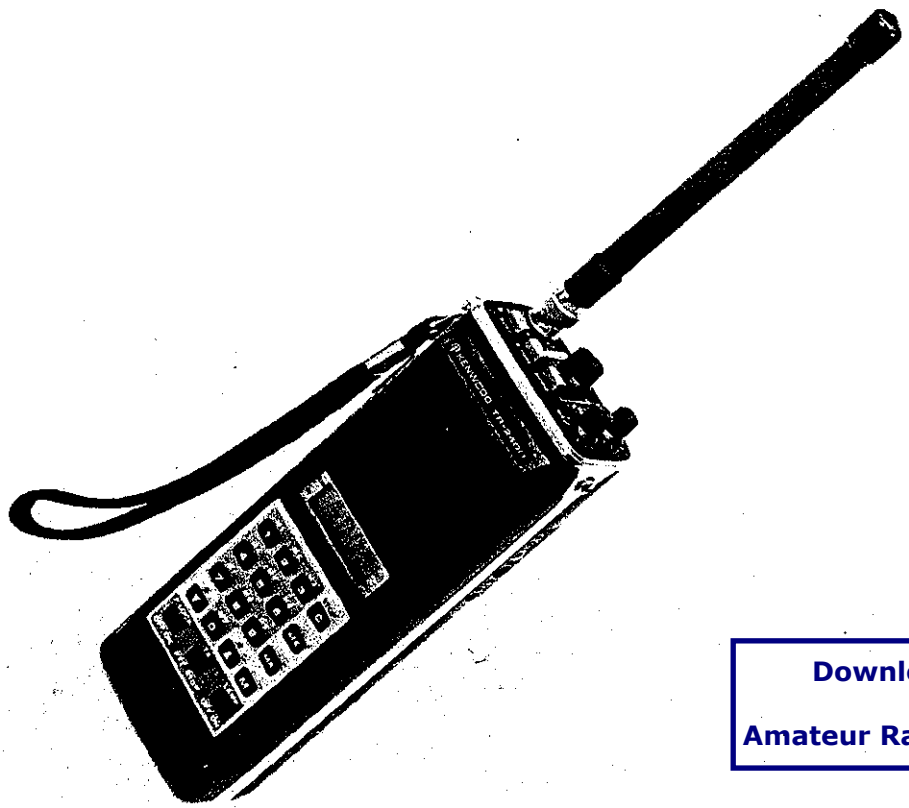
$10.00

KENWOOD

SERVICE MANUAL

Model TR-2400



2m FM SYNTHESIZED HAND-HELD TRANSCEIVER

TR-2400

CONTENTS

SPECIFICATIONS

[K type]

GENERAL

Semiconductors	Transistors	28
	FET	1
	ICs	18
	Diodes	52
Display	LCD (Liquid Crystal Display)	
Frequency Range	144.00 to 147.995 MHz	
Frequency Synthesizer	Digital control of phase locked VCO	
Synthesizer Stability	Less than ±750 Hz at 25°C	
Mode	FM	
Channels	800	
Memory Channels	10	
Operating Temperature	−20 to 50°C	
Power Voltage	9.6 VDC±15%	
Grounding	Negative groudning	
Antenna Impedance	50Ω	
DC Current	Approx. 28 mA in receive with no input signal Approx. 500 mA in transmit (at 1.5 W RF output) Approx. 0.8 mA in memory backup with power switch off	
Dimensions	71 mm (2-13/16") wide 192 mm (7-9/16") high 47 mm (1-7/8") deep	
Weight	740 gr (1.62 lbs.)	

TRANSMITTER SECTION

RF Output Power	1.5 Watts
Modulation	Variable reactance direct shift
Max. Frequency Deviation	±5 kHz
Spurious Radiation	Less than −60 dB
Microphone	Condensor microphone

RECEIVER SECTION

Circuitry	Double superheterodyne
Intermediate Frequency	1st IF.....10.7 MHz 2nd IF.....455 kHz
Sensitivity	Less than 0.2μV for 12 dB SINAD (Less than 1μV for 30 dB S/N)
Squelch Sensitivity	Less than 0.25μV
Pass Band Width	More than 12 kHz at 6 dB down
Audio Output	More than 200 m watts across 8Ω load (10% distortion)

NOTE: Circuit and ratings may change without notice due to developments in technology.

[W type]

GENERAL

Semiconductors	Transistors	29
	FET	1
	ICs	18
	Diodes	53
Display	LCD (Liquid Crystal Display)	
Frequency Range	144.00 to 145.995 MHz	
Frequency Synthesizer	Digital control of phase locked VCO	
Synthesizer Stability	Less than ±750 Hz at 25°C	
Mode	FM	
Channels	400	
Memory Channels	10	
Operating Temperature	−20 to 50°C	
Power Voltage	9.6 VDC±15%	
Grounding	Negative groudning	
Antenna Impedance	50Ω	
DC Current	Approx. 28 mA in receive with no input signal Approx. 500 mA in transmit (at 1.5 W RF output) Approx. 0.8 mA in memory backup with power switch off	
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CIRCUIT DESCRIPTION

RECEIVING UNIT

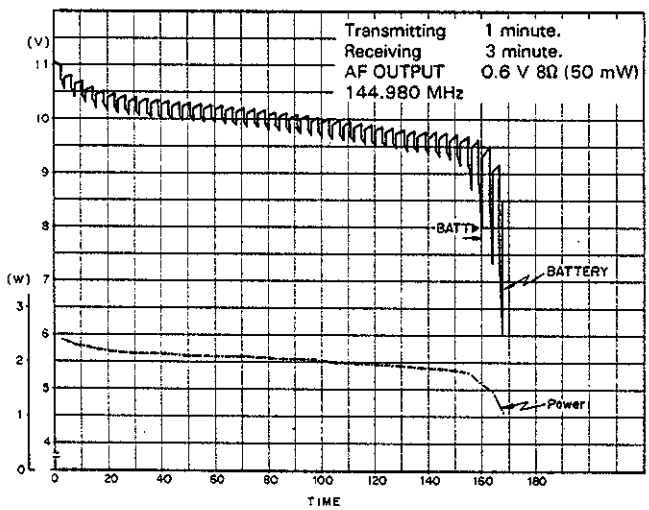
The receiving unit employs a double superheterodyne circuit with 3 hybrid IC's. The RF stage is toued by variable capacitance diodes. The receive signal is RF amplified by Q1 and mixed with VCO outlet by Q2 to produce an IF signal at 10.7 MHz. This signal passes through a Monolithic Crystal filter and is fed to Q4 a hybrid IC containing at the 2nd oscillator and 2nd mixer. Output is the 2nd IF signal 455 kHz. The IF signal is amplified by Q5 a hybrid and becomes an AF signal through the ceramic discriminator. In the receive mode, standby current is about 28 mA, squelsh closed (no signal).

Transmitting Unit

The transmitter is a simple 3-stage circuit using direct modulation of the VCO operating at the signal transmit frequency. Since this circuit has no MIXER stage, excellent transmit signal characteristics are obtained.

Operating time:

Normal operating time of TR-2400 is 2 hours and 30 minutes for 1 minute transmission and 3 minutes reception. Fig. 1 shows the voltage/power vesus time characteristics.



PLL CONTROL UNIT

Fig. 2 shows the PLL unit. An important feature of the PLL circuit is that the VCO output frequency during transmission operates between 144.00~147.99 MHz. This directly feeds the driver and PA sections. In the receive mode, the VCO frequency operates between 133.3~137.29 MHz. Thus, the VCO output in transmit mode is different from that in receive mode. This PLL unit is compact and its current consumption is very low.

Individual local oscillator triplet circuits are used for transmission and reception. The local oscillator output frequency for transmission is 138.5 MHz and for reception is

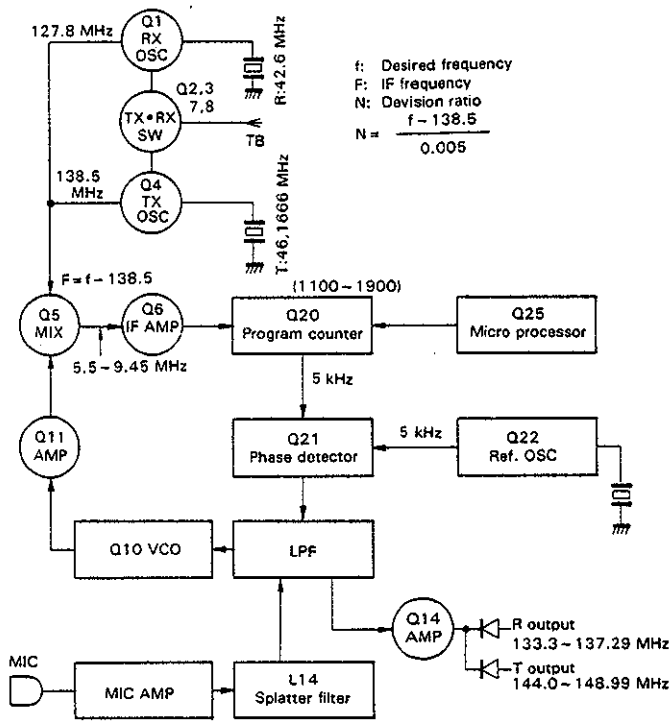


Fig. 2 PLL unit

127.8 MHz. The VCO output is amplified by Q11. This circuit has a variable tuning circuit which varies the transmit and receive bandpass by 10.7 MHz.

The output mixed BY Q5 is an IF signal of 5.5~9.45 MHz which is fed to a low-pass filter and is amplified by Q6. This signal is then applied to the programmable divider.

The programmable divider is controlled by a microprocessor. the signal is frequency divided by the program counter (frequency division: 1100~1900) to obtain the output frequency in 5 kHz steps. The 10.240 MHz signal from the reference oscillator is compared with the reference frequency (5 kHz) by the phase comparator Q21 and its output is applied through a low-pass filter to the VCO.

The VCO is an FET oscillator circuit. The vari-cap diode D2 (1S2208) is used for controlling frequencies, D5 (1SV50S) for modulation, and D3 (1S2588) for switching transmit and receive modes.

For direct modulation of the VCO, a sharp splatter filter is used after the MIC amplifier. A condenser microphone assures good sensitivity and high quality tone. The control unit is composed of a 4-bit micro-processor having both the frequency control and memory functions required for the TR-2400. The micro-processor is C MOS, and employes a 500 kHz ceramic element as the clock oscillator. Current drain for memory backup is about 800μA. The microprocessor is controlled by a 16 key (4×4) pad to provide fre-

CIRCUIT DESCRIPTION

quency selection, UP/DOWN channel selection, memory channel and memory scan channel selection.

DISPLAY UNIT

The display unit is composed of an oscillator (Q2), LCD driver unit, and display driver unit as shown. The LCD is lighted by a 36 Hz oscillator pulse. This pulse is delivered to the LCD backplane.

The display BCD code and digit output from the microprocessor are latched by the LCD drivers Q3 ~ 6 (TC4243BP) to produce output for lighting the LCD. This output is simultaneously delivered at the 36 Hz pulse rate to the LCD backplane with a 180° phase difference.

The 36 Hz pulse is also applied to Q1 (TC4030BP), thereby lighting the display lamps for transmission, battery alarm and MR. Q2 (TC4011BP) is the 36 Hz oscillator.

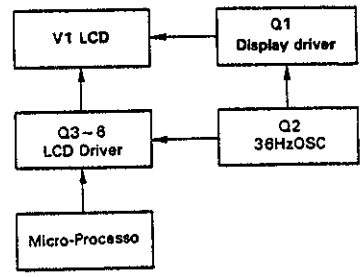


Fig. 3 Display unit

BLOCK DIAGRAM (K type)

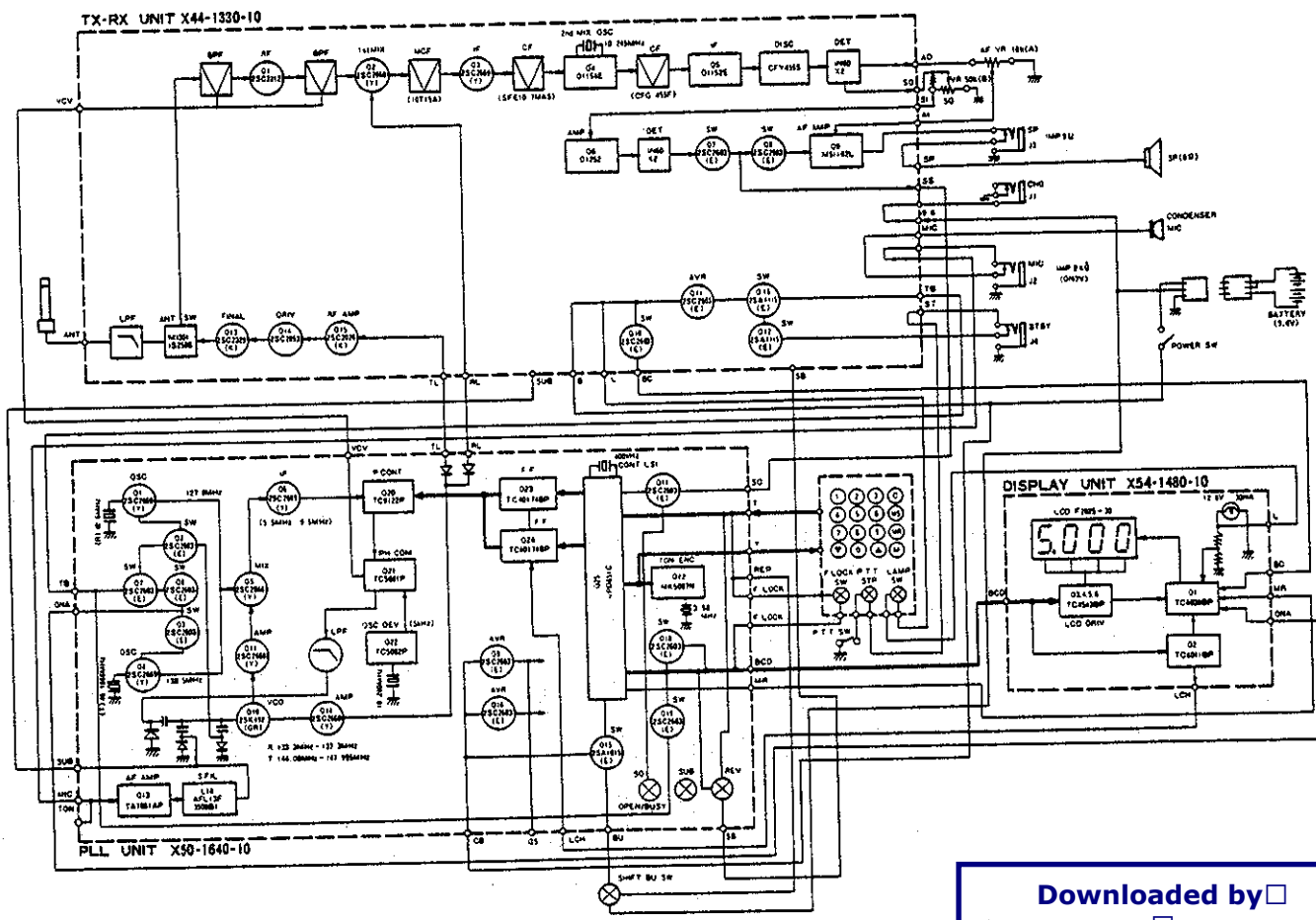


Fig. 4

SEMICONDUCTOR DATA

H8D1154E (TX.RX unit Q4)

