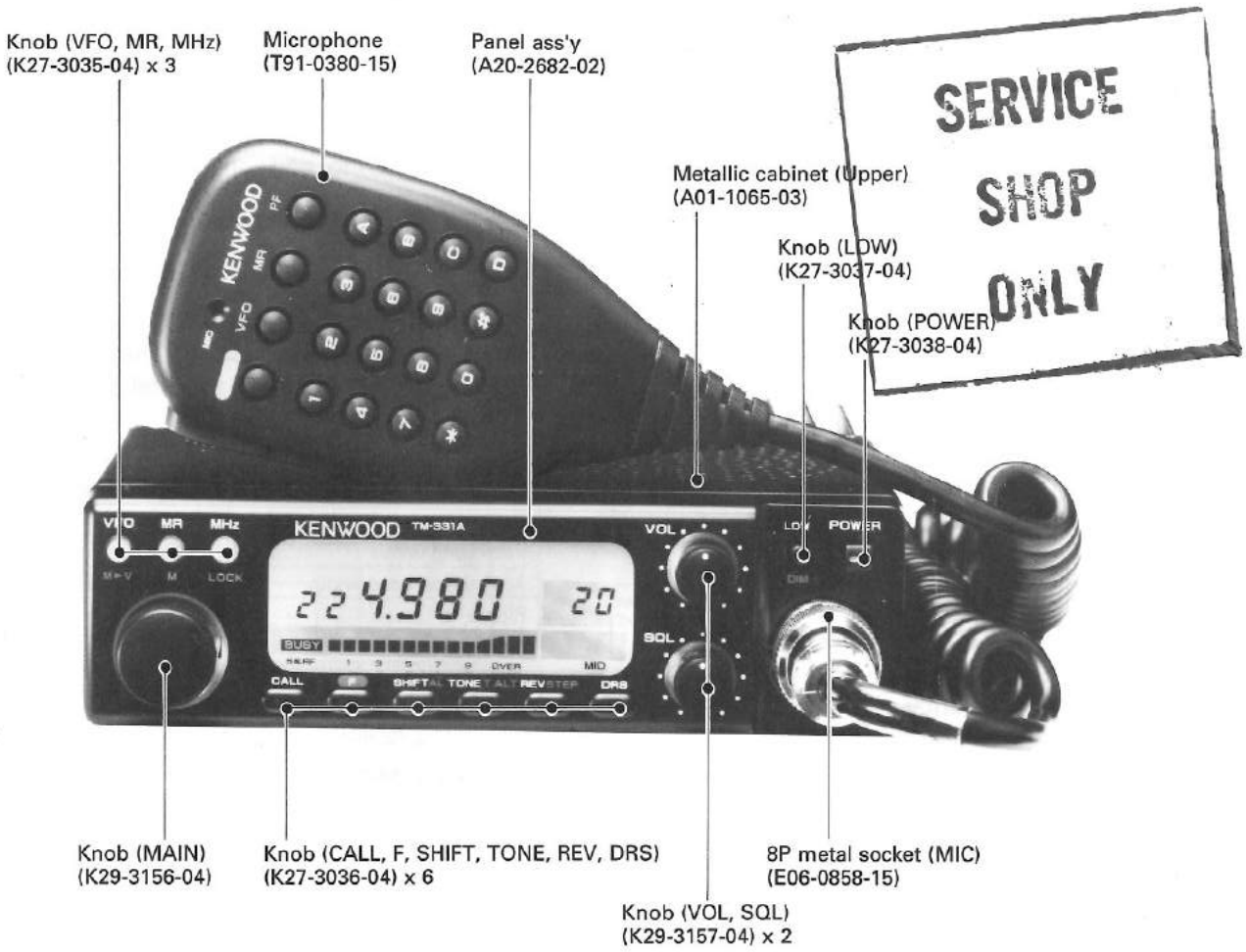
220MHz FM TRANSCEIVER

TM-331A

SERVICE MANUAL

KENWOOD

B51-3826-00 (O) 473



CONTENTS

CIRCUIT DESCRIPTION

Circuit Configuration By Frequency

The TM-331A incorporates a PLL synthesizer which uses a digital VFO to allow any channel step of 5, 10, 12.5, 15, 20, or 25kHz to be selected (See Figure 1).

The receiving system utilizes double-conversion techniques. That is, an incoming signal is mixed down to the 1st intermediate frequency (IF) of 30.825MHz, using a 1st local oscillator frequency of from 189.175 to 194.170MHz. The 1st IF signal is then mixed with the 2nd local oscillator frequency of 12.8MHz to generate the 2nd IF of 455 kHz.

The transmitting system consists of a PLL circuit which allows direct modulation and direct frequency division. Signals from the PLL circuit are amplified by a linear amplifier for transmission.

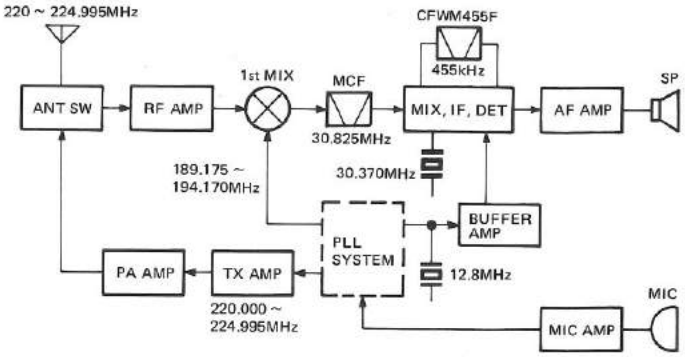


Fig. 1 Frequency configuration

Receiving System

• Overview

Incoming signals from the antenna pass through a low-pass filter in the final block of the transmitter system, and are switched to the front-end of the receiver system via a receive/transmit switching diode.

The signals are then passed through an antenna matching coil, where the high-frequency components are amplified by a GaAs FET. The signals are then fed into a three-stage bandpass filter that uses vari-cap tuning to reject unwanted signal components, and is fed to the 1st mixer. The 1st mixer uses the N-channel MOS FET that are used in the RF stage to obtain better two-signal characteristics. The 1st mixer mixes the signal with the 1st local oscillator frequency and converts it to the 1st IF (30.825MHz). The signal then passes through two monolithic crystal filters (MCFs) to remove unnecessary near-by frequency components. The signal from the MCFs is used as the 1st IF signal.

The 1st IF signal is amplified and fed into IC1 (KCD01) in the FM IF HIC. The IF signal is then mixed with the 2nd local oscillator frequency of 30.370MHz to generate the 2nd IF of 455kHz. The 455kHz signal is then passed through a six element ceramic filter (CFWM455F), and fed back into IC1 for additional amplification. The output signal from the IC1 is then fed into a power amplifier via the audio volume control for application to the speaker.

• S-meter circuit

S-meter control voltage from IC1 (KCD01) in the FM IF HIC is fed into the control unit. The CPU converts the voltage from an analog to a digital signal in order to operate the LCD bar meter.

Item	Rating
Nominal center frequency (fo)	30.825MHz
Pass band width	±7.5kHz or more at 3dB
Attenuation band width	±28kHz or less at 40dB
Ripple	1.5dB or less
Insertion loss	3dB or less
Guaranteed attenuation	60dB or more within ±1MHz (Spurious : 40dB or more)
Terminating impedance	1.4kΩ/1pF

Table 1 MCF (L71-0270-05) (TX-RX unit XF1)

Item	Rating
Nominal center frequency	455kHz ± 1kHz
6dB bandwidth	±6kHz or more (from 455kHz)
50dB bandwidth	±12.5kHz or less (from 455kHz)
Ripple (within ±4kHz of 455kHz)	3dB or less
Insertion loss	6dB or less
Guaranteed attenuation (within ±100kHz of 455kHz)	35dB or more
I/O matching impedance	2.0kΩ

Table 2 Ceramic filter CFWM455F (L72-0372-05) (TX-RX unit CF1)

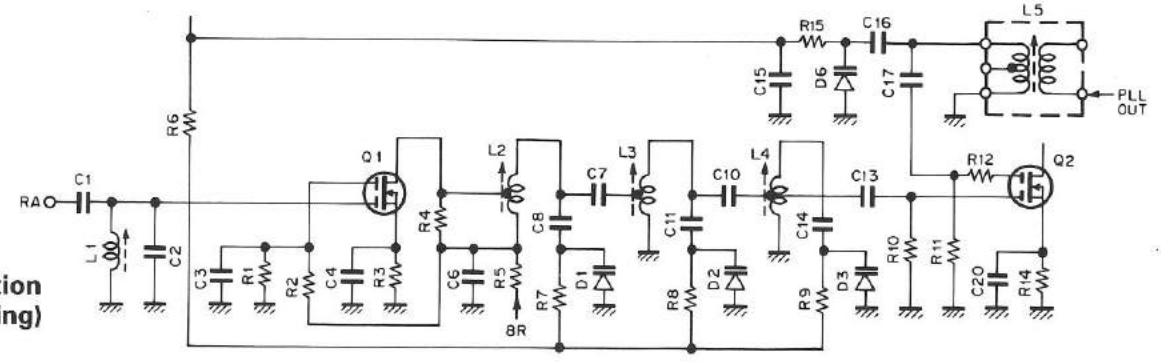


Fig. 2 Front-end section (vari-cap tuning)

CIRCUIT DESCRIPTION

Transmitting System

• Overview

The transmitter produces the target frequency thru the use of direct FM-modulation via a varactor diode.

• Modulation circuit

Audio signals from the microphone are fed into the mic amplifier unit for amplification by the first transistor amplifier, and then into two operational amplifiers. The operational amplifiers form a splatter filter for pre-emphasis, amplification, limiting, and removal of unnecessary high-frequency components.

The FM modulation circuit directly FM-modulates the VCO signals, using a varactor diode.

• Pre-amplifier stage circuit

Signals from the VCO are applied to the drive HIC IC8 (KCB08). The amplifier always operates in a linear mode so that signals can be amplified without degradation. Additionally, the amplifier is designed to cover a wide range of frequencies and can produce stable output without adjustment. The APC (Automatic Power Control) controls collector voltage from the last stage of the pre-amplifier.

• Power amplifier circuit

The drive signal is amplified to the required level by the power module. The TM-331A uses a large heat sink for efficient heat dissipation.

• APC circuit

The APC circuit for automatic transmit output control detects part of the power module output, and amplifies it to provide a control voltage for output control. The output control voltage is in inverse proportion to the output from the power module, so it is maintained at the same level.

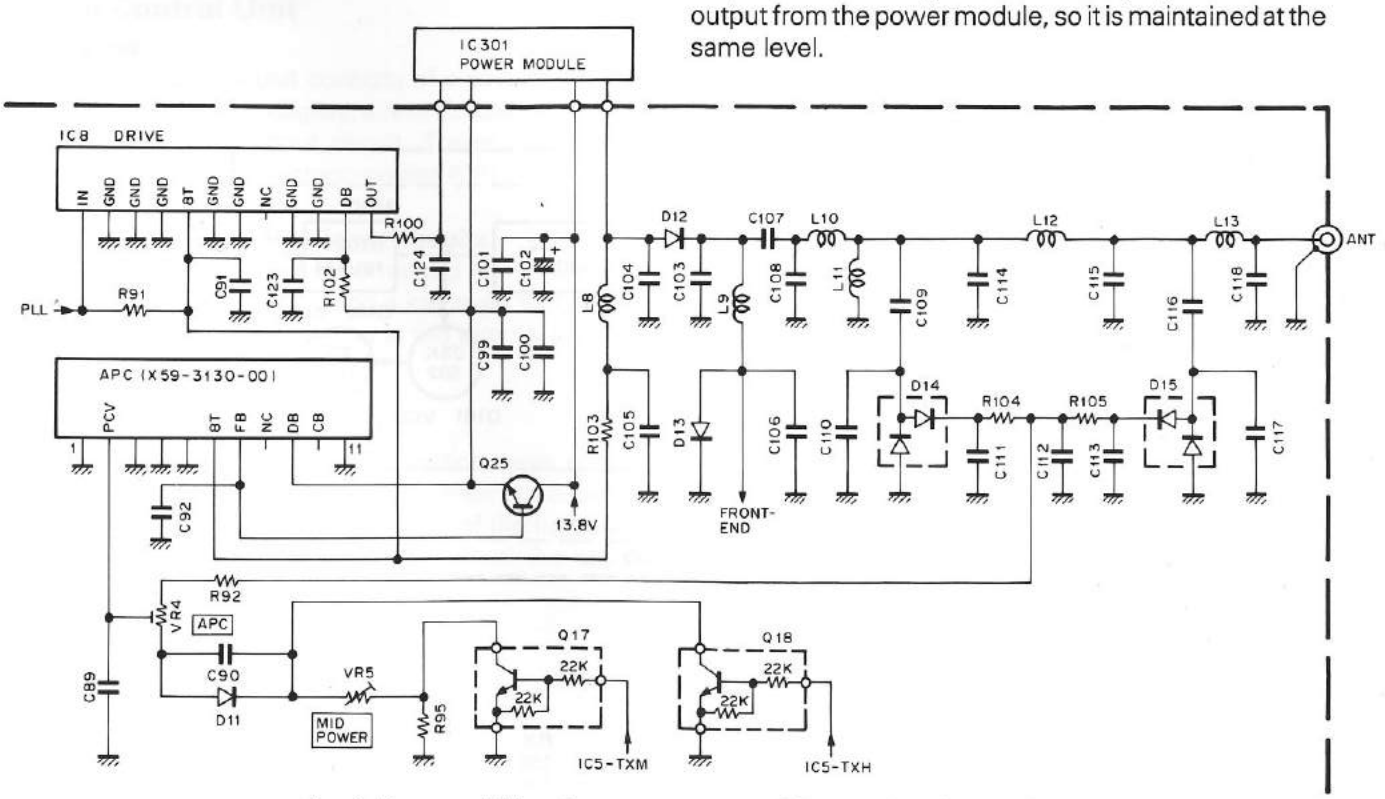


Fig. 3 Pre-amplifier stage, power amplifier, and APC circuits

(Tc = 25°C)

Item	Symbol	Condition	Rating	Unit
Operating voltage	Vcc		17	V
Current consumption	Icc		7	A
Input power	Pin	ZG = ZL = 50Ω	0.6 (Vcc1 ≤ 12.5V)	W
Output power	Po		40	W
Operating case temperature	Tc(op)		−30 ~ +110	°C
Storage temperature	Tstg		−40 ~ +110	°C

Table 3 Power module M57774 maximum ratings (IC301)

CIRCUIT DESCRIPTION

PLL Synthesizer Unit

Figure 4 is the PLL and VCO block diagram. In the TM-331A, the PLL system is implemented as a sub-unit which is divided into the upper VCO and lower PLL blocks. The sub-unit is shielded to prevent external interference.

There are two reference frequencies, 6.25kHz and 5 kHz, available to allow 5, 10, 12.5, 15, or 25 kHz-step operation. The 6.25kHz is obtained by dividing the reference oscillator frequency of 12.8MHz by 2048, and the 5kHz is obtained by dividing it by 2560. The VCO directly generates the dial frequency. This dial frequency is amplified once and then fed into a pulse swallow-type PLL IC for frequency division and phase comparison, in order to lock the frequency.

The PLL system is locked without switching between transmit mode and receive mode. By using a signal ("H" in transmit mode) from pin 10 of the PLL IC (M54959FP), the LPF is deactivated-activated by Q4 only for the moment when the TM-331A enters transmit mode. This helps produce lock more rapidly than previous methods.

In 220MHz mode, fvco (RX) is calculated by the following formula:

$f_{VCO} = (220 - 30.825) = \{(n \times 128) + A\} \times f_{OSC} / R$

where,

- f_{VCO} : VCO output frequency
- n : Binary value of the 10-bit programmable counter
- A : Binary value of the 7-bit programmable counter
- f_{OSC} : 12.8MHz reference frequency
- R : Binary value of the 14-bit programmable counter
  2560 (5, 10, 15, 20, or 25kHz step mode)
  2048 (12.5kHz step mode)

In 5, 10, 15, 20, or 25kHz step mode,
n = 295 and A = 75.
Therefore, f_{VCO} is calculated as follows:

$f_{VCO} = \{(295 \times 128) + 75\} \times 12800 / 2560$
$= \{37760 + 75\} \times 5$
$= 189175kHz = 189.175MHz$

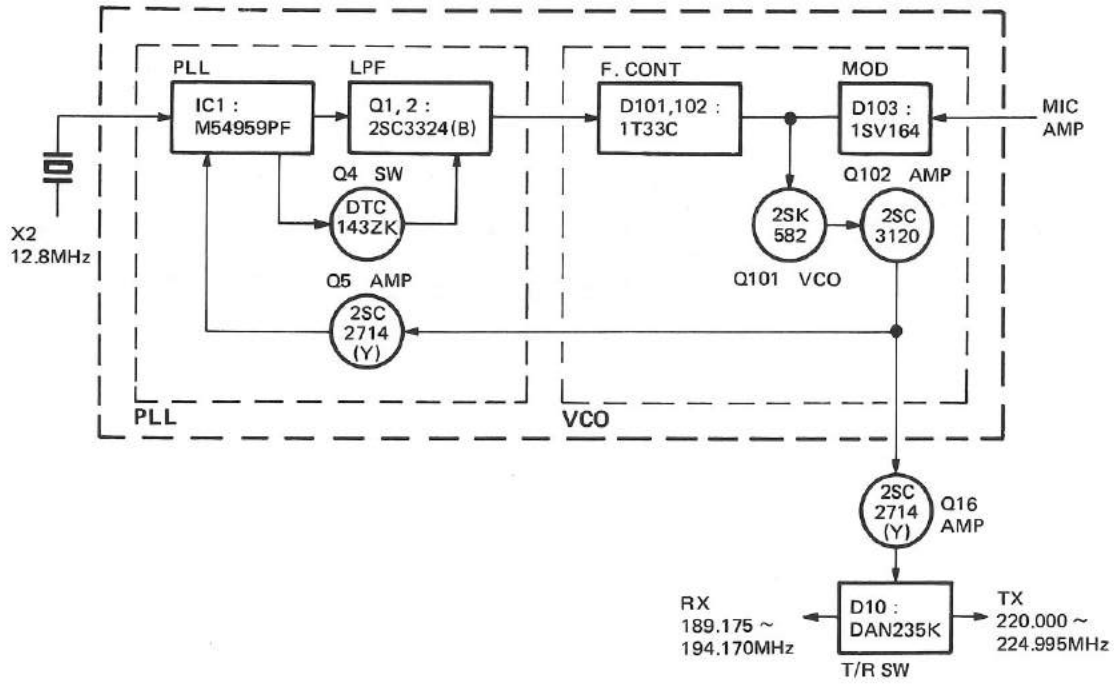


Fig. 4 PLL block diagram

CIRCUIT DESCRIPTION

• 8T (8V in transmit mode) and unlock circuits

In receive mode, the base of Q11 has 0.7V. As a result, Q11 is on, and Q10 and Q8 are off, and the collector of Q8 (8T) provides no voltage.

The CPU outputs serial data to the shift register IC5 when the PTT switch is depressed. As a result, pin 8 of IC5 becomes "L", turning Q11 off, and Q10 and Q8 on. The 8T line is therefore supplied with 8V.

The unlock circuit operates only in transmit mode. Q12 is a PLL unlocking switching transistor. Usually, the base of Q12 is supplied with 0V ("L"), and the collector is supplied with 8V ("H").

When the PLL is unlocked, the base of Q12 is supplied with 0.7V, turning Q12 on. As a result, the collector of Q12 becomes "L" (0V). This turns Q10 off and the collector of Q8 becomes 8V, turning it off. Therefore, when the PLL is unlocked, Q8 is off removing bias voltage from the 8T line. Without the 8T voltage no transmit signal is generated.

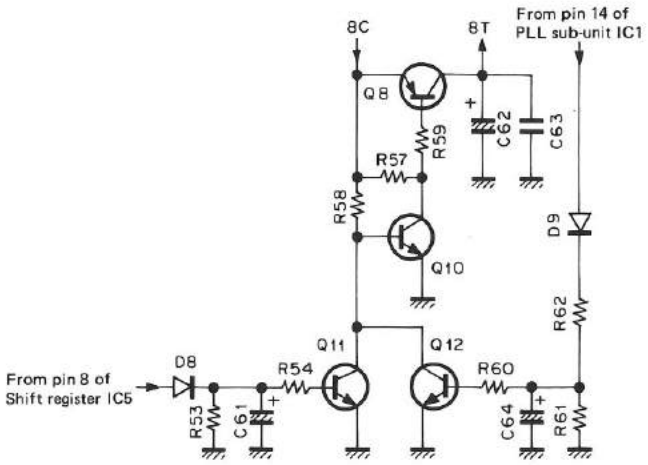


Fig. 5 8T and unlock circuits

Digital Control Unit

• Overview

The digital control unit consists of a several keys, a rotary encoder input, a display, a reset circuit, a back-up circuit, and a tone output circuit. These circuits are controlled by a single microcomputer (CPU).

• Key and rotary encoder input circuits

The keys on the panel are arranged in matrix. Key input is fed into the CPU, using a key scan technique. Output from the rotary encoder is fed directly into the CPU.

• Microphone key input circuit

The UP, DOWN, and other function keys of the microphone are directly connected to their corresponding analog input pins of the CPU. Each of the functions is activated by a voltage generated when the corresponding key is pressed.

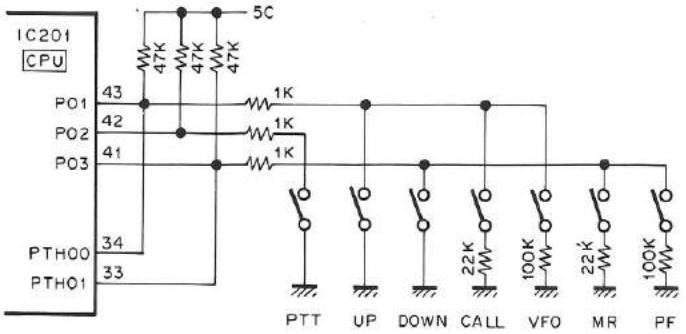


Fig. 6 Microphone key input circuit

CIRCUIT DESCRIPTION

• Reset and back-up circuits

When the TM-331A power is turned on, the reset circuit sends a "L" level pulse to the RESET pin of the CPU for approx. 3ms. This initiates the power-on reset sequence.

When the TM-331A power is turned off, the back-up circuit detects a voltage drop in the 13.8V line and sets CPU INT4 to a "H" level. This causes the CPU to enter a back-up state.

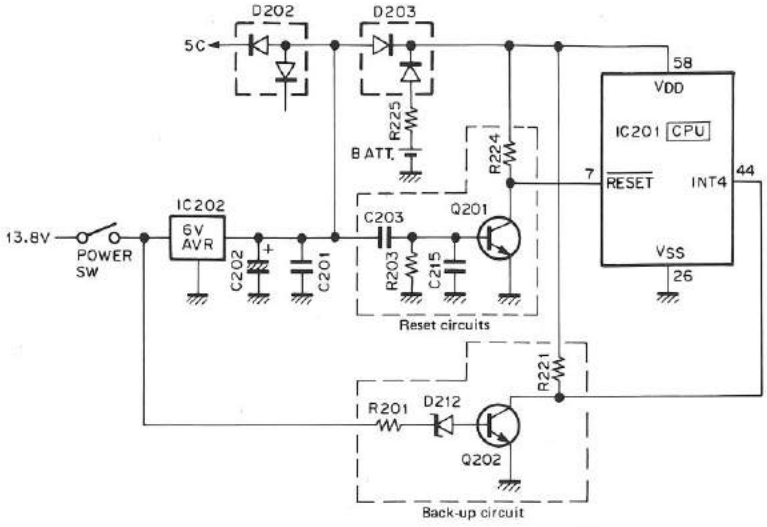


Fig. 7 Reset and back-up circuits

• Display circuit

The display circuit is contained in the LCD assembly. It consists of a LCD driver, its peripheral circuits, and an LCD. The LCD is dynamically operated at a 50% duty cycle. The LCD driver receives LCD data from P33, P141, and P140 of the CPU.

