ICOM

SERVICE MANUAL

IC-M8

VHF MARINE TRANSCEIVER

ICOM INCORPORATED

INTRODUCTION

This service manual contains information relative to the theoretical, physical, mechanical and electrical characteristics of the **IC-M8** VHF MARINE TRANSCEIVER.

ASSISTANCE

If you require assistance or further information regarding the operation and capabilities of the **IC-M8**, please contact your nearest authorized ICOM Dealer or ICOM Service Center.

ORDERING PARTS

For the fastest service, supply all of the following information when ordering parts from your dealer or ICOM Service Center:

1. Equipment model and serial number
2. Schematic part identifier (e.g., IC301, Q318)
3. Printed circuit board name and number (e.g., RF UNIT/B-1436B)
4. Part number and name (e.g., 2SC2053 Transistor)
5. Quantity required

TABLE OF CONTENTS

SECTION 1 SPECIFICATIONS

■ GENERAL

Frequency coverrange	:	156MHz~163MHz
Antena impedance	:	50Ω unbalance
Usable temperature	:	−20°C~+60°C
Current drain (with CM-24)	:	Receive stand-by 40mA
		Max audio 200mA
		Transmit High 800mA
		Transmit Low 500mA
		(High power less than 450mA with CM-21)
Power supply voltage	:	7.2~10.8V DC
		negative ground
Demensions (with CM-21)	:	58(61)W×112.5(120.5)H×29(30.5)Dmm
		Bracked values include projections
Weight (with CM-21)	:	250g

■ TRANSMITTER

Output power (with CM-24)	:	High 2.5W
		Low 1.0W
		(High power more than 1W with CM-21)
Emission mode	:	16K0G3E
Modulation system	:	Variable reactance frequency modulation
Audio frequency response	:	6dB/octave from 300Hz to 3000Hz
Audio harmonic distortion	:	10% max
Noise and hum	:	More than 40dB

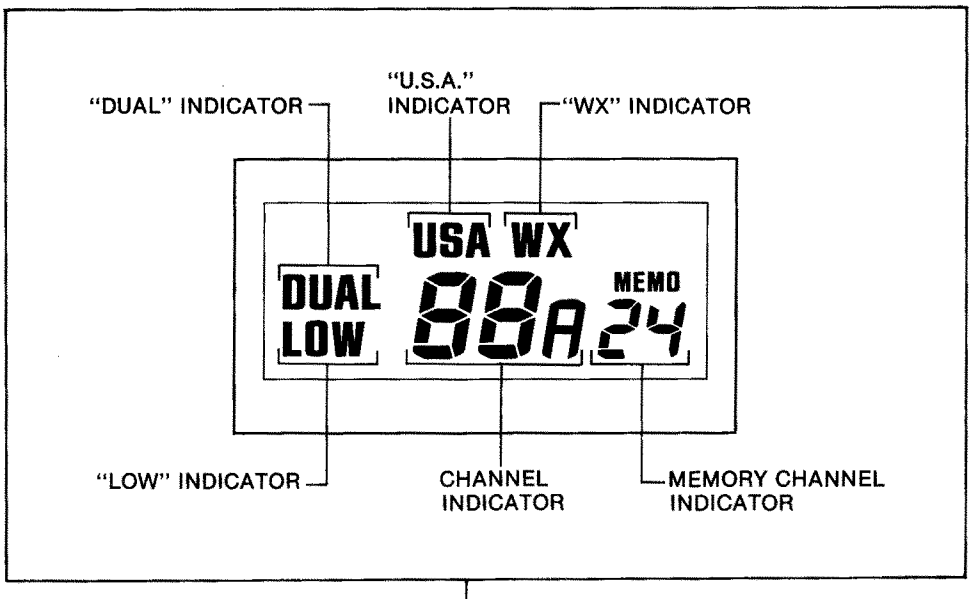
■ RECEIVER

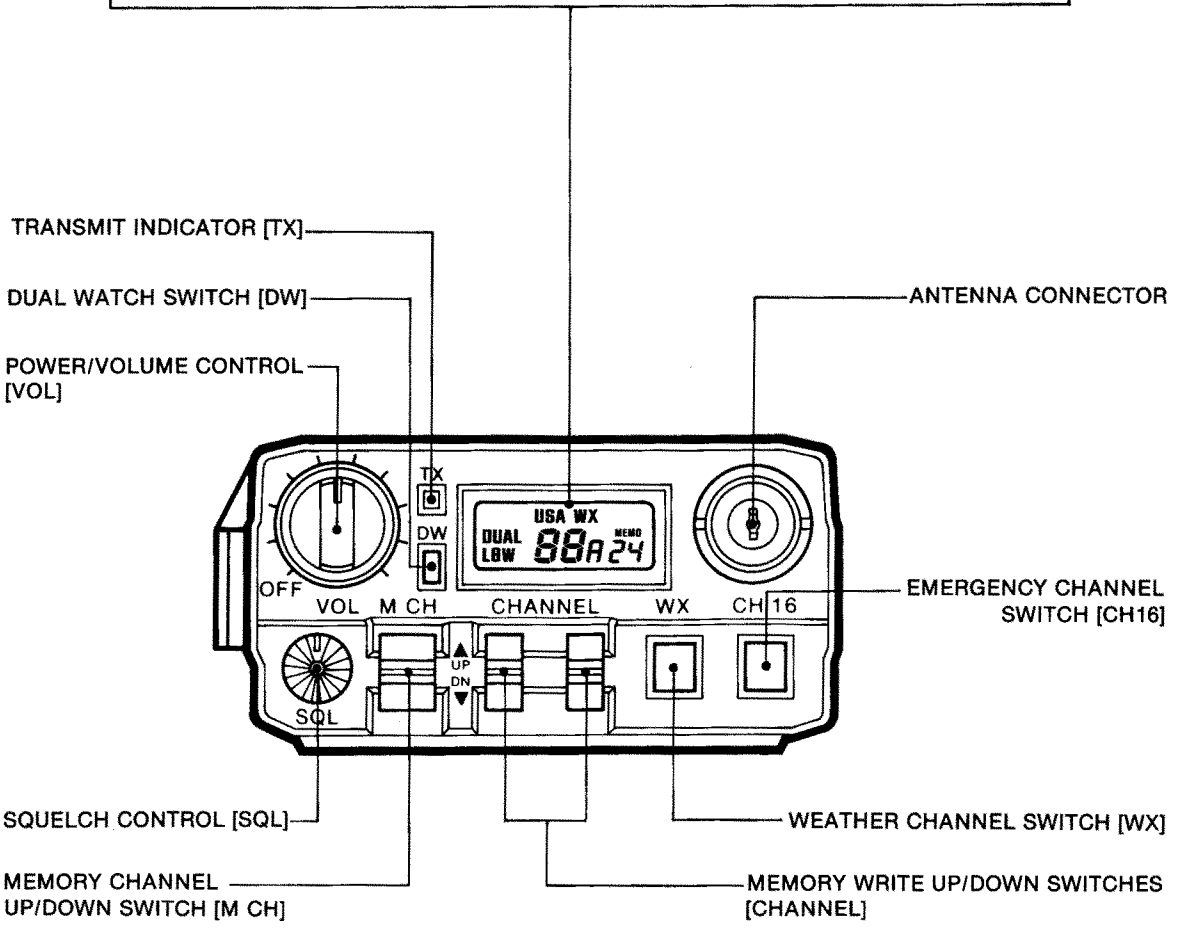
Receiving system	:	Double-conversion superheterodyne
Imtermediate frequencies	:	1st 21.8MHz 2nd 455kHz
Modulation acceptance	:	16K0G3E
Sensitivity	:	0.35μV for 12dB SINAD
Squelch sensitivity (Threshold)	:	Less than 0.3μV
Audio power output	:	0.25W at 10% distortion
Adjacent channel selectivity	:	More than 70dB
Spurious response	:	More than 70dB
Blocking and desensitization	:	90dBμ e.m.f
Audio frequency response	:	6dB/octave from 300Hz to 3000Hz
Noise and hum	:	More than 40dB

SECTION 2 OUTSIDE AND INSIDE VIEWS

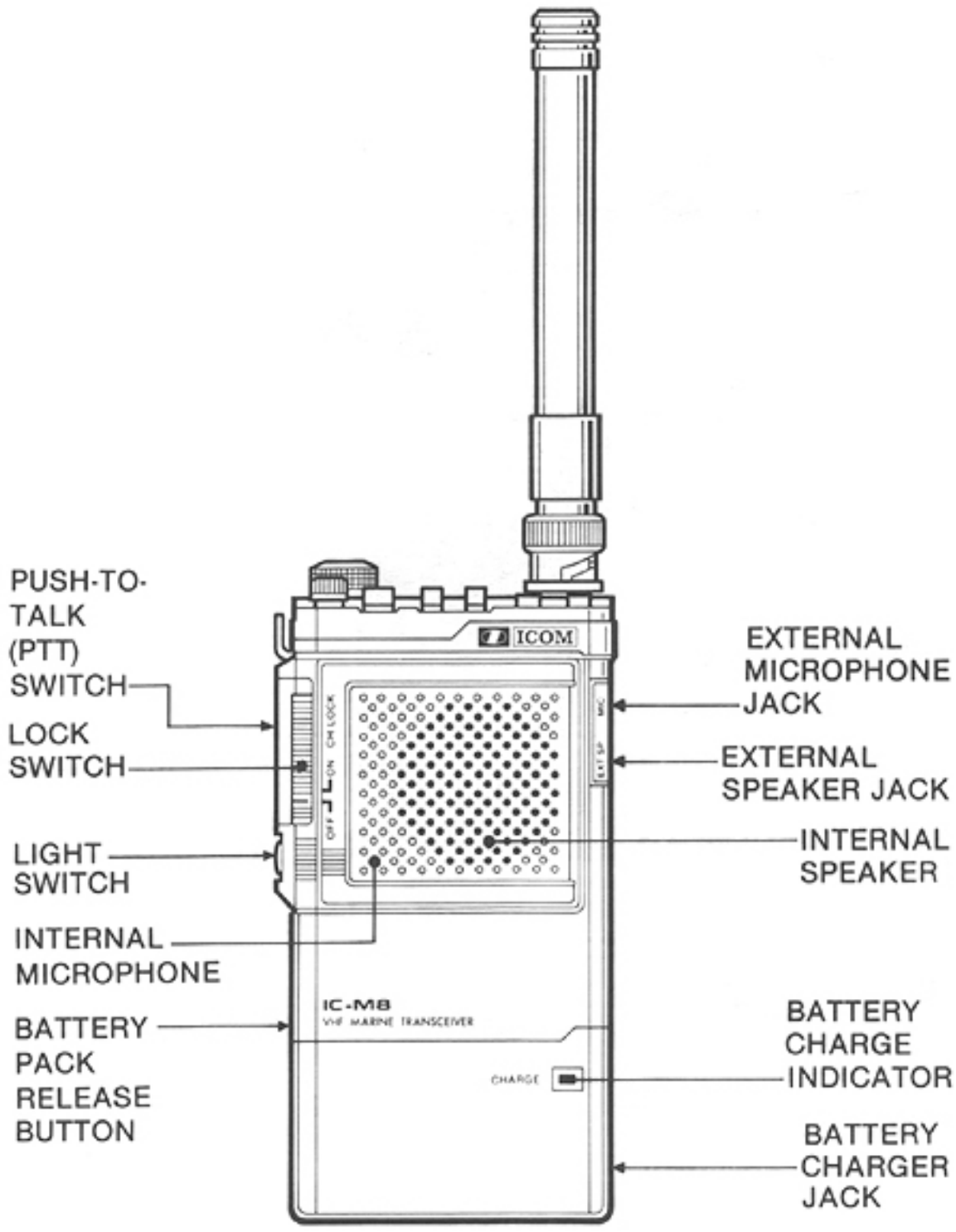
2-1 TOP VIEW

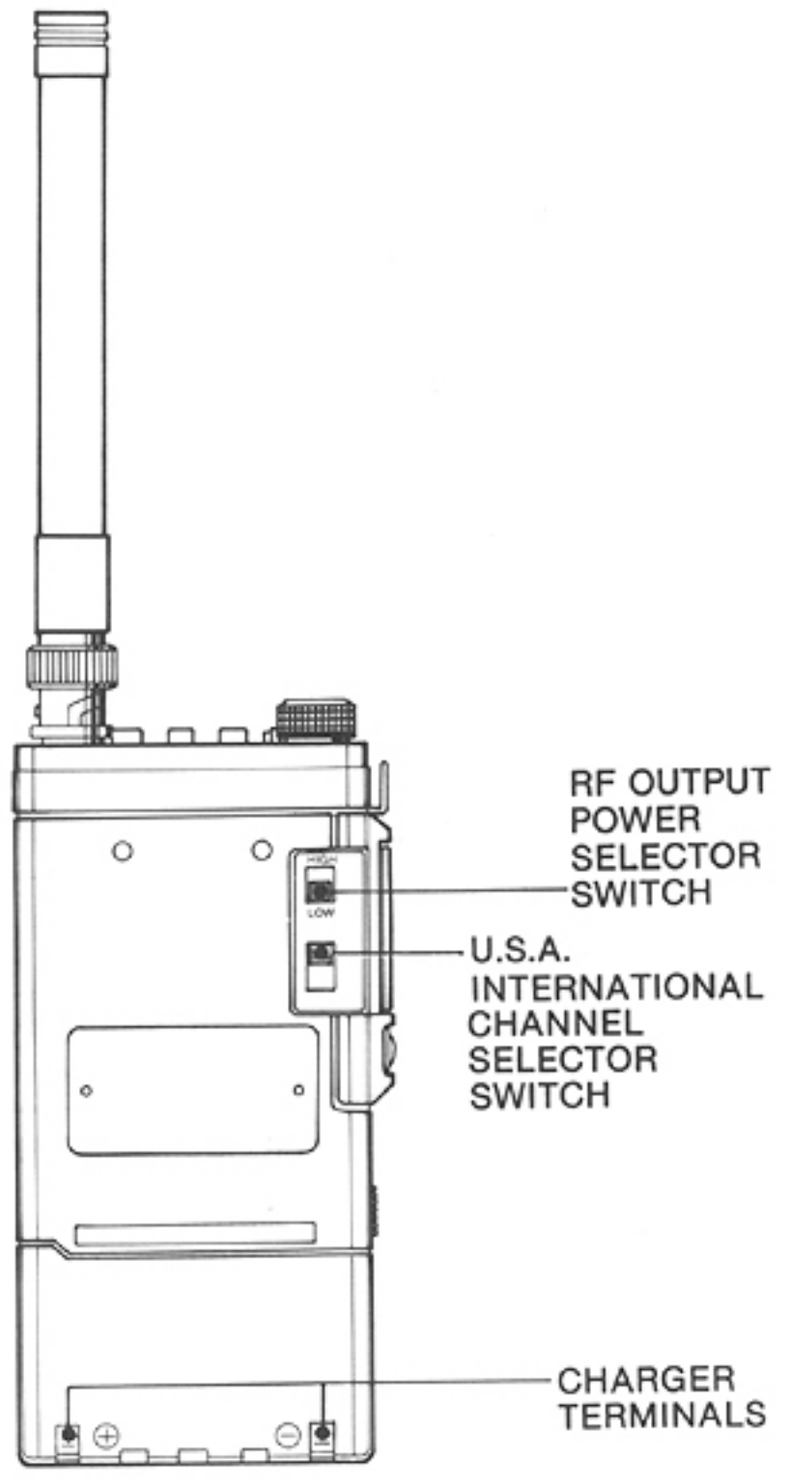
• FREQUENCY DISPLAY



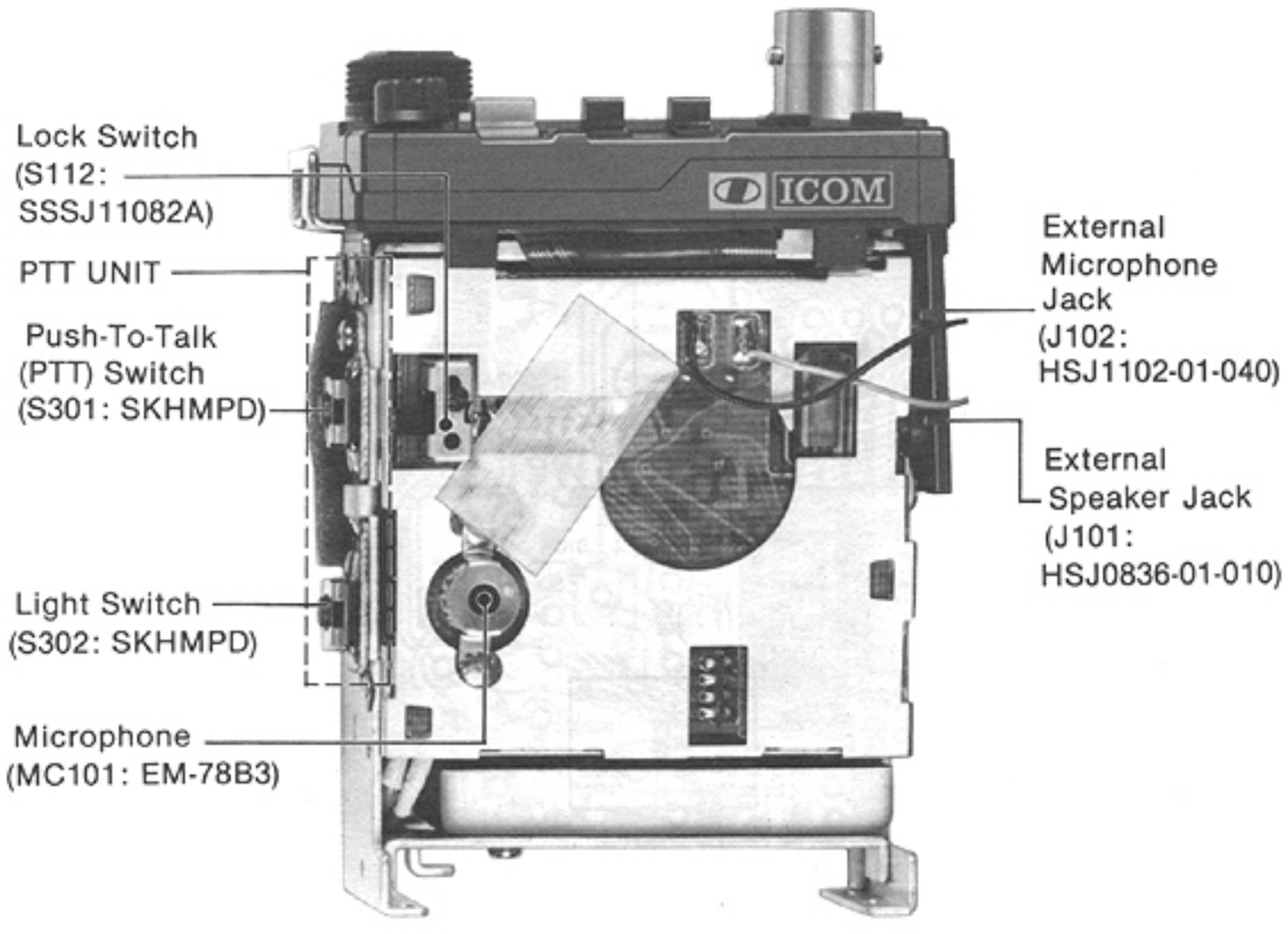


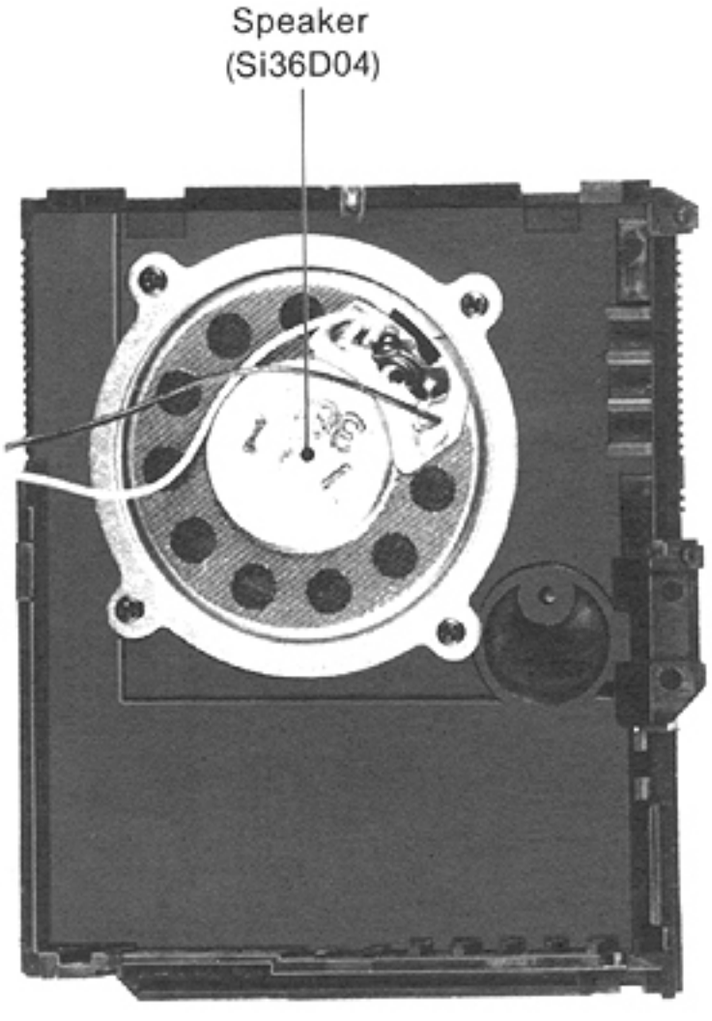
2-2 FRONT AND REAR PANEL VIEWS





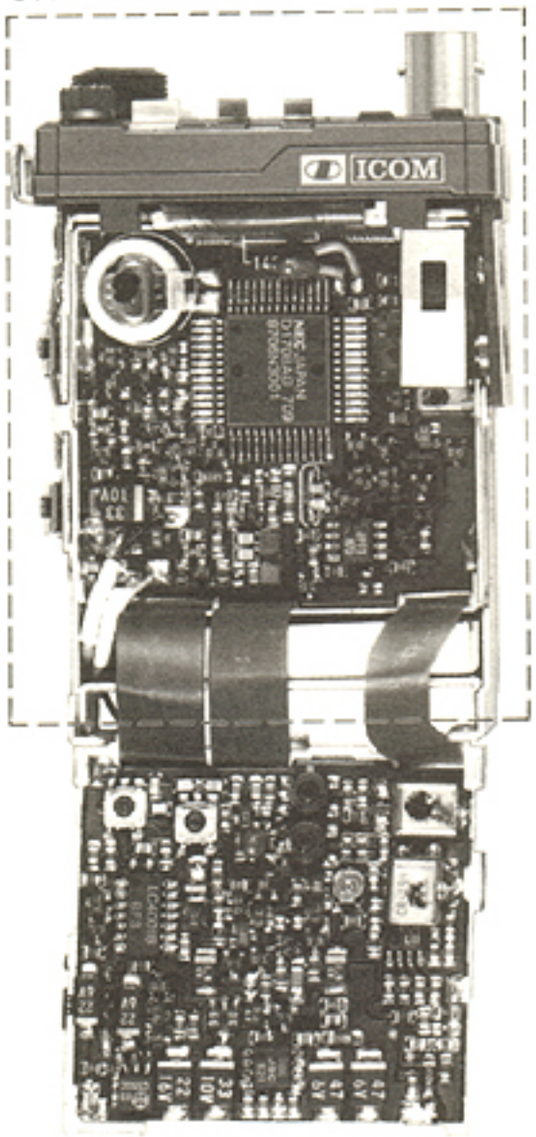
2-3 FRONT INSIDE VIEWS

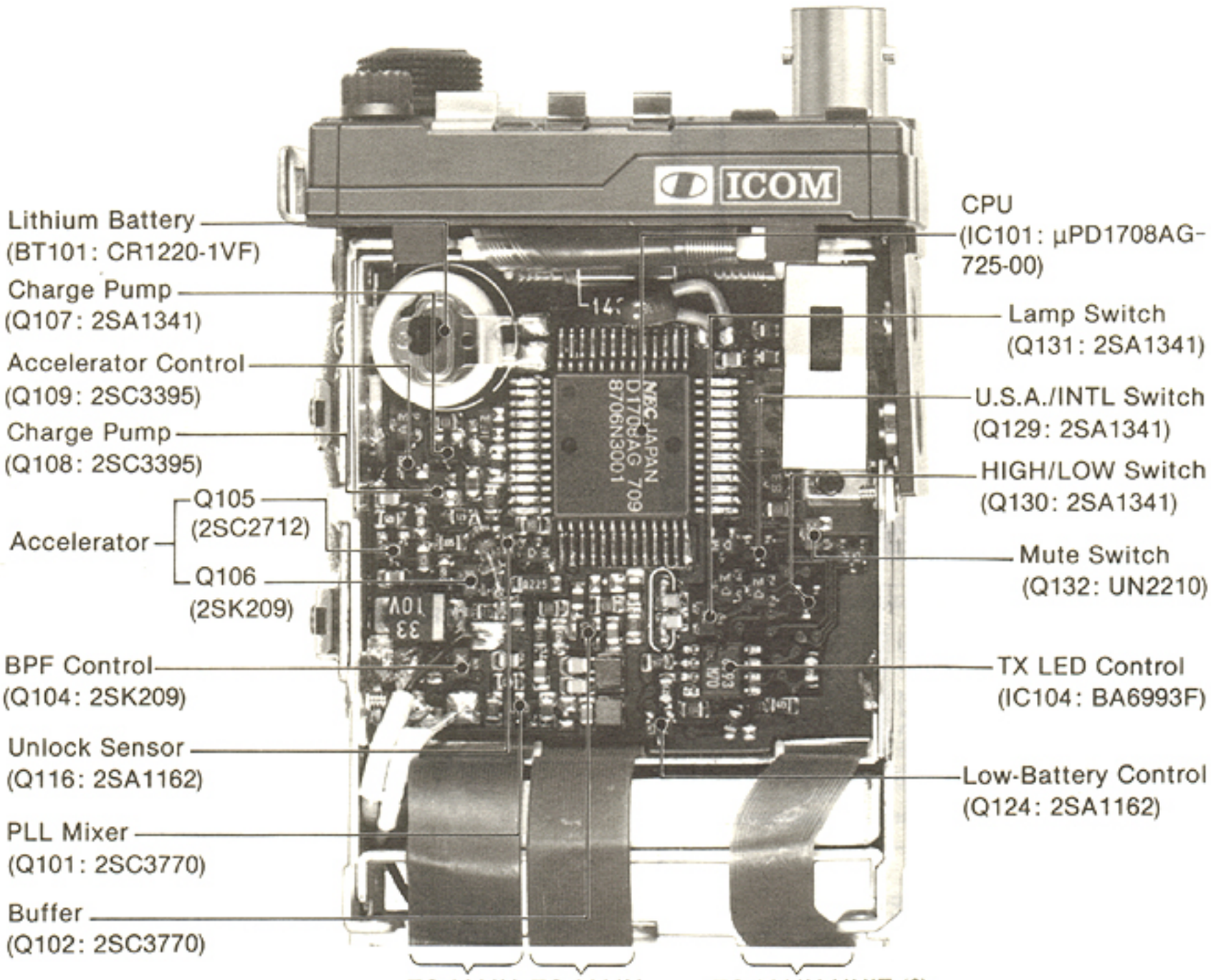




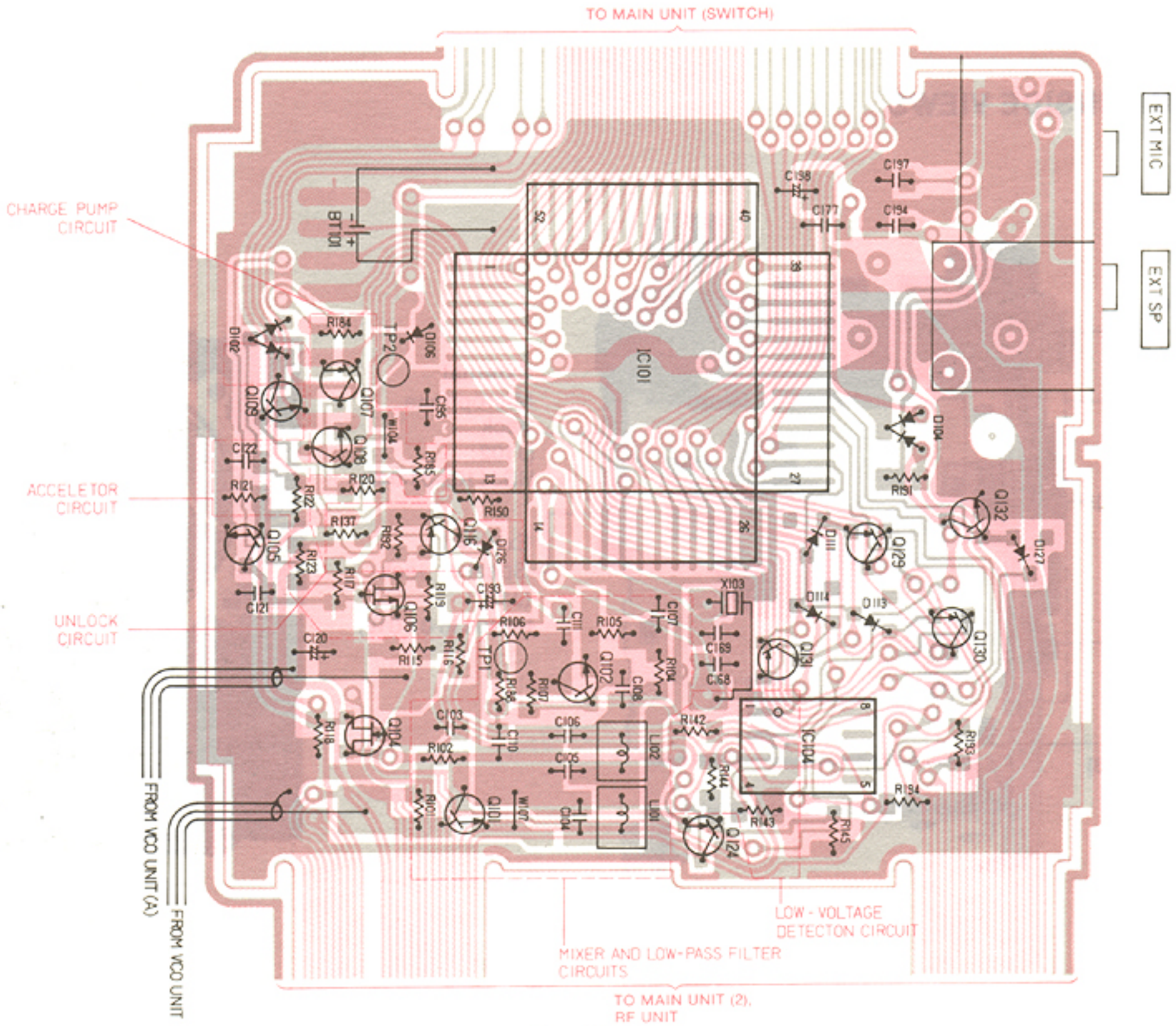
• FRONT INSIDE VIEW/MAIN UNIT (1)

