ICOM

SERVICE MANUAL

IC-μ2A/AT/E

144MHz FM TRANSCEIVER

ICOM INCORPORATED

FOREWORD

Thank you for purchasing the ICOM IC-μ2A/AT/E, one of the most technologically advanced and sophisticated pocket-sized handheld transceiver on the market today.

Exceptionally flexible for a variety of uses yet surprisingly compact and easy to handle, the IC-μ2A/AT/E is a complete, high performance integrated handheld-the beneficiary of the very latest in ICOM technical know-how and state-of-the-art integrated engineering.

IC-μ2A IC-μ2AT IC-μ2E

ASSISTANCE

Eight separate versions of the IC-μ2A/AT/E have been designed for use in the U.S.A., Europe, Australia, and Southeast Asia. This Service manual covers every versions. When using the manual each model can be referred to by the following assigned version numbers:

MODEL	CODE NO.	VERSION	FREQUENCY RANGE (MHz)	TONE ENCODERS	TUNING STEP (kHz)
IC-μ2E	#02	Europe (1)	144.00～145.9875	TONE CALL	12.5
	#03	Europe (2)	144.00～145.995	TONE CALL	5
	#04	Europe (3)	* 140.00～149.9875	TONE CALL	12.5
IC-μ2AT	#05	U.S.A. (1)	* 140.00～149.995	DTMF/ SUBAUDIBLE TONE ENCODER	5
IC-μ2A	#06	U.S.A. (2)	* 140.00～149.995	——	5
	#07	Australia	144.00～147.995	——	5
	#08	Southeast Asia (1)	* 140.00～149.995	——	5
IC-μ2AT	#09	Southeast Asia (2)	* 140.00～149.995	DTMF/ SUBAUDIBLE TONE ENCODER	5

* Guaranteed frequency range: 144.00～148.00 MHz

IF you require assistance or information regarding the operation and capabilities of the IC-μ2A/AT/E. Please contact your nearest ICOM Service Center. Addresses are provided on the inside back cover page of this manual.

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SECTION 1 SPECIFICATIONS

■ GENERAL

Frequency coverage and tuning step :

MODEL	CODE NO.	VERSION	FREQUENCY RANGE (MHz)	TONE ENCODERS	TUNING STEP (kHz)
IC-μ2E	#02	Europe (1)	144.00~145.9875	TONE CALL	12.5
	#03	Europe (2)	144.00~145.995	TONE CALL	5
	#04	Europe (3)	* 140.00~149.9875	TONE CALL	12.5
IC-μ2AT	#05	U.S.A. (1)	* 140.00~149.995	DTMF/ SUBAUDIBLE TONE ENCODER	5
IC-μ2A	#06	U.S.A. (2)	* 140.00~149.995	———	5
	#07	Australia	144.00~147.995	———	5
	#08	Southeast Asia (1)	* 140.00~149.995	———	5
IC-μ2AT	#09	Southeast Asia (2)	* 140.00~149.995	DTMF/ SUBAUDIBLE TONE ENCODER	5

* Guaranteed frequency range: 144.00~148.00MHz

Antena impedance : 50Ω unbalance
Usable temperature : −10°C~+60°C
Frequency stability : ±15ppm at 0°C~60°C
Current drain at 8.4V DC :

Receiving	Power saved	Approx.	6mA
	Squelched	Max.	30mA
	At max. audio output	Max.	170mA
Transmitting	High (1.0W)	Max.	600mA
	Low (0.1W)	Max.	300mA

Dimensions (with BP-22) : 58(61)W×140(148)H×29(33)Dmm
Bracketed values include projections.
Weight (with BP-22) : 340g

■ TRANSMITTER

Output power : HIGH 1.0W LOW 0.1W
Emission mode : 16K0F3E
Modulation system : Variable reactance frequency modulation
Max. frequency deviation : ±5kHz
Spurious emission : More than 60dB below carrier

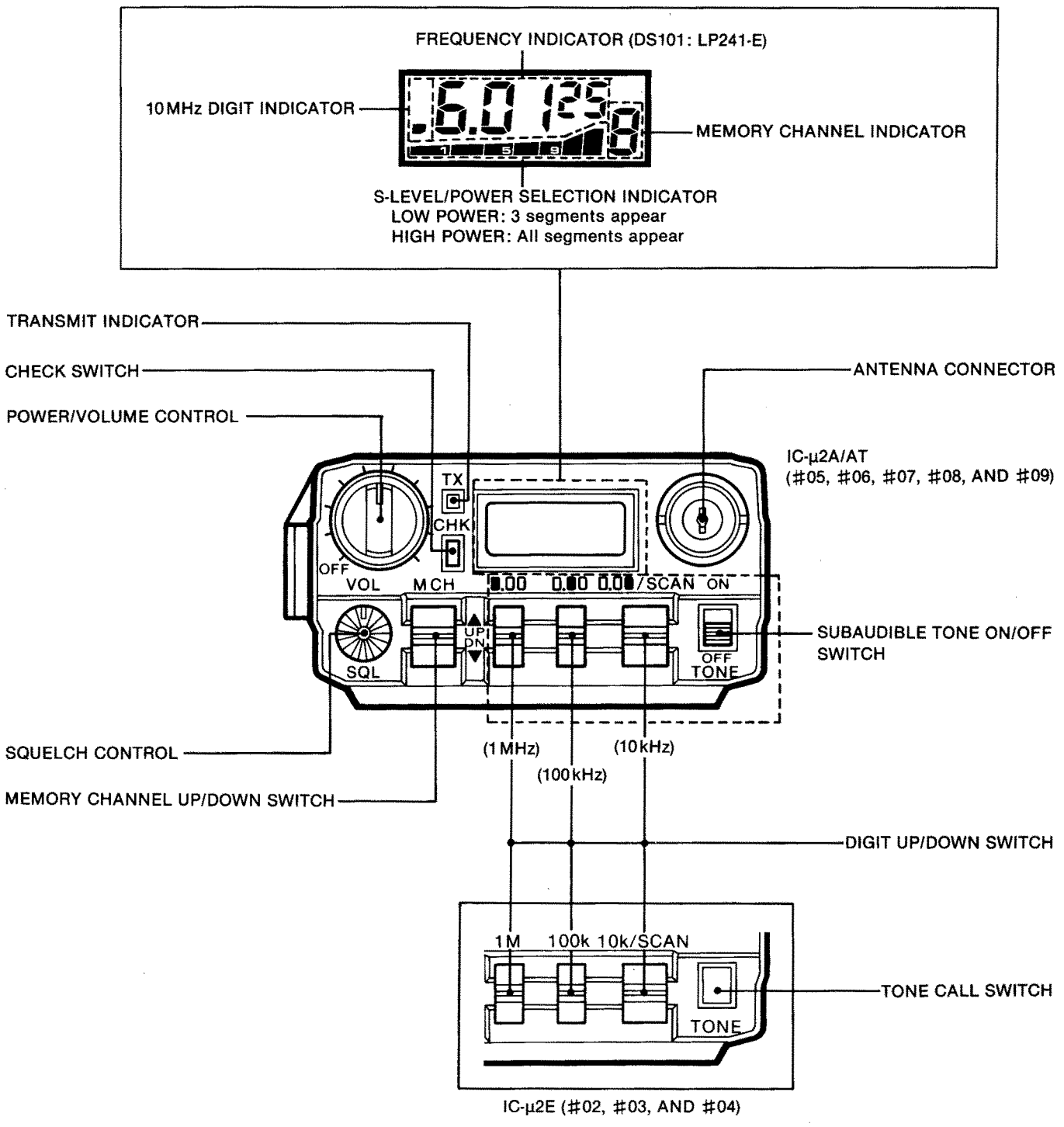
■ RECEIVER

Receiving system : Double-conversion superheterodyne
Intermediate frequencies : 1st 16.9MHz 2nd 455kHz
Modulation acceptance : 16K0F3E
Sensitivity : Less than 0.25μV (−119dBm) for 12dB SINAD
Squelch sensitivity (Threshold) : Less than 0.1μV (−127dBm)
Spurious response rejection ratio : More than 60dB
Audio output power : More than 0.25W at 10% distortion with an 8Ω load

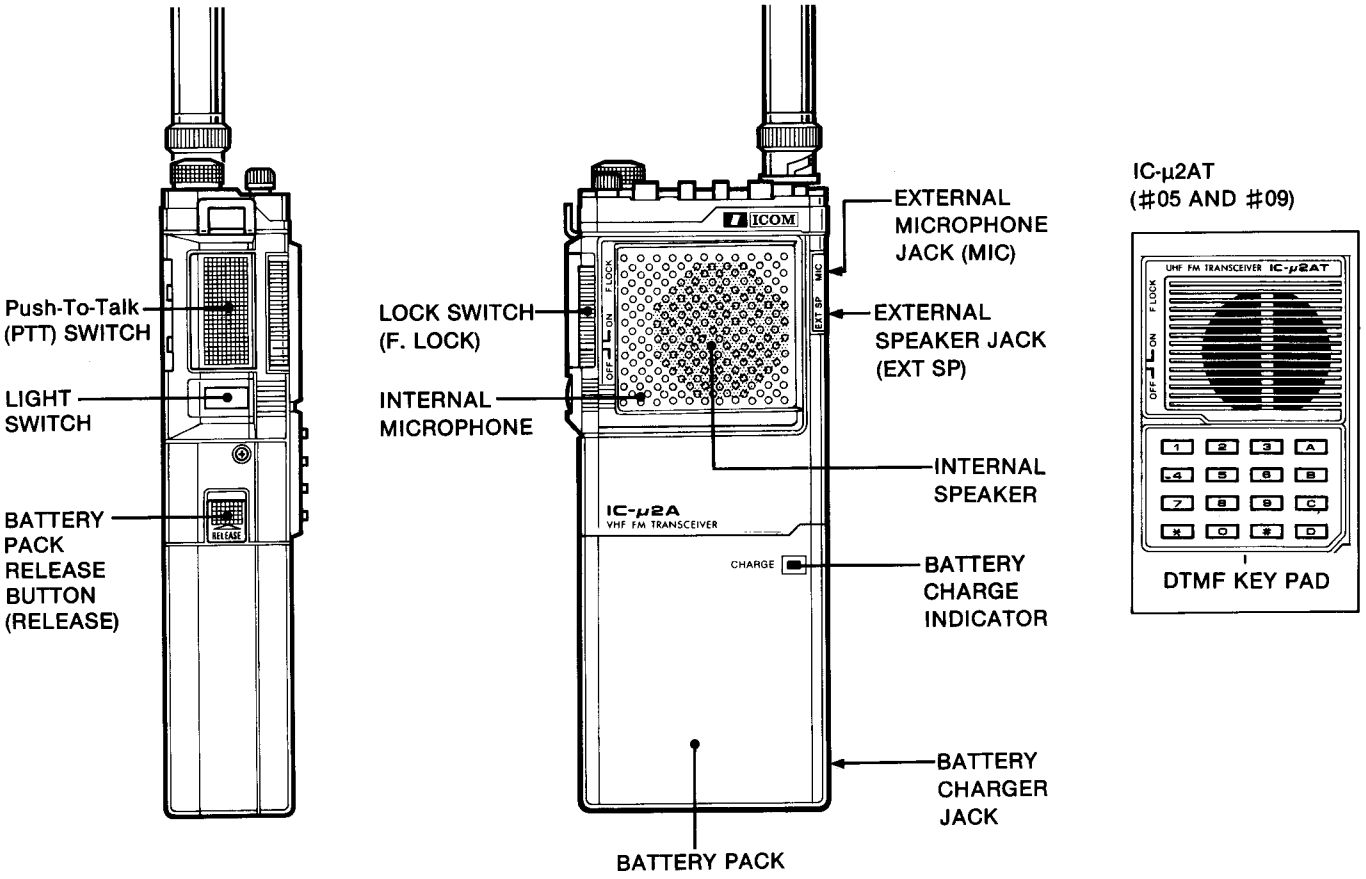
SECTION 2 OUTSIDE AND INSIDE VIEWS

2-1 TOP VIEW

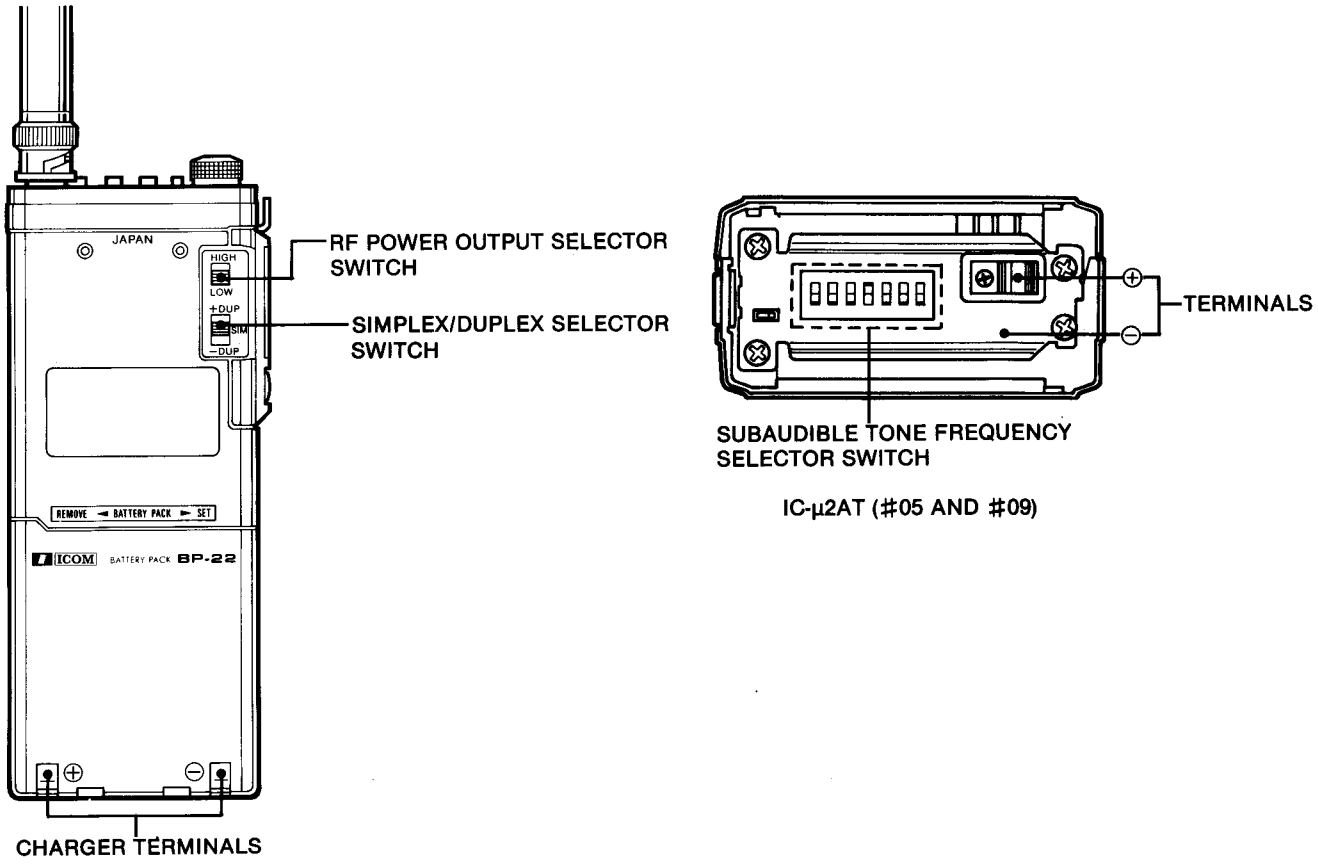
• FREQUENCY DISPLAY



2-2 FRONT AND SIDE VIEWS

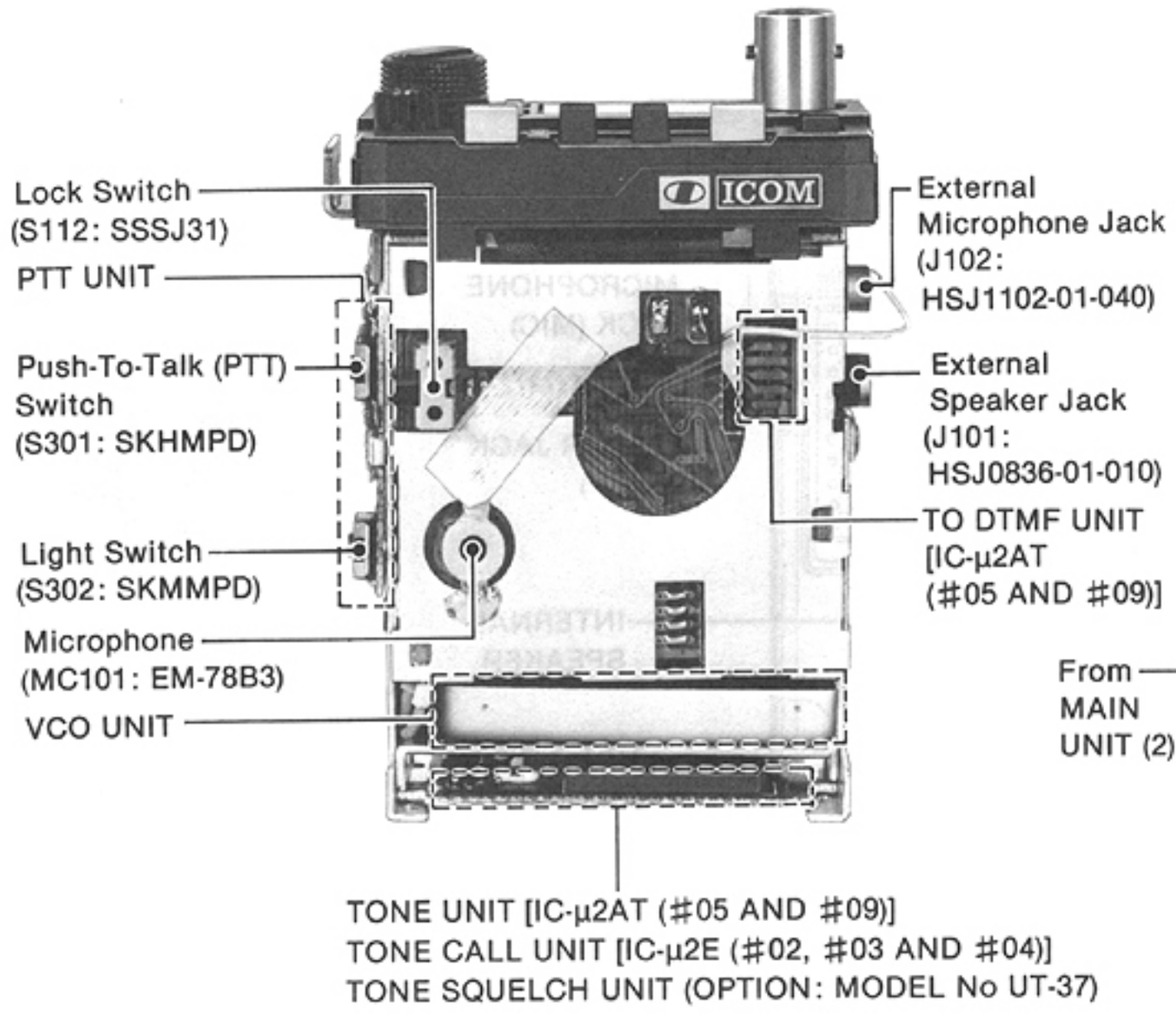


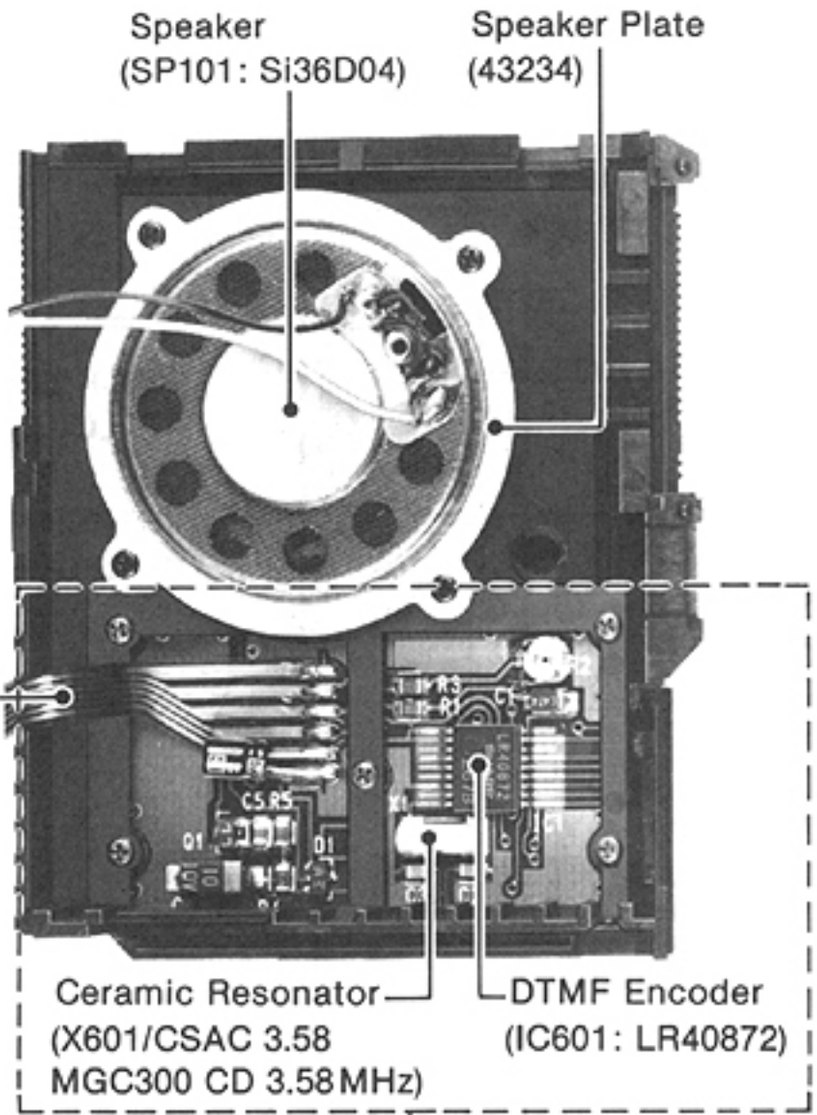
2-3 REAR AND BOTTOM VIEWS



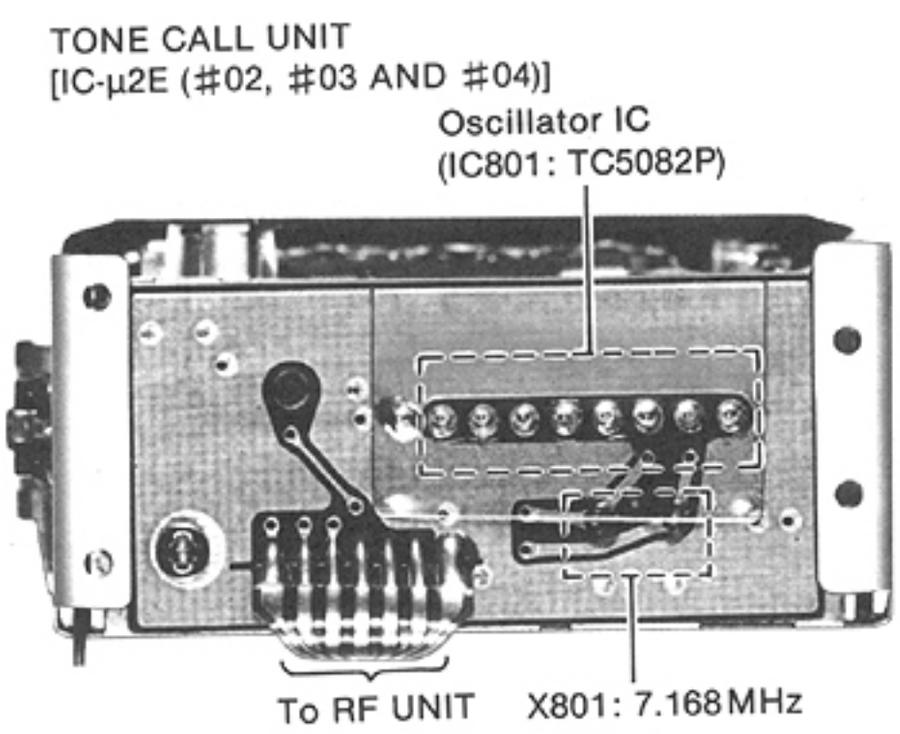
2-4 FRONT AND BOTTOM INSIDE VIEWS

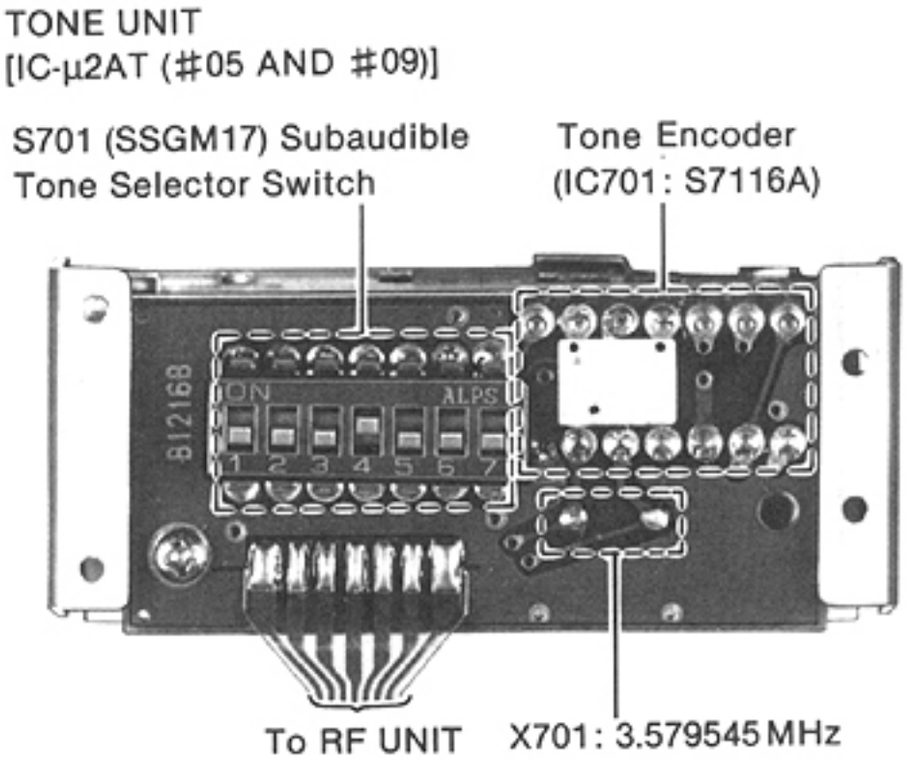
• FRONT INSIDE VIEWS





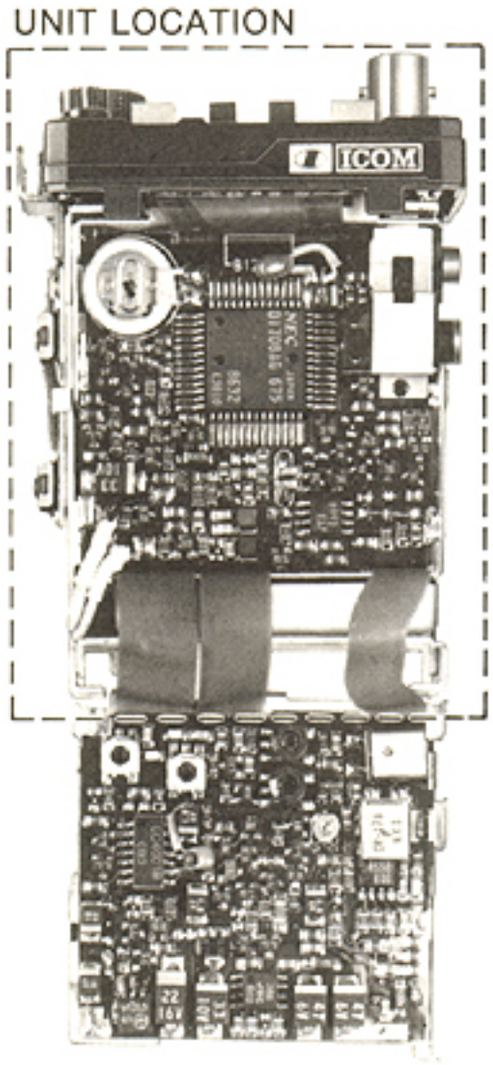
• BOTTOM INSIDE VIEW

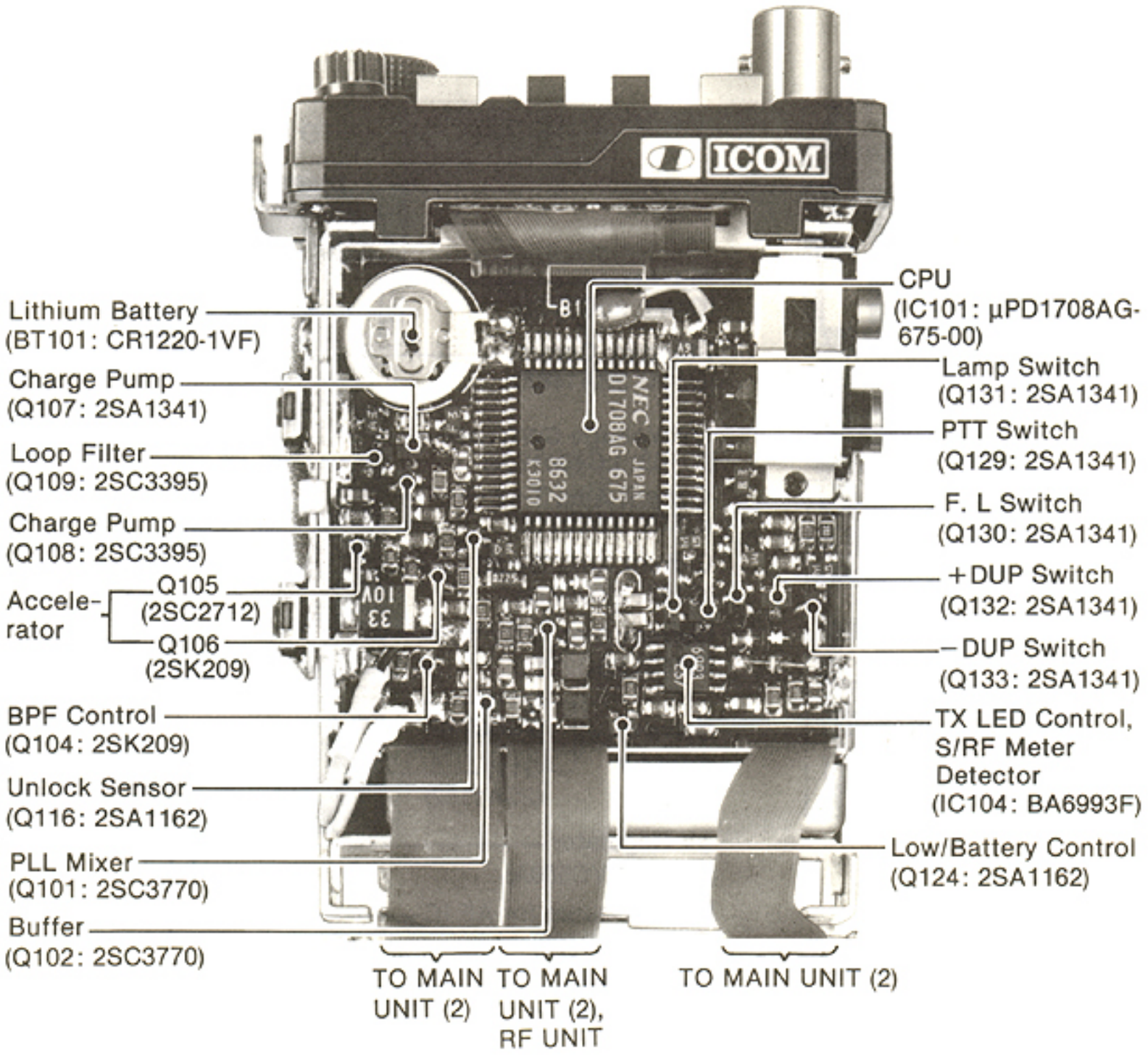




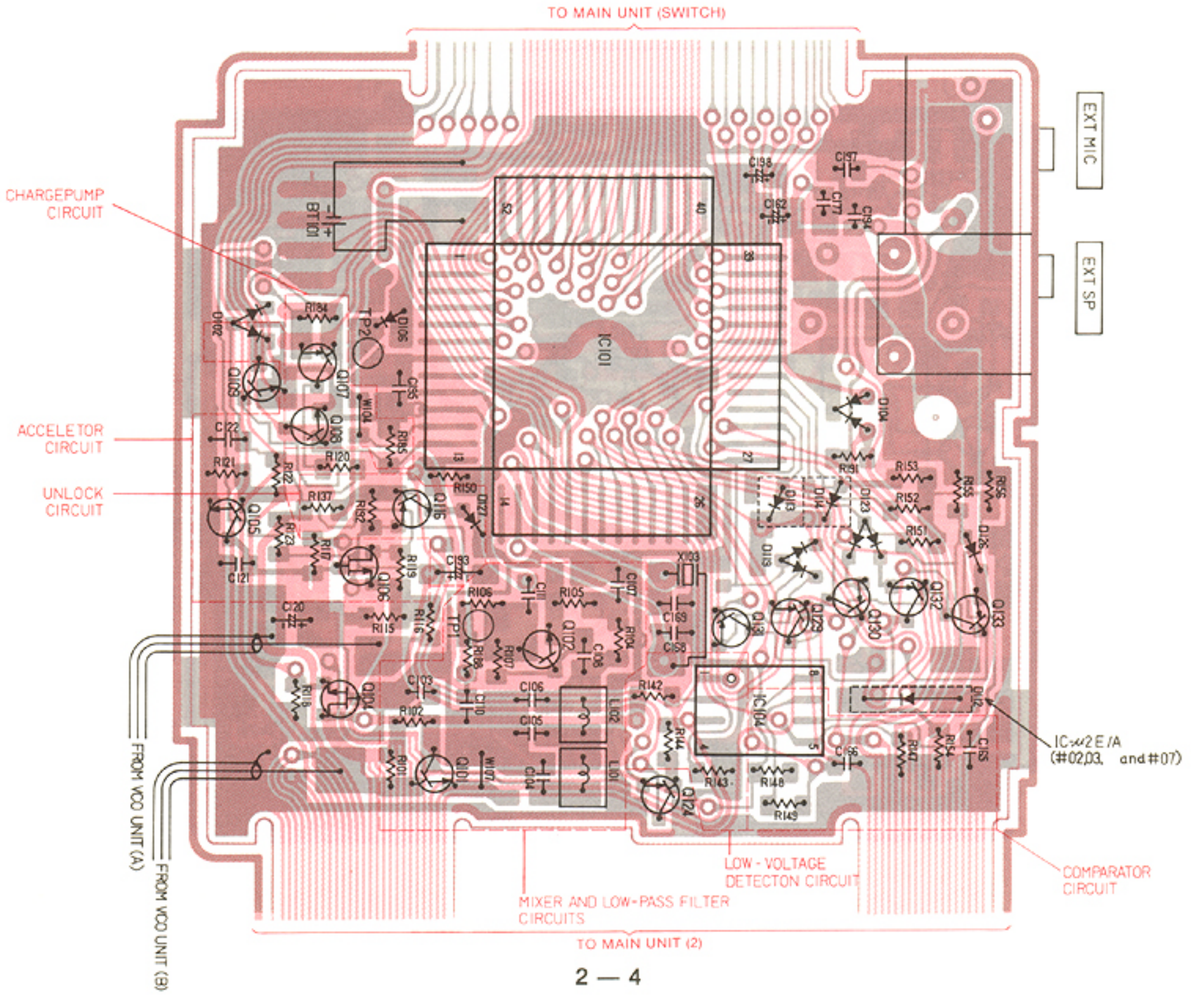
• FRONT INSIDE VIEW [MAIN UNIT (1)]

