



# SERVICE MANUAL

VHF FM TRANSCEIVER

**IC-2GA**

**IC-2GAT**

**IC-2GE**

## INTRODUCTION

This service manual contains the latest service information for the IC-2GA/GAT/GE VHF FM TRANSCEIVER at the time of going to press.

The following version numbers are often used in this manual.

MODEL NAME	VERSION	VERSION NUMBER
IC-2GA	Australia	07
IC-2GA	Southeast Asia	08
IC-2GA	U.S.A.	06
IC-2GAT	Southeast Asia	09
IC-2GAT	U.S.A.	05
IC-2GE	Europe	02
IC-2GE	Italy	04

## ORDERING PARTS

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

1. Desired date of delivery
2. 10-digit ordering number (for mechanical parts only)
3. Part number and name
4. Equipment model and unit name
5. Quantity required

Example: 8810003850, No. 0-3 PH B0 1.4 × 2.5 Ni, screw, IC-2GAT DTMF unit, 3 pcs.

## REPAIR NOTE

1. **DO NOT** open transceiver covers until the transceiver is disconnected from a power source.
2. **DO NOT** force any of the variable components. Turn them slowly and smoothly.
3. **DO NOT** short any circuits or electronic parts.
4. An insulated tuning tool **MUST BE** used for all adjustments.
5. **DO NOT** keep power on for a long time when the transceiver is defective.
6. **DO NOT** transmit power into a signal generator or sweep generator.
7. Always connect a 30dB or 40dB attenuator between the transceiver and a deviation meter or spectrum analyzer when using such test equipment.
8. Read the instructions of test equipment thoroughly before connecting the equipment to the transceiver.



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## SECTION 1 SPECIFICATIONS

## ■ GENERAL

## ● Frequency coverage

MODEL	VERSION	OPERATIONAL RANGE (MHz)	
		RECEIVE	TRANSMIT
IC-2GA	#06 (U.S.A.)	138.00 ~ 174.00*	140.00 ~ 150.00*
	#07 (Australia) <sup>†</sup>		
	#08 (Southeast Asia)		
IC-2GAT	#05 (U.S.A.)		
	#09 (Southeast Asia)		
IC-2GE	#02 (Europe)	144.00 ~ 146.00	144.00 ~ 146.00
	#04 (Italy)	138.00 ~ 174.00*	138.00 ~ 174.00*

\* Specifications guaranteed for 144.00 ~ 148.00 MHz.

<sup>†</sup> Operational range: 144.00 ~ 148.00 MHz.● Mode  
● Tuning step increment

: FM (F3)

IC-2GA, IC-2GAT	5, 10, 15, 20 or 25 kHz
IC-2GE	12.5 or 25 kHz

## ● Memory channels

IC-2GA, IC-2GAT	20 plus a CALL channel
IC-2GE	20

● Antenna impedance  
● Power supply requirement  
● Current drain  
(at 13.2 V DC)  
● Usable temperature range  
● Dimensions

: 50  $\Omega$  unbalanced  
 : 5.5 V ~ 16.0 V DC (negative ground)  
 : RECEIVE: power saver on, 10 mA (typical); max. aud. output, 250 mA  
 : TRANSMIT: HIGH, 1.8 A; LOW, 900 mA  
 : -10°C ~ +60°C (14°F ~ 140°F)  
 : All versions: 65(W)×35(D) mm; 2.6(W)×1.4(D) in  
 : IC-2GAT (U.S.A.) with BP-70 : 151(H) mm; 5.9(H) in  
 : IC-2GA, IC-2GAT (Southeast Asia) with BP-4: 140(H) mm; 5.5(H) in  
 : IC-2GA (U.S.A.), IC-2GE with BP-3 : 130(H) mm; 5.1(H) in  
 : IC-2GAT (U.S.A.) with BP-70: 500 g (1.1 lb)  
 : IC-2GA, IC-2GAT (Southeast Asia) with BP-4: 450 g (1.0 lb)  
 : IC-2GA (U.S.A.), IC-2GE with BP-3: 430 g (0.9 lb)

## ● Weight

## ■ TRANSMITTER

- Output power (at 13.2 V DC) : HIGH, 7 W; LOW, 1 W
- Modulation system : Variable reactance frequency modulation
- Max. frequency deviation :  $\pm 5$  kHz
- Spurious emissions : Less than -60 dB
- Microphone impedance : 2 k $\Omega$

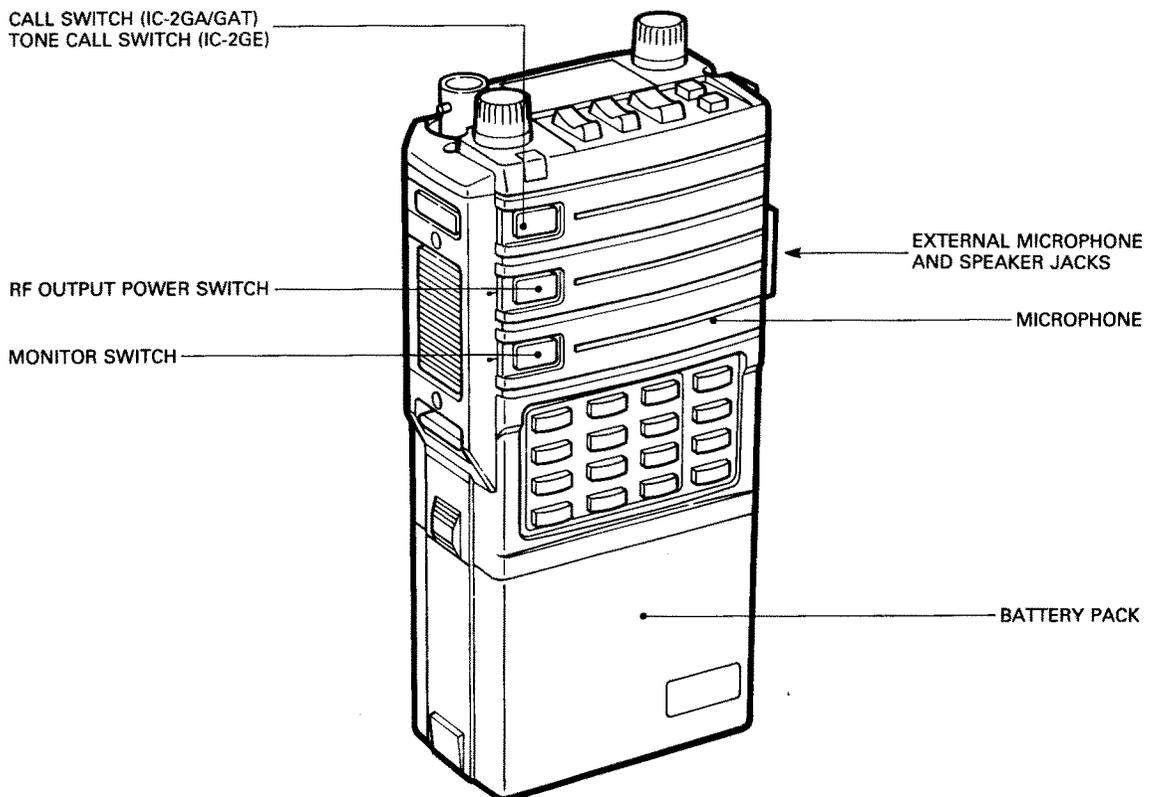
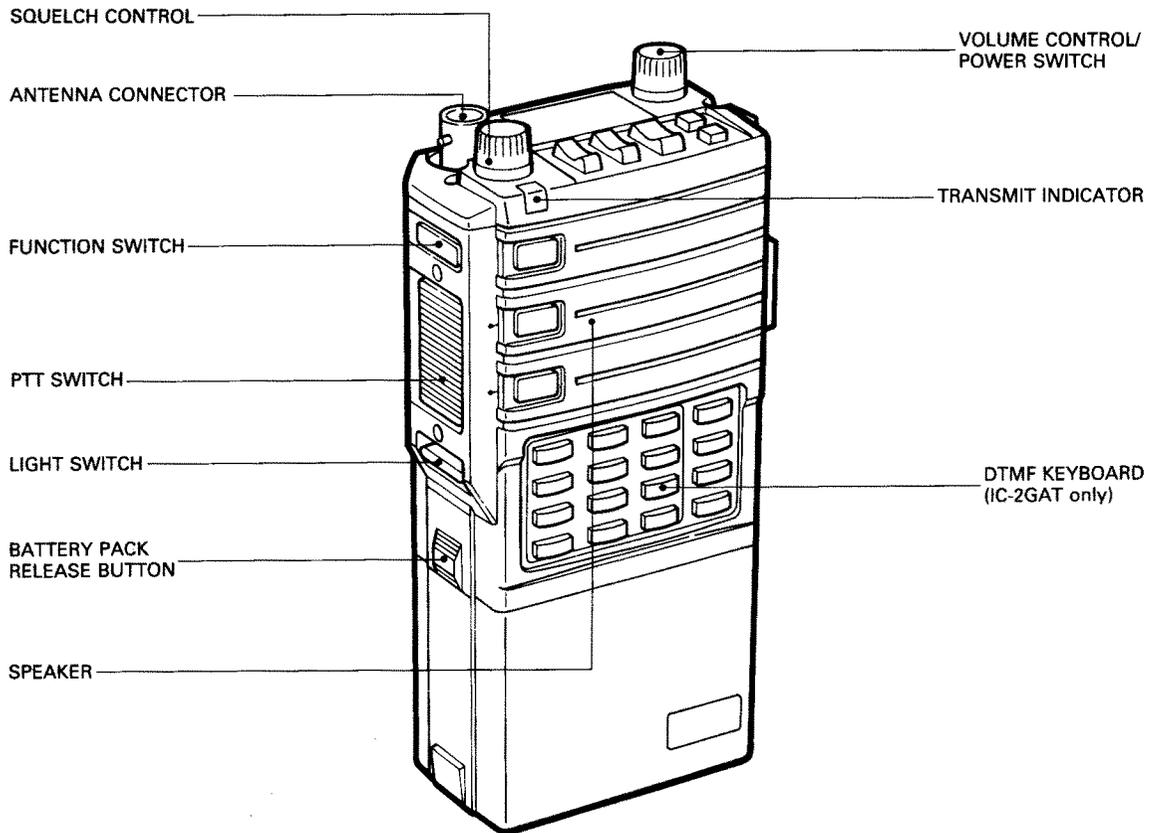
## ■ RECEIVER

- Receiver system : Double-conversion superheterodyne
- Intermediate frequencies : 1st 16.9 MHz  
2nd 455 kHz
- Sensitivity : Less than 0.25  $\mu$ V for 12 dB SINAD
- Spurious rejection : Less than -60 dB
- Audio output power : More than 400 mW at 10% distortion with an 8  $\Omega$  load
- Audio output impedance : 8  $\Omega$

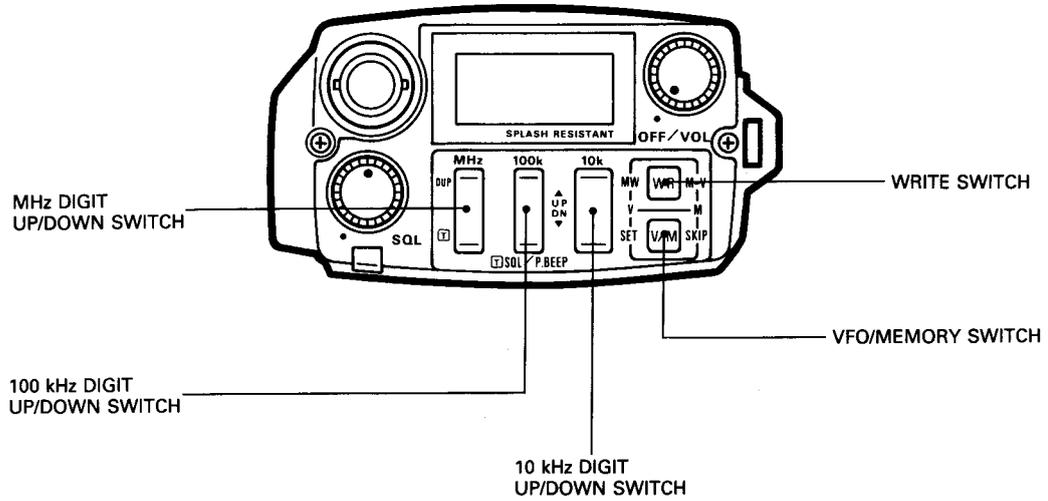
All stated specifications are subject to change without notice or obligation.

**SECTION 2 OUTSIDE AND INSIDE VIEWS**

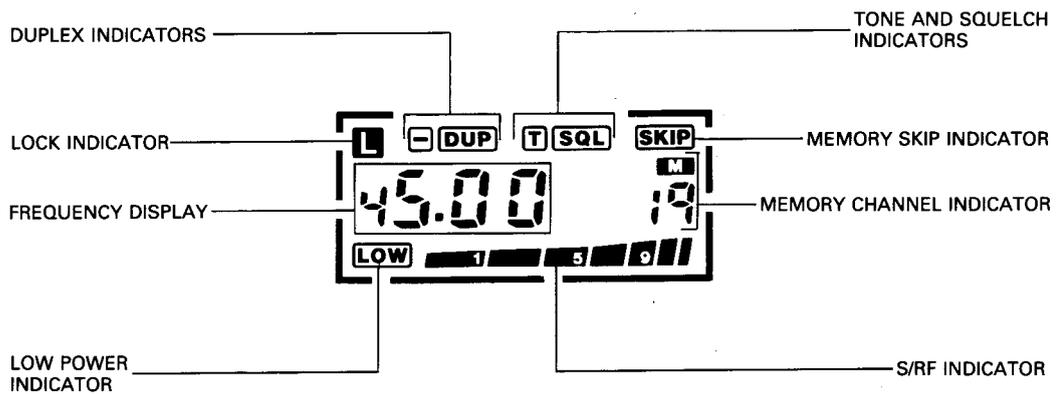
**2 - 1 FRONT AND SIDE PANELS**



## 2 - 2 TOP PANEL

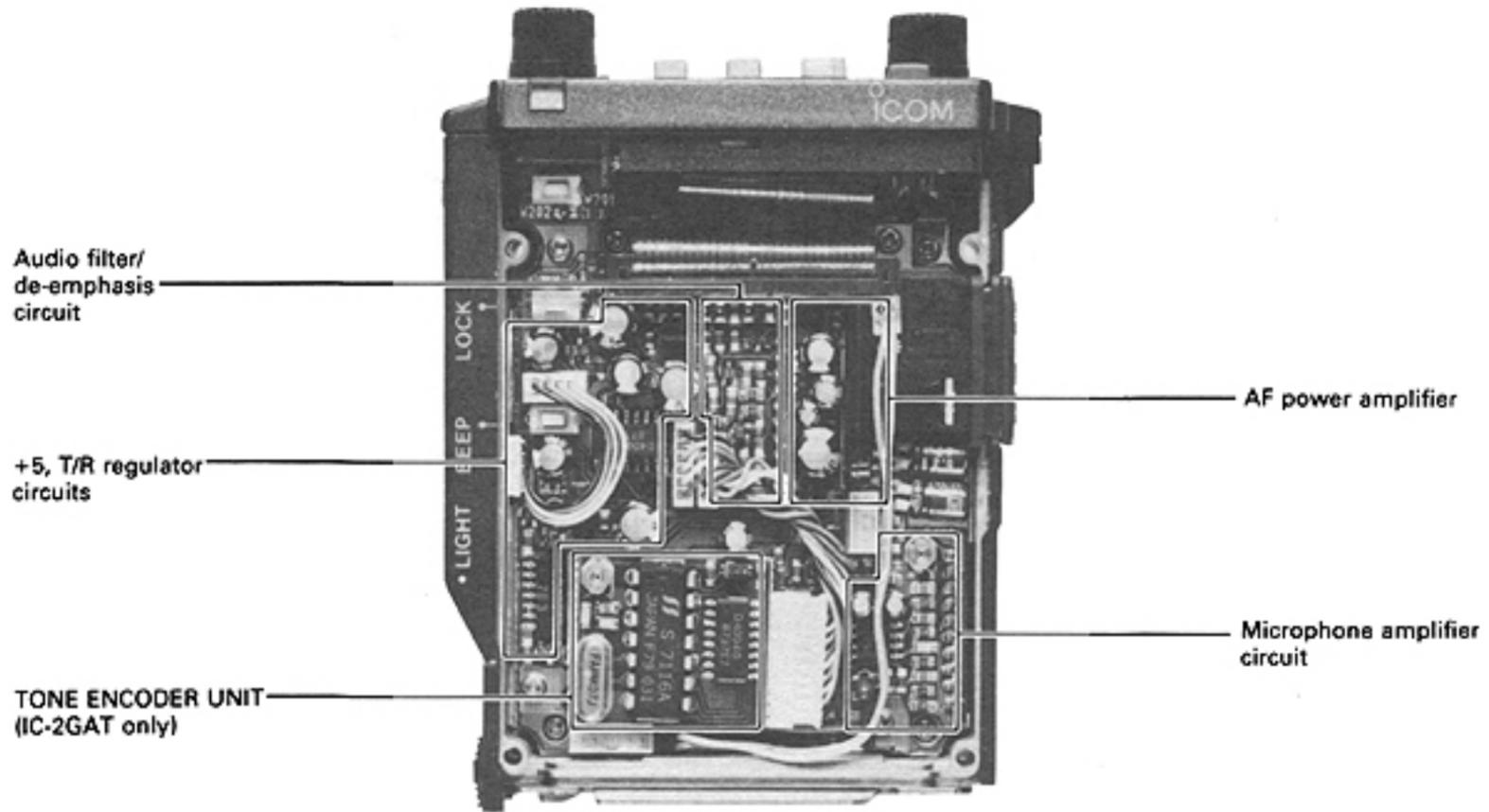


## 2 - 3 FUNCTION DISPLAY

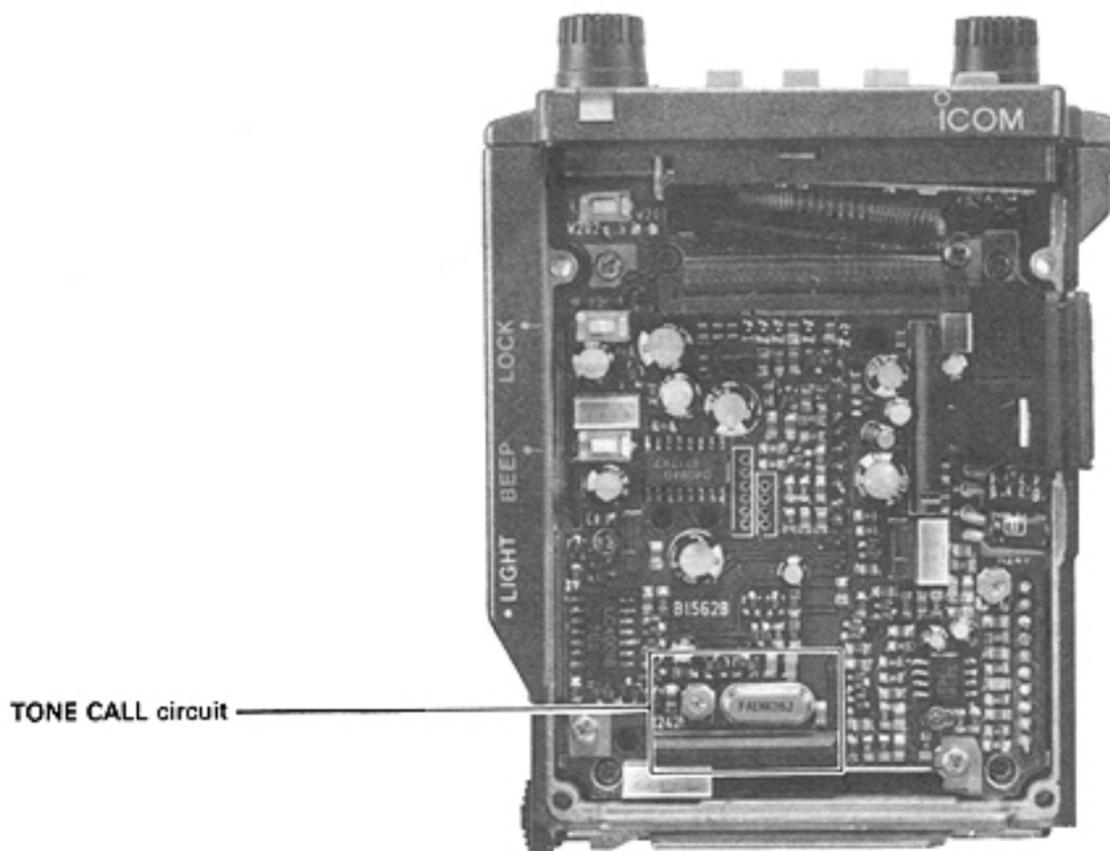


## 2 - 4 MAIN UNIT

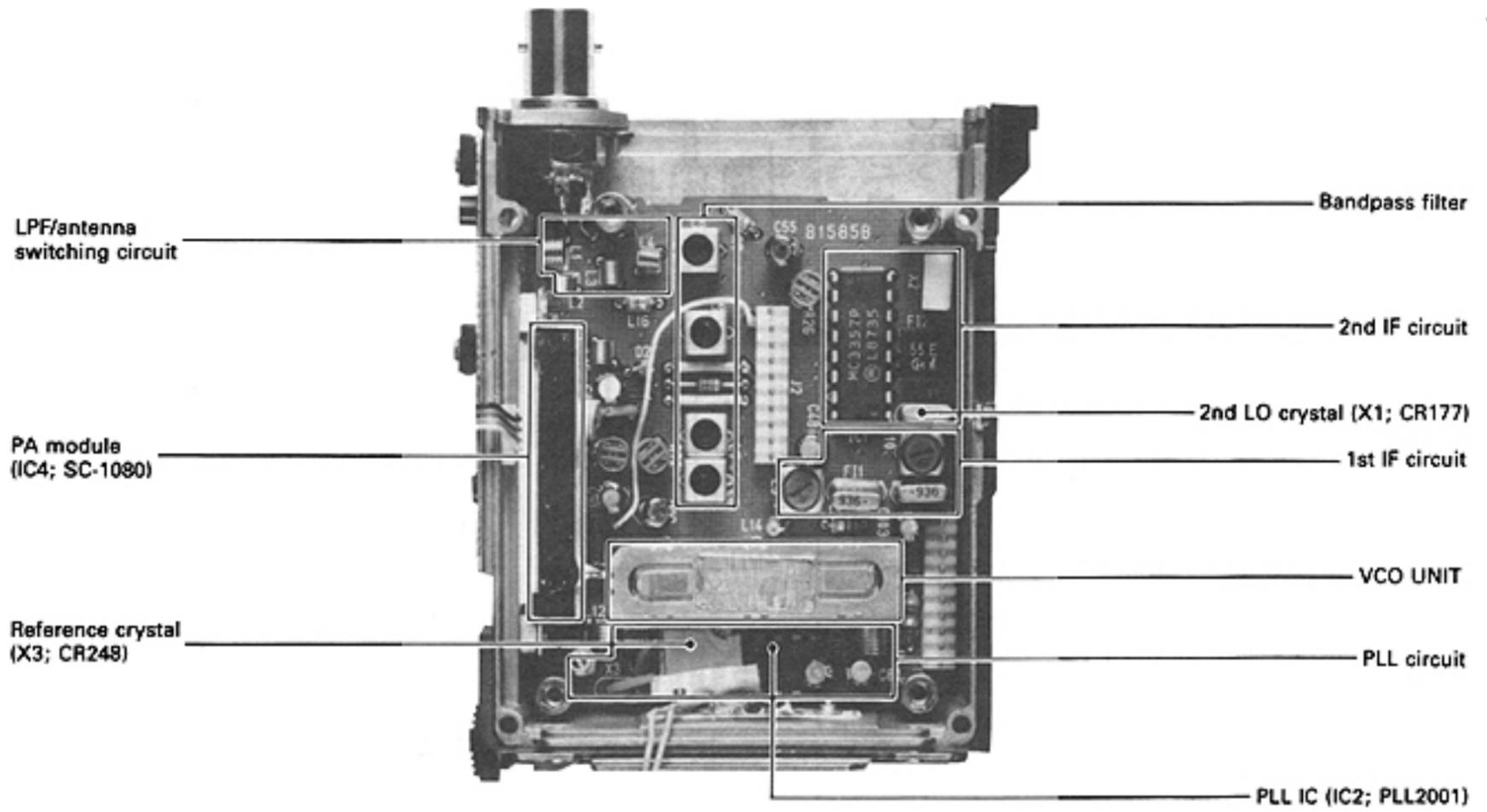
### IC-2GA, IC-2GAT



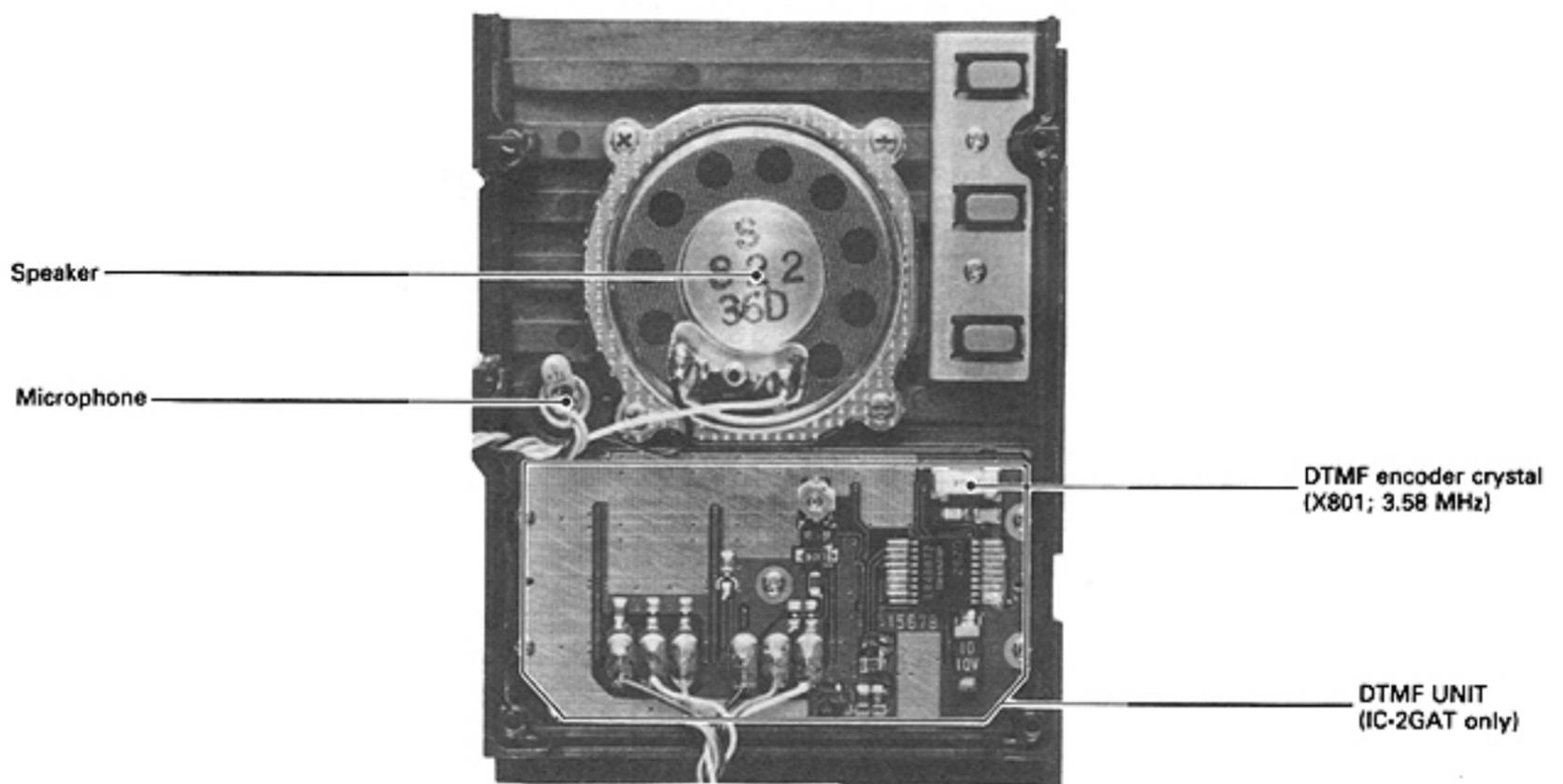
### IC-2GE



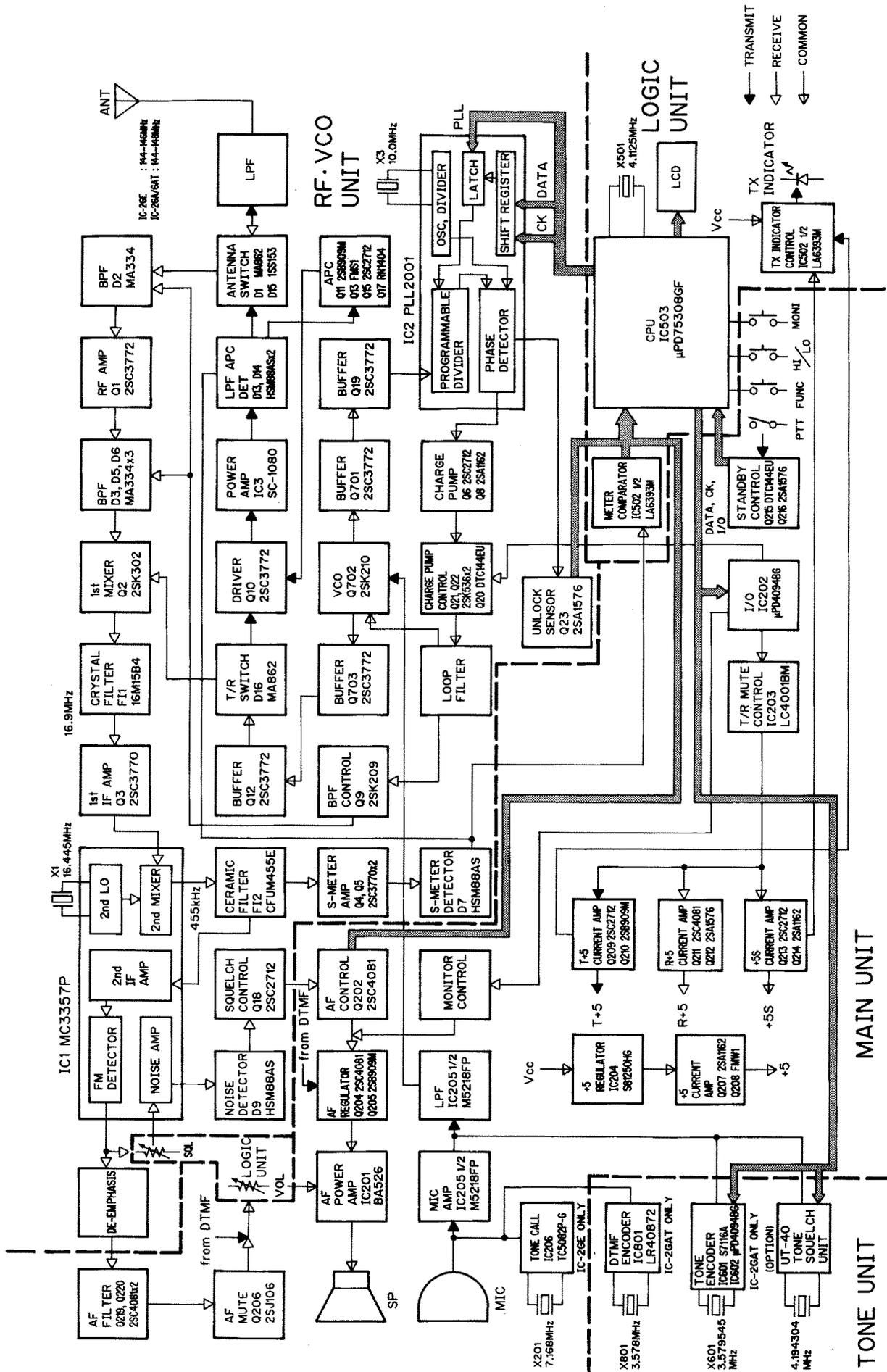
## 2 - 5 RF UNIT



## 2 - 6 SPEAKER AND DTMF UNITS



SECTION 3 BLOCK DIAGRAM



## SECTION 4 CIRCUIT DESCRIPTION

## 4 - 1 RECEIVER CIRCUITS

## (1) ANTENNA SWITCHING CIRCUIT (RF UNIT)

RF signals enter the antenna connector and pass through a series of Chebyshev low-pass filters (L1, L2, C1, C2, C6, C7, C8). The signals are then applied to the antenna switching circuit, which employs a two-stage diode switching system (L3, L4, C4, C5, C11, D1).