UNIT LOCATION



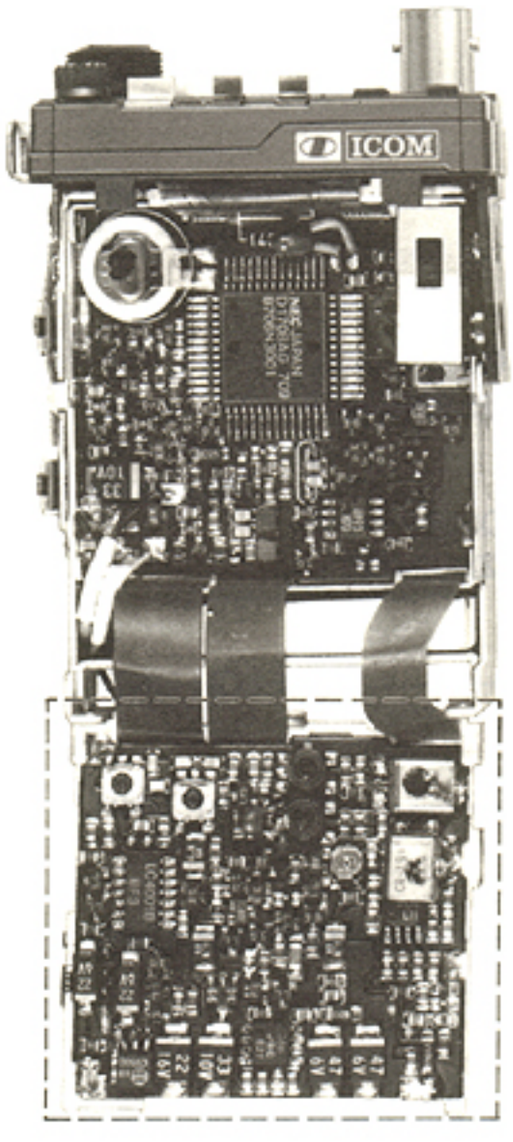


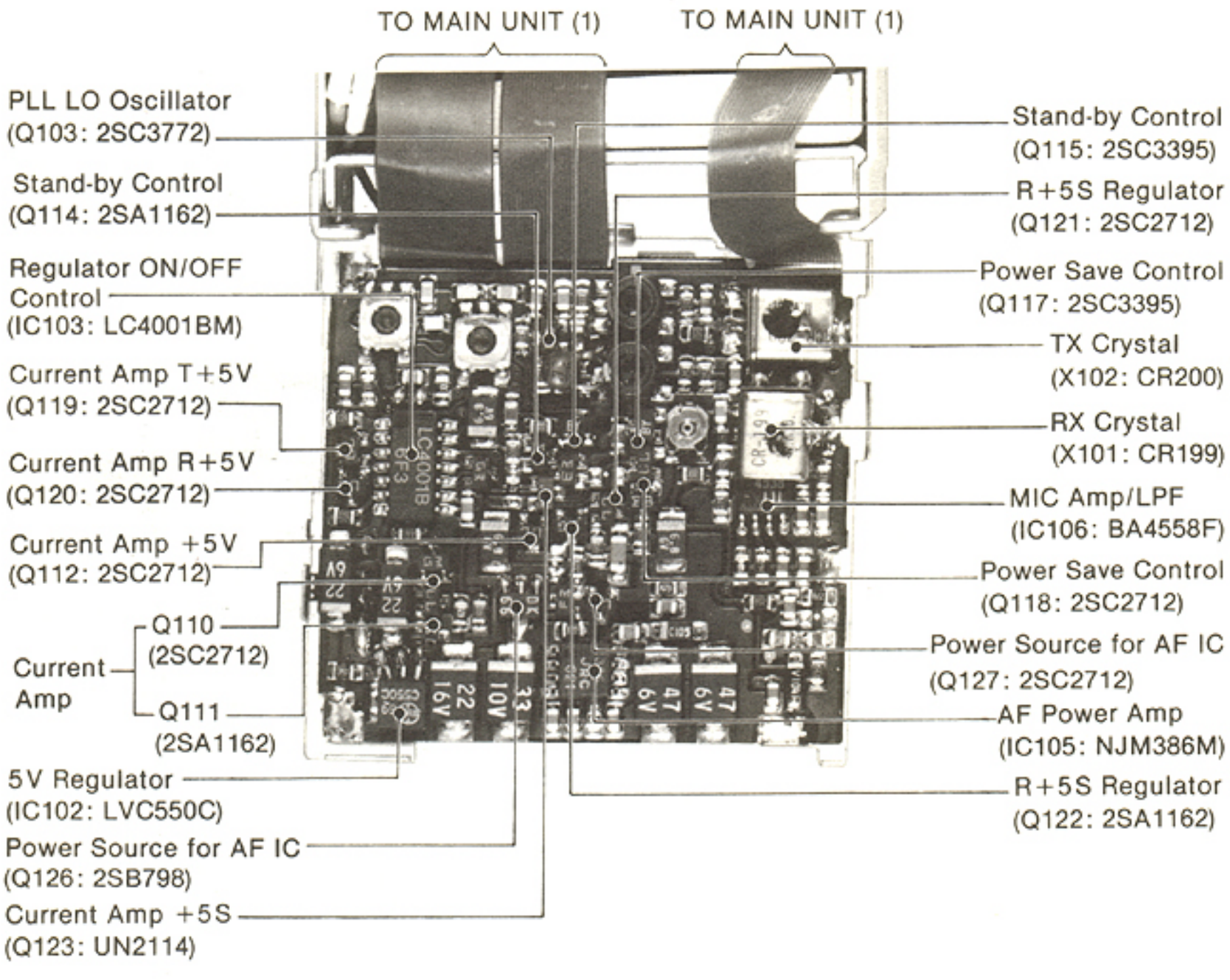
ILLUSTRATED VIEW



• FRONT INSIDE VIEW/MAIN UNIT (2)

UNIT LOCATION





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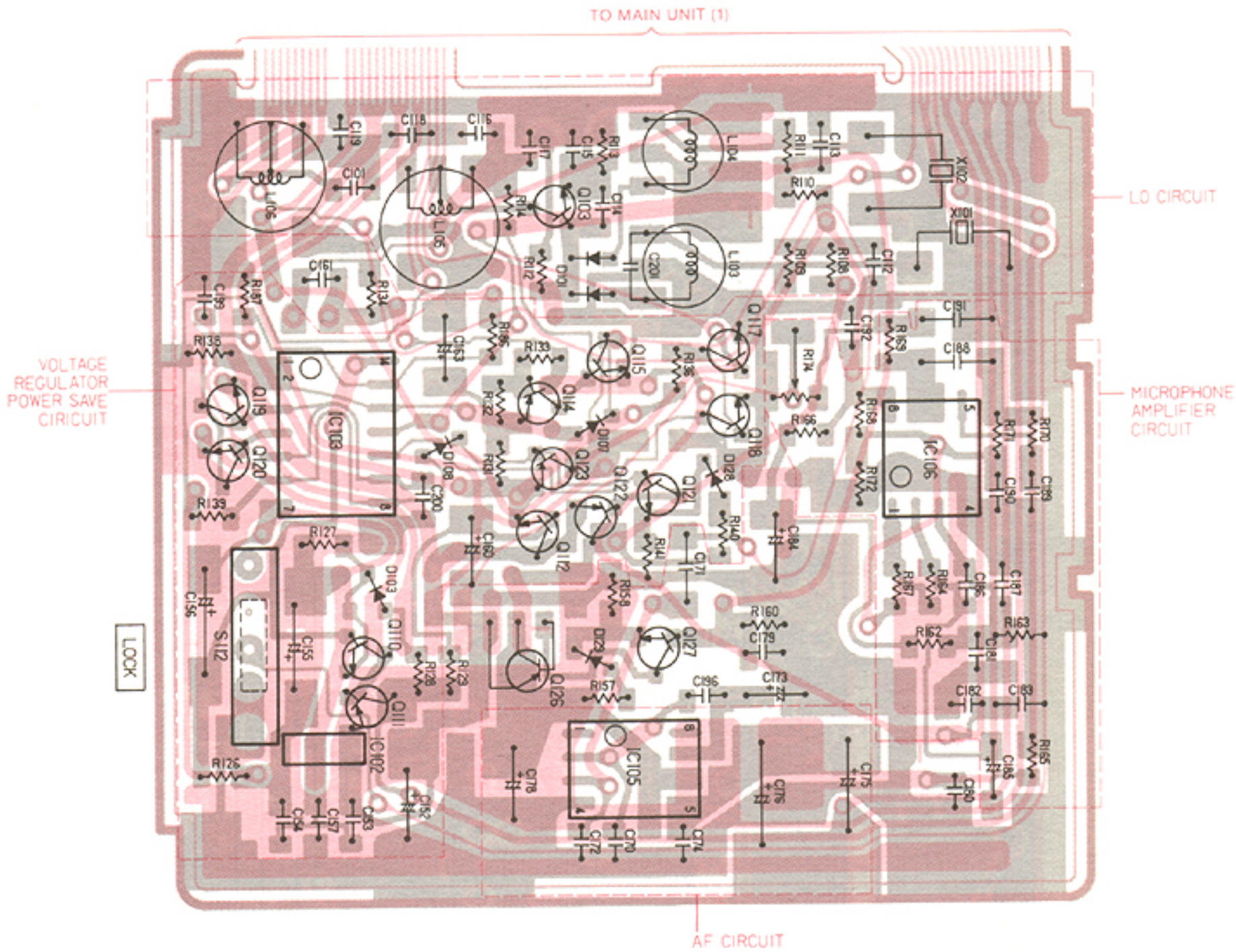
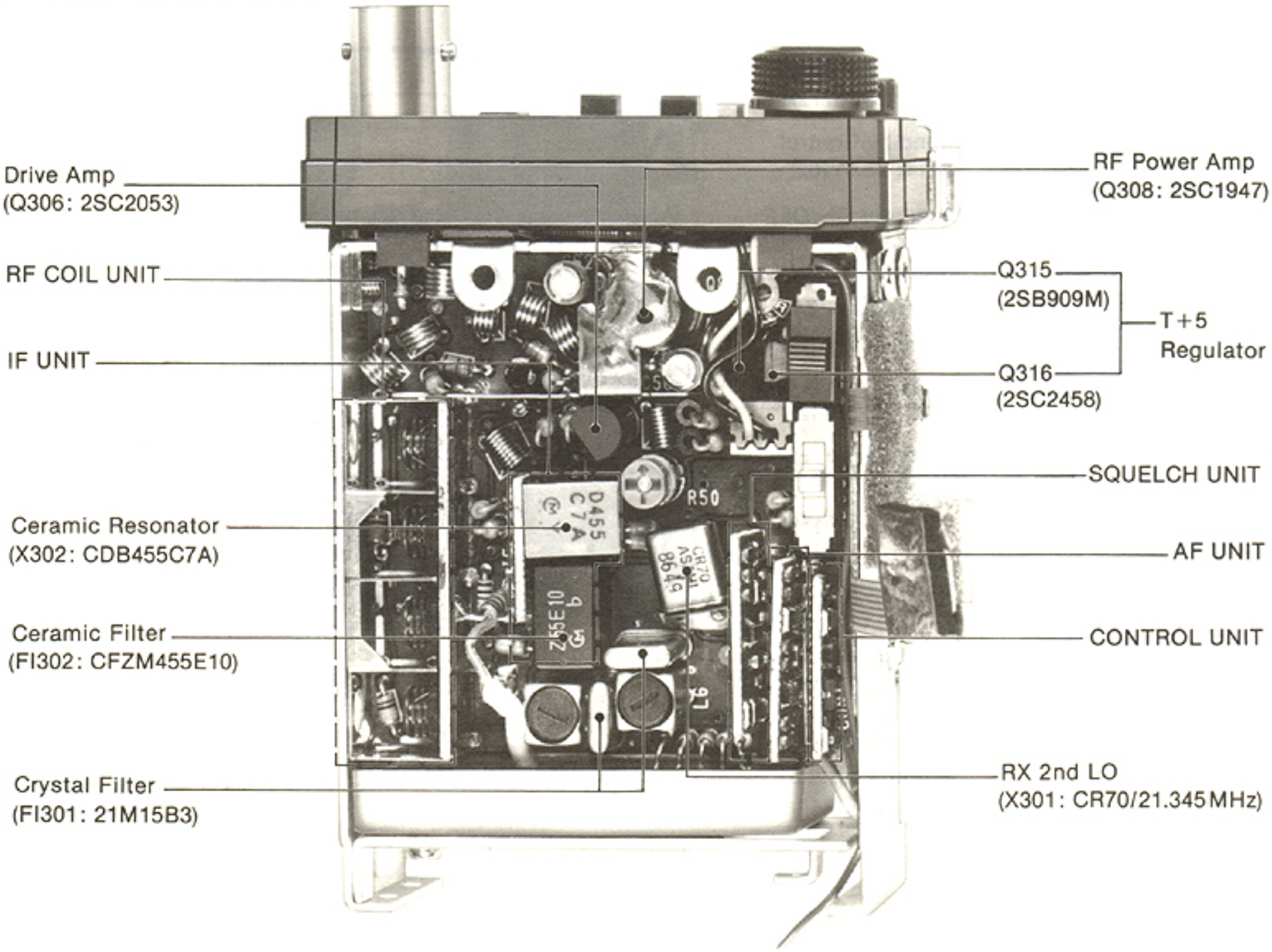
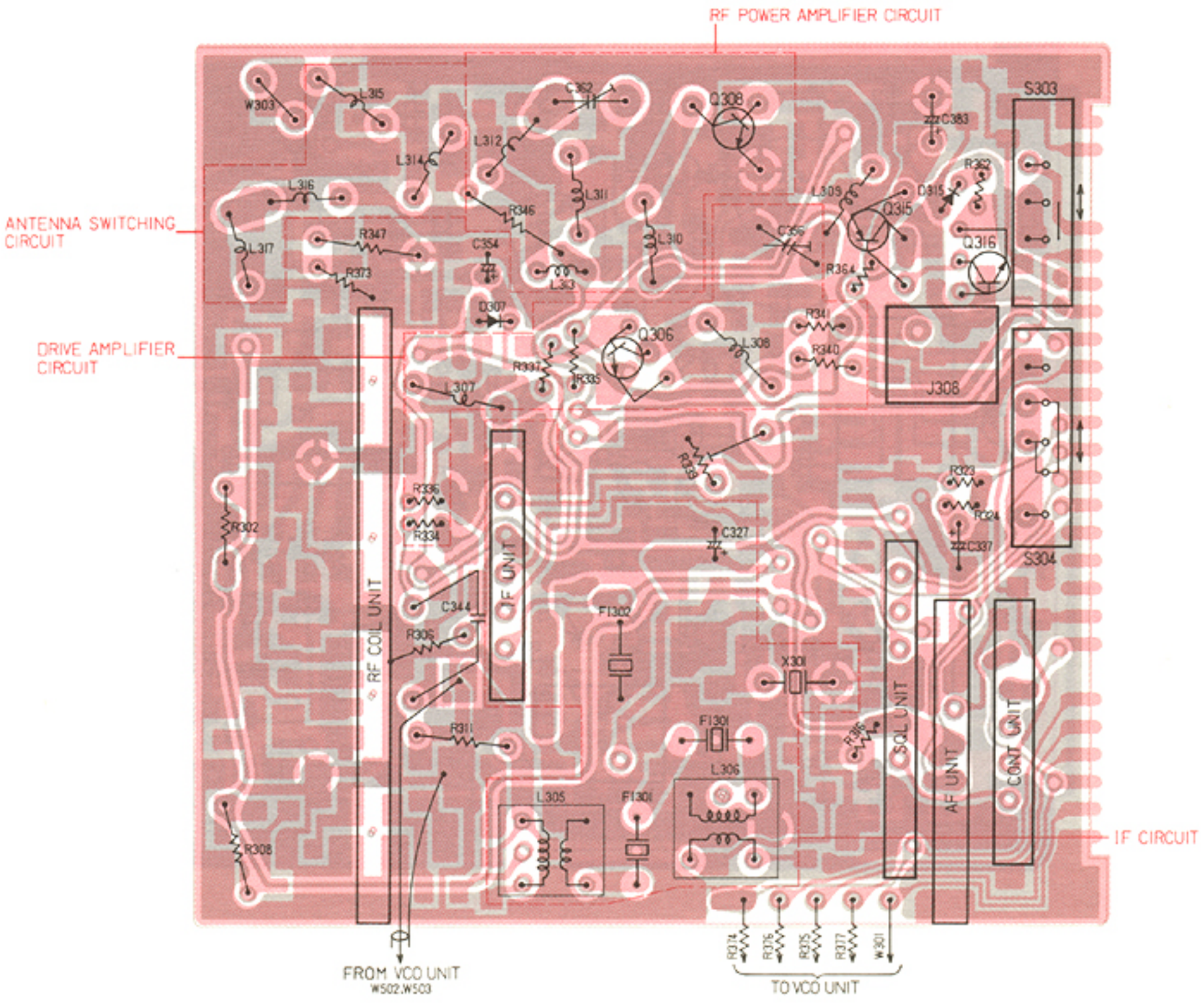


2-4 REAR INSIDE VIEWS

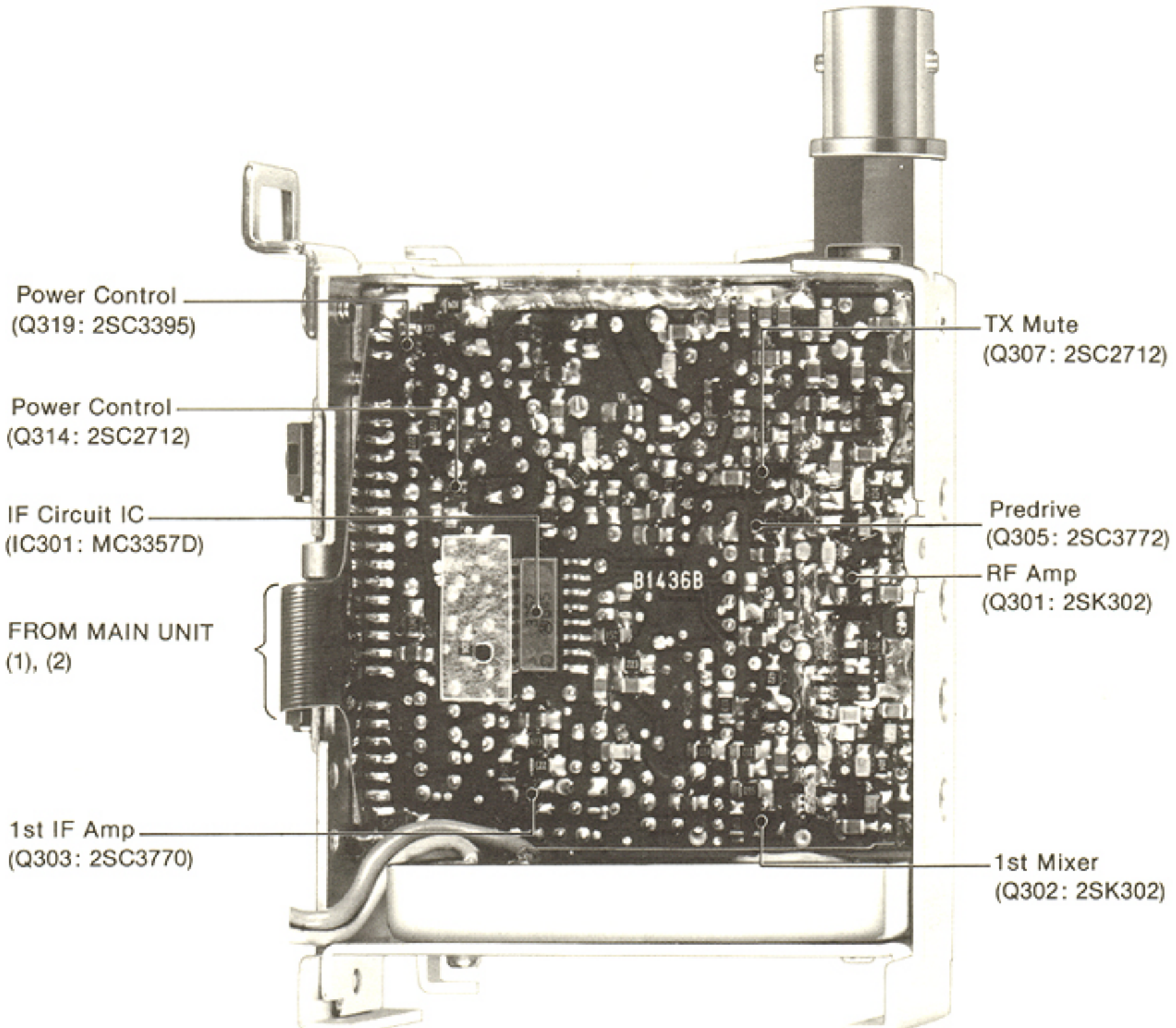
• RF UNIT COMPONENTS SIDE



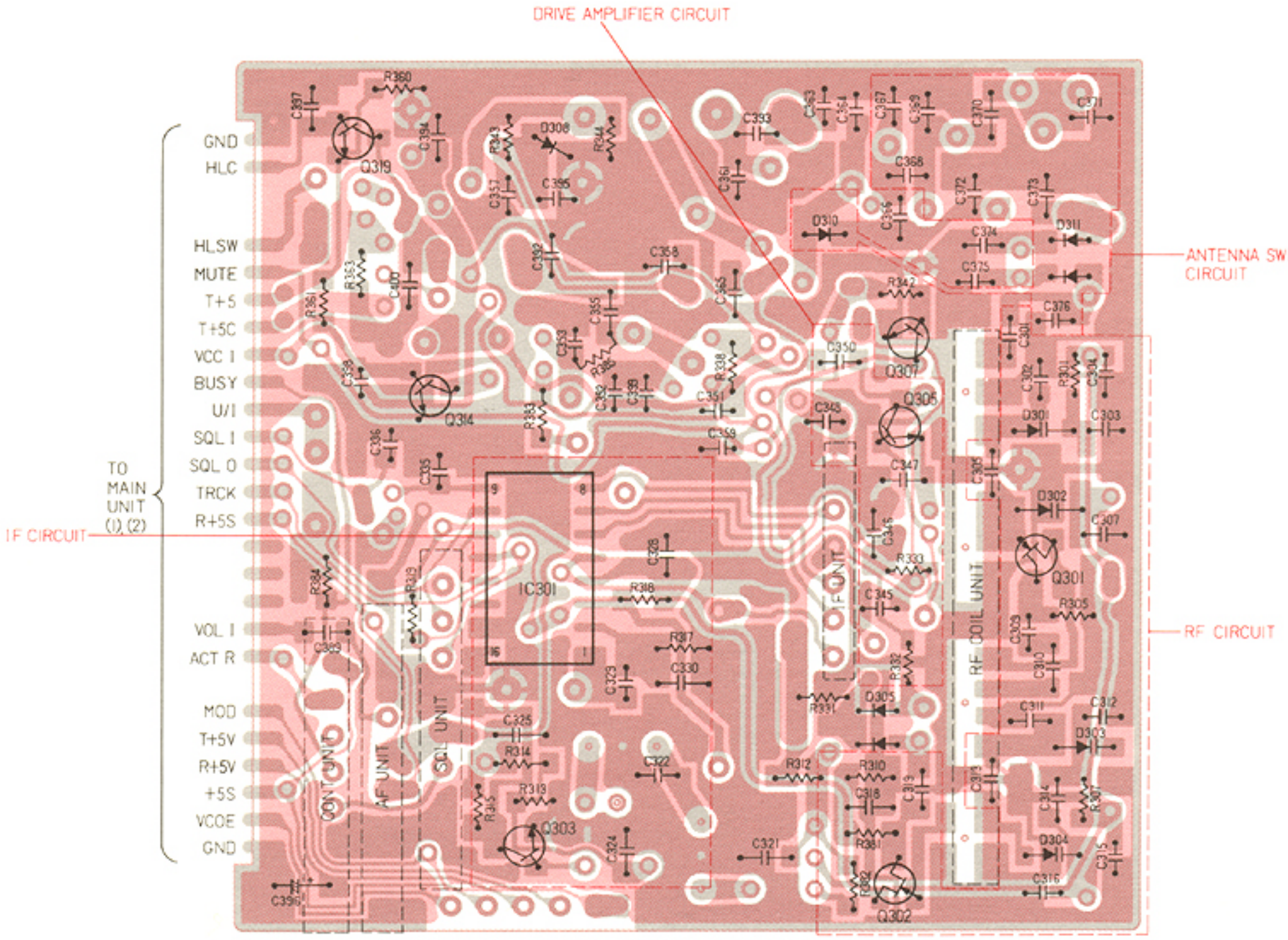
ILLUSTRATED VIEW



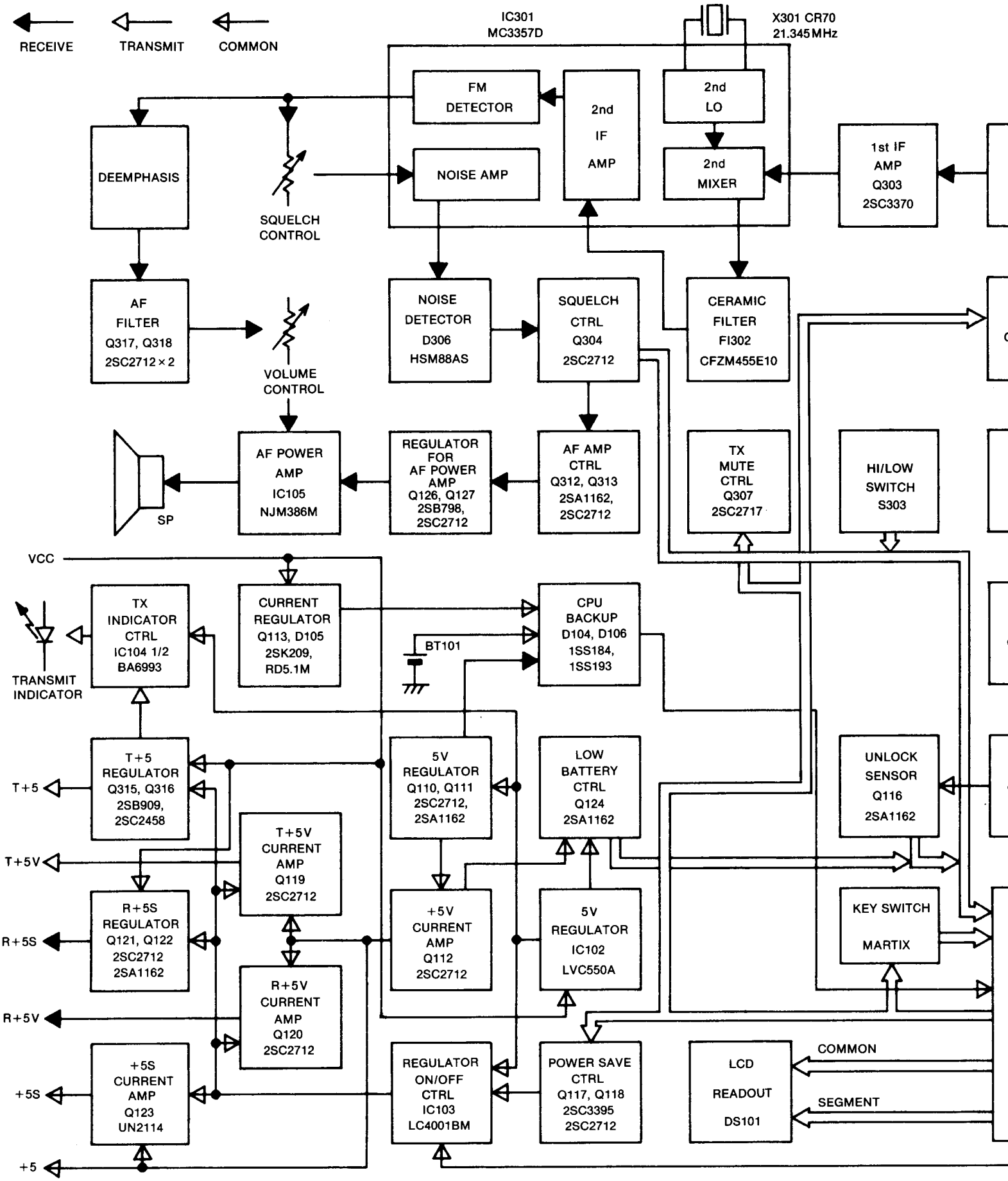
• RF UNIT FOIL SIDE

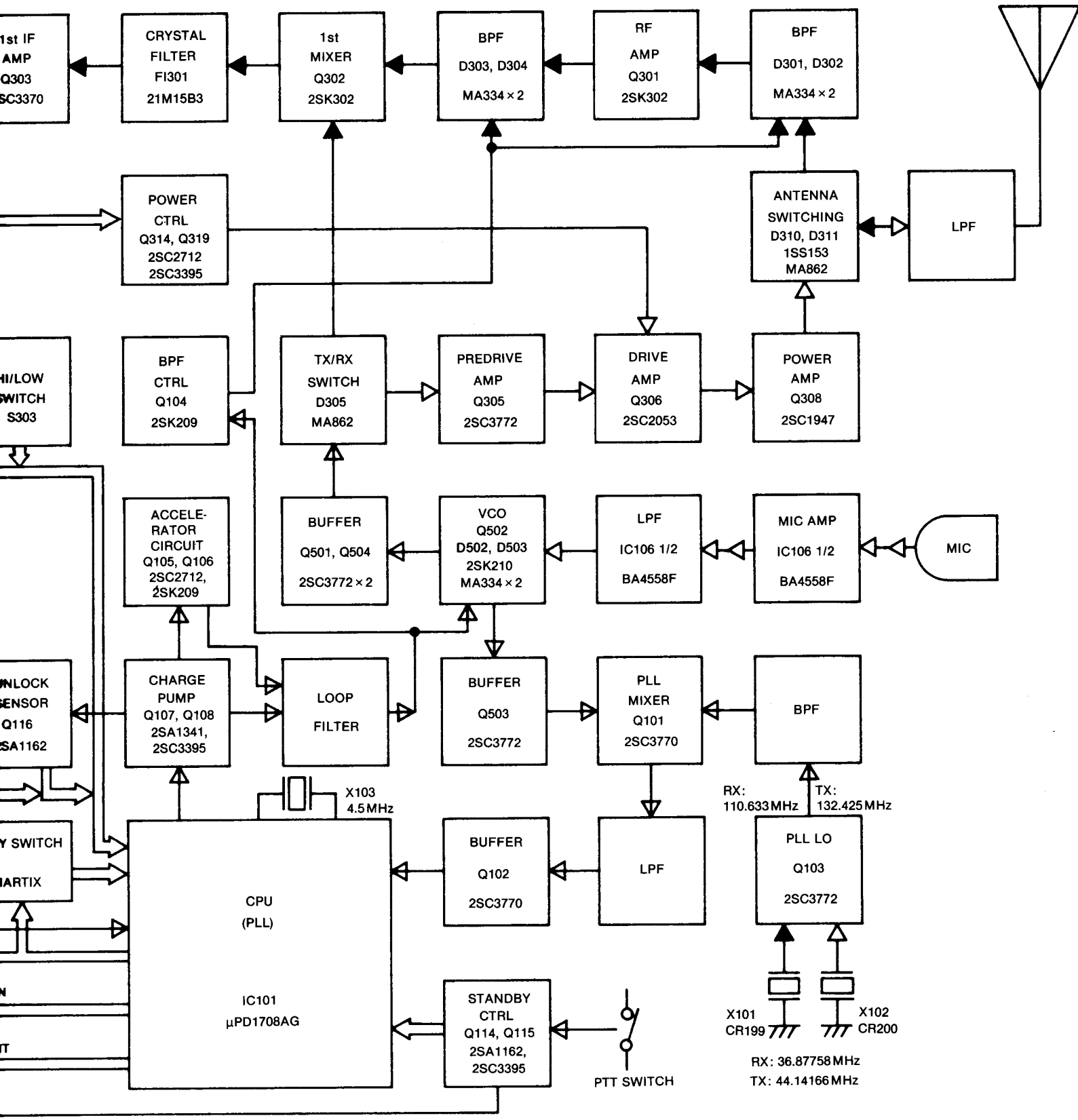


ILLUSTRATED VIEW



SECTION 3 BLOCK DIAGRAM




1st IF AMP Q303 SC3370
CRYSTAL FILTER FI301 21M15B3
1st MIXER Q302 2SK302
BPF D303, D304 MA334×2
RF AMP Q301 2SK302
BPF D301, D302 MA334×2
POWER CTRL Q314, Q319 2SC2712 2SC3395
ANTENNA SWITCHING D310, D311 1SS153 MA862
LPF
HI/LOW SWITCH S303
BPF CTRL Q104 2SK209
TX/RX SWITCH D305 MA862
PREDRIVE AMP Q305 2SC3772
DRIVE AMP Q306 2SC2053
POWER AMP Q308 2SC1947
ACCELE-RATOR CIRCUIT Q105, Q106 2SC2712, 2SK209
BUFFER Q501, Q504 2SC3772×2
VCO Q502 D502, D503 2SK210 MA334×2
LPF IC106 1/2 BA4558F
MIC AMP IC106 1/2 BA4558F
MIC
UNLOCK SENSOR Q116 SA1162
CHARGE PUMP Q107, Q108 2SA1341, 2SC3395
LOOP FILTER
BUFFER Q503 2SC3772
PLL MIXER Q101 2SC3770
BPF
X103 4.5MHz
RX: 110.633MHz
TX: 132.425MHz
Y SWITCH
IARTIX
CPU (PLL)
IC101 μPD1708AG
BUFFER Q102 2SC3770
LPF
PLL LO Q103 2SC3772
STANDBY CTRL Q114, Q115 2SA1162, 2SC3395
PTT SWITCH
X101 CR199
X102 CR200
RX: 36.87758MHz
TX: 44.14166MHz

4-1 RECEIVER CIRCUITS

4-1-1 ANTENNA SWITCHING CIRCUIT (RF UNIT)

The receive signals enter the RF UNIT from antenna connector (J301), pass through a low-pass filter and are fed to the antenna switching circuit. The low-pass filter is a Chebyschev low-pass filter comprising L314, L315, C367~C371. The antenna switching circuit employs a λ/4-type diode switching system which does not allow current to flow during reception.

The antenna switching circuit comprises D310 and D311. D310 and D311 are turned OFF during reception and the receive signals are fed to the two-stage λ/4 circuit comprising L316, L317, C372, C373 and C376. After passing through the λ/4 circuit, the signals are fed to the RF circuit.