• Shift register circuit

The shift register circuit consists of IC5 (TC9174F). The IC5 receives serial data from the microcomputer to perform the controls listed below.

Pin No.	Pin name	Function
1	GND	
2	B1	Usually "H".
3	B2	Open.
4	CE	Electronic VOL select : "H" when electronic VOL selected, "L" when panel VOL selected or interface connected.
5	VOLD	Electronic VOL DOWN : "L" when DOWN key ON.
6	VOLU	Electronic VOL UP : "L" when UP key ON.
7	MUTE	AF MUTE : "H" when TX mode, AL 1ch receive mode, CTCSS, bell, or squelch is ON.
8	T/R	Transmit/receive select : "H" in RX mode, "L" in TX mode.
9	TXM	TX power select : "H" in HI or MID mode, "L" in LOW mode.
10	TXH	TX power select : "H" in HI mode, "L" in MID or LOW mode.
11	–	Open.
12	–	Open.
13	DATA	Serial data input.
14	CLOCK	Clock input.
15	EN	Enable input.
16	VDD	

Table 5

• Tone output circuit

IC203 (ladder resistor) receives signals from P40 to P43 and P50 to P53 of the CPU and converts them from digital to analog to produce 38 different waveforms from 67.0Hz to 250.3Hz. Figure 8 shows the internal configuration of IC203.

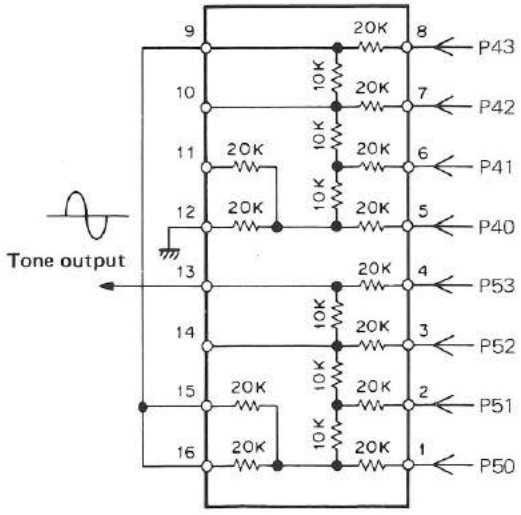


Fig. 8 Internal configuration of ladder resistor KRR-C001 (TX-RX unit IC203)

CIRCUIT DESCRIPTION

• PLL data output

PLL data is available from P21 (CK), P22 (DT), P61 (ACL), and P23 (EN1) of the CPU. Figure 9 is a timing chart for PLL data transfer, and Figure 10 shows the format of PLL data.

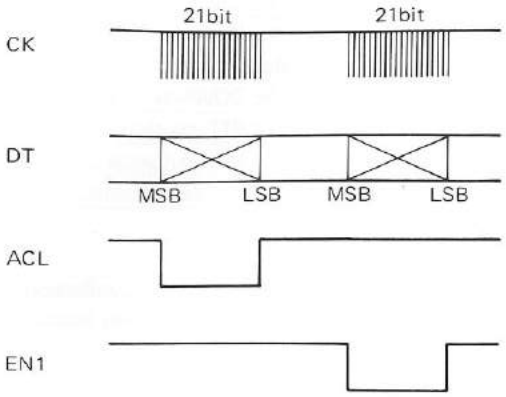
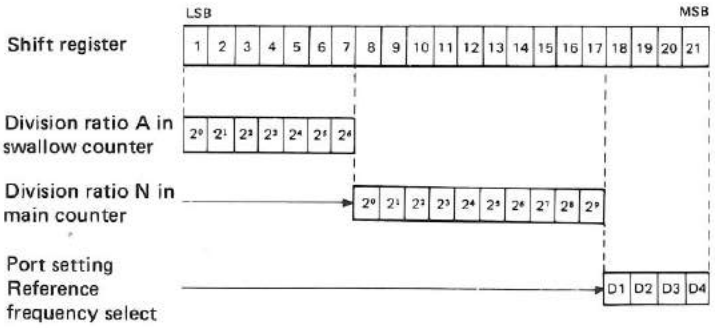


Fig. 9 timing chart for PLL data transfer



The 21-bit data is made up of the following:

1. Division ratio data A and N (17 bits)

F (display – 30.825MHz in RX mode)
= {(N x 128) + A} x 12.8MHz / ref

N : Division ratio set in 10-bit main counter (binary)
A : Division ratio set in 7-bit swallow counter (binary)

2. Reference frequency (ref) select (2 bits)

Data		Phase reference frequency	
D1	D2		
L	L	5kHz	5, 10, 15, 20, 25kHz step mode
H	L	6.25kHz	12.5kHz step mode

3. Switch select (2 bits)

Data		Output port		
D3	D4	SW1	SW2	
L	H	L	H	RX mode
H	L	H	L	TX mode

Fig. 10 PLL data format

• Input and output of CTCSS unit (option)

The optional CTCSS unit receives data from P21, P22, an P73 of the CPU. Figure 11 is a timing chart for CTCSS data transfer, and Figure 12 shows the format of CTCSS data. When a tone from the CTCSS unit is detected, a "H" level signal is sent to P63 of the CPU, opening the squelch.

• Input and output of the remote control unit (option)

When the optional remote control unit is connected, a "H" level signal is applied to INT0 of the CPU, and the following pins have different functions:

P03 → S1 : Serial data input pin
P02 → S2 : Serial data output pin
P01 → SCK : Serial clock I/O pin

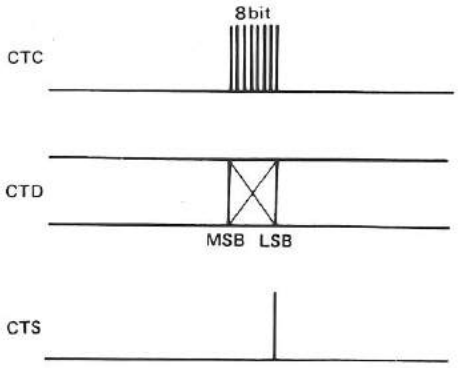


Fig. 11 Timing chart for CTCSS data transfer

Tone frequency select data for CTCSS unit

D1	D2	D3	D4	D5	D6

Example : 88.5Hz L H L H H H

Fig. 12 CTCSS data format

CIRCUIT DESCRIPTION

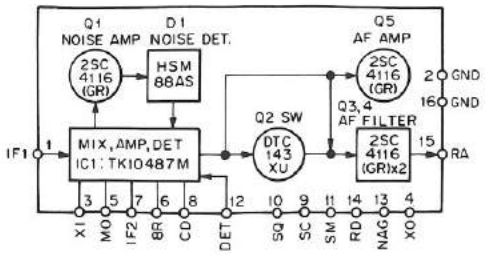
Pin No.	Pin name	I/O	Logic	Function	Pin No.	Pin name	I/O	Logic	Function
1	P41	O	–	D/A digital output (tone).	33	PTH01	I	–	Mic DOWN input.
2	P40	O	–		34	PTH00	I	–	Mic UP input.
3	P53	O	–		35	TI1	–	L	Not used.
4	P52	O	–		36	TI0	–	L	Not used.
5	P51	O	–		37	P23	O	L	PLL IC enable output.
6	P50	O	–		38	P22	O	–	PLL IC data output.
7	$\overline{\text{RESET}}$	I	L	Reset input.	39	P21	O	–	PLL IC clock output.
8	X2	–	–	4.194304MHz crystal oscillator.	40	P20	O	–	Beeper output.
9	X1	–	–		41	P03/SI	I/I	L/–	Mic DOWN/serial data input.
10	P63	I	H	CTCSS tone matching input.	42	P02/SO	I/O	L/–	Mic PTT input/serial data output.
11	P62	O	H	Power switch.	43	P01/$\overline{\text{SCK}}$	I/–	L/–	Mic UP input/serial clock I/O.
12	P61	O	–	Not used.	44	INT4	I	H	Back-up detect input.
13	P60	I	–	Not used.	45	P123	I	L	CALL, VFO
14	P73	O	H	CTCSS unit enable output.	46	P122	I	L	F, MR/M
15	P72	O	H	Shift register enable output.	47	P121	I	L	SHIFT, MHz
16	P71	O	H	DRS unit VOB output.	48	P120	I	L	TONE
17	P70	O	H	DRS unit VOA output.	49	P133	I	L	REV
18	P83	O	–	Not used.	50	P132	I	L	LOW, DRS
19	P82	O	H	DRS unit STBY output.	51	P131	I	L	Transmit power select.
20	P81	O	L	DRS unit $\overline{\text{WR}}$ output.	52	P130	I	L	Busy input.
21	P80	O	L	DRS unit $\overline{\text{RD}}$ output.	53	P143	O	L	Squelch control.
22	P93	O	H	DRS unit data output.	54	P142	O	H	Dimmer control.
23	P92	O	H		55	P141	O	–	LCD driver clock output.
24	P91	O	H		56	P140	O	–	LCD driver data output.
25	P90	O	H		57	NC	–	–	Not used.
26	Vss	–	–	GND.	58	V_{DD}	–	–	Power supply pin.
27	INT3	I	H	DRS unit connect check.	59	P33	O	–	LCD driver enable output.
28	INT2	I	–	Encoder input.	60	P32	O	L	Distination output.
29	INT1	I	–		61	P31	O	L	Key output.
30	INT0	I	H	Remote connect detect input.	62	P30	O	L	
31	PTH03	I	–	S-meter analog input.	63	P43	O	–	D/A digital output (tone).
32	PTH02	I	–	Not used.	64	P42	O	–	

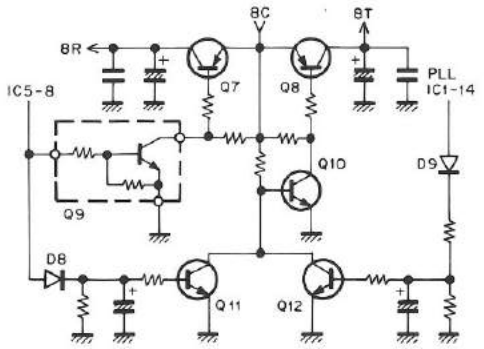
Destination, key input.

Table 5 75108G-E10-1B terminal functions (TX-RX unit IC201)

DESCRIPTION OF COMPONENTS

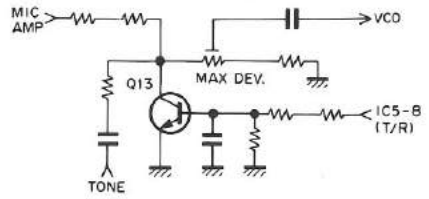
TX-RX UNIT (X57-3320-10)

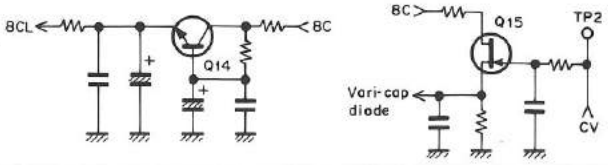
Component	Use/Function	Operation/Condition/Compatibility
IC1	2nd local oscillator, IF amplification, detection, low-frequency amplification, noise amplification, noise detection, squelch switching	① 1st IF signal input (30.825MHz). ③ ④ 2nd local oscillator (30.370MHz). ⑨ Busy output. ⑩ Squelch control. ⑪ S-meter output. ⑭ RD output. ⑮ Low-frequency output. 
IC3	AF amplification	① AF input, ⑧ AF output.
IC4	Electronic volume control, AF switch	② AF output. ③ "L" during step-up. ④ "L" during step-down. ⑤ "H" when electronic volume selected. ⑦ Panel volume input. ⑧ Panel volume output. ⑩ AF input.
IC5	Shift register	See circuit description.
IC6	5V AVR	
IC7	10V AVR	For PLL.
IC8	Transmit drive	
IC9	8V AVR	
IC201	Microprocessor	See circuit description.
IC202	6V AVR	
IC203	Tone A/D convertor	
Q1	High-frequency amplification	Operates in receive mode.
Q2	1st mixer	Converts received 220MHz-range signals to 1st IF 30.825MHz.
Q3	High-frequency amplification	Amplifies 1st IF signal.
Q4 (1/2)	RD line mute	ON when DRS unit replays.
Q4 (2/2)	AF line mute	
Q5	Low-frequency amplification	Operates when DRS unit replays.
Q6	AF line mute	Operates when transmit mode, AL 1ch receive mode, CTCSS, bell or squelch is ON.
Q7	8R switching	ON in receive mode.
Q8	8T switching	ON in transmit mode.
Q9	8R switching control	ON in receive mode.
Q10	8T switching control	ON in transmit mode.
Q11	8T switching control	OFF in transmit mode.
Q12	8T switching control	OFF when PLL locked.

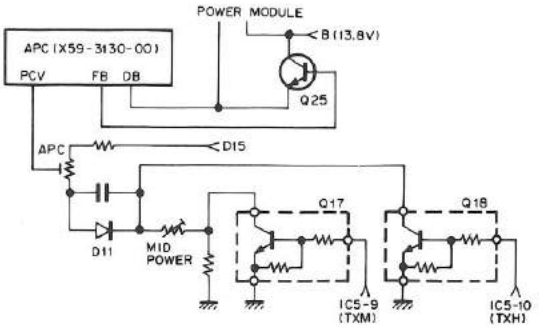


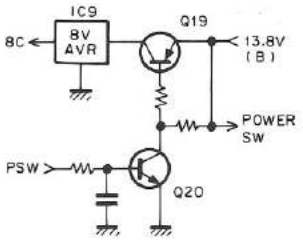
DESCRIPTION OF COMPONENTS

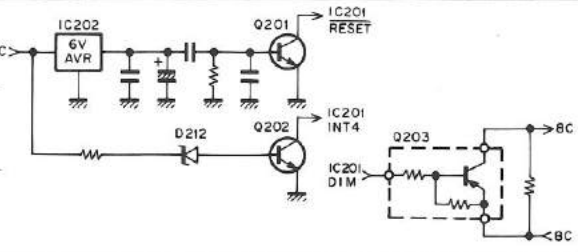
Component	Use/Function	Operation/Condition/Compatibility
Q13	Mic line mute	ON in receive mode.
Q14	PLL 8V ripple filter	
Q15	CV line buffer	
Q16	VCO output amplification	
Q17	TX power select	ON in HI or MID mode.
Q18	TX power select	ON in HI mode.
Q25	TX drive stage +B control	
Q19	Power switch	
Q20	Power switch control	ON when power switch is ON.
Q201	Reset switch	ON for approx. 3ms when system power turned on, usually OFF.
Q202	Back-up switch	OFF when 13.8V line becomes 7.5V or less, usually ON.
Q203	Dimmer switch	
Q204	Reset switch	ON for approx. 3ms when DRS power turned on, usually OFF.
D1 ~ 3, 6	Vari-cap tuning	
D7 ~ 9	Reverse current prevention	
D10	VCO output switch	
D11	Temperature compensation	For APC.
D12, 13	Transmit/receive switching	











DESCRIPTION OF COMPONENTS

Component	Use/Function	Operation/Condition/Compatibility
D14, 15	Power detection	For APC.
D16	Reverse power protection	
D201~203	Reverse current prevention	
D204, 205	Microprocessor protection	
D206, 207	To be set at destination	
D210	To be set at destination	
D212	Back-up detection	

PLL (X58-3580-10)

Component	Use/Function	Operation/Condition/Compatibility
IC1	PLL	① VCO input 189.175 ~ 194.170MHz in receive mode. 220.000 ~ 224.995MHz in transmit mode. ⑩ "H" in transmit mode. ⑭ "H" when PLL unlocked.
Q1, 2	LPF	
Q4	Transmit switch	ON for moment when transmission starts.
Q5	VCO output buffer	
Q101	VCO	189.175 ~ 194.170MHz in receive mode. 220.000 ~ 224.995MHz in transmit mode.
Q102	VCO output buffer	
D101,102	VCO voltage control	
D103	For modulation in TX mode	

APC (X59-3130-00)

Component	Use/Function	Operation/Condition/Compatibility
Q1	Differential amplification	
Q2 (2/2)	APC control	
Q3	Drive stage +B AVR	

MIC AMP (X59-3610-00)

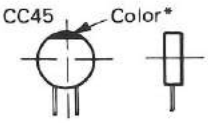
Component	Use/Function	Operation/Condition/Compatibility
IC1 (1/2)	Limited amplification	
IC1 (2/2)	LPF	
Q1	Low-frequency amplification	

PARTS LIST

CAPACITORS

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

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



- **Capacitor value**

0 1 0 = 1pF
1 0 0 = 10pF
1 0 1 = 100pF
1 0 2 = 1000pF = 0.001μF
1 0 3 = 0.01μF

2 2 0 = 22pF
1st number | Multiplier
2nd number

- **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±60 ppm/°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

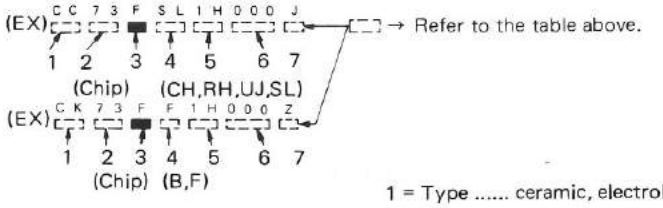
Less than 10 pF

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

- **Rating voltage**

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**



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

Dimension

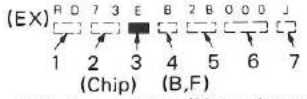
Dimension code	L	W	T
Empty	5.6 ± 0.5	5.0 ± 0.5	Less than 2.0
E	3.2 ± 0.2	1.6 ± 0.2	Less than 1.25
F	2.0 ± 0.3	1.25 ± 0.2	Less than 1.25

Dimension

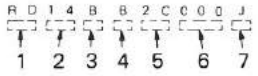
Dimension code	L	W	T	Wattage
E	3.2 ± 0.2	1.6 ± 0.2	0.57	2B
F	2.0 ± 0.3	1.25 ± 0.2	0.45	2A

RESISTORS

- **Chip resistor (Carbon)**



- **Carbon resistor (Normal type)**



Rating wattage

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

Dimension

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.

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
			TM-331A			
1	1B		A01-1065-03	METALLIC CABINET (UPSIDE)		
2	2B		A01-1066-03	METALLIC CABINET (BOTTOM)		
3	1C		A10-1292-01	CHASSIS CALKED ASSY		
4	2A	*	A20-2682-02	PANEL ASSY		
5	2B		A22-0760-13	SUB PANEL		
9	2B		B38-0311-15	LCD ASSY		
11	1B,1C		B42-2455-04	LABEL (M4X8 MAX)		
-		*	B40-3912-04	MODEL NAME PLATE		
-			B42-2454-04	SERIAL NO LABEL(PACKING)		
-			B42-3343-04	SERIAL NO LABEL(NAME PLATE)		
-			B42-3356-04	LABEL (EXT SP)		
-			B46-0410-20	WARRANTY CARD		
-			B50-8286-10	INSTRUCTION MANUAL		
			E30-2111-05	DC CORD		
			E31-3197-05	CONNECTING WIRE(SP)		
		*	E40-5205-05	PIN CONNECTOR		
15	1C		E30-2137-05	DC CORD		
16	1C		E30-2145-05	ANT CABLE		
			F05-8021-05	FUSE (8A)		
17	1C		F05-2036-05	FUSE (20A)		
18	2B		F12-0415-04	CONDUCTIVE SHEET		
19	2B		F20-0521-04	INSULATING BOARD(LITHIUM BATT)		
20	2B		F20-0587-04	INSULATING SHEET(LITHIUM BATT)		
22	1B		G02-0576-14	FLAT SPRING		
23	2A		G09-0405-05	KNOB FIXED SPRING		
24	1C		G10-0651-04	NON-WOVEN FABRIC		
25	1B,2C		G10-0681-04	NON-WOVEN FABRIC(CHASSIS)		
26	2A		G13-0907-04	CUSHION (6 KEY)		
27	2B		G13-0906-04	CUSHION (3 KEY)		
28	2B		G13-0926-04	CUSHION		
-		*	H01-8222-04	ITEM CARTON BOX		
-		*	H03-2746-04	OUTER PACKING CASE		
-			H10-2658-02	POLYSTYRENE FOAMED FIXTURE		
-			H11-0822-04	POLYSTYRENE PLATE		
-			H13-0814-04	PROTECTION PLATE(BRACKET)		
-			H25-0029-04	PROTECTION BAG(MIC HOOK,SCREW)		
-			H25-0049-03	PROTECTION BAG (DC CORD)		
-			H25-0720-04	PROTECTION BAG (TM-331A)		
			J20-0319-24	MIC HOOK		
			J21-4147-14	STACKING PLATE		
			J29-0436-03	BRACKET		
30	1C		J19-1434-04	HOLDER (SP)		
32	2B		K27-3035-04	KNOB (VFO,MR,MHZ)		
33	2A		K27-3036-04	KNOB (CALL,ETC)		
34	2B		K27-3037-04	KNOB (LOW)		
35	2B		K27-3038-04	KNOB (POWER)		
36	2A		K29-3156-04	KNOB (MAIN)		
37	2A		K29-3157-04	KNOB (VOL,SQL)		
			N46-3010-46	PAN HEAD TAPPING SCREW		
			N99-0331-05	SCREW SET		
A	2B		N09-0626-04	SCREW		

E: Scandinavia & Europe K: USA P: Canada W:Europe
U: PX(Far East, Hawaii) T: England M: Other Areas
UE : AAFES(Europe) X: Australia

⚠ 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.