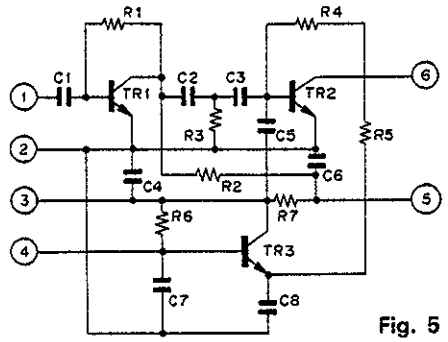


Fig. 5

H8D1152E (TX.RX unit Q5)

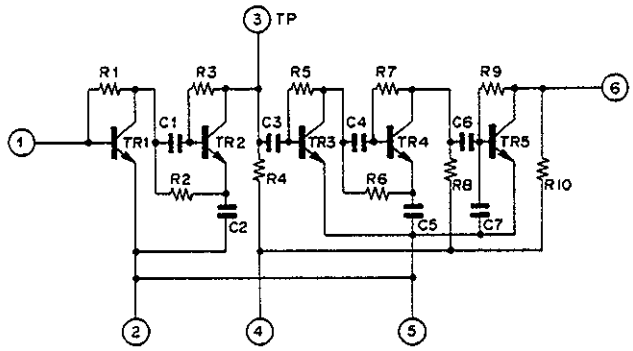


Fig. 6

H8D1252 (TX.RX unit Q6)

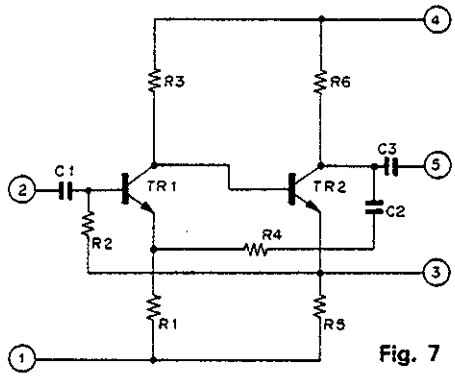


Fig. 7

Monolithic filter L71-0217-05 (TX•RX unit L24)

Item	Rating
Nominal center frequency (f_0)	10.7 MHz
Pass bandwidth	$f_0 \pm 7.5$ kHz or more at 3 dB
Attenuation bandwidth	$f_0 \pm 25$ kHz or less at 18 dB
Ripple	0.5 dB or less
Insertion loss	2.0 dB or less
Guaranteed attenuation	30 dB or more within $f_0 \pm 1$ MHz Spurious; 18 dB or more
Terminal impedance	3 kΩ//2 pF

M51182L (TX.RX unit Q9)

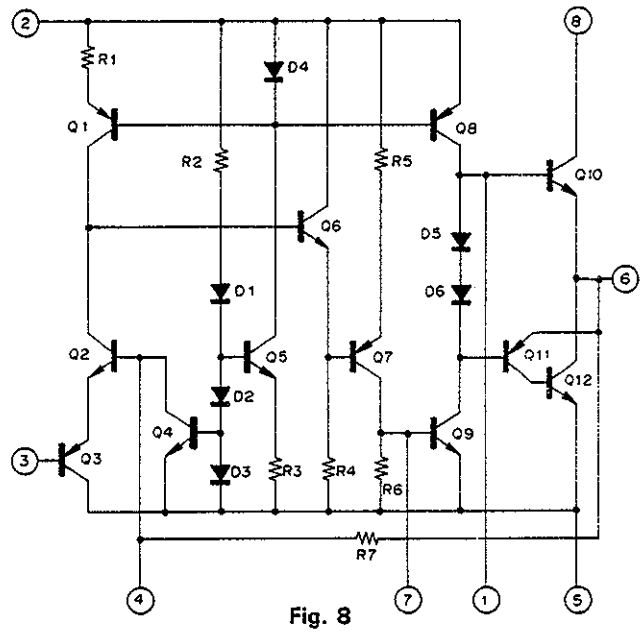


Fig. 8

2SC 2329 (TX•RX unit Q13)

Usage	High-Frequency power amplifier	
Type	NPN epitaxial silicon transistor	
Collector voltage	V_{CBO}	38 V
Emitter voltage	V_{EBO}	3.0 V
Collector-emitter voltage	V_{CEO}	18 V
Collector current	Ic	0.75 mA
Total loss	P_T (Tc = 25°C)	7.5 W (Rth(j-c) = 20°C/W)
Junction temperature	Tj	175°C
Storage temperature	Tstg	−65 ~ +175°C

Ceramic filter L72-0318-05 (TX•RX unit L9)

Item	Rating
Nominal center frequency	455 kHz
3 dB bandwidth	±4.2 kHz or more
6 dB bandwidth	±6 kHz or more
60 dB bandwidth	±12 kHz or less
Guaranteed attenuation(within ± 100kHz)	50 dB or more
Spurious (within 0.1 ~ 1 MHz)	25 dB or more
Ripple (within ± 4.2 KHz)	3 dB or less
Insertion loss	6 dB or less
Input impedance	2.0 kΩ

SEMICONDUCTOR DATA

MK5087 (N) (PLL unit Q12-K type only)

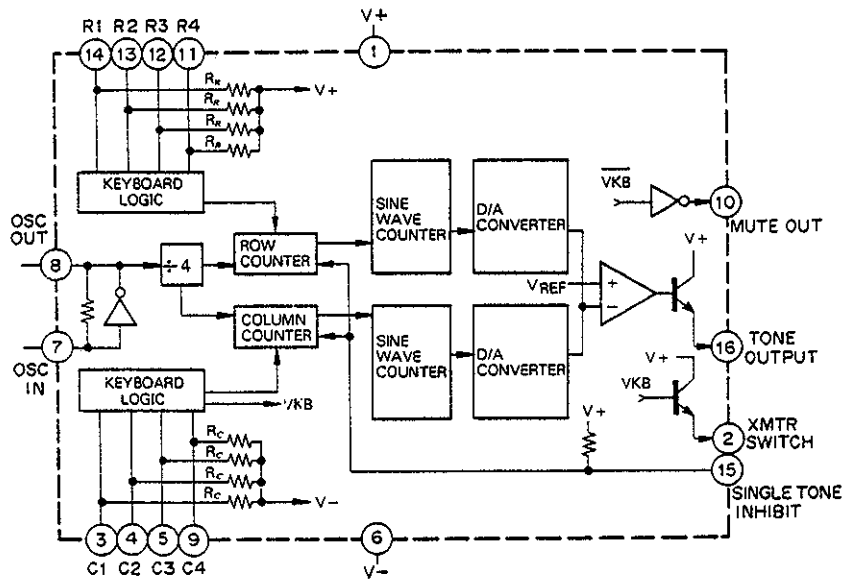


Fig. 9

TC40174BP (PLL unit Q23, 24)

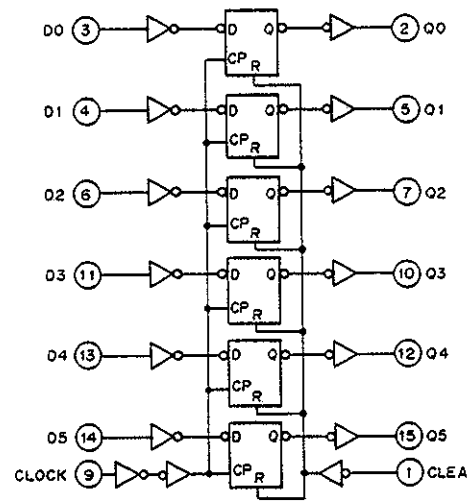


Fig. 12

TC5081P (PLL unit Q21)

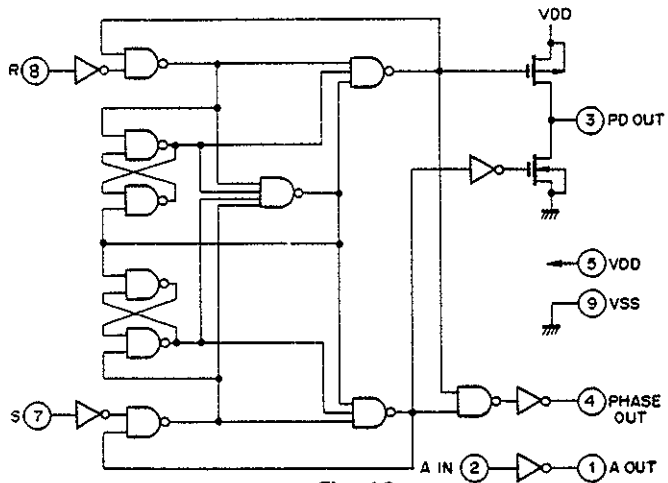


Fig. 10

TC40174BP (PLL unit Q23, 24)

Truth table

INPUTS			OUTPUTS
CLOCK△	D_n	CLEAR	Q_n
↑	H	H	H
↑	L	H	L
↓	*	H	Q_n•
*	*	L	L

△: Level change
•: No change
*: Don't care

TC5082P (PLL unit Q22)

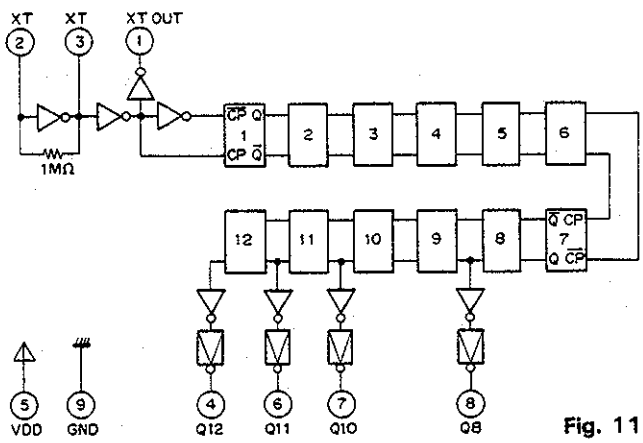


Fig. 11

PIN NO	8	7	6	4	1
PIN NAME	Q_8	Q_{10}	Q_{11}	Q_{12}	XT_{out}
Dividing ratio	1/256	1/1020	1/2048	1/4096	1/1
Output frequency X-tal 10.24 MHz	40 kHz	10 kHz	5 kHz	2.5 kHz	10.24 MHz

SEMICONDUCTOR DATA

TC9122P (PLL unit Q20)

Function explanation

Symbol	Name	Content and operation	Remarks
P_{in}	Programmble counter input terminal	Programmable counter input terminal to which the signal to be divided is input.	Build-in bias circuit
P_{out}	Programmable counter output terminal	Programmable couter output terminal. Output is 1/N of the input frequency. The output pulse width equals that of the input.	
$A_1 \sim A_4$ $B_1 \sim B_4$ $C_1 \sim C_4$ $D_1 \sim D_4$	×1 ×10 ×100 ×1000 } Program input terminals	Terminal to set the dividing ratio. The following input combination is prohibited.	Built-in pull-down resistor

A_1	A_2	A_3	A_4	B_1	B_2	B_3	B_4	C_1	C_2	C_3	C_4	D_1	D_2
1	0	0	0	0	0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0	0	0	0	0	0
1	0	1	0	0	0	0	0	0	0	0	0	0	0
0	1	1	0	0	0	0	0	0	0	0	0	0	0
1	1	1	0	0	0	0	0	0	0	0	0	0	0

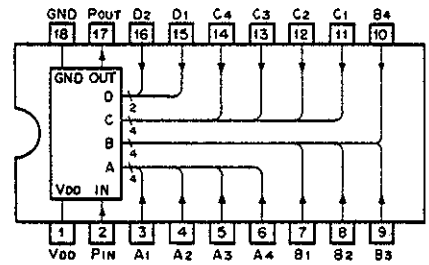


Fig. 13

LCD F2025-30 (Display unit V1)

Max rating (Absolute max. rating)

Item	Symbol	Min.	Max.	Unit
Storage temperature	T_{stg}	−20	60	°C
Operation temperature	T_{op}	−20	50	°C
Applied voltage	V_{OP}		10	V
Allowable DC voltage			25	mV

Recommendable operating condition

Item	Symbol	Min.	Norm.	Max.	Unit
Operating voltage	V_{op}	3	5	5.5	V
Operating frequency	f_{op}	30	32	35	Hz
Operating temperature	T_{OP}	−5	25	50	°C

Notes on operation

1. Excessive force will damage the package.
   If the liquid crystal leaks due to damage to the package, do not touch it. If the liquid crystal gets on your skin, wipe it off with alcohol and wash with water.
2. Do not store or operate at high temperature or humidity.
3. If it is exposed to direct sunlight, use the ultraviolet ray cut filter (cut-off frequency: approx. 460 mm).
4. Do not apply a DC voltage as far as possible. (ADC voltage can be applied for only 1 minute.)