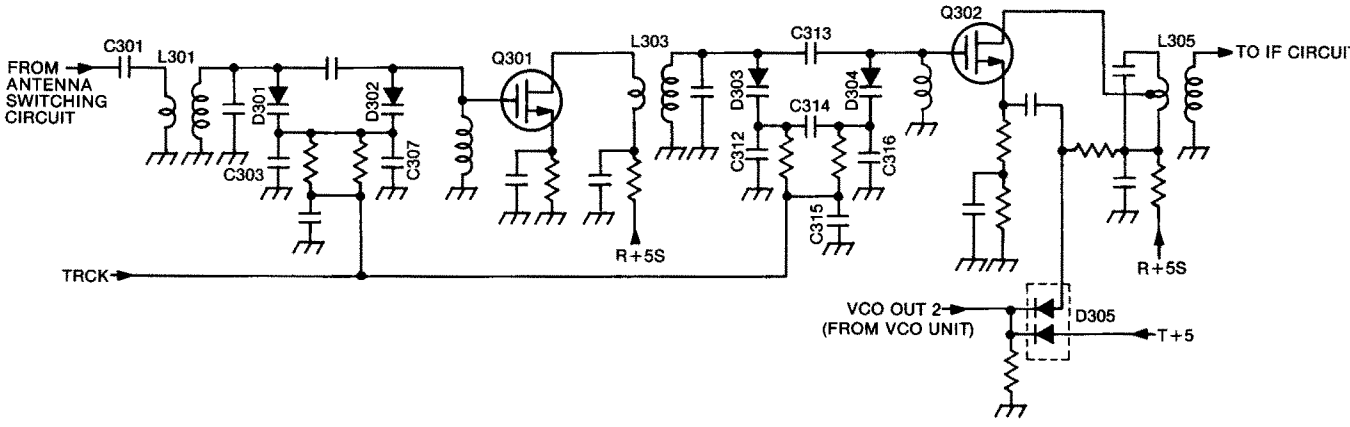
4-1-2 RF CIRCUIT (RF UNIT)

The receive signals fed from the antenna switching circuit pass through C301 and are fed to the bandpass filter comprising D301, D302, C303, C305 and C307.

After passing through the bandpass filter, the signals are amplified at Q301. After amplification at Q301, RF out-of-band signals are further suppressed by passing through a bandpass filter comprising L303, L304 D303, D304, C312~C314 and C316. This bandpass filter is a circuit for varying the voltage capacity between the terminals of D303 and D304 for obtaining ideal tracking characteristics over a wide frequency range. This is achieved by varying the voltages applied to the respective cathodes of D303 and D304. After passing through the bandpass filter, the signals are fed to the gate of 1st mixer (Q302).

The 130MHz-band LO signals fed from the VCO UNIT pass through the transmit/receive switching circuit (D305) and are applied to the source of 1st mixer (Q302). The receive signals and 130MHz-band LO signals are mixed by the 1st mixer (Q302), and the 21.8MHz 1st IF signals are applied to the IF circuit.

RF CIRCUIT



4-1-3 IF CIRCUIT (RF AND IF UNITS)

The 1st IF signals fed from Q302 pass through FI301 which is a pair of crystal mechanical filters of matching characteristics. This further suppresses out-of-band signals. After passing through FI301, the signals are amplified at Q303, pass through C326 and are applied to IC301 (pin 16).

IC301 contains the 2nd LO circuit, 2nd mixer circuit, limiter amplifier circuit and quadrature detector circuit. The 2nd LO circuit located in IC301 and X301 generate 2nd LO signals of frequency 21.345MHz which are fed to the 2nd mixer section of IC301.

The 1st IF signals and 2nd LO signals applied to IC301 (pin 16) are mixed at the 2nd mixer section in IC301. These are converted to the 2nd IF signals of frequency 455kHz which are output from IC301 (pin 3).

The 2nd IF signals output from pin 3 are applied to IC301 (pin 5). The 2nd IF signals input to pin 5 are amplified by the limiter amplifier section of IC301.

The output of the limiter amplifier section is input to the quadrature detector section and simultaneously output from pin 7.

After being output from pin 7, the signals pass through X302 (ceramic resonator), are input to IC301 (pin 8) and are detected by the quadrature detector section to convert to the AF signals which are output from pin 9.

4-1-4 AF CIRCUIT (RF, AF AND MAIN UNITS)

The AF signals output from IC301 (pin 9) pass through the deemphasis circuit comprising R324 and C337, and are applied to the AF amplifier comprising Q317 and Q318 where they are amplified. This deemphasis circuit is an integrating circuit possessing frequency characteristics of 6dB/octave.

Q317 and Q318 amplify 300Hz~3kHz signals and suppress out-of-band signals. Q317 and Q318 therefore operates as a bandpass filter.

The signals amplified at Q317 and Q318 pass through R125 (VOLUME CONTROL) and are applied to AF power amplifier (IC105) in the MAIN UNIT.

The signals power-amplified at IC105 are fed to the speaker as the drive signals.

4-1-5 SQUELCH CIRCUIT (RF, SQUELCH AND MAIN UNITS)

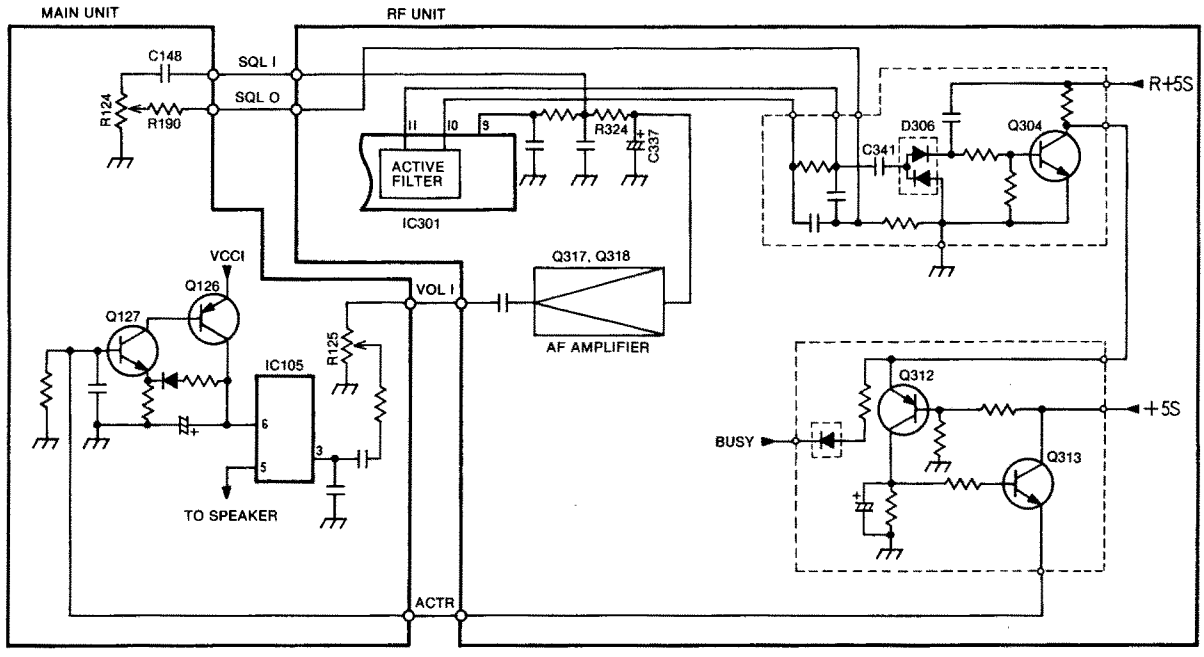
A portion of AF signals from IC301 (pin 9) pass through C148, R124 and R190 (SQUELCH CONTROL) in the MAIN UNIT, and are fed to IC301 (pin 10). After being input to pin 10, the signals pass through the active filter section of IC301 and are output from pin 11. This active filter amplifies noise components of frequency approximately 20kHz and above.

After being output from pin 11, the noise components pass through C341 and are noise-detected by D306.

If no signals are received from antenna connector, the voltages of the noise detection output signals which are output from D306 increase which result in turning Q304 ON. When Q304 is turned ON, Q312 and Q313 are turned OFF, and the output voltage (ACTR) of Q313 becomes "LOW". The output signals of Q313 control Q126 and Q127 in the MAIN UNIT. This suppresses the AF signals output from AF POWER AMPLIFIER (IC105).

Furthermore, the emitter voltage of Q312 becomes "LOW" during transmission thus turning Q312 and Q313 OFF and turning the output voltage (ACTR) of Q313 to "LOW".

AF AND SQUELCH CIRCUITS



4-1-6 130MHz LO CIRCUIT (VCO UNIT)

The 130MHz-band local oscillation signals oscillated at Q502 (VCO) are buffer amplified by the circuit comprising Q501 and Q504, and are fed to the transmit/receive switching circuit (D305) in the RF UNIT. After passing through D305, the LO signals are applied to the source of the 1st mixer (Q302).

4-2 TRANSMITTER CIRCUITS

4-2-1 MICROPHONE AMPLIFIER CIRCUIT (MAIN UNIT)

The AF signals output from the INTERNAL MICROPHONE or EXTERNAL MICROPHONE JACK (J102) are amplified at the limiter amplifier comprising IC106.

This limiter amplifier possesses a negative feedback circuit whose frequency characteristics have been set so that its frequency characteristics become 6dB/octave in the 300Hz~3kHz range. This causes IC106 to function as a preemphasis circuit. IC106 (limiter amplifier) comprises an operational amplifier which is for making the waveform of the output signals of the limiter amplifier vertically symmetrical.

As the waveform of the output signals of IC106 (limiter amplifier) is close to a square, it contains many RF components. IC106 therefore operates as a low-pass filter (splatter-filter) to reduce the signals which are 3kHz and above.

After passing through the low-pass filter, the signals pass through R174, are applied to the VCO circuit in the VCO UNIT and are frequency-modulated.

4-2-2 DRIVE AMPLIFIER CIRCUIT (RF UNIT)

The 156 MHz-band signals output from Q502 (VCO) are amplified by the buffer amplifier comprising Q501 and Q504, pass through D305 (transmit/receive switching circuit) and are applied to Q305 (predrive amplifier) where they are amplified.

After being output from Q305, the signals are further amplified by Q306 (drive amplifier) where signals over a wide frequency band can be amplified without adjustment.

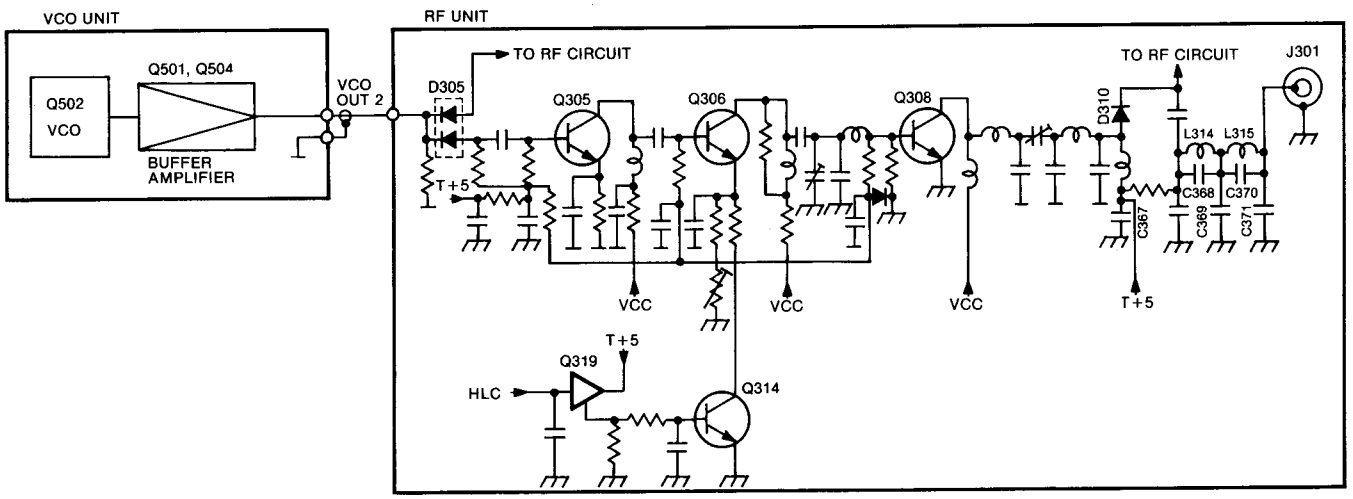
The output power of Q306 is controlled by Q314. This enables HIGH/LOW switching of the RF output power.

4-2-3 RF POWER AMPLIFIER CIRCUIT (RF UNIT)

Signals output from Q306 are power-amplified at Q308. Q308 outputs stable power for 2.5 W or more during high-power transmissions and less than 1 W during low-power transmissions.

After being power-amplified at Q308, the RF signals pass through D310 and the low-pass filter, and are output from the antenna connector. D310 is turned ON during transmission. This low-pass filter comprises L314, L315, and C367~C371, and sufficiently suppresses high-frequency spurious signals.

DRIVE AMPLIFIER AND RF POWER AMPLIFIER CIRCUITS



4-3 PLL CIRCUITS

4-3-1 LO CIRCUIT (MAIN UNIT)

Mixer-type PLL circuits are built into IC-M8. The LO circuit in the PLL circuits contain two crystal units, X102 for reception and X101 for transmission, which are selected and used as required.

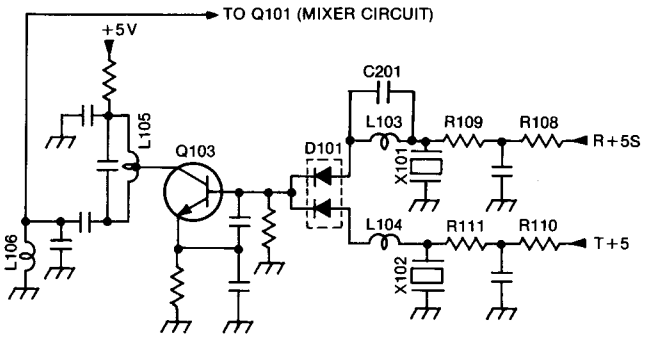
Local oscillation is performed by Q103, X101 and X102. The type of circuit is the 3rd overtone oscillation circuit. The oscillation signals are output from the collector of Q103 after passing through the band-pass filter comprising L105 and L106. The frequency of the oscillation signals is 110.63274 MHz during reception and 132.425 MHz during transmission.

During reception, R+5S is applied to D101 1/2 via R108, R109, and L103 which causes D101 1/2 to be turned ON. A voltage is applied to the base of Q103 and the LO signals are oscillated by X101. During transmission, T+5 is applied to D101 1/2 via R110, R111 and L104 which causes D101 1/2 to be turned ON. A voltage is applied to the base of Q103 and the LO signals are oscillated by X102.

4-3-2 MIXER AND LOW PASS FILTER CIRCUITS (MAIN UNIT)

After passing through buffer amplifier (Q503), the oscillator output signals from VCO (Q502) and the output signals from the LO circuit are fed to the base of Q101.

Q101 is the mixer circuit where these two signals are mixed. The output signals of mixer circuit (Q101) pass through a low-pass filter comprising L101, L102, C104~C106, pass through buffer amplifier (Q102) and are input to IC101 (pin 9).



4-3-3 LOOP CIRCUIT (MAIN UNIT)

The frequency of the signals fed to IC101 (pin 9) from mixer circuit (Q101) is approximately 46.16MHz. These signals are divided by 32 or 33 by the prescaler circuit located internally at IC101, and are further divided by the programmable counter circuit. (The prescaler circuit has two dividing ratios, 1/32 and 1/33. Selection of these dividing ratios is carried out by the PSC signals output from the swallow-type counter located internally at IC101.)

The dividing ratio of the programmable counter circuit varies in accordance with the channel number displayed on the CHANNEL INDICATOR.

X103 oscillates a frequency in the oscillation circuit in IC101 which outputs signals of approximately 4.5MHz. These signals are divided by 360 by the divider in IC101 to obtain 12.5kHz which are used in IC101 as the reference frequency.

The output signals of the programmable counter are applied to the phase detector circuit located internally at IC101 and are phase-compared. The output signals of the phase detector circuit are output from IC101 (pins 11 and 12).

The output from pins 11 and 12 pass through the charge pump circuit comprising Q107 and Q108, and are fed to the VCO UNIT after passing through the lag lead-type loop filter comprising R120, R119, R115 and C120. In the VCO UNIT, these signals are used as the voltage for controlling the VCO.

This loop filter aims at improving the rise characteristics of the operation of the power save circuit during transmit/receive switching etc., and is provided with an acceleration circuit comprising D102, Q105 and Q106. When the frequency is greatly varied, a phase difference is generated between the output signals of IC101 pins 11 and 12. This phase difference is detected at D102 and Q105. The output signals of Q105 turn Q106 ON. Turning ON of Q106 causes a short between both ends of R119, which in turn reduces the lock up time.

The output of this loop filter, passes through Q104, and is used as the voltage for controlling the band-pass filter of the RF circuit located internally at the receiver circuits.

4-3-4 VCO AND FM MODULATOR CIRCUITS (VCO AND MAIN UNITS)

The VCO circuit is a Colpitts oscillator circuit comprising Q502. Switching of the oscillation frequency during transmit/receive switching is carried out by switching the two diodes in D501 to vary the inductive reactance in the VCO circuit. The oscillation frequency is controlled by using a varicap. This enables stable oscillation over a wide frequency range of the VCO.

The modulation signals are applied to the anode of D502 which varies the voltage capacity between the terminals of D502 to perform FM modulation.

Setting of the deviation is carried out by adjusting the level of the modulation signal at R174.

Switching of the oscillation frequency during transmit/receive switching is carried out as follows.

During transmission, T+5V is 4.3V, and R+5V is 0V. This connects C508 in series to L503, increasing oscillation frequency.

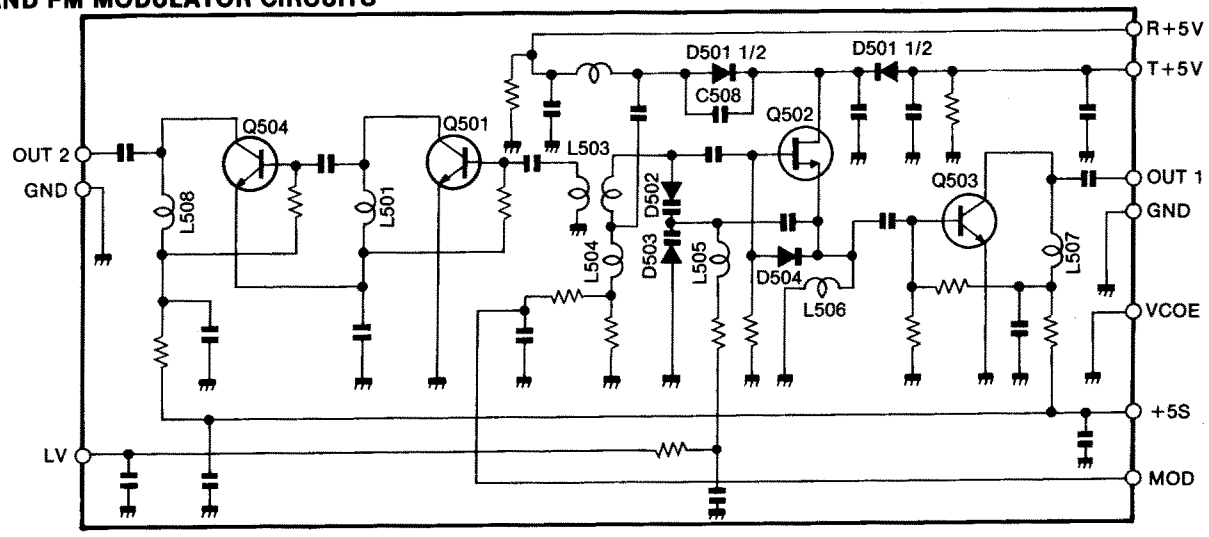
During reception, T+5V is 0V, and R+5V is 4.3V. C508 then seems to short, decreasing oscillation frequency.

4-3-5 UNLOCK CIRCUIT (MAIN UNIT)

When the PLL is unlocked, the voltage at D102 anode becomes "LOW". This voltage passes through an integrating circuit comprising R137 and C193, and is applied to the base of Q116. This turns Q116 ON, and a "HIGH" is fed to CPU (IC101 pin 19). (These signals act to inform the CPU that the PLL is in an unlocked state.

At the same time, these signals are fed to IC103D (pin 13) which operates to control T+5C.

VCO AND FM MODULATOR CIRCUITS



4-4 LOGIC CIRCUITS

4-4-1 CPU PORT ALLOCATION

PIN NO.	I/O	ACTIVE STATUS	NAME OF TERMINAL	PIN NO.	I/O	ACTIVE STATUS	NAME OF TERMINAL	PIN NO.	I/O	ACTIVE STATUS	NAME OF TERMINAL
1	OUTPUT	—	LCD4	23	INPUT	HIGH	KEY 1 (K1)	45	OUTPUT	—	LCD 12
2	OUTPUT	—	LCD3	24	INPUT	HIGH	KEY 0 (K0)	46	OUTPUT	—	LCD 11
3	OUTPUT	—	LCD2	25	OUTPUT	HIGH	STB 3 (PB3)	47	OUTPUT	—	LCD 10
4	OUTPUT	—	LCD1	26	OUTPUT	HIGH	STB 2 (PB2)	48	OUTPUT	—	LCD 9
5	OUTPUT	—	COM2	27	OUTPUT	HIGH	STB 1 (PB1)	49	OUTPUT	—	LCD 8
6	OUTPUT	—	COM1	28	OUTPUT	HIGH	STB 0 (PB0)	50	OUTPUT	—	LCD 7
7	—	—	VDD (5V)	29	OUTPUT	HIGH *1	LAMP 0 (PC3)	51	OUTPUT	—	LCD 6
8	INPUT	—	—	30	OUTPUT	HIGH *2	PSC (PC2)	52	OUTPUT	—	LCD 5
9	INPUT	CK	F IN	31	OUTPUT	HIGH *3	HLC (PC1)	53	—	—	—
10	—	—	GND	32	OUTPUT	HIGH *4	MUTE (PC0)	54	—	—	—
11	OUTPUT	HIGH	EO1	33	—	—	VDD (5V)	55	—	—	—
12	OUTPUT	HIGH	EO2	34	OUTPUT	—	LCD 23	56	—	—	—
13	INPUT	LOW	CE	35	OUTPUT	—	LCD 22	57	—	—	—
14	—	—	NC	36	OUTPUT	—	LCD 21	58	—	—	—
15	INPUT	CK	XI	37	OUTPUT	—	LCD 20	59	—	—	—
16	INPUT	CK	XO	38	OUTPUT	—	LCD 19	60	—	—	—
17	INPUT	LOW	PTT (PA3)	39	OUTPUT	—	LCD 18	61	—	—	—
18	INPUT	LOW	LOCK (PA2)	40	OUTPUT	—	LCD 17	62	—	—	—
19	INPUT	HIGH	UNLOCK	41	OUTPUT	—	LCD 16	63	—	—	—
20	INPUT	LOW	BUSY (PA0)	42	OUTPUT	—	LCD 15	64	—	—	—
21	INPUT	HIGH	KEY 3 (K3)	43	OUTPUT	—	LCD 14				
22	INPUT	HIGH	KEY 3 (K2)	44	OUTPUT	—	LCD 13				

NOTES:

*1 LAMP 0—Lamp circuit control port (output port PC3)
This port is for controlling the lamp circuit which is provided with a function for extending the illumination time of the lamp by a software timer.

*2 PSC—Power save control port (output port PC3)
This is a control port for controlling the power save function during reception.

*3 HLC—Transmission power control port (output port PC1)
This port is for outputting control signals for switching transmission power.

HLC	Transmission power
HIGH	2.5W
LOW	Less than 1W

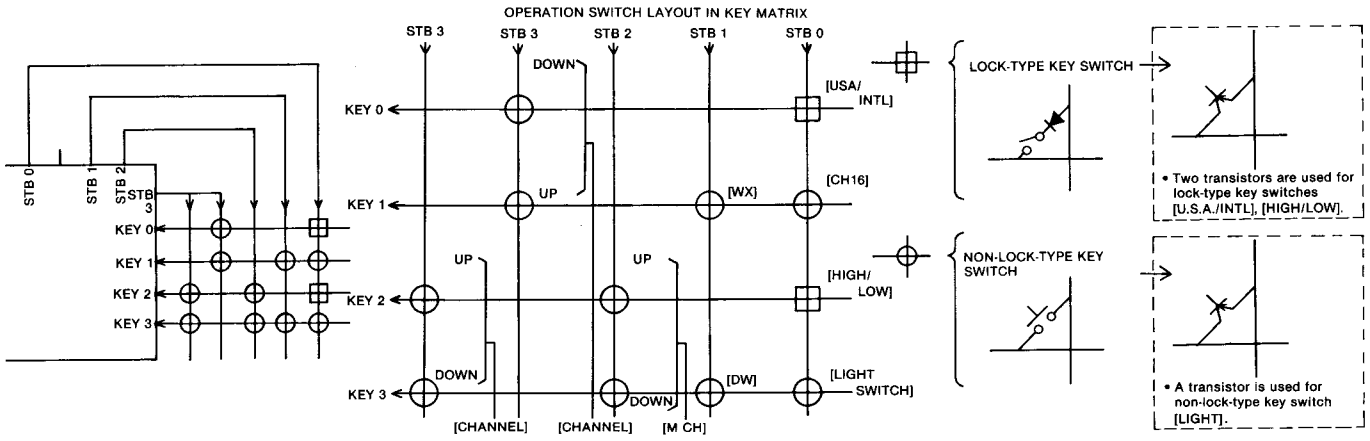
*4 MUTE—Transmission prohibition control port (output port PC0)
This port is for outputting control signals for disabling transmission in an off-band state and in a PLL unlocked state.

4-4-2 KEY MATRIX

The key matrix checks which of the non-lock switches has been pressed, and which of the lock key switches is ON.

STB 0
STB 1 — Port for outputting strobe signals for key switch detection
STB 2
STB 3

HARDWARE CONFIGURATION OF KEY MATRIX



4-4-3 RAM

The RAM section in IC101 can memorize 24 channels each for receive and transmit frequencies.

CHANNEL CHART

Channel No.	Frequency (MHz)		Transmitter output power
	Transmit	Receive	
01	156.050	160.650	2.5W & 1W
01A	156.050	156.050	2.5W & 1W
02	156.100	160.700	2.5W & 1W
02A	156.100	156.100	2.5W & 1W
03	156.150	160.750	2.5W & 1W
03A	156.150	156.150	2.5W & 1W
04	156.200	160.800	2.5W & 1W
04A	156.200	156.200	2.5W & 1W
05	156.250	160.850	2.5W & 1W
05A	156.250	156.250	2.5W & 1W
06	156.300	156.300	2.5W & 1W
07	156.350	160.950	2.5W & 1W
07A	156.350	156.350	2.5W & 1W
08	156.400	156.400	2.5W & 1W
09	156.450	156.450	2.5W & 1W
10	156.500	156.500	2.5W & 1W
11	156.550	156.550	2.5W & 1W
12	156.600	156.600	2.5W & 1W
13	156.650	156.650	2.5W & 1W
14	156.700	156.700	2.5W & 1W
15	156.750	156.750	1W only
16	156.800	156.800	2.5W & 1W
17	156.850	156.850	1W only
18	156.900	161.500	2.5W & 1W
18A	156.900	156.900	2.5W & 1W
19	156.950	161.550	2.5W & 1W
19A	156.950	156.950	2.5W & 1W
20	157.000	161.600	2.5W & 1W
20A	157.000	157.000	2.5W & 1W
21	157.050	161.650	2.5W & 1W
21A	157.050	157.050	2.5W & 1W
22	157.100	161.700	2.5W & 1W
22A	157.100	157.100	2.5W & 1W
23	157.150	161.750	2.5W & 1W
23A	157.150	157.150	2.5W & 1W
24	157.200	161.800	2.5W & 1W
25	157.250	161.850	2.5W & 1W
26	157.300	161.900	2.5W & 1W
27	157.350	161.950	2.5W & 1W
28	157.400	162.000	2.5W & 1W
60	156.025	160.625	2.5W & 1W
60A	156.025	156.025	2.5W & 1W
61	156.075	160.675	2.5W & 1W
61A	156.075	156.075	2.5W & 1W

Channel No.	Frequency (MHz)		Transmitter output power
	Transmit	Receive	
62	156.125	160.725	2.5W & 1W
62A	156.125	156.125	2.5W & 1W
63	156.175	160.775	2.5W & 1W
63A	156.175	156.175	2.5W & 1W
64	156.225	160.825	2.5W & 1W
64A	156.225	156.225	2.5W & 1W
65	156.275	160.875	2.5W & 1W
65A	156.275	156.275	2.5W & 1W
66	156.325	160.925	2.5W & 1W
66A	156.325	156.325	2.5W & 1W
67	156.375	156.375	2.5W & 1W
68	156.425	156.425	2.5W & 1W
69	156.475	156.475	2.5W & 1W
70	156.525	156.525	1W only
71	156.575	156.575	2.5W & 1W
72	156.625	156.625	2.5W & 1W
73	156.675	156.675	2.5W & 1W
74	156.725	156.725	2.5W & 1W
75	.....	.....	Guard
76	.....	.....	Guard
77	156.875	156.875	2.5W & 1W
78	156.925	161.525	2.5W & 1W
78A	156.925	156.925	2.5W & 1W
79	156.975	161.575	2.5W & 1W
79A	156.975	156.975	2.5W & 1W
80	157.025	161.625	2.5W & 1W
80A	157.025	157.025	2.5W & 1W
81	157.075	161.675	2.5W & 1W
81A	157.075	157.075	2.5W & 1W
82	157.125	161.725	2.5W & 1W
82A	157.125	157.125	2.5W & 1W
83	157.175	161.775	2.5W & 1W
83A	157.175	157.175	2.5W & 1W
84	157.225	161.825	2.5W & 1W
84A	157.225	157.225	2.5W & 1W
85	157.275	161.875	2.5W & 1W
85A	157.275	157.275	2.5W & 1W
86	157.325	161.925	2.5W & 1W
86A	157.325	152.325	2.5W & 1W
87	157.375	161.975	2.5W & 1W
87A	157.375	157.375	2.5W & 1W
88	157.425	162.025	2.5W & 1W
88A	157.425	157.425	2.5W & 1W

4-5 POWER SUPPLY CIRCUITS

4-5-1 VOLTAGE REGULATOR CIRCUIT (MAIN UNIT)

IC-M8 has with a 3-terminal regulator (IC102). IC102 outputs a constant voltage of 5V in relation to the input voltages of 6.5V~12V.

The noise components of the outputs of IC102 are removed by passing through a noise filter comprising R126 and C156, and the outputs are then fed to the current amplifying circuit comprising Q110 and Q111.

In order to obtain a high current amplification factor, Q110 and Q111 are complimentary-connected. For this reason, the voltage applied to the base of Q110 is almost the same as the output voltage of IC102. Further, the temperature coefficients of V_{BE} of Q110 and the coupling voltage of D103 are almost equal.

Consequently, an output voltage stable with respect to temperature can be obtained. This output voltage is also used as the power supply voltage of the optional VOX UNIT (HS-10SA).

T+5V, R+5V and R+5S are switched by Q114, Q115, IC103A, IC103B and IC103C. T+5V is current-amplified by Q119, R+5V by Q120, and R+5S by Q121 and Q122, and are supplied to their respective circuits.

In the power save mode, the power save signal from IC101 (pin 29) is fed to Q117. Q117 and Q118 control R+5V, R+5S and +5S.

4-5-2 CPU POWER SUPPLY CIRCUIT (MAIN UNIT)

IC-M8 has storage elements in the CPU where frequency data is stored. The contents of this memory are destroyed if supply of voltage to the CPU is stopped. In order to prevent this, a voltage is applied via Q113, D105 and D104½ to IC101 (pin 7) from the battery pack when the POWER switch is turned OFF.

When the battery pack is removed from the transceiver, a voltage is applied to IC101 (pin 7) via D106 from the lithium battery installed in the transceiver to provide back up for the memory contents.

The current consumption for backing up the memory contents when the battery pack is connected to the transceiver is approximately 30μA.

4-6 OTHER CIRCUITS

4-6-1 LOW VOLTAGE DETECTOR CIRCUIT

The low voltage detector circuit comprises IC104A, R142 and R143. 5V voltage is applied to IC104A (pin 3), and a voltage obtained by dividing V_{CC} at R142 and R143 is applied to pin 2.

The voltage dividing ratio is set so that a 5V voltage is applied to IC104A (pin 2) when V_{CC} is approximately 6.5V.

When the voltage of V_{CC} is approximately 6.5V or above, the voltage applied to IC104A (pin 2) becomes greater than the voltage applied to pin 3 which causes the output signals from pin 1 to become "LOW".

