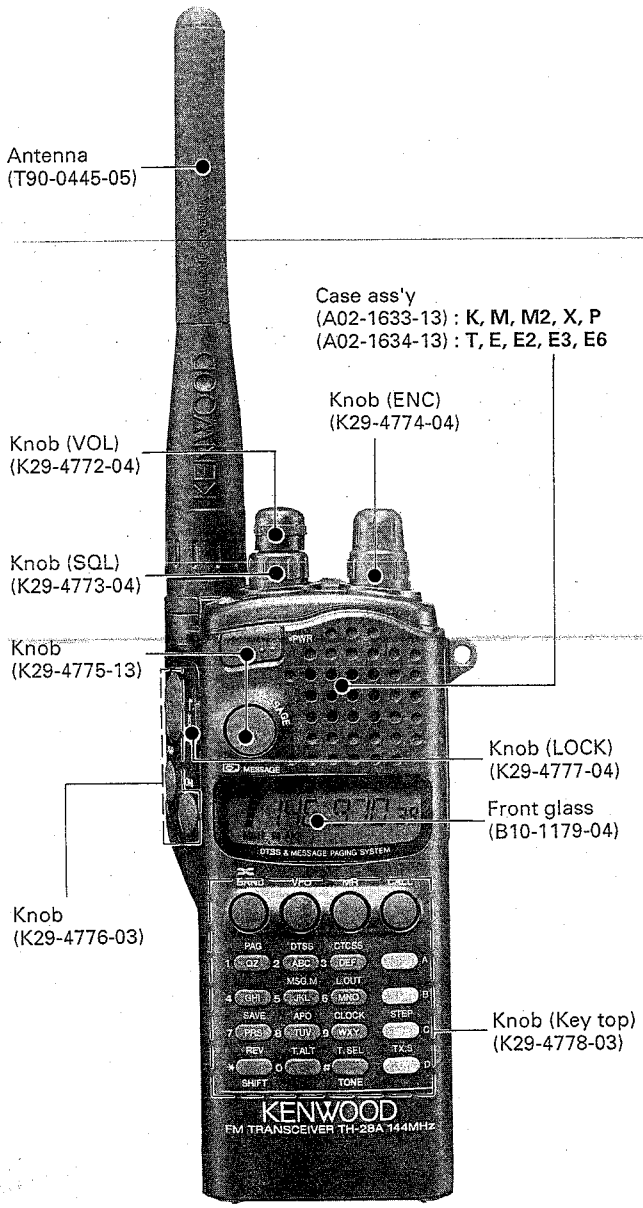
144MHz FM TRANSCEIVER

TH-28A/E

SERVICE MANUAL

KENWOOD

B51-8170-00(O)1209



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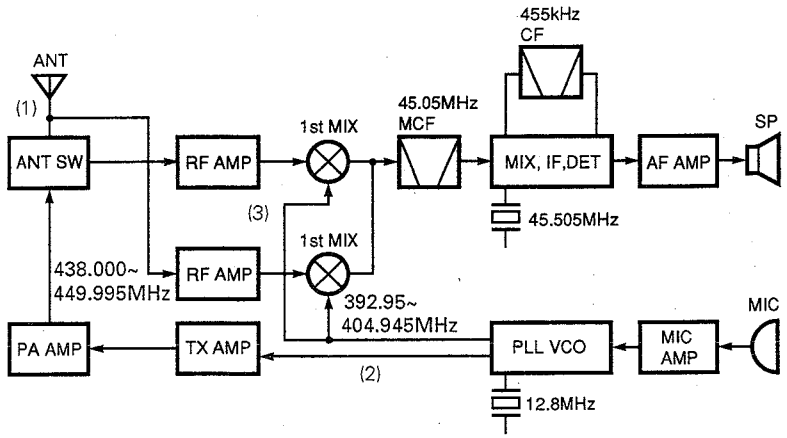
CONTENTS

CIRCUIT DESCRIPTION

Frequency Configuration

The frequency configuration is shown in Figure 1 and Table 1.



(1) 144.000~147.995MHz (K, P, M, X)
144.000~145.995MHz (T, E)

(2) 144.000~147.995MHz (K, P, M, X)
144.000~145.995MHz (T, E)

(3) 189.050~193.045MHz (K, P, M, X)
189.050~191.045MHz (T, E)

Fig. 1 Frequency configuration

Receiver System

Receiving system	Double superheterodyne system	
	1st IF frequency	45.05MHz
	2nd IF frequency	455kHz
Transmitting system	Direct oscillating amplification system	
Modulation system	Variable reactance phase modulation	

Table 1 Basic configuration

• RF amplifier

The signal from the antenna is passed through a low-pass filter and transmission/reception selector circuit, and input to the RF amplifier.

The input signal is amplified by Q213 and sent to the bandpass filter to eliminate the unwanted frequency band.

For sub-UHF reception, the signal from the antenna passes through the high-pass filter, and is amplified by RF amplifier Q216.

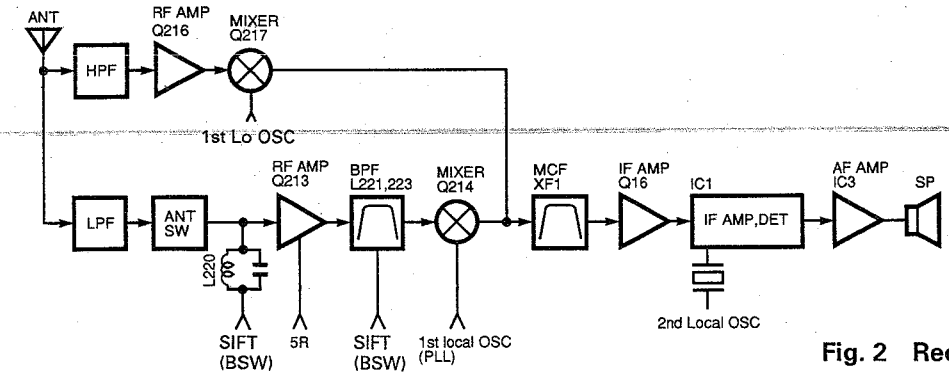


Fig. 2 Receiver section configuration

• First-stage mixer

The input signal is mixed with the first local oscillator signal from the PLL circuit by first-stage mixer Q214 (Q217 for sub-UHF) and so is converted into the first IF singal. The unwanted frequency band of the first IF signal is eliminated by a two-stage monolithic crystal filter (MCF).

Item	Rating
Nominal center frequency (fo)	45.05MHz
Pass bandwidth	±7.5kHz or more at 3dB
Attenuation bandwidth	±22kHz or less at 25dB
Guaranteed attenuation	80dB or more at –910kHz Spurious : 40dB or more wthin ±1MHz
Ripple	1.0dB or less
Insertion loss	4.0dB or less
Terminal impedance	800Ω/2pF

Table 2 MCF (L71-0409-05) (TX-RX unit XF1)

CIRCUIT DESCRIPTION

• IF amplifier

The first IF singal is amplified by Q16 and input to IC1 (FM signal processing IC), where it is mixed with the scecond local oscillator signal and so is converted into the second IF signal.

The unwanted frequency band of the second IF signal is eliminated by a ceramic filter. The resulting signal is then amplified and detected.

Item	Rating
Center frequency of 6dB bandwidth (fo)	Within 455 ±1.5kHz
6dB bandwidth	±7.5kHz or more
40dB bandwidth	±15kHz or less
Passband ripple	1.5dB or less (within 455 ±1.5kHz)
Guaranteed attenuation	27dB or more (±100kHz)
Insertion loss	6dB or less
Input/output impedance	1.5kΩ

Table 3 Ceramic filter (L72-0362-05) (TX-RX unit CF1)

• AF amplifier

The frequency characteristics of the audio signal output by the FM detector are corrected by the Q12 active high-pass filter and deemphasis circuit consisting of C29 and R43.

The audio signal is then passed through an AF variable resistor and amplified by power amplifier IC3 to obtain the desired output.

• Squelch and mute circuits

The output of the squelch circuit consisting of IC1 and Q11 is output from SQ SW (Q9, 10) to pin 26 of the microprocessor as the BUSY signal. The microprocessor controls the MUTE and AFC signals in accordance with the BUSY input signal logic and other function states, and so controls the audio signal.

The microprocessor also controls the MUTE and AFC signals during the T. ALT and CTCSS and DTSS operations, thus controling the audio signal.

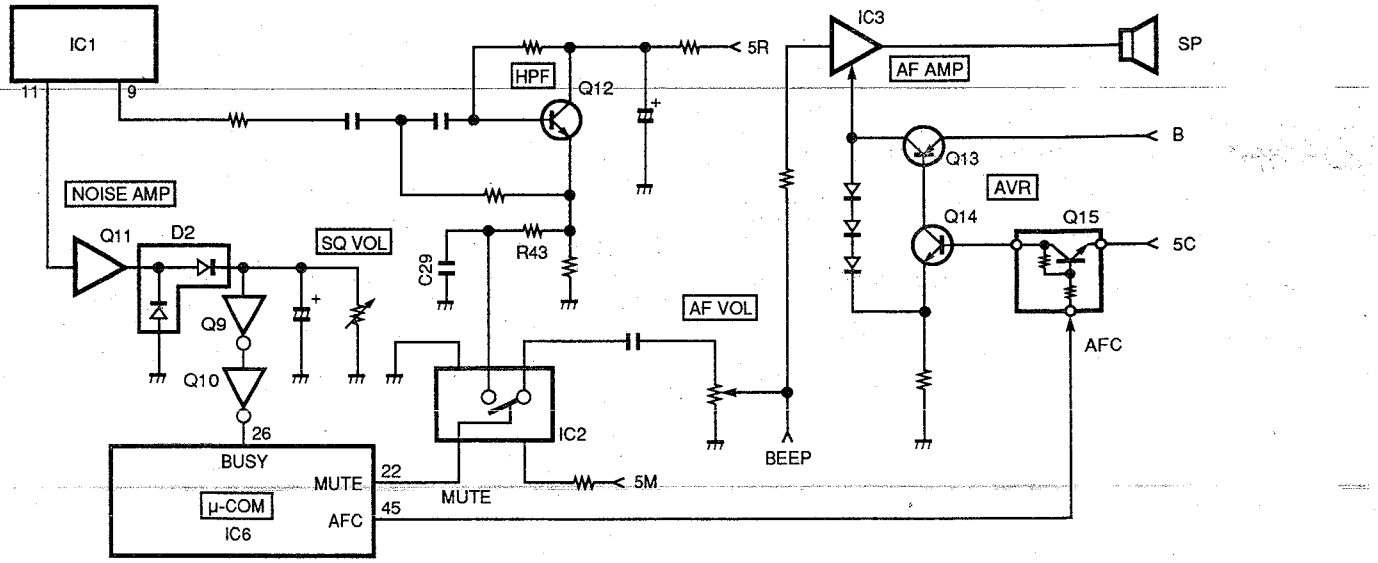


Fig. 3 AF amplifier, squelch, and mute circuits

Condition			MUTE	AFC
Transmission			L	L
Reception	Normal operation	Squelch on	L	L
		Squenlch off	H	H
	T. ALT	Standby	L	L
		Receive (T. ALT)	H	L

MUTE : Muted when low
AFC : Muted when low

Table 4 Muting conditions

CIRCUIT DESCRIPTION

• S-merer circuit

The S-meter signal is output from pin 13 of IC1 as a direct current corresponding to the input signal, converted to a voltage by R63, then input to pin 3 of the microprocesser. The DC voltage is digitized to control the LCD S-meter display.

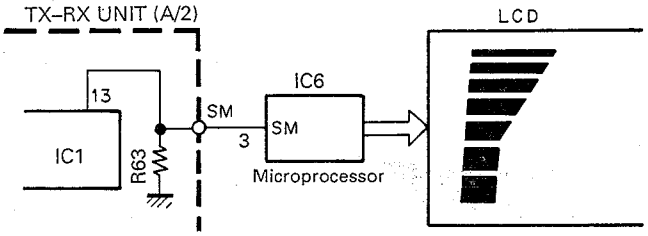


Fig. 4 S-meter circuit

Transmitter System

• Microphone amplifier

The signal from the microphone is passed through a 6dB/oct pre-emphasis circuit consisting of C79 and R91, 92 to amplifier IC7 (1/2), then limited. Distortion components exceeding the audio band of the resulting signal are then eliminated by a splatter filter consisting of IC7 (2/2).

• Modulator circuit

The output from the microphone amplifier is passed through variable resistor VR8 for modulation adjustment to varicap diode D3 of the VCO, controlling the VCO frequency and so producing a frequency-modulated RF output.

• Drive and final circuits

The modulated RF signal from the VCO is amplified to about –5dBm by a buffer amplifer. The signal is then amplified to about 15dBm by the drive. The amplified signal is input through pin diode D208 for transmission output adjustment to power module IC202. The power module consists of a two-stage amplifier and amplifies the signal to about 5W for output.

• Transmmission/reception selector circuit

The transmission output is passed through the transmission/reception selector circuit and low-pass filter to the antenna.

The transmission/reception selector circuit, which consists of D209 and D210, is turned on during transmission and off during reception to switch the signal.

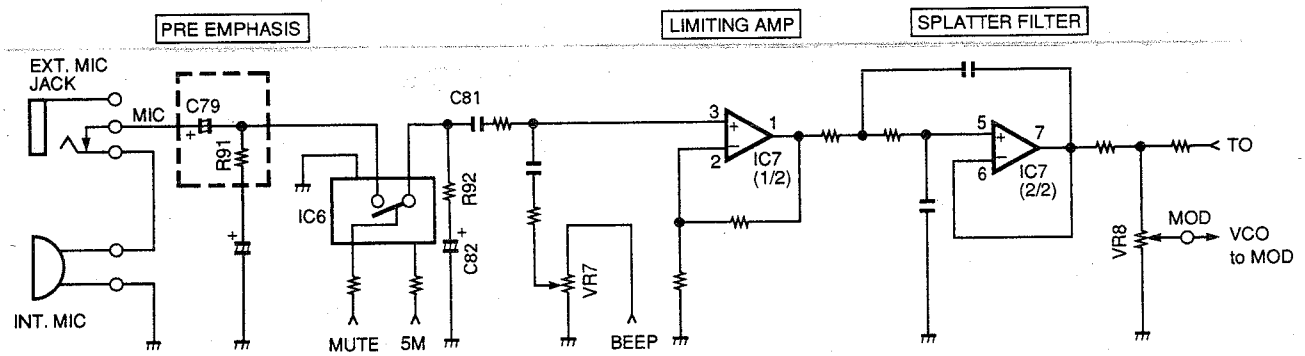


Fig. 5 Microphone amplifier

CIRCUIT DESCRIPTION

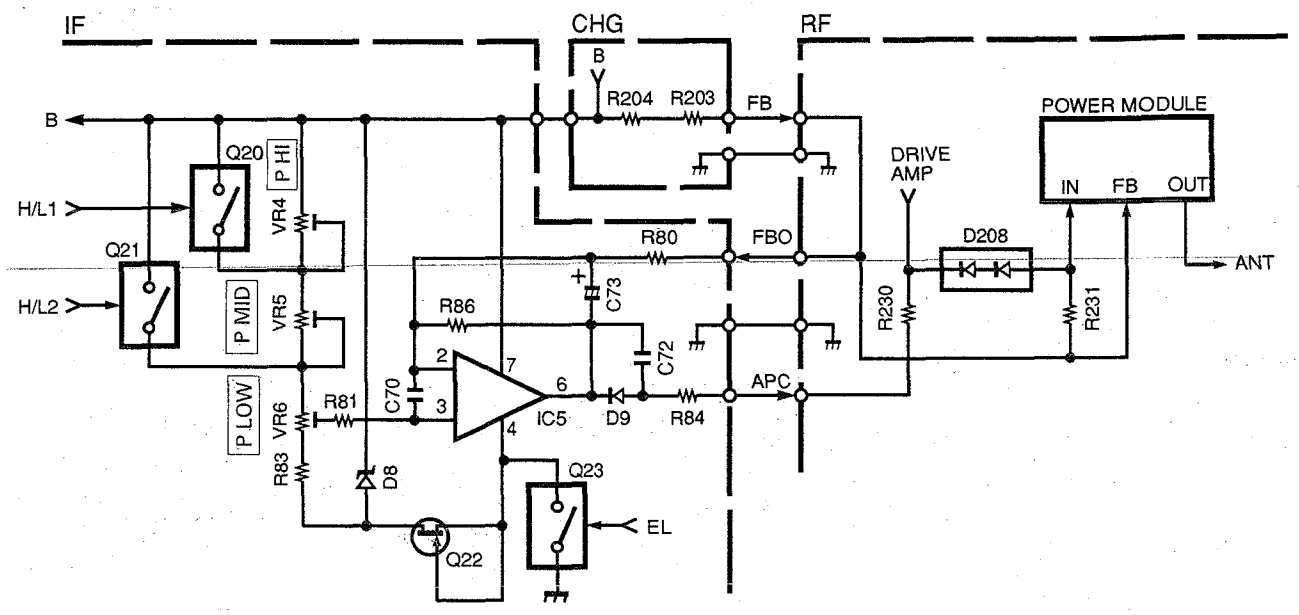
• APC and transmission output selector circuits

The automatic power control (APC) circuit is used to obtain a stable transmission current. This circuit detects the collector current in the final stage of the power module and controls the transmission output as follows:

To differential DC amplifier IC5, two voltages are applied the reference voltage produced by dividing the voltage of constant-current zener diode D8 by variable resistors VR4 through VR6 for transmission output ajustment, and the detection voltage generated across R203, 204 in proportion to the collector voltage in the final stage.

The APC voltage, proportional to the difference between the reference voltage and the detection voltage, is obtained at the output pin (pin 6) of IC5. This APC voltage controls the attenuation of input diode D208 of the power module and stabilizes the transmission output.

Q20 and Q21 are selected when the transmission output is selected. The reference voltage is then changed, and the transmission output is fixed at about 5W (high), 2.5W (medium), or 0.5W (low). Q23 stops the operation of the APC circuit when the transmission output is set to EL (economic low power).



Q20, Q21, and Q23 are transistor switches.
These switches are high when active.
H/L1, H/L2, and EL are control signals from the microprocessor unit (MPU).
The logical relationship is shown in the table below.

	H/L1	H/L2	EL
HI	L	L	H
MID	H	L	H
LOW	L	H	H
E-LOW	–	–	L

Fig. 6 APC and transmission output selector circuit

CIRCUIT DESCRIPTION

• Economic low-power circuit

The economic low-power circuit is used to send the drive circuit output directly to the antenna without passing through the power module. When this is done, the bias power at the base of the power module is turned off. This reduces the power consumption.

The E-LOW pin is made low when the transmission output is set to EL. The transmission circuit then operates as follows:

1. Q210 and Q211 are turned off, and the 5V of the power module is set to 0V. D209 is turned off at the same time and the power module output is opened.
2. Q209 is tuned off, so D208 is turned off. Thus the drive circuit output is not supplied to the power module.
3. Q208 is turned off and Q207 is turned on, so D207 and D211 (1/2) are turned on. Q212 is also turned off and D210 is turned off. The drive circuit output is passed through D207, D211 (1/2), L219, and L217 to the antenna.

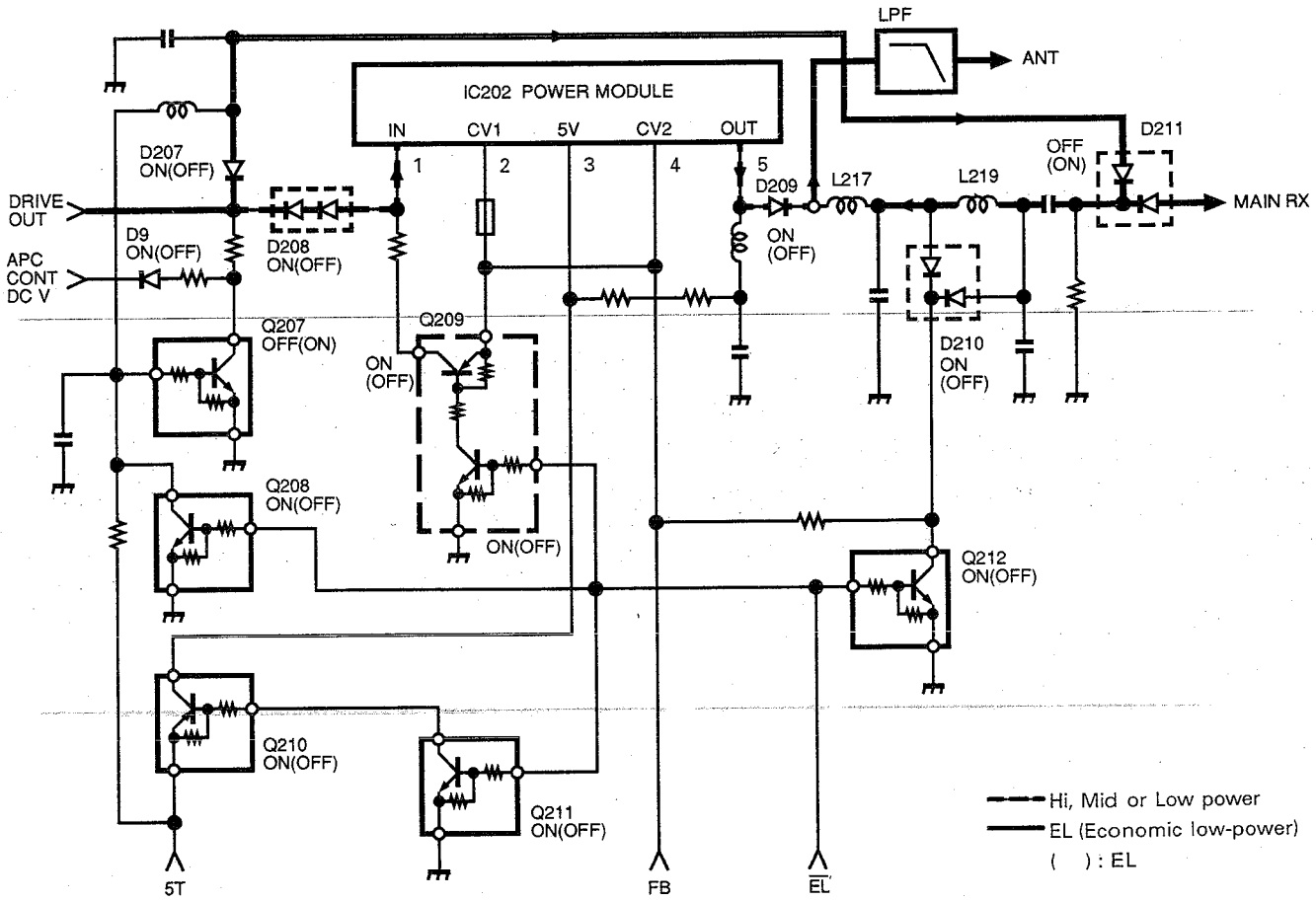


Fig. 7 Economic low-power circuit

CIRCUIT DESCRIPTION

PLL Circuit

• PLL

A 5kHz or 6.25kHz reference frequency is obtained by dividing 12.8MHz reference oscillation frequency X201 in IC201. A comparison frequency is obtained when the VCO output is amplified by Q202 then divided in IC201 (pulse swallow system-based PLL IC).

A 5, 10, 12.5, 15, 20, or 25kHz PLL synthesizer is implemented by phase-comparing the reference frequency and comparison frequency obtained when reference oscillation frequency X201 is divided.

• VCO (X58-3870-XX)

The desired frequency is produced directly by a Colpitts oscillator circuit consisting of FET Q2. The VCO control voltage is applied to varicap diodes D1 and D2 to change the oscillation frequencycy. The TX pin is made high during reception. Q1 and D4 are then turned on to change over the oscillation frequency.

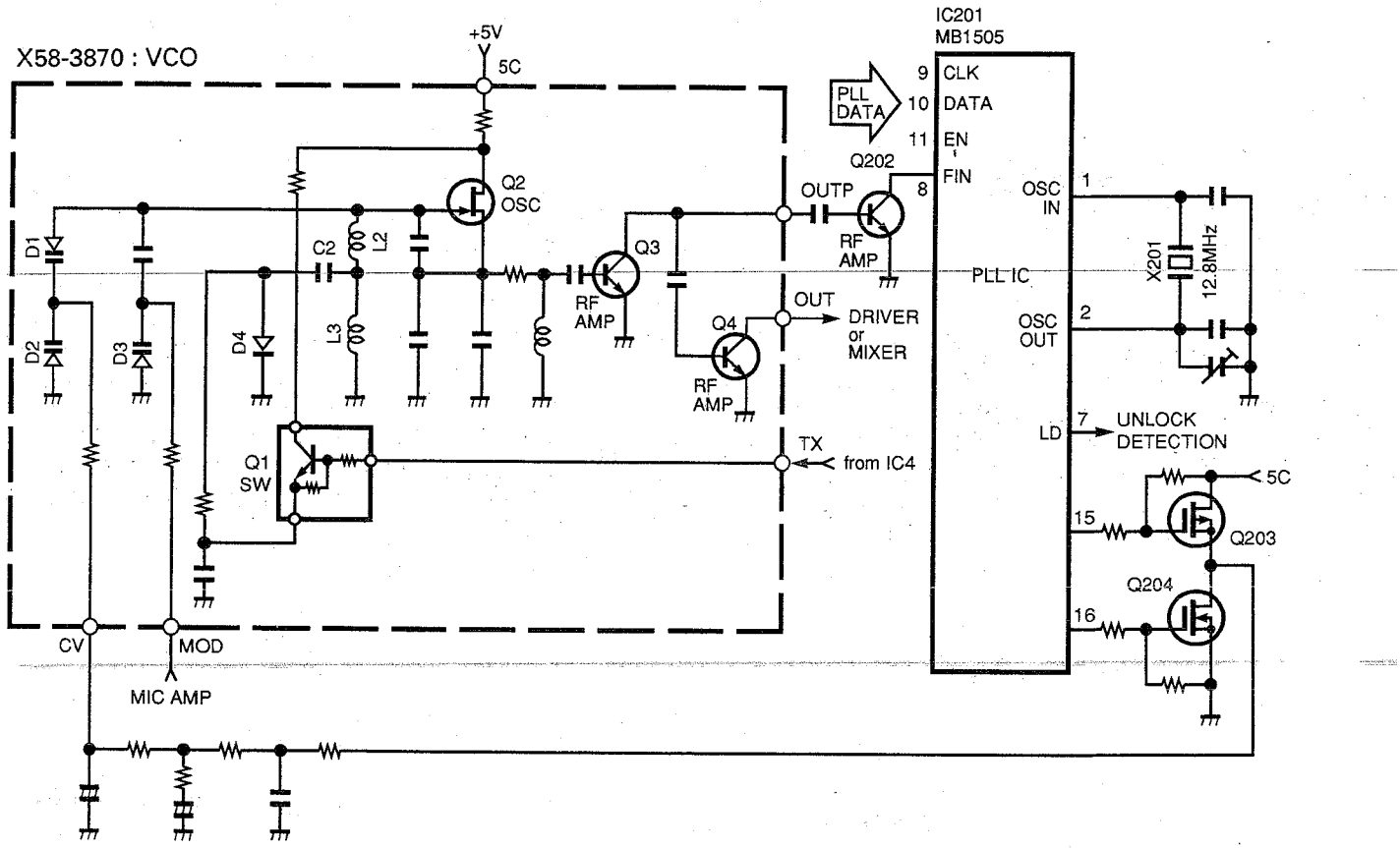


Fig. 8 PLL and VCO circuits

• Unlock detector circuit

When the PLL circuit is in the unlock state, the pulse that is output to the UL pin (pin 7) of IC201 is wave from shaped by D202, C210, C211 and R212. The UL pin is then made high. The voltage at the UL pin is monitored by the microprocessor to control the transmission or reception selection timing.

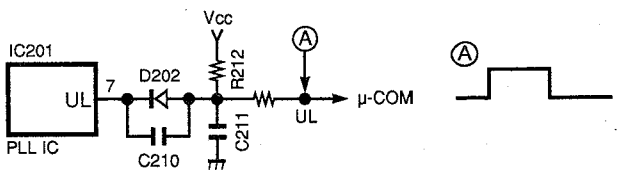


Fig. 9 Unlock detector circuit

CIRCUIT DESCRIPTION

Digital Control Circuit

• Key and rotary encoder input circuits

As shown in Figure 10, signals are input directly to the microprocessor.

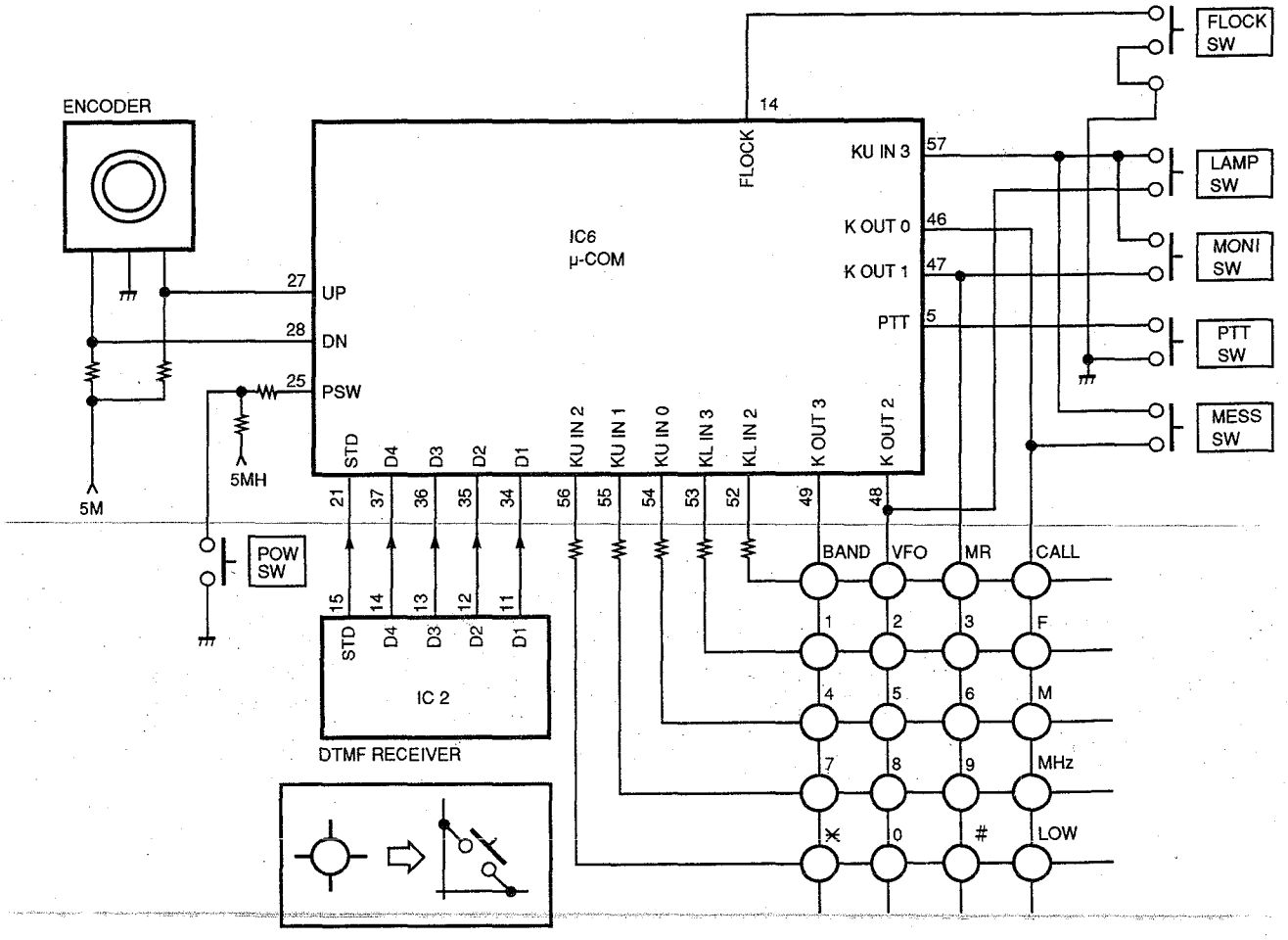


Fig. 10 Key and rotary encoder input circuits

CIRCUIT DESCRIPTION

• Reset and backup circuits

A high pulse of duration about 10ms is output from reset circuits C12 and Q4 when power B is turned on. Microprocessor IC6 is then reset. Voltage detector circuit IC3 detects a decrease in the 5V line when power B is turned off. The output level is then changed from high to low. The microprocessor enters the backup state when microprocessor port INT4 is made low.

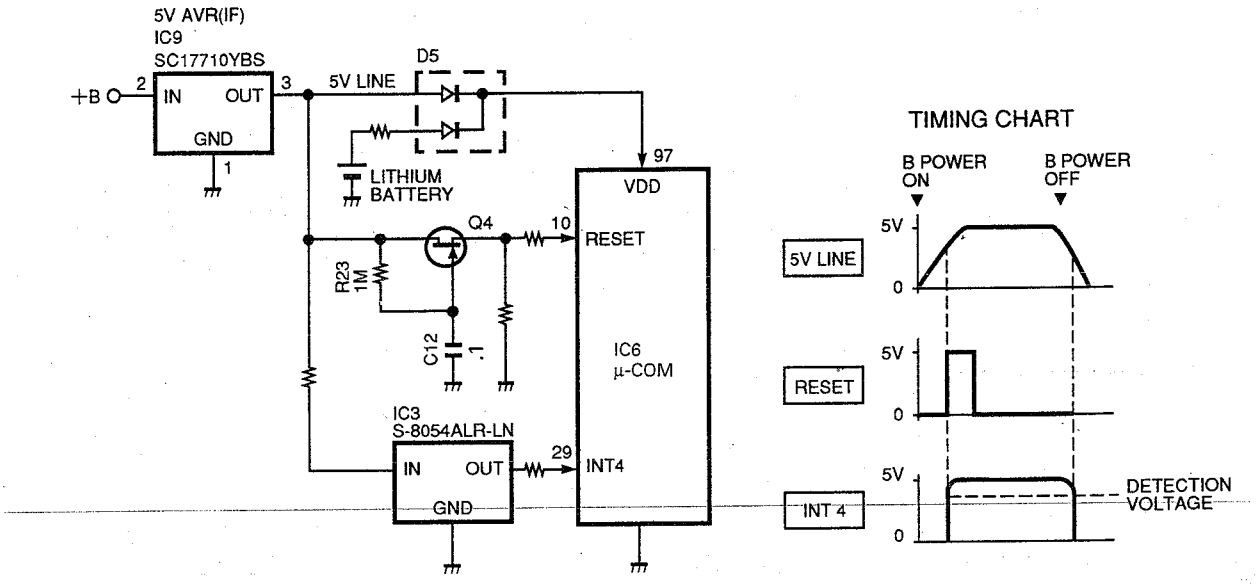


Fig. 11 Reset and backup circuits

• Battery voltage detector circuit

The supply voltage is divided and input to the analog port of the microprosessor. The voltage input to the microprocessor is digitized to drive the LCD battery display.

