REVISED EDITION

KENWOOD

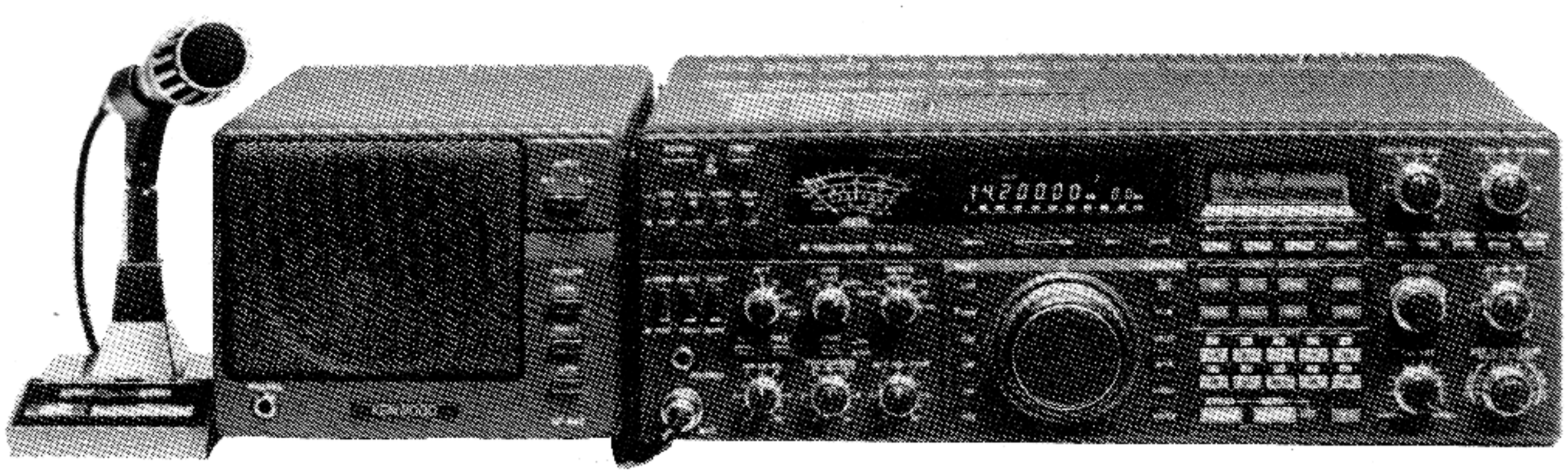
KB2LJJ
Radio Mods Database

SERVICE MANUAL

TS-940S

SP-940, AT-940, SO-1, VS-1

HF TRANSCEIVER



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TS-940S SPECIFICATIONS

[General]

Transmitter Frequency :
Range . . . . . 160m Band 1.8—2.0MHz
80m Band 3.5—4.0MHz
40m Band 7.0—7.3MHz
30m Band 10.1—10.15MHz (10.0MHz WWV)
20m Band 14.0—14.35MHz
17m Band 18.068—18.168MHz
15m Band 21.0—21.45MHz
12m Band 24.89—24.99MHz
10m Band 28.0—29.7MHz

Receiver Frequency :
Range . . . . . 150kHz—30MHz
Mode . . . . . A3J (USB, LSB), A1 (CW), F1 (FSK), A3 (AM), F3 (FM)
Frequency Stability . . . . . ±10 x 10^{-6} (0°C—+50°C)

Antenna Impedance with AT-940 antenna tuner . . . 50Ω
20—150Ω (Transmission only)
Power Requirement . . . . . 120/220/240 VAC, 50/60Hz
Power dissipation . . . . . Max. 510W during transmission, 80W during reception
Grounding . . . . . Negative
Dimensions . . . . . W401 x H141 x D350mm
W409 x H154 x D420mm (Projections Inc.)
W160.4 x H56.4 x D140 inch
W163.6 x H61.6 x D168 inch (Projections Inc.)
Weight . . . . . With antenna tuner : Approx. 20kg
Without antenna tuner : Approx. 18.5kg

[Transmitter]

Rated Final Power Input . . . . . 250W (160—15m bands in SSB, CW, FSK, FM)
250W (10m Band in SSB, CW, FSK, FM)
140W (in AM)
Modulation . . . . . SSB : Balanced, FM : Reactance, AM : Low level
Maximum Frequency Deviation . . . . . ±5kHz
RTTY Shift 170Hz
Carrier Suppression . . . . . —40dB or less (in CW)
Unwanted Sideband Suppression . . . . . Better than 50dB (with 1.5kHz modulation)
Third Harmonic Modulation Distortion . . . . . —31dB or less (based on single tone output)
Microphone Impedance . . . . . 500Ω—50kΩ
Frequency Response . . . . . 400—2600Hz at —6dB in SSB

[Receiver]

Circuitry . . . . . Quadruple conversion for SSB, CW, AM, FSK, Triple conversion for FM
Intermediate Frequencies . . . . . 1st IF : 45.05MHz, 2nd IF : 8.83MHz
3rd IF : 455kHz, 4th IF : 100kHz