When the voltage of V_{CC} is below 6.5V, the voltage applied to pin 2 becomes less than the voltage applied to pin 3 which causes the output signals from pin 1 to become "HIGH" to control TRANSMIT INDICATOR (D109).

4-6-2 LAMP CIRCUIT (MAIN UNIT)

When S302 is turned ON, a high voltage level from IC101 (pin 29) is output to Q128 which current-amplifies this voltage to light up the two chip-type LEDs (D117 and D118).

Illumination of these two LEDs continues for approximately 5 seconds in accordance with operation of the timer circuit located internally at the IC101. These LEDs are turned OFF even if S302 is turned ON again within 5 seconds after being initially turned ON.

4-6-3 TRANSMIT/RECEIVE SWITCHING CIRCUIT (MAIN UNIT)

When S301 is ON, Q114 is turned ON, and a "LOW" is fed to IC103A (pins 1 and 2) from the collector of Q115. A "HIGH" is output from IC103A (pin 3) to the base of Q119 which controls T+5V.

At the same time, a "LOW" is fed also to IC103D (pin 12). At this time, if a "LOW" is being fed to IC103D (pin 13), a "HIGH" is output from pin 11 as T+5C to control T+5.

When S301 is OFF, Q114 is turned OFF, and a "HIGH" is fed to IC103A (pins 1 and 2) from the collector of Q115. A "LOW" is output from IC103A (pin 3) to IC103B (pin 6) and IC103C (pin 8).

At this time, if a "LOW" is being fed to IC103B (pin 6) and IC103C (pin 8), a "HIGH" is output from IC103B (pin 4) and IC103C (pin 10). Q120 controls R+5V, and Q121 and Q122 control R+5S.

4-6-4 POWER SAVER CIRCUIT (MAIN UNIT)

IC-M8 is configured so that the receive and PLL circuits are controlled by the output signals from the CPU (IC101) with the aim of reducing the current consumption during the receive waiting period.

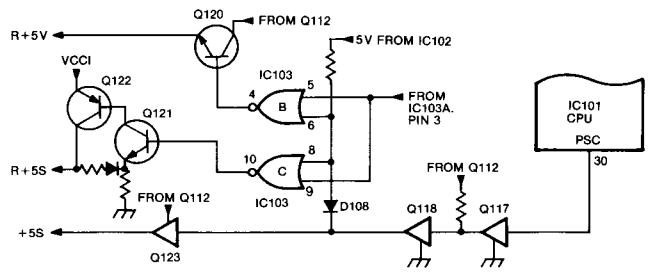
The power save signals are output from IC101 (pin 30) and fed to Q118 via Q117.

When a PSC port is "HIGH", output from IC103B (pin 4) and IC103C (pin 10) are "LOW". This causes R+5V and R+5S to stop being supplied to their respective circuits owing to Q120, Q121 and Q122 being turned OFF.

Also, as Q123 is OFF, +5S stops being output. At this time, operation of almost all circuits stops except the CPU backup. This state is the power save mode.

A PSC port continues "HIGH" 30 seconds after key operation. This causes the transceiver to enter the power save mode.
500ms after switching to the power save mode, a PSC port is "LOW" for the next 125ms during which time the transceiver is in a reception state. If signals are received from the antenna connector during this time, the power save mode is cancelled. Otherwise, repetition of a 500ms non-reception state and 125ms reception state is continued.

POWER SAVER CIRCUIT



SECTION 5 MECHANICAL PARTS AND DISASSEMBLY

5-1 FRONT PANEL DISASSEMBLY

1. Turn the power switch OFF and remove the battery pack as shown in the figure.

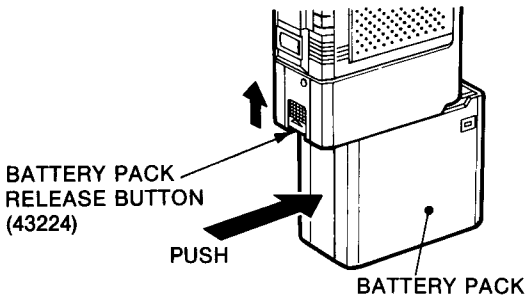


Fig. 5-1-1

2. Remove the 4 screws Ⓐ on the bottom and the sliding guide as shown in the figure.

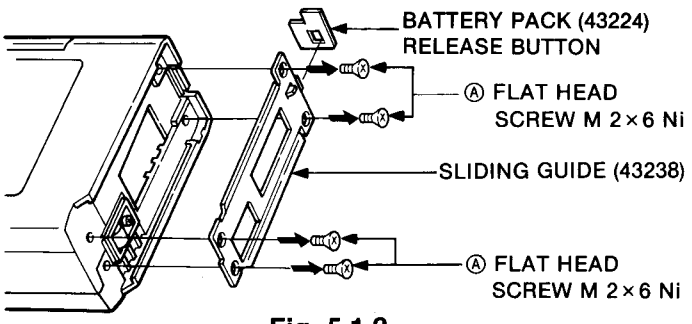


Fig. 5-1-2

3. Remove the screw Ⓑ and the front panel as shown in figure.
4. Remove the PTT SWITCH and the LIGHT SWITCH.

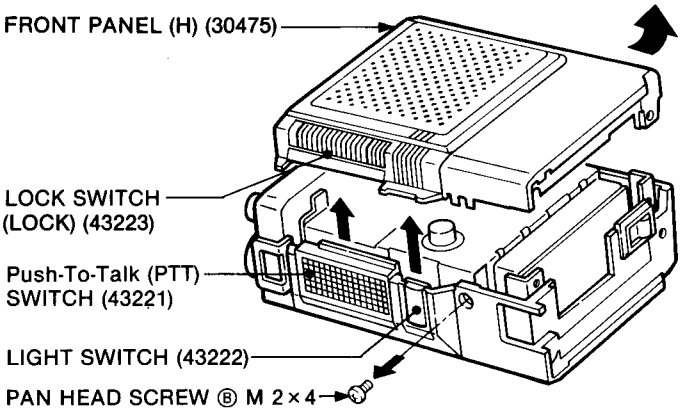


Fig. 5-1-3

CAUTION:
Take care not to cut the lead wires of the speaker.

5-2 SPEAKER DISASSEMBLY

1. Remove the 4 screws Ⓐ and the speaker plate as shown in the figure.

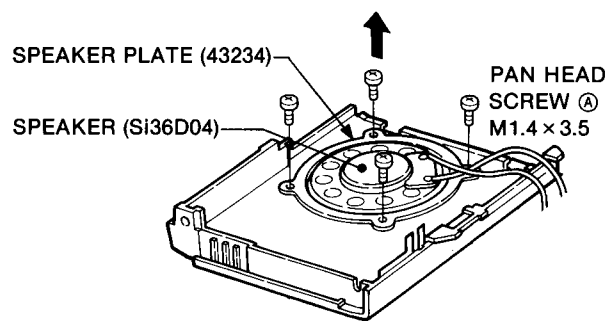
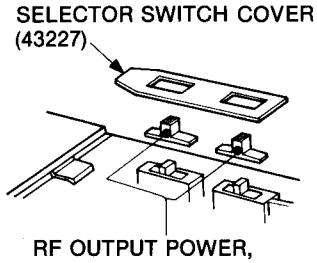


Fig. 5-2-1

5-3 REAR CASE DISASSEMBLY

1. Remove the battery terminal from the bottom case and remove the rear case as shown in figure.
2. Remove the shield case.

NOTE: Be careful not to lose any parts during disassembly.



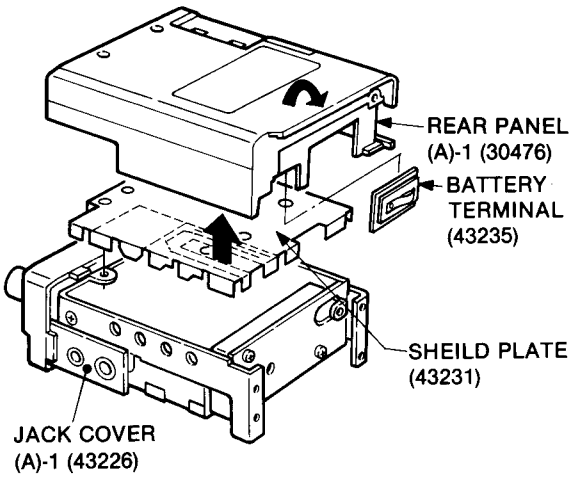


Fig. 5-3-1

5-4 TOP PANEL DISASSEMBLY

1. Remove the POWER/VOLUME CONTROL knob and the SQUELCH CONTROL knob.
2. Release the 4 hooks with front and rear chassies. Remove the top panel.

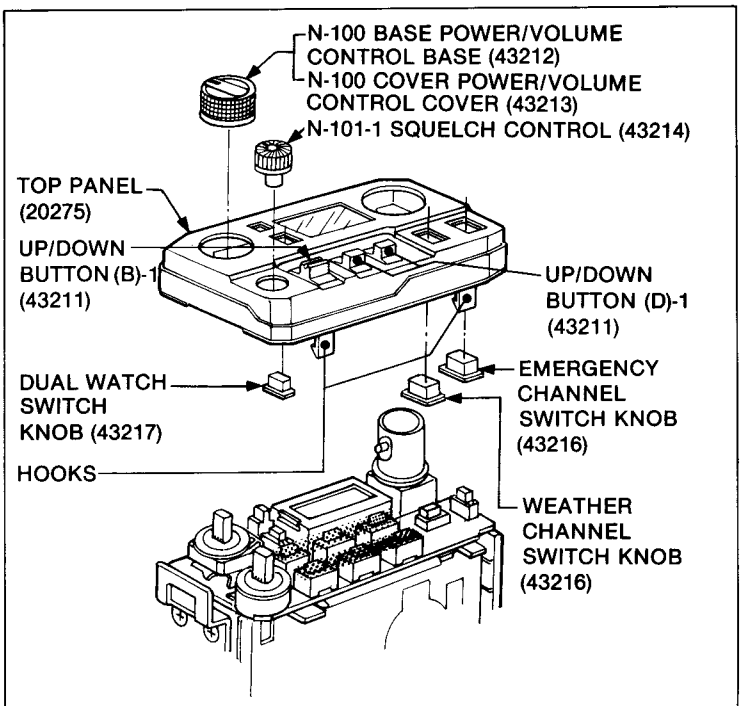


Fig. 5-4-1

SECTION 6 MAINTENANCE AND ADJUSTMENT

6-1 PREPARATION BEFORE SERVICING

1. Detach the power cable and turn OFF the POWER SWITCH before parforming any work on the transceiver.

2. DO NOT short circuit components while making adjustments.

3. Use an insulated tuning tool for all adjustments.

4. DO NOT force any of the variable components. Tune them slowly and smoothly.

5. Follow the instructions exactly. If an indicated result is not obtained, repeat the instruction until the correct result is obtained.

6. Check the condition of connectors, solder joints and screws when adjustments are complete. Confirm that components do not touch each other.

7. Confirm defective operation of the transceiver first when checking an out-of-service unit.

8. Use the correct tools and test equipment.

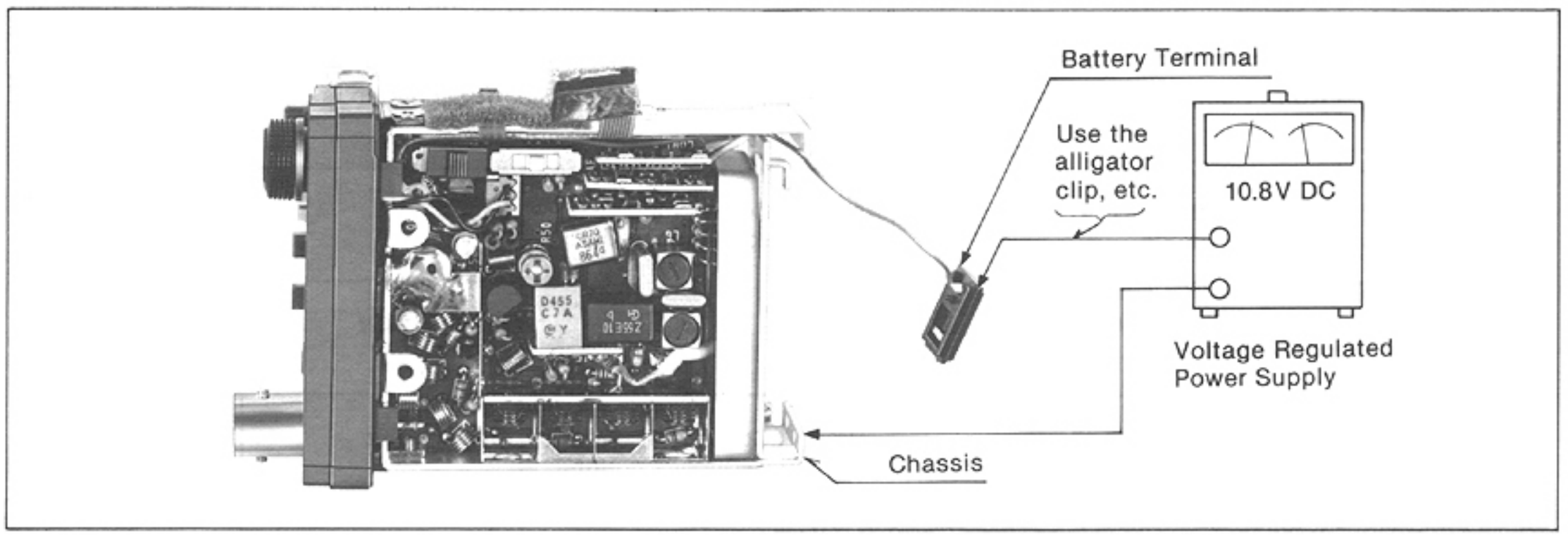
9. To remove the transceiver covers, refer to SECTION 5-1 and 5-3.

10. Connect a voltage regulated power supply as shown in the figure. Make sure to check the voltage polarity.

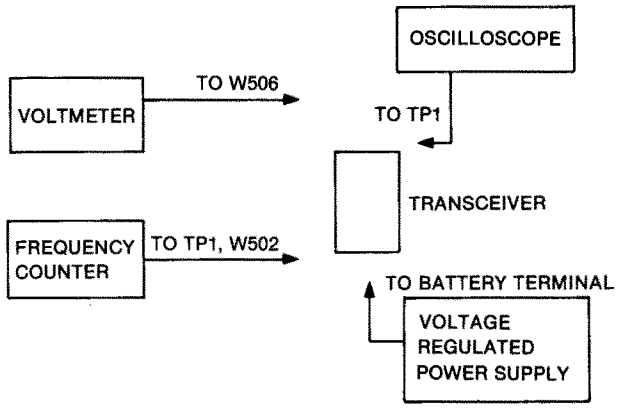
11. For transmission problems, connect a 50Ω dummy load to the ANTENNA CONNECTOR. For reception problems, connect an antenna or signal generator to the ANTENNA CONNECTOR. DO NOT transmit into the signal generator.

12. Re-check for the suspected malfunction with the POWER SWITCH ON.

13. Check the defective circuit. Measure the DC voltages of the collector, base and emitter of each transistor.

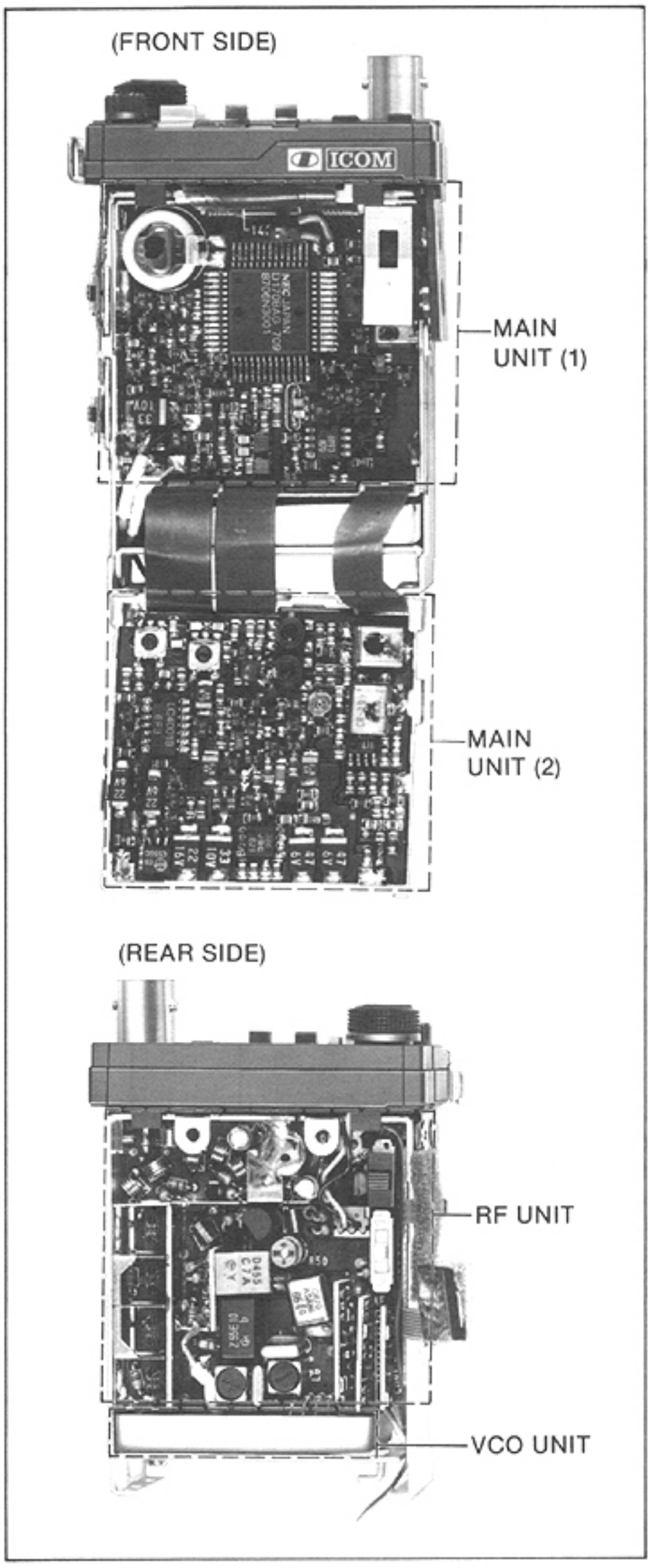


6-2 PLL ADJUSTMENT

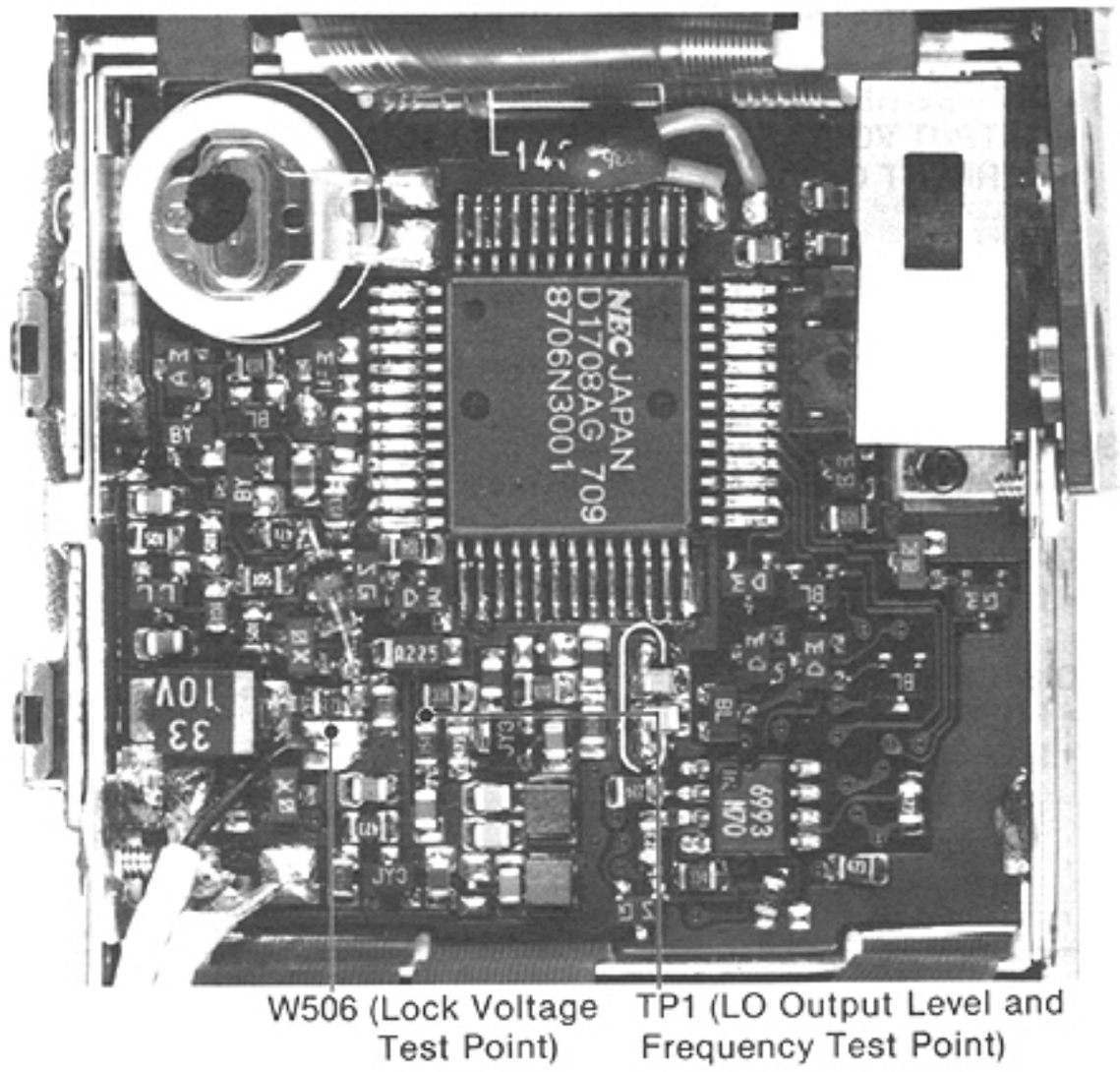
INSTRUMENTS REQUIRED	CONNECTIONS
(1) VOLTAGE REGULATED POWER SUPPLY • OUTPUT VOLTAGE : 10.8V DC±15% • CURRENT CAPACITY : 2A (2) VOLTMETER • INPUT IMPEDANCE : 50kΩ/V DC OR BETTER (3) FREQUENCY COUNTER • FREQUENCY RANGE : 0.1~200MHz • ACCURACY : BETTER THAN±1ppm • SENSITIVITY : 100mV OR BETTER (4) OSCILLOSCOPE • FREQUENCY RANGE : AT LEAST 20MHz • MEASURING RANGE : 0.01~10V	

ADJUSTMENT		ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT	
			UNIT	LOCATION		UNIT	ADJUST
LO OUTPUT	1	• Display channel: 16 • Receive mode	MAIN (1)	Connect an oscilloscope to TP1.	Maximum (More than 50mVp-p)	MAIN (2)	L106
	2	• Display channel: 16 • Transmit mode					L105
		Note: Repeat steps 1 and 2 several times, until the measured value for each step is equal.					
PLL LOCK VOLTAGE	1	• Display channel: 60A • Receive mode	MAIN (1)	Connect a voltmeter to W506.	2.0V	VCO	L503
	2	• Display channel: 60A • Transmit mode			Approx. 2.0V		Verify
LO FREQUENCY	1	• Display channel: 16 • Receive mode	RF	Connect a frequency counter to W502.	135.000MHz	MAIN (2)	L103
	2	• Display channel: 16 • Transmit mode			156.800MHz		L104
REFERENCE FREQUENCY	1	• Display channel: 16 • Receive mode	MAIN (1)	Connect a frequency counter to TP1.	46.16726MHz±300Hz		Verify

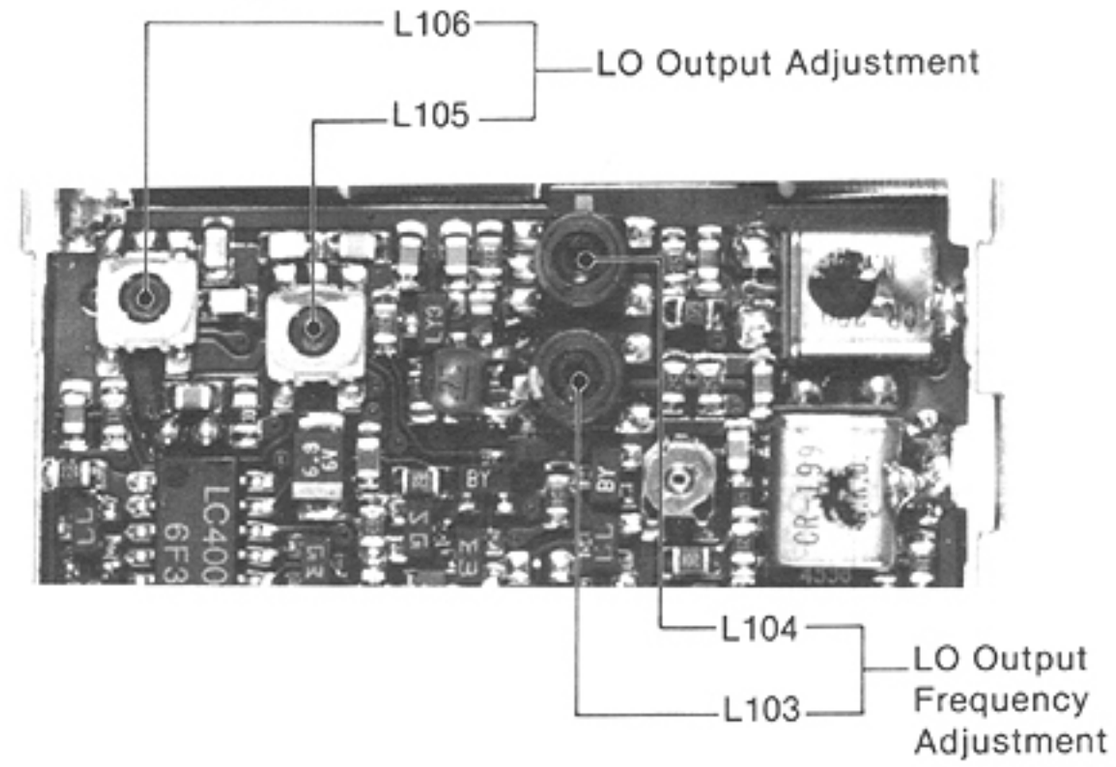
UNIT LOCATIONS



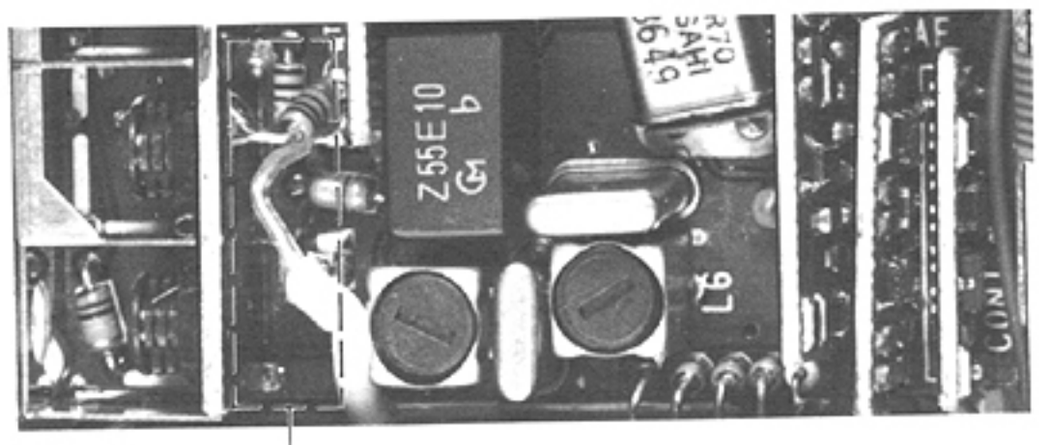
MAIN UNIT (1)



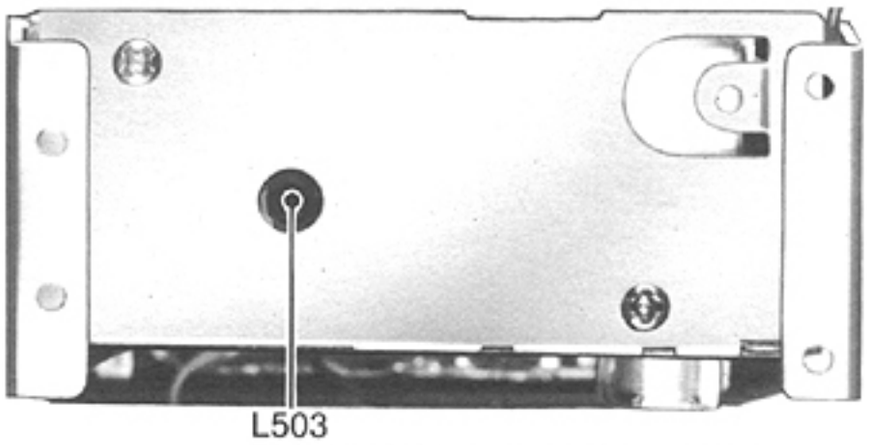
MAIN UNIT (2)



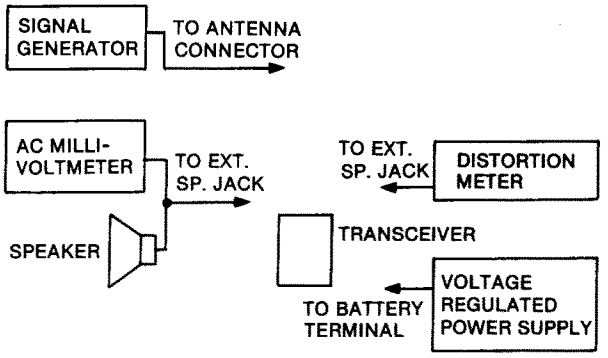
RF UNIT



VCO UNIT

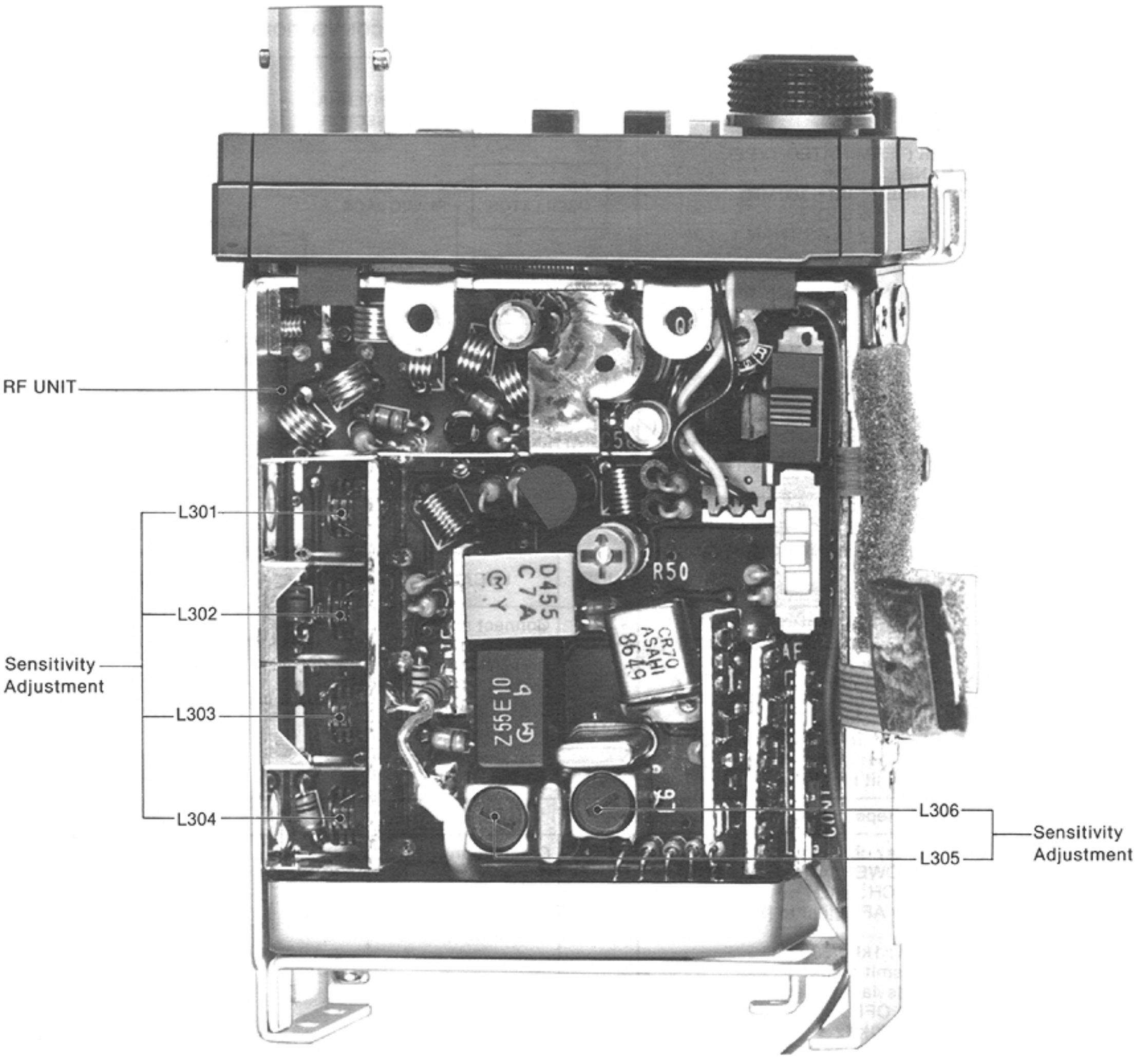


6-3 RECEIVER ADJUSTMENT

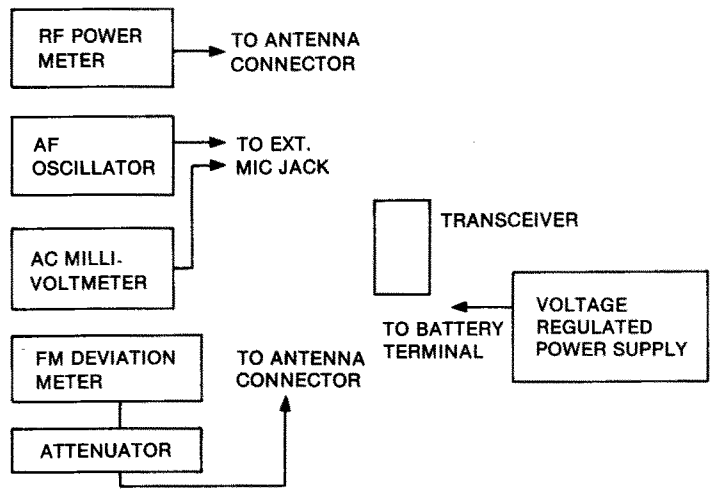
INSTRUMENTS REQUIRED	CONNECTIONS
(1) VOLTAGE REGULATED POWER SUPPLY • OUTPUT VOLTAGE : 10.8V DC±15% • CURRENT CAPACITY : 2A (2) SIGNAL GENERATOR (SSG) • FREQUENCY RANGE : 0.1~180MHz • OUTPUT LEVEL : 0.1μV~32mV (−127dBm~−17dBm) (3) AC MILLIVOLTMETER • MEASURING RANGE : 0.001~4V (4) SPEAKER • IMPEDANCE : 8Ω (5) DISTORTION METER • FREQUENCY RANGE : 1kHz±10Hz • MEASURING RANGE : 1%~100%	