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
B	2B		N09-0650-05	SCREW				
C	1C,2C		N33-2606-45	OVAL HEAD MACHINE SCREW				
D	1C,2B		N87-2606-46	BRAZIER HEAD TAPTITE SCREW				
E	2B		N88-2606-46	FLAT HEAD TAPTITE SCREW				
			T91-0380-15	MICROPHONE				
40	1C		T07-0246-05	LOUDSPEAKER(FULLRANGE)				
IC1			LC7582	IC(LCD DRIVER)				
			W01-0414-04	WRENCH				
41	2B		W09-0326-05	LITHIUM BATTERY				
42	2B,2C	*	X57-3320-10	TX-RX UNIT				
TX-RX UNIT (X57-3320-10)								
C1			CC73FCH1H030C	CHIP C	3.0PF	C		
C2			CC73FCH1H060D	CHIP C	6.0PF	D		
C3 ,4			CK73FB1H102K	CHIP C	1000PF	K		
C5			CK73FB1H103K	CHIP C	0.010UF	K		
C6			CK73FB1H102K	CHIP C	1000PF	K		
C7			CC73FCH1H0R5C	CHIP C	0.5PF	C		
C8			CC73FCH1H560J	CHIP C	56PF	J		
C9			CK73FB1H103K	CHIP C	0.010UF	K		
C10			CC73FCH1H020C	CHIP C	2.0PF	C		
C11			CC73FCH1H560J	CHIP C	56PF	J		
C12			CK73FB1H102K	CHIP C	1000PF	K		
C13			CC73FCH1H100D	CHIP C	10PF	D		
C14			CC73FCH1H560J	CHIP C	56PF	J		
C15			CK73FB1H103K	CHIP C	0.010UF	K		
C16 ,17			CC73FCH1H040C	CHIP C	4.0PF	C		
C18			CK73FB1H102K	CHIP C	1000PF	K		
C19			CK73FB1H103K	CHIP C	0.010UF	K		
C20			CK73FB1H102K	CHIP C	1000PF	K		
C21			CC73FCH1H060D	CHIP C	6.0PF	D		
C22 ,23			CK73FB1H103K	CHIP C	0.010UF	K		
C24			CC73FCH1H220J	CHIP C	22PF	J		
C25			CK73FB1H102K	CHIP C	1000PF	K		
C26			CC73FCH1H120J	CHIP C	12PF	J		
C27			CC73FCH1H390J	CHIP C	39PF	J		
C28			CK73FB1H102K	CHIP C	1000PF	K		
C41			CK73EF1C105Z	CHIP C	1.0UF	Z		
C42			CK73FB1H103K	CHIP C	0.010UF	K		
C43			CE04EW1A470M	ELECTRO	47UF	10WV		
C44			C92-0002-05	CHIP TAN	0.22UF	35WV		
C45 ,46			CK73EF1C105Z	CHIP C	1.0UF	Z		
C47			CK73EB1H104K	CHIP C	0.10UF	K		
C48			CE04EW1A471M	ELECTRO	470UF	10WV		
C49			CK73FB1H103K	CHIP C	0.010UF	K		
C50			CE04EW1C470M	ELECTRO	47UF	16WV		
C51 -53			CE04EW1A470M	ELECTRO	47UF	10WV		
C54			CK73FB1H273K	CHIP C	0.027UF	K		
C55			CC73FSL1H101J	CHIP C	100PF	J		
C56			CE04EW1E4R7M	ELECTRO	4.7UF	25WV		
C57 ,58			CK73EF1C105Z	CHIP C	1.0UF	Z		
C59			CK73FB1H103K	CHIP C	0.010UF	K		
C60			CE04EW1A470M	ELECTRO	47UF	10WV		

E: Scandinavia & Europe K: USA P: Canada W: Europe
U: PX(Far East, Hawaii) T: England M: Other Areas
UE: AAFES(Europe) X: Australia

⚠ 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.

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
C61			C92-0504-05	CHIP-TAN	0.68UF	20WV		
C62			CE04EW1A470M	ELECTRO	47UF	10WV		
C63			CK73FB1H103K	CHIP C	0.010UF	K		
C64			C92-0504-05	CHIP-TAN	0.68UF	20WV		
C65 ,66			CK73FB1H102K	CHIP C	1000PF	K		
C68			C92-0501-05	CHIP TAN	1.5UF	6.3WV		
C69 ,70			CK73FB1H103K	CHIP C	0.010UF	K		
C71			CK73FB1H102K	CHIP C	1000PF	K		
C72			CK73EB1H473K	CHIP C	0.047UF	K		
C73			CK73FB1H102K	CHIP C	1000PF	K		
C74			CK73EF1C105Z	CHIP C	1.0UF	Z		
C75 ,76			CK73FB1H102K	CHIP C	1000PF	K		
C77			CK73EF1C105Z	CHIP C	1.0UF	Z		
C78			CK73FB1H102K	CHIP C	1000PF	K		
C79			CC73FCH1H100D	CHIP C	10PF	D		
C80			CK73FB1H102K	CHIP C	1000PF	K		
C81			CC73FCH1H100D	CHIP C	10PF	D		
C82			CK73FB1H103K	CHIP C	0.010UF	K		
C83			CE04EW1A470M	ELECTRO	47UF	10WV		
C84			CK73FB1H103K	CHIP C	0.010UF	K		
C85 ,86			CE04EW1A221M	ELECTRO	220UF	10WV		
C87 ,88			CK73FB1H103K	CHIP C	0.010UF	K		
C89 -92			CK73FB1H102K	CHIP C	1000PF	K		
C93			CK73FB1H103K	CHIP C	0.010UF	K		
C94			CE04EW1A470M	ELECTRO	47UF	10WV		
C95 ,96			CK73FB1H103K	CHIP C	0.010UF	K		
C97			CE04EW1C102M	ELECTRO	1000UF	16WV		
C99			CK73FB1H102K	CHIP C	1000PF	K		
C100			CK73EF1C105Z	CHIP C	1.0UF	Z		
C101			CK73FB1H102K	CHIP C	1000PF	K		
C102			CE04EW1C100M	ELECTRO	10UF	16WV		
C103			CC45SL2H220J	CERAMIC	22PF	J		
C104			CC45SL2H030C	CERAMIC	3.0PF	C		
C105			CK73FB1H102K	CHIP C	1000PF	K		
C106			CC73FCH1H050C	CHIP C	5.0PF	C		
C107			CK45B2H102K	CERAMIC	1000PF	K		
C108			CC45SL2H040C	CERAMIC	4.0PF	C		
C109			CC73FCH1H020C	CHIP C	2.0PF	C		
C110			CC73FCH1H020C	CHIP C	2.0PF	C		
C111,113			CK73FB1H102K	CHIP C	1000PF	K		
C114			CC73FCH1H0R5C	CHIP C	0.5PF	C		
C115			CC45SL2H180J	CERAMIC	18PF	J		
C116			CC73FCH1H020C	CHIP C	2.0PF	C		
C117			CC73FCH1H030C	CHIP C	3.0PF	C		
C118			CM73F2H050D	CHIP C	5.0PF	D		
C119			CK73FB1H102K	CHIP C	1000PF	K		
C120			C92-0511-05	CHIP TAN	0.15UF	35WV		
C121			CK73EF1C105Z	CHIP C	1.0UF	Z		
C122			CK73FB1H102K	CHIP C	1000PF	K		
C123			CK73EF1C105Z	CHIP C	1.0UF	Z		
C124			CC73FCH1H080D	CHIP C	8.0PF	D		
C201			CK73FB1H103K	CHIP C	0.010UF	K		
C202			CE04CW1C100M	ELECTRO	10UF	16WV		
C203			CK73FB1H223K	CHIP C	0.022UF	K		
C204,205			CK73FB1H102K	CHIP C	1000PF	K		

E: Scandinavia & Europe K: USA P: Canada W: Europe
U: PX(Far East, Hawaii) T: England M: Other Areas
UE: AAFES(Europe) X: Australia

⚠ 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.

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
C206,207			CC73FCH1H330J	CHIP C 33PF J		
C208,209			CK73FB1H103K	CHIP C 0.010UF K		
C210,215			CK73FB1H102K	CHIP C 1000PF K		
C216			CK73FB1H223K	CHIP C 0.022UF K		
C217			CK73FB1H102K	CHIP C 1000PF K		
TC1			C05-0349-05	TRIMMING 10PF		
CN1			E40-3237-05	PIN CONNECTOR (SP)		
CN2			E40-5182-05	PIN CONNECTOR (VOICE)		
CN3 ,4			E40-5202-05	PIN CONNECTOR (CONTROL)		
CN201,202			E40-5203-05	PIN CONNECTOR (TX-RX)		
CN203			E40-5185-05	PIN CONNECTOR (VOICE 8P)		
CN204			E40-5187-05	PIN CONNECTOR (VOICE 10P)		
CN205,206			E40-5204-05	PIN CONNECTOR (LCD)		
J1			E11-0425-05	PHONE JACK		
J101			E06-0858-15	8P METAL SOCKET		
TP1 ,2			E23-0465-05	TERMINAL		
W1			E33-1872-05	FINISHED WIRE SET(HET)		
W201			E33-1871-05	FINISHED WIRE SET		
W202			E31-6003-15	CONNECTING WIRE(CTCSS)		
CD1			L79-0855-05	CERAMIC DISCRI		
CF1			L72-0372-05	CERAMIC FILTER (455KHZ)		
L1 -4			L34-4103-05	COIL		
L5			L34-2265-05	TUNING COIL		
L6			L34-2157-05	TUNING COIL		
L7			L40-1001-48	SMALL FIXED INDUCTOR(10UH)		
L8			L34-1239-05	COIL		
L9			L34-1207-05	COIL		
L10			L34-1208-05	COIL		
L12 ,13			L34-0641-05	COIL		
L14		*	L40-4772-48	SMALL FIXED INDUCTOR(47NH)		
L15			L40-1092-81	SMALL FIXED INDUCTOR(1UH)		
L141			L34-0908-05	COIL		
X1			L77-1312-05	CRYSTAL RESONATOR(30.370MHZ)		
X2			L77-1405-05	CRYSTAL RESONATOR(12.8MHZ)		
X201			L77-1397-05	CRYSTAL RESONATOR(4.194304MHZ)		
XF1			L71-0270-05	MCF (30.825MHZ)		
R1			RK73FB2A101J	CHIP R 100 J 1/10W		
R1			RK73FB2A333J	CHIP R 33K J 1/10W		
R2			RK73FB2A274J	CHIP R 270K J 1/10W		
R4			RK73FB2A103J	CHIP R 10K J 1/10W		
R5			RK73FB2A101J	CHIP R 100 J 1/10W		
R6			RK73FB2A103J	CHIP R 10K J 1/10W		
R7 -9			RK73FB2A104J	CHIP R 100K J 1/10W		
R10			RK73FB2A473J	CHIP R 47K J 1/10W		
R11			RK73FB2A223J	CHIP R 22K J 1/10W		
R12			RK73FB2A470J	CHIP R 47 J 1/10W		
R13			RK73FB2A274J	CHIP R 270K J 1/10W		
R14			RK73FB2A221J	CHIP R 220 J 1/10W		
R15			RK73FB2A104J	CHIP R 100K J 1/10W		
R16			RK73FB2A102J	CHIP R 1.0K J 1/10W		
R17			RK73FB2A222J	CHIP R 2.2K J 1/10W		
R18			RK73FB2A101J	CHIP R 100 J 1/10W		
R19			R92-0670-05	CHIP R 0 OHM		

E: Scandinavia & Europe K: USA P: Canada W: Europe
U: PX(Far East, Hawaii) T: England M: Other Areas
UE: AAFES(Europe) X: Australia

⚠ 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.

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
R20			RK73FB2A122J	CHIP R 1.2K J 1/10W		
R21 ,22			R92-0670-05	CHIP R 0 OHM		
R23			RK73FB2A471J	CHIP R 470 J 1/10W		
R24			RK73FB2A101J	CHIP R 100 J 1/10W		
R25			RK73FB2A103J	CHIP R 10K J 1/10W		
R26			RK73FB2A473J	CHIP R 47K J 1/10W		
R27 ,28			RK73FB2A103J	CHIP R 10K J 1/10W		
R29 ,30			RK73FB2A102J	CHIP R 1.0K J 1/10W		
R31			RK73FB2A334J	CHIP R 330K J 1/10W		
R32			RK73FB2A331J	CHIP R 330 J 1/10W		
R34			RK73FB2A331J	CHIP R 330 J 1/10W		
R43			RK73FB2A3R3J	CHIP R 3.3 J 1/10W		
R44			RK73FB2A101J	CHIP R 100 J 1/10W		
R45			R92-0670-05	CHIP R 0 OHM		
R46			RK73FB2A102J	CHIP R 1.0K J 1/10W		
R47			RK73FB2A473J	CHIP R 47K J 1/10W		
R48			RK73FB2A333J	CHIP R 33K J 1/10W		
R49			RK73FB2A473J	CHIP R 47K J 1/10W		
R50			RK73FB2A223J	CHIP R 22K J 1/10W		
R51			RK73FB2A472J	CHIP R 4.7K J 1/10W		
R52			RK73FB2A102J	CHIP R 1.0K J 1/10W		
R53			RK73FB2A334J	CHIP R 330K J 1/10W		
R54			RK73FB2A223J	CHIP R 22K J 1/10W		
R55			RK73FB2A182J	CHIP R 1.8K J 1/10W		
R56 -58			RK73FB2A103J	CHIP R 10K J 1/10W		
R59			RK73FB2A182J	CHIP R 1.8K J 1/10W		
R60			RK73FB2A223J	CHIP R 22K J 1/10W		
R61			RK73FB2A473J	CHIP R 47K J 1/10W		
R62			R92-0670-05	CHIP R 0 OHM		
R63			RK73FB2A332J	CHIP R 3.3K J 1/10W		
R64			RK73FB2A392J	CHIP R 3.9K J 1/10W		
R65 ,66			R92-0670-05	CHIP R 0 OHM		
R67			RK73FB2A220J	CHIP R 22 J 1/10W		
R68			R92-0670-05	CHIP R 0 OHM		
R69			RK73FB2A184J	CHIP R 180K J 1/10W		
R70 ,71			RK73FB2A103J	CHIP R 10K J 1/10W		
R72			R92-0670-05	CHIP R 0 OHM		
R73			RK73FB2A223J	CHIP R 22K J 1/10W		
R74			R92-0670-05	CHIP R 0 OHM		
R75 -78			RK73FB2A472J	CHIP R 4.7K J 1/10W		
R79			RK73FB2A105J	CHIP R 1.0M J 1/10W		
R80			RK73FB2A104J	CHIP R 100K J 1/10W		
R81			RK73FB2A471J	CHIP R 470 J 1/10W		
R82			RK73FB2A220J	CHIP R 22 J 1/10W		
R83			R92-0670-05	CHIP R 0 OHM		
R84			RK73FB2A152J	CHIP R 1.5K J 1/10W		
R85			R92-0670-05	CHIP R 0 OHM		
R86			RK73FB2A223J	CHIP R 22K J 1/10W		
R87			RK73FB2A103J	CHIP R 10K J 1/10W		
R88 ,89			RK73FB2A101J	CHIP R 100 J 1/10W		
R90			RK73FB2A222J	CHIP R 2.2K J 1/10W		
R91			RK73FB2A102J	CHIP R 1.0K J 1/10W		
R92			RK73FB2A104J	CHIP R 100K J 1/10W		
R93			RK73FB2A220J	CHIP R 22 J 1/10W		
R95			RK73FB2A822J	CHIP R 8.2K J 1/10W		

E: Scandinavia & Europe K: USA P: Canada W: Europe
U: PX(Far East, Hawaii) T: England M: Other Areas
UE: AAFES(Europe) X: Australia

⚠ 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.
Telle ohne **Parts No.** werden nicht geliefert.

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
R96			RK73FB2A103J	CHIP R 10K J 1/10W		
R97			R92-1215-05	CHIP R 470 1/ 2W		
R98			RK73FB2A103J	CHIP R 10K J 1/10W		
R100			R92-0670-05	CHIP R 0 OHM		
R102			R92-0699-05	SOLID 10 1/2W		
R103			R92-1213-05			
R104,105			RK73FB2A223J	CHIP R 22K J 1/10W		
R107			R92-0670-05	CHIP R 0 OHM		
R108			RK73FB2A273J	CHIP R 27K J 1/10W		
R201			RK73FB2A472J	CHIP R 4.7K J 1/10W		
R202			RK73FB2A104J	CHIP R 100K J 1/10W		
R203			RK73FB2A563J	CHIP R 56K J 1/10W		
R204			RK73FB2A103J	CHIP R 10K J 1/10W		
R205			R92-0670-05	CHIP R 0 OHM		
R207			R92-0670-05	CHIP R 0 OHM		
R208-210			RK73FB2A473J	CHIP R 47K J 1/10W		
R211-213			RK73FB2A102J	CHIP R 1.0K J 1/10W		
R215			RK73FB2A105J	CHIP R 1.0M J 1/10W		
R216,217			RK73FB2A104J	CHIP R 100K J 1/10W		
R218			RK73FB2A102J	CHIP R 1.0K J 1/10W		
R219			RK73FB2A473J	CHIP R 47K J 1/10W		
R220			RK73FB2A332J	CHIP R 3.3K J 1/10W		
R221			RK73FB2A474J	CHIP R 470K J 1/10W		
R222			RK73FB2A473J	CHIP R 47K J 1/10W		
R223			R92-1212-05			
R224			RK73FB2A474J	CHIP R 470K J 1/10W		
R225			RK73FB2A472J	CHIP R 4.7K J 1/10W		
R226-230			R92-0670-05	CHIP R 0 OHM		
R232,233			RK73FB2A472J	CHIP R 4.7K J 1/10W		
R234			R92-0670-05	CHIP R 0 OHM		
R235			RK73FB2A563J	CHIP R 56K J 1/10W		
R236			RK73FB2A474J	CHIP R 470K J 1/10W		
TH1			R92-1216-05	THERMISTOR 10K		
VR1			R12-5058-05	TRIMMING POT. 100K		
VR3			R12-3132-05	TRIMMING POT. 47K		
VR4 ,5			R12-3126-05	TRIMMING POT. 10K		
VR201			R05-3441-05	POTENTIOMETER 10K(A)(VOL)		
VR202			R05-4420-05	POTENTIOMETER 50K(B)(SQL)		
S201			S40-2458-05	PUSH SWITCH (POWER)		
S202-211			S40-1086-05	TACT SWITCH		
D1 -3			1SV164	CHIP VARI-CAP DIODE		
D6			1SV164	CHIP VARI-CAP DIODE		
D7			DLS1585	CHIP DIODE		
D8 ,9			1SS184	CHIP DIODE		
D10			DAN235(K)	CHIP DIODE		
D11			MA716	CHIP DIODE		
D12			MI407	DIODE		
D13			MI308	DIODE		
D14 ,15			1SS226	CHIP DIODE		
D16			DSA3A1	DIODE		
D17 ,18			DTC124EK	DIGITAL TRANSISTOR		
D201			DLS1585	CHIP DIODE		
D202			1SS181	CHIP DIODE		
D203			1SS184	CHIP DIODE		

E: Scandinavia & Europe K: USA P: Canada W:Europe
U: PX(Far East, Hawaii) T: England M: Other Areas
UE: AAFES(Europe) X: Australia

⚠印は安全部品
⚠ 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.

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
D204			1SS187	CHIP DIODE		
D205			1SS193	CHIP DIODE		
D206,207			1SS187	CHIP DIODE		
D210			MA141A	CHIP DIODE		
D212			02CZ7.5(X,Y)	CHIP ZENER DIODE		
IC1			KCD01	H.IC		
IC3			UPC1241H	IC		
IC4			KCC02	H.IC		
IC5			TC9174F	IC(CMOS I/O)		
IC6			NJM78L05UA	IC(VOLTAGE REGULATOR/ +5V)		
IC7			LA5009M	IC		
IC8		*	KCB08	H.IC		
IC9			MC7808CT	IC(VOLTAGE REGULATORS/ +8V)		
IC201			75108G-E10-1B	IC(MICROPROCESSOR) ←75108GF-N573BE		
IC202			NJM78L06UA	IC(VOLTAGE REGULATOR/ +6V)		
IC203			KRR-C001	IC(CHIP NETWORK)		
IC301			M57774	IC(POWER MODULE)		
Q1 ,2			3SK184(S)	CHIP FET		
Q3			2SC2714(Y)	CHIP TRANSISTOR		
Q4			FMG2	DIGITAL TRANSISTOR		
Q5			2SC2712(Y)	CHIP TRANSISTOR		
Q6			2SD1757(K)	CHIP TRANSISTOR		
Q7 ,8			2SB1119S	CHIP TRANSISTOR		
Q9			DTC144WK	DIGITAL TRANSISTOR		
Q10 -12			2SC2712(Y)	CHIP TRANSISTOR		
Q13			2SD1757(K)	CHIP TRANSISTOR		
Q14			2SC2712(Y)	CHIP TRANSISTOR		
Q15			2SK208(Y)	CHIP FET		
Q16			2SC2714(Y)	CHIP TRANSISTOR		
Q19			2SB1302S	CHIP TRANSISTOR		
Q20			2SC2712(Y)	CHIP RTANSISTOR		
Q25			2SD1406(Y)	TRANSISTOR		
Q201,202			2SC2712(Y)	CHIP TRANSISTOR		
Q203			2SA1519	DIGITAL TRANSISTOR		
Q204			2SC2712(Y)	CHIP TRANSISTOR		
S212			W02-0388-05	ENCODER		
		*	X58-3580-10	SUB YNIT (PLL)		
			X59-3130-00	MODULE UNIT (APC)		
			X59-3610-00	MODULE UNIT (MIC AMP)		
PLL (X58-3580-10)						
C1			CK73FB1H223K	CHIP C 0.022UF K		
C2			CC73FCH1H120J	CHIP C 12PF J		
C3			CC73FUJ1H220J	CHIP C 22PF J		
C4			CK73FB1H102K	CHIP C 1000PF K		
C5			CK73EB1H333K	CHIP C 0.033UF K		
C6			CK73FB1H102K	CHIP C 1000PF K		
C7			CK73FB1H223K	CHIP C 0.022UF K		
C8 ,9			C92-0008-05	CHIP TAN 3.3UF 16WV		
C10			C92-0502-05	ELECTRO 0.33UF 35WV		
C11			CK73FB1H223K	CHIP C 0.022UF K		
C12			CC73FCH1H100D	CHIP C 10PF D		
C13			CK73FB1E393K	CHIP C 0.039UF K		
C14			CC73FCH1H050C	CHIP C 5.0PF C		
C15			CK73FB1H102K	CHIP C 1000PF K		

E: Scandinavia & Europe K: USA P: Canada W:Europe
U: PX(Far East, Hawaii) T: England M: Other Areas
UE: AAFES(Europe) X: Australia

⚠ 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.