## (2) RF CIRCUIT (RF UNIT)

The signals from the antenna switching circuit are amplified at Q1. Amplified signals are applied to a bandpass filter (C17, C22, C25, D3, D5, D6, L6~L8) where out-of-band signals are suppressed. D2, D3, D5, and D6 are varactor diodes which track the bandpass filters with the PLL lock voltage.

## (3) 1st MIXER CIRCUIT (RF UNIT)

The signals are applied to the gate of the first mixer (Q2). A frequency oscillated in the PLL passes through the LO switching circuit (D16), and is applied to the source of Q2. The received signals are mixed with the PLL output to produce the first IF of 16.9 MHz, which is picked up at L9.

## (4) 1st IF AMPLIFIER (RF UNIT)

The first IF signal is applied to a set of two monolithic filters (F11) which determine the bandwidth (15 kHz/-3 dB) and suppress unwanted heterodyned signals. The first IF signal is amplified at Q3, and then applied to IC1 (pin 16) via C34.

## (5) 2nd IF AND DEMODULATOR CIRCUITS (RF UNIT)

IC1 contains the second local oscillator, the second mixer, a limiter amplifier, and the quadrature detector.

Using X1, IC1 oscillates a 2nd LO frequency of 16.445 MHz. The second IF of 455 kHz is output from pin 3. Applied to IC1 (pin 5), the second IF is amplified at the IC's internal limiter amplifier. The amplified signal is applied to the quadrature detector (IC1, pins 7, 8; X2). An AF signal is output from the quadrature detector through pin 9.

After passing through the ceramic filter (F12), a portion of the second IF is applied to the S-meter amplifier (Q4, Q5).

## (6) AF CIRCUIT (MAIN UNIT)

The AF signal is applied to the de-emphasis circuit (C55, R33), and then to the AF amplifier (Q219, Q220). The de-emphasis circuit is an integrated circuit with frequency characteristics of -6 dB/octave (300 Hz~3 kHz). Passing through the volume control (R502), the signals are amplified by IC201, and sent to the speaker.

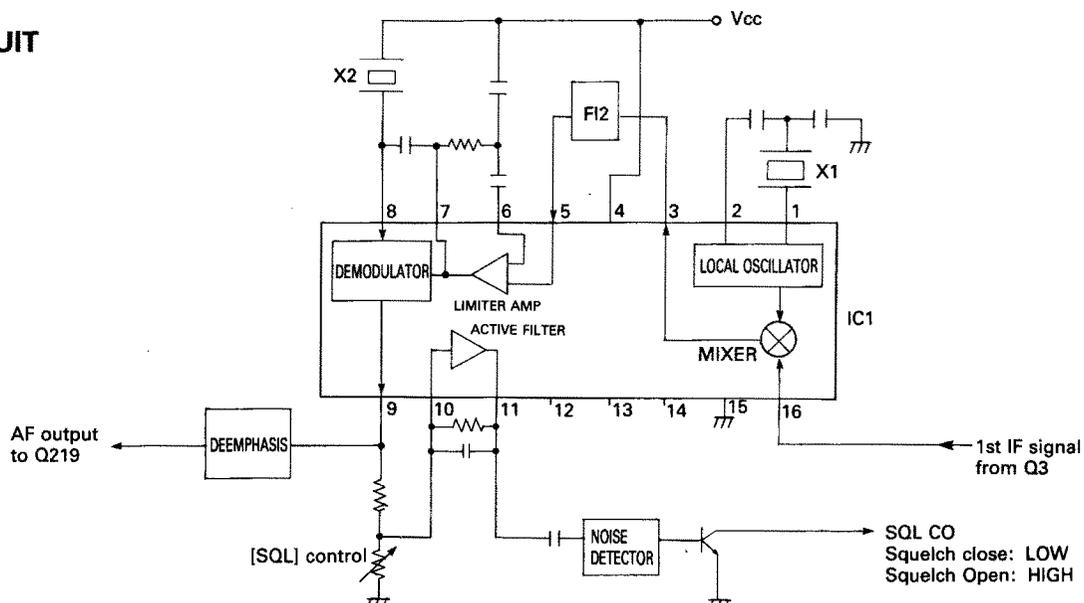
## (7) SQUELCH CIRCUIT (RF AND MAIN UNITS)

A portion of the AF signal from IC1 (pin 9) is applied to pin 10 (the active filter). The SQL pot (R501) adjusts the input level at pin 1. The active filter in IC1 amplifies noise components of frequencies of 20 kHz and above, and outputs the resulting signals from pin 11. The signals pass through D9 for noise detection. If the detected noise voltage is high, Q18 is turned on; Q202 is turned off, cutting off voltage buffer (Q204, Q205) output voltage. In this way, IC201 is deactivated when the squelch is closed. When transmitting, a decrease in Q202 voltage cuts off voltage buffer output voltage — turning off IC201.

## (8) LOCAL OSCILLATOR CIRCUIT (RF UNIT)

Q12 buffer amplifies the VCO output, which then passes through D16 and is applied to the source of Q2.

## IF CIRCUIT



## 4 - 2 TRANSMITTER CIRCUITS

### (1) MICROPHONE AMPLIFIER (MAIN UNIT)

AF signals from the built-in condenser microphone or from the external microphone jack are amplified at a limiter amplifier (IC205), and are pre-emphasized to 6 dB/octave (300 Hz~3 kHz). Pin 1 outputs a square wave which contains many high harmonic components. The signals pass through the splatter filter in IC205 where signals of 3 kHz and above are attenuated. The signals from pin 7 are applied to the VCO UNIT for frequency modulation (FM).

### (2) DRIVE AMPLIFIER (RF UNIT)

The VCO output is buffer amplified at Q12. Passing through D16, the signals are then amplified at the drive amplifier (Q10).

### (3) RF POWER AMPLIFIER (RF UNIT)

Q10 output is amplified at IC3 to 7 W (HIGH) or 1 W (LOW). When transmitting, the RF signals amplified at IC3 pass through the antenna switching diode (D15) and the low pass filter where harmonic signals are rejected. The signal is then applied to the antenna connector.

### (4) APC CIRCUIT (Automatic Power Control) (RF UNIT)

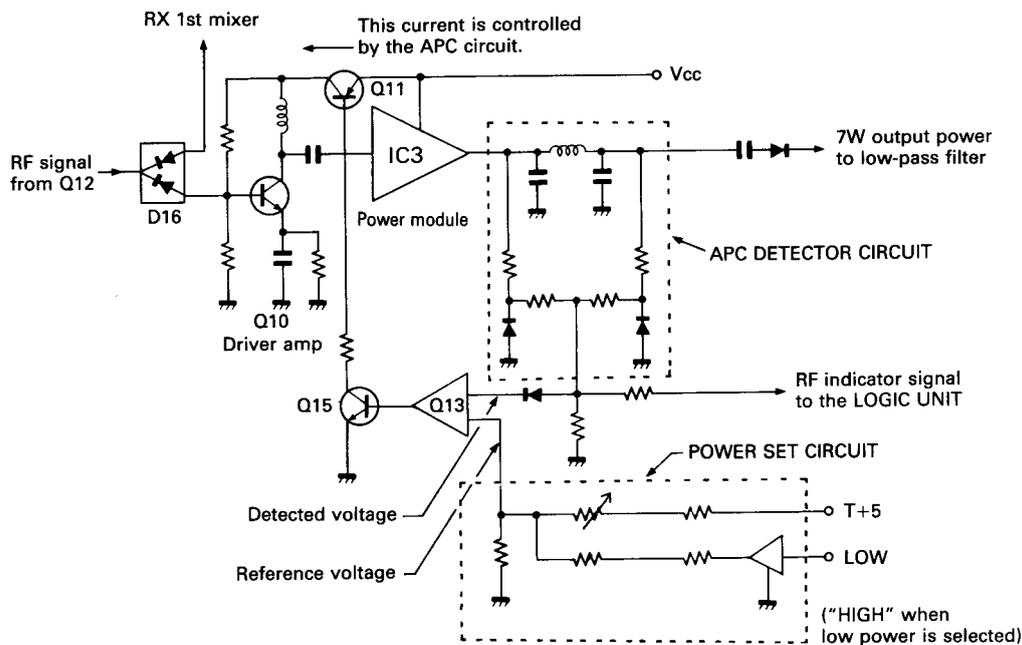
IC3 output passes through the APC detector circuit (D13, D14, L15, etc.) where its RF output level is detected.

The detected output, compared at the differential amplifier (Q13) to the reference voltage output of the power set circuit, is applied to the base of Q15.

When the antenna is matched at 50 Ω, the detected output is at a minimum. When mismatched, the detected output increases. The current at the collectors of Q11 and Q15, as well as the gain of the driver (Q10), decreases until the detected output and the reference voltage become equal. In this way, the power module (IC3) is protected from damage.

Q17 acts as a switch for the reference voltage used in the APC circuit. In this way, HIGH/LOW transmit output power switching is accomplished.

### APC CIRCUIT



## 4 - 3 PLL CIRCUITS

### (1) GENERAL

The PLL circuit, using a one-chip PLL IC (IC2), directly generates the desired frequency. IC2 sets the dividing ratio based on serial data from the CPU (IC501), and compares the phases of the VCO signal and the reference oscillator frequency. It detects the out-of-step phase and outputs it.

### (2) REFERENCE OSCILLATOR CIRCUIT (RF UNIT)

X3 oscillates a 10 MHz signal. IC2 divides this signal with N-data from the CPU. In this way, one of six tuning steps (5, 10, 12.5, 15, 20, 25 kHz) can be selected.

### (3) CHARGE PUMP AND LOOP FILTER CIRCUITS (RF UNIT)

Phase-detected signals from pins 5 and 12 are converted to DC voltage by the charge pump (Q6~Q8) and the lag-lead loop filter (R48~R50, C81, C112 and C113).

The frequency at which the VCO oscillates is controlled by varactor diodes (D703, D704). DC voltage (PLL lock voltage) is provided through the loop filter. The output of the loop filter passes through Q9, and is used to control the bandpass filter (D3, D5, D6) in the receiver RF circuit.

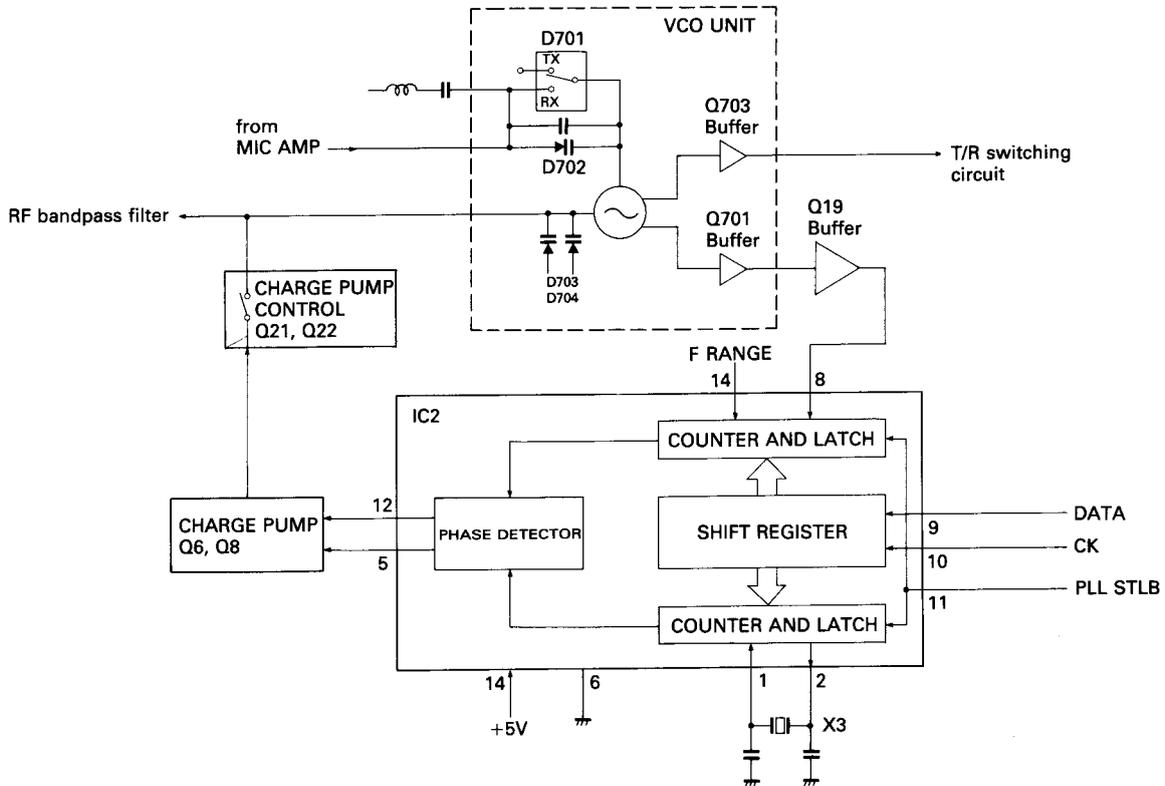
When the power save function is on, the charge pump control circuit (Q20~Q22, D18) cuts off the charge pump and the VCO.

**(4) VCO CIRCUIT (RF UNIT)**

D701 changes the inductive reactance of the oscillator (Q702), shifting the receive and transmit frequencies. Varactor diode D702 provides frequency control. Q703 buffer amplifies the VCO output signal; Q701 buffer amplifies the PLL feedback signal; Q701 buffer amplifies the PLL feedback signal.

**(5) UNLOCK SENSOR CIRCUIT**

When the PLL circuit is unlocked, pin 7 of IC2 is "LOW" and a "LOW" signal is applied to the unlock sensor (Q23). The unlock sensor outputs a current amplified "LOW" signal to the CPU, IC503 (pin 60).



**4 - 4 POWER SUPPLY CIRCUITS**

**(1) VOLTAGE LINES**

LINE	DESCRIPTION
Vcc	Battery pack output that passes through the power switch. Vcc is applied to the power module (IC3), the AF power amp regulator, and the following 5 V lines.
+5	Common 5 V current-amplified at (Q207, Q208) using IC output as a reference voltage. The heat factor of the voltage at Q207 ( $V_{BE}$ ) equals that of the junction voltage at Q208. The output is stable even with regard to temperature changes.
+5S	Common 5 V controlled by the power save function. Current-amplified at Q213, Q214.
R+5	5 V controlled by the power save function. Current-amplified at Q211, Q212. Used by the receiver circuits.
T+5	5 V current-amplified at Q209, Q210. Used by the transmitter circuits.

**(2) VOLTAGE REGULATOR CIRCUIT (MAIN UNIT)**

When the battery voltage is 5.5~16 V, the regulator (IC204) outputs a reference voltage of 5 V. The noise components are removed by the noise filter (C220, R213). This output is applied to the current amplifier (Q207, Q208).

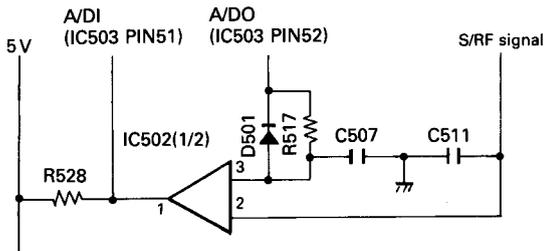
**(3) CPU POWER SUPPLY CIRCUIT (LOGIC UNIT)**

When the power is turned off, voltage from the lithium battery is applied to the CPU, IC501 (pin 52) via D502.

## 4 - 5 OTHER CIRCUITS

### (1) S/R F METER CIRCUIT (LOGIC UNIT)

The voltages detected at the S-meter detector (Q4, Q5, D7) or the APC detector (D13, D14) are applied to pin 2 of IC502 (1/2). When the voltage level is detected, IC503 (pin 52) outputs a "HIGH" signal. Because the signal passes through an integrator circuit (C507, R517), the voltage at pin 3 increases with time. When the voltage at pin 3 is greater than that at pin 2, pin 1 outputs a "HIGH" signal to IC503 (pin 51). When IC503 (pin 52) becomes "HIGH," the S/R F level, calculated from the delay time, is displayed.



### (2) LAMP CIRCUIT (LOGIC UNIT)

When the LIGHT SWITCH is pushed, the IC503 (pin 53) LAMP signal becomes "HIGH." The current of this signal is amplified at Q501 to light the two chip-type LED (DS502, DS503).

### (3) LOW VOLTAGE DETECTOR CIRCUIT (LOGIC UNIT)

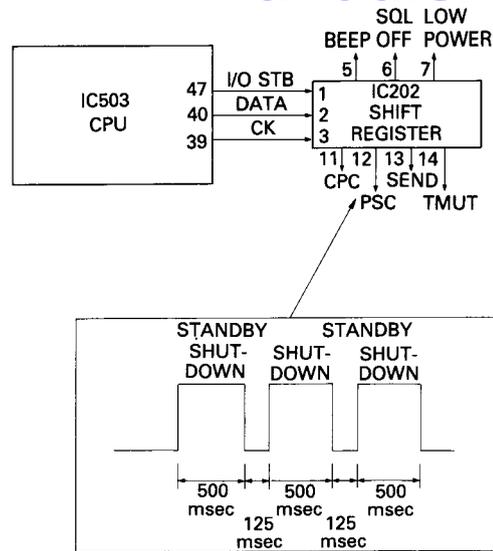
+5S is divided over R523 and R524. 1.16 V are applied to IC502B (pin 5). The Vcc voltage, divided over R525 and R526, is applied to pin 6. When the Vcc voltage exceeds 5.7 V, the voltage at pin 6 becomes greater than that at pin 5. Output pin 1 becomes "LOW." When the Vcc voltage is less than 5.7 V, the voltage at pin 5 exceeds that at pin 6. Pin 1 outputs "HIGH." The TRANSMIT INDICATOR does not light even when transmitting.

### (4) BEEP CIRCUIT (MAIN UNIT)

When some switches are pushed, the CPU sends BEEP data to IC102. Beep tones are output from IC202 (pin 5) in square waves of about 1 kHz and 500 Hz.

### (5) POWER SAVER CIRCUIT (MAIN UNIT)

When the squelch is closed, IC503 (pin 41) BUSY signal is "LOW." If no operation is performed for more than 30 seconds, the power save function is automatically activated. After 30 seconds, the IC503 sends power save data to IC202.



Using this data, IC202 (pin 12) alternately outputs "HIGH" (shut-down) for 500 msec. and "LOW" (standby) for 125 msec. This output, applied to IC203D (pins 5 and 6) and IC203C (pin 9), controls the bases of Q211 and Q213 — thus controlling +5S and R+5.

If a signal is received, the BUSY signal becomes "HIGH," shutting off the power save function. If a signal is not received, "HIGH" and "LOW" signals continue to alternate.

### (6) SUBAUDIBLE TONE ENCODER (IC-2GA, IC-2GAT)

When the tone encoder is turned on, the X601 reference frequency (3.579545 MHz) is divided by IC601's dividing ratio based on 6-bit data from IC503. A tone (67.0 Hz~250.3 Hz) is output from pin 1. The tone output passes through R601 for deviation adjustment and is supplied to the MAIN UNIT.

### (7) TONE CALL (IC-2GE)

Pushing the TONE CALL SWITCH (S206) turns on Q218. A voltage is applied to IC206. IC206 divides 7.168 MHz by 4,096; and outputs a 1750 Hz tone through pin 4. R242 provides deviation adjustment.

### (8) DTMF ENCODER (IC-2GAT)

IC801 generates DTMF tone signals. When transmitting, T+5 V are applied to IC801 (pins 1 and 2). If, at this time, data are entered with the keypad, the frequency (3.58 MHz) oscillated by X801 is divided by the appropriate dividing ratio.

Pin 17 outputs audio frequencies corresponding to ROW and COL input. R801 provides deviation adjustment. When a key is pushed, a "HIGH" signal is output to pin 11. Q801 is turned on for about one second to maintain transmission without pushing the PTT switch.

**(9) T5/R5 SWITCHING CIRCUIT (MAIN UNIT)**

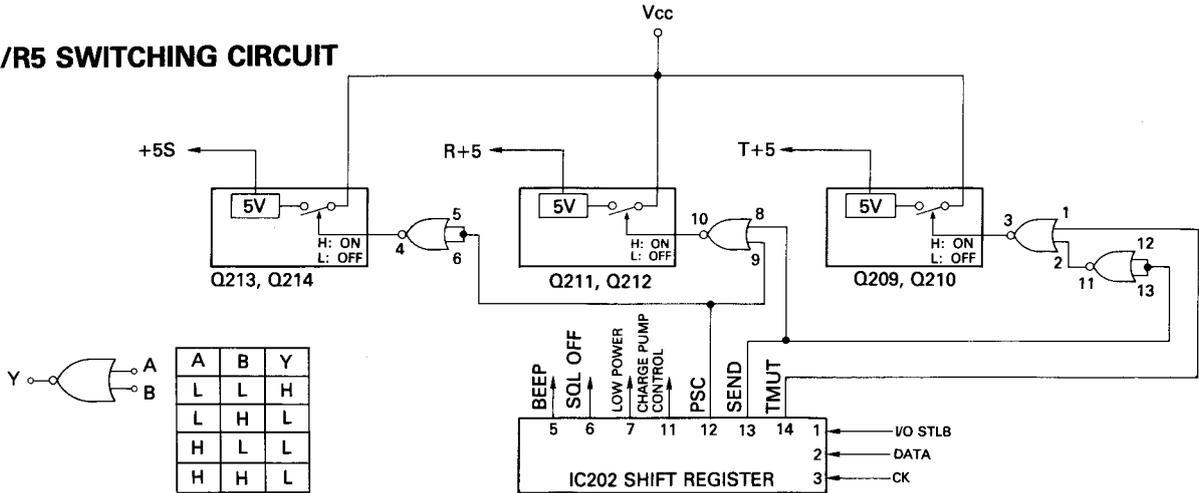
When the PTT switch (S205) is pushed, Q216 is turned on. The collector of Q215 outputs a "LOW" signal to the CPU (IC503, pin 44). Using the "LOW" signal, the CPU sends TRANSMIT data to IC202. IC202 (pin 13) outputs a "HIGH" signal to IC203C (pin 8) and IC203A (pins 12 and 13), controlling IC203C (pin 10) — turning on R+5S.

Releasing the PTT switch turns off Q216. The collector of Q215 outputs a "HIGH" signal which causes the CPU to send RECEIVE data to IC202. IC202 (pin 13) outputs a "LOW" signal to IC203C (pin 8) and IC203A (pins 12 and 13), controlling IC203C (pin 10) — turning on R+5S.

IC203A (pin 11) outputs a "HIGH" signal to IC203B (pin 2), controlling the base of Q209 — turning off T+5.

IC203A (pin 11) outputs a "LOW" signal to IC203B (pin 2), controlling the base of Q209 — turning on T+5.

**T5/R5 SWITCHING CIRCUIT**

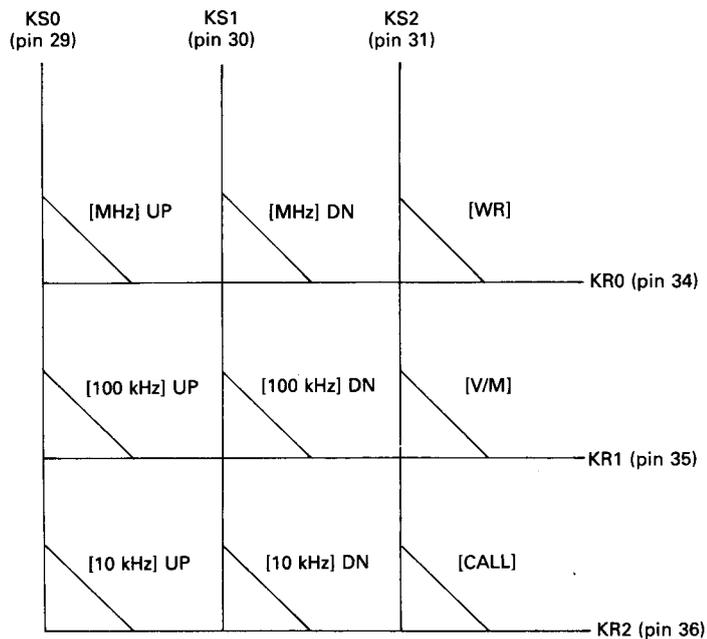


**4 - 6 CPU (IC501) PORT ALLOCATION**

PIN	PORT	STANDBY		OPERATION		NAME	DESCRIPTION
		I/O	H/L	I/O	H/L		
1~28	S13~S31	COM					
29	P40	O	L	O	L	KS0	Output for the SW matrix.
30	P41	O	L	O	L	KS1	Output for the SW matrix.
31	P42	O	L	O	L	KS2	Output for the SW matrix.
32	P43	O	L	O	L	KS10	Output for the SW matrix.
33						Vss	Ground
34	P50	O	L	I	L	KR0	Input for the matrix return.
35	P51	O	L	I	L	KR1	Input for the matrix return.
36	P52	O	L	I	L	KR2	Input for the matrix return.
37	P53	O	L	I	L	KR3	Input for the matrix return.
38	P00	I	L	I		INT4	Standby detector input. Goes to standby at the end of a pulse.
39	P01	I	L	O		CK	Serial data output clock: a) PLL N b) CTCSS TONE c) I/O EXPANSION
40	P02	I	L	O	H	DATA	Serial data output synchronized with CK.
41	P03	I	L	I	H	BUSY	BUSY input used when a signal is received.
42	P10	I	L	I	L	LAMP1	Input used for lamp output HI/LOW control.
43	P11	I	L	I	L	MON1	Input used for ON/OFF control of SQL OFF and BEEP output.
44	P12	I	L	I	L	PTT	Tx/Rx switching input.
45	P13	I	L	I	L	FUNC	Switches matrix input to FUNC functions.
46	P20	O	L	O	L	KS11	Output for the initial matrix.

PIN	PORT	STANDBY		OPERATION		NAME	DESCRIPTION
		I/O	H/L	I/O	H/L		
47	P21	O	L	O		I/OSTB	Strobe signal output for I/O expansion serial data.
48	P22	O	L	O		PLSTB	PLL serial data, strobe signal output.
49	P23	O	L	O		CTSTB	CTCSS serial data, strobe signal output.
50	P30	I	L	I	H	DET	Data equalizer signal input from the CTCSS decoder.
51	P31	I	L	I	H	SRFI	S/RF meter comparison input.
52	P32	O	L	O	H	SRFO	S/RF meter comparison output.
53	P33	O	L	O	H	LAMPO	LCD backlight LAMP output.
54			2 V		5 V	VDD	
55~59						XTAL	
60	P60	I	L	I	L	UNLK	PLL unlock input.
61	P61	O	L	I	L	HI/LOW	Used for HLC output HI/LOW and KEYLOCK ON/OFF switching.
62	P62	O	L	I	L	ENC/DEC	Determines whether or not a CTCSS encoder/decoder (MN6520) is online.
63	P63	O	L	I	L	ENC	Determines whether or not a CTCSS encoder (S7116A) is online.
64	P70	O	L	O	H	DA0	
65	P71	O	L	O	H	DA1	
66	P72	O	L	O	H	DA2	
67	P73	O	L	O	H	DA3	
68		I		I	L	RESET	Turns off standby. When resetting, becomes "LOW" for initialization.
69~80	S0~S12	O	H	O	H		LCD driver output

### 4 - 7 MATRICES



## SECTION 5 MECHANICAL PARTS AND DISASSEMBLY

NUMBER	DESCRIPTION	ORDERING NUMBER	QTY	NUMBER	DESCRIPTION	ORDERING NUMBER	QTY
①	No. 0-3 PH B0 1.4 × 2.5 Ni	8810003850	5	⑳	Lens	8930011940	1
②	573 keyboard (#05, 09)	8010006870	1	㉑	No. 0-1 PH M2 × 2.5	8810004870	2
③	PH B0 2 × 31.5 ZK	8810004000	4	㉒	Button K-106	8610004210	1
④	Rear panel	8010006860	1	㉓	Button K-107	8610004220	2
⑤	No. 0-1 PH B0 2 × 4	8810004800	4	㉔	No. 0-1 PH M2 × 2.5	8810004870	3
⑥	Speaker plate	8930012100	1	㉕	No. 0-3 PH B0 1.4 × 4.5 Ni	8810004980	6
⑦	Casing seal (side)	8930011990	1	㉖	Spacer plate	8930012140	1
⑧	Microphone holder	8930011930	1	㉗	Top panel switch seal	8930011960	1
⑨	Casing seal (center)	8930011870	1	㉘	Top panel* (#05, 06, 07, 08, 09)	8310011520	1
⑩	No. 0-1 PH M2 × 5 ZK	8810000530	2	㉙	Top panel* (#02, 04)	8310011940	1
⑪	PTT button	8930011910	1	㉚	VR angle plate	8930012120	1
⑫	PTT holder-1	8930011920	1	㉛	LCD contact strip SRCN573	8930012090	2
⑬	PTT switch rubber	8930011950	1	㉜	LCD reflector	8010006980	1
⑭	No. 0-3 PH B0 1.4 × 2.5 Ni	8810003850	2	㉝	LCD LD-B9213J	5030000280	1
⑮	Front switch plate	8930012130	1	㉞	LCD window plate	8310011530	1
⑯	Switch seal (#05, 06, 07, 08, 09)	8310011820	1	㉟	PH M2 × 4	8810000010	4
	Switch seal (B) (#02, 04)	8310011920	1	㊱	Jack cover flap	8930011980	1
⑰	Speaker seal	8930011580	1	㊲	Antenna connector BNC-R111-E (includes nut)	6510007130	1
⑱	Front panel (A) (#06, 07, 08)	8210002950	1	㊳	573 standoff-1	8930012081	4
	T.T. front panel (#05, 09)	8210002880	1	㊴	No. 0-1 PH M2 × 8 ZK	8810004840	2
	Front panel (B) (#02, 04)	8210002960	1	㊵	Connection spring	8930005980	1
⑲	Knobs (Power/Volume/Squelch) N-126	8610004230	2	㊶	BuH M2 × 6 Ni	8810002580	1
⑳	PH M2 × 6 ZK	8810004860	2	㊷	Release button	8930008610	1
㉑	VR nut (E)	8830000550	2	㊸	Sliding guide	8010006990	1
㉒	Top panel* (#05, 06, 07, 08, 09)	8310011520	1	㊹	FH M2 × 4 Ni	8810002310	4
	Top panel* (#02, 04)	8310011940	1	㊺	Screw lug M2	8860000010	2
㉓	Top panel seal	8930011970	1	㊻	Contact holder	8930011880	1
				㊼	BuH M2 × 6 Ni	8810002580	1
				㊽	Latch plate (A)-1	8930008601	1

\* The top panel is available completely assembled, i.e., with parts ㉒, ㉓, ㉔, ㉕, and ㉖ built-in.