ADJUSTMENT		ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT	
			UNIT	LOCATION		UNIT	ADJUST
SENSITIVITY	1	• Display channel: 16 • SQUELCH CONTROL: max. counterclockwise • Apply RF signal to ANTENNA CONNECTOR. Level: 0.2μV (−121dBm) Dev.: ±3.5kHz Mod.: 1kHz • Receive mode	SIDE PANEL	Connect a distortion meter to the [EXT. SP] JACK with an 8Ω speaker.	Minimum distortion level	RF	L301~ L306
AF OUTPUT	1	• Apply RF signal to ANTENNA CONNECTOR. Level: 1mV (−47dBm) Dev.: ±3.5kHz Mod.: 1kHz • Receive mode	SIDE PANEL	Connect an AC millivoltmeter to the [EXT. SP] JACK with an 8Ω speaker.	More than 1.4Vrms at 10% distortion.		Verify

RF UNIT

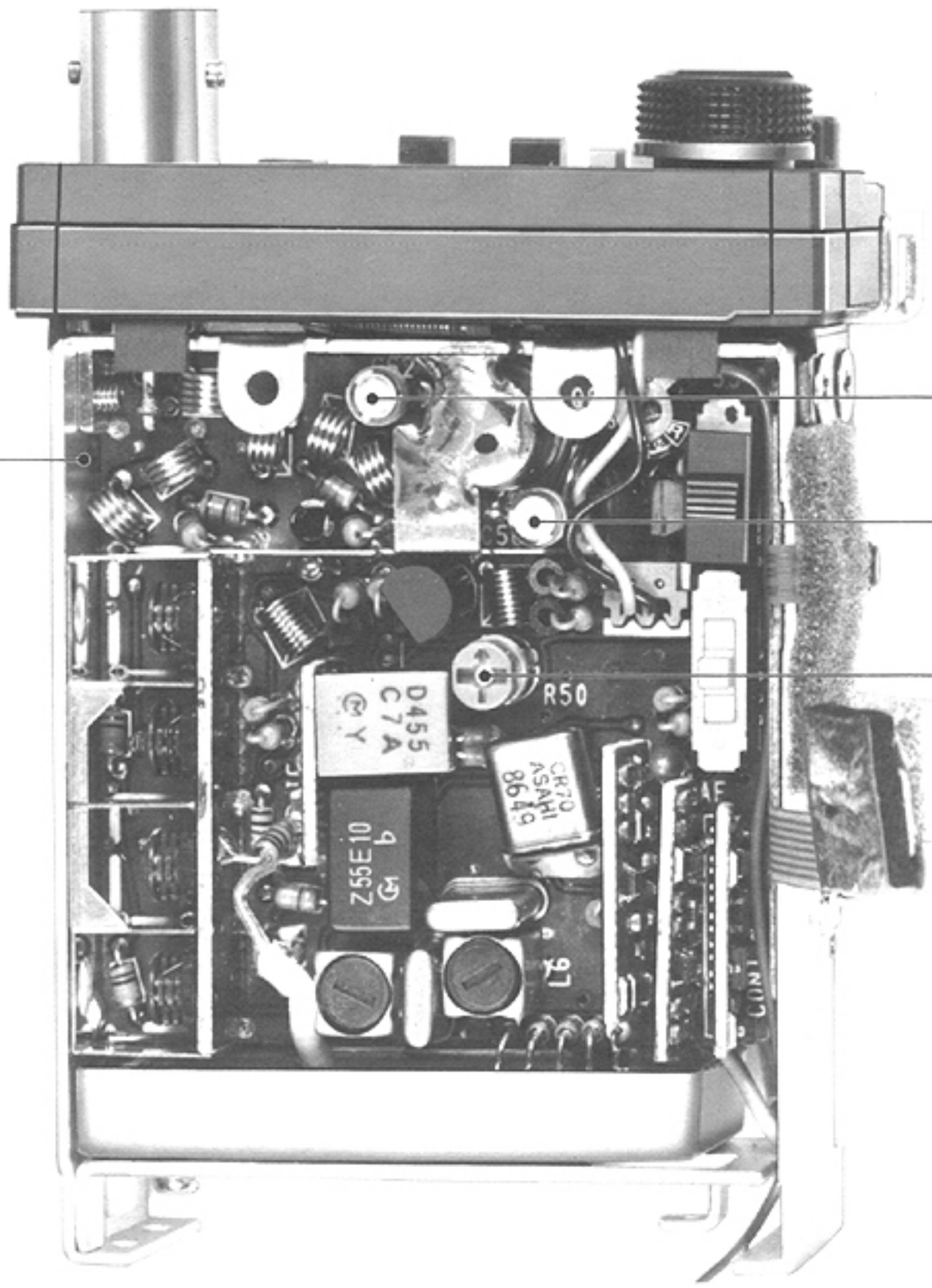

RF UNIT
L301
L302
Sensitivity Adjustment
L303
L304
L306
L305
Sensitivity Adjustment
D455 C7A
CR70 ASAHI 8649
Z55E10
R50

6-4 TRANSMITTER ADJUSTMENT

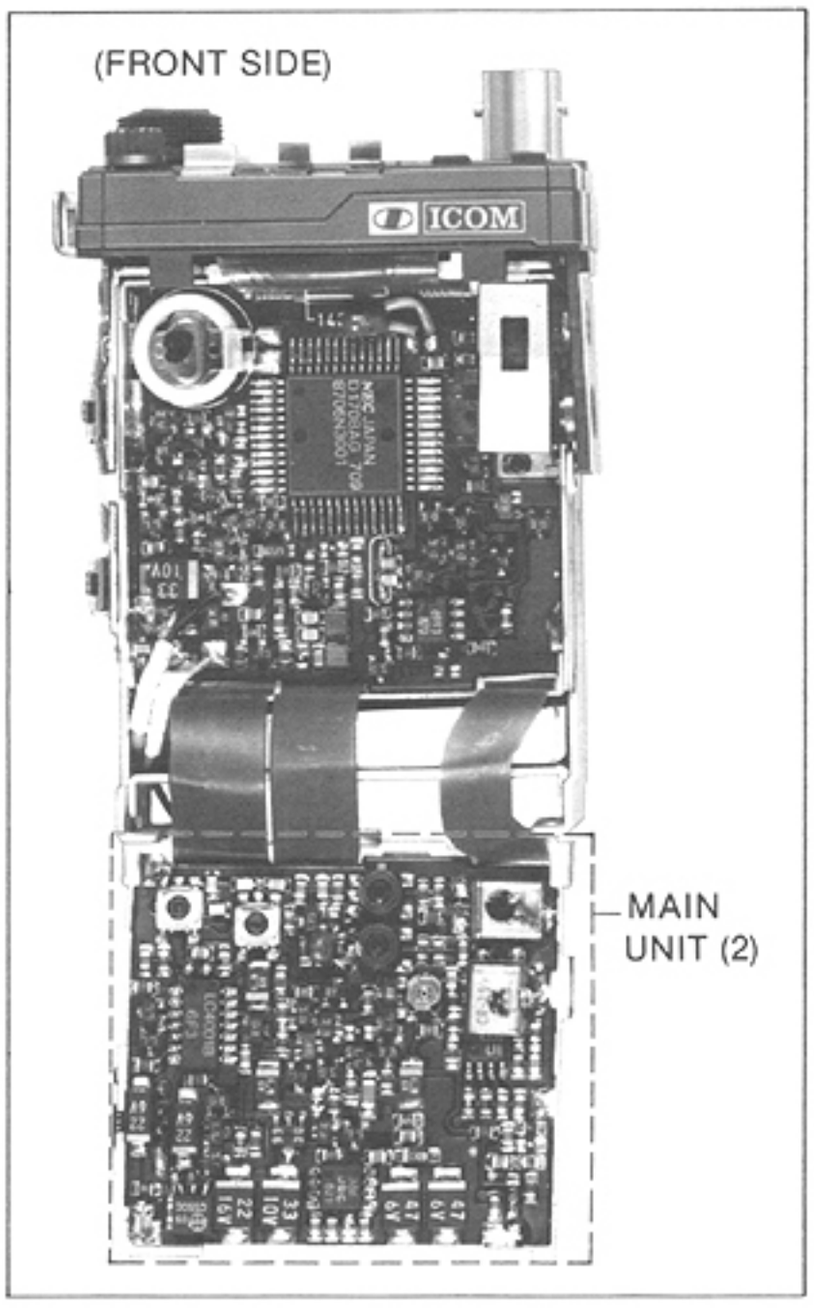
INSTRUMENTS REQUIRED	CONNECTIONS
(1) VOLTAGE REGULATED POWER SUPPLY • OUTPUT VOLTAGE : 10.8V DC±15% • CURRENT CAPACITY : 2A (2) RF POWER METER (TERMINATED TYPE) • MEASURING RANGE : 2W • FREQUENCY RANGE : 0.1~180MHz • IMPEDANCE : 50Ω • SWR : LESS THAN 1: 1.2 (3) AF OSCILLATOR • OUTPUT FREQUENCY : AT LEAST 3000Hz • OUTPUT LEVEL : 0~200mV (4) AC MILLIVOLTMETER • MEASURING RANGE : 10mV~3V (5) FM DEVIATION METER • FREQUENCY RANGE : 140MHz~180MHz • MEASURING RANGE : 0~±10kHz	

ADJUSTMENT		ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT	
			UNIT	LOCATION		UNIT	ADJUST
OUTPUT POWER	1	• Display channel: 16 • RF POWER OUTPUT SELECTOR SWITCH: HIGH • Transmit mode	TOP PANEL	Connect an RF power meter to ANTENNA CONNECTOR.	Maximum (4.0W~2.5W)	RF	C356, C362
	2	• Display channel: 16 • RF POWER OUTPUT SELECTOR SWITCH: LOW • Transmit mode			1W		R339
		Note: Repeat steps 1 and 2 several times.					
DEVIATION	1	• Display channel: 16 • RF POWER OUTPUT SELECTOR SWITCH: HIGH • Apply AF signal to [EXT. MIC] JACK Level: 1kHz/50mV • Transmit mode • FM deviation meter HPF: OFF LPF: 20kHz Deemphasis: OFF Deviation sense: P-P/2	TOP PANEL	Connect an FM deviation meter to ANTENNA CONNECTOR via an attenuator (20dB).	±4.7kHz	MAIN (2)	R174
	2	• Display channel: 16 • Apply AF signal to [EXT. MIC] JACK • Level: 1kHz/5mV • Transmit mode			±3kHz~±4kHz		Verify
	3	• Display channel: 60, 88 • Apply AF signal to [EXT. MIC] JACK Level: 1kHz/50mV • Transmit mode			±4kHz~±5kHz		
TRANSMIT S/N	1	• Display channel: 16 • Apply AF signal to [EXT. MIC] JACK		Connect an FM deviation meter to ANTENNA CONNECTOR via an attenuator (20dB).	±3.5kHz	AF oscillator level	
	2	• Apply no signal to [EXT. MIC] JACK		Connect an AC millivoltmeter to the FM deviation meter.	Verify that the ratio between AF signals applied and not applied to the [EXT. MIC] JACK is more than 40dB.		

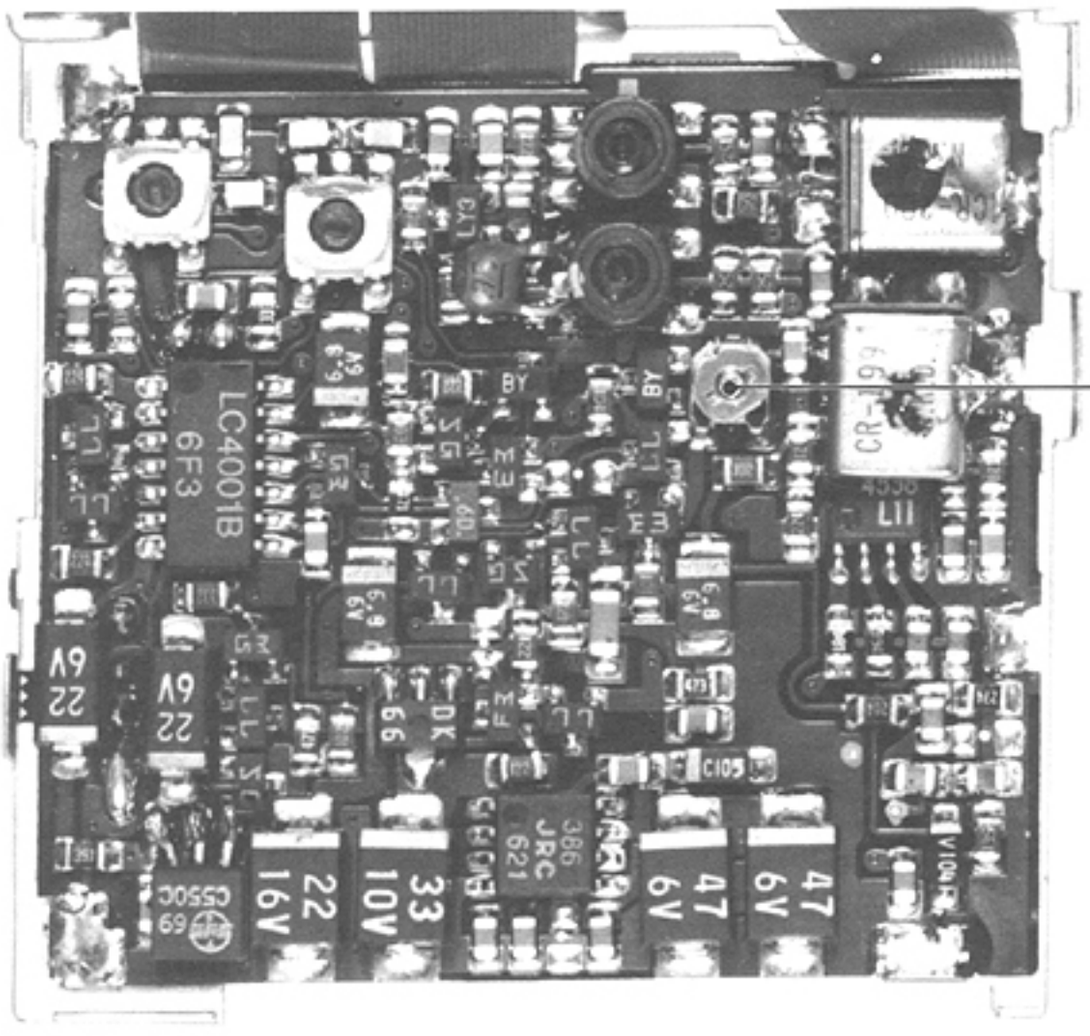
RF UNIT



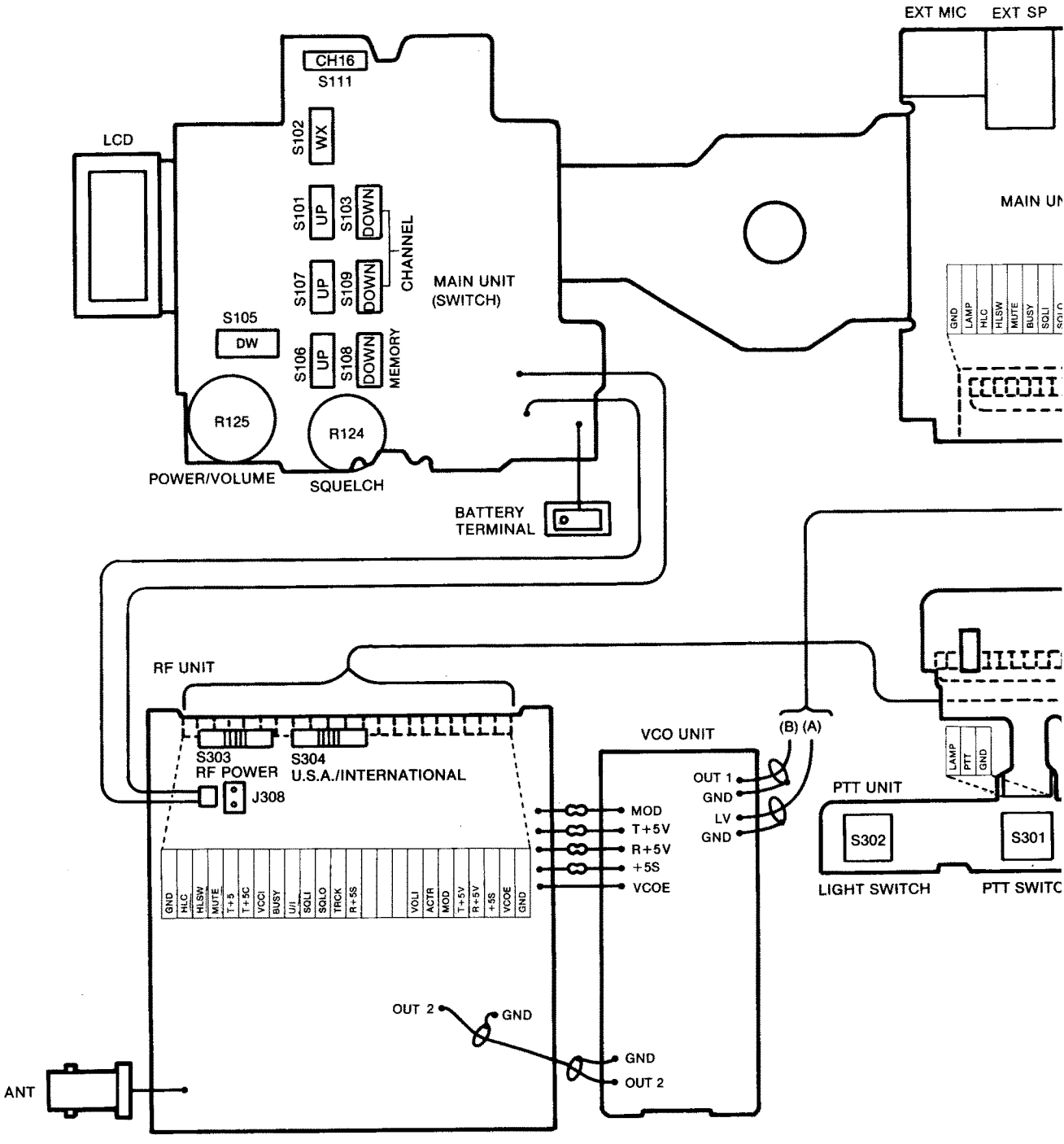
UNIT LOCATION

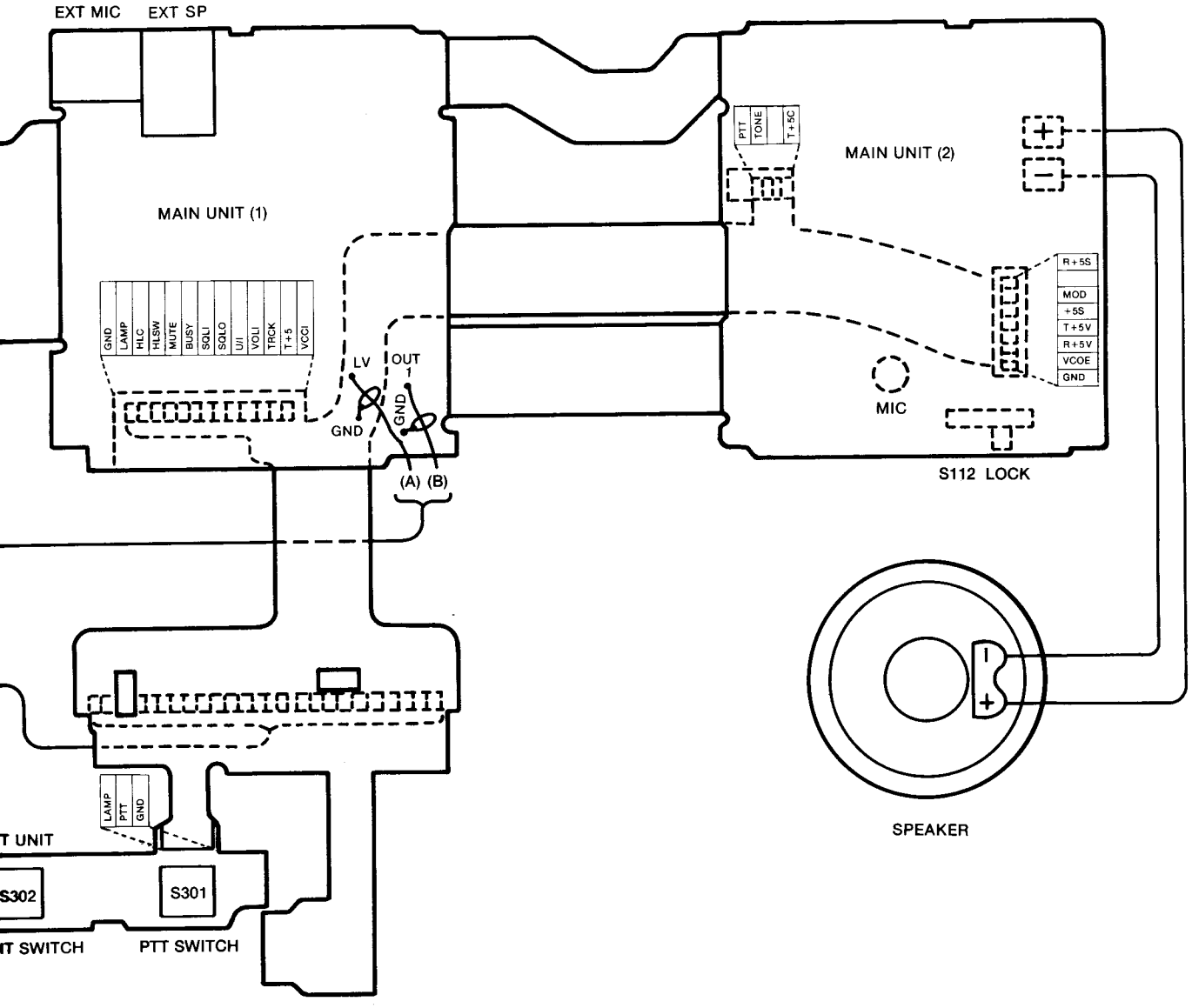


MAIN UNIT (2)

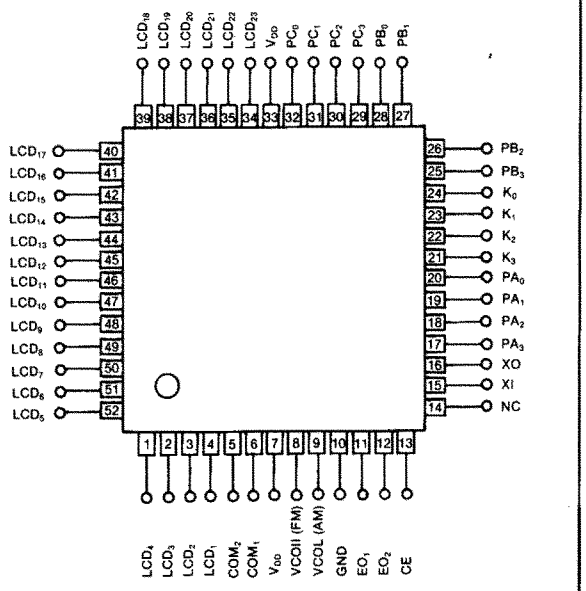
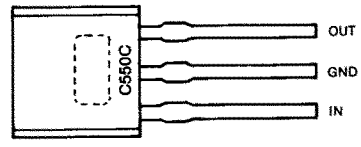
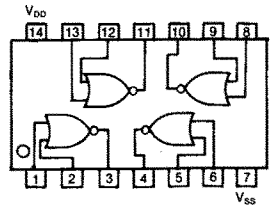
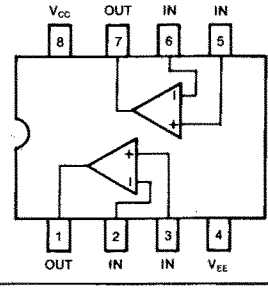
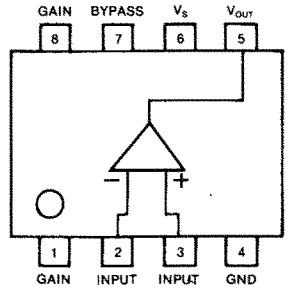


7-1 INTER CONNECTION

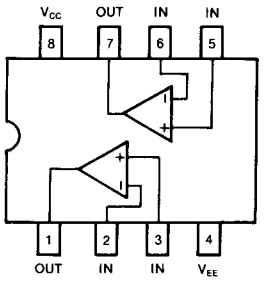



EXT MIC
EXT SP
MAIN UNIT (1)
GND
LAMP
HLC
HLSW
MUTE
BUSY
SQLI
SQLO
U/I
VOLI
TRGK
T+5
VCCI
LV
OUT
1
GND
GND
(A) (B)
PTT
TONE
T+5C
MAIN UNIT (2)
R+5S
MOD
+5S
T+5V
R+5V
VCOE
GND
MIC
S112 LOCK
SPEAKER
LAMP
PTT
GND
T UNIT
S302
S301
IT SWITCH
PTT SWITCH

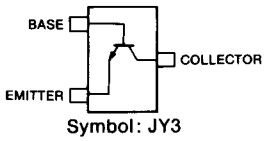
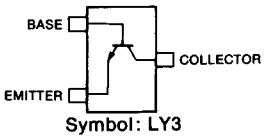
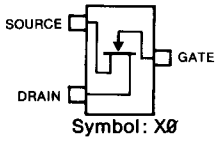
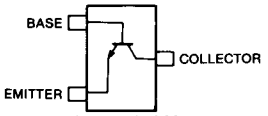
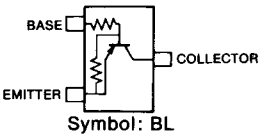
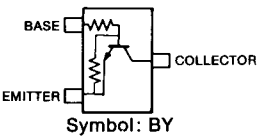
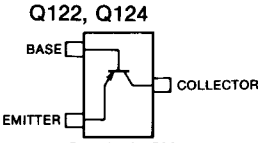
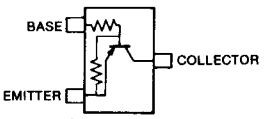
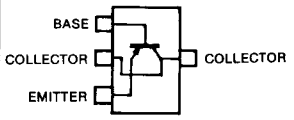
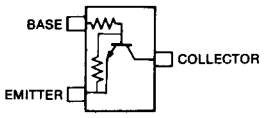
7-2 MAIN UNIT

ICs		
IC101	**μPD1708AG-725-00** (CPU) (μPD1708AG-709-00 is used in equipment not equipped with a U.S.A./INT SWITCH.)	
IC102	**LVC550C** (3 TERMINAL POSITIVE VOLTAGE REGULATOR)	
IC103	**LC4001BM** (QUAD 2-INPUT NOR GATE)	
IC104	**BA6993F** (DUAL COMPARATOR)	
IC105	**NJM386M** (AUDIO AMPLIFIER)	

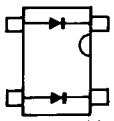
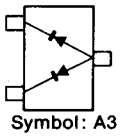
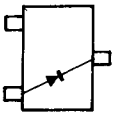
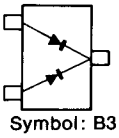
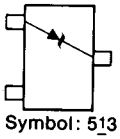
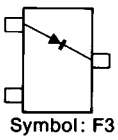
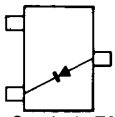
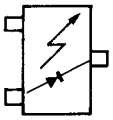
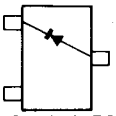
ICs

IC106	**BA4558F** (DUAL OPERATION AMPLIFIER)	

TRANSISTORS

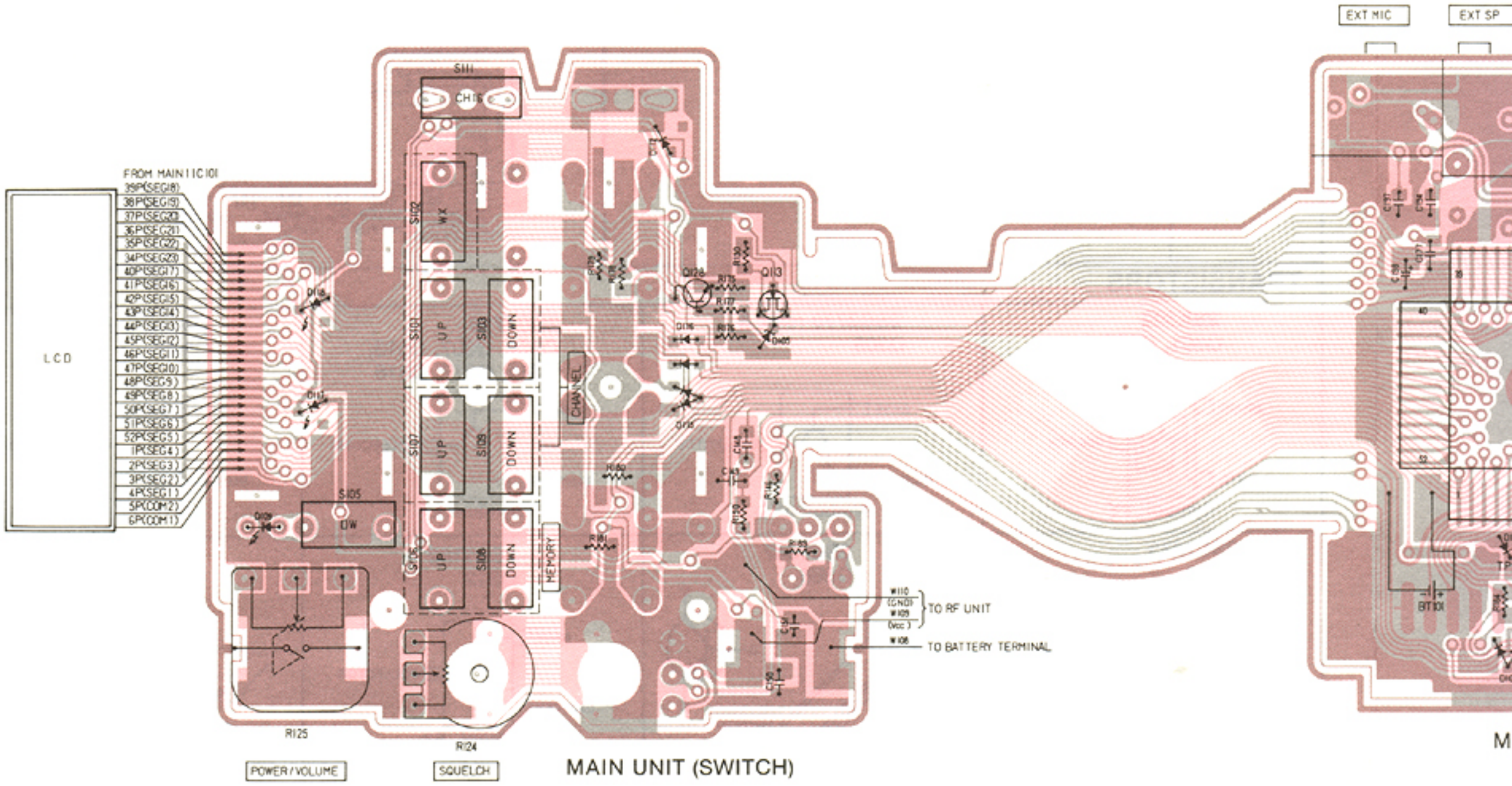
2SC3770 rank 3 Q101, Q102  Symbol: JY3	**2SC3772 rank 3** Q103  Symbol: LY3	**2SK209 rank O** Q104, Q106, Q113  Symbol: XØ	**2SC2712** Q105, Q110, Q112, Q118, Q119, Q120, Q121, Q127, Q128  Symbol: LY
2SA1341 Q107, Q129, Q130, Q131  Symbol: BL	**2SC3395** Q108, Q109, Q115, Q117  Symbol: BY	**2SA1162** Q111, Q114, Q116, Q122, Q124  Symbol: SY	**UN2114** Q123  Symbol: 6D
2SB798 Q126  Symbol: DL	**UN2210** Q132  Symbol: 8L □ ※ ※RANK		

