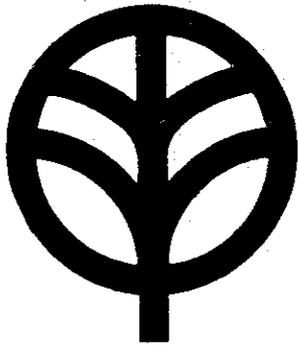


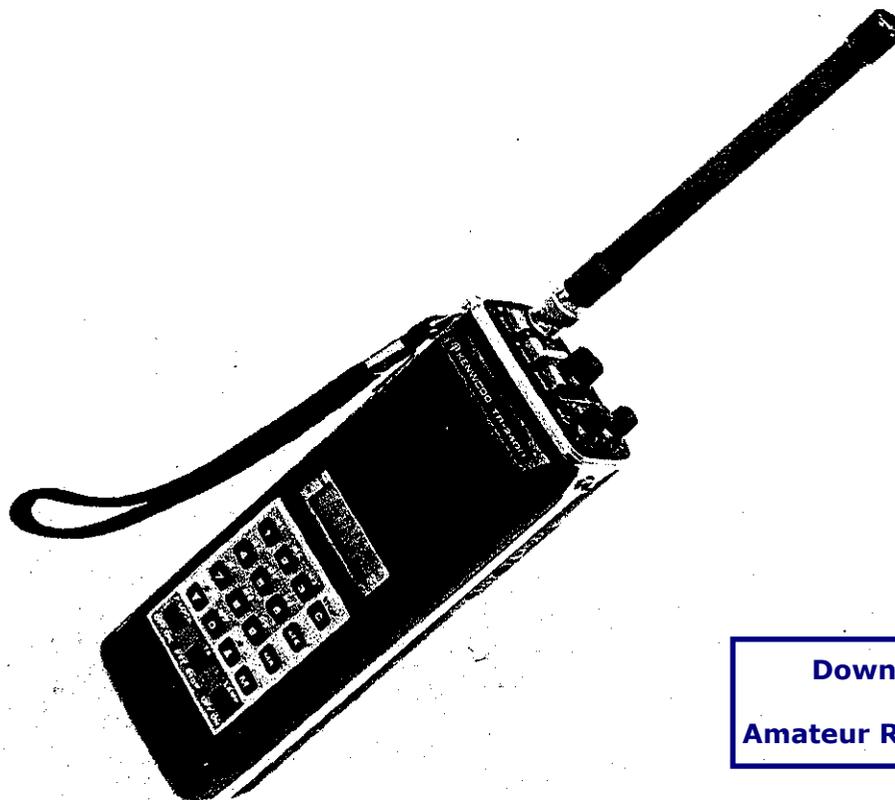
\$10<sup>00</sup>



**KENWOOD**

# SERVICE MANUAL

**Model TR-2400**



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**2m FM SYNTHESIZED  
HAND-HELD TRANSCEIVER**

## TR-2400

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## 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 $\pm 750$ Hz at 25°C	
Mode	FM	
Channels	800	
Memory Channels	10	
Operating Temperature	- 20 to 50°C	
Power Voltage	9.6 VDC $\pm 15\%$	
Grounding	Negative grounding	
Antenna Impedance	50 $\Omega$	
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	$\pm 5$ 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 0.2 $\mu$ V for 12 dB SINAD (Less than 1 $\mu$ V for 30 dB S/N)
Squelch Sensitivity	Less than 0.25 $\mu$ V
Pass Band Width	More than 12 kHz at 6 dB down
Audio Output	More than 200 m watts across 8 $\Omega$ load (10% distortion)

## [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 $\pm 750$ Hz at 25°C	
Mode	FM	
Channels	400	
Memory Channels	10	
Operating Temperature	- 20 to 50°C	
Power Voltage	9.6 VDC $\pm 15\%$	
Grounding	Negative grounding	
Antenna Impedance	50 $\Omega$	
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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Squelch Sensitivity	Less than 0.25 $\mu$ V
Pass Band Width	More than 12 kHz at 6 dB down
Audio Output	More than 200 m watts across 8 $\Omega$ load (10% distortion)

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

## CIRCUIT DESCRIPTION

### RECEIVING UNIT

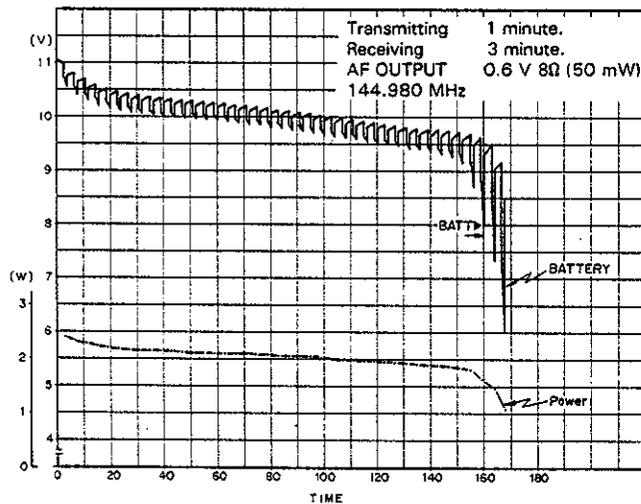
The receiving unit employs a double superheterodyne circuit with 3 hybrid IC's. The RF stage is tuned by variable capacitance diodes. The receive signal is RF amplified by Q1 and mixed with VCO output by Q2 to produce an IF signal at 10.7 MHz. This signal passes through a Monolithic Crystal filter and 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, squeish 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 versus 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

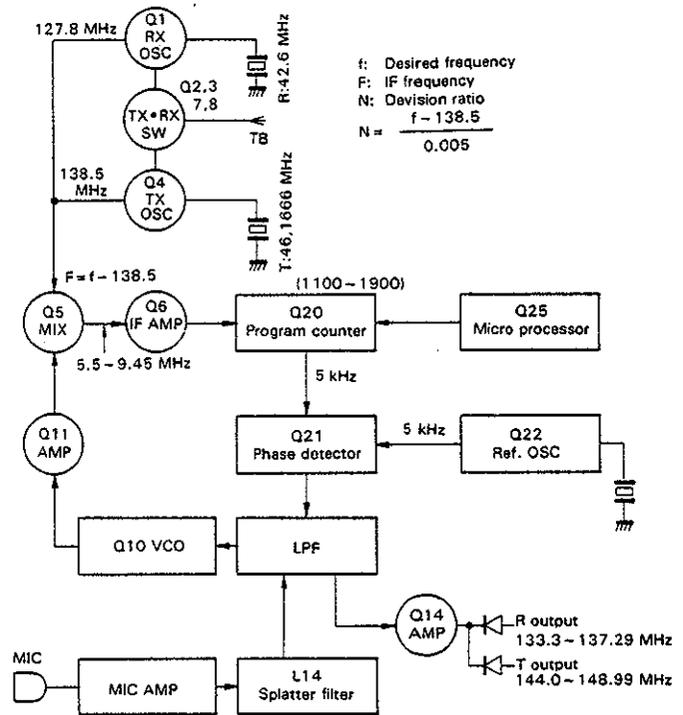


Fig. 2 PLL unit

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 micro-processor. 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 employs a 500 kHz ceramic element as the clock oscillator. Current drain for memory backup is about 800μA. The micro-processor is controlled by a 16 key (4x4) pad to provide fre-

# TR-2400

## 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 micro-processor 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.

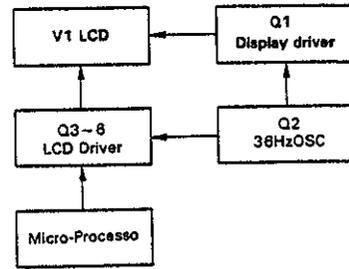


Fig. 3 Display unit

## BLOCK DIAGRAM (K type)

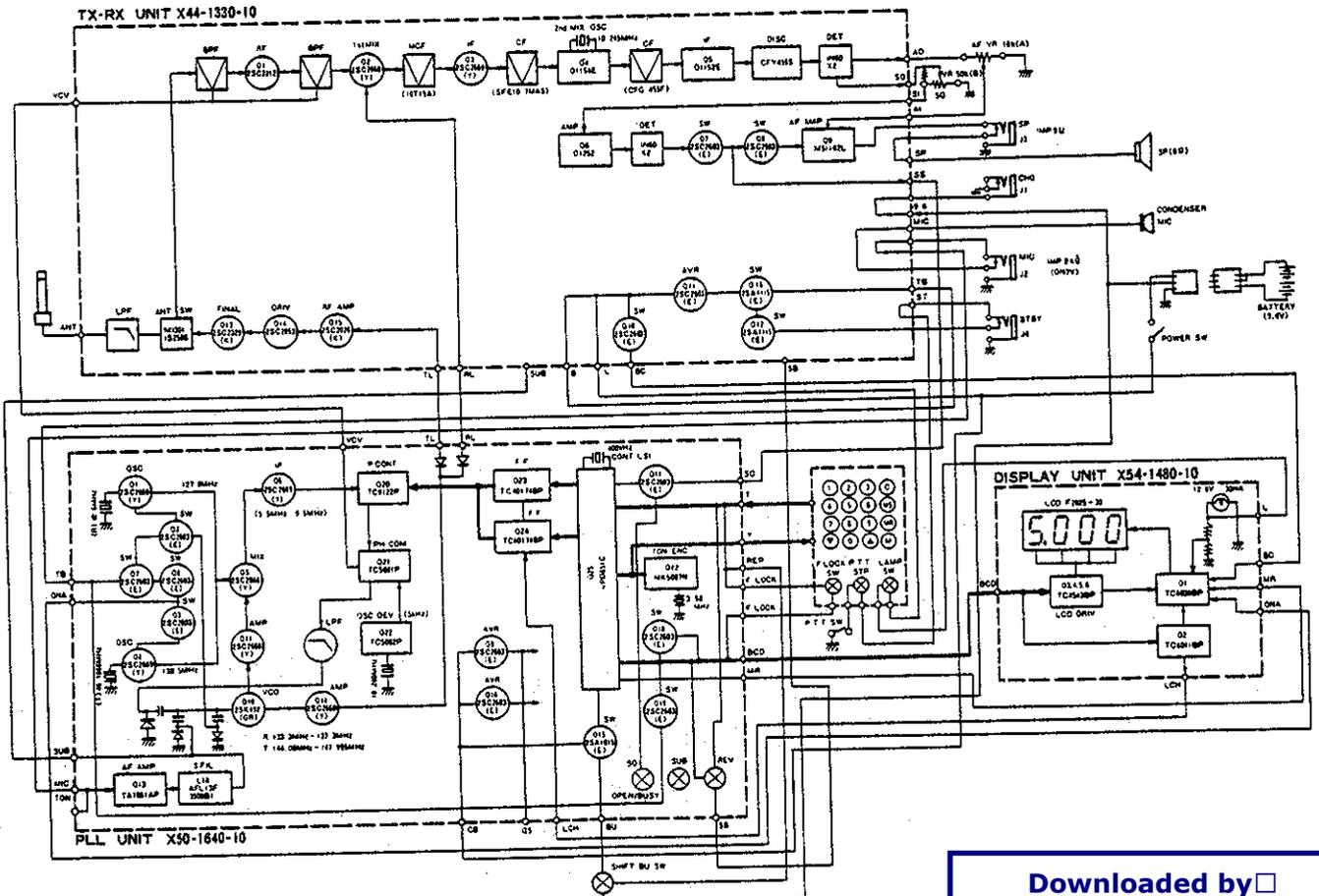


Fig. 4

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SEMICONDUCTOR DATA

H8D1154E (TX.RX unit Q4)