Pin connection

Pin No.	Segment	Pin No.	Segment
1	Common	21	Delta-3
2	Minus	22	4D-b
3	Delta-2	23	4D-a
4	1D-e	24	4D-f
5	1D-d	25	4D-g
6	1D-c	26	3D-b
7	2D-dp.	27	3D-a
8	2D-e	28	3D-f
9	2D-d	29	3D-g
10	2D-c	30	Colon
11	3D-dp.	31	2D-b
12	3D-e	32	2D-a
13	3D-d	33	2D-f
14	3D-c	34	2D-g
15	4D-dp.	35	1D-b
16	4D-e	36	1D-a
17	4D-d	37	1D-f
18	4D-c	38	1D-g
19	Delta-5	39	Delta-1
20	Delta-4	40	Common

SEMICONDUCTOR DATA

TC4030BP (DISPLAY unit Q1)

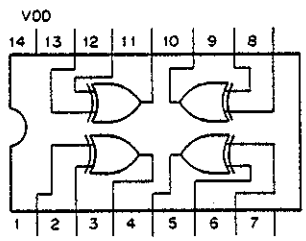


Fig. 14

Truth table

INPUTS		OUTPUTS
A	B	X
L	L	L
L	H	H
H	L	H
H	H	L

TC4543BP (PLL unit Q3 ~ 6)

Truth table

INPUT							OUTPUT							DISPLAY
LD	BI	PHASE	A	B	C	D	a	b	c	d	e	f	g	
*	H	H	*	*	*	*	H	H	H	H	H	H	H	BLANK
*	H	L	*	*	*	*	L	L	L	L	L	L	L	BLANK
L	L	H	*	*	*	*	LATCH							
L	L	L	*	*	*	*	LATCH							
H	L	H	L	L	L	L	L	L	L	L	L	L	H	0
H	L	H	H	L	L	L	H	L	L	H	H	H	H	1
H	L	H	L	H	L	L	L	L	H	L	L	H	L	2
H	L	H	H	H	L	L	L	L	L	L	H	H	L	3
H	L	H	L	L	H	L	H	L	L	H	H	L	L	4
H	L	H	H	L	H	L	L	H	L	L	H	L	L	5
H	L	H	L	H	H	L	L	H	L	L	L	L	L	6
H	L	H	H	H	H	L	L	L	L	H	H	H	H	7
H	L	H	L	L	L	H	L	L	L	L	L	L	L	8
H	L	H	H	L	L	H	L	L	L	L	H	L	L	9
H	L	H	L	H	L	H	H	H	H	H	H	H	H	BLANK
H	L	H	H	H	L	H	H	H	H	H	H	H	H	BLANK
H	L	H	L	L	H	H	H	H	H	H	H	H	H	BLANK
H	L	H	H	L	H	H	H	H	H	H	H	H	H	BLANK
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H	L	H	H	H	H	H	H	H	H	H	H	H	H	BLANK
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H	L	L	H	L	L	L	L	H	H	L	L	L	L	1
H	L	L	L	H	L	L	H	H	L	H	H	L	H	2
H	L	L	H	H	L	L	H	H	H	H	L	L	H	3
H	L	L	L	L	H	L	L	H	H	L	L	H	H	4
H	L	L	H	L	H	L	H	L	H	H	L	H	H	5
H	L	L	L	H	H	L	H	L	H	H	H	H	H	6
H	L	L	H	H	H	L	H	H	H	L	L	L	L	7
H	L	L	L	L	L	H	H	H	H	H	H	H	H	8
H	L	L	H	L	L	H	H	H	H	H	L	H	H	9
H	L	L	L	H	L	H	L	L	L	L	L	L	L	BLANK
H	L	L	H	H	L	H	L	L	L	L	L	L	L	BLANK
H	L	L	L	L	H	H	L	L	L	L	L	L	L	BLANK
H	L	L	H	L	H	H	L	L	L	L	L	L	L	BLANK
H	L	L	L	H	H	H	L	L	L	L	L	L	L	BLANK
H	L	L	H	H	H	H	L	L	L	L	L	L	L	BLANK

* Don't care.

7 SEGMENT DISPLAY

Display indicator mode

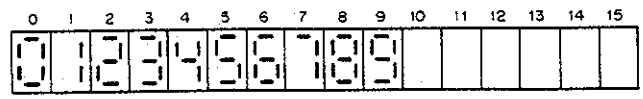


Fig. 15

SEMICONDUCTOR DATA

μPD651C-13 Terminal function (PLL unit Q25)

Pin No.	Terminal Name	Input signal	Output signal	Description
1	CL1			
2	PC0		○	X100 program data output
3	PC1		○	X100 program data output
4	PC2		○	X100 program data output
5	PC3		○	X100 program data output
6	INT	○		H when receiving L when transmitting or back-up
7	RES	○		Normally (without operating the keyboard) L
8	PD0		○	X10 Program data output
9	PD1		○	X10 Program data output
10	PD2		○	X10 Program data output
11	PD3		○	X10 Program data output
12	PE0		○	X1 Program data output
13	PE1		○	X1 Program data output
14	PE2		○	X1 Program data output
15	PE3		○	X1 Program data output
16	PF0		○	Indication BCD output
17	PF1		○	Indication BCD output
18	PF2		○	Indication BCD output
19	PF3		○	Indication BCD output
20	TEST	○		5V Power supply
21	VCC	○		5V Power supply

Pin No.	Terminal Name	Input signal	Output signal	Description
22	PG0		○	Keyboard output
23	PG1		○	Keyboard output
24	PG2		○	Keyboard output
25	PG3		○	Keyboard output
26	PH0		○	Indication digit output
27	PH1		○	Indication digit output
28	PH2		○	Indication digit output
29	PH3		○	Indication digit output
30	PI0		○	
31	PI1		○	Pulse output at MR output
32	PI2		○	Vacant terminal
33	PA0	○		Always H (K)
34	PA1	○		Always H (K)
35	PA2	○		L when receiving H when transmitting
36	PA3	○		Squelch Suppression input, Stops at L
37	PB0	○		Keyboard input
38	PB1	○		Keyboard input
39	PB2	○		Keyboard input
40	PB3	○		Keyboard input
41	VSS			Ground
42	CL0			Oscillatin output 397kHz

Key board ass'y (S59-0403-05)

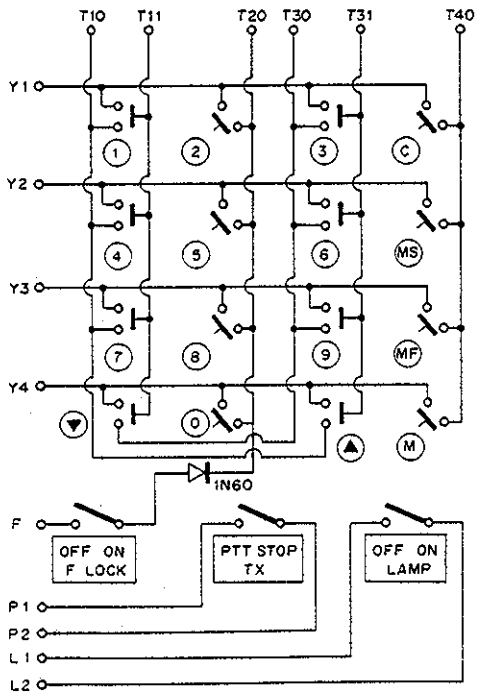
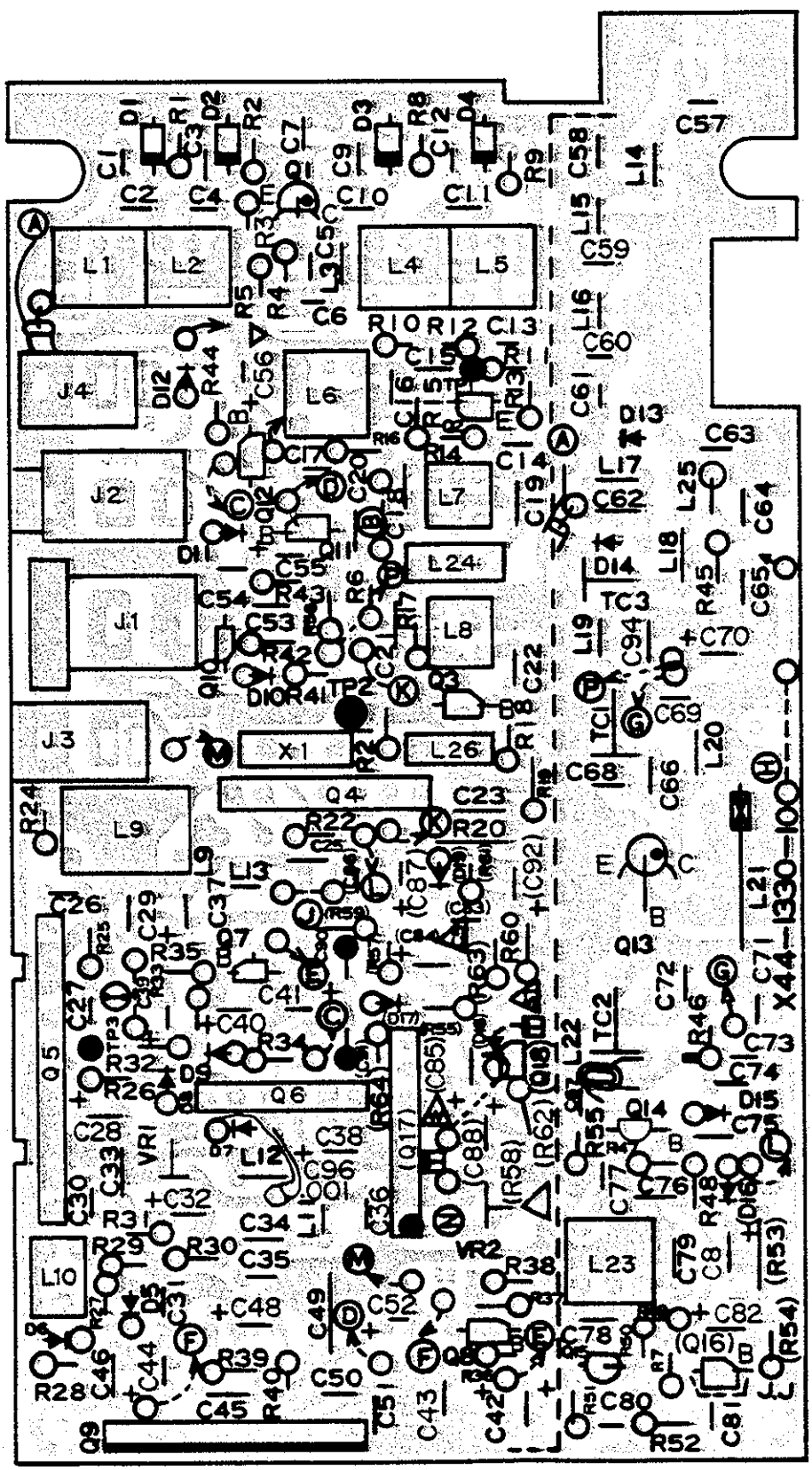


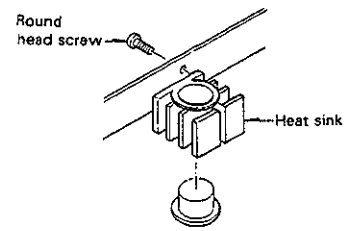
Fig. 16

TR-2400

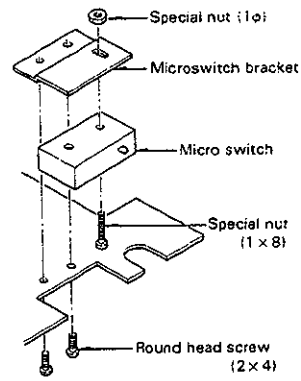
PRINTED CIRCUIT BOARD

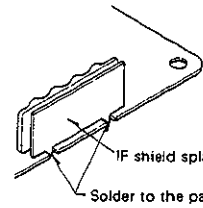
▼ TX-RX unit

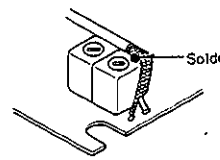




Apply heat sinker to the contact surfaces of heat sink, shielding plate and transistor.



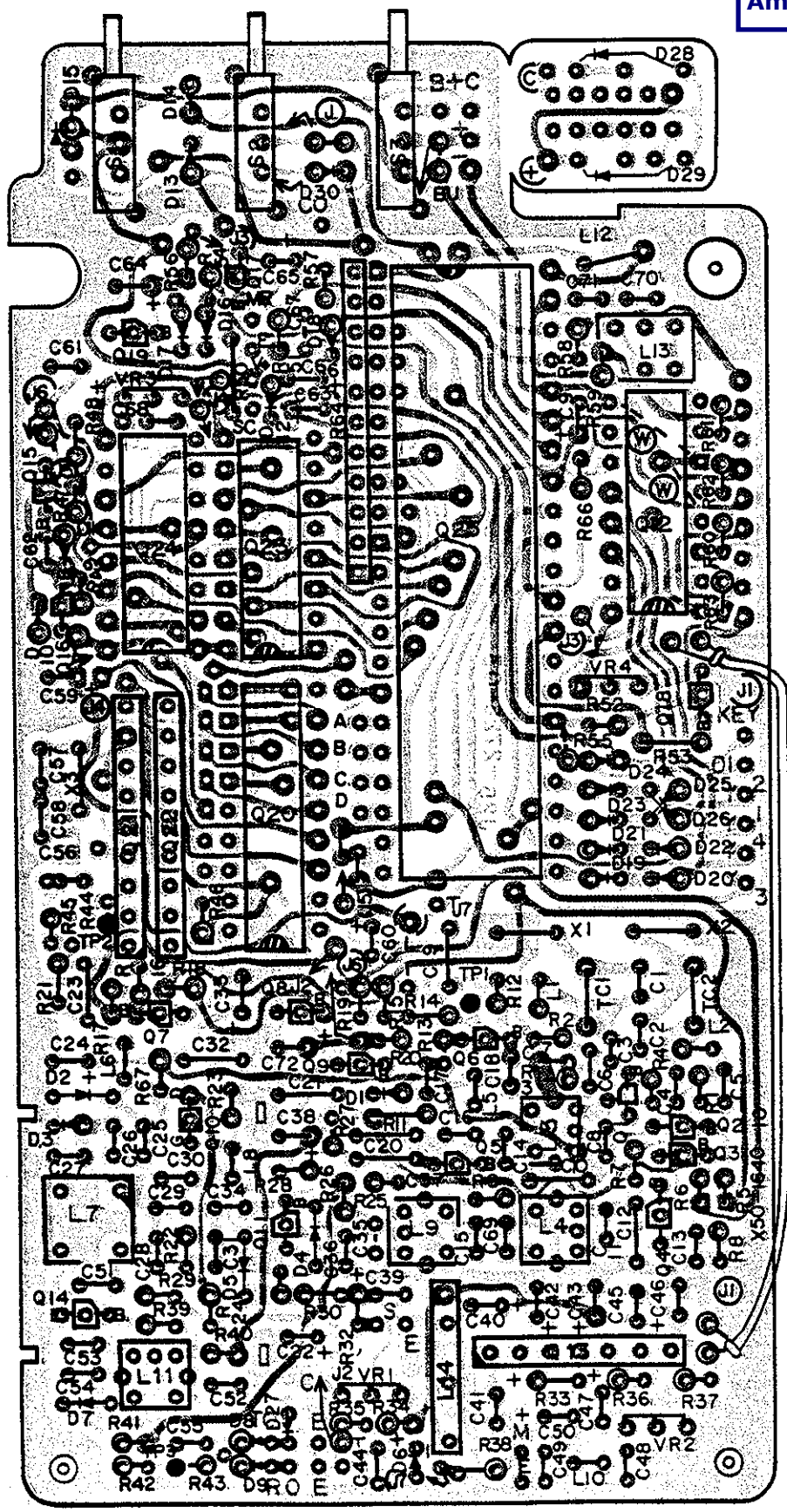




Q1 : 2SC2212
Q2 : 2SC2668(Y)
Q3 : 2SC2669(Y)
Q4 : D1154E
Q5 : D1152E
Q6 : D1252
Q7,8,10,11
: 2SC2603(E)
Q9 : M51182L
Q12,16: 2SA1115(E)
Q13 : 2SC2329(K)
Q14 : 2SC2053
Q15 : 2SC2026(K)