Sensitivity :
150kHz—500kHz . . . . . 10dB S/N 10dBμ (1μV) or less in SSB, CW and FSK
10dB S/N 10dBμ (10μV) or less
500kHz—1.8MHz . . . . . 10dB S/N 12dBμ (4μV) or less in SSB, CW and FSK
10dB S/N 30dBμ (32μV) or less in AM
1.8MHz—30MHz . . . . . 10dB S/N —14dBμ (0.2μV) or less in SSB, CW and FSK
10dB S/N 6dBμ (2μV) or less in AM
12dB SINAD —6dBμ (0.5μV) or less in FM
Squelch Sensitivity . . . . . —10dBμ (0.32μV) or less
Image Ratio . . . . . 80dB or more in 1.8—30MHz
IF Rejection . . . . . 70dB or more in 1.8—30MHz
Selectivity :
(SSB, CW, AM (N), FSK) . . . . . 2.4kHz or more/—6dB, 3.6kHz or less/—60dB
(AM (W)) . . . . . —6kHz or more/—6dB, 18kHz or less/—50dB
(FM) . . . . . 12kHz or more/—6dB, 24kHz or less/—60dB

Variable Range with SSB filter :
(SSB Slope Tune) . . . . . High-cut : 1500Hz or more, Low -cut : 700Hz or more without SSB filter
(CW VBT) . . . . . 600Hz—2.4kHz variable continuously
RIT/XIT Variable Range . . . . . ±9.99kHz
Notch Filter Attenation . . . . . 40dB or more
Audio Output . . . . . 1.5W (at 8 ohm load/10% distortion)
Audio load Impedance . . . . . 8 ohms

Note : Circuits and ratings subject to change without notice due to developments in technology.

CIRCUIT DESCRIPTION

Item \ Model	TS-940S								TS-94X		REF'
DISTINATION	K1	K2	M1	M2	T1	T2	W1	W2	X1	X2	
CODE	11	12	21	22	51	52	61	62	71	72	
AT-940	W	W/O	W	W/O	W	W/O	W	W/O	W	W/O	W : with, W/O : without
AC INPUT	120V		220V		240V		220V		240V		Selectable. 120–220–240V
BRAND NAME	KENWOOD				TRIO		KENWOOD				

Note : 1) K1;K2 : USA M1,M2 : General T1,T2 : United Kingdom W1,W2 : Europe X1,X2 : Australia/Newzealand

Table 1

Frequency configuration

The TS-940 is quadruple conversion in SSB, CW, AM and FSK modes and triple conversion in FM mode. As a transmitter, it is double conversion in CW and FM modes and triple conversion in SSB, AM and FSK modes.