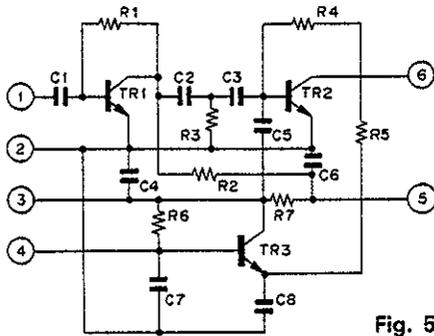


Fig. 5

M51182L (TX.RX unit Q9)

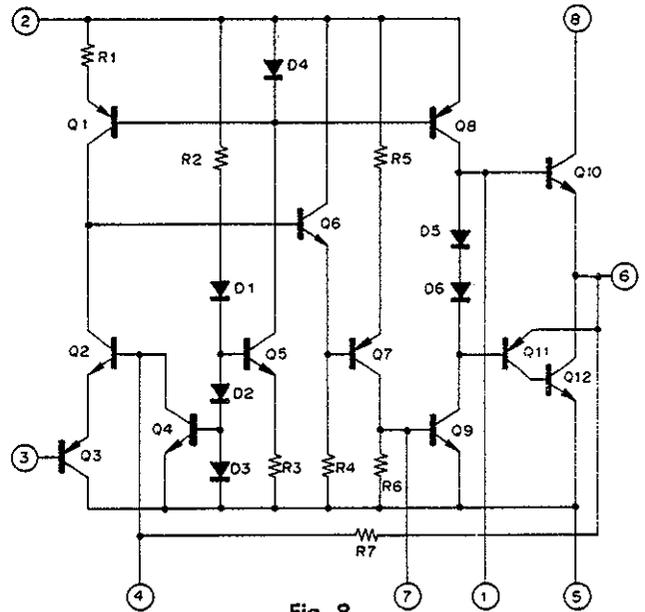


Fig. 8

H8D1152E (TX.RX unit Q5)

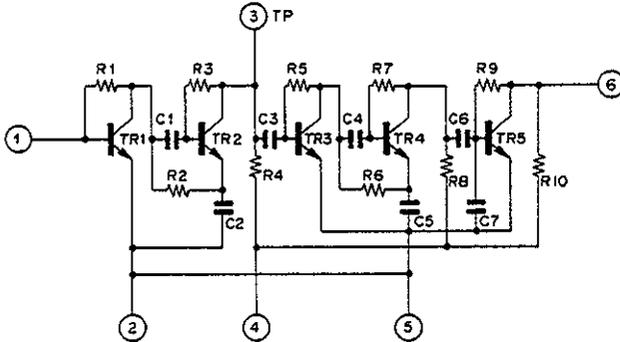


Fig. 6

2SC 2329 (TX•RX unit Q13)

Usage	High-Frequency power amplifier	
Type	NPN epitaxial silicon transistor	
Collector voltage	V <sub>CB0</sub>	38 V
Emitter voltage	V <sub>EB0</sub>	3.0 V
Collector-emitter voltage	V <sub>CE0</sub>	18 V
Collector current	I <sub>c</sub>	0.75 mA
Total loss	P <sub>T</sub> (T <sub>c</sub> = 25°C)	7.5 W (R <sub>th(j-c)</sub> = 20°C/W)
Junction temperature	T <sub>j</sub>	175°C
Storage temperature	T <sub>stg</sub>	-65 ~ +175°C

H8D1252 (TX.RX unit Q6)

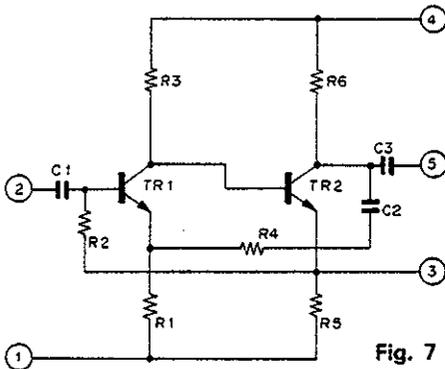


Fig. 7

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

Item	Rating
Nominal center frequency (f <sub>0</sub> )	10.7 MHz
Pass bandwidth	f <sub>0</sub> ± 7.5 kHz or more at 3 dB
Attenuation bandwidth	f <sub>0</sub> ± 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 <sub>0</sub> ± 1 MHz Spurious; 18 dB or more
Terminal impedance	3 kΩ // 2 pF

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

TR-2400

SEMICONDUCTOR DATA

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

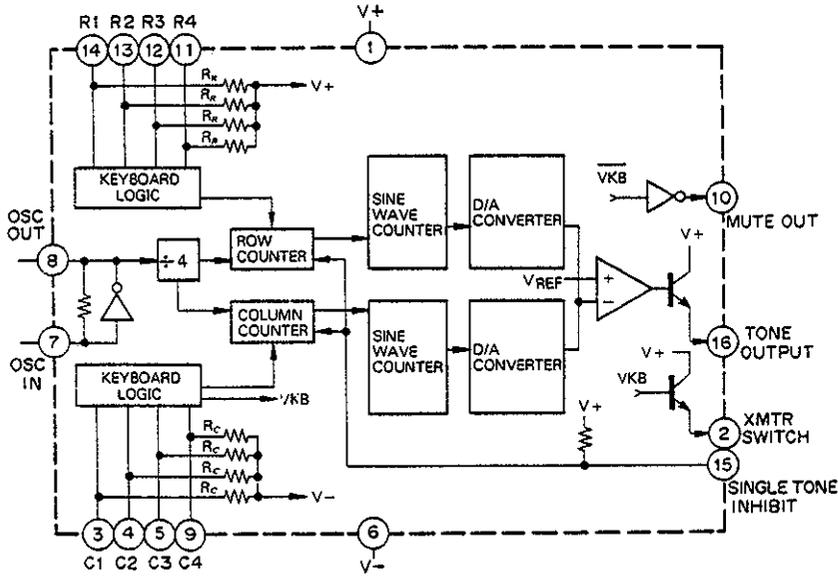


Fig. 9

TC40174BP (PLL unit Q23, 24)

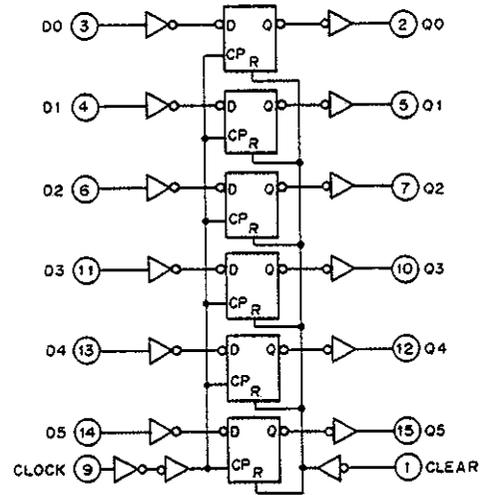


Fig. 12

TC5081P (PLL unit Q21)

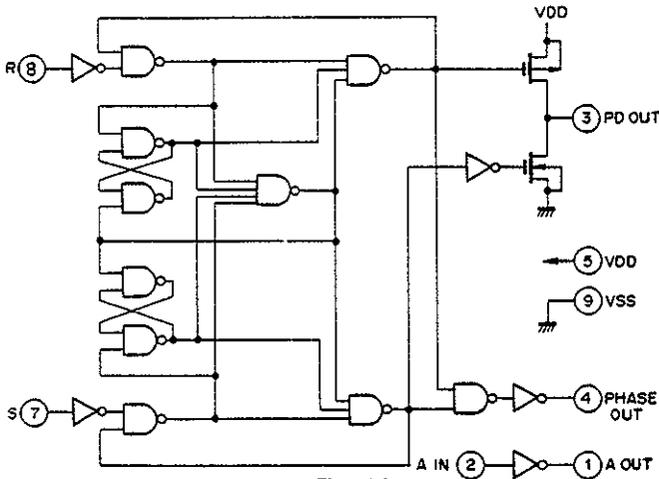


Fig. 10

TC40174BP (PLL unit Q23, 24)

Truth table

INPUTS		OUTPUTS
CLOCK <sup>Δ</sup>	D <sub>n</sub>	Q <sub>n</sub>
	H	H
	L	L
	*	Q <sub>n-1</sub> *
*	*	L

Δ: Level change  
 •: No change  
 \*: Don't care

TC5082P (PLL unit Q22)

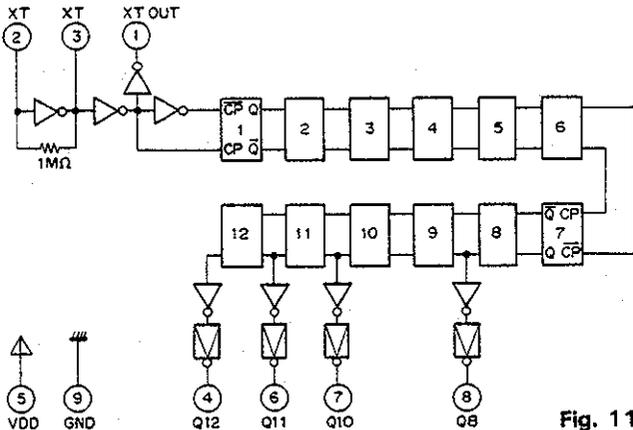


Fig. 11

PIN NO	8	7	6	4	1
PIN NAME	Q <sub>8</sub>	Q <sub>10</sub>	Q <sub>11</sub>	Q <sub>12</sub>	XT <sub>out</sub>
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 <sub>in</sub>	Programmable counter input terminal	Programmable counter input terminal to which the signal to be divided is input.	Build-in bias circuit
P <sub>out</sub>	Programmable counter output terminal	Programmable counter output terminal. Output is 1/N of the input frequency. The output pulse width equals that of the input.	
A <sub>1</sub> ~A <sub>4</sub> B <sub>1</sub> ~B <sub>4</sub> C <sub>1</sub> ~C <sub>4</sub> D <sub>1</sub> ~D <sub>4</sub>	× 1 × 10 × 100 × 1000 Program input terminals	Terminal to set the dividing ratio. The following input combination is prohibited. A <sub>1</sub> A <sub>2</sub> A <sub>3</sub> A <sub>4</sub> B <sub>1</sub> B <sub>2</sub> B <sub>3</sub> B <sub>4</sub> C <sub>1</sub> C <sub>2</sub> C <sub>3</sub> C <sub>4</sub> D <sub>1</sub> D <sub>2</sub> 1 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 1 0 1 0 0 0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0 1 1 1 0 0 0 0 0 0 0 0 0	Built-in pull-down resistor