UNIT LOCATION



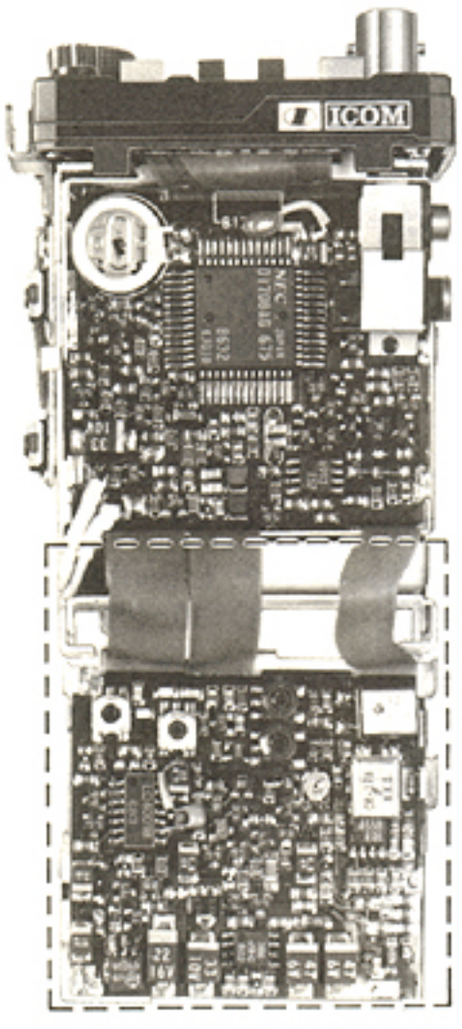


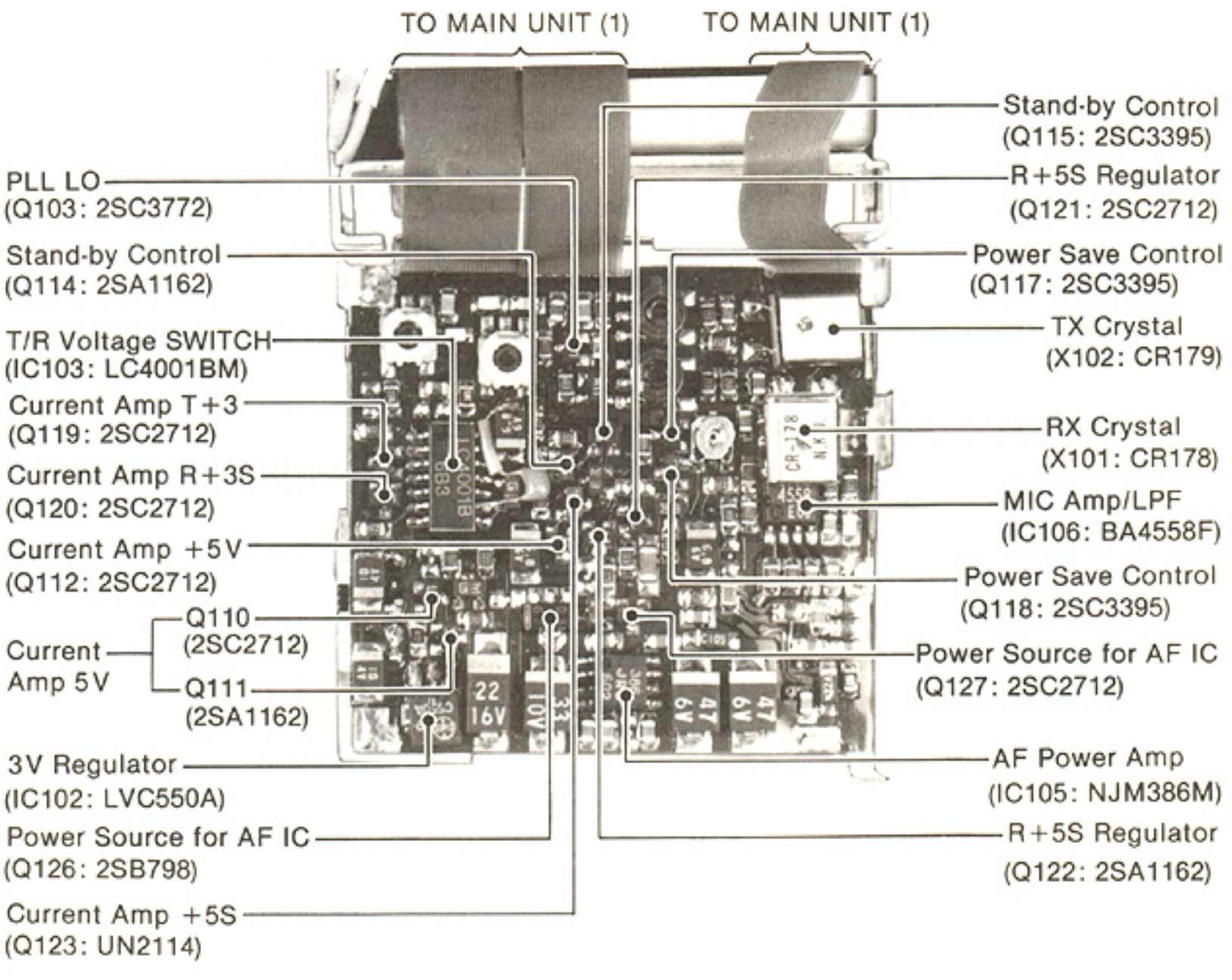
ILLUSTRATED APPEARANCE



• FRONT INSIDE VIEW [MAIN UNIT (2)]

UNIT LOCATION





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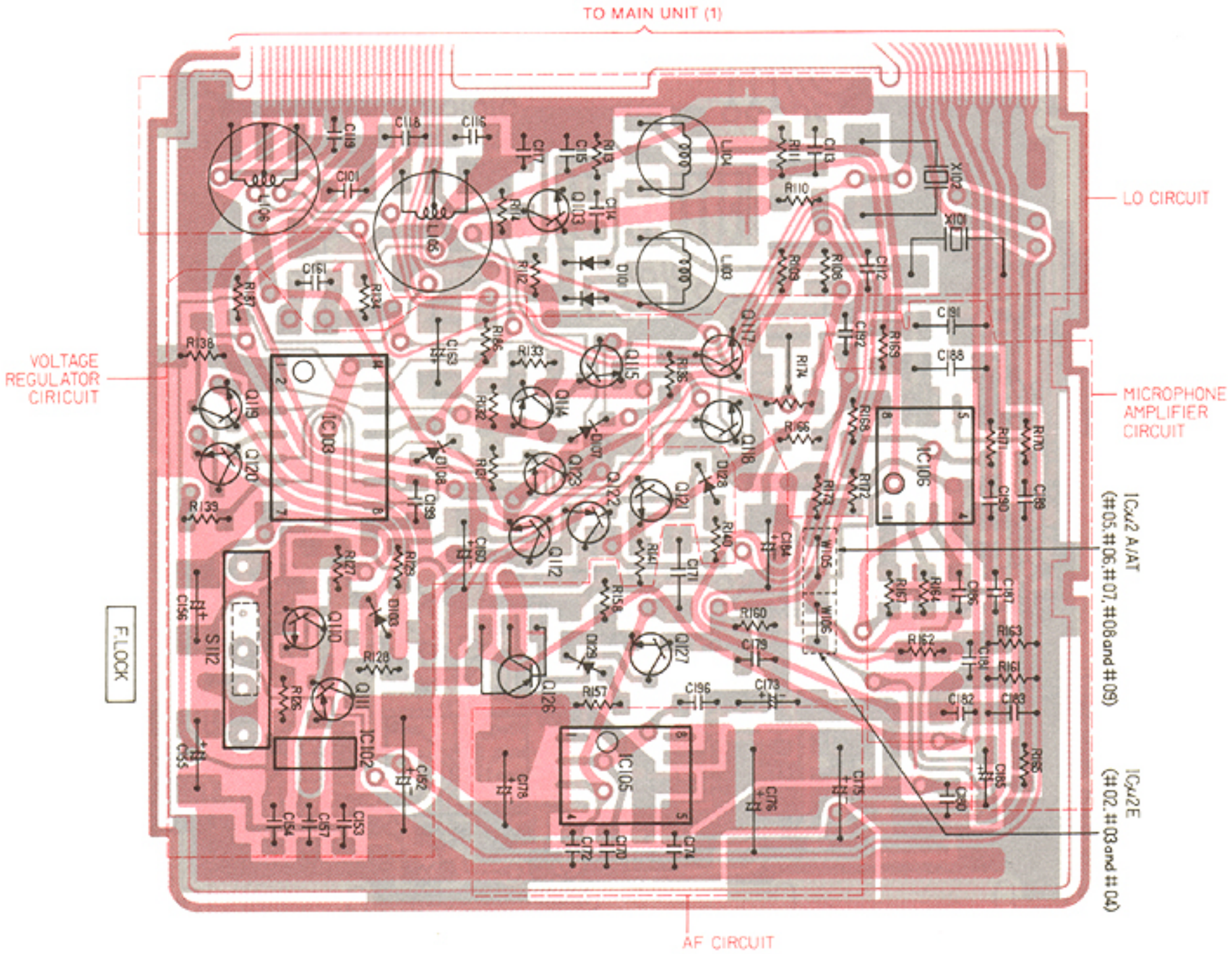
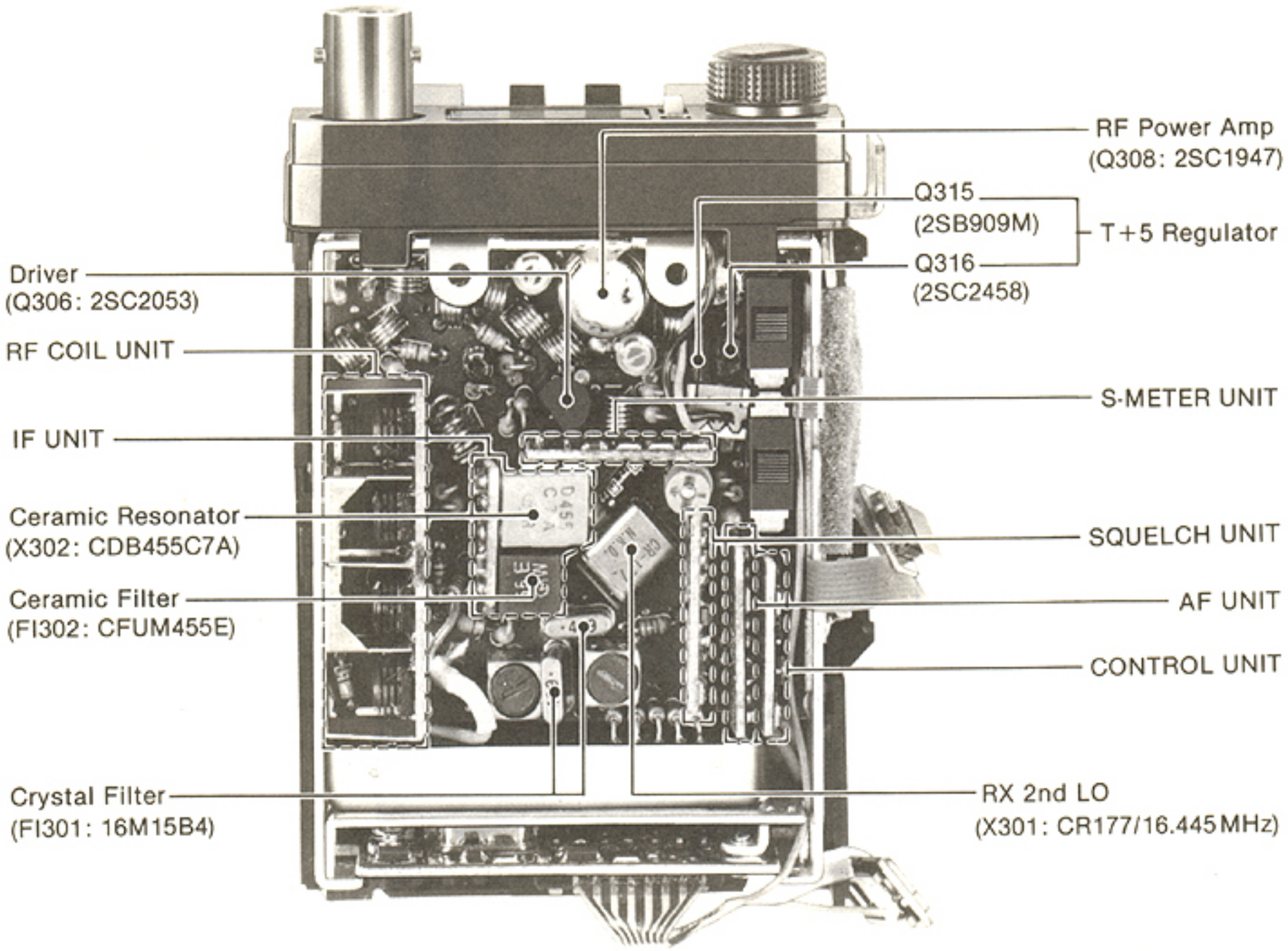
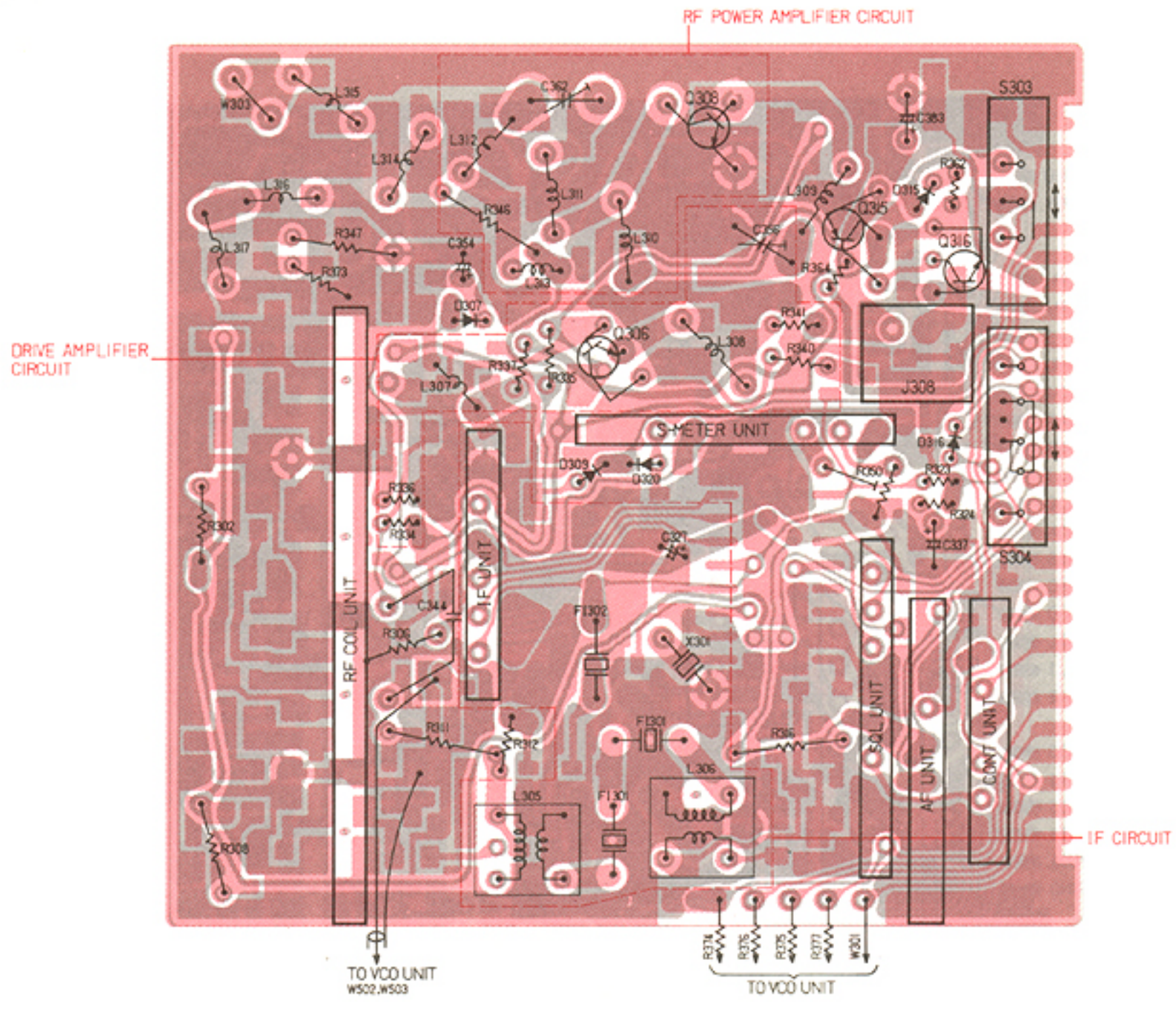


2-5 REAR INSIDE VIEW

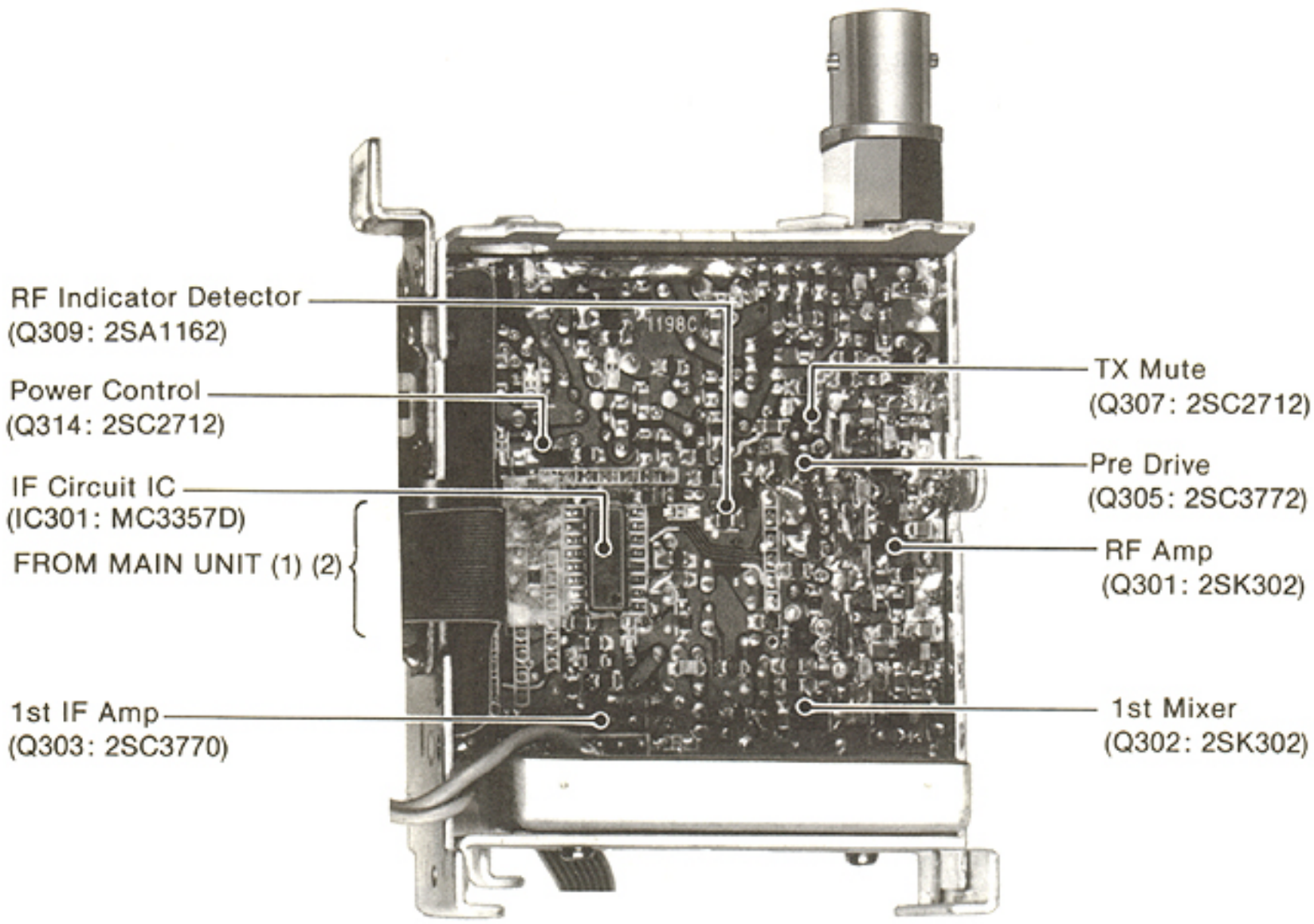
• **RF UNIT (1)**



ILLUSTRATED APPEARANCE



• **RF UNIT (2)**



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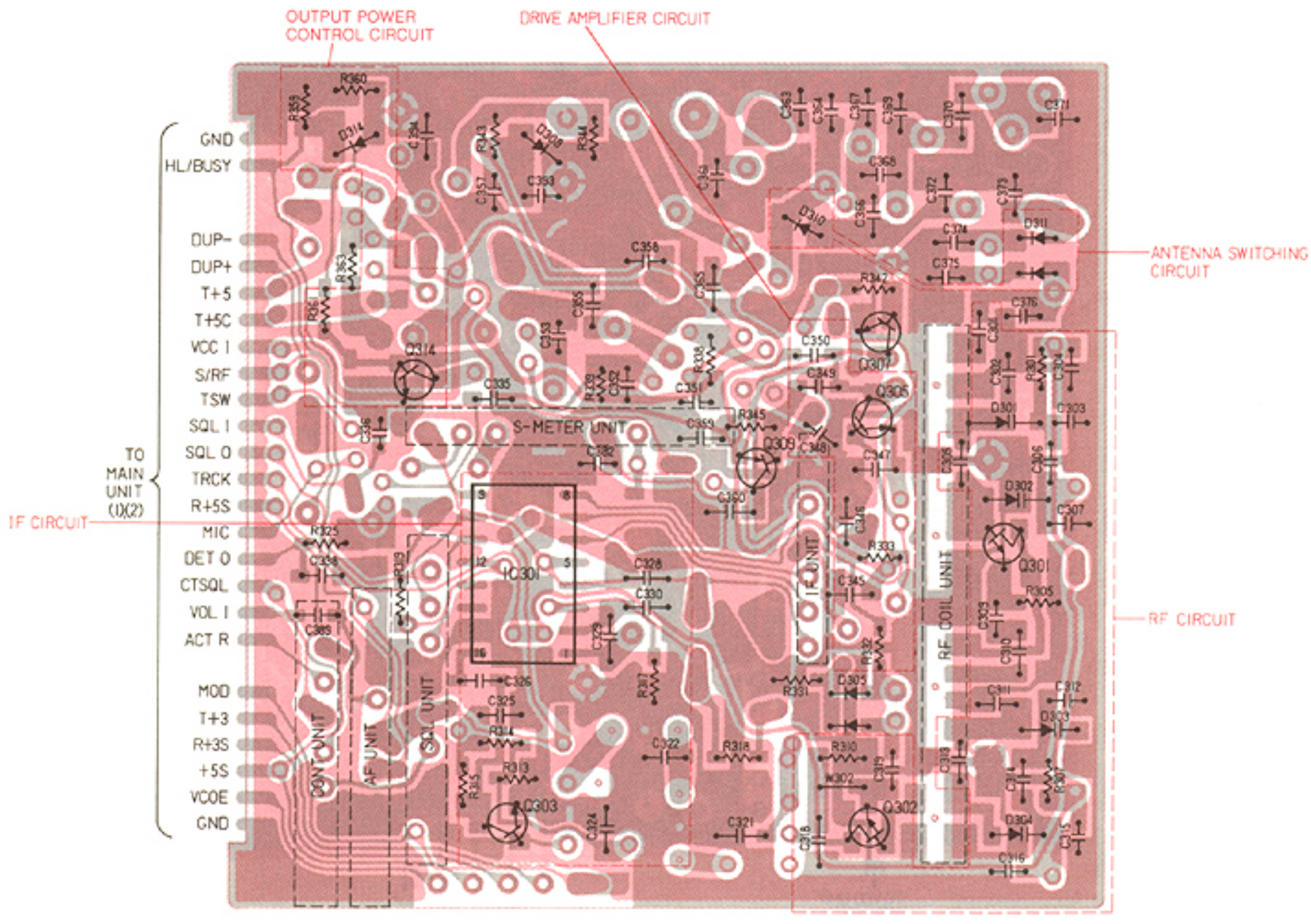
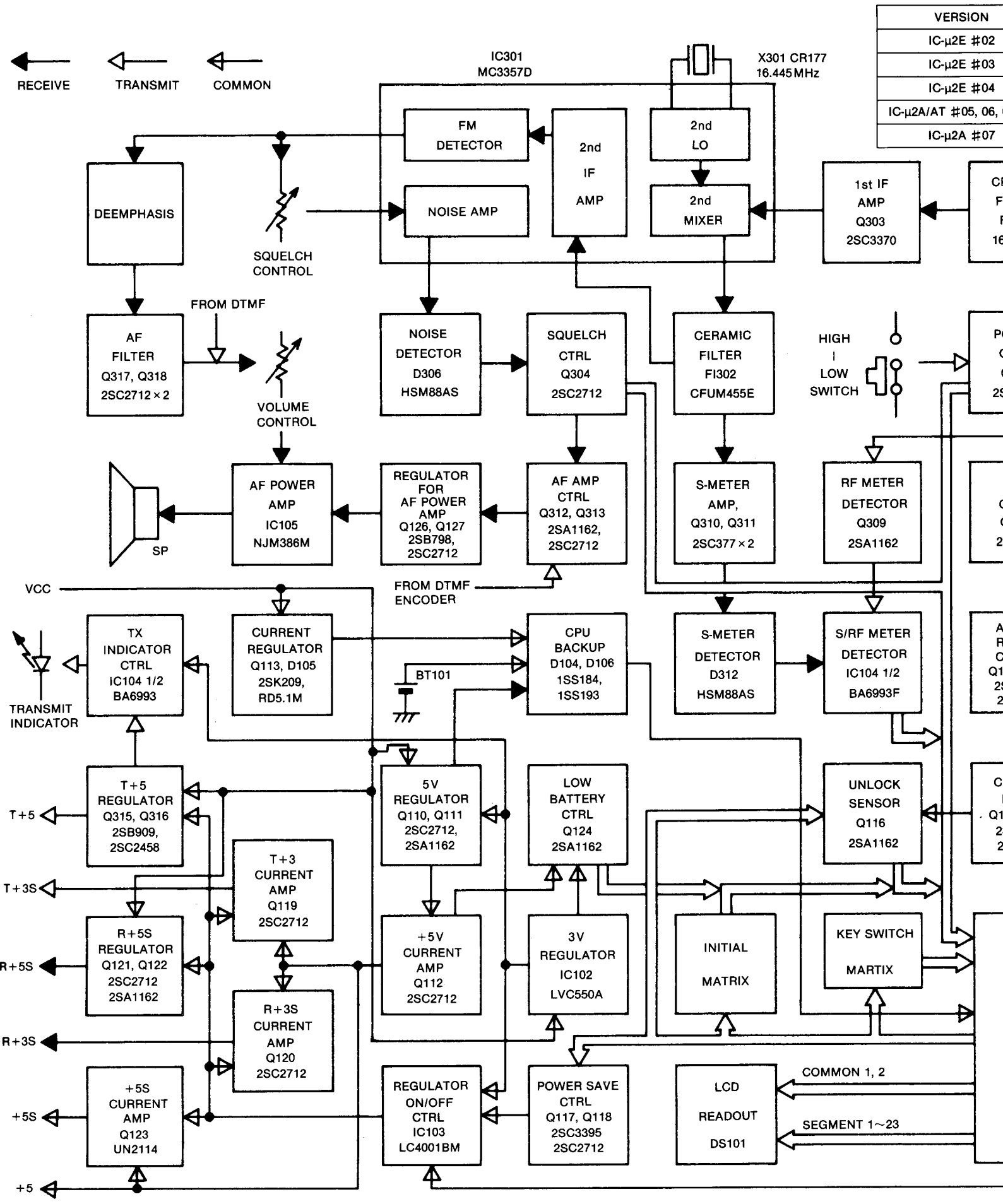
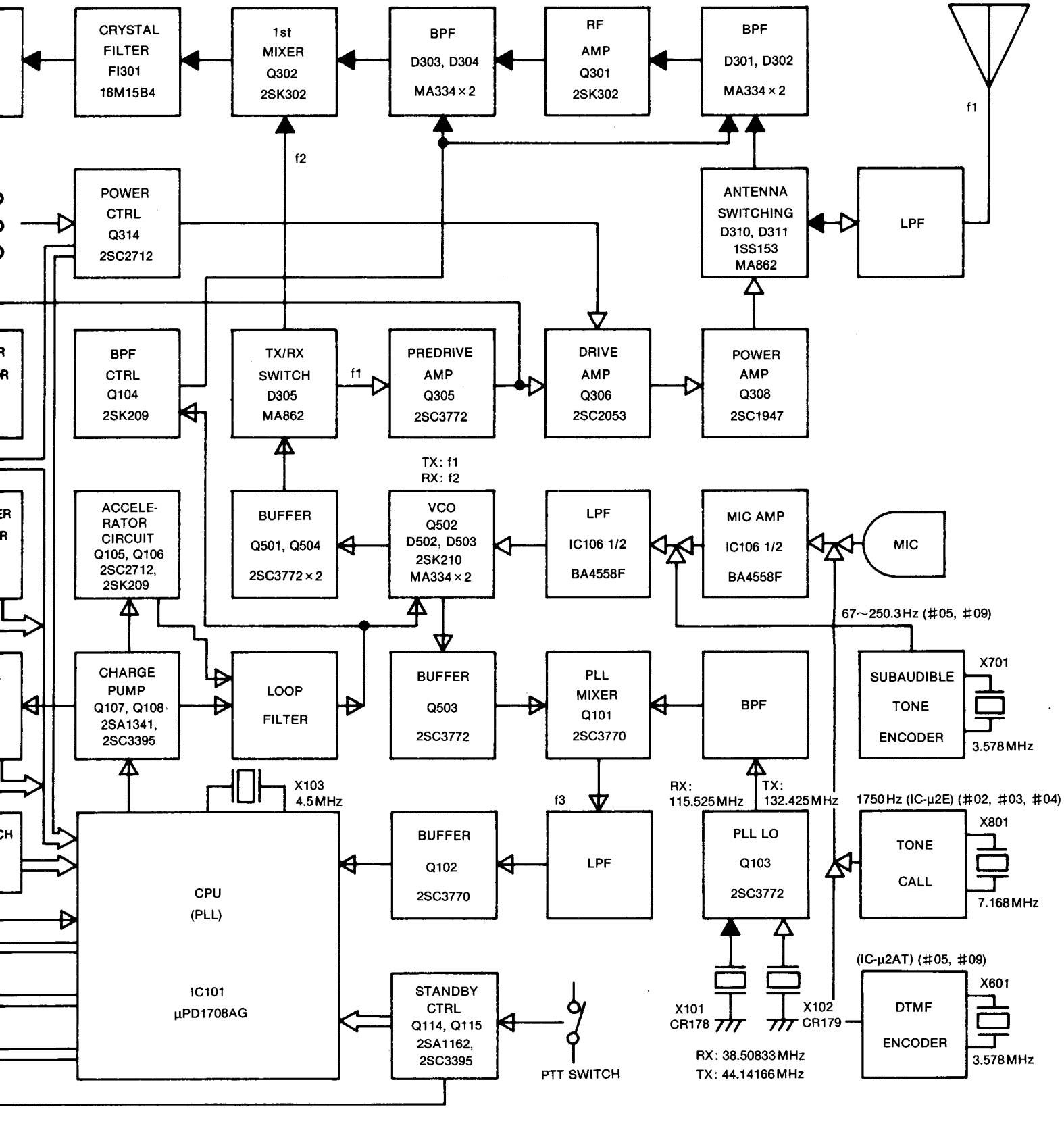


SECTION 3 BLOCK DIAGRAM



VERSION	f1 (Transmit frequency) MHz	f2 (Local Osc. frequency) MHz	f3 (PLL IF) MHz
IC-μ2E #02	144.000.0~145.987.5	127.100.0~129.087.5	11.575.0~13.562.5
IC-μ2E #03	144.000 ~145.995	127.100 ~129.095	11.575 ~13.570
IC-μ2E #04	140.000.0~149.987.5	123.100 ~133.087.5	7.575.0~17.562.5
C-μ2A/AT #05, 06, 08, 09	140.000 ~149.995	123.100 ~133.095	7.575 ~17.570
IC-μ2A #07	144.000 ~147.995	127.100 ~131.095	11.575 ~15.570



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. After passing through the λ/4 circuit, the signals are fed to the RF circuit.

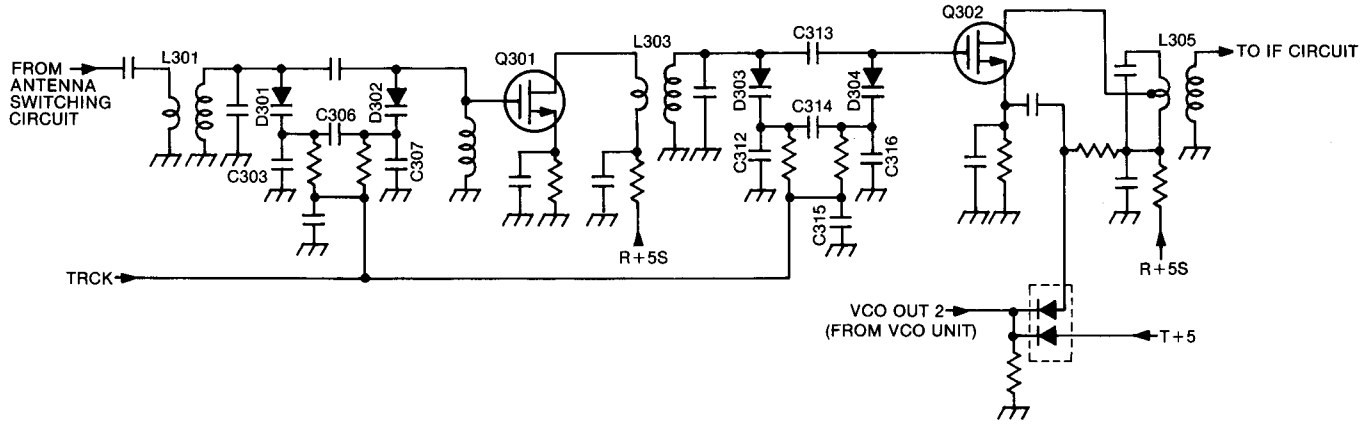
4-1-2 RF CIRCUIT (RF UNIT)

The receive signals fed from the antenna switching circuit pass through L301 and are fed to the bandpass filter comprising D301, D302, C303, C305, C306 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 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 128MHz-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 128MHz-band LO signals are mixed by the 1st mixer (Q302), and the 16.9MHz 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 16.445MHz 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) and S-meter amplifier circuit comprising Q310 and Q311. 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 detection 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 S-METER CIRCUIT (S-METER UNIT)

Q310 and Q311 are S-meter amplifiers.

A portion of 2nd IF signals from FI302 are amplified at Q310 and Q311. The signals from Q311 pass through C379 and are voltage doubler detected by D312.

The output signals from D312 charge C380 and C381, and the terminal voltages of C380 and C381 are fed to the comparator circuit in the MAIN UNIT.

4-1-5 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.

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.

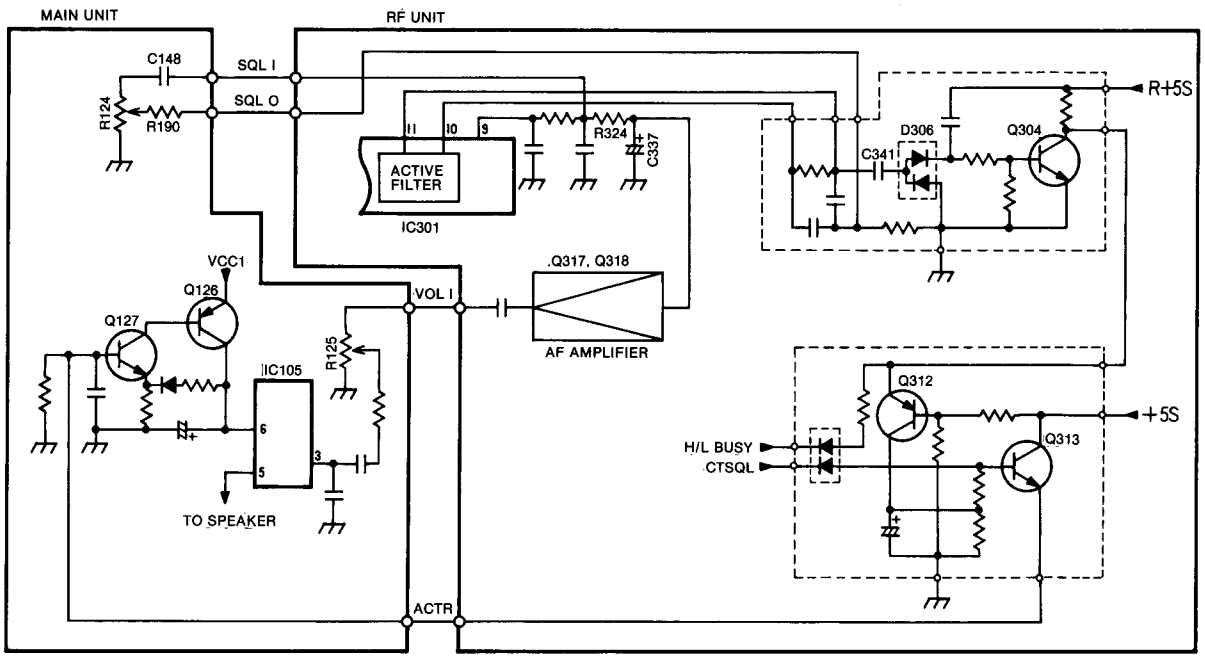
4-1-6 SQUELCH CIRCUIT (RF, SQUELCH AND MAIN UNITS)

A portion of IF 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



4-1-7 128MHz LO CIRCUIT (VCO UNIT)

The 128MHz-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$^{1}/_{2}$.

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 144MHz-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.

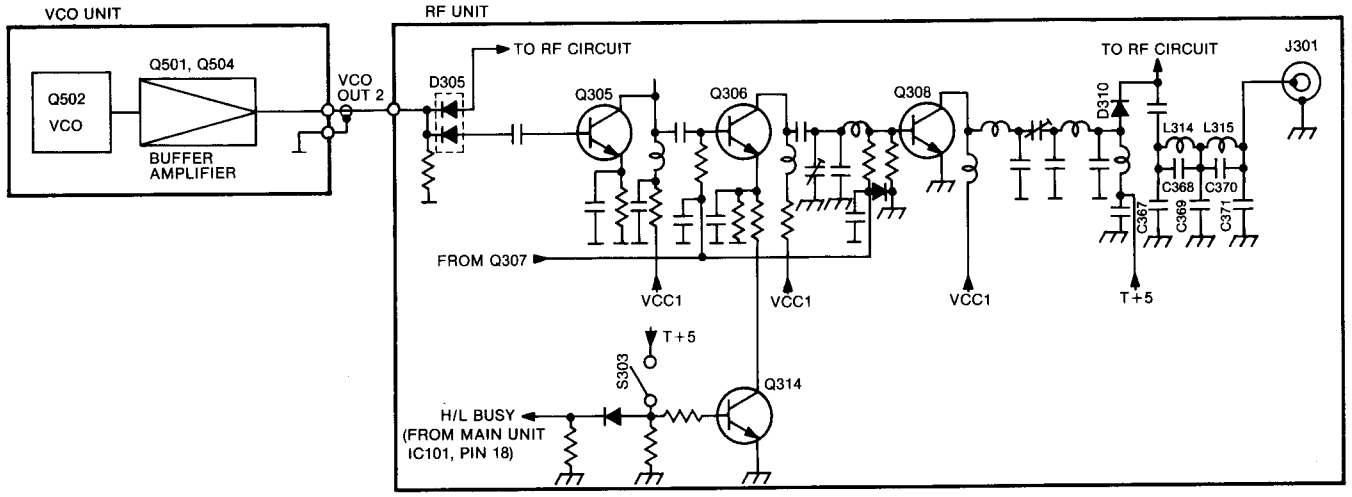
The output power of Q306 is controlled by Q314. This enables HIGH/LOW switching of the RF output power. At the same time, the output signals of Q305 are detected by Q309 and are fed to the comparator circuit (IC104$^1/_2$) in the MAIN UNIT.