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
C16 ,17			CC73FSL1H101J	CHIP C 100PF J		
C101,102			CK73FB1H102K	CHIP C 1000PF K		
C103			CK73FB1H471K	CHIP C 470PF K		
C104			CC73FCH1H030C	CHIP C 3.0PF C		
C105			CC73FCH1H040C	CHIP C 4.0PF C		
C106,107			CC73FCH1H1R5C	CHIP C 1.5PF C		
C108			CC73FCH1H220J	CHIP C 22PF J		
C109			CC73FCH1H180J	CHIP C 18PF J		
C110			CC73FCH1H010C	CHIP C 1.0PF C		
C111			CC73FCH1H050C	CHIP C 5.0PF C		
C112,113			CK73FB1H102K	CHIP C 1000PF K		
CN1			E40-5201-05	PIN CONNECTOR (7P)		
CN101			E40-0411-05	PIN CONNECTOR (4P)		
CN102			E40-0311-05	PIN CONNECTOR (3P)		
			F11-1122-14	SHIELDING COVER		
L1			L40-1082-48	SMALL FIXED INDUCTOR(100NH)		
L101,102			L40-3391-19	SMALL FIXED INDUCTOR(3.3UH)		
L103		*	L34-2341-05	COIL		
L104		*	L40-1292-19	SMALL FIXED INDUCTOR(1.2UH)		
L105			L40-5682-19	SMALL FIXED INDUCTOR(0.56UH)		
L106		*	L40-6872-48	SMALL FIXED INDUCTOR(68NH)		
R1 ,2			RK73FB2A473J	CHIP R 47K J 1/10W		
R3 -5			RK73FB2A102J	CHIP R 1.0K J 1/10W		
R6 ,7			R92-0670-05	CHIP R 0 OHM		
R8			RK73FB2A332J	CHIP R 3.3K J 1/10W		
R9			RK73FB2A392J	CHIP R 3.9K J 1/10W		
R10 -12			RK73FB2A473J	CHIP R 47K J 1/10W		
R13			RK73FB2A103J	CHIP R 10K J 1/10W		
R14			RK73FB2A331J	CHIP R 330 J 1/10W		
R15			RK73FB2A472J	CHIP R 4.7K J 1/10W		
R16			RK73FB2A222J	CHIP R 2.2K J 1/10W		
R101			R92-0670-05	CHIP R 0 OHM		
R102			RK73FB2A102J	CHIP R 1.0K J 1/10W		
R103			RK73FB2A104J	CHIP R 100K J 1/10W		
R104			RK73FB2A470J	CHIP R 47 J 1/10W		
R106			RK73FB2A680J	CHIP R 68 J 1/10W		
R107			RK73FB2A470J	CHIP R 47 J 1/10W		
R108			RK73FB2A392J	CHIP R 3.9K J 1/10W		
R109			RK73FB2A103J	CHIP R 10K J 1/10W		
R110			RK73FB2A221J	CHIP R 220 J 1/10W		
D101,102		*	1T33C	CHIP VARI-CAP DIODE		
D103			1SV164	CHIP VARI-CAP DIODE		
IC1			M54959FP	IC(FREQ SYNTHESIZER PLL)		
Q1 ,2			2SC3324(B)	CHIP TRANSISTOR		
Q4		*	DTC143ZK	DIGITAL TRANSISTOR		
Q5			2SC2714(Y)	CHIP TRANSISTOR		
Q101			2SK582	FET		
Q102			2SC3120	CHIP TRANSISTOR		
APC (X59-3130-00)						
C1			CK73FB1H102K	CHIP C 1000PF K		
C2			C92-0501-05	CHIP TAN 1.5UF 6.3WV		
C3			CK73FB1H472K	CHIP C 4700PF K		

E: Scandinavia & Europe K: USA P: Canada W:Europe
U: PX(Far East, Hawaii) T: England M: Other Areas
UE: AAFES(Europe) X: Australia

⚠ 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.
Telle ohne **Parts No.** werden nicht geliefert.

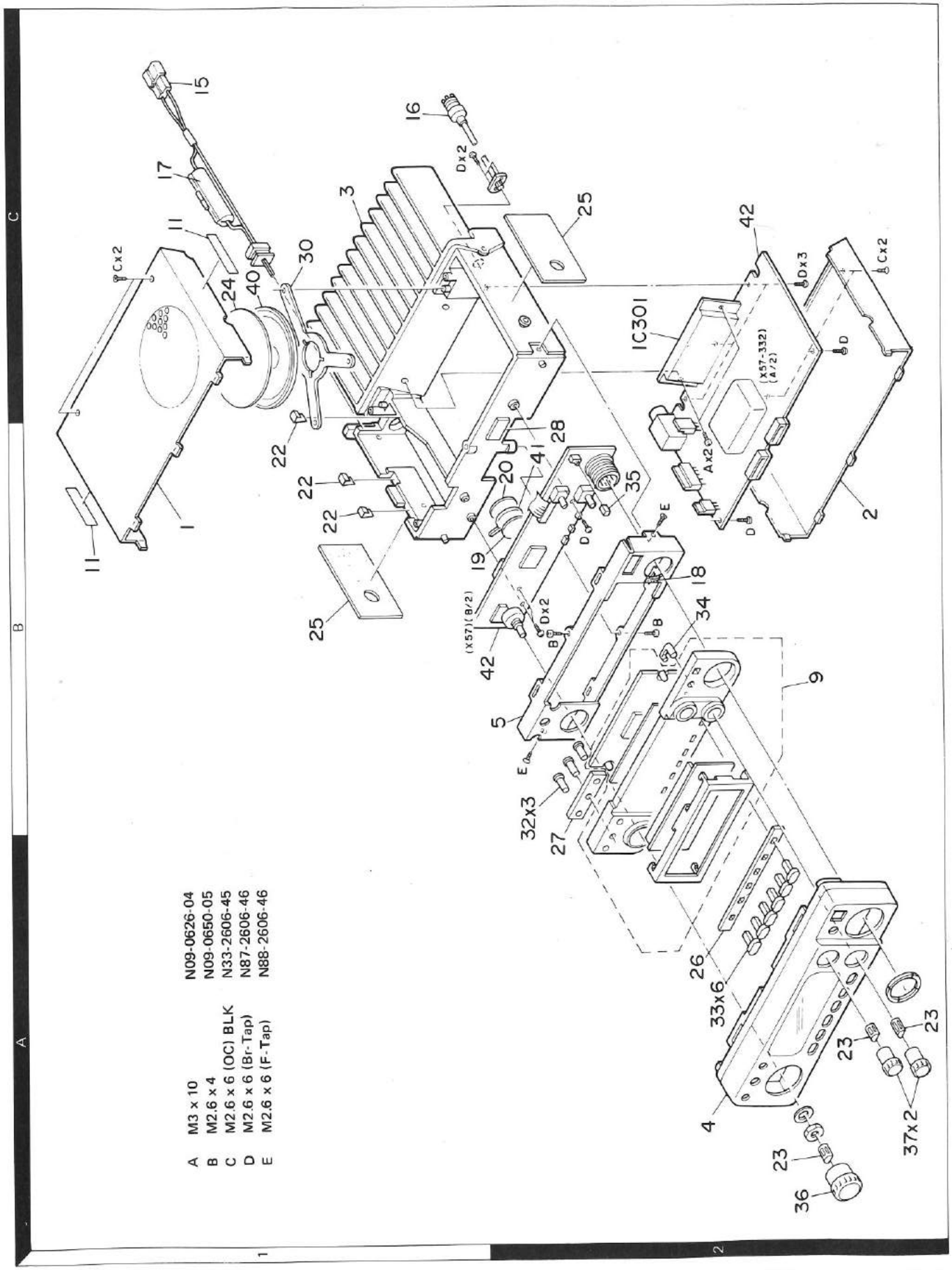
Ref. No. 参照番号	Address 位置	New Parts 新	Parts No. 部品番号	Description 部品名／規格	Destination 仕向	Remarks 備考
C4			CK73FB1H102K	CHIP C 1000PF K		
C5			CK73FB1H472K	CHIP C 4700PF K		
C6			CK73FB1H102K	CHIP C 1000PF K		
			E23-0471-05	TERMINAL		
R1			RD41FB2B222J	CYLND CHIP R 2.2K J 1/8W		
R2			RD41FB2B102J	CYLND CHIP R 1.0K J 1/8W		
R3			RD41FB2B152J	CYLND CHIP R 1.5K J 1/8W		
R4 ,5			RD41FB2B103J	CYLND CHIP R 10K J 1/8W		
R6			RD41FB2B122J	CYLND CHIP R 1.2K J 1/8W		
Q1 ,2			FMW1	DIGITAL TRANSISTOR		
Q3			2SA1162(Y)	CHIP TRANSISTOR		
MIC AMP (X59-3610-00)						
C1			CK73FF1E104Z	CHIP C 0.10UF Z		
C2			CK73GB1H102K	CHIP C 1000PF K		
C3			CK73FB1E333K	CHIP C 0.033UF K		
C4			CC73GCH1H270J	CHIP C 27PF J		
C5			C92-0004-05	CHIP TAN 1UF 16WV		
C6			CK73FB1E333K	CHIP C 0.033UF K		
C7			CK73GB1H681K	CHIP C 680PF K		
C8			CK73GB1H332K	CHIP C 3300PF K		
C9		*	CC73GCH1H820J	CHIP C 82PF J		
C10		*	CC73GCH1H101J	CHIP C 100PF J		
			E23-0471-05	TERMINAL		
R1			RK73GB1J223J	CHIP R 22K J 1/16W		
R2			RK73GB1J104J	CHIP R 100K J 1/16W		
R3			RK73GB1J561J	CHIP R 560 J 1/16W		
R3			RK73GB1J561J	CHIP R 560 J 1/16W		
R4			RK73GB1J470J	CHIP R 47 J 1/16W		
R5			RK73GB1J561J	CHIP R 560 J 1/16W		
R5			RK73GB1J561J	CHIP R 560 J 1/16W		
R6			RK73GB1J000J	CHIP R 0.0 J 1/16W		
R6			RK73GB1J000J	CHIP R 0.0 J 1/16W		
R7			RK73GB1J394J	CHIP R 390K J 1/16W		
R8			RK73GB1J224J	CHIP R 220K J 1/16W		
R8			RK73GB1J224J	CHIP R 220K J 1/16W		
R9			RK73GB1J184J	CHIP R 180K J 1/16W		
R10			RK73GB1J333J	CHIP R 33K J 1/16W		
R11			RK73FB2A473J	CHIP R 47K J 1/10W		
R12			RK73GB1J224J	CHIP R 220K J 1/16W		
R12			RK73GB1J224J	CHIP R 220K J 1/16W		
R13 -15			RK73GB1J823J	CHIP R 82K J 1/16W		
R16			RK73GB1J000J	CHIP R 0.0 J 1/16W		
R16			RK73GB1J000J	CHIP R 0.0 J 1/16W		
IC1			NJM4558M	IC(OP AMP X2)		
Q1			2SC4116(Y)	CHIP TRANSISTOR		

E: Scandinavia & Europe K: USA P: Canada W:Europe
U: PX(Far East, Hawaii) T: England M: Other Areas
UE: AAFES(Europe) X: Australia

⚠ indicates safety critical components.

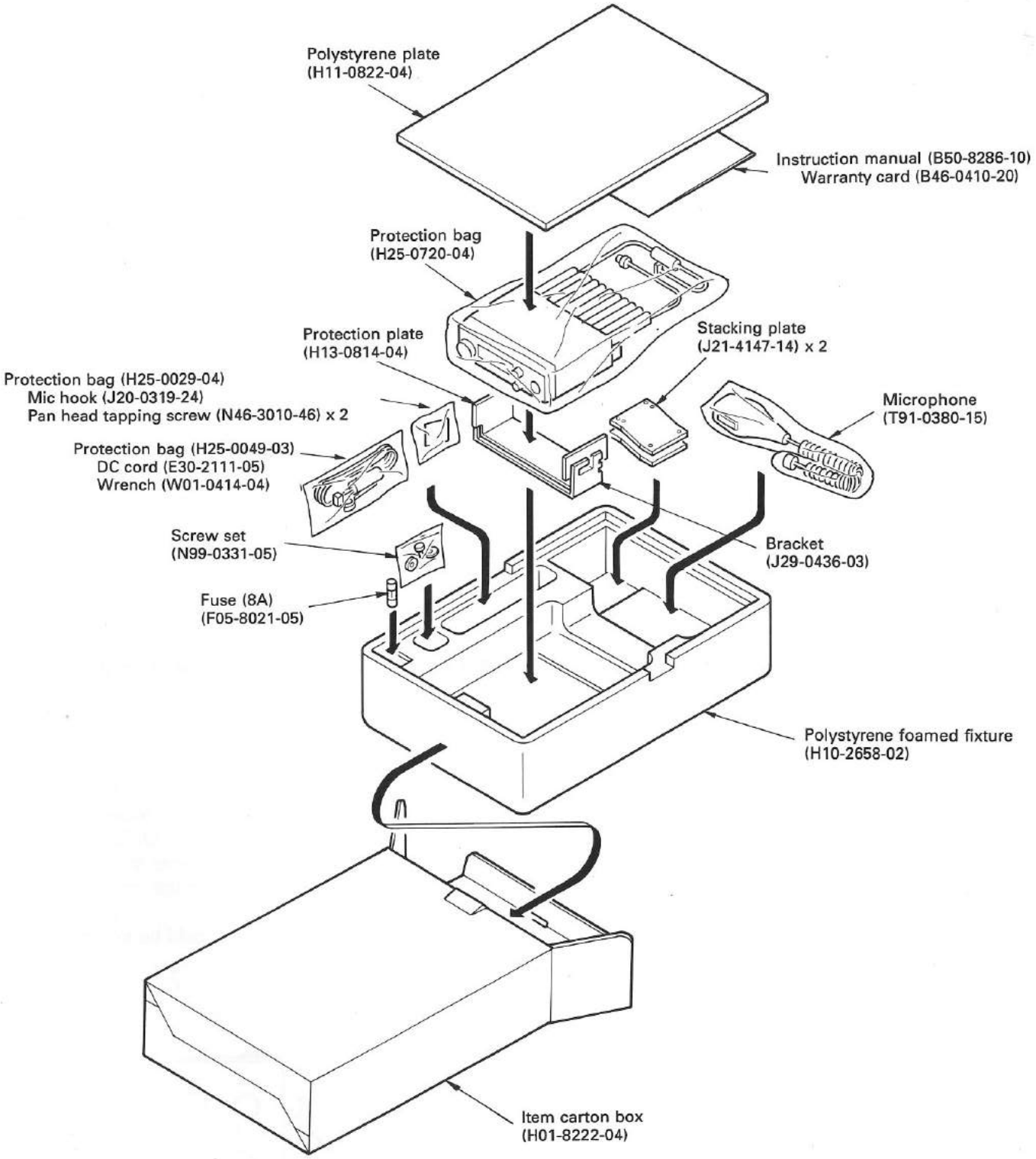
TM-331A

EXPLODED VIEW



Parts with the exploded numbers larger than 700 are not supplied.

PACKING


Polystyrene plate
(H11-0822-04)
Instruction manual (B50-8286-10)
Warranty card (B46-0410-20)
Protection bag
(H25-0720-04)
Protection plate
(H13-0814-04)
Stacking plate
(J21-4147-14) x 2
Protection bag (H25-0029-04)
Mic hook (J20-0319-24)
Pan head tapping screw (N46-3010-46) x 2
Microphone
(T91-0380-15)
Protection bag (H25-0049-03)
DC cord (E30-2111-05)
Wrench (W01-0414-04)
Screw set
(N99-0331-05)
Bracket
(J29-0436-03)
Fuse (8A)
(F05-8021-05)
Polystyrene foamed fixture
(H10-2658-02)
Item carton box
(H01-8222-04)

ADJUSTMENT

REQUIRED TEST EQUIPMENT

1. **DC V.M and Tester**
   1) High input impedance
2. **RF VTVM (RF V.M)**
   1) Input impedance : 1MΩ min., 2pF max.
   2) Voltage range : F.S = 10mV to 300V
   3) Frequency range : Up to 450MHz
3. **Frequency Counter (f. counter)**
   1) Input sensitivity : Approx. 50mV
   2) Frequency range : Up to 450MHz
4. **DC Power Supply**
   1) Voltage : 10V to 17V, variable
   2) Current : 15A min.
5. **Power Meter**
   1) Measurement range : Approx. 30W, 3W, 1W
   2) Input impedance : 50Ω
   3) Frequency range : 450MHz
6. **AF VTVM (AF V.M)**
   1) Input impedance : 1MΩ min.
   2) Voltage range : F.S = 1mV to 30V
   3) Frequency range : 50Hz to 10kHz
7. **AF Generator (AG)**
   1) Output frequency : 100Hz to 10kHz
   2) Output voltage : 0.5mV to 1V
8. **Linear Detector**
   1) Frequency range : 450MHz
9. **Spectrum Analyzer**
   1) Frequency range : 450MHz
10. **Directional Coupler**
11. **Oscilloscope**
    1) High sensitivity oscilloscope with horizontal input terminal
12. **SSG**
    1) Frequency range : 220MHz band
    2) Modulation: AM and FM MOD.
    3) Output level : 0.1μV to 100mV
13. **Dummy Load**
    1) 8Ω, 5W (approx.)
14. **Noise Generator**
    1) Must generate ignition-like noise containing harmonics beyond 450MHz.
15. **Sweep Generator**
    1) Sweep range : 220MHz band
16. **Tracking Generator**

PREPARATION

1) Unless otherwise specified, knobs and switches should be set as follows **Table 6.**

POWER SW	ON	CALL	OFF
AF VOL VR	MIN	SHIFT/AL	OFF
SQL VOL VR	MIN	TONE/T. ALT	OFF
VFO	VFO	REV/STEP	OFF
MR	OFF	DRS	OFF

Table 6

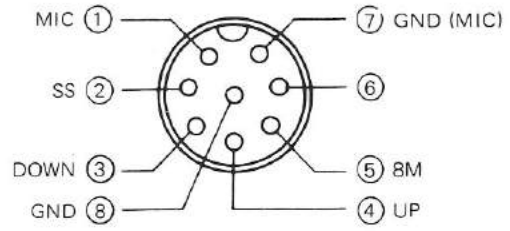


Fig. 13 MIC terminals (view from front panel side)

2) Use an insulated adjusting rod to adjust trimmers and coils.
3) To prevent damaging SSG, never set the stand by switch to SEND while adjusting the receiver section.
4) Be sure to turn the power switch OFF, before connecting the power cable to a power source.
5) SSG output levels are those at the time the output terminal is open.
6) Meter and display section should be set as follows **Fig. 14.**

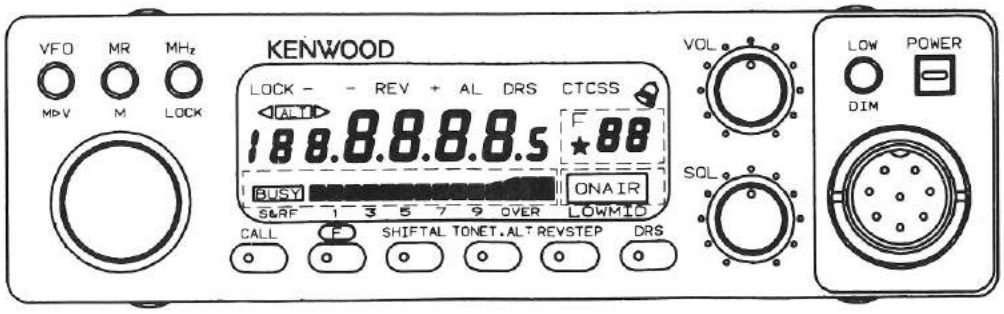


Fig. 14

ADJUSTMENT

COMMON SECTION ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specifications/Remarks
		Test-equipment	Unit	Terminal	Unit	Parts	Method	
1. Setting	1) Source voltage : DC 13.8V POWER SW : OFF VOL VR : Full counter-clock-wise (CCW) SQL VR : CCW TX-RX unit VR3, 4 : CCW VR1 : Center							
2. Reset	1) Turn POWER SW ON while holding down MR/M.							Display 220.000
3. PLL	1) RX VCO FREQ. : 222.500 Receive.	DVM Dummy	TX-RX Rear panel	TP2 ANT			Check	2.0 ~ 2.6V
	2) TX VCO FREQ. : 222.500 Transmit.						Check	6.2 ~ 6.9V
4. Transmit frequency adjustment	1) FREQ. : 222.500 Transmit.	f.counter Power meter	Rear panel	ANT	TX-RX	TC1	222.500MHz	±100Hz

RECEIVER SECTION ADJUSTMENT

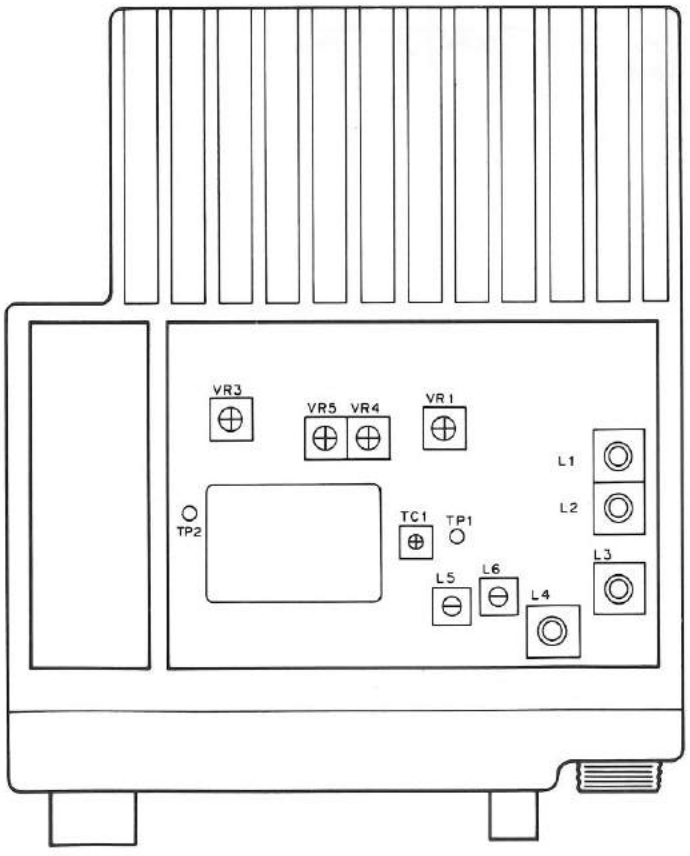
Item	Condition	Measurement			Adjustment			Specifications/Remarks
		Test-equipment	Unit	Terminal	Unit	Parts	Method	
1. BPF	1) FREQ. : 222.520 Connect the SSG to ANT. Connect the DC V.M to TP1. SSG output : –113dBm (0.5µV) SSG MOD : 1kHz SSG DEV : 3kHz	DC V.M	TX-RX	TP1	TX-RX	L1 ~ 5	Repeat for MAX.	
2. Distortion	1) FREQ. : 222.520 SSG output : –103dBm (1.7µV) SSG MOD : 1kHz SSG DEV : 3kHz	Distortion meter Oscilloscope	Rear panel	SP	TX-RX	L6	Repeat for MIN.	Turn L6 core CCW until best SINAD point obtained.
3. Receiving sensitivity	1) FREQ. : 222.520 SSG output : –123dBm (0.16µV) SSG MOD : 1kHz SSG DEV : 3kHz	AF V.M Oscilloscope	Rear panel	SP	TX-RX	L1 ~ 6	Check	SINAD 12dB or more.
	2) FREQ. : 220.020							
	3) FREQ. : 224.960							
4. S-meter	1) FREQ. : 222.520 SSG output : –93dBm (5µV) SSG MOD : 1kHz SSG DEV : 3kHz	LCD (S-meter)			TX-RX	VR1	All S-meter segments on (Adjust VR5 so that last segment just turns on.)	
	2) SSG : OFF						Check	S-meter off.