PRINTED CIRCUIT BOARD

▼ PLL unit

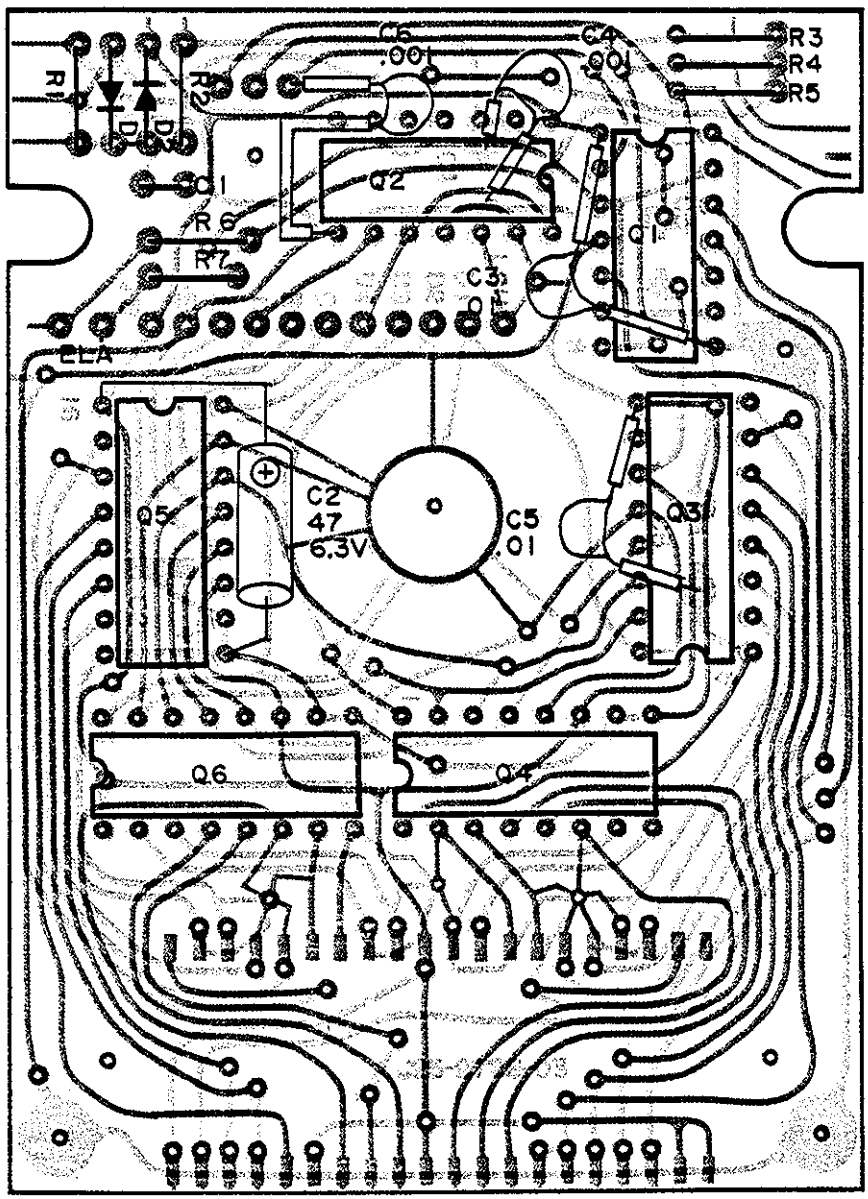


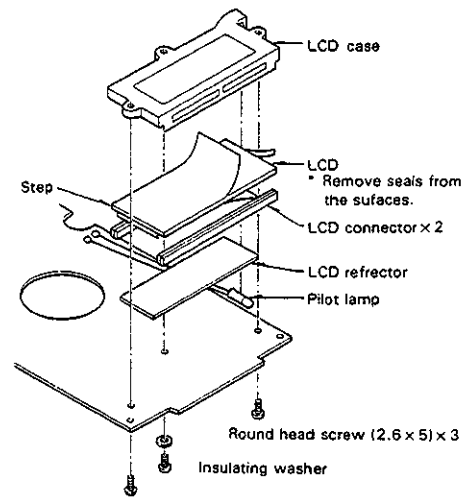
Q1,4,6 : 2SC2669(Y)
Q2,3,7~9,16~19 : 2SC2603(E)
Q5,11,14 : 2SC2668(Y)
Q10 : 2SK192(GR)
Q12 : MK5087N
Q13 : TA7061AP
Q15 : 2SA1115(E)
Q20 : TC9122P
Q21 : TC5081P
Q22 : TC5082P
Q23,24 : TC40174BP
Q25 : μPD651C-13

D1,11 : XZ-060
D2,4,7 : 1S2208
D3,8,9,27 : 1S2588
D5 : 1SV50S
D6 : XZ-070
D10,13~17,19~26,28,29 : 1N60
D12,18,32~35 : 1S1555

TR-2400

▼ DISPLAY unit





Q1 : TC4030BP
Q2 : TC4011UBP
Q3~6 : TC4543BP
D1,2 : 1S1555
V1 : F2025-30

PARTS LIST

Note 1:

K: U.S.A. W: Europe T: Britain

Note: 2:

Only special type of resistors (example: cement, metal film, etc.) and capacitors (example: electrolytic, tantalum, mylar, temp. coeff. capacitors) are detailed in the PARTS LIST. For the value of all common type components, refer to the schematic diagram of the PC board illustration. Resistors not otherwise detailed are carbon type (1/4 or 1/8W).
Order carbon resistors and capacitors according to the following example:
A carbon resistor's part number is RD14BB 2E222J.
A ceramic capacitor's number is CK45F1H103Z, CC45TH1H220J.

RESISTOR

1. Type of the carbon resistor

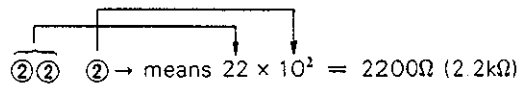

RD14BB


RD14CB

2. Warrage

1/4W → 2E
1/8W → 2B

3. Resistance value



Significant figure Multiplier

Example: 221 → 220 Ω 224 → 220 kΩ
222 → 2.2 kΩ 225 → 2.2 MΩ
223 → 22 kΩ

4. Tolerance

J = ±5% (Gold)
K = ±10% (Silver)

CAPACITORS

Type I

CK	45	F	1H	103	Z
1	2	3	4	5	6

Type II

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

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

6 = Tolerance

Cord	C	D	G	J	K	M	X	Z	P	No cord
(%)	±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

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

5 = Capacitor value

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

3 = CK45F

Ceramic capacitor (type I) 3

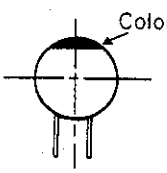
Cord	B	D	E	F
Operating temperature °C	−30 +85	−30 +85	−30 +85	−10 +70

3' = CC4500 ....

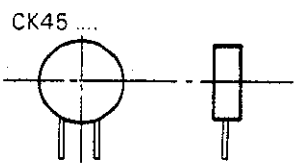
Ceramic capacitor (type II) temperature coeff. capacitor 1' 3'.

1st word (Color)	CH (Black)	LH (Red)	PH (Orange)	RH (Yellow)	SL (Green)	TH (Blue)	UH (Violet)
ppm/°C	0	−80	−150	−220	−330	−470	−750

CC45 ....



CK45 ....



Type II 45

PARTS LIST

Ref. No.	Parts No.	Description	Remarks
GENERAL ☆: New Parts			
–	A02-0607-02	Case (Front)	☆
–	A02-0608-02	Case (Rear)	☆
–	A21-0731-04	Ornamental panel (K type)	☆
–	A21-0734-04	Ornamental panel (W type)	☆
–	A21-0735-04	Ornamental panel (T type)	☆
–	A53-0301-03	Cover ass'y (Battery case)	☆
–	B03-0514-04	Switch mask × 3 (Push switch)	☆
–	B10-0626-04	Front glass	☆
–	B40-2494-04	Name plate (K type)	☆
–	B40-2496-04	Name plate (W type)	☆
–	B40-2497-04	Name plate (T type)	☆
–	B42-1677-04	Name plate (Key board) (K type)	☆
–	B42-1678-04	Name plate (Key board) (W, T type)	☆
–	B42-1679-04	Name plate (LCD)	☆
–	B43-0631-04	Badge (K, W type)	☆
–	B43-0634-04	Badge (T type)	☆
–	B46-0058-00	Warranty card (K type)	☆
–	B50-2689-00	Operating manual (K type)	☆
–	B50-2690-00	Operating manual (W type)	☆
–	B50-2691-00	Operating manual (T type)	☆
–	E04-0251-05	BNC Receptacle	☆
–	E12-0001-05	Plug (Microphone)	
–	E12-0401-05	Plug (Stand-by)	
–	E31-2047-05	Cable with plug (Battery)	☆
–	F15-0628-04	Shadow mask	☆
–	F15-0629-04	Jack mask (A)	☆
–	F15-0630-04	Jack mask (B)	☆
–	F20-0513-04	Insulating sheet (PLL U.–RX·TX U.)	☆
–	G01-0810-04	Coil spring (PTT)	☆
–	G13-0625-04	Sponge A (Speaker)	☆
–	G13-0626-04	Sponge B (Microphone)	☆
–	G13-0627-04	Sponge C (Cover)	☆
–	H01-2656-03	Carton case (K, W type)	☆
–	H01-2657-03	Carton case (T type)	☆
–	H10-2530-02	Polystyrene foam cushion A	☆
–	H10-2531-04	Polystyrene foam cushion B	☆
–	H10-2533-04	Cushion	☆
–	H20-1416-03	Protection cover	☆
–	H25-0049-03	Accessories bag	
–	J19-1331-03	Battery case	☆
–	J32-0740-04	Boss A (large) × 4	☆
–	J32-0741-04	Boss B (Small) × 2	☆
–	J32-0742-04	Boss C (Hand strap)	☆
–	J69-0301-03	Hand strap ass'y	☆
–	J69-0302-04	Both-side adhesive sheet	
–	K23-0730-04	Knob A (POWER, SQ.) × 2	☆
–	K23-0731-04	Knob B (TX-OFFSETJ)	☆
–	K27-0411-04	Push knob (SCAN, TONE, REV.) × 3	☆
–	K27-0413-04	Cap knob × 3	☆
–	K29-0730-04	Lever (PTT)	☆
–	N08-0504-04	Ornamental screw (Frame)	☆
–	N09-0616-04	Flat head screw (Key board) × 4	☆
–	N30-2004-41	Round head screw (Panel) × 3	
–	N30-2604-41	Round head screw (Case A, PTT) × 7	
–	N30-3008-45	Round head screw (Case B) × 2	
–	N30-3025-45	Round head screw (Case B) × 2	
–	N87-2005-46	Tap tight screw (Desplay unit) × 4	
–	R05-3409-05	Variable resistor 10kΩ (B) (VOL)	☆
–	R05-4403-05	Variable resistor 50KΩ (SQ.)	
–	S59-0402-05	Key board ass'y (K type)	☆
–	S59-0403-05	Key board ass'y (W, T type)	☆
–	T07-0206-05	Speaker	☆
–	T18-0051-05	Earphone	☆
–	T90-0311-05	Helical antenna	☆
–	T91-0312-05	Condenser microphone	☆
–	W09-0306-05	Nickel-Cadmium Battery pack	☆
–	W09-0307-05	Battery charger (K type)	☆
–	W09-0308-05	Battery charger (W type)	
–	W09-0309-05	Battery charger (T type)	☆
–	X44-1330-10	TX-RX UNIT (K type)	
–	X44-1330-61	TX-RX UNIT (W type)	
–	X44-1330-51	TX-RX UNIT (T type)	
–	X50-1640-10	PLL UNIT (K type)	
–	X50-1640-61	PLL UNIT (W type)	
–	X50-1640-51	PLL UNIT (T type)	

TX·RX UNIT (X44-1330-10)

C1	CC45TH1H070D	Ceramic	7pF	±0.5pF	
C2	CC45CH1H010C	Ceramic	1pF	±0.25pF	
C3	CC45TH1H070D	Ceramic	7pF	±0.5pF	
C4	CC45SL1H101J	Ceramic	100pF	±5%	
C5,6	CK45B1H102K	Ceramic	1000pF	±10%	
C7	C91-0462-05	Semiconductor capacitor	0.0047μF		☆
C8	CS15E1E3R3M	Tantalum	3.3μF	25WV	
C9	CC45TH1H070D	Ceramic	7pF	±0.5pF	
C10	CC45CH1H220J	Ceramic	22pF	±5%	
C11	CC45CH1H0R5C	Ceramic	0.5pF	±0.25pF	
C12	CC45TH1H070D	Ceramic	7pF	±0.5pF	
C13	CC45SL1H101J	Ceramic	100pF	±5%	
C14	C91-0462-05	Semiconductor capacitor	0.0047μF		☆
C15	CC45CH1H0R5C	Ceramic	0.5pF	±0.25pF	
C16	CC45TH1H070D	Ceramic	7pF	±0.5pF	
C17	CC45CH1H070D	Ceramic	7pF	±0.5pF	
C18	C91-0462-05	Semiconductor capacitor	0.0047μF		☆
C19	CC45CH1H070D	Ceramic	7pF	±0.5pF	
C20	C91-0462-05	Semiconductor capacitor	0.0047μF		☆
C21	CC45CH1H030C	Ceramic	3pF	±0.25pF	
C22	CC45SL1H101J	Ceramic	100pF	±5%	
C23	CQ92M1H103K	Mylar	0.01μF	±10%	
C24	Not used				
C25	C91-0462-05	Semiconductor capacitor	0.0047pF		☆
C26	CK45B1H471K	Ceramic	470pF	±10%	
C27	CK45B1H102K	Ceramic	1000pF	±10%	
C28	CS15E1C220M	Tantalum	22μF	16WV	
C29	C91-0462-05	Semiconductor capacitor	0.0047μF		☆
C30	CQ92M1H332K	Mylar	3300pF	±10%	☆
C31	CQ92M1H222K	Mylar	2200pF	±10%	
C32	CE04Q1HR47Q	Electrolytic	0.47μF	50WV	
C33	CQ92M1H333K	Mylar	0.033μF	±10%	
C34	CQ92M1H153K	Mylar	0.015μF	±10%	
C35	CQ92M1H102K	Mylar	1000pF	±10%	
C36	CQ92M1H222K	Mylar	2200pF	±10%	
C37	CE04W1A470Q	Electrolytic	47μF	10WV	
C38	CS15E1A470M	Tantalum	47μF	10WV	
C39	CS15E1C4R7M	Tantalum	4.7μF	16WV	
C40	CS15E1E3R3M	Tantalum	3.3μF	25WV	
C41	CK45B1H102K	Ceramic	1000pF	±10%	