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

Signals output from Q306 are power-amplified at Q308. Q308 outputs stable power for 1W or more during high-power transmissions and approximately 0.1W 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-μ2A/AT/E. 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 115.525MHz during reception and 132.425MHz 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.

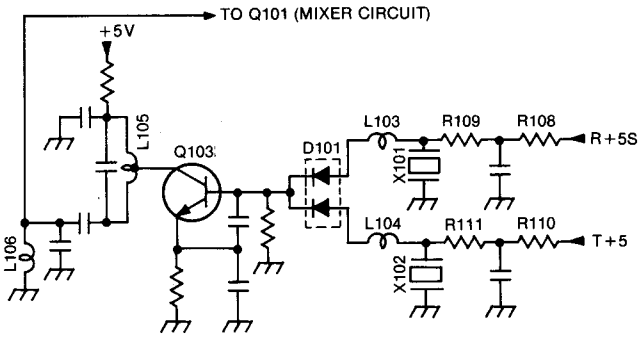
4-3-2 MIXER AND LOW PASS FILTER CIRCUITS (MAIN UNIT)

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).

The output signals of mixer circuit (Q101) pass through the low-pass filter.

LO CIRCUIT



4-3-3 LOOP CIRCUIT (MAIN UNIT)

The frequency of the signals fed to IC101 (pin 9) from mixer circuit (Q101) is approximately 12.575MHz. 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 frequency displayed on the FREQUENCY DISPLAY.

X103 oscillates a frequency in the oscillation circuit in IC101 which outputs signals of approximately 4.5MHz. These signals are divided by 900 by the divider in IC101 to obtain 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+3 is 3V, and R+3S is 0V. This connects C508 in series to L503, increasing oscillation frequency.

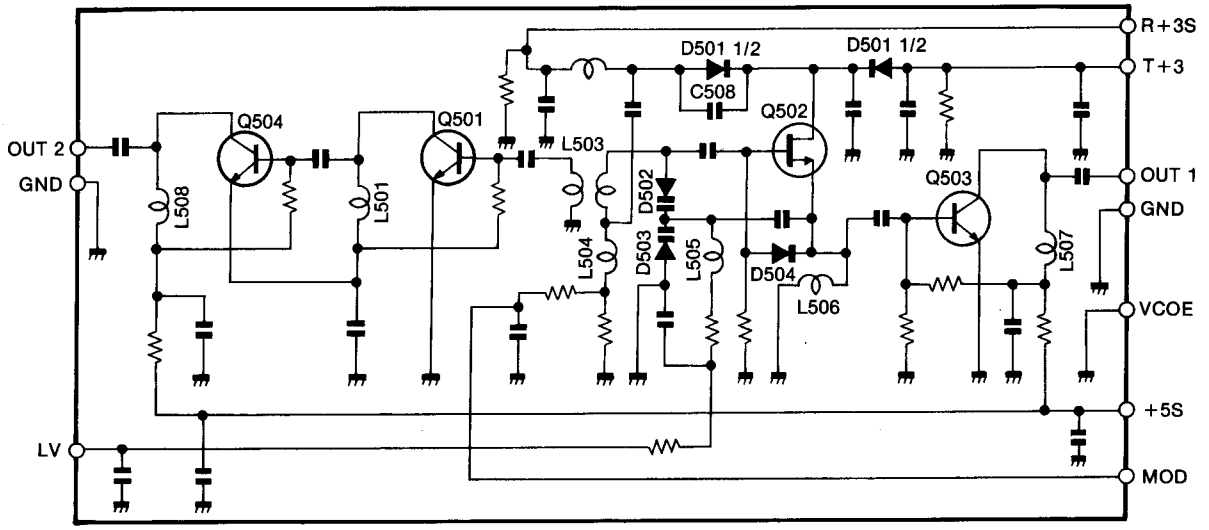
During reception, T+3 is 0V, and R+3S is 2.3V. C508 then seems to short, decreasing oscillation frequency.

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 17). (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 MAIN FUNCTIONS OF CPU (IC101)

(1) Distinction between specifications by initial matrix.
Specifications by initial matrix are divided into two types as follows:
a) Related to frequency band data...BAND matrix
b) Functional specifications for partial change... specification expansion matrix

(2) I/O port allocation.
The CPU (IC101) a has few I/O ports. In order to compensate for this, other functions are allocated to ports not used in normal operation such as the scan port of the initial matrix.

Furthermore, as key scanning of the lock switches and the meter detection A/D port are not used simultaneously in the software, they partially share the same port.

(3) Key scan and meter detection A/D port.
The software is designed so that the ports are not scanned when there is no external input.

CPU (IC101) I/O PORT ALLOCATION

PIN NO.	PORT NO.	NAME OF TERMINAL	I/O	FUNCTION STATUS	
				"LOW"	"HIGH"
17	PA3	MUTE	OUTPUT	RX, TX	MUTE
18	PA2	BUSY	INPUT	SQL CLOSE, RF OUTPUT LOW	SQL OPEN, RF OUTPUT HIGH
19	PA1	AD IN	INPUT	A/D CONVERTER INPUT	
20	PA0	INIT	INPUT	INITIAL MATRIX INPUT	
21	K3	KEY 3	INPUT	EXTERNAL PULL-DOWN, DATA VALID AT "HIGH"	
22	K2	KEY 2	INPUT		
23	K1	KEY 1	INPUT		
24	K0	KEY 0	INPUT		
25	PB3	STB 3	OUTPUT	NON-LOCK KEY SWITCH STROBE	
26	PB2	STB 2	OUTPUT		
27	PB1	STB 1	OUTPUT		
28	PB0	LAMP	OUTPUT	LAMP OFF	LAMP ON
29	PC3	PSC	OUTPUT	RX, TX	IN POWER SAVE MODE
30	PC2	A/D1	OUTPUT	COMPARISON VOLTAGE FOR S-INDICATOR VOLTAGE DETECTION	
31	PC2	A/D2	OUTPUT		
32	PC0	A/D4	OUTPUT		

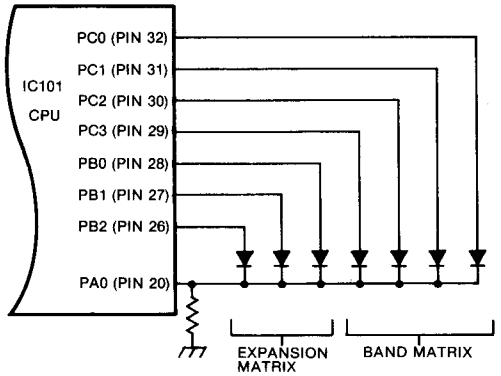
* PC0~3 and PB0~1 can be substituted for initial matrix output.
* PC0~3, and PB1 become effective data when ON. (PC0~3 are for band designation.)

4-4-2 INITIAL MATRIX CIRCUIT (MAIN UNIT)

The initial matrix circuit is provided for initializing the data in the CPU (IC101) when the transceiver is reset. The data that is initialized by the initial matrix circuit is as follows:

- NOR band designated data
- EXP band designated data
- 10/1 kHz step, thumbwheel/dial designated data
- All memory frequency data
- Duplex frequency data

INITIAL MATRIX CIRCUIT

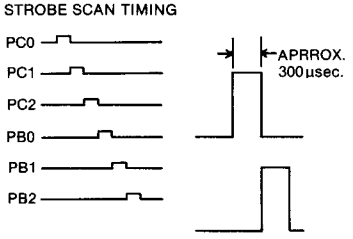


The initial matrix circuit is strobe scanned in order PCO → PC3 → PB0 → PB2. "HIGH" signals are the active signals.

EXPANSION MATRIX

PBO	Specification Name	Specification Contents
0	EXP	Expands band width designated by BAND matrix
1	NOR	Makes band width designated by BAND matrix the standard specification.

STROBE SCAN TIMING



The output ports for the initial matrix of the CPU (IC101) are used in common for specifications other than the initial matrix.
These ports are used as the ports below when strobe scanning of the initial matrix is completed:

PC0, PC1, PC2 — Ports for setting the comparison voltage for S/RF meter voltage detection (A/D converter)
PC2 — Port for outputting strobe signals for lock-type key switch detection
PB0 — Output port of LAMP control signals, outputs "HIGH" signals to turn lamp ON
PB1, PB2, PB3 — Port for outputting strobe signals for non-lock-type key switch detection

4-4-3 CONFIGURATION OF KEY MATRIX AND KEY SWITCH INPUT

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

Below follows an explanation regarding key scanning of the key matrix.

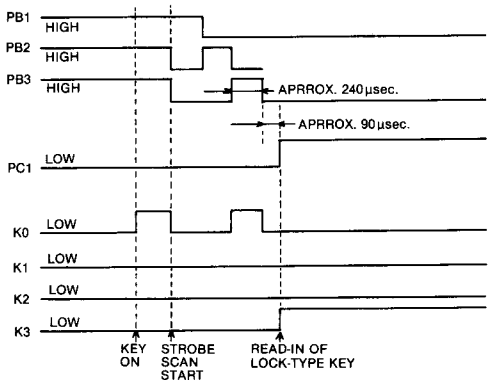
(1) When all the non-lock key switches are OFF, all output signals of ports PB1~PB3 for key strobe signal output are "HIGH", and subsequently strobe scanning cannot be carried out.
At this time, checking of the lock key switches cannot be carried out.

(2) When the non-lock key switches are ON, "HIGH" is input to one of input ports K0~K3. Therefore, the CPU can detect if the non-lock key switches are ON.

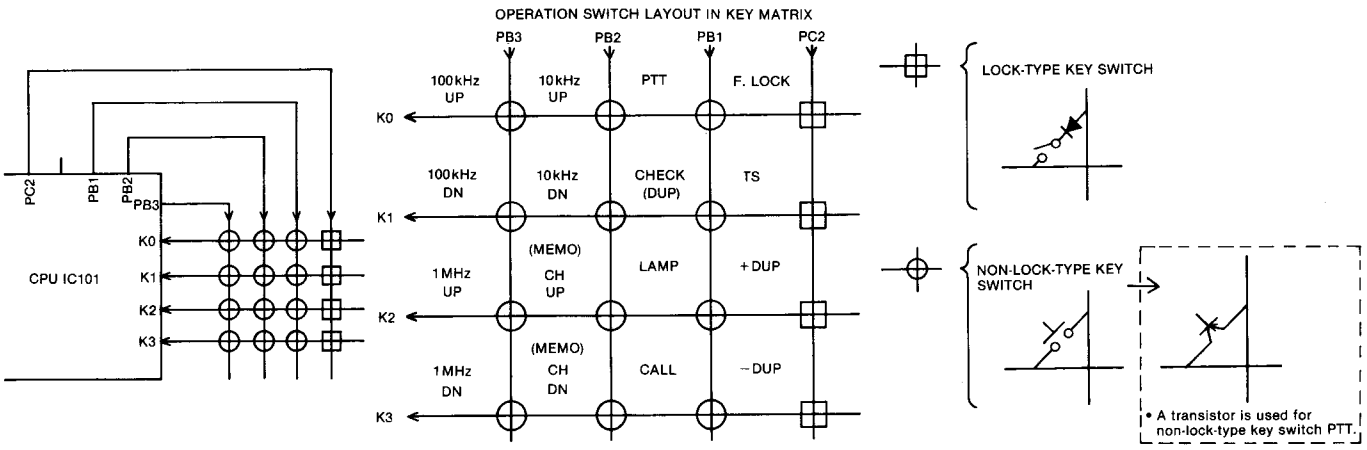
(3) In order to detect which non-lock key switches are ON, the CPU conducts a strobe scan in order PB1 → PB2 → PB3. Key switches which are turned ON are detected by the strobe in which "HIGH" signals are input to input ports K0~K3.

(4) When the search of the non-lock keys is completed, all output of ports PB1~PB3 become "LOW", and the output from port PC2 becomes "HIGH". This causes the status of the lock key switches to be input to input ports K0~K3.

Example: Below is a timing chart for when non-lock key switch 100kHz UP has been turned ON when +DUP is ON.



HARDWARE CONFIGURATION OF KEY MATRIX



4-4-4 S/RF LEVEL VOLTAGE DETECTION AND SQUELCH DETECTION

S/RF level voltage detection is carried out by comparing the product of the 3-bit signals output from CPU output ports PC0~PC2 with the meter voltage by the comparator. Below follows an explanation of S/RF meter voltage detection and squelch open detection:

(1) PC0~PC2 are ports used for generation of the comparison voltage for meter voltage detection. While receiving, an additional scan is carried out by voltage output from these ports until comparison by the comparator is established.

Furthermore, while transmitting, output from PC1 become "HIGH", and output from PC0 and PC2 are "LOW". For this reason, scanning cannot be performed.

(2) PA1 is an input port for judging the level indicator voltage detection comparison. Verification of the indicator display when "HIGH" is input to this port during reception is carried out as follows:

[value obtained by addition of the signals output from PC0~PC2]−1=[value displayed on meter]

When the input to PA1 is not a "HIGH" is even if the addition scan by the output from PC0~PC2 is carried out until completion, the meter registers a full-scale reading.

During transmission, scanning by output ports PC0~PC2 is not carried out, meter display is carried out when the input to PA1 is a "HIGH", and the meter display is not carried out when the input to PA1 is a "LOW".

(Port scanning is carried out in order PC2 → PC0. Subsequently, the most significant bit is PC0 and the least significant bit is PC2.)

(3) If "HIGH" is being input to PA2 during reception, verification of whether the squelch open is carried out. When the squelch is open, a single dot is displayed at the meter.

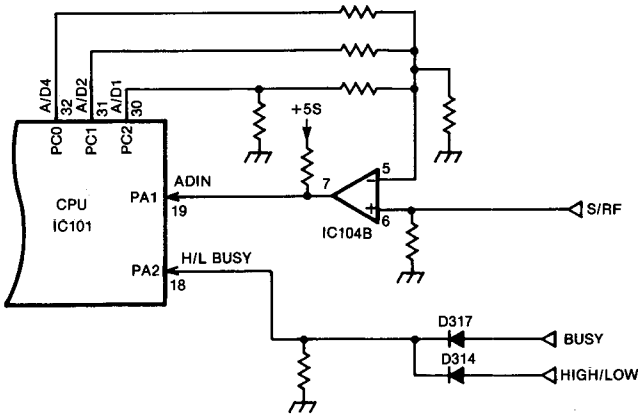
The "HIGH" input to PA2 is used also for verifying cancellation of the power save mode.

During transmission, PA2 is used for verifying the transmission power status. The meter display status is changed in the software by the status of the input signals to PA2.

The level of the output is "LOW" when "LOW" is input to PA2, and a 3-dot display is registered on the meter.

The level of the output is "HIGH" when "HIGH" is input to PA2, and the meter registers a full-scale reading.

S/RF INDICATOR VOLTAGE DETECTION AND SQUELCH OPEN DETECTION



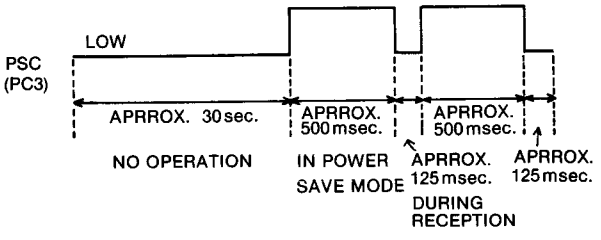
4-4-5 I/O PORTS FOR CONTROL OF LOGIC EXTERNAL CIRCUITS

(1) PSC−Power save control port (output port PC3)
This is a control port for controlling the power save function during reception.
When "HIGH" signals are output from PSC, a request for power save operation is sent to a predetermined circuit. At this time, the PLL circuit is disabled.
When "LOW" signals are output from PSC, a request for reception status is sent to a predetermined circuit. At this time, the PLL circuit is enabled.

The control timing of the power save function by the signal output from the PSC port is set as follows:

Time stipulation of power save function

1. The power save function starts 30 seconds after external operations have ceased.
2. The transceiver is enabled for reception approximately 500msec. after the power save function begins operating.
3. Reception status is maintained for 125msec. from commencement of the status described in operation 2. above, and verification as to whether "HIGH" has been input to the BUSY port during that time is carried out. At this time, operations 2. and 3. are repeated if "HIGH" is not input to the BUSY port.



(2) MUTE−Transmission prohibition control port (output port PA3)
This port is for outputting control signals for disabling transmission in an off-band state and in a PLL unlocked state.

Transmission status can be enabled when "LOW" from MUTE is being output. Transmission status cannot be enabled when "HIGH" from MUTE is being output.

(3) LAMP—Lamp circuit control port (output port PB0)
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.

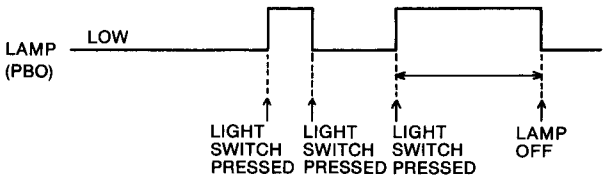
"HIGH" signals output from LAMP cause the lamp circuit to start operating and thus illuminate the lamp.

"LOW" output from LAMP cause the lamp circuit to stop operating and thus turn the lamp OFF.

When the non-lock key switch LIGHT SWITCH is pressed, "HIGH" is output from LAMP. At the same time, the software timer starts operating to extend the illumination time. If the LIGHT SWITCH is pressed again while the software timer is operating, the output from LAMP is "LOW".

Timer stipulation

1. After the LIGHT SWITCH has been turned ON, "LOW" is output after approximately 5 seconds has elapsed if no operations have been carried out.
2. "LOW" is output from LAMP approximately 5 seconds after any switch other than the PTT and CHECK SWITCH have been pressed after the LIGHT SWITCH has been turned ON. (The illumination time cannot be extended by the software timer even if the PTT and CHECK SWITCH are operated.)



4-5 POWER SUPPLY CIRCUITS

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

IC-μ2A/AT/E has with a 3-terminal regulator (IC102). IC102 outputs a constant voltage of 3V in relation to the input voltages of 5.1V~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+3, R+3S and R+5S are switched by Q114, Q115, IC103A, IC103B and IC103C. T+3 is current-amplified by Q119, R+3S 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+3S, R+5S and +5S.

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

IC-μ2A/AT/E 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 COMPARATOR CIRCUIT (MAIN UNIT)

The voltage detected at the S-meter circuit and drive amplifier circuit is input to IC104B (pin 5). The D/A signals output from the CPU (IC101) are input to IC104B (pin 6).

When the voltage applied to IC104B (pin 6) is less than the voltage applied to pin 5, the output voltage from pin 7 is "HIGH".

Also, when the voltage applied to pin 6 increases and results in a voltage greater than that applied to pin 5, the output voltage from pin 7 is "LOW".

The output voltage from IC104B (pin 7) is input to the CPU (IC101). The CPU (IC101) operates in accordance with the status of the D/A signals to output the receive sinal level at S/RF LEVEL INDICATOR during reception and output the RF output level at S/RF LEVEL INDICATOR during transmission.

4-6-2 LOW VOLTAGE DETECTOR CIRCUIT

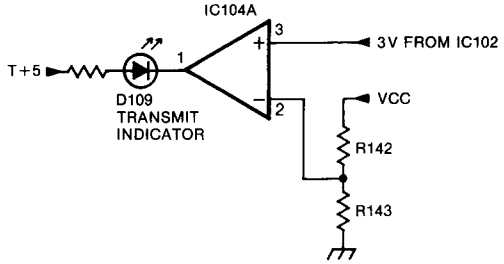
The low voltage detector circuit comprises IC104A, R142 and R143. 3V voltage is applied to IC104A (pin 3), and a voltage obtained by dividing V_{CC} at R142 and R143 is applied to pin 2.

The voltage dividing ratio is set so that a 3V voltage is applied to IC104A (pin 2) when V_{CC} is approximately 5.45V.

When the voltage of V_{CC} is approximately 5.45V 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 5.45V, 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).

LOW VOLTAGE DETECTOR CIRCUIT



4-6-3 LAMP CIRCUIT (MAIN UNIT)

When S302 is turned ON, a high voltage level from IC101 (pin 28) 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.

4-6-4 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+3.

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+3S, and Q121 and Q122 control R+5S.

4-6-5 POWER SAVER CIRCUIT (MAIN UNIT)

IC-μ2A/AT/E 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.

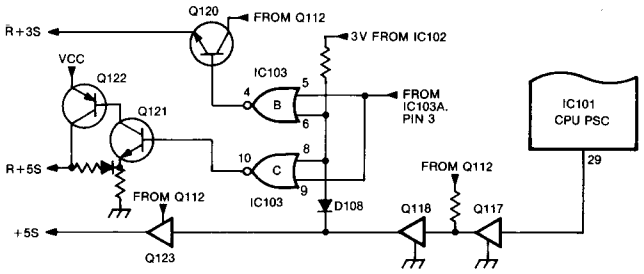
The power save signals are output from IC101 (pin 29) and fed to Q118 via Q117.

When a PSC port is "HIGH", output from IC103B (pin 4) and IC103C (pin 10) are "LOW". This causes R+3S 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



4-6-6 DTMF ENCODER CIRCUIT (#05, #09 ONLY) (DTMF UNIT)

IC601 is a DTMF encoder which generates tone signals suitable for DTMF dialing.

When IC-μ2AT is ready for transmission, T+5 is applied to IC601. The oscillation signals of 3.58MHz generated by X601 located internally at IC601 are divided at the dividing ratio selected in accordance with the ROW and COLUMN inputs if there is input from the KEYBOARD to IC601 while T+5 is being applied to IC601, and AF signals with dual tone are output from IC601 (pin 17). R602 is provided for adjusting the deviation.

If there is input from the KEYBOARD to IC601, "HIGH" is output from IC601 (pin 11). This level passes through an integrating circuit with a time constant of approximately 1 second comprising R604,

R605, and C604 and turns Q601 ON for approximately 1 second.
As transmission status is maintained for the duration that Q601 is ON, the tone signal can be transmitted continuously.

4-6-7 SUBAUDIBLE ENCODER CIRCUIT (#05, #09 ONLY) (TONE UNIT)

When the SUBAUDIBLE TONE SWITCH (S111) is turned ON, or when IC-μ2AT is in transmission status after P7 of S701 has been turned ON, signals of 3.57954 MHz oscillated by X701 are divided internally at IC701 at a dividing ratio matching the 6-bit data set by P1~P7 of S701, and are output from IC701 (pin 1). R701 is for adjustment of the deviation.

4-6-8 TONE CALL CIRCUIT (#02, #03, #04 ONLY) (TONE CALL UNIT)

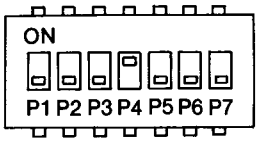
The tone call circuit is for accessing repeater stations in the European area, and is for generating tone signals of frequency 1750 Hz.

When the TONE CALL SWITCH (S111) is pushed ON, D316 turns ON which causes the voltage in the MIC line to drop and result in a transmission state. Furthermore, at the same time, Q801 is turned ON which causes a voltage to be applied to IC801 (pin 5).

The signals of frequency 7.168 MHz oscillated by X801 are divided internally at IC801 at a ratio of 1/4096 to obtain signals of frequency 1750 Hz which are output from pin 4. R801 is for adjustment of the deviation.

TABLE OF SUBAUDIBLE TONE ENCODER FREQUENCY SETTINGS

SETTING (Hz)	CALCULATION OUTPUT (Hz)	DIVIDING RATIO	P1	P2	P3	P4	P5	P6	SETTING (Hz)	CALCULATION OUTPUT (Hz)	DIVIDING RATIO	P1	P2	P3	P4	P5	P6
67.0	66.98	1670	1	0	0	0	0	0	136.5	136.58	819	1	0	1	0	1	0
71.9	71.89	1556	0	1	0	0	0	0	141.3	141.24	792	0	1	1	0	1	0
74.4	74.38	1504	1	1	0	0	0	0	146.2	146.22	765	1	1	1	0	1	0
77.0	76.99	1453	0	0	1	0	0	0	151.4	151.37	739	0	0	0	1	1	0
79.7	79.67	1404	1	0	1	0	0	0	156.7	156.67	714	1	0	0	1	1	0
82.5	82.49	1356	0	1	1	0	0	0	162.2	162.12	690	0	1	0	1	1	0
85.4	85.39	1310	1	1	1	0	0	0	167.9	167.96	666	1	1	0	1	1	0
88.5	88.50	1264	0	0	0	1	0	0	173.8	173.70	644	0	0	1	1	1	0
91.5	91.46	1223	1	0	0	1	0	0	179.9	179.84	622	1	0	1	1	1	0
94.8	94.80	1180	0	1	0	1	0	0	186.2	186.12	601	0	1	1	1	1	0
97.4	97.44	1148	1	1	0	1	0	0	192.8	192.86	580	1	1	1	1	1	0
100.0	93.96	1119	0	0	1	1	0	0	203.5	203.38	550	0	0	0	0	0	1
103.5	103.48	1081	1	0	1	1	0	0	210.7	210.66	531	1	0	0	0	0	1
107.2	107.25	1043	0	1	1	1	0	0	218.1	218.05	513	0	1	0	0	0	1
110.9	110.86	1009	1	1	1	1	0	0	225.7	225.53	496	1	1	0	0	0	1
114.8	114.85	974	0	0	0	0	1	0	233.6	233.53	479	0	0	1	0	0	1
118.8	118.75	942	1	0	0	0	1	0	241.8	241.60	463	1	0	1	0	0	1
123.0	123.06	909	0	1	0	0	1	0	250.3	250.25	447	0	1	1	0	0	1
127.3	127.26	879	1	1	0	0	1	0									
131.8	131.76	849	0	0	1	0	1	0									



S701

Symbol 1 in the table indicates that S701 is ON.
Symbol 0 in the table indicates that S701 is OFF.

Note:
If P7 of S701 is set to ON, the subaudible tone encoder circuit operates regardless of operation of the SUBAUDIBLE TONE SWITCH (S111).
P7: ON...TONE ENCODER=ON
OFF...TONE ENCODER=OFF

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.

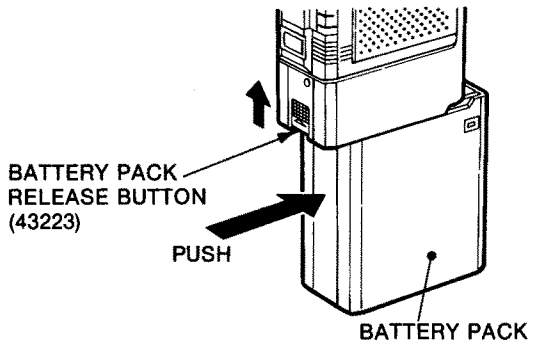


Fig. 5-1-1

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

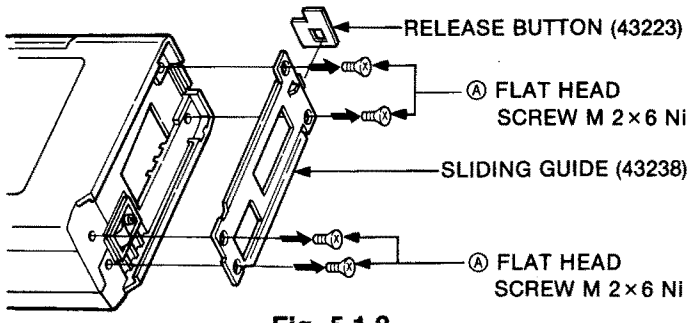


Fig. 5-1-2

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

IC-μ2E/A (#02, #03, #04, #06, #07 AND #08)
CAUTION:
Take care not to cut the lead wires of the speaker.

IC-μ2AT (#05 AND #09)
CAUTION:
Take care not to cut the lead wires of the speaker and the flexible lead.

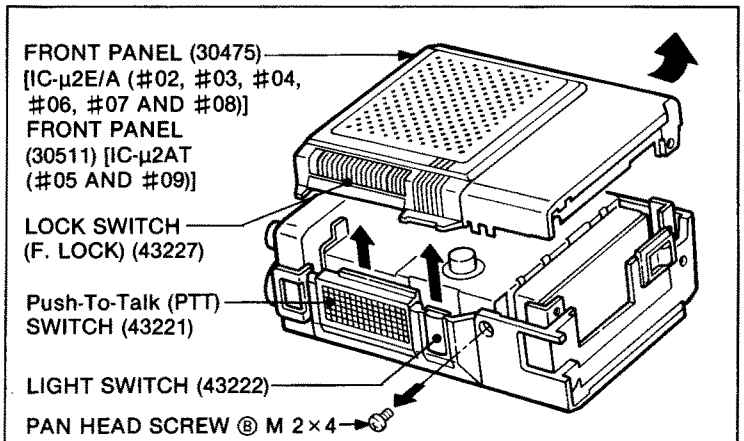


Fig. 5-1-3

IC-μ2AT (#05 AND #09) version

5. Unsolder solder point Ⓐ to remove the FLEXIBLE BOARD.

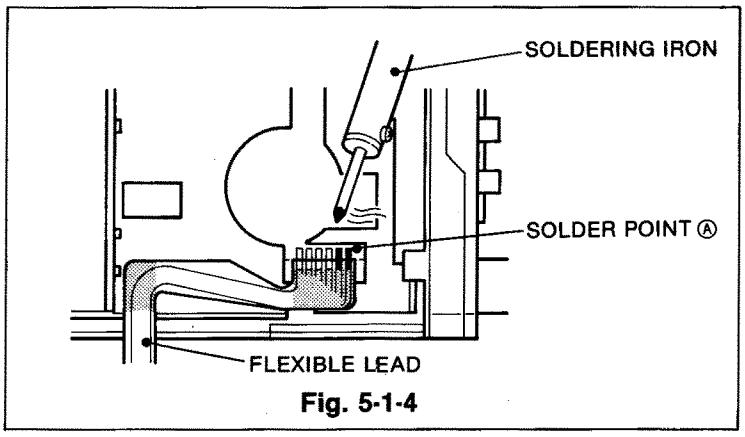


Fig. 5-1-4

NOTE: When assembling the front panel, turn the FLEXIBLE BOARD in as shown in figure 5-1-5.

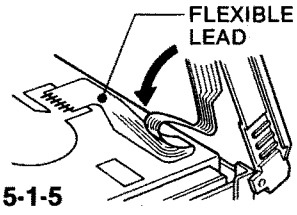


Fig. 5-1-5

5-2 SPEAKER DISASSEMBLY

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

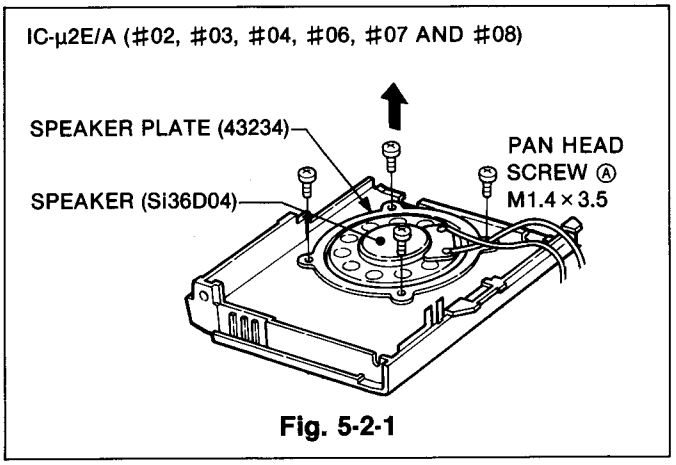


Fig. 5-2-1

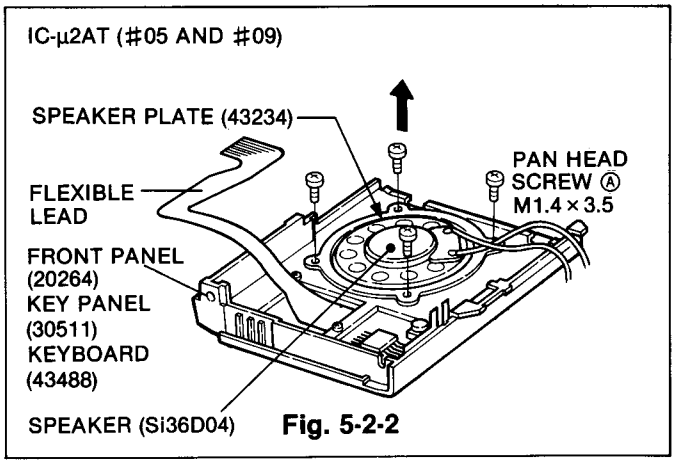
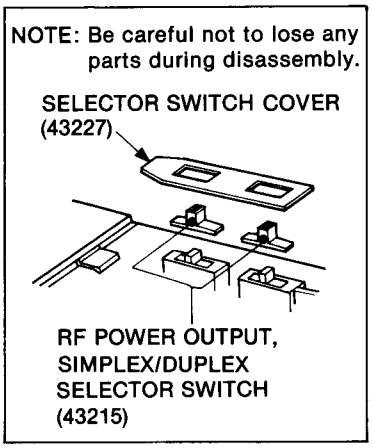


Fig. 5-2-2

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.



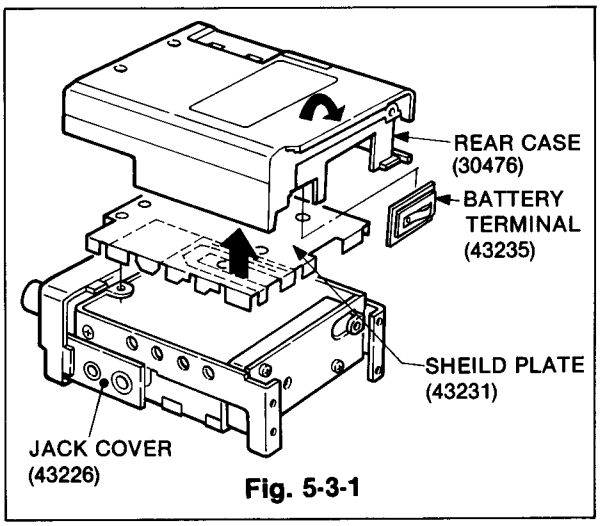


Fig. 5-3-1

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.

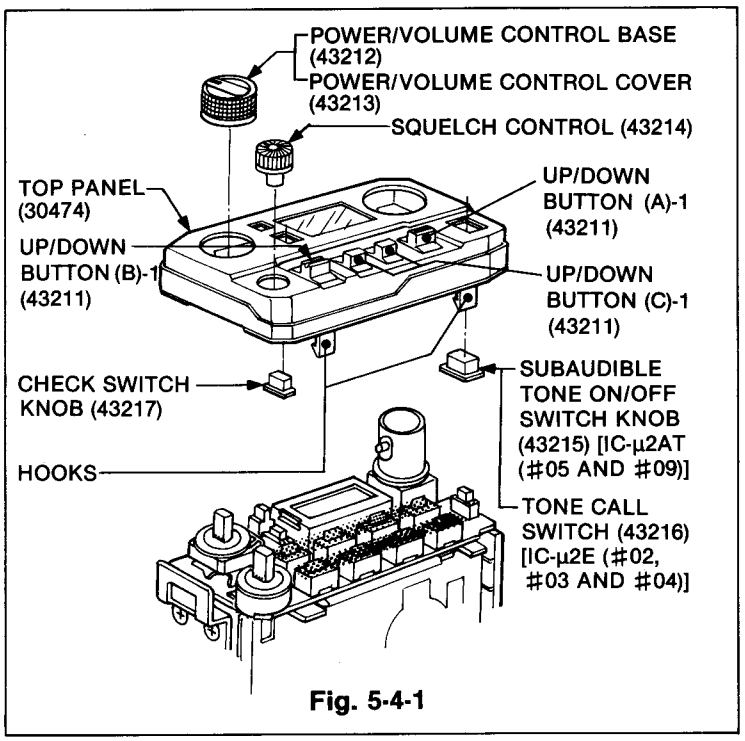


Fig. 5-4-1

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. There are different versions of this transceiver. Adjustment procedures and results may differ for each version. Be certain to follow the correct procedure for the transceiver you adjust.

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

9. Use the correct tools and test equipment.

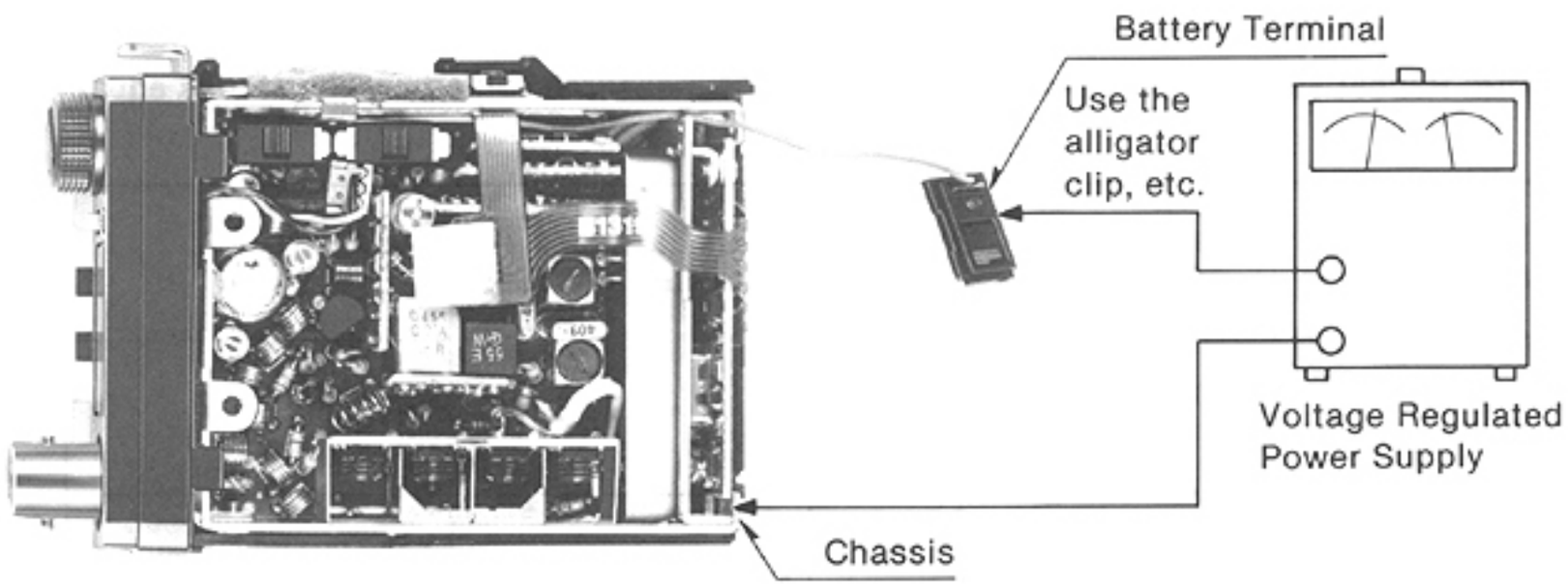
10. To remove the transceiver covers, refer to SECTION 5-1 and 5-3.