ADJUSTMENT

TRANSMITTER SECTION ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specifications/Remarks
		Test-equipment	Unit	Terminal	Unit	Parts	Method	
1-1. APC	1) FREQ. : 220.000 TX-RX unit VR4 : CCW Transmit.	Power meter Ammeter	Rear panel	ANT			Check	29W or more.
								ON AIR LED on.
					TX-RX	VR4	28W	±1W, 6.5A or less.
	2) FREQ. : 224.980 Transmit.						Check Read RF meter.	24 ~ 32W, 6.5A or less. All RF meter LEDs on.
	3) FREQ. : 220.000 Transmit.							
1-2. MID power	1) FREQ. : 222.500 MID SW : ON Transmit.				TX-RX	VR5	12W Read RF meter.	±1W 10 RF meter LEDs on.
1-3. LOW power	1) FREQ. : 222.500 LOW SW : ON Transmit.						Check Read RF meter.	3.0 ~ 8.0W 6 RF meter LEDs on.
2. DEV.	1) FREQ. : 222.520 AG : 1kHz, 50mV Transmit.	Linear detector Oscilloscope Power meter	Rear panel	ANT	TX-RX	VR3	±4.4kHz (Read higher absolute value of + or – value)	±200Hz Check for detected waveform.
	2) AG : 1kHz, 5.0mV						Check	±2.2 ~ 3.6kHz
3. Protection	1) FREQ. : 220.000 ANT : OPEN Transmit.	Ammeter					Check	6.5A or less.
4. TONE	1) FREQ. : 222.600 TONE : ON Transmit.	Linear detector Oscilloscope Power meter	Rear panel	ANT			Check	DEV. : ±0.5 ~ 1.0kHz

Adjustment Points (Top View)

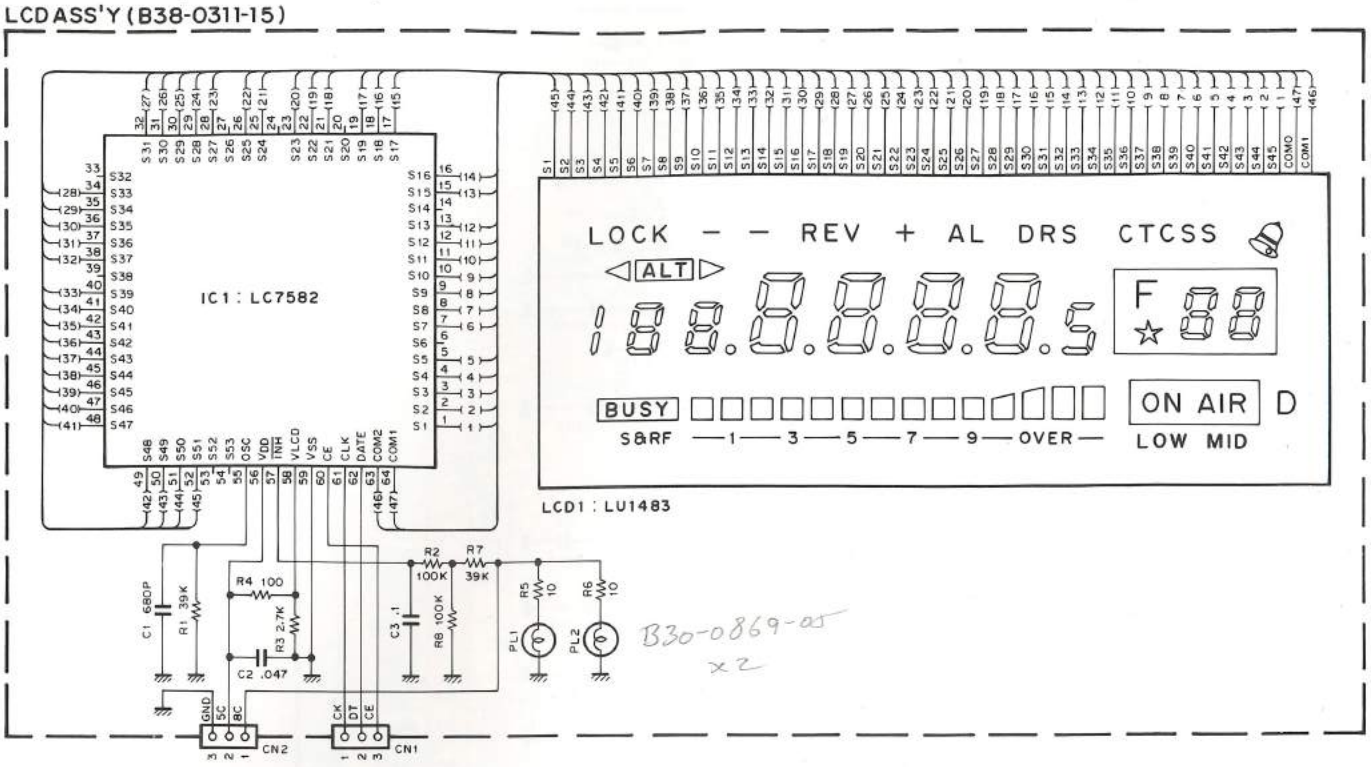


TX-RX unit (X57-3320-10)

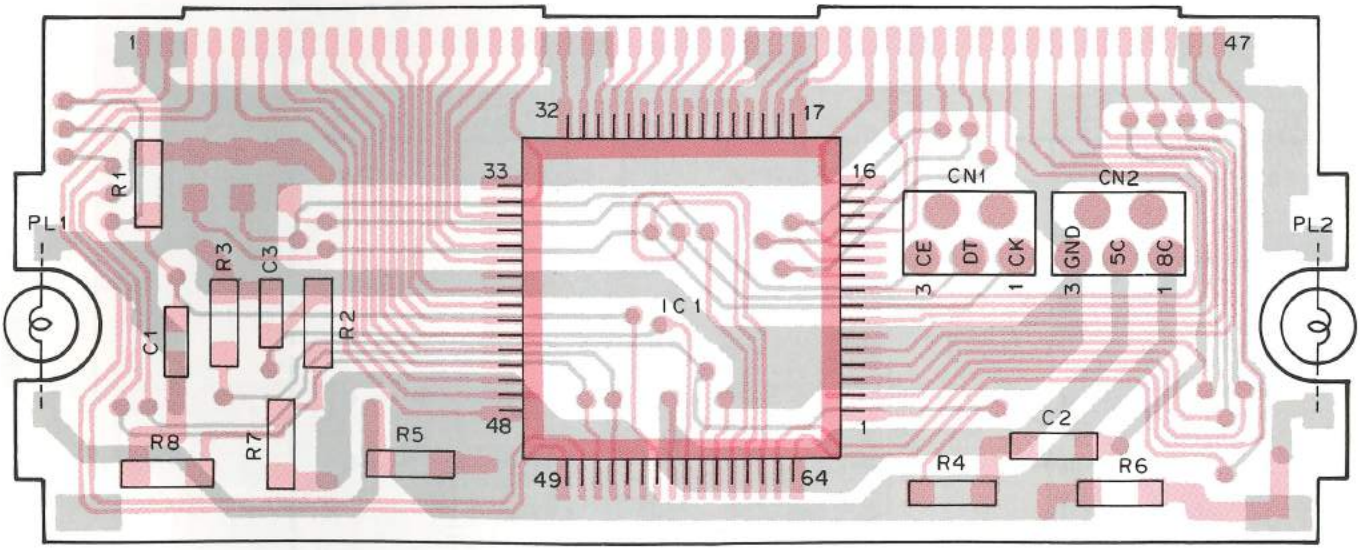
VR1 : S-meter
VR3 : ±4.4kHz at 1kHz, 50mV
VR4 : APC
VR5 : MID POWER
L1 ~ 4 : BPF, RX sensitivity
L5, 6 : Distortion, RX sensitivity
TC1 : TX frequency

LCD ASS'Y (B38-0311-15)

LCD ASS'Y (B38-0311-15)

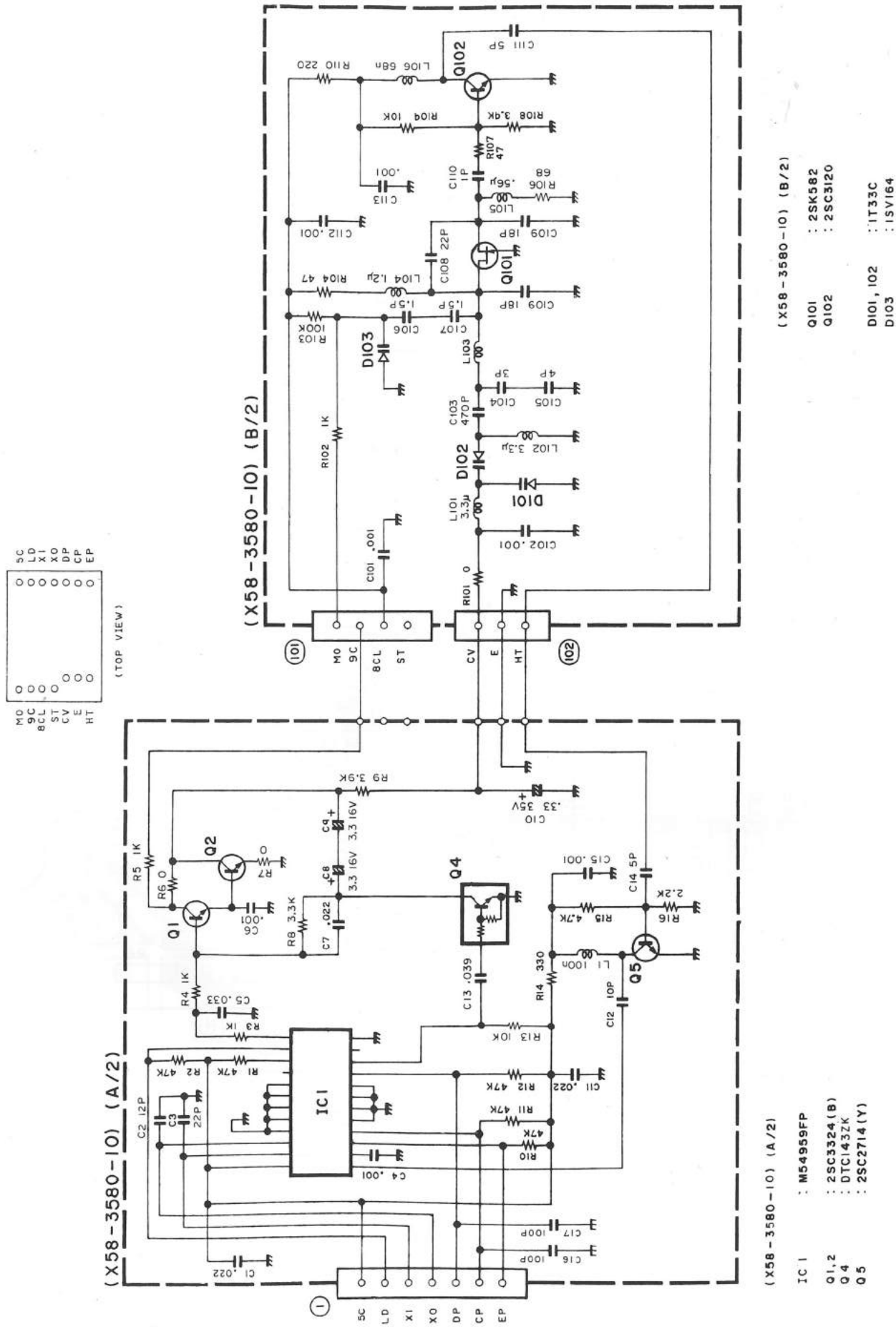


LCD ASS'Y (B38-0311-15) Component side view



TM-331A CIRCUIT DIAGRAM

PLL (X58-3580-10)



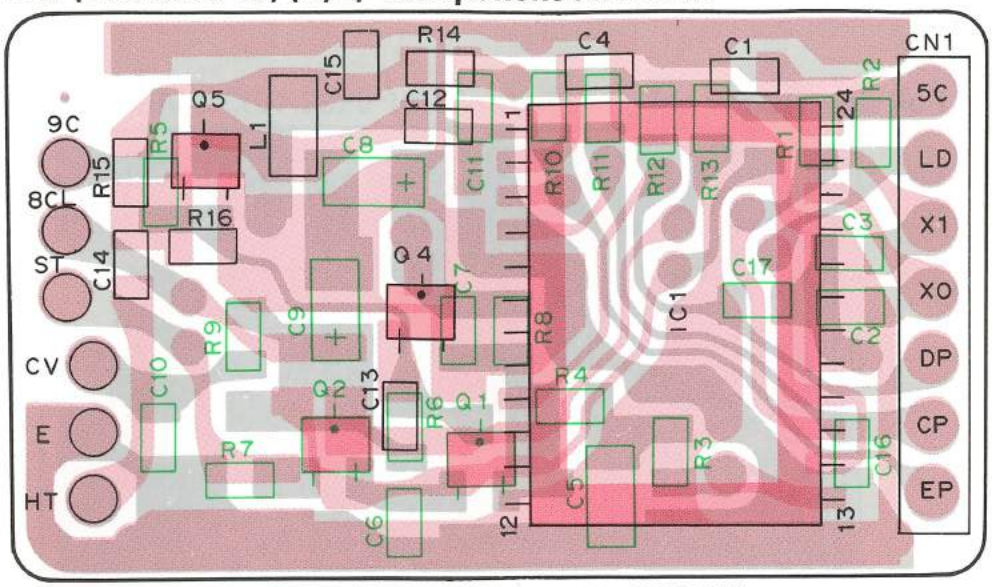
(X58-3580-10) (B/2)

Q101	: 2SK582
Q102	: 2SC3120
D101, 102	: 1T33C
D103	: 1SV164

(X58-3580-10) (A/2)

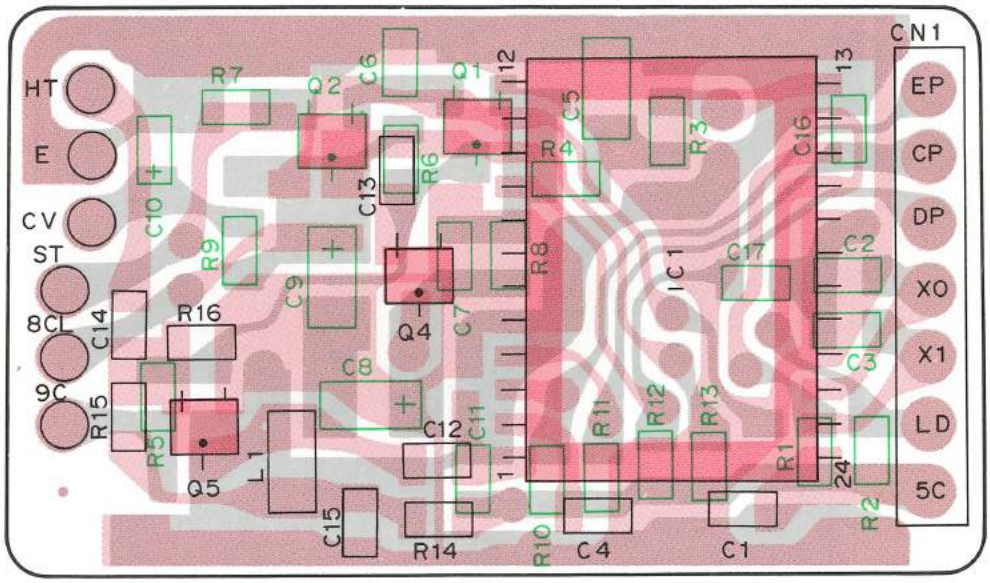
IC1	: M54959FP
Q1,2	: 2SC3324(B)
Q4	: DTC143ZK
Q5	: 2SC2714(Y)

PLL (X58-3580-10) (A/2) Component side view

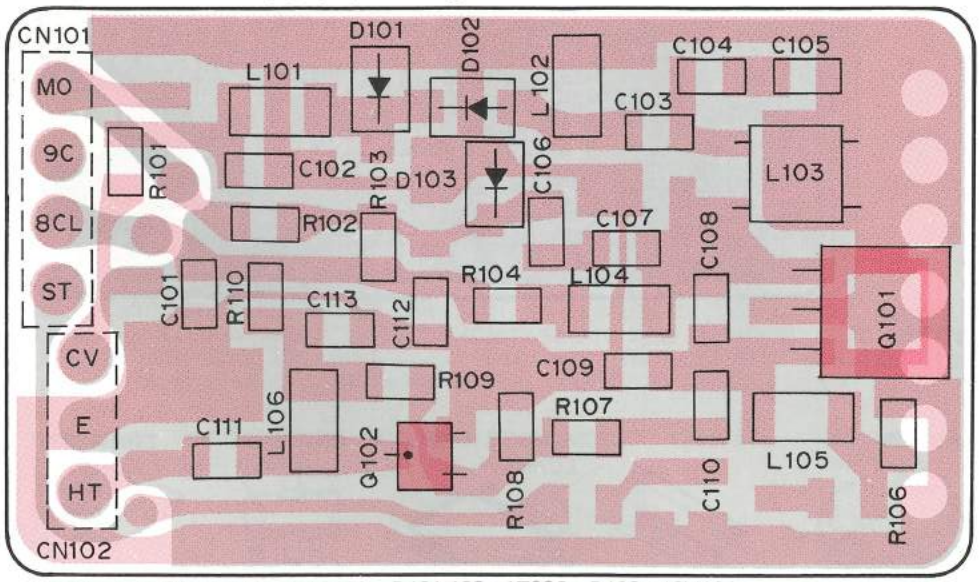


IC1 : M54959FP Q1,2 : 2SC3324(B) Q4 : DTC143ZK Q5 : 2SC2714(Y)

PLL (X58-3580-10) (A/2) Foil side view

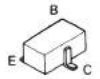


PLL (X58-3580-10) (B/2) Component side view



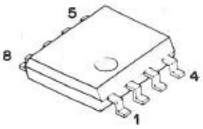
Q101 : 2SK582 Q102 : 2SC3120 D101,102 : 1T33C D103 : 1SV164

2SC2714(Y)
2SC3120
2SC3324(B)
2SA1162 (GR)
2SC4116(Y)
DTC143ZK

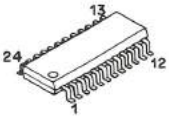


FMW1

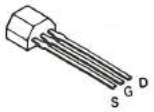
NJM4558M



M54959FP

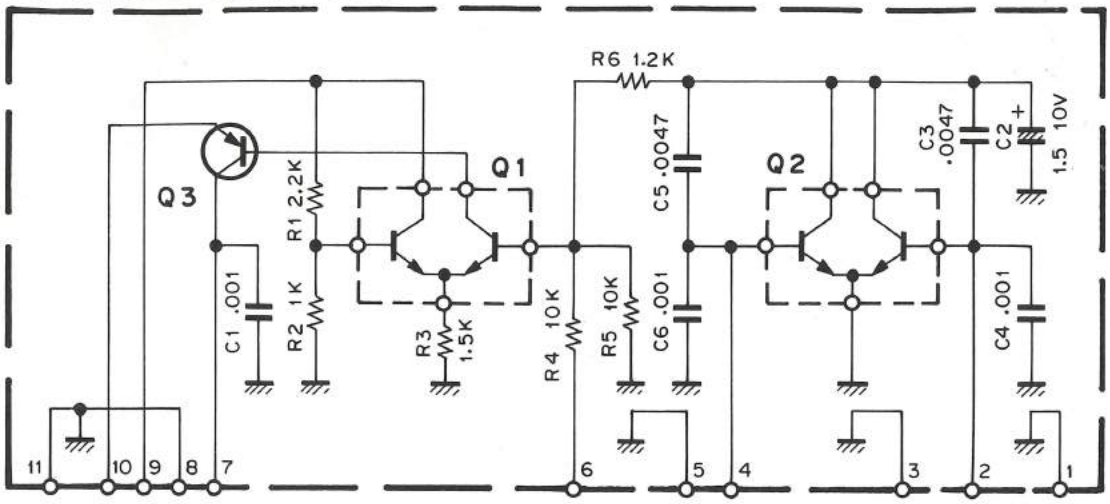


2SK582



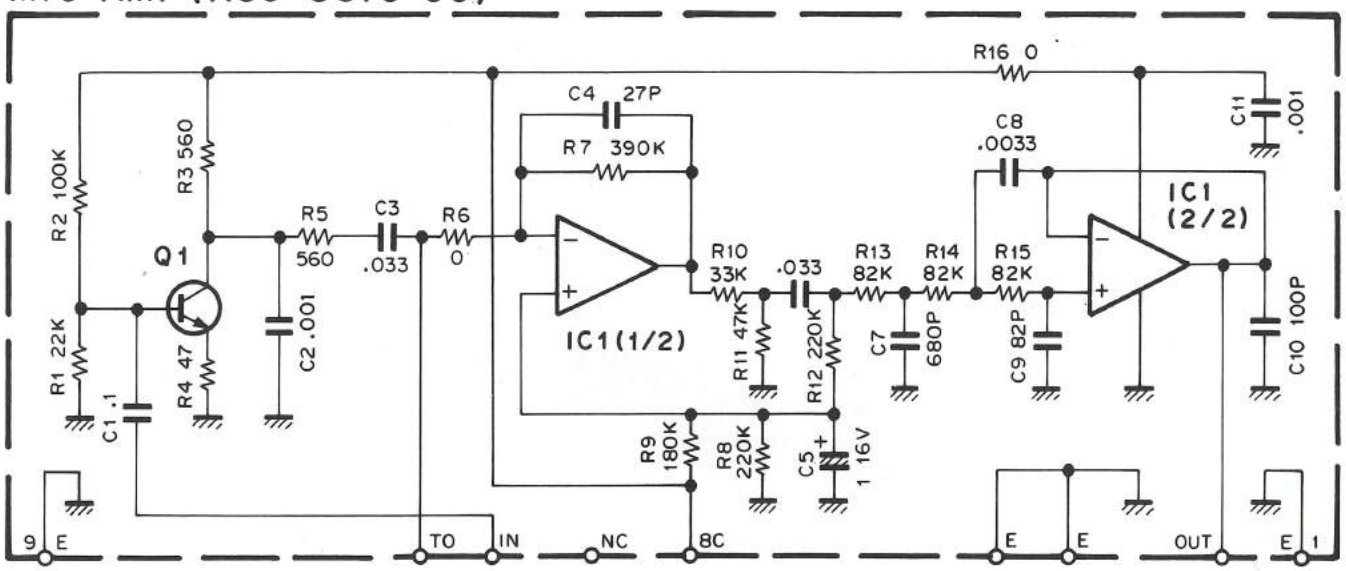
PC BOARD VIEW/CIRCUIT DIAGRAM TM-331A

APC (X59-3130-00)



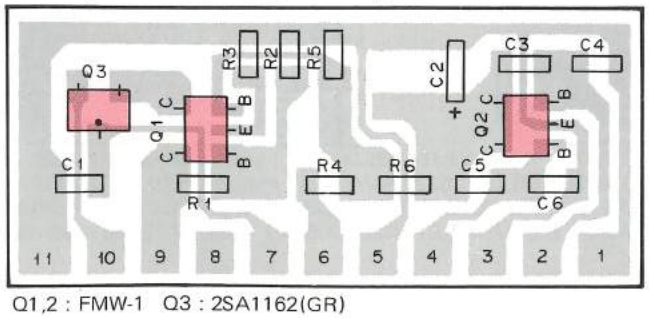
Q1,2 : FMW-1 Q3 : 2SA1162(GR)

MIC AMP (X59-3610-00)



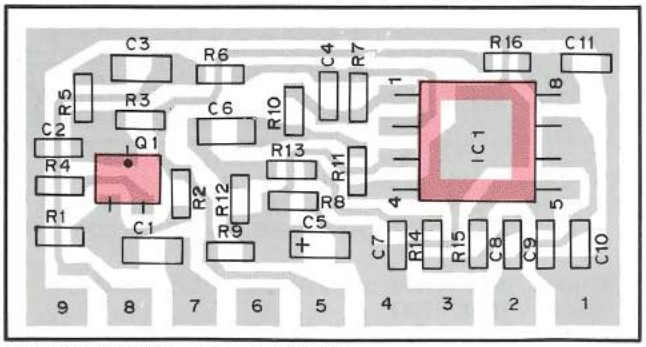
Q1 : 2SC4116(Y) IC1 : NJM4558M

APC (X59-3130-00) Component side view



Q1,2 : FMW-1 Q3 : 2SA1162(GR)

