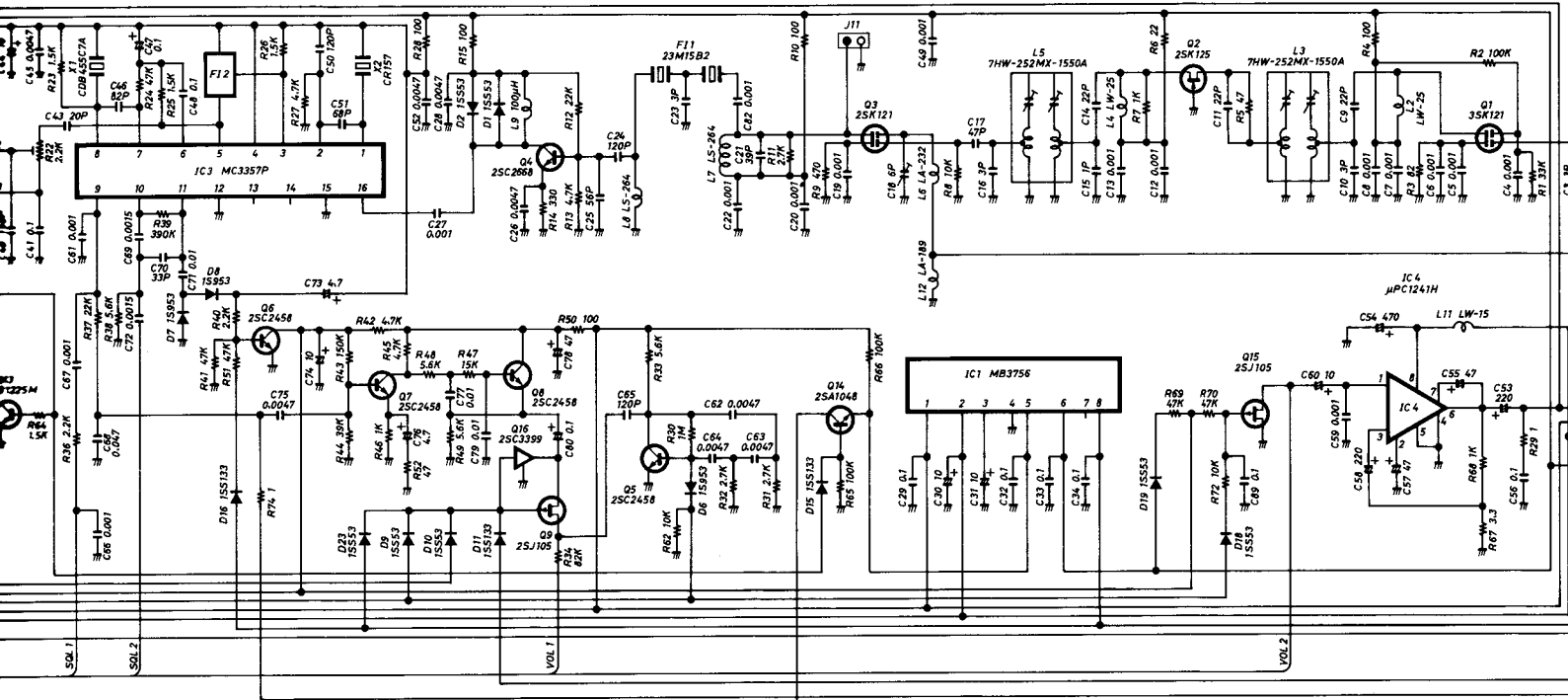


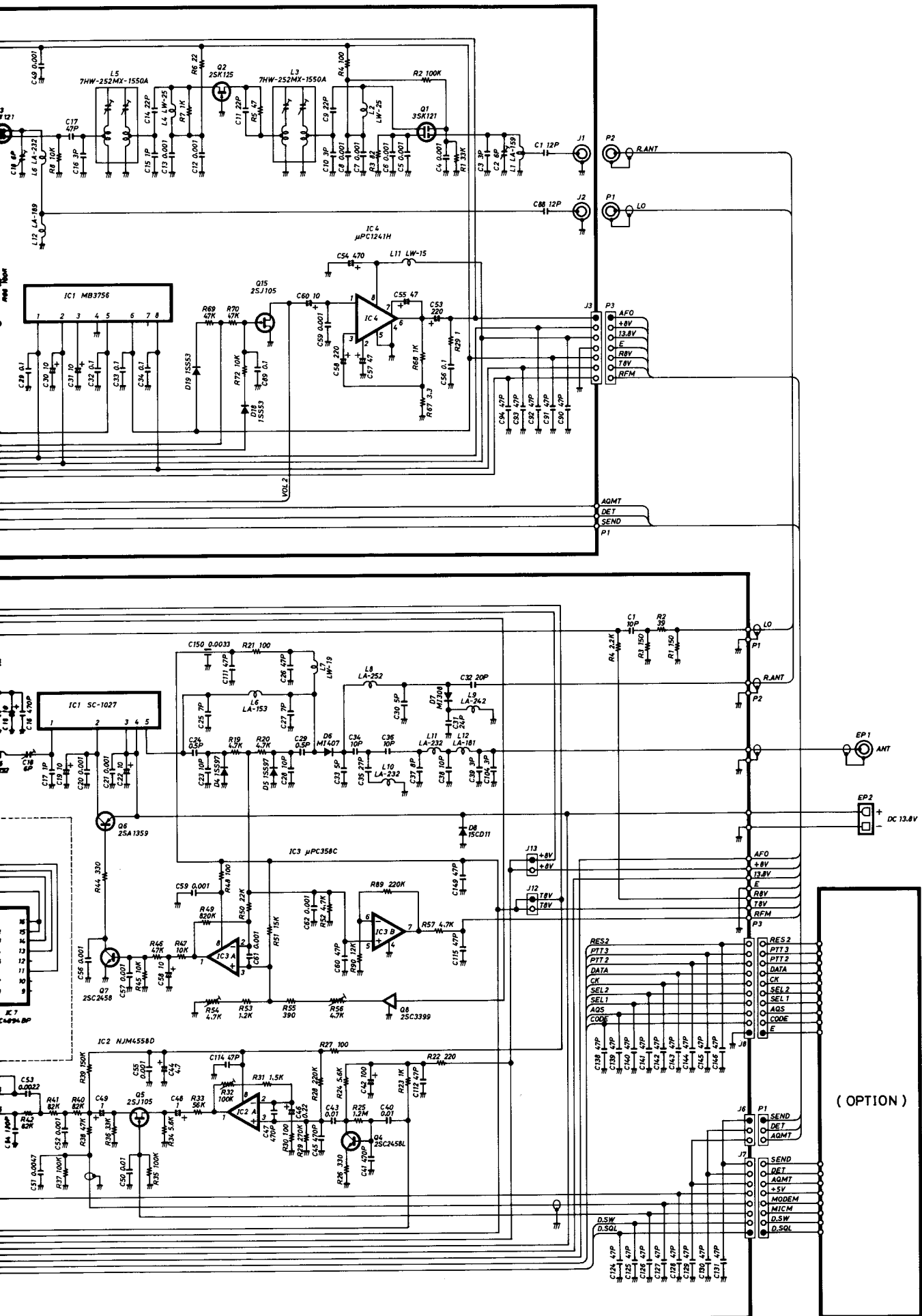
IC-48A/E SCHEMATIC DIAGRAM



C DIAGRAM







To upgrade quality, some components may be subject to change without notice.



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