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

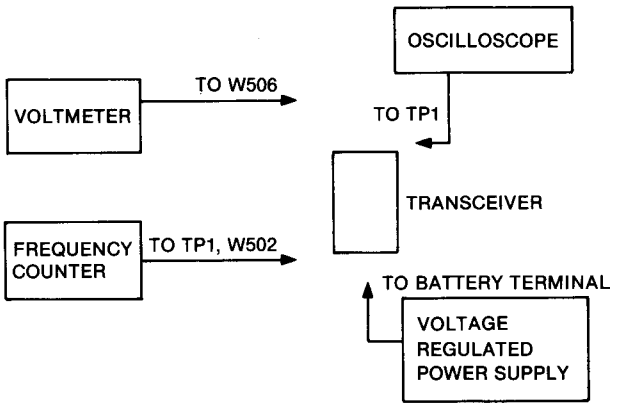
12. For transmission problems, connect a 50Ω dummy load to the ANTENNA CONNECTOR. For reception problems, attach an antenna or signal generator to the ANTENNA CONNECTOR. DO NOT transmit into the signal generator.

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

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

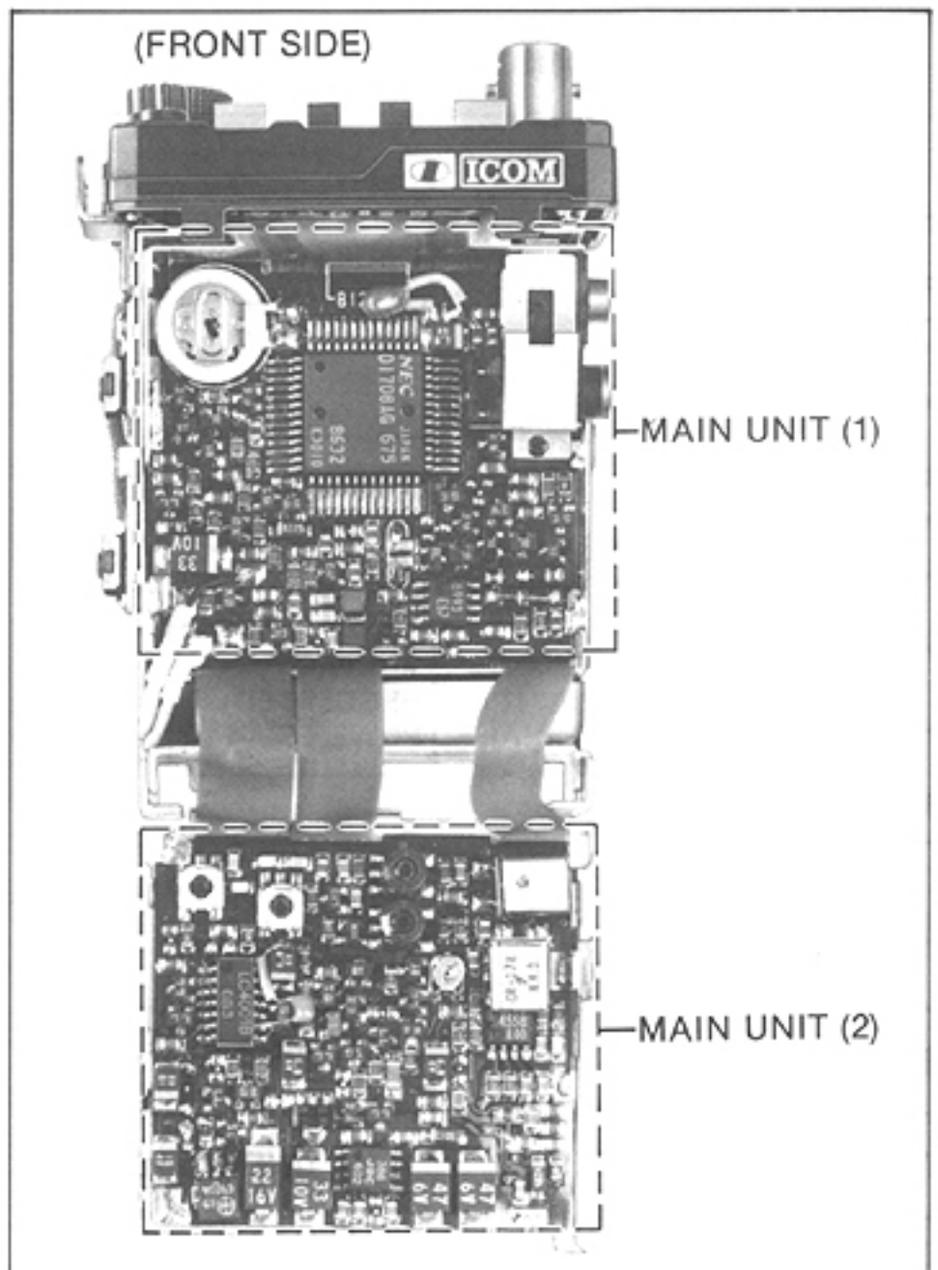


6-2 PLL ADJUSTMENT

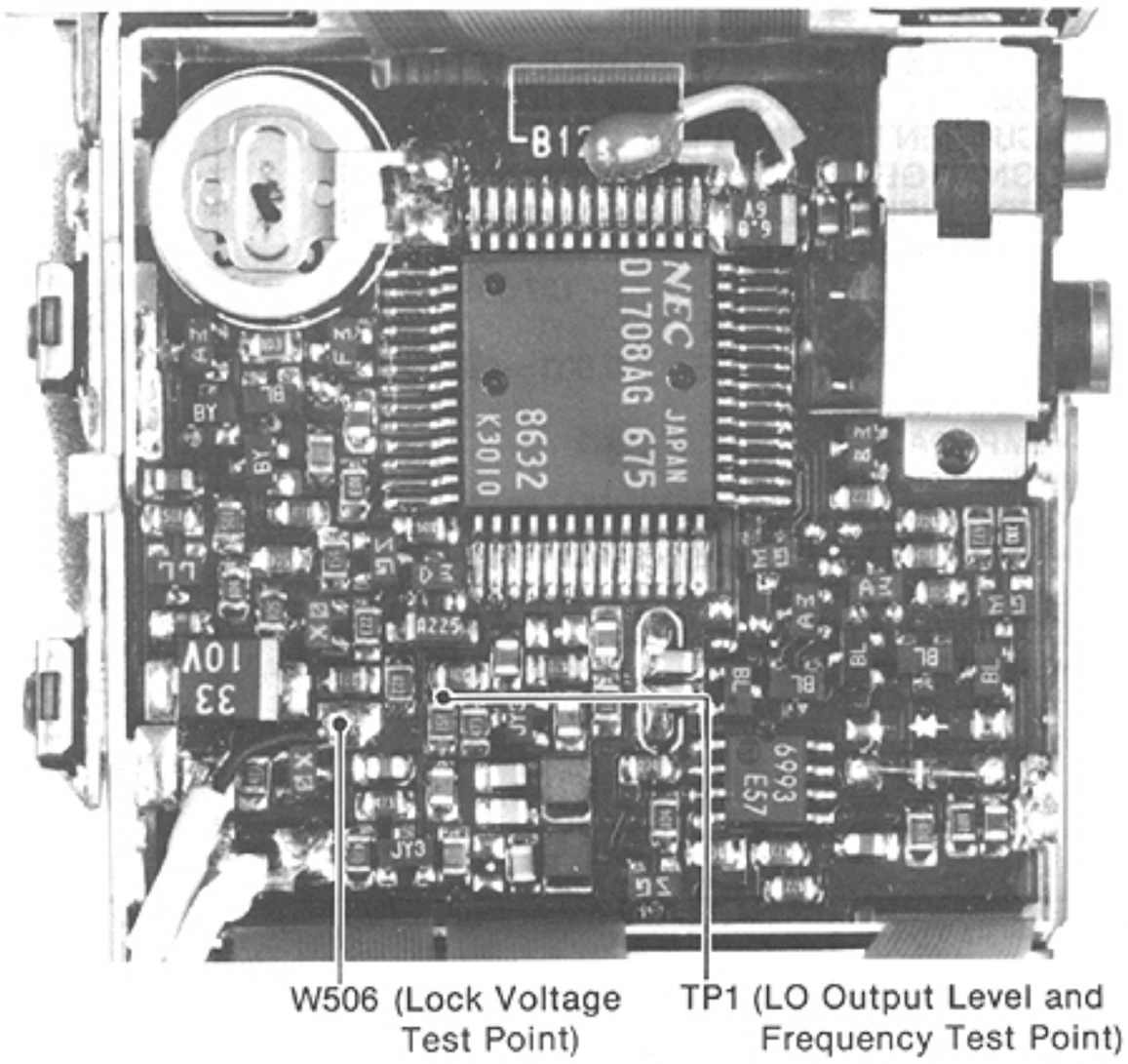
INSTRUMENTS REQUIRED	CONNECTIONS
(1) VOLTAGE REGULATED POWER SUPPLY • OUTPUT VOLTAGE : 9V DC±15% • CURRENT CAPACITY : 2A (2) VOLTMETER • INPUT IMPEDANCE : 50kΩ/V DC OR BETTER (3) FREQUENCY COUNTER • FREQUENCY RANGE : 0.1~200MHz • ACCURACY : BETTER THAN±1ppm • SENSITIVITY : 100mV OR BETTER (4) OSCILLOSCOPE • FREQUENCY RANGE : DC~5MHz • MEASURING RANGE : 0.01~10V	

ADJUSTMENT		ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT	
			UNIT	LOCATION		UNIT	ADJUST
LO OUTPUT	1	• Display freq.: 145.000MHz • Receive mode	MAIN (1)	Connect an oscilloscope to TP1.	Maximum (More than 50mVp-p)	MAIN (2)	L106
	2	• Display freq.: 145.000MHz • 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 freq.: 144.000MHz • Receive mode	MAIN (1)	Connect a voltmeter to W506.	1V	VCO	L503
	2	• Display freq.: 144.000MHz • Transmit mode			0.7~1.5V		Verify
LO FREQUENCY	1	• Display freq.: 145.000MHz (#02, #03) 146.000MHz (#04~#09) • Receive mode	RF	Connect a frequency counter to W502.	128.100MHz (#02, #03) 129.100MHz (#04~#09)	MAIN (2)	L103
	2	• Display freq.: 145.000MHz (#02, #03) 146.000MHz (#04~#09) • Transmit mode			145.000MHz (#02, #03) 146.000MHz (#04~#09)		L104
REFERENCE FREQUENCY	1	• Display freq.: 145.000MHz (#02, #03) 146.000MHz (#04~#09) • Receive mode	MAIN (1)	Connect a frequency counter to TP1.	12.57500MHz±300Hz (#02, #03) 13.57500MHz±300Hz (#04~#09)		Verify

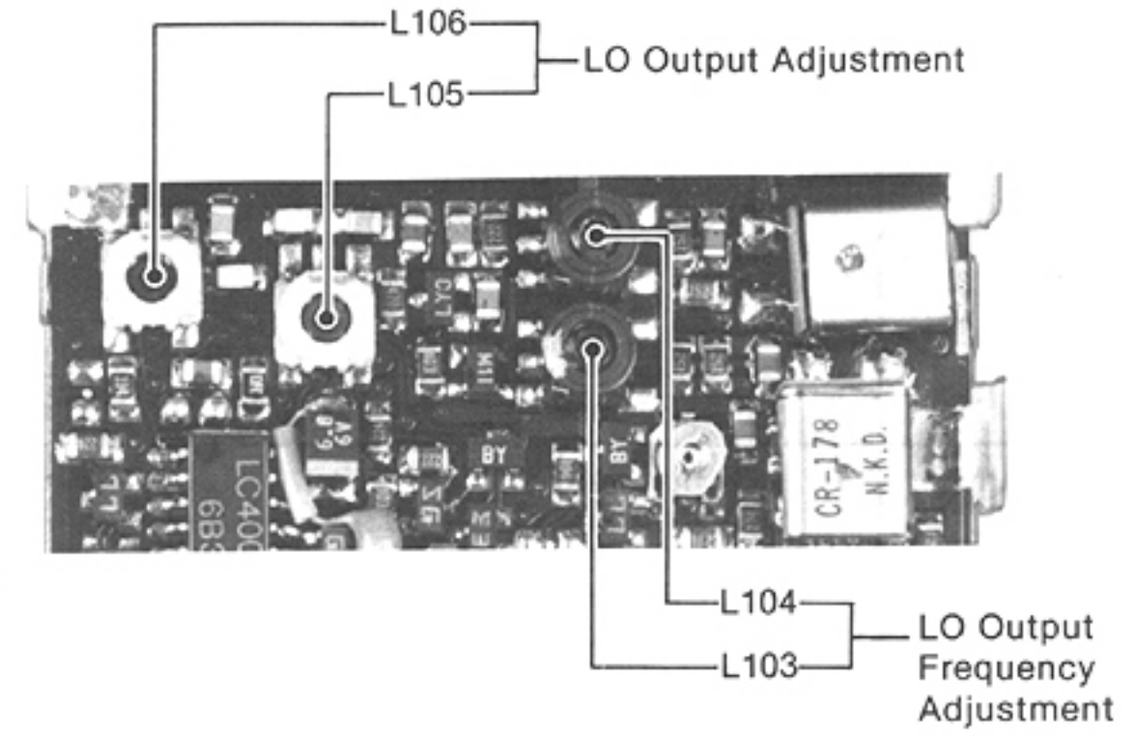
UNIT LOCATIONS



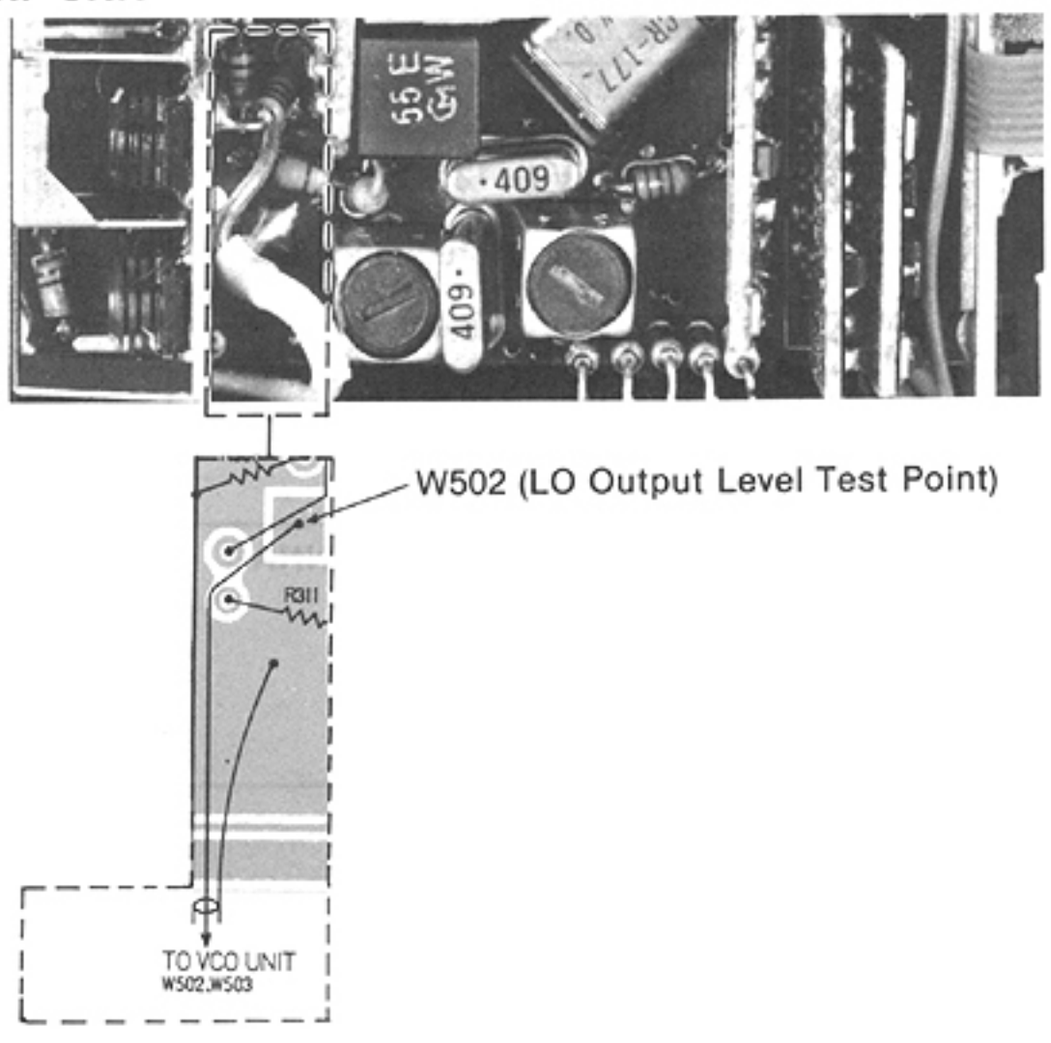
MAIN UNIT (1)



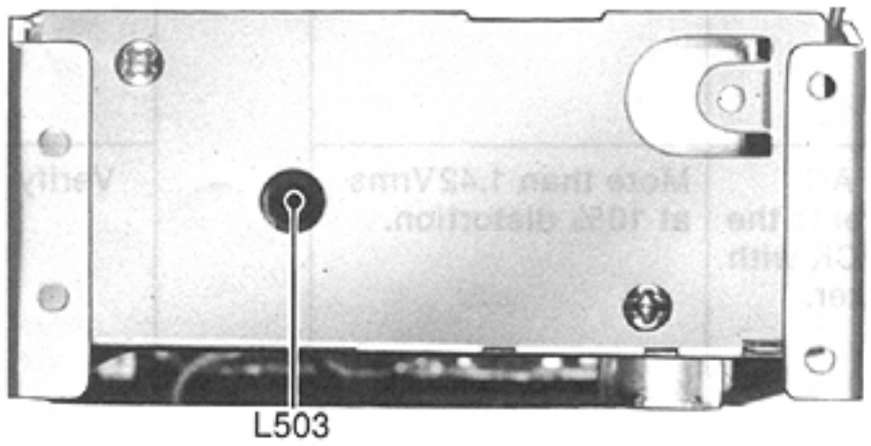
MAIN UNIT (2)



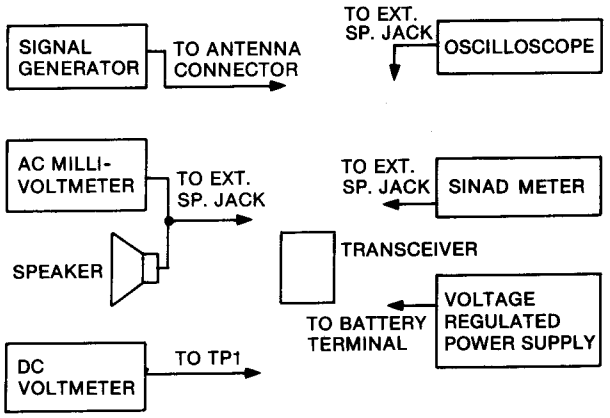
RF UNIT



VCO UNIT



6-3 RECEIVER ADJUSTMENT

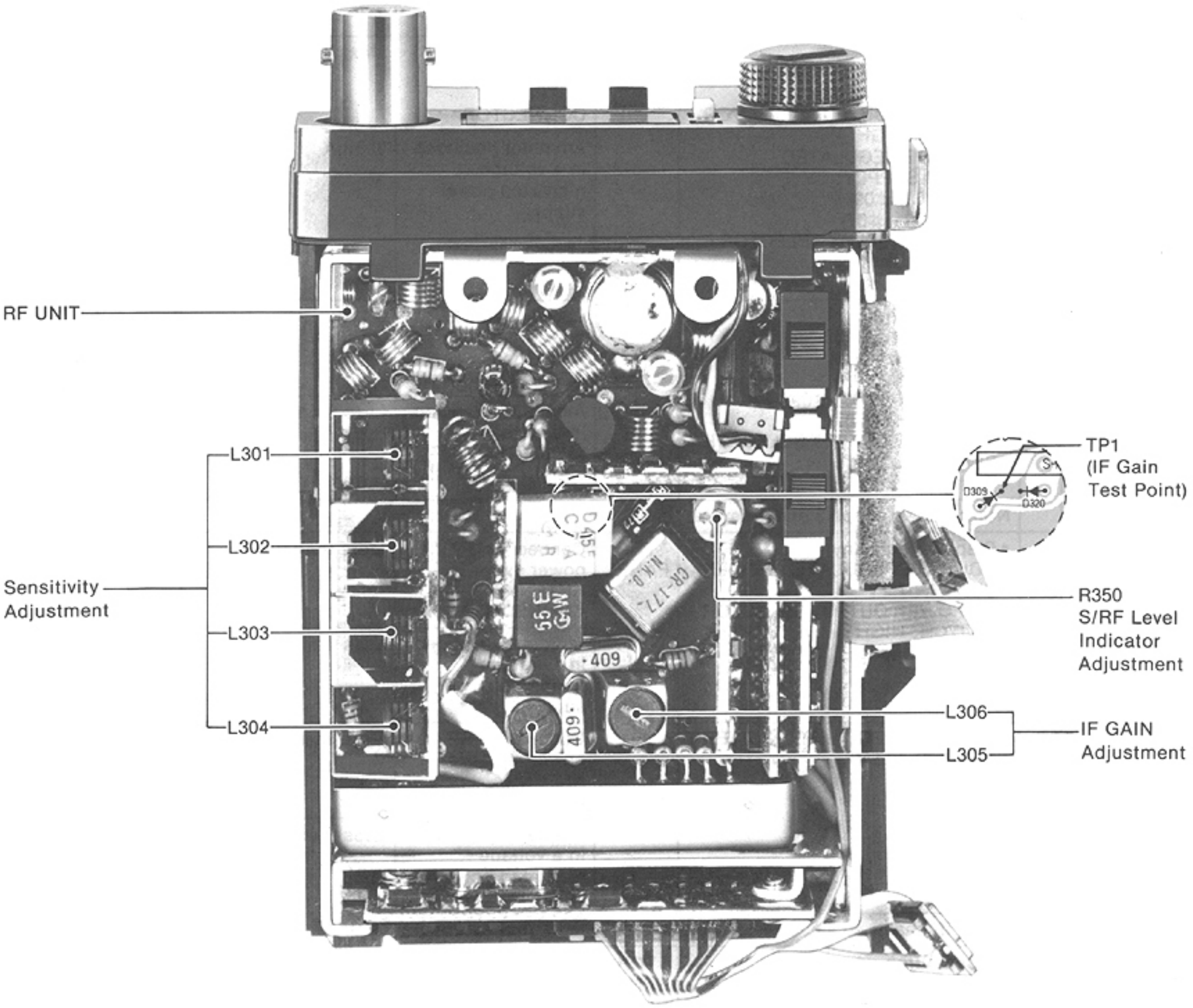
INSTRUMENTS REQUIRED	CONNECTIONS
(1) VOLTAGE REGULATED POWER SUPPLY • OUTPUT VOLTAGE : 9V DC±15% • CURRENT CAPACITY : 2A (2) SIGNAL GENERATOR (SSG) • FREQUENCY RANGE : 0.1~180MHz • OUTPUT VOLTAGE : 0.1μV~32mV (−127dBm~−17dBm) (3) AC MILLIVOLTMETER • MEASURING RANGE : 0.001~4V (4) SPEAKER • IMPEDANCE : 8Ω (5) OSCILLOSCOPE • FREQUENCY RANGE : DC~5MHz • MEASURING RANGE : 0.01~10V (6) SINAD METER (7) DC VOLTMETER • INPUT IMPEDANCE : 50kΩ OR BETTER	

ADJUSTMENT		ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT	
			UNIT	LOCATION		UNIT	ADJUST
SENSITIVITY	1	• Display freq.: 145.000MHz (#02, #03) 146.000MHz (#04~#09) • 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 SINAD meter to the [EXT SP] JACK with an 8Ω speaker.	Maximum	RF	L301~ L304
		Note: Repeat step 1 several times, so that measured value becomes maximum.					
IF GAIN	1	• Display freq.: 145.000MHz (#02, #03) 146.000MHz (#04~09) • SQUELCH CONTROL: max. counterclockwise • Apply RF signal to ANTENNA CONNECTOR. Level: 2.0μV (−101dBm) Dev.: ±3.5kHz Mod.: 1kHz • Receive mode	RF	Connect a DC voltmeter to TP1.	Maximum level	RF	L305, L306
	2	• Apply RF signal to ANTENNA CONNECTOR. Level: 0.2μV (−121dBm) Mod.: OFF Vary the output frequency as shown below. 144.994MHz~145.006MHz (#02, #03) 145.994MHz~146.006MHz (#04~#09) • Receive mode	SIDE PANEL	Connect an AC millivoltmeter to the [EXT SP] JACK with an 8Ω speaker.	Ripple voltage is less than 3dB.		
AF OUTPUT	1	• Apply RF signal to ANTENNA CONNECTOR. Level: 1mV (−47dBm) Dev.: ±3.5kHz Mod.: 1kHz • Receive mode		Connect an AC millivoltmeter to the [EXT SP] JACK with an 8Ω speaker.	More than 1.42Vrms at 10% distortion.		Verify

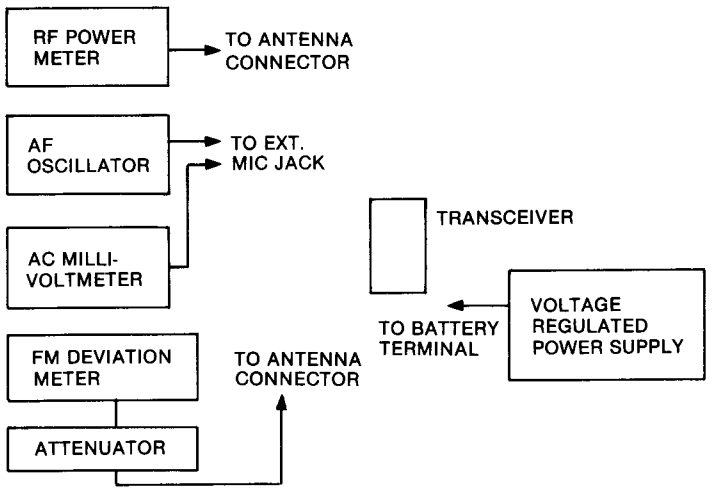
RECEIVER ADJUSTMENT (Continued)

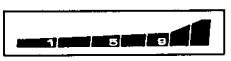
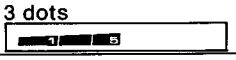
ADJUSTMENT		ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT	
			UNIT	LOCATION		UNIT	ADJUST
S/RF LEVEL INDICATOR	1	• Display freq.: 145.000MHz (#02, #03) 146.000MHz (#04~#09) • Apply RF signal to ANTENNA CONNECTOR. Level: 2.0μV (−101dBm) • Receive mode	TOP PANEL	S/RF LEVEL INDICATOR	2 dots	RF	R350
TIGHT SQUELCH SENSITIVITY	1	• SQUELCH CONTROL: Maximum clockwise • Apply RF signal to ANTENNA CONNECTOR. Level: 0.14μV (−124dBm) Dev.: ±3.5kHz Mod.: 1kHz • Receive mode	SIDE PANEL	Connect a speaker to the [EXT SP]	Squelch opens.		Verify

RF UNIT



6-4 TRANSMITTER ADJUSTMENT

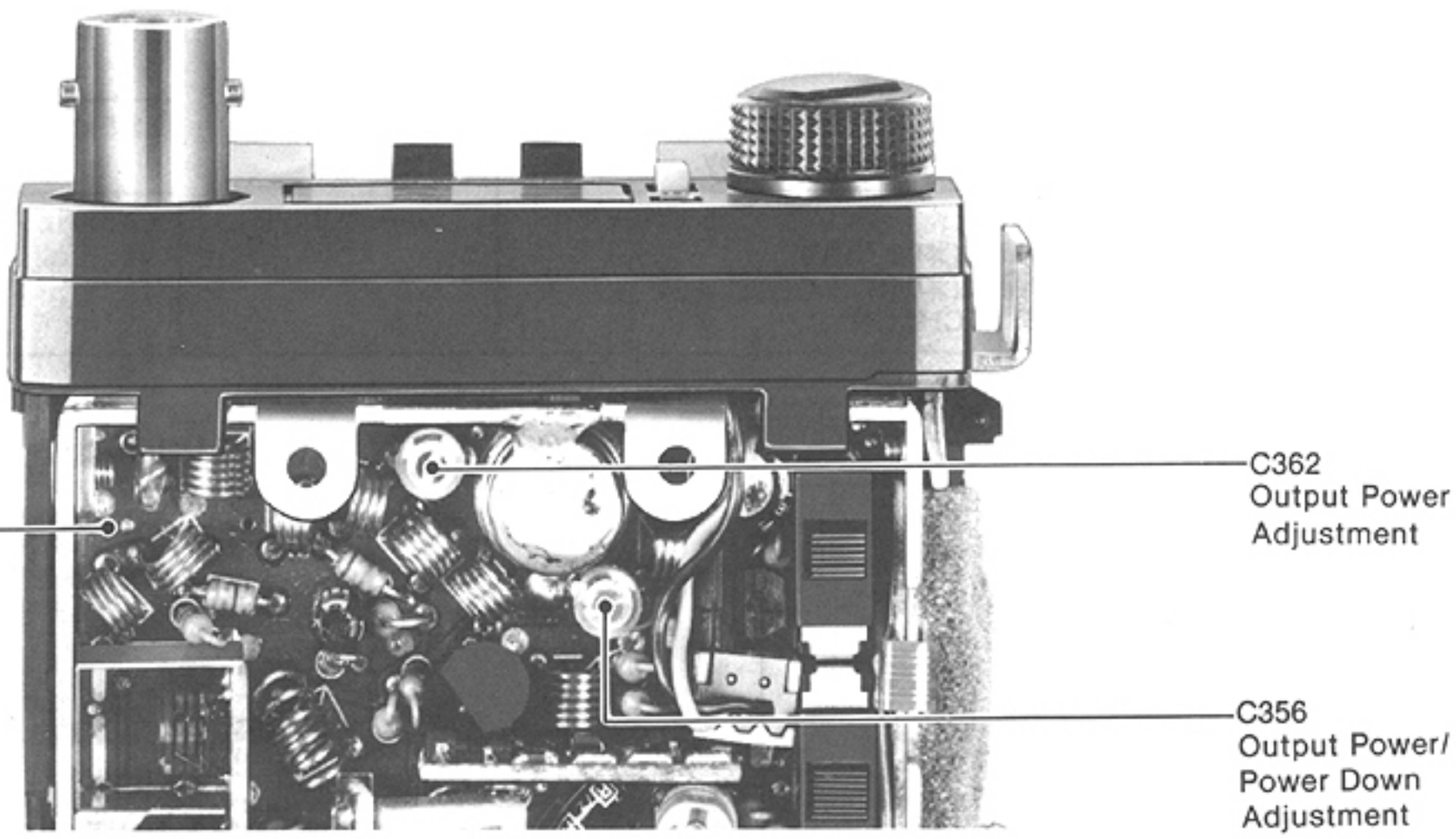
INSTRUMENTS REQUIRED	CONNECTIONS
(1) VOLTAGE REGULATED POWER SUPPLY • OUTPUT VOLTAGE : 9V DC±15% • CURRENT CAPACITY : 2A (2) RF POWER METER (TERMINATED TYPE) • MEASURING RANGE : 2W • FREQUENCY RANGE : 0.1~180MHz • IMPEDANCE : 50Ω • SWR : LESS THAN 1: 1.2 (3) AF OSCILLATOR • OUTPUT FREQUENCY : AT LEAST 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 freq.: 145.000MHz (#02, #03) 146.000MHz (#04~#09) • RF POWER OUTPUT SELECTOR SWITCH: HIGH • VOLTAGE REGULATED POWER SUPPLY: 9.0V (#08, #09) 8.4V (#02~#07) • SIMPLEX/DUPLEX SELECTOR SWITCH: SIM • Transmit mode	TOP PANEL	Connect an RF power meter to ANTENNA CONNECTOR.	Maximum	RF	C356, C362
	2			Ammeter (included in a voltage regulated power supply)	500mA		C362
	3	• Display freq.: 145.9875MHz (#02) 145.995MHz (#03) 149.995MHz (#04~#06, #08, #09) 147.995MHz (#07) • RF POWER OUTPUT SELECTOR SWITCH: LOW • Transmit mode		Connect an RF power meter to ANTENNA CONNECTOR.	0.1W		C356
	4			Ammeter (included in a voltage regulated power supply)	Less than 300mA		Verify
		Note: Repeat steps 3 and 4 several times.					
POWER DOWN	1	• Display freq.: Any • VOLTAGE REGULATED POWER SUPPLY: 7.2V • RF POWER OUTPUT SELECTOR SWITCH: HIGH • Transmit mode	TOP PANEL	Connect an RF power meter to ANTENNA CONNECTOR.	More than 0.6W	RF	Verify
	2			Ammeter (included in a voltage regulated power supply)	Less than 500mA		
	3	• VOLTAGE REGULATED POWER SUPPLY: 10.8V		Connect an RF power meter to ANTENNA CONNECTOR.	More than 2.2W		C356
	4			Ammeter (included in a voltage regulated power supply)	Less than 800mA		Verify
		Note: If measured value is not less than 800mA at step 4, repeat step 3.					
S/RF LEVEL INDICATOR	1	• Display freq.: Any • RF POWER OUTPUT SELECTOR SWITCH: HIGH • Transmit mode	TOP PANEL	S/RF LEVEL INDICATOR	Full scale 		Verify
	2	• RF POWER OUTPUT SELECTOR SWITCH: LOW			3 dots 		

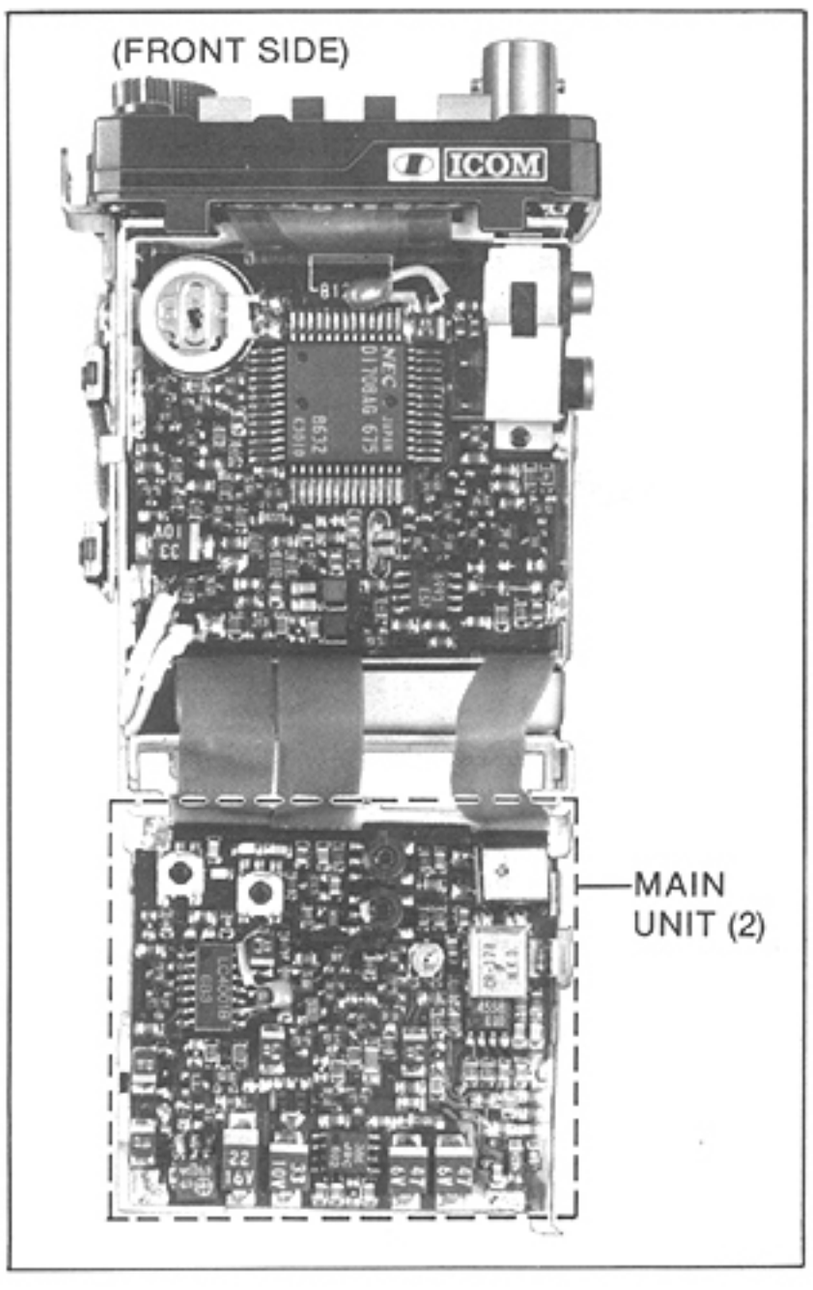
TRANSMITTER ADJUSTMENT (Continued)