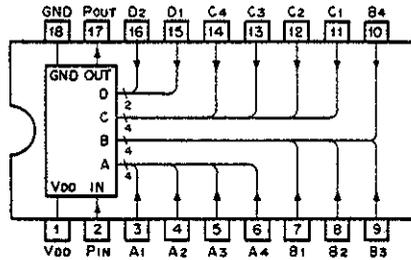


Fig. 13

LCD F2025-30 (Display unit V1)

Max rating (Absolute max. rating)

Item	Symbol	Min.	Max.	Unit
Storage temperature	T <sub>stg</sub>	-20	60	°C
Operation temperature	T <sub>op</sub>	-20	50	°C
Applied voltage	V <sub>OP</sub>		10	V
Allowable DC voltage			25	mV

Recommendable operating condition

Item	Symbol	Min.	Norm.	Max.	Unit
Operating voltage	V <sub>OP</sub>	3	5	5.5	V
Operating frequency	f <sub>OP</sub>	30	32	35	Hz
Operating temperature	T <sub>OP</sub>	-5	25	50	°C

Notes on operation

- 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.
- Do not store or operate at high temperature or humidity.
- If it is exposed to direct sunlight, use the ultraviolet ray cut filter (cut-off frequency: approx. 460 nm).
- 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

TR-2400

SEMICONDUCTOR DATA

TC4030BP (DISPLAY unit Q1)

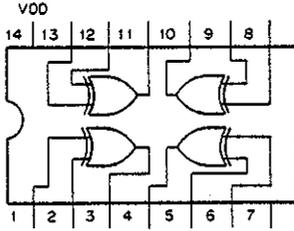


Fig. 14

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	L	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
H	L	H	H	H	H	H	H	H	H	H	H	H	H	BLANK
H	L	L	L	L	L	L	H	H	H	H	H	H	L	0
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	L	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
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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	L	H	H	H	L	L	L	L	L	L	L	BLANK

\* Don't care.



7 SEGMENT DISPLAY

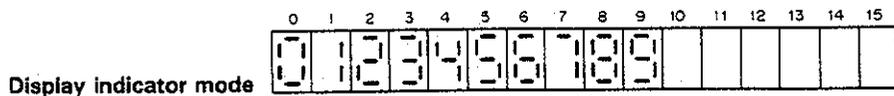


Fig. 15

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	PDO		○	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	PFO		○	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	PIO		○	
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)

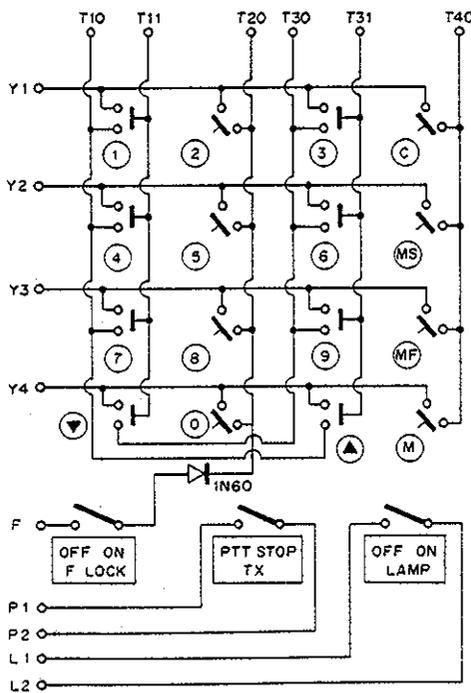
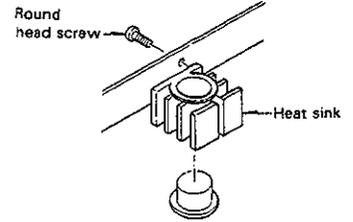
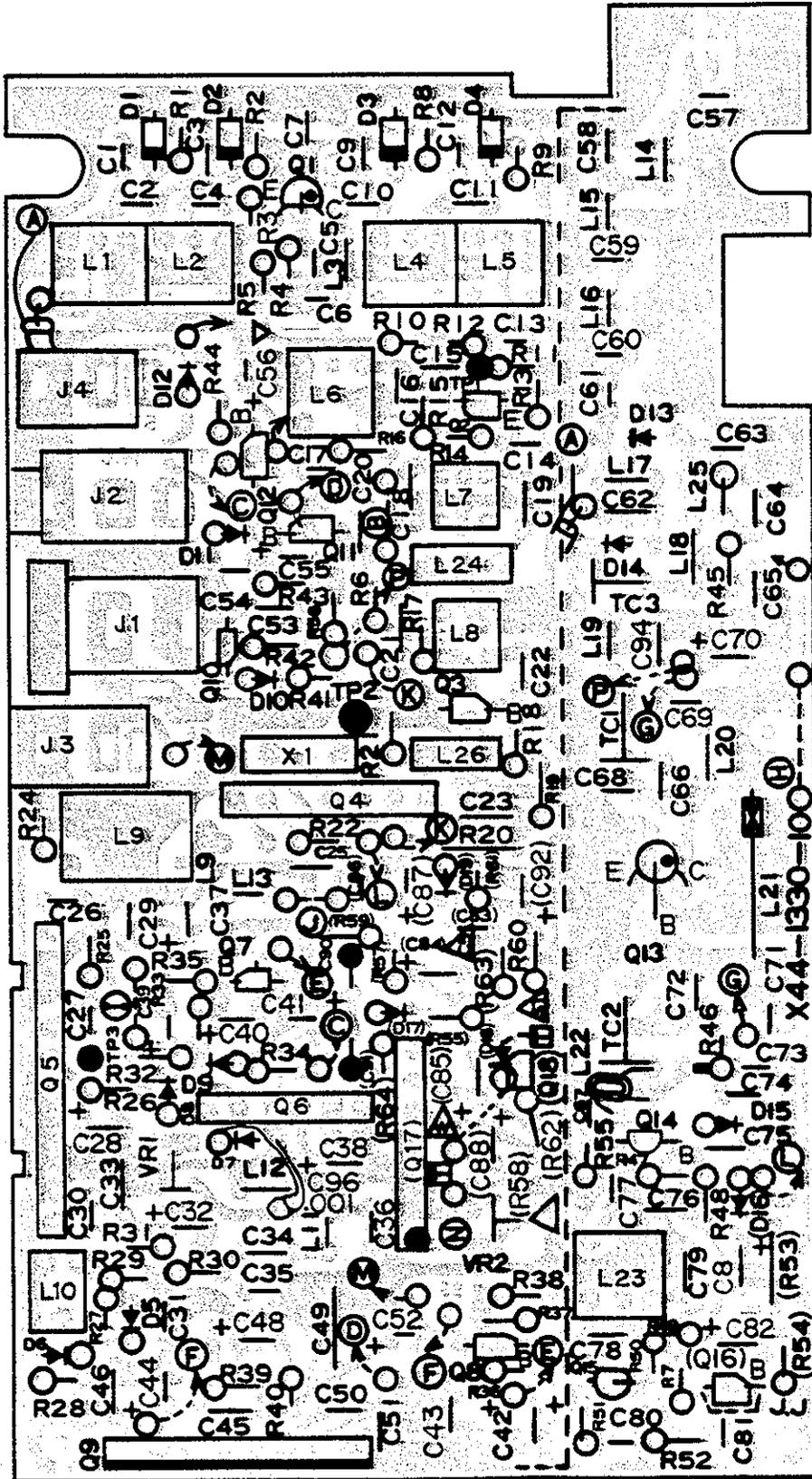


Fig. 16

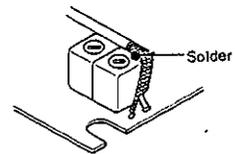
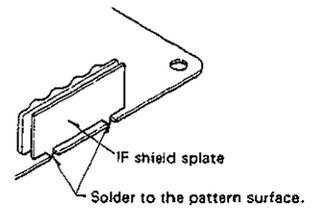
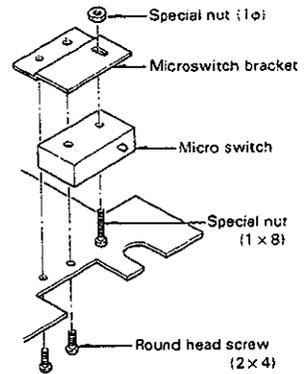
TR-2400