DIODES

MA862 D101, D116  Symbol: M1I	**1SS181** D102, D115  Symbol: A3	**1SS196** D103, D108, D127  Symbol: G3	**1SS184** D104  Symbol: B3	**RD5. 1M B3** D105  Symbol: 513
1SS193 D106, D129  Symbol: F3	**1SS190** D107, D112, D128  Symbol: E3	**SLM-13MW** D117, D118 	**1SS187** D111, D113, D114, D126  Symbol: D3	

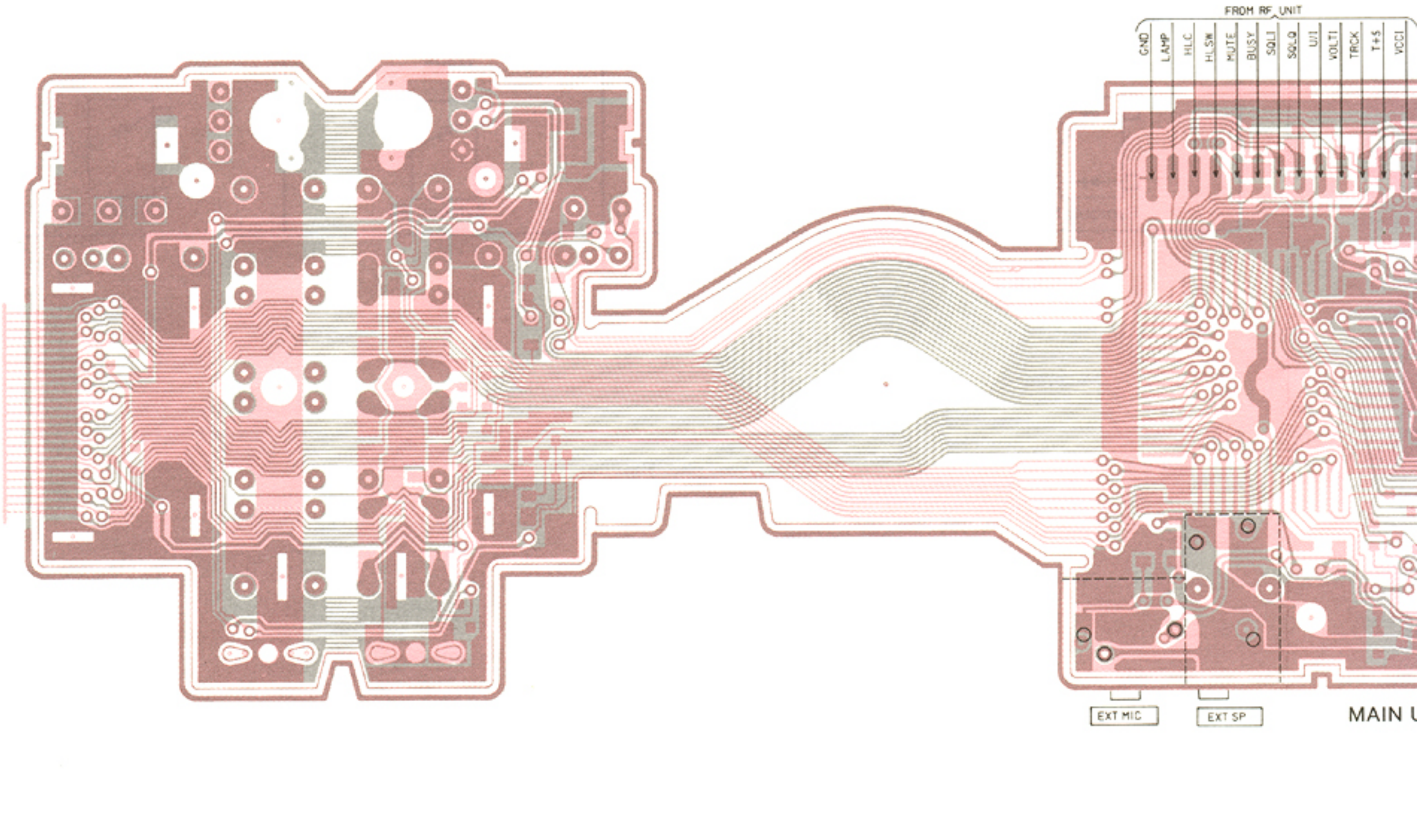
• MAIN UNIT

COMPONENT SIDE

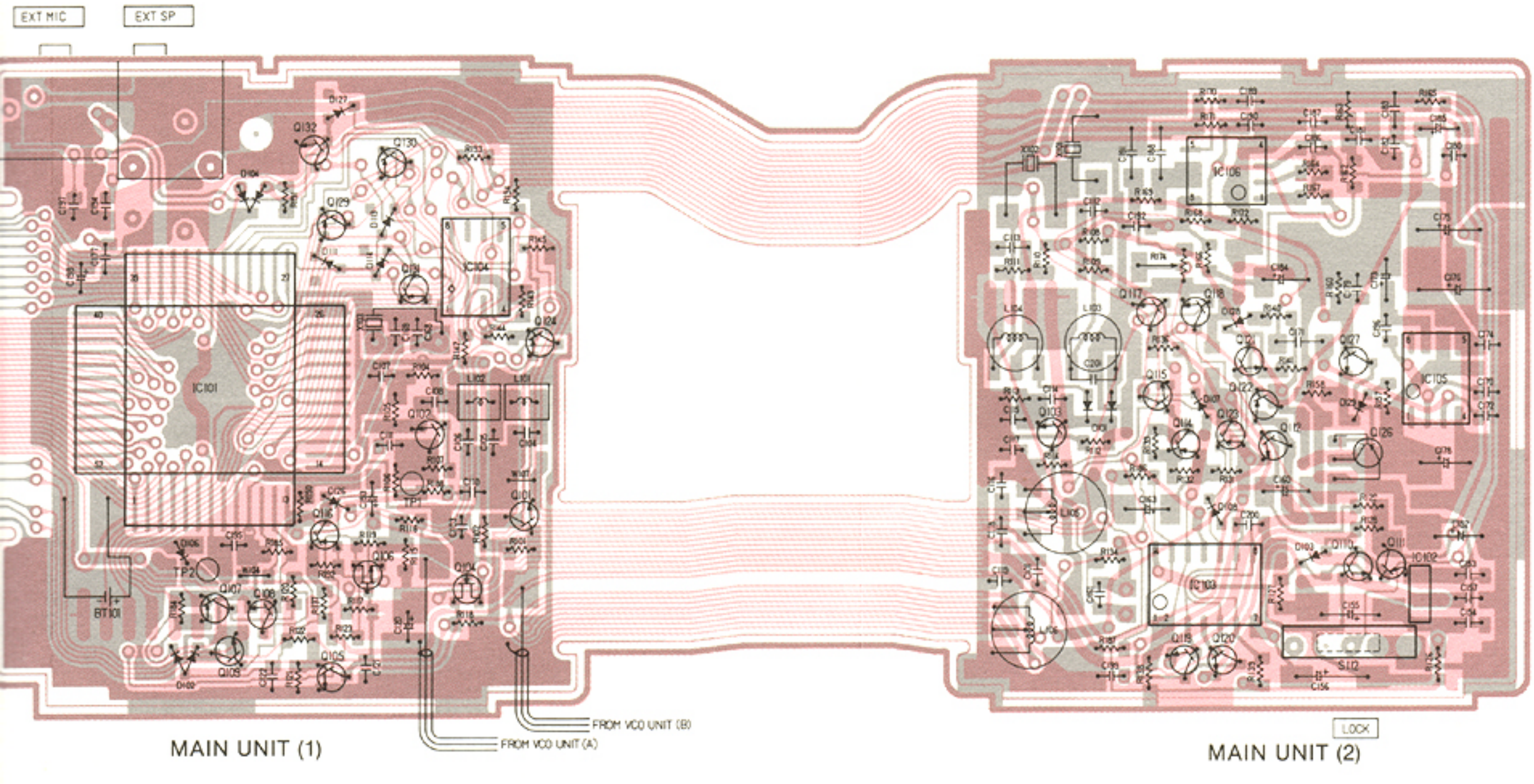


MAIN UNIT (SWITCH)

FOIL SIDE

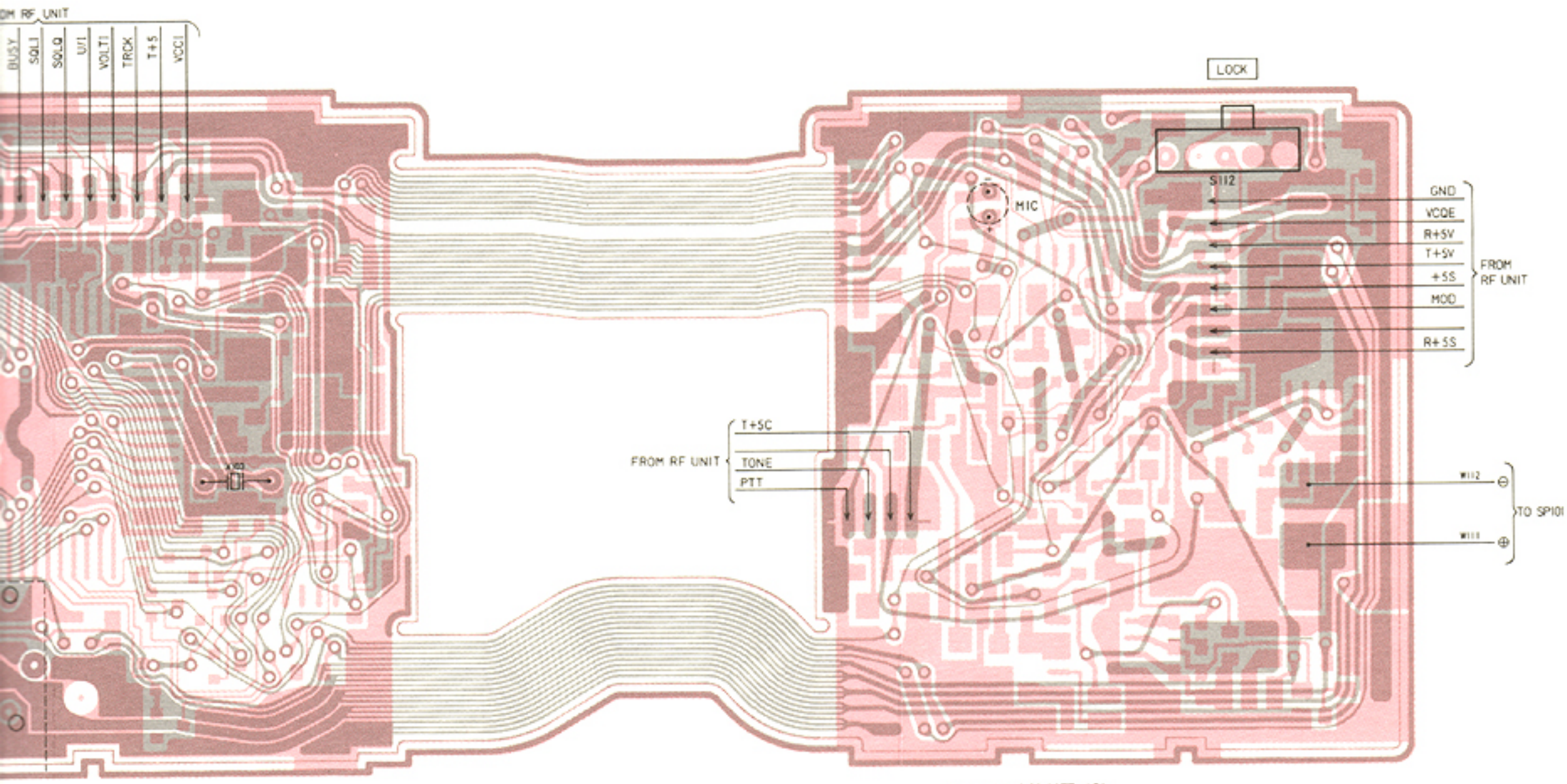


MAIN U



MAIN UNIT (1)

MAIN UNIT (2)

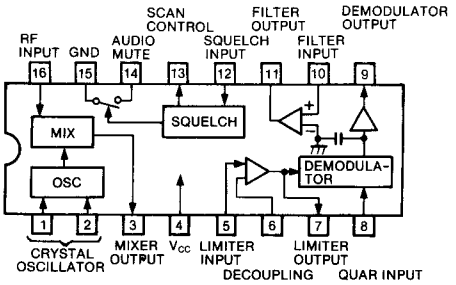


MAIN UNIT (1)

MAIN UNIT (2)

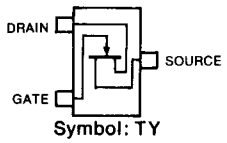
7-3 RF UNIT

IC

IC301	**MC3357D** (LOW POWER FM IF)	