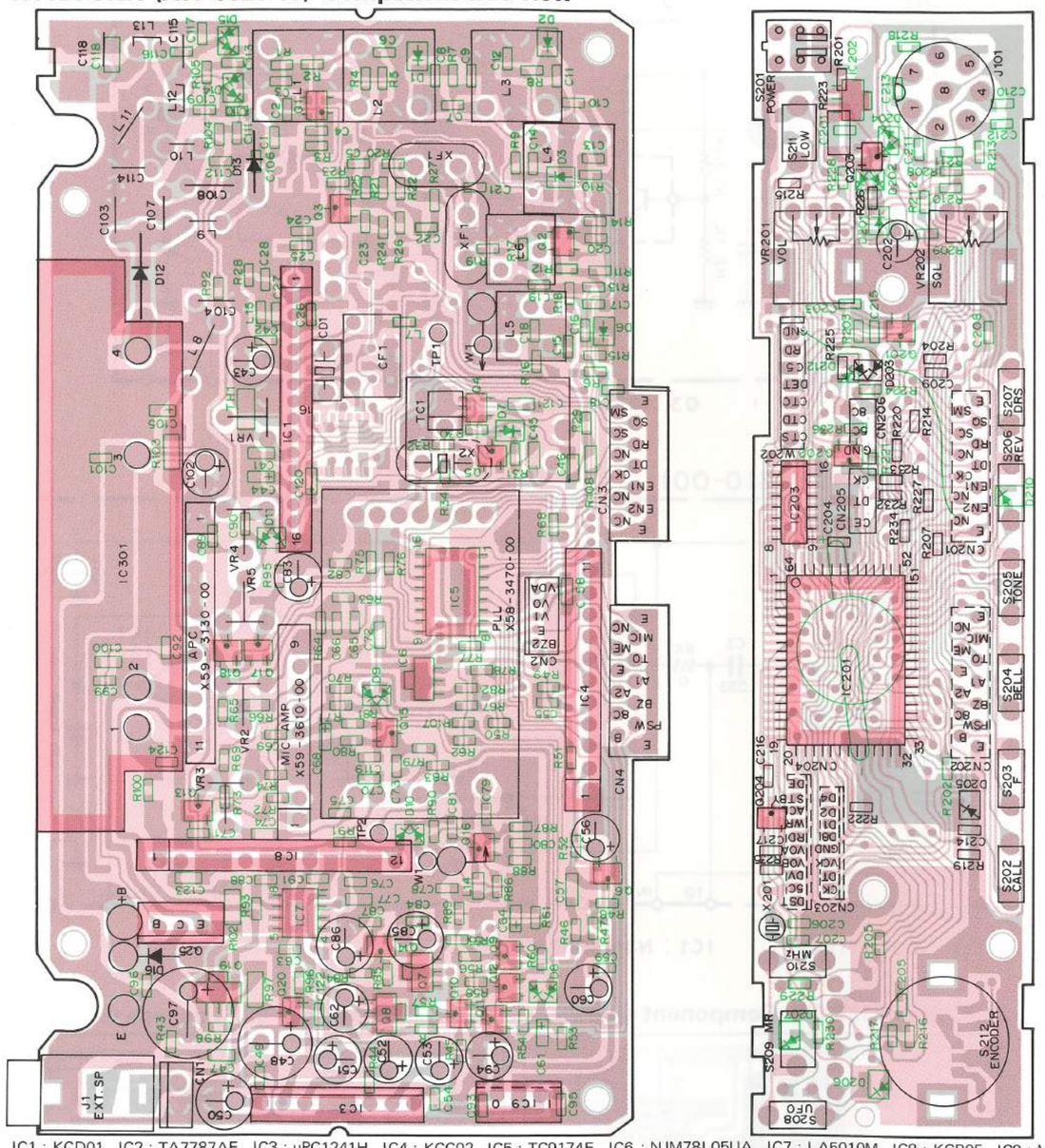
MIC AMP (X59-3610-00) Foil side view



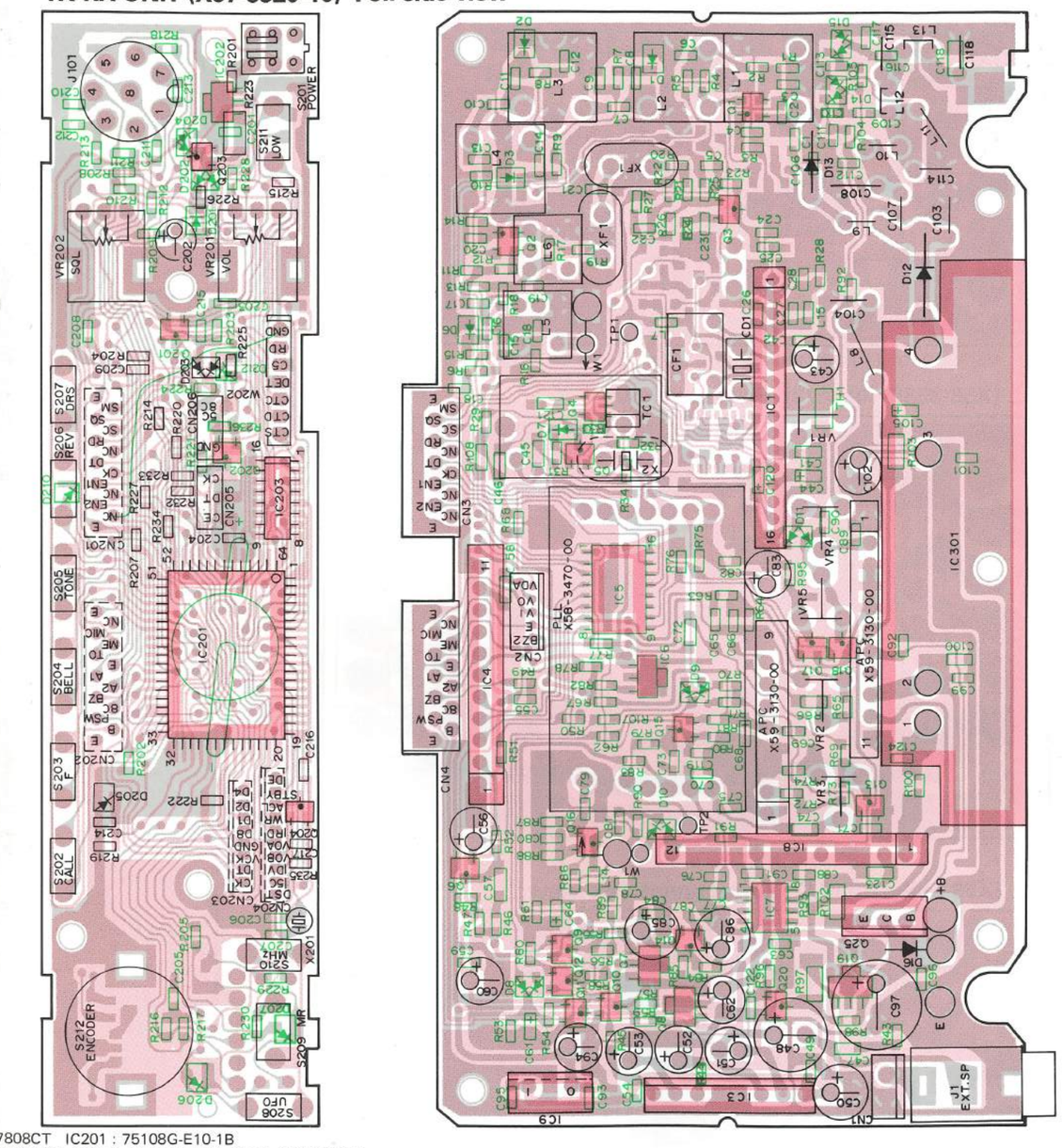
Q1 : 2SC4116(Y) IC1 : NJM4558M

TM-331A PC BOARD VIEWS

TX-RX UNIT (X57-3320-10) Component side view



TX-RX UNIT (X57-3320-10) Foil side view

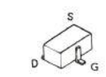


IC1 : KCD01 IC2 : TA7787AF IC3 : µPC1241H IC4 : KCC02 IC5 : TC9174F IC6 : NJM78L05UA IC7 : LA5010M IC8 : KCB05 IC9 : MC7808CT IC201 : 75108G-E10-1B
IC202 : NJM78L06UA IC203 : KRR-C001 IC301 : S-AV17 Q1,2 : 3SK184(S) Q3,16 : 2SC2714(Y) Q4 : FMG2 Q5,10,12,14,20,201,204 : 2SC2712(Y) Q6,13 : 2SD1757(K) Q7,8 : 2SB1119 S
Q9 : DTC144WK Q15 : 2SK208(Y) Q17,18 : DTC124EK Q19 : 2SB1302 S Q25 : 2SD1406(Y) Q203 : 2SA1519 D1~ 3,6 : 1SV164 D7,201 : DLS1585 D8,9,203 1SS184 D10 DAN235(K)
D11 : HA716 D12 : MI407 D13 : MI808 D14,15 : 1SS226 D16 : DSA3A1 D202 : 1SS181 D204,206,207 : 1SS187 D205 : 1SS193 D210 : MA141A

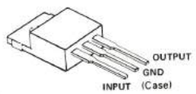
DTC124EK
DTC144WK
2SA1519
2SC2712(Y)

2SC2714(Y)
2SD1757(K)

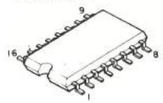
2SK208(Y)



MC7808CT



TC9174F
TA7787AF



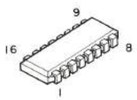
2SB1119S
2SB1302S

NJM78L05UA
NJM78L06UA

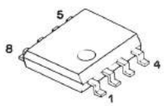
3SK184(S)

FMG2

KRR-C001

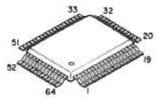


LA5010M



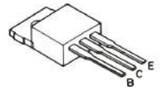
S-AV17

75108G-E10-1B
LC7582



µPC1241H

2SD1406(Y)



信号系　Control signal line　Common DC line

(X57-3320-10) (A/2)

IC 301 POWER MODULE

MIC AMP (X59-3610-00)

IC8 DRIVE

PLL (X58-3580-10)

APC (X59-3130-00)

IC 1 : KCD01
IC 2 : TA7787AF
IC 3 : μPC1241H
IC 4 : KCC02
IC 5 : TC9174F
IC 6 : NJM78L05UA
IC 7 : LA5010M
IC 8 : KCB05
IC 9 : MC7808CT
IC 201 : 751086-E10-1B
IC 202 : NJM78L06UA
IC 203 : KRR-C001
IC 301 : S-AV17

(X57-3320-10) (B/2)

= Common DC line

SCHEMATIC DIAGRAM

TM-331A

IC 1	: KCD01	Q1,2	: 3SK184(S)	D1~3,6	: 1SV164
IC 2	: TA7787AF	Q3,16	: 2SC2714(Y)	D7,201	: DLS1585
IC 3	: μPC1241H	Q4	: FM64	D8,9,203	: 1SS184
IC 4	: KCC02	Q5,10 12,14,20,201,202,204	: 2SC2712(Y)	D10	: DAN235(K)
IC 5	: TC9174F	Q6,13	: 2SD1757(K)	D11	: HA716
IC 6	: NJM78L05UA	Q7,8	: 2SB1119(S)	D12	: M1407
IC 7	: LA5010M	Q9	: DTC144WK	D13	: M1606
IC 8	: KCB05	Q15	: 2SK208(Y)	D14,15	: 1SS226
IC 9	: MC7808CT	Q17,18	: DTC124EK	D16	: DSA3A1
IC 201	: 751086-E10-1B	Q19	: 2SB1302(S)	D202	: 1SS181
IC 202	: NJM78L06UA	Q25	: 2SD1406(Y)	D204,206,207	: 1SS187
IC 203	: KRR-C001	Q203	: 2SA1519	D205	: 1SS193
IC 301	: S-AV17			D210	: MA141A

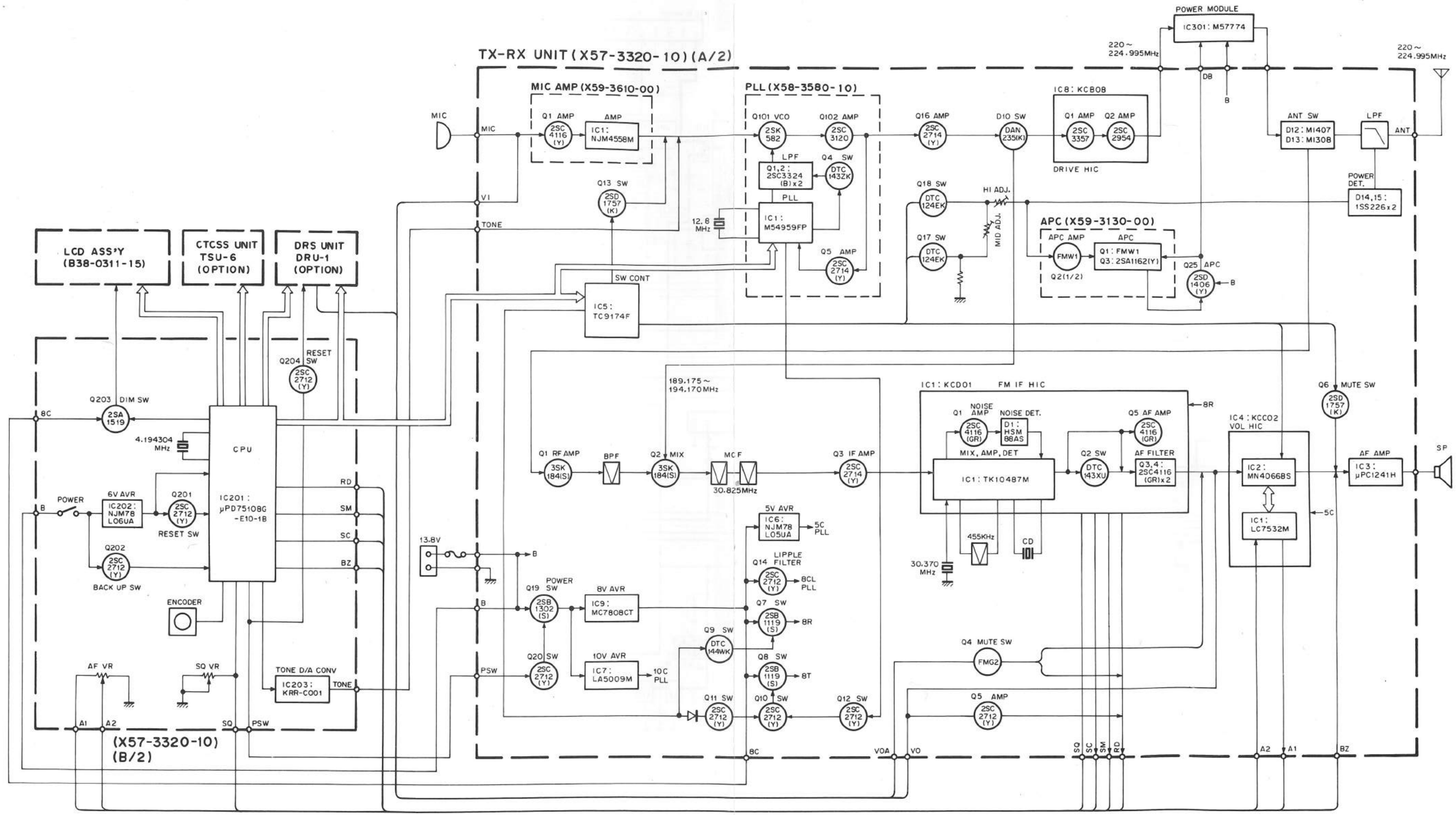
TM-331A

TERMINAL FUNCTIONS

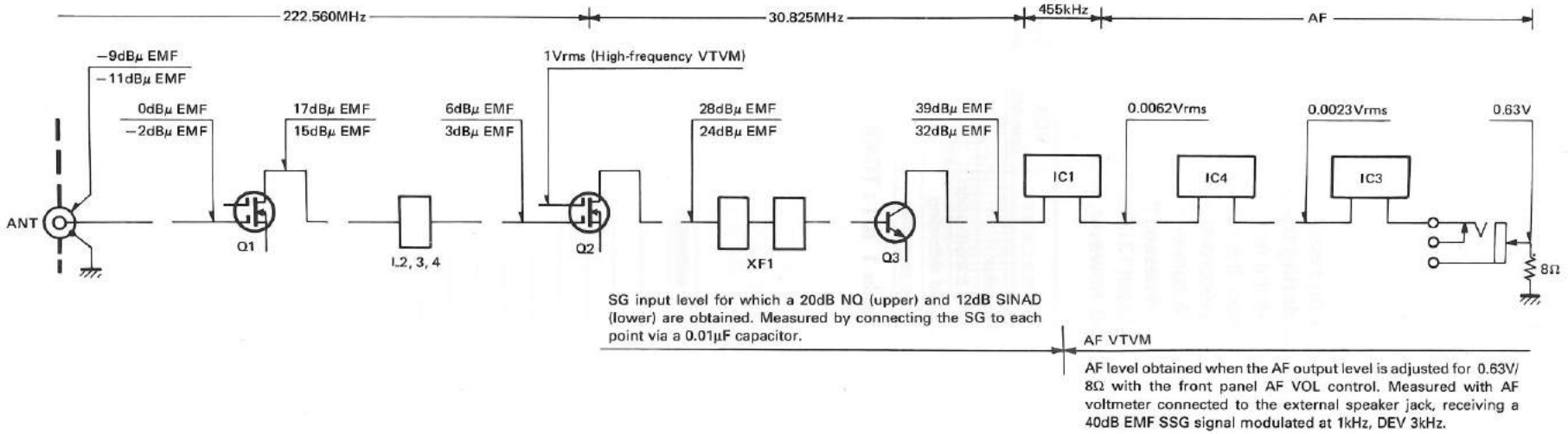
Connector No.	Terminal No.	Terminal Name	Terminal Function
TX-RX UNIT (X57-3320-10) (A/2)			
CN1	1	SP	Speaker input.
	2	E	GND.
CN2	1	VOA	Power supply for voice memory.
	2	VO	Voice memory output.
	3	VI	Voice memory input.
	4	E	GND.
	5	BZZ	
CN3	1	E	GND.
	2	SM	S-meter output.
	3	SQ	Squelch output.
	4	SC	Squelch busy control output.
	5	RD	Audio output.
	6	NC	
	7	DT	PLL data.
	8	CK	PLL clock.
	9	EN1	PLL enable.
	10	NC	
	11	EN2	Shift register (IC5) enable.
	12	NC	
	13	E	GND.
CN4	1	E	GND.
	2	NC	
	3	MIC	Mic input (To MIC AMP unit).
	4	ME	MIC GND.
	5	TO	Tone input.
	6	E	GND.
	7	A1	Audio output (To AF VOL).
	8	A2	Audio input (To electronic volume from AF VOL).
	9	BZ	Beep input (To AF IC from CPU).
	10	8C	Common +8V.
	11	PSW	Power switch control input.
	12	B	+13.8V.
	13	E	GND.
TX-RX UNIT (X57-3320-10) (B/2)			
CN201	1	E	GND.
	2	SM	S-meter input (To CPU IC201).
	3	SQ	Squelch input (To CPU IC201).
	4	SC	Squelch busy control input (To CPU IC201).
	5	RD	Audio input (CPU IC201).
	6	NC	
	7	DT	PLL data (From CPU IC201).
	8	CK	PLL clock (From CPU IC201).
	9	EN1	PLL enable (From CPU IC201).
	10	NC	
	11	EN2	Shift register enable (From CPU IC201).
	12	NC	
	13	E	GND.

Connector No.	Terminal No.	Terminal Name	Terminal Function
CN202	1	E	GND.
	2	NC	
	3	MIC	Mic output (From mic jack).
	4	ME	MIC GND.
	5	TO	Tone output (From IC203).
	6	E	GND.
	7	A1	Audio input (To AF VOL).
	8	A2	Audio output (To electronic volume from AF VOL).
	9	BZ	Beep output (From CPU).
	10	8C	Common +8V.
	11	PSW	Power switch control output (From CPU).
	12	B	+13.8V.
	13	E	GND.
CN203	1	CK	PLL IC clock output (From CPU P21).
	2	DT	PLL IC data output (From CPU P22).
	3	VCK	
	4	GND	GND.
	5	D8	DRS unit data.
	6	D1	DRS unit data.
	7	D2	DRS unit data.
	8	D4	DRS unit data.
CN204	1	DST	
	2	5C	Common +5V.
	3	DV	
	4	VOB	DRS unit VOB output.
	5	VOA	DRS unit VOA output.
	6	RD	DRS unit RD output.
	7	WR	DRS unit WR output.
	8	ACL	DRS unit RESET output.
	9	STBY	DRS unit STBY output
	10	OE	
CN205	1	CE	LCD driver enable output.
	2	DT	LCD driver data output.
	3	CK	LCD driver clock output.
CN206	1	GND	GND.
	2	5C	Common +5V.
	3	8C	Common +8V.
W202	1	GND	GND.
	2	RD	CTCSS unit voice de-modulation input.
	3	C5	Common +5V.
	4	DET	CTCSS unit tone matching input.
	5	CTC	CTCSS unit clock output.
	6	CTD	CTCSS unit data output.
	7	CTS	CTCSS unit enable output.

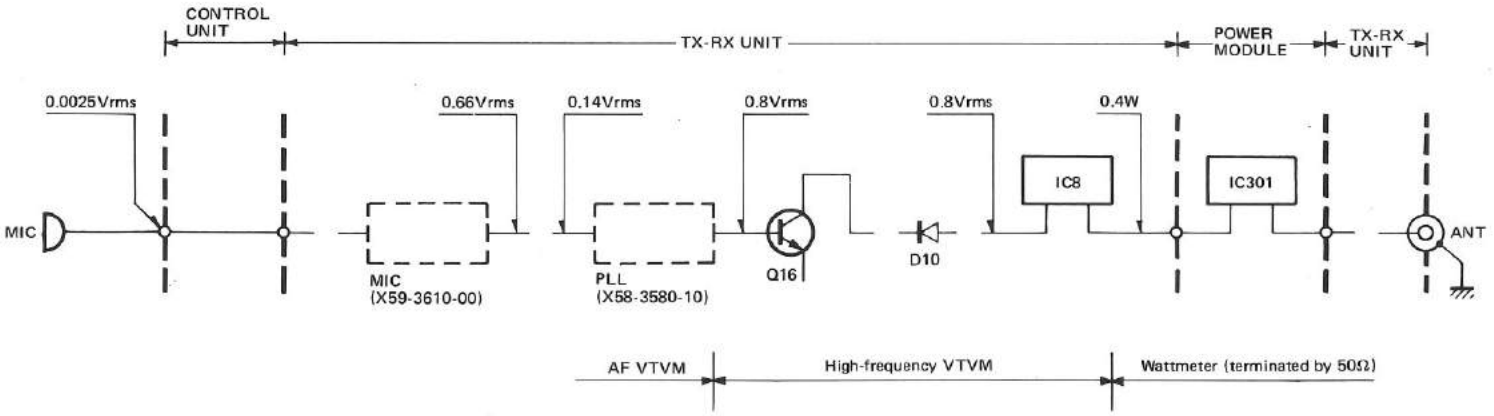
BLOCK DIAGRAM



Receiver section



Transmitter section



1. AG is set so that MIC input becomes 3kHz DEV at 1kHz MOD.
2. Transmitting frequency : 222.560MHz

DRU-1 (DIGITAL RECORDING UNIT)

DRU-1 CIRCUIT DESCRIPTION

1. Overview

The DRU-1 is a digital recording and playback unit designed to be installed inside the TM-331A series. This unit has the following features:

- Recording received audio (for output to the internal speaker) or transmit audio (microphone input)
- Outputting recorded audio to the internal speaker or outputting recorded audio as modulating signals during transmission
- Built-in lithium battery back-up for maintaining DRU-1 contents

2. Operations

• Recording received audio (for output to the internal speaker)

A received signal from the VO pin is fed into pin 1 (0Y) of the multiplexer IC1 (TC4052BF). It is then fed into pin 59 (MIC IN) of IC3 (TC8830F) via pin 3 (Y). The signal is amplified approx. 26dB by a mic amplifier in IC3, and output via pin 60 (C1). The signal from pin 60 is fed into pin 63 (C2) and amplified approx. 20dB. The amplified signal is applied to pin 64 (MIC OUT) and pin 65 (ADI).