ADJUSTMENT		ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT	
			UNIT	LOCATION		UNIT	ADJUST
DEVIATION	1	• Display freq.: 145.000 MHz (#02, #03) 146.000 MHz (#04～#09) • RF POWER OUTPUT SELECTOR SWITCH: HIGH • Apply AF signal to EXT. MIC JACK Level: 1 kHz/40 mV (#02～#09) 1 kHz/100 mV (#05, #06) • Transmit mode	TOP PANEL	Connect a FM deviation meter to ANTENNA CONNECTOR via an attenuator (20 dB).	±4.8 kHz	MAIN (2)	R174
	2	• Verfy both band eages			5 kHz ± 15%		Verify

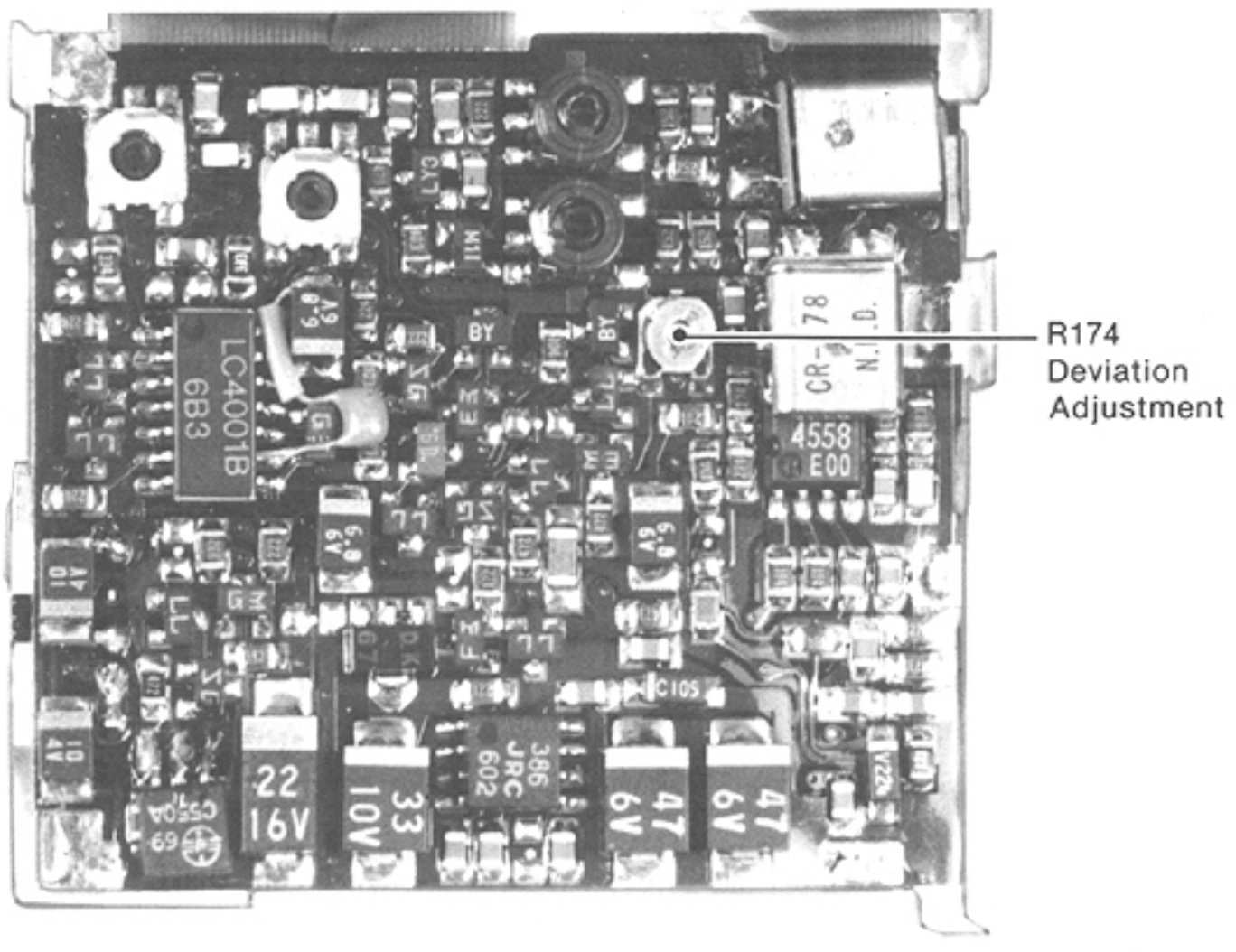
RF UNIT



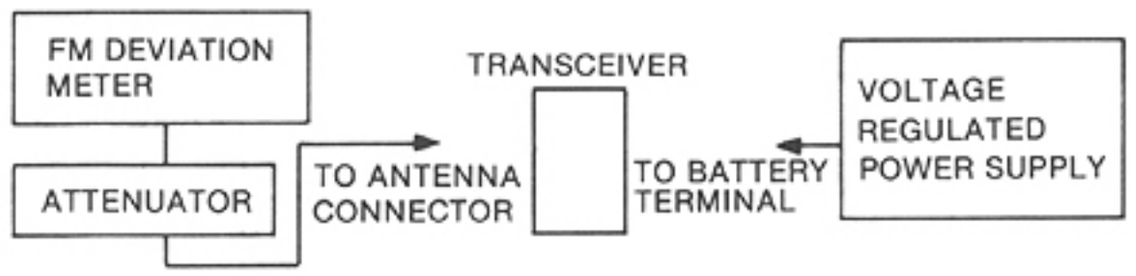
UNIT LOCATION



MAIN UNIT (2)

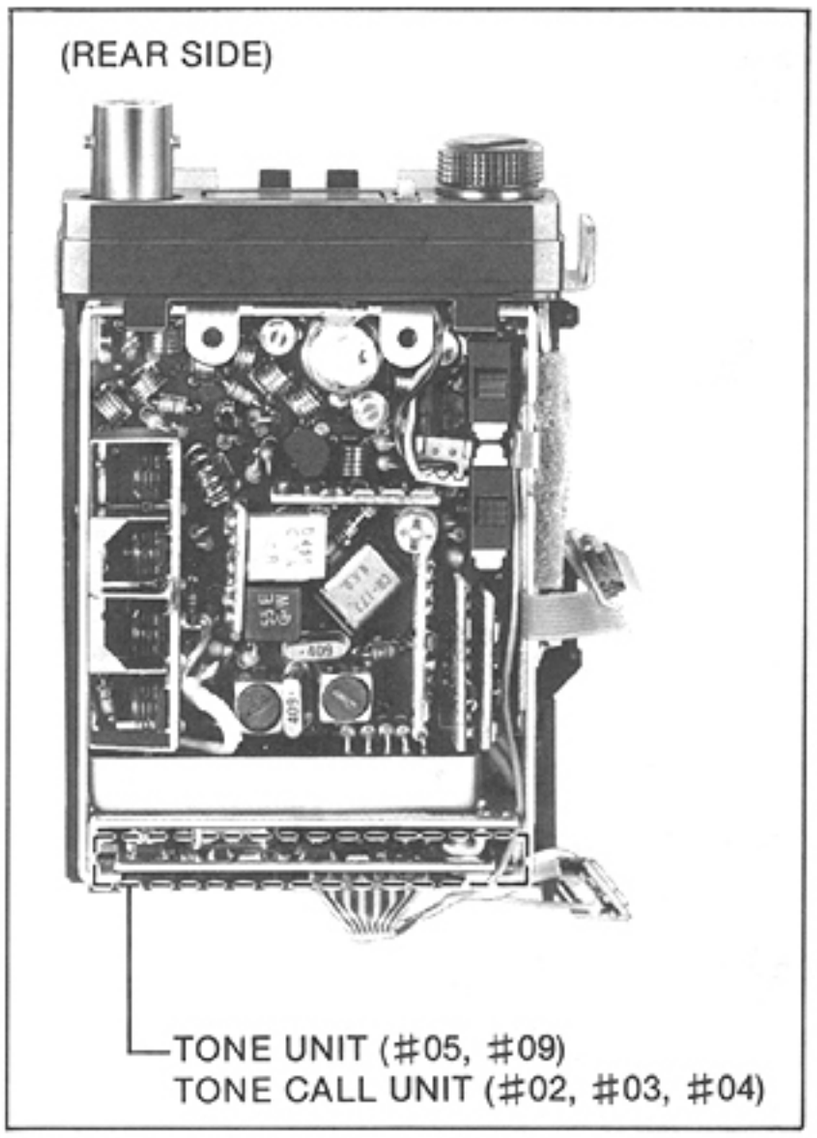


6-5 SUBAUDIBLE TONE, DTMF AND TONE CALL ADJUSTMENTS

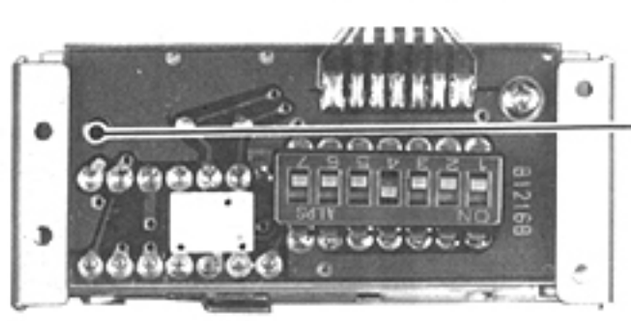
INSTRUMENTS REQUIRED	CONNECTIONS
(1) VOLTAGE REGULATED POWER SUPPLY • OUTPUT VOLTAGE : 9V DC±15% • CURRENT CAPACITY : 2A (2) FM DEVIATION METER • FREQUENCY RANGE : 140MHz~180MHz • MEASURING RANGE : 0~±10kHz (3) ATTENUATOR	

ADJUSTMENT		ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT	
			UNIT	LOCATION		UNIT	ADJUST
SUBAUDIBLE TONE (#05, #09)	1	• Display freq.: 146.000MHz • FM DEVIATION METER: HPF (50Hz) OFF, LPF (20Hz) ON • Push SUBAUDIBLE TONE SWITCH.	TOP PANEL	Connect an FM deviation meter to ANTENNA CONNECTOR via an attenuator.	±0.75kHz	TONE	R701
DTMF (#05, #09)	1	• Display freq.: 146.000MHz • Push PTT switch and "D" key.			±3.5kHz	DTMF	R602
TONE CALL (#02, #03, #04)	1	• Display freq.: 145.000MHz(#02, #03) 146.000MHz(#04) • TONE SWITCH: ON			±3.5kHz	TONE CALL	R801

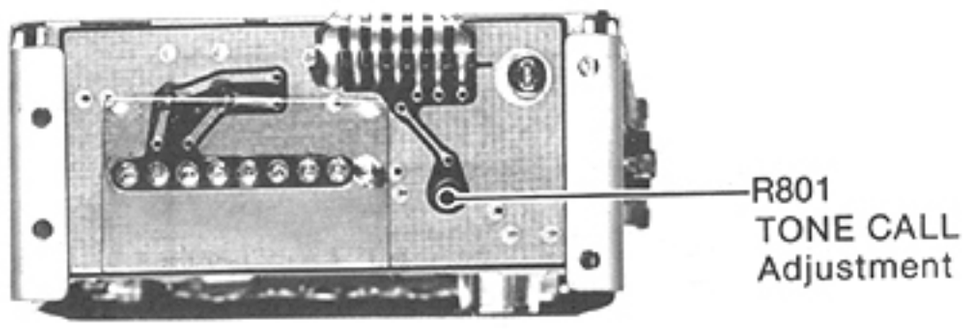
UNIT LOCATION



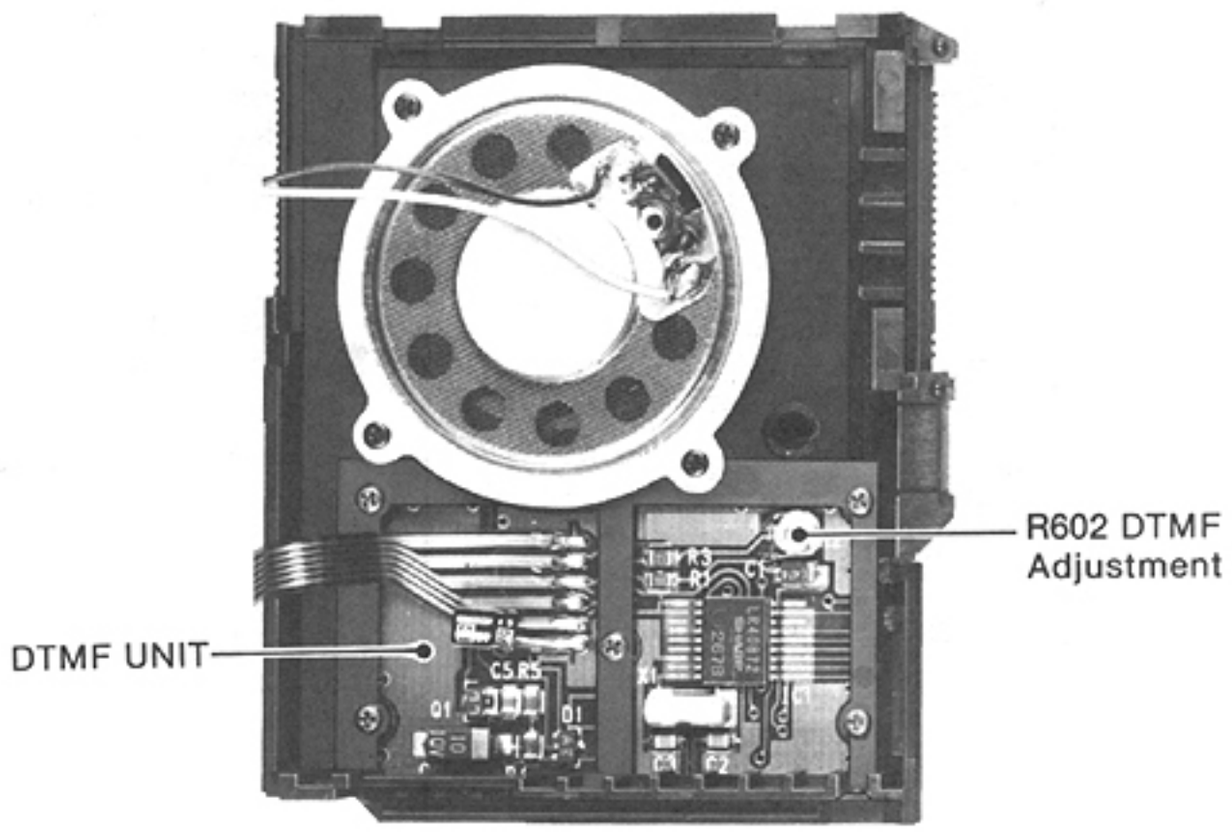
TONE UNIT (#05, #09)



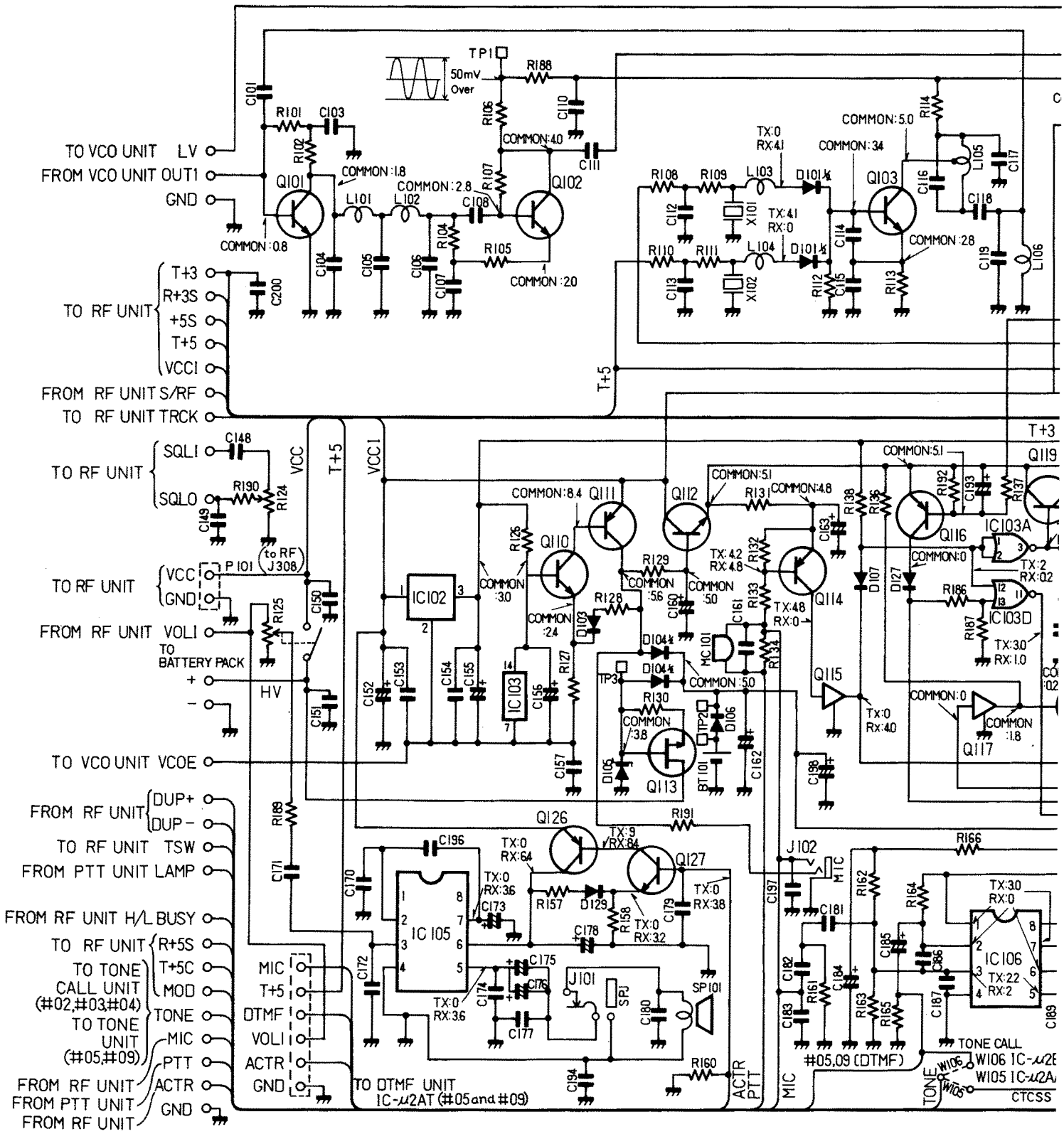
TONE CALL UNIT (#02, #03, #04)

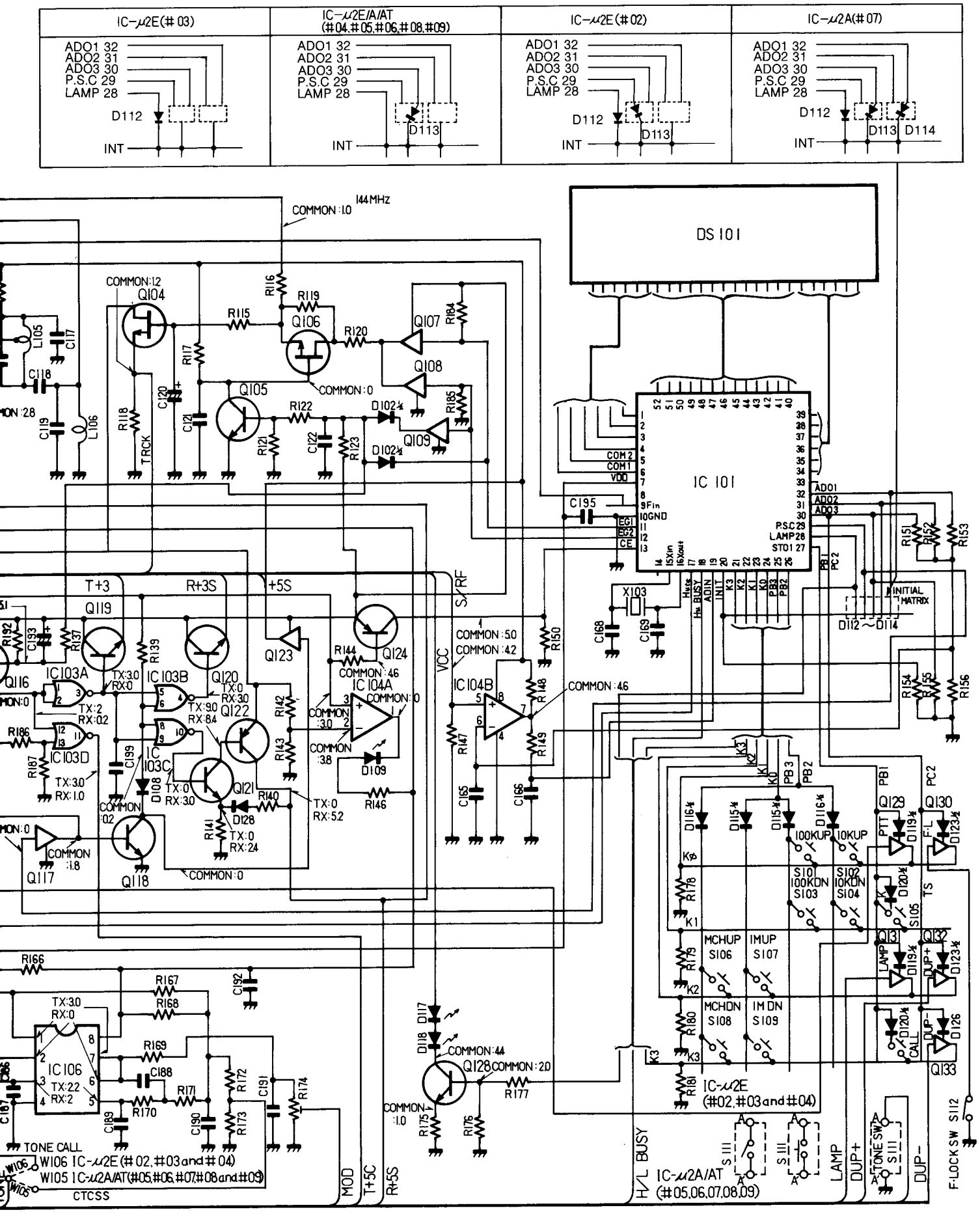


DTMF UNIT (#05, #09)

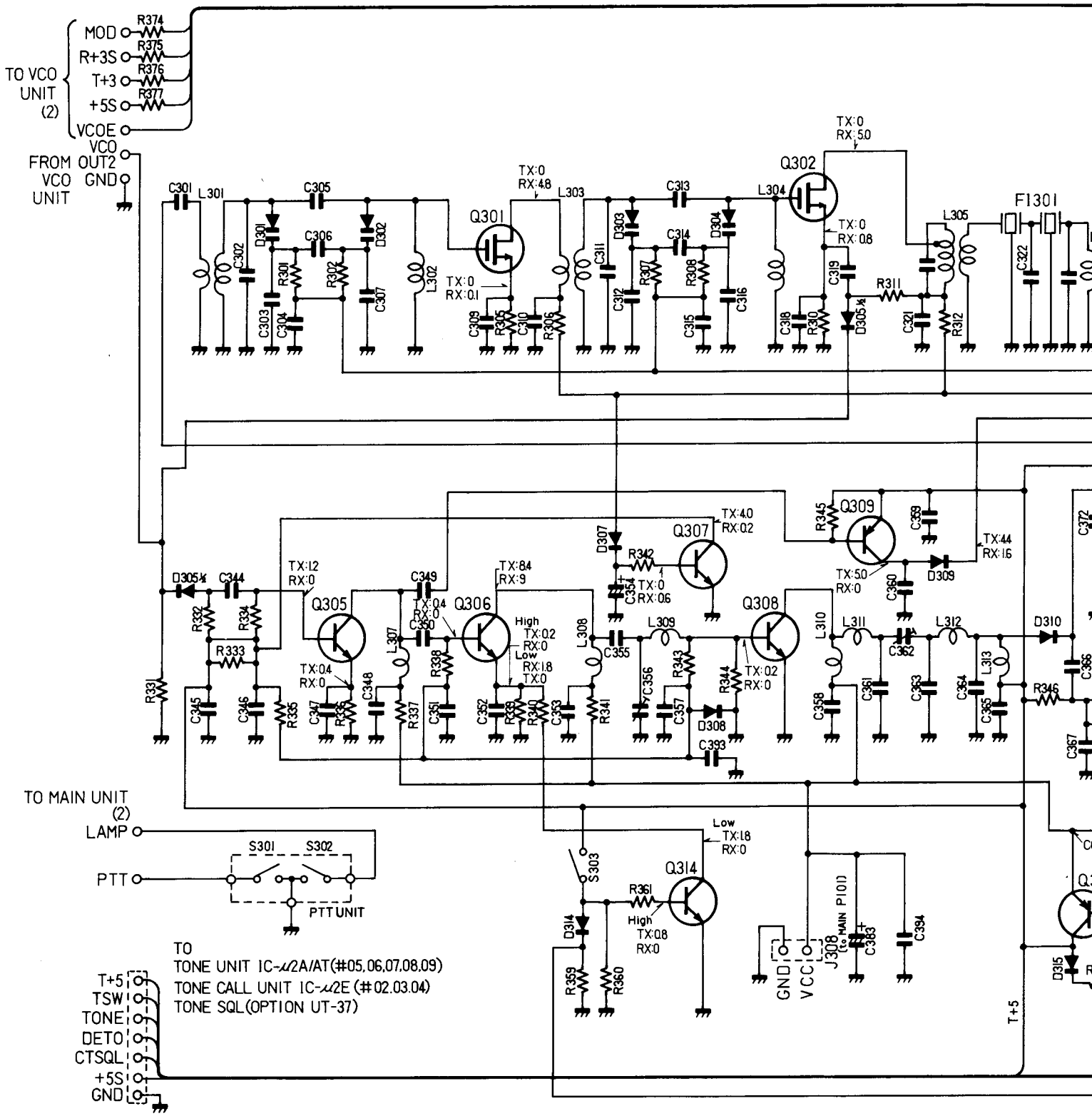


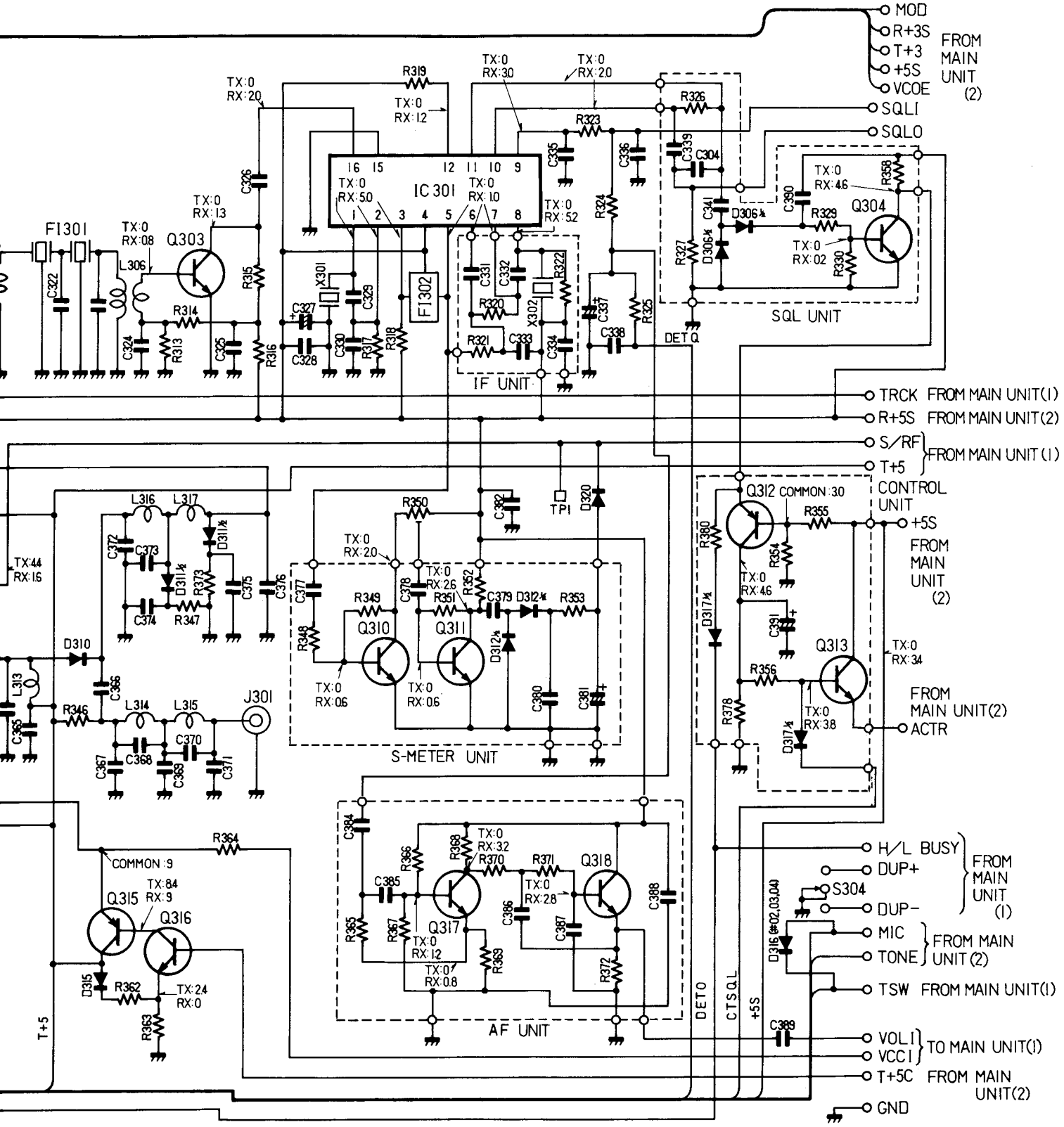
7-1 MAIN UNIT


TO VCO UNIT LV
FROM VCO UNIT OUT1
GND
TO RF UNIT T+3 R+3S +5S T+5 VCC1
FROM RF UNIT S/RF
TO RF UNIT TRCK
TO RF UNIT SQLI SQLO
TO RF UNIT VCC GND
FROM RF UNIT VOLI
TO BATTERY PACK + HV −
TO VCO UNIT VCOE
FROM RF UNIT DUP+ DUP−
TO RF UNIT TSW
FROM PTT UNIT LAMP
FROM RF UNIT H/L BUSY
TO RF UNIT R+5S
TO TONE CALL UNIT (#02,#03,#04) T+5C MOD
TO TONE UNIT (#05,#09) TONE
MIC
PTT
FROM RF UNIT ACTR
FROM PTT UNIT GND
FROM RF UNIT
MIC T+5 DTMF VOLI ACTR GND
TO DTMF UNIT IC-μ2AT (#05 and #09)
TP1 50mV Over
COMMON:1.8
COMMON:2.8
COMMON:0.8
COMMON:4.0
COMMON:2.0
COMMON:5.0
COMMON:3.4
COMMON:2.8
COMMON:8.4
COMMON:5.1
COMMON:4.8
COMMON:3.0
COMMON:5.6
COMMON:5.0
COMMON:2.4
COMMON:3.8
COMMON:1.8
COMMON:0
TX:0 RX:4.1
TX:4.1 RX:0
TX:4.2 RX:4.8
TX:4.8 RX:0
TX:0 RX:4.0
TX:2 RX:0.2
TX:3.0 RX:1.0
TX:9 RX:8.4
TX:0 RX:6.4
TX:0 RX:3.6
TX:0 RX:3.2
TX:0 RX:3.8
TX:3.0 RX:0
TX:2.2 RX:2
#05,09 (DTMF)
TONE CALL
W106 IC-μ2E
W105 IC-μ2A
CTCSS
IC105
IC106
IC102
IC103
IC103A
IC103D
Q101
Q102
Q103
Q110
Q111
Q112
Q113
Q114
Q115
Q116
Q117
Q119
Q126
Q127
T+5
T+3
VCC
VCC1


IC-μ2E(#03)
ADO1 32
ADO2 31
ADO3 30
P.S.C 29
LAMP 28
D112
INT
IC-μ2E/A/AT (#04,#05,#06,#08,#09)
D113
IC-μ2E(#02)
IC-μ2A(#07)
D114
DS101
IC 101
COMMON:1.0
144MHz
COMMON:12
Q104
Q106
Q107
Q108
Q105
Q109
COMMON:0
TRCK
D102
C195
X103
INITIAL MATRIX
D112～D114
T+3
R+3S
+5S
S/RF
Q119
Q123
Q124
IC103A
IC103B
IC103D
IC103C
Q120
Q122
Q121
Q116
Q117
Q118
IC104A
IC104B
COMMON:5.0
COMMON:4.2
COMMON:4.6
COMMON:3.0
COMMON:3.8
D109
D108
D128
VCC
IC106
TONE CALL
W106 IC-μ2E(#02,#03and#04)
W105 IC-μ2A/AT(#05,#06,#07,#08and#09)
CTCSS
MOD
T+5C
R+5S
D117
D118
Q128
COMMON:4.4
COMMON:2.0
COMMON:1.0
IC-μ2E (#02,#03and#04)
IC-μ2A/AT (#05,06,07,08,09)
H/L BUSY
LAMP
DUP+
DUP-
TONE SW
F-LOCK SW S112
Q129
Q130
Q131
Q132
Q133
PTT
F/L
TS
CALL
100KUP
10KUP
100KDN
10KDN
MCHUP
IMUP
MCHDN
IMDN
S101
S102
S103
S104
S105
S106
S107
S108
S109
S111

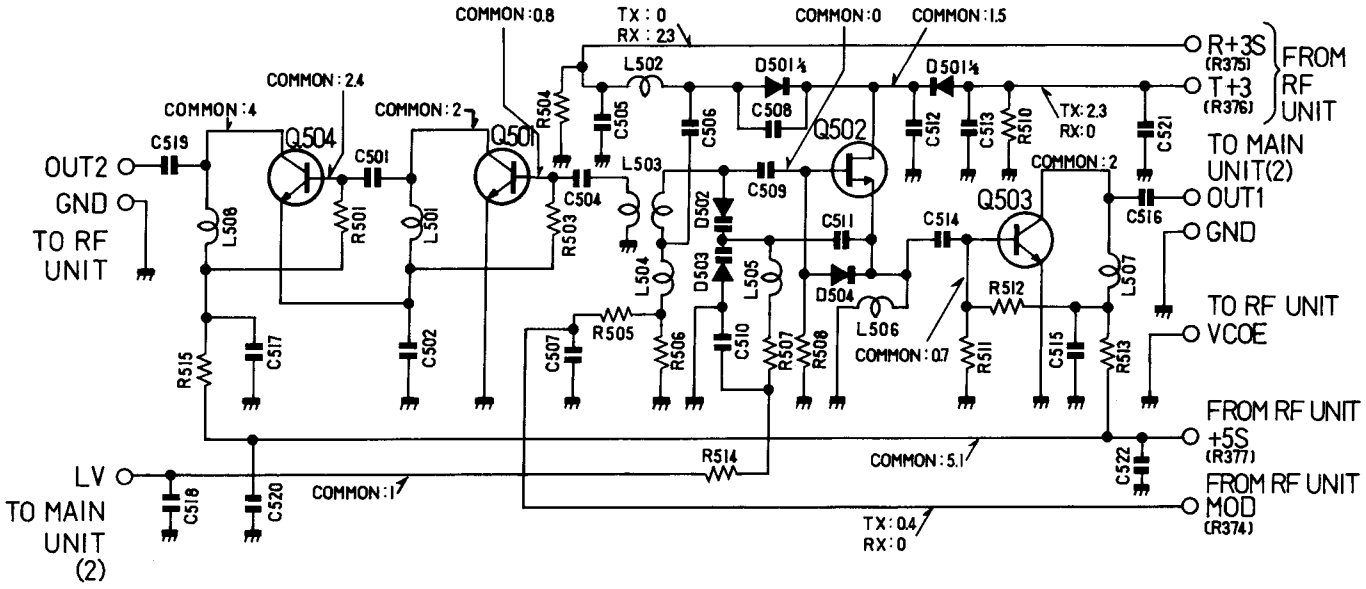
7-2 RF UNIT


TO VCO UNIT (2)
MOD
R+3S
T+3
+5S
VCOE
R374
R375
R376
R377
FROM VCO UNIT
VCO OUT2
GND
Q301
Q302
Q305
Q306
Q307
Q308
Q309
Q314
F1301
TX:0 RX:4.8
TX:0 RX:5.0
TX:0 RX:0.1
TX:0 RX:0.8
TX:1.2 RX:0
TX:8.4 RX:9
TX:0.4 RX:0
TX:0.4 RX:0
High TX:0.2 RX:0
Low RX:1.8 TX:0
TX:4.0 RX:0.2
TX:0 RX:0.6
TX:5.0 RX:0
TX:4.4 RX:1.6
TX:0.2 RX:0
Low TX:1.8 RX:0
High TX:0.8 RX:0
TO MAIN UNIT (2)
LAMP
PTT
S301
S302
PTT UNIT
S303
TO
TONE UNIT IC-μ2A/AT(#05,06,07,08,09)
TONE CALL UNIT IC-μ2E (#02.03.04)
TONE SQL(OPTION UT-37)
T+5
TSW
TONE
DETO
CTSQL
+5S
GND
VCC
J308
(to MAIN P101)