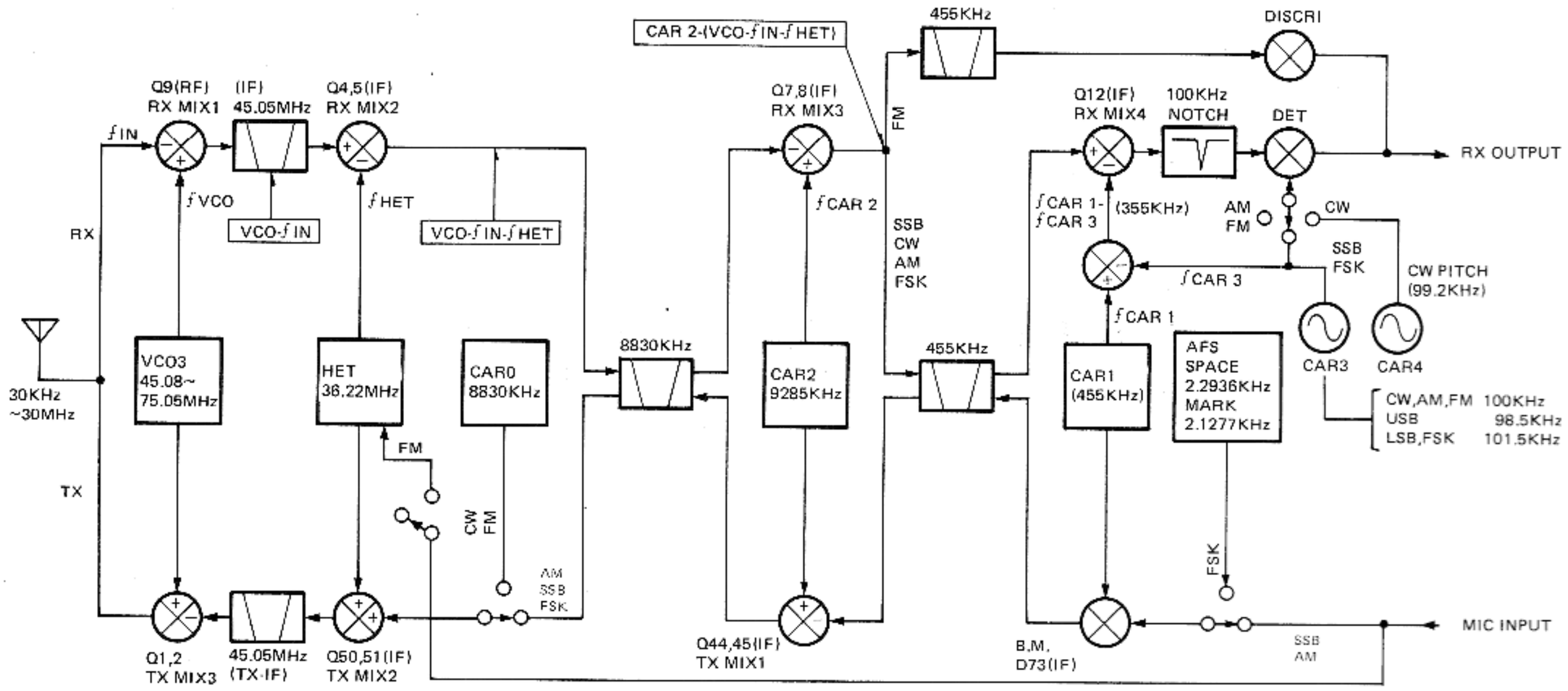


Fig. 1 TS-940S signal channel

Fig. 1 shows the frequency configuration of the signal channels as both a transmitter and a receiver. The receiver frequency in SSB mode will be described now. It is assumed that the input frequency entered from the antenna is fIN' the local oscillator input of RX MIX1 is fVCC' the local oscillator input of RX MIX2 is fHET' the local oscillator input of RX MIX3 is fCAR2 and the local oscillator input of RX MIX4 is fCAR1 – fCAR3.

When the receiver output tone frequency by fIN is zerc beat (namely, at zero to the SSB signal with a carrier point of fIN), the relationship between these signals is expressed by the following equation.

$$\left[f_{CAR2} - \left\{\underbrace{(f_{VCO} - f_{IN})}_{MIX1} - f_{HET}\right\}\right] - (f_{CAR1} - f_{CAR3}) = f_{CAR3}$$

MIX2

MIX3

MIX4

CIRCUIT DESCRIPTION

The equation is arranged as follows.

$$fIN = fVCO - fHET + fCAR1 - fCAR2 \quad \cdots\cdots\cdots (1)$$

The term fCAR3 is eliminated as it is not related to the receiver frequency itself. As for the remaining terms, all are generated in the PLL (Phase Locked Loop) circuit in the configuration shown in **Fig. 2**. The frequencies generated are now examined for each loop.

In VCO0 $\quad \dfrac{f_{VCO0}}{N0} = \dfrac{\frac{1}{2} \cdot f_{STD}}{500}$

$$\therefore f_{VCO0} = \frac{N0}{1000} \cdot f_{STD} \quad \cdots\cdots (2)$$

In VCO1 $\quad \dfrac{f_{VCO1}}{N1} = \dfrac{\frac{1}{4} \cdot f_{STD}}{500}$

$$\therefore f_{VCO1} = \frac{N1}{2000} \cdot f_{STD} \quad \cdots\cdots (3)$$

In VCO2 $\quad \dfrac{f_{VCO2} + \frac{f_{VCO4} + f_{VCO5}}{10} - \frac{f_{VCO1}}{100}}{N2} = \dfrac{\frac{1}{2} \cdot f_{STD}}{500}$

$$\therefore f_{VCO2} = \frac{N2}{1000} \cdot f_{STD} + \frac{f_{VCO1}}{100} - \frac{f_{VCO4}}{10} - \frac{f_{VCO5}}{10} \quad \cdots\cdots (4)$$

In VCO3 $\quad \dfrac{\frac{f_{VCO2}}{10} + f_{STD} + 3 \cdot f_{STD} - f_{VCO3}}{N3} = \dfrac{\frac{1}{2} \cdot f_{STD}}{20}$

$$\therefore f_{VCO3} = \frac{160 - N3}{40} \cdot f_{STD} + \frac{f_{VCO2}}{10} \quad \cdots\cdots (5)$$

In VCO4 $\quad \dfrac{f_{VCO4}}{N4} = \dfrac{f_{CP}}{1800}$

$$\therefore f_{VCO4} = \frac{N4}{1800} \cdot f_{CP} \quad \cdots\cdots (6)$$

In VCO5 $\quad \dfrac{f_{VCO5}}{N5} = \dfrac{f_{VB}}{1800}$

$$\therefore f_{VCO5} = \frac{N5}{1800} \cdot f_{VB} \quad \cdots\cdots (7)$$

The above equations are thusly arranged so the frequencies of each local oscillator are expressed as follows.

$$f_{VCO} = \left(\frac{160 - N3}{40} + \frac{N2}{10000} + \frac{N1}{2000000}\right) f_{STD} - \frac{N4}{180000} \cdot f_{CP} - \frac{N5}{180000} \cdot f_{VB} \quad \cdots\cdots (8)$$

$$f_{HET} = f_{VCO0} = \frac{N0}{1000} \cdot f_{STD} \quad \cdots\cdots (9)$$

$$f_{CAR1} = \frac{1}{100} \cdot f_{VCO4} = \frac{N4}{180000} \cdot f_{CP} \quad \cdots\cdots (10)$$

$$f_{CAR2} = \frac{1}{2} \cdot f_{STD} - \frac{1}{100} \cdot f_{VCO5} = \frac{1}{2} \cdot f_{STD} - \frac{N5}{180000} \cdot f_{VB} \quad \cdots\cdots (11)$$

$$f_{CAR3} = f_{CAR2} - f_{CAR1}$$

$$= \frac{1}{2} \cdot f_{STD} - \frac{N5}{180000} \cdot f_{VB} - \frac{N4}{180000} \cdot f_{CP} \quad \cdots\cdots (12)$$

Therefore, the term "fIN" of equation (1) is re-written as follows.

$$f_{IN} = \left(\frac{160 - N3}{40} + \frac{N2}{10000} + \frac{N1}{2000000} - \frac{N0}{1000}\right) \cdot f_{STD} \quad \cdots\cdots (13)$$

As shown in equation (13), the receiver frequency is determined only by the reference fSTD and the dividing ratio N0—N3. This shows the following.