PARTS LIST

Ref. No.	Parts No.	Description	Re-marks
C42	CS15E1C4R7M	Tantalum 4.7μF 16WV	
C43	CE04W1C101Q	Electrolytic 100μF 16WV	
C44	CE04W1H010Q	Electrolytic 1μF 50WV	
C45	CQ92M1H103K	Mylar 0.01μF ±10%	
C46	C91-0457-05	Semiconductor capacitor 0.022μF	
C47	Not used		
C48	CS15E1C220M	Tantalum 22μF 16WV	
C49	CQ92M1H104K	Mylar 0.1μF ±10%	
C50	CQ92M1H222K	Mylar 2200pF ±10%	
C51	CQ92M1H392K	Mylar 3900pF ±10%	
C52	CS15E1A470M	Tantalum 57μF 10WV	
C53	CK45B1H102K	Ceramic 1000pF ±10%	
C54	CE04W1C100Q	Electrolytic 10μF 16WV	
C55	C91-0462-05	Semiconductor capacitor 0.0047μF	☆
C56	CE04W1C220Q	Electrolytic 22μF 16WV	
C57	CC45SL1H220J	Ceramic 22pF ±5%	
C58	CC45SL1H390J	Ceramic 39pF ±5%	
C59	CC45SL1H220J	Ceramic 22pF ±5%	
C60	CC45SL1H150J	Ceramic 15pF ±5%	
C61	CK45B1H102K	Ceramic 1000pF ±10%	
C62	CC45CH1H150J	Ceramic 15pF ±5%	
C63	CC45SL1H220J	Ceramic 22pF ±5%	
C64	C91-0462-05	Semiconductor Capacitor 0.0047μF	☆
C65	CK45B1H102K	Ceramic 1000pF ±10%	
C66	CC45CH1H220J	Ceramic 22pF ±5%	
C67	CK45B1H102K	Ceramic 1000pF ±10%	
C68	CC45CH1H050C	Ceramic 5pF ±0.25pF	
C69	CK45B1H102K	Ceramic 1000pF ±10%	
C70	C90-0825-05	Electrolytic 22μF 16WV	☆
C71	C91-0462-05	Semiconductor capacitor 0.0047μF	☆
C72	CC45CH1H220J	Ceramic 22pF ±5%	
C73	C91-0462-05	Semiconductor capacitor 0.0047μF	☆
C74,75	CK45B1H102K	Ceramic 1000pF ±10%	
C76	C91-0462-05	Semiconductor capacitor 0.0047μF	☆
C77	CC45SL1H390J	Ceramic 39pF ±5%	
C78	CC45TH1H050C	Ceramic 5pF ±0.25pF	
C79	C91-0462-05	Semiconductor capacitor 0.0047μF	☆
C80	CC45CH1H270J	Ceramic 27pF ±5%	
C81	CK45B1H102K	Ceramic 1000pF ±10%	
C82	CS15E1E3R3M	Tantalum 3.3μF 25WV	
C83	CK45B1H102K	Ceramic 1000pF ±10%(W,T)	
C84	CE04W1C220Q	Electrolytic 22μF 16WV(W,T)	
C85	CE04W1H010Q	Electrolytic 1μF 50WV(W,T)	
C86	CK45B1H102K	Ceramic 1000pF ±10%(W,T)	
C87	C90-0824-05	Electrolytic 1μF 50WV(W,T)	☆
C88	CE04W1C220Q	Electrolytic 22μF 50WV(W)	
C88	CE04W1HR47Q	Electrolytic 0.47μF 50WV(T)	
C89	CK45B1H102K	Ceramic 1000pF ±10%(W)	
C90	CS15E1C150M	Tantalum 15μF 16WV(T)	
C91	CK45B1H102K	Ceramic 1000pF ±10%(T)	
C92	CS15E1A150M	Tantalum 15μF 10WV(T)	
C93	CK45B1H102K	Ceramic 1000pF ±10%(T)	
C94	C91-0462-05	Semiconductor capacitor 0.0047μF	☆
C95	CK45B1H102K	Ceramic 1000pF ±10%	
TC1	C05-0309-05	Ceramic trimmer 40pF	
TC2	C05-0067-05	Ceramic trimmer 25pF	
TC3	C05-0309-05	Ceramic trimmer 40pF	
J1	E03-0203-05	DC jack	☆
J2	E11-0408-05	MIC jack	☆
J3,4	E11-0407-05	Earphone jack	☆
—	F01-0745-04	Heat sunk	☆
—	F10-1242-14	RX shield plate	☆
—	F10-1243-14	DRIVE shield plate	☆
—	F10-1244-14	IC shield plate	☆

Ref. No.	Parts No.	Description	Re-marks
—	F10-1245-04	TX shield plate	☆
—	F10-1251-04	IF shield plate	☆
L1,2	L31-0347-05	Tuning coil	
L3	L40-2292-01	Ferri-inductor 2.2μH	
L4~6	L31-0347-05	Tuning coil	
L7,8	L34-0891-05	Tuning coil	☆
L9	L72-0318-05	Ceramic filter CFG455F	☆
L10	L79-0446-05	Ceramic discriminator CFY455S	
L11	L40-1021-03	Ferri-inductor 1mH	
L12	L40-6825-04	Ferri-inductor 6.8mH	
L13	L40-1021-03	Ferri-inductor 1mH	
L14	L34-0894-05	Coil 3φ5T	☆
L15	L34-0893-05	Coil 3φ4T	☆
L16	L34-0894-05	Coil 3φ5T	☆
L17	L34-0892-05	Coil 2φ10T	☆
L18	L34-0893-05	Coil 3φ4T	☆
L19,20	L34-0895-05	Coil 3φ6T	☆
L21	L33-0632-05	Choke coil	☆
L22	L19-0321-05	Transformer (wide band)	☆
L23	L34-0897-05	Tuning coil	☆
L24	L71-0217-05	Monolithic filter 10T15A	☆
L25	L33-0002-05	Choke coil	
L26	L72-0014-05	Ceramic filter SFE10.7MA5	
X1	L77-0863-05	Quarty crystal 10.245MHz	
—	N09-0615-05	Special round head screw M1×8	☆
—	N14-0514-05	Special nut M1	☆
VR1	R12-3423-05	Semi-fixed resistor 22kΩ(B)	☆
VR2	R12-3424-05	Semi-fixed resistor 20kΩ	☆
—	S50-1405-05	Micro-switch	☆
D1~4	V11-0317-05	Diode 1S2208	
D5~8	V11-0051-05	Diode 1N60	
D9	V11-0076-05	Diode 1S1555	
D10	V11-4163-46	Zener diode XZ-080	
D11	V11-4160-86	Zener diode WZ-071	
D12	V11-0076-05	Diode 1S1555	
D13	V11-0255-05	Diode MI301	
D14	V11-0414-05	Diode 1S2588	
D15	V11-0076-05	Diode 1S1555	
D16	V11-0051-05	Diode 1N60	
D17	V11-0076-05	Diode 1S1555 (W,T type)	
D18	V11-0076-05	Diode 1S1555 (W type)	
D19	V11-0076-05	Diode 1S1555 (T type)	
Q1	V03-2212-06	Transistor 2SC2212	☆
Q2	V03-2668-16	Transistor 2SC2668(Y)	
Q3	V03-2669-16	Transistor 2SC2669(Y)	
Q4	V30-1138-06	IC H8D1154E	☆
Q5	V30-1137-06	IC H8D1152E	☆
Q6	V30-1139-06	IC H8D1252	☆
Q7,8	V03-2668-16	Transistor 2SC2603(E)	
Q9	V30-1140-06	IC M51182L	☆
Q10,11	V03-2668-16	Transistor 2SC2603(E)	
Q12	V01-1115-16	Transistor 2SA1115(E)	
Q13	V03-2329-16	Transistor 2SC2329(K)	
Q14	V03-2053-06	Transistor 2SC2053	
Q15	V03-2026-16	Transistor 2SC2026(K)	
Q16	V01-1115-16	Transistor 2SA1115(E)	

PARTS LIST

Ref. No.	Parts No.	Description	Remarks
Q17	V30-1141-06	IC AFG05F1750A	
Q18	V03-2603-06	Transistor 2SC2603(E) (T type)	

PLL UNIT (X50-1640-10)