• Lamp circuit

The constant current circuit consisting of Q1 and D3 is switched using the output signal at the shift register IC4 LAMP. The LED is then turned on or off.

• Lithium battery charging circuit

The backup lithium battery is a rechargeable secondary lithium battery. So a charging current is supplied to the battery from the output pin of 5V AVR IC9 by LED D6. The battery voltage becomes about 3.3V when the battery is fully charged.

The lithium battery supplies current when the battery pack is removed and the external power is turned off.

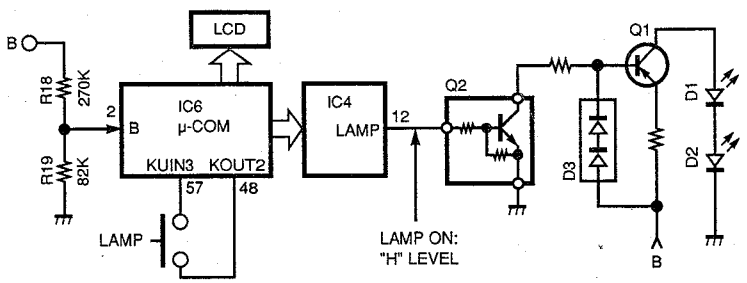


Fig. 12 Battery voltage detector and lamp circuits

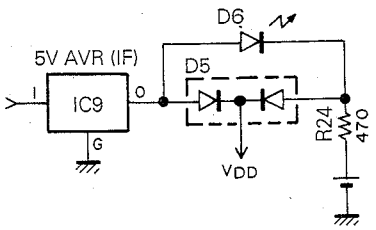


Fig. 13 Lithium battery charging circuit

CIRCUIT DESCRIPTION

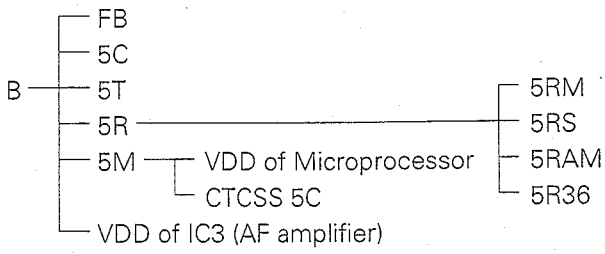
Power Supply Circuit

• Ni-Cd charging circuit

A constant current of about 60mA is supplied to the Ni-Cd battery from the external power connected to the DC IN pin by the constant current circuit consisting of Q201 and D204.

• Power selector circuit

The power circuit configuration is shown in Figure 14. The power circuit branches as follows:



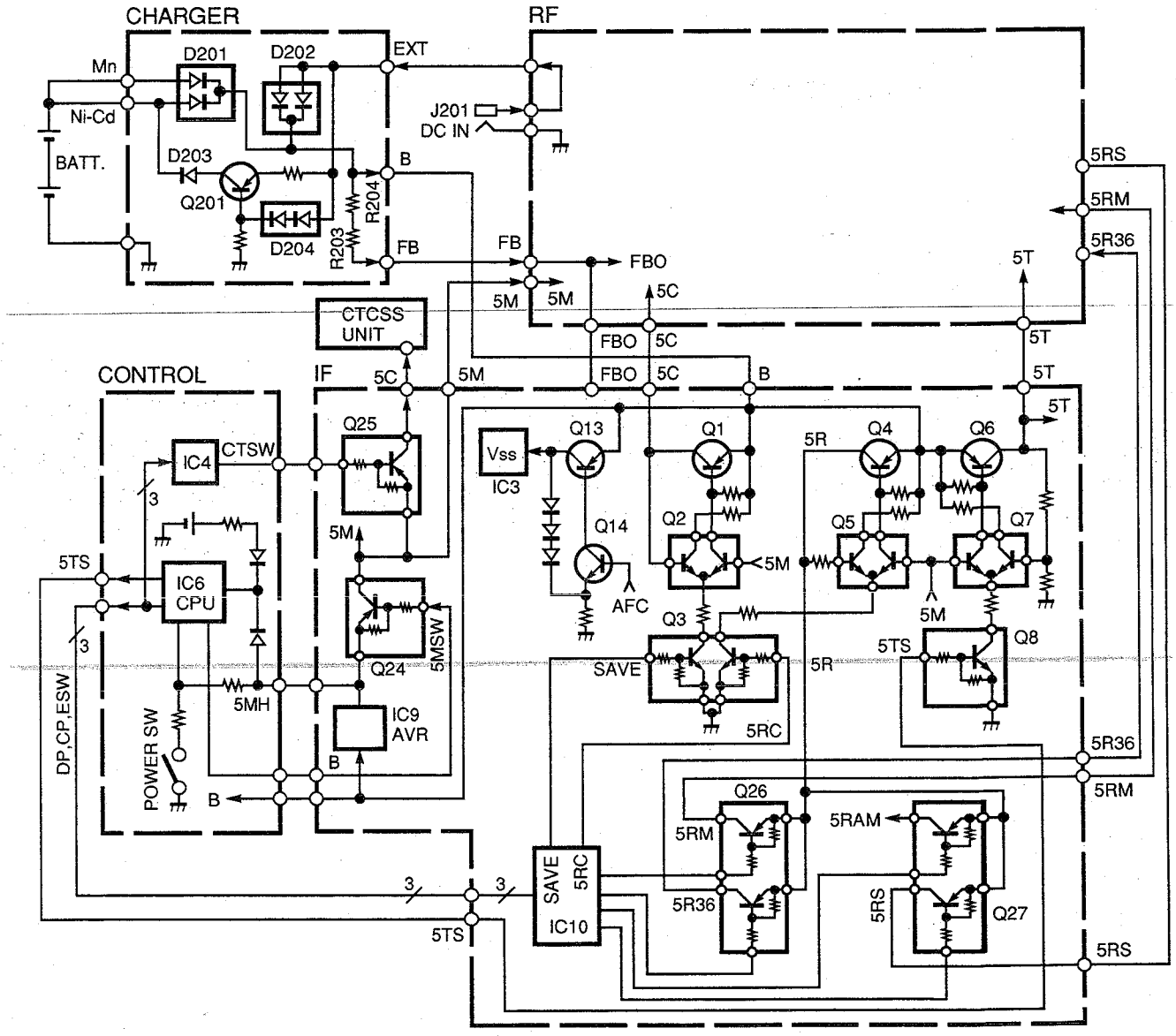


Fig. 14 Power supply circuit

CIRCUIT DESCRIPTION

• Battery save circuit

The squelch is switched in during receive (SCAN OFF). The power circuit enters the battery save mode if no key is pressed for more than ten seconds.

Q3 (1/2) is then turned on or off in a 1 : 8 cycle by the signal output from the SAVE pin of the shift register IC10. As a result, the power consumption in the standby state is reduced by controlling the 5C AVR circuit consisting of Q1 and Q2, turning it on or off.

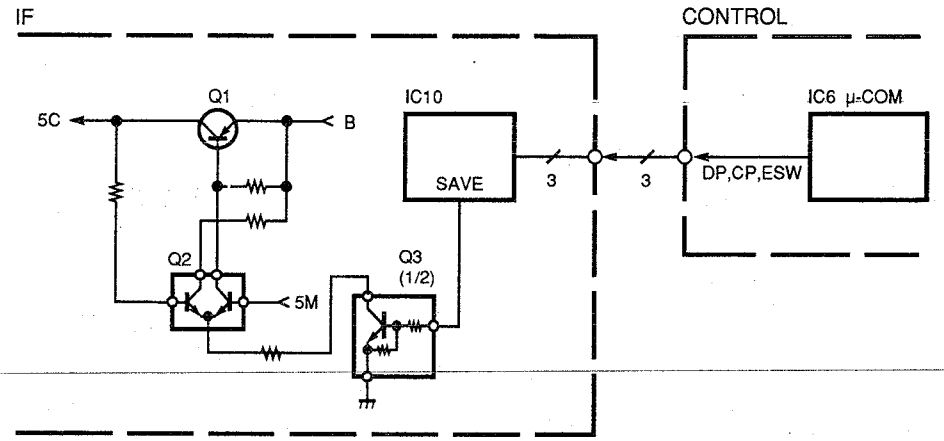
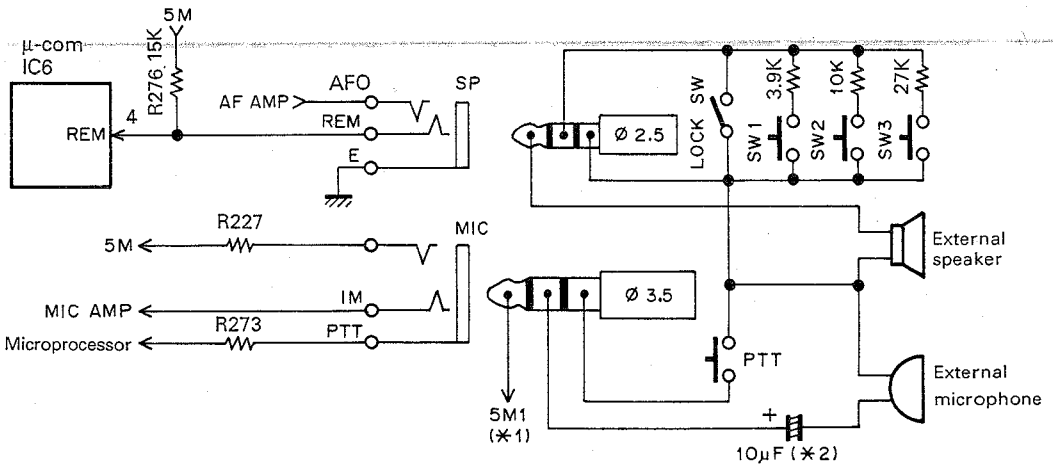


Fig. 15 Battery save circuit

• Remote control circuit

The voltage at the REM (remote) pin of the microprocessor is digitized. The remote control circuit is then remotely activated according to the digitized voltage.

The voltage at the REM pin is usually about 5V as a result of R276. When the remote control microphone switch is pressed, this voltage is divided by the resistor connected in series with the switch and by R276. The divided voltage indicates which switch was pressed.



*1 : Voltage appears from the internal 5M line (5V) via R277.

*2 : In the next case, the capacitor is not requierd.
Make the connection directly.
* In the case when a capacitor to cut DC voltage is connected to the external device.
* In the case when a two-terminal condensor microphone is used as the external microphone.

Fig. 16 Speaker, microphone jack, remote control circuit

CIRCUIT DESCRIPTION

Supplied circuit

• CTCSS

The tone frequency is set by the serial date from microprocessor (IC6). The audio input signal is passed through a deemphasis circuit from the datection output pin and input from the CI pin.

The SDO pin is made high when the tone frequency coincides. Microprocessor determines the SDO pin state and controls the MUTE pin.

• DTSS

A DTMF code is input or output as parallel date of microprocessor. The audio input signal is input from the CI pin in the same way as in CTCSS. The date is sent to microprocessor when a DTMF signal is detected. Microprocessor determines the coincidence of the code and controls the MUTE pin.

The DTMF signal corresponding to the numeric keypad entry is output from microprocessor during DTMF signal transmission. The DTMF signal is modulated through the microphone amplifier. During DTMF signal transmission, the MUTE pin is made low and the microphone signal is muted. Power to the AF amplifier is then turned on, and the DTMF signal can be monitored with the speaker.

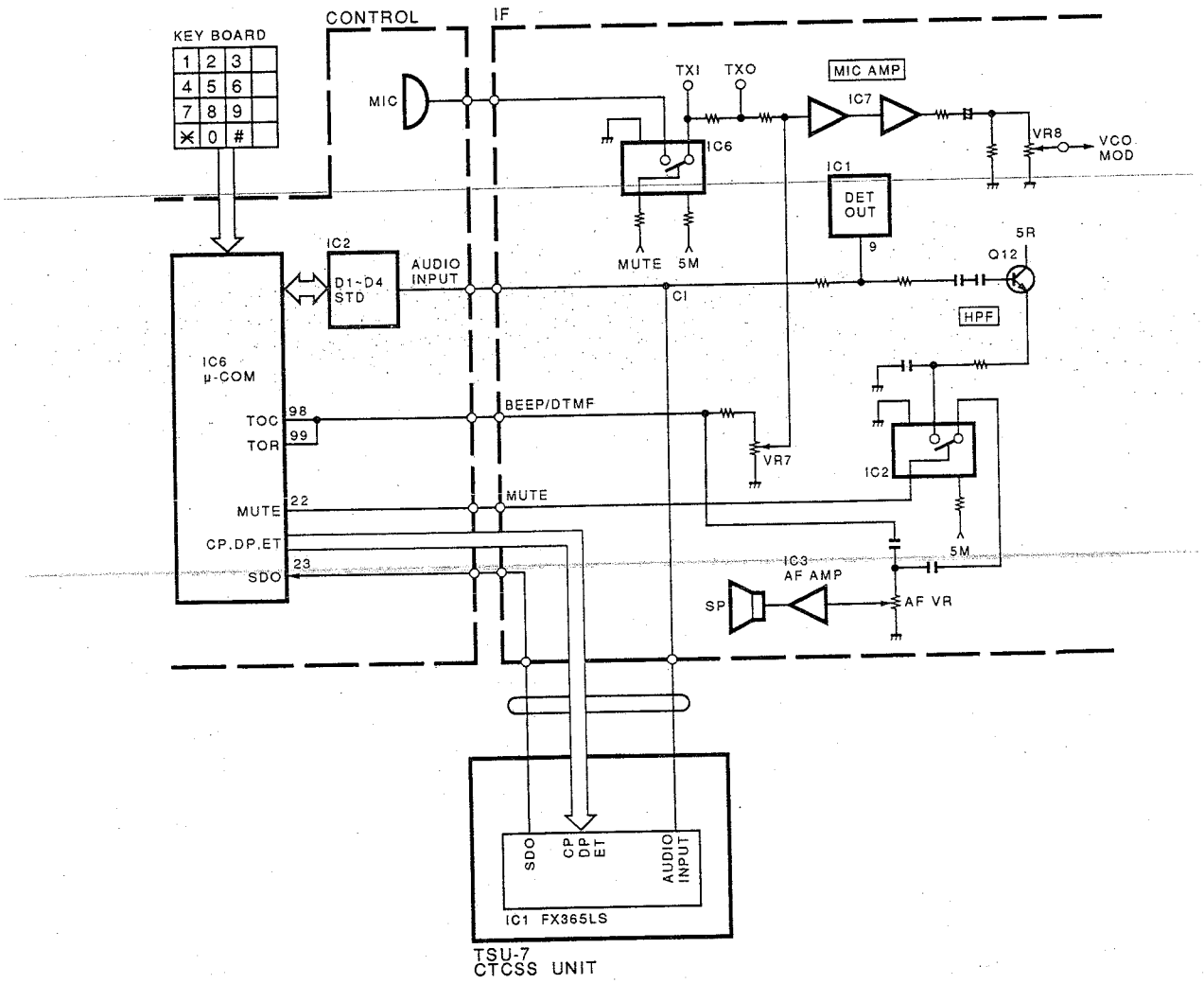


Fig. 17 Supplied circuits (DTMF, CTCSS, BEEP and TONE)

DESCRIPTION OF COMPONENTS

CONTROL UNIT (X53-340X-XX) 0-11 : K, P 0-21 : M 0-22 : M2 0-71 : X 2-71 : E, E3, E6, T 2-72 : E2

Ref. No.	Use/Function	Operation/Condition/Compatibility
IC2	DTMF receiver	
IC3	Voltage detection	
IC4	Shift register	
IC5	EEPROM for memory	
IC6	Microprocessor	
Q1	Constant-current source for lamp	
Q2	Lamp switch	LAMP "H" : On
Q3	DC SW	Always on
Q4	Reset output	
Q5	DC SW	IC5 power supply
Q201	Constant-current circuit	Charging
D1, D2	LED	LAMP
D3	Constant-current setting	
D4	Reverse-flow prevention	
D5	Microprocessor power supply	
D6	Lithium battery charging	
D7	Microprocessor noise removal	
D8~D15	For destination	
D16, D17	Reverse-flow prevention	
D18	Receive shift voltage switching	
D19	Electrostatic surge prevention	
D201~D203	Reverse-flow prevention	
D224	Constant-current circuit	

TX-RX UNIT (X57-404X-XX) 0-11 : K, P 0-21 : M, X 0-22 : M2 2-71 : E, E3, E6, T 2-72 : E2

Ref. No.	Use/Function	Operation/Condition/Compatibility
IC1	FM IC	Second oscillator, second mixer, quadrature detector, AF amplifier output, noise amplifier output, S-meter output.
IC2	Switch	When beep or DTMF is output or AL is received : Off
IC3	AF power amplifier	
IC4	Amplitude demodulation	
IC5	APC comparator	
IC6	Switch	Same as IC2
IC7	Microphone amplifier	Limiter amplifier, active low-pass filter
IC8	Active low-pass filter	For sub-tone
IC9	5V AVR	
IC10	Shift register	
IC201	PLL IC	
IC202	Transmission power amplifier	
Q1	AVR	5C
Q2	Differential DC amplifier	
Q3	5C, 5R switch	
Q4	AVR	5R
Q5	Differential DC amplifier	
Q6	AVR	5T
Q7	Differential DC amplifier	
Q8	5T switch	
Q9	Squelch switch	On/off according to noise detector output
Q10	Squelch switch, hysterisis switch	On/off according to Q9 output
Q11	Noise amplifier	
Q12	Active high-pass filter	
Q13	AVR	AF amplifier power supply
Q14	Error amplifier	Q13 bias control

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DESCRIPTION OF COMPONENTS

Ref. No.	Use/Function	Operation/condition/compatibility
Q15	AF control	
Q16	First IF amplifier	
Q17	Electronic volume	For AGC, Q16 base bias current
Q18	AF amplifier	For AM.
Q19	Mute switch	FM demodulation mute
Q20	Transmit power switching	MID : On
Q21	Transmit power switching	LO : On
Q22	Constant-current source	
Q23	Transmit power switching	EL : Off
Q24	5M switch	5MSW "L" : On
Q25	CTCSS switch	CTCSS, TSU-7 (option) power switch
Q26	5RM, 5R36 switch	
Q27	5RS, 5RAM switch	
Q201	Ripple filter	5C
Q202	RF amplifier	PLL IC 8 pin input
Q203, Q204	Charge pump	
Q205	RF power amplifier	During transmission : First stage of driver, During reception : Local oscillator amplifier
Q206	RF power amplifier	Final stage of driver
Q207	DC switch	D208 is controlled by Q208.
Q208	DC switch	D207 and D211 (1/2) are controlled by EL.
Q209	DC switch	D208 is controlled by EL.
Q210	DC switch	IC202 5V and D209 are controlled by Q211.
Q211	DC switch	Q210 is controlled by EL.
Q212	Switch	During transmission : On, During E-low and reception : Off
Q213	RF amplifier	144MHz band
Q214	First mixer (main)	144MHz band → 45.05MHz conversion
Q216	RF amplifier	430MHz band
Q217	First mixer (sub)	430MHz band → 45.05MHz conversion
D1	Reverse-flow prevention	
D2	Noise rectification	Voltage maltiplier
D3	DC switch	Capacitor discharge prevention
D4, D5	Constant-voltage shift	AF IC AVR
D6	AFC switch	
D7	AGC control	IC1 input pin voltage control (AM)
D8	Reference voltage	APC
D9	APC switch	
D10	LED	ON AIR
D11	Protection	Surge protection
D201	Quick charge	5C ripple filter
D202	Waveform rectification	
D204	DC switch	During transmission : On
D205	RF switch	During reception : On
D206	RF switch	During transmission : On
D207	RF switch	During E-LOW transmission : On
D208	ATT	
D209, D210	Transmission/reception switching	During transmission : On, During E-LOW transmission and reception : Off
D211	RF switch	See the E-LOW circuit description.
D212~D214	Receive shift	
D215	RF switch	
D216~D218	RF switch	Sub-reception : On (1/2)

DESCRIPTION OF COMPONENTS

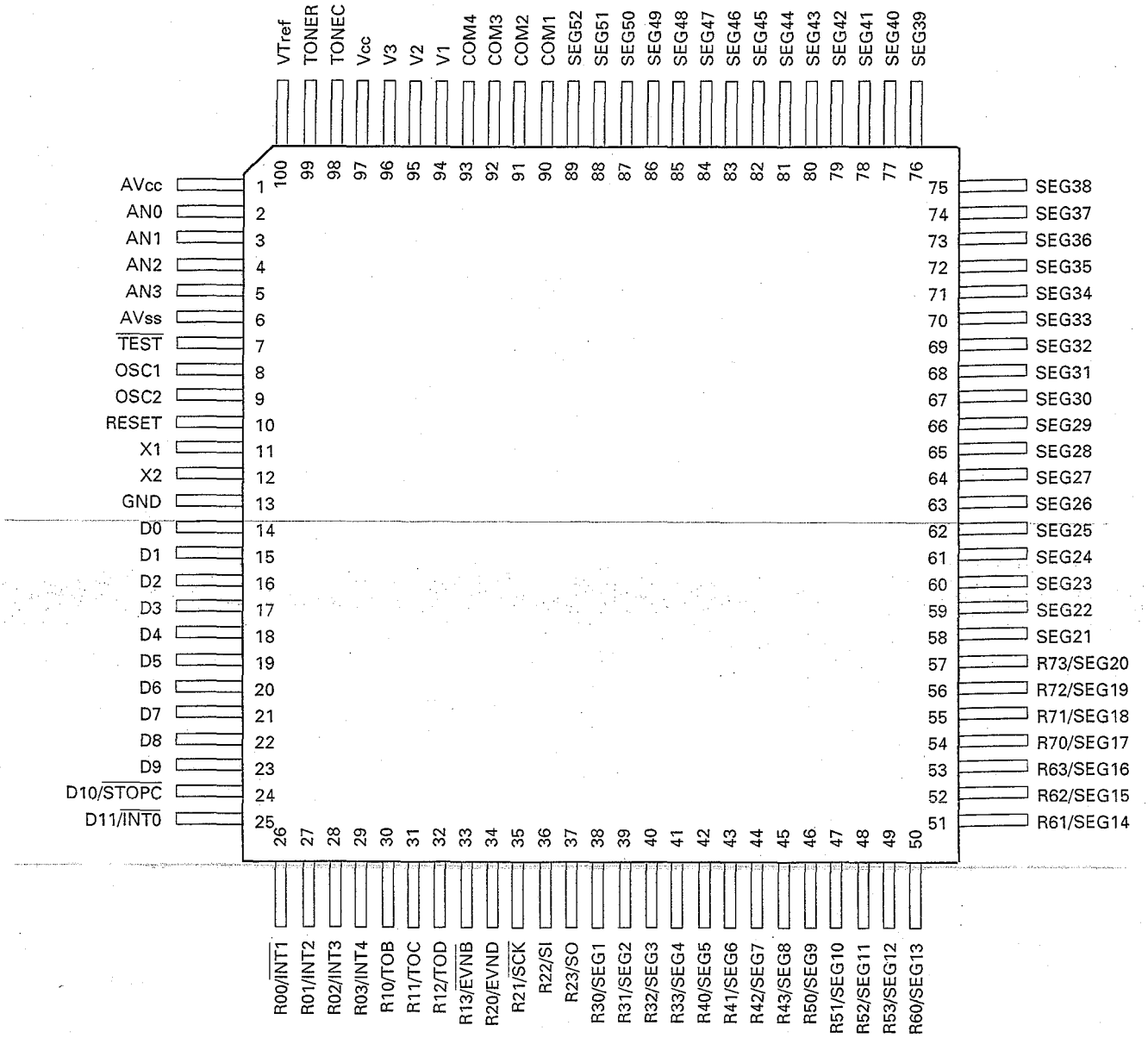
VCO (X58-3870-XX) -00 : K, P, M, X, E, E3, E6, T -21 : M2, E2

Ref. No.	Use/Function	Operation/condition/compatibility
Q1	Switch	D4 control. On : During reception
Q2	VCO	
Q3, Q4	Buffer amplifier	
D1, D2	VCO frequency control	
D3	Modulation	
D4	Frequency shift	During reception : On, During transmission : Off

SEMICONDUCTOR DATA

Microprocessor : HD404629A24H (Control unit IC6)

- ***Terminal connection diagram***



- **Terminal function**

Pin No.	Pin name	Port name	I/O	Description
1	AVcc	AVcc		A/D converter power supply pin
2	AN0	B	I	Battery check
3	AN1	SM	I	S-meter
4	AN2	REM	I	Remote MIC
5	AN3	PTT	I	PTT input. "H" : RX, "L" : TX
6	AVss	AVss		AVcc ground pin
7	TEST	TEST	I	Connect to Vcc
8	OSC1	OSC1	I	Internal oscillator input pin
9	OSC2	OSC2	I	Internal oscillator input pin
10	Reset	RESET	I	Reset pin. Normally "L"

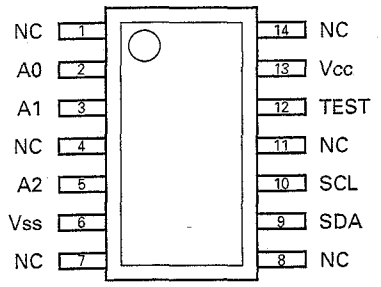
SEMICONDUCTOR DATA

Pin No.	Pin name	Port name	I/O	Description
11	X1	X1	I	Clock oscillator input pin. 32.768kHz
12	X2	X2	I	Clock oscillator input pin. 32.768kHz
13	GND	Vss		GND
14	D0	FLOCK	I	Lock switch. "H" : Off, "L" : On
15	D1	ESW2	O	Shift register 2 (IC4) enable
16	D2	4CL	O	Internal EEPROM SCL (4K bit)
17	D3	DIO	I/O	Internal EEPROM data input/output pin
18	D4	5TS	O	Transmit request output. "H" : Transmit, "L" : Receive
19	D5	5MS	O	EEPROM power supply control output pin. "L" : On
20	D6	16CL	O	Optional EEPROM SCL(16K bit)
21	D7	STD	I	DTMF valid tone detection pin. "H" : Off, "L" : On
22	D8	MUTE	O	Mute. "H" : In receive mode (off). "L" : Beep or DTMF is output or AL is recived
23	D9	SDO	I	CTCSS tone detection. "H" : Mismatch, "L" : Match
24	D10/$\overline{\text{STOPC}}$	UL	I	Unlock input pin. "H" : Match, "L" : Mismatch
25	D11/$\overline{\text{INT0}}$	PSW	I	Power switch input (Active "L")
26	R00/$\overline{\text{INT1}}$	BUSY	I	Squelch input pin. "H" : On, "L" : Busy
27	R01/INT2	UP	I	Encoder input pin
28	R02/INT3	DN	I	Encoder input pin
29	R03/INT4	INT4	I	Power supply voltage detection pin. "H" : Battery, "L" : No battery (back up)
30	R10/TOB	EP	O	PLL IC enable
31	R11/TOC	BEEP	O	Beep tone, 1750Hz output pin
32	R12/TOD	CP	O	Common clock pin (PLL, shift register, CTCSS)
33	R13/$\overline{\text{EVNB}}$	ESW	I	Shift register 1 (IC10) enable
34	R20/EVND	D1	I	DTMF data
35	R21/$\overline{\text{SCK}}$	D2	I	DTMF data
36	R22/SI	D3	I	DTMF data
37	R23/SO	D4	I	DTMF data
38	R30/SEG1	TO1	O	Sub tone output. Low side
39	R31/SEG2	TO2	O	Sub tone output
40	R32/SEG3	TO3	O	Sub tone output
41	R33/SEG4	TO4	O	Sub tone output. High side
42	R40/SEG5	5MSW	O	5M power switch. "H" : Off, "L" : On, RX, TX : Normally "L"
43	R41/SEG6	DP	O	Common data output pin (PLL, shift register, CTCSS)
44	R42/SEG7	ET	O	CTCSS unit enable
45	R43/SEG8	AFC	O	AF AMP power switch. "H" : Off, "L" : On
46	R50/SEG9	KOUT0	O	Key matrix output
47	R51/SEG10	KOUT1	O	Key matrix output
48	R52/SEG11	KOUT2	O	Key matrix output
49	R53/SEG12	KOUT3	O	Key matrix output
50	R60/SEG13	SIN0	I	Destination input 1
51	R61/SEG14	SIN1	I	Destination input 2
52	R62/SEG15	KLIN2	I	Key matrix input
53	R63/SEG16	KLIN3	I	Key matrix input
54	R70/SEG17	KUIN0	I	Key matrix input
55	R71/SEG18	KUIN1	I	Key matrix input
56	R72/SEG19	KUIN2	I	Key matrix input
57	R73/SEG20	KUIN3	I	Key matrix input
58~89	SEG21~52	SEG1~32	O	LCD segment signal output pin
90~93	COM1~4	COM1~4	O	LCD common signal output pin
94~96	V1~V3			LCD power supply pin. Normally open
97	Vcc	VDD		Power supply voltage
98	TONEC	TOC	O	DTMF signal output pin
99	TONER	TOR	O	DTMF signal output pin
100	VTref	VTREF		DTMF output reference level power supply pin

SEMICONDUCTOR DATA

EEPPROM For Memory : X24C04SI-3.5 (Control unit IC5)

- **Terminal connection diagram**

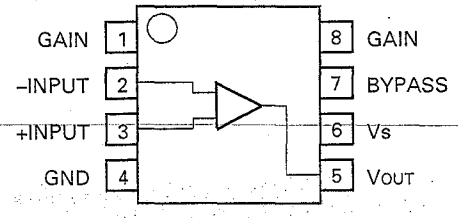


- **Terminal description**

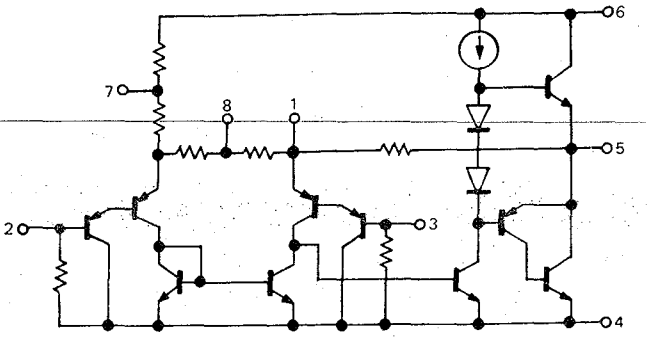
Pin name	Description
A0~A2	Address Inputs
SDA	Serial Data
SCL	Serial Clock
TEST	Hold at Vss
Vss	Ground
Vcc	+35V to -6V
NC	No Connect

AF Power Amplifier : NJM386BE (TX-RX unit IC3)

- **Terminal connection diagram**

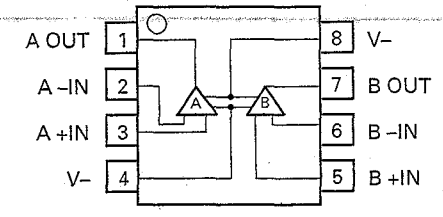


- **Equivalent circuit**

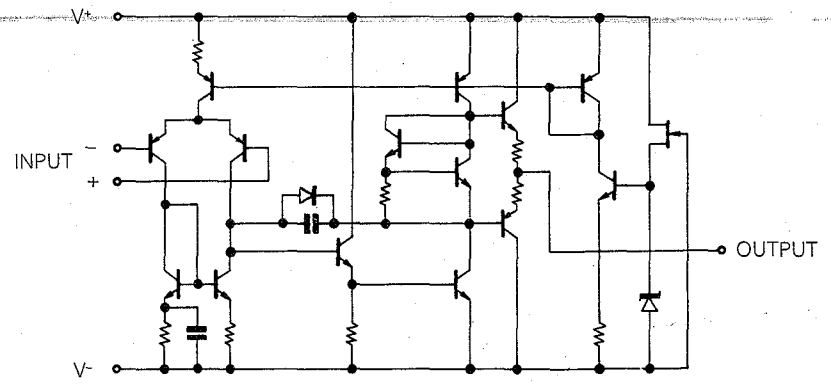


Microphone Amplifier : NJM4560E (TX-RX unit IC7)

- **Terminal connection diagram**



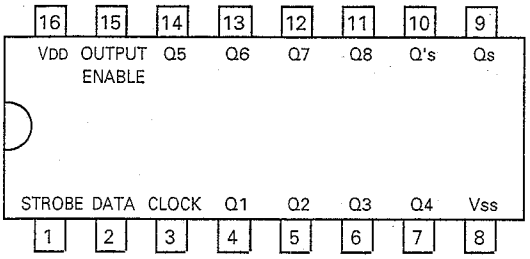
- **Equivalent circuit**



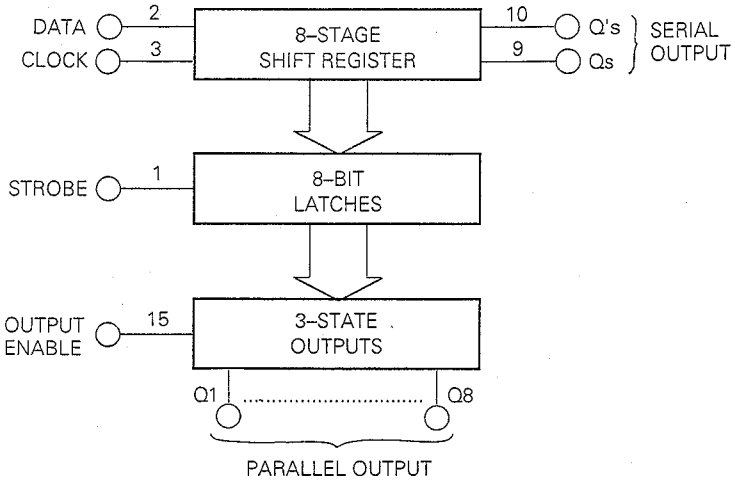
SEMICONDUCTOR DATA

Shift Register : BU4094BF (TX-RX unit IC10, Control unit IC4)