1. N is the numeric value determined by the microprocessor in accordance with the operating frequency and, essentially, does not include an error component.
2. With the primary term of fSTD only, the reference frequency accuracy is directly considered as an operating frequency accuracy.
3. The operating frequency does not change even if N4, N5, fCP and fVB change.

The accuracy of the reference crystal oscillator used in the TS-940 is 10PPM (-10 ~ +50°C). It is 0.5PPM (-10 ~ + 50°C) when the optional TCXO (Temperature Compensated Crystal Oscillator) S0-1 is used.
According to 1 and 2, the overall accuracy of the TS-940 is highly stable with the same value as described above obtainable at any point in the 30kHz-30MHz range. Utilizing the characteristic of 3 above, the TS-940 has variable bandwidth functions such as VBT and slope tuning controlled by the microprocessor, which operates N4 and N5. At the same time, the TS-940 sets the carrier point by making fine adjustment of fCP and adjusts the initial setting of VBT by making fine adjustment of fVB.

CIRCUIT DESCRIPTION

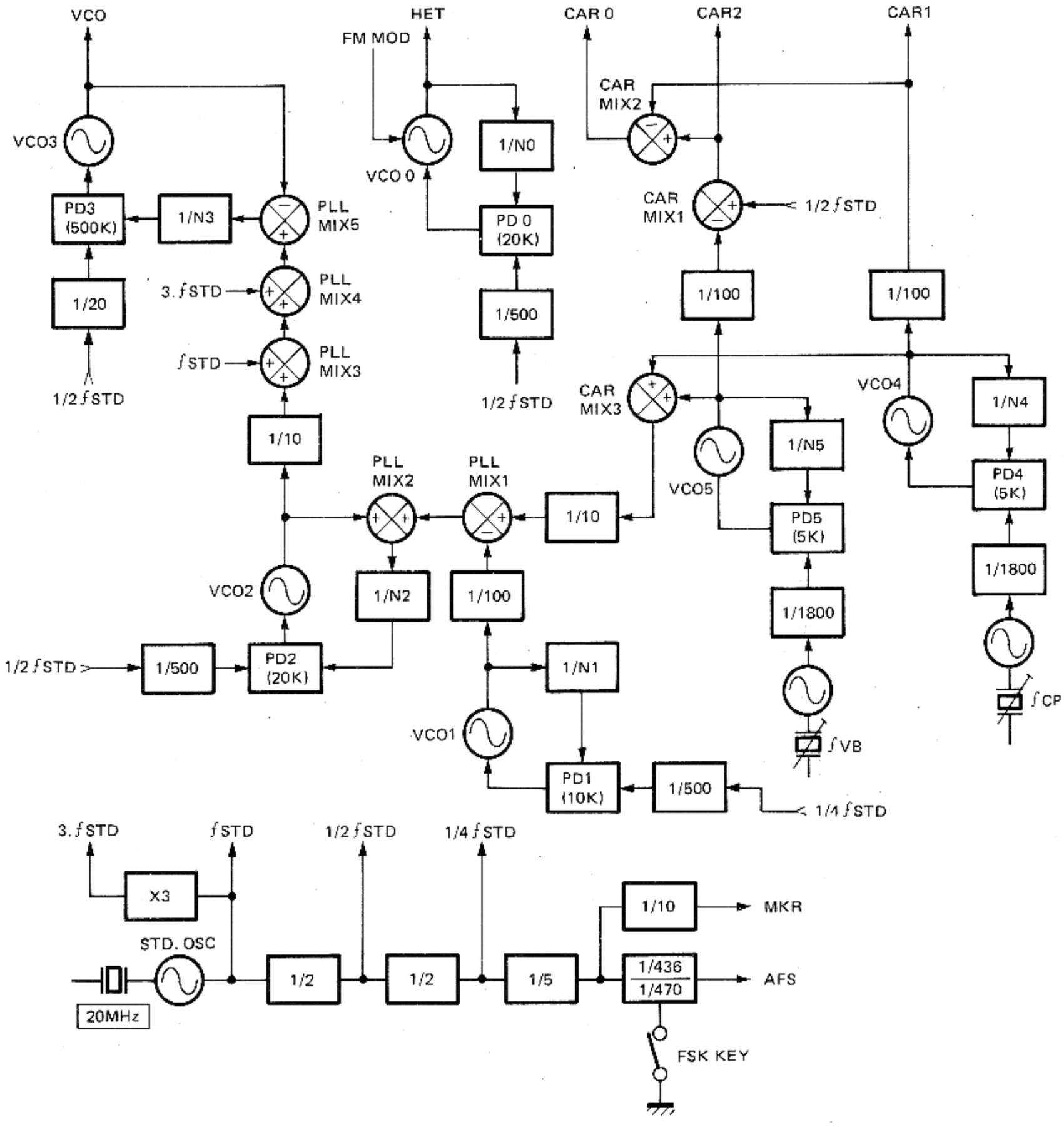


Fig. 2 TS-940S PLL channel

The receiver frequency in SSB mode has been described. In other modes or when used as a transmitter, likewise, the frequency is determined by the reference fSTD and dividing ratio.
The display frequencies are as shown in the following table.