PRINTED CIRCUIT BOARD

▼ TX-RX unit



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

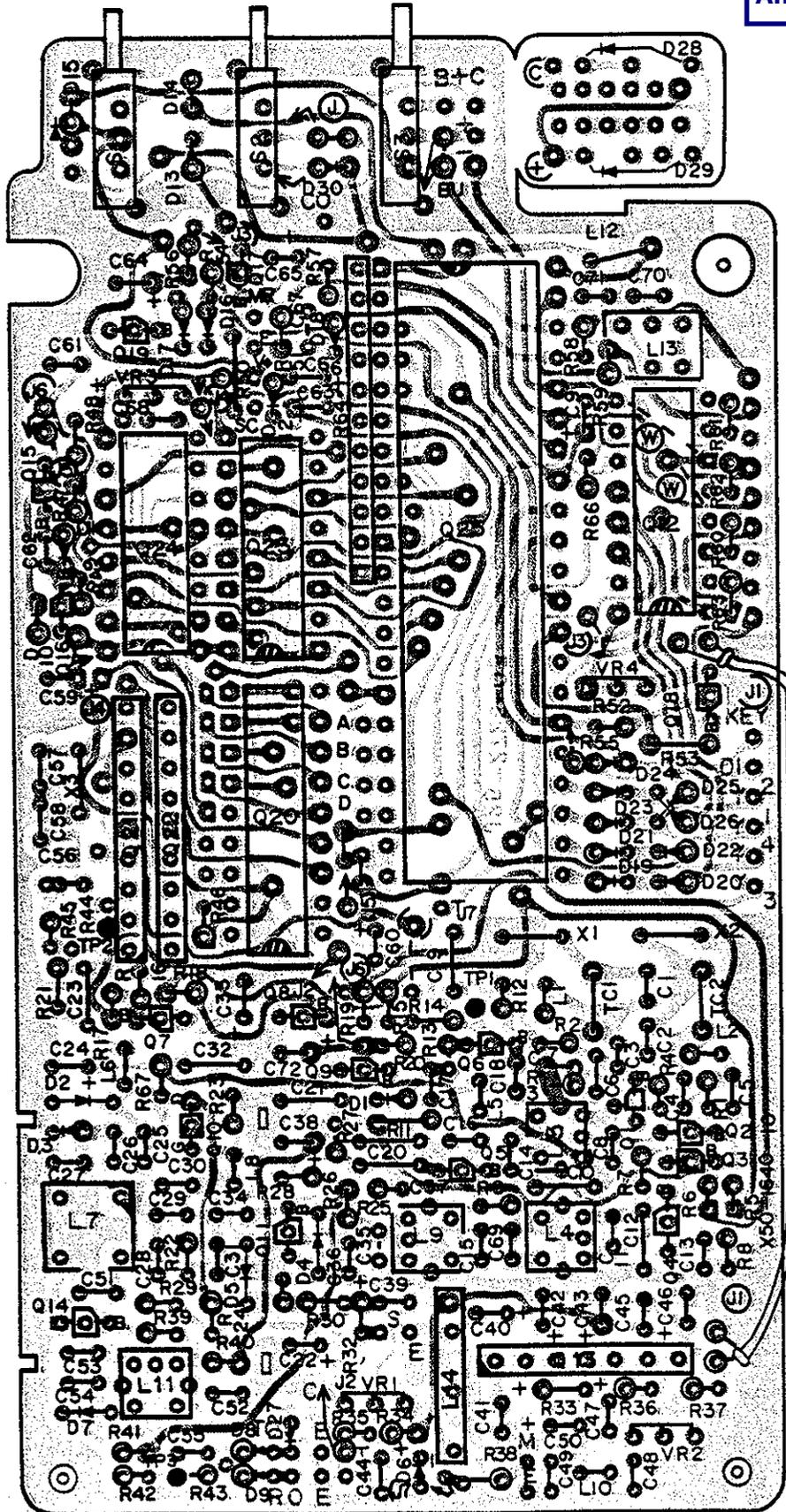


- Q1 : 2SC2212
- Q2 : 2SC2668(Y)
- Q3 : 2SC2669(Y)
- Q4 : D1154E
- Q5 : D1152E
- Q6 : D1252
- Q7,8,10,11 : 2SC2603(E)
- Q9 : M51182L
- Q12,16 : 2SA1115(E)
- Q13 : 2SC2329(K)
- Q14 : 2SC2053
- Q15 : 2SC2026(K)

PRINTED CIRCUIT BOARD

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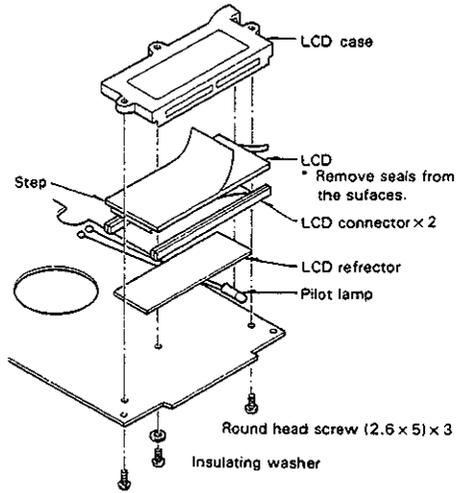
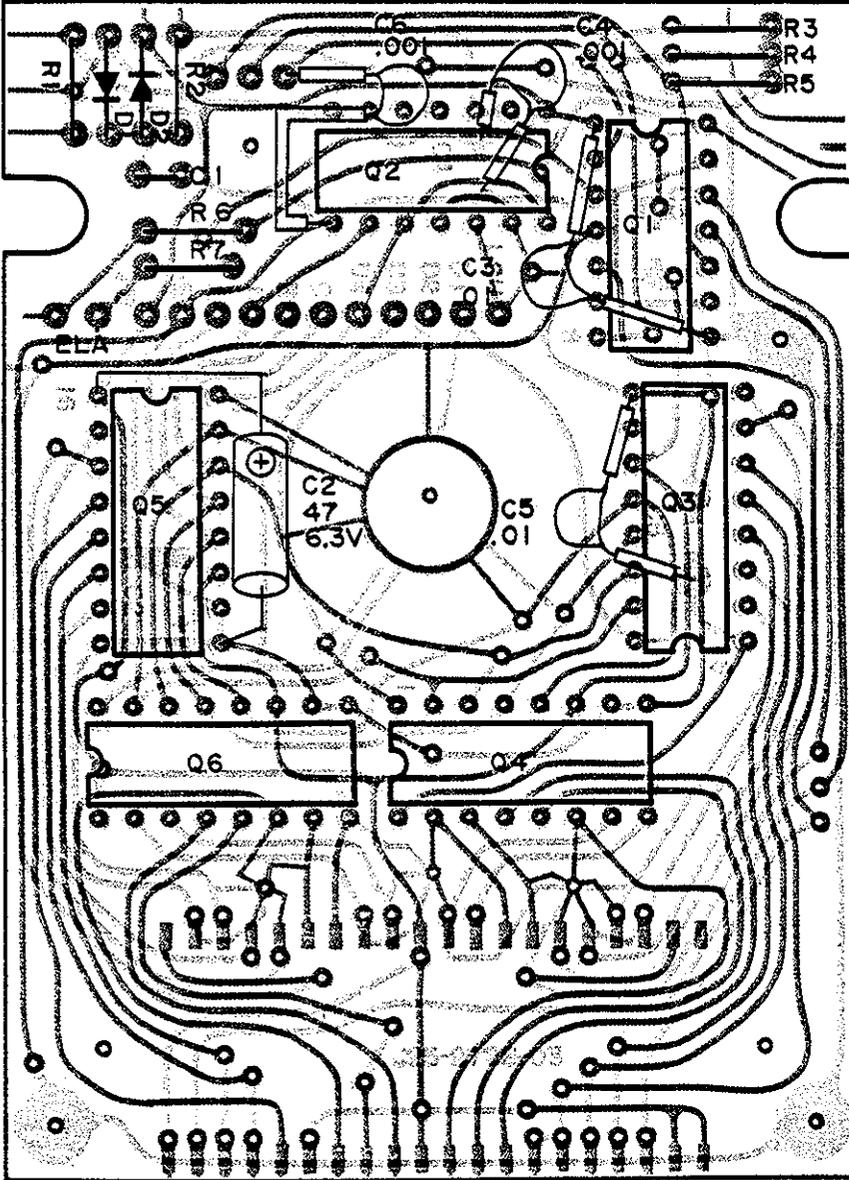
▼ PLL unit



- 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 :  $\mu$ PD651C-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.

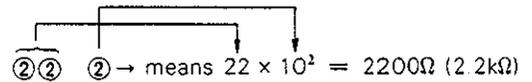
A ceramic capacitor's number is CK45F1H103Z, CC45TH1H220J.

**RESISTOR**

1. Type of the carbon resistor



3. Resistance value



2. Warrage

1/4W → 2E  
1/8W → 2B



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

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 ....

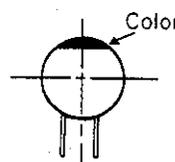
Ceramic capacitor (type II) temperature coeff. capacitor. 1' 3'

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

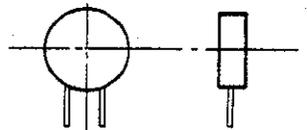
5 = Capacitor value

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

CC45 ....



CK45 ....