- **Terminal connection diagram**



- **Block diagram**



- **Terminal function**

IC10 (X57-404X-XX)

Pin No.	IC pin name	Port name	I/O	SAVE	Description
1	STROBE	ESW	I		Enable input pin
2	DATA	DP	I		Common data input pin
3	CLOCK	CP	I		Common clock input pin
4	Q1	5RS	O	H	Sub-reception. "H" : Off, "L" : On
5	Q2	5RAM	O	H	AM reception. "H" : Off, "L" : On
6	Q3	5RC	O	L	Reception power supply. "H" : Receive, "L" : Transmit
7	Q4	SAVE	O	L	"H" : On (reception), "L" : Off (save)
8	Vss	E			Ground pin
9	Qs		O		No connection
10	Q's		O		No connection
11	Q8	5RM	O	H	Main reception. "H" : Off, "L" : On
12	Q7	5R36	O	H	360MHz reception. "H" : Off, "L" : On
13	Q6	H/L2	O	L	Transmit output switching. HI : "L", MID : "L", LOW : "H"
14	Q5	H/L1	O	L	Transmit output switching. HI : "L", MID : "H", LOW : "H"
15	OUTPUT ENABLE	OUTE			Connect to VDD
16	VDD	VDD			Power supply pin

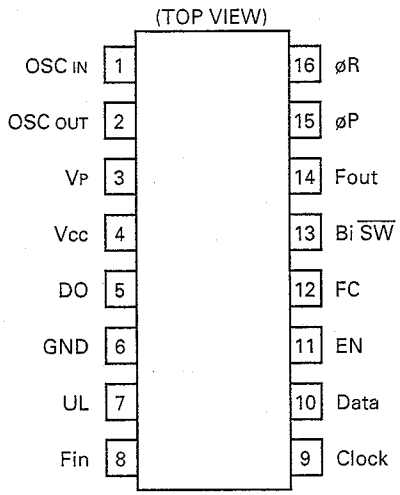
IC4 (X53-340X-XX)

Pin No.	IC pin name	Port name	I/O	SAVE	Description
1	STROBE	ESW2	I		Enable input pin
2	DATA	DP	I		Common data input pin
3	CLOCK	CP	I		Common clock input pin
4	Q1	CTSW	O	H	CTCSS power supply. "H" : Off, "L" : On
5	Q2	EL	O	H	Economic low power. "H" : Off, "L" : On
6	Q3	TX	O		"H" : Receive, "L" : Transmit
7	Q4	PD	O	L	DTMF decoder power supply. "H" : Off "L" : On
8	Vss	E			Ground pin
9	Qs		O		No connection
10	Q's		O		No connection
11	Q8		O		No connection
12	Q7	LAMP	O	H	LAMP operation is given priority. "H" : On "L" : Off
13	Q6	BAND1	O	L	
14	Q5	BAND2	O	L	
15	OUTPUT ENABLE	OUTE			Connect to VDD
16	VDD	VDD			Power supply pin

SEMICONDUCTOR DATA

PLL IC : MB1505PF-G-BND (TX-RX unit IC201)

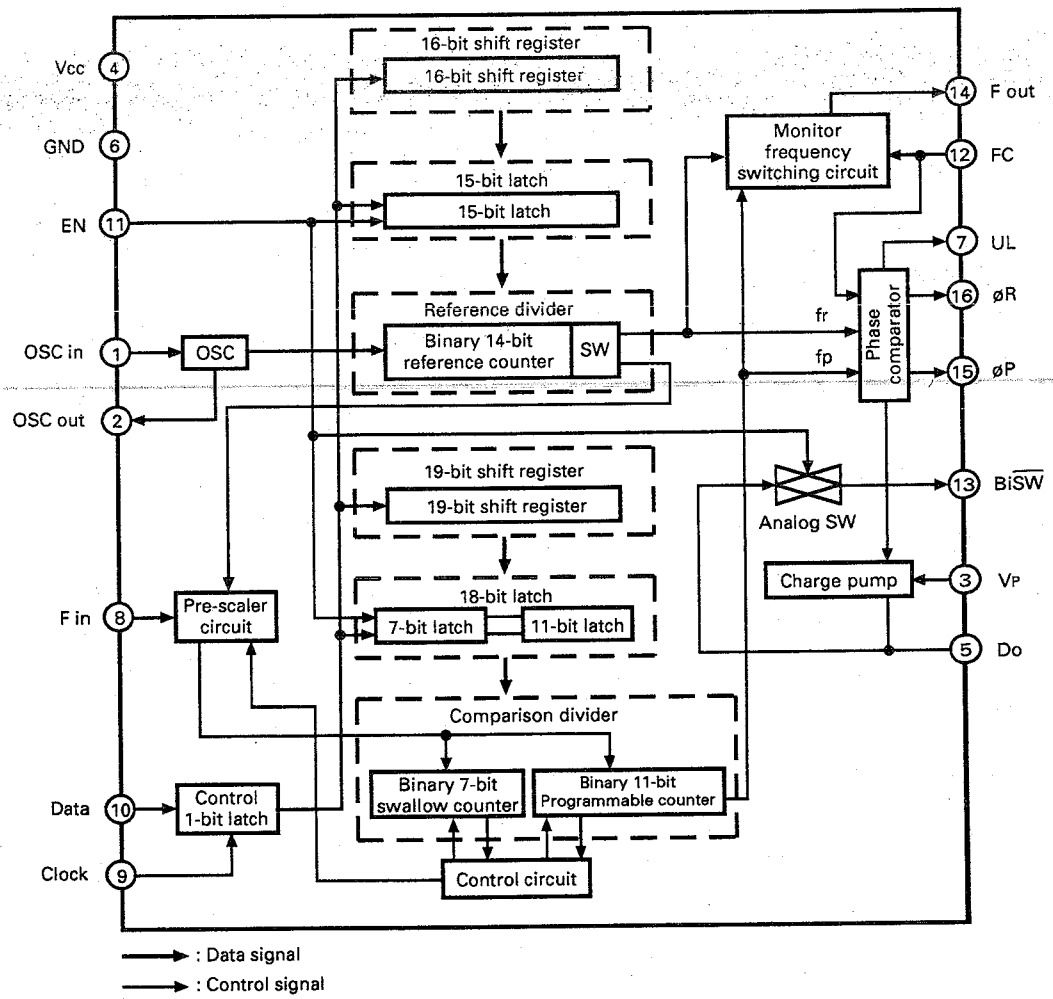
- **Terminal connecction diagram**



- **Terminal function**

Pin No.	Code	Name	Function
1	OSC in	Crystal oscillator input	12.8MHz input pin
2	OSC out	Crystal oscillator output	12.8MHz output pin
3	VP		
4	Vcc	Power supply	
5	Do		
6	GND	GND	Ground
7	UL	Lock detection output	L : Unlock, H : Lock
8	Fin	Local oscillator input	VCO input
9	Clock	Clock	Clock pulse input
10	Data	Data	Data pulse input
11	EN	Enable	Enable pulse input
12	FC		
13	Bi SW		
14	Fout		
15	øP	Output port	Charge pump output
16	øR	Output port	Charge pump output

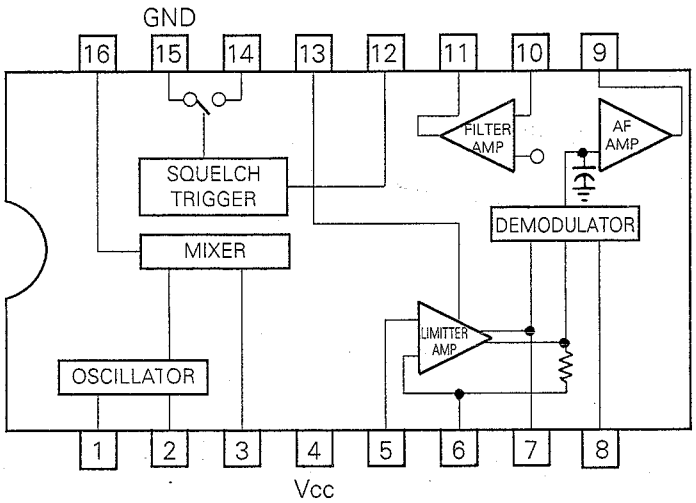
- **Block diagram**



SEMICONDUCTOR DATA

FM Receiver IC : MC3372D (TX-RX unit IC1)

- **Block diagram**



- **Terminal functions**

Pin No.	Pin name	Description
1	OSC In	The crystal oscillator is connected to this pin to form a Colpitts oscillator. If an external oscillator is used, input to pin 1, and connect pin 2 to Vcc.
2	OSC Out	
3	MIX Out	Mixer output pin.
4	Vcc	Power supply pin.
5	LIM In	Limiter amplifier input pin and decoupling pin. AC-couple pins 6 and 7.
6	DEC1	
7	DEC2	
8	QUAD In	Phase-shifter connection pin.
9	AF Out	FM detector signal is output.
10	F amp. In	Operational amplifier inverted input pin.
11	F amp. Out	Operational amplifier output pin.
12	SQSW In	Squelch switch input pin.
13	Smeter Out	The current corresponding to the limiter amplifier input signal level is output.
14	SQSW Out	Squelch switch output pin.
15	GND	Ground pin.
16	MIX In	Mixer input pin.

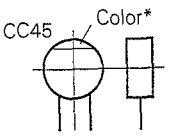
TH-28A/E

PARTS LIST

CAPACITORS

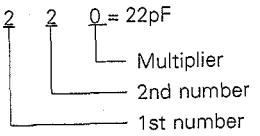
CC 45 TH 1H 220 J
1 2 3 4 5 6

1 = Type ... ceramic, electrolytic, etc.
2 = Shape ... round, square, ect.
3 = Temp. coefficient
4 = Voltage rating
5 = Value
6 = Tolerance



• Capacitor value

010 = 1pF
100 = 10pF
101 = 100pF
102 = 1000pF = 0.001μF
103 = 0.01μF



• Temperature coefficient

1st Word	C	L	P	R	S	T	U
Color*	Black	Red	Orange	Yellow	Green	Blue	Violet
ppm/°C	0	–80	–150	–220	–330	–470	–750

2nd Word	G	H	J	K	L
ppm/°C	±30	±60	±120	±250	±500

Example : CC45TH = –470 ± 60ppm/°C

• Tolerance

Code	C	D	G	J	K	M	X	Z	P	No code
(%)	±0.25	±0.5	±2	±5	±10	±20	+40 –20	+80 –20	+100 –0	More than 10μF – 10 ~ +50 Less than 4.7μF –10 ~ +75

Less than 10pF

Code	B	C	D	F	G
(pF)	±0.1	±0.25	±0.5	±1	±2

• Voltage rating

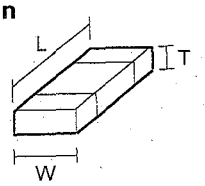
1st word \ 2nd word	A	B	C	D	E	F	G	H	J	K	V
0	1.0	1.25	1.6	2.0	2.5	3.15	4.0	5.0	6.3	8.0	–
1	10	12.5	16	20	25	31.5	40	50	63	80	35
2	100	125	160	200	250	315	400	500	630	800	–
3	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	–

• Chip capacitors (Refer to the table above except dimension)

(EX) CC 73 F SL 1H 000 J
1 2 3 4 5 6 7
(Chip) (CH, RH, UJ, SL)

(EX) CK 73 F F 1H 000 Z
1 2 3 4 5 6 7
(Chip) (B, F)

Dimension



• Dimension (Chip capacitor)

Dimension code	L	W	T
Empty	5.6 ± 0.5	5.0 ± 0.5	Less than 2.0
E	3.2 ± 0.2	1.6 ± 0.2	Less than 1.25
F	2.0 ± 0.3	1.25 ± 0.2	Less than 1.25

RESISTORS

• Chip resistor (Carbon)

(EX) RD 73 E B 2B 000 J
1 2 3 4 5 6 7
(Chip) (B,F)

• Dimension (Chip resistor)

Dimension code	L	W	T	Wattage
E	3.2 ± 0.2	1.6 ± 0.2	0.57	2B
F	2.0 ± 0.3	1.25 ± 0.2	0.45	2A

• Carbon resistor (Normal type)

(EX) RD 14 B B 2C 000 J
1 2 3 4 5 6 7

1 = Type ... ceramic, electrolytic, etc.
2 = Shape ... round, square, ect.
3 = Dimension
4 = Temp. coefficient
5 = Voltage rating
6 = Value
7 = Tolerance

Rating wattage

Code	Wattage	Code	Wattage	Code	Wattage
2A	1/10W	2E	1/4W	3A	1W
2B	1/8W	2H	1/2W	3D	2W
2C	1/6W				

PARTS LIST

× New Parts
Parts without **Parts No.** are not supplied.
Les articles non mentionnes dans le **Parts No.** ne sont pas fournis.
Teile ohne **Parts No.** werden nicht gellefert.

TH-28A/E

Ref. No. 参照番号	Address 位置	New Parts 新	Parts No. 部品番号	Description 部品名／規格	Destination 仕向	Remarks 備考
			TH-28A/E			
1	3B	*	A01-2052-22	METALLIC CABINET(REAR)		
2	1A	*	A02-1633-13	CASE ASSY	KMM2XP	
2	1A	*	A02-1634-13	CASE ASSY	TEE2	
2	1A	*	A02-1634-13	CASE ASSY	E3E6	
3	2A	*	A62-0173-03	PANEL ASSY		
4	-	*	B09-0329-03	CAP(DCIN,MIC,SP)		
5	1B	*	B10-1179-04	FRONT GLASS		
6	-	*	B11-1051-04	FILTER(ON AIR)		
7	1B		B42-3343-04	S/NO LABEL(RADIO)		
8	-		B42-3394-14	FCC PLATE	K	
9	-		B46-0410-30	WARRNTY CARD	K	
9	-		B46-0419-00	WARRNTY CARD	EE2E3	
9	-		B46-0419-00	WARRNTY CARD	E6	
9	-		B46-0422-00	WARRNTY CARD	P	
10	-	*	B59-0453-00	QUICK REFERENCE SHEET		
12	-	*	B62-0236-20	INSTRUCTION MANUAL(ENGLISH)		
12	-	*	B62-0238-00	INSTRUCTION MANUAL(IT,GE)	EE2	
12	-	*	B62-0237-10	INSTRUCTION MANUAL(FR,SP,DU)	MM2	
12	-	*	B62-0237-10	INSTRUCTION MANUAL(FR,SP,DU)	E3E6P	
~~13~~	~~3B~~	~~*~~	~~B72-0376-04~~	~~MODEL NAME PLATE (TH-28A)~~	~~KP~~	
13	3B	*	B72-0377-04	MODEL NAME PLATE (TH-28A)	MM2	
13	3B	*	B72-0377-04	MODEL NAME PLATE (TH-28A)	X	
13	3B	*	B72-0378-04	MODEL NAME PLATE (TH-28E)	TEE2	
13	3B	*	B72-0378-04	MODEL NAME PLATE (TH-28E)	E3E6	
14	2B	*	D10-0610-03	LEVER		
15	3A	*	E04-0184-05	BNC RECEPTACLE		
16	-		E19-0254-05	AC PLUG	MM2	
18	2B	*	E23-0700-14	DC TERMINAL		
-	-	*	E23-0603-05	TERMINAL(RF-BNC)		
19	1A		E37-0031-15	CONNECTING WIRE (SP)		
20	2B	*	E37-0282-15	CONNECTING WIRE (RF-CHARGE)		
21	2B	*	F10-2032-12	SHIELDING PLATE		
~~22~~	~~2B~~	~~*~~	~~F10-2041-13~~	~~SHIELDING PLATE(CONT)~~		
23	2A	*	F20-1108-04	INSULATING BOARD(SP,LITHIUM BA		
24	3A		F29-0435-05	INSULATOR (BELT FOOK)		
25	2A		G01-0856-04	COIL SPRING		
-	-	*	G11-0683-04	SHEET (FPC:RF-IF)		
27	2A	*	G13-1356-04	CUSHION (VOL/ENC)		
29	-	*	H10-2751-02	POLYSTYRENE FOAMED FIXTURE		
30	-		H11-0808-14	POLYSTYRENE FOAMED BOARD	KTX	
30	-		H13-0823-04	PROTECTION BOARD	EE2	
31	-		H11-0842-04	POLYSTYRENE FOAMED BOARD	KMM2	
31	-		H11-0842-04	POLYSTYRENE FOAMED BOARD	EXP	
31	-		H11-0842-04	POLYSTYRENE FOAMED BOARD	E2E3	
33	-		H25-0085-04	PROTECTION BAG (RADIO 100X200)		
34	-	*	H52-0252-04	ITEM CARTON BOX (TH-28A)	KMM2	
34	-	*	H52-0252-04	ITEM CARTON BOX (TH-28A)	XP	
34	-	*	H52-0253-04	ITEM CARTON BOX (TH-28E)	TEE2	
34	-	*	H52-0253-04	ITEM CARTON BOX (TH-28E)	E3E6	
36	2B	*	J19-1515-03	HOLDER (CHARGE UNIT)		
37	1B	*	J19-1516-03	HOLDER (20 KEY)		

L:Scandinavia **K:**USA **P:**Canada
Y:PX(Far East, Hawaii) **T:**England **E:**Europe
Y:AAFES(Europe) **X:**Australia **M:**Other Areas

TH-28A : K,P,X,M,M2
TH-28E : E,E2,E3,E6,T

⚠ indicates safety critical components.

TH-28A/E

PARTS LIST

* New Parts
Parts without **Parts No.** are not supplied.
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Teile ohne **Parts No.** werden nicht geliefert.

TH-28A/E
CONTROL UNIT (X53-340X-XX)

Ref. No. 参照番号	Address 位置	New Parts 新	Parts No. 部品番号	Description 部品名／規格	Destination 仕向	Remarks 備考
38	2A	*	J21-4386-14	MOUNTING HARDWARE (VOL/ENC)		
39		*	J29-0465-04	BELT HOOK		
40	1B	*	J39-0449-04	SPACER (MIC)		
41	1B		J69-0327-04	HAND STARP		
42	2A	*	J82-0013-05	FPC (RF-IF)		
43	2A	*	J82-0014-05	FPC (IF-CONT)		
44	2A	*	J82-0015-05	FPC (CONT-PTT)		
45	1B	*	J82-0016-05	FPC (20 KEY)		
46	2A	*	J99-0325-04	ADHESIVE SHEET (LITHIUM BATT)		
-	-	*	J99-0326-14	ADHESIVE SHEET (VOL/ENC)		
48	3A	*	K29-4772-04	KNOB (VOL)		
49	3A	*	K29-4773-04	KNOB (SQL)		
50	2A	*	K29-4774-04	KNOB (ENC)		
51	1A	*	K29-4775-13	KNOB (POWER,MESSAGE)		
52	1A	*	K29-4776-03	KNOB (PTT etc,)		
53	1B	*	K29-4777-04	KNOB (LOCK)		
54	1B	*	K29-4778-03	KNOB (KEY TOP)		
A	3A		N09-2028-05	SCREW (M3X4)		
B	2A,2B		N09-2139-25	SCREW (M2X10.5)		
C	3A	*	N14-0556-04	NUT (BNC)		
D	2A	*	N14-0557-04	NUT (VOL/ENC)		
E	2B		N30-2608-46	PAN HEAD MACHINE SCREW		
F	2B		N39-2045-45	PAN HEAD MACHINE SCREW		
G	2A,2B	*	N79-2035-45	PAN HEAD MACHINE SCREW		
H	2B		N79-2050-46	PAN HEAD MACHINE SCREW		
I	3A,3B		N80-2012-45	PAN HEAD MACHINE SCREW		
SP	1A		T07-0266-05	LOUDSPEAKER		
55	-		T90-0445-05	ANTENNA		
56	-		W09-0563-05	BATTERY PACK (PB-13)	KMM2	
56	-		W09-0563-05	BATTERY PACK (PB-13)	TXP	
56	-		W09-0563-05	BATTERY PACK (PB-13)	EE2E3	
57	-		W09-0565-15	BATTERY CHARGER (120V･BC-14)	KP	
57	-		W09-0566-05	BATTERY CHARGER (120V/240V)	MM2	
57	-		W09-0567-05	BATTERY CHARGER (240V)	X	
57	-		W09-0568-05	BATTERY CHARGER (240V)	T	
57	-		W09-0569-15	BATTERY CHARGER (230V)	EE2E3	
59	2A	*	W09-0802-05	LITHIUM BATTERY		
60	2B		X52-3170-00	CTCSS UNIT	KP	
		*	X53-3400-11	CONTROL UNIT	KP	
		*	X53-3400-21	CONTROL UNIT	M	
		*	X53-3400-22	CONTROL UNIT	M2	
		*	X53-3400-71	CONTROL UNIT	X	
		*	X53-3402-71	CONTROL UNIT	TEE3E6	
		*	X53-3402-72	CONTROL UNIT	E2	
		*	X57-4040-11	TX,RX UNIT(A/2:IF,B/2:RF)	KP	
		*	X57-4040-21	TX,RX UNIT(A/2:IF,B/2:RF)	MX	
		*	X57-4040-22	TX,RX UNIT(A/2:IF,B/2:RF)	M2	
		*	X57-4042-71	TX,RX UNIT(A/2:IF,B/2:RF)	TEE3E6	
		*	X57-4042-72	TX,RX UNIT(A/2:IF,B/2:RF)	E2	
CONTROL UNIT (X53-340X-XX) 0-11 : K,P 0-21 : M 0-22 : M2 0-71 : X 2-71 : E,E3,E6,T 2-72 : E2						
		*	B38-0372-15	LCD		
			B11-0492-14	FILTER (LCD)		
D1 ,2			B30-2033-05	LED		

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TH-28E : E,E2,E3,E6,T

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PARTS LIST

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CONTROL UNIT (X53-340X-XX)

Ref. No. 参照番号	Address 位置	New Parts 新	Parts No. 部品番号	Description 部品名／規格	Destination 仕向	Remarks 備考
D6			B30-0897-05	LED		
C1			CK73FF1C105Z	CHIP C 1.0UF Z		
C2			C92-0507-05	CHIP TAN 4.7UF 6.3WV		
C3			CK73FF1C105Z	CHIP C 1.0UF Z		
C4			CK73FB1E104K	CHIP C 0.10UF K		
C5 ,6			CC73GCH1H300J	CHIP C 30PF J		
C8			CK73FF1C105Z	CHIP C 1.0UF Z		
C9			CK73FB1E104K	CHIP C 0.10UF K		
C10			CK73GB1H471K	CHIP C 470PF K		
C11			CK73FF1C105Z	CHIP C 1.0UF Z		
C12			CK73FB1E104K	CHIP C 0.10UF K		
C13			CK73GB1H471K	CHIP C 470PF K		
C15			C92-0507-05	CHIP TAN 4.7UF 6.3WV		
C16			CK73GB1H103K	CHIP C 0.01UF K		
C17			CK73GB1H332K	CHIP C 3300PF K		
C18			CC73GCH1H430J	CHIP C 43PF J		
C19			CC73GCH1H390J	CHIP C 39PF J		
C20 ,21			CC73GCH1H150J	CHIP C 15PF J		
C22			CK73GB1H103K	CHIP C 0.01UF K		
C23			CK73FF1C105Z	CHIP C 1.0UF Z		
C24			CK73GB1H471K	CHIP C 470PF K		
			B29-0492-14	CONNECTOR (LCD)		
		*	E29-1110-04	GND TERMINAL		
CN1		*	E40-5572-05	PIN CONNECTOR (5PIN)		
CN201			E40-5180-05	PIN CONNECTOR (3PIN)		
		*	J21-4389-04	MOUNTING HARDWARE (LCD)		
L1 -5			L92-0131-05	FERRITE CHIP COIL		
X1		*	L78-0096-05	CERAMIC RESONATOR (4MHz)		
X2		*	L78-0301-05	CERAMIC RESONATOR (3.5795MHz)		
X3			L77-1441-05	CRYSTAL RESONATOR (32KHz)		
CP1		*	R90-0723-05	MULTI COMP 47KX2		
CP2 ,3			R90-0714-05	MULTI COMP 10KX4		
CP4		*	R90-0724-05	MULTI COMP 1KX4		
CP5			R90-0714-05	MULTI COMP 10KX4		
CP6			R90-0718-05	MULTI COMP 4.7X4		
CP7 ,8		*	R90-0724-05	MULTI COMP 1KX4		
CP9 -11		*	R90-0725-05	MULTI COMP 1KX2		
CP12		*	R90-0726-05	MULTI COMP 10KX2		
CP13		*	R90-0725-05	MULTI COMP 1KX2		
R1			RK73GB1J390J	CHIP R 39 J 1/16W		
R2			RK73GB1J392J	CHIP R 3.9K J 1/16W		
R3			RK73GB1J393J	CHIP R 39K J 1/16W		
R4			RK73GB1J273J	CHIP R 27K J 1/16W		
R5			RK73GB1J101J	CHIP R 100 J 1/16W		
R6			RK73GB1J472J	CHIP R 4.7K J 1/16W		
R7			RK73GB1J473J	CHIP R 47K J 1/16W		
R9 ,10			RK73GB1J104J	CHIP R 100K J 1/16W		
R11			RK73GB1J472J	CHIP R 4.7K J 1/16W		
R12			RK73GB1J105J	CHIP R 1.0M J 1/16W		
R13			RK73GB1J102J	CHIP R 1.0K J 1/16W		
R14			RK73GB1J331J	CHIP R 330 J 1/16W		
R15			RK73GB1J334J	CHIP R 330K J 1/16W		
R16			RK73GB1J224J	CHIP R 220K J 1/16W		

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CONTROL UNIT (X53-340X-XX)

Ref. No. 参照番号	Address 位置	New Parts 新	Parts No. 部品番号	Description 部品名／規格	Destination 仕向	Remarks 備考
R17			RK73GB1J473J	CHIP R 47K J 1/16W		
R18			RK73GB1J274J	CHIP R 270K J 1/16W		
R19			RK73GB1J124J	CHIP R 120K J 1/16W		
R20			RK73GB1J333J	CHIP R 33K J 1/16W		
R21			RK73GB1J472J	CHIP R 4.7K J 1/16W		
R22			RK73GB1J101J	CHIP R 100 J 1/16W		
R23			RK73GB1J105J	CHIP R 1.0M J 1/16W		
R24			RK73GB1J471J	CHIP R 470 J 1/16W		
R25			R92-1252-05	CHIP R 0 ΩHM		
R26			RK73GB1J473J	CHIP R 47K J 1/16W		
R27			RK73GB1J472J	CHIP R 4.7K J 1/16W		
R29			RK73GB1J473J	CHIP R 47K J 1/16W		
R30			RK73GB1J471J	CHIP R 470 J 1/16W		
R31			RK73GB1J331J	CHIP R 330 J 1/16W		
R32			RK73GB1J105J	CHIP R 1.0M J 1/16W		
R34			RK73GB1J223J	CHIP R 22K J 1/16W		
R35			RK73GB1J472J	CHIP R 4.7K J 1/16W		
R36 -38			RK73GB1J473J	CHIP R 47K J 1/16W		
R39			RK73GB1J153J	CHIP R 15K J 1/16W		
R40			RK73GB1J472J	CHIP R 4.7K J 1/16W		
R41			RK73GB1J101J	CHIP R 100 J 1/16W		
R42			RK73GB1J102J	CHIP R 1.0K J 1/16W		
R43			RK73GB1J472J	CHIP R 4.7K J 1/16W		
R201			RK73FB2A100J	CHIP R 10 J 1/10W		
R202			RK73GB1J472J	CHIP R 4.7K J 1/16W		
R203,204			R92-1218-05	CHIP R 0.1 J 1/2W		
VR401			R23-3406-05	POTENTIOMETER(AF:10KA,SO:50KB)		
S1 ,2			S70-0408-05	TACT SWITCH (POWER,MESS)		
S301-303		*	S70-0417-05	TACT SWITCH (PTT,MONI,LAMP)		
S304		*	S62-0421-05	SLIDE SWITCH (F LOCK)		
MIC	1A		T91-0502-05	MICROPHONE		
D3			DA221	DIODE		
D4			MA110	DIODE		
D5			DAN222	DIODE		
D7			DA221	DIODE		
D8 ,9			MA110	DIODE		
D10			MA110	DIODE	KMTEE3	
D10			MA110	DIODE	XP	
D11			MA110	DIODE	KTEE2	
D11			MA110	DIODE	E3E6XP	
D12			MA110	DIODE	KMM2T	
D12			MA110	DIODE	EE2E3P	
D13			MA110	DIODE		
D14			MA110	DIODE	MM2T	
D14			MA110	DIODE	EE2E3	
D14			MA110	DIODE	E6X	
D15			MA110	DIODE	MM2TE	
D15			MA110	DIODE	E2E3E6	
D16			MA110	DIODE		
D17		*	HN2D01FU	DIODE		
D18			DAP202U	DIODE		
D19		*	MA8062	DIODE		
D201,202			DE5SC4M	DIODE		

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CONTROL UNIT (X53-340X-XX)
TX-RX UNIT (X57-404X-XX)

Ref. No. 参照番号	Address 位置	New Parts 新	Parts No. 部品番号	Description 部品名／規格	Destination 仕向	Remarks 備考
D203			MA110	DIODE		
D204			DA221	DIODE		
IC2			LC7385M	IC (DTMF RECEIVER)		
IC3			S-8054ALR-LN	IC (VOLTAGE DETECTOR)		
IC4			BU4094BF	IC (SHIFT/STORE REGISTER)		
IC5		*	X24C04SI-3.5	IC (EEPROM)		
IC6		*	HD404629A24H	IC (MPU)		
Q2			DTC114YE	DIGITAL TRANSISTOR		
Q3			DTA143ZE	DIGITAL TRANSISTOR		
Q5			DTA114YE	DIGITAL TRANSISTOR		
S401			W02-0900-15	ENCODER		
Q1			2SB798(DL,DK)	TRANSISTOR		
Q4		*	2SJ243	FET		
Q201			2SB798(DL,DK)	TRANSISTOR		
TX-RX UNIT (X57-404X-XX) 0-11 : K,P 0-21 : M,X 0-22 : M2 2-71 : E,E3,E6,T 2-72 : E2						
D10		*	B30-2036-05	LED		
C1			C92-0045-05	ELECTRO 22UF 6.3WV		
C2			C92-0038-05	ELECTRO 22UF 16WV		
C3 ,4			CK73GB1H471K	CHIP C 470PF K		
C7			C92-0507-05	CHIP TAN 4.7UF 6.3WV		
C8			CK73GB1H471K	CHIP C 470PF K		
C9			C92-0045-05	ELECTRO 22UF 6.3WV		
C10 ,11			C92-0005-05	ELECTRO 2.2UF 6.3WV		
C12		*	CK73GR1C473K	CHIP C 0.047UF K		
C13			CK73GB1H472K	CHIP C 4700PF K		
C14			CK73GR1C333K	CHIP C 0.033UF K		
C16			CK73GB1H102K	CHIP C 1000PF K		
C17			C92-0045-05	ELECTRO 22UF 6.3WV		
C18			CK73GB1H103K	CHIP C 0.01UF K		
C19 ,20			CK73GB1H471K	CHIP C 470PF K		
C21			CK73GB1H102K	CHIP C 1000PF K		
C22 ,23			CK73GB1E183K	CHIP C 0.018UF K		
C25			CK73GB1H152K	CHIP C 1500PF K		
C26			CK73GB1H332K	CHIP C 3300PF K		
C27			C92-0005-05	ELECTRO 2.2UF 6.3WV		
C28			CK73FF1C105Z	CHIP C 1.0UF Z		
C29			CK73FB1E104K	CHIP C 0.10UF K		
C30			CK73GR1C333K	CHIP C 0.033UF K		
C31			CK73GB1H103K	CHIP C 0.01UF K		
C32			C92-0507-05	CHIP TAN 4.7UF 6.3WV		
C33			CK73GB1H102K	CHIP C 1000PF K		
C34			C92-0047-05	ELECTRO 47UF 6.3WV		
C35			CK73GB1H471K	CHIP C 470PF K		
C36			C90-2052-05	ELECTRO 68UF 10WV		
C37			CK73FB1E473K	CHIP C 0.047UF K		
C38			C92-0507-05	CHIP TAN 4.7UF 6.3WV		
C39			CK73GB1H102K	CHIP C 1000PF K		
C40			C92-0005-05	ELECTRO 2.2UF 6.3WV		
C41			CK73GB1H471K	CHIP C 470PF K		
C42			CK73GB1H103K	CHIP C 0.01UF K		
C43			CC73GCH1H080D	CHIP C 8PF D		
C44			CK73FB1E104K	CHIP C 0.10UF K		
C45			CC73GCH1H150J	CHIP C 15PF J		

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TH-28A/E

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TX-RX UNIT (X57-404X-XX)