USB, LSB	Carrier point frequency
CW	Transmission carrier frequency
AM, FM	IF filter center frequency
FSK	Space transmitter frequency

Table 2 Display frequency in each mode

CIRCUIT DESCRIPTION

In CW mode, the TS-940 receiving pitch can be changed to the required frequency while the desired signal remains in the center of the IF filter passband. (Variable CW pitch system)
The receiving pitch is interlocked and varies with the transmitter CW side tone. It is thus possible to immediately zero-beat by receiving the desired signal at the same pitch as the side tone. FSK transmission is executed in LSB mode. The audio signal made by dividing the reference frequency (space = $\frac{fSTD}{8720}$ ≒ 2.2936kHz, mark ≒ $\frac{1}{9400}$ = 2.1277kHz) is used as the AFSK (Audio Frequency Shift Keying) signal.

In FSK mode, unlike the operation in LSB mode, the IF is shifted (the dividing frequency N4 is shifted) for both transmission and reception so that the signal at 2.2936kHz/2.1277kHz passes through the center of the IF filter. The fVCO1 is shifted, since the display frequency is the space transmitter frequency. (The dividing ratio N1 is shifted.)
FM transmission is obtained in this system by modulating the fHET by applying the audio signal from the microphone to the VCO0.
The specifications of each frequency element are as follows.

fSTD	20MHz		Standard : ±10PPM (-10°C~+50°C) max. SO-1 mounted : ±0.5PPM (-10°C~+50°C) max.
fCP	9MHz±ΔCP		ΔCP = Carrier point adjustment component
fVB	9MHz±ΔVB		ΔVB = VBT initial setting adjustment component
	Dividing ratio		
N0	1811		
N1	10000-10999		Applicable to the display frequency 0.00kHz-9.99kHz + 229 added in FSK mode.
N2	2310-2555		Applicable to display frequencies 000.00-490.00kHz and 500.00-990.00kHz. (Only the integer multiple of 5 is used.)
N3	77-17		Applicable to every multiple of 500kHz within 30kHz-30MHz.
N4	9100 + (Mode shift)±Δ4		Δ4 = Variable band
	USB	−30	AM-W, N 0
	LSB	+ 30	FM 0
	CW-W	−14	FSK-W, N + 44
	CW-N	0	
N5	14300±Δ5		Δ5 = Variable band

Local oscillator

PLL Circuit

This is a digital VFO (Variable Frequency Oscillator) to cover a frequency range of from 45.08MHz-75.05MHz in 10Hz steps, in accordance with the TS-940s operating frequency of 30kHz-30MHz. Five PLL loops are linked in analog mode. The dividing ratio data to each PLL is controlled by the microprocessor.

Each loop is of a single crystal frequency control system : the VCO phase is compared with the unique reference frequency fSTD · CAR1 and CAR2 frequencies are inserted halfway in the analog link, enabling variable bandwidth functions such as VBT and slope tuning.
Operation of the PLL circuit is explained with reference to **Fig. 3** "PLL block diagram"