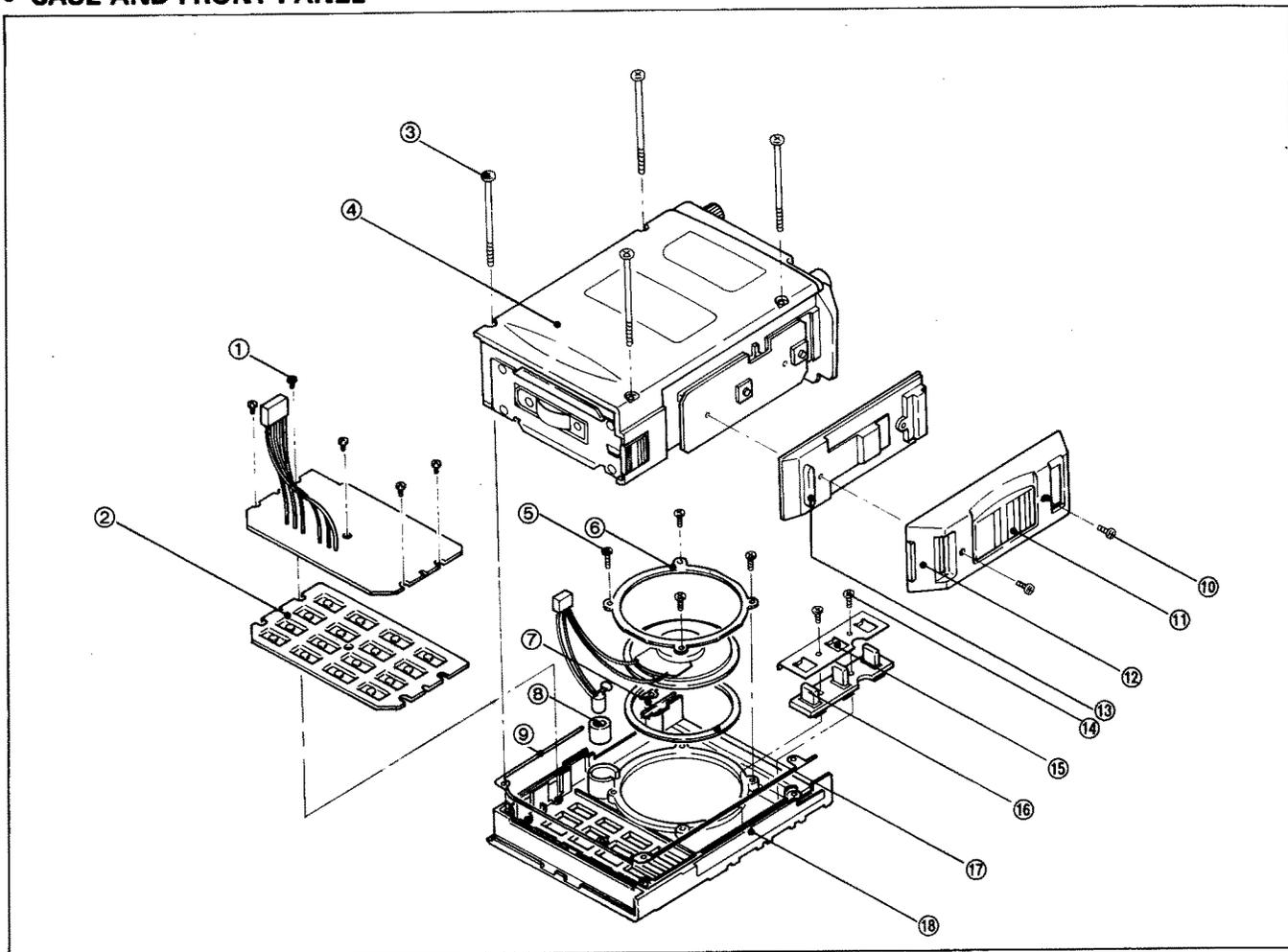
#05, 06, 07, 08, 09: 8210002870

#02, 04 : 8210003060

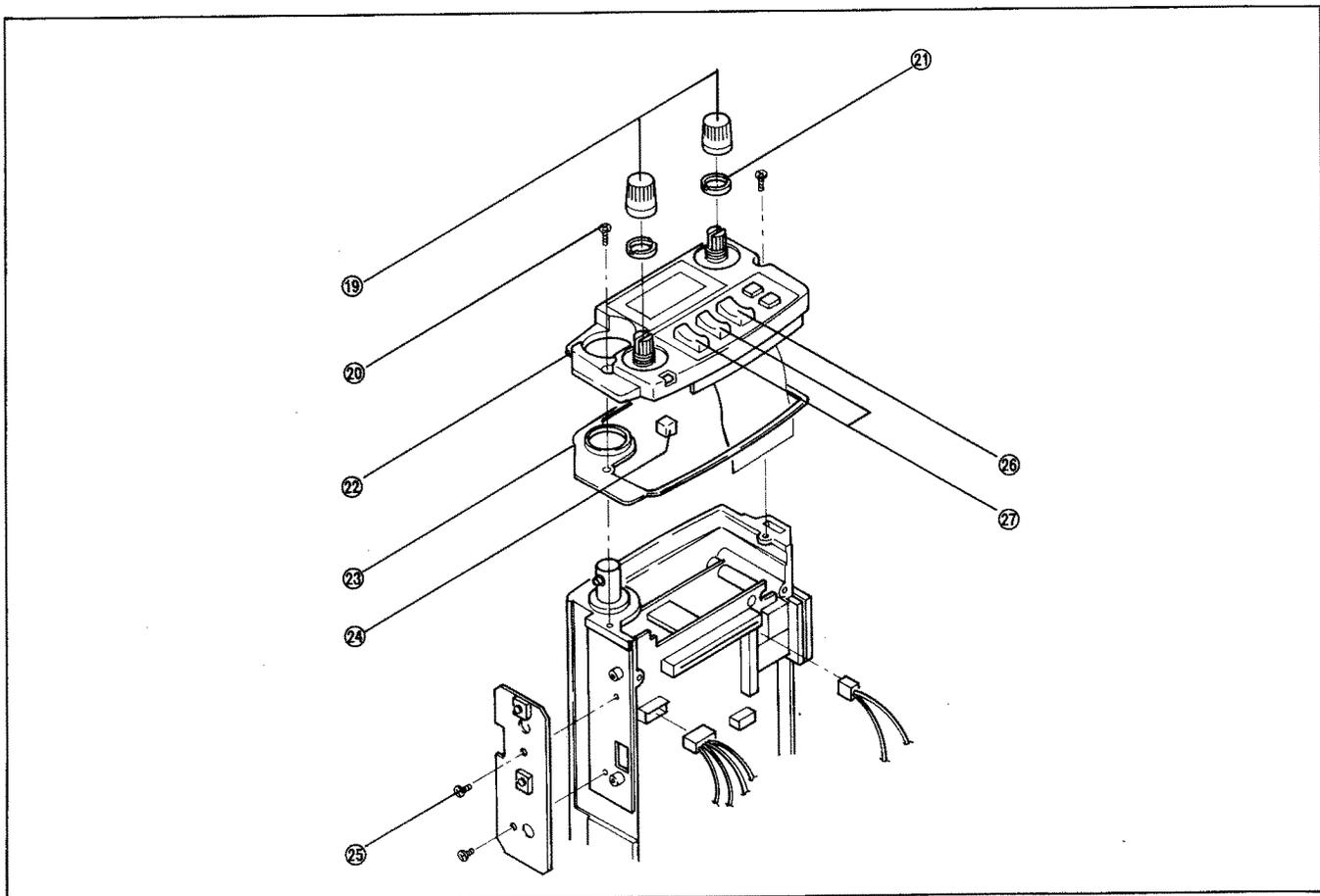
**Screw type**  
**Head style of screws**

Screw: M2 × 6, M2 × 3, etc. Self-tapping screw: B0 2 × 4, B0 2 × 31.5, etc. Precision-type screw: No. 0-1  
PH: Pan head BuH: Button head FH: Flat head

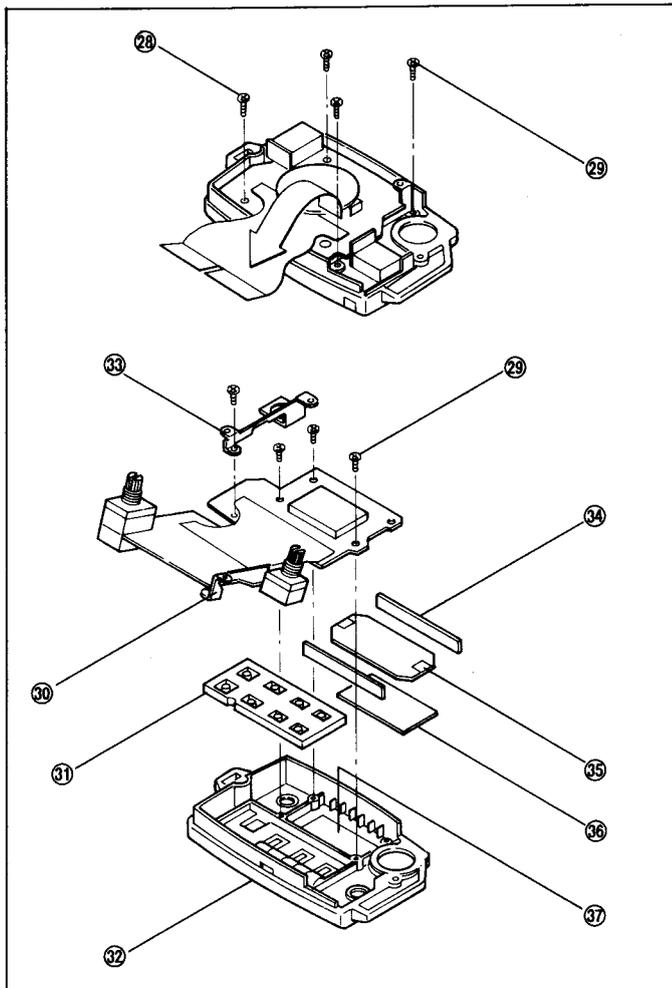
● CASE AND FRONT PANEL



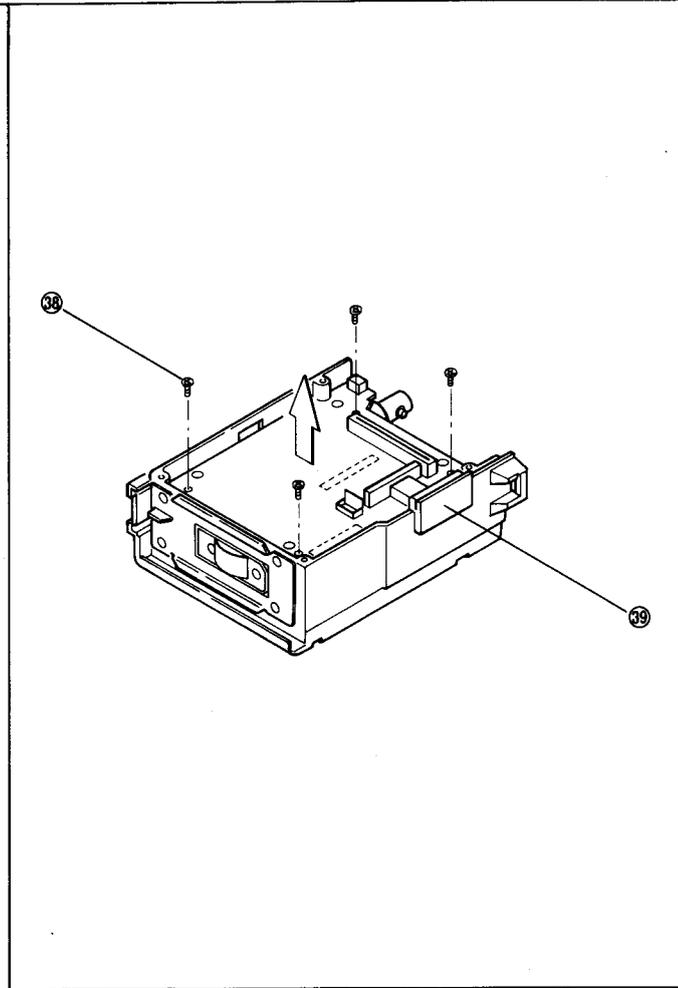
● TOP PANEL



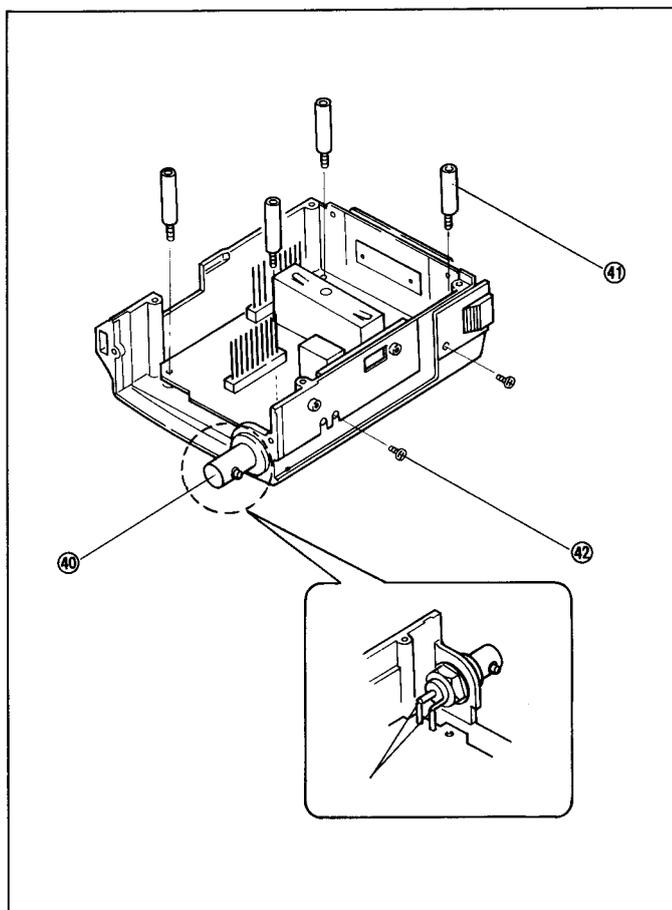
• LOGIC-A AND LOGIC-B UNITS



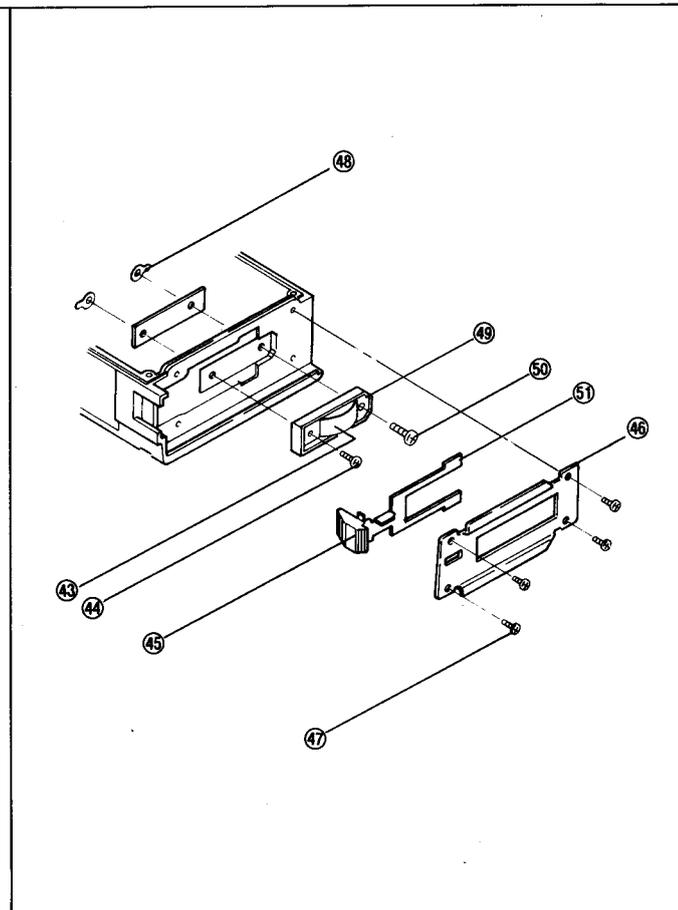
• MAIN UNIT



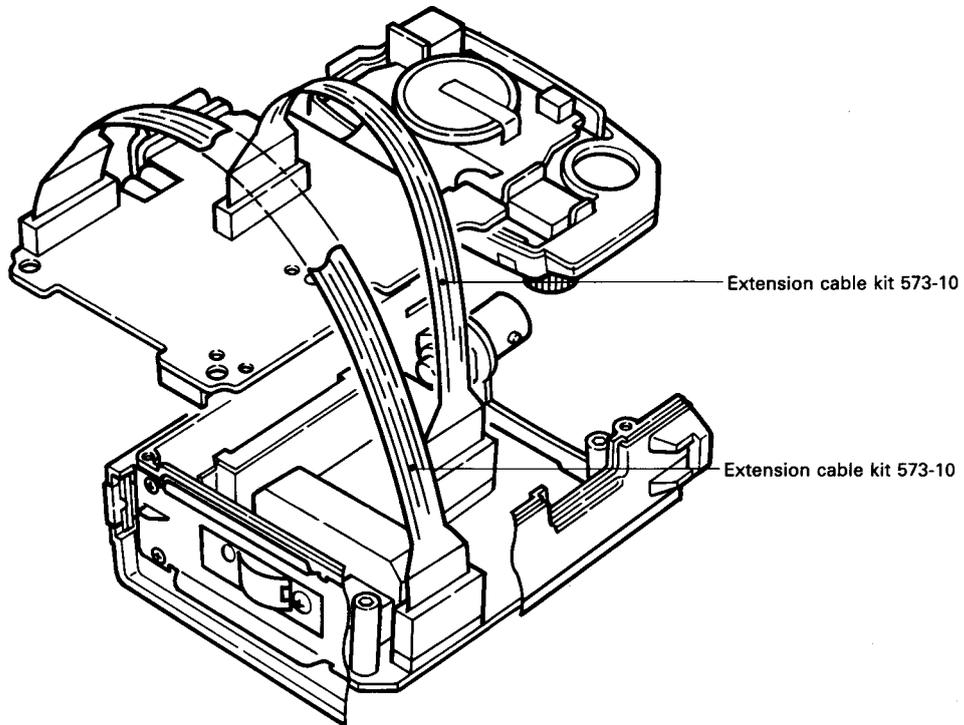
• RF UNIT



• CONTACT HOLDER



■ SEPARATING THE RF UNIT FROM THE MAIN UNIT



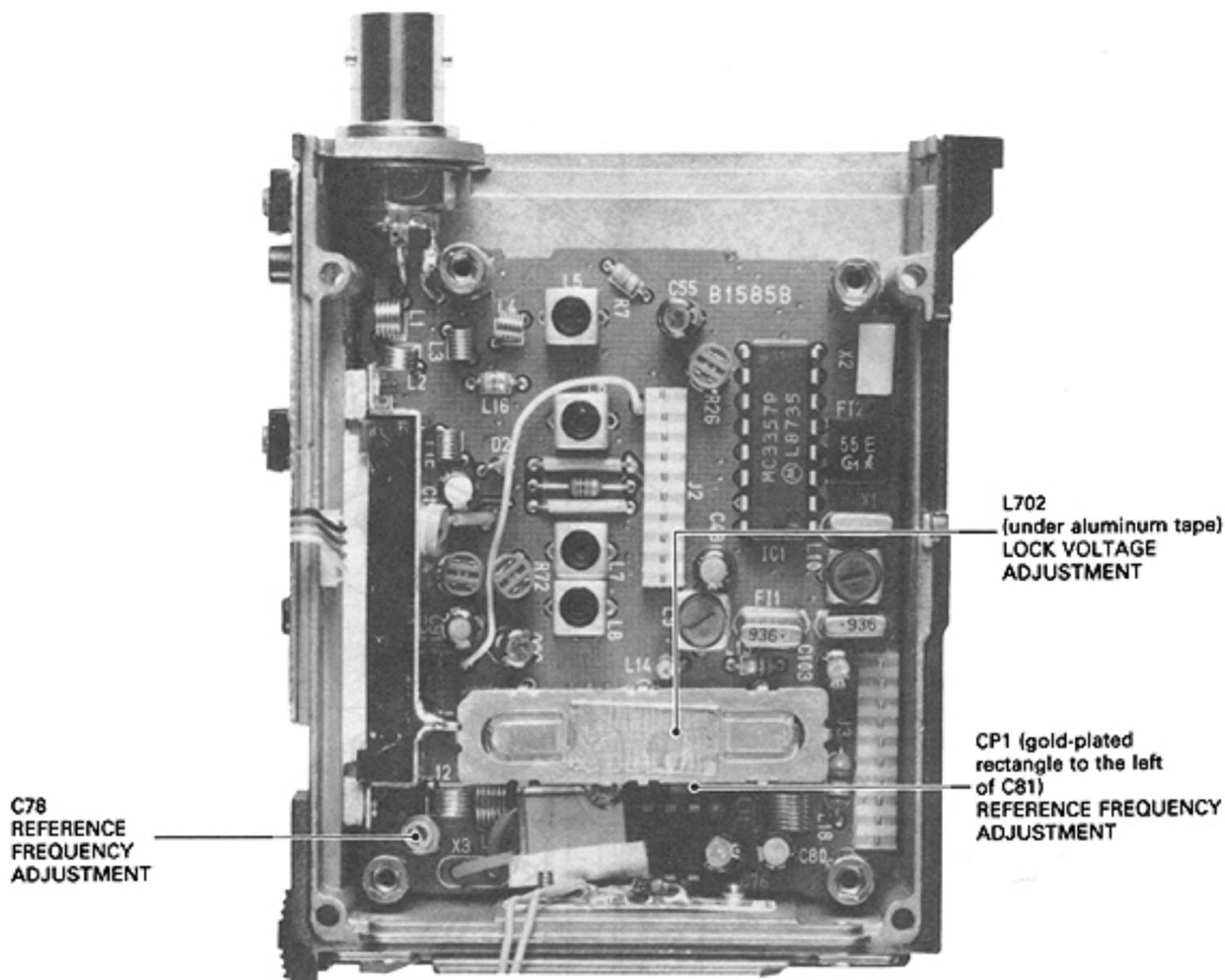
Order the extension cable kits from an authorized Icom Dealer.

**SECTION 6 ADJUSTMENT PROCEDURES**

**6 - 1 PLL ADJUSTMENT**

TEST INSTRUMENTS REQUIRED		MEASUREMENT CONNECTION LOCATION				
(1) AC POWER SUPPLY • Output voltage : 13.2 V DC • Current capacity : 3 A or more  (2) FREQUENCY COUNTER • Frequency range : 0.1~180 MHz • Frequency accuracy : ±1 ppm or better • Sensitivity : 100 mV or better  (3) DC VOLTMETER • Input impedance : 50 kΩ/DC or better		<p style="text-align: center;">To separate the RF UNIT from the MAIN UNIT, see the diagram on p. 6-1 (fold-out).</p>				
ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT	
		UNIT	LOCATION		UNIT	ADJUST
REFERENCE FREQUENCY	• Connect a 50 Ω dummy load. • Frequency: 146.00 MHz • Transmit	Top panel	Loose couple the frequency counter to the dummy load.	146.00 MHz	RF	C78
LOCK VOLTAGE	• Frequency: 146.00 MHz • Receive	RF	Connect the voltmeter to CP1.	1.5 V	VCO	L702

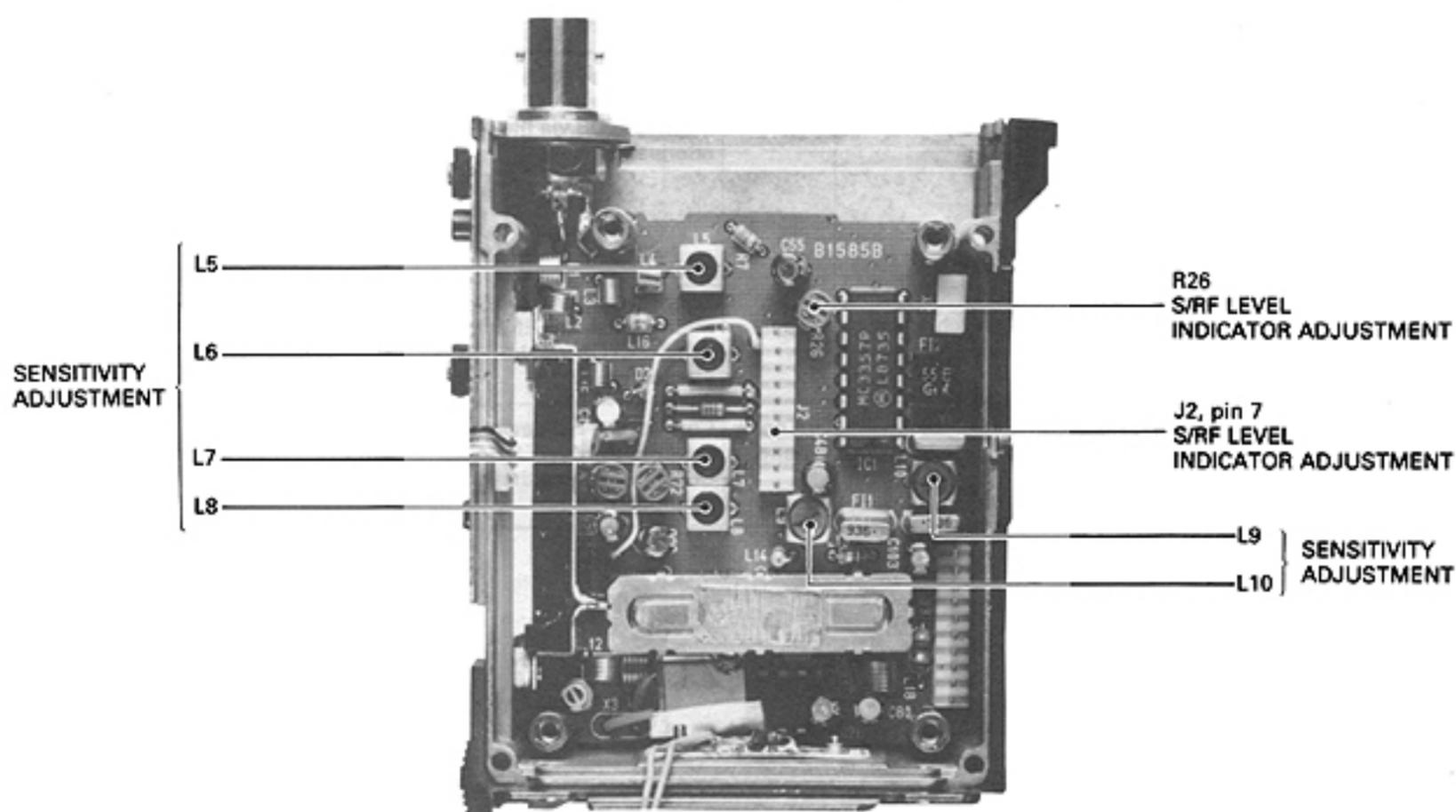
**RF AND VCO UNITS**



## 6 - 2 RECEIVER ADJUSTMENT

TEST INSTRUMENTS REQUIRED		MEASUREMENT CONNECTION LOCATION					
(1) AC POWER SUPPLY • Output voltage : 13.2 V DC • Current capacity : 3 A or more  (2) STANDARD SIGNAL GENERATOR (SSG) • Frequency range : 0.1~180 MHz • Output level : -127~-17 dBm (0.1 μV~32 mV)  (3) DISTORTION METER • Frequency range : 1 kHz±10 Hz • Measuring range : 1~100%  (4) EXTERNAL SPEAKER • Impedance : 8 Ω  (5) DC VOLTMETER • Input impedance : 50 kΩ/DC or better		<p>To separate the RF UNIT from the MAIN UNIT, see the diagram on p. 6-1 (fold-out).</p>					
ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT		
		UNIT	LOCATION		UNIT	ADJUST	
SENSITIVITY	1	NOTE: When the sensitivity is better than 0.25 μV (12 dB SINAD) on all frequencies, the following sensitivity adjustment is unnecessary. Skip to the S/RF level indicator adjustment (below).					
	2	• Frequency: 145.00 MHz • Receiving • Apply an RF signal to the ANTENNA CONNECTOR. Frequency : 145.00 MHz Level : -119 dBm (0.25 μV) Modulation : 1 kHz Deviation : ±3.5 kHz • Squelch control: maximum counter-clockwise	Side panel	Connect the voltmeter to J2, pin 7.	Peak voltage	RF	L5, L6, L7, L8, L9, L10
	2	Same as above.		Connect the distortion meter to the EXT. SP JACK with an 8 Ω load.	Minimum distortion	RF	L7
S/RF LEVEL INDICATOR	• Apply an RF signal to the ANTENNA CONNECTOR: Level : -101 dBm (2.0 μV) Modulation : 1 kHz Deviation : ±3.5 kHz	Top panel	FUNCTION DISPLAY	Two bars	RF	R26	

### RF UNIT

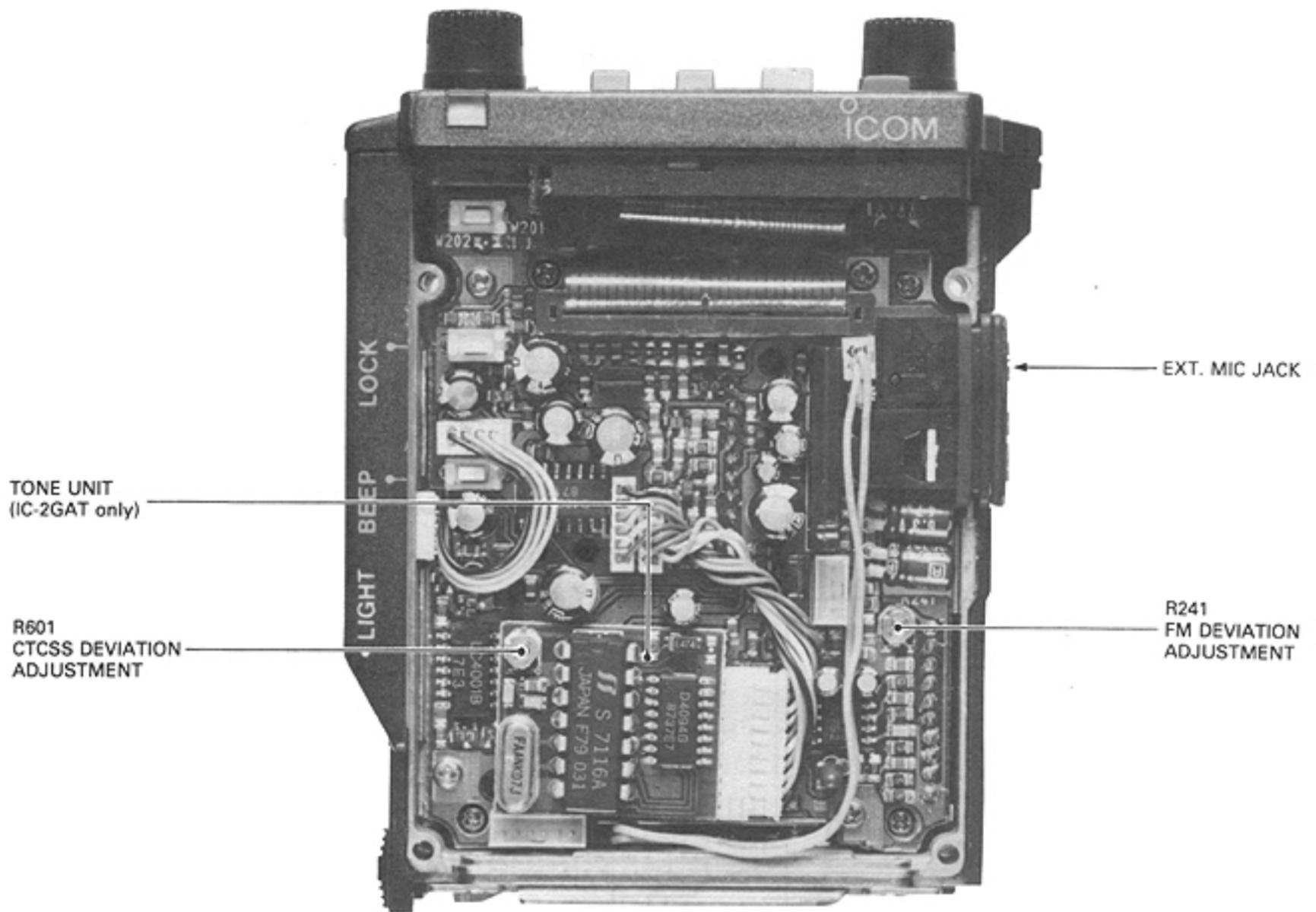


### 6 - 3 TRANSMITTER ADJUSTMENT

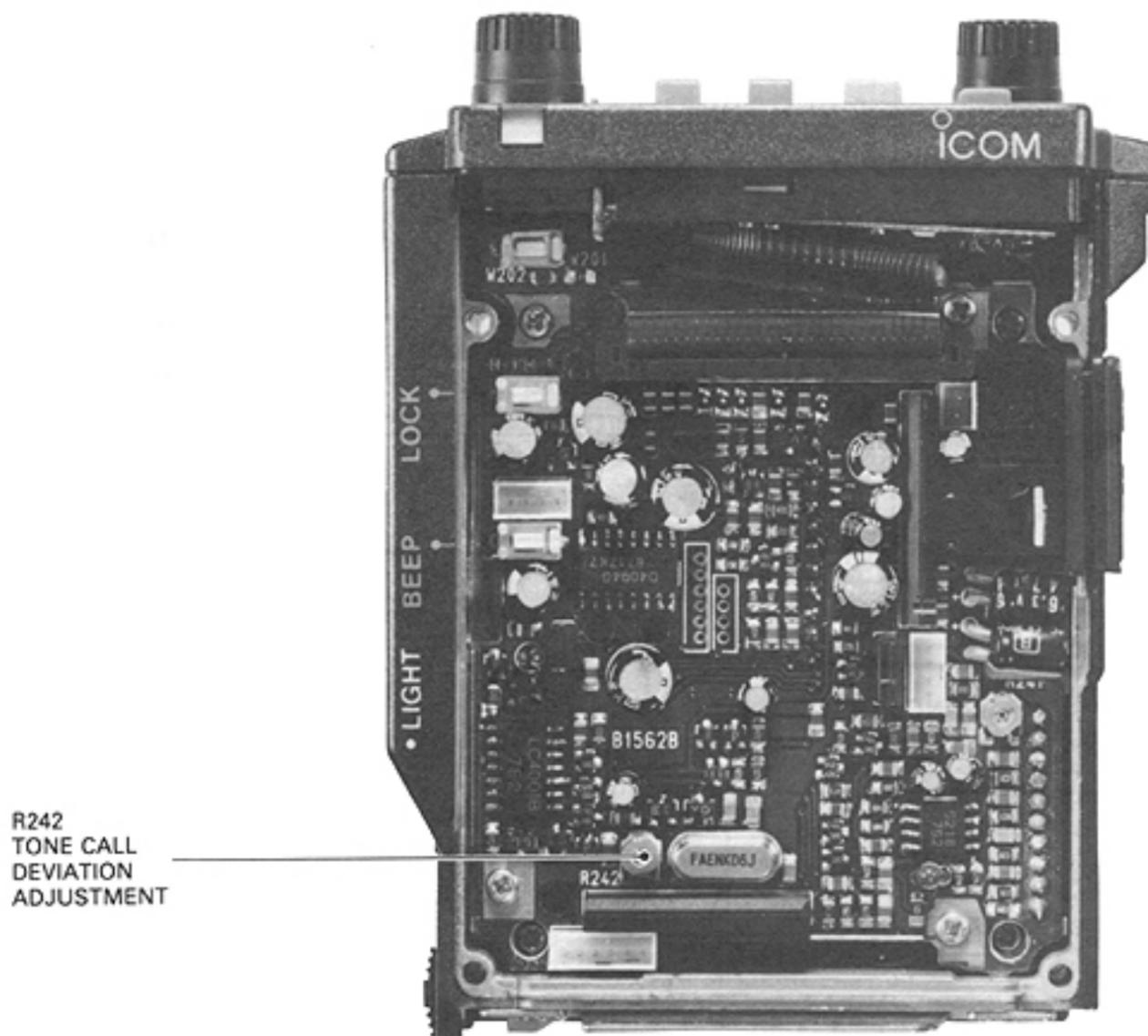
TEST INSTRUMENTS REQUIRED	MEASUREMENT CONNECTION LOCATION
<p>(1) AC POWER SUPPLY</p> <ul style="list-style-type: none"> <li>• Output voltage : 8~13.2 V DC (selectable)</li> <li>• Current capacity : 3 A or more</li> </ul> <p>(2) RF POWER METER (TERMINATED-TYPE)</p> <ul style="list-style-type: none"> <li>• Measuring range : 1~10 W</li> <li>• Frequency range : 120~180 MHz</li> <li>• Impedance : 50 Ω</li> <li>• SWR : Less than 1.2:1</li> </ul> <p>(3) AF GENERATOR (AG)</p> <ul style="list-style-type: none"> <li>• Frequency range : 200~2000 Hz</li> <li>• Output level : 0~200 mV</li> </ul> <p>(4) AC MILLI-VOLTMETER</p> <ul style="list-style-type: none"> <li>• Measuring range : 2~200 mV</li> </ul> <p>(5) FM DEVIATION METER</p> <ul style="list-style-type: none"> <li>• Minimum frequency : 180 MHz</li> <li>• Measuring range : ±10 kHz</li> </ul> <p>(6) ATTENUATOR</p> <ul style="list-style-type: none"> <li>• Attenuation ratio : 30 or 40 dB</li> </ul>	<p>To separate the RF UNIT from the MAIN UNIT, see the diagram on p. 6-1 (fold-out).</p>

ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT	
		UNIT	LOCATION		UNIT	ADJUST
OUTPUT POWER	1	Top panel	Connect the RF power meter to the ANTENNA CONNECTOR.	7 W	RF	R69
	2			1 W	RF	R72
	3			More than 2.5 W		Verify
	4			More than 2.0 W		Verify
FM DEVIATION	<ul style="list-style-type: none"> <li>• Frequency: 145.00 MHz</li> <li>• FM deviation meter: <ul style="list-style-type: none"> <li>HPF : 50 kHz</li> <li>LPF : 20 kHz</li> </ul> </li> <li>Deemphasis: OFF</li> <li>Detector : (P-P)/2</li> <li>• Apply an AF signal to the EXT. MIC JACK: 1 kHz, 40 mV (USA version: 1 kHz, 100 mV)</li> </ul>	Top panel	Connect the FM deviation meter to the ANTENNA CONNECTOR via the attenuator.	±4.8 kHz	MAIN	R241
CTCSS DEVIATION (IC-2GAT only)	<ul style="list-style-type: none"> <li>• Frequency: 145.00 MHz</li> <li>• Set the tone frequency to 88.5 MHz.</li> <li>• HPF : OFF</li> <li>• LPF : 20 kHz</li> <li>De-emphasis : OFF</li> <li>Detector : (P-P)/2</li> <li>• Cut off microphone input</li> <li>• Transmit</li> </ul>	Top panel	Connect the FM deviation meter to the ANTENNA CONNECTOR via the attenuator.	±0.75 kHz	TONE UNIT	R601
DTMF DEVIATION (IC-2GAT only)	<ul style="list-style-type: none"> <li>• Frequency: 145.00 MHz</li> <li>• While pushing the [PTT] switch, push and hold "D" on the keypad.</li> </ul>	Top panel	Connect the FM deviation meter to the ANTENNA CONNECTOR via the attenuator.	±3.5 kHz	DTMF UNIT	R801
TONE CALL DEVIATION (IC-2GE only)	<ul style="list-style-type: none"> <li>• Frequency: 145.00 MHz</li> <li>• Push and hold [T. CALL].</li> </ul>	Top panel	Connect the FM deviation meter to the ANTENNA CONNECTOR via the attenuator.	±3.5 kHz	MAIN	R242

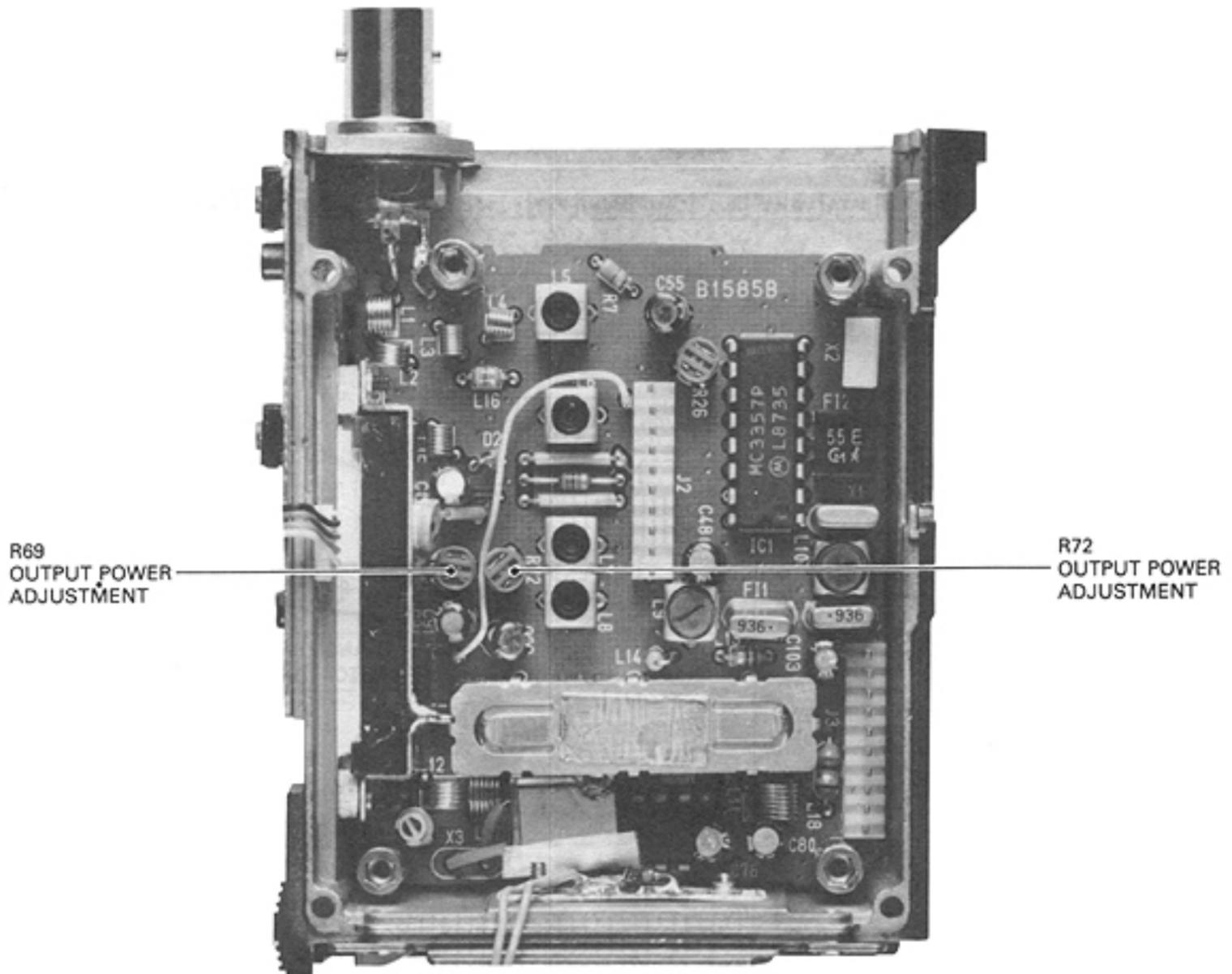
**MAIN AND TONE UNITS  
IC-2GA, IC-2GAT**



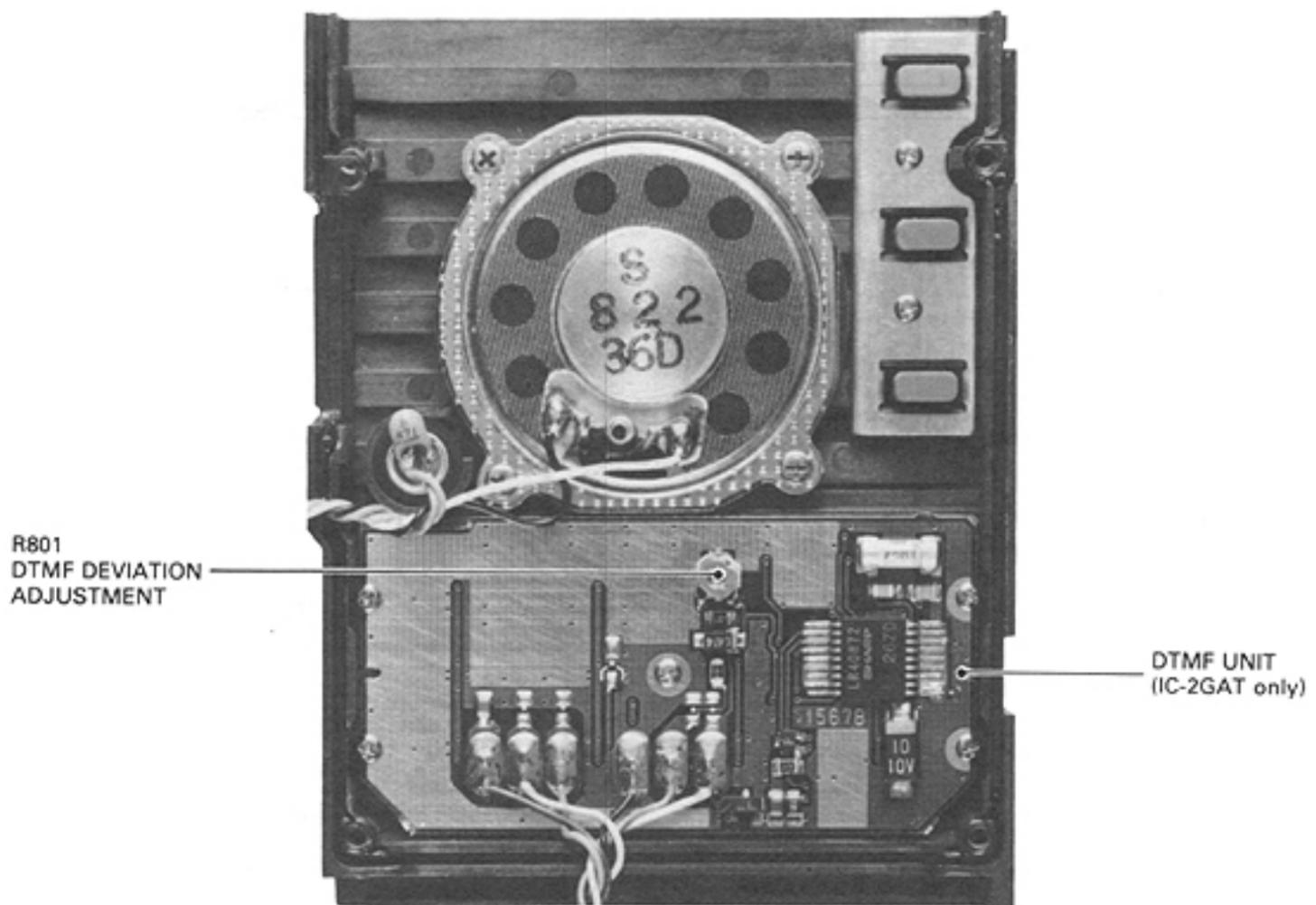
**IC-2GE**



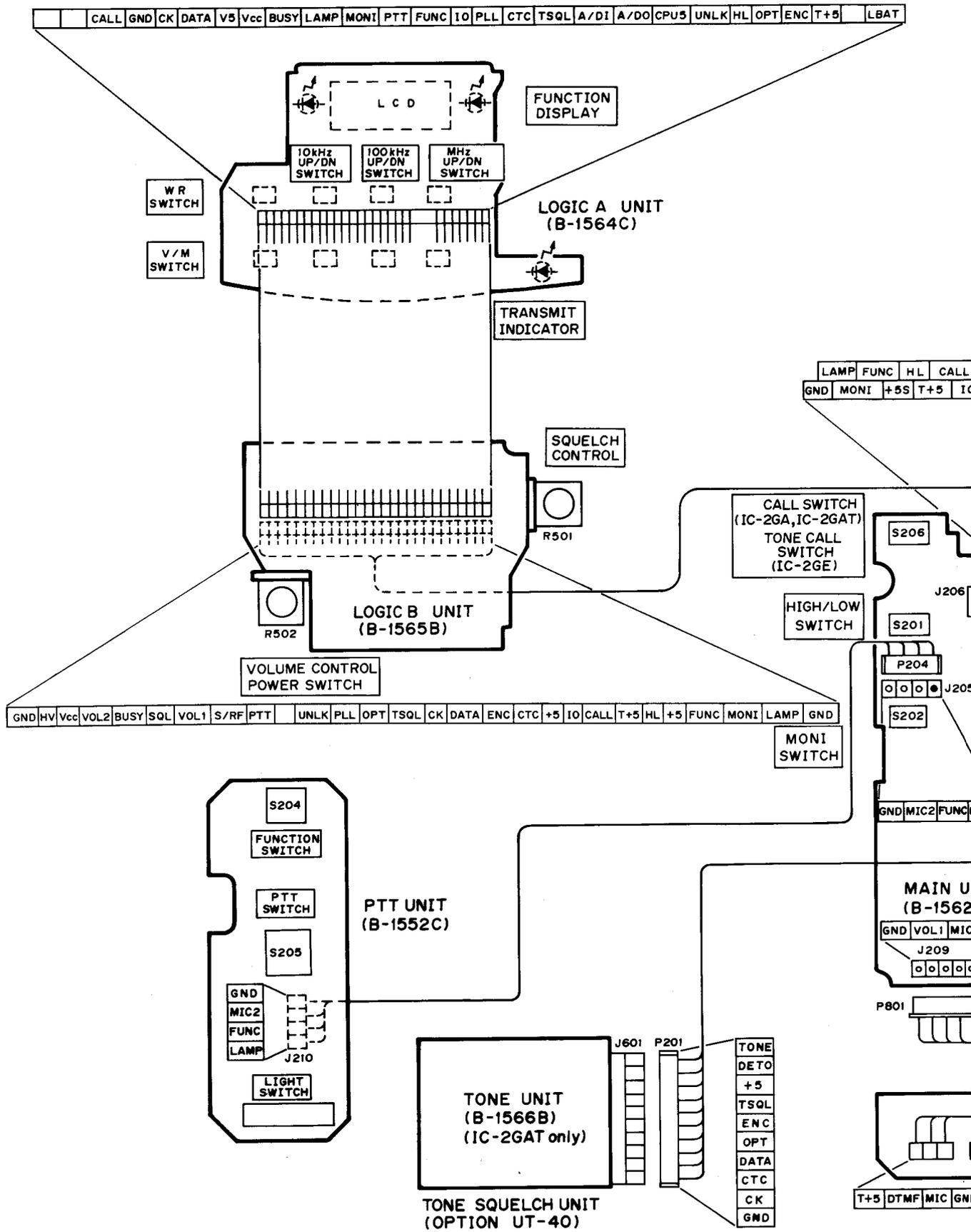
RF UNIT



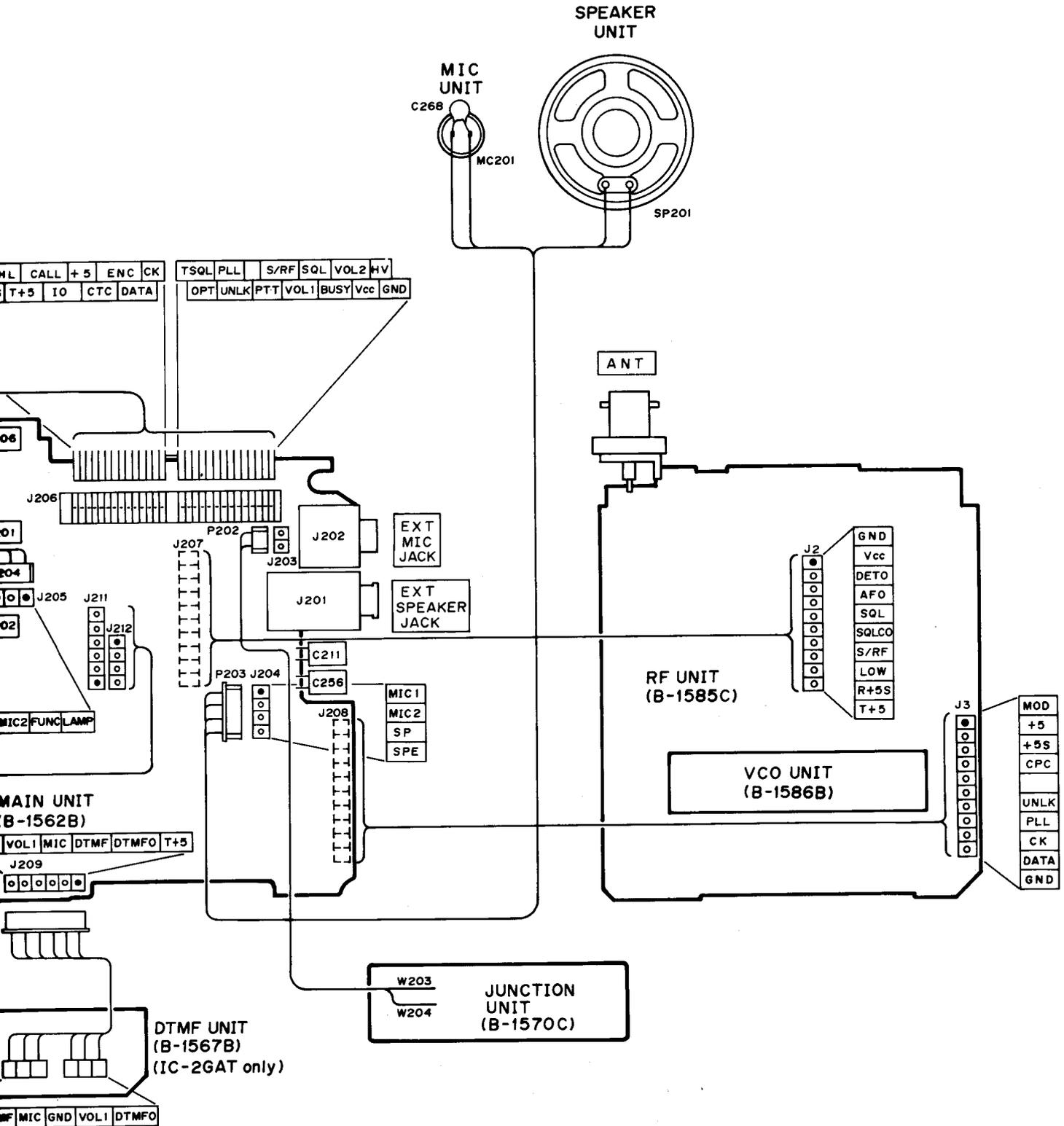
SPEAKER AND DTMF UNITS



SECTION 7 BOARD LAYOUTS

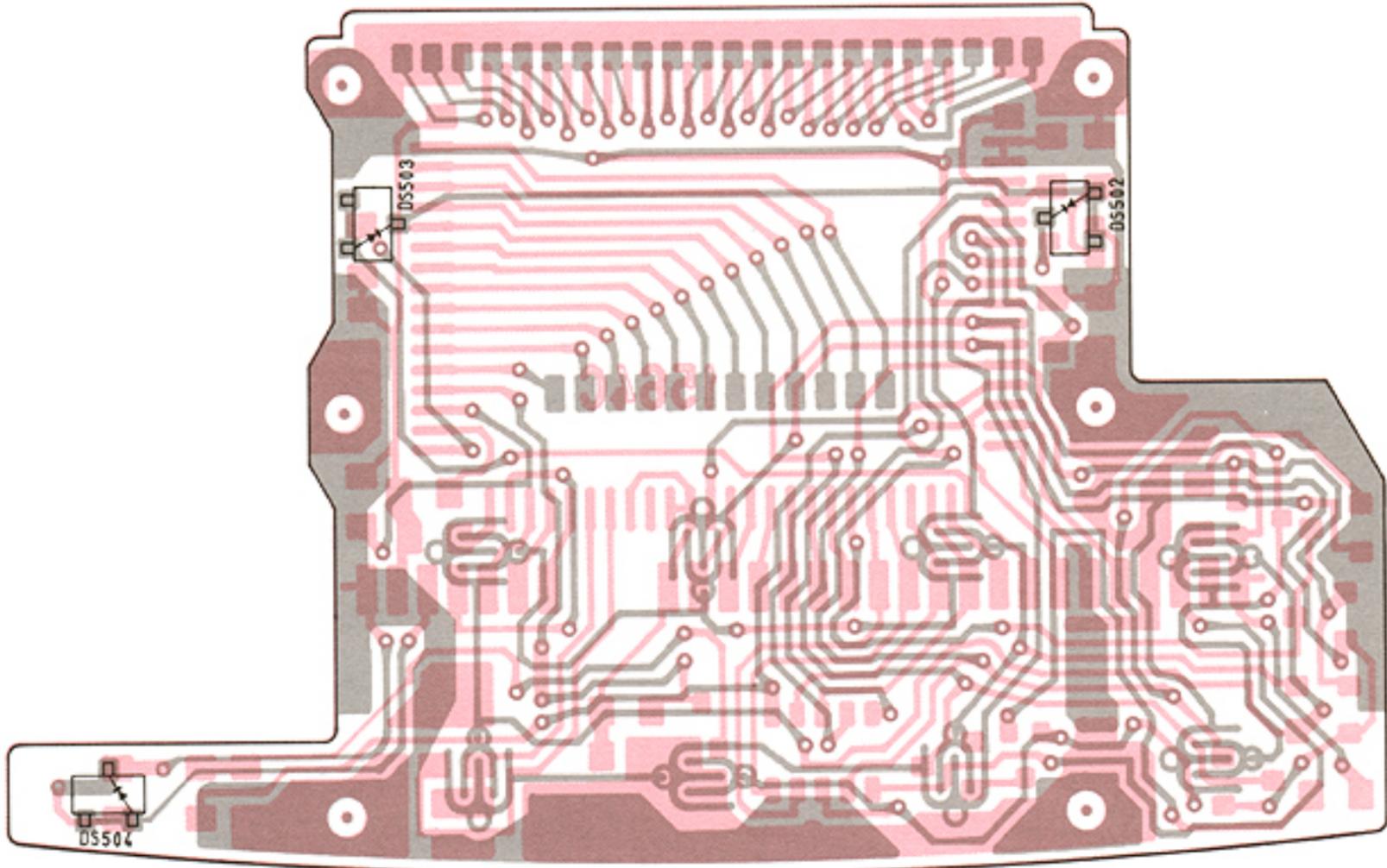


### 7 - 1 INTERCONNECTION

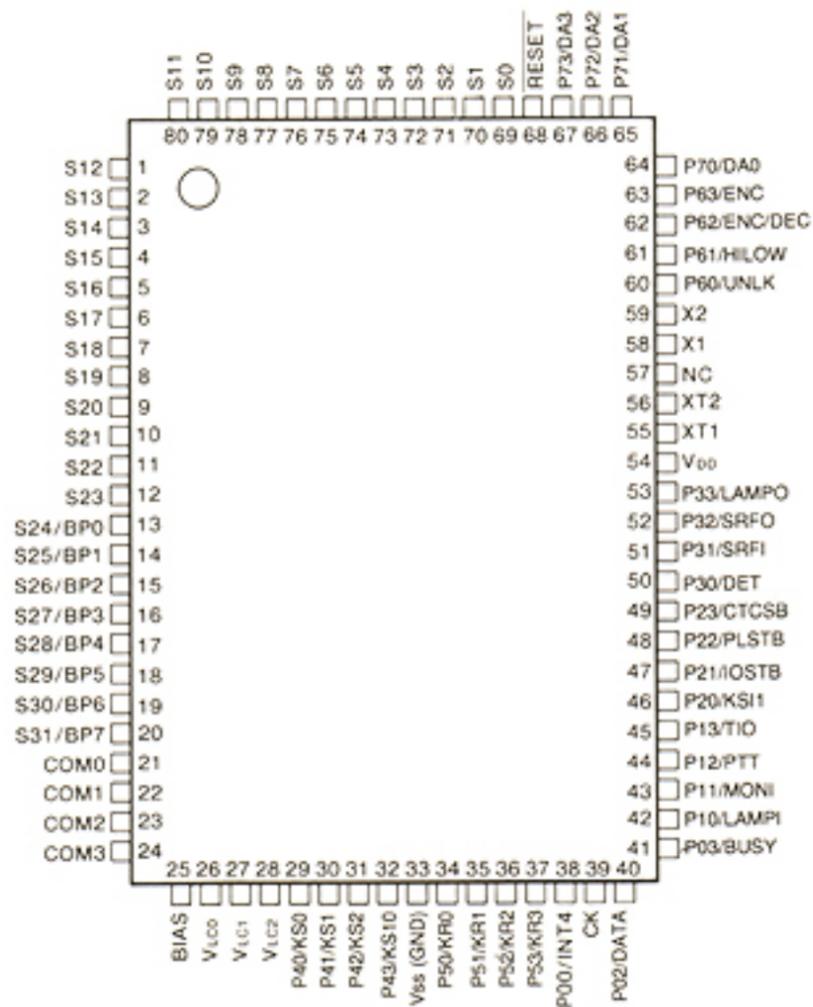


## 7 - 2 LOGIC-A UNIT

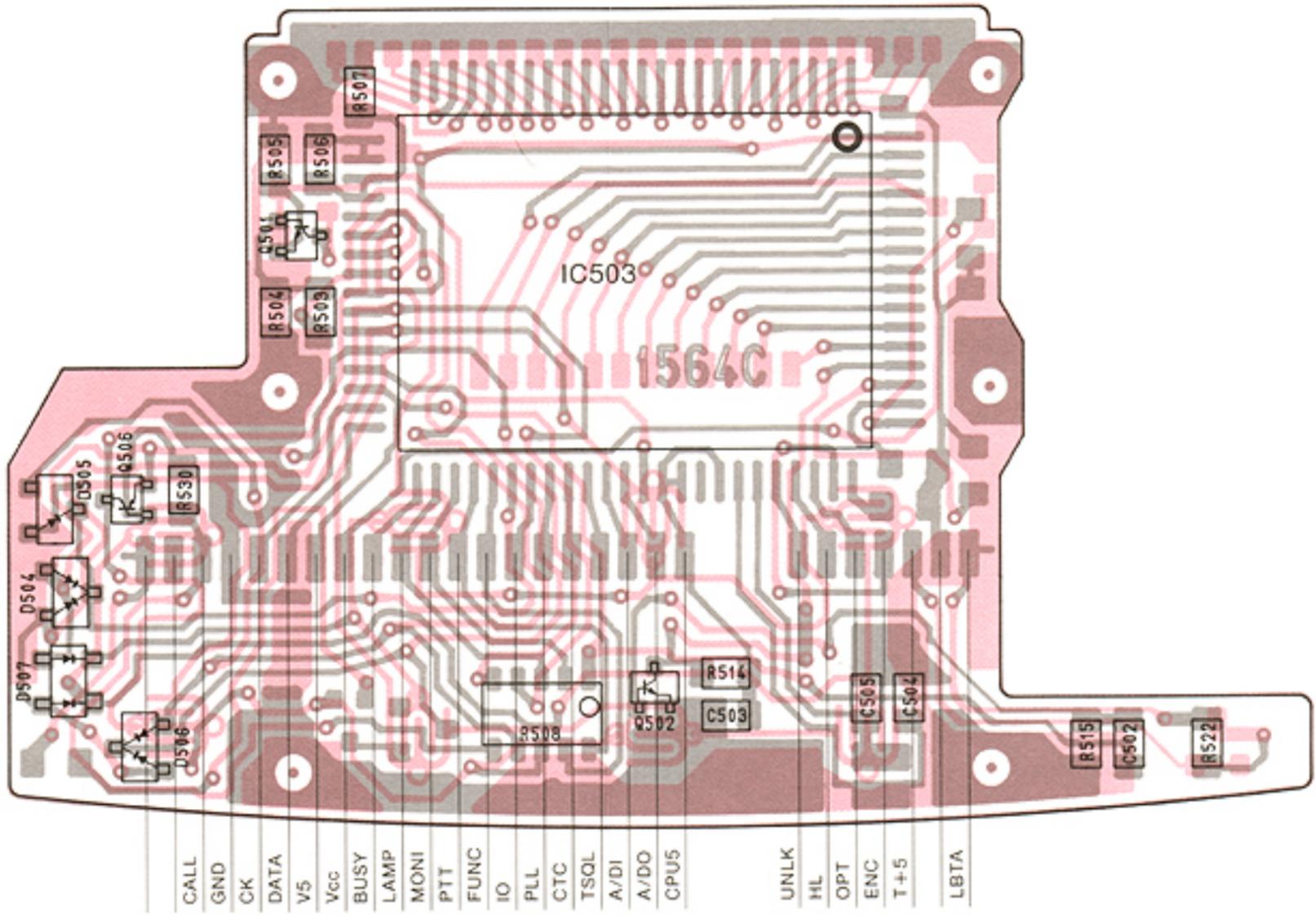
### COMPONENT SIDE



$\mu$ PD75308GF-034-3B9 IC503 (CPU)