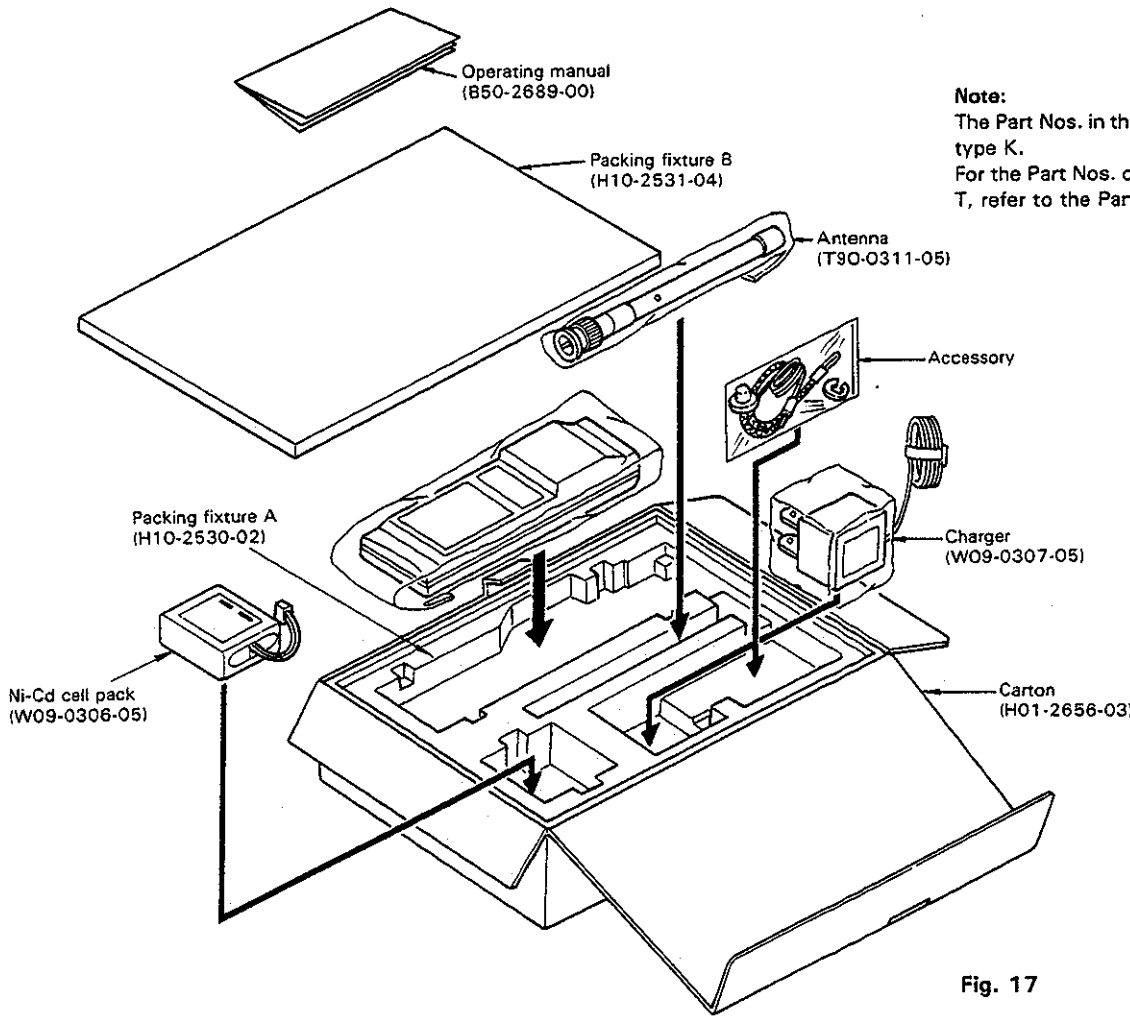
C1,2	CC45CH1H100D	Ceramic 10pF ±0.5pF	
C3	CC45CH1H220J	Ceramic 22pF ±5%	
C4	CC45CH1H180J	Ceramic 18pF ±5%	
C5,6	CC45CH1H030C	Ceramic 3pF ±0.25pF	
C7	CC45CH1H030C	Ceramic 22pF ±5%	
C8	CC45TH1H080D	Ceramic 8pF ±0.5pF	
C9	CS15E1VR47M	Tantalum 0.47μF 35WV	
C10	CK45F1H103Z	Ceramic 0.01μF +80%, −20%	
C11	CC45TH1H050C	Ceramic 5pF ±0.25pF	
C12	CK45F1H103Z	Ceramic 0.01μF +80%, −20%	
C13	CC45CH1H220J	Ceramic 22pF ±5%	
C14,15	CC45CH1H050C	Ceramic 5pF ±0.25pF	
C16,17	CC45CH1H030C	Ceramic 3pF ±0.25pF	
C18	CC45SL1H101J	Ceramic 100pF ±5%	
C19	C90-0246-05	Ceramic 0.01μF ±10%	
C20,21	CK45F1H103Z	Ceramic 0.01μF +80%, −20%	
C22	CE04W1A330Q	Electrolytic 33μF 10WV	
C23	CQ92M1H472K	Mylar 4700pF 50V	
C24	CS15E1C1R5M	Tantalum 1.5μF 16WV	
C25	CC45CH1H120J	Ceramic 12pF ±5%	
C26	CC45TH1H060D	Ceramic 6pF ±0.5pF	
C27	CC45CH1H020C	Ceramic 2pF ±0.25pF	
C28	CC45CH1H010D	Ceramic 1pF ±0.25pF	
C29	CC45CH1H080D	Ceramic 8pF ±0.5pF	
C30	CC45CH1H030C	Ceramic 3pF ±0.25pF	
C31	CC45CH1H050C	Ceramic 5pF ±0.25pF	
C32	CK45F1H103Z	Ceramic 0.01μF +80%, −20%	
C33	CE04W1C100Q	Electrolytic 10μF 16WV	
C34	CC45CH1H030C	Ceramic 3pF ±0.25pF	
C35	CC45TH1H080D	Ceramic 8pF ±0.5pF	
C36	CC45TH1H010C	Ceramic 1pF ±0.25pF	
C37	CK45F1H103Z	Ceramic 0.01μF +80%, −20%	
C38	CE04W1A470Q	Electrolytic 47μF 10WV	
C39,40	CS15E1V0R1M	Tantalum 0.1μF 35WV	
C41	CE04W1A470Q	Electrolytic 47μF 10WV	
C42	CE04W1E4R7Q	Electrolytic 4.7μF 25WV	
C43	CE04W1C100Q	Electrolytic 10μF 16WV	
C44	CE04W1A330Q	Electrolytic 33μF 10WV	
C45	CK4581H102K	Ceramic 1000pF ±10%	
C46	CE04W1A470Q	Electrolytic 47μF 10WV	
C47	CS15E1V0R1M	Tantalum 0.1μF 35WV	
C48,49	CK45B1H102K	Ceramic 1000pF ±10%	
C50	CS15E1V0R1M	Tantalum 0.1μF 35WV	
C51	CC45CH1H050C	Ceramic 5pF ±0.25pF	
C52	CK45B1H102K	Ceramic 1000pF ±10%	
C53	CC45TH1H080D	Ceramic 8pF ±0.5pF	
C54	CC45TH1H010C	Ceramic 1pF ±0.25pF	
C55	CC45CH1H330J	Ceramic 33pF ±5%	
C56	C90-0821-05	Tantalum (Non pole) 4.7μF 3.15WV	
C57	CC45CH1H180J	Ceramic 18pF ±5%	
C58	CC45CH1H330J	Ceramic 33pF ±5%	
C59	CE04W1A470Q	Electrolytic 47μF 10WV	
C60	CE04W1C100Q	Electrolytic 10μF 16WV	
C61	C90-0822-05	Electrolytic 47μF 16WV	☆
C62	C91-0462-05	Semiconductor capacitor 0.0047μF	
C63	CS15E1VR33M	Tantalum 0.33μF 35WV	
C64	CS15E0J470M	Tantalum 47μF 6.3V	
C65	CE04W1E4R7Q	Electrolytic 4.7μF 25WV	
C66	CS15E1VR68M	Tantalum 0.68μF 35WV	
C67,68	CK45B1H102K	Ceramic 1000pF ±10%	
C69	CC45CH1H050C	Ceramic 5pF ±0.25pF	
C70	CC45SL1H121J	Ceramic 120pF ±5%	
C71	CC45CH1H330J	Ceramic 33pF ±5%	
C72	CE04W1C330Q	Electrolytic 33μF 16WV	
C73	CC45SL1H101J	Ceramic 100pF ±5%	
C74	CE04W1C330Q	Electrolytic 33μF 16WV	
TC1,2	C05-0303-05	Trimmer	
—	F10-1246-14	PLL shield plate	☆
—	F11-0765-04	VCO shield plate	☆
L1,2	L33-0605-05	Choke coil 47μH	
L3,4	L34-0890-05	Tuning coil	☆
L5	L40-2201-03	Ferri-inductor 22μH	
L6	L40-1092-01	Ferri-inductor 1μH	
L7	L32-0625-05	VCO coil	☆
L8	L40-1092-01	Ferri-inductor 1μH	
L9	L34-0890-05	Tuning coil	☆
L10	L40-1021-03	Ferri-inductor 1mH	
L11	L34-0890-05	Tuning coil	☆
L12	L78-0004-05	Ceramic oscillator 397KHz	☆
L13	L78-0003-05	Ceramic oscillator 3.58MHz	☆
L14	L79-0458-05	Spurious filter AFL13F3500B1	☆
L15	L40-1001-01	Ferri-inductor 10μH	
X1	L77-0860-05	Quartz crystal 42.6MHz	☆
X2	L77-0861-05	Quartz crystal 46.1666MHz	☆
X3	L77-0862-05	Quartz crystal 10.240MHz	☆
R64	R90-0527-05	Resistor block 470K×10	☆
VR1	R12-3422-05	Semi-fixed resistor 20kΩ	☆
VR2,3	R12-2408-05	Semi-fixed resistor 5kΩ	☆
VR4	R12-2408-05	Semi-fixed resistor 5kΩ(K type)	☆
S1	S40-1401-05	Push switch SQUELCH	☆
S2	S40-1401-05	Push switch SUB TONE (K, T type)	☆
S2	S40-1402-05	Push switch (W type)	☆
S3	S40-1402-05	Push switch REVERSE	☆
—	S29-1416-05	Rotary switch TX OFFSET (K type)	☆
—	S29-1417-05	Rotary switch TX OFFSET (W, T type)	☆
Q1	V03-2669-16	Transistor 2SC2669 (Y)	☆
Q2,3	V03-2603-06	Transistor 2SC2603 (E)	
Q4	V03-2669-16	Transistor 2SC2669 (Y)	☆
Q5	V03-2668-16	Transistor 2SC2668 (Y)	☆
Q6	V03-2669-16	Transistor 2SC2669 (Y)	☆
Q7~9	V03-2603-06	Transistor 2SC2603 (E)	
Q10	V09-1016-06	FET 2SK192 (GR)	☆
Q11	V03-2668-16	Transistor 2SC2668 (Y)	☆
Q12	V30-1074-06	IC MK5087N	
Q13	V30-0039-05	IC TA7061AP	
Q14	V03-2668-16	Transistor 2SC2668 (Y)	☆
Q15	V01-1115-16	Transistor 2SA1115 (E)	☆
Q16~19	V03-2603-06	Transistor 2SC2603 (E)	
Q20	V30-1036-16	IC TC9122P	
Q21	V30-1132-06	IC TC5081P	
Q22	V30-1015-16	IC TC5082P	
Q23,24	V30-1145-06	IC TC40174BP	☆
Q25	V30-1146-06	IC μPD651C-013	☆
D1	V11-4173-06	Zener diode XZ-066	
D2	V11-0317-05	Diode 1S2208	

PARTS LIST

Ref. No.	Parts No.	Description		Re-marks
D3	V11-0414-05	Diode	1S2588	☆
D4	V11-0317-05	Diode	1S2208	
D5	V11-1260-36	Diode	1SV50S	
D6	V11-4161-96	Zener diode	XZ-070	
D7	V11-0317-05	Diode	1S2208	
D8,9	V11-0414-05	Diode	1S2588	
D10	V11-0051-05	Diode	1N60	
D11	V11-4173-06	Zener diode	XZ-066	
D12	V11-0076-05	Diode	1S1555	
D13~17	V11-0051-05	Diode	1N60	
D18	V11-0076-05	Diode	1S1555	
D19	V11-0051-05	Diode	1N60	
D20	V11-0051-05	Diode	1N60 (K type)	
D21	V11-0051-05	Diode	1N60	
D22	V11-0051-05	Diode	1N60 (K type)	
D23,24	V11-0051-05	Diode	1N60	
D25,26	V11-0051-05	Diode	1N60 (K type)	
D27	V11-0414-05	Diode	1S2588	
D28,29	V11-0051-05	Diode	1N60	
D30,31	Not used			
D32~35	V11-0076-05	Diode	1S1555	

DISPLAY UNIT (X54-1480-10)				
–	B11-0408-05	LCD reflector		☆
–	B30-0815-05	Pilot lamp 12.6V 30mA		☆
C1	C91-0426-05	Laminated capacitor 0.022μF		
C2	C90-0823-05	Electrolytic 47μF 6.3WV		☆
C3	CK45F1H103Z	Ceramic 0.01μF +80%, −20%		
C4	CK45B1H102K	Ceramic 1000pF ±10%		
C5	CK45F1H103Z	Ceramic 0.01μF +80%, −20%		
–	E29-0415-05	LCD connector		☆
–	F07-0831-04	LCD case		☆
–	N19-0619-04	Insulating washer		☆
Q1	V30-1143-06	IC	TC4030BP	☆
Q2	V30-1144-06	IC	TC4011UBP	
Q3~6	V30-1142-06	IC	TC4543BP	☆
D1,2	V11-0076-05	Diode	1S1555	
V1	V11-3172-86	LCD	F2025-30	☆

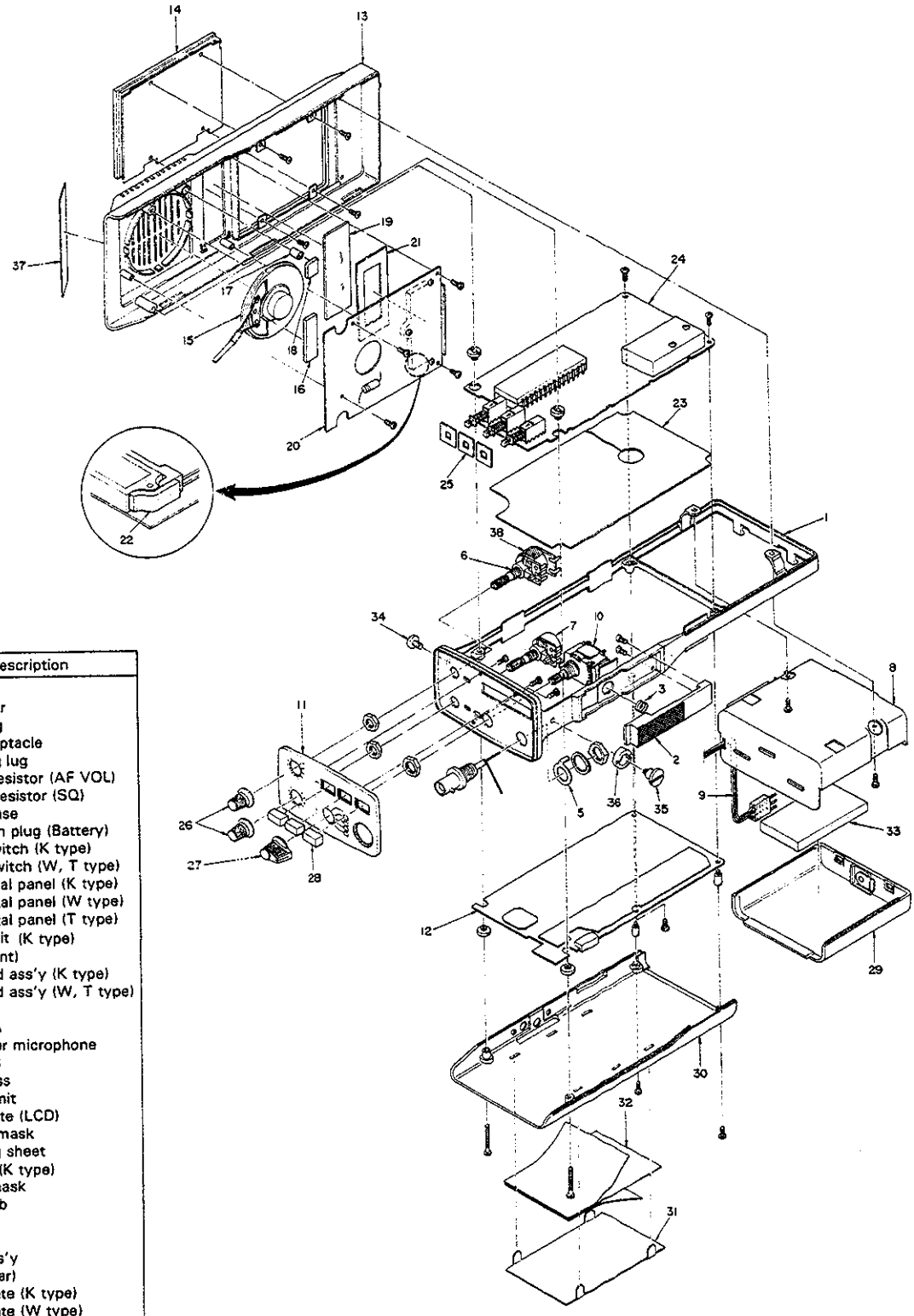
PACKING



Note:
The Part Nos. in the figure are for type K.
For the Part Nos. of types W and T, refer to the Parts List.

Fig. 17

DISASEMBLY

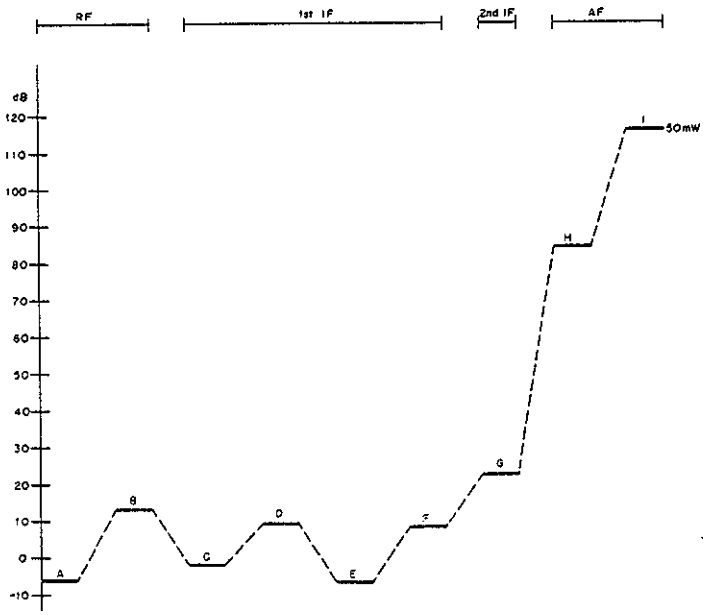


No.	Parts No.	Description
1		Frame
2	K29-0730-04	P.T.T lever
3	G01-0810-04	Coil spring
4	E04-0251-05	BCN Receptacle
5	E23-0513-05	Grounding lug
6	R05-3409-05	Variable resistor (AF VOL)
7	R05-4403-05	Vaeiable resistor (SQ)
8	J19-1331-03	Battery case
9	E31-2047-05	Cable with plug (Battery)
10	S29-1416-05	Rotary switch (K type)
	S29-1417-05	Rotaey switch (W, T type)
11	A21-0731-04	Ornamental panel (K type)
	A21-0734-04	Ornamental panel (W type)
	A21-0735-04	Ornamental panel (T type)
12	X44-1330-10	TX.RX unit (K type)
13	A02-0607-02	Case (Front)
14	S59-0402-05	Key board ass'y (K type)
	S59-0403-05	Key board ass'y (W, T type)
15	T07-0206-05	Speaker
16	G13-0625-04	Sponge A
17	T91-0312-05	Condenser microphone
18	G13-0626-04	Sponge B
19	B10-0626-04	Front glass
20	X54-1480-10	Display unit
21	B42-1679-04	Name plate (LCD)
22	F15-0628-04	Shadow mask
23	F20-0513-04	Insulating sheet
24	X50-1640-10	PLL unit (K type)
25	B03-0514-04	Switch mask
26	K27-0411-04	Push knob
27	K23-0730-04	Knob A
28	K23-0731-04	Knob B
29	A53-0301-03	Cover ass'y
30	A02-0608-02	Case (Rear)
31	B40-2494-04	Name plate (K type)
	B40-2496-04	Name plate (W type)
	B40-2497-04	Name plate (T type)
32	J69-0302-04	Both-side adhesive sheet
33	G13-0627-04	Sponge C
34	N08-0504-04	Ornamental screw
35	J32-0742-04	Boss C
36	J32-0743-04	Boss D
37	B43-0631-04	Badge (K, W type)
	B43-0634-04	Badge (T type)
38		Mylar tape