Ref. No. 参照番号	Address 位置	New Parts 新	Parts No. 部品番号	Description 部品名／規格			Destination 仕向	Remarks 備考
C46 ,47			CK73GB1H103K	CHIP C	0.01UF	K		
C48			CC73GCH1H270J	CHIP C	27PF	J		
C49			CC73GCH1H150J	CHIP C	15PF	J		
C50			CK73GB1H103K	CHIP C	0.01UF	K		
C51			CK73FB1E104K	CHIP C	0.10UF	K		
C52			CC73GCH1H270J	CHIP C	27PF	J		
C53			CK73FB1E104K	CHIP C	0.10UF	K		
C54			C92-0004-05	ELECTRO	1.0UF	16WV		
C55			CK73GB1H103K	CHIP C	0.01UF	K		
C56			C92-0507-05	CHIP TAN	4.7UF	6.3WV		
C58			C92-0509-05	TANTAL	10UF	6.3WV		
C59			C92-0004-05	ELECTRO	1.0UF	16WV		
C60			CC73GCH1H101J	CHIP C	100PF	J		
C61			CK73GB1H103K	CHIP C	0.01UF	K		
C62			CK73GB1E223K	CHIP C	0.022UF	K		
C63			CK73GR1C333K	CHIP C	0.033UF	K		
C64 -66			CK73FB1E104K	CHIP C	0.10UF	K		
C67			CK73GB1H103K	CHIP C	0.01UF	K		
C68 -70			CK73GB1H471K	CHIP C	470PF	K		
C71			CC73GCH1H151J	CHIP C	150PF	J		
C72			CK73GB1H471K	CHIP C	470PF	K		
C73			C92-0002-05	CHIP TAN	0.22UF	35WV		
C74			CK73GB1H471K	CHIP C	470PF	K		
C76			CK73GB1H471K	CHIP C	470PF	K		
C77 ,78			CK73GB1H103K	CHIP C	0.01UF	K		
C79			C92-0002-05	CHIP TAN	0.22UF	35WV		
C80			CK73GB1H471K	CHIP C	470PF	K		
C81			CK73GB1E223K	CHIP C	0.022UF	K		
C82			C92-0005-05	ELECTRO	2.2UF	6.3WV		
C83			CK73GB1H471K	CHIP C	470PF	K		
C84			C92-0005-05	ELECTRO	2.2UF	6.3WV		
C86			CK73GB1H471K	CHIP C	470PF	K		
C87			CK73GB1H182K	CHIP C	1800PF	K		
C88			CC73GCH1H151J	CHIP C	150PF	J		
C89			CK73GB1H103K	CHIP C	0.01UF	K		
C90			C92-0507-05	CHIP TAN	4.7UF	6.3WV		
C91 -93			CK73GB1H471K	CHIP C	470PF	K		
C94			CK73FB1E104K	CHIP C	0.10UF	K		
C95			C92-0509-05	TANTAL	10UF	6.3WV		
C96			CE04CW0J331M	ELECTRO	330UF	6.3WV		
C97			CK73GB1H471K	CHIP C	470PF	K		
C98			C92-0507-05	CHIP TAN	4.7UF	6.3WV		
C99			CK73GR1C333K	CHIP C	0.033UF	K		
C100			CK73GB1H471K	CHIP C	470PF	K		
C101			CK73GB1H103K	CHIP C	0.01UF	K		
C102-104			CK73GB1H471K	CHIP C	470PF	K		
C106			CK73GB1H471K	CHIP C	470PF	K		
C108			C92-0507-05	CHIP TAN	4.7UF	6.3WV		
C110			CK73GB1H152K	CHIP C	1500PF	K		
C111			CK73GB1E223K	CHIP C	0.022UF	K		
C112			CK73GB1H103K	CHIP C	0.01UF	K		
C113			C92-0507-05	CHIP TAN	4.7UF	6.3WV		
C115			CK73GB1E153K	CHIP C	0.015UF	K		
C116			CK73FF1C105Z	CHIP C	1.0UF	Z		
C201,202			CK73GB1H102K	CHIP C	1000PF	K		

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TX-RX UNIT (X57-404X-XX)

Ref. No. 参照番号	Address 位置	New Parts 新	Parts No. 部品番号	Description 部品名／規格			Destination 仕向	Remarks 備考
C203			C92-0507-05	CHIP TAN	4.7UF	6.3WV		
C204,205			CK73GB1H102K	CHIP C	1000PF	K		
C206			CC73GCH1H330J	CHIP C	33PF	J		
C207			CC73GCH1H120J	CHIP C	12PF	J		
C208			C92-0507-05	CHIP TAN	4.7UF	6.3WV		
C209			CK73GB1H102K	CHIP C	1000PF	K		
C210			CC73GCH1H101J	CHIP C	100PF	J		
C211			CK73FB1E104K	CHIP C	0.10UF	K		
C212			CK73FB1E473K	CHIP C	0.047UF	K		
C213			C92-0009-05	CHIP TAN	4.7UF	10WV		
C214			C92-0002-05	CHIP TAN	0.22UF	35WV		
C215			CC73GCH1H101J	CHIP C	100PF	J		
C216-218			CK73GB1H102K	CHIP C	1000PF	K		
C219			CC73GCH1H100D	CHIP C	10PF	D		
C220,221			CK73GB1H102K	CHIP C	1000PF	K		
C222			CC73GCH1H150J	CHIP C	15PF	J		
C223			CC73GCH1H220J	CHIP C	22PF	J		
C224-227			CK73GB1H102K	CHIP C	1000PF	K		
C228			CK73GB1H103K	CHIP C	0.01UF	K		
C229			CK73GB1H102K	CHIP C	1000PF	K		
C230			CK73GB1H103K	CHIP C	0.01UF	K		
C231			CK73FB1E104K	CHIP C	0.10UF	K		
C232			CK73GB1H102K	CHIP C	1000PF	K		
C233			CK73GB1H103K	CHIP C	0.01UF	K		
C234			CK73FB1E104K	CHIP C	0.10UF	K		
C235-237			CK73GB1H102K	CHIP C	1000PF	K		
C238			CC73GCH1H220J	CHIP C	22PF	J		
C239			CC73GCH1H070D	CHIP C	7PF	D		
C240			CC73GCH1H220J	CHIP C	22PF	J		
C241			CC73GCH1H040C	CHIP C	4PF	C		
C242			CK73GB1H102K	CHIP C	1000PF	K		
C243			CC73GCH1H180J	CHIP C	18PF	J		
C244			CC73GCH1H220J	CHIP C	22PF	J		
C245			CC73GCH1H030C	CHIP C	3PF	C		
C246,247			CK73GB1H102K	CHIP C	1000PF	K		
C248			CC73GCH1H270J	CHIP C	27PF	J		
C249			CC73GCH1H121J	CHIP C	120PF	J		
C250			CC73GCH1H270J	CHIP C	27PF	J		
C251			CC73GCH1H680J	CHIP C	68PF	J		
C252,253			CK73GB1H102K	CHIP C	1000PF	K		
C254			CC73GCH1H680J	CHIP C	68PF	J		
C255,256			CK73GB1H102K	CHIP C	1000PF	K		
C258			CK73GB1H102K	CHIP C	1000PF	K		
C259			CC73GCH1H680J	CHIP C	68PF	J		
C260			CK73GB1H471K	CHIP C	470PF	K		
C261			CC73GCH1H020C	CHIP C	2.0PF	C		
C262,263			CK73GB1H102K	CHIP C	1000PF	K		
C264			CC73GCH1H080D	CHIP C	8PF	D		
C265			CK73GB1H102K	CHIP C	1000PF	K		
C266			CC73GCH1H060D	CHIP C	6PF	D		
C268			CC73GCH1H060D	CHIP C	6PF	D		
C270			CC73GCH1H100D	CHIP C	10PF	D		
C271			CC73GCH1H040C	CHIP C	4PF	C		
C272			CC73GCH1H040C	CHIP C	4PF	C		
C273,274			CC73GCH1H270J	CHIP C	27PF	J		

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TH-28A/E

PARTS LIST

× New Parts
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TX-RX UNIT (X57-404X-XX)

Ref. No. 参照番号	Address 位置	New Parts 新	Parts No. 部品番号	Description 部品名／規格	Destination 仕向	Remarks 備考
C275-277			CK73GB1H471K	CHIP C 470PF K		
C278			CC73GCH1H330J	CHIP C 33PF J		
C279			CK73GB1H471K	CHIP C 470PF K		
C282			CK73GB1H471K	CHIP C 470PF K		
C283			CC73GCH1H240J	CHIP C 24PF J		
C284			CC73GCH1H050C	CHIP C 5PF C		
C285			CK73GB1H471K	CHIP C 470PF K		
C287,288			CK73GB1H471K	CHIP C 470PF K		
C291			CC73GCH1HR75C	CHIP C 0.75PF C		
C292			CC73GCH1H470J	CHIP C 47PF J		
C293			CK73GB1H471K	CHIP C 470PF K		
C294			CC73GCH1H020C	CHIP C 2.0PF C		
C295			CK73GB1H471K	CHIP C 470PF K		
C297			CK73FB1H102K	CHIP C 1000PF K		
C298-300			CC73GCH1H010C	CHIP C 1PF C		
C302			CK73GR1C333K	CHIP C 0.033UF K		
TC201			C05-0371-05	TRIM CAP (10PF)		
TC202,203			C05-0369-05	TRIM CAP (6PF)		
61	3B	*	E29-1102-04	SPACER GND TERMINAL		
CN1		*	E40-5571-05	CONNECTOR (30PIN)		
CN3			E40-5343-05	PIN CONNECTOR (9PIN)		
J201			E03-0170-05	DC JACK		
J202			E11-0420-15	MIC JACK		
J203			E11-0439-05	SP JACK		
			J30-0545-05	SPACER (MCF, X'tal)		
CD1			L79-1013-05	DISCRIMINATOR		
CF1			L72-0362-05	CERAMIC FILTER (CFUM455E)		
L1			L92-0131-05	FERRITE CHIP COIL		
L2			L40-8282-48	SMALL FIXED INDUCTOR (0.82UH)	TXEE2M	
L2			L40-8282-48	SMALL FIXED INDUCTOR (0.82UH)	E3E6M2	
L2			L40-5682-48	SMALL FIXED INDUCTOR (0.56UH)	KP	
L3			L40-1092-81	SMALL FIXED INDUCTOR (1MH)		
L4 -6			L92-0131-05	FERRITE CHIP COIL		
L201-204			L92-0131-05	FERRITE CHIP COIL		
L205			L92-0131-05	FERRITE CHIP COIL		
L207			L40-1092-19	SMALL FIXED INDUCTOR (1UH)		
L208,209			L40-1081-80	SMALL FIXED INDUCTOR (100NH)		
L210		*	L40-4771-34	SMALL FIXED INDUCTOR (47NH)		
L211			L92-0131-05	FERRITE CHIP COIL		
L212			L34-1272-15	COIL (7.5T)		
L213			L34-1271-15	COIL (8.5T)		
L214			L40-1092-19	SMALL FIXED INDUCTOR (1UH)		
L215		*	L40-1095-34	SMALL FIXED INDUCTOR (1UH)		
L216			L34-1269-05	COIL (3.5T)		
L217			L34-1187-25	COIL (8T)		
L218		*	L40-1085-34	SMALL FIXED INDUCTOR (100NH)		
L219		*	L40-1871-34	SMALL FIXED INDUCTOR (18NH)		
L220			L34-4249-05	COIL		
L221			L34-4248-05	COIL		
L222			L40-3982-48	SMALL FIXED INDUCTOR (0.39UH)		
L223			L34-4247-05	COIL		
L224,225			L34-1266-05	COIL (1.5T)		
L226			L40-1071-48	SMALL FIXED INDUCTOR (10NH)		

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TH-28E : E,E2,E3,E6,T

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PARTS LIST

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TX-RX UNIT (X57-404X-XX)

Ref. No. 参照番号	Address 位置	New Parts 新	Parts No. 部品番号	Description 部品名／規格	Destination 仕向	Remarks 備考
L227			L40-1572-48	SMALL FIXED INDUCTOR (15NH)		
L228		*	L40-1571-34	SMALL FIXED INDUCTOR (15NH)		
L229		*	L40-1271-34	SMALL FIXED INDUCTOR (12NH)		
L230		*	L40-3371-34	SMALL FIXED INDUCTOR (33NH)		
L231		*	L40-8271-34	SMALL FIXED INDUCTOR (82NH)		
L234			L33-0680-05	CHOKE COIL		
L235			L92-0131-05	FERRITE CHIP COIL		
X1			L77-1438-05	CRYSTAL RESONATOR (45.505MHz)		
X201			L77-1440-05	CRYSTAL RESONATOR (12.8MHz)		
XF1			L71-0409-05	MCF (45.05MHz)		
CP1			R90-0714-05	MULTI COMP 10KX4		
CP201			R90-0714-05	MULTI COMP 10KX4		
R1			RK73GB1J472J	CHIP R 4.7K J 1/16W		
R2			RK73GB1J332J	CHIP R 3.3K J 1/16W		
R3			RK73GB1J102J	CHIP R 1.0K J 1/16W		
R4			RK73GB1J472J	CHIP R 4.7K J 1/16W		
R5			RK73FB2A331J	CHIP R 330 J 1/10W		
R6 ,7			RK73GB1J472J	CHIP R 4.7K J 1/16W		
R9			RK73GB1J472J	CHIP R 4.7K J 1/16W		
R10			RK73GB1J332J	CHIP R 3.3K J 1/16W		
R11			RK73GB1J102J	CHIP R 1.0K J 1/16W		
R12			RK73GB1J472J	CHIP R 4.7K J 1/16W		
R13			RK73GB1J102J	CHIP R 1.0K J 1/16W		
R14			RK73GB1J332J	CHIP R 3.3K J 1/16W		
R15			RK73GB1J683J	CHIP R 68K J 1/16W		
R16			RK73GB1J102J	CHIP R 1.0K J 1/16W		
R17			RK73GB1J472J	CHIP R 4.7K J 1/16W		
R18			RK73GB1J272J	CHIP R 2.7K J 1/16W		
R19			RK73GB1J472J	CHIP R 4.7K J 1/16W		
R20			RK73GB1J152J	CHIP R 1.5K J 1/16W		
R21			RK73GB1J101J	CHIP R 100 J 1/16W		
R22			RK73GB1J182J	CHIP R 1.8K J 1/16W		
R23			RK73GB1J103J	CHIP R 10K J 1/16W		
R24			RK73GB1J123J	CHIP R 12K J 1/16W		
R25			RK73GB1J471J	CHIP R 470 J 1/16W		
R26			RK73GB1J332J	CHIP R 3.3K J 1/16W		
R27			RK73GB1J561J	CHIP R 560 J 1/16W		
R28			RK73GB1J274J	CHIP R 270K J 1/16W		
R29			RK73GB1J154J	CHIP R 150K J 1/16W		
R30			RK73GB1J122J	CHIP R 1.2K J 1/16W		
R31			RK73GB1J681J	CHIP R 680 J 1/16W		
R32			RK73GB1J472J	CHIP R 4.7K J 1/16W		
R33			RK73GB1J182J	CHIP R 1.8K J 1/16W		
R34			RK73GB1J472J	CHIP R 4.7K J 1/16W		
R36			RK73GB1J472J	CHIP R 4.7K J 1/16W		
R37			R92-1252-05	CHIP R 0 OHM		
R38			RK73GB1J103J	CHIP R 10K J 1/16W		
R39			RK73GB1J154J	CHIP R 150K J 1/16W		
R40 ,41			RK73GB1J392J	CHIP R 3.9K J 1/16W		
R42			RK73GB1J102J	CHIP R 1.0K J 1/16W		
R43			RK73GB1J472J	CHIP R 4.7K J 1/16W		
R44			R92-1252-05	CHIP R 0 OHM		
R45			RK73GB1J473J	CHIP R 47K J 1/16W		
R46			RK73GB1J103J	CHIP R 10K J 1/16W		
R47			RK73GB1J153J	CHIP R 15K J 1/16W		

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TX-RX UNIT (X57-404X-XX)

Ref. No. 参照番号	Address 位置	New Parts 新	Parts No. 部品番号	Description 部品名／規格	Destination 仕向	Remarks 備考
R48			RK73GB1J474J	CHIP R 470K J 1/16W		
R49			RK73GB1J220J	CHIP R 22 J 1/16W		
R50			RK73GB1J100J	CHIP R 10 J 1/16W		
R51			RK73GB1J822J	CHIP R 8.2K J 1/16W		
R53			RK73GB1J103J	CHIP R 10K J 1/16W		
R54			RK73GB1J102J	CHIP R 1.0K J 1/16W		
R55			RK73GB1J182J	CHIP R 1.8K J 1/16W		
R57			RK73GB1J822J	CHIP R 8.2K J 1/16W		
R58			RK73GB1J103J	CHIP R 10K J 1/16W		
R59			RK73GB1J472J	CHIP R 4.7K J 1/16W		
R60			RK73GB1J330J	CHIP R 33 J 1/16W		
R61			RK73GB1J681J	CHIP R 680 J 1/16W		
R62			RK73GB1J334J	CHIP R 330K J 1/16W		
R63			RK73GB1J683J	CHIP R 68K J 1/16W		
R64			RK73GB1J103J	CHIP R 10K J 1/16W		
R66			RK73GB1J152J	CHIP R 1.5K J 1/16W		
R67			RK73GB1J103J	CHIP R 10K J 1/16W		
R68			RK73GB1J222J	CHIP R 2.2K J 1/16W		
R69			RK73GB1J561J	CHIP R 560 J 1/16W		
R70			RK73GB1J473J	CHIP R 47K J 1/16W		
R71			RK73GB1J472J	CHIP R 4.7K J 1/16W		
R72			RK73GB1J101J	CHIP R 100 J 1/16W		
R73			RK73GB1J102J	CHIP R 1.0K J 1/16W		
R74			RK73GB1J274J	CHIP R 270K J 1/16W		
R75			R92-1252-05	CHIP R 0 OHM		
R76			RK73GB1J102J	CHIP R 1.0K J 1/16W		
R77			RK73GB1J391J	CHIP R 390 J 1/16W		
R80			RK73GB1J222J	CHIP R 2.2K J 1/16W		
R81			RK73GB1J102J	CHIP R 1.0K J 1/16W		
R83			RK73GB1J392J	CHIP R 3.9K J 1/16W		
R84			RK73GB1J152J	CHIP R 1.5K J 1/16W		
R85			R92-1252-05	CHIP R 0 OHM		
R86			RK73GB1J274J	CHIP R 270K J 1/16W		
R87			RK73GB1J103J	CHIP R 10K J 1/16W		
R88			RK73GB1J473J	CHIP R 47K J 1/16W		
R89			RK73GB1J100J	CHIP R 10 J 1/16W		
R90			RK73GB1J104J	CHIP R 100K J 1/16W		
R91 ,92			RK73GB1J562J	CHIP R 5.6K J 1/16W		
R93			R92-1252-05	CHIP R 0 OHM		
R94			RK73GB1J472J	CHIP R 4.7K J 1/16W		
R96			RK73GB1J103J	CHIP R 10K J 1/16W		
R97			RK73GB1J391J	CHIP R 390 J 1/16W		
R98			RK73GB1J472J	CHIP R 4.7K J 1/16W		
R99			RK73GB1J333J	CHIP R 33K J 1/16W		
R100			RK73GB1J223J	CHIP R 22K J 1/16W		
R101			RK73GB1J154J	CHIP R 150K J 1/16W		
R103,104			RK73GB1J104J	CHIP R 100K J 1/16W		
R106			RK73GB1J472J	CHIP R 4.7K J 1/16W		
R107			R92-1252-05	CHIP R 0 OHM		
R108			RK73GB1J103J	CHIP R 10K J 1/16W		
R109			RK73FB2A183J	CHIP R 18K J 1/10W		
R110,111			RK73GB1J473J	CHIP R 47K J 1/16W		
R112			RK73GB1J222J	CHIP R 2.2K J 1/16W	M2E2	
R113			RK73GB1J103J	CHIP R 10K J 1/16W		
R114			RK73GB1J473J	CHIP R 47K J 1/16W		

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TX-RX UNIT (X57-404X-XX)

Ref. No. 参照番号	Address 位置	New Parts 新	Parts No. 部品番号	Description 部品名／規格	Destination 仕向	Remarks 備考
R116,117			RK73GB1J104J	CHIP R 100K J 1/16W		
R118,119			RK73GB1J273J	CHIP R 27K J 1/16W		
R120			RK73GB1J223J	CHIP R 22K J 1/16W		
R122,123			RK73GB1J103J	CHIP R 10K J 1/16W		
R201			RK73GB1J470J	CHIP R 47 J 1/16W		
R202			RK73GB1J472J	CHIP R 4.7K J 1/16W		
R203,204			RK73GB1J563J	CHIP R 56K J 1/16W		
R205			RK73GB1J821J	CHIP R 820 J 1/16W		
R206			RK73GB1J823J	CHIP R 82K J 1/16W		
R207,208			R92-1252-05	CHIP R 0 OHM		
R209			RK73GB1J183J	CHIP R 18K J 1/16W		
R210			RK73GB1J100J	CHIP R 10 J 1/16W		
R211			RK73GB1J183J	CHIP R 18K J 1/16W		
R212			RK73GB1J124J	CHIP R 120K J 1/16W	M2E2	
R213			RK73GB1J473J	CHIP R 47K J 1/16W		
R214			RK73GB1J223J	CHIP R 22K J 1/16W		
R215			RK73GB1J332J	CHIP R 3.3K J 1/16W		
R216			RK73GB1J222J	CHIP R 2.2K J 1/16W		
R217			RK73GB1J681J	CHIP R 680 J 1/16W	KMTXPE	
R217			RK73GB1J681J	CHIP R 680 J 1/16W	E3E6	
R218			RK73GB1J222J	CHIP R 2.2K J 1/16W	KMTXPE	
R218			RK73GB1J222J	CHIP R 2.2K J 1/16W	E3E6	
R219			RK73GB1J103J	CHIP R 10K J 1/16W		
R220			RK73GB1J152J	CHIP R 1.5K J 1/16W		
R221			RK73GB1J272J	CHIP R 2.7K J 1/16W		
R222			RK73GB1J101J	CHIP R 100 J 1/16W		
R223			RK73GB1J331J	CHIP R 330 J 1/16W		
R224			RK73GB1J390J	CHIP R 39 J 1/16W		
R225			RK73GB1J152J	CHIP R 1.5K J 1/16W		
R226			RK73GB1J272J	CHIP R 2.7K J 1/16W		
R227			RK73GB1J680J	CHIP R 68 J 1/16W		
R228			RK73GB1J470J	CHIP R 47 J 1/16W		
R229			RK73GB1J561J	CHIP R 560 J 1/16W		
R230,231			RK73GB1J271J	CHIP R 270 J 1/16W		
R232			RK73GB1J182J	CHIP R 1.8K J 1/16W		
R233			RK73GB1J152J	CHIP R 1.5K J 1/16W		
R235,236			RK73GB1J680J	CHIP R 68 J 1/16W		
R237			RK73GB1J473J	CHIP R 47K J 1/16W		
R238			RK73GB1J472J	CHIP R 4.7K J 1/16W		
R239			RK73GB1J222J	CHIP R 2.2K J 1/16W		
R240			RK73GB1J104J	CHIP R 100K J 1/16W		
R241			RK73GB1J101J	CHIP R 100 J 1/16W		
R242			RK73GB1J102J	CHIP R 1.0K J 1/16W		
R243			RK73GB1J104J	CHIP R 100K J 1/16W		
R244			RK73GB1J272J	CHIP R 2.7K J 1/16W		
R245			RK73GB1J470J	CHIP R 47 J 1/16W		
R246			RK73GB1J104J	CHIP R 100K J 1/16W		
R248			RK73GB1J101J	CHIP R 100 J 1/16W		
R249			RK73GB1J103J	CHIP R 10K J 1/16W		
R250			RK73GB1J472J	CHIP R 4.7K J 1/16W		
R251			RK73GB1J471J	CHIP R 470 J 1/16W		
R252			RK73GB1J102J	CHIP R 1.0K J 1/16W		
R253			RK73GB1J222J	CHIP R 2.2K J 1/16W		
R254			RK73GB1J222J	CHIP R 2.2K J 1/16W		
R255,256			RK73GB1J332J	CHIP R 3.3K J 1/16W		

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TH-28A/E

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TX-RX UNIT (X57-404X-XX)

Ref. No. 参照番号	Address 位置	New Parts 新	Parts No. 部品番号	Description 部品名／規格	Destination 仕向	Remarks 備考
R257			RK73GB1J471J	CHIP R 470 J 1/16W		
R258			RK73GB1J271J	CHIP R 270 J 1/16W		
R259			RK73GB1J180J	CHIP R 18 J 1/16W		
R260			RK73GB1J101J	CHIP R 100 J 1/16W		
R261			RK73GB1J682J	CHIP R 6.8K J 1/16W		
R262			RK73GB1J101J	CHIP R 100 J 1/16W		
R263			RK73GB1J222J	CHIP R 2.2K J 1/16W		
R264			RK73GB1J333J	CHIP R 33K J 1/16W		
R265			RK73GB1J153J	CHIP R 15K J 1/16W		
R266			RK73GB1J103J	CHIP R 10K J 1/16W		
R267			RK73GB1J151J	CHIP R 150 J 1/16W		
R268			RK73GB1J222J	CHIP R 2.2K J 1/16W		
R269			RK73GB1J470J	CHIP R 47 J 1/16W		
R270			RK73GB1J682J	CHIP R 6.8K J 1/16W		
R271			RK73GB1J392J	CHIP R 3.9K J 1/16W		
R272			RK73GB1J471J	CHIP R 470 J 1/16W		
R273			RK73FB2A101J	CHIP R 100 J 1/10W		
R276			RK73GB1J153J	CHIP R 15K J 1/16W		
R277			RK73GB1J221J	CHIP R 220 J 1/16W		
R278,279			R92-1252-05	CHIP R 0 OHM		
R280			R92-1252-05	CHIP R 0 OHM		
VR3			R12-6708-05	TRIM POT 1.5K		
VR4			R12-6705-05	TRIM POT 470		
VR5			R12-6703-05	TRIM POT 220		
VR6			R12-6705-05	TRIM POT 470		
VR7 ,8			R12-6717-05	TRIM POT 47K		
D1			MA110	DIODE		
D2			MA742	DIODE		
D3			DAN222	DIODE		
D4 ,5			DA221	DIODE		
D6			MA110	DIODE		
D7			MA728	DIODE		
D8			MA8039	DIODE		
D9			DAN222	DIODE		
D11			RD22P	DIODE		
D201,202			MA110	DIODE		
D204			MA110	DIODE		
D205-207			MA77	DIODE		
D208			1SV172	DIODE		
D209		*	MI809	DIODE		
D210,211			1SS312	DIODE		
D212-214		*	MA368	DIODE		
D215-217			1SS312	DIODE		
D218			DAN222	DIODE		
IC1			MC3372D	IC (FM IC)		
IC2			TC4S66F	IC(BILATERAL SWITCH)		
IC3		*	NJM386BE	IC(AF POWER AMP)		
IC4			TA7787AF	IC(FM/AM IF/3V)		
IC5			LM301AD	IC(OP AMP)		
IC6			TC4S66F	IC(BILATERAL SWITCH)		
IC7		*	NJM4560E	IC(MIC AMP)		
IC8			TA75S01F	IC(OP AMP)		
IC9			SCI7710YBS	IC(VOLTAGE REGULATOR)		
IC10			BU4094BF	IC(SHIFT/STORE REGISTER)		

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TX-RX UNIT (X57-404X-XX)
VCO (X58-3870-XX)

Ref. No. 参照番号	Address 位置	New Parts 新	Parts No. 部品番号	Description 部品名／規格	Destination 仕向	Remarks 備考
IC201			MB1505PF-G-BND	IC(PLL)		
IC202			S-AV22A	IC(VHF POWER MODULE)		
Q1			2SB798(DL,DK)	TRANSISTOR		
Q2			UMW1	DIGITAL TRANSISTOR		
Q3			UMG2	DIGITAL TRANSISTOR		
Q4			2SB798(DL,DK)	TRANSISTOR		
Q5			UMW1	DIGITAL TRANSISTOR		
Q6			2SB798(DL,DK)	TRANSISTOR		
Q7			UMW1	DIGITAL TRANSISTOR		
Q8			DTC114EE	DIGITAL TRANSISTOR		
Q9			DTC114YE	DIGITAL TRANSISTOR		
Q10			UMG2	DIGITAL TRANSISTOR		
Q11		*	2SC4738(GR)	TRANSISTOR		
Q12		*	2SC4738(GR)	TRANSISTOR		
Q13			2SB798(DL,DK)	TRANSISTOR		
Q14		*	2SC4738(GR)	TRANSISTOR		
Q15			DTA144EE	DIGITAL TRANSISTOR		
Q16			2SC4619	TRANSISTOR		
Q17 ,18		*	2SC4738(GR)	TRANSISTOR		
Q19			DTC144EE	DIGITAL TRANSISTOR		
Q20 ,21			FMC3	DIGITAL TRANSISTOR		
Q22			2SK879(Y)	FET		
Q23			DTC114YE	DIGITAL TRANSISTOR		
Q24			DTA143ZE	DIGITAL TRANSISTOR		
Q25			DTA144EE	DIGITAL TRANSISTOR		
Q26 ,27			UMA9	DIGITAL TRANSISTOR		
Q201		*	2SC4738(GR)	TRANSISTOR		
Q202			2SC4619	TRANSISTOR		
Q203		*	2SJ243	FET		
Q204			2SK1824	FET		
Q205			2SC4083(N,P)	TRANSISTOR		
Q206			2SC4093	TRANSISTOR		
Q207			DTC144EE	DIGITAL TRANSISTOR		
Q208			DTC114YE	DIGITAL TRANSISTOR		
Q209		*	UMC5	DIGITAL TRANSISTOR		
Q210			DTA123EU	DIGITAL TRANSISTOR		
Q211			DTC144EE	DIGITAL TRANSISTOR		
Q212			DTC114YE	DIGITAL TRANSISTOR		
Q213			2SK360(E)	FET		
Q214			2SC4083(N,P)	TRANSISTOR		
Q215			2SC4226(R24,25)	TRANSISTOR		
Q216		*	3SK240	FET		
Q217			2SC4083(N,P)	TRANSISTOR		
A201		*	X58-3870-00	SUB UNIT (VCO)	KTEE3P	
A201		*	X58-3870-00	SUB UNIT (VCO)	MXE6	
A201		*	X58-3870-21	SUB UNIT (VCO)	E2M2	
VCO (X58-3870-XX) -00 : M,M2,X,E,E2,E3,E6,T -11 : K,P						
C1			CC73GUJ1H010C	CHIP C 1PF C		
C2			CK73GB1H102K	CHIP C 1000PF K		
C3 ,4			CC73GCH1H030C	CHIP C 3PF C		
C5			CC73GCH1H010C	CHIP C 1PF C		
C6 ,7			CK73GB1H102K	CHIP C 1000PF K		
C8			CC73GCH1H100D	CHIP C 10PF D		
C9 ,10			CK73GB1H102K	CHIP C 1000PF K		

L:Scandinavia K:USA P:Canada
Y:PX(Far East, Hawaii) T:England E:Europe
Y:AAFES(Europe) X:Australia M:Other Areas

TH-28A : K,P,X,M,M2
TH-28E : E,E2,E3,E6,T

⚠ indicates safety critical components.

PARTS LIST

* New Parts
Parts without **Parts No.** are not supplied.
Les articles non mentionnes dans le **Parts No.** ne sont pas fournis.
Teile ohne **Parts No.** werden nicht geliefert.