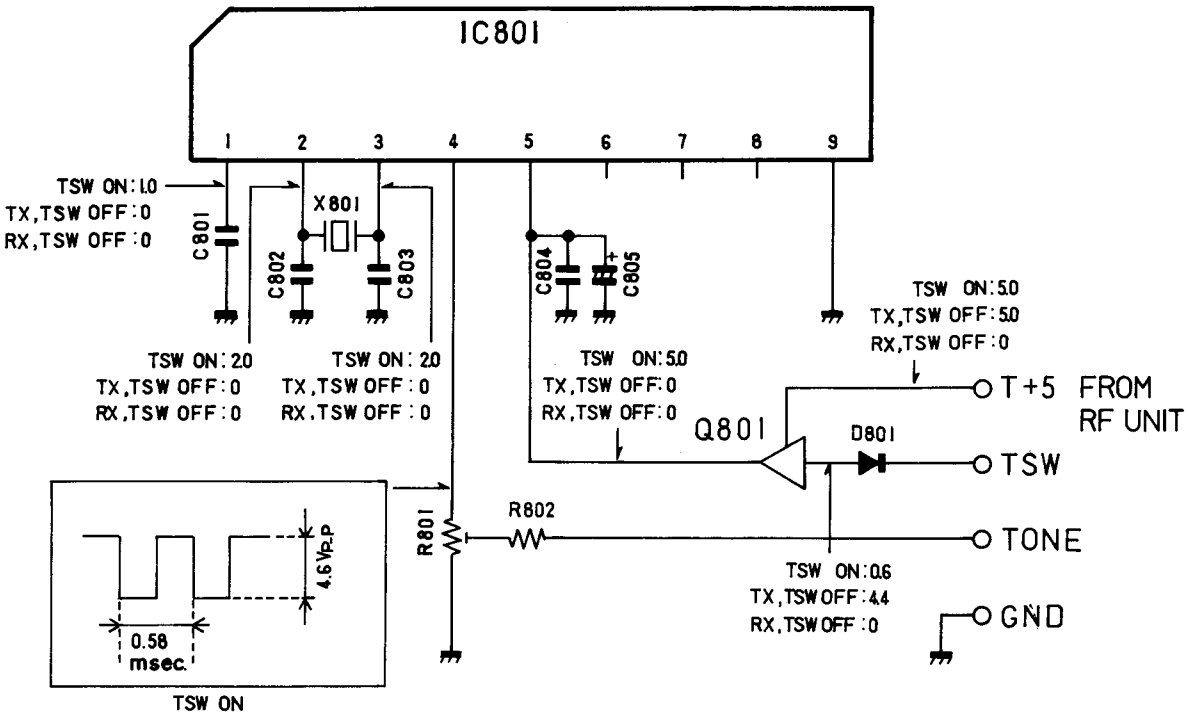

MOD
R+3S
T+3
+5S
VCOE
FROM MAIN UNIT (2)
SQLI
SQLO
IC 301
IF UNIT
SQL UNIT
DETQ
TRCK FROM MAIN UNIT(1)
R+5S FROM MAIN UNIT(2)
S/RF
T+5
FROM MAIN UNIT (1)
CONTROL UNIT
+5S
FROM MAIN UNIT (2)
S-METER UNIT
AF UNIT
H/L BUSY
DUP+
DUP-
S304
FROM MAIN UNIT (1)
MIC
TONE
FROM MAIN UNIT (2)
TSW FROM MAIN UNIT(1)
VOLI
VCCI
TO MAIN UNIT(1)
T+5C FROM MAIN UNIT(2)
GND
ACTR
FROM MAIN UNIT(2)
DETQ
CTSQL
+5S
T+5

7-3 VCO UNIT AND TONE CALL UNIT [IC-μ2E (#02, #03 AND #05)]

• VCO UNIT TONE

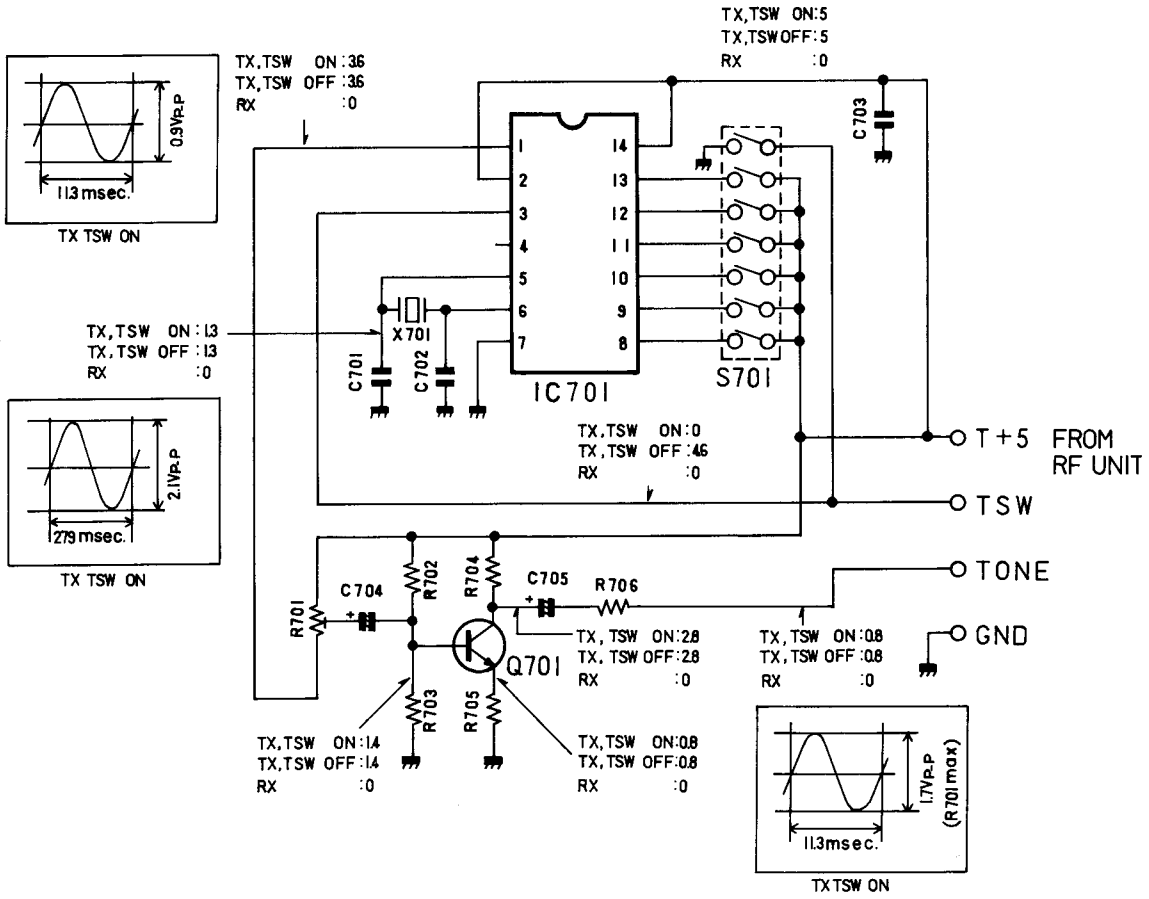


• TONE CALL UNIT [IC-μ2E (#02, #03 AND #05)]

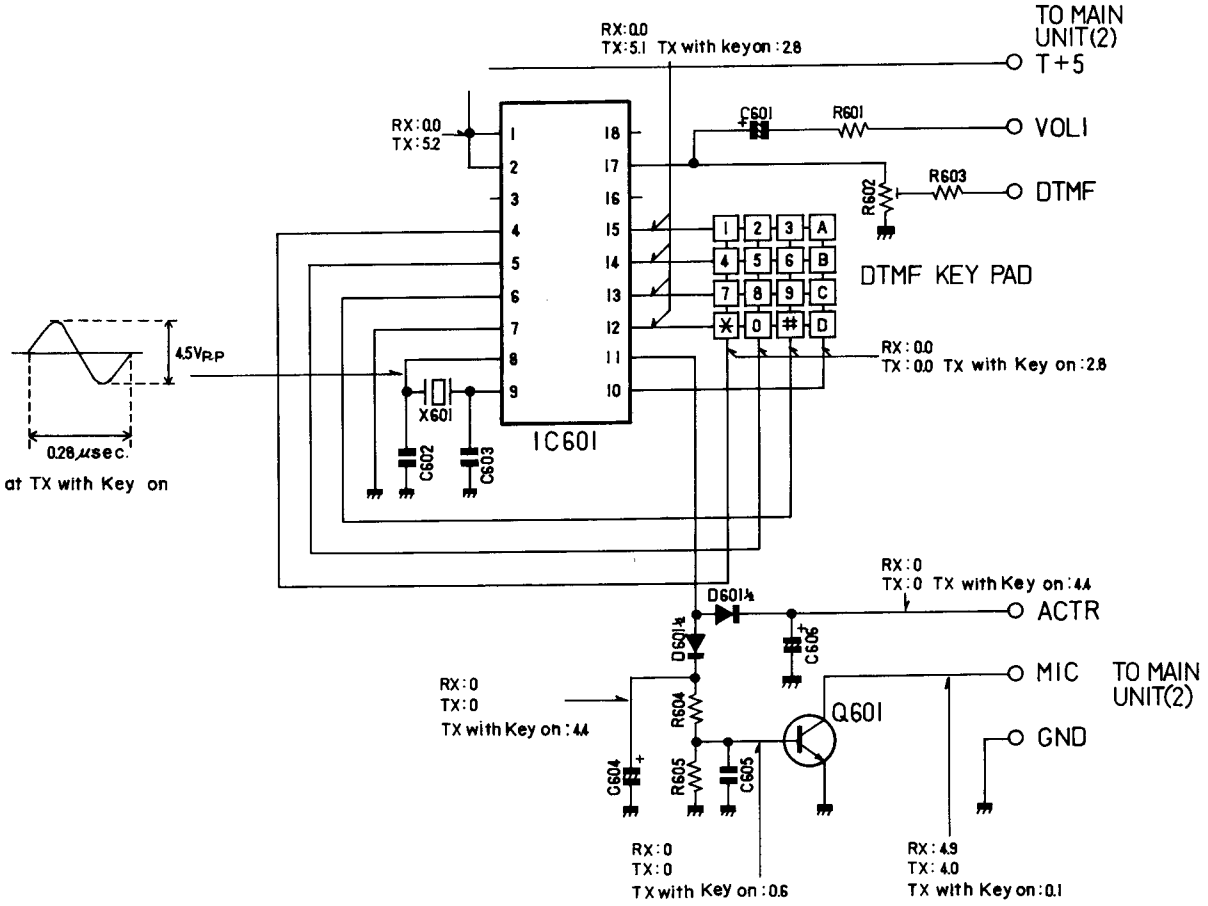


7-4 TONE UNIT AND DTMF UNIT [IC-μ2AT (#05 AND #09)]

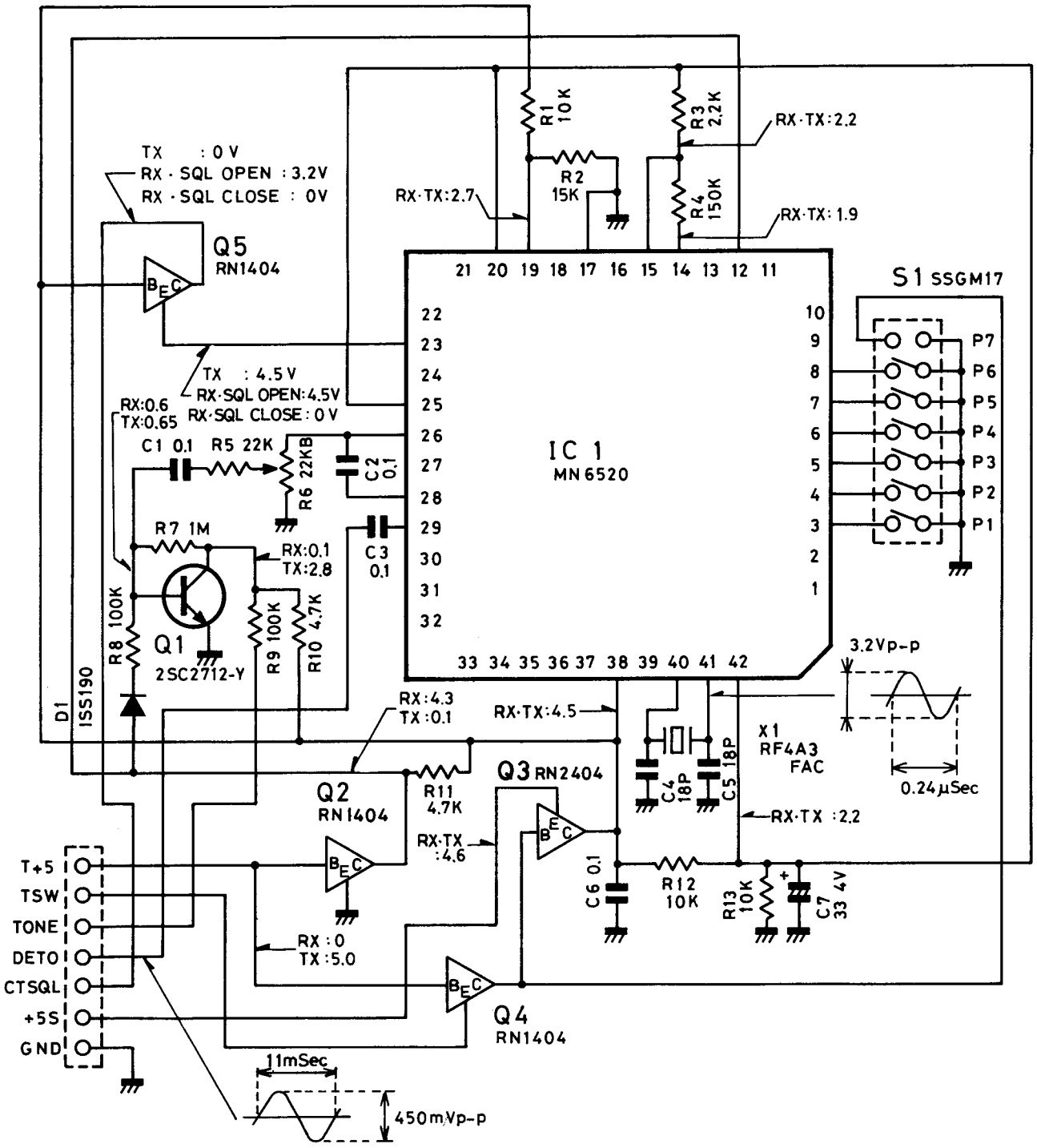
• TONE UNIT [IC-μ2AT (#05 AND #09)]



• DTMF UNIT [IC-μ2AT (#05 AND #09)]

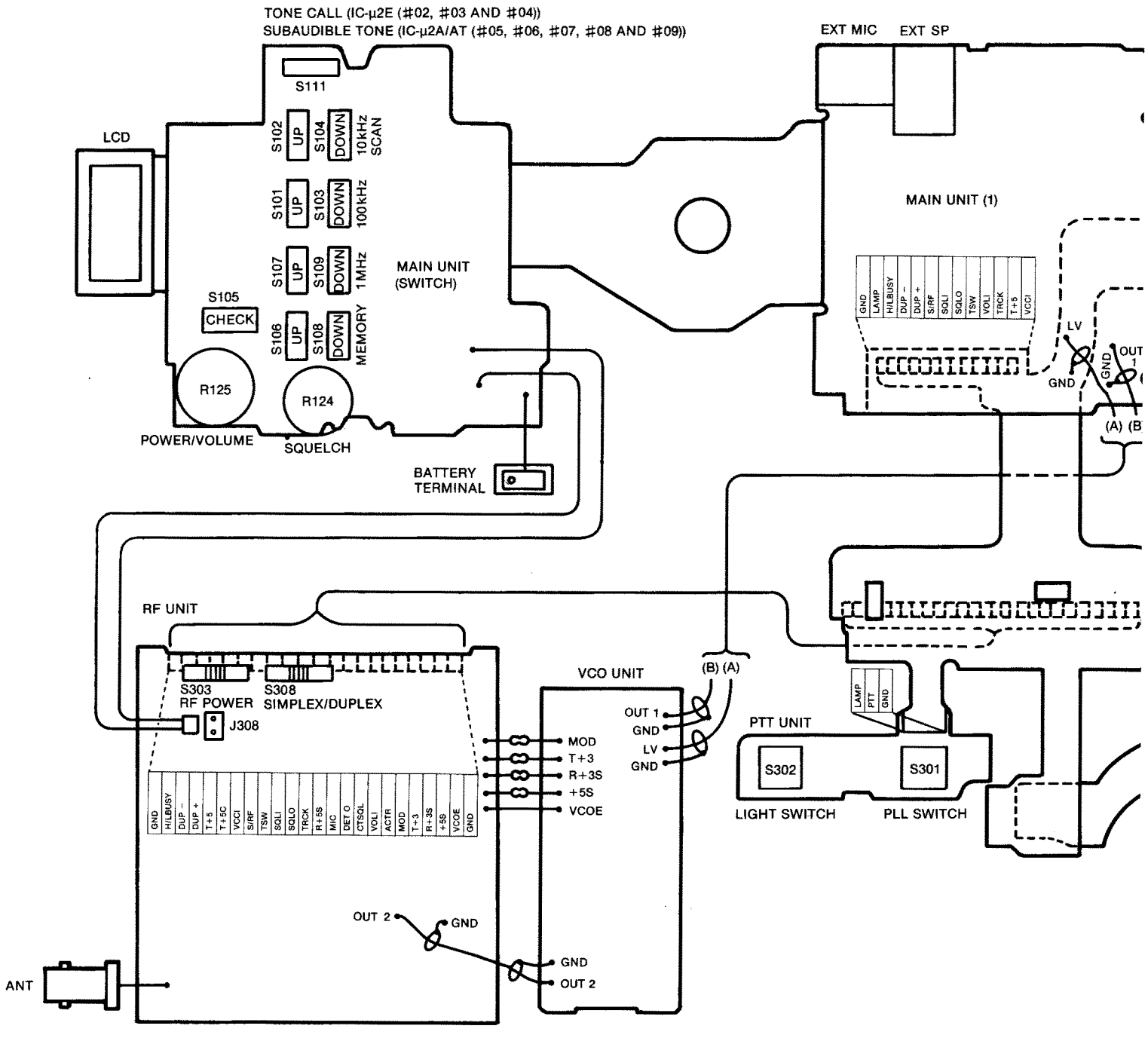


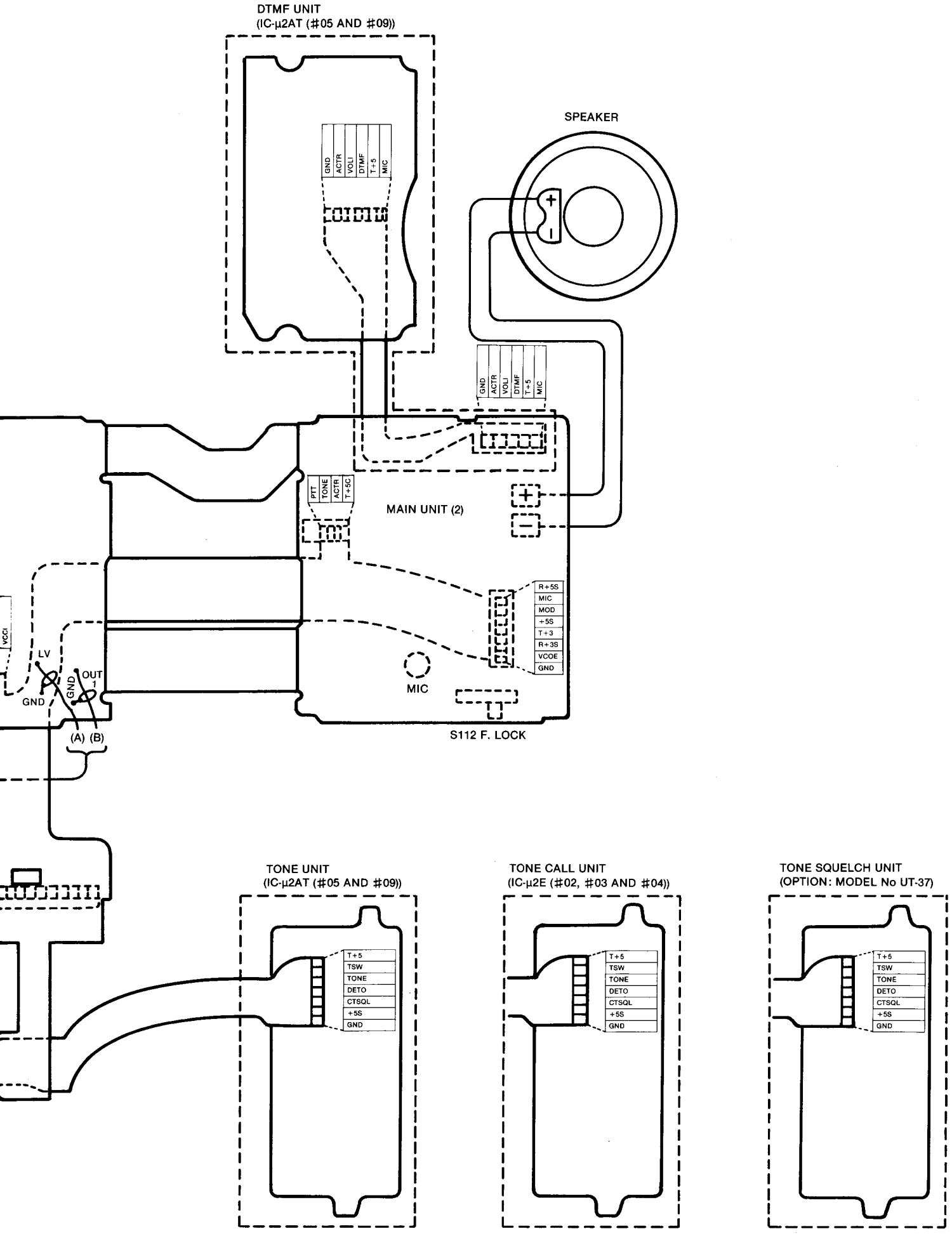
7-5 TONE SQUELCH UNIT (OPTION: MODEL No UT-37)



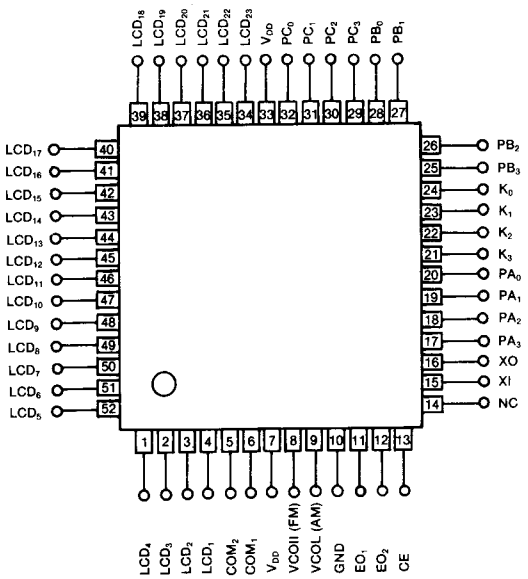
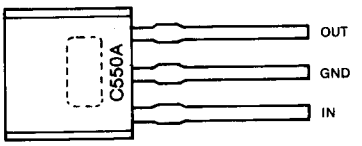
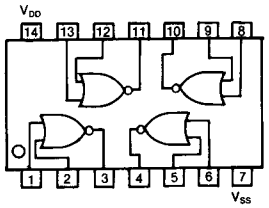
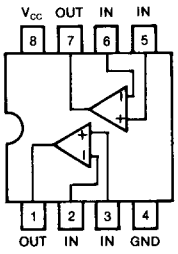
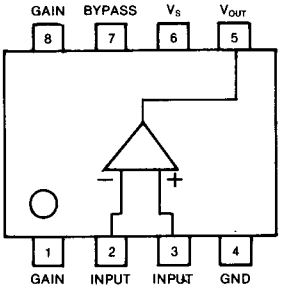
SECTION 8 BOARD LAYOUT

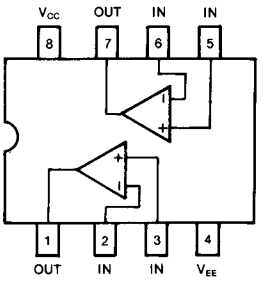
8-1 INTER CONNECTION



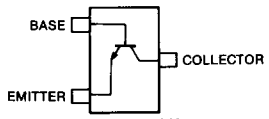
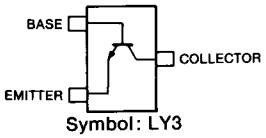
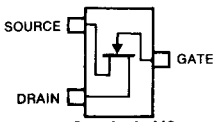
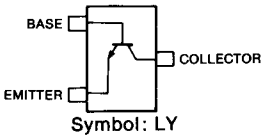
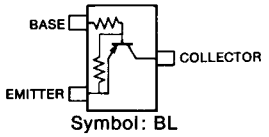
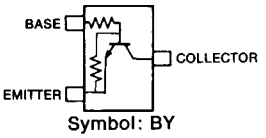
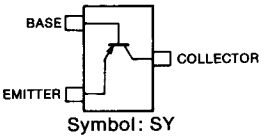
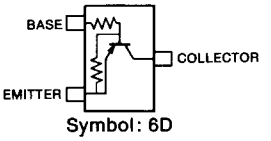
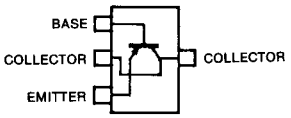

DTMF UNIT
(IC-μ2AT (#05 AND #09))
GND
ACTR
VOLI
DTMF
T+5
MIC
SPEAKER
+
-
GND
ACTR
VOLI
DTMF
T+5
MIC
PTT
TONE
ACTR
T+5G
MAIN UNIT (2)
R+5S
MIC
MOD
+5S
T+3
R+3S
VCOE
GND
VCCI
LV
GND
OUT
GND
(A) (B)
MIC
S112 F. LOCK
TONE UNIT
(IC-μ2AT (#05 AND #09))
T+5
TSW
TONE
DETO
CTSQL
+5S
GND
TONE CALL UNIT
(IC-μ2E (#02, #03 AND #04))
T+5
TSW
TONE
DETO
CTSQL
+5S
GND
TONE SQUELCH UNIT
(OPTION: MODEL No UT-37)
T+5
TSW
TONE
DETO
CTSQL
+5S
GND

8-2 MAIN UNIT

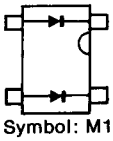
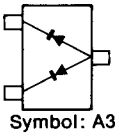
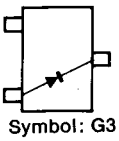
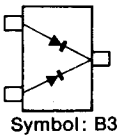
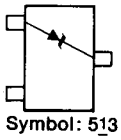
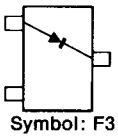
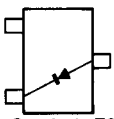
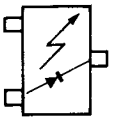
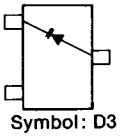
IC		
IC101	**μPD1708AG-675-00** (CPU)	
IC102	**LVC550A** (3 TERMINAL POSITIVE VOLTAGE REGULATOR)	
IC103	**LC4001BM** (QUAD 2-INPUT NOR GATE)	
IC104	**BA6993F** (DUAL COMPARATOR)	
IC105	**NJM386M** (AUDIO AMPLIFIER)	

IC106	**BA4558F** (DUAL OPERATION AMPLIFIER)	

TRANSISTORS

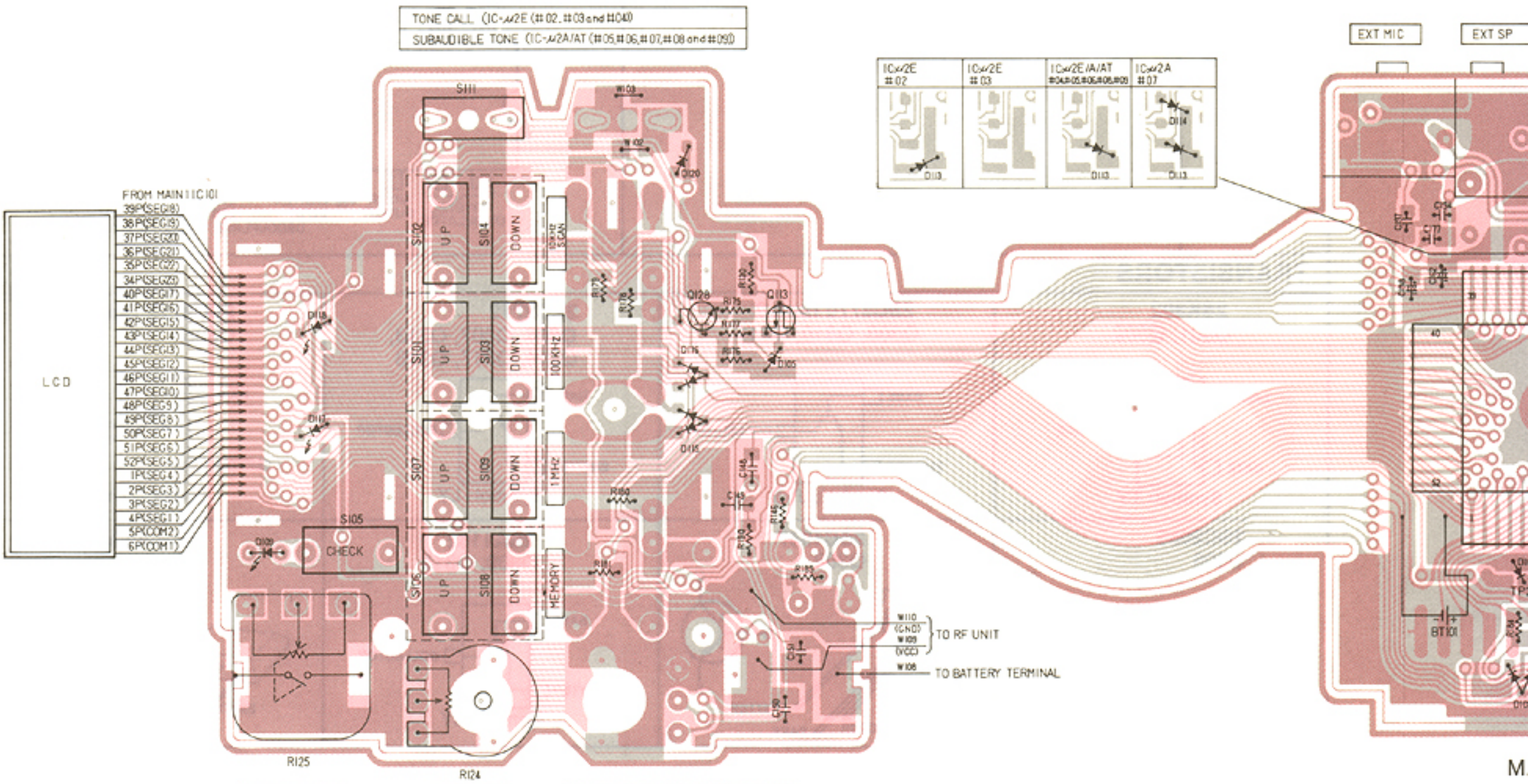
2SC3770 rank 3 Q101, Q102  Symbol: JY3	**2SC3772 rank 3** Q103  Symbol: LY3	**2SK209 rank O** Q104, Q106, Q113  Symbol: X∅	**2SC2712** Q105, Q110, Q112, Q118, Q119, Q120, Q127, Q128  Symbol: LY
2SA1341 Q107, Q129, Q130, Q131, Q132, Q133  Symbol: BL	**2SC3395** Q108, Q109, Q115, Q117  Symbol: BY	**2SA1162** Q111, Q114, Q116, Q122, Q124  Symbol: SY	**UN2114** Q123  Symbol: 6D
2SB798 Q126  Symbol: DL			

DIODES

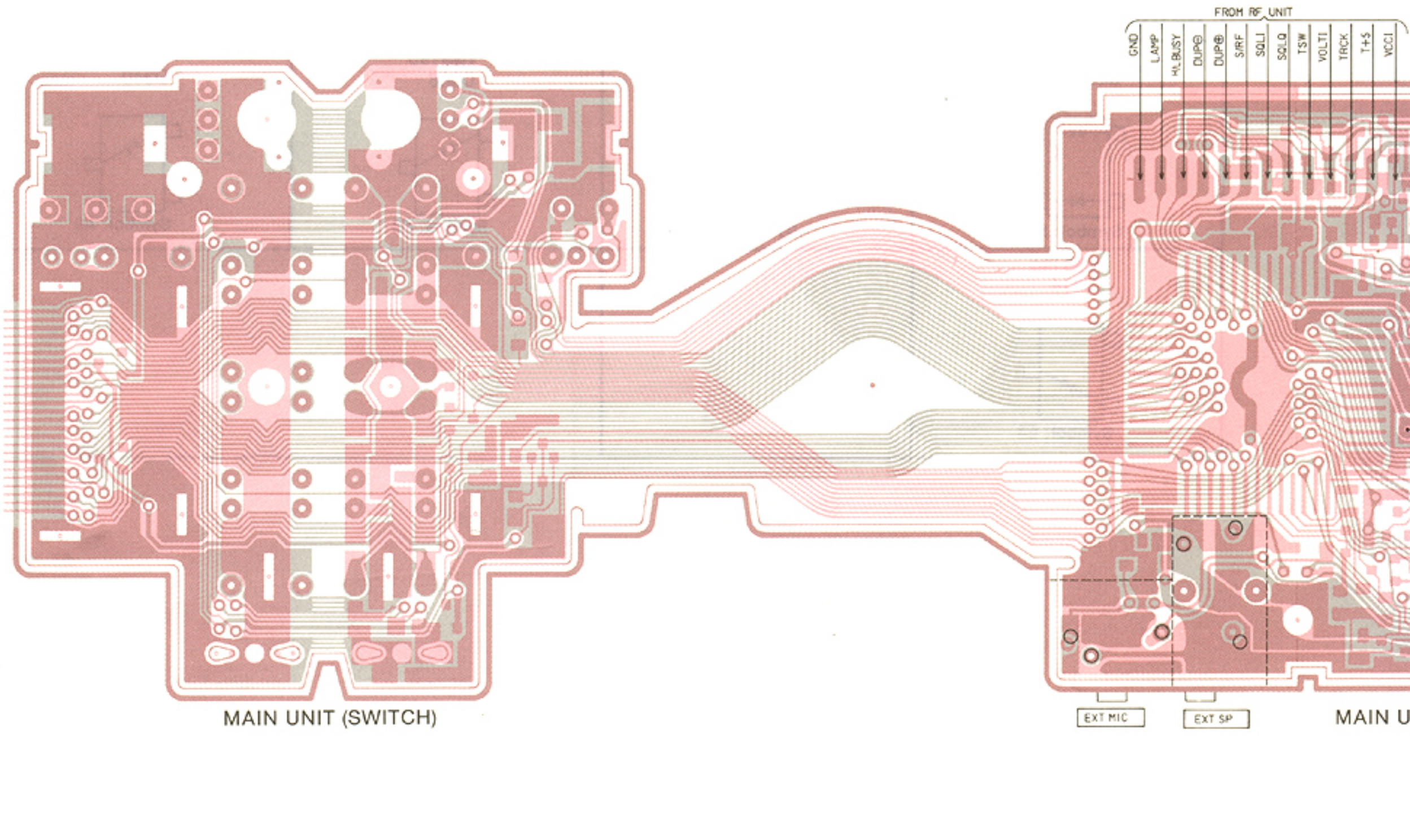
MA862 D101  Symbol: M1I	**1SS181** D102, D115, D116, D119, D123  Symbol: A3	**1SS196** D103, D108, D126  Symbol: G3	**1SS184** D104  Symbol: B3	**RD5. 1M B3** D105  Symbol: 513
1SS193 D106, D113, D114, D129  Symbol: F3	**1SS190** D107, D128  Symbol: E3	**SLM-13MW** D117, D118 	**1SS187** D120, D127  Symbol: D3	

• MAIN UNIT

CONPONENTS SIDE



FOIL SIDE



T MIC

EXT SP

IC-μ2E I/A
(#02,03, and #07)

IC-μ2A/AT
(#05,#06,#07,#08 and #09)

IC-μ2E
(#02, #03 and #04)

IC101

IC104

IC105

IC106

IC109

IC302

S112

BT101

TP1

TP2

FROM VCO UNIT (B)

FROM VCO UNIT (A)

F.LOCK

MAIN UNIT (1)

MAIN UNIT (2)

UNIT

SQLO

TSW

VOLT I

TRCK

T+5

VCC I

F.LOCK

S112

MIC

GND

VCOE

R+3S

T+3

+5S

MOD

MIC

R+5S

FROM RF UNIT

C200

W112

W111

TO SP101

FROM RF UNIT

T+5C

ACTR

TONE

PTT

MIC

T+5

DTMF

VOLT

ACTR

GND

(EP602)

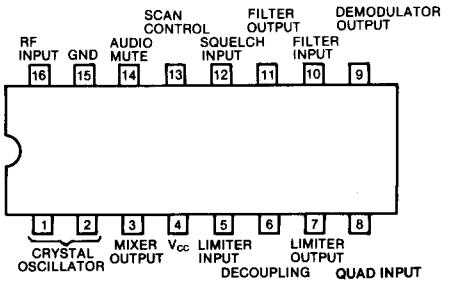
TO DTMF UNIT
IC-μ2AT
(#05 and #09)

MAIN UNIT (1)

MAIN UNIT (2)