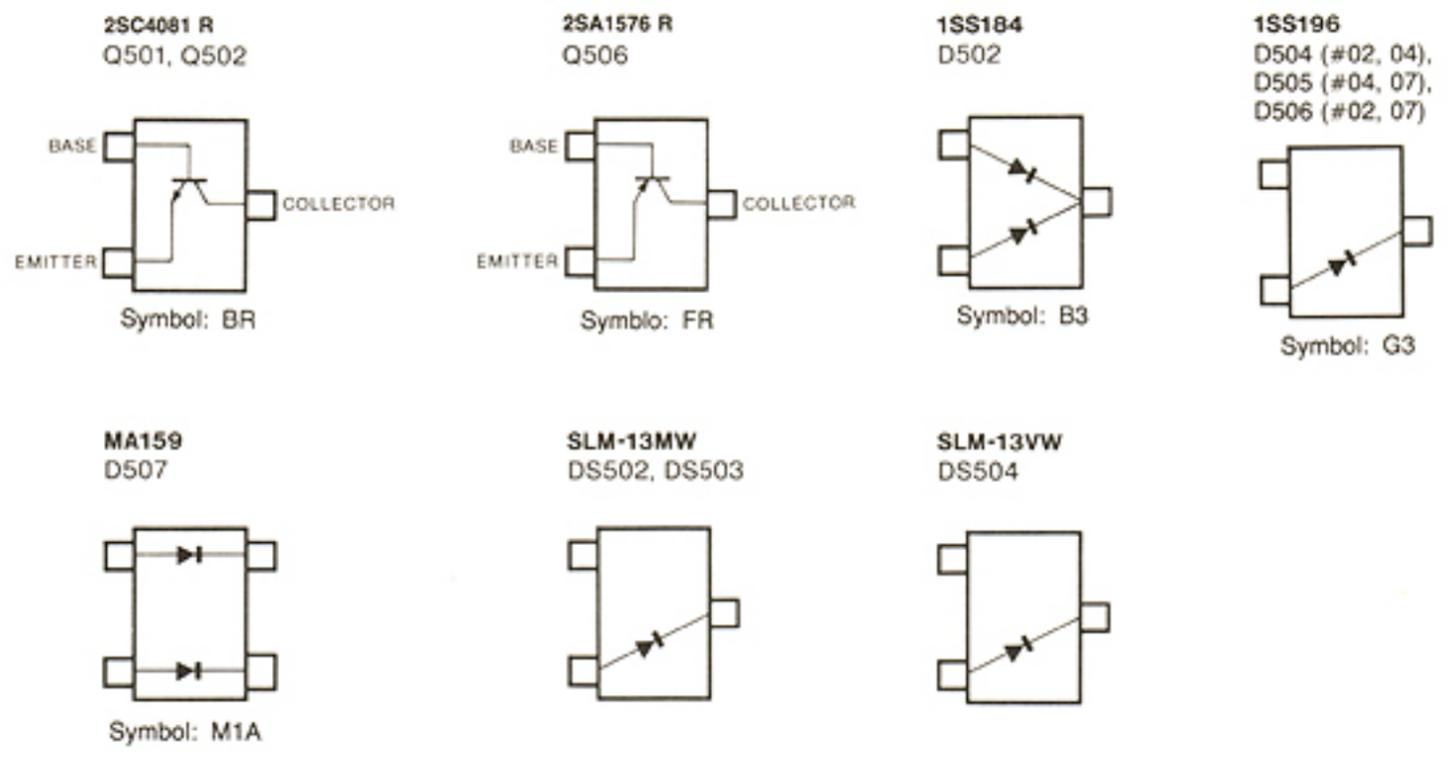


FOIL SIDE



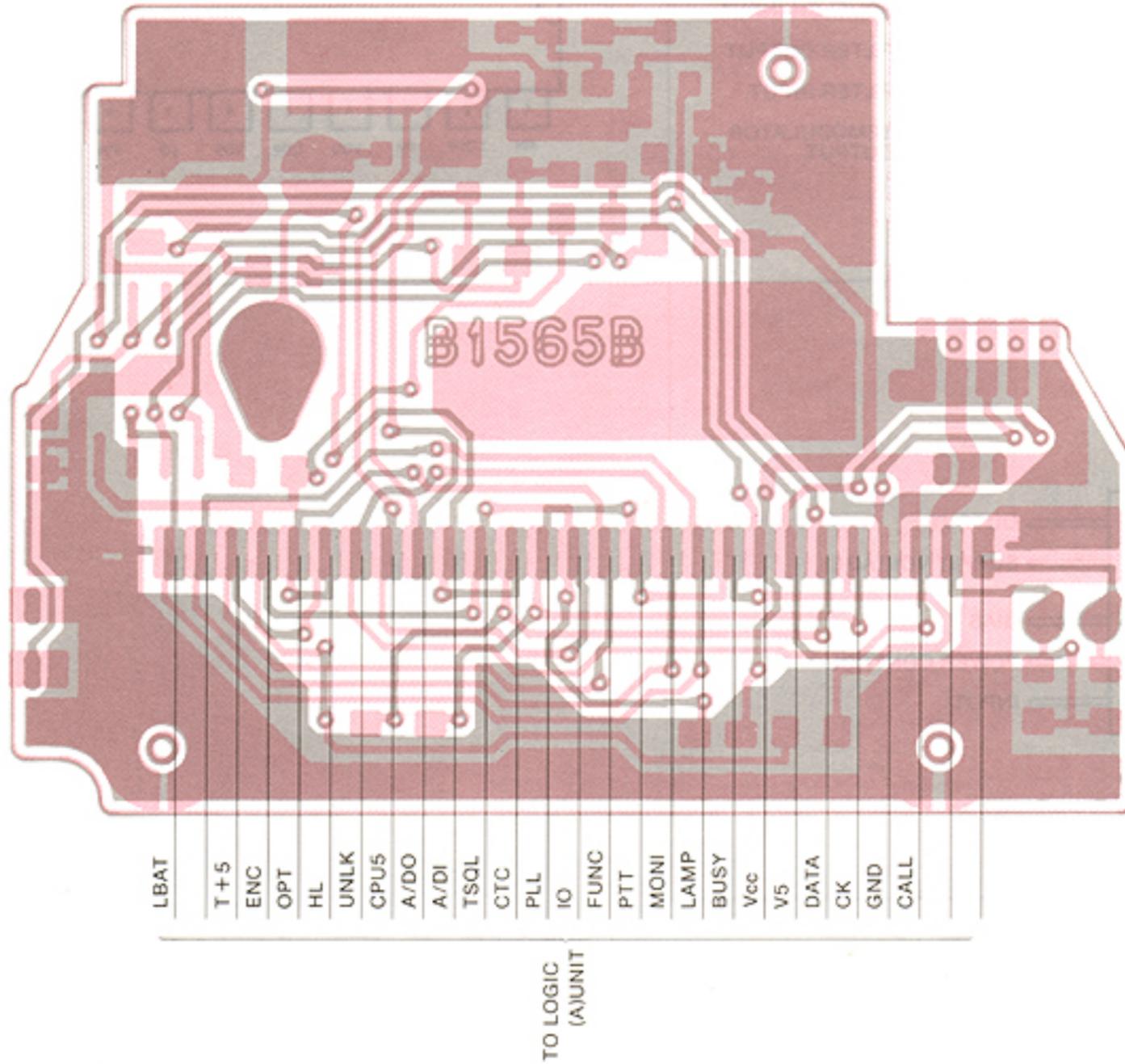
CALL	GND	CK	DATA	V5	Vcc	BUSY	LAMP	MONI	PTT	FUNC	IO	PLL	CTC	TSQL	A/DI	A/DO	CPU5	UNLK	HL	OPT	ENC	T+5	LBTA
------	-----	----	------	----	-----	------	------	------	-----	------	----	-----	-----	------	------	------	------	------	----	-----	-----	-----	------

TO LOGIC  
(BIUNIT)

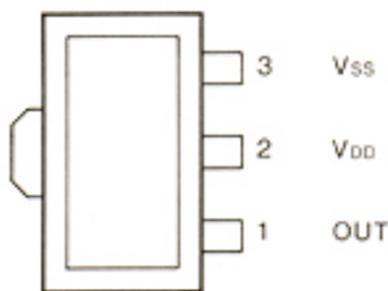


### 7 - 3 LOGIC-B UNIT

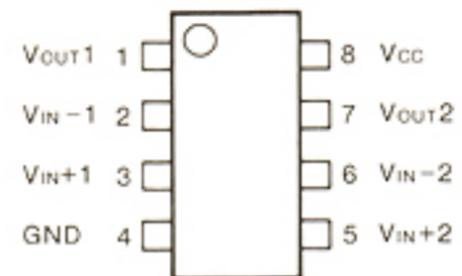
#### COMPONENT SIDE

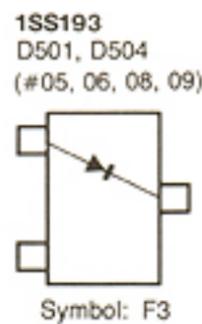
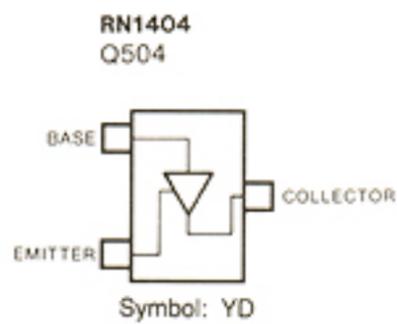
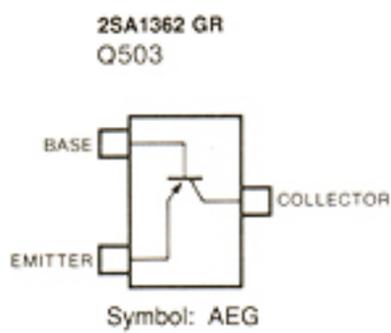
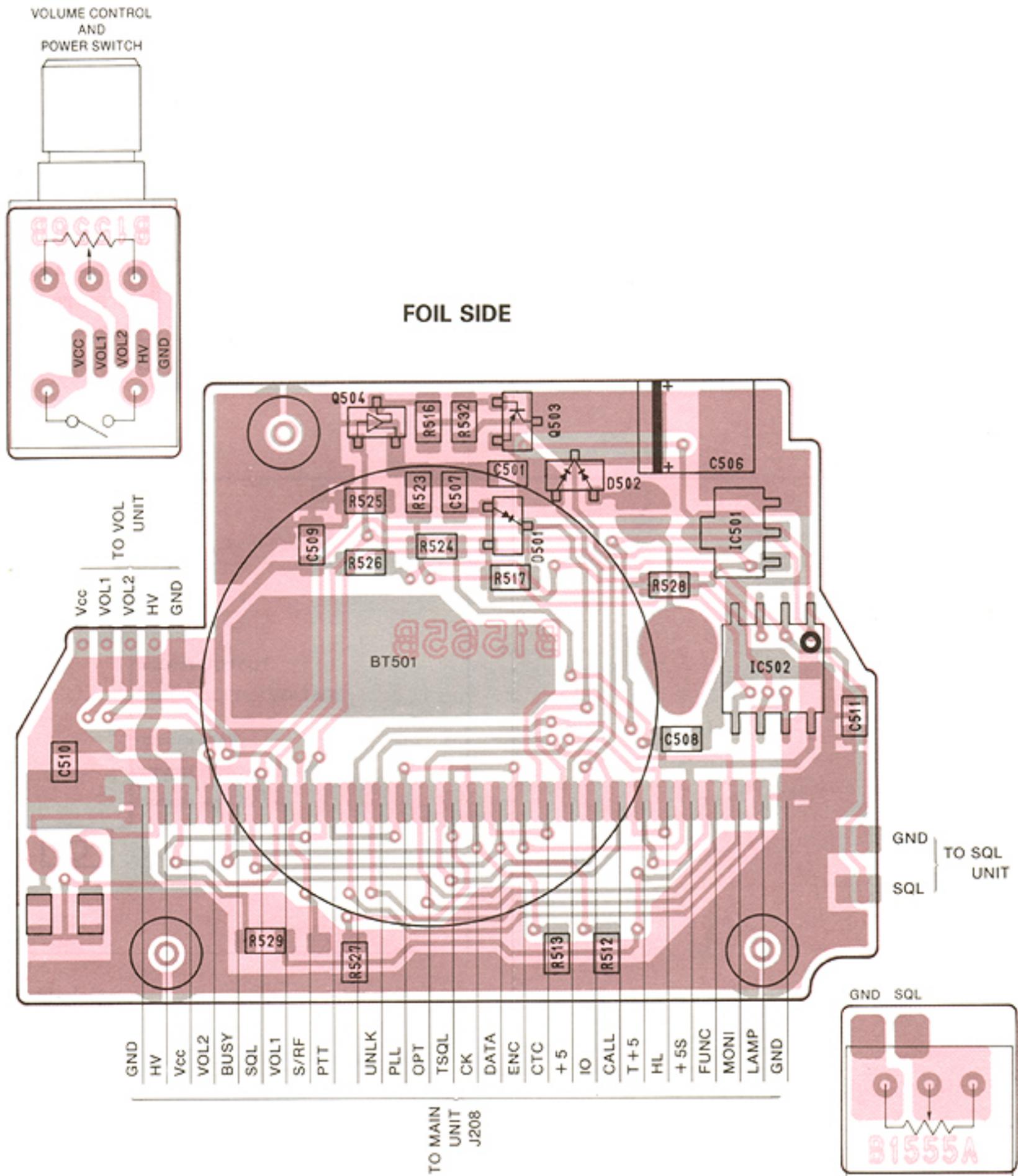


**S-8054ALB IC501  
(RESET)**

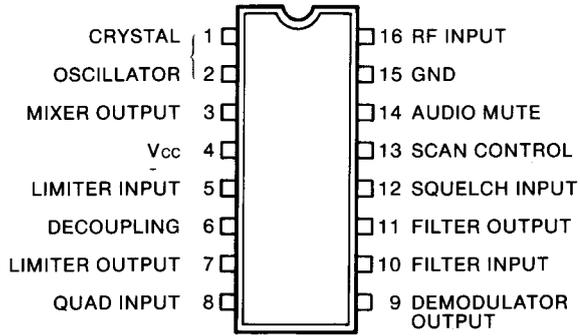


**LA6393M IC502  
(DUAL COMPARATOR)**

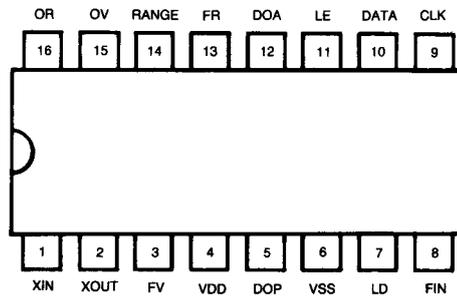




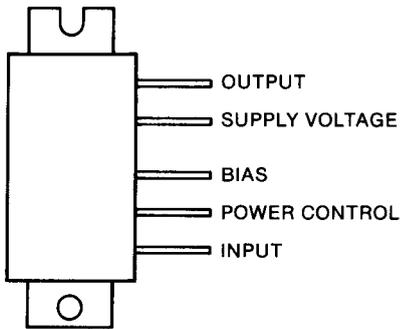
**MC3357P IC1**  
(LOW POWER FM IF)



**PLL2001 IC2**  
(PLL SYNTHESIZER)

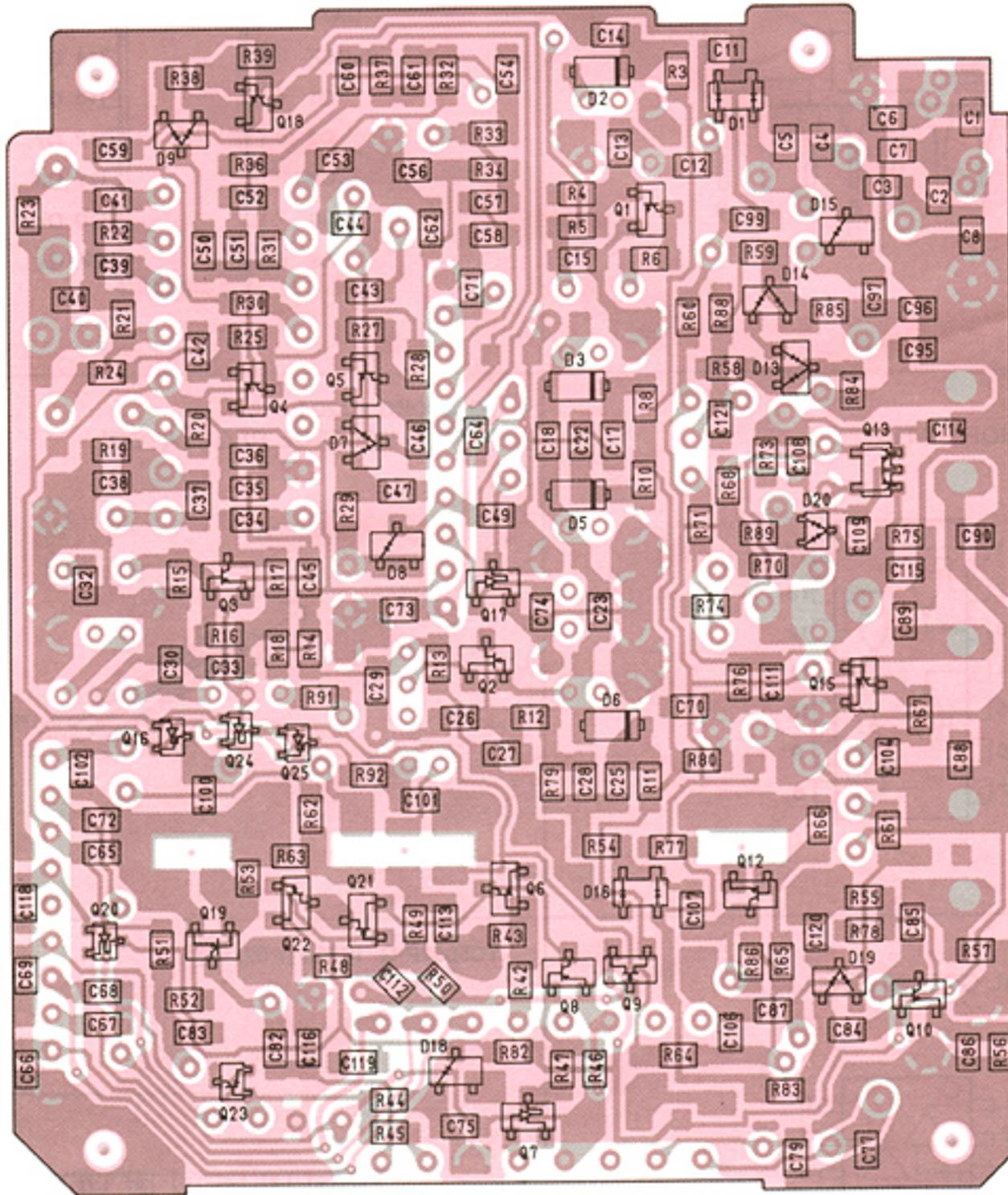


**SC-1080 IC3**  
(POWER MODULE)

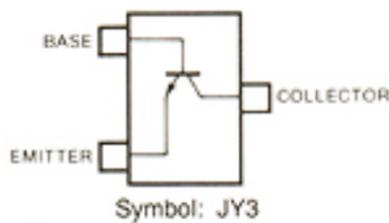


# 7 - 4 RF UNIT

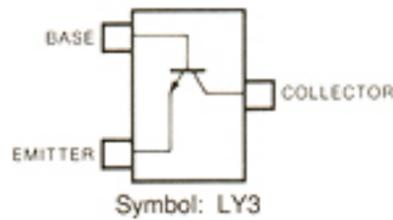
FOIL SIDE



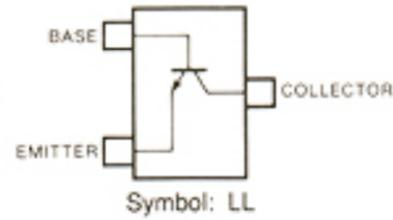
2SC3770 3  
Q3, Q4, Q5



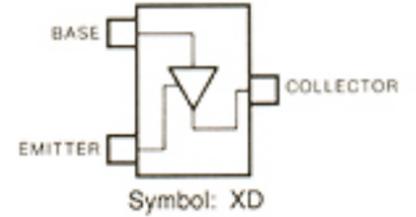
2SC3772 3  
Q1, Q10, Q12  
Q19



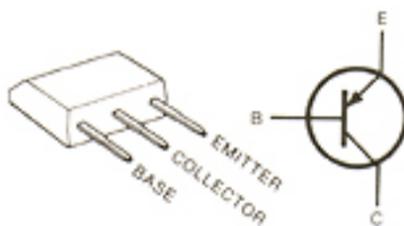
2SC2712 Y, BL  
Q6, Q15, Q18



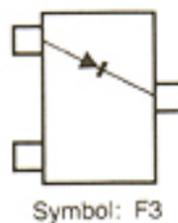
RN1404  
Q7, Q17



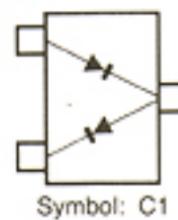
2SB909M Q/R  
Q11



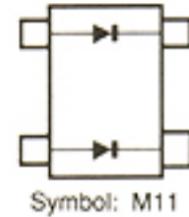
1SS193  
D8



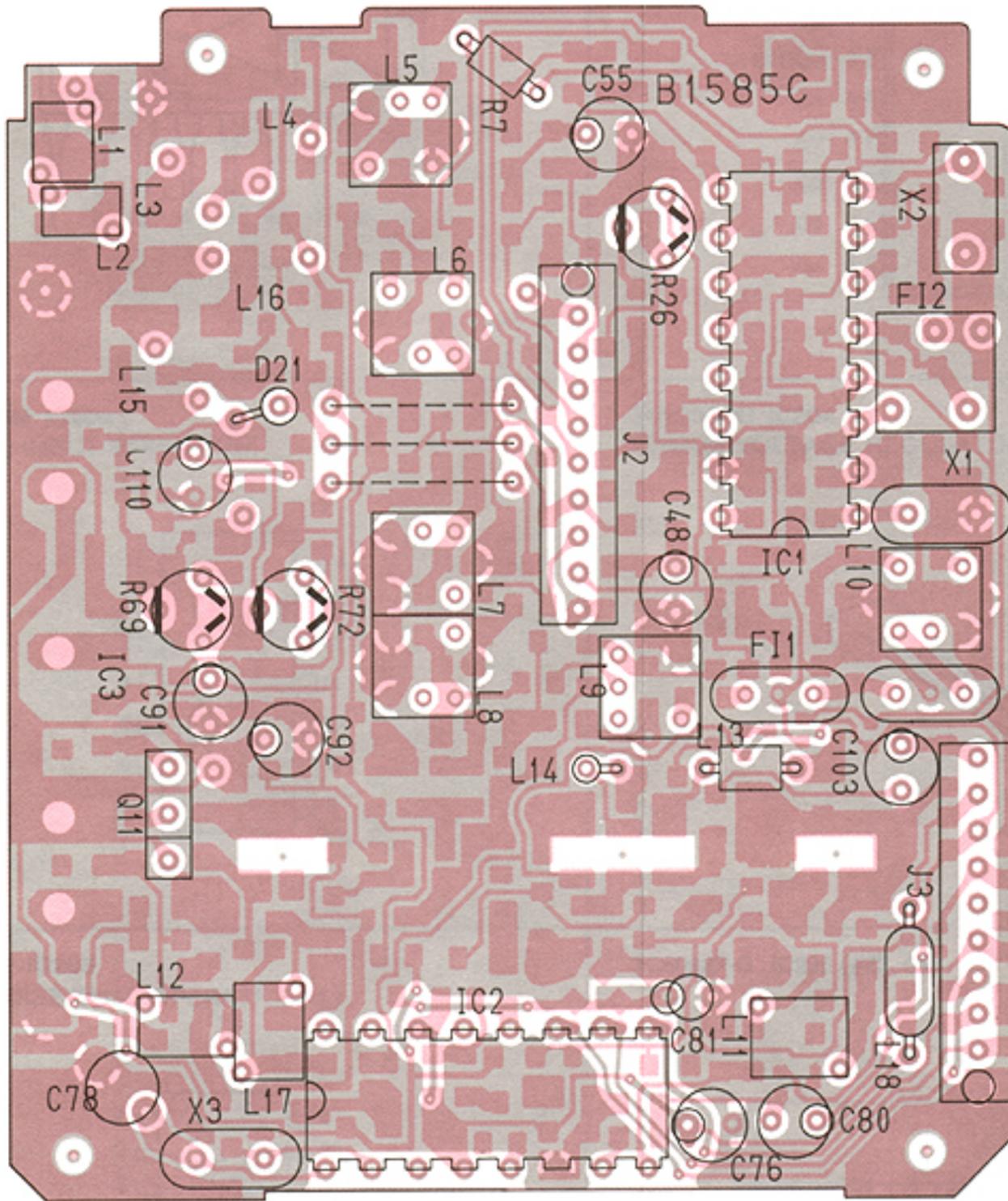
HSM88AS  
D7, D9, D13  
D14



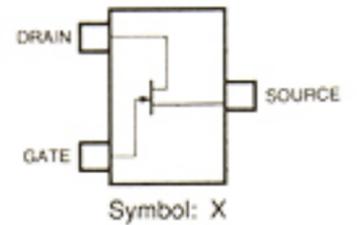
MA862  
D1, D16



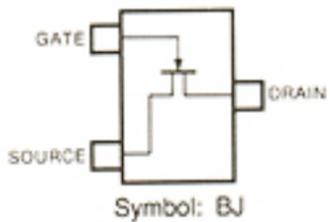
COMPONENT SIDE



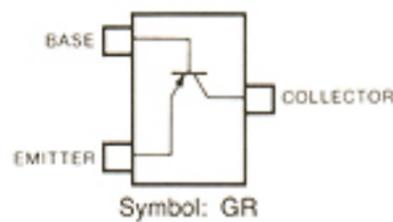
2SK209 Y  
Q9



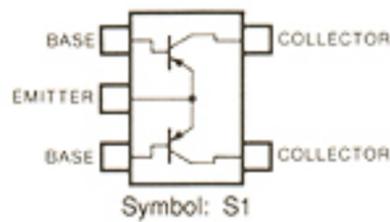
2SK536  
Q21, Q22



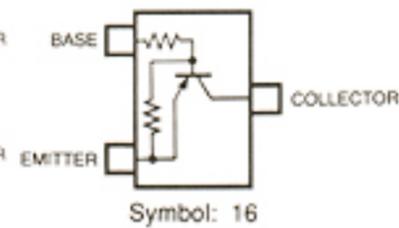
2SA1162 GR  
Q8



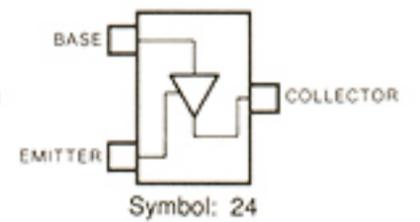
FMS1  
Q13



DTA144EU  
Q16, Q25



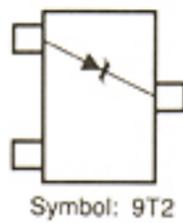
DTC114EU  
Q2, Q24



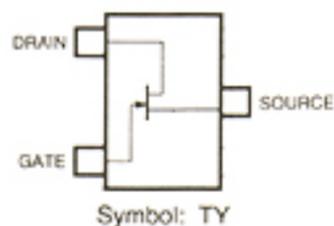
1SS153  
D15



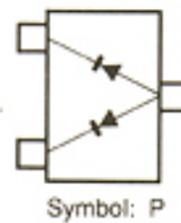
RD9.1M B2  
D18



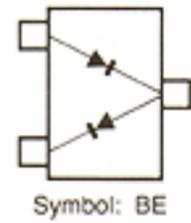
2SK302 Y  
Q2



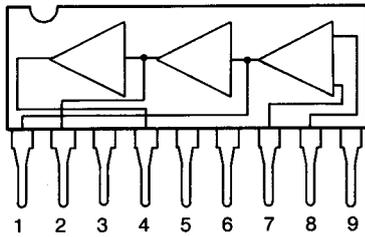
DAP202U  
D20



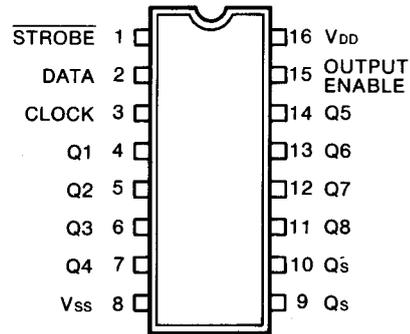
1SV172  
D19



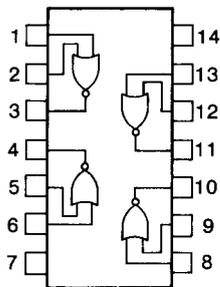
**BA526 IC201**  
(SINGLE POWER AMPLIFIER)



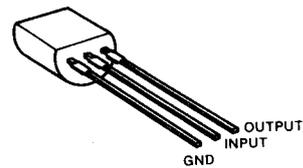
**μPD4094BG IC202**  
(8 STAGE SHIFT/STORE BUS REGISTER)



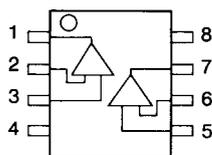
**LC4001BM IC203**  
(QUAD 2 INPUT NOR GATE)



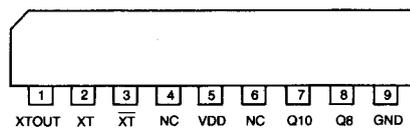
**S81250HG IC204**  
(C-MOS VOLTAGE REGULATOR)



**M5218FP IC205**  
(LOW NOISE DUAL OPERATIONAL)

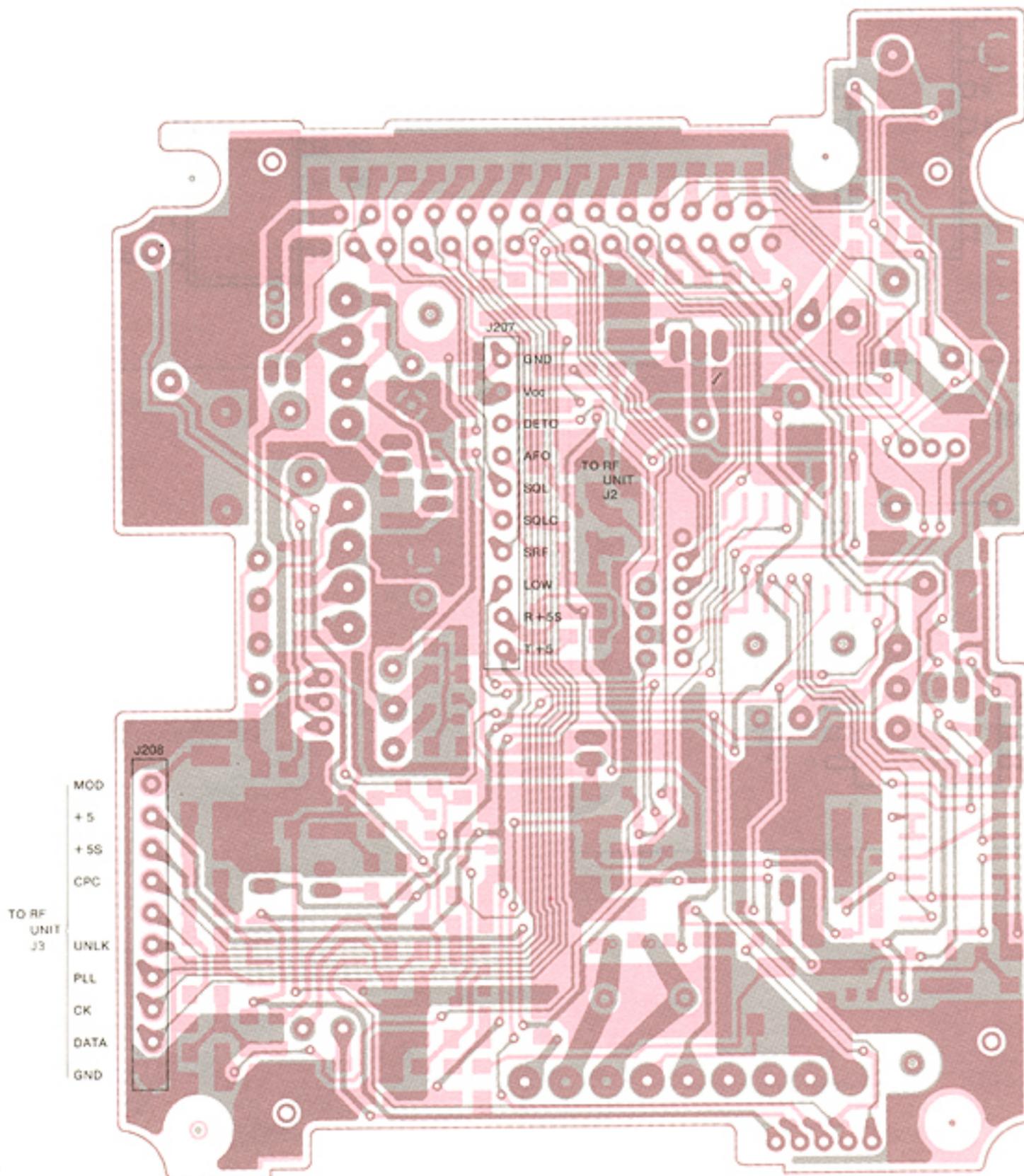


**TC5082P-G IC206 (#02, 04)**

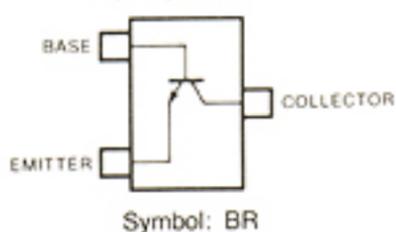


# 7 - 5 MAIN UNIT

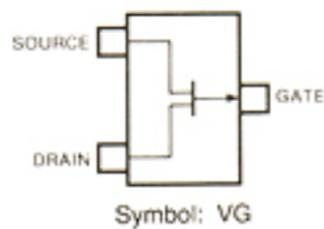
## FOIL SIDE



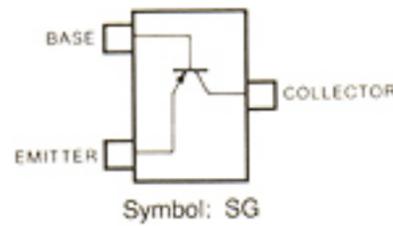
**2SC4081 R**  
Q202, Q204, Q211  
Q219, Q220