VCO (X58-3870-XX)

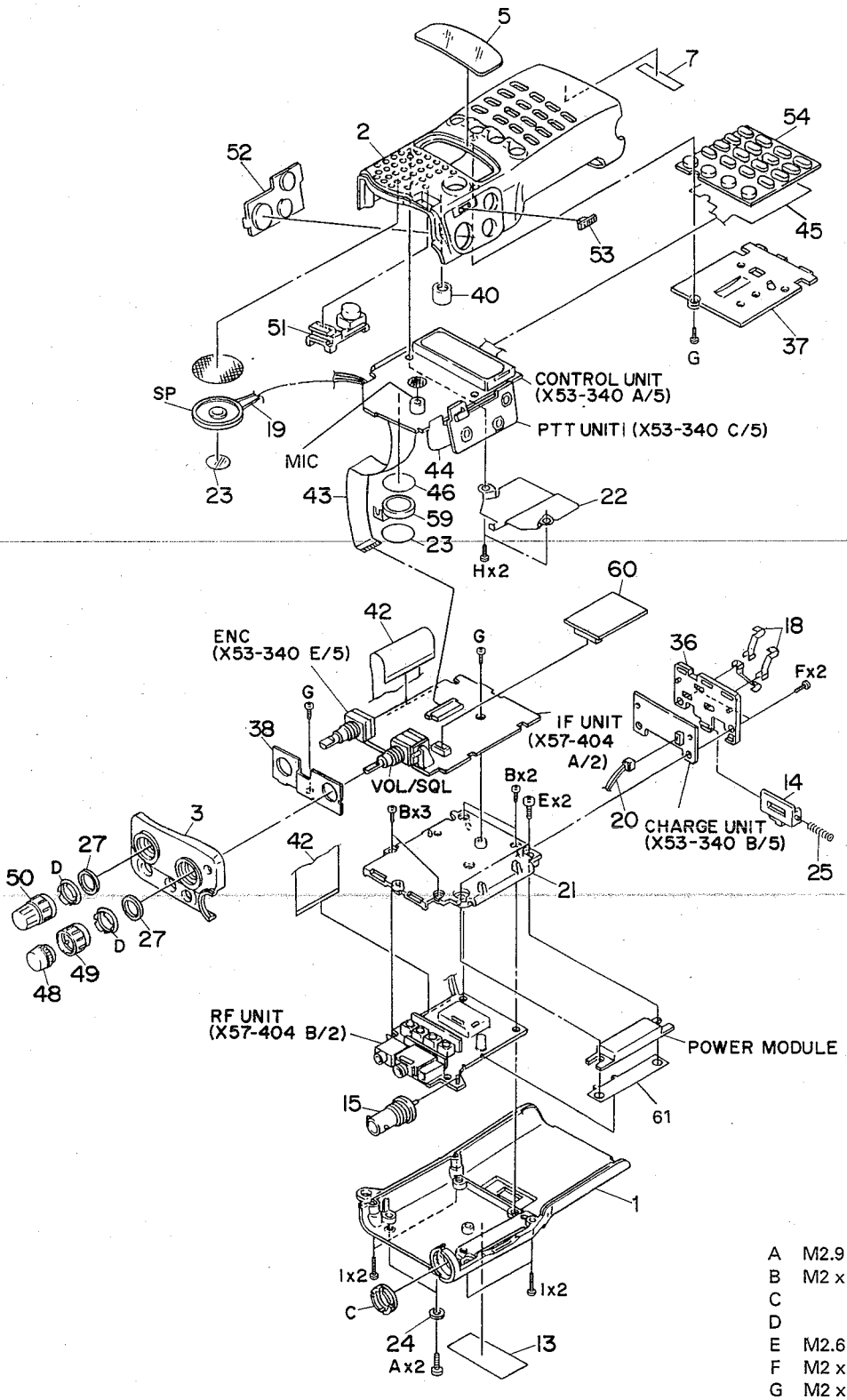
Ref. No. 参照番号	Address 位置	New Parts 新	Parts No. 部品番号	Description 部品名／規格	Destination 仕向	Remarks 備考
Q1			DTC144EE	DIGITAL TRANSISTOR		
A1 -6			E23-0486-05	TERMINAL		
A7		*	F10-2033-04	SHIELDING CASE		
L2		*	L34-1367-05	COIL		
L3		*	L34-1368-05	COIL		
L4			L40-1092-48	SMALL FIXED INDUCTOR (1UH)		
R1			RK73GB1J332J	CHIP R 3.3K J 1/16W		
R2			RK73GB1J104J	CHIP R 100K J 1/16W		
R3			RK73GB1J222J	CHIP R 2.2K J 1/16W		
R4			RK73GB1J561J	CHIP R 560 J 1/16W		
R5			RK73GB1J221J	CHIP R 220 J 1/16W		
R6			RK73GB1J470J	CHIP R 47 J 1/16W		
R7			RK73GB1J823J	CHIP R 82K J 1/16W		
R8			RK73GB1J821J	CHIP R 820 J 1/16W		
R9			RK73GB1J823J	CHIP R 82K J 1/16W		
R11			RK73GB1J821J	CHIP R 820 J 1/16W		
D1 ,2			MA333	DIODE		
D3			MA360	DIODE		
D4			MA77	DIODE		
Q2			2SK238(K17)	FET		
Q3			2SC4083(P,Q)	TRANSISTOR		
Q4			2SC4083(N,P)	TRANSISTOR		

L:Scandinavia **K:**USA **P:**Canada
Y:PX(Far East, Hawaii) **T:**England **E:**Europe
Y:AAFES(Europe) **X:**Australia **M:**Other Areas

TH-28A : K,P,X,M,M2
TH-28E : E,E2,E3,E6,T

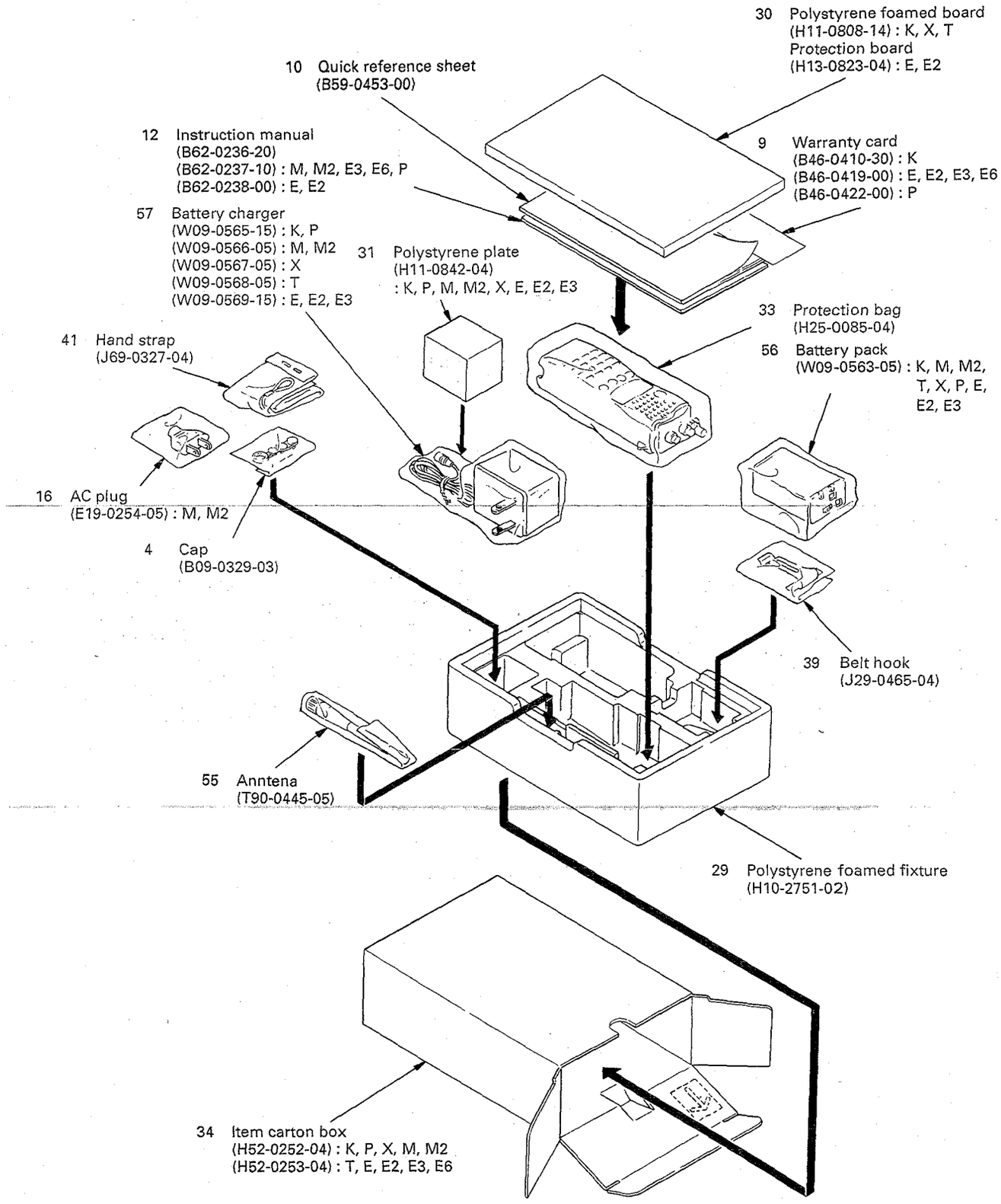
⚠ indicates safety critical components.

EXPLODED VIEW



A	M2.9 x 4	: N09-2028-05
B	M2 x 10.5	: N09-2139-25
C		: N14-0556-04
D		: N14-0557-04
E	M2.6 x 8	: N30-2608-46
F	M2 x 4.5	: N39-2045-45
G	M2 x 3.5	: N79-2035-45
H	M2 x 5.0	: N79-2050-46
I	M2 x 12	: N80-2012-45

PACKING


30 Polystyrene foamed board
(H11-0808-14) : K, X, T
Protection board
(H13-0823-04) : E, E2
10 Quick reference sheet
(B59-0453-00)
12 Instruction manual
(B62-0236-20)
(B62-0237-10) : M, M2, E3, E6, P
(B62-0238-00) : E, E2
9 Warranty card
(B46-0410-30) : K
(B46-0419-00) : E, E2, E3, E6
(B46-0422-00) : P
57 Battery charger
(W09-0565-15) : K, P
(W09-0566-05) : M, M2
(W09-0567-05) : X
(W09-0568-05) : T
(W09-0569-15) : E, E2, E3
31 Polystyrene plate
(H11-0842-04)
: K, P, M, M2, X, E, E2, E3
33 Protection bag
(H25-0085-04)
56 Battery pack
(W09-0563-05) : K, M, M2, T, X, P, E, E2, E3
41 Hand strap
(J69-0327-04)
16 AC plug
(E19-0254-05) : M, M2
4 Cap
(B09-0329-03)
39 Belt hook
(J29-0465-04)
55 Anntena
(T90-0445-05)
29 Polystyrene foamed fixture
(H10-2751-02)
34 Item carton box
(H52-0252-04) : K, P, X, M, M2
(H52-0253-04) : T, E, E2, E3, E6

ADJUSTMENT

Required Test Equipment

1. **Stabilized Power Supply**
   1) The supply voltage can be changed between 5V and 18V, and the current is 5A or more.
   2) The standard voltage is 13.8V.
2. **DC Ammeter**
   1) Class 1 ammeter (17 ranges and other features).
   2) The full scale can be set to either 300mA or 3A.
   3) A cable of less internal loss must be used.
3. **Frequency Counter (f. counter)**
   1) Frequencies of up to 1GHz or so can be measured.
   2) The sensitivity can be changed to 250MHz or below, and measurements are highly stable and accurate (0.2ppm or so).
4. **Power Meter**
   1) Measurable frequency : Up to 500MHz.
   2) Impedance : 50Ω, unbalanced.
   3) Measuring range : Full scale of 10W or so.
   4) A standard cable (5D2W 1m) must be used.
5. **RF VTVM (RF V.M)**
   1) Measurable frequency : Up to 500MHz or so.
6. **Linear Detector**
   1) Measurable frequency : Up to 500MHz.
   2) Characteristics are flat, and CN is 60dB or more.
7. **Digetal Voltmeter**
   1) Voltage range : FS = 18V or so.
   2) Input resistance : 1MΩ or more.
8. **Oscilloscope**
   1) Measuring range : DC to 30MHz
   2) Provides highly accurate measurements for 5 to 25MHz.
9. **AF Voltmeter (AF V.M)**
   1) Measurable frequency : 50Hz to 1MHz.
   2) Maximum sensitivity : 1mV or more.
10. **Spectrum Analyzer**
    1) Measuring range : DC to 1GHz or more.
11. **Standard Signal Generator (SSG)**
    1) Maximum frequency : 500MHz or more.
    2) Output : –20dB/0.1μV to 120dB/1V.
    3) Output impedance : 50Ω.
12. **Tracking Generator**
    1) Center frequency : 50kHz to 500MHz.
    2) Frequency deviation : ±35MHz.
    3) Output voltage : 100mV or more.
13. **Dummy Load**
    1) 8Ω, 3W or more.
14. **Distortion Meter**
    1) Measurable frequency : 30Hz to 100kHz.
    2) Input level : 50mV to 10Vrms.

TH-28A/E

ADJUSTMENT

TX/RX Common Adjustment

Item	Condition	Measurement			Adjustment			Specifications/Remarks
		Test-equipment	Unit	Terminal	Unit	Parts	Method	
1. Setting	1) DC IN terminal : 13.8V ⊕—●—⊖							
2. Reset	1) While pressing the F key down, set the POWER : ON.						Display check.	All segments on.
							Reset frequency check	MAIN : 144.000 SUB : 440.000 **K,P** 430.000 **M,M2,X,E,E2,E3,E6,T**

PLL Adjustment

Item	Condition	Measurement			Adjustment			Specifications/Remarks
		Test-equipment	Unit	Terminal	Unit	Parts	Method	
1. VCO voltage	1) Frequency : Center frequency	DC V.M	RF	TP2			Check	1.5 to 2.5V

TX Adjustment

Item	Condition	Measurement			Adjustment			Specifications/Remarks
		Test-equipment	Unit	Terminal	Unit	Parts	Method	
1. Reference frequency	1) Frequency : 147.975MHz **K,P,M,M2,X** 145.975MHz **E,E2,E3,E6,T** PTT : ON	f. counter Power meter	RF	ANT	RF	TC201	147.975MHz **K,P,M,M2,X** 145.975MHz **E,E2,E3,E6,T**	±750Hz
2. Power (MAX power)	1) Frequency : 146.000MHz **K,P,M,M2,X** 144.975MHz **E,E2,E3,E6,T** HI/LOW : L PTT : ON	Power meter Ammeter	RF	ANT	IF	VR6	MAX	5.7W or more.
(Low power)	2) PTT : ON					VR6	0.5W	±0.1W 800mA or less.
(Mid power)	3) HI/LOW : M PTT : ON					VR5	2.5W	±0.1W
(Economy power)	4) HI/LOW : EL PTT : ON						Check	10mW or more.
(Hi power)	5) HI/LOW : H PTT : ON				IF	VR4	5.5W	±0.1W 1.8A or less.
	6) Frequency : 144.000MHz 147.975MHz **K,P,M,M2,X** 145.975MHz **E,E2,E3,E6,T** DC IN terminal : 7.7V PTT : ON						Check	1.0W or more.
3. Deviation	1) Frequency : 146.000MHz **K,P,M,M2,X** 144.975MHz **E,E2,E3,E6,T** AG : 1kHz/50mV PTT : ON	Power meter Linear detector f. counter AG Oscilloscope	RF	ANT MIC	IF	VR8	±4.3kHz (+/– greater)	±100Hz
	2) AG : 1kHz/5mV PTT : ON	AF V.M					Check	±2.2 to ±3.5kHz.
4. DTMF deviation	1) AG : OFF PTT : ON D key : Push				IF	VR7	±3.5kHz (+/– greater)	±200Hz

ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specifications/Remarks
		Test-equipment	Unit	Terminal	Unit	Parts	Method	
5. TONE deviation	1) F key : Push # key : Push PTT : ON **K,P,M,M2,X**	Power meter Linear detector f. counter	RF	ANT			Check	Display "T" on. DEV : 0.5 to 1.25kHz
	2) TONE key : Push **E,E2,E3,E6,T**	AG Oscilloscope AF V.M		MIC			Check	During TONE key pushing down, display "T" on, and transmit mode. DEV : 2.5 to 4.5kHz
6. CTCSS (TSU-7)	1) F key : Push 3 key : Push PTT : ON						Check	Display "CT" on.
					CTCSS	VR1	±0.7kHz	±0.5 to ±1.25kHz

VHF RX Adjustment

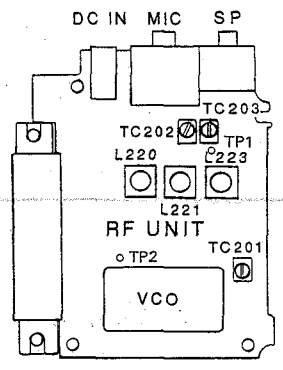
Item	Condition	Measurement			Adjustment			Specifications/Remarks
		Test-equipment	Unit	Terminal	Unit	Parts	Method	
1. BPF	1) Tracking generator output : –40dBm Connect the spectrum analyzer to TP1.	Tracking generator Spectrum analyzer	RF	ANT TP1	RF	L220 L221 L223	Align the L220, L221, L223 and set the waveform of spectrum analyzer to Fig. 1.	
2. Receive sensitivity	1) Frequency : 146.050MHz **K,P,M,M2,X** 145.050MHz **E,E2,E3,E6,T** SSG output : 0.18µV/–122dBm MOD : 1kHz DEV : ±3kHz AF VR : 0.63V/8Ω	SSG	RF	ANT			Check	SINAD 12dB or more.
		Oscilloscope Distortion meter AF V.M		SP				
	2) Frequency : 144.050MHz							
	3) Frequency : 147.950MHz **K,P,M,M2,X** 145.950MHz **E,E2,E3,E6,T**							
	4) Display : VFO mode F key (1 sec) : Push LOW key : Push Frequency : 118.000MHz K,P only SSG output : 1.6µV/–103dBm AM MOD : 1kHz/60%						Check	S/N 10dB or more.
	5) MHz key : Push Frequency : 162MHz (Encoder) SSG output : 1µV/–107dBm MOD : 1kHz DEV : ±3kHz						Check	SINAD 12dB or more.
3. S-meter	1) Frequency : 146.050MHz **K,P,M,M2,X** 145.050MHz **E,E2,E3,E6,T** SSG output : 0.18µV/–122dBm	SSG Oscilloscope SP Ammeter AF V.M	RF	ANT	IF	VR3	The 1st segment is just turned on.	When VR3 is unable to be adjusted as follows, at the point of 9 o'clock of VR3 and SSG output is 0.28µV /–118dBm, the 1st segment or more is acceptable.
	2) SSG output : 8.9µV/–88dBm						Check	All segments on.
	3) SSG output : 0.1µV/–127dBm						Check	All segments off.
4. Squelch	1) SSG RF : OFF SQL VR : Noise disappear point						Check	SQL knob scale : 1.5 to 4 65mA or less.
	2) SSG output : 0.1µV/–127dBm						Check	Squelch should be open.
	3) SQL VR : MAX						Tight squelch	Squelch should be close.
	4) SSG output : 0.4µV/–116dBm						Check	Squelch should be open.

ADJUSTMENT

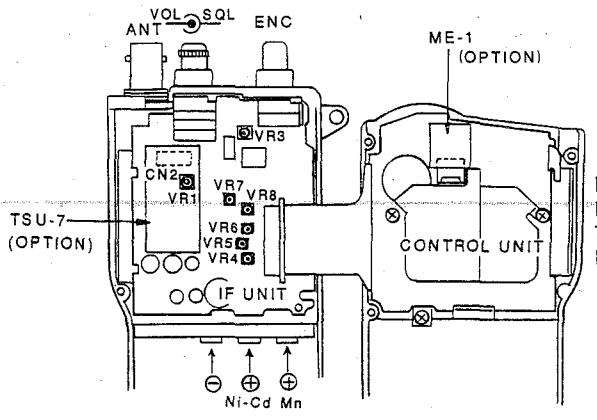
UHF RX Adjustment

Item	Condition	Measurement			Adjustment			Specifications/Remarks
		Test-equipment	Unit	Terminal	Unit	Parts	Method	
1. Receive sensitivity	1) Frequency : 438.050MHz **K,P** 430.050MHz **M,M2,X,E,E2,E3,E6,T** SSG output : 0.36μV/–116dBm MOD : 1kHz DEV : ±3kHz AF VR : 0.63V/8Ω	SSG Oscilloscope Distortion meter AF V.M	RF	ANT SP	RF	TC202 TC203	Max. sensitivity	SINAD 12dB or more.
	2) Frequency : 444.050MHz **K,P** 435.050MHz **M,M2,X,E,E2,E3,E6,T**						Check	SINAD 12dB or more.
	3) Frequency : 449.950MHz **K,P** 439.950MHz **M,M2,X,E,E2,E3,E6,T**							
2. S-meter	1) Frequency : 444.050MHz **K,P** 435.050MHz **M,M2,X,E,E2,E3,E6,T** SSG output : 31.6mV/–77dBm						Check	All segments on.
	2) SSG output : 0.1μV/–127dBm							All segments off.
3. Squelch	1) Frequency : 438.050MHz **K,P** 430.050MHz **M,M2,X,E,E2,E3,E6,T** SSG RF : OFF SQL VR : Noise disappear point						Check	SQL knob scale : 1.5 to 4 65mA or less.
	2) SSG output : 0.25μV/–119dBm						Check	Squelch should be open.
	3) SQL VR : MAX							Squelch should be close.
	4) SSG output : 0.63μV/–111dBm							Squelch should be open.

Adjustment Points



RF UNIT
TC201 : TX frequency
L220, 221, 223 : BPF
TC202, 203 : RX sensitivity



IF UNIT
VR3 : S-meter
VR4 : Power HI
VR5 : Power MID
VR6 : Power LOW
VR7 : DTMF
VR8 : DEV

PTT
LAMP : A
TONE T. SEL : E
MONI

CTCSS (TSU-7)
VR1 : CTCSS

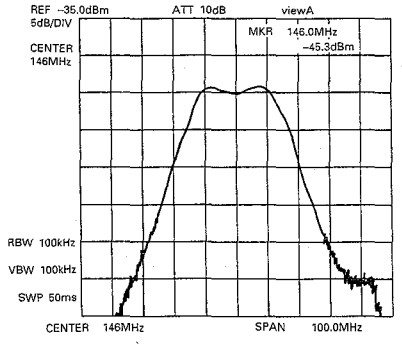


Fig. 1

POWER MODULE INSTALLATION METHOD

Install the power module and RF unit as shown in Figure 1. When the power module is replaced following repair, use the procedure below to maintain dimensions *1 and *2.

> Do not bend the ground spacer when removing the power module, and do not use power module with a bent ground spacer.

1. Insert the power module into the RF unit, and place it on the rear part of the case without soldering any wires or securing it with screws.

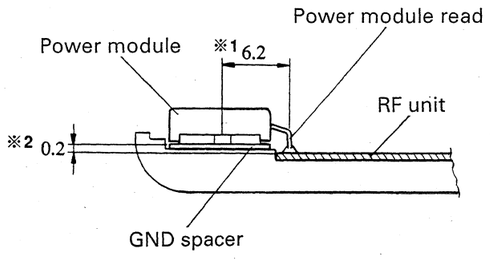


Fig. 1

2. Pressing the power module from above with your fingers to prevent it lifting, temporarily secure the power module leads at two points by soldering from the component side of the RF unit. (Fig. 2)

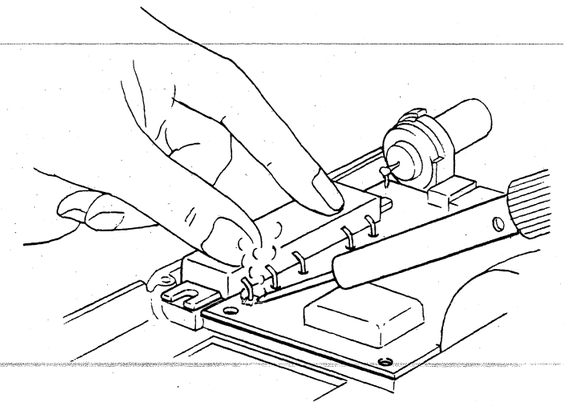


Fig. 2

3. Stand the RF unit upright, and solder the five leads properly from the soldered side. (Fig. 3)
   Fix the RF unit to the rear part of the case with screws.

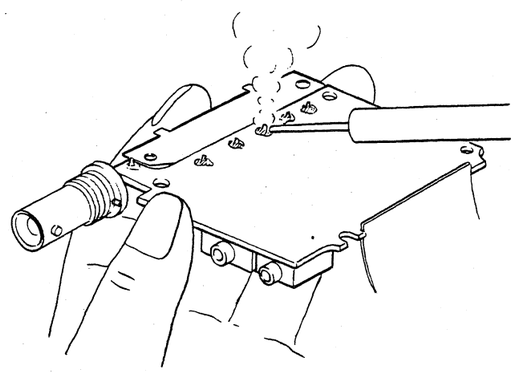


Fig. 3

TH-28A/E

TERMINAL FUNCTION

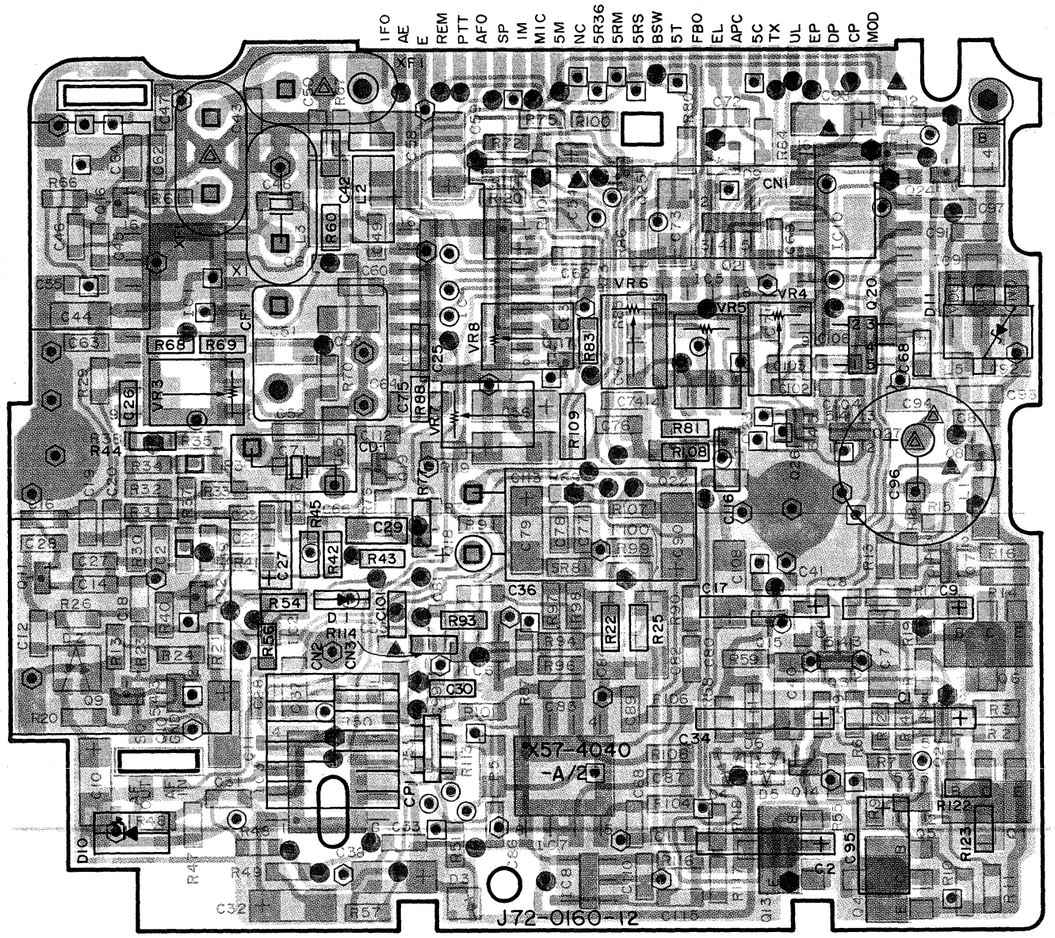
Connector No.	Terminal No.	Terminal Name	Terminal Function
TX-RX UNIT (B/2) : RF ↔ TX-RX UNIT (A/2) : IF			
	1	MOD	Modulation input
	2	CP	Clock signal
	3	DP	Data signal
	4	EP	Enable signal
	5	UL	PLL unlock signal
	6	TX	VCO switching signal
	7	5C	5V power supply
	8	APC	APC voltage input
	9	EL	EL power switching signal
	10	FBO	Power supply
	11	5T	Transmit 5V power supply
	12	BSW	Receive BPF switching power supply
	13	5RS	UHF receive power supply
	14	5RM	VHF receive power supply
	15	5R36	360MHz band receive power supply
	16	NC	
	17	5M	Microphone 5V power supply
	18	MIC	Microphone signal
	19	IM	Internal microphone signal
	20	SP	Internal speaker signal
	21	AFO	Audio output
	22	PTT	PTT switch signal
	23	REM	Remote controller microphone signal
	24	E	Ground
	25	AE	Audio line ground
	26	IFO	IF signal
CONTROL UNIT (A/5) : CONTROL ↔ ME-1 (Option)			
CN1	1	E	Ground
	2	S5M	5V power supply
	3	16CL	Clock signal
	4	NC	
	5	DIO	Serial data
TX-RX UNIT (A/2) : IF ↔ TSU-7 (Option)			
CN3	1	TO	Tone signal output
	2	E	Ground
	3	SDO	Tone signal match/mismatch identification signal
	4	CI	Signaling AF output
	5	CP	Clock signal
	6	5C	5V power supply
	7	DP	Tone serial data
	8	TXO	Modulation input
	9	ET	Tone enable
TX-RX UNIT (A/2) : IF ↔ CONTROL UNIT (A/5) : CONTROL			
CN1	1	AE	Audio ground
	2	SP	Internal speaker signal

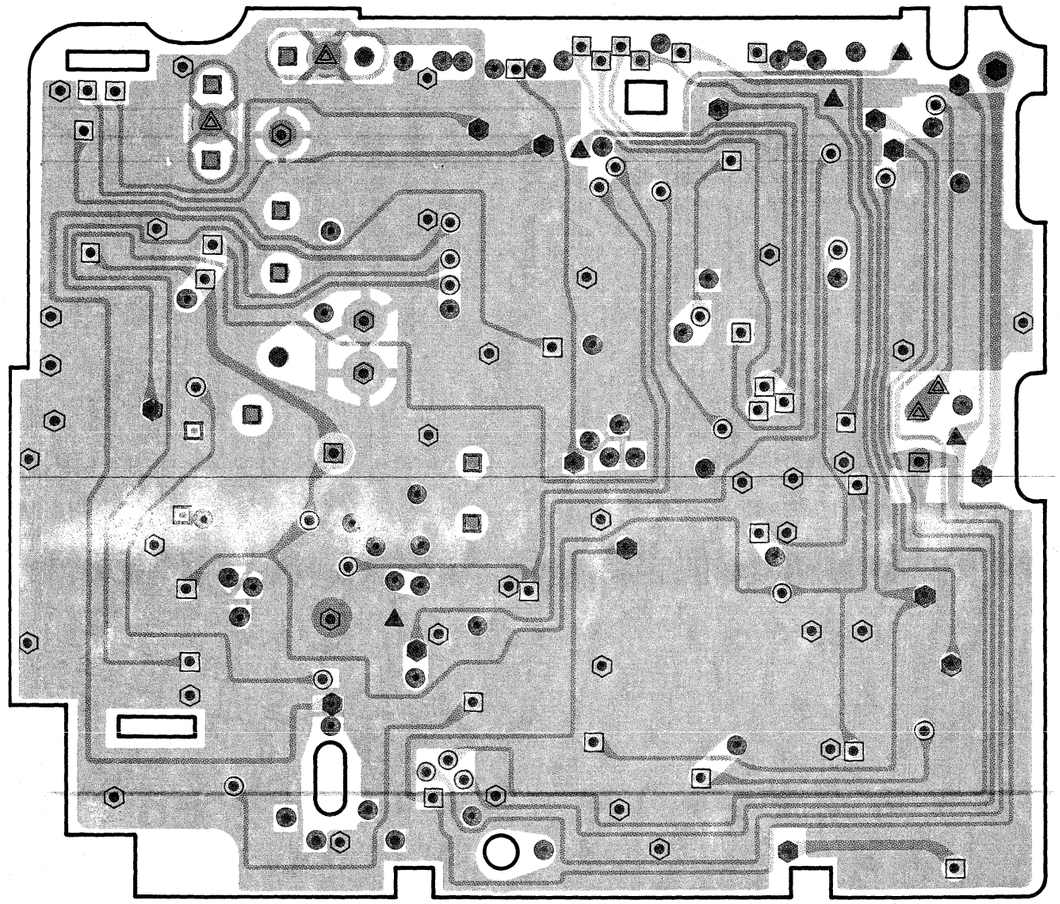
Connector No.	Terminal No.	Terminal Name	Terminal Function
	3	IM	Microphone signal
	4	CI	Signaling AF output
	5	SM	S-meter control power supply
	6	BEEP	Beep signal
	7	BUSY	Busy signal
	8	DN	Encoder down signal
	9	MUTE	Audio mute signal
	10	CTSW	Tone control signal
	11	UP	Encoder up signal
	12	PTT	PTT switch signal
	13	TO	Tone signal
	14	E	Ground
	15	REM	Remote controller microphone signal
	16	BSW	Receive BPF switching power supply
	17	5MH	Microphone 5V power supply
	18	EL	EL power switching signal
	19	TX	VCO switching signal
	20	UL	PLL unlock signal
	21	EP	Enable signal
	22	CP	Clock signal
	23	ESW	EL power control signal
	24	5MSW	Microphone 5V
	25	DP	Data signal
	26	SDO	Tone signal identification signal
	27	ET	Tone enable signal
	28	B	Power supply
	29	AFC	Audio amplifier power supply control signal
	30	5TS	Transmit 5V power supply control signal
CONTROL UNIT (A/5) : CONTROL ↔ KEYBOARD FPC			
	1	TK1	Key matrix input
	2	TK2	Key matrix input
	3	TK3	Key matrix input
	4	TK4	Key matrix input
	5	TK5	Key matrix input
	6	TK6	Key matrix output
	7	TK7	Key matrix output
	8	TK8	Key matrix output
	9	TK9	Key matrix output
CONTROL UNIT (A/5) : CONTROL ↔ PTT UNIT			
	1	PTT	PTT switch signal. "L" : TX, "H" : RX
	2	FLOCK	Lock switch signal
	3	COM	Key matrix output
	4	MONI	Key matrix input. MONI SW
	5	LAMP	Key matrix input. LAMP SW
	6	E	Ground

TH-28A/E PC BOARD VIEWS

TX-RX UNIT : IF (X57-404X-XX) (A/2) Component side view

0-11 : K,P 0-21 : M,X 0-22 : M2 2-71 : E,E3,E6,T 2-72 : E2





A pattern
B pattern

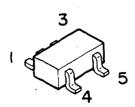
C pattern
D pattern

Component side
A pattern
C pattern
D pattern
B pattern
Foil side

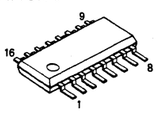
- A and C connected
- A and D connected
- A and B connected
- C and D connected
- C and B connected
- D and B connected
- A, C and D connected
- A, C and B connected
- A, D and B connected
- C, D and B connected
- A, C, D and B connected
- A only
- C only
- D only
- B only