Type II 45

TR-2400

PARTS LIST

Ref. No.	Parts No.	Description	Re- marks	Ref. No.	Parts No.	Description	Re- marks
<b>GENERAL ☆: New Parts</b>							
—	A02-0607-02	Case (Front)	☆	—	N30-2604-41	Round head screw (Case A, PTT) × 7	
—	A02-0608-02	Case (Rear)	☆	—	N30-3008-45	Round head screw (Case B) × 2	
—	A21-0731-04	Ornamental panel (K type)	☆	—	N30-3025-45	Round head screw (Case B) × 2	
—	A21-0734-04	Ornamental panel (W type)	☆	—	N87-2005-46	Tap tight screw (Display unit) × 4	
—	A21-0735-04	Ornamental panel (T type)	☆	—	R05-3409-05	Variable resistor 10kΩ (B) (VOL)	☆
—	A53-0301-03	Cover ass'y (Battery case)	☆	—	R05-4403-05	Variable resistor 50KΩ (SQ.)	
—	B03-0514-04	Switch mask × 3 (Push switch)	☆	—	S59-0402-05	Key board ass'y (K type)	☆
—	B10-0826-04	Front glass	☆	—	S59-0403-05	Key board ass'y (W, T type)	☆
—	B40-2494-04	Name plate (K type)	☆	—	T07-0206-05	Speaker	☆
—	B40-2496-04	Name plate (W type)	☆	—	T18-0051-05	Earphone	☆
—	B40-2497-04	Name plate (T type)	☆	—	T90-0311-05	Helical antenna	☆
—	B42-1677-04	Name plate (Key board) (K type)	☆	—	T91-0312-05	Condenser microphone	☆
—	B42-1678-04	Name plate (Key board) (W, T type)	☆	—	W09-0306-05	Nickel-Cadmium Battery pack	☆
—	B42-1679-04	Name plate (LCD)	☆	—	W09-0307-05	Battery charger (K type)	☆
—	B43-0631-04	Badge (K, W type)	☆	—	W09-0308-05	Battery charger (W type)	
—	B43-0634-04	Badge (T type)	☆	—	W09-0309-05	Battery charger (T type)	☆
—	B46-0058-00	Warranty card (K type)	☆	—	X44-1330-10	TX-RX UNIT (K type)	
—	B50-2689-00	Operating manual (K type)	☆	—	X44-1330-61	TX-RX UNIT (W type)	
—	B50-2690-00	Operating manual (W type)	☆	—	X44-1330-51	TX-RX UNIT (T type)	
—	B50-2691-00	Operating manual (T type)	☆	—	X50-1640-10	PLL UNIT (K type)	
—	E04-0251-05	BNC Receptacle	☆	—	X50-1640-61	PLL UNIT (W type)	
—	E12-0001-05	Plug (Microphone)		—	X50-1640-51	PLL UNIT (T type)	
—	E12-0401-05	Plug (Stand-by)		<b>TX-RX UNIT (X44-1330-10)</b>			
—	E31-2047-05	Cable with plug (Battery)	☆	C1	CC45TH1H070D	Ceramic 7pF ± 0.5pF	
—	F15-0628-04	Shadow mask	☆	C2	CC45CH1H010C	Ceramic 1pF ± 0.25pF	
—	F15-0629-04	Jack mask (A)	☆	C3	CC45TH1H070D	Ceramic 7pF ± 0.5pF	
—	F15-0630-04	Jack mask (B)	☆	C4	CC45SL1H101J	Ceramic 100pF ± 5%	
—	F20-0513-04	Insulating sheet (PLL U. — RX-TX U.)	☆	C5,6	CK45B1H102K	Ceramic 1000pF ± 10%	
—	G01-0810-04	Coil spring (PTT)	☆	C7	C91-0462-05	Semiconductor capacitor 0.0047μF	☆
—	G13-0625-04	Sponge A (Speaker)	☆	C8	CS15E1E3R3M	Tantalum 3.3μF 25WV	
—	G13-0626-04	Sponge B (Microphone)	☆	C9	CC45TH1H070D	Ceramic 7pF ± 0.5pF	
—	G13-0627-04	Sponge C (Cover)	☆	C10	CC45CH1H220J	Ceramic 22pF ± 5%	
—	H01-2656-03	Carton case (K, W type)	☆	C11	CC45CH1H0R5C	Ceramic 0.5pF ± 0.25pF	
—	H01-2657-03	Carton case (T type)	☆	C12	CC45TH1H070D	Ceramic 7pF ± 0.5pF	
—	H10-2530-02	Polystyrene foam cushion A	☆	C13	CC45SL1H101J	Ceramic 100pF ± 5%	
—	H10-2531-04	Polystyrene foam cushion B	☆	C14	C91-0462-05	Semiconductor capacitor 0.0047μF	☆
—	H10-2533-04	Cushion	☆	C15	CC45CH1H0R5C	Ceramic 0.5pF ± 0.25pF	
—	H20-1416-03	Protection cover	☆	C16	CC45TH1H070D	Ceramic 7pF ± 0.5pF	
—	H25-0049-03	Accessories bag	☆	C17	CC45CH1H070D	Ceramic 7pF ± 0.5pF	
—	J19-1331-03	Battery case	☆	C18	C91-0462-05	Semiconductor capacitor 0.0047μF	☆
—	J32-0740-04	Boss A (large) × 4	☆	C19	CC45CH1H070D	Ceramic 7pF ± 0.5pF	
—	J32-0741-04	Boss B (Small) × 2	☆	C20	C91-0462-05	Semiconductor capacitor 0.0047μF	☆
—	J32-0742-04	Boss C (Hand strap)	☆	C21	CC45CH1H030C	Ceramic 3pF ± 0.25pF	
—	J69-0301-03	Hand strap ass'y	☆	C22	CC45SL1H101J	Ceramic 100pF ± 5%	
—	J69-0302-04	Both-side adhesive sheet	☆	C23	CQ92M1H103K	Mylar 0.01μF ± 10%	
—	K23-0730-04	Knob A (POWER, SQ.) × 2	☆	C24	Not used		
—	K23-0731-04	Knob B (TX-OFFSETJ)	☆	C25	C91-0462-05	Semiconductor capacitor 0.0047pF	☆
—	K27-0411-04	Push knob (SCAN, TONE, REV.) × 3	☆	C26	CK45B1H471K	Ceramic 470pF ± 10%	
—	K27-0413-04	Cap knob × 3	☆	C27	CK45B1H102K	Ceramic 1000pF ± 10%	
—	K29-0730-04	Lever (PTT)	☆	C28	CS15E1C220M	Tantalum 22μF 16WV	
—	N08-0504-04	Ornamental screw (Frame)	☆	C29	C91-0462-05	Semiconductor capacitor 0.0047μF	☆
—	N09-0616-04	Flat head screw (Key board) × 4	☆	C30	CQ92M1H332K	Mylar 3300pF ± 10%	☆
—	N30-2004-41	Round head screw (Panel) × 3	☆	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	Ref. No.	Parts No.	Description	Re- marks
C42	CS15E1C4R7M	Tantalum 4.7 $\mu$ F 16WV		—	F10-1245-04	TX shield plate	☆
C43	CE04W1C101Q	Electrolytic 100 $\mu$ F 16WV		—	F10-1251-04	IF shield plate	☆
C44	CE04W1H010Q	Electrolytic 1 $\mu$ F 50WV					
C45	CQ92M1H103K	Mylar 0.01 $\mu$ F $\pm$ 10%					
C46	C91-0457-05	Semiconductor capacitor 0.022 $\mu$ F					
C47	Not used						
C48	CS15E1C220M	Tantalum 22 $\mu$ F 16WV		L1,2	L31-0347-05	Tuning coil	
C49	CQ92M1H104K	Mylar 0.1 $\mu$ F $\pm$ 10%		L3	L40-2292-01	Ferri-inductor 2.2 $\mu$ H	
C50	CQ92M1H222K	Mylar 2200pF $\pm$ 10%		L4~6	L31-0347-05	Tuning coil	
C51	CQ92M1H392K	Mylar 3900pF $\pm$ 10%		L7,8	L34-0891-05	Tuning coil	☆
C52	CS15E1A470M	Tantalum 57 $\mu$ F 10WV		L9	L72-0318-05	Ceramic filter CFG455F	☆
C53	CK45B1H102K	Ceramic 1000pF $\pm$ 10%		L10	L79-0446-05	Ceramic discriminator CFY455S	
C54	CE04W1C100Q	Electrolytic 10 $\mu$ F 16WV		L11	L40-1021-03	Ferri-inductor 1mH	
C55	C91-0462-05	Semiconductor capacitor 0.0047 $\mu$ F	☆	L12	L40-6825-04	Ferri-inductor 6.8mH	
C56	CE04W1C220Q	Electrolytic 22 $\mu$ F 16WV		L13	L40-1021-03	Ferri-inductor 1mH	
C57	CC45SL1H220J	Ceramic 22pF $\pm$ 5%		L14	L34-0894-05	Coil 3 $\phi$ 5T	☆
C58	CC45SL1H390J	Ceramic 39pF $\pm$ 5%		L15	L34-0893-05	Coil 3 $\phi$ 4T	☆
C59	CC45SL1H220J	Ceramic 22pF $\pm$ 5%		L16	L34-0894-05	Coil 3 $\phi$ 5T	☆
C60	CC45SL1H150J	Ceramic 15pF $\pm$ 5%		L17	L34-0892-05	Coil 2 $\phi$ 10T	☆
C61	CK45B1H102K	Ceramic 1000pF $\pm$ 10%		L18	L34-0893-05	Coil 3 $\phi$ 4T	☆
C62	CC45CH1H150J	Ceramic 15pF $\pm$ 5%		L19,20	L34-0895-05	Coil 3 $\phi$ 6T	☆
C63	CC45SL1H220J	Ceramic 22pF $\pm$ 5%		L21	L33-0632-05	Choke coil	☆
C64	C91-0462-05	Semiconductor Capacitor 0.0047 $\mu$ F	☆	L22	L19-0321-05	Transformer (wide band)	☆
C65	CK45B1H102K	Ceramic 1000pF $\pm$ 10%		L23	L34-0897-05	Tuning coil	☆
C66	CC45CH1H220J	Ceramic 22pF $\pm$ 5%		L24	L71-0217-05	Monolithic filter 10T15A	☆
C67	CK45B1H102K	Ceramic 1000pF $\pm$ 10%		L25	L33-0002-05	Choke coil	☆
C68	CC45CH1H050C	Ceramic 5pF $\pm$ 0.25pF		L26	L72-0014-05	Ceramic filter SFE10.7MA5	
C69	CK45B1H102K	Ceramic 1000pF $\pm$ 10%		X1	L77-0863-05	Quarty crystal 10.245MHz	
C70	C90-0825-05	Electrolytic 22 $\mu$ F 16WV	☆				
C71	C91-0462-05	Semiconductor capacitor 0.0047 $\mu$ F	☆				
C72	CC45CH1H220J	Ceramic 22pF $\pm$ 5%		—	N09-0615-05	Special round head screw M1 x 8	☆
C73	C91-0462-05	Semiconductor capacitor 0.0047 $\mu$ F	☆	—	N14-0514-05	Special nut M1	☆
C74,75	CK45B1H102K	Ceramic 1000 $\mu$ F $\pm$ 10%					
C76	C91-0462-05	Semiconductor capacitor 0.0047 $\mu$ F	☆				
C77	CC45SL1H390J	Ceramic 39pF $\pm$ 5%		VR1	R12-3423-05	Semi-fixed resistor 22k $\Omega$ (B)	☆
C78	CC45TH1H050C	Ceramic 5pF $\pm$ 0.25pF		VR2	R12-3424-05	Semi-fixed resistor 20k $\Omega$	☆
C79	C91-0462-05	Semiconductor capacitor 0.0047 $\mu$ F	☆				
C80	CC45CH1H270J	Ceramic 27pF $\pm$ 5%					
C81	CK45B1H102K	Ceramic 1000pF $\pm$ 10%					
C82	CS15E1E3R3M	Tantalum 3,3 $\mu$ F 25WV					
C83	CK45B1H102K	Ceramic 1000pF $\pm$ 10%(W,T)					
C84	CE04W1C220Q	Electrolytic 22 $\mu$ F 16WV(W,T)		D1~4	V11-0317-05	Diode 1S2208	
C85	CE04W1H010Q	Electrolytic 1 $\mu$ F 50WV(W,T)		D5~8	V11-0051-05	Diode 1N60	
C86	CK45B1H102K	Ceramic 1000pF $\pm$ 10%(W,T)		D9	V11-0076-05	Diode 1S1555	
C87	C90-0824-05	Electrolytic 1 $\mu$ F 50WV(W,T)	☆	D10	V11-4163-46	Zener diode XZ-080	
C88	CE04W1C220Q	Electrolytic 22 $\mu$ F 50WV(W)		D11	V11-4160-86	Zener diode WZ-071	
C88	CE04W1HR47Q	Electrolytic 0.47 $\mu$ F 50WV(T)		D12	V11-0076-05	Diode 1S1555	
C89	CK45B1H102K	Ceramic 1000pF $\pm$ 10%(W)		D13	V11-0255-05	Diode MI301	
C90	CS15E1C150M	Tantalum 15 $\mu$ F 16WV(T)		D14	V11-0414-05	Diode 1S2588	
C91	CK45B1H102K	Ceramic 1000pF $\pm$ 10%(T)		D15	V11-0076-05	Diode 1S1555	
C92	CS15E1A150M	Tantalum 15 $\mu$ F 10WV(T)		D16	V11-0051-05	Diode 1N60	
C93	CK45B1H102K	Ceramic 1000pF $\pm$ 10%(T)		D17	V11-0076-05	Diode 1S1555 (W,T type)	
C94	C91-0462-05	Semiconductor capacitor 0.0047 $\mu$ F	☆	D18	V11-0076-05	Diode 1S1555 (W type)	
C95	CK45B1H102K	Ceramic 1000pF $\pm$ 10%		D19	V11-0076-05	Diode 1S1555 (T type)	
TC1	C05-0309-05	Ceramic trimmer 40pF		Q1	V03-2212-06	Transistor 2SC2212	☆
TC2	C05-0067-05	Ceramic trimmer 25pF		Q2	V03-2668-16	Transistor 2SC2668(Y)	
TC3	C05-0309-05	Ceramic trimmer 40pF		Q3	V03-2669-16	Transistor 2SC2669(Y)	
J1	E03-0203-05	DC jack	☆	Q4	V30-1138-06	IC H8D1154E	☆
J2	E11-0408-05	MIC jack	☆	Q5	V30-1137-06	IC H8D1152E	☆
J3,4	E11-0407-05	Earphone jack	☆	Q6	V30-1139-06	IC H8D1252	☆
—	F01-0745-04	Heat sunk	☆	Q7,8	V03-2668-16	Transistor 2SC2603(E)	
—	F10-1242-14	RX shield plate	☆	Q9	V30-1140-06	IC M51182L	☆
—	F10-1243-14	DRIVE shield plate	☆	Q10,11	V03-2668-16	Transistor 2SC2603(E)	
—	F10-1244-14	IC shield plate	☆	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)	