• Recording transmit audio (microphone input)

Microphone input from the VI pin is amplified by Q5, and fed into pin 2 (2Y) of the multiplexer IC1 (TC4052BF). It is then supplied to IC3 (TC8830F) via pin 3 (Y) and recorded in the same way as in recording received sound.

• Outputting recorded audio to the internal speaker

D/A convertor output from pin 66 (DAO) of IC3 (TC8830F) is passed through a CR filter, and amplified by Q6. The amplified signal is then fed into pin 13 (X) of the multiplexer IC1 (TC4052BF), and output to the VO pin via pin 14 (1X).

• Outputting recorded audio as modulating signals during transmission

When sound recorded in the DRU-1 is played during transmission, the same operations as written above in outputting recorded audio to the internal speaker occur. That is, D/A convertor output from pin 66 (DAO) of IC3 (TC8830F) is passed through a CR filter, amplified by Q6, and fed into pin 13 (X) of the multiplexer IC1 (TC4052BF). The sound, however, is output via pin 11 (3X).

	VOA (pin 10)	VOB (pin 9)	On channel
Output to speaker	H	L	1X (pin 14)
Output during transmission	H	H	3X (pin 11)
Received audio recording	L	L	0Y (pin 1)
Transmit aidop recording	L	H	2Y (pin 2)

Table 1 IC1 : TC4052BF operations

DRU-1 DESCRIPTION OF COMPONENTS

ACCESSORY UNIT (X42-3010-00)

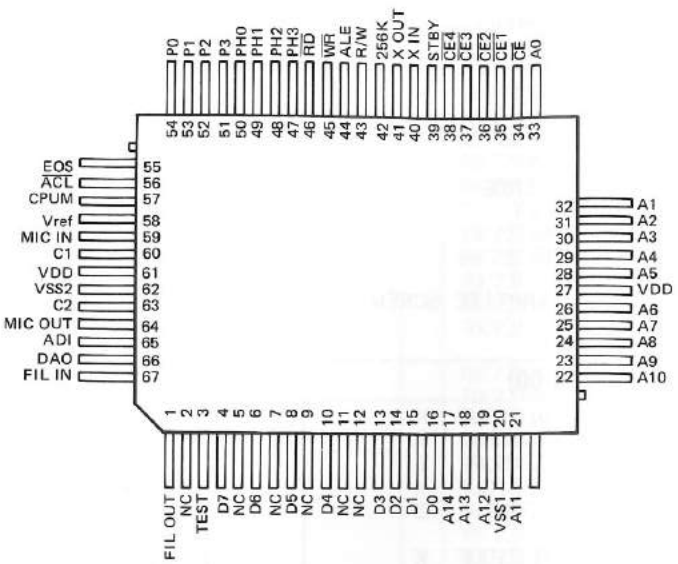
Component	Use/Function	Description
IC1	Multiplexer	See DRU-1 circuit description.
IC3	Audio recording and playback	See DRU-1 semiconductor data.
IC4~7	S-RAM	
Q5	AF amplification	Mic input amplification.
Q6	AF amplification	Playback sound amplification.
D1	Reverse current prevention	
D2	Reverse current prevention	Back-up.

DRU-1 (DIGITAL RECORDING UNIT)

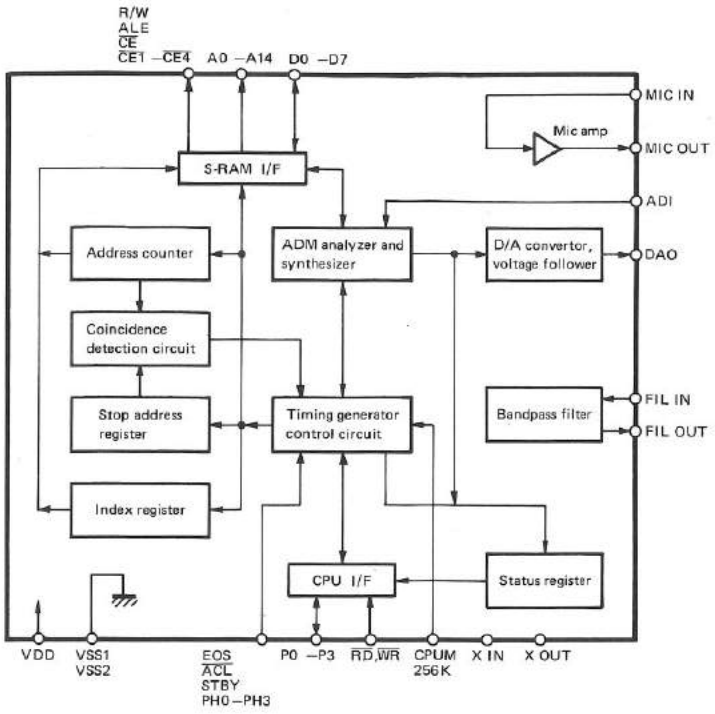
DRU-1 SEMICONDUCTOR DATA

1. Audio recording and playback : TC8830F (IC3)

• **Terminal connection diagram**



• **Block diagram**



• **Terminal functions**

Pin No.	Pin name	I/O	Function	Pin No.	Pin name	I/O	Function
1	FIL OUT	O	Not used.	41	X OUT	O	512kHz oscillation circuit.
2	NC	–	Not connected.	42	256K	I	64K/256K RAM select,
3	TEST	–	Not used.				"H" when 256K used.
4	D7	I/O	RAM data I/O.	43	R/W	O	RAM read/write output.
5	NC	–	Not connected.	44	ALE	–	Not used.
6	D6	I/O	RAM data I/O.	45	$\overline{WR}$	I	Write pulse input.
7	NC	–	Not connected.	46	$\overline{RD}$	I	Read pulse input.
8	D5	I/O	RAM data I/O.	47~50	PH3~PH0	–	Not used.
9	NC	–	Not connected.	51~54	P3~P0	I/O	Data bus.
10	D4	I/O	RAM data I/O.	55	EOS	–	Not used.
11,12	NC	–	Not connected.	56	ACL	I	Reset signal input.
13~16	D3~D0	I/O	RAM data I/O.	57	CPUM	I	"H" when CPU control enabled.
17~19	A14~A12	O	RAM address output.	58	Vref	O	Analog circuit reference voltage output.
20	V_{SS1}	–	GND.	59	MIC IN	I	Mic amp. 1 input.
21~26	A11~A6	O	RAM address output.	60	C1	O	Mic amp. 1 output.
27	V_{DD}	–	Power supply.	61	V_{DD}	–	Power supply.
28~33	A5~A0	O	RAM address output.	62	V_{SS2}	–	GND.
34	$\overline{CE}$	–	Not used.	63	C2	I	Mic amp. 2 input.
35~38	$\overline{CE1}$~$\overline{CE4}$	O	RAM chip enable.	64	MIC OUT	O	Mic amp. 2 output.
39	STBY	I	Minimum current standby when standby	65	ADI	I	Audio analysis circuit input.
			input is "H".	66	DAO	O	D/A convertor output.
40	X IN	I	512kHz oscillation circuit.	67	FIL IN	I	Not used.

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.

DRU-1 PARTS LIST

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
DRU-1						
			B42-3317-04	LABEL		
-			B50-8290-00	INSTRUCTION MANUAL		
			G10-0666-04	NON-WOVEN FABRIC		
			G10-0679-04	NON-WOVEN FABRIC		
			G13-0913-04	FORMED PLATE		
-			H01-8249-03	ITEM CARTON BOX		
-			H03-2772-04	OUTER PACKING CASE		
-			H21-0704-04	PROTECTION SHEET		
-			H25-0029-04	PROTECTION BAG		
-			H25-0710-04	PROTECTION BAG		
			N87-2606-46	BRAZIER HEAD TAPTITE SCREW		
			X42-3010-00	ACCESSORY UNIT		
ACCESSORY UNIT (X42-3010-00)						
C1			CK73FB1H103K	CHIP C 0.010UF K		
C2			CK73FB1H102K	CHIP C 1000PF K		
C3			CK73FF1E154Z	CHIP C 0.15UF Z		
C4 -6			CK73FB1H103K	CHIP C 0.010UF K		
C7			CK73EF1C105Z	CHIP C 1.0UF Z		
C8 -10			CK73FB1H103K	CHIP C 0.010UF K		
C11			CK73FF1E104Z	CHIP C 0.10UF Z		
C12			CK73FB1H103K	CHIP C 0.010UF K		
C13 ,14			CK73FB1H102K	CHIP C 1000PF K		
C15			CK73FF1E104Z	CHIP C 0.10UF Z		
C16			CK73FB1H103K	CHIP C 0.010UF K		
C17			CK73FF1E104Z	CHIP C 0.10UF Z		
C19			CK73FB1H103K	CHIP C 0.010UF K		
C20			CK73FB1H102K	CHIP C 1000PF K		
C21 ,22			CC73FSL1H101J	CHIP C 100PF J		
C23			CK73FB1H103K	CHIP C 0.010UF K		
C24			C92-0010-05	CHIP TAN 6.8UF 6.3WV		
C25			CK73EB1H104K	CHIP C 0.10UF K		
C26			CK73FB1H103K	CHIP C 0.010UF K		
C27			CC73FSL1H101J	CHIP C 100PF J		
C28			CK73FF1E104Z	CHIP C 0.10UF Z		
CN1		*	E40-5207-05	PIN CONNECTOR		
CN2		*	E40-5206-05	PIN CONNECTOR		
CN3		*	E40-5181-05	PIN CONNECTOR		
W1		*	E31-6005-05	CONNECTING WIRE		
W2		*	E31-6006-05	CONNECTING WIRE		
W3		*	E31-6007-05	CONNECTING WIRE		
			F20-0520-04	INSULATING BOARD		
			F20-0521-04	INSULATING BOARD		
X1		*	L77-1398-05	CRYSTAL RESONATOR 3.579545MHZ		
X2		*	L78-0050-05	RESONATOR 512KHZ		
R1			RK73FB2A103J	CHIP R 10K J 1/10W		
R2			RK73FB2A392J	CHIP R 3.9K J 1/10W		
R3			RK73FB2A103J	CHIP R 10K J 1/10W		
R4			RK73FB2A105J	CHIP R 1.0M J 1/10W		
R5			RK73FB2A102J	CHIP R 1.0K J 1/10W		

E: Scandinavia & Europe K: USA P: Canada W:Europe
U: PX(Far East, Hawaii) T: England M: Other Areas
UE: AAFES(Europe) X: Australia

⚠ indicates safety critical components.

DRU-1 (DIGITAL RECORDING UNIT)

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

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
R6			R92-0670-05	CHIP R 0 OHM		
R7			RK73FB2A223J	CHIP R 22K J 1/10W		
R8			RK73FB2A102J	CHIP R 1.0K J 1/10W		
R9			RK73FB2A105J	CHIP R 1.0M J 1/10W		
R10			R92-0670-05	CHIP R 0 OHM		
R11			RK73FB2A223J	CHIP R 22K J 1/10W		
R12			R92-0670-05	CHIP R 0 OHM		
R13			RK73FB2A222J	CHIP R 2.2K J 1/10W		
R14			RK73FB2A472J	CHIP R 4.7K J 1/10W		
R15			RK73FB2A104J	CHIP R 100K J 1/10W		
R16			RK73FB2A105J	CHIP R 1.0M J 1/10W		
R17			RK73FB2A103J	CHIP R 10K J 1/10W		
R18			RK73FB2A105J	CHIP R 1.0M J 1/10W		
R19			RK73FB2A562J	CHIP R 5.6K J 1/10W		
R20			RK73FB2A104J	CHIP R 100K J 1/10W		
R21			RK73FB2A103J	CHIP R 10K J 1/10W		
R22			RK73FB2A102J	CHIP R 1.0K J 1/10W		
R23			RK73FB2A564J	CHIP R 560K J 1/10W		
R24			RK73FB2A273J	CHIP R 27K J 1/10W		
R25			RK73FB2A683J	CHIP R 68K J 1/10W		
R26			RK73FB2A105J	CHIP R 1.0M J 1/10W		
R27			RK73FB2A222J	CHIP R 2.2K J 1/10W		
R28			RK73FB2A224J	CHIP R 220K J 1/10W		
R29 -31			R92-0670-05	CHIP R 0 OHM		
R32			RK73FB2A220J	CHIP R 22 J 1/10W		
R33			RK73FB2A394J	CHIP R 390K J 1/10W		
D1 ,2			1SS184	DIODE		
IC1		*	TC4052BF	IC(4CH MPX/DE-MPX)		
IC2		*	LR4102N	IC		
IC3		*	TC8830F	IC		
IC4 -7			HM62256LFP-15T	IC		
Q1 -3			2SC2712(BL)	TRANSISTOR		
Q4			DTC144EK	DIGITAL TRANSISTOR		
Q5 ,6			2SC2712(BL)	TRANSISTOR		
			W09-0326-05	LITHIUM BATTERY		

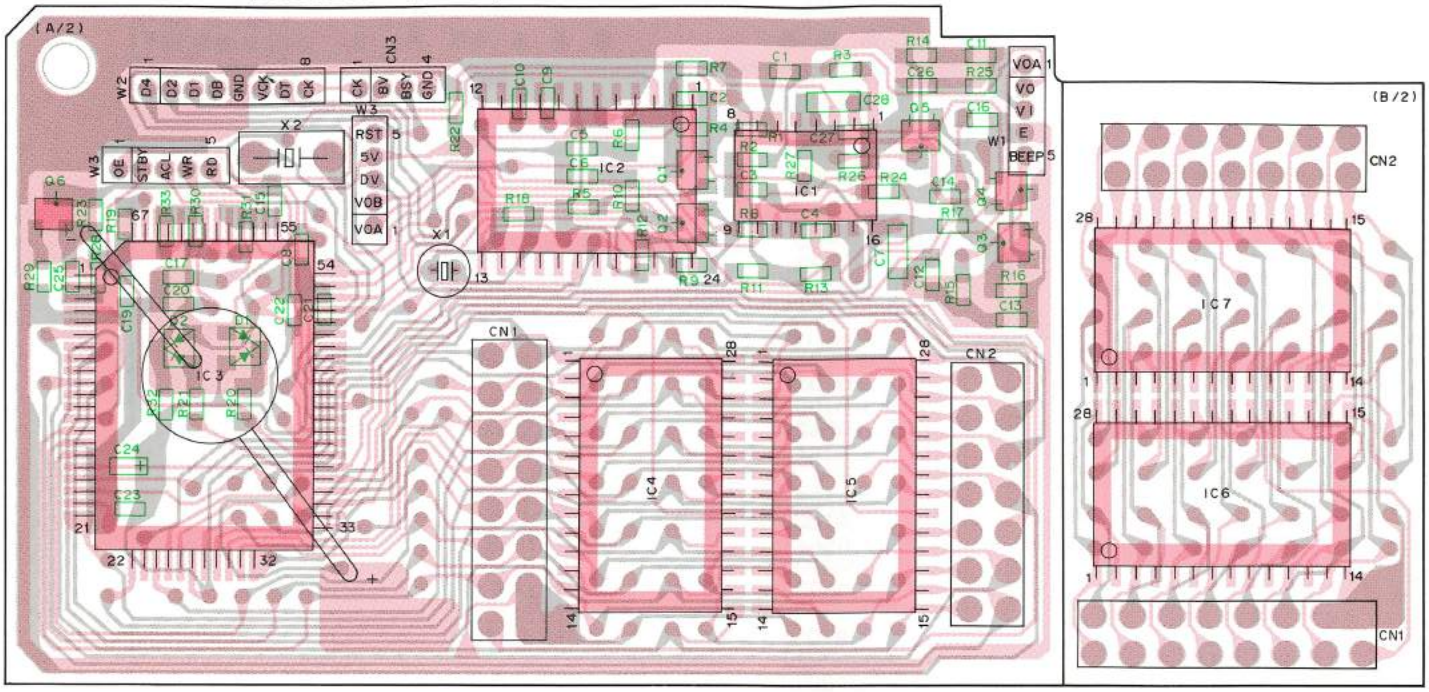
E: Scandinavia & Europe K: USA P: Canada W:Europe
U: PX(Far East, Hawaii) T: England M: Other Areas
UE : AAFES(Europe) X: Australia

⚠ indicates safety critical components.

TM-331A DRU-1 (DIGITAL RECORDING UNIT)

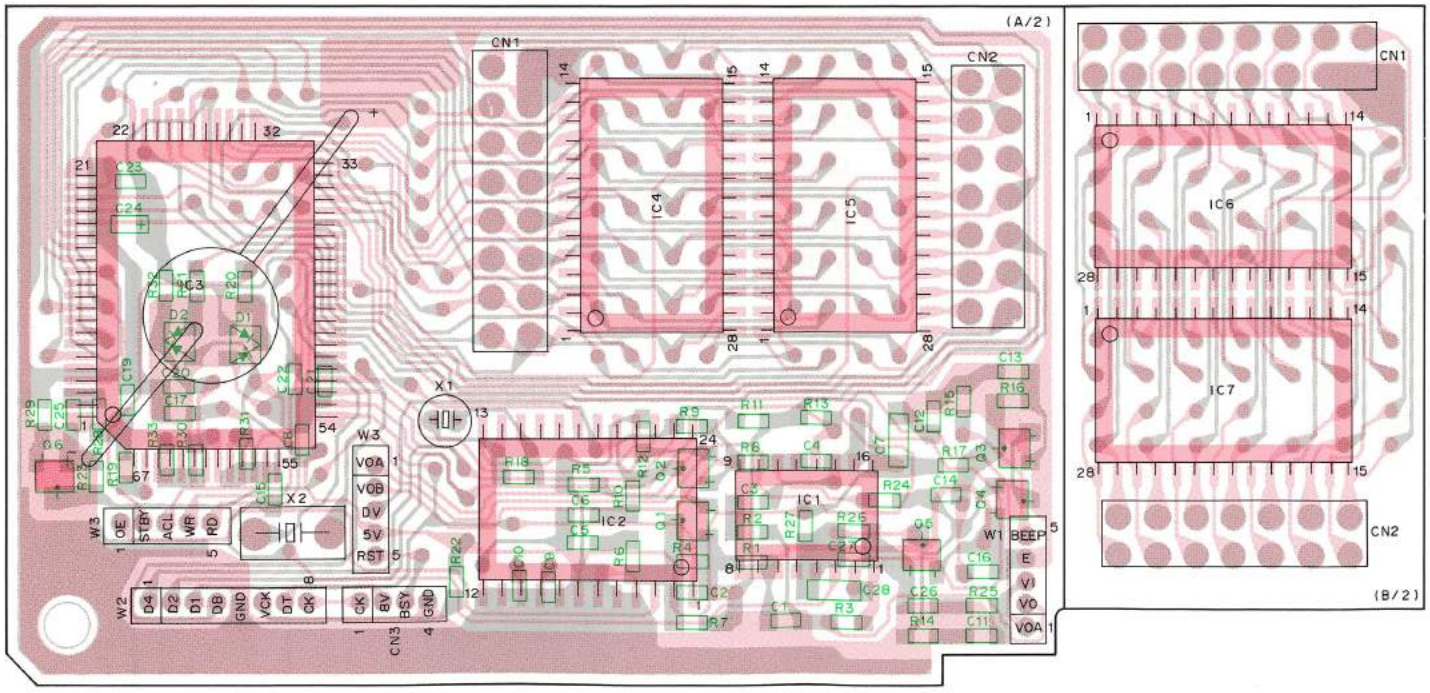
DRU-1 PC BOARD VIEWS

ACCESSORY UNIT (X42-3010-00) Component side view

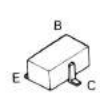


IC1 : TC4052BF IC2 : LR4102N IC3 : TC8830F IC4~7 : HM62256LFP–15T Q5,6 : 2SC2712(BL) D1,2 : ISS184

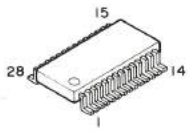
ACCESSORY UNIT (X42-3010-00) Foil side view



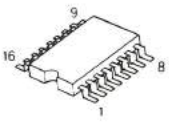
DTC144EK
2SC712(BL)