No mark is not connected

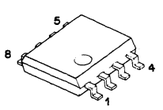
TA75S01F
TC4S66F



BU4094BF
MC3372D
TA7787AF



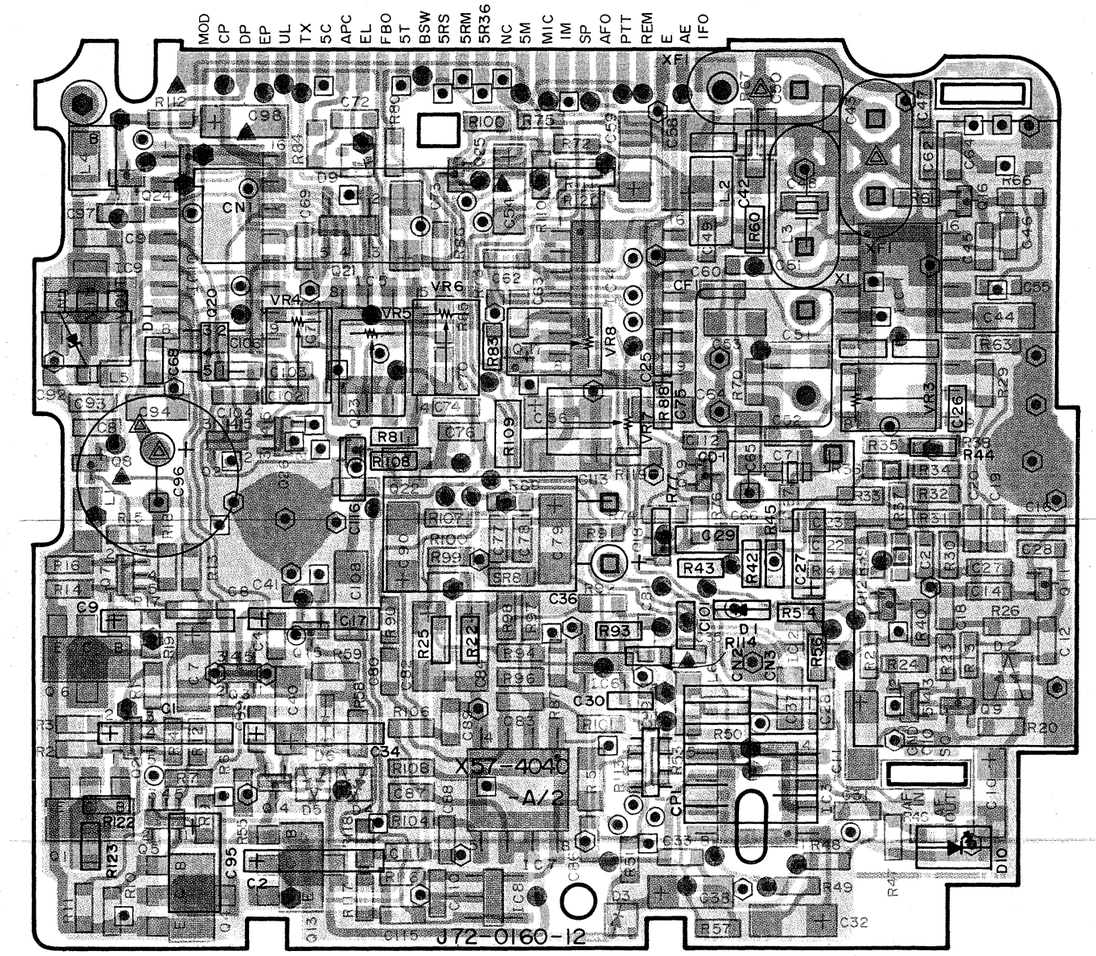
LM301AD
NJM386BE
NJM4560E



SCI7710YBS

TX-RX UNIT : IF (X57-404X-XX) (A/2) Foil side view

0-11 : K,P 0-21 : M,X 0-22 : M2 2-71 : E,E3,E6,T 2-72 : E2

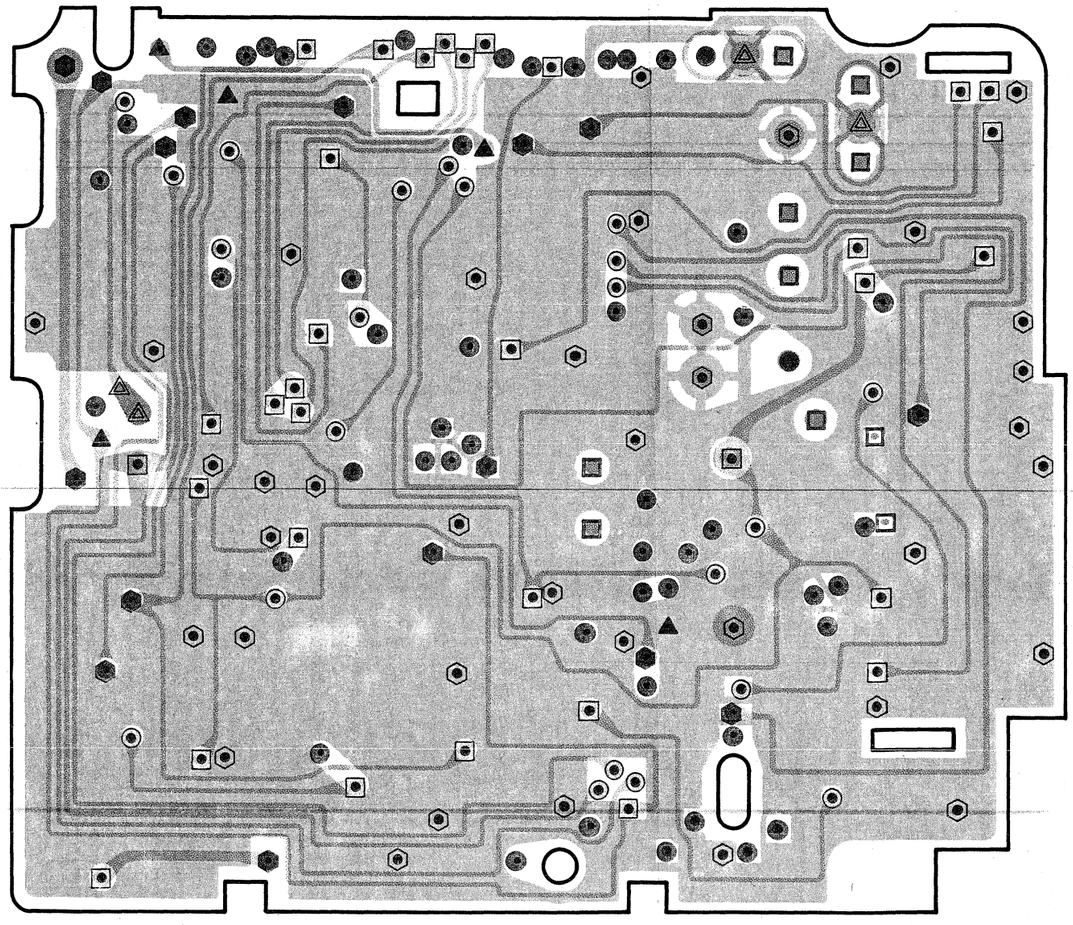


A pattern
B pattern

Component side
A pattern
C pattern
D pattern
B pattern
Foil side

- A and C connected
- A and D connected
- A and B connected
- C and D connected
- C and B connected
- D and B connected
- A, C and D connected
- A, C and B connected
- A, D and B connected
- C, D and B connected
- A, C, D and B connected
- A only
- C only
- D only
- B only

No mark is not connected



C pattern
D pattern

DTA143ZE
DTA144EE
DTC114EE
DTC114YE
DTC144EE
2SC4619
2SC4738

2SB798

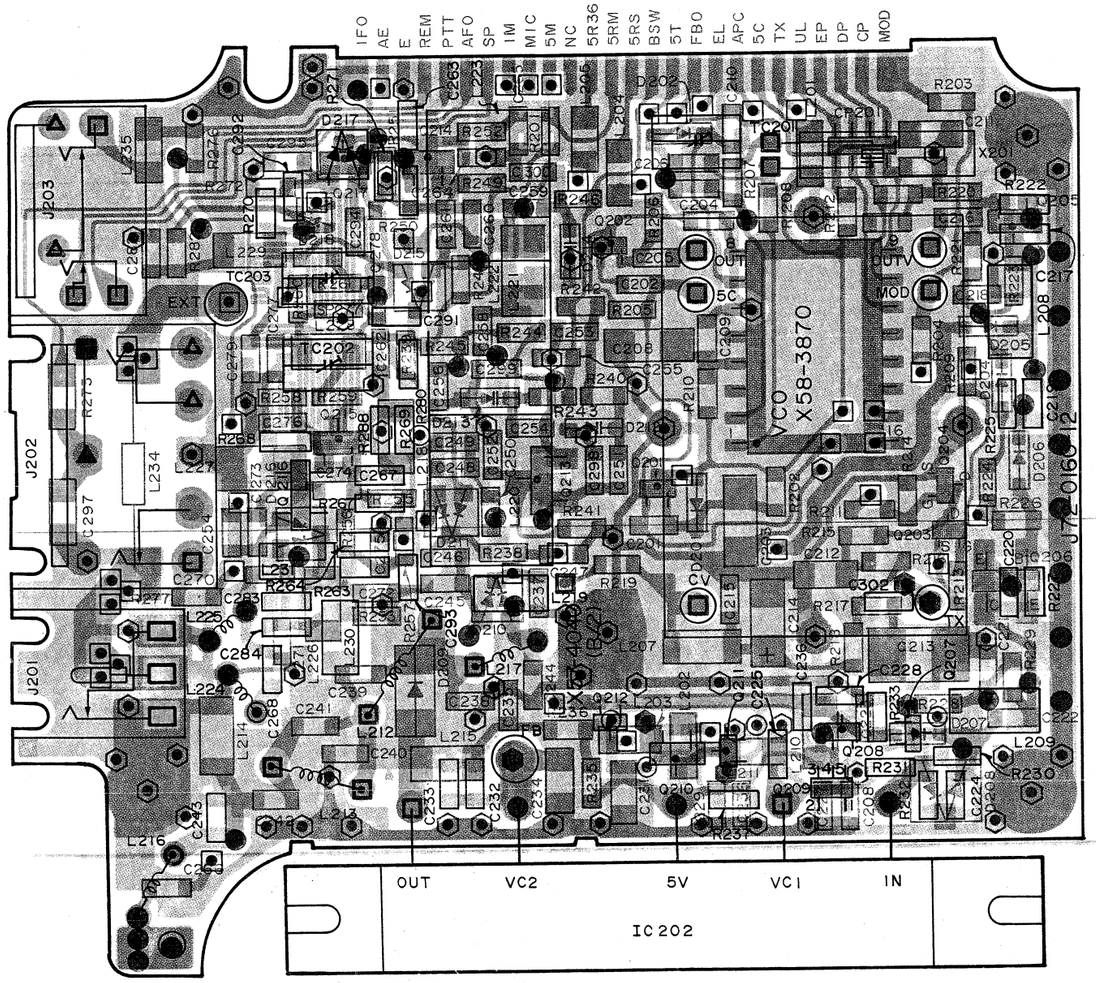
FMC3
UMA9
UMG2
UMW1

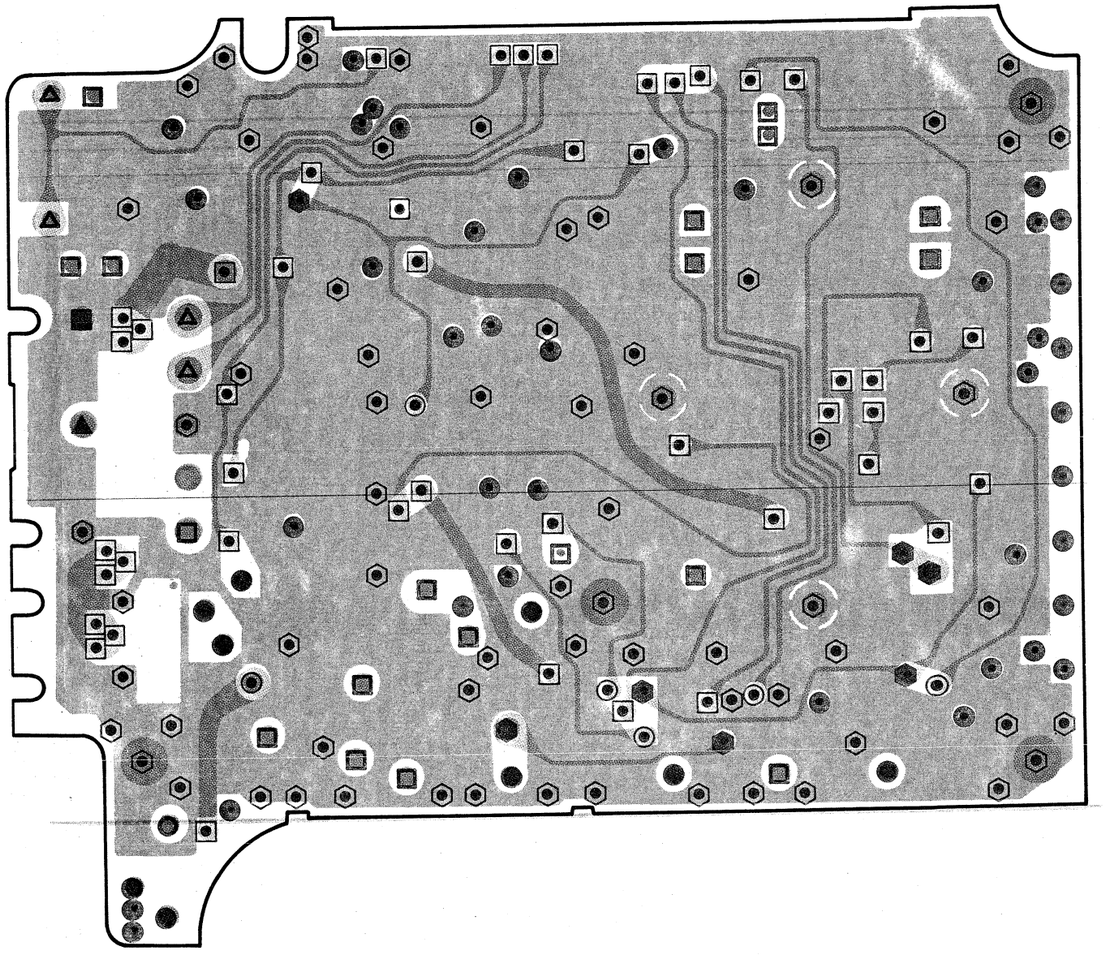
2SK879

TH-28A/E PC BOARD VIEWS

TX-RX UNIT : RF (X57-404X-XX) (B/2) Component side view

0-11 : K,P 0-21 : M,X 0-22 : M2 2-71 : E,E3,E6,T 2-72 : E2





A pattern
B pattern

C pattern
D pattern

Component side
A pattern
C pattern
D pattern
B pattern
Foil side

- A and C connected
- A and D connected
- A and B connected
- C and D connected
- C and B connected
- D and B connected
- A, C and D connected
- A, C and B connected
- A, D and B connected
- C, D and B connected
- A, C, D and B connected
- A only
- C only
- D only
- B only

No mark is not connected

DTA123EU
DTC114YE
DTC144EE
2SC4083
2SC4226
2SC4619
2SC4738

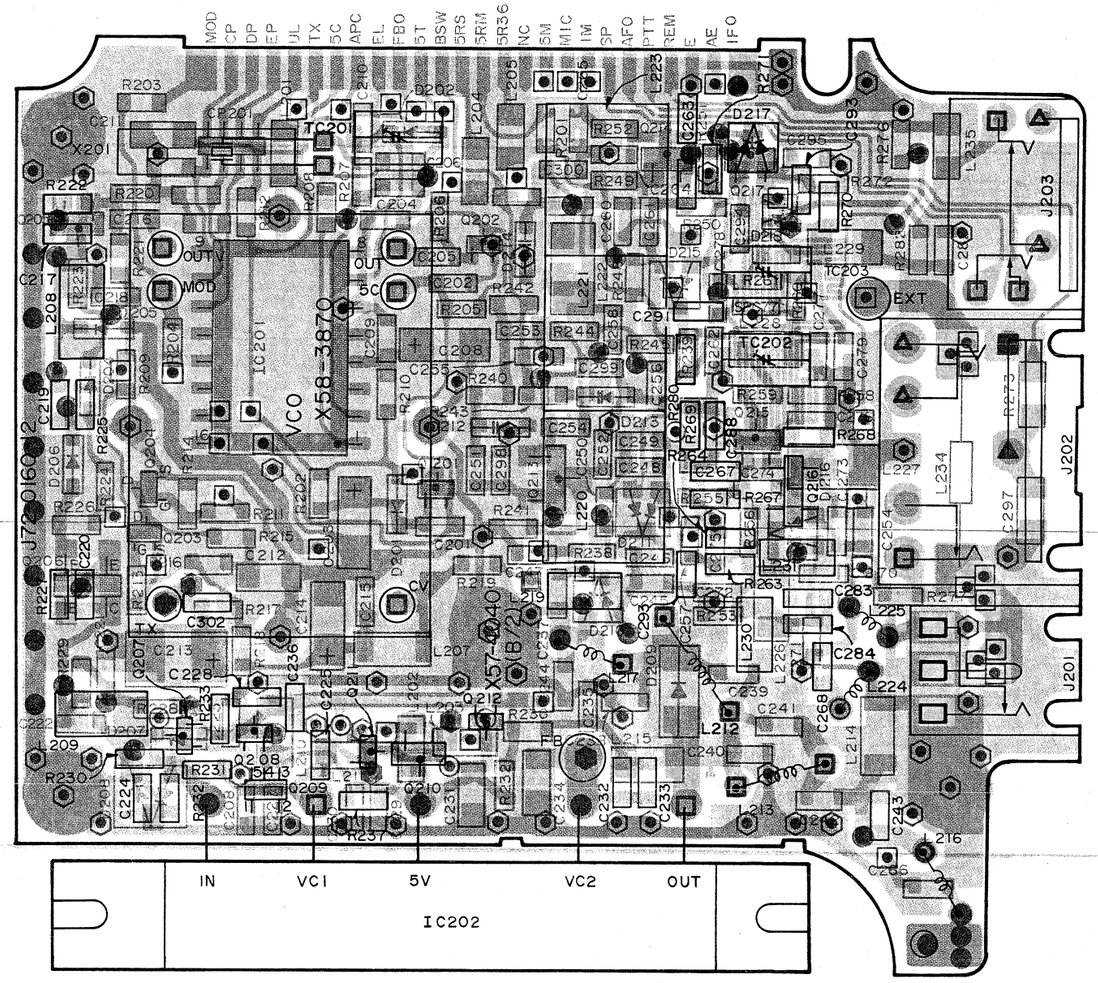
2SJ243
2SK1824

UMC5

2SK360

TX-RX UNIT : RF (X57-404X-XX) (B/2) Foil side view

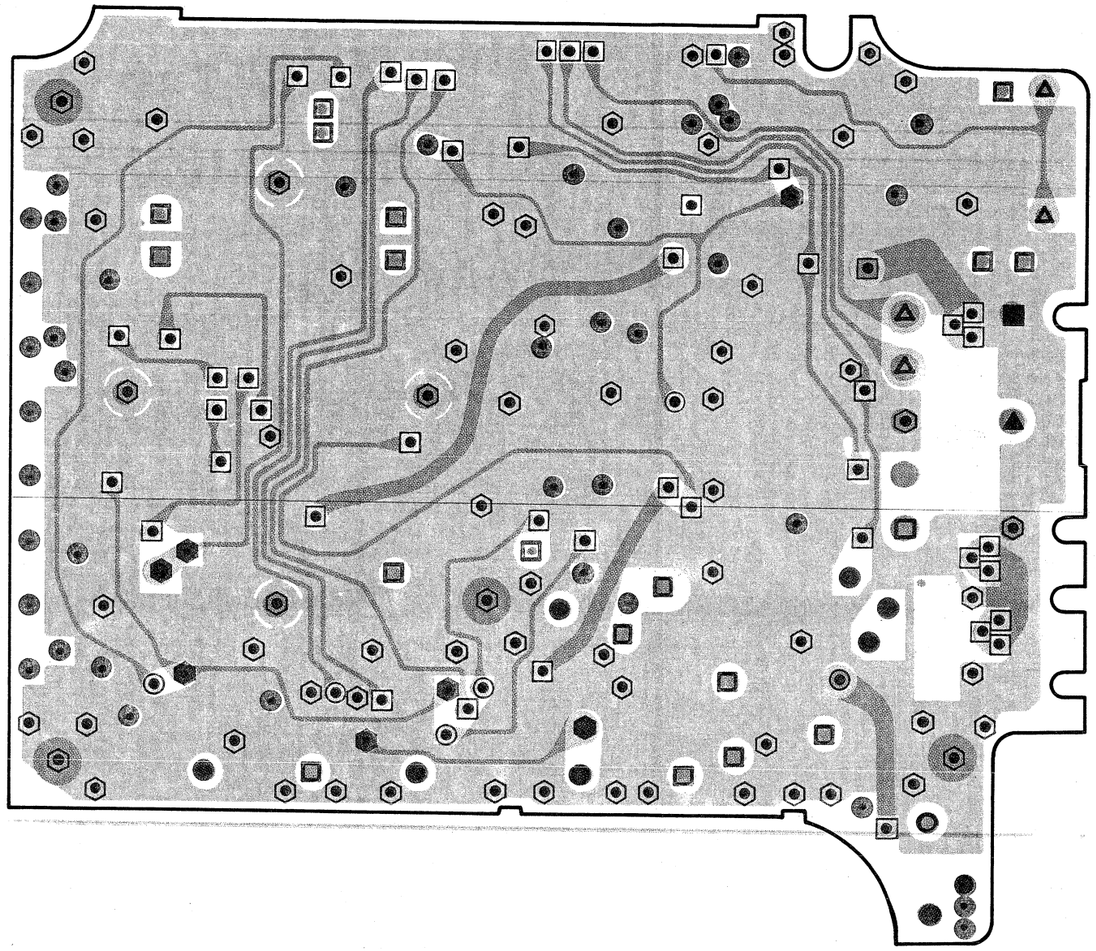
0-11 : K,P 0-21 : M,X 0-22 : M2 2-71 : E,E3,E6,T 2-72 : E2



A pattern
B pattern

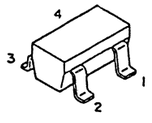
Component side
A pattern
C pattern
D pattern
B pattern
Foil side

- A and C connected
- A and D connected
- A and B connected
- C and D connected
- C and B connected
- D and B connected
- A, C and D connected
- A, C and B connected
- A, D and B connected
- C, D and B connected
- A, C, D and B connected
- A only
- C only
- D only
- B only
- No mark is not connected

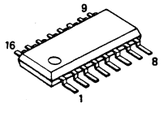


C pattern
D pattern

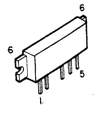
2SC4093



MB1505PF-G-BND



S-AV22A

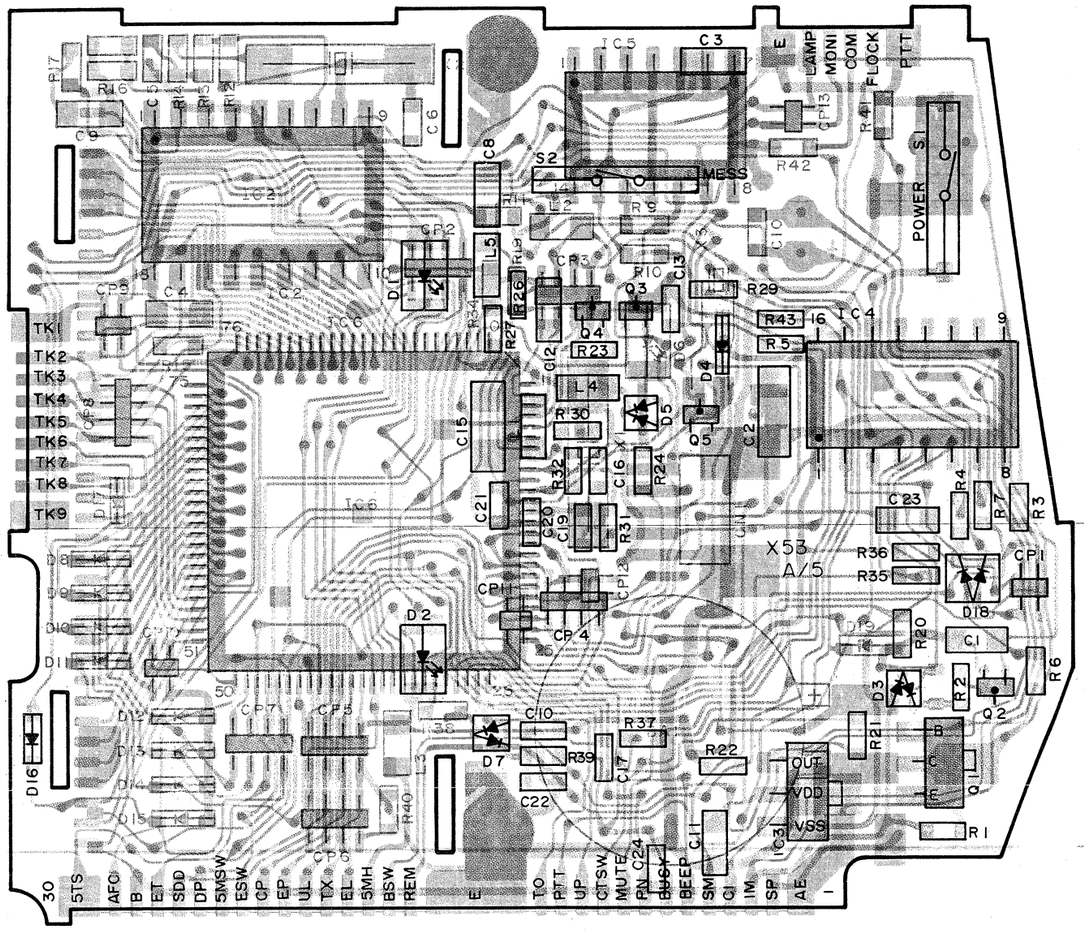


3SK240

TH-28A/E PC BOARD VIEWS

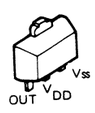
CONTROL UNIT (X53-340X-XX) (A/5) Component side view

0-11 : K,P 0-21 : M 0-22 : M2 0-71 : X 2-71 : E,E3,E6,T 2-72 : E2

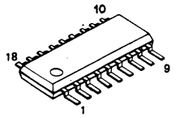


: Component side
: Foil side

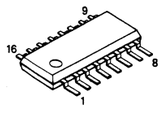
S-8054ALR-LN



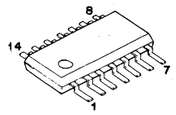
LC7385M



BU4094BF

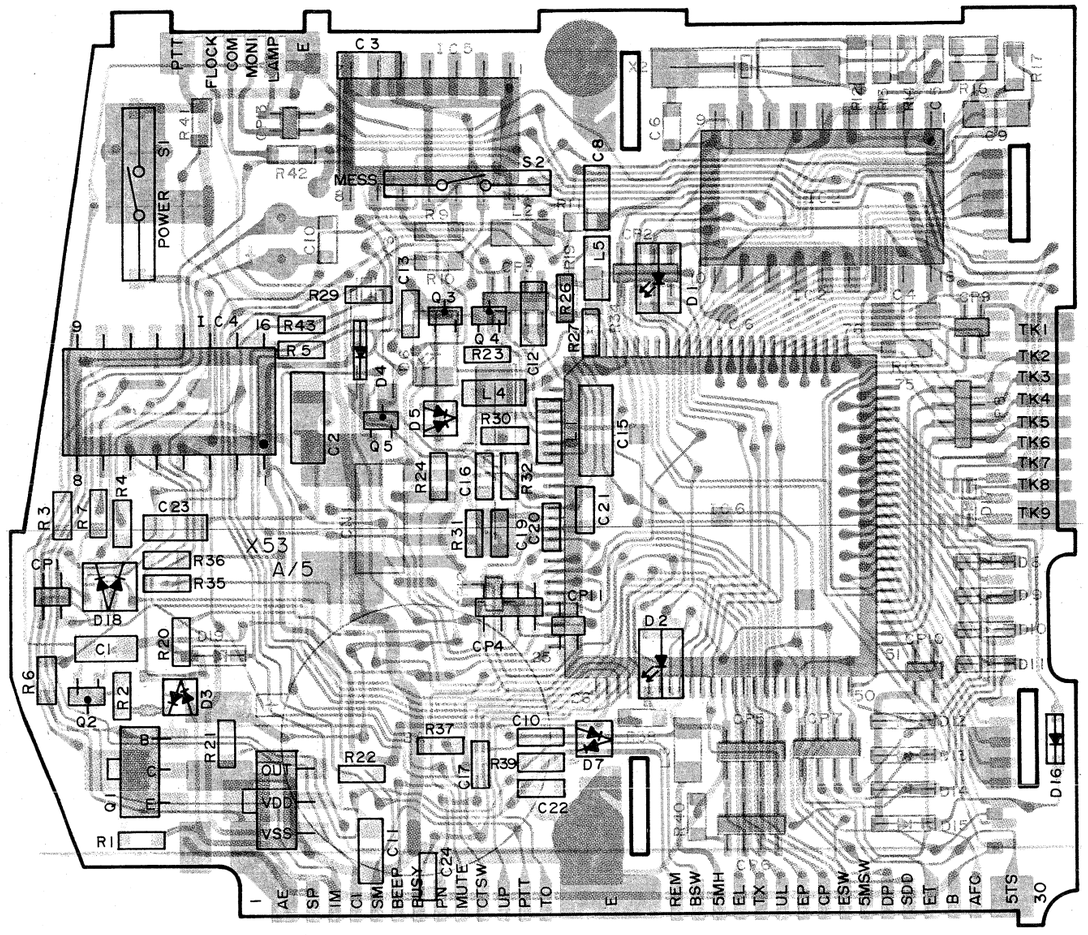


X24C04SI-3.5

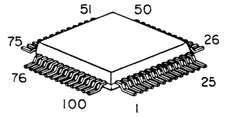


CONTROL UNIT (X53-340X-XX) (A/5) Foil side view

0-11 : K,P 0-21 : M 0-22 : M2 0-71 : X 2-71 : E,E3,E6,T 2-72 : E2



HD404629A24H



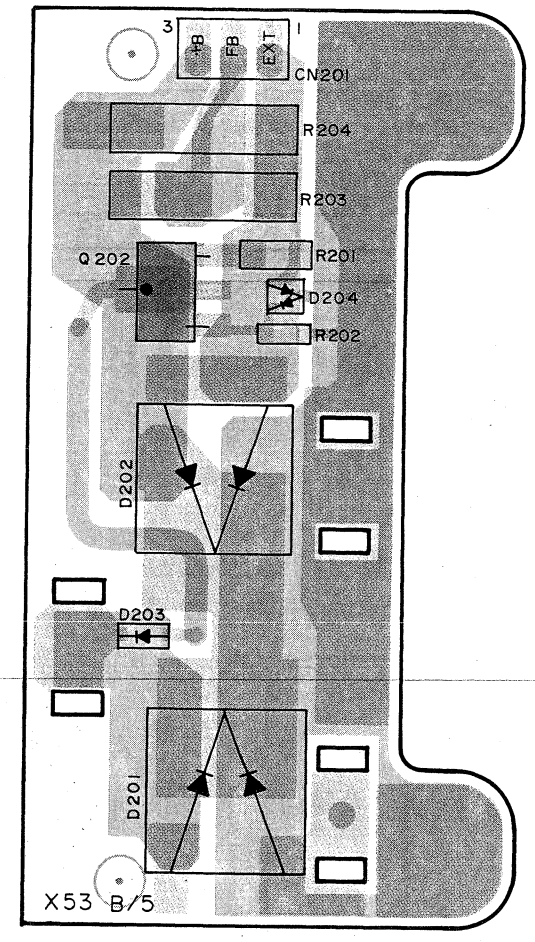
2SB798

DTA114YE
DTA143ZE
DTC114YE

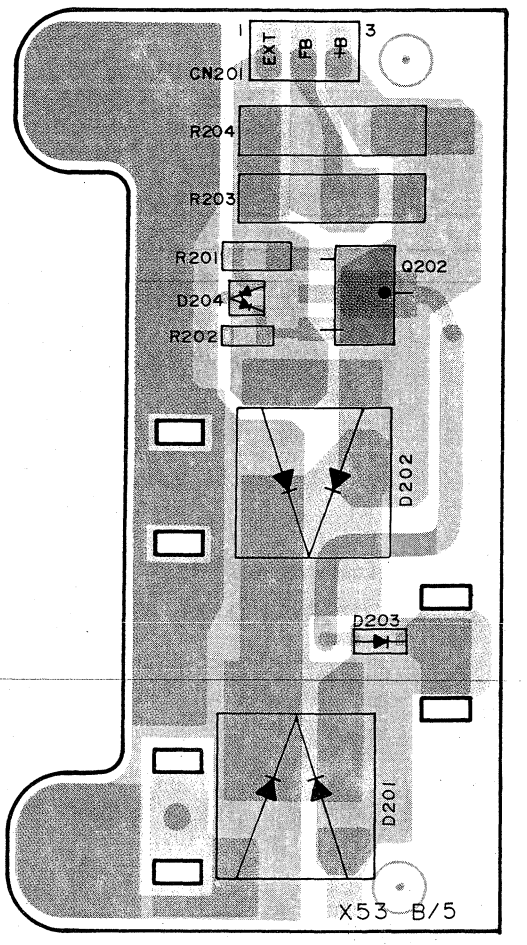
2SJ243

PC BOARD VIEWS TH-28A/E

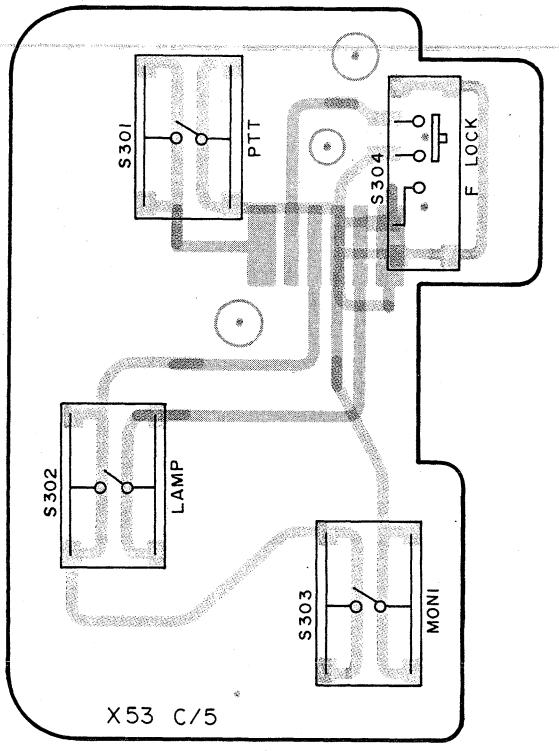
CONTROL UNIT : CHARGER
(X53-340X-XX) (B/5) Component side view



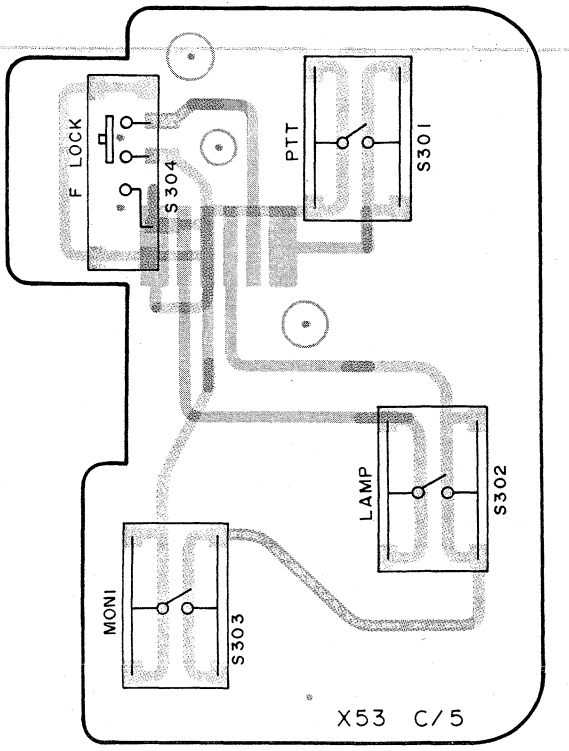
CONTROL UNIT : CHARGER
(X53-340X-XX) (B/5) Foil side view