Fig. 18

LEVEL DIAGRAM

RX Section

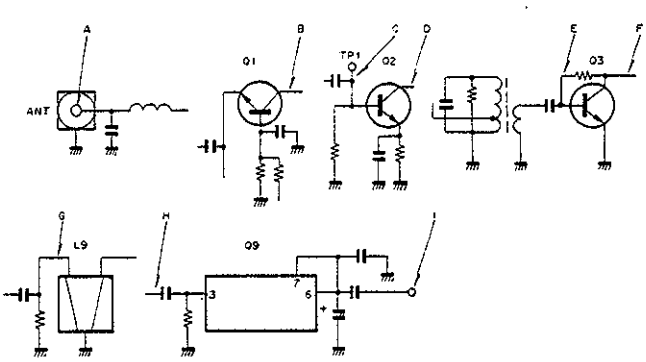


Measuring conditions

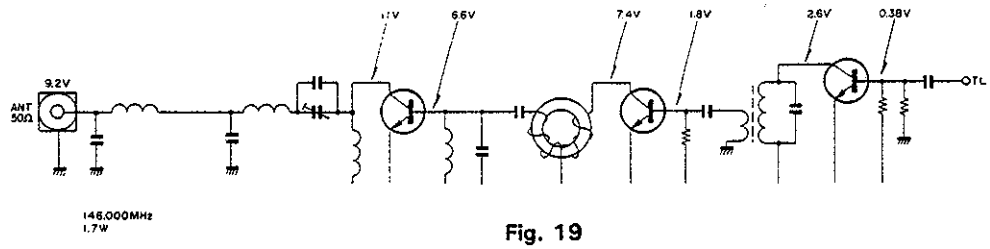
1. C
   C = 0.01 μF (1 μF for AF circuit)
2. f = 145.950 MHz
   Mod. = 1 kHz, Dev. = 5 kHz
   AG f = 1kHz
3. Output = 50 mW/8Ω

Test Equipment

1. SSG: MG518A (Anritsu)
2. AG: AG-201 (Trio)
3. AF voltmeter: VT-106 (Trio)
4. RF voltmeter: ML69A (Anritsu)



TX section



Measuring conditions

1. f = 146.000 MHz
2. Output = 1.7 W

Fig. 19

ADJUSTMENT

TEST EQUIPMENT REQUIRED

1. **RF Valve Voltmeter**
   - Input impedance: 1MΩ min., 20 pF max.
   - Voltage range: F.S. = 10 mV to 300 V
   - Measuring frequencies: 200 MHz min.
2. **Power Meter**
   - Impedance: 50 Ω
   - Measuring range: 2 W
   - Measuring frequencies: 150 MHz min.
3. **DC Power Supply**
   - Voltage: Variable from 6 V to 12 V
   - Current: 1 A min.
4. **Linear Detector**
5. **Directional Coupler**
6. **Oscilloscope**

   With horizontal input terminal and high sensitivity.
7. **Audio Voltmeter**
   - Measuring frequency: 50 Hz to 10 kHz
   - Input impedance: More than 1 MHz
   - Voltage range: F.S. = 3 mV to 30 V
8. **AF Oscillator**
   - Frequency range: 300 Hz to 5 kHz
   - Output: 0.5 mV to 1 V
9. **Frequency Counter**
   - Minimum input sensitivity: About 50 mV
   - Measuring frequency: 150 MHz min.
10. **SSG**
    - Capable of covering 144 ~ 148 MHz
    - Frequency modulation is possible.
11. **DC Voltmeter**
    - Input impedance: Sufficient
12. **Dummy Resistor**
    - 8 Ω, 5 W (approx.)

ADJUSTMENT

BEFORE ADJUSTMENTS AND REPAIRS

If you are making adjustments or repairs for the first time, or if you are not familiar with the proper way of handling the transceiver, read the instruction manual first before attempting adjustments or repairs. It is necessary to keep the following in mind.

Adjusting tools

(1) When adjusting the trimmers or coils, use a non-induced adjusting rod of bakelite or the like.
(2) This transceiver uses small-sized, semi-fixed variable resistors and coils. Use a regular screwdriver of the size which matches the adjusting holes.

Operation on External Power

When operating the transceiver on external power, connect the power cord to the CHARGE jack, making sure that the polarity is correct. Refer to Fig. 20.

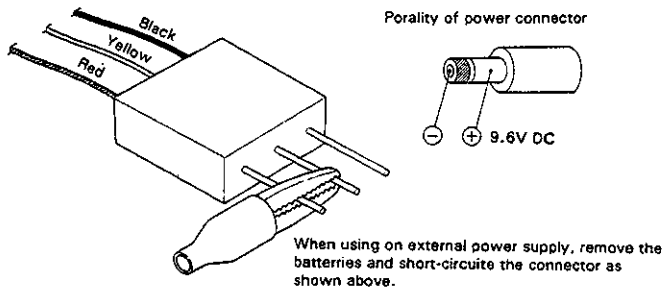


Fig. 20

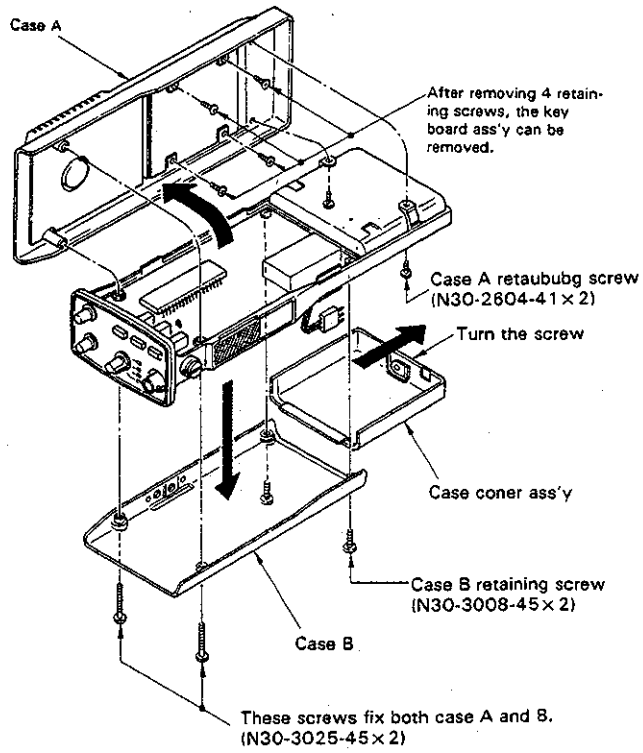


Fig. 21

INSPECTION AND ADJUSTMENT OF RECEIVER UNIT

Before making inspection and adjustment, ascertain that the TX switch is set to the STOP position. Also, insert a high frequency fuse to the SSG output terminal before connecting the SSG to the transceiver. The insertion of the fuse will protect the transceiver against accidental damage.

1. Settings of Controls and Switches

Power Switch	ON
TX OFFSET Switch	Bu OFF
Squelch Control	Minimum position
BUSY/OPEN Switch	BUSY
S. TONE switch	OFF
REV/NORM Switch	NORM

2. Checking the Micro Processor

1) Power voltage

Check the following points using a digital voltmeter.

a. Voltage of 4.7~5.2 V should be present at the pin-21 of Q25 in the PLL unit.
b. Voltage of 5~5.5 V should be present at C2 (+) in the indicator unit.
c. With the PTT switch pressed, voltage of 9.6 V should be present at the TB line in the PLL unit.

2) Set the power switch to ON and check that the indicator displays 5.000.

3) Frequency setting with key input

a. With numeral keys pressed, the figure of the 1st digit (MHz) of the indicator should be 4, 5, 6 or 7 (K type), or 4 or 5 (W, T type). No other figures should be indicated.
b. The figures of the 2nd digit (100 kHz) and 3rd digit (10 kHz) should be the same as the figures set by the numeral keys.
c. The figure of the 4th digit (1 kHz) should be 0 when the key 0, 1, 2, 3 or 4 is pressed, and should be 5 when the key 5, 6, 7, 8 or 9 is pressed.
d. The indicator should display 5.000 when the key "C" is pressed.
e. The frequency display should advance 5 kHz each time when the key "▲" is pressed. The display should keep advancing when the key is kept depressed.
   * Over-range: The display should repeat between 3.900 and 8.495 (K type only).
f. The indicator should count down the frequency in the same manner as noted in the above item "e" when the key "▼" is pressed.
g. With a given frequency displayed, press the keys M1~0 in order to check the memory function. The MR mark "◀" should appear at the end of memory input.
h. The frequencies stored in the memory by item "g" should be displayed in order when the keys "MR"

TR-2400

ADJUSTMENT

1 – 0 are pressed.
  * The frequencies are displayed following the channels. By pressing the key "MR", the frequency display goes off and a channel appears for a few seconds.

i. The memory should be scanned when the key "MS" is pressed.
  * When the key "MS" is pressed, MS cannot be released unless the key "STOP" is pressed. In the MS mode, key input is not possible.

j. None of key inputs should be possible when F. LOCK switch is set to ON.

3. Adjustment of PLL Unit

1) Adjustment of PLL IF

a. Set the frequency to 6.000 (5.000 for W, T type) and connect a RF VTVM to TP1 of the PLL unit.
b. Turn L3 and L9 in the PLL unit for the maximum point.
c. Next, press the PTT switch and adjust L4 for the maximum point.

2) Setting of PLL Voltage

a. Set the frequency to 4.000 and connect a digital voltmeter to TP2 of the PLL unit.
b. Adjust L7 of the PLL unit for 1.5 V.
c. Next, set the frequency to 7.995 and check that the voltage is less than 4.5 V.
d. Press the PTT switch and check that the voltage at the frequencies of 4.000 to 7.995 is within 1 ~ 4.5 V.

3) Frequency adjustment

a. Set the frequency to 6.000 and connect a frequency counter to TP3 in the PLL unit.
b. Adjust TC1 until the frequency reaches 135.300 MHz.
c. Press the PTT switch and adjust TC2 for 146.000 MHz.

4. Adjustment of Backup Circuit

a. Set the TX OFF SET switch to the "S" position and connect the digital voltmeter to the pin-21 of Q25 of the PLL unit.
b. With the power switch set to OFF and the voltage stabilized, adjust VR3 to obtain 4.7 V.

5. Adjustment of Transmitter Unit

a. Set the frequency to 146.000 MHz and connect a power meter to the antenna.
b. With the transceiver set in transmit mode, adjust L11 in the PLL unit and L23 and TC2 in the TX-RX unit for the maximum point observing the ampere meter on the DC Power Supply.
c. Adjust TC1 and TC3 observing the power meter. Note that the current is increased depending on the position of TC3. Obtain a maximum power with less current. The power should be more than 1.5 W within the bandwidth.

6. Adjustment of Modulator Unit

a. Connect a direct detector to the antenna via a power meter and coupler.
b. Set the frequency to 146.000 MHz and apply 2 mV of AG output through the MIC terminal for transmission. Then, adjust VR2 in the PLL unit so that the direct detector indicates 3.5 kHz.
  * Connect a capacitor of 10 μF/16 V between the MIC terminal and the AG output.
c. Increase the AG output 20 dB up above the output in item "b" and adjust VR1 in the PLL unit until the detector indicates 5 kHz.
d. Set the AG output back to 2 mV and check that the detector indicates 3.5 kHz. If required, readjust VR2 for 3.5 kHz.
  * Set the frequency to 144.000 MHz and 147.995 MHz and check that the maximum frequency deviation is 5 kHz ± 1 kHz.
e. Set the AG output to 0 and press the key "C" in the transmit mode. Adjust VR4 in the PLL unit so that the detector indicates 4 kHz (K type only).
f. With the power voltage varied to 8.1 ~ 11.5 V, check the detector for abnormal oscillation.

7. Adjustment of RX Unit

a. Connect SSG (DEV: 5 kHz, MOD: 1 kHz) to the antenna and a dummy load (8 ohms) to the EAR terminal. Also, connect AF VTVM and oscilloscope.
b. Receive 145.980 MHz signal and connect a RF VTVM to TP3 in the TX-RX unit. Set the SSG output to about 10 dB and adjust L1, L2, L4, L5, L6, L7 and L8 for the maximum point.

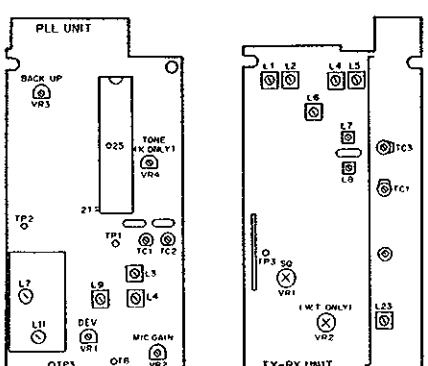


Fig. 22 Parts layout

c. Set the SSG output to – 6 dB and adjust L1 and L2 for the maximum point observing the AF VTVM.
d. Check to see that the S/N ratio in the band is more than 28 dB at 1 μV input.
e. With the transceiver set in an empty channel, turn the squelch VR to 9 o'clock position and adjust VR1 until the noise disappears.