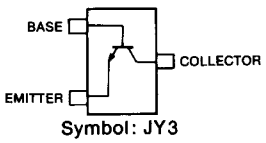
TRANSISTORS

2SK302
Q301, Q302



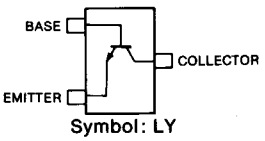
Symbol: TY

2SC3770 rank 3
Q303



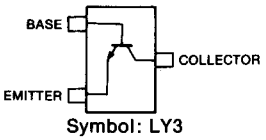
Symbol: JY3

2SC2712
Q304, Q307, Q313, Q314, Q317, Q318



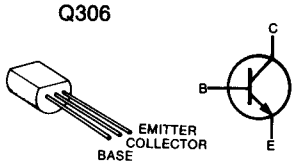
Symbol: LY

2SC3772 rank 3
Q305

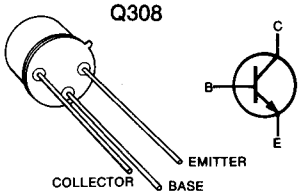


Symbol: LY3

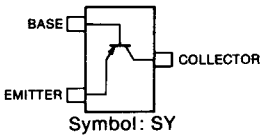
2SC2053
Q306



2SC1947
Q308

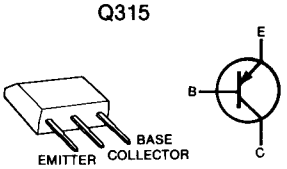


2SA1162
Q312

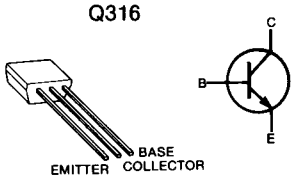


Symbol: SY

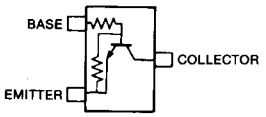
2SB909M
Q315



2SC2458
Q316



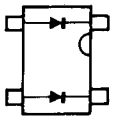
2SC3395
Q319



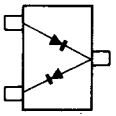
Symbol: BY

DIODES

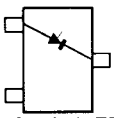
MA862
D305, D311


Symbol: M1I

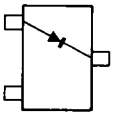
HSM88AS
D306


Symbol: C1

1SS193
D308

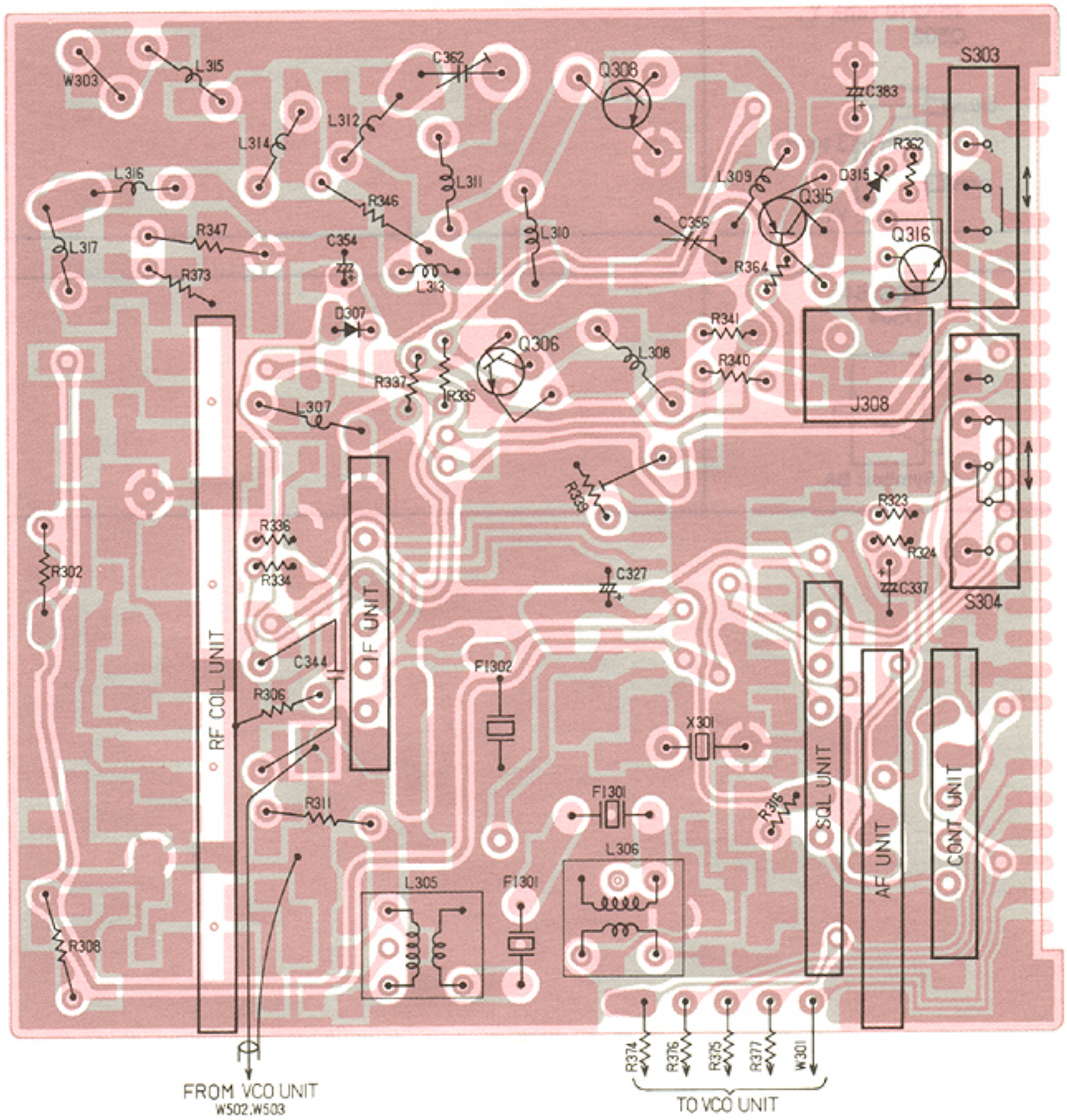

Symbol: F3

1SS153
D310

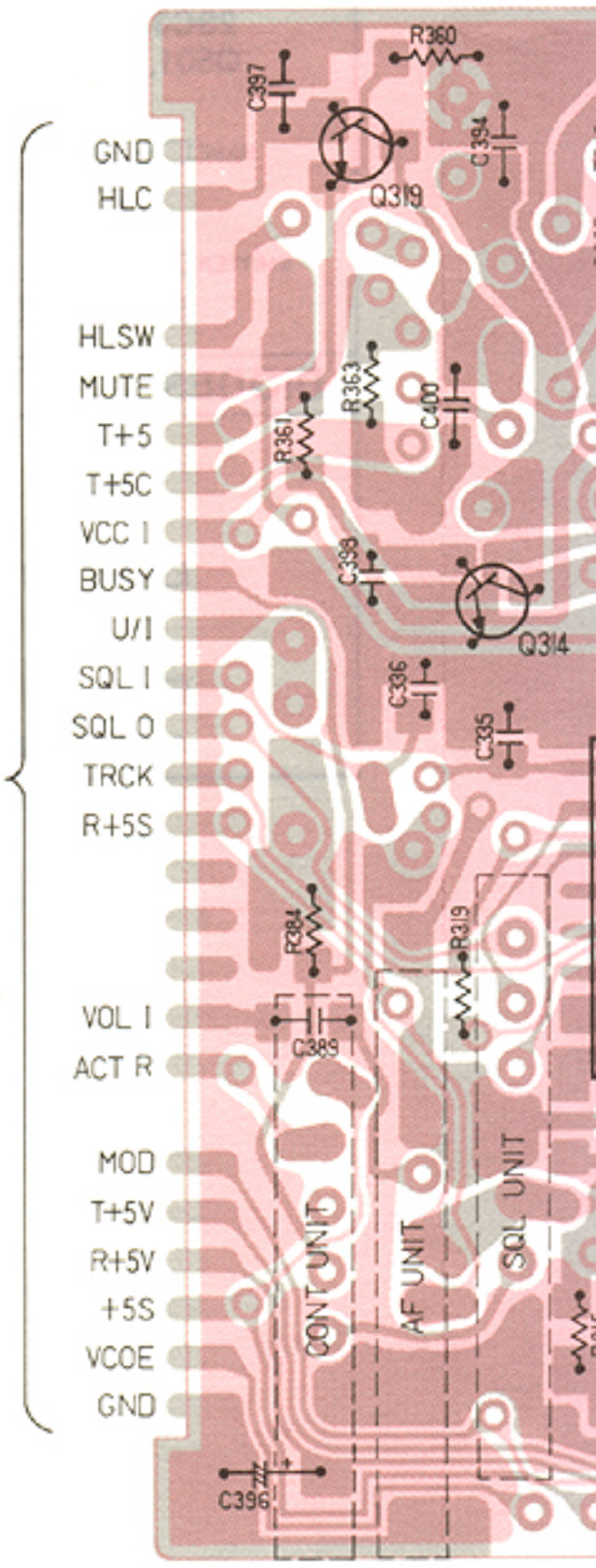

Symbol: A9

• RF UNIT

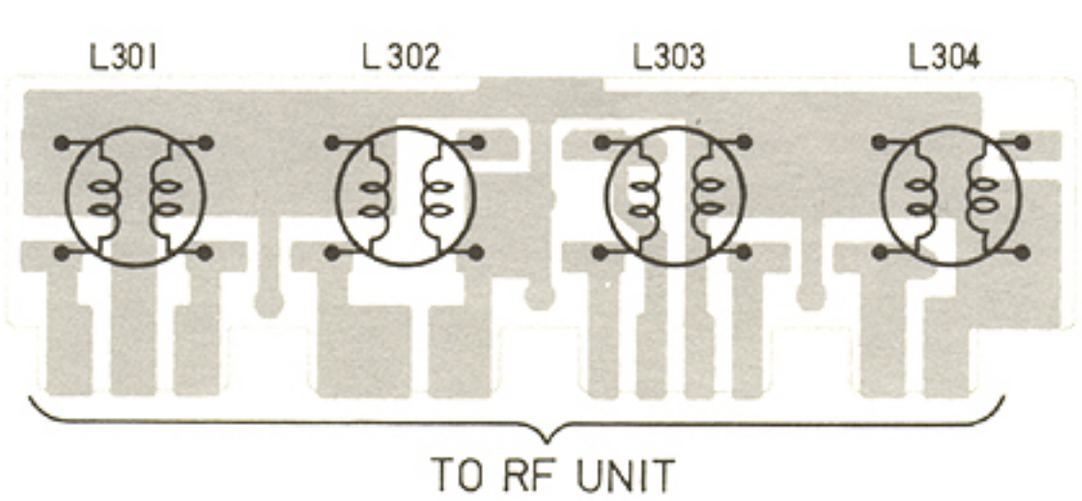
COMPONENT SIDE



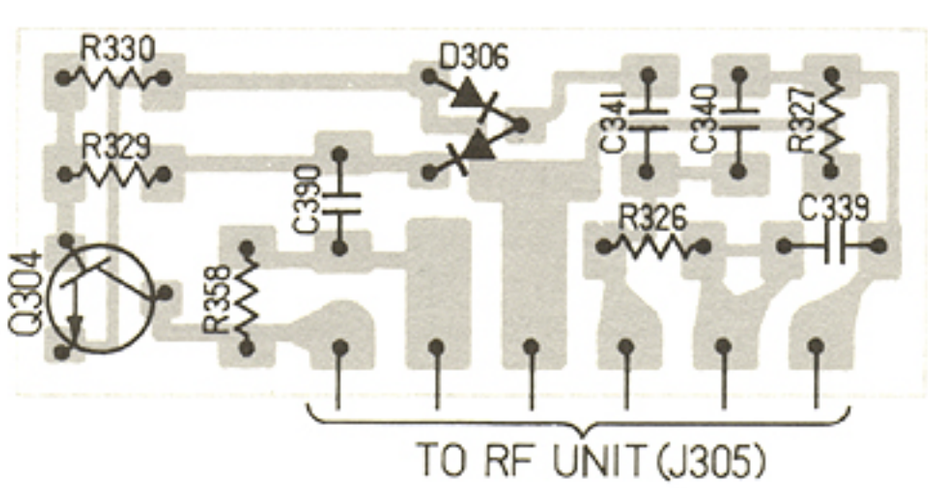
FOIL SIDE



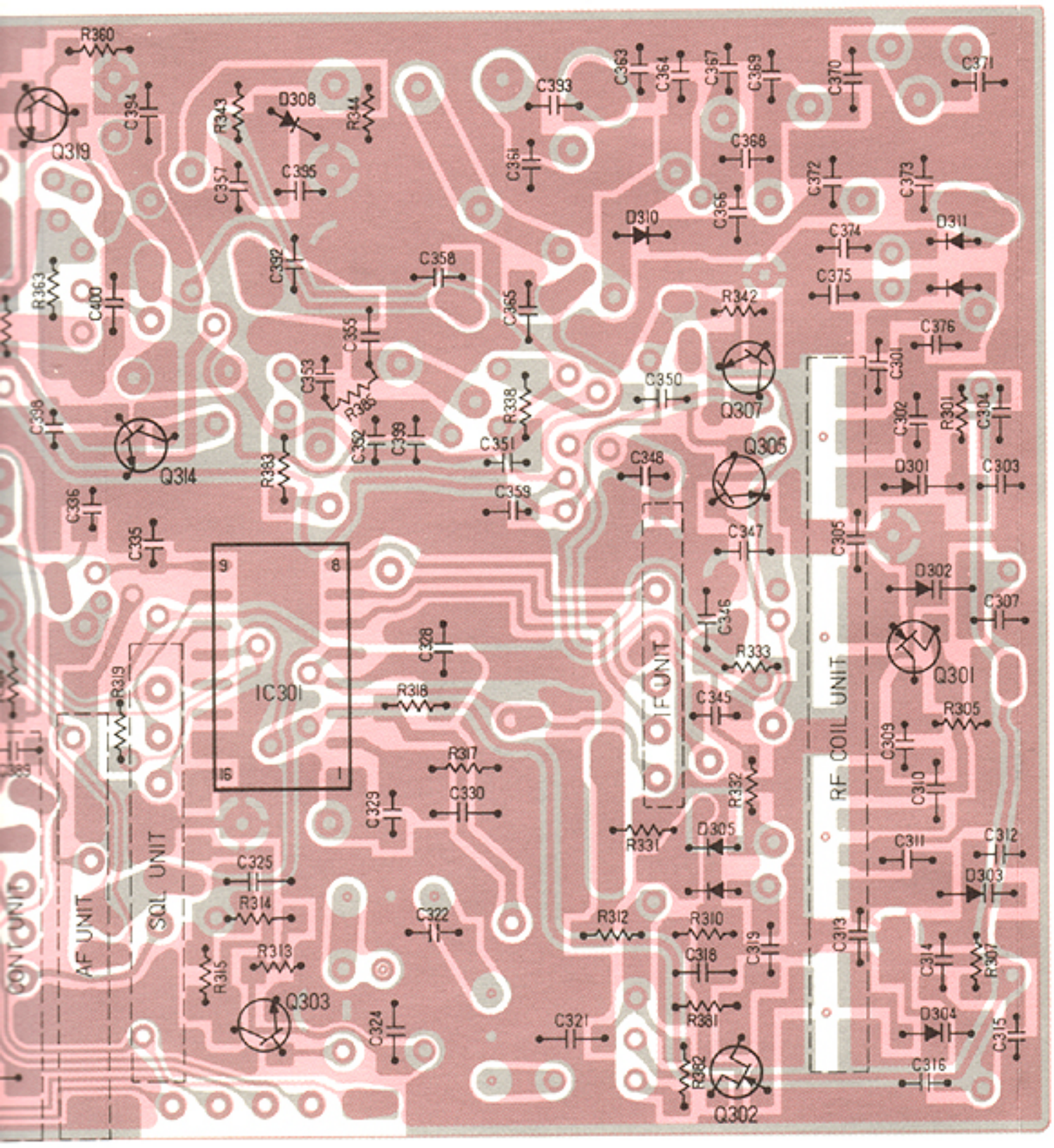
RF COIL UNIT

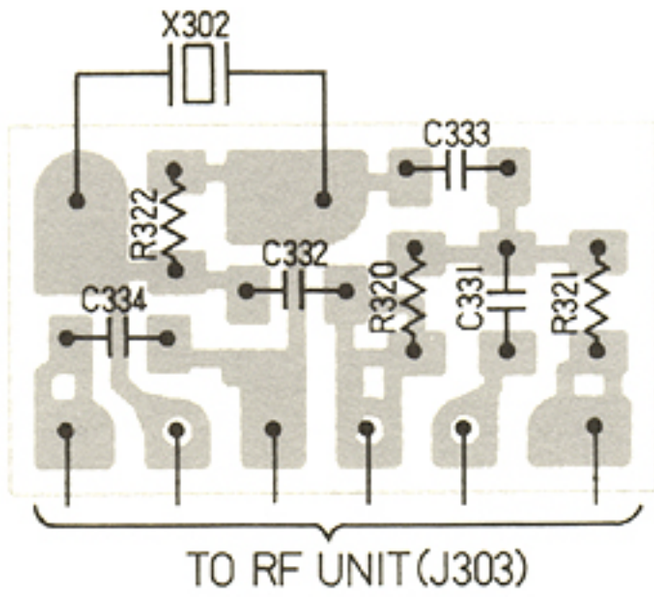


SQUELCH UNIT

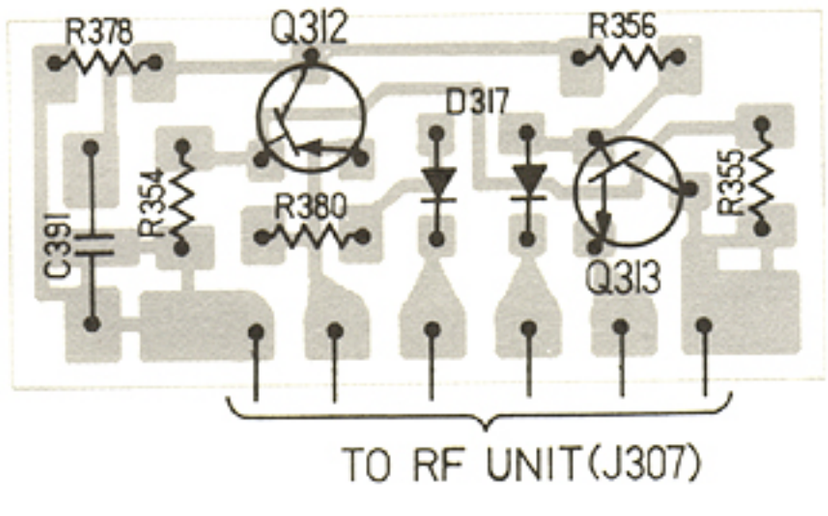


IF UNIT

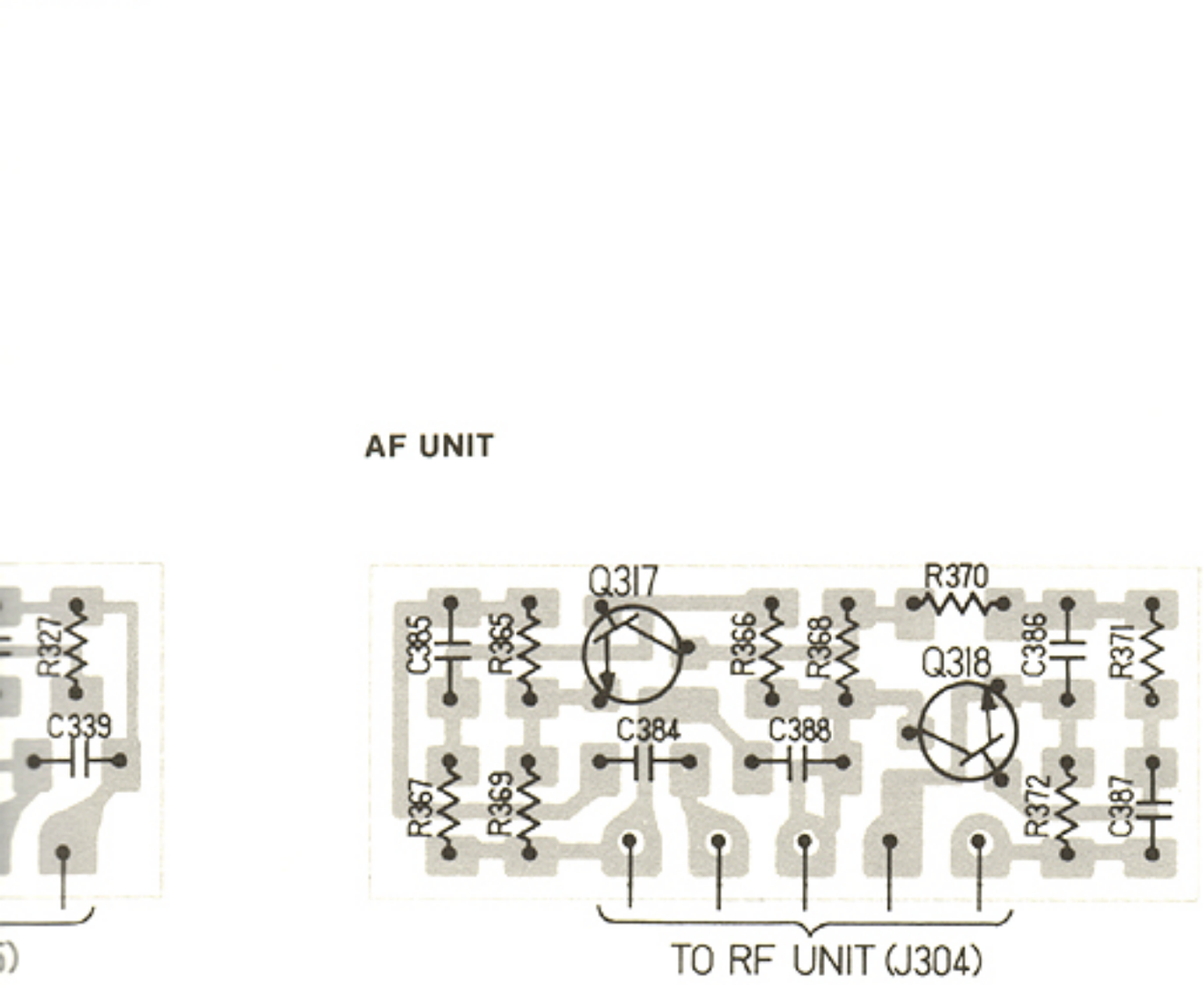




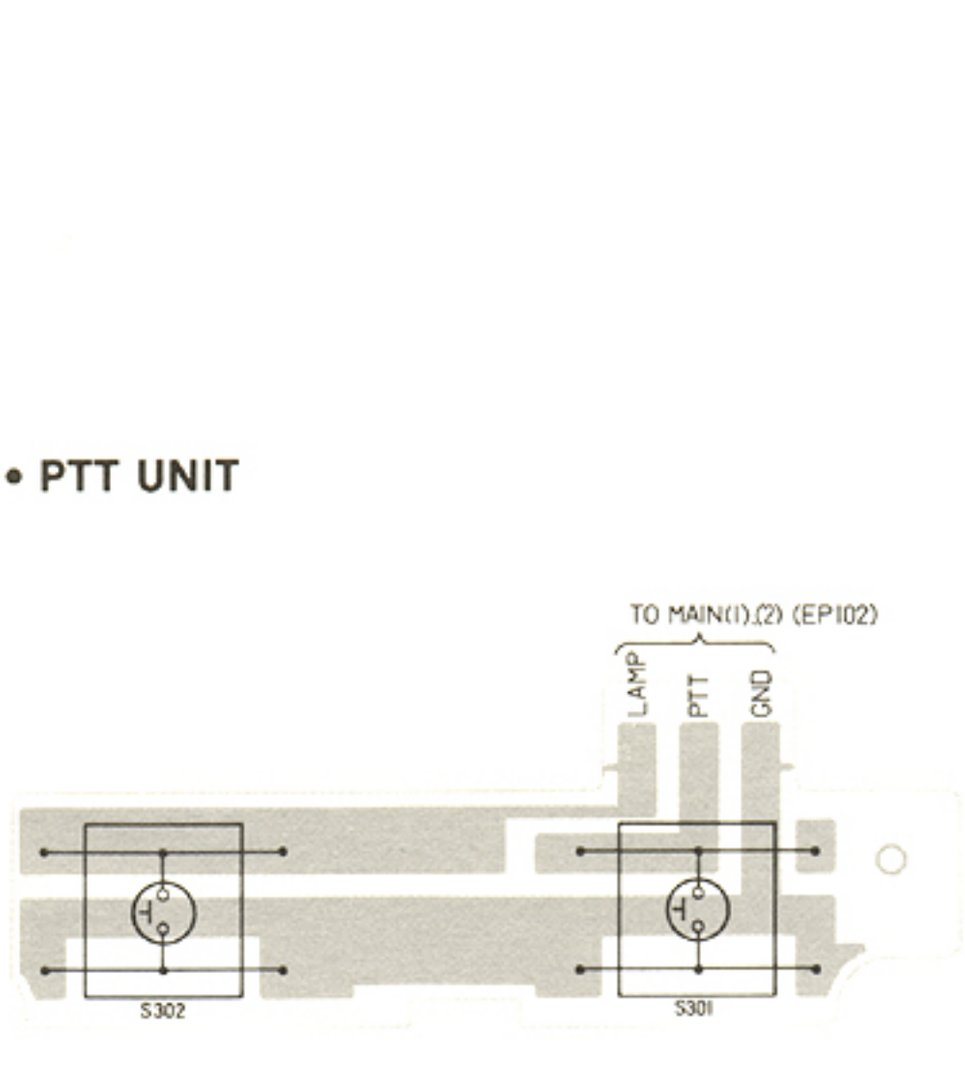
CONTROL UNIT



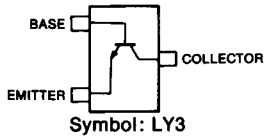
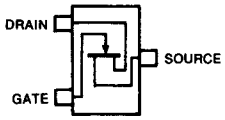
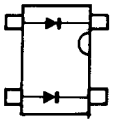
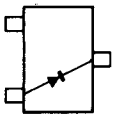
AF UNIT



• PTT UNIT

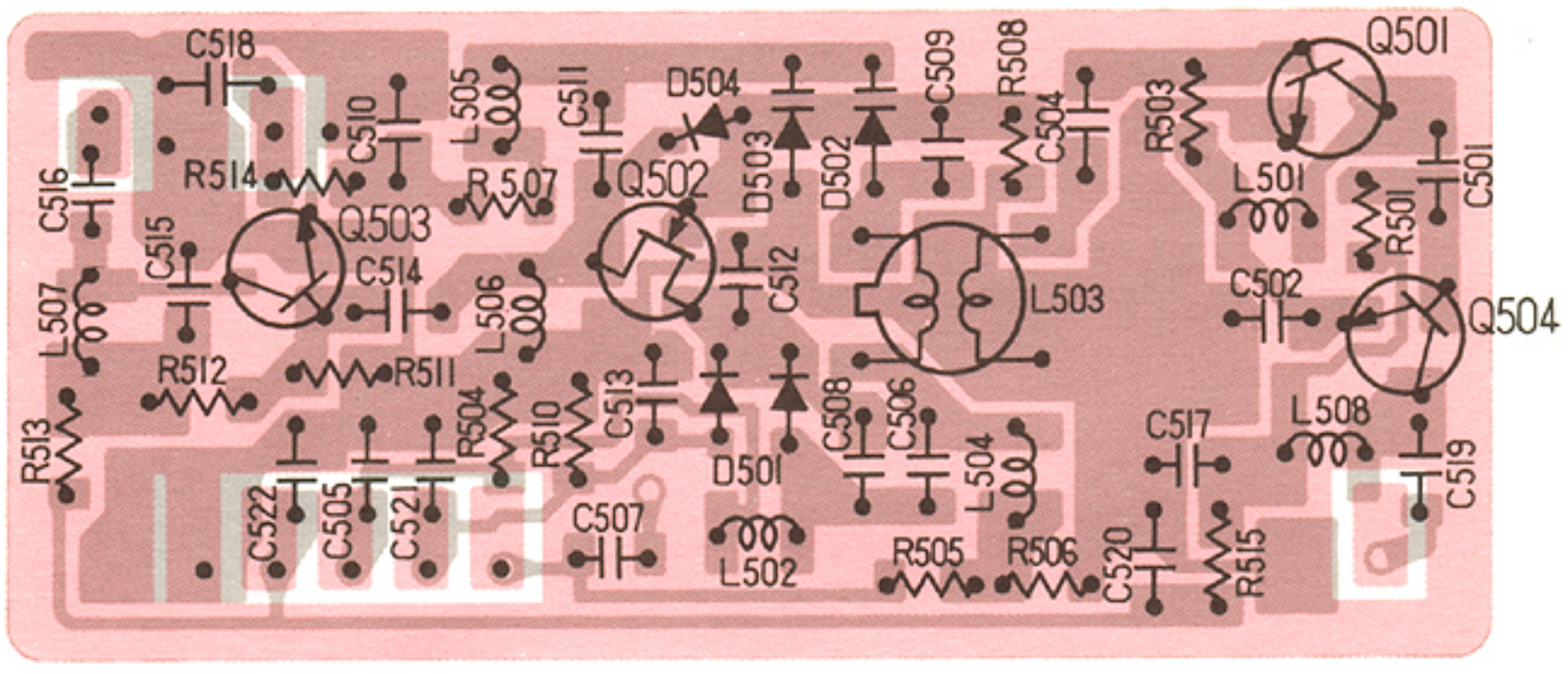


7-4 VCO UNIT

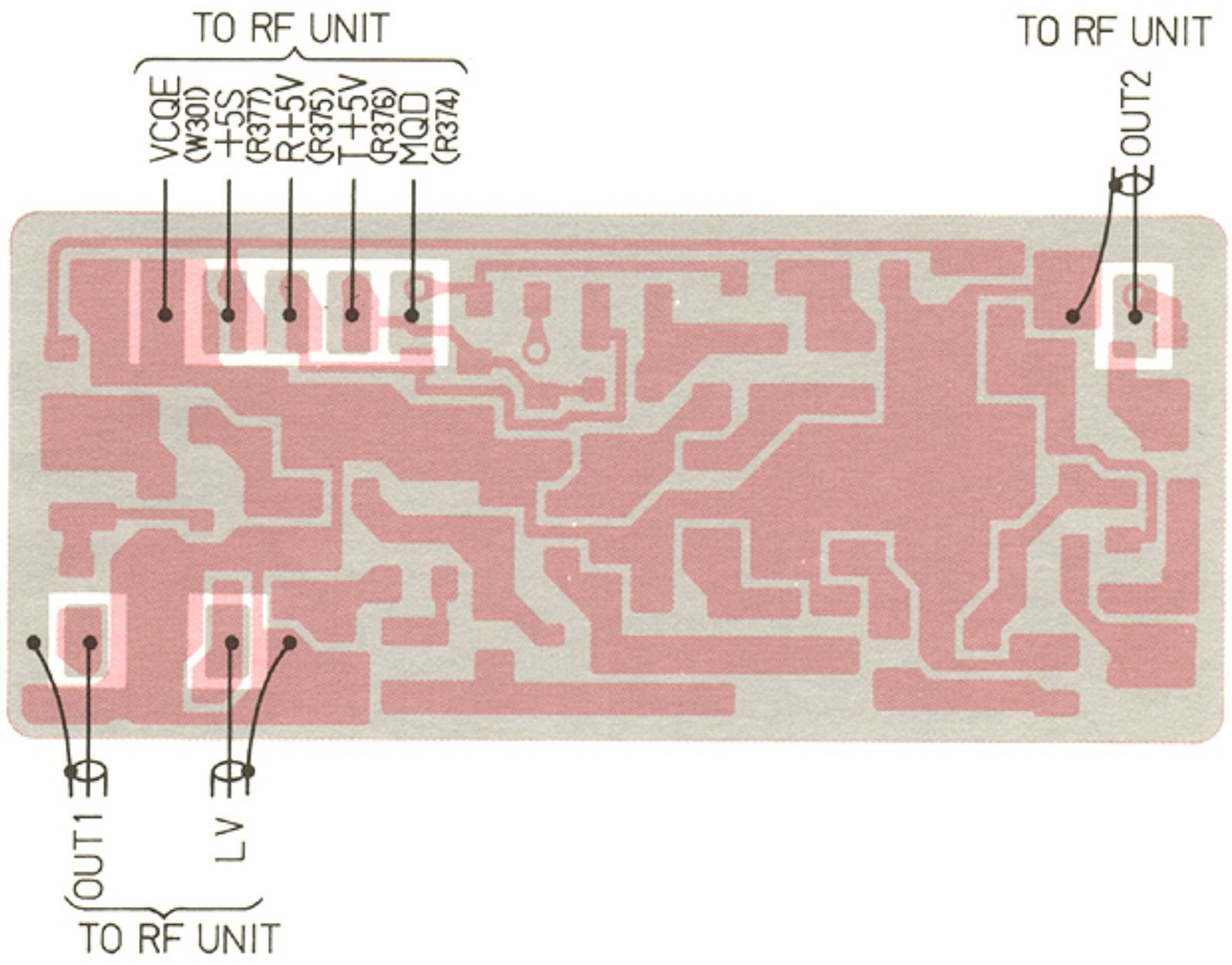
TRANSISTORS		
2SC3772 rank 3 Q501, Q503, Q504  Symbol: LY3	**2SK210 rank Y** Q502  Symbol: YY	
DIODES		
MA862 D501  Symbol: M1I	**1SS154** D504  Symbol: BA	

• VCO UNIT

COMPONENTS SIDE



FOIL SIDE



SECTION 8 PARTS LIST

[MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.
IC101	IC	μPD1708AG-725-00 (μPD1708AG-709-00 is used in equipment not equipped with a U.S.A./INT SWITCH.)
IC102	IC	LVC550C
IC103	IC	LC4001BM
IC104	IC	BA6993F
IC105	IC	NJM386M
IC106	IC	BA4558F
Q101	Transistor	2SC3770 3
Q102	Transistor	2SC3770 3
Q103	Transistor	2SC3772 3
Q104	FET	2SK209 O
Q105	Transistor	2SC2712 BL
Q106	FET	2SK209 O
Q107	Transistor	2SA1341
Q108	Transistor	2SC3395
Q109	Transistor	2SC3395
Q110	Transistor	2SC2712 BL
Q111	Transistor	2SA1162 GR
Q112	Transistor	2SC2712 BL
Q113	FET	2SK209 O
Q114	Transistor	2SA1162 GR
Q115	Transistor	2SC3395
Q116	Transistor	2SA1162 GR
Q117	Transistor	2SC3395
Q118	Transistor	2SC2712 BL
Q119	Transistor	2SC2712 BL
Q120	Transistor	2SC2712 BL
Q121	Transistor	2SC2712 BL
Q122	Transistor	2SA1162 GR
Q123	Transistor	UN2114
Q124	Transistor	2SA1162 GR
Q126	Transistor	2SB798 DK
Q127	Transistor	2SC2712 BL
Q128	Transistor	2SC2712 BL
Q129	Transistor	2SA1341
Q130	Transistor	2SA1341
Q131	Transistor	2SA1341
Q132	Transistor	UN2210
D101	Diode	MA862
D102	Diode	1SS181
D103	Diode	1SS196
D104	Diode	1SS184
D105	Zener	RD5.1M B3
D106	Diode	1SS193
D107	Diode	1SS190
D108	Diode	1SS196
D109	LED	SLB-22VR
D111	Diode	1SS187
D112	Diode	1SS190
D113	Diode	1SS187
D114	Diode	1SS187
D115	Diode	1SS181
D116	Diode	MA862
D117	LED	SLM-13MW
D118	LED	SLM-13MW
D126	Diode	1SS187

[MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.
D127	Diode	1SS196
D128	Diode	1SS190
D129	Diode	1SS193
X101	Crystal	CR199
X102	Crystal	CR200
X103	Crystal	RF4A3 FAD (4.5MHz)
L101	Coil	LQH3N R39M
L102	Coil	LQH3N R39M
L103	Coil	LB-192
L104	Coil	LB-191
L105	Coil	LB-198
L106	Coil	LB-198
R101	Chip	47 MCR10
R102	Chip	47k MCR10
R104	Chip	100 MCR10
R105	Chip	47 MCR10
R106	Chip	330 MCR10
R107	Chip	47k MCR10
R108	Chip	1.5k MCR10
R109	Chip	1.5k MCR10
R110	Chip	1.5k MCR10
R111	Chip	1.5k MCR10
R112	Chip	10k MCR10
R113	Chip	2.2k MCR10
R114	Chip	47 MCR10
R115	Chip	270 MCR10
R116	Chip	8.2k MCR10
R117	Chip	1M MCR10
R118	Chip	47k MCR10
R119	Chip	22k MCR10
R120	Chip	470 MCR10
R121	Chip	1M MCR10
R122	Chip	1M MCR10
R123	Chip	100k MCR10
R124	Variable	V105-B10K
R125	Variable	V108-S-B10K
R126	Chip	390 MCR10
R127	Chip	3.3k MCR10
R128	Chip	470 MCR10
R129	Chip	1k MCR10
R130	Chip	6.8k MCR10
R131	Chip	470 MCR10
R132	Chip	10k MCR10
R133	Chip	2.2k MCR10
R134	Chip	33k MCR10
R136	Chip	100k MCR10
R137	Chip	1M MCR10
R138	Chip	220k MCR10
R139	Chip	220k MCR10
R140	Chip	100 MCR10
R141	Chip	4.7k MCR10
R142	Chip	220k MCR10
R143	Chip	330k MCR10
R144	Chip	12k MCR10
R145	Chip	56k MCR10

[MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.
R146	Chip	330 MCR10
R150	Chip	100k MCR10
R157	Chip	1.2k MCR10
R158	Chip	1.2k MCR10
R162	Chip	200k MCR10
R163	Chip	270k MCR10
R164	Chip	390k MCR10
R165	Chip	560 MCR10
R166	Chip	1k MCR10
R167	Chip	180k MCR10
R168	Chip	120k MCR10
R169	Chip	12k MCR10
R170	Chip	82k MCR10
R171	Chip	82k MCR10
R172	Chip	270k MCR10
R174	Trimmer	RH04A3AS4J 47kB
R175	Chip	47 MCR10
R176	Chip	3.3k MCR10
R177	Chip	5.6k MCR10
R178	Chip	47k MCR10
R179	Chip	47k MCR10
R180	Chip	47k MCR10
R181	Chip	47k MCR10
R184	Chip	10k MCR10
R185	Chip	10k MCR10
R186	Chip	MCR10-JPW
R187	Chip	330k MCR10
R188	Chip	150 MCR10
R189	Chip	10k MCR10
R190	Chip	10k MCR10
R191	Chip	1.2k MCR10
R192	Chip	150k MCR10
R193	Chip	47k MCR10
R194	Chip	47k MCR10
C101	Monolithic	2P GRM40
C103	Monolithic	0.001 GRM40
C104	Monolithic	22P GRM40
C105	Monolithic	82P GRM40
C106	Monolithic	12P GRM40
C107	Monolithic	0.001 GRM40
C108	Monolithic	0.001 GRM40
C110	Monolithic	0.01 GRM40 F
C111	Monolithic	0.001 GRM40
C112	Monolithic	0.001 GRM40
C113	Monolithic	0.001 GRM40
C114	Monolithic	22P GRM40 UJ
C115	Monolithic	56P GRM40 UJ
C116	Monolithic	10P GRM40
C117	Monolithic	0.001 GRM40
C118	Monolithic	2P GRM40
C119	Monolithic	10P GRM40
C120	Tantalum	TESVD21A336M12L 10V 33
C121	Monolithic	0.1 GRM40 F
C122	Monolithic	0.1 GRM40 F
C148	Monolithic	0.001 GRM40
C149	Monolithic	470P GRM40
C150	Monolithic	470P GRM40
C151	Monolithic	470P GRM40
C152	Tantalum	TESVD1C226M12L 16V 22
C153	Monolithic	470P GRM40

[MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.
C154	Monolithic	470P GRM40
C155	Tantalum	TESVC0J226M12L 6.3V 22
C156	Tantalum	TESVC0J226M12L 6.3V 22
C157	Monolithic	470P GRM40
C160	Tantalum	TESVB20J685M8L 6.3V 6.8
C161	Monolithic	470P GRM40
C163	Tantalum	TESVB20J685M8L 6.3V 6.8
C168	Monolithic	10P GRM40
C169	Monolithic	15P GRM40
C170	Monolithic	470P GRM40
C171	Monolithic	0.1 GRM42 F
C172	Monolithic	470P GRM40
C173	Tantalum	TESVA1C105M1-8L 16V 1
C174	Monolithic	470P GRM40
C175	Tantalum	TESVD20J476M12L 6.3V 47
C176	Tantalum	TESVD20J476M12L 6.3V 47
C177	Monolithic	470P GRM40
C178	Tantalum	TESVD21A336M12L 10V 33
C179	Monolithic	470P GRM40
C180	Monolithic	470P GRM40
C181	Monolithic	0.01 GRM40 F
C182	Monolithic	0.1 GRM40 F
C183	Monolithic	0.001 GRM40
C184	Tantalum	TESVB20J685M8L 6.3V 6.8
C185	Tantalum	TESVA1V104KI-8L 35V 0.1
C186	Monolithic	470P GRM40
C187	Monolithic	470P GRM40
C188	Monolithic	0.0022 GRM42
C189	Monolithic	150P GRM40
C190	Monolithic	0.001 GRM40
C191	Monolithic	0.0022 GRM42
C192	Monolithic	0.1 GRM40 F
C193	Tantalum	TESVA1A225M1-8L 10V 2.2
C194	Monolithic	0.001 GRM40
C195	Monolithic	0.001 GRM40
C196	Monolithic	0.01 GRM40 F
C197	Monolithic	470P GRM40
C198	Tantalum	DSB0J336M1S 6.3V 33
C199	Monolithic	0.1 GRM40 F
C200	Monolithic	0.1 GRM40 F
C201	Ceramic	0.75P
J101	Connector	HSJ0836-01-010
J102	Connector	HSJ1102-01-040
P101	Connector	02DR-E8M
DS101	LCD	LF7334M

[MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.
MC101	Microphone	EM-78B3
S101	Switch	SKHLAD [UP (CHANNEL)]
S102	Switch	SKHLAD [UP (WX)]
S103	Switch	SKHLAD [DOWN (CHANNEL)]
S105	Switch	SKHLAD [DW]
S106	Switch	SKHLAD [UP (MEMORY)]
S107	Switch	SKHLAD [UP (CHANNEL)]
S108	Switch	SKHLAD [DOWN (MEMORY)]
S109	Switch	SKHLAD [DOWN (CHANNEL)]
S111	Switch	SKHLAD [CH16]
S112	Switch	SSSJ11082A [LOCK]
SP101	Speaker	Si36D04
BT101	Litihum Battery	CR1220-1VF
EP101	F.P.C. Board	B-1435 A
EP102	F.P.C. Board	B-1212 D
W104	Jumper	MCR10-JPW
W107	Jumper	MCR10-JPW
W108	Jumper	23/02/115/W01/W01
W109	Jumper	23/03/040/W01/Y
W110	Jumper	23/00/040/W01/Y
W111	Jumper	24/04/050/W01/W01
W112	Jumper	24/00/050/W01/W01

[RF UNIT]

REF. NO.	DESCRIPTION	PART NO.
IC301	IC	MC3357D
Q301	FET	2SK302 Y
Q302	FET	2SK302 Y
Q303	Transistor	2SC3770 3
Q304	Transistor	2SC2712 BL
Q305	Transistor	2SC3772 3
Q306	Transistor	2SC2053
Q307	Transistor	2SC2712 BL
Q308	Transistor	2SC1947
Q312	Transistor	2SA1162 GR
Q313	Transistor	2SC2712 BL
Q314	Transistor	2SC2712 BL
Q315	Transistor	2SB909M R
Q316	Transistor	2SC2458 GR
Q317	Transistor	2SC2712 BL
Q318	Transistor	2SC2712 BL
Q319	Transistor	2SC3395
D301	Varicap	MA334 B
D302	Varicap	MA334 B
D303	Varicap	MA334 B
D304	Varicap	MA334 B
D305	Diode	MA862
D306	Diode	HSM88AS
D307	Diode	1SS211
D308	Diode	1SS193
D310	Diode	1SS153
D311	Diode	MA862
D315	Diode	1SS211
D317	Diode	MA159
FI301	Crystal	21M15B3
FI302	Ceramic	CFZM455E10
X301	Crystal	CR70
X302	Ceramic Resonator	CDB455C7A
L301	Coil	LB-194
L302	Coil	LB-195
L303	Coil	LB-205
L304	Coil	LB-194
L305	Coil	LS-263
L306	Coil	LS-263
L307	Coil	LA-229
L308	Coil	LA-229
L309	Coil	LA-243
L310	Coil	LA-234
L311	Coil	LA-234
L312	Coil	LA-234
L313	Coil	LAL02NA 1R8K
L314	Coil	LA-234
L315	Coil	LA-235
L316	Coil	LA-234
L317	Coil	LA-234
R301	Chip	100k MCR10
R302	Resistor	100k R20

[RF UNIT]

REF. NO.	DESCRIPTION	PART NO.	
R305	Chip	22	MCR10
R306	Resistor	100	R20
R307	Chip	100k	MCR10
R308	Resistor	100k	R20
R310	Chip	2.2k	MCR10
R311	Resistor	4.7k	R20
R312	Resistor	100	MCR10
R313	Chip	22k	MCR10
R314	Chip	47k	MCR10
R315	Chip	1.5k	MCR10
R316	Resistor	2.2k	ELR20
R317	Chip	22k	MCR10
R318	Chip	1.5k	MCR10
R319	Chip	100k	MCR10
R320	Chip	47k	MCR10
R321	Chip	1.5k	MCR10
R322	Chip	1.5k	MCR10
R323	Resistor	470	ELR20
R324	Resistor	2.7k	ELR20
R326	Chip	330k	MCR10
R327	Chip	5.6k	MCR10
R329	Chip	100k	MCR10
R330	Chip	1M	MCR10
R331	Chip	10k	MCR10
R332	Chip	4.7k	MCR10
R333	Chip	330	MCR10
R334	Resistor	470	ELR20
R335	Resistor	56	ELR20
R336	Resistor	47	ELR20
R337	Resistor	47	ELR20
R338	Chip	47	MCR10
R339	Trimmer	RH0521C12J08A	100
R340	Resistor	33	ELR20
R341	Resistor	15	ELR20
R342	Chip	10k	MCR10
R343	Chip	22	MCR10
R344	Chip	150	MCR10
R346	Resistor	15k	R20
R347	Resistor	180	R20
R354	Chip	100k	MCR10
R355	Chip	68k	MCR10
R356	Chip	150k	MCR10
R358	Chip	10k	MCR10
R360	Chip	100k	MCR10
R361	Chip	2.2k	MCR10
R362	Resistor	100	ELR20
R363	Chip	2.2k	MCR10
R364	Resistor	2.2	ELR20
R365	Chip	5.6k	MCR10
R366	Chip	330k	MCR10
R367	Chip	150k	MCR10
R368	Chip	4.7k	MCR10
R369	Chip	2.2k	MCR10
R370	Chip	22k	MCR10
R371	Chip	22k	MCR10
R372	Chip	4.7k	MCR10
R373	Resistor	3.3k	ELR20
R374	Resistor	1	R20
R375	Resistor	1	R20
R376	Resistor	1	R20
R377	Resistor	1	R20
R378	Chip	470k	MCR10
R380	Chip	47k	MCR10
R381	Chip	56	MCR10

[RF UNIT]

REF. NO.	DESCRIPTION	PART NO.	
R382	Chip	10k	MCR10
R383	Chip	120	MCR10
R384	Chip	330k	MCR10
R385	Chip	1k	MCR10
C301	Monolithic	100P	GRM40
C302	Monolithic	1P	GRM40
C303	Monolithic	47P	GRM40
C304	Monolithic	0.001	GRM40
C305	Monolithic	1P	GRM40
C307	Monolithic	33P	GRM40
C309	Monolithic	470P	GRM40
C310	Monolithic	470P	GRM40
C311	Monolithic	3P	GRM40
C312	Monolithic	56P	GRM40
C313	Monolithic	0.5P	GRM40
C314	Monolithic	2P	GRM40
C315	Monolithic	0.001	GRM40
C316	Monolithic	27P	GRM40
C318	Monolithic	0.0047	GRM40
C319	Monolithic	10P	GRM40
C321	Monolithic	0.0047	GRM40
C322	Monolithic	5P	GRM40
C324	Monolithic	0.01	GRM40 F
C325	Monolithic	0.1	GRM40 F
C326	Monolithic	10P	GRM40
C327	Electrolytic	4.7	16V MS5
C328	Monolithic	0.1	GRM40 F
C329	Monolithic	120P	GRM40
C330	Monolithic	68P	GRM40
C331	Monolithic	0.1	GRM40 F
C332	Monolithic	82P	GRM40
C333	Monolithic	0.1	GRM40 F
C334	Monolithic	0.1	GRM40 F
C335	Monolithic	0.001	GRM40
C336	Monolithic	0.0047	GRM40
C337	Tantalum	DN1VR22K1S	35V 0.022
C339	Monolithic	0.001	GRM40
C340	Monolithic	33P	GRM40
C341	Monolithic	0.001	GRM40
C344	Cylindrical	UP050B102K-NA	
C345	Monolithic	0.001	GRM40
C346	Monolithic	0.001	GRM40
C347	Monolithic	0.001	GRM40
C348	Monolithic	0.001	GRM40
C350	Monolithic	15P	GRM40
C351	Monolithic	0.001	GRM40
C352	Monolithic	0.001	GRM40
C353	Monolithic	0.001	GRM40
C354	Electrolytic	4.7	16V MS5
C355	Monolithic	5P	GRM40
C356	Trimmer	ECR-GA010D30	
C357	Monolithic	0.001	GRM40
C358	Monolithic	0.001	GRM40
C359	Monolithic	0.001	GRM40
C361	Monolithic	5P	GRM40
C362	Trimmer	ECR-GA010D30	
C363	Monolithic	12P	GRM40
C364	Monolithic	12P	GRM40
C365	Monolithic	0.001	GRM40
C366	Monolithic	0.001	GRM40
C367	Monolithic	12P	GRM40
C368	Monolithic	12P	GRM40

[RF UNIT]