CONTROL UNIT : PTT
(X53-340X-XX) (C/5) Component side view

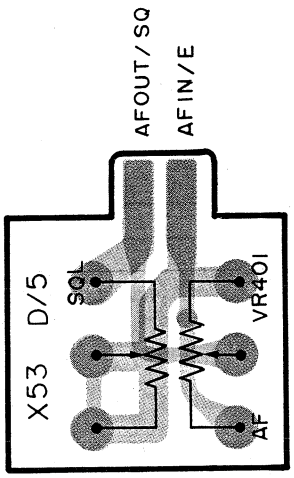


CONTROL UNIT : PTT
(X53-340X-XX) (C/5) Foil side view

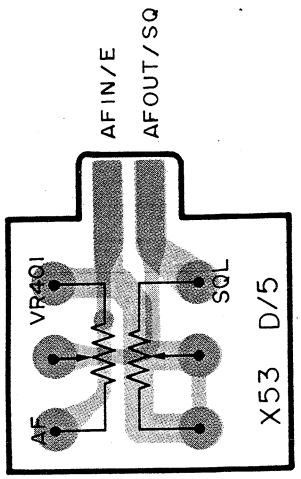


TH-28A/E PC BOARD VIEWS

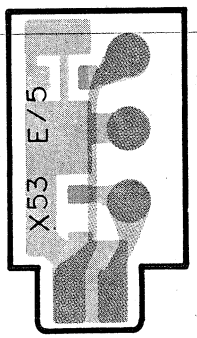
CONTROL UNIT : VOL/SQL
(X53-340X-XX) (D/5) Component side view



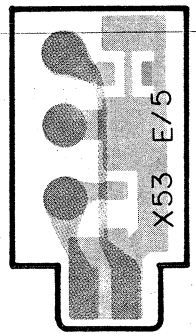
CONTROL UNIT : VOL/SQL
(X53-340X-XX) (D/5) Foil side view



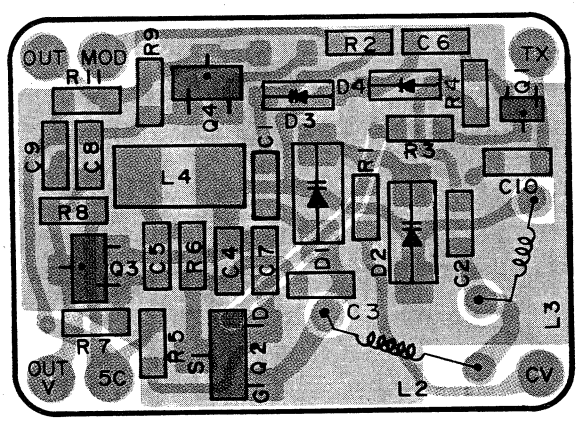
CONTROL UNIT : ENCODER
(X53-340X-XX) (E/5) Component side view



CONTROL UNIT : ENCODER
(X53-340X-XX) (E/5) Foil side view



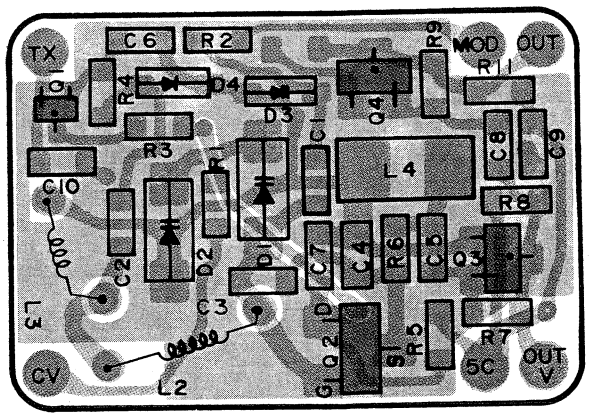
VCO (X58-3870-XX) Component side view
-00 : M,M2,X,E,E2,E3,E6,T -11 : K,P

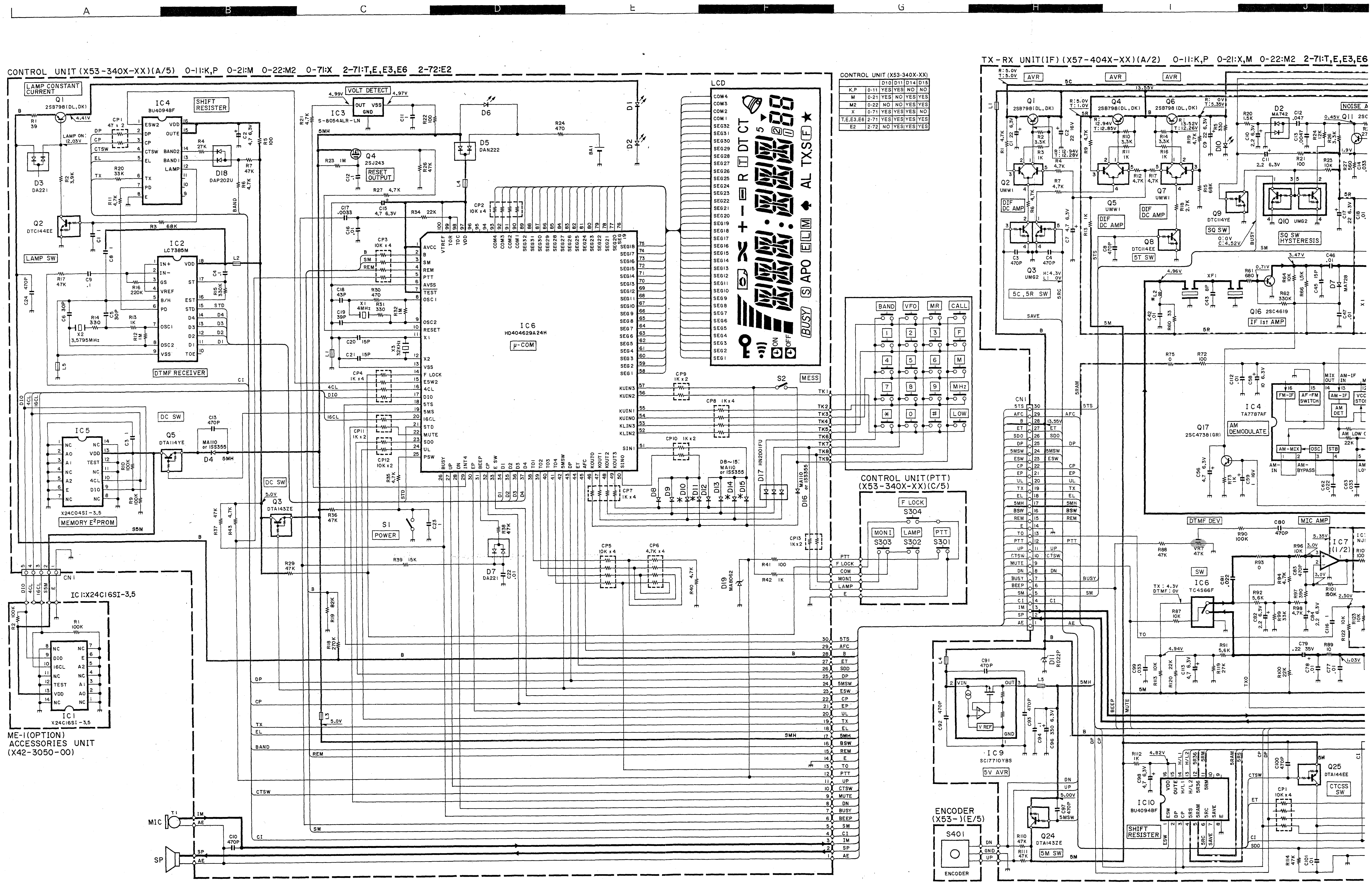


DTC144EE
2SC4083

2SK238

VCO (X58-3870-XX) Foil side view
-00 : M,M2,X,E,E2,E3,E6,T -11 : K,P





CONTROL UNIT (X53-340X-XX)

		D10	D11	D14	D15
K,P	0-11	YES	YES	NO	NO
M	0-21	YES	NO	YES	YES
M2	0-22	NO	NO	YES	YES
X	0-71	YES	YES	YES	NO
T,E,E3,E6	2-71	YES	YES	YES	YES
E2	2-72	NO	YES	YES	YES

IC10	EL	L	M	H
H/L1	0V	0V	3.9V	0V
H/L2	0V	3.9V	0V	0V

F G H I J K L M N O P

CONTROL UNIT (X53-340X-XX)

	D10	D11	D14	D15
K,P	0-11	YES	YES	NO	NO
M	0-21	YES	NO	YES	YES
M2	0-22	NO	NO	YES	YES
X	0-71	YES	YES	YES	NO
T,E,E3,E6	2-71	YES	YES	YES	YES
E2	2-72	NO	YES	YES	YES

TX-RX UNIT(IF)(X57-404X-XX)(A/2) 0-11:K,P 0-21:X,M 0-22:M2 2-71:T,E,E3,E6 2-72:E2

TX-RX UNIT(RF)(X57-404X-XX)(B/2) 0-11:K,P 0-21:X,M 0-22:M2 2-71:T,E,E3,E6 2-72:E2

VOL/SQL UNIT (X53-)(D/5)

VCO (X58-3870-XX)-21: M2,E2

TX-RX UNIT (IF) (X57-404X-XX)

	L2
K,P	0-11	.56μ
X,M	0-21	
M2	0-22	.82μ
T,E,E3,E6	2-71	
E2	2-72	

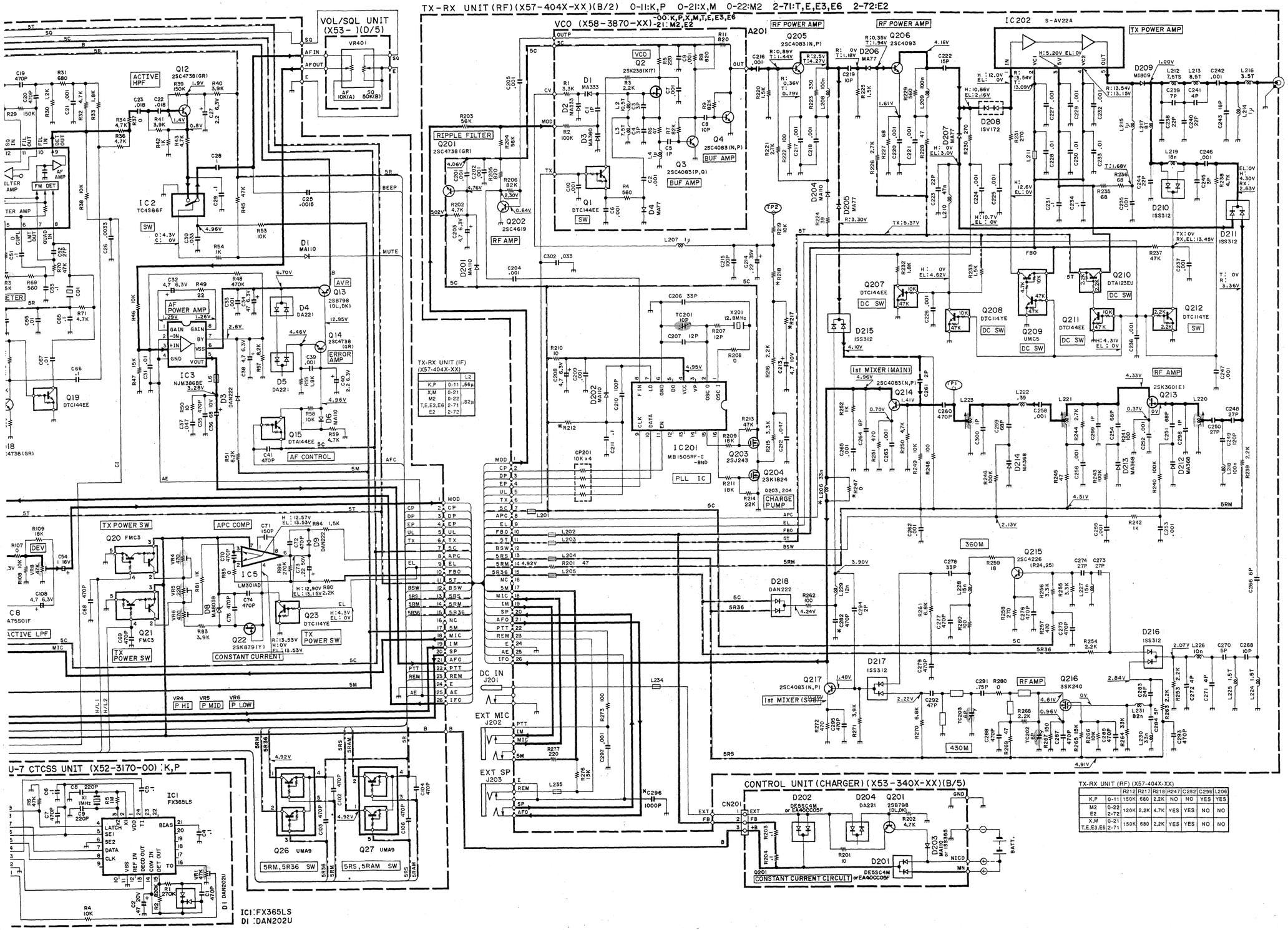
CONTROL UNIT(PTT) (X53-340X-XX)(C/5)

ENCODER (X53-)(E/5)

TSU-7 CTCSS UNIT (X52-3170-00) :K,P

IC1:FX365LS
DI :DAN202U

SCHEMATIC DIAGRAM TH-28A/E



CONTROL UNIT
(X53-340X-XX)

IC2	: LC7385M
IC3	: S-8054ALR-LN
IC4	: BU4094BF
IC5	: X24C04SI-3.5
IC6	: HD404629A24H
Q1,201	: 2SB798(DL,DK)
Q2	: DTC144EE
Q3	: DTA143ZE
Q4	: 2SJ243
Q5	: DTA114YE
D1,2	: B30-2033-05
D3,7,204	: DA221
D4,8~16,203	: MA110 or 1SS355
D5	: DAN222
D6	: B30-0897-05
D17	: HN2D01FU
D18	: DAP202U
D19	: MA8062
D201,202	: DE5SC4M or EA40CC05F

TX-RX UNIT (IF)
(X57-404X-XX)

IC1	: MC3372D
IC2,6	: TC4S66F
IC3	: NJM386BE
IC4	: TA7787AF
IC5	: LM301AD
IC7	: NJM4560E
IC8	: TA75S01F
IC9	: SCI7710YBS
IC10	: BU4094BF
Q1,4,6,13	: 2SB798(DL,DK)
Q2,5,7	: UMW1
Q3,10	: UMG2
Q8	: DTC114EE
Q9,23	: DTC114YE
Q11,12,14,17,18	: 2SC4738(GR)
Q15,25	: DTA144EE
Q16	: 2SC4619
Q19	: DTC144EE
Q20,21	: FMC3
Q22	: 2SK879(Y)
Q24	: DTA143ZE
Q26,27	: UMA9
D1,6	: MA110
D2	: MA742
D3,9	: DAN222
D4,5	: DA221
D7	: MA728
D8	: MA8039
D10	: B30-2036-05
D11	: RD22P

TX-RX UNIT (RF)
(X57-404X-XX)

IC201	: MB1505PF-G-BND
IC202	: S-AV22A
Q201	: 2SC4738(GR)
Q202	: 2SC4619
Q203	: 2SJ243
Q204	: 2SK1824
Q205,214,217	: 2SC4083(N,P)
Q206	: 2SC4093
Q207,211	: DTC144EE
Q208,212	: DTC114YE
Q209	: UMC5
Q210	: DTA123EU
Q213	: 2SK360(E)
Q215	: 2SC4226(R24,25)
Q216	: 3SK240
D201,202,204	: MA110
D205~207	: MA77
D208	: 1SV172
D209	: MI809
D210,211,215~217	: 1SS312
D212~214	: MA368
D218	: DAN222

SUB UNIT(VCO)
(X58-3870-XX)

Q1	: DTC144EE
Q2	: 2SK238(K17)
Q3	: 2SC4083(P,Q)
Q4	: 2SC4083(N,P)
D1,2	: MA333
D3	: MA360
D4	: MA77

TX-RX UNIT (IF) (X57-404X-XX)

		L2
K,P	0-11	1.56µ
X,M	0-21	
M2	0-22	.82µ
T,E,E3,E6	2-71	
E2	2-72	

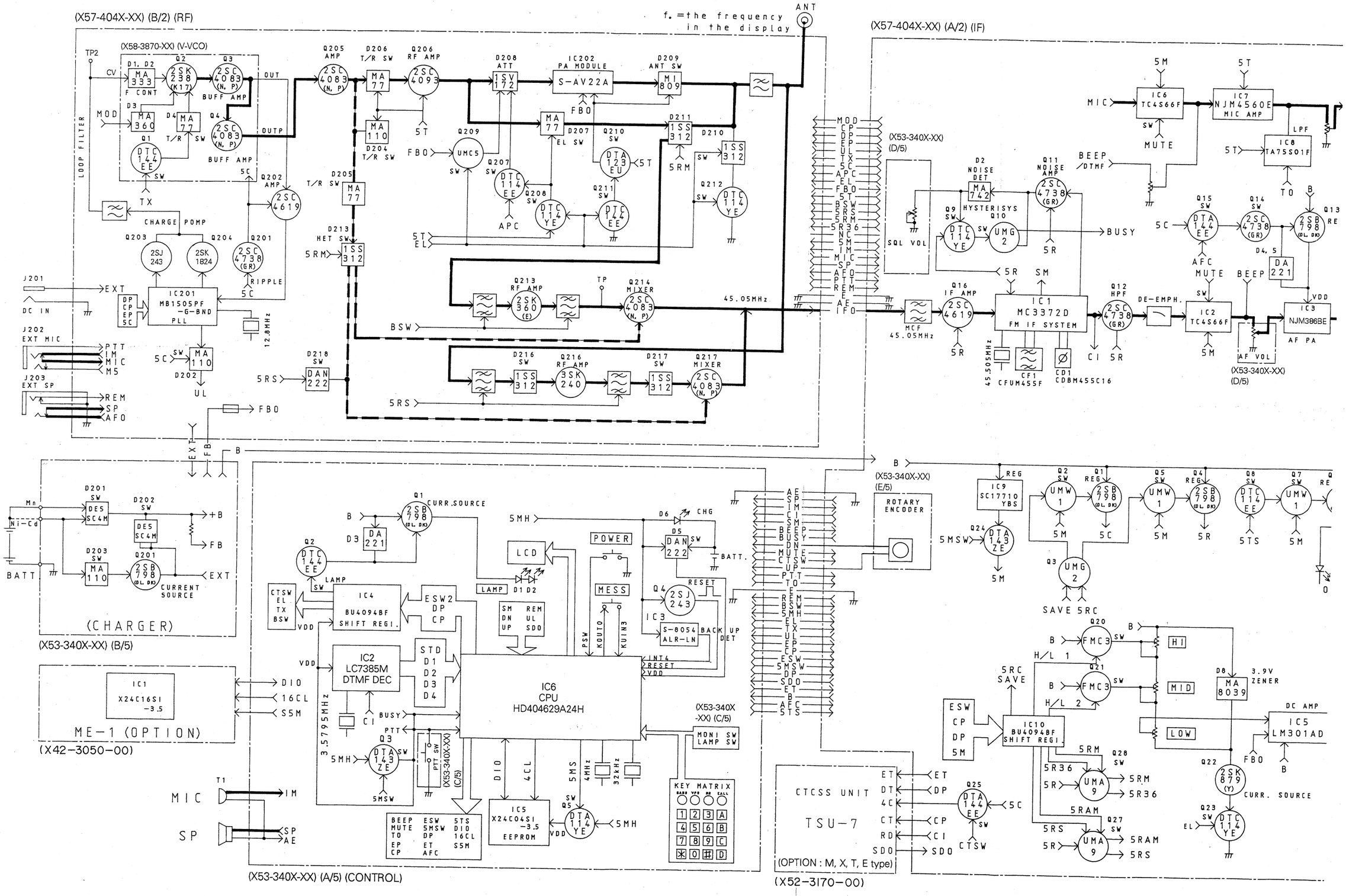
TX-RX UNIT (RF) (X57-404X-XX)

		R212	R217	R218	R247	C282	C296	L206
K,P	0-11	150K	680	2.2K	NO	NO	YES	YES
M2	0-22	120K	2.2K	4.7K	YES	YES	NO	NO
E2	2-72							
X,M	0-21	150K	680	2.2K	YES	YES	NO	NO
T,E,E3,E6	2-71							

TH-28A/E

TH-28A/E

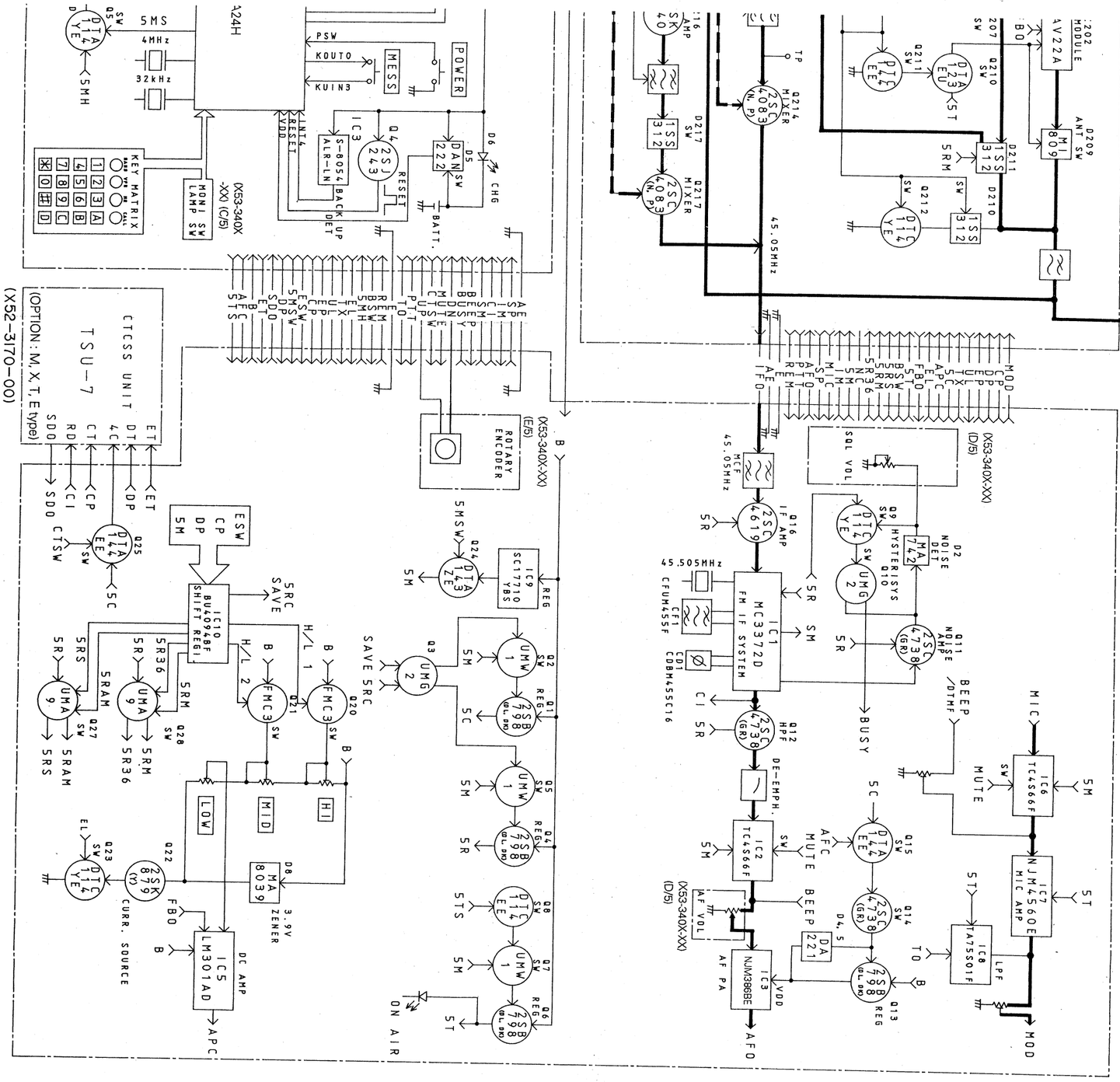
BLOCK DIAGRAM



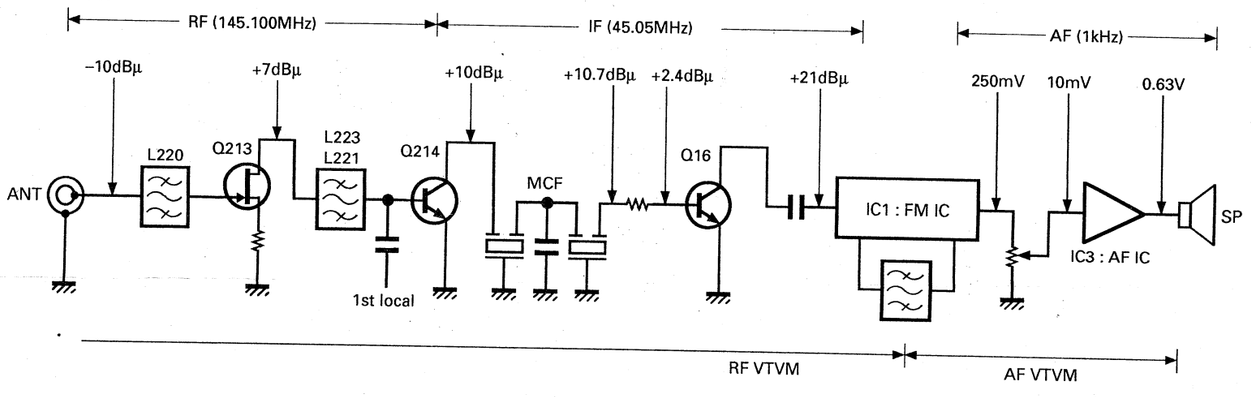
BLOCK DIAGRAM

f. = the frequency in the display

(X57-404X-XX) (A/2) (IF)



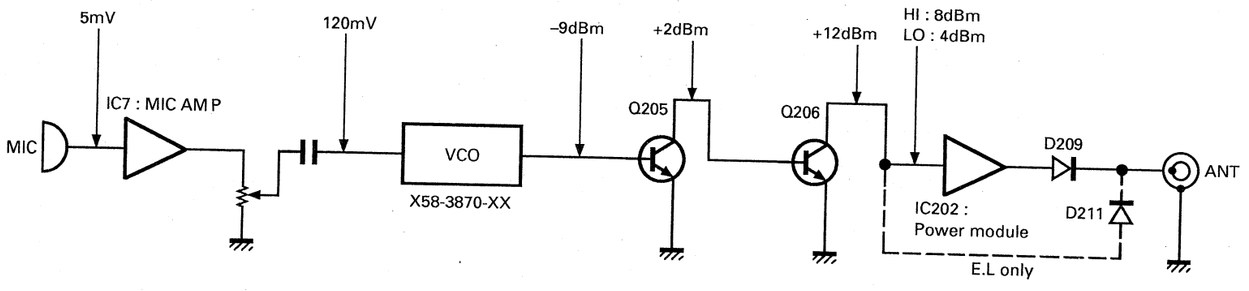
RX Section



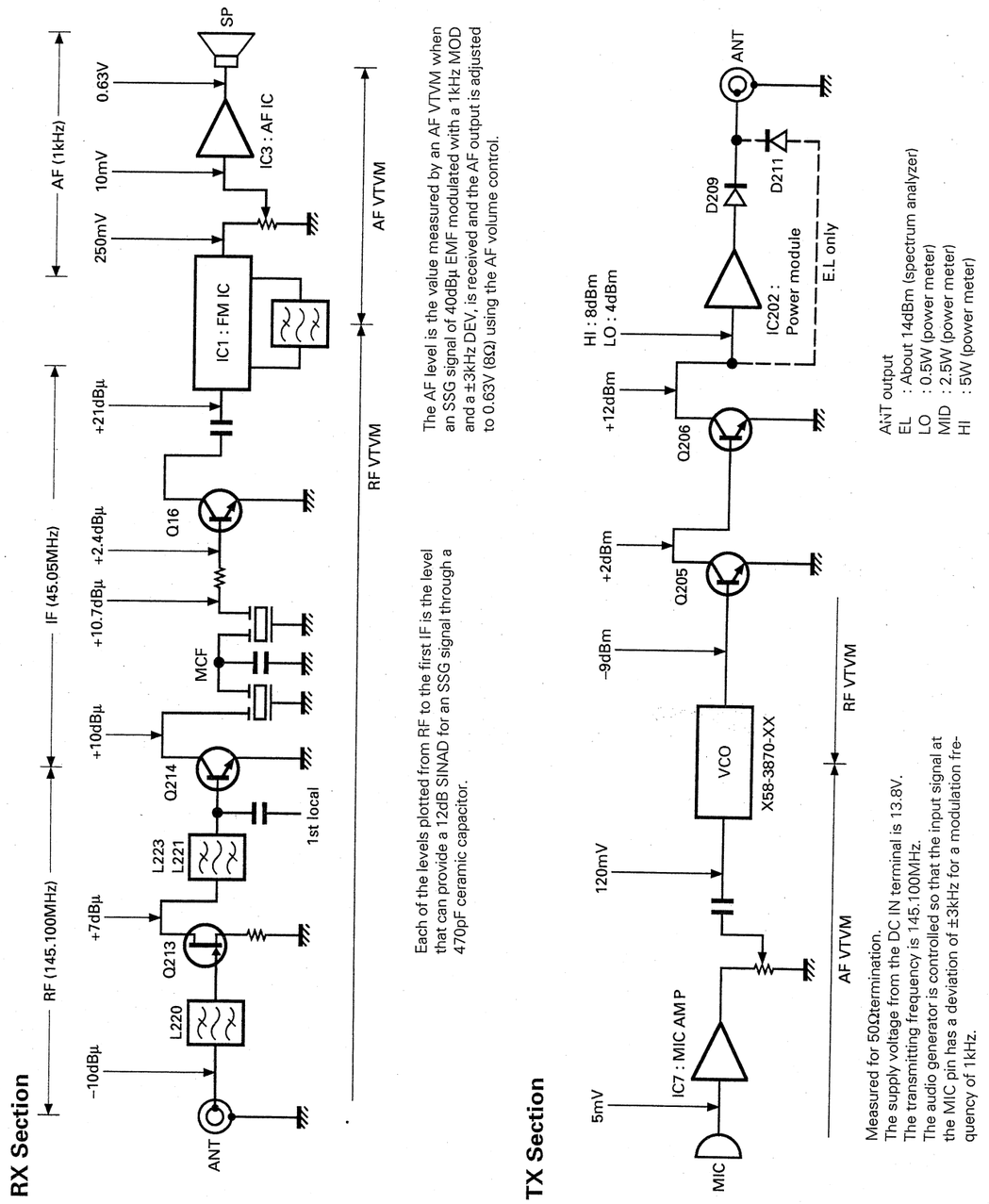
Each of the levels plotted from RF to the first IF is the level that can provide a 12dB SINAD for an SSG signal through a 470pF ceramic capacitor.

The AF level is the value measured by an AF VTVM when an SSG signal of 40dBμ EMF modulated with a 1kHz MOD and a ±3kHz DEV, is received and the AF output is adjusted to 0.63V (8Ω) using the AF volume control.