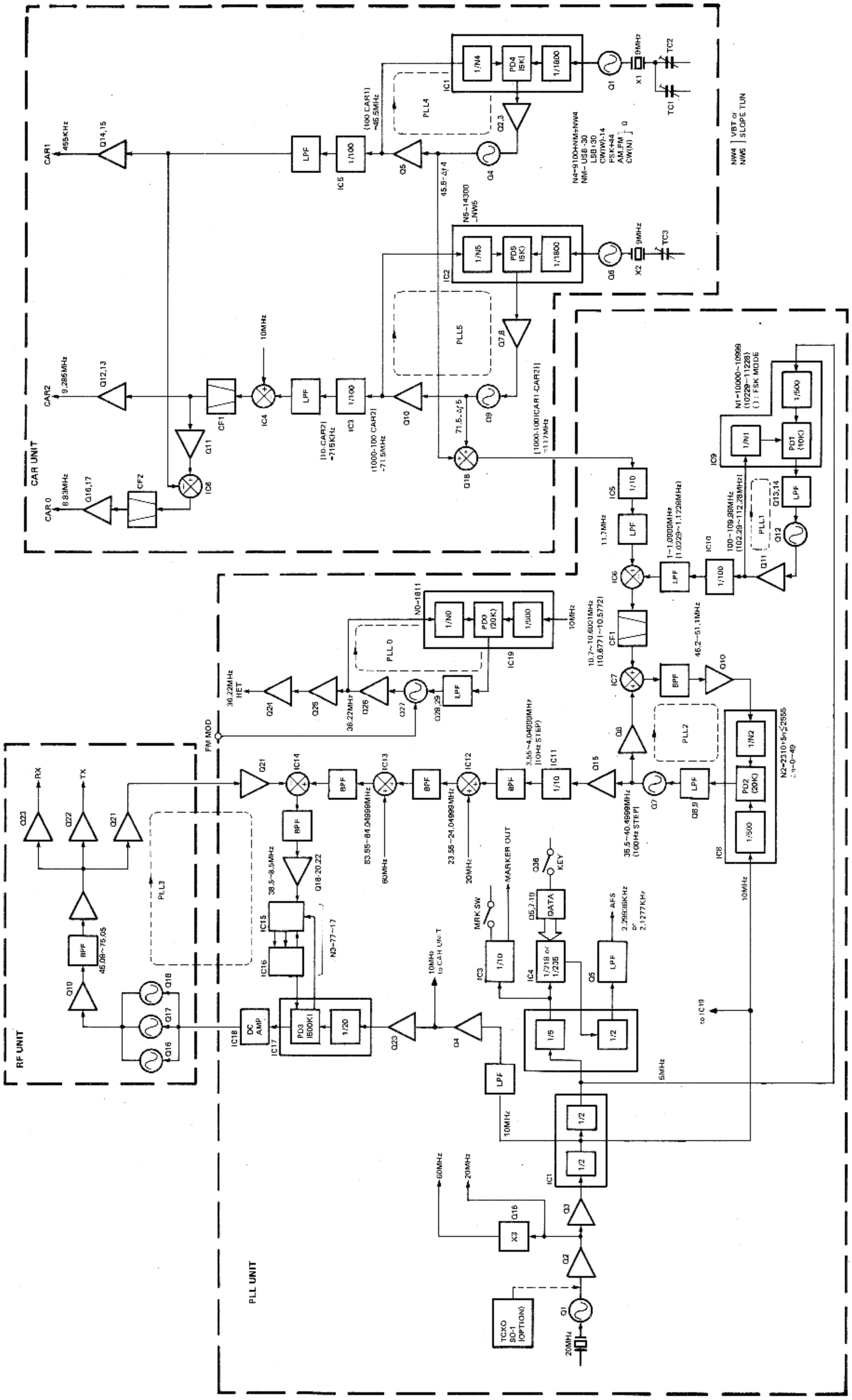


Fig. 3 PLL block diagram

CIRCUIT DESCRIPTION

The PLL-1 consists mainly of IC9 : MN6147. VCO1 of Q12 : 2SC2668 is locked in the 100-109.99MHz range. The 1/4 fSTD (5MHz) signal is supplied from the reference signal generator to IC9, where it is divided to 1/500 and output as a 10kHz comparison frequency.
The VCO1 output is applied to the same IC9 via buffer amplifier Q11, where it is divided to 1/N1. The signal is then coupled to the phase comparator, where it is compared with the above 10kHz signal, and the output locks PLL-1 in 10kHz steps.
As N1, the 1000 steps (10000-10999) of dividing data equivalent to the low order 9.99kHz width of the operating frequency is sent from the digital A unit to the PLL unit as a 4 bit serial data stream. A microprocessor is used for this data sending operation. (DA0-DA3, CK1) In FSK mode, as the space frequency is used as an operating frequency, N1 is shifted to 10229-11228.
The PLL-1 output is divided to 1/100 by IC10 : M54459L and becomes a signal of 1MHz-1.0999MHz (1.0229-1.1228MHz in FSK mode) in 100Hz steps. This signal sent from the PLL-1 channel to IC6 : SN16913P, i.e., the signal sent from the PLL-1 channel to IC6 is :

$$\frac{f_{VCO1}}{100}=\frac{1}{100}\times\frac{N1}{500}\times\frac{1}{4}\cdot f_{STD}=\frac{N1}{200000}\cdot f_{STD} \quad \cdots\cdots(1)$$

On the other hand, the fVCO4 + fVCO5 signal (approx. 117MHz) is sent from the carrier unit to PLL unit. This signal is divided to 1/10 by IC5 : HD10551 and applied to the mixer IC6. This signal is expressed by the equation :

$$\frac{1}{10}\cdot(f_{VCO4}+f_{VCO5})=\frac{1}{10}\left\{100\cdot f_{CAR1}+100\left(\frac{1}{2}f_{STD}-f_{CAR2}\right)\right\}$$

$$=5\cdot f_{STD}+10f_{CAR1}-10f_{CAR2} \quad \cdots\cdots(2)$$

It becomes a signal of approx. 11.7MHz. Therefore, IC6 output becomes a signal of approx. 10.65MHz expressed by :

$$5f_{STD}+10f_{CAR1}-10f_{CAR2}-\frac{N1}{200000}\cdot f_{STD} \quad \cdots\cdots(3)$$

Any mixer spurious is eliminated by ceramic filter CF1 : SFJ10.7MA-D and applied to the next PLL-2 loop. PLL-2 consists mainly of IC8 : MN6147, which locks the output signal of mixer IC7 : SN16913P, which is the VCO2 output of Q7 : 2SC2668 and the signal from CF1, in the range of 46.2-51.1MHz. The 1/2 fSTD (10MHz) signal is supplied from the reference frequency generator to IC8, where it is divided to 1/500 to make a comparison frequency of 20 kHz. The VCO2 output is applied to mixer IC7 via buffer amplifier Q6 : 2SC2668 and added to the signal (the configuration of equaion (3) ÷ 10.65MHz) from CF1, and this output is sent to IC8 via a BPF (Band Pass Filter) and amplifier Q10 : 2SC2668.