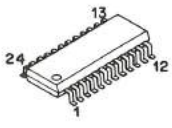
HM62256LFP-15T



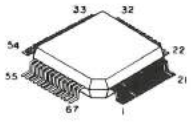
TC4052BF



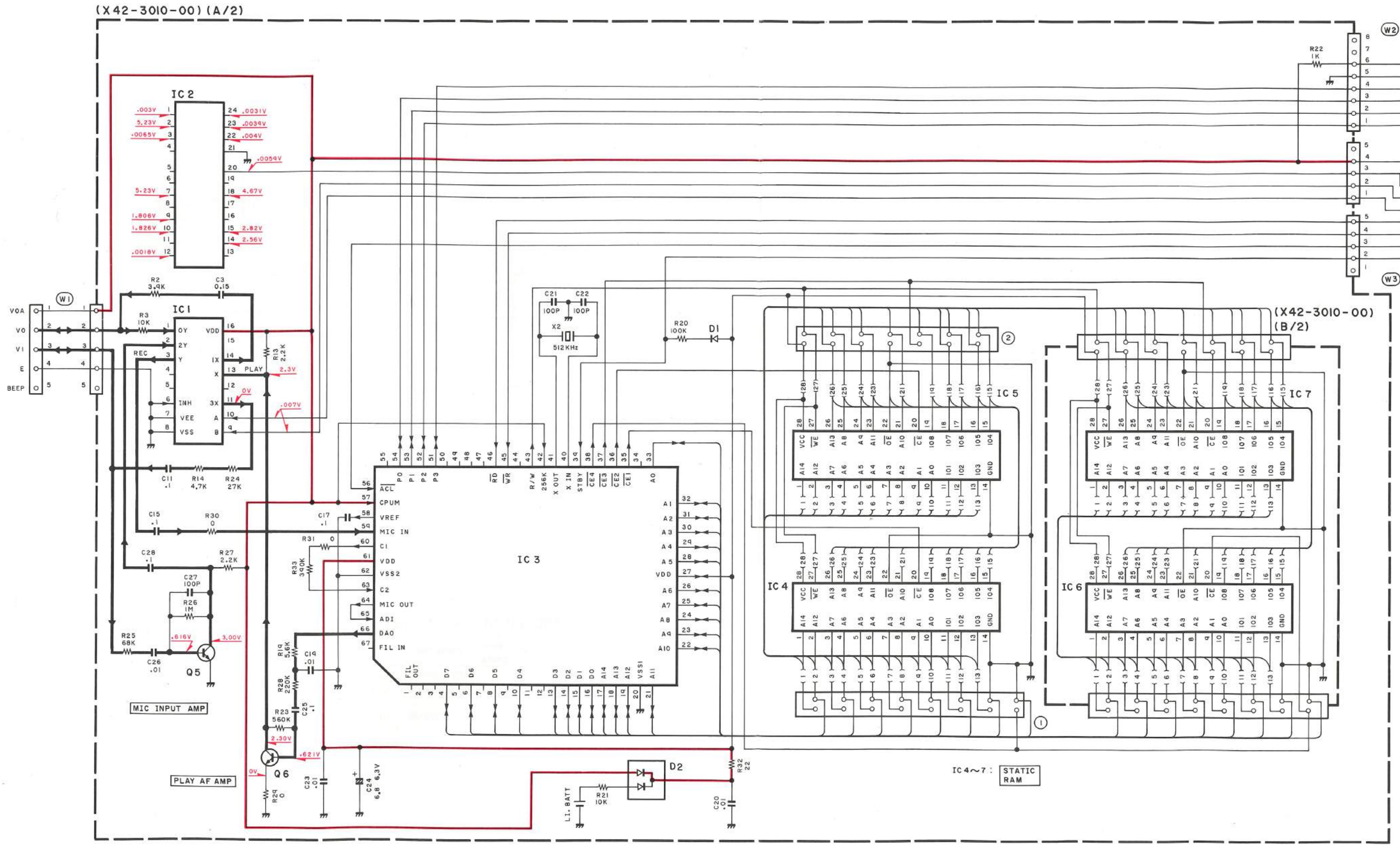
TC8830F



LR4102N



DRU-1 SCHEMATIC DIAGRAM

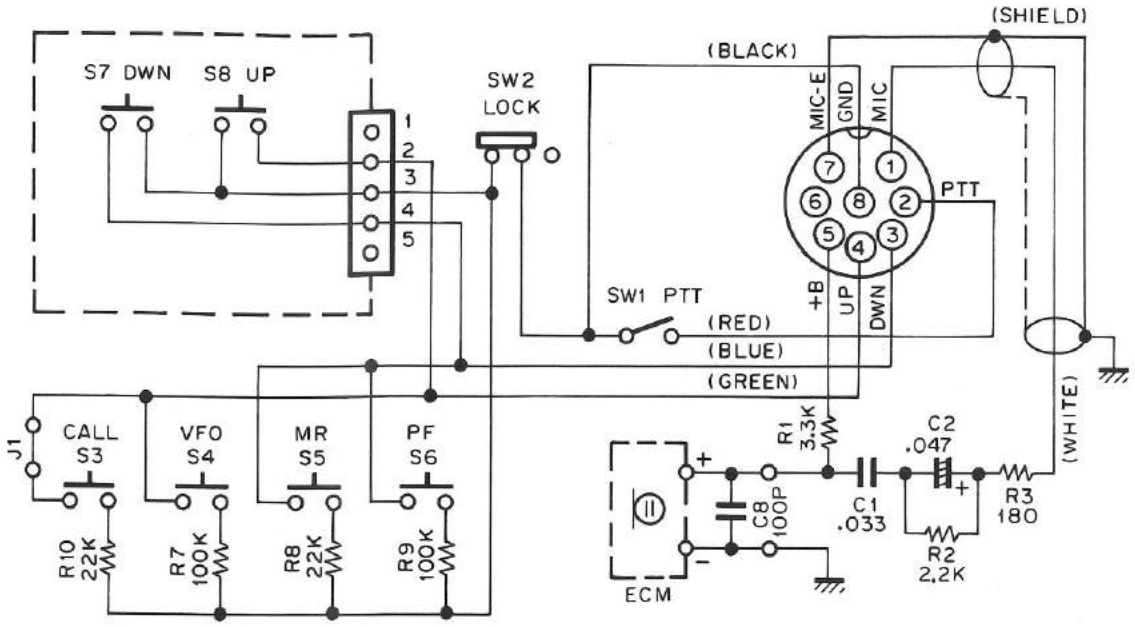


(X42-3010-00) (A/2)

IC 1	: TC4052BF	Q5, 6	: 2SC2712(BL)
IC 2	: LR4102N		
IC 3	: TC8830F	D1, 2	: 1SS184
IC 4~7	: HM62256LFP-15T		

MC-44 (MULTI FUNCTION MICROPHONE)

MC-44 SCHEMATIC DIAGRAM



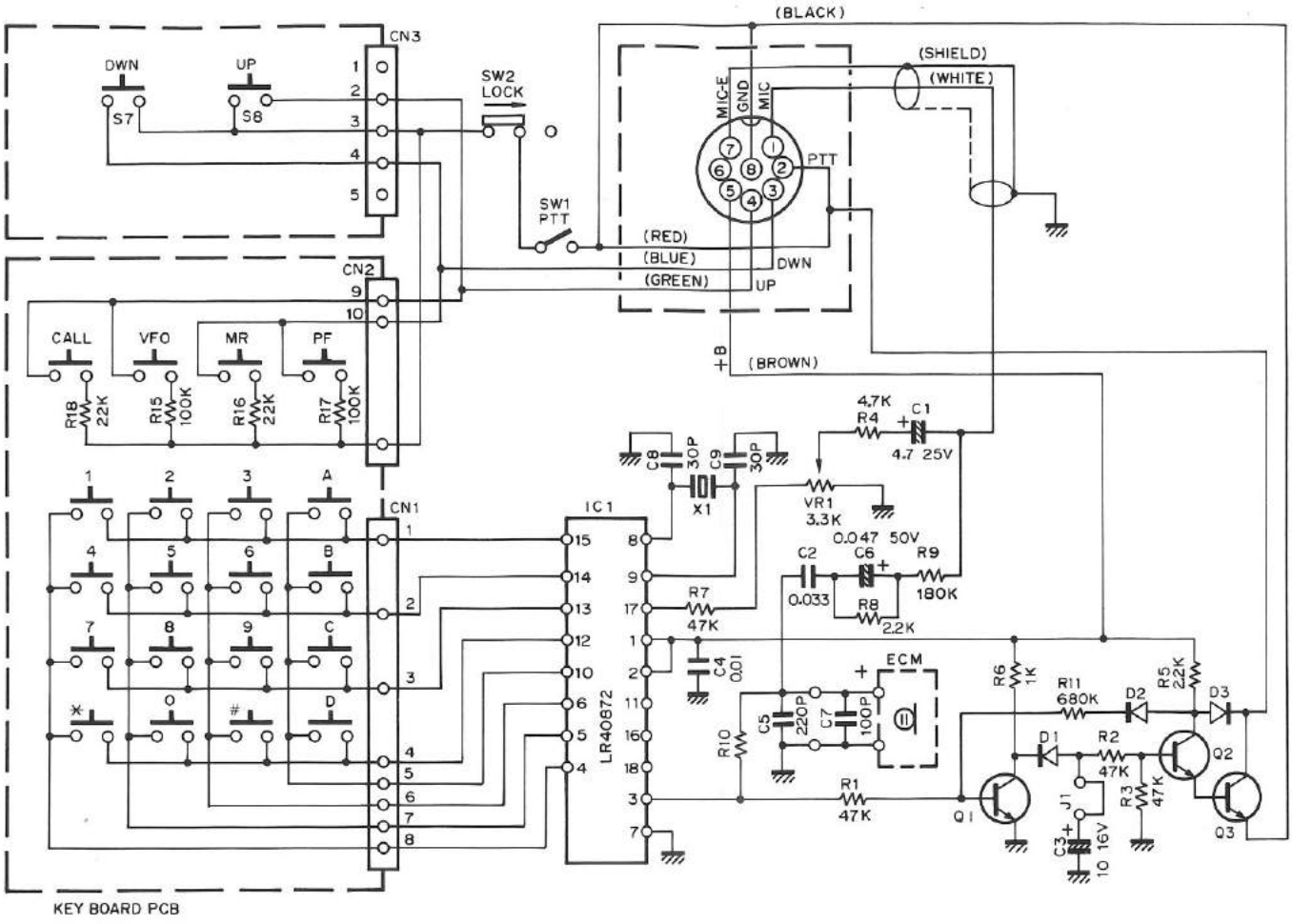
MC-44 PARTS LIST

Ref. No.	New parts	Parts No.	Description	
	*	A02-0896-08	Case (Front)	
	*	A02-0900-08	Case (Rear)	
	*	B50-8293-08	Instruction manual	
		E30-2149-08	Curl cord	
		K29-3165-08	Knob	PTT
	*	K29-3168-08	Knob	UP
	*	K29-3169-08	Knob	DOWN
	*	K29-3170-08	Knob	CALL, VFO, MR, PF
SW2	*	S31-1422-08	Slide switch	LOCK
SW1	*	S50-1431-08	Micro switch	PTT
S7, 8	*	S59-1409-08	Switch	UP, DOWN
	*	T91-0383-08	Microphone element (Condenser microphone)	

TM-331A

MC-44DM (MULTI FUNCTION MICROPHONE WITH AUTOPATCH)

MC-44DM SCHEMATIC DIAGRAM

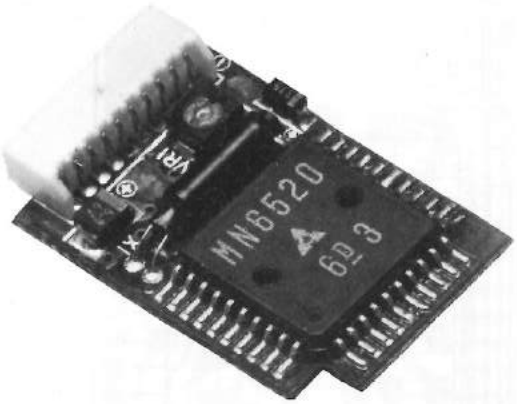


MC-44DM PARTS LIST

Ref. No.	New parts	Parts No.	Description
	*	A02-0898-08	Case (Front) DTMF
	*	A02-0901-08	Case (Rear) DTMF
	*	B50-8293-08	Instruction manual
		E30-2149-08	Curl cord
		K29-3165-08	Knob PTT
	*	K29-3167-08	Key top DTMF
	*	K29-3168-08	Knob UP
	*	K29-3169-08	Knob DOWN
SW2	*	S31-1422-08	Slide switch LOCK
SW1	*	S50-1431-08	Micro switch PTT
S7, 8	*	S59-1409-08	Switch UP, DOWN
	*	T91-0383-08	Microphone element (Condenser microphone)

TSU-6 (CTCSS UNIT)

TSU-6 EXTERNAL VIEW



TSU-6 PARTS LIST

* : New Parts

Ref. No.	New Parts	Parts No.	Description
		CTCSS UNIT (X52-3100-00)	
C1		CK73FB1H102K	Chip C 1000pF K
C2		C92-0010-05	Tantal 6.8μF 6.3WV
C3	*	C92-0006-05	Tantal 3.3μF 4.0WV
C4, 5		CK73EB1E104K	Chip C 0.1μF K
C6		CK73EB1H223K	Chip C 0.022μF K
C7		CK73EB1E104K	Chip C 0.1μF K
C8, 9		CC73FCH1H150J	Chip C 15pF J
C10		CK73FB1H102K	Chip C 1000pF K
C11		CK73EB1E104K	Chip C 0.1μF K
C12		C92-0507-05	Chip tan. 4.7μF 6.3WV
C13	*	C92-0510-05	Chip tan. 3.3μF 4.0WV
	*	E40-5121-05	Pin connector (10P)
X1		L77-1313-05	X'tal resonator 4.194304MHz
R1–10		RK73FB2A○○○J	Chip resistor
R12–14		RK73FB2A○○○J	Chip resistor
VR1	*	R12-3460-05	Trimming pot. 33kΩ
Q1		DTC144TK	Digital transistor
Q2		DTA114EK	Digital transistor
Q3		2SC2712(GR)	Chip transistor
IC1		MN6520	IC
IC2		MN4094BS	IC

TSU-6 FINE ADJUSTMENT OF TONE FREQUENCY

The tone frequency can be fine adjusted with an interval of 0.5% step over the range of 0 to +1.5%. Ground the T1 (pin 10) and T2 (pin 9) of IC1 to obtain the desired frequency.

	T1	T2
0%	X	X
+0.5%	O	X
+1.0%	X	O
+1.5%	O	O

O : GND, X : OPEN

Table 3

TSU-6 REFERENCE DATA

TH-25's condition and MN4094BS (IC2) relationship

CTCSS switch	TONE switch	TX/RX	MN4094BS terminal		
			Q5	Q6	Q1 ~ 4, 7, 8
OFF	OFF	TX	L	H	L
		RX	L	H	L
	ON	TX	L	L	See table 2
		RX	L	H	L
ON	OFF	TX	L	L	See table 2
		RX	H	L	
	ON	TX	L	L	
		RX	H	L	

Q1 ~ 4, 7, 8 : Tone frequency setting
Q5 : TX/RX switch for MN6520 (IC1). "H" : RX, "L" : TX.
Q6 : Power switch for MN6520 (IC1). "H" : OFF, "L" : ON.

Table 1

Tone frequency and MN6520 (IC1) relationship

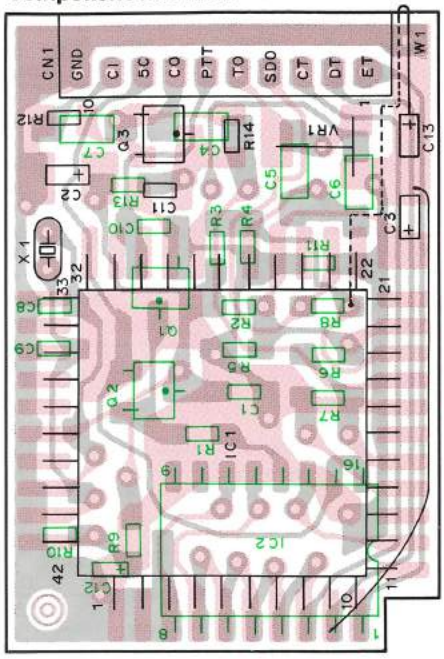
Tone frequency (Hz)	MN6520 terminal					
	$\overline{S6}$	$\overline{S5}$	$\overline{S4}$	$\overline{S3}$	$\overline{S2}$	$\overline{S1}$
	MN4094BS terminal					
	Q1	Q2	Q3	Q4	Q7	Q8
67.0	L	H	H	H	L	H
71.9	L	H	H	H	L	L
74.4	L	H	H	L	H	H
77.0	L	H	H	L	H	L
79.7	L	H	H	L	L	H
82.5	L	H	H	L	L	L
85.4	L	H	L	H	H	H
88.5	L	H	L	H	H	L
91.5	L	H	L	H	L	H
94.8	H	H	H	L	L	H
100.0	H	H	H	L	L	L
103.5	H	H	L	H	H	H
107.2	H	H	L	H	H	L
110.9	H	H	L	H	L	H
114.8	H	H	L	H	L	L
118.8	H	H	L	L	H	H
123.0	H	H	L	L	H	L
127.3	H	H	L	L	L	H
131.8	H	H	L	L	L	L
136.5	H	L	H	H	H	H
141.3	H	L	H	H	H	L
146.2	H	L	H	H	L	H
151.4	H	L	H	H	L	L
156.7	H	L	H	L	H	H
162.2	H	L	H	L	H	L
167.9	H	L	H	L	L	H
173.8	H	L	H	L	L	L
179.9	H	L	L	H	H	H
186.2	H	L	L	H	H	L
192.8	H	L	L	H	L	H
203.5	H	L	L	H	L	L
210.7	H	L	L	L	H	H
218.1	H	L	L	L	H	L
225.7	H	L	L	L	L	H
233.6	H	L	L	L	L	L
241.8	L	H	H	H	H	H
250.3	L	H	H	H	H	L

Table 2

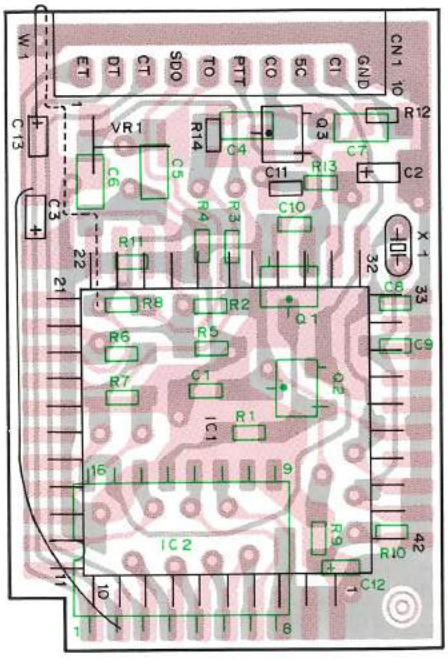
TSU-6 (CTCSS UNIT)

TSU-6 PC BOARD VIEWS

Component side view



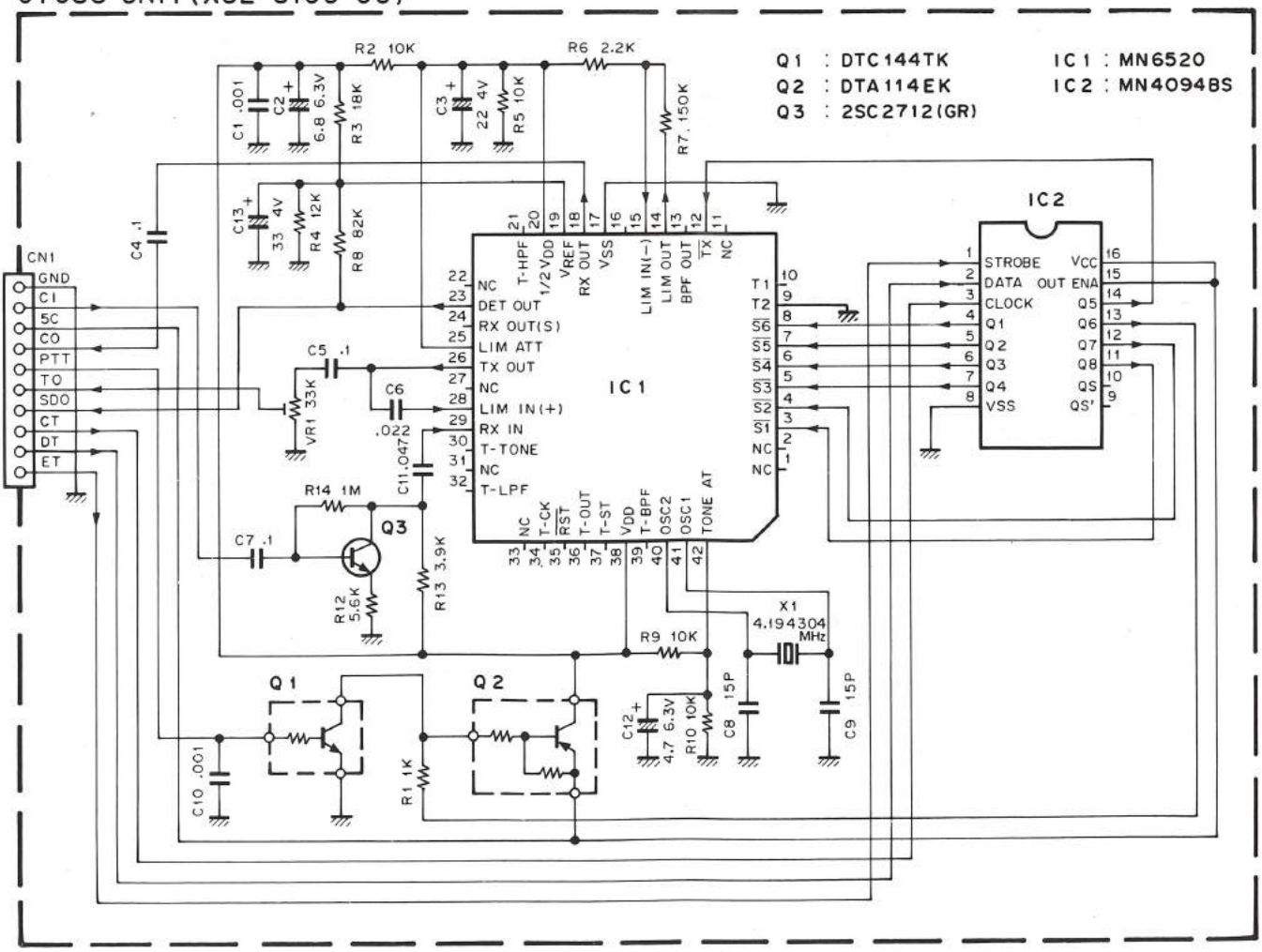
Foil side view



: Component side
: Foil side

TSU-6 CIRCUIT DIAGRAM

CTCSS UNIT (X52-3100-00)



TM-331A

SPECIFICATIONS

General

Frequency range	220 to 225MHz
Mode	F3E (FM)
Antenna impedance	50Ω
Power requirements	13.8V DC ±15% (11.7 to 15.8)
Ground	Negative
Frequency stability	Less than ±10ppm
Current drain	
Transmit mode	Less than 6.5A
Receiver mode with no signal	Less than 0.6A
Operating temperature	–20°C to +60°C (–4°F to +140°F)
Dimensions (W x H x D)	140 x 40 x 160 mm (5-1/2" x 1-37/64" x 6-19/64")
(Projection included)	141 x 42 x 171 mm (5-9/16" x 1-21/32" x 6-47/64")
Weight	1.2kg (2.65lbs)

Transmitter

Output power*	
HI	25W
MID	10W
LOW	Approx. 5W
Modulation	Reactance modulation
Spurious radiation	Less than –60dB
Maximum frequency deviation	±5kHz
Audio distortion (at 60% modulation)	Less than 3% (300 to 3000Hz)
Microphone impedance	500 to 600Ω

Receiver

Circuitry	Double conversion superheterodyne
Intermediate frequency (1st/2nd)	30.825MHz/455kHz
Sensitivity (12dB SINAD)	Less than 0.16μV
Selectivity	
–6dB	More than 12kHz
–60dB	Less than 24kHz
Squelch sensitivity	Less than 0.1μV
Output (5% distortion)	More than 2W across 8Ω loads
External speaker impedance	8Ω

Notes :

1. Circuit and ratings are subject to change without notice due to advancements in technology.
2. * Recommended duty cycle : 1 minute Transmit, 3 minutes Reception.

KENWOOD CORPORATION
Shionogi Shibuya Building, 17-5, 2-chome Shibuya, Shibuya-ku, Tokyo 150, Japan

KENWOOD U.S.A. CORPORATION
COMMUNICATIONS & TEST EQUIPMENT GROUP
P.O. BOX 22745, 2201 East Dominguez St., Long Beach, CA 90801-5745, U.S.A.

KENWOOD ELECTRONICS DEUTSCHLAND GMBH
Rembrücker Str. 15, 6056 Heusenstamm, West Germany

KENWOOD ELECTRONICS BENELUX N.V.
Mechelsesteenweg 418 B-1930 Zaventem, Belgium

TRIO-KENWOOD FRANCE S.A.
13, Boulevard Ney, 75018 Paris, France

KENWOOD ELECTRONICS AUSTRALIA PTY. LTD.
(INCORPORATED IN N.S.W.)
4E. Woodcock Place, Lane Cove, N.S.W. 2066, Australia

KENWOOD & LEE ELECTRONICS, LTD.
Wang Kee Building, 5th Floor, 34-37, Connaught Road, Central, Hong Kong

KENWOOD ELECTRONICS CANADA INC.
P.O. BOX 1075, 959 Gana Court, Mississauga, Ontario, Canada L4T 4C2