TR-2400

PARTS LIST

Ref. No.	Parts No.	Description	Re- marks	Ref. No.	Parts No.	Description	Re- marks
Q17	V30-1141-06	IC AFG05F1750A		C70	CC45SL1H121J	Ceramic 120pF ± 5%	
Q18	V03-2603-06	Transistor 2SC2603(E) (T type)		C71	CC45CH1H330J	Ceramic 33pF ± 5%	
PLL UNIT (X50-1640-10)				C72	CE04W1C330Q	Electrolytic 33µF 16WV	
				C73	CC45SL1H101J	Ceramic 100pF ± 5%	
C1,2	CC45CH1H100D	Ceramic 10pF ± 0.5pF		C74	CE04W1C330Q	Electrolytic 33µF 16WV	
C3	CC45CH1H220J	Ceramic 22pF ± 5%		TC1,2	C05-0303-05	Trimmer	
C4	CC45CH1H180J	Ceramic 18pF ± 5%		-	F10-1246-14	PLL shield plate	☆
C5,6	CC45CH1H030C	Ceramic 3pF ± 0.25pF		-	F11-0765-04	VCO shield plate	☆
C7	CC45CH1H030C	Ceramic 22pF ± 5%		L1,2	L33-0605-05	Choke coil 47µH	
C8	CC45TH1H080D	Ceramic 8pF ± 0.5pF		L3,4	L34-0890-05	Tuning coil	☆
C9	CS15E1VR47M	Tantalum 0.47µF 35WV		L5	L40-2201-03	Ferri-inductor 22µH	
C10	CK45F1H103Z	Ceramic 0.01µF +80%, -20%		L6	L40-1092-01	Ferri-inductor 1µH	
C11	CC45TH1H050C	Ceramic 5pF ± 0.25pF		L7	L32-0625-05	VCO coil	☆
C12	CK45F1H103Z	Ceramic 0.01µF +80%, -20%		L8	L40-1092-01	Ferri-inductor 1µH	
C13	CC45CH1H220J	Ceramic 22pF ± 5%		L9	L34-0890-05	Tuning coil	☆
C14,15	CC45CH1H050C	Ceramic 5pF ± 0.25pF		L10	L40-1021-03	Ferri-inductor 1mH	
C16,17	CC45CH1H030C	Ceramic 3pF ± 0.25pF		L11	L34-0890-05	Tuning coil	☆
C18	CC45SL1H101J	Ceramic 100pF ± 5%		L12	L78-0004-05	Ceramic oscillator 397KHz	☆
C19	C90-0246-05	Ceramic 0.01µF ± 10%		L13	L78-0003-05	Ceramic oscillator 3.58MHz	☆
C20,21	CK45F1H103Z	Ceramic 0.01µF +80%, -20%		L14	L79-0458-05	Spurious filter AFL13F3500B1	☆
C22	CE04W1A330Q	Electrolytic 33µF 10WV		L15	L40-1001-01	Ferri-inductor 10µH	
C23	CQ92M1H472K	Mylar 4700pF 50V		X1	L77-0860-05	Quartz crystal 42.6MHz	☆
C24	CS15E1C1R5M	Tantalum 1.5µF 16WV		X2	L77-0861-05	Quartz crystal 46.1866MHz	☆
C25	CC45CH1H120J	Ceramic 12pF ± 5%		X3	L77-0862-05	Quartz crystal 10.240MHz	☆
C26	CC45TH1H060D	Ceramic 6pF ± 0.5pF		R64	R90-0527-05	Resistor block 470K x 10	☆
C27	CC45CH1H020C	Ceramic 2pF ± 0.25pF		VR1	R12-3422-05	Semi-fixed resistor 20kΩ	☆
C28	CC45CH1H010D	Ceramic 1pF ± 0.25pF		VR2,3	R12-2408-05	Semi-fixed resistor 5kΩ	☆
C29	CC45CH1H080D	Ceramic 8pF ± 0.5pF		VR4	R12-2408-05	Semi-fixed resistor 5kΩ(K type)	☆
C30	CC45CH1H030C	Ceramic 3pF ± 0.25pF		S1	S40-1401-05	Push switch SQUELCH	☆
C31	CC45CH1H050C	Ceramic 5pF ± 0.25pF		S2	S40-1401-05	Push switch SUB TONE (K, T type)	☆
C32	CK45F1H103Z	Ceramic 0.01µF +80%, -20%		S2	S40-1402-05	Push switch (W type)	☆
C33	CE04W1C100Q	Electrolytic 10µF 16WV		S3	S40-1402-05	Push switch REVERSE	☆
C34	CC45CH1H030C	Ceramic 3pF ± 0.25pF		-	S29-1416-05	Rotary switch TX OFFSET (K type)	☆
C35	CC45TH1H080D	Ceramic 8pF ± 0.5pF		-	S29-1417-05	Rotary switch TX OFFSET (W, T type)	☆
C36	CC45TH1H010C	Ceramic 1pF ± 0.25pF		Q1	V03-2669-16	Transistor 2SC2669 (Y)	☆
C37	CK45F1H103Z	Ceramic 0.01µF +80%, -20%		Q2,3	V03-2603-06	Transistor 2SC2603 (E)	☆
C38	CE04W1A470Q	Electrolytic 47µF 10WV		Q4	V03-2669-16	Transistor 2SC2669 (Y)	☆
C39,40	CS15E1V0R1M	Tantalum 0.1µF 35WV		Q5	V03-2668-16	Transistor 2SC2668 (Y)	☆
C41	CE04W1A470Q	Electrolytic 47µF 10WV		Q6	V03-2669-16	Transistor 2SC2669 (Y)	☆
C42	CE04W1E4R7Q	Electrolytic 4.7µF 25WV		Q7~9	V03-2603-06	Transistor 2SC2603 (E)	☆
C43	CE04W1C100Q	Electrolytic 10µF 16WV		Q10	V09-1016-06	FET 2SK192 (GR)	☆
C44	CE04W1A330Q	Electrolytic 33µF 10WV		Q11	V03-2668-16	Transistor 2SC2668 (Y)	☆
C45	CK45B1H102K	Ceramic 1000pF ± 10%		Q12	V30-1074-06	IC MK5087N	
C46	CE04W1A470Q	Electrolytic 47µF 10WV		Q13	V30-0039-05	IC TA7061AP	
C47	CS15E1V0R1M	Tantalum 0.1µF 35WV		Q14	V03-2668-16	Transistor 2SC2668 (Y)	☆
C48,49	CK45B1H102K	Ceramic 1000pF ± 10%		Q15	V01-1115-16	Transistor 2SA1115 (E)	☆
C50	CS15E1V0R1M	Tantalum 0.1µF 35WV		Q16~19	V03-2603-06	Transistor 2SC2603 (E)	☆
C51	CC45CH1H050C	Ceramic 5pF ± 0.25pF		Q20	V30-1036-16	IC TC9122P	
C52	CK45B1H102K	Ceramic 1000pF ± 10%		Q21	V30-1132-06	IC TC5081P	
C53	CC45TH1H080D	Ceramic 8pF ± 0.5pF		Q22	V30-1015-16	IC TC5082P	
C54	CC45TH1H010C	Ceramic 1pF ± 0.25pF		Q23,24	V30-1145-06	IC TC40174BP	☆
C55	CC45CH1H330J	Ceramic 33pF ± 5%		Q25	V30-1146-06	IC µPD651C-013	☆
C56	C90-0821-05	Tantalum (Non pole) 4.7µF 3.15WV		D1	V11-4173-06	Zener diode XZ-066	
C57	CC45CH1H180J	Ceramic 18pF ± 5%		D2	V11-0317-05	Diode 1S2208	
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					

PARTS LIST

Ref. No.	Parts No.	Description	Re- marks	DISPLAY UNIT (X54-1480-10)				
D3	V11-0414-05	Diode	1S2588	*	—	B11-0408-05	LCD reflector	*
D4	V11-0317-05	Diode	1S2208		—	B30-0815-05	Pilot lamp 12.6V 30mA	*
D5	V11-1260-36	Diode	1SV50S		C1	C91-0426-05	Laminated capacitor 0.022μF	
D6	V11-4161-96	Zener diode	XZ-070		C2	C90-0823-05	Electrolytic 47μF 6.3WV	*
D7	V11-0317-05	Diode	1S2208		C3	CK45F1H103Z	Ceramic 0.01μF +80%, -20%	
D8,9	V11-0414-05	Diode	1S2588		C4	CK45B1H102K	Ceramic 1000pF ±10%	
D10	V11-0051-05	Diode	1N60		C5	CK45F1H103Z	Ceramic 0.01μF +80%, -20%	
D11	V11-4173-06	Zener diode	XZ-066		—	E29-0415-05	LCD connector	*
D12	V11-0076-05	Diode	1S1555		—	F07-0831-04	LCD case	*
D13-17	V11-0051-05	Diode	1N60		—	N19-0619-04	Insulating washer	*
D18	V11-0076-05	Diode	1S1555		Q1	V30-1143-06	IC TC4030BP	*
D19	V11-0051-05	Diode	1N60		Q2	V30-1144-06	IC TC4011UBP	*
D20	V11-0051-05	Diode	1N60 (K type)		Q3-6	V30-1142-06	IC TC4643BP	*
D21	V11-0051-05	Diode	1N60		D1,2	V11-0076-05	Diode 1S1555	
D22	V11-0051-05	Diode	1N60 (K type)		V1	V11-3172-86	LCD F2025-30	*
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					