TX Section



LEVEL DIAGRAM



TH-28A/E

BC-14 (BATTERY CHARGER) / BC-15 (RAPID CHARGER)

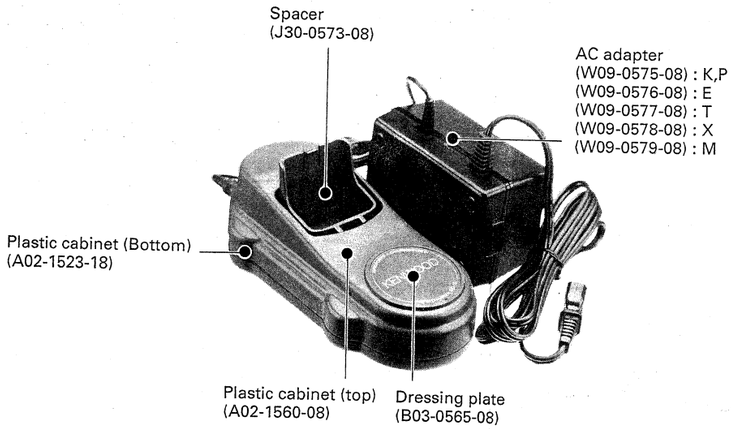
BC-14 External View

BC-14 Specifications

Electrical characteristics
- Charging system ..... 0.1C normal charging
- Charging time ..... Approx. 15 hours

Dimensions ..... 46 W x 43.5 H x 72 D (mm)
Weight 180g

BC-15 External View

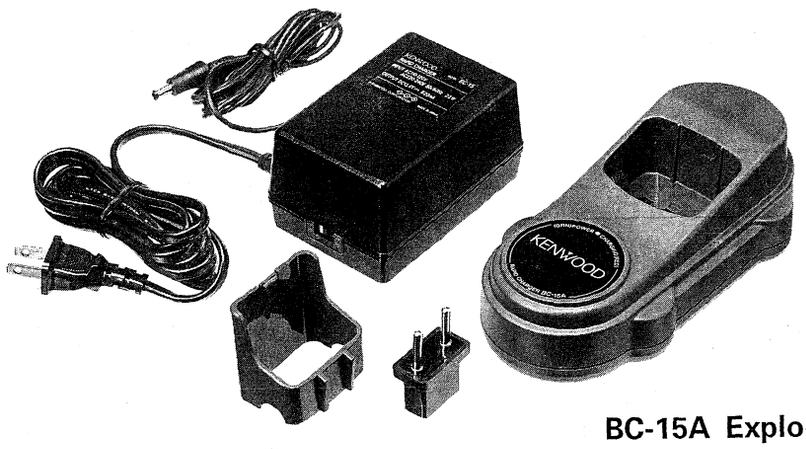


BC-15 Specifications

Charge temperature range ..... 5°c to 40°C (41°F to 104°F)
Recharging time
(When fully dscharged) ..... Approx. 1 hour
Power requirement..... 13.8V DC normal (max. 3A)
Dimensions (W x H x D) ..... 88 x 55 x 177 (mm)
Weight 0.2kg

BC-15A (RAPID CHARGER)

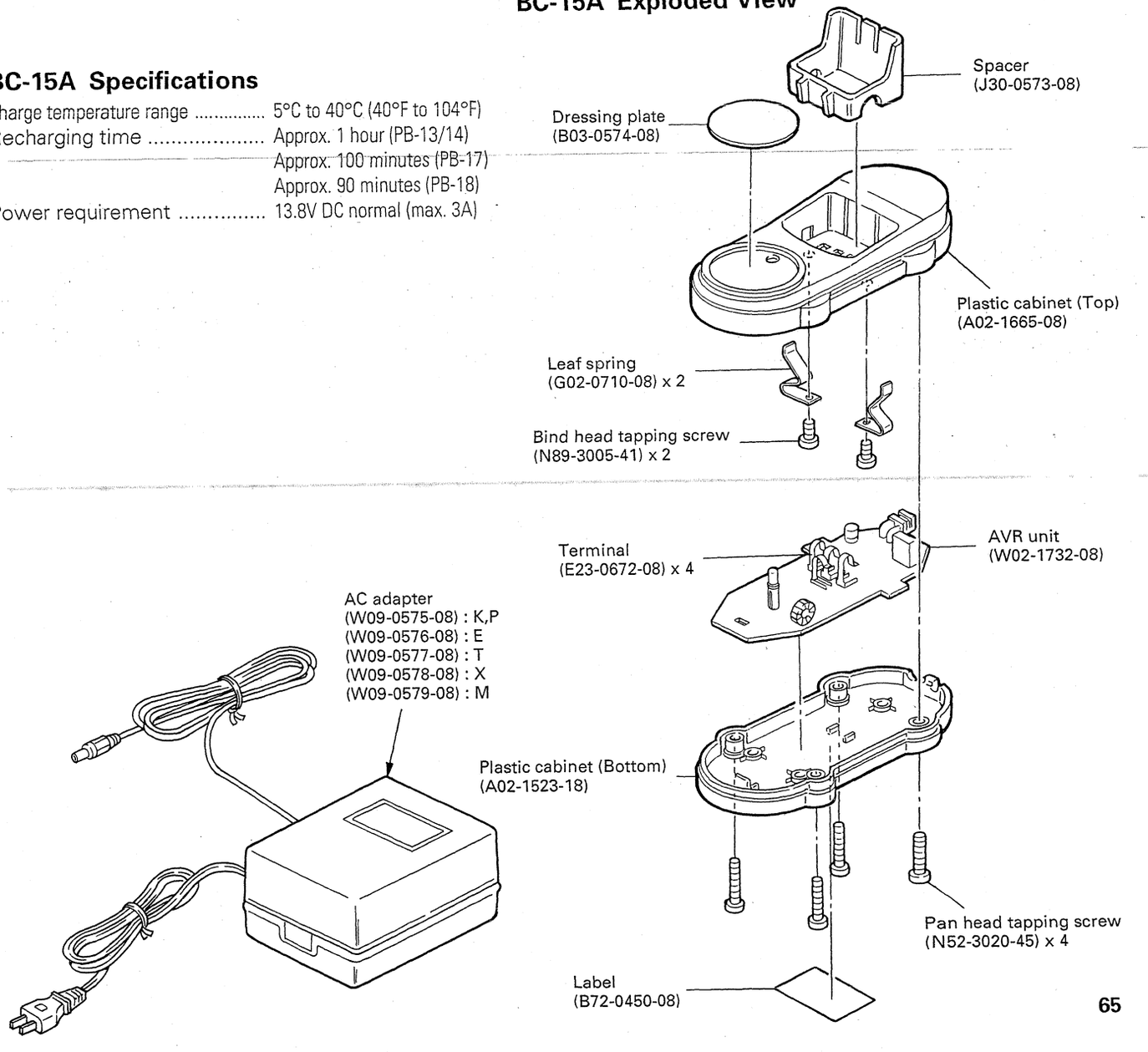
BC-15A External View



BC-15A Specifications

Charge temperature range	5°C to 40°C (40°F to 104°F)
Recharging time	Approx. 1 hour (PB-13/14)
	Approx. 100 minutes (PB-17)
	Approx. 90 minutes (PB-18)
Power requirement	13.8V DC normal (max. 3A)

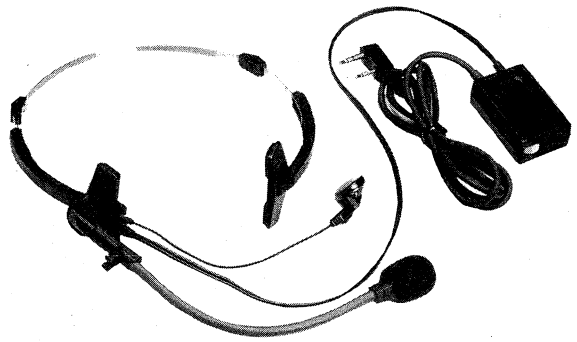
BC-15A Exploded View



TH-28A/E

HMC-2 (HEAD SET WITH VOX & PTT)

HMC-2 External View



HMC-2 Specifications

Electrical characteristics

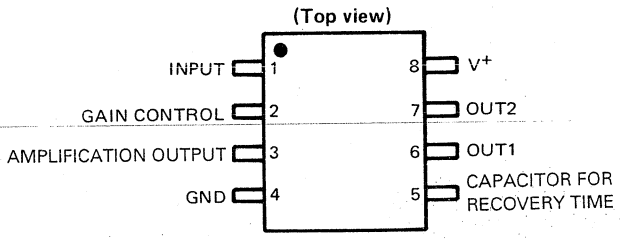
- **Earphone**
  - Diameter ..... ø19 (mm)
  - Impedance 19Ω (1000Hz)
  - Max. input power..... 50mW
- **Microphone**
  - Output sensitivity..... –67.5dB (0dB=1V/µbar 1000Hz)
  - Output impedance 1.6kΩ (1000Hz)

HMC-2 Parts List

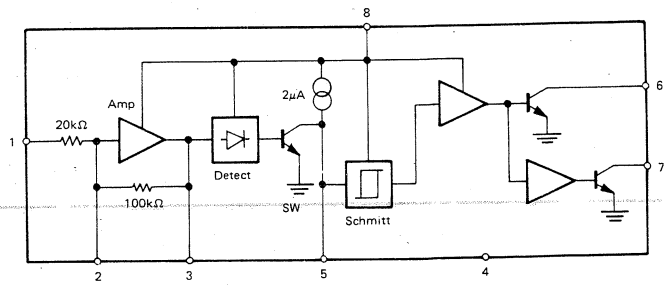
Ref. No.	New	Parts No.	Description
		A02-0840-08	Case (Front)
		A02-0841-08	Case (Rear)
		E30-2088-08	Cable with plug
		E30-3002-08	Junction wire
		F09-0418-08	Microphone pad
		F09-0419-08	Ear pad
		J29-0427-08	Clip
VR1		R05-4422-08	Potentiometer 50kΩ
S1		S31-1416-08	Slide switch PTT/VOX
S2		S50-1413-05	Tact switch PTT
		T18-0056-08	Earphone with cable
		T91-0373-18	MIC ass'y
		W02-0806-18	VOX/PTT unit
Q1		FMG2	Digital transistor
Q2		FMW2	Digital transistor
Q3		2SC2712(GR)	Chip transistor
IC1		NJM2072M	IC
D1		1SS133	Diode

HMC-2 Semiconductor Data

- **Terminal connection diagram**



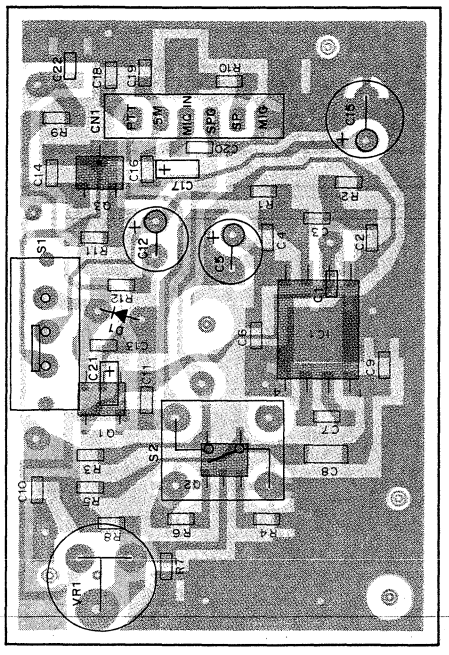
- **Block diagram**



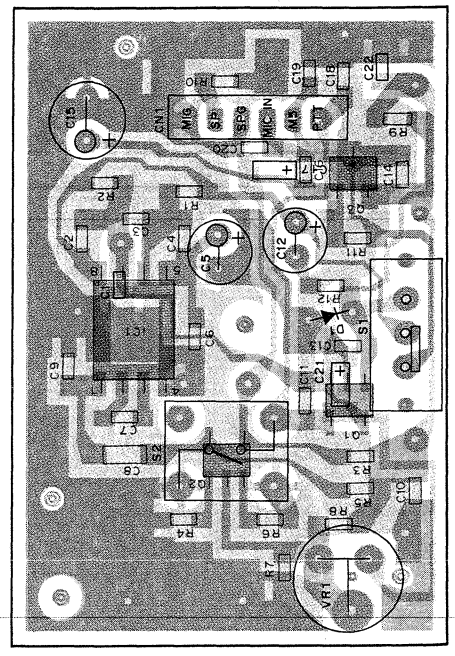
HMC-2 (HEAD SET WITH VOX & PTT)

HMC-2 PC Board Views

Component side view

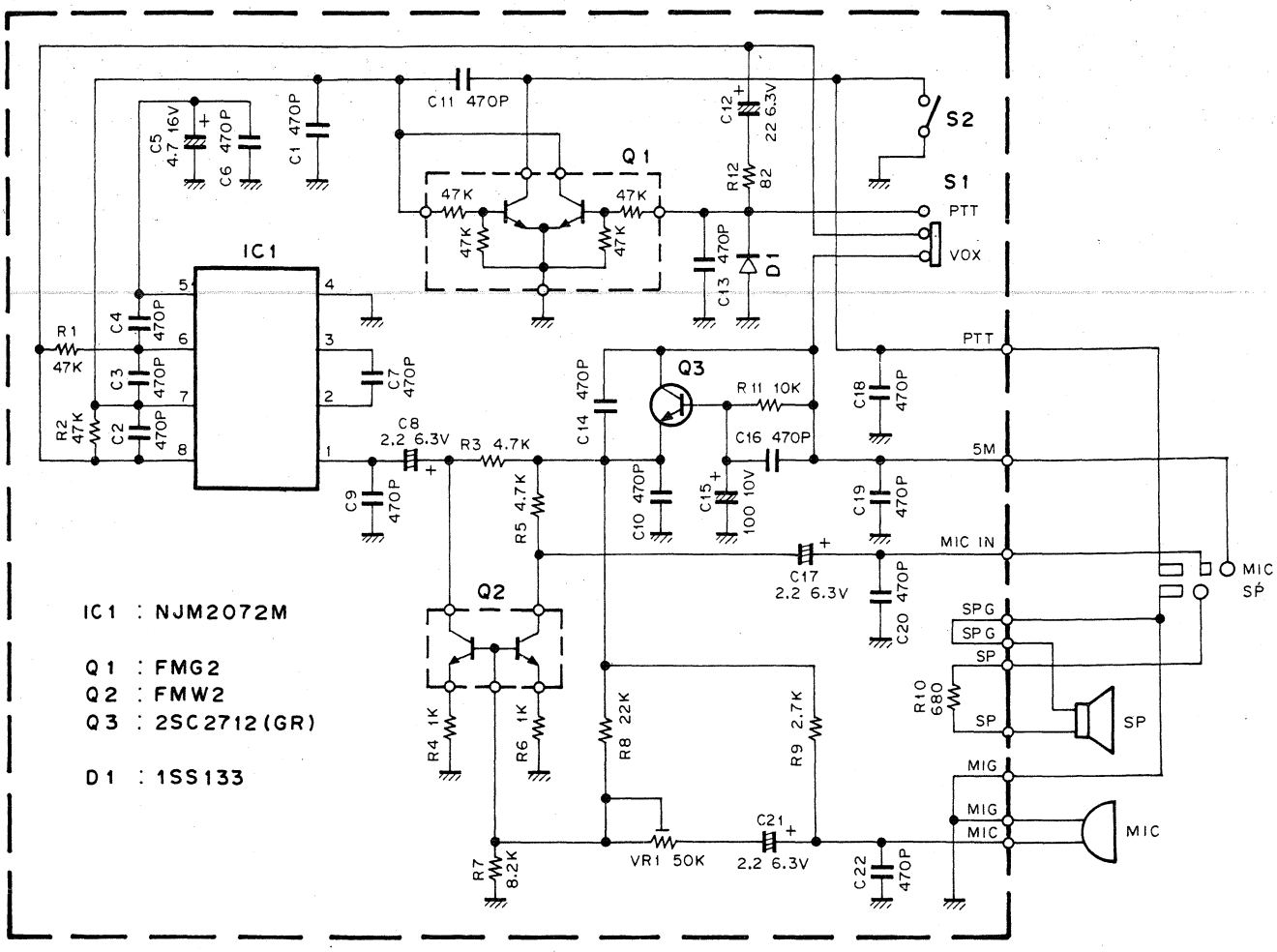


Foil side view



: Component side
: Foil side

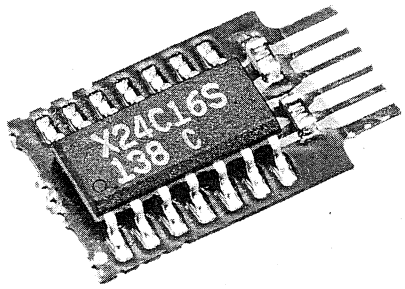
HMC-2 Circuit Diagram



TH-28A/E

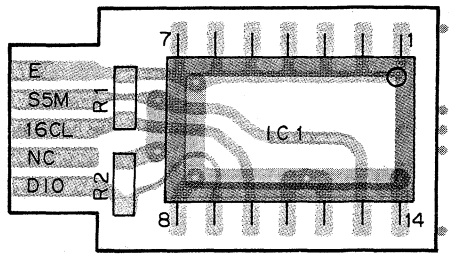
ME-1 (MEMORY EXPANSION UNIT) / PB-13 (Ni-Cd BATTERY)

ME-1 External View

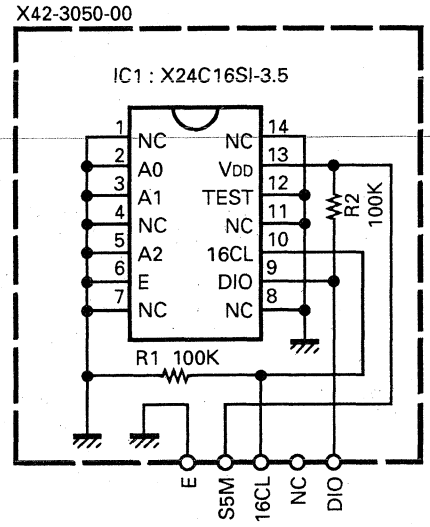


ME-1 PC Board View

Component side view



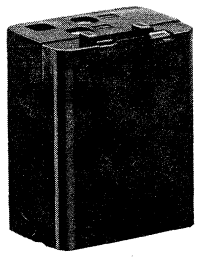
ME-1 Circuit Diagram



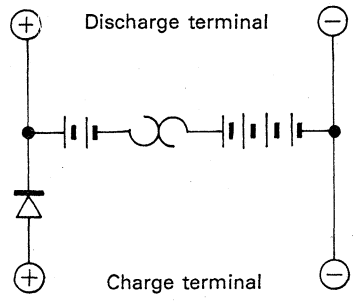
ME-1 Parts List

Ref. No.	New	Parts No.	Description
		B62-0255-00	Instruction manual
		X42-3050-00	Expansion memory unit
R1, 2		RX73GB1J104J	Chip R 100K J
IC1		X24C16SI-3.5	IC

PB-13 External View



PB-13 Circuit Diagram



PB-13 Specifications

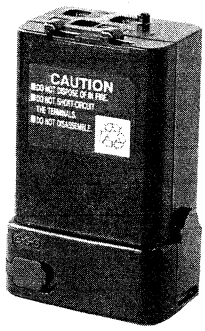
Electrical characteristics
- Voltage 7.2V
- Charging current 700mAh

Dimensions (H x D x W) ..... 55 x 30 x 45.5 (mm)
- Protections included ..... 58 x 30 x 49 (mm)

Weight ..... Approx. 170g

PB-14 (Ni-Cd BATTERY)

PB-14 External View

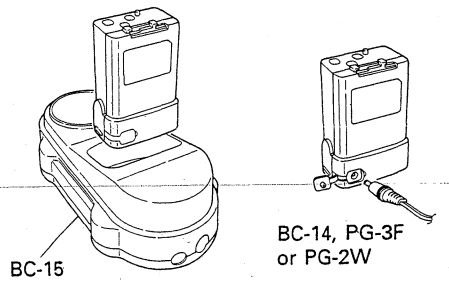


PB-14 Specifications

Voltage ..... 12V DC
Capacity 300mAh
Recharging time (When fully discharged)
- BC-15 ..... Approx. 1 hour
- BC-14 ..... Approx. 15 hours
- PG-3H ..... Approx. 15 hours (*1)
- PG-2W ..... Approx. 15 hours (*1)

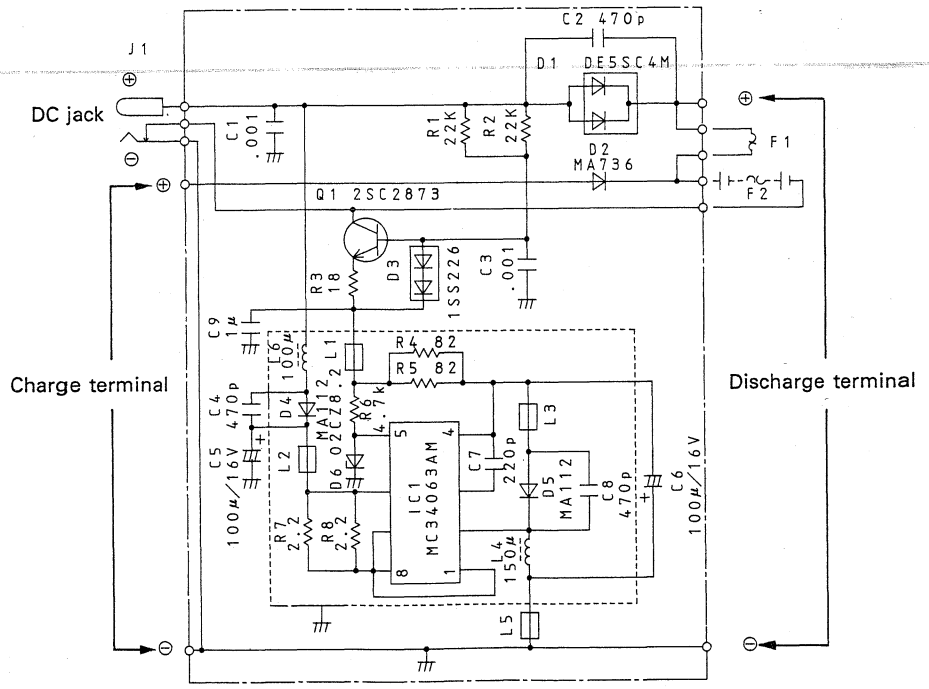
*1 : It is possible to charge the battery pack while it is ON or OFF the radio.
The battery pack can not be charged from transceiver's DC IN terminal.

Caution
Clean the terminal of the charger and the PB-14 with a soft cloth before charging.



Charging temperature range ..... 5°C to 40°C (41°F to 104°F)
Power requirement ..... 11.5V DC to 16V DC
(DC IN terminal)

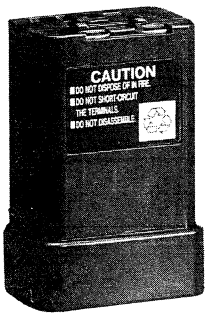
PB-14 Circuit Diagram



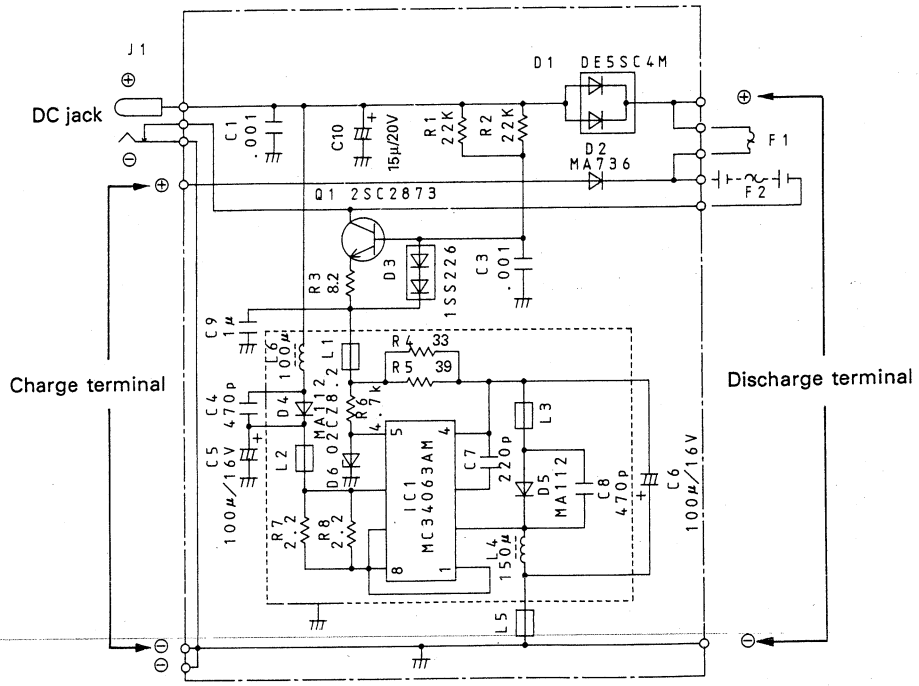
TH-28A/E

PB-17 (HIGH POWER BATTERY PACK) / PB-18 (LONG LIFE BATTERY PACK)

PB-17 External View



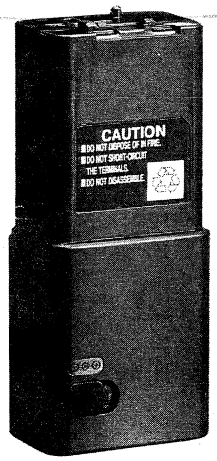
PB-17 Circuit diagram



PB-17 Specifications

Voltage	12V DC
Capacity	700mAh

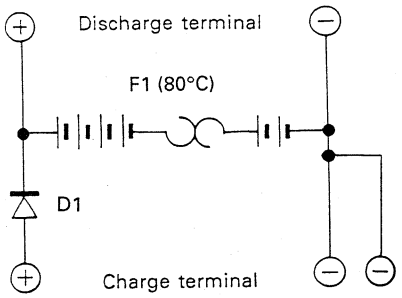
PB-18 External View



PB-18 Specifications

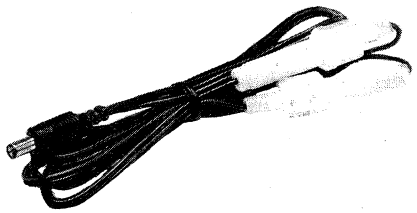
Voltage	7.2V
Capacity	1100mAh

PB-18 Circuit diagram

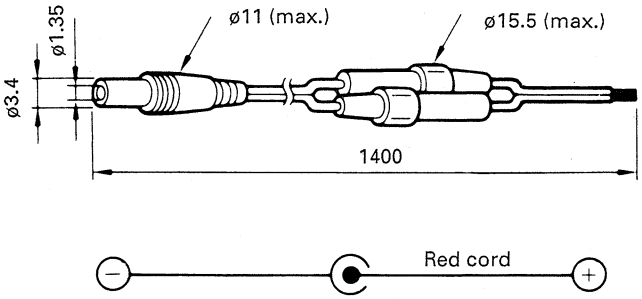


PG-2W (DC CORD) / PG-3H (FILTERED CIGAR LIGHTER CORD)

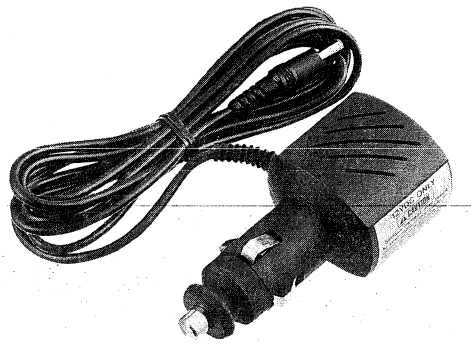
PG-2W External View



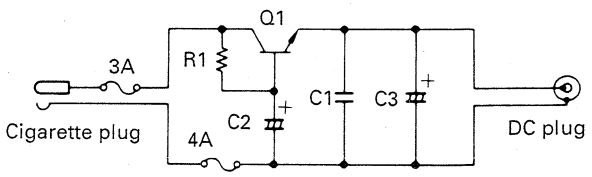
PG-2W Dimensions



PG-3H External View



PG-3H Circuit Diagram



Q1 : 2SD717(O,Y)
R1 : 22Ω 1/4W
C1 : 0.001µF 50V
C2 : 2.2µF 16V
C3 : 100µF 16V

TH-28A/E

SMC-31, 32, 33 (SPEAKER MICROPHONE)

SMC-31 External View

SMC-31 Specifications

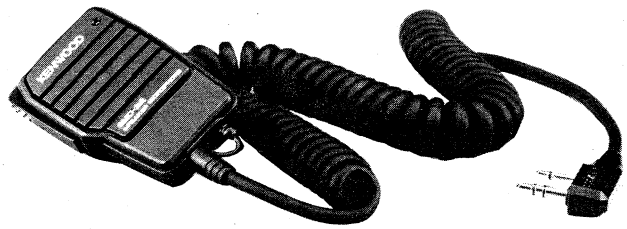
Electrical characteristics

- **Speaker**
  Diameter ..... ø45 (mm)
  Impedance 8Ω
  Rated input power 0.15W
  Max. input power 0.3W
- Microphone
  Sensitivity ..... 66dB ± 3dB at 1300Hz
  Output impedance ..... 2kΩ ± 30% at 1000Hz

SMC-31 Parts List

Ref. No.	New	Parts No.	Description
		D10-0605-08	PTT lever
		E30-2110-05	Curl cord ass'y
		J19-1360-08	Clip
		T07-0219-08	Speaker
		T97-1024-08	Microphone

SMC-32 External View



SMC-32 Specifications

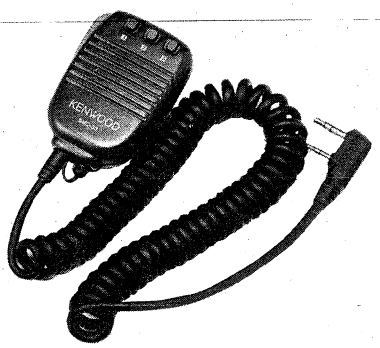
Electrical characteristics

- **Speaker**
  Diameter ..... ø28 (mm)
  Impedance 8Ω
  Rated input power 0.5W
  Max. input power 1W
- Microphone
  Sensitivity ..... 66dB ± 3dB at 1300Hz
  Output impedance ..... 2kΩ ± 30% at 1000Hz

SMC-32 Parts List

Ref. No.	New	Parts No.	Description
		E30-3127-08	Curl cord ass'y

SMC-33 External View



SMC-33 Specifications

Electrical characteristics

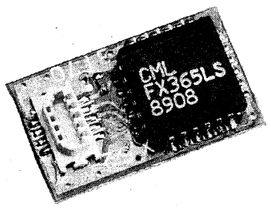
- **Speaker**
  Diameter ..... ø28 (mm)
  Impedance 8Ω
  Rated input power.. 0.5W
  Max. input power ... 1W
- **Microphone**
  Sensitivity ..... 58dB ±3dB (0dB=1V/μbar) at 1300Hz
  Output impedance ..... 2kΩ ± 30% at 1000Hz

SMC-33 Parts List

Ref. No.	New	Parts No.	Description
		E30-2196-08	Curl cord ass'y
		T91-0392-05	Microphone with speake

TSU-7 / CTCSS UNIT (X52-3170-00)

TSU-7 External View

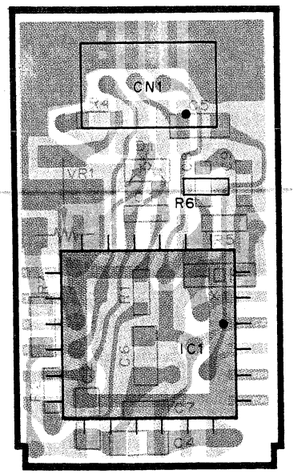


TSU-7 Parts List

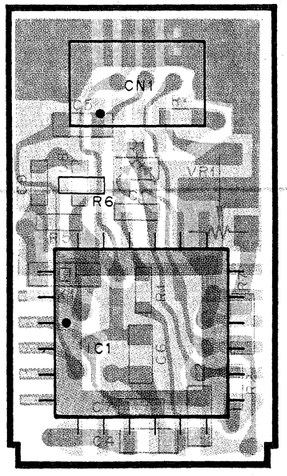
Ref. No.	New	Parts No.	Description
		TSU-7 (X52-3170-00)	
C1		CK73GB1H471K	Chip C 470pF K
C2		C92-0521-05	Chip Tan. 0.47µF 20WV
C4~6		CK73FB1E104K	Chip C 0.1µF K
C7		CK73GB1H471K	Chip C 470pF K
C8,9		CC73GCH1H221J	Chip C 220pF J
CN1		E40-5341-05	Connector
		G10-0692-04	Cushion
		H21-0704-04	Cushion
X1		L78-0062-05	Crystal 1MHz
R1		RK73BG1J274J	Chip R 270k J
R2		RK73BG1J824J	Chip R 820k J
R4		RK73BF1J103J	Chip R 10k J
R5		RK73BG1J105J	Chip R 1M J
R6		RK73BG1J473J	Chip R 47k J
VR1		R12-6526-05	Trimming pot. 47k
IC1		FX365LS	IC
D1		DAN202U	Chip diode

TSU-7 PC Board Views

Component side view



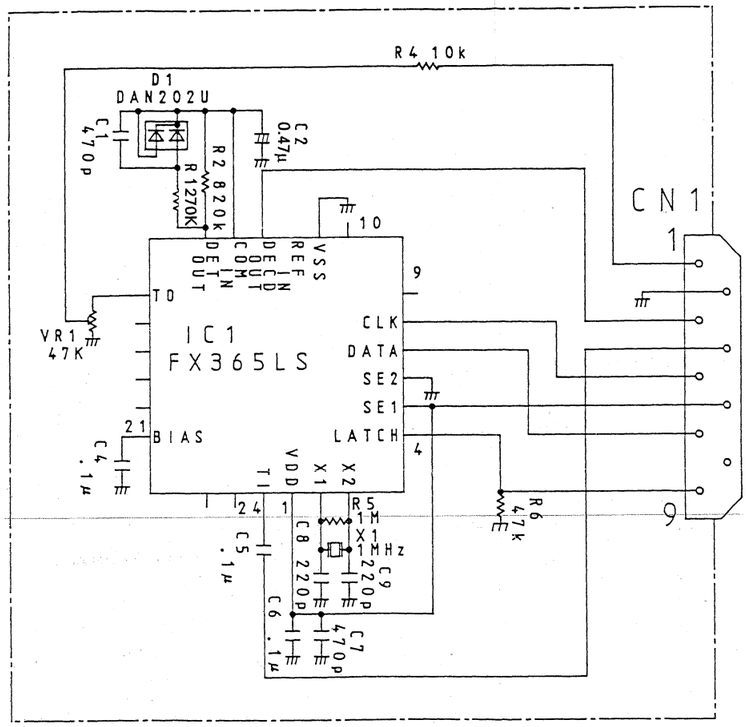
Foil side view



TH-28A/E

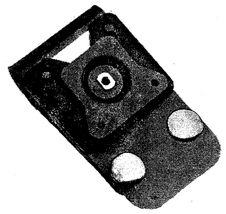
TSU-7 / CTCSS UNIT (X52-3170-00)

TSU-7 Circuit Diagram



BH-6 (SWIVEL MOUNT) / HB-2 (HAND STRAP) / SC-30, 33, 34 (SOFT CASE) / WR-2 (WATERPROOF CASE)

BH-6 External View



HB-2 External View

SC-30 External View

SC-33 External View

SC-34 External View

WR-2 External View

TH-28A/E

SPECIFICATIONS

GENERAL

Frequency range (MHz)	
U.S.A. Version	144 to 148
U.K. and Europe	144 to 146
Other market	144 to 146 or 144 to 148
Mode	F3E (FM)
Antenna impedance	50Ω
Operating temperature	–20°C~+60°C (–4°F~+140°F)
Power requirements	
DC IN (nominal)	7.2V~16V DC (13.8V DC)
Battery pack	6.3V~16V DC (7.2V DC)
Current drain (Approx.)	
13.8V DC (Ext. Power Supply) H	1.4A
7.2V DC (Battery) H	0.95A
Transmit mode L	0.5A
Transmit mode EL	90mA
Receive mode with no signal	55mA
Battery save mode	15mA
Ground	Negative
Dimension (W x H x D)	49.5 x 115.8 x 37.8 mm
Dimension (Projection Included)	61.2 x 131.5 x 37.8 mm
Weight	330g
Microphone impedance	2kΩ

TRANSMITTER

Output power	
H (13.8V DC)	More than 5W
H (7.2V DC)	Approx. 2W
M (13.8V DC)	Approx. 2.5W
L (7.2V DC)	Approx. 0.5W
EL (7.2V DC)	Approx. 20mW
Modulation	Reactance
Max. frequency deviation	±5kHz
Spurious radiation	Less than –60dB

RECEIVER

Circuitry	Double conversion superheterodyne
Intermediate frequency 1st	45.05MHz
Intermediate frequency 2nd	455kHz
Sensitivity (12dB SINAD)	Less than –15dBμ (0.18μV)
Squelch sensitivity	Less than –20dBμ (0.1μV)
SELECTIVITY	
–6dB	More than 12kHz
–40dB	Less than 28kHz
Audio output power (10% distortion)	More than 200mW (across 8Ω load)

NOTES :

1. Circuits and ratings are subject to change without notice, due to development in technology.
2. Recommended duty cycle : 1 minute Transmission, 3 minutes Reception.

KENWOOD CORPORATION
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