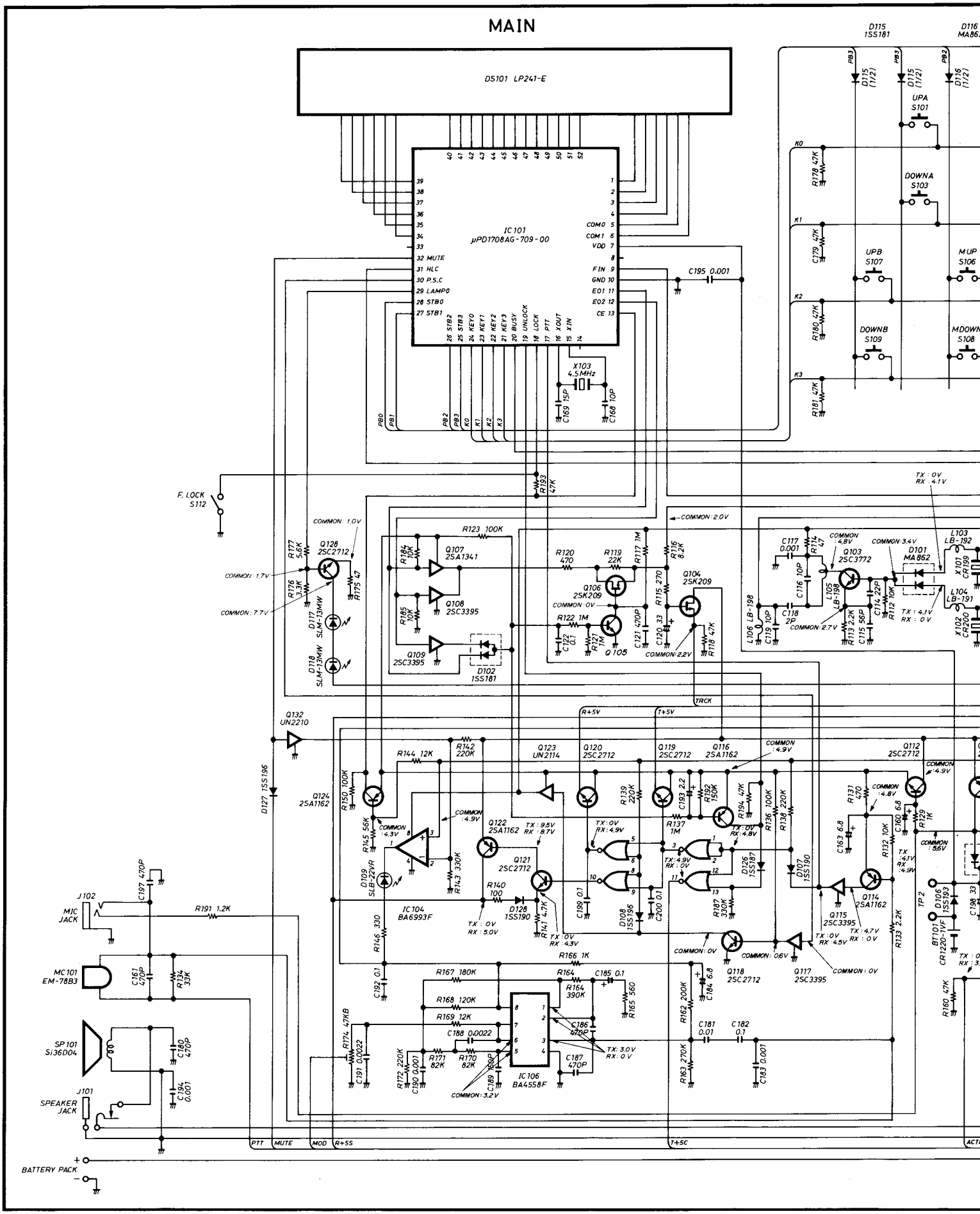
REF. NO.	DESCRIPTION	PART NO.
C369	Monolithic	22P GRM40
C370	Monolithic	4P GRM40
C371	Monolithic	15P GRM40
C372	Monolithic	22P GRM40
C373	Monolithic	39P GRM40
C374	Monolithic	0.001 GRM40
C375	Monolithic	0.001 GRM40
C376	Monolithic	33P GRM40
C383	Electrolytic	47 16V MS5
C384	Monolithic	0.1 GRM40 F
C385	Monolithic	0.01 GRM40 F
C386	Monolithic	0.001 GRM40
C387	Monolithic	0.001 GRM40
C388	Monolithic	0.1 GRM40 F
C389	Monolithic	0.1 GRM40 F
C390	Monolithic	0.1 GRM40 F
C391	Tantalum	TESVA1E474M1-8L 25V 0.47
C392	Monolithic	12P GRM40
C393	Monolithic	0.1 GRM40 F
C394	Monolithic	0.1 GRM40 F
C395	Monolithic	0.1 GRM40 F
C396	Tantalum	TESVA1C105M1-8L 16V 1
C397	Monolithic	0.001 GRM40
C398	Monolithic	0.001 GRM40
C399	Monolithic	0.001 GRM40
C400	Monolithic	0.001 GRM40
J301	Connector	BNC-RM-107
J303	Connector	50002-8106
J304	Connector	50002-8105
J305	Connector	50002-8106
J307	Connector	50002-8106
J308	Connector	B02-DR
S301	Switch	SKHMPD [PTT]
S302	Switch	SKHMPD [LIGHT]
S303	Switch	SSSS31 578A [RF POWER]
S304	Switch	SSSS31 579A [U.S.A./INT L]
EP301	P.C. Board	B-1436B
EP302	P.C. Board	B-1442
EP303	P.C. Board	B-1439
EP304	P.C. Board	B-1440
EP306	P.C. Board	B-1438
EP307	P.C. Board	B-1211C
EP308	P.C. Board	B-1441
W301	Wire	JPW-01 R-01
W303	Wire	72/98/050/X98/X98

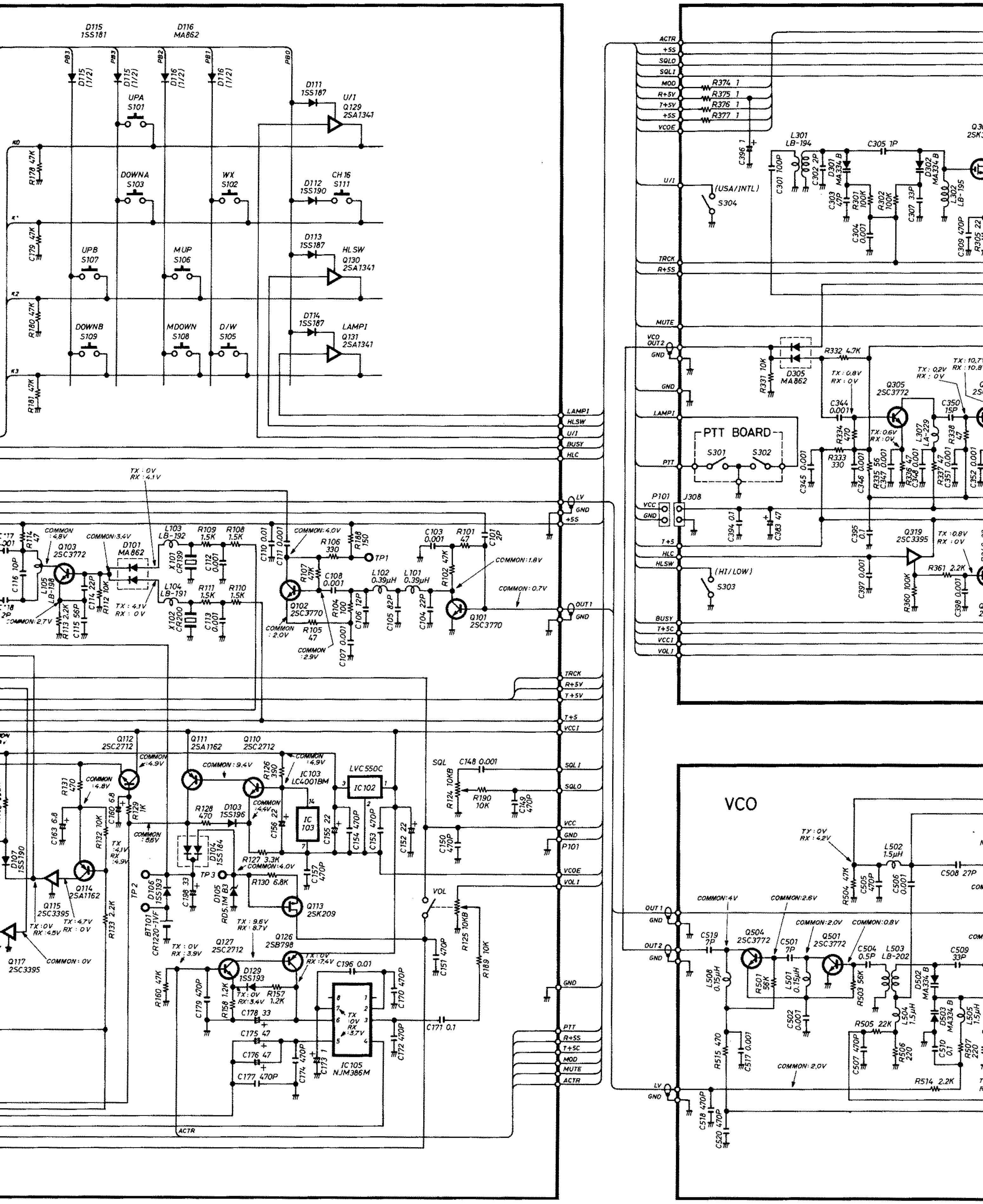
[VCO UNIT]

REF. NO.	DESCRIPTION	PART NO.
Q501	Transistor	2SC3772 3
Q502	FET	2SK210 Y
Q503	Transistor	2SC3772 3
Q504	Transistor	2SC3772 3
D501	Diode	MA862
D502	Varicap	MA334 B
D503	Varicap	MA334 B
D504	Diode	1SS154
L501	Coil	LQN2A R15K
L502	Coil	LQH3N 1R5M
L503	Coil	LB-202
L504	Coil	LQH3N 1R5M
L505	Coil	LQH3N 1R5M
L506	Coil	LQH3N 1R5M
L507	Coil	LQN2A R15K
L508	Coil	LQN2A R15K
R501	Chip	56k MCR10
R503	Chip	56k MCR10
R504	Chip	47k MCR10
R505	Chip	22k MCR10
R506	Chip	220 MCR10
R507	Chip	220 MCR10
R508	Chip	100k MCR10
R510	Chip	47k MCR10
R511	Chip	39k MCR10
R512	Chip	100k MCR10
R513	Chip	1k MCR10
R514	Chip	2.2k MCR10
R515	Chip	470 MCR10
C501	Monolithic	7P GRM40
C502	Monolithic	0.001 GRM40
C504	Monolithic	0.5P GRM40
C505	Monolithic	470P GRM40
C506	Monolithic	0.001 GRM40
C507	Monolithic	470P GRM40
C508	Monolithic	27P GRM40
C509	Monolithic	33P GRM40
C510	Monolithic	0.1 GRM40 F
C511	Monolithic	0.001 GRM40
C512	Monolithic	0.001 GRM40
C513	Monolithic	470P GRM40
C514	Monolithic	0.5P GRM40
C515	Monolithic	0.001 GRM40
C516	Monolithic	7P GRM40
C517	Monolithic	0.001 GRM40
C518	Monolithic	470P GRM40
C519	Monolithic	7P GRM40
C520	Monolithic	470P GRM40
C521	Monolithic	470P GRM40
C522	Monolithic	470P GRM40
EP501	P.C. Board	B-1210C

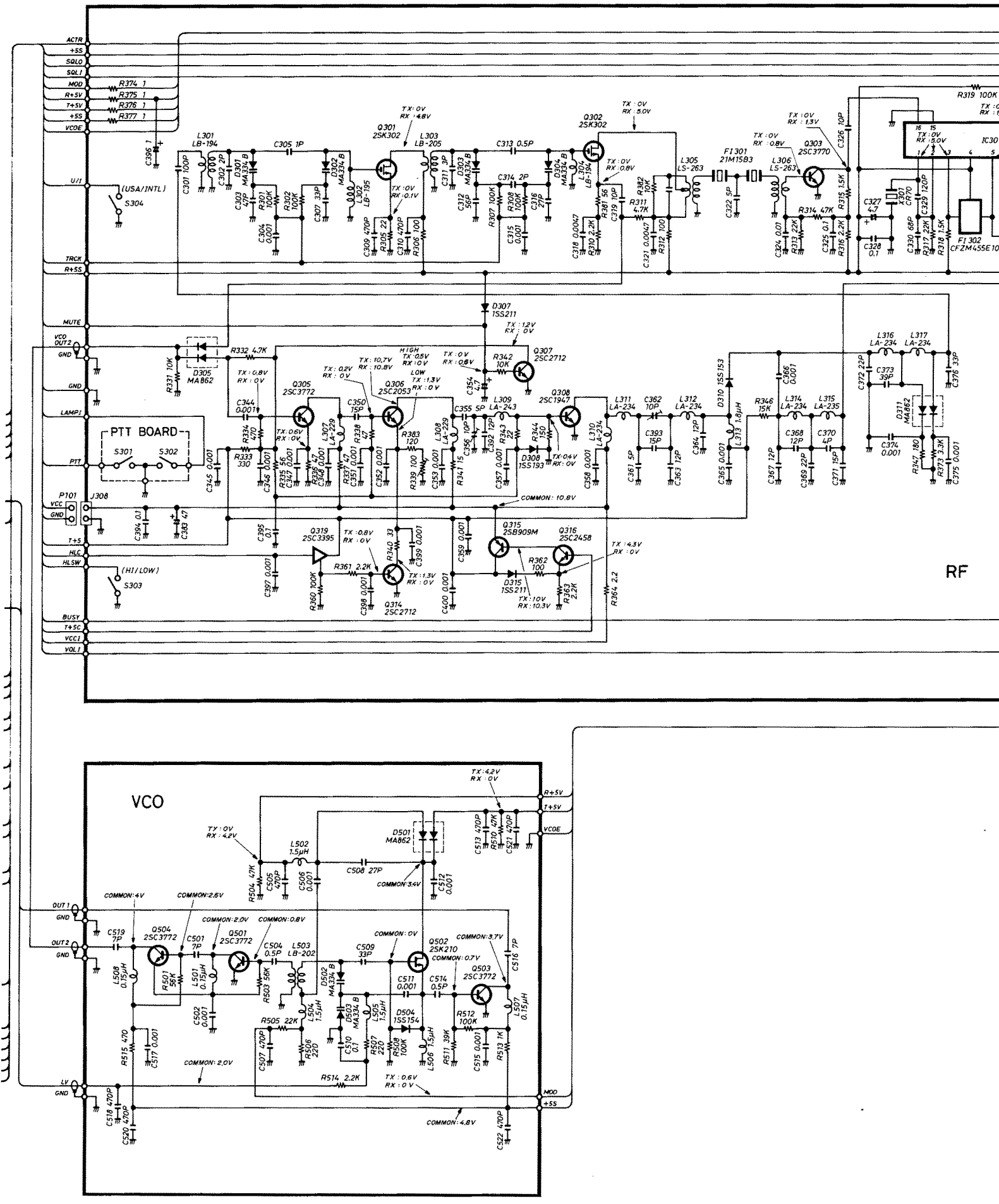
[VCO UNIT]

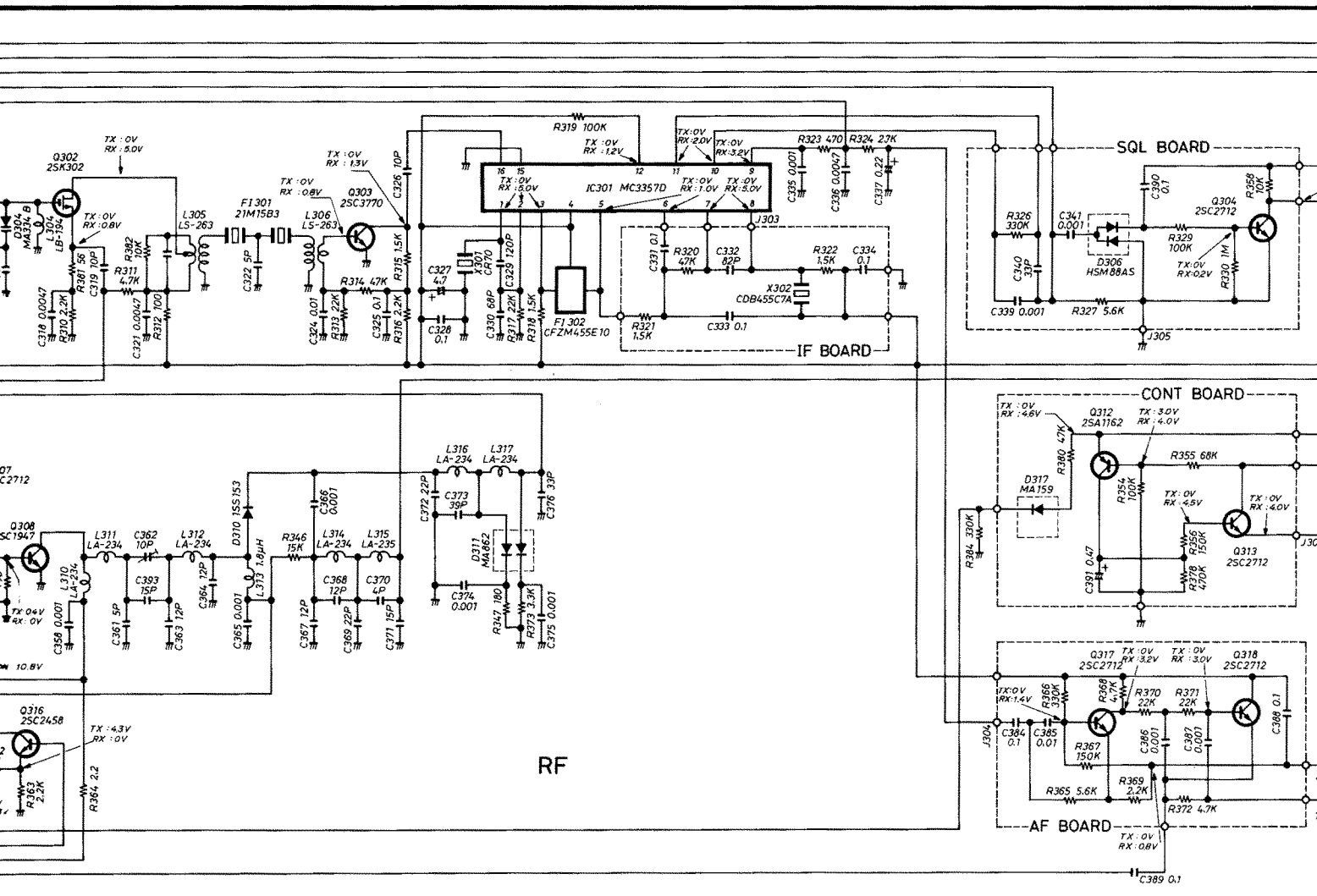
REF. NO.	DESCRIPTION	PART NO.
W502 W503	Wire	66/99/040/W18/W99A 08 A
W504 W505	Wire	66/99/045/W18/W99A 08 A
W506 W507	Wire	51/99/055/W18/W99A 08 A

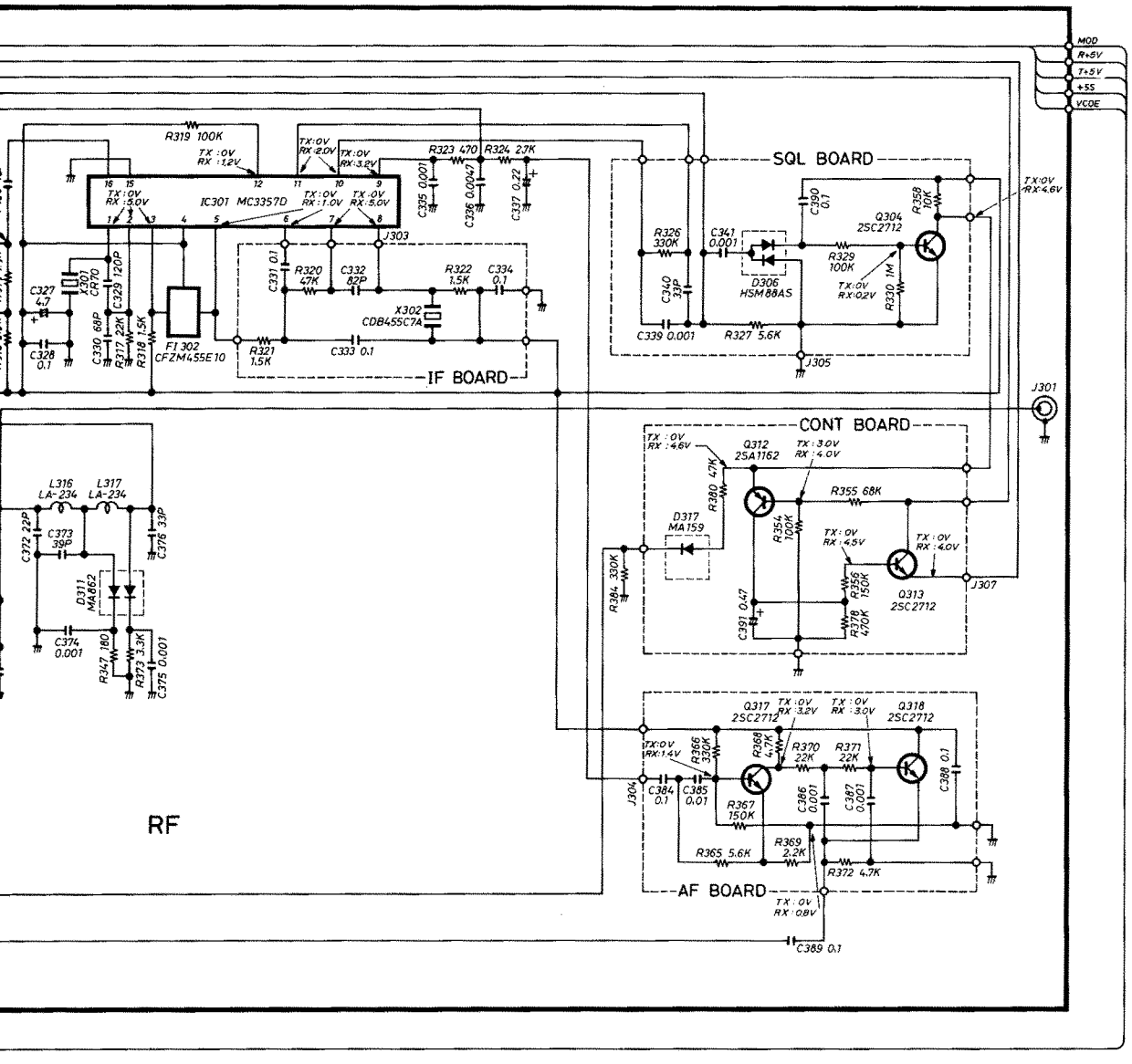

MAIN
DS101 LP241-E
IC101
μPD1708AG-709-00
IC104
BA6993F
IC106
BA4558F
X103
4.5MHz
UPA
S101
DOWNA
S103
UPB
S107
DOWNB
S109
MUP
S106
MDOWN
S108
F. LOCK
S112
J102
MIC JACK
J101
SPEAKER JACK
MC101
EM-78B3
SP101
SI36D04
BATTERY PACK
PTT
MUTE
MOD
R+5S
T+5C
TRCK
R+5V
T+5V
D115
1SS181
D116
MA86
D101
MA862
D102
1SS181
D107
1SS190
D108
1SS196
D109
SLB-22VR
D118
SLM-13MW
D126
1SS187
D127
1SS196
D128
1SS190
Q101
2SA1162
Q102
2SC3772
Q104
2SK209
Q105
Q106
2SK209
Q107
2SA1341
Q108
2SC3395
Q109
2SC3395
Q112
2SC2712
Q114
2SA1162
Q115
2SC3395
Q116
2SA1162
Q117
2SC3395
Q118
2SC2712
Q119
2SC2712
Q120
2SC2712
Q121
2SC2712
Q122
2SA1162
Q123
UN2114
Q124
2SA1162
Q128
2SC2712
Q132
UN2210
TP2
BT101
CR1220-1VF



D115 1SS181
D116 MA862
PB3
PB2
PB1
PB0
UPA S101
DOWNA S103
WX S102
UPB S107
MUP S106
DOWNB S109
MDOWN S108
D/W S105
D111 1SS187
U/I Q129 2SA1341
D112 1SS190
CH 16 S111
D113 1SS187
HL SW Q130 2SA1341
D114 1SS187
LAMPI Q131 2SA1341
R178 47K
C179 47K
R180 47K
R181 47K
LAMPI
HLSW
U/I
BUSY
HLC
LV
GND
+5S
OUT1
TRCK
R+5V
T+5V
T+5
VCCI
SQL I
SQLO
VCC
P101
VCOE
VOL I
PTT
R+5S
T+5C
MOD
MUTE
ACTR
TX : 0V RX : 4.1V
COMMON :4.8V
COMMON:3.4V
D101 MA862
Q103 2SC3772
L105 LB-198
L103 LB-192
L104 LB-191
X101 CR199
X102 CR200
R109 1.5K
R108 1.5K
R111 1.5K
R110 1.5K
C112 0.001
C113 0.001
R114 47
C116 10P
C114 22P
R112 10K
R113 2.2K
C115 56P
TX : 4.1V RX : 0V
COMMON: 2.7V
C110 0.01
C111 0.001
COMMON: 4.0V
R106 330
R188 150
TP1
R107 47K
C108 0.001
Q102 2SC3770
R104 100
R105 47
C107 0.001
COMMON : 2.0V
COMMON : 2.9V
C106 12P
L102 0.39μH
L101 0.39μH
C105 82P
C104 22P
C103 0.001
R101 47
R102 47K
C101 2P
Q101 2SC3770
COMMON: 1.8V
COMMON: 0.7V
Q112 2SC2712
Q111 2SA1162
Q110 2SC2712
COMMON :4.9V
COMMON : 9.4V
R126 390
IC103 LC4001BM
LVC 550C
IC 102
R131 470
C163 6.8
R132 10K
C160 6.8
R129 1K
COMMON : 5.6V
R128 470
D103 1SS196
COMMON :4.4V
C156 22
IC 103
C155 22
C154 470P
C153 470P
C152 22
D104 1SS184
R127 3.3K
COMMON : 4.0V
C157 470P
R130 6.8K
Q113 2SK209
TP 2
TP 3
D106 1SS193
C198 33
D105 RD5.1M B3
BT101 CR1220-1VF
D107 1SS190
Q114 2SA1162
Q115 2SC3395
TX : 0V RX : 4.5V
TX : 4.7V RX : 0V
R133 2.2K
Q117 2SC3395
COMMON : 0V
TX : 9.6V RX : 8.7V
Q127 2SC2712
Q126 2SB798
TX : 0V RX : 3.9V
TX : 0V RX : 7.4V
R160 47K
C179 470P
D129 1SS193
TX : 0V RX : 3.4V
R157 1.2K
R158 1.2K
C178 33
C175 47
C176 47
C177 470P
C174 470P
C173 1
C196 0.01
C170 470P
IC105 NJM386M
TX : 0V RX : 3.7V
C172 470P
C171 0.1
SQL
C148 0.001
R124 10KB
R190 10K
C149 470P
C150 470P
VOL
R125 10KB
R189 10K
C151 470P
SQL0
SQL1
R+5V
T+5V
VCOE
R374 1
R375 1
R376 1
R377 1
C396 1
L301 LB-194
C305 1P
Q30
2SK
C301 100P
C302 2P
D301 MA334 B
D302 MA334 B
L302 LB-195
C303 47P
R301 100K
R302 100K
C307 33P
C304 0.001
C309 470P
R305 22
(USA/INTL)
S304
R+5S
VCO OUT2
R332 4.7K
R331 10K
D305 MA862
TX : 0.8V RX : 0V
TX : 0.2V RX : 0V
TX : 10.7V RX : 10.8V
Q305 2SC3772
C344 0.001
C350 15P
PTT BOARD
S301
S302
R334 470
TX : 0.6V RX : 0V
L307 LA-229
R338 47
R333 330
C345 0.001
C346 0.001
R335 56
C347 0.001
R336 47
C348 0.001
R337 47
C351 0.001
C352 0.001
P101
VCC
J308
C394 0.1
C383 47
C395 0.1
Q319 2SC3395
TX : 0.8V RX : 0V
T+5
HLC
(HI/LOW)
S303
C397 0.001
R361 2.2K
R360 100K
C398 0.001
BUSY
T+5C
VCCI
VOL I
VCO
TX : 0V RX : 4.2V
L502 1.5μH
R504 47K
C505 470P
C506 0.001
C508 27P
OUT 1
OUT 2
COMMON: 4V
COMMON: 2.6V
COMMON: 2.0V
COMMON: 0.8V
C519 7P
Q504 2SC3772
C501 7P
Q501 2SC3772
C504 0.5P
L503 LB-202
C509 33P
L508 0.15μH
R501 56K
L501 0.15μH
R503 56K
D502 MA334 B
C502 0.001
L504 1.5μH
D503 MA334 B
L505 1.5μH
R505 22K
R515 470
C517 0.001
C507 470P
R506 220
C510 0.1
R507 220
COMMON: 2.0V
R514 2.2K
C518 470P
C520 470P


PTT BOARD
S301
S302
S303
S304
(USA/INTL)
(HI/LOW)
RF
VCO
COMMON: 10.8V
COMMON: 4V
COMMON: 2.6V
COMMON: 2.0V
COMMON: 0.8V
COMMON: 0V
COMMON: 3.7V
COMMON: 0.7V
COMMON: 3.4V
COMMON: 4.8V
COMMON: 2.0V
ACTR
+5S
SQLO
SQLI
MOD
R+5V
T+5V
+5S
VCOE
U/I
TRCK
R+5S
MUTE
VCO OUT2
GND
LAMP1
PTT
P101
VCC
GND
T+5
HLC
HLSW
BUSY
T+5C
VCC1
VOL1
OUT1
GND
OUT2
GND
LV
GND
MOD
+5S


SQL BOARD
IF BOARD
CONT BOARD
AF BOARD
RF
IC301 MC3357D
Q302 2SK302
Q303 2SC3770
Q304 2SC2712
Q306 SC1947
Q308 SC1947
Q312 2SA1162
Q313 2SC2712
Q316 2SC2458
Q317 2SC2712
Q318 2SC2712
F1301 21M15B3
F1302 CFZM455E10
X301
X302 CDB455C7A
D306 HSM88AS
D310 1SS153
D311 MA862
D317 MA159
J303
J304
J305
R319 100K
R323 470
R324 2.7K
R326 330K
R327 5.6K
R329 100K
R330 1M
R354 100K
R355 68K
R356 150K
R358 10K
R366 330K
R367 150K
R368 47K
R369 2.2K
R370 22K
R371 22K
R372 4.7K
R378 470K
R380 4.7K
R384 330K
C339 0.001
C389 0.1
TX : 0V RX : 5.0V
TX : 0V RX : 0.8V
TX : 0V RX : 1.3V
TX : 0V RX : 1.2V
TX : 0V RX : 2.0V
TX : 0V RX : 3.2V
TX : 0V RX : 5.0V
TX : 0V RX : 1.0V
TX : 0V RX : 0.2V
TX : 3.0V RX : 4.0V
TX : 0V RX : 4.5V
TX : 0V RX : 4.0V
TX : 0V RX : 3.2V
TX : 0V RX : 3.0V
TX : 0V RX : 1.4V
TX : 4.3V RX : 0V
TX : 0V RX : 0.8V


MOD
R+5V
T+5V
+5S
VCOE
SQL BOARD
IF BOARD
CONT BOARD
AF BOARD
RF
IC301 MC3357D
F1 302 CFZM455E10
X301 CR70
X302 CDB455C7A
D306 HSM88AS
D317 MA159
D311 MA862
Q304 2SC2712
Q312 2SA1162
Q313 2SC2712
Q317 2SC2712
Q318 2SC2712
J301
J303
J304
J305
J307
R319 100K
R323 470
R324 2.7K
R326 330K
R327 5.6K
R329 100K
R330 1M
R355 68K
R365 5.6K
R372 4.7K
C339 0.001
C341 0.001
C389 0.1
L316 LA-234
L317 LA-234

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ICOM

ICOM INCORPORATED

1-6-19, Kamikuratsukuri, Hirano-ku, Osaka 547, Japan
Phone: (06) 793-5301
Telex : 05277822 ICOMTR J
Fax : (06) 793-0013

ICOM AMERICA, INC.,
2380 116th Avenue N.E.,
Bellevue, WA 98004
Phone: (206) 454-8155
Telex : 230-152210 ICOM AMER BVUE
Fax : (206) 454-1509

3150 Premier Drive, Suite 126,
Irving, TX 75063
Phone: (214) 550-7525
Fax : (214) 550-7423

1777 Phoenix Parkway, Suite 201,
Atlanta, GA 30349
Phone: (404) 991-6166

ICOM CANADA, LTD.,
3071-#5 Road, Unit 9,
Richmond, B.C.,
V6X 2T4 Canada
Phone: (604) 273-7400
Fax : (604) 273-1900

ICOM (EUROPE) GmbH,
Himmelgeister Strasse 100,
4000 Düsseldorf 1,
West Germany
Phone: 0211-346047
Telex : 41-8588082 ICOM D
Fax : 0211-333639

ICOM AUSTRALIA, PTY., LTD.,
7 Duke Street, Windsor 3181,
Victoria, Australia
Phone: (03) 529-7582
Telex : 71-35521 ICOMAS
Fax : (03) 529-8485