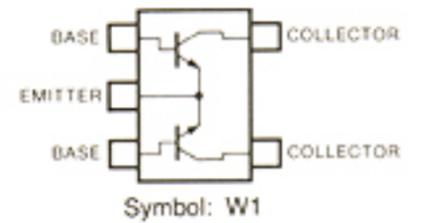
**2SJ106 GR**  
Q206



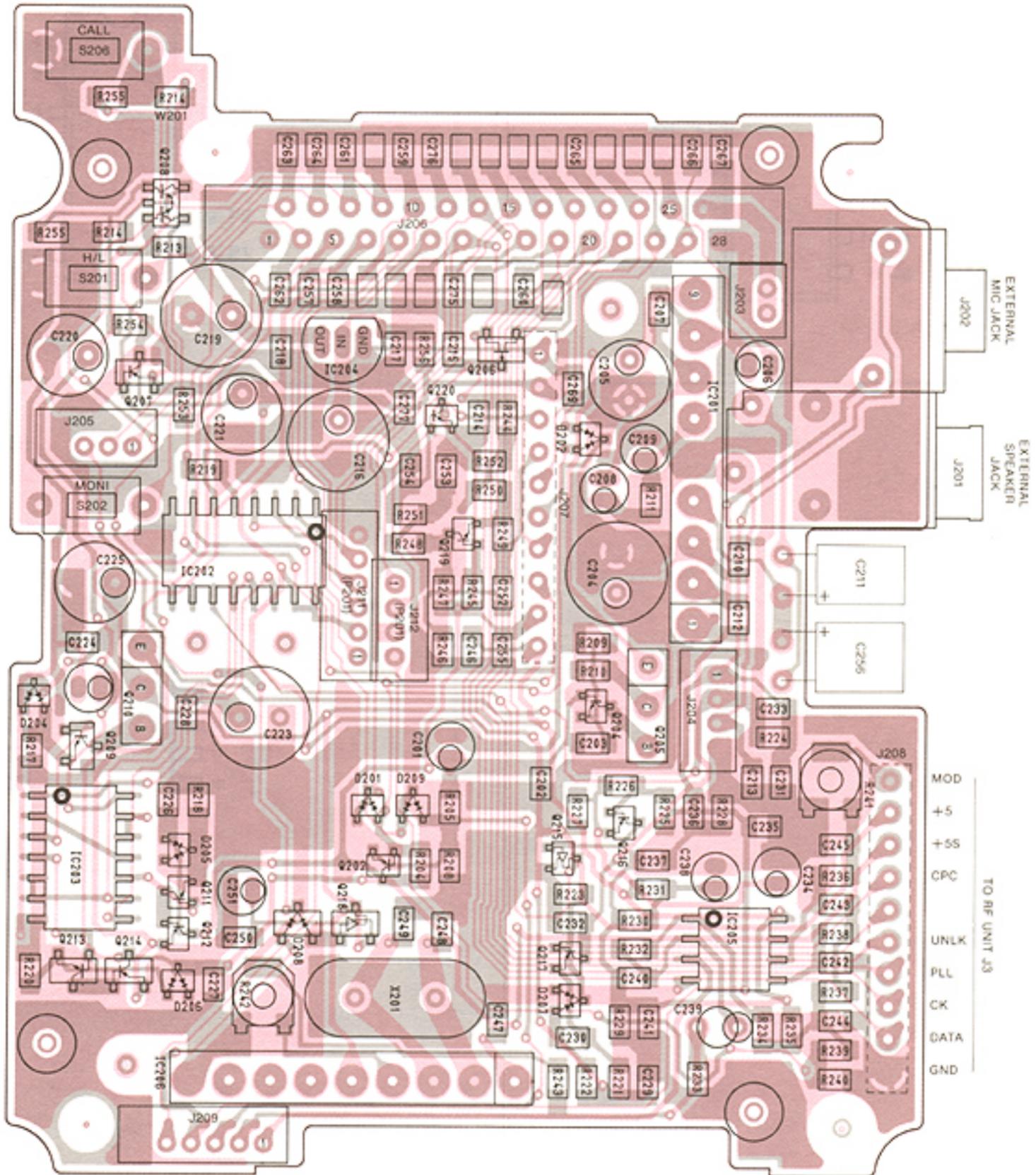
**2SA1162**  
Q207, Q214



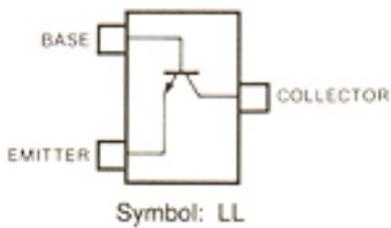
**FMW1**  
Q208



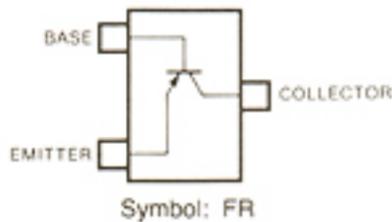
COMPONENT SIDE



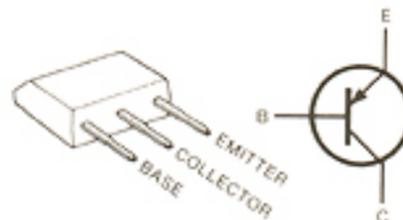
2SC2712 BL  
Q209, Q213



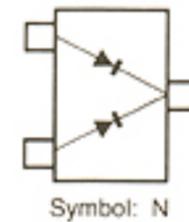
2SA1576 R  
Q212, Q216, Q217



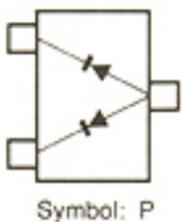
2SB909M  
Q205, Q210



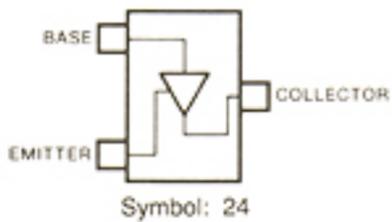
DAN202U  
D201, D202, D205  
D207



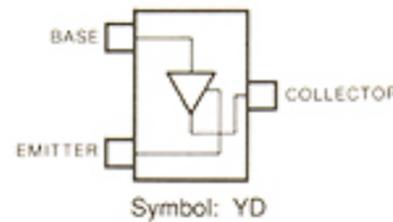
DAP202U  
D204, D206, D209



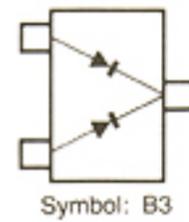
DTC144EU  
Q215



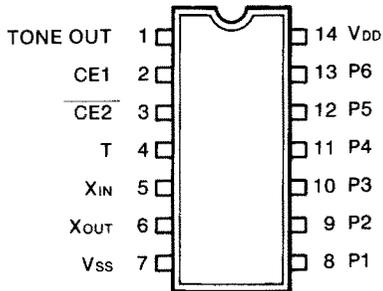
RN2404  
Q218 (#02, 04)



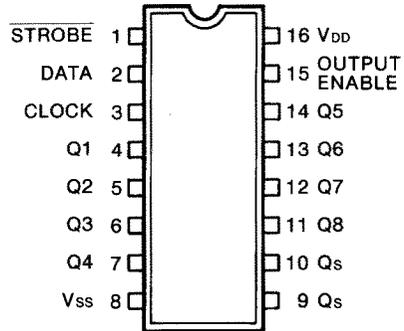
1SS184  
D208 (#02, 04)



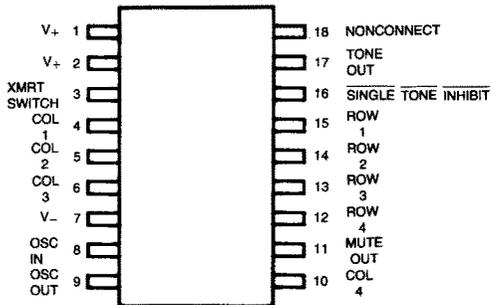
**S7116A IC601**  
(TONE GENERATOR C-MOS LSI)



**μPD4094BG IC602**  
(8 STAGE SHIFT/STORE BUS REGISTER)

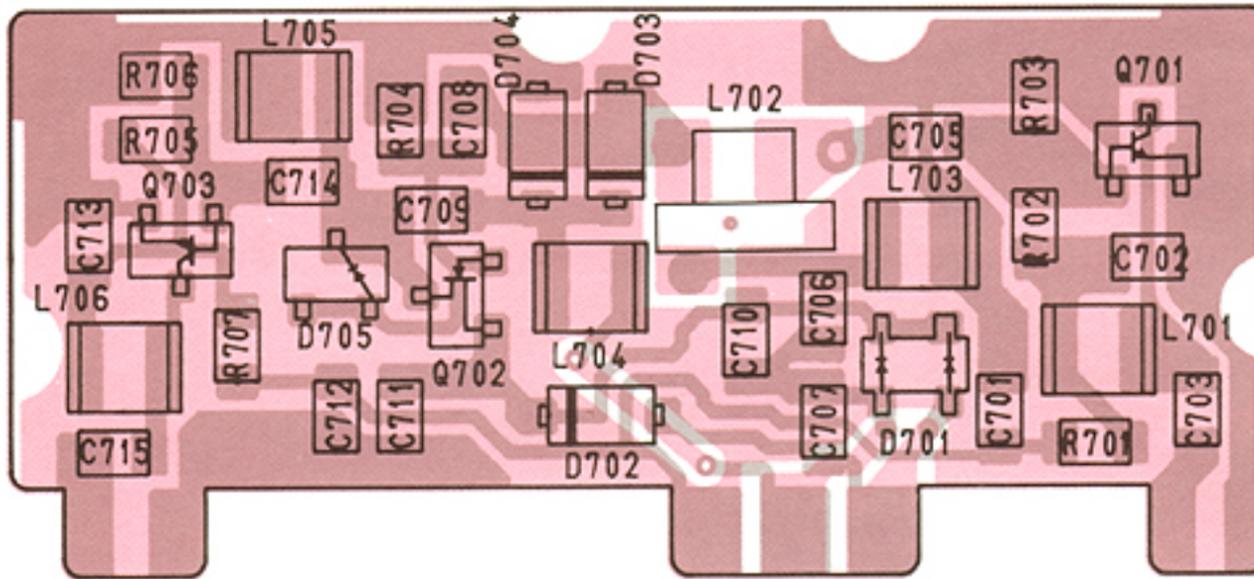


**LR40872 IC801**  
(TONE DIALING)

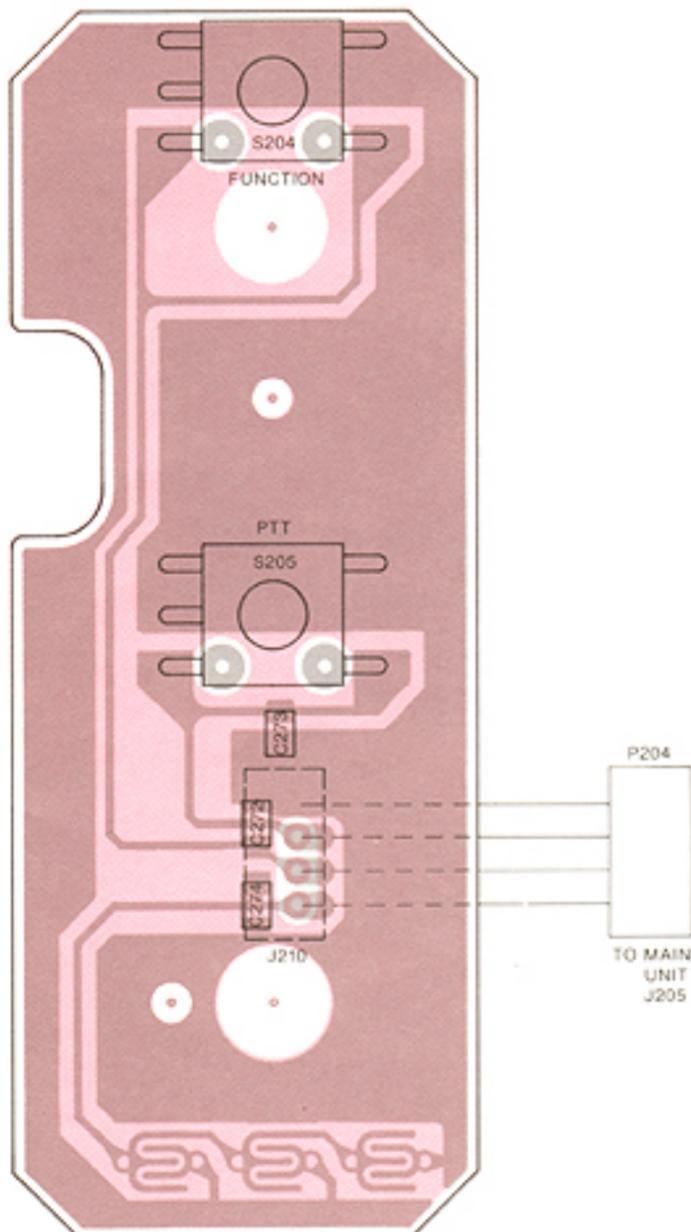


## 7 - 6 OTHER UNITS

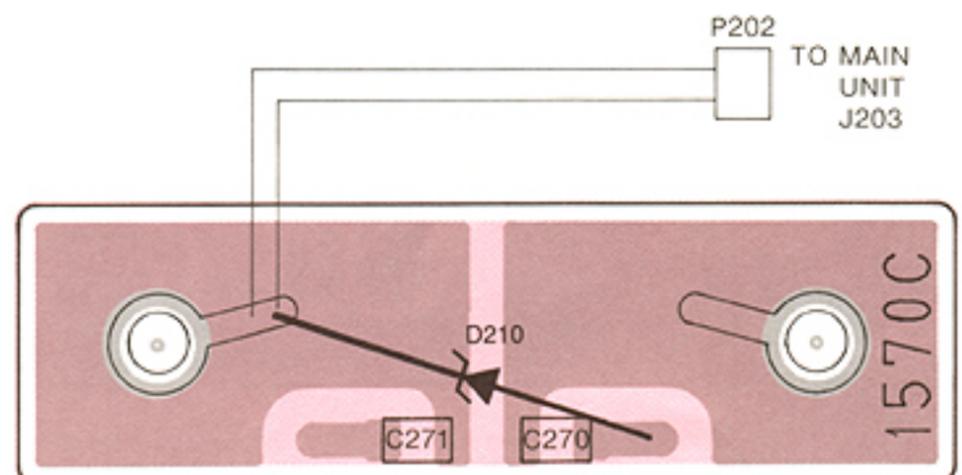
- VCO UNIT



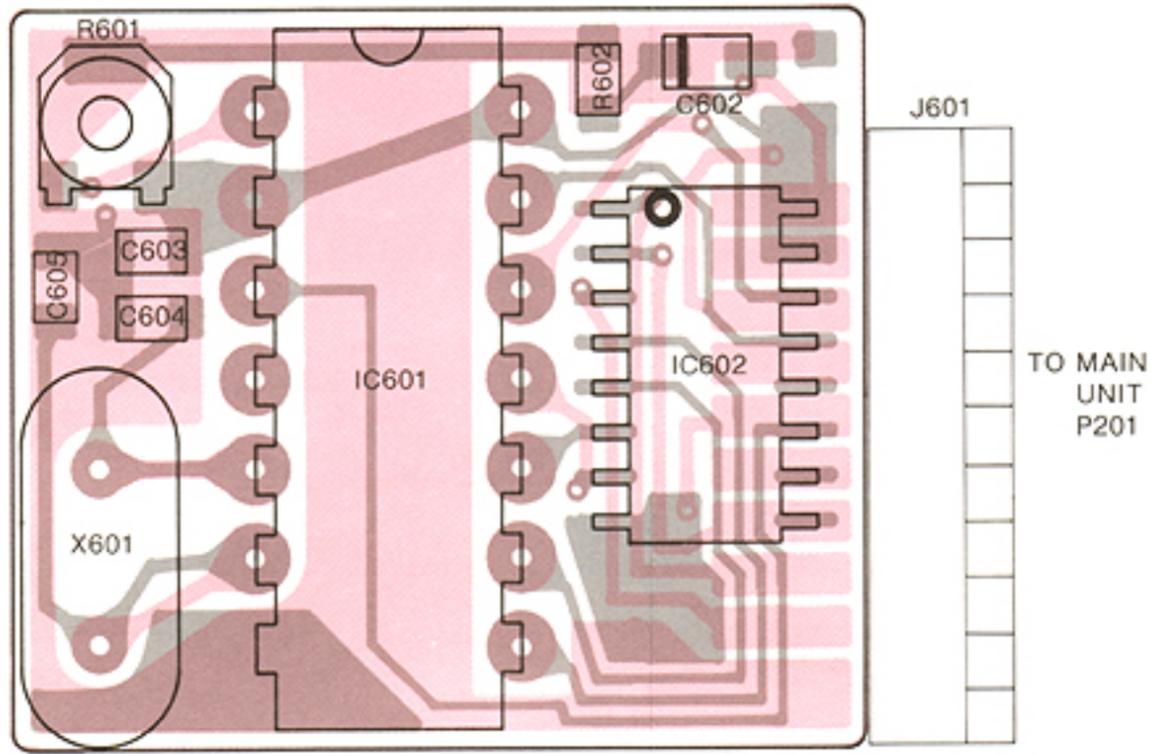
- PTT UNIT



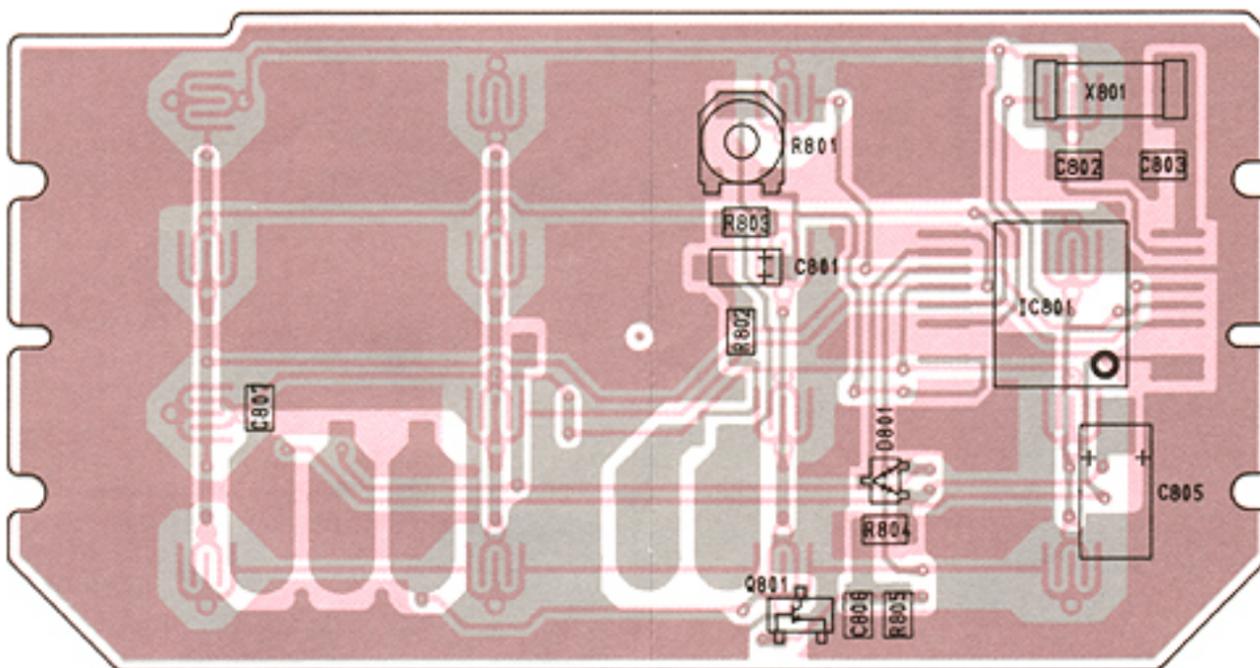
- JUNCTION UNIT



• TONE UNIT (Versions #05, 09)



• DTMF UNIT (Versions #05, 09)



## SECTION 8 PARTS LIST

## 8-1 MAIN UNIT

REF. NO.	DESCRIPTION	PART NO.	REF. NO.	DESCRIPTION	PART NO.
IC201	IC	BA526	R222	Resistor	5.6 kΩ MCR10
IC202	IC	μPD4094BG	R223	Resistor	47 kΩ MCR10
IC203	IC	LC4001BM	R224	Resistor	33 kΩ MCR10
IC204	IC	S81250HG	R225	Resistor	2.2 kΩ MCR10
IC205	IC	M5218FP	R226	Resistor	10 kΩ MCR10
IC206	IC	TC5082P-G (Versions #02, 04)	R227	Resistor	470Ω MCR10
Q202	Transistor	2SC4081 R	R228	Resistor	47 kΩ MCR10
Q204	Transistor	2SC4081 R	R229	Resistor	270 kΩ MCR10
Q205	Transistor	2SB909M Q/R	R230	Resistor	180 kΩ MCR10
Q206	FET	2SJ106 GR	R231	Resistor	1 kΩ MCR10
Q207	Transistor	2SA1162 GR	R232	Resistor	180 kΩ MCR10
Q208	Transistor	FMW1	R233	Resistor	120Ω MCR10
Q209	Transistor	2SC2712 BL			(Versions #02, 04, 07, 08, 09)
Q210	Transistor	2SB909M Q/R			270Ω MCR10
Q211	Transistor	2SC4081 R			(Versions #05, 06)
Q212	Transistor	2SA1576 R	R234	Resistor	270 kΩ MCR10
Q213	Transistor	2SC2712 BL	R235	Resistor	220 kΩ MCR10
Q214	Transistor	2SA1162 GR	R236	Resistor	12 kΩ MCR10
Q215	Transistor	DTC144EU	R237	Resistor	82 kΩ MCR10
Q216	Transistor	2SA1576 R	R238	Resistor	82 kΩ MCR10
Q217	Transistor	2SA1576 R	R239	Resistor	220 kΩ MCR10
Q218	Transistor	RN2404 (Versions #02, 04)	R240	Resistor	68 kΩ MCR10
Q219	Transistor	2SC4081 R	R241	Trimmer	47 kΩ RH04A3AS4J
Q220	Transistor	2SC4081 R	R242	Trimmer	10 kΩ RH04A3A14J
D201	Diode	DAN202U			(Versions #02, 04)
D202	Diode	DAN202U	R243	Resistor	47 kΩ MCR10
D204	Diode	DAP202U			(Versions #02, 04)
D205	Diode	DAN202U	R244	Resistor	1 MΩ MCR10
D206	Diode	DAP202U	R245	Resistor	330 kΩ MCR10
D207	Diode	DAN202U	R246	Resistor	150 kΩ MCR10
D208	Diode	1SS184 (Versions #02, 04)	R247	Resistor	4.7 kΩ MCR10
D209	Diode	DAP202U	R248	Resistor	39 kΩ MCR10
D210	Zener	RD20E B2	R249	Resistor	15 kΩ MCR10
X201	Crystal	RF4A3 FAE (Versions #02, 04)	R250	Resistor	2.2 kΩ MCR10
R204	Resistor	47 kΩ MCR10	R251	Resistor	39 kΩ MCR10
R205	Resistor	4.7 kΩ MCR10	R252	Resistor	4.7 kΩ MCR10
R208	Resistor	22 kΩ MCR10	R253	Resistor	3.3 kΩ MCR10
R209	Resistor	680Ω MCR10	R254	Resistor	560Ω MCR10
R210	Resistor	1 kΩ MCR10	R255	Resistor	22 kΩ MCR10
R211	Resistor	1 kΩ MCR10	R256	Resistor	470Ω MCR10
R213	Resistor	4.7 kΩ MCR10	C201	Electrolytic	2.2 μF 50 V RC3
R214	Resistor	4.7 kΩ MCR10	C202	Ceramic	470 pF GRM40
R217	Resistor	2.2 kΩ MCR10	C203	Ceramic	470 pF GRM40
R218	Resistor	10 kΩ MCR10	C204	Electrolytic	47 μF 10 V RC3
R219	Resistor	100 kΩ MCR10	C205	Electrolytic	33 μF 10 V RC3
R220	Resistor	10 kΩ MCR10	C206	Electrolytic	0.47 μF 50 V MS5
R221	Resistor	27Ω MCR10	C207	Ceramic	0.001 μF GRM40
			C208	Electrolytic	1 μF 50 V RC3
			C209	Electrolytic	10 μF 10 V RC3
			C210	Ceramic	0.001 μF GRM40
			C211	Electrolytic	47 μF 6.3 V MS7
			C212	Ceramic	0.01 μF GRM40 F
			C213	Ceramic	47 pF GRM40
			C214	Ceramic	0.1 μF GRM40 F

REF. NO.	DESCRIPTION	PART NO.
C215	Ceramic	0.001 $\mu$ F GRM40
C216	Electrolytic	33 $\mu$ F 16 V RC3
C217	Ceramic	470 pF GRM40
C218	Ceramic	470 pF GRM40
C219	Electrolytic	100 $\mu$ F 6.3 V MS5
C220	Electrolytic	47 $\mu$ F 6.3 V MS5
C221	Electrolytic	47 $\mu$ F 6.3 V MS5
C223	Electrolytic	47 $\mu$ F 16 V MS5
C224	Ceramic	470 pF GRM40
C225	Electrolytic	22 $\mu$ F 16 V MS5
C226	Ceramic	470 pF GRM40
C227	Ceramic	0.1 $\mu$ F GRM40 F
C228	Ceramic	470 pF GRM40
C229	Ceramic	470 pF GRM40
C230	Ceramic	470 pF GRM40
C231	Ceramic	470 pF GRM40
C232	Ceramic	470 pF GRM40
C233	Ceramic	470 pF GRM40
C234	Electrolytic	1 $\mu$ F 50 V MS5
C235	Ceramic	0.001 $\mu$ F GRM40
C236	Ceramic	103K (0.01 $\mu$ F) GRM40 B 25PT
C237	Ceramic	0.0047 $\mu$ F GRM40
C238	Electrolytic	4.7 $\mu$ F 16 V MS5
C239	Tantalum	0.22 $\mu$ F 35 V DN (Versions #02, 04, 07, 08, 09) 0.1 $\mu$ F 35 V DN (Versions #05, 06)
C240	Ceramic	470 pF GRM40
C241	Ceramic	470 pF GRM40
C242	Ceramic	120 pF GRM40
C243	Ceramic	222K (0.0022 $\mu$ F) GRM40 B 50PT
C244	Ceramic	0.001 $\mu$ F GRM40
C245	Ceramic	222K (0.0022 $\mu$ F) GRM40 B 50PT
C246	Ceramic	0.1 $\mu$ F GRM40 F
C247	Ceramic	47 pF GRM40 (Versions #02, 04)
C248	Ceramic	10 pF GRM40 (Versions #02, 04)
C249	Ceramic	10 pF GRM40 (Versions #02, 04)
C250	Ceramic	0.001 $\mu$ F GRM40 (Versions #02, 04)
C251	Electrolytic	0.1 $\mu$ F 50 V MS5 (Versions #02, 04)
C252	Ceramic	0.01 $\mu$ F GRM40 F
C253	Ceramic	222K (0.0022 $\mu$ F) GRM40 B 50PT
C254	Ceramic	0.001 $\mu$ F GRM40
C255	Ceramic	0.1 $\mu$ F GRM40 F
C256	Electrolytic	47 $\mu$ F 6.3 V MS7
C257	Ceramic	470 pF GRM40
C258	Ceramic	470 pF GRM40
C259	Ceramic	470 pF GRM40
C260	Ceramic	470 pF GRM40
C261	Ceramic	470 pF GRM40
C262	Ceramic	470 pF GRM40
C263	Ceramic	470 pF GRM40
C264	Ceramic	470 pF GRM40
C265	Ceramic	470 pF GRM40
C266	Ceramic	470 pF GRM40
C267	Ceramic	470 pF GRM40
C268	Ceramic	470 pF 50 V

REF. NO.	DESCRIPTION	PART NO.
C269	Ceramic	470 pF GRM40
C270	Ceramic	470 pF GRM40
C271	Ceramic	470 pF GRM40
C272	Ceramic	470 pF GRM40
C273	Ceramic	470 pF GRM40
C274	Ceramic	470 pF GRM40
C275	Ceramic	470 pF GRM40
C276	Ceramic	470 pF GRM40
C277	Ceramic	470 pF GRM40
J201	Connector	HSJ0836-01-010 (Speaker Jack)
J202	Connector	HSJ1102-01-540 (Mic. Jack)
J203	Connector	PI28A02M
J204	Connector	PI28A04M
J205	Connector	PI28A04M
J206	Connector	CFP4128-0121
J207	Connector	BB04A 10F (M-R)
J208	Connector	BB04A 10F (M-R)
J209	Connector	PI28A06M
J210	Connector	TZB-P04H-A1
J211	Connector	TZB-P06H-A1 (Versions #05, 06, 07, 08, 09)
J212	Connector	TZB-P04H-A1 (Versions #05, 06, 07, 08, 09)
P201	Connector	PI28A10F (Versions #05, 06, 07, 08, 09)
P202	Connector	PI28A02F
P203	Connector	PI28A04F
P204	Connector	PI28A04F
MC201	Microphone	KUC2023-01-006
S201	Switch	SKHLAD035A (HI/LOW)
S202	Switch	SKHLAD035A (MONI)
S204	Switch	SKHMPD004A (FUNC)
S205	Switch	SKHMPD004A (PTT)
S206	Switch	SKHLAD035A (CALL or TONE CALL)
SP201	Speaker	Si36D04
W201	Jumper	MCR10-JPW (Versions #05, 06, 07, 08, 09)
W202	Jumper	MCR10-JPW (Versions #02, 04)
EP201	P. C. Board	B-1562B (Main)
EP202	P. C. Board	B-1552C (PTT)
EP203	P. C. Board	B-1570C (Junction)
EP204	Tube	IRRAX d=0.7 L=2.0
EP205	Crystal Seat	X201 (Versions #02, 04)

## 8-2 RF UNIT

REF. NO.	DESCRIPTION	PART NO.
IC1	IC	MC3357P
IC2	IC	PLL2001
IC3	IC	SC-1080
Q1	Transistor	2SC3772 3
Q2	FET	2SK302 Y
Q3	Transistor	2SC3770 3
Q4	Transistor	2SC3770 3
Q5	Transistor	2SC3770 3
Q6	Transistor	2SC2712 Y
Q7	Transistor	RN1404
Q8	Transistor	2SA1162 GR
Q9	FET	2SK209 Y
Q10	Transistor	2SC3772 3
Q11	Transistor	2SB909M Q/R
Q12	Transistor	2SC3772 3
Q13	Transistor	FMS1
Q15	Transistor	2SC2712 BL
Q16	Transistor	DTA144EU
Q17	Transistor	RN1404
Q18	Transistor	2SC2712 BL
Q19	Transistor	2SC3772 3
Q20	Transistor	DTC144EU
Q21	FET	2SK536
Q22	FET	2SK536
Q23	Transistor	2SA1576 R
Q24	Transistor	DTC144EU
Q25	Transistor	DTA144EU
D1	Diode	MA862
D2	Varicap	MA334 B
D3	Varicap	MA334 B
D5	Varicap	MA334 B
D6	Varicap	MA334 B
D7	Diode	HSM88AS
D8	Diode	1SS193
D9	Diode	HSM88AS
D13	Diode	HSM88AS
D14	Diode	HSM88AS
D15	Diode	1SS153
D16	Diode	MA862
D18	Zener	RD9.1M B2
D19	Diode	1S V172
D20	Diode	DAP202U
D21	Diode	1SS254
F1	Monolithic	16M15B4
F2	Ceramic	CFUM455E
X1	Crystal	CR-177 (16.445 MHz)
X2	Discriminator	CDB455C7A
X3	Crystal	CR-248 (10.0 MHz)
L1	Coil	LA-235
L2	Coil	LA-234
L3	Coil	LA-227
L4	Coil	LA-226