This signal is divided to 1/N2, compared in phase with the above 20kHz signal and used to control VCO2. This operaiton is expressed by :

$$\left(f_{VCO2}+5f_{STD}+10f_{CAR1}-10f_{CAR2}-\frac{N1}{200000}\cdot f_{STD}\right)$$

$$\times\frac{1}{N2}=\frac{1}{500}\times\frac{1}{2}f_{STD} \quad \cdots\cdots(4)$$

N2 means to cover the low order 500kHz width of the operating frequency in 10kHz steps and takes a numeric value of 50 steps which beocmes an integer multiple of 5 in the range 2310-2555. Like N1 in PLL-1, this data is sent by the microproceesor from the digital A unit to the PLL unit IC8 as a 4 bit serial data stream. (DA0-DA3, CK2) Therefore, the output signal of PLL-2 is expressed by the equation :

$$f_{VCO2}=\left(\frac{N1}{200000}+\frac{N2}{1000}-5\right)f_{STD}-10f_{CAR1}+10f_{CAR2} \quad \cdots\cdots(5)$$

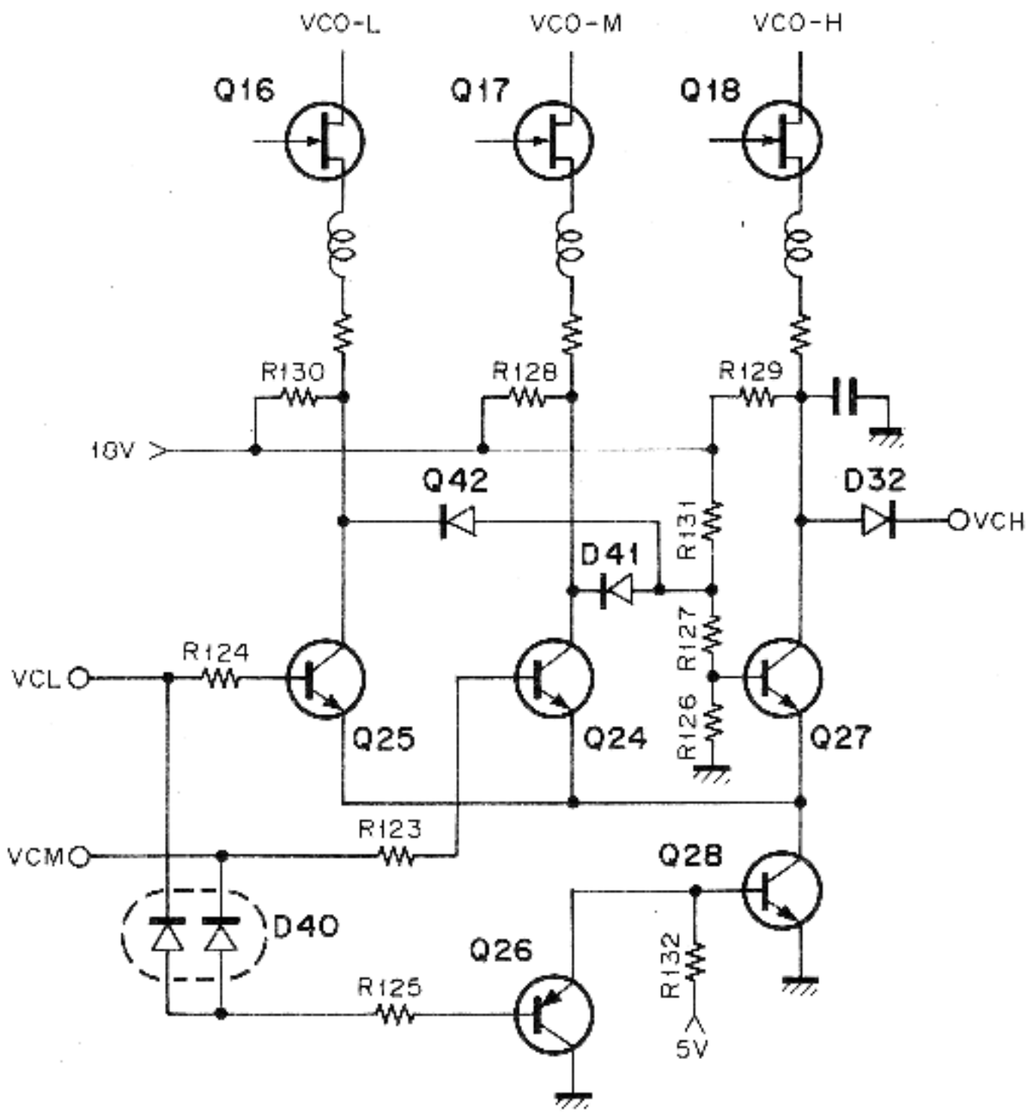
According to the values of N1 and N2, a frequency of 35.5-40.4999MHz is generated in 100Hz steps. The PLL-2 output is divided to 1/10 by IC11 : HD10551 via buffer amplifier Q15 : 2SC2668, and becomes a signal in 10Hz steps in the 3.55-4.04999MHz range.
First, fSTD (20MHz) is added in mixer IC12 : SN16913P and then, 3.fSTD (80MHz) is added in mixer IC13 : SN16913P and the signal is converted to 83.55-84.04999 MHz. As a result, 4.fSTD (80MHz) is added, but such a frequency configuration is employed in order to avoid unwanted mixer spurious components. This signal is applied to mixer IC14, where it is mixed with the final VCO output signal.