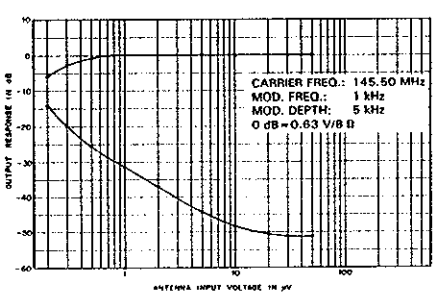


Fig. 23 Signal-to-noise ratio and output level vs antenna

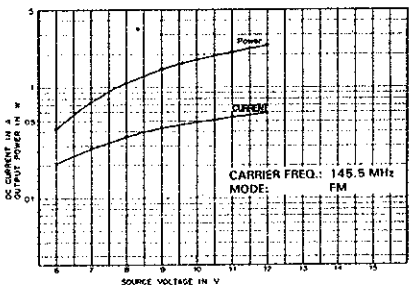
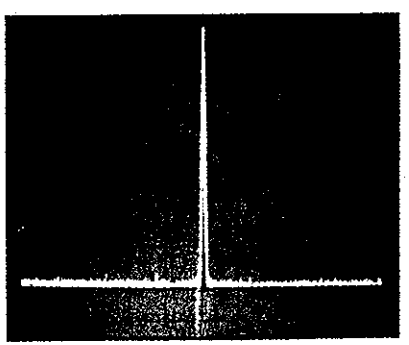
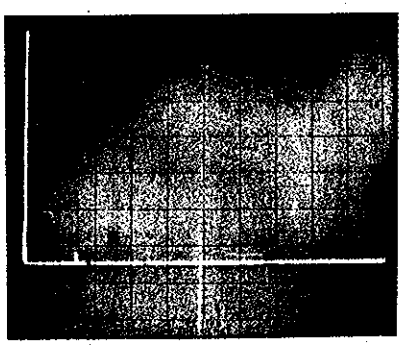


Fig. 24 Source voltage vs current drain and transmitting



CARRIER FREQ.: 145.00 MHz
RF POWER: 1.5 W
SCAN WIDTH: 5 MHz/DIV
BAND WIDTH: 100 kHz
SCAN TIME: 0.1 SEC
VIDEO FILTER: 10 kHz

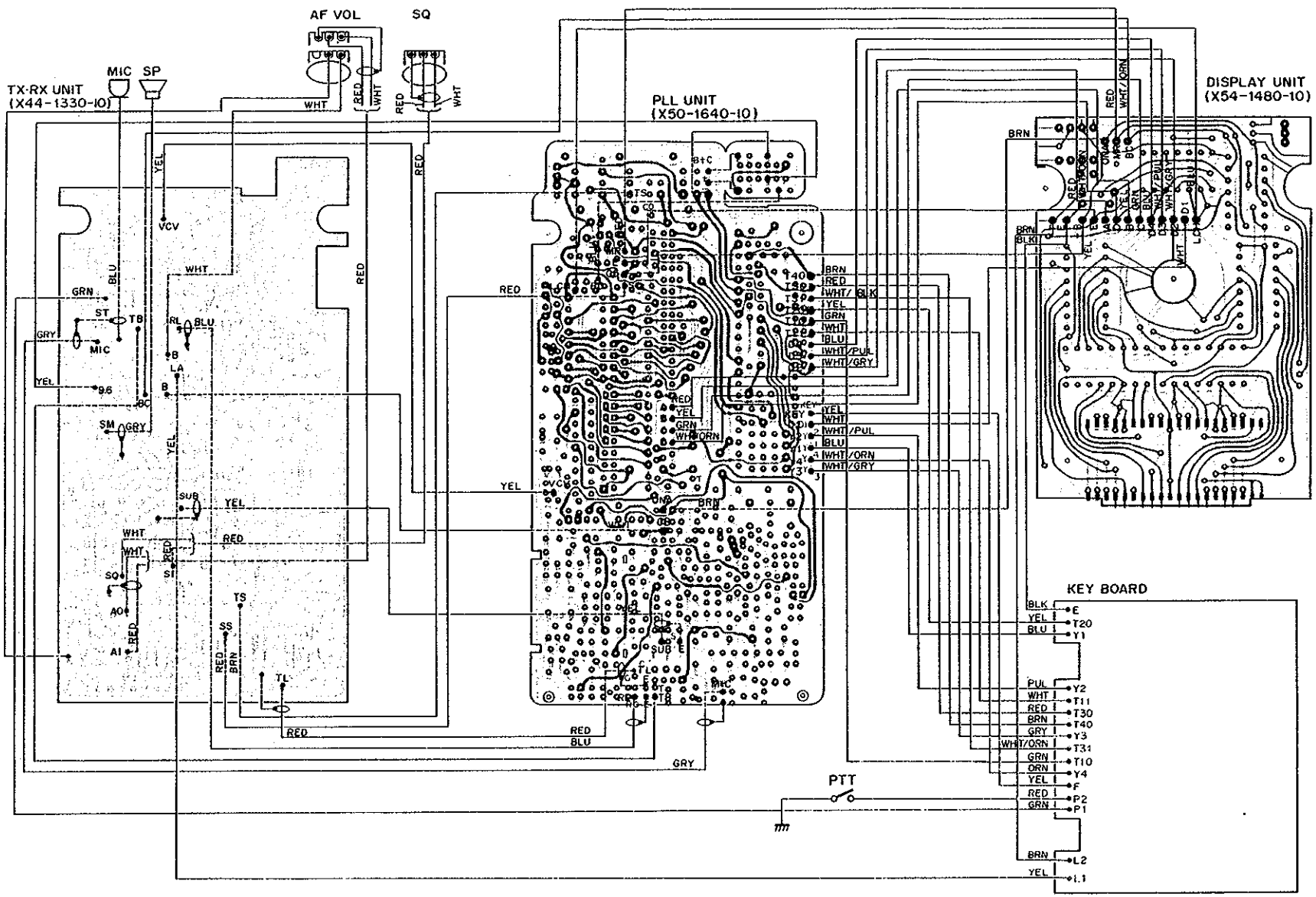
Fig. 25 (a) An example of adjacent spurious



CARRIER FREQ.: 145.00 MHz
RF POWER: 1.5 W
SCAN WIDTH: 100 MHz/DIV
BAND WIDTH: 100 kHz
SCAN TIME: 10 SEC
VIDEO FILTER: 100 Hz

Fig. 25 (b) An example of adjacent spurious

WIRING DIAGRAM (K type)

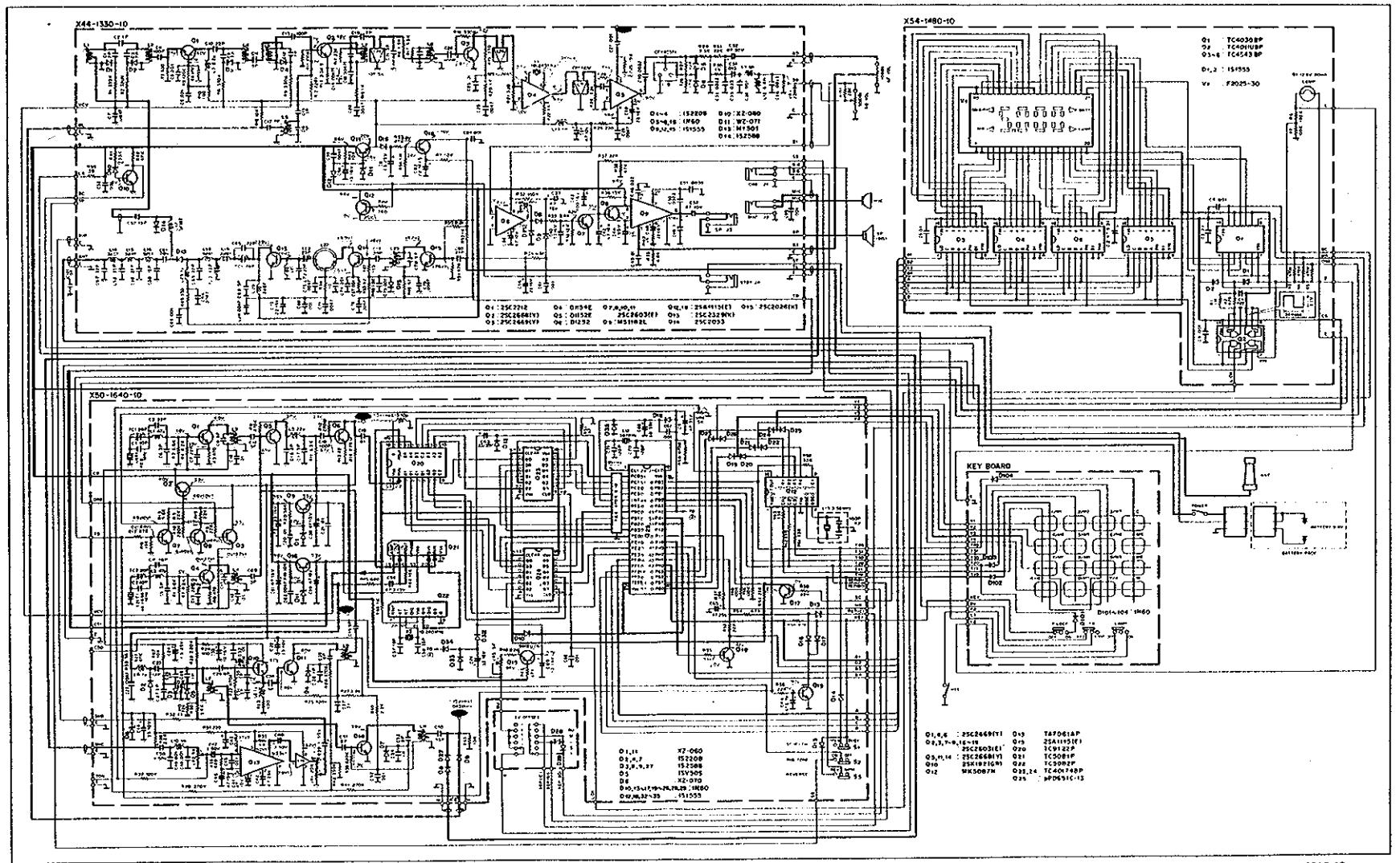


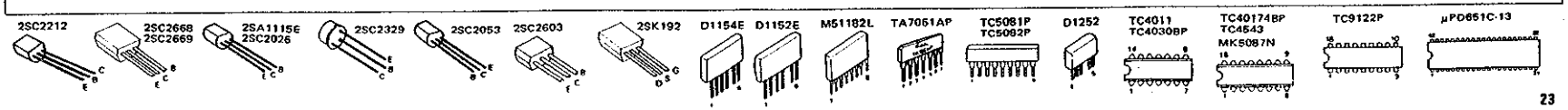
SCHEMATIC DIAGRAM (K type)

Signal line — — — OSC & Control line ——— B line ⌓ Adjusting point

Voltage measure condition.
Power supply voltage: 9.6 V
MODE: S
Frequency: 145.000 MHz

Receive section: no input signal, squelch on.
Transmitter section: 50 Ω Load
( ): Transmitter voltage



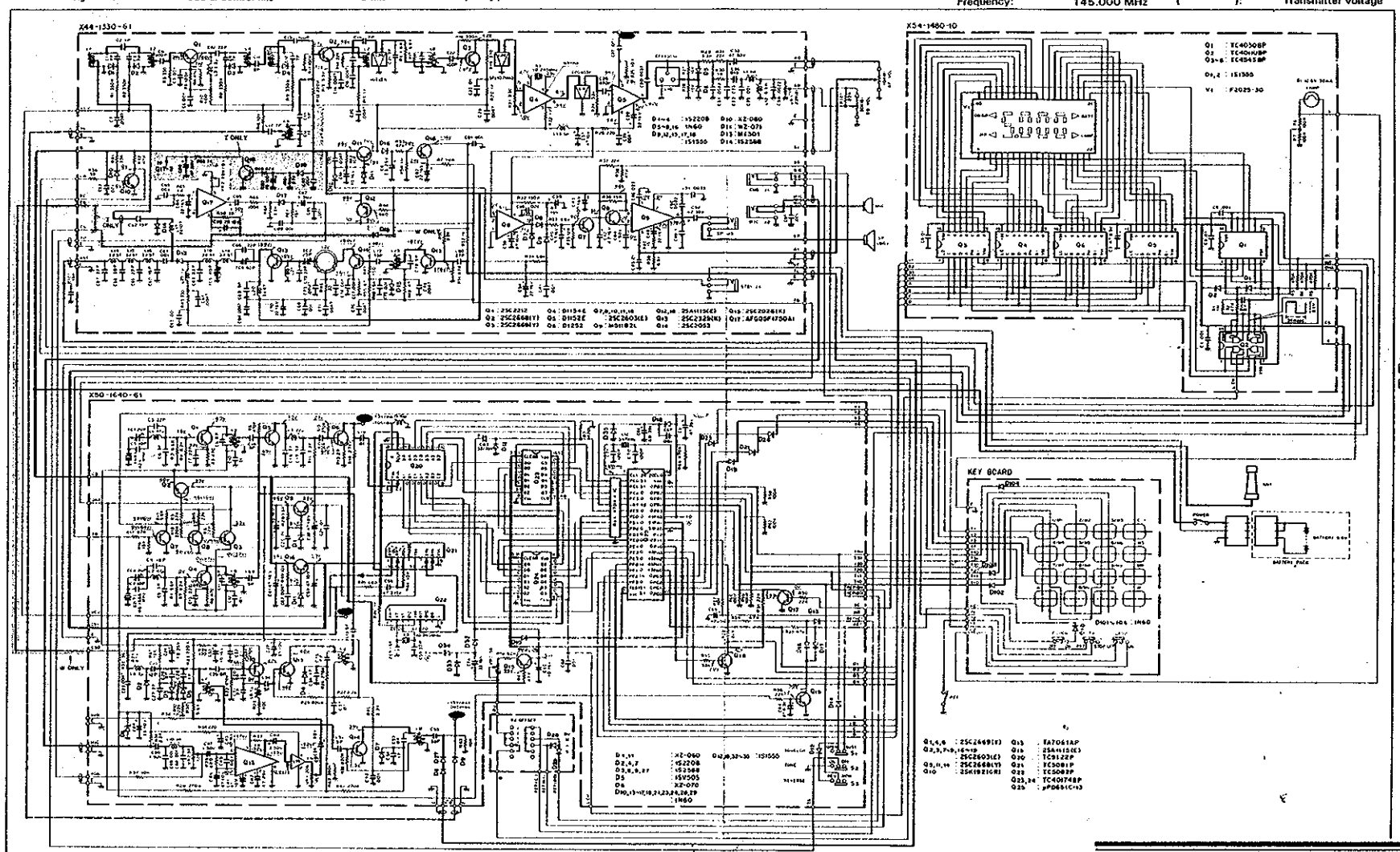


TR-2400

SCHEMATIC DIAGRAM (W, T type)

Voltage measure condition.
Power supply voltage: 9.6 V
MODE: S
Frequency: 145.000 MHz
Receive section: no input signal. squelch on.
Transmitter section: 50 Ω Load
( ): Transmitter voltage

——— Signal line — — — OSC & Control line ——— B line ○ Adjusting point



TC4011
TC4030BP

TC40174BP
TC4543

TC9122P

μPD651C-13

2SC2212 2SC2668 2SC2669 2SA1116E 2SC2026 2SC2329 2SC2053 2SC2603 2SK192 D1154E D1152E M51182L TA7061AP TC5081P TC5082P D1262 AFG05F1750A1

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