REF. NO.	DESCRIPTION	PART NO.
L5	Coil	LS-321
L6	Coil	LS-321
L7	Coil	LS-321
L8	Coil	LS-321
L9	Coil	LS-262
L10	Coil	LS-354
L11	Coil	LA-247
L12	Coil	LA-246
L13	Coil	LAL02KR 1R5M
L14	Coil	LAL02KR 1R5M
L15	Coil	LA-228
L16	Coil	LAL02KR 4R7K
L17	Coil	LA-246
L18	Coil	LAL03NA 1R5M
R3	Resistor	100 k $\Omega$ MCR10
R4	Resistor	6.8 k $\Omega$ MCR10
R5	Resistor	22 k $\Omega$ MCR10
R6	Resistor	33 $\Omega$ MCR10
R7	Resistor	330 $\Omega$ R20
R8	Resistor	100 k $\Omega$ MCR10
R10	Resistor	100 k $\Omega$ MCR10
R11	Resistor	100 k $\Omega$ MCR10
R12	Resistor	22 $\Omega$ MCR10
R13	Resistor	4.7 k $\Omega$ MCR10
R14	Resistor	470 $\Omega$ MCR10
R15	Resistor	22 k $\Omega$ MCR10
R16	Resistor	47 k $\Omega$ MCR10
R17	Resistor	1.5 k $\Omega$ MCR10
R18	Resistor	2.2 k $\Omega$ MCR10
R19	Resistor	22 k $\Omega$ MCR10
R20	Resistor	1.5 k $\Omega$ MCR10
R21	Resistor	1.5 k $\Omega$ MCR10
R22	Resistor	47 k $\Omega$ MCR10
R23	Resistor	1.5 k $\Omega$ MCR10
R24	Resistor	33 k $\Omega$ MCR10
R25	Resistor	560 k $\Omega$ MCR10
R26	Trimmer	20 k $\Omega$ E VM-LGG A00 B24
R27	Resistor	680 k $\Omega$ MCR10
R28	Resistor	10 k $\Omega$ MCR10
R29	Resistor	330 k $\Omega$ MCR10
R30	Resistor	100 k $\Omega$ MCR10
R31	Resistor	330 k $\Omega$ MCR10
R32	Resistor	470 $\Omega$ MCR10
R33	Resistor	2.7 k $\Omega$ MCR10
R34	Resistor	27 k $\Omega$ MCR10
R36	Resistor	5.6 k $\Omega$ MCR10
R37	Resistor	2.2 k $\Omega$ MCR10
R38	Resistor	100 k $\Omega$ MCR10
R39	Resistor	1 M $\Omega$ MCR10
R42	Resistor	47 k $\Omega$ MCR10
R43	Resistor	10 k $\Omega$ MCR10
R44	Resistor	270 k $\Omega$ MCR10
R45	Resistor	100 k $\Omega$ MCR10
R46	Resistor	100 k $\Omega$ MCR10
R47	Resistor	470 k $\Omega$ MCR10
R48	Resistor	1 k $\Omega$ MCR10
R49	Resistor	8.2 k $\Omega$ MCR10
R50	Resistor	390 $\Omega$ MCR10
R51	Resistor	470 $\Omega$ MCR10
R52	Resistor	47 k $\Omega$ MCR10

REF. NO.	DESCRIPTION	PART NO.
R53	Resistor	15 kΩ MCR10
R54	Resistor	10 kΩ MCR10
R55	Resistor	5.6 kΩ MCR10
R56	Resistor	10Ω MCR10
R57	Resistor	100 kΩ MCR10
R58	Resistor	330Ω MCR10
R59	Resistor	330Ω MCR10
R60	Resistor	150Ω MCR10
R61	Resistor	330Ω MCR10
R62	Resistor	390 kΩ MCR10
R63	Resistor	56 kΩ MCR10
R64	Resistor	100Ω MCR10
R65	Resistor	10 kΩ MCR10
R66	Resistor	6.8 kΩ MCR10
R67	Resistor	5.6 kΩ MCR10
R68	Resistor	82 kΩ MCR10
R69	Trimmer	20 kΩ E VM-LGG A00 B24
R70	Resistor	2.7 kΩ MCR10
R71	Resistor	1.2 kΩ MCR10
R72	Trimmer	3 kΩ E VM-LGG A00 B33
R73	Resistor	22 kΩ MCR10
R74	Resistor	220 kΩ MCR10
R75	Resistor	22 kΩ MCR10
R76	Resistor	560 kΩ MCR10
R77	Resistor	2.2 kΩ MCR10
R78	Resistor	22 kΩ MCR10
R79	Resistor	2.2 kΩ MCR10
R80	Resistor	47 kΩ MCR10
R82	Resistor	10 kΩ MCR10
R83	Resistor	100Ω MCR10
R84	Resistor	1.8 kΩ MCR10
R85	Resistor	1.8 kΩ MCR10
R86	Resistor	150Ω MCR10
R87	Resistor	1 MΩ R20
R88	Resistor	100 kΩ MCR10
R89	Resistor	22 kΩ MCR10
R90	Thermistor	ERT-D2FHL503S
R91	Resistor	1 kΩ MCR10
R92	Resistor	560Ω MCR10
C1	Ceramic	3 pF GRM40
C2	Ceramic	12 pF GRM40
C3	Ceramic	0.001 μF GRM40
C4	Ceramic	22 pF GRM40
C5	Ceramic	39 pF GRM40
C6	Ceramic	15 pF GRM40
C7	Ceramic	27 pF GRM40
C8	Ceramic	10 pF GRM40
C11	Ceramic	22 pF GRM40
C12	Ceramic	22 pF GRM40
C13	Ceramic	470 pF GRM40
C14	Ceramic	68 pF GRM40
C15	Ceramic	470 pF GRM40
C17	Ceramic	68 pF GRM40
C18	Ceramic	0.5 pF GRM40
C22	Ceramic	68 pF GRM40
C23	Ceramic	1 pF GRM40
C25	Ceramic	68 pF GRM40
C26	Ceramic	47 pF GRM40
C27	Ceramic	0.001 μF GRM40
C28	Ceramic	0.001 μF GRM40

REF. NO.	DESCRIPTION	PART NO.
C29	Ceramic	0.001 μF GRM40
C30	Ceramic	4 pF GRM40
C32	Ceramic	0.001 μF GRM40
C33	Ceramic	0.1 μF GRM40 F
C34	Ceramic	0.001 μF GRM40
C35	Ceramic	0.1 μF GRM40 F
C36	Ceramic	0.001 μF GRM40
C37	Ceramic	27 pF GRM40
C38	Ceramic	56 pF GRM40
C39	Ceramic	0.1 μF GRM40 F
C40	Ceramic	0.1 μF GRM40 F
C41	Ceramic	82 pF GRM40
C42	Ceramic	15 pF GRM40
C43	Ceramic	470 pF GRM40
C44	Ceramic	0.1 μF GRM40 F
C45	Ceramic	0.001 μF GRM40
C46	Ceramic	470 pF GRM40
C47	Ceramic	100 pF GRM40
C48	Electrolytic	0.22 μF 50 V MS7
C49	Ceramic	0.001 μF GRM40
C50	Ceramic	0.001 μF GRM40
C51	Ceramic	33 pF GRM40
C52	Ceramic	0.001 μF GRM40
C53	Ceramic	0.001 μF GRM40
C54	Ceramic	0.001 μF GRM40
C55	Electrolytic	0.1 μF 50 V MS7
C56	Ceramic	0.01 μF GRM40 F
C57	Ceramic	103K (0.01 μF) GRM40 B 25PT
C58	Ceramic	0.001 μF GRM40
C59	Ceramic	0.1 μF GRM40 F
C60	Ceramic	470 pF GRM40
C61	Ceramic	470 pF GRM40
C62	Ceramic	0.001 μF GRM40
C64	Ceramic	0.001 μF GRM40
C65	Ceramic	0.001 μF GRM40
C66	Ceramic	0.001 μF GRM40
C67	Ceramic	0.001 μF GRM40
C68	Ceramic	0.001 μF GRM40
C69	Ceramic	0.001 μF GRM40
C70	Ceramic	0.001 μF GRM40
C71	Ceramic	0.001 μF GRM40
C72	Ceramic	0.001 μF GRM40
C73	Ceramic	0.001 μF GRM40
C74	Ceramic	0.001 μF GRM40
C75	Ceramic	0.001 μF GRM40
C76	Electrolytic	1 μF 50 V MS7
C77	Ceramic	18 pF GRM40 CH
C78	Trimmer	ECR-GA020E30 20P
C79	Ceramic	27 pF GRM40
C80	Electrolytic	10 μF 16 V MS7
C81	Tantalum	3.3 μF 16 V DN
C82	Ceramic	33 pF GRM40
C83	Ceramic	0.001 μF GRM40
C84	Ceramic	33 pF GRM40
C85	Ceramic	12 pF GRM40
C86	Ceramic	0.001 μF GRM40
C87	Ceramic	0.001 μF GRM40
C88	Ceramic	0.001 μF GRM40
C89	Ceramic	0.001 μF GRM40
C90	Ceramic	0.001 μF GRM40
C91	Electrolytic	10 μF 16 V MS7
C92	Electrolytic	10 μF 16 V MS7

REF. NO.	DESCRIPTION	PART NO.
C95	Ceramic	22 pF GRM40
C96	Ceramic	22 pF GRM40
C97	Ceramic	0.001 μF GRM40
C99	Ceramic	0.001 μF GRM40
C100	Ceramic	0.001 μF GRM40
C101	Ceramic	0.001 μF GRM40
C102	Electrolytic	0.001 μF GRM40
C103	Electrolytic	0.47 μF 50 V MS7
C104	Ceramic	0.001 μF GRM40
C106	Ceramic	0.001 μF GRM40
C107	Ceramic	10 pF GRM40
C108	Ceramic	0.001 μF GRM40
C109	Ceramic	0.001 μF GRM40
C110	Electrolytic	4.7 μF 35 V MS7
C111	Ceramic	0.001 μF GRM40
C112	Ceramic	0.1 μF GRM40 F
C113	Ceramic	0.001 μF GRM40
C114	Ceramic	0.001 μF GRM40
C115	Ceramic	0.001 μF GRM40
C116	Ceramic	7 pF GRM40
C118	Ceramic	0.001 μF GRM40
C119	Ceramic	0.001 μF GRM40
C120	Ceramic	0.001 μF GRM40
C121	Ceramic	0.001 μF GRM40
J1	Connector	BNC-R111-E
J2	Connector	BB04G 10M
J3	Connector	BB04G 10M
W3	Jumper	72/98/050/X98/X98
W4	Jumper	72/98/050/X98/X98
W7	Jumper	73/98/020/X98/X98
W8	Jumper	73/98/020/X98/X98
W9	Jumper	74/98/010/X98/X98
EP1	P. C. Board	B-1585C
EP2	Filter Spacer	41590
EP3	Tube	IRRAX d=0.7 L=8.0
EP4	Tube	IRRAX d=0.7 L=10.0

### 8 - 3 VCO UNIT

REF. NO.	DESCRIPTION	PART NO.
Q701	Transistor	2SC3772 3
Q702	FET	2SK210 Y
Q703	Transistor	2SC3772 3
D701	Diode	MA862
D702	Varicap	MA334 B
D703	Varicap	MA333
D704	Varicap	MA334 B
D705	Diode	1SS154
L701	Coil	LQN2A R15K
L702	Coil	LB-224

REF. NO.	DESCRIPTION	PART NO.
L703	Coil	LQH3N 1R5M
L704	Coil	LQH3N 1R5M
L705	Coil	LQH3N 1R5M
L706	Coil	LQN2A R15K
R701	Resistor	1 kΩ MCR10
R702	Resistor	100 kΩ MCR10
R703	Resistor	39 kΩ MCR10
R704	Resistor	10 kΩ MCR10
R705	Resistor	100 kΩ MCR10
R706	Resistor	39 kΩ MCR10
R707	Resistor	1 kΩ MCR10
C701	Ceramic	0.001 μF GRM40
C702	Ceramic	0.001 μF GRM40
C703	Ceramic	7 pF GRM40
C705	Ceramic	0.5 pF GRM40
C706	Ceramic	0.001 μF GRM40
C707	Ceramic	0.001 μF GRM40
C708	Ceramic	0.001 μF GRM40
C709	Ceramic	0.001 μF GRM40
C710	Ceramic	47 pF GRM40
C711	Ceramic	0.001 μF GRM40
C712	Ceramic	0.001 μF GRM40
C713	Ceramic	0.001 μF GRM40
C714	Ceramic	0.5 pF GRM40
C715	Ceramic	7 pF GRM40
EP701	P. C. Board	B-1586B (VCO)
EP702	P. C. Board	B-1604 (COIL)

### 8 - 4 TONE UNIT (Versions #05, 09)

REF. NO.	DESCRIPTION	PART NO.
IC601	IC	S7116A
IC602	IC	μPD4094BG
X601	Crystal	RF4A3 FAA (3.579545 MHz)
R601	Trimmer	47 kΩ RH04A3AS4J
R602	Resistor	47 kΩ MCR10
C602	Tantalum	0.47 μF 25 V SV
C603	Ceramic	470 pF GRM40
C604	Ceramic	47 pF GRM40
C605	Ceramic	39 pF GRM40
J601	Connector	PI28A10M
EP601	P. C. Board	B-1566B
EP602	Crystal Seat	41424
EP603	Sponge	(BC)

## 8-5 DTMF UNIT (Versions #05, 09)

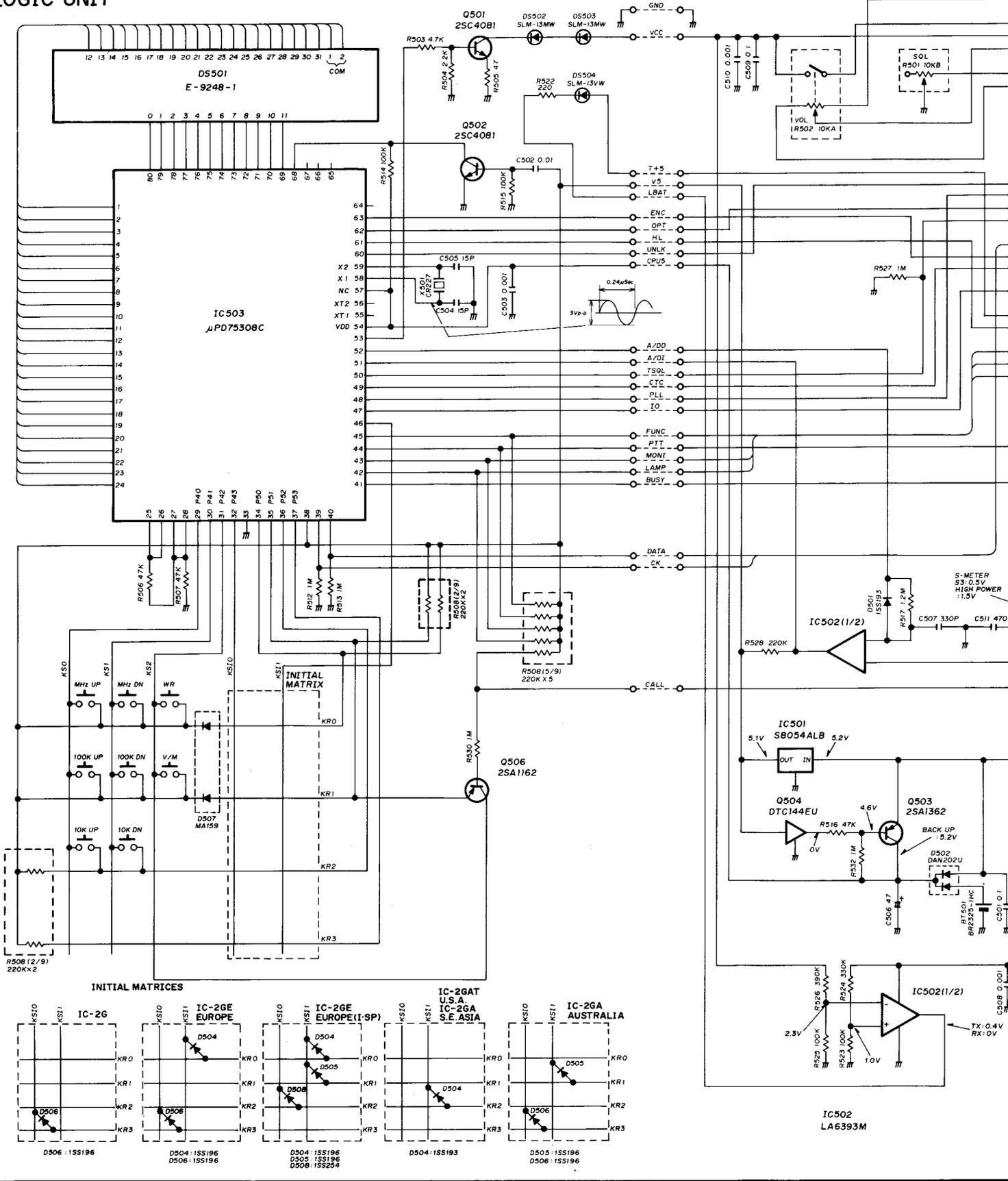
REF. NO.	DESCRIPTION	PART NO.	
IC801	IC	LR40872	
Q801	Transistor	2SC2712 BL	
D801	Diode	DAP202U	
X801	Discriminator	CSAC3.58MGC300CD	
R801	Trimmer	10 kΩ	RH04A3A14J
R802	Resistor	33 kΩ	MCR10
R803	Resistor	22 kΩ	MCR10
R804	Resistor	47 kΩ	MCR10
R805	Resistor	68 kΩ	MCR10
C801	Tantalum	0.47 μF	25 V SV
C802	Ceramic	GRM40 SL 300J 50PT	
C803	Ceramic	GRM40 SL 300J 50PT	
C805	Tantalum	TES VC1A106M12L	
C806	Ceramic	470 pF	GRM40
C807	Ceramic	470 pF	GRM40
P801	Connector	PI28A06F	
EP801	P. C. Board	B-1567B	

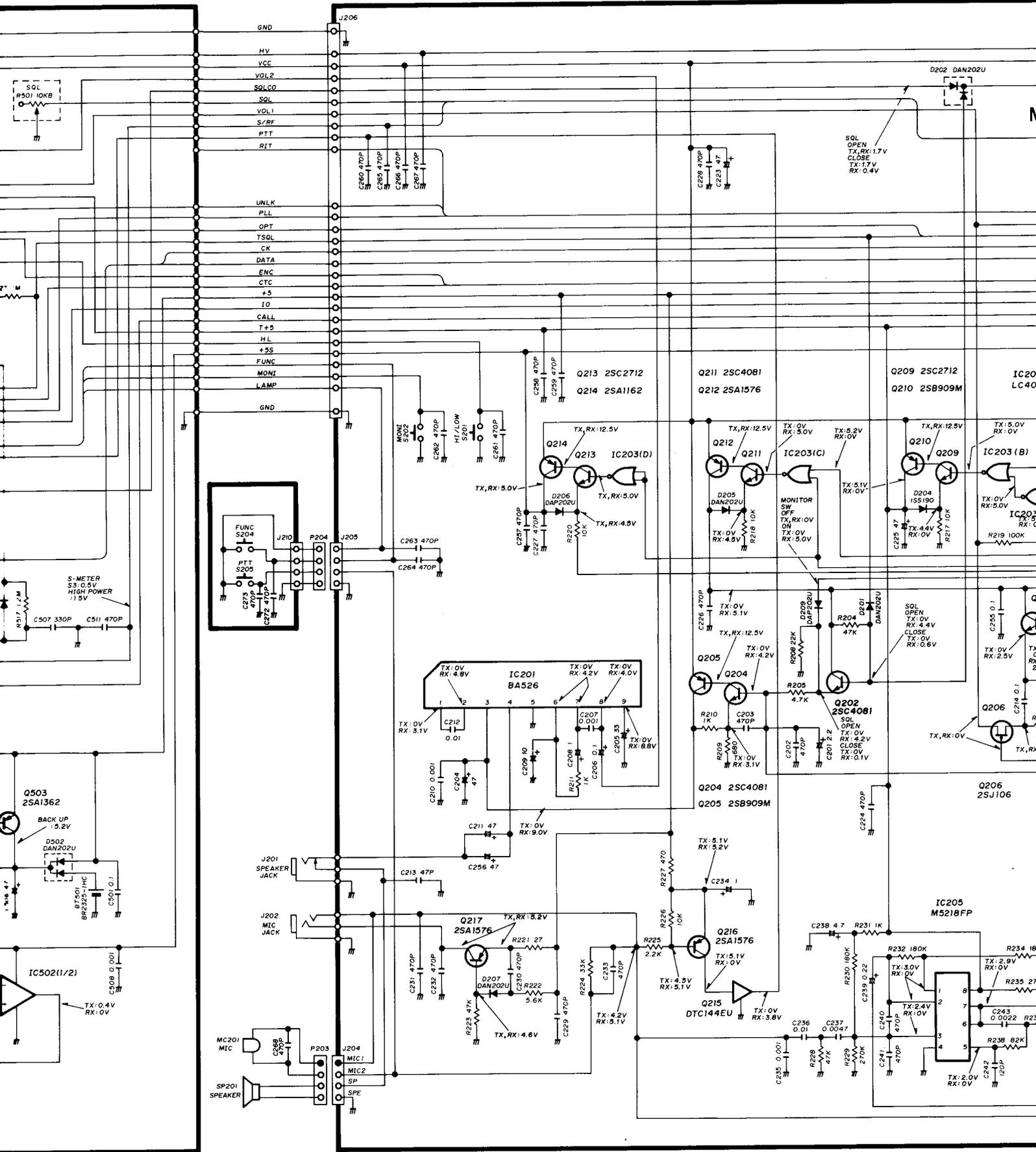
## 8-6 LOGIC UNIT

REF. NO.	DESCRIPTION	PART NO.
IC501	IC	S-8054ALB-LM
IC502	IC	LA6393M
IC503	IC	μPD75308GF-034-3B9
Q501	Transistor	2SC4081 R
Q502	Transistor	2SC4081 R
Q503	Transistor	2SA1362 GR
Q504	Transistor	RN1404
Q506	Transistor	2SA1576 R
D501	Diode	1SS193
D502	Diode	1SS184
D504	Diode	1SS196 (Versions #02, 04)
D504	Diode	1SS193 (Versions #05, 06, 08, 09)
D505	Diode	1SS196 (Versions #04, 07)
D506	Diode	1SS196 (Versions #02, 07)
D507	Diode	MA159
D508	Diode	1SS254 (Version #04)
X501	Crystal	CR-227

REF. NO.	DESCRIPTION	PART NO.	
R501	Variable Resistor	RK0971110051A 10KB (SQL)	
R502	Variable Resistor	RK097111101NA 10KA (VOL)	
R503	Resistor	4.7 kΩ	MCR10
R504	Resistor	2.2 kΩ	MCR10
R505	Resistor	47Ω	MCR10
R506	Resistor	47 kΩ	MCR10
R507	Resistor	47 kΩ	MCR10
R508	Resistor Array	MA5025 F 09 224 J	
R512	Resistor	1 MΩ	MCR10
R513	Resistor	1 MΩ	MCR10
R514	Resistor	100 kΩ	MCR10
R515	Resistor	100 kΩ	MCR10
R516	Resistor	47 kΩ	MCR10
R517	Resistor	1.2 MΩ	MCR10
R522	Resistor	220Ω	MCR10
R523	Resistor	100 kΩ	MCR10
R524	Resistor	330 kΩ	MCR10
R525	Resistor	100 kΩ	MCR10
R526	Resistor	390 kΩ	MCR10
R527	Resistor	1 MΩ	MCR10
R528	Resistor	220 kΩ	MCR10
R529	Resistor	1 MΩ	MCR10
R530	Resistor	1 MΩ	MCR10
R532	Resistor	1 MΩ	MCR10
C501	Ceramic	0.1 μF	GRM40 F
C502	Ceramic	0.01 μF	GRM40 F
C503	Ceramic	0.001 μF	GRM40
C504	Ceramic	15 pF	GRM40
C505	Ceramic	15 pF	GRM40
C506	Tantalum	47 μF	6.3 V SV
C507	Ceramic	330 pF	GRM40 CH
C508	Ceramic	0.001 μF	GRM40
C509	Ceramic	0.1 μF	GRM40 F
C510	Ceramic	0.001 μF	GRM40
C511	Ceramic	470 pF	GRM40
DS501	LCD	LD-B9213J	
DS502	LED	SLM-13MW	
DS503	LED	SLM-13MW	
DS504	LED	SLM-13 VW	
BT501	Lithium Battery	BR2325-1HC	
EP501	P. C. Board	B-1564C (LOGIC-A)	
EP502	P. C. Board	B-1565B (LOGIC-B)	
EP503	P. C. Board	B-1555A (SQL)	
EP504	P. C. Board	B-1556B (VOL)	
EP505	Flexible P. C. Board	B-1568A (M-L)	
EP506	Flexible P. C. Board	B-1569A (A-B)	
EP507	LCD Contact Strip	SRCN573	
EP508	Tube	IRRAX d=0.7 L=7.0 (Version #04)	

LOGIC UNIT











## SECTION 10 BC-35, BC-36 AC BATTERY CHARGERS

## 10 - 1 SPECIFICATIONS

## BC-35, BC-36 VERSIONS

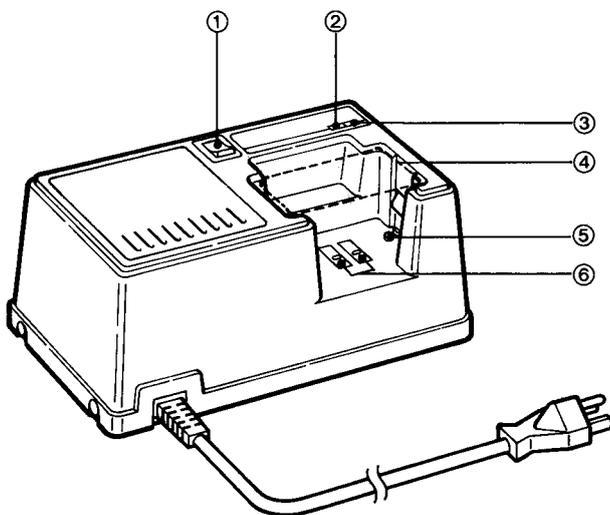
MODEL NUMBER	VERSION NUMBER	POWER SUPPLY REQUIREMENT
BC-35	#02 (USA)	117 V AC, 50/60 Hz
	#03 (Europe)	240 V AC, 50/60 Hz
BC-36	#04 (W. Germany)	220 V AC, 50 Hz
	#05 (Australia)	240 V AC, 50 Hz

## BATTERY PACK SPECIFICATIONS (when using BC-35 or BC-36)

	BP-2	BP-3	BP-4*	BP-5	BP-5A	BP-7	BP-8	BP-70
Capacity (mAh)	450	270	—	450		450	800	270
Voltage (V)	7.2	8.4	9.0 (drycells) 7.2 (NiCd)	10.8		13.2	8.4	13.2
Charging Time (hrs)	1.5	15	15	1.5		1.5	3	9
Charging Current (mA)	600	25	45	600		600	600	45
Usable Temperature Range	10°C~40°C (50°F~104°F)	0°C~40°C (32°F~104°F)	0°C~45°C (32°F~113°F)	10°C~40°C (50°F~104°F)		10°C~40°C (50°F~104°F)	10°C~40°C (50°F~104°F)	10°C~45°C (50°F~113°F)
Height (mm, in)	39, 1.5	39, 1.5	49, 1.9	56, 2.2	80, 3.1	80, 3.1	80, 3.1	60.5, 2.4

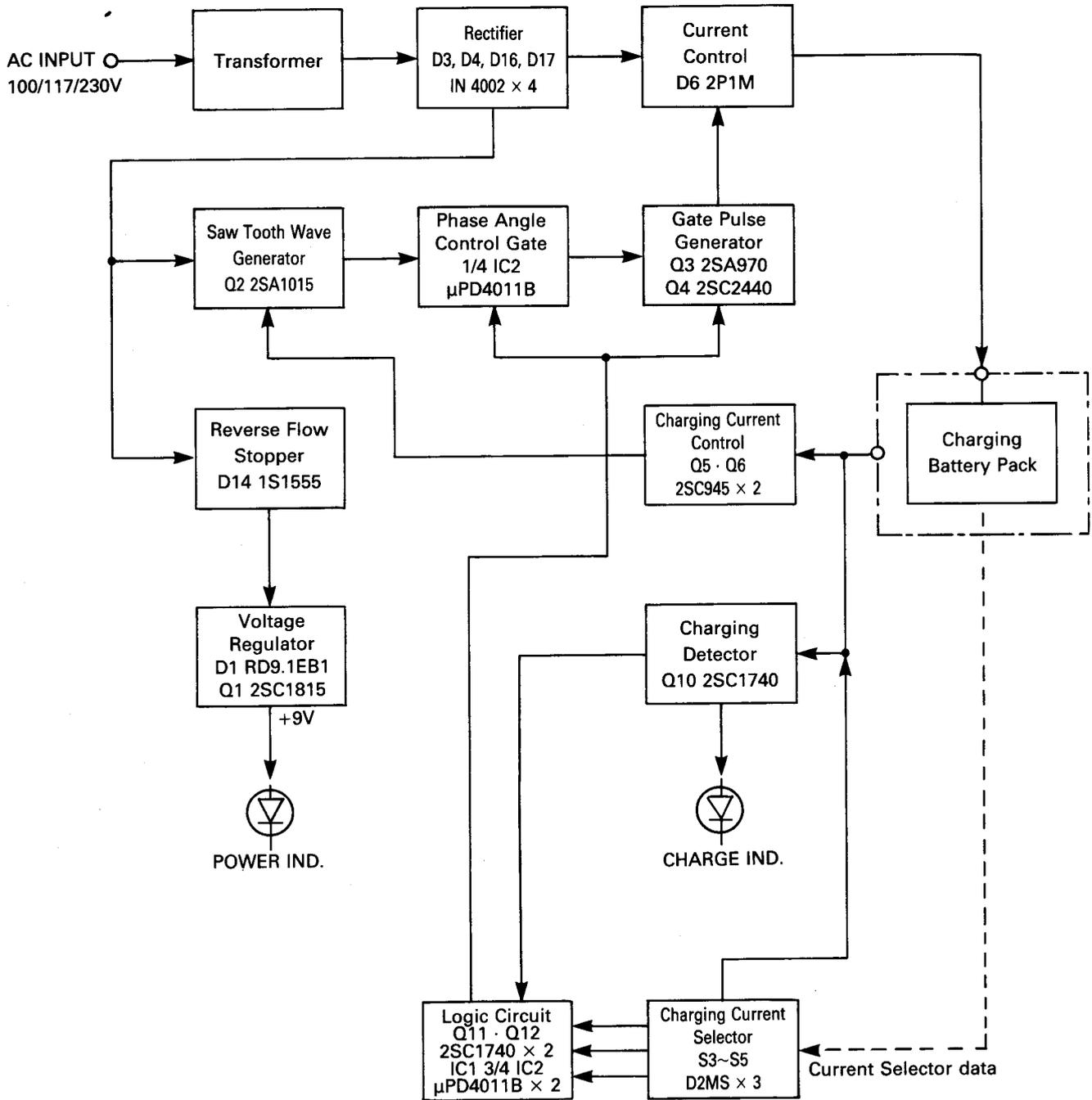
\* When sold with IC-2GA or IC-2GAT (Southeast Asia versions), BP-4 comes with drycells. NEVER charge drycells. Replace them with six AA NiCd batteries before charging.

## 10 - 2 PANEL DESCRIPTION



- ① **POWER SWITCH**  
Turns power on and off.
- ② **CHG INDICATOR**  
Lighted when charging. Goes out after charging is completed.
- ③ **PWR INDICATOR**  
Lighted when the power is on.
- ④ **BATTERY PACK INSERTION SLOT**
- ⑤ **CHARGING TERMINAL**  
Corresponds to the terminals on the base of a battery pack.
- ⑥ **MICROSWITCHES**  
The microswitches select the correct current and capacity for each battery pack.