PACKING

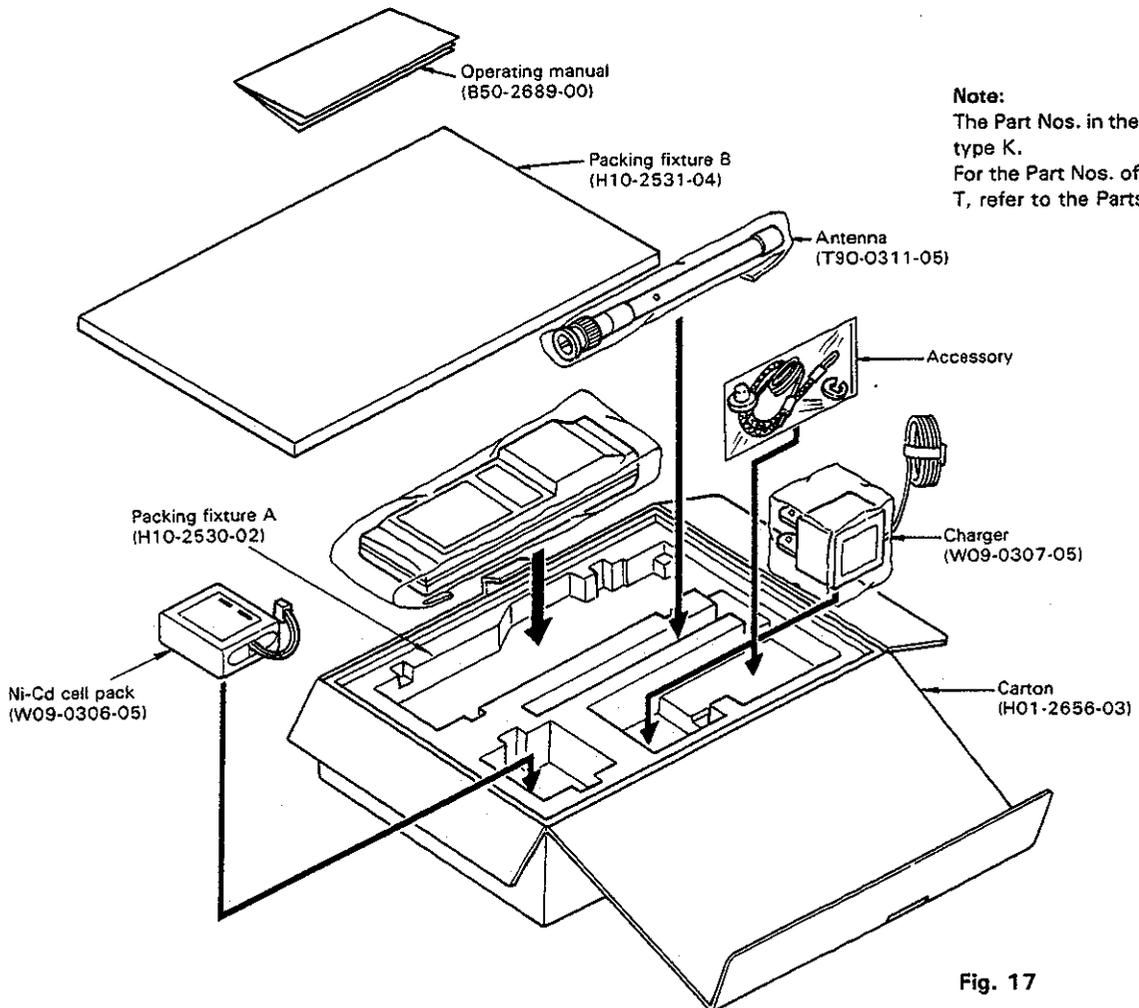
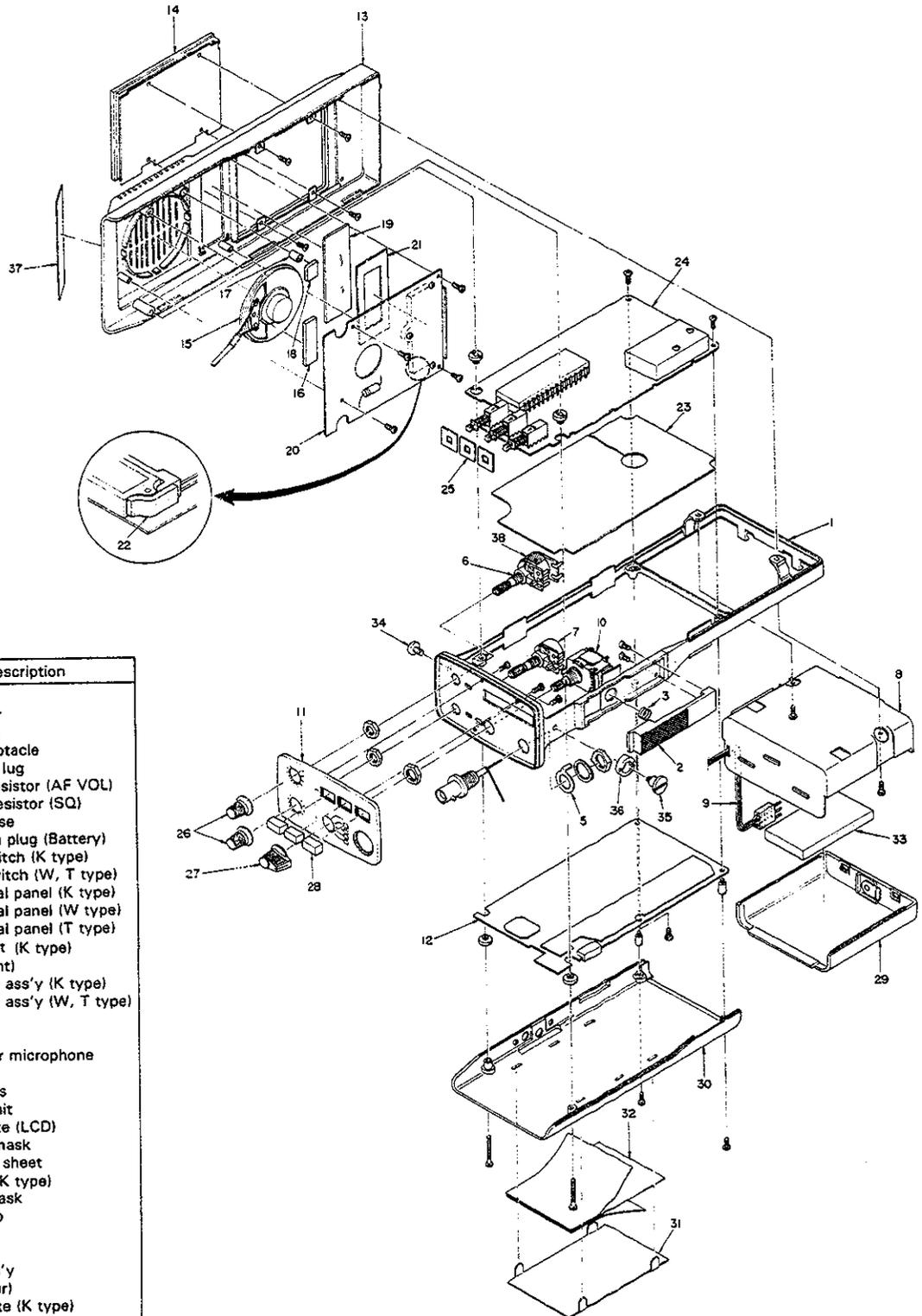


Fig. 17

TR-2400

DISASSEMBLY

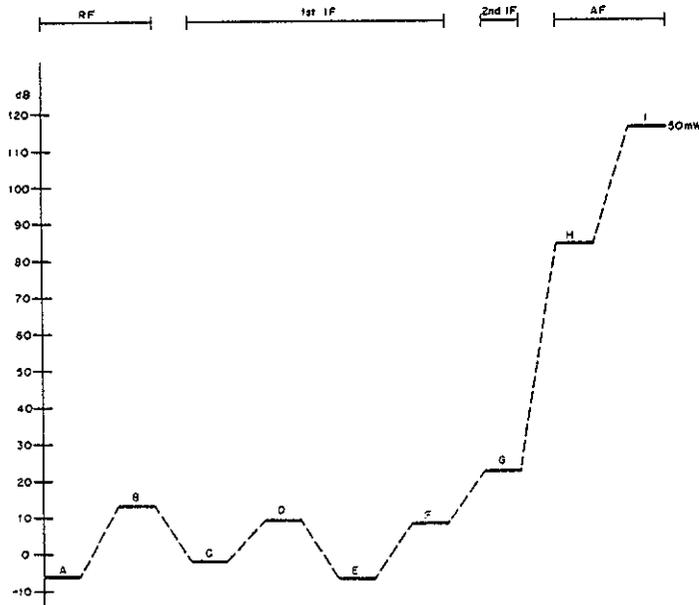


No.	Parts No.	Description
1		Frame
2	K29-0730-04	P.T.T lever
3	G01-0810-04	Coil spring
4	E04-0251-05	BCN Receptacle
5	E23-0513-05	Grounding lug
6	R05-3409-05	Variable resistor (AF VOL)
7	R05-4403-05	Variable resistor (SQ)
8	J19-1331-03	Battery case
9	E31-2047-05	Cable with plug (Battery)
10	S29-1416-05	Rotary switch (K type)
	S29-1417-05	Rotary 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

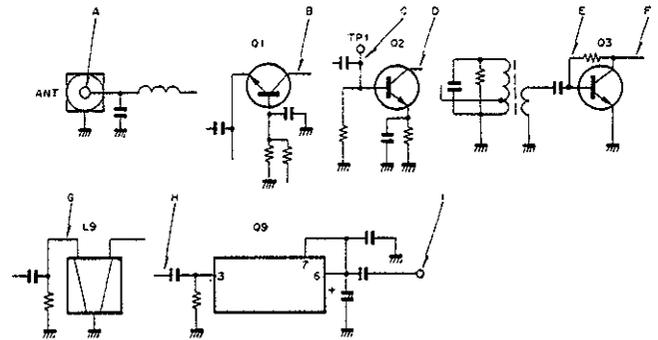


#### Measuring conditions

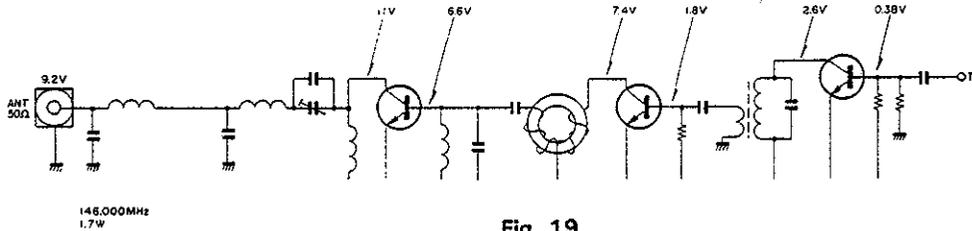
1. C
2.  $C = 0.01 \mu F$  ( $1 \mu F$  for AF circuit)  
 $f = 145.950 \text{ MHz}$   
 Mod. = 1 kHz, Dev. = 5 kHz  
 AG f = 1 kHz
3. Output = 50 mW/8Ω

#### 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.  $f = 146.000 \text{ MHz}$
  2. Output = 1.7 W

Fig. 19

## ADJUSTMENT

### TEST EQUIPMENT REQUIRED

#### 1. RF Valve Voltmeter

- Input impedance:  $1 M\Omega$  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 MΩ
- 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.)