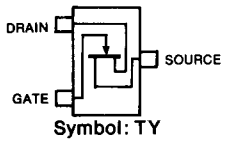
8-3 RF UNIT

IC

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

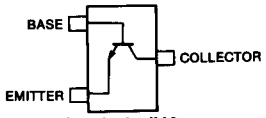
TRANSISTORS

2SK302
Q301, Q302



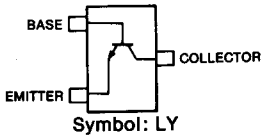
Symbol: TY

2SC3770 rank 3
Q303, Q310, Q311



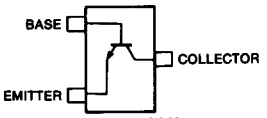
Symbol: JY3

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



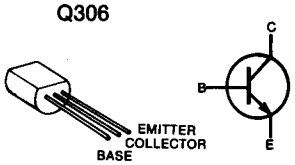
Symbol: LY

2SC3772 rank 3
Q305

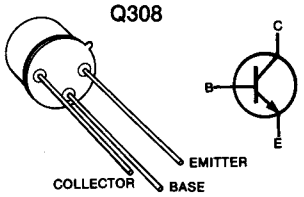


Symbol: LY3

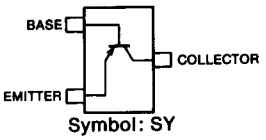
2SC2053
Q306



2SC1947
Q308

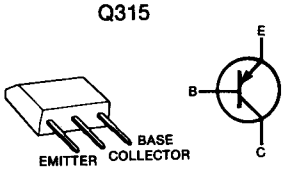


2SA1162
Q309, Q312

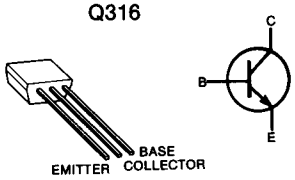


Symbol: SY

2SB909M
Q315

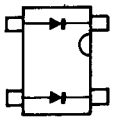


2SC2458
Q316

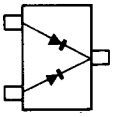


DIODES

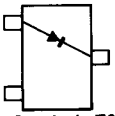
MA862
D305, D311


Symbol: M1I

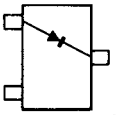
HSM88AS
D306, D312


Symbol: C1

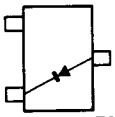
1SS193
D308


Symbol: F3

1SS153
D310

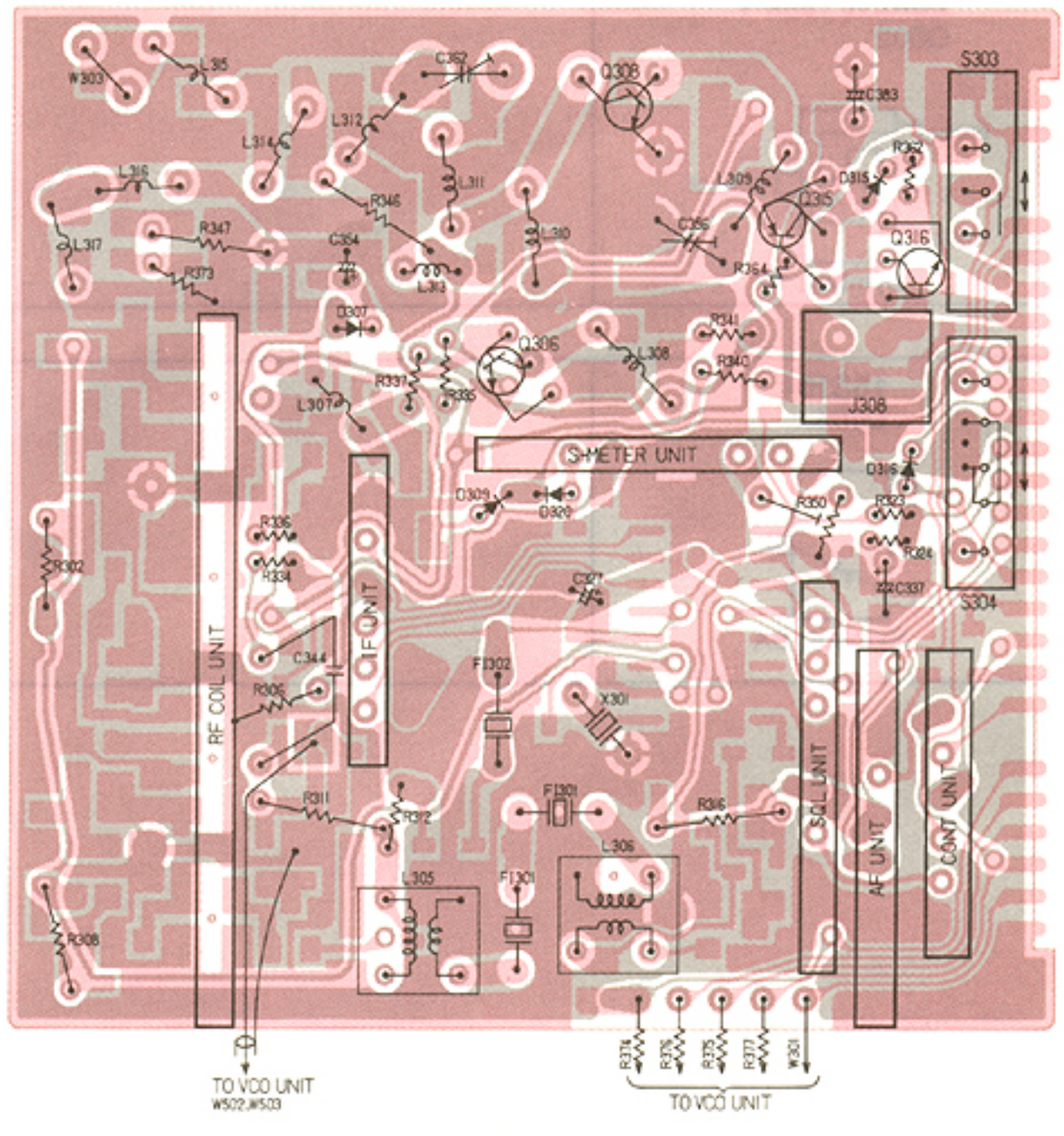

Symbol: A9

1SS190
D314

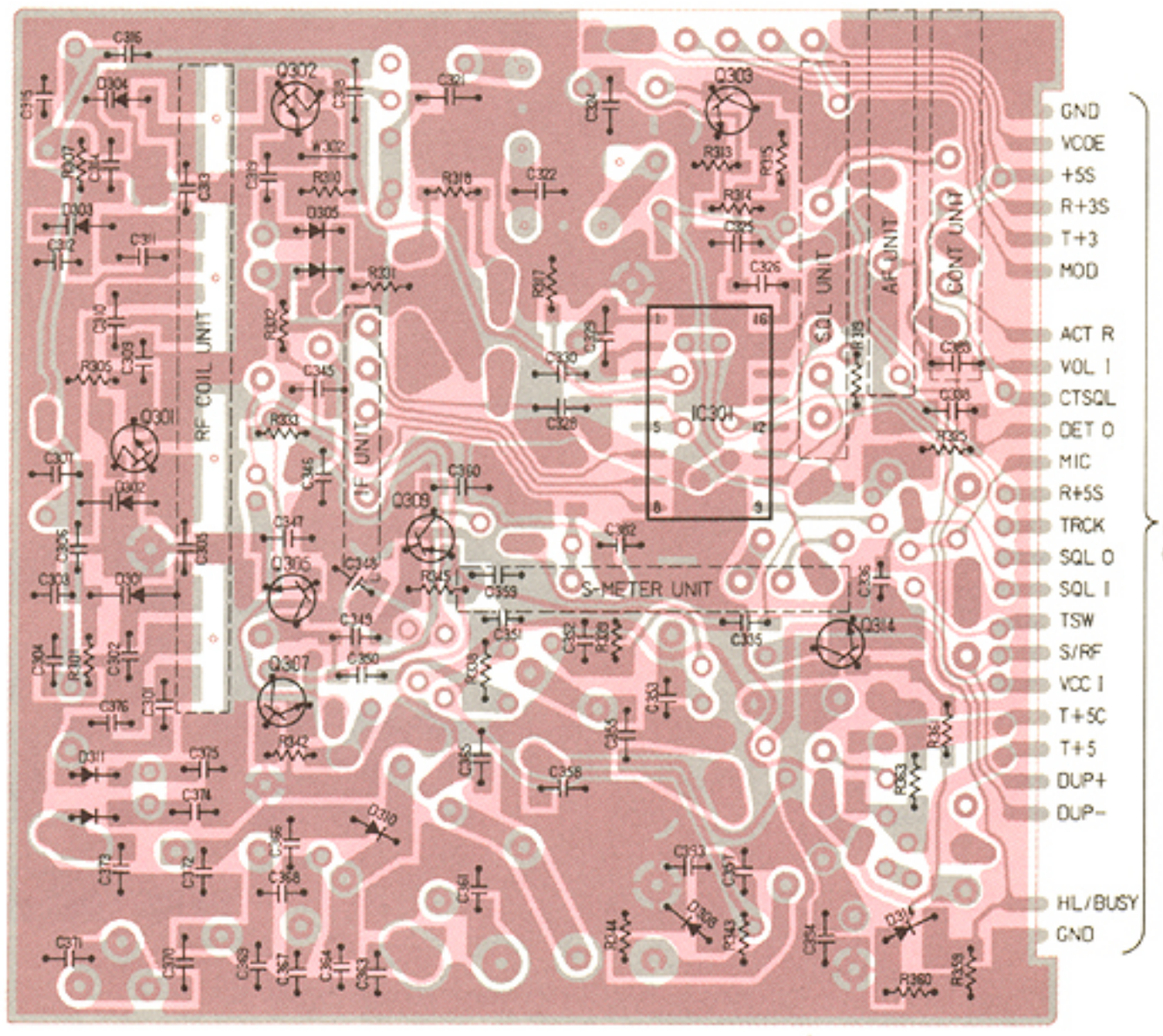

Symbol: E3

• RF UNIT

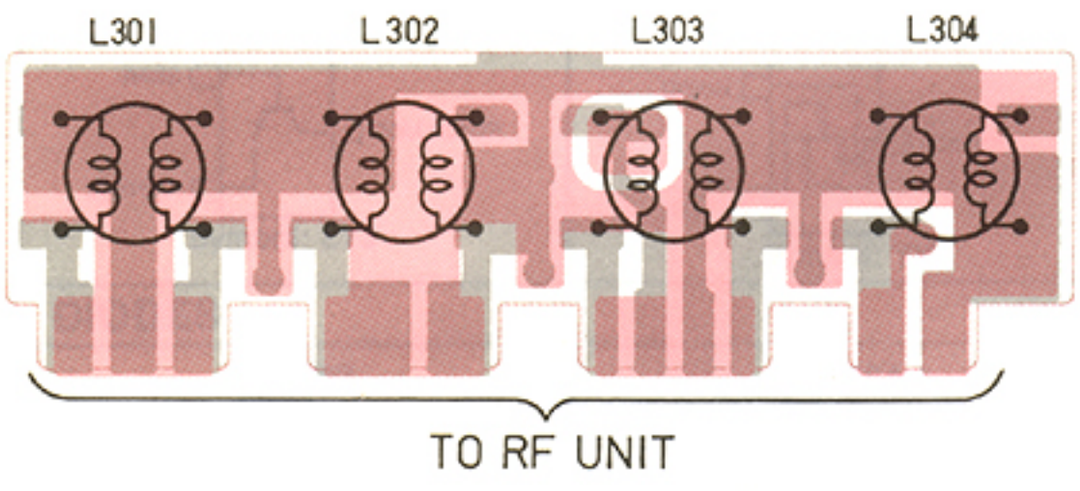
COMPONENTS SIDE



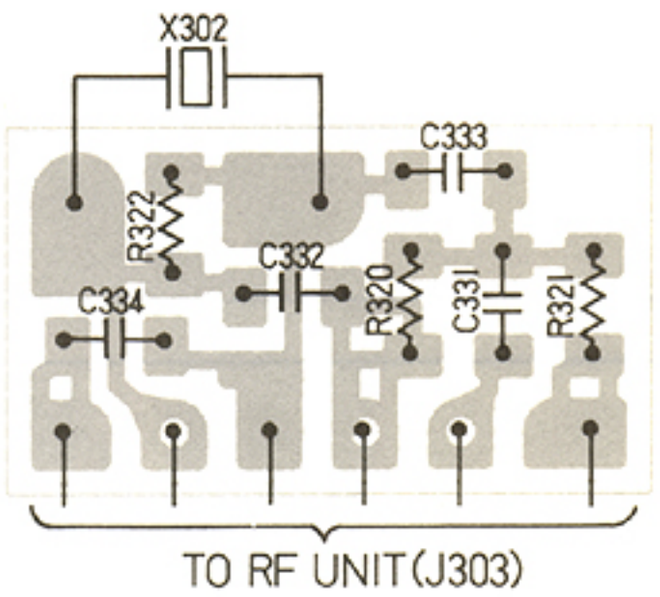
FOIL SIDE



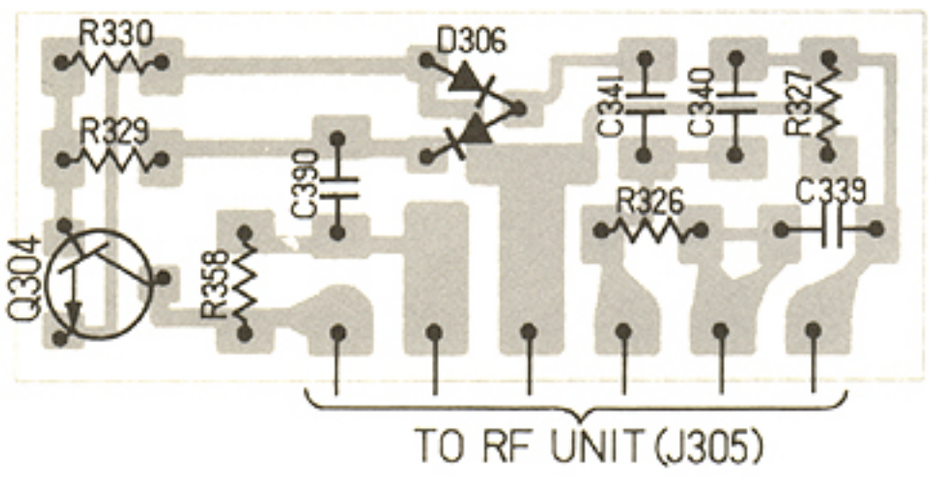
RF COIL UNIT



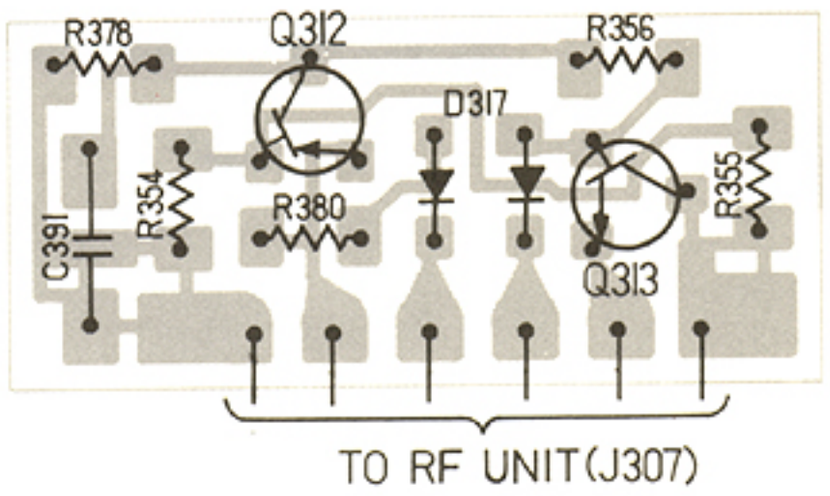
IF UNIT



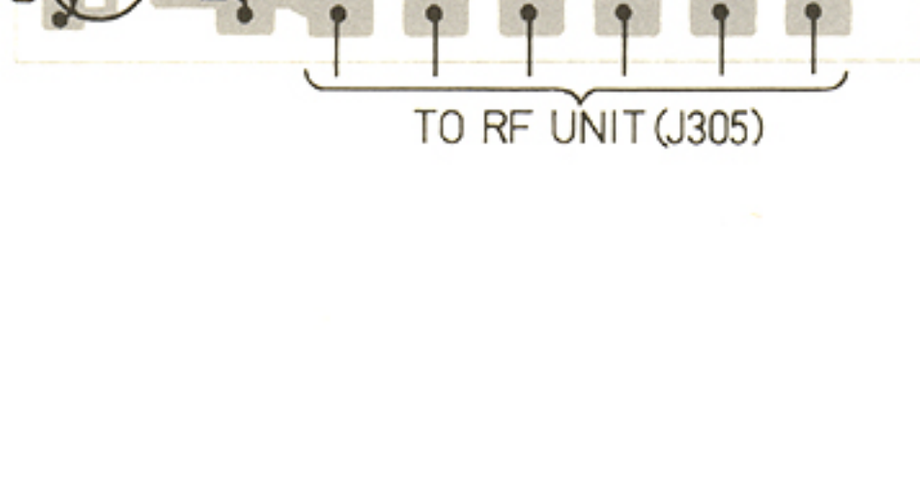
SQUELCH UNIT



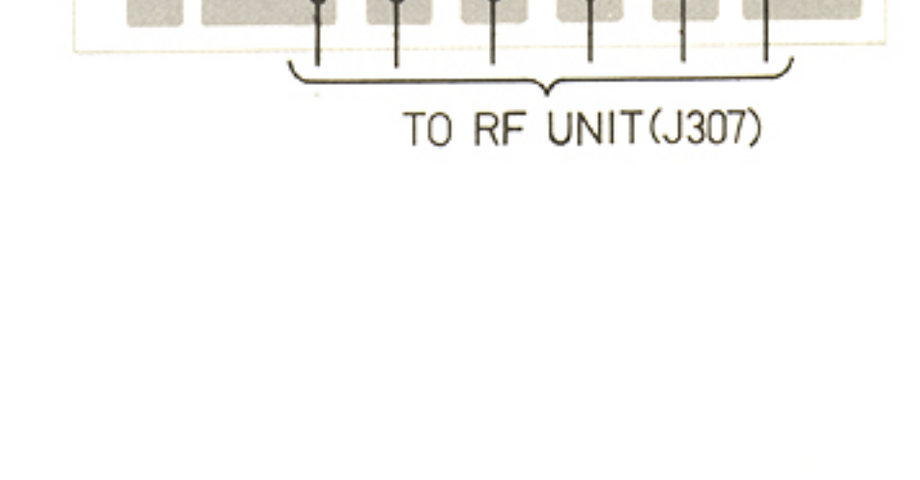
CONTROL UNIT



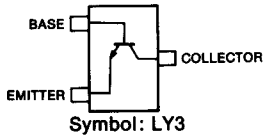
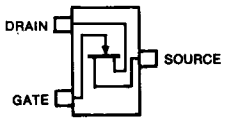
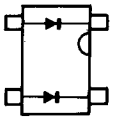
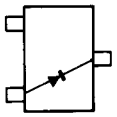
S-METER UNIT



AF UNIT

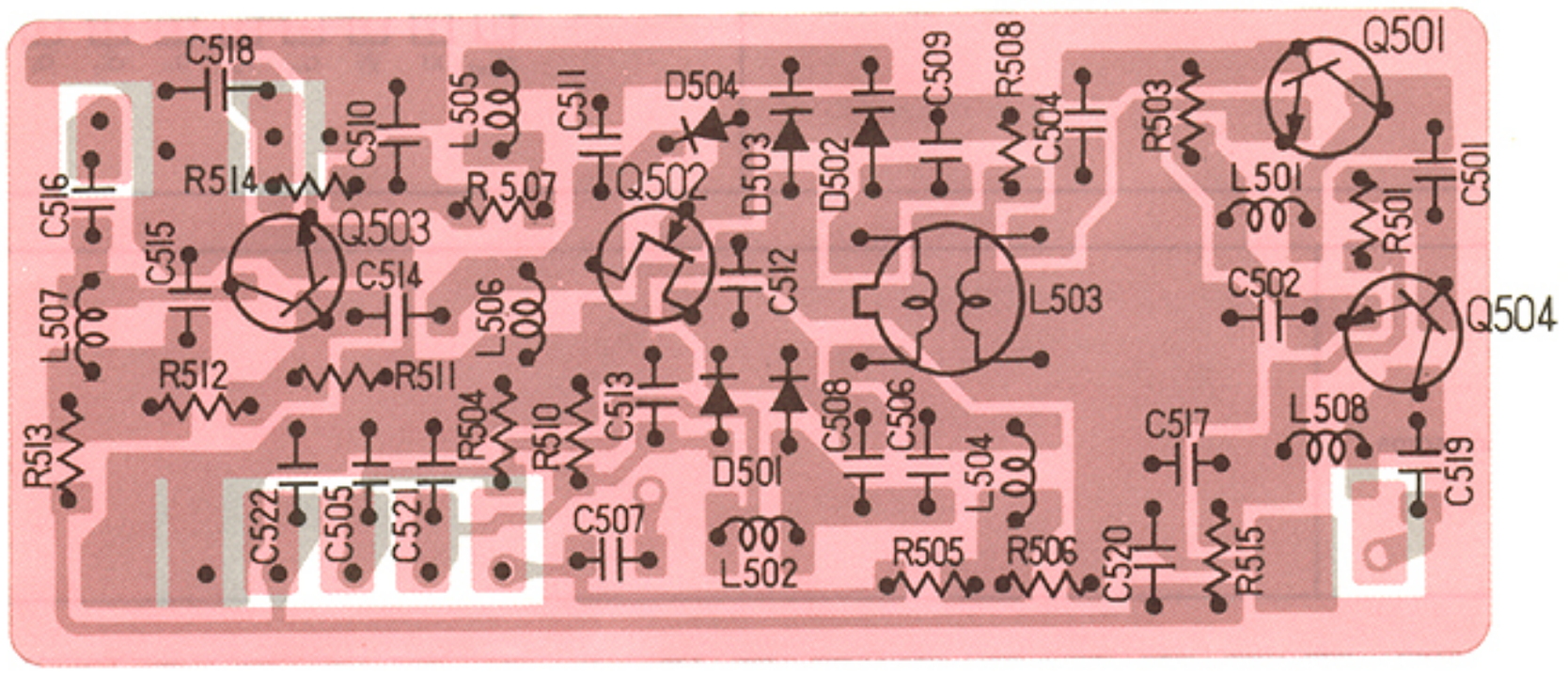


8-4 VCO UNIT

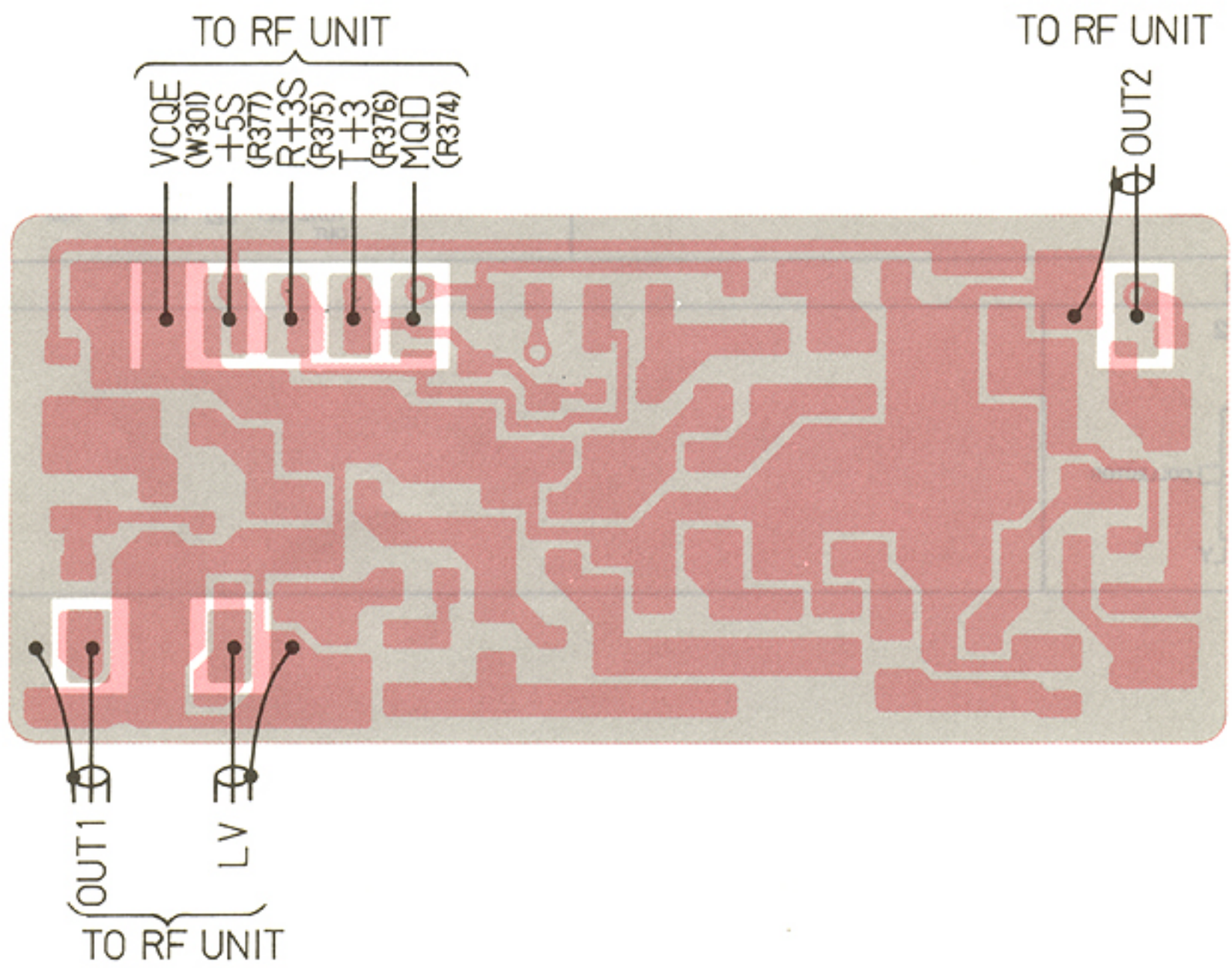
TRANSISTORS		
2SC3772 rank 3 Q501, Q503, Q504  Symbol: LY3	**2SK210 rank Y** Q502  Symbol: YY	
DIODES		
MA862 D501  Symbol: M1I	**1SS154** D504  Symbol: BA	

• VCO UNIT

COMPONENTS SIDE



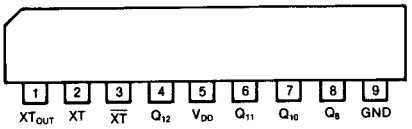
FOIL SIDE



8-5 TONE CALL UNIT [IC-μ2E (#02, #03 AND #04)]

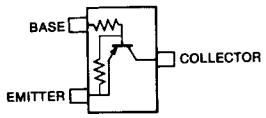
• TONE CALL UNIT [IC-μ2E (#02, #03 AND #04)]

IC

IC801	**TC5082P** (OSCILLATOR AND 12 STAGE DIVIDER)	

TRANSISTOR

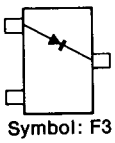
RN2404
Q801



Symbol: YD

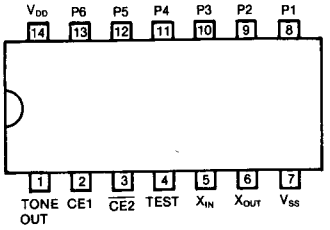
DIODE

1SS193
D801


Symbol: F3

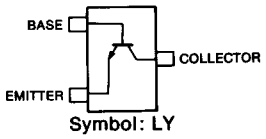
• TONE UNIT [IC-μ2AT (#05 AND #09)]

IC

IC701	**S7116A** (PROGRAMMABLE TONE GENERATOR)	

TRANSISTOR

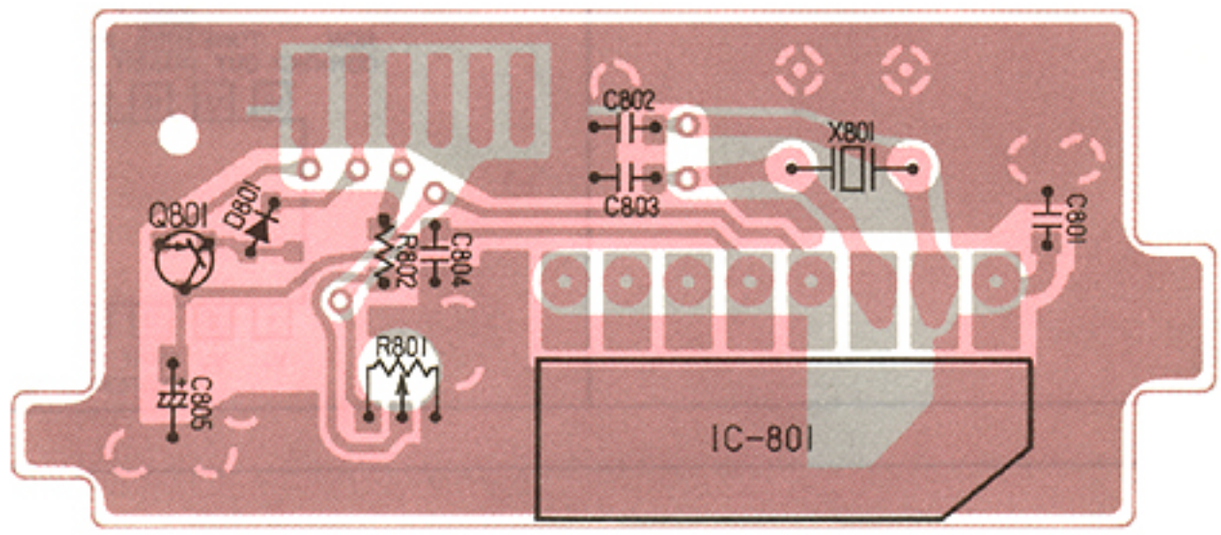
2SC2712
Q701



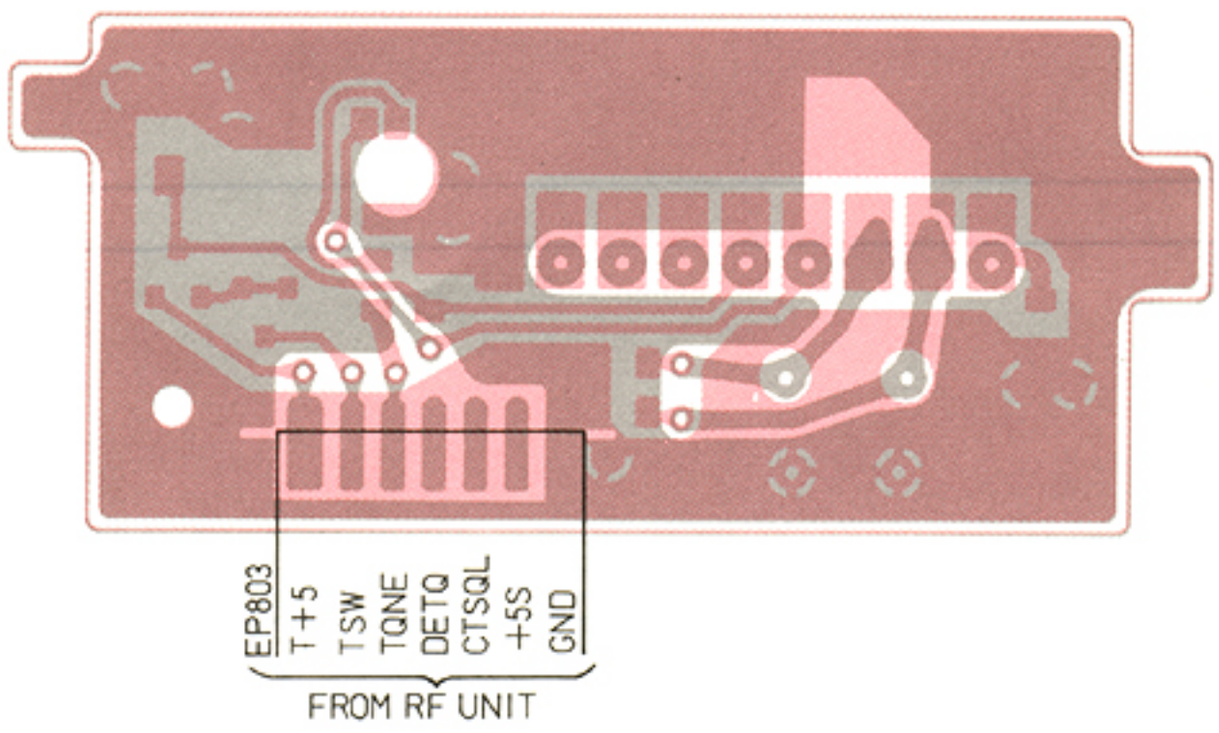
Symbol: LY

• TONE CALL UNIT [IC-μ2E (#02, #03 AND #04)]

COMPONENTS SIDE

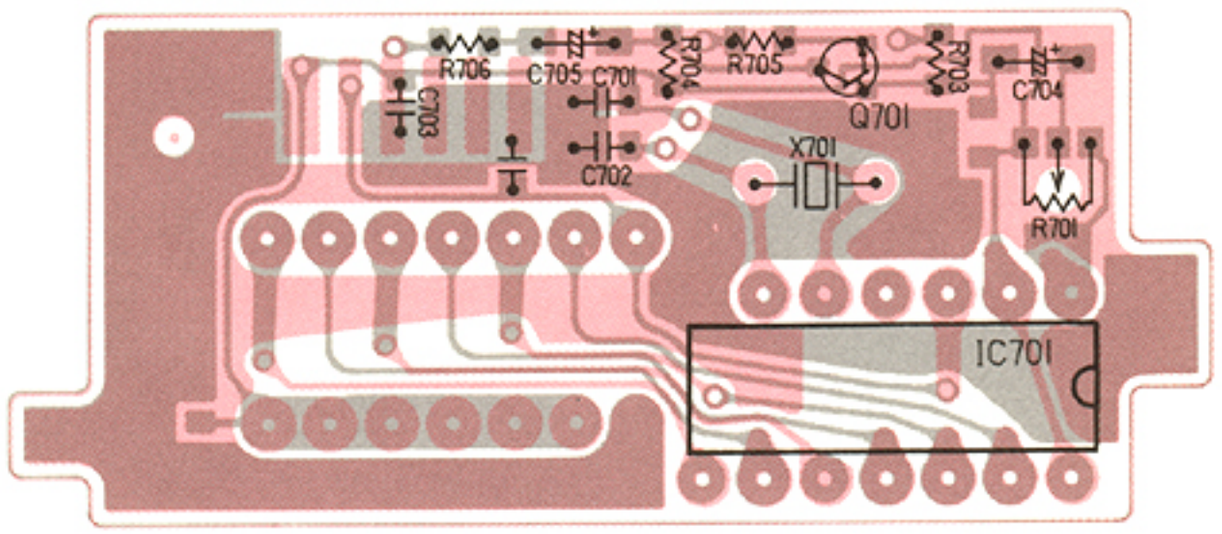


FOIL SIDE

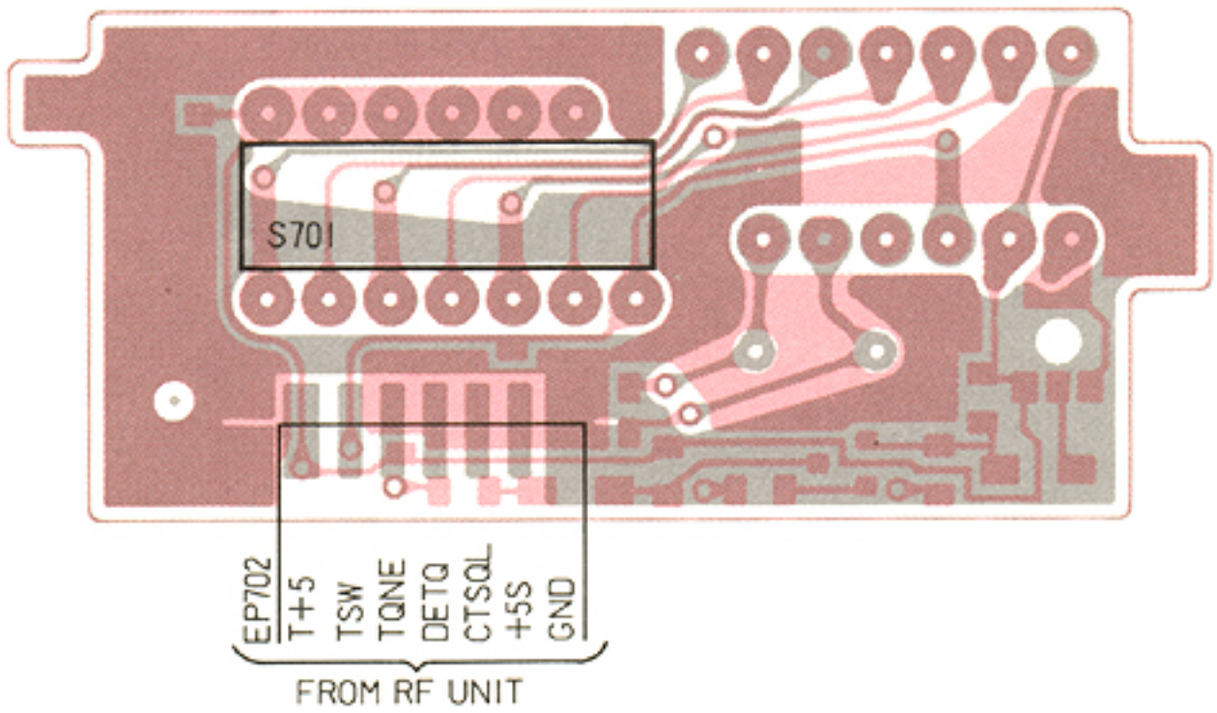


• TONE UNIT [IC-μ2AT (#05 AND #09)]

COMPONENTS SIDE



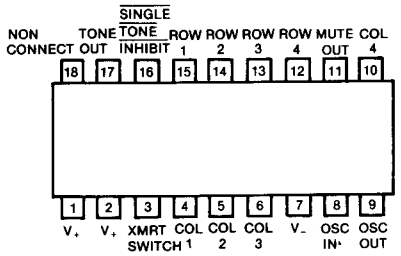
FOIL SIDE



8-6 DTME UNIT [IC-μ2AT (#05 AND #09)]

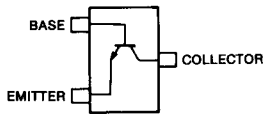
PTT UNIT

IC

IC601	LR40872 (TONE DIARING)	