10 - 3 BLOCK DIAGRAM



## 10 - 4 CIRCUIT DESCRIPTION

This charger is designed for the following battery packs: BP-2, BP-3, BP-4, BP-5, BP-5A, BP-7 and BP-70. The charger's selector board, which selects the correct charging current for the battery pack, as well as the battery pack sensors, prevent overcharging. The phase angle control circuit, a feedback loop, ensures charging at a stable current.

### (1) PHASE ANGLE CONTROL CIRCUIT

An SCR (D6) controls the current using the phase angle. In order to synchronize the gate pulse with the supplied voltage, the charger generates a saw-tooth wave synchronized with the rectified AC input. A gate pulse of the desired phase angle (approx.  $40^{\circ}$ ~ $160^{\circ}$ ) is generated by changing the fall time of the saw-tooth wave.

Diagram 1

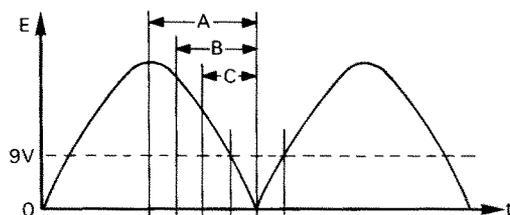


Diagram 2

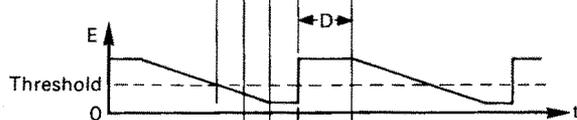


Diagram 3

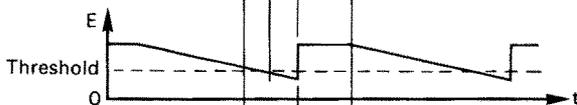


Diagram 4



Explanation of diagrams:

- 1) Rectified AC Sine Wave ( $360^{\circ}$ )
- 2) Voltage Waveform When the Current is Increased.
- 3) Voltage Waveform When the Current is Increased.
- 4) Voltage Waveform When the Current is Stable.

When the rectified voltage is less than +9 V, the saw-tooth wave generator circuit (Q2, Q5) charges C9 to +7.8 V. Q2 is turned on. When the voltage exceeds +9 V, C9 discharges through Q5 (Diagrams 2~4), creating a saw-tooth wave voltage.

This voltage is applied to IC2 (pin 12). When the voltage is less than +9 V, IC2 (pin 11) is "HIGH." Q3 and Q4 are turned on. A pulse, applied to the gate of the SCR (D6), turns on D6. D6 remains on if the current exceeds +9 V. The entire rectified wave ( $360^{\circ}$ ) is applied to the anode of D6. When the voltage becomes less than +9 V, reverse bias turns off D6.

S3~S5 are used to select the correct impedance of the series R37~R42, and thus the charging current. R37~R42 are connected in series between the battery and ground. C16 and R14 differentiate the voltage across these resistors. The resulting voltage is applied to the differential amplifier (Q5, Q6). The Vcc voltage (+9 V), divided by R11 and R12, is applied to the base of Q5. Q5 collector current, controlled by the base voltage of Q6, controls the discharge time constant of C9.

When the charging current exceeds a specified level, Q6 collector current increases. Q5 collector current decreases, increasing the discharge time constant of C9. Hence, the gate of D6 receives a pulse with a delayed phase angle, decreasing the current. When the charging current is less than the specified level, the circuit functions in reverse, keeping the charging current constant.

### (2) OVERCHARGE PROTECTOR

Using microswitches (S3~S5) and a charging detector (Q10), the overcharge protector circuit prevents overcharging. When charging BP-2, BP-5, BP-7 or BP-8, the microswitches on the base of the battery pack closes S5.

Thermo-sensors are included in all quick-charge battery packs. After the pack is fully charged, the temperature inside the pack rises. The charger shuts off current flow to the pack and stops charging. D10 and Q10 are used to detect charging current.

During normal speed charging, 25 mA, 45 mA and 70 mA are consecutively applied to the battery cells. During quick charging, 600 mA is reapplied to the cells until the thermo-sensor begins to function. The negative charging terminal inside the battery pack is unconnected. Q10 is turned off, and IC2 (pin 5) becomes "LOW." The RS flip-flop works in reverse.

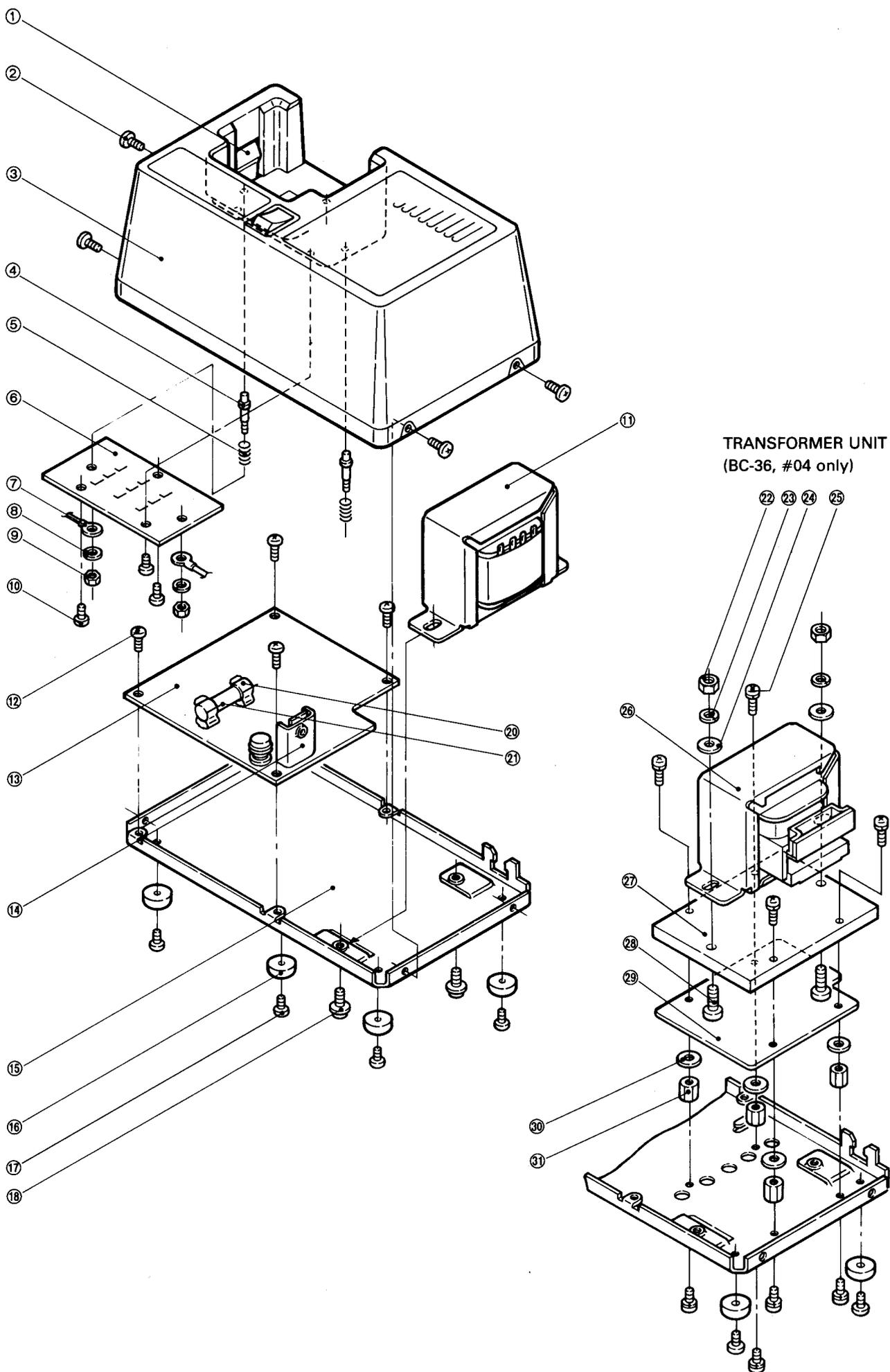
IC2 (pin 10) becomes "HIGH." Q4 remains off. Even if the temperature cools, D6 shuts off the current, preventing further charging. The CHG INDICATOR goes out, indicating that the pack is fully charged. Removing the battery pack at this time opens S5. IC1 (pin 5) becomes "LOW," resetting the RS flip-flop.

D1 and Q1 supply +9 V of stable voltage to the overcharge protector circuit.

## 10 - 5 MECHANICAL PARTS AND DISASSEMBLY

NUMBER	DESCRIPTION	ORDERING NUMBER	QTY.	
①	Spring lock plate	8930005700	2	
②	Self-tapping screw BH M3 × 6	8810002860	4	
③	Top cover	8010001040	1	
④	Contact pin	8930006140	2	
⑤	Spring (A)-1	8930007220	2	
⑥	P.C. Board	0910004414	1	
⑦	Wire crimped lug	green wire	9037701001	2
		red wire	9037701007	
⑧	Spring washer M2.6	8850000410	2	
⑨	Nut M2.6	8830000180	2	
⑩	Pan head screw M3 × 6	8810001350	3	
⑪	Transformer	#02 TP-34	5910000220	1
		#03 TP-36	5910000240	
		#05 TP-41	5910000270	
⑫	Self tapping-screw M3 × 6	8810002870	4	
⑬	P.C. Board B-439D	0910004414	1	
⑭	Heatsink	8410000070	1	
⑮	Chassis #02, 03, 04	8010001860	1	
	Chassis (A) #05	8010003340		
⑯	Rubber foot SK-136	8930002820	4	
⑰	Self-tapping screw M2.6 × 6	8810001590	4	
⑱	Set screw (c) 4 × 8	8810003390	2	
⑲	Power switch SDJ2S	2260000010	1	
⑳	Fuse holder S-N5051	5220000020	2	
㉑	Fuse	#02, 03, 05 FGB 2A	5210000040	1
		#04 3SF2 2A	5210000160	
㉒	Nut M4	8830000110	2	
㉓	S washer M4	8850000430	2	
㉔	Flat washer M4	8850000140	2	
㉕	Pan head screw M3 × 6 (incl. S washer)	8810002870	4	
㉖	Transformer #04 TP-35	5910000230	1	
㉗	Transformer base (A)	8930006810	1	
㉘	Pan head screw M4 × 10	8810000380	2	
㉙	Transformer base (B)	8930002010	1	
㉚	Flat washer M3	8850000130	4	
㉛	Spacer 40274 (D) L=7.5 (incl. screw, M3)	8860000130	4	

**Screw type** Screw: M2 × 6, etc. Self-tapping screw: B0 2 × 4, etc. Precision-type screw: No. 0-1  
**Screw head style** PH: Pan head BH: Button head FH: Flat head HLH: Headless hex head

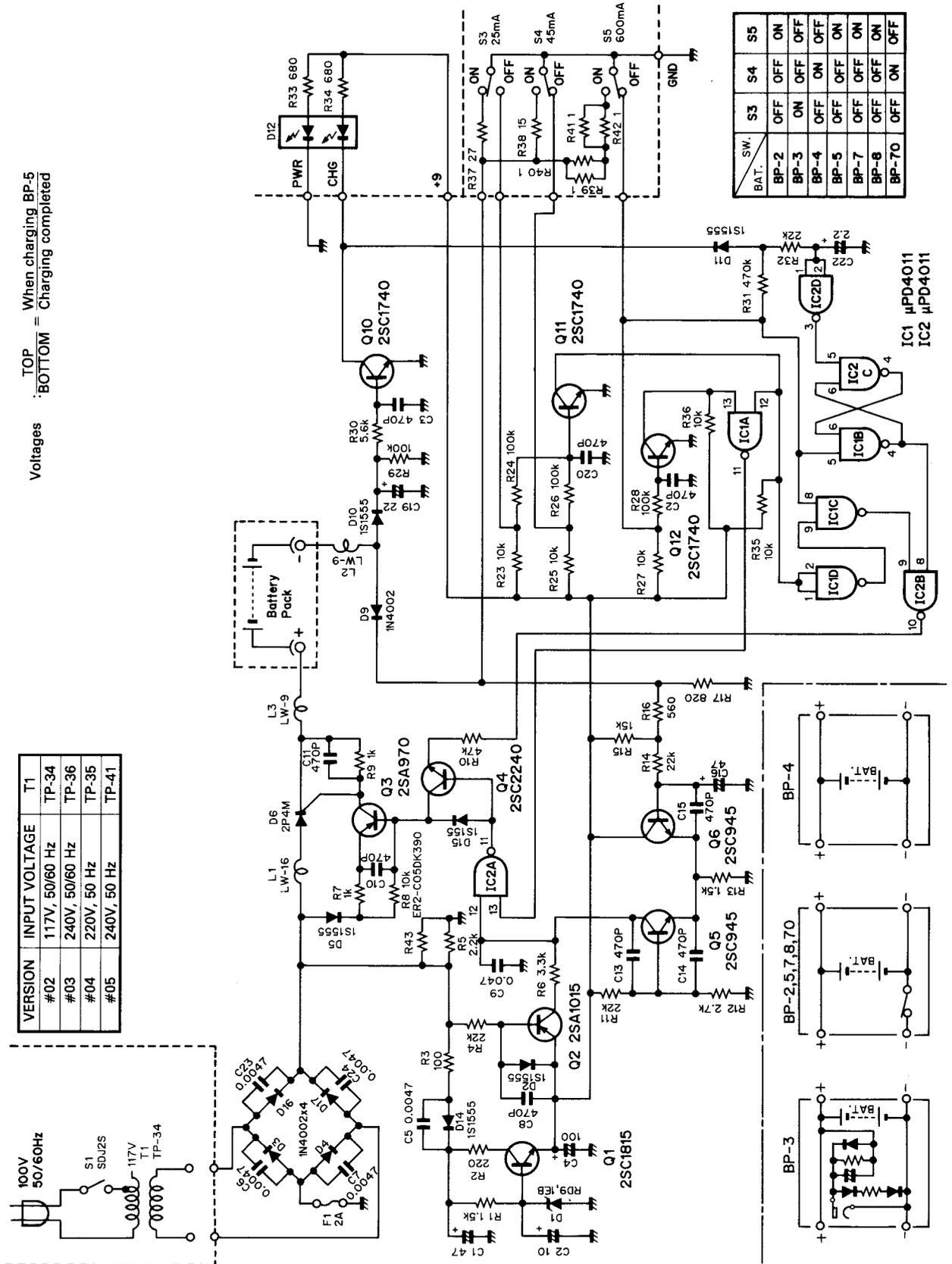


## 10-6 PARTS LIST

REF. NO.	DESCRIPTION	PART NO.
IC1	IC	μPD4011B
IC2	IC	μPD4011B
Q1	Transistor	2SC1815-O, Y, GR, BL
Q2	Transistor	2SA1015-Y
Q3	Transistor	2SA970-GR, BL
Q4	Transistor	2SC2240-GR, BL
Q5	Transistor	2SC945-P
Q6	Transistor	2SC945-P
Q10	Transistor	2SC1740-Q R, S, E
Q11	Transistor	2SC1740-Q R, S, E
Q12	Transistor	2SC1740-Q R, S, E
D1	Zener	RD9.1EB1
D2	Diode	1S1555
D3	Diode	1N4002
D4	Diode	1N4002
D5	Diode	1S1555
D6	SCR	2P4M
D9	Diode	1N4002
D10	Diode	1S1555
D11	Diode	1S1555
D12	LED	LD-002R
D14	Diode	1S1555
D15	Diode	1S1555
D16	Diode	1N4002
D17	Diode	1N4002
L1	Choke	LW-16
L2	Choke	LW-9
L3	Choke	LW-9
R1	Resistor	1.5 kΩ ELR25
R2	Resistor	220Ω ELR25
R3	Resistor	100Ω ELR25
R4	Resistor	22 kΩ ELR25
R5	Resistor	2.2 kΩ ELR25
R6	Resistor	3.3 kΩ ELR25
R7	Resistor	1 kΩ R25
R8	Resistor	10 kΩ R25
R9	Resistor	1 kΩ ELR25
R10	Resistor	47 kΩ R25
R11	Resistor	22 kΩ ELR25
R12	Resistor	2.7 kΩ ELR25
R13	Resistor	1.5 kΩ ELR25
R14	Resistor	22 kΩ ELR25
R15	Resistor	15 kΩ ELR25
R16	Resistor	560Ω ELR25
R17	Resistor	820Ω ELR25
R23	Resistor	10 kΩ ELR25
R24	Resistor	100 kΩ ELR25
R25	Resistor	10 kΩ ELR25
R26	Resistor	100 kΩ ELR25
R27	Resistor	10 kΩ R25
R28	Resistor	100 kΩ ELR25
R29	Resistor	100 kΩ R25

REF. NO.	DESCRIPTION	PART NO.
R30	Resistor	5.6 kΩ R25
R31	Resistor	470 kΩ R25
R32	Resistor	22 kΩ R25
R33	Resistor	680Ω R25
R34	Resistor	680Ω R25
R35	Resistor	10 kΩ ELR25
R36	Resistor	10 kΩ ELR25
R37	Resistor	27Ω R25
R38	Resistor	15Ω R25
R39	Resistor	1Ω R25
R40	Resistor	1Ω R25
R41	Resistor	1Ω R25
R42	Resistor	1Ω R25
R43	Surge Absorber	ERZ-C05DK390
C1	Electrolytic	47 μF 25 V MS
C2	Electrolytic	10 μF 16 V MS
C3	Ceramic	470 pF 50 V
C4	Electrolytic	100 μF 10 V MS
C5	Ceramic	0.0047 μF 50 V
C6	Ceramic	0.0047 μF 50 V
C7	Ceramic	0.0047 μF 50 V
C8	Ceramic	470 pF 50 V
C9	Barrier Layer	0.047 μF 25 V
C10	Ceramic	470 μF 50 V
C11	Ceramic	470 μF 50 V
C13	Ceramic	470 μF 50 V
C14	Ceramic	470 μF 50 V
C15	Ceramic	470 μF 50 V
C16	Electrolytic	47 μF 10 V MS
C19	Electrolytic	22 μF 16 V MS
C20	Ceramic	470 pF 50 V
C21	Ceramic	470 pF 50 V
C22	Electrolytic	2.2 μF 50 V MS
C23	Ceramic	0.0047 μF 50 V
C24	Ceramic	0.0047 μF 50 V
S1	Switch	SDJ2S
S3	Switch	D2MS
S4	Switch	D2MS
S5	Switch	D2MS
W17	Jumper	JPW-02
W18	Jumper	JPW-02
EP1	Power Cord	
	#02	OPC-013
	#03	OPC-019
	#04	OPC-146
	#05	OPC-071
EP2	P. C. Board	B-439D

10 - 7 SCHEMATIC AND VOLTAGE DIAGRAM



## SECTION 11 UT-40 TONE SQUELCH UNIT

## 11 - 1 UT-40 CIRCUIT DESCRIPTION

## (1) GENERAL

IC1 is a tone encoder/decoder which outputs and detects 37 tone frequencies. IC2 functions as a serial/parallel converter. 6-bit parallel data are applied to IC1. Refer to the following table for tone frequencies and corresponding input data.

OUTPUT FREQUENCY [Hz]	IC1 INPUT PIN NUMBER						OUTPUT FREQUENCY [Hz]	IC1 INPUT PIN NUMBER					
	3	4	5	6	7	8		3	4	5	6	7	8
67.0	H	L	H	H	H	L	136.5	H	H	H	H	L	H
71.9	L	L	H	H	H	L	141.3	L	H	H	H	L	H
74.4	H	H	L	H	H	L	146.2	H	L	H	H	L	H
77.0	L	H	L	H	H	L	151.4	L	L	H	H	L	H
79.7	H	L	L	H	H	L	156.7	H	H	L	H	L	H
82.5	L	L	L	H	H	L	162.2	L	H	L	H	L	H
85.4	H	H	H	L	H	L	167.9	H	L	L	H	L	H
88.5	L	H	H	L	H	L	173.8	L	L	L	H	L	H
91.5	H	L	H	L	H	L	179.9	H	H	H	L	L	H
94.8	H	L	L	H	H	H	186.2	L	H	H	L	L	H
100.0	L	L	L	H	H	H	192.8	H	L	H	L	L	H
103.5	H	H	H	L	H	H	203.5	L	L	H	L	L	H
107.2	L	H	H	L	H	H	210.7	H	H	L	L	L	H
110.9	H	L	H	L	H	H	218.1	L	H	L	L	L	H
114.8	L	L	H	L	H	H	225.7	H	L	L	L	L	H
118.8	H	H	L	L	H	H	233.6	L	L	L	L	L	H
123.0	L	H	L	L	H	H	241.8	H	H	H	H	H	L
127.3	H	L	L	L	H	H	250.3	L	H	H	H	H	L
131.8	L	L	L	L	H	H	—	—	—	—	—	—	—

## (2) ENCODER

IC1 (pin 26) outputs the programmed tone frequency when IC1 (pin 12) becomes "LOW." Q4 functions as a buffer amplifier. The collector of Q4 outputs the tone signal which is applied to the VCO circuit to be modulated. Tone deviation is adjusted with R10.

## (3) DECODER

The detected tone from the transceiver is applied to IC1 (pin 29). When the signal is tone modulated and the tone equals the programmed tone frequency, pin 23 becomes "HIGH."

When the tone squelch function is turned off, IC2 (pins 11 and 12) are "HIGH." +5 V are not applied to IC1. Q2 and Q3 are turned off and the TSQL line is "HIGH."

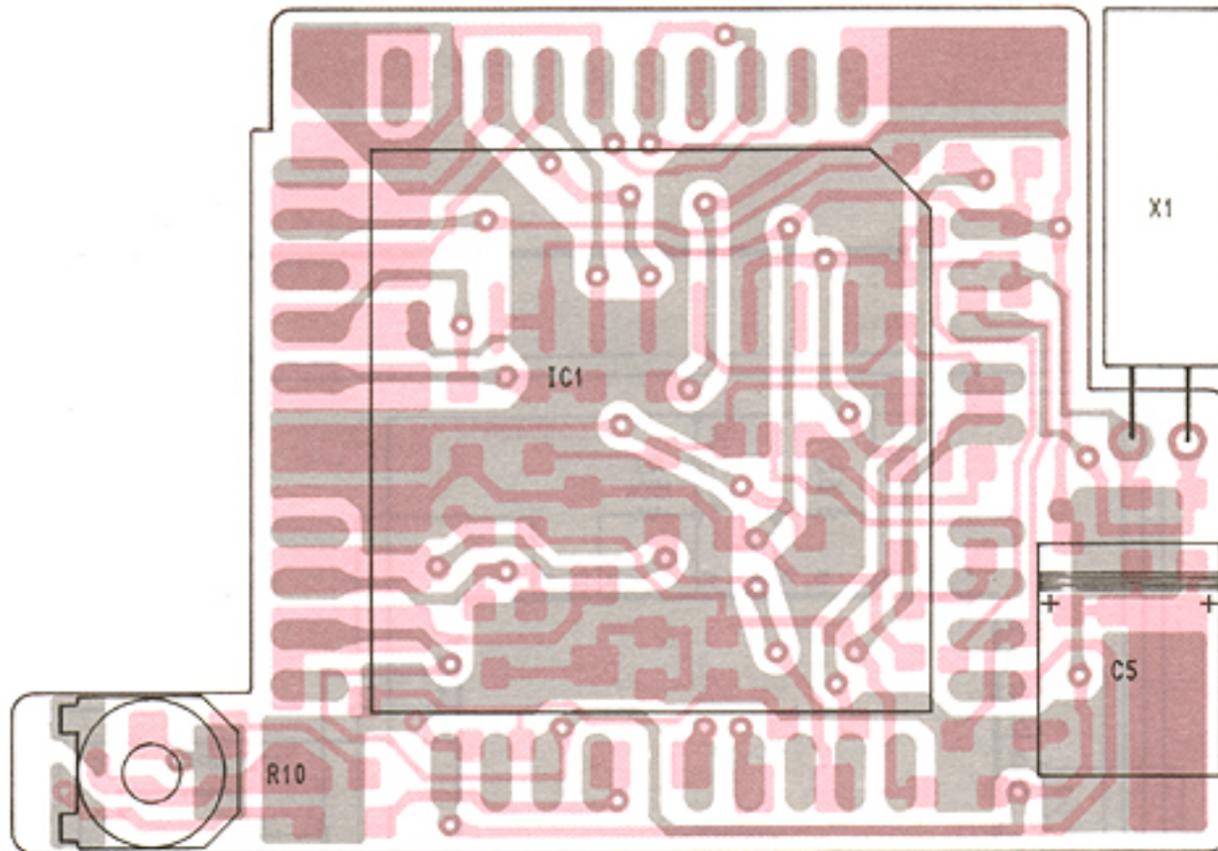
When the tone squelch function is turned on, IC2 (pin 11) is "HIGH" and IC12 (pin 12) is "LOW." Q2 and Q3 are turned on.

When the received tone frequency equals the programmed tone frequency, pin 23 is "HIGH" and the TSQL line is "HIGH."

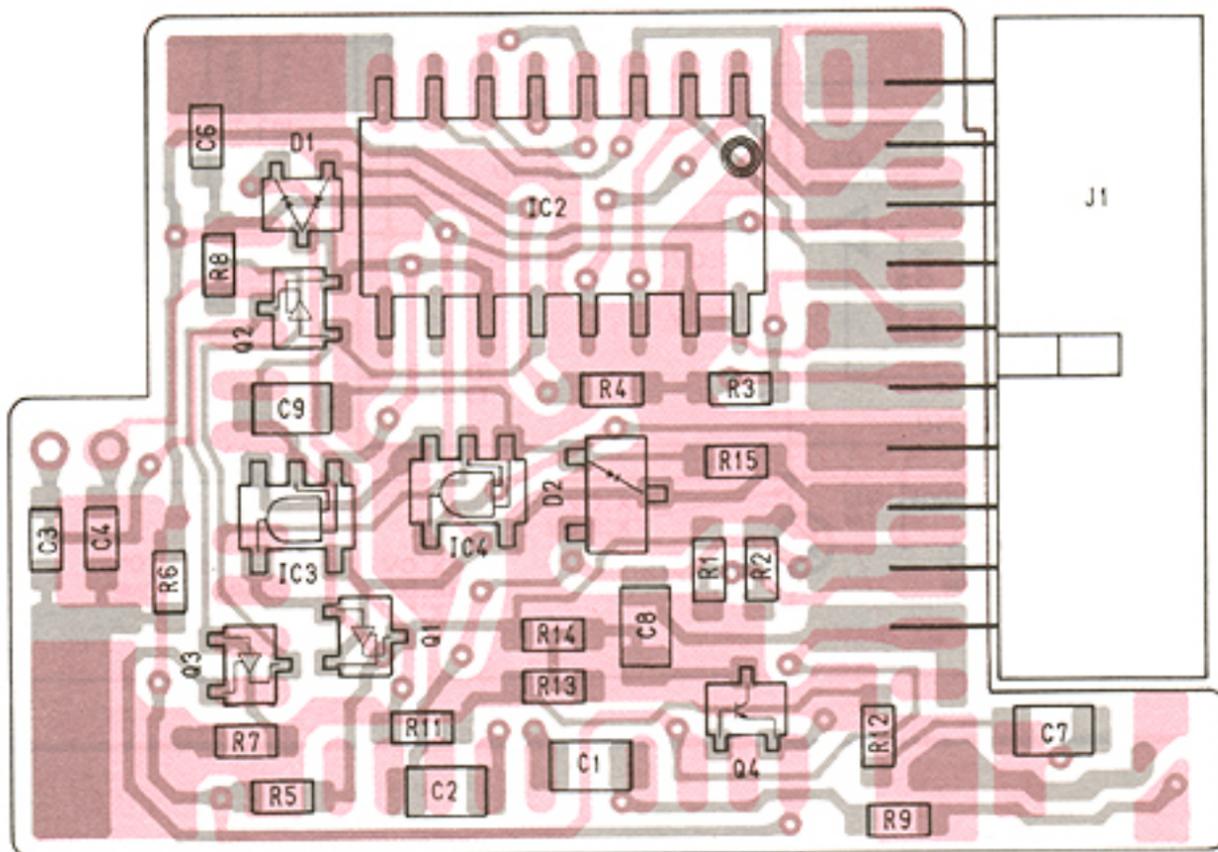
When the received tone frequency does not equal the programmed tone frequency, IC1 (pin 23) is "LOW," and the TSQL line is "LOW."

# 11 - 2 BOARD LAYOUT

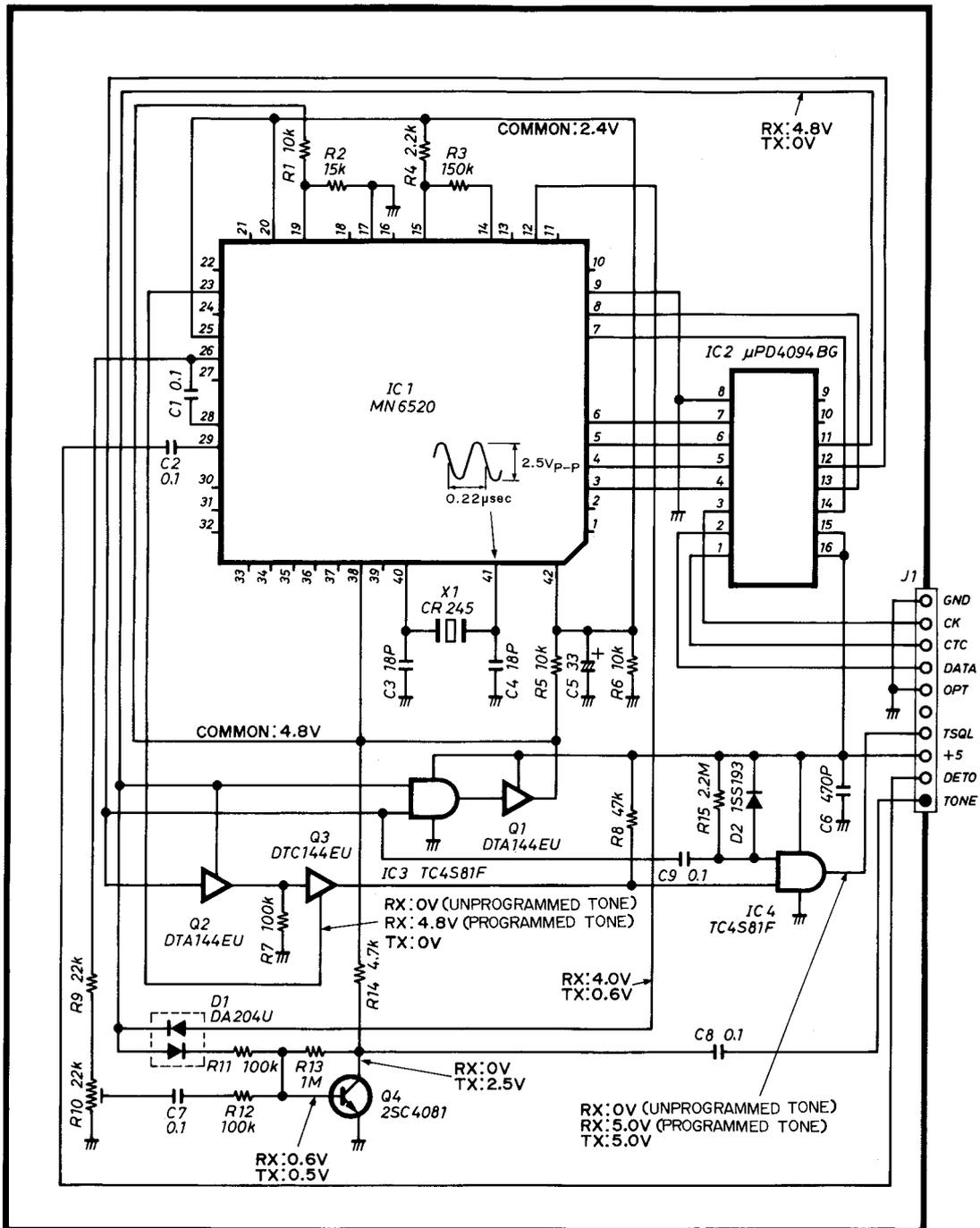
## ■ SIDE A



## ■ SIDE B



11 - 3 SCHEMATIC AND VOLTAGE DIAGRAM



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