## TR-2400

## 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.

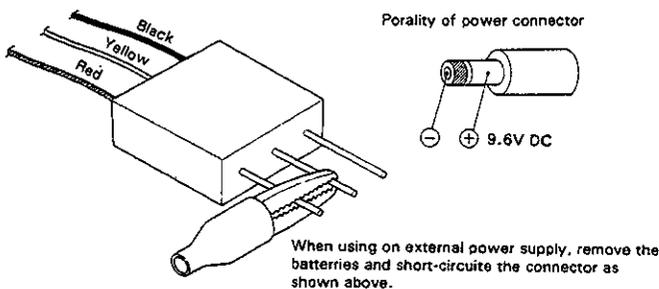


Fig. 20

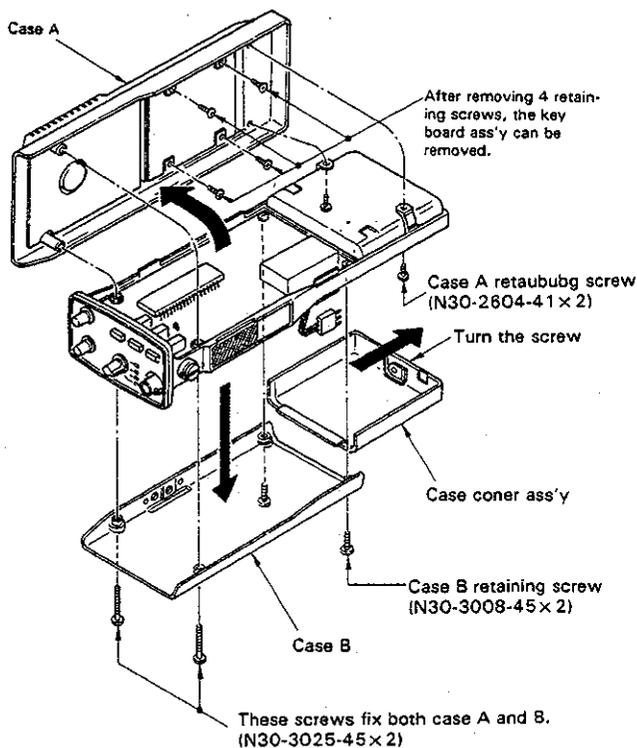


Fig. 21

## 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"

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.
- 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.
- 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 #F/16 V between the MIC terminal and the AG output.
- 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.
- 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  $\pm$  1 kHz.
- 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).
- 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.

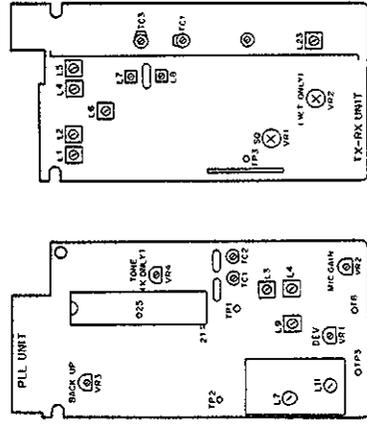


Fig. 22 Parts layout

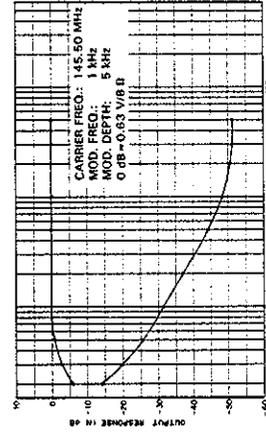


Fig. 23 Signal-to-noise ratio and output level vs antenna

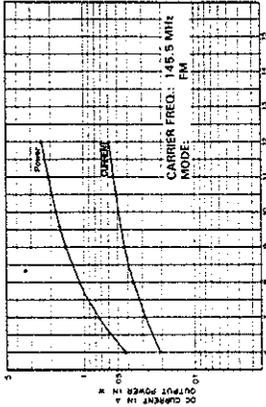


Fig. 24 Source voltage vs current drain and transmitting

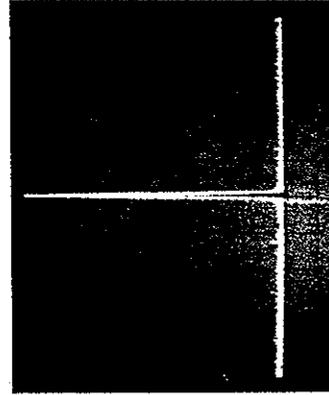


Fig. 25 (a) An example of adjacent spurious

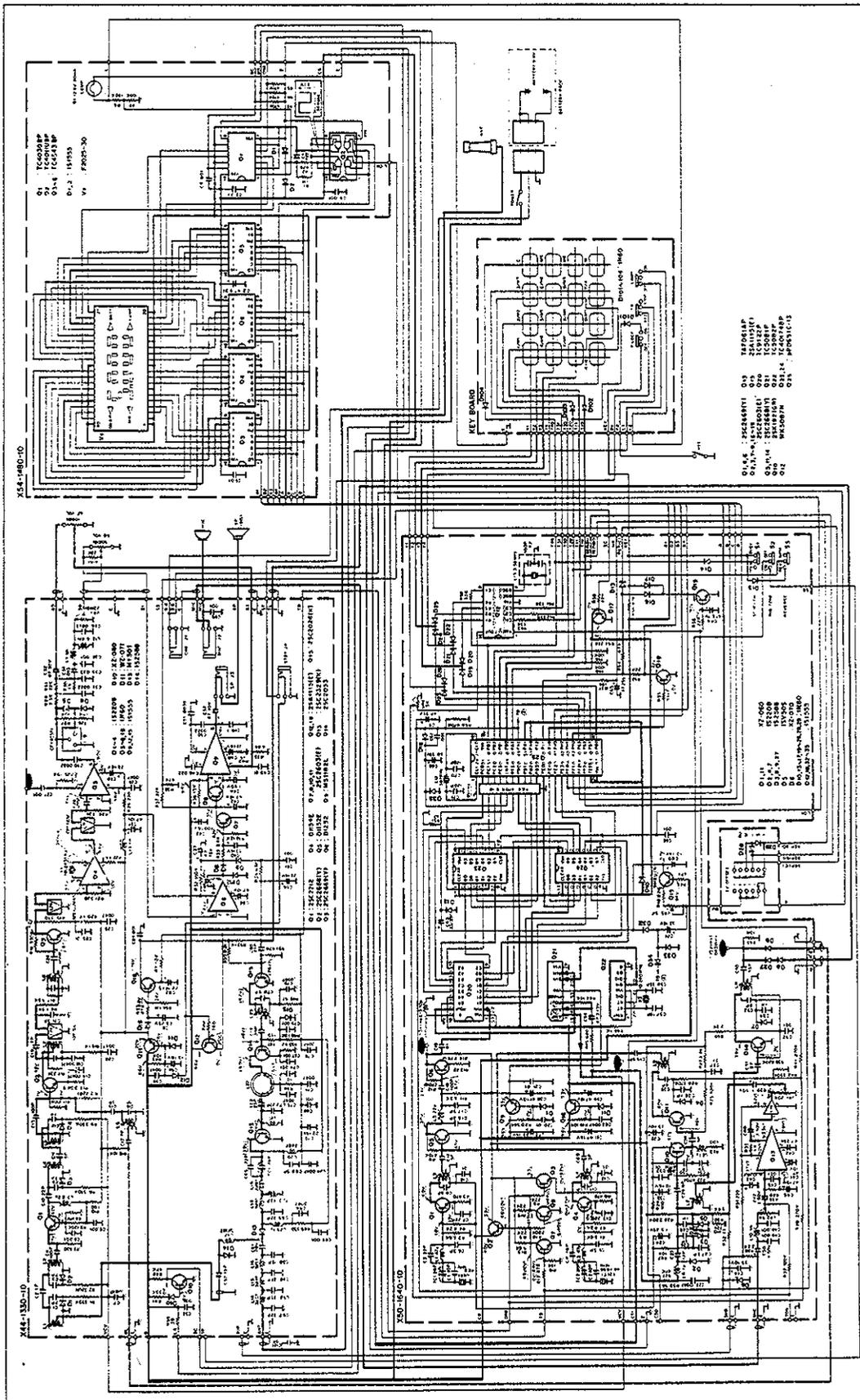


TR-2400

SCHEMATIC DIAGRAM (K type)

Voltage measure condition: no input signal, squelch on.  
 Power supply voltage: 9.6 V  
 MODE: S  
 Frequency: 145,000 MHz  
 Transmitter section: 50 Ω Load  
 Transmitter voltage ( ) :

Signal line  
 --- OSC & Control line  
 --- 8 line  
 --- Adjusting point



- 25C2712
- 25C2668
- 25C2669
- 25C2669
- 25C2026
- 25A1115E
- 25C2026
- 25C3329
- 25C2063
- 25C2603
- 25K192
- D1154E
- D1152E
- M511B2L
- TA7051AP
- TC5081P
- TC5081P
- D1252
- TC4030BP
- TC4030BP
- TC4017BP
- TC4643
- MK5087N
- TC9122P
- μP0651C-13

D1,4,6 : 25C4857T1  
 D1,4,7 : 25C4857T1  
 D1,4,8 : 25C4857T1  
 D1,4,9 : 25C4857T1  
 D1,4,10 : 25C4857T1  
 D1,4,11 : 25C4857T1  
 D1,4,12 : 25C4857T1  
 D1,4,13 : 25C4857T1  
 D1,4,14 : 25C4857T1  
 D1,4,15 : 25C4857T1  
 D1,4,16 : 25C4857T1  
 D1,4,17 : 25C4857T1  
 D1,4,18 : 25C4857T1  
 D1,4,19 : 25C4857T1  
 D1,4,20 : 25C4857T1  
 D1,4,21 : 25C4857T1  
 D1,4,22 : 25C4857T1  
 D1,4,23 : 25C4857T1  
 D1,4,24 : 25C4857T1  
 D1,4,25 : 25C4857T1  
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