TRANSISTOR

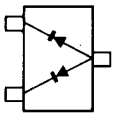
2SC2712
Q601



Symbol: LY

DIODE

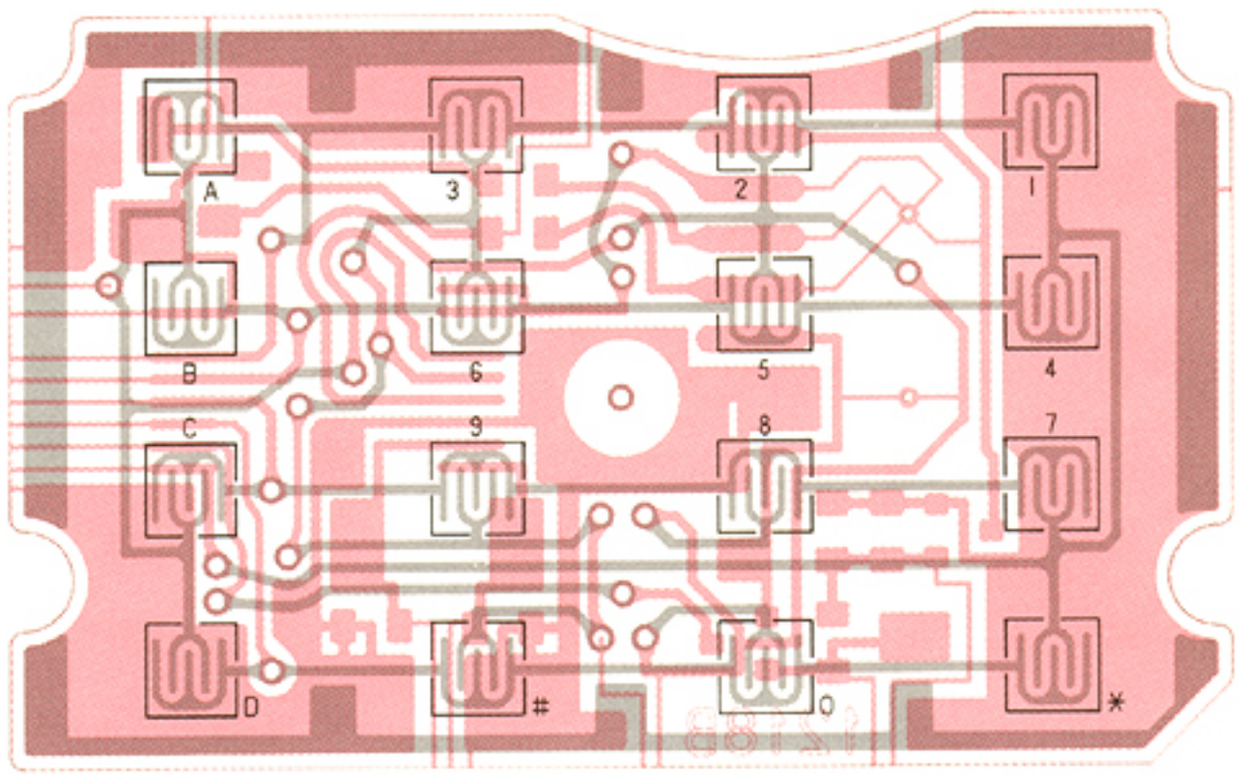
1SS181
D601



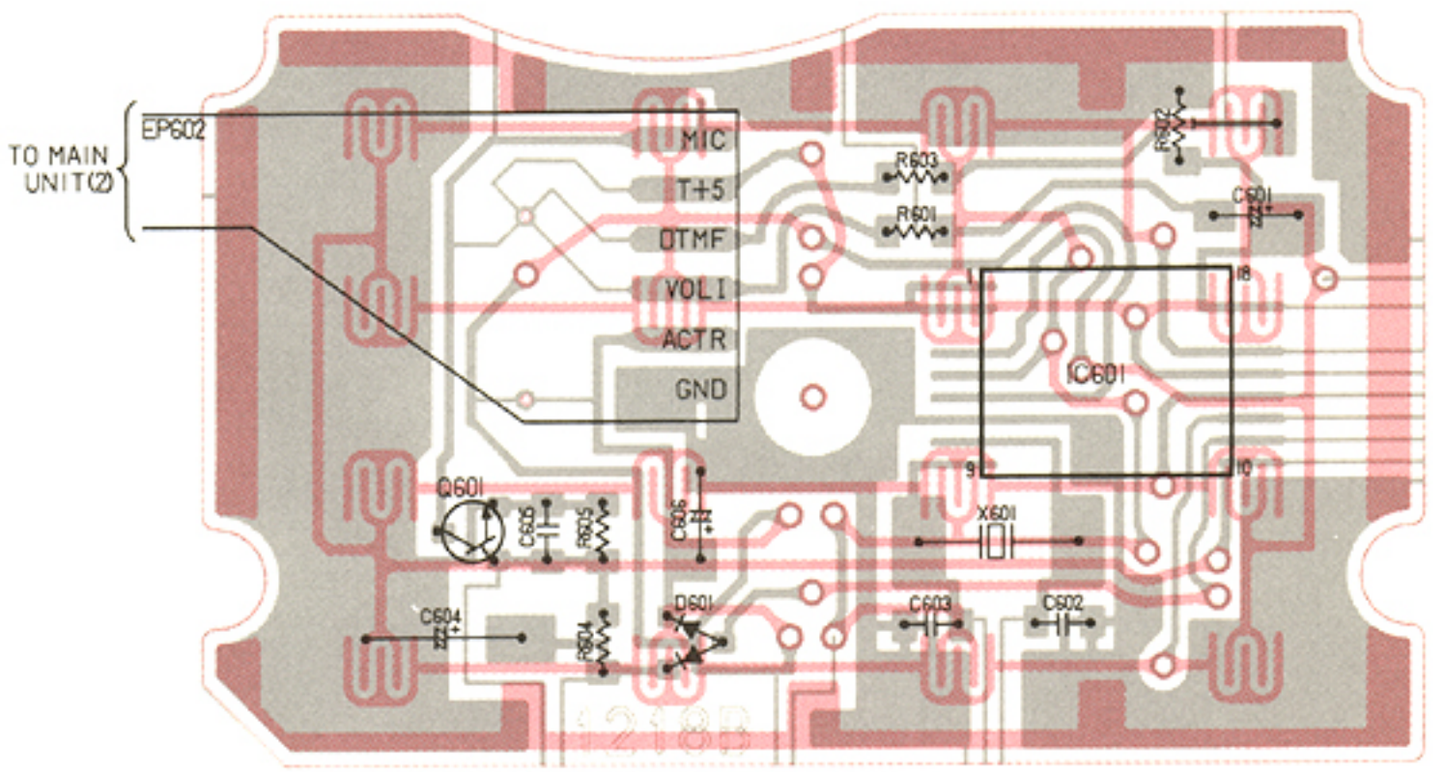
Symbol: A3

• DTMF UNIT [IC-μ2AT (#05 AND #09)]

FOIL SIDE



COMPONENTS SIDE



• PTT UNIT

SECTION 9 PARTS LIST

[MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.
IC101	IC	μPD1708AG-675-00
IC102	IC	LVC550A
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	2SA1341
Q133	Transistor	2SA1341
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
D112	Diode	1SS211 (#02, #03, #07 only)
D113	Diode	1SS193 (except #03)
D114	Diode	1SS193 (#07 only)
D115	Diode	1SS181
D116	Diode	1SS181
D117	LED	SLM-13MW

[MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.	
D118	LED	SLM-13MW	
D119	Diode	1SS181	
D120	Diode	1SS187	
D123	Diode	1SS181	
D126	Diode	1SS196	
D127	Diode	1SS187	
D128	Diode	1SS190	
D129	Diode	1SS193	
X101	Crystal	CR178	
X102	Crystal	CR179	
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	4.7k	MCR10
R127	Chip	3.3k	MCR10
R128	Chip	3.9k	MCR10
R129	Chip	2.2k	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

[MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.
R140	Chip	4.7k MCR10
R141	Chip	4.7k MCR10
R142	Chip	270k MCR10
R143	Chip	330k MCR10
R144	Chip	100k MCR10
R146	Chip	330 MCR10
R147	Chip	470k MCR10
R148	Chip	47k MCR10
R149	Chip	4.7k MCR10
R150	Chip	100k MCR10
R151	Chip	1M MCR10
R152	Chip	470k MCR10
R153	Chip	220k MCR10
R154	Chip	100k MCR10
R155	Chip	47k MCR10
R156	Chip	33k MCR10
R157	Chip	1.2k MCR10
R158	Chip	1.2k MCR10
R160	Chip	47k MCR10
R161	Chip	47k MCR10
R162	Chip	180k MCR10
R163	Chip	270k MCR10
R164	Chip	180k MCR10
R165	Chip	120 MCR10 (#02, #03, #04, #07, #08, #09 only)
		270 MCR10 (#05, #06 only)
R166	Chip	1k MCR10
R167	Chip	180k MCR10
R168	Chip	270k MCR10
R169	Chip	12k MCR10
R170	Chip	82k MCR10
R171	Chip	82k MCR10
R172	Chip	270k MCR10
R173	Chip	100k 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	220k MCR10
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
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

[MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.
C112	Monolithic	0.001 GRM40
C113	Monolithic	0.001 GRM40
C114	Monolithic	GRM40 UJ 220J 50PT
C115	Monolithic	GRM40 UJ 560J 50PT
C116	Monolithic	10P GRM40
C117	Monolithic	0.001 GRM40
C118	Monolithic	2P GRM40
C119	Monolithic	8P 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
C154	Monolithic	470P GRM40
C155	Tantalum	TESVB20G106M8L 4V 10
C156	Tantalum	TESVB20G106M8L 4V 10
C157	Monolithic	470P GRM40
C160	Tantalum	TESVB20J685M8L 6.3V 6.8
C161	Monolithic	470P GRM40
C162	Tantalum	TESVB20J685M8L 6.3V 6.8
C163	Tantalum	TESVB20J685M8L 6.3V 6.8
C165	Monolithic	0.001 GRM40
C166	Monolithic	0.001 GRM40
C168	Monolithic	10P GRM40
C169	Monolithic	15P GRM40
C170	Monolithic	470P GRM40
C171	Monolithic	GRM42-6 B 153K 50PT
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	0.0047 GRM40
C182	Monolithic	GRM40 B 103K 25PT
C183	Monolithic	0.001 GRM40
C184	Tantalum	TESVB20J685M8L 6.3V 6.8
C185	Tantalum	TESVA1V224K1-8L (#02, #03, #04, #07, #08, #09 only) TESVA1V104K1-8L (#05, #06 only)
C186	Monolithic	470P GRM40
C187	Monolithic	470P GRM40
C188	Monolithic	GRM42-6 SL 222J 50PT

[MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.
C189	Monolithic	120P GRM40
C190	Monolithic	GRM40 SL 102J 50PT
C191	Monolithic	GRM42-6 SL 222J 50PT
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	DSB1A226M1S 10V 22
C199	Monolithic	0.1 GRM40 F
C200	Ceramic	470P 50V
J101	Connector	HSJ0836-01-010
J102	Connector	HSJ1102-01-040
P101	Connector	02DR-E8M
DS101	LCD	LP241-E
MC101	Microphone	EM-78B3
S101	Switch	SKHLAD [UP (100kHz)]
S102	Switch	SKHLAD [UP (10kHz)]
S103	Switch	SKHLAD [DOWN (100kHz)]
S104	Switch	SKHLAD [DOWN (10kHz)]
S105	Switch	SKHLAD [CHECK]
S106	Switch	SKHLAD [UP (MEMORY)]
S107	Switch	SKHLAD [UP (1MHz)]
S108	Switch	SKHLAD [DOWN (MEMORY)]
S109	Switch	SKHLAD [DOWN (1MHz)]
S111	Switch	SKHLAD [TONE CALL] (#02, #03, #04 only) SSSS31 [SUBAUDIBLE TONE] (#05, #06, #08, #09 only)
S112	Switch	SSSJ31 (B) [F. LOCK]
SP101	Speaker	Si36D04
BT101	Litihum Battery	CR1220-1VF
EP101	F.P.C. Board	B-1200 D
EP102	F.P.C. Board	B-1212 D
W102	Jumper	MCR10-JPW
W103	Jumper	MCR10-JPW
W104	Jumper	MCR10-JPW

[MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.
W106	Jumper	MCR10-JPW (#02, #03, #04 only)
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
Q309	Transistor	2SA1162 GR
Q310	Transistor	2SC3770 3
Q311	Transistor	2SC3770 3
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
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
D309	Diode	1SS211
D310	Diode	1SS153
D311	Diode	MA862
D312	Diode	HSM88AS
D314	Diode	1SS190
D315	Diode	1SS211
D316	Diode	1SS211 (#02, #03, #04 only)
D317	Diode	MA159
D320	Diode	1SS211
FI301	Crystal	16M15B4
FI302	Ceramic	CFUM455E
X301	Crystal	CR177
X302	Ceramic Resonator	CDB455C7A
L301	Coil	LB-194
L302	Coil	LB-195
L303	Coil	LB-205
L304	Coil	LB-194
L305	Coil	LS-262
L306	Coil	LS-262
L307	Coil	LA-236
L308	Coil	LA-236
L309	Coil	LA-234
L310	Coil	LA-235
L311	Coil	LA-235
L312	Coil	LA-234
L313	Coil	LAL02NA 1R8K

[RF UNIT]

REF. NO.	DESCRIPTION	PART NO.	
L314	Coil	LA-234	
L315	Coil	LA-235	
L316	Coil	LA-234	
L317	Coil	LA-234	
R301	Chip	100k	MCR10
R302	Resistor	100k	R20
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	470	ELR20
R313	Chip	22k	MCR10
R314	Chip	47k	MCR10
R315	Chip	1.5k	MCR10
R316	Resistor	2.2k	R20
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
R325	Chip	27k	MCR10
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	470	MCR10
R334	Resistor	470	ELR20
R335	Resistor	82	ELR20
R336	Resistor	47	ELR20
R337	Resistor	47	ELR20
R338	Chip	47	MCR10
R339	Chip	220	MCR10
R340	Resistor	2.2	ELR20
R341	Resistor	4.7	ELR20
R342	Chip	10k	MCR10
R343	Chip	22	MCR10
R344	Chip	150	MCR10
R345	Chip	1M	MCR10
R346	Resistor	15k	R20
R347	Resistor	330	R20
R348	Chip	33k	MCR10
R349	Chip	560k	MCR10
R350	Trimmer	RH0521CJ4J06A	22k
R351	Chip	680k	MCR10
R352	Chip	10k	MCR10
R353	Chip	330k	MCR10
R354	Chip	100k	MCR10
R355	Chip	68k	MCR10
R356	Chip	150k	MCR10
R358	Chip	10k	MCR10
R359	Chip	330k	MCR10
R360	Chip	100k	MCR10
R361	Chip	2.2k	MCR10
R362	Resistor	2.2k	ELR20
R363	Chip	2.2k	MCR10

[RF UNIT]

REF. NO.	DESCRIPTION	PART NO.	
R364	Resistor	2.2	ELR20
R365	Chip	15k	MCR10
R366	Chip	330k	MCR10
R367	Chip	150k	MCR10
R368	Chip	4.7k	MCR10
R369	Chip	2.2k	MCR10
R370	Chip	39k	MCR10
R371	Chip	39k	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
C301	Monolithic	100P	GRM40
C302	Monolithic	2P	GRM40
C303	Monolithic	47P	GRM40
C304	Monolithic	0.001	GRM40
C305	Monolithic	1P	GRM40
C306	Monolithic	27P	GRM40
C307	Monolithic	47P	GRM40
C309	Monolithic	470P	GRM40
C310	Monolithic	470P	GRM40
C311	Monolithic	7P	GRM40
C312	Monolithic	47P	GRM40
C313	Monolithic	0.5P	GRM40
C314	Monolithic	7P	GRM40
C315	Monolithic	0.001	GRM40
C316	Monolithic	47P	GRM40
C318	Monolithic	47P	GRM40
C319	Monolithic	0.001	GRM40
C321	Monolithic	0.001	GRM40
C322	Monolithic	4P	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	27P	GRM40
C330	Monolithic	56P	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	DN1V0R1K1S 35V 0.1	
C338	Monolithic	GRM40 B 223K 25PT	
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
C349	Monolithic	3P	GRM40
C350	Monolithic	15P	GRM40
C351	Monolithic	0.001	GRM40
C352	Monolithic	0.001	GRM40

[RF UNIT]

REF. NO.	DESCRIPTION	PART NO.	
C353	Monolithic	0.001	GRM40
C354	Electrolytic	4.7	16V MS5
C355	Monolithic	7P	GRM40
C356	Trimmer	ECR-GA020E30	
C357	Monolithic	0.001	GRM40
C358	Monolithic	0.001	GRM40
C359	Monolithic	0.001	GRM40
C360	Monolithic	0.001	GRM40
C361	Monolithic	7P	GRM40
C362	Trimmer	ECR-GA035M30	
C363	Monolithic	15P	GRM40
C364	Monolithic	15P	GRM40
C365	Monolithic	0.001	GRM40
C366	Monolithic	0.001	GRM40
C367	Monolithic	12P	GRM40
C368	Monolithic	12P	GRM40
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
C377	Monolithic	15P	GRM40
C378	Monolithic	470P	GRM40
C379	Monolithic	470P	GRM40
C380	Monolithic	0.1	GRM40 F
C381	Tantalum	TESVA1V224M1-8L 35V 0.22	
C382	Monolithic	0.1	GRM40 F
C383	Electrolytic	47	16V MS5
C384	Monolithic	GRM40 B 103K 50PT	
C385	Monolithic	GRM40 B 103K 50PT	
C386	Monolithic	0.0022	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	
C393	Monolithic	0.1	GRM40 F
C394	Monolithic	0.1	GRM40 F
J301	Connector	BNC-RM-107	
J302	Connector	07FM-ST	
J303	Connector	50002-8106	
J304	Connector	50002-8105	
J305	Connector	50002-8106	
J306	Connector	50002-8107	
J307	Connector	50002-8106	
J308	Connector	B02-DR	
S301	Switch	SKHMPD [PTT]	
S302	Switch	SKHMPD [LIGHT]	
S303	Switch	SSSS31 [RF POWER]	
S304	Switch	SSSS31 [SIMPLEX/DUPLEX]	
EP301	P.C. Board	B-1198D	
EP302	P.C. Board	B-1223B	

[RF UNIT]

REF. NO.	DESCRIPTION	PART NO.
EP303	P.C. Board	B-1224B
EP304	P.C. Board	B-1225B
EP305	P.C. Board	B-1226B
EP306	P.C. Board	B-1234B
EP307	P.C. Board	B-1211B
EP308	P.C. Board	B-1228B
W301	Wire	JPW-01 R-01
W302	Jumper	MCR10-JPW
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	47P	GRM40
C509	Monolithic	33P	GRM40
C510	Monolithic	0.1	GRM40
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

[TONE CALL UNIT] [IC-μ2E (#02, #03 AND #04)]

REF. NO.	DESCRIPTION	PART NO.
IC801	IC	TC5082P-G
Q801	Transistor	RN2404
D801	Diode	1SS193
X801	Crystal	RF4A3 FAE (7.168MHz)
R801	Trimmer	RH04BPA14J 10kB
R802	Chip	47k MCR10
C801	Monolithic	47P GRM40
C802	Monolithic	10P GRM40
C803	Monolithic	10P GRM40
C804	Monolithic	0.001 GRM40
C805	Tantalum	TESVA1V104M1-8L 35V 0.1
EP802	P.C. Board	B-1215B
EP803	F.P.C. Board	B-1319

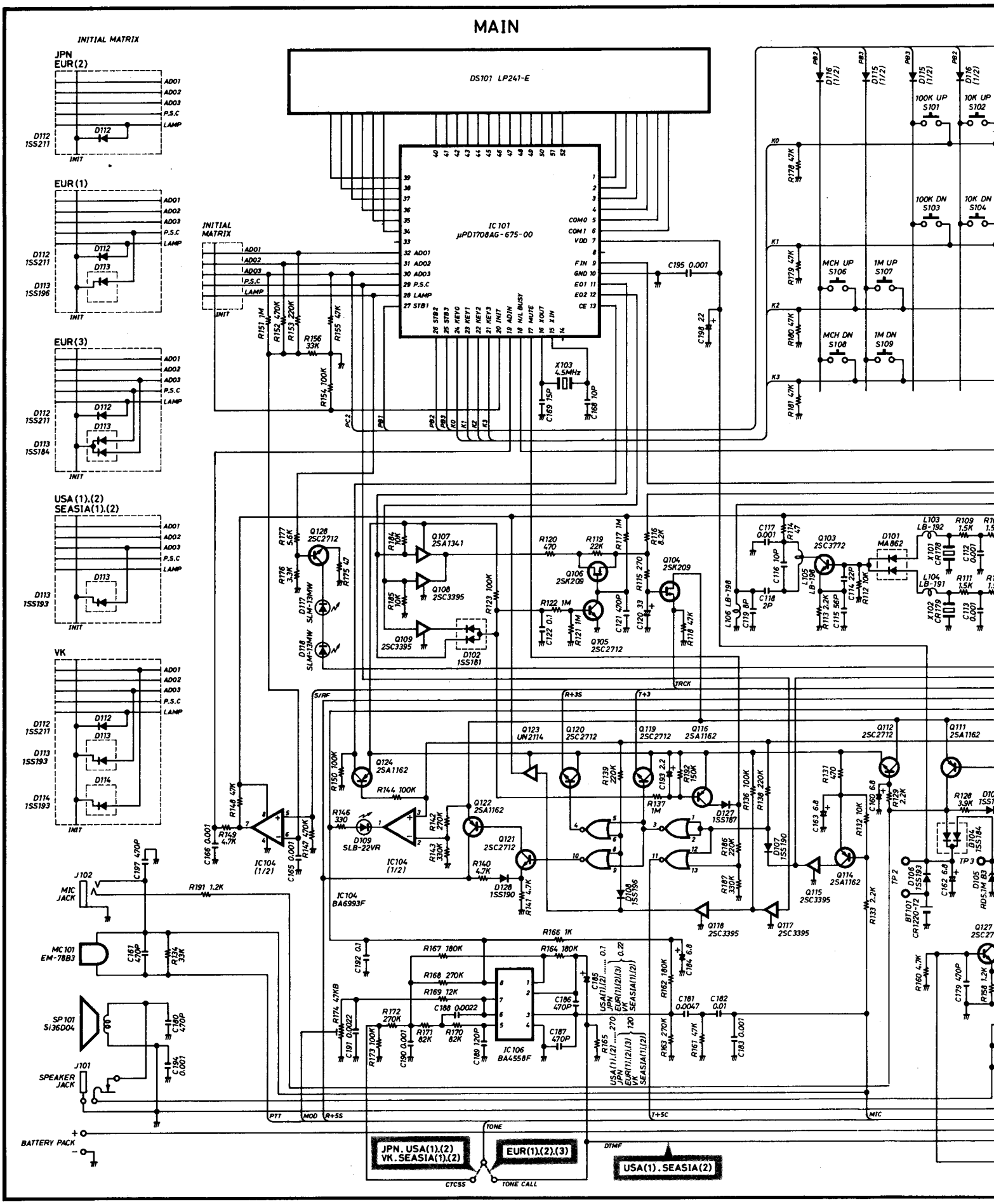
[TONE UNIT] [IC-μ2AT (#05 AND #09)]

REF. NO.	DESCRIPTION	PART NO.
IC701	IC	S7116A
Q701	Transistor	2SC2712 BL
X701	Crystal	RF4A3 FAA (3.579545)
R701	Trimmer	RH04BPAS4J 47kB
R702	Chip	330k MCR10
R703	Chip	150k MCR10
R704	Chip	3.3k MCR10
R705	Chip	1.2k MCR10
R706	Chip	47k MCR10
C701	Monolithic	47P GRM40
C702	Monolithic	39P GRM40
C703	Monolithic	470P GRM40
C704	Tantalum	TESVA1E474M1-8L 25V 0.47
C705	Tantalum	TESVA1E474M1-8L 25V 0.47
S701	Switch	SSGM17 [SUBAUDIBLE TONE FREQUENCY SELECTOR]
EP701	P.C. Board	B-1216C
EP702	F.P.C. Board	B-1319

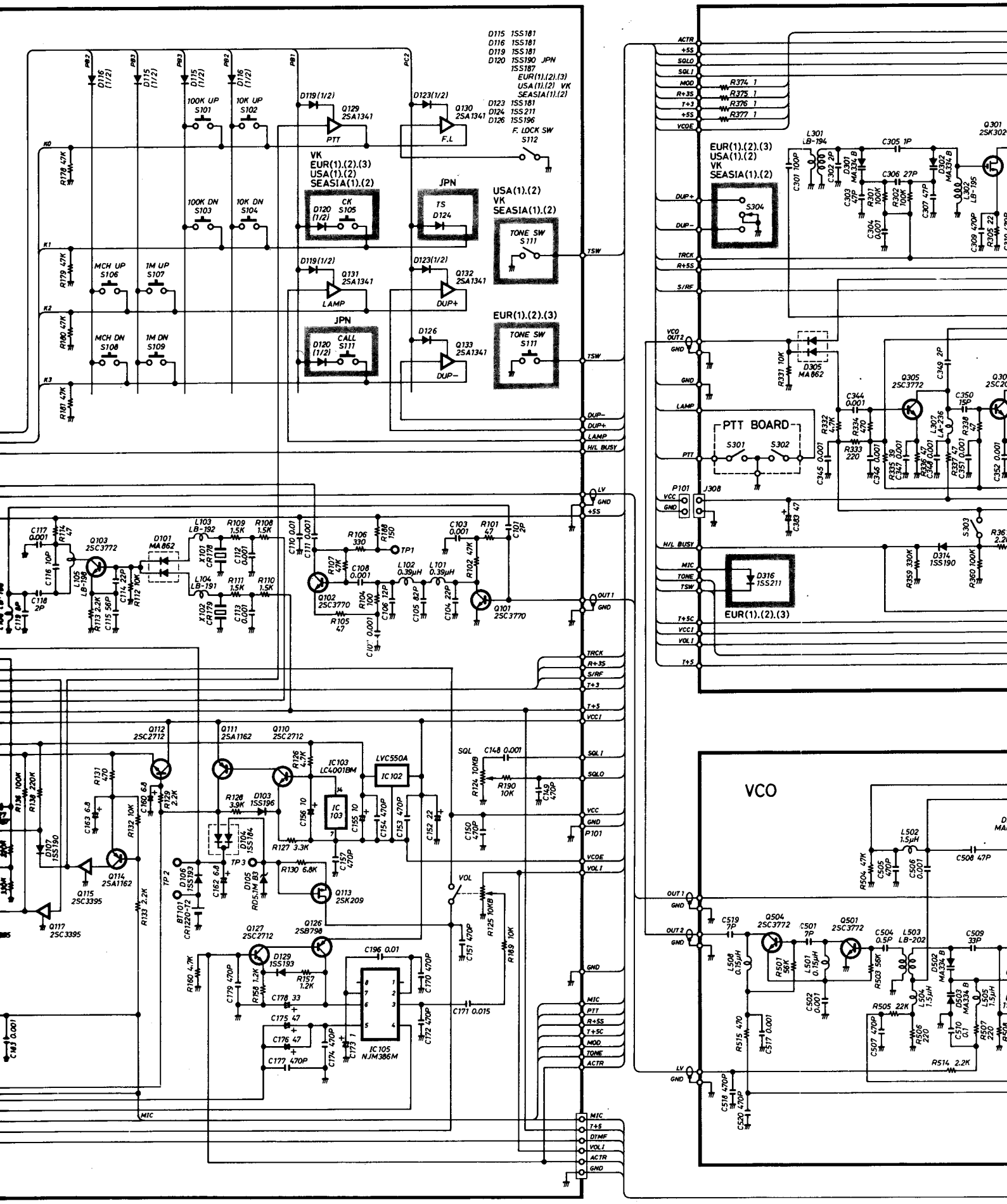
[DTMF UNIT] [IC-μ2AT (#05 AND #09)]

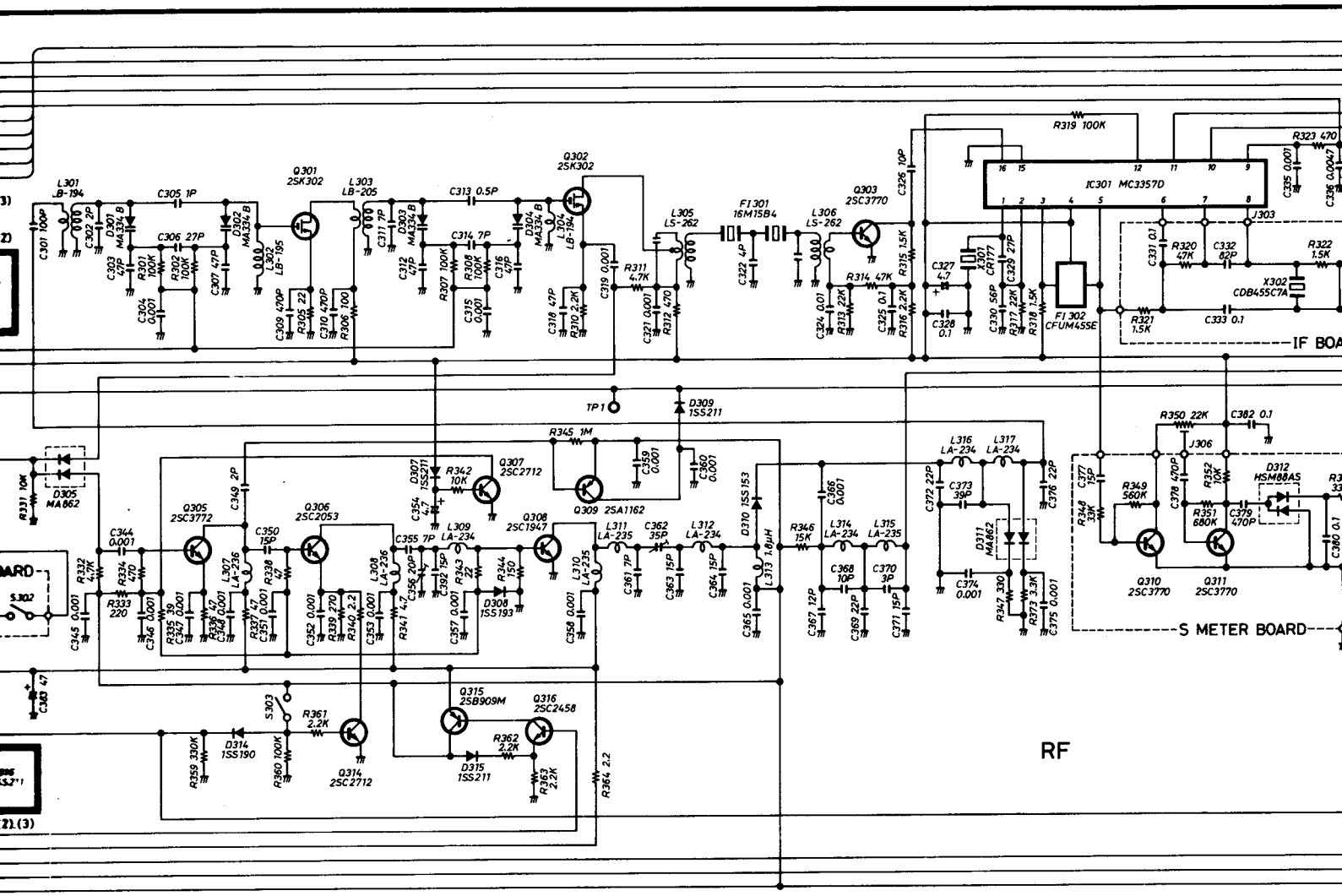
REF. NO.	DESCRIPTION	PART NO.
IC601	IC	LR40872
Q601	Transistor	2SC2712 BL
D601	Diode	1SS181
X601	Ceramic Resonator	CSAC3.58MGC300CD
R601	Chip	33k MCR10
R602	Trimmer	RH04A3A14J 10kB
R603	Chip	22k MCR10
R604	Chip	47k MCR10
R605	Chip	68k MCR10
C601	Tantalum	TESVA1E474M1-8L 25V 0.47
C602	Monolithic	30P GRM40
C603	Monolithic	30P GRM40
C604	Tantalum	TESVC1A106M12L 10V 10
C605	Monolithic	470P GRM40
C606	Tantalum	TESVA1A225M1-8L 10V 2.2
EP601	P.C. Board	B-1218B
EP602	F.P.C. Board	B-1366

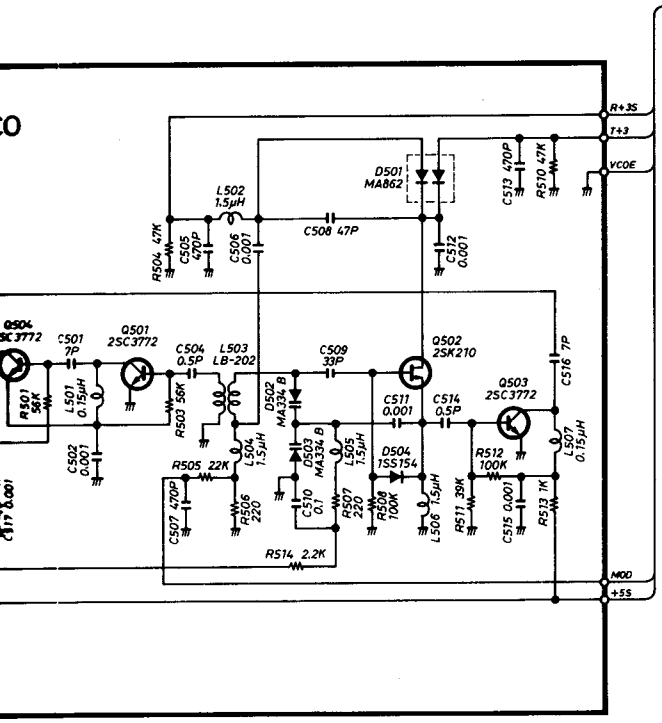
IC-μ2A/AT/E SCHEMATIC D

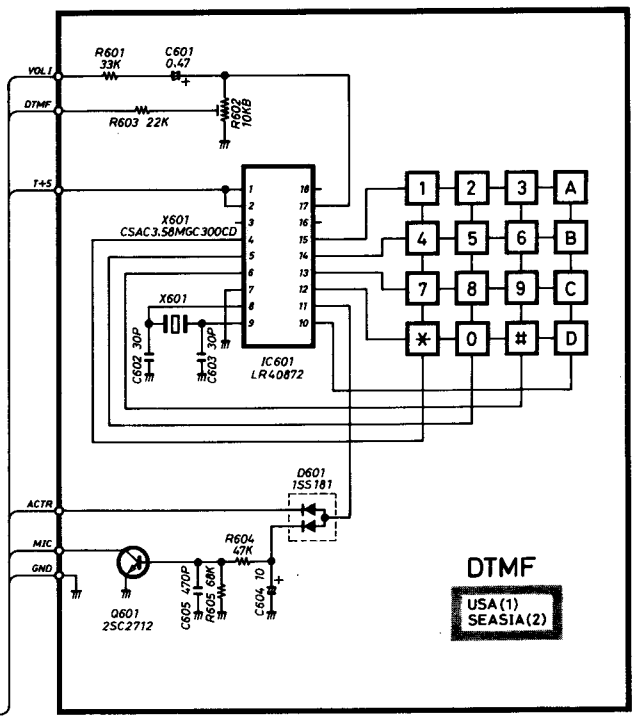


IEMATIC DIAGRAM









TONE SQL
(OPTION)

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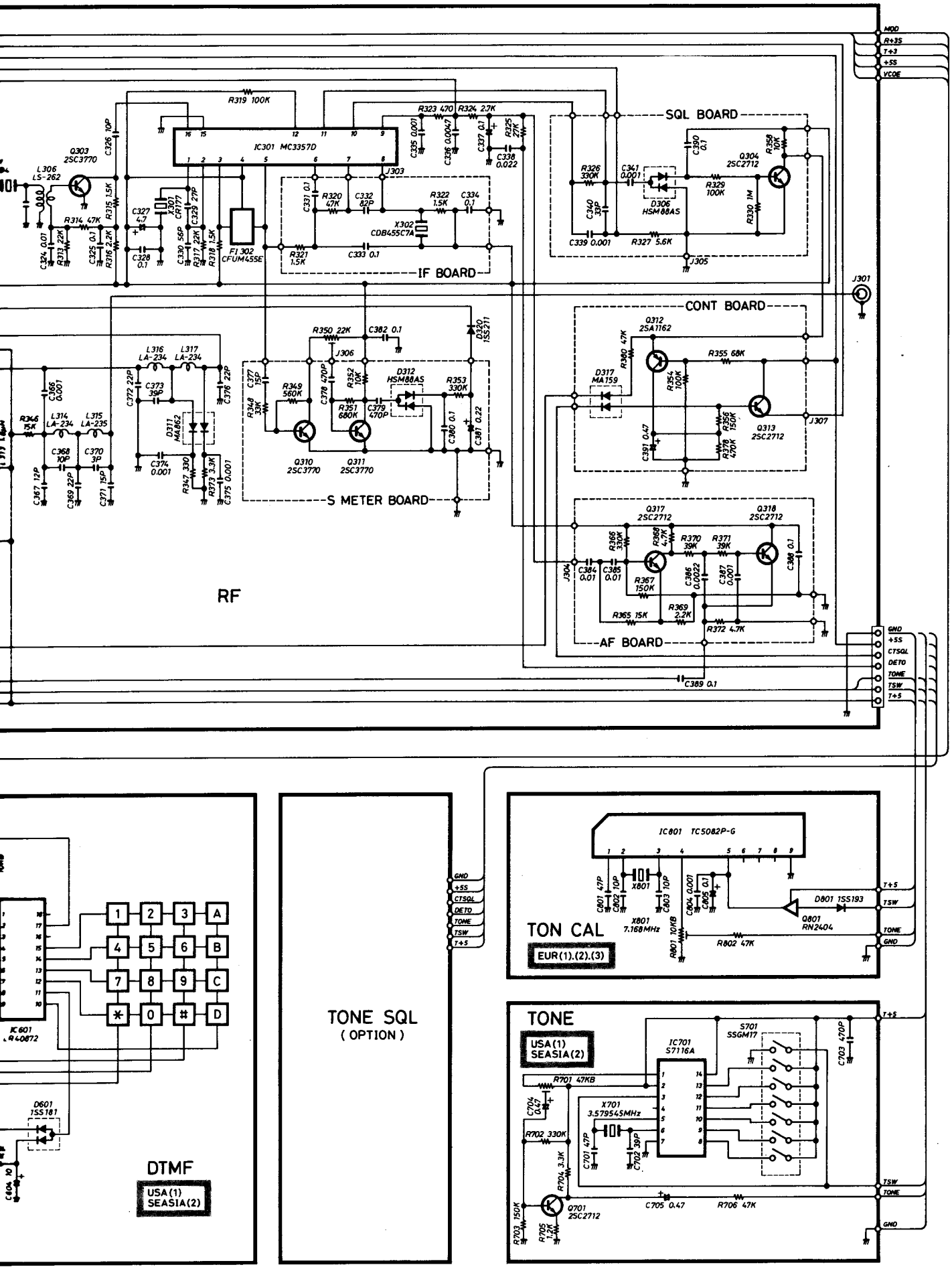

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To upgrade quality, some components may be subject to change without notice.

A-0837

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