Item	Rating
Center frequency	D : 10.64MHz±30kHz (Black)
3dB band width	280±50kHz within
50dB bandwidth	750kHz or less
Insertion loss $20\cdot\log\left(\frac{E1}{2E2}\right)$	7±2dB within
Spurious attenuation	55dB or more at 9—13MHz
Input and output impedance	330Ω

Table 3 PLL ceramic filter (L72-0349-04) (PLL unit CF1)

CIRCUIT DESCRIPTION

The final VCO is located on the RF unit and consists of three elements : Q16 : 2SK192A handling the frequency below 9.5MHz, Q17 : 2SK192A for 9.5-19.5MHz and Q18 : 2SK192A for 19.5MHz–30MHz. Each VCO is selected by the VCO select information (VCM or VCL, VCH is derived) sent from the Digital A unit by the microprocessor. The VCO selector circuit is shown in **Fig. 4**.
The oscillator output runs through the buffer amplifier Q19 : 2SC1907 and the high frequency component is eliminated by a BPF. The signal runs through the buffer amplifier Q20 : 2SC1907 and is then separated into three channels of buffered output.The Q21 : 2SC2668 output is supplied to the PLL unit, composing a final PLL loop. The Q22 : 2SC1907 output is applied to the third transmitter mixer. From Q23 : 2SC1907, the VCO output is applied to the first receiver mixer via amplifier Q6 : 2SC2053.



Freq' (Hz)	VCO selected data VCM	VCL	Q25	Q24	Q27	VCO freq' (MHz)	VCH
30k–9.5M	L	H	O	X	X	45.08–54.55	H
9.5M–19.5M	H	L	X	O	X	54.55–64.55	H
19.5–30M	L	L	X	X	O	64.55–75.05	L

O : ON X : CUT OFF

Fig. 4 VCO selector circuit

The signal from the RF unit final VCO is connected to the PLL unit VCO terminal and is applied to mixer IC14 via buffer amplifier Q21 : 2SC2668. Therefore, the mixer output becomes :

$$\frac{f_{VCO2}}{10}+f_{STD}+3f_{STD}-f_{VCO}=\left(\frac{N1}{2000000}+\frac{N2}{10000}+\frac{7}{2}\right)f_{STD}$$
$$-f_{CAR1}+f_{CAR2}-f_{VCO} \cdots\cdots\cdots (6)$$

This signal goes through a BPF and is amplified by Q18, 19 : 2SC2668, Q20 : 2SC1907 and Q22 : 2SC2668 and then, waveform shaped by IC15-1/3 : SN74S10N and applied to 1/3 or 1/4 prescaler IC16 : SN74S112N. IC16 is originally a dual function flip-flop circuit and works as a 1/4 divider, but its function is changed to a 1/3 divides by the control signal from the later stage PLL IC17 : MC145158, i.e., a pulse swallow divider is composed of IC17 internal divider, IC16 and IC15-1/3.
PLL IC17, the primary element of the final PLL loop PLL-3, is provided with the modulus control function which externally sets both the reference dividing ratio and comparison dividing ratio by serial data, and composes a pulse swallow counter using an external prescaler.
The 1/2 fSTD (10MHz) signal is supplied from the reference frequency generator to IC16 via buffer amplifier Q23 : 2SC2668. The signal is divided to 1/20 in IC16 to make a comparison output frequency of 500kHz.
The signal supplied from IC14 to the swallow counter via the BPF and amplifier is divided to 1/N3 and compared in phase with the 500kHz signal in the phase comparator. This controls the RF unit final VCO by the error correction voltage.
The operaiton is expressed by :

$$\left\{\left(\frac{N1}{2000000}+\frac{N2}{10000}+\frac{7}{2}\right)f_{STD}-f_{CAR1}+f_{CAR2}-f_{VCO}\right\}\times\frac{1}{N3}$$
$$=\frac{1}{20}\times\frac{1}{2}f_{STD} \cdots\cdots\cdots (7)$$

N3 means to cover the overall operating frequency range (30kHz-30MHz) in 500kHz steps and becomes 60 steps of 77-17. This data is also sent by the microprocessor from the Digital A unit to the PLL unit as serial data. (PLD, PLE and CK3)
As a result, the final VCO output signal is expressed by :

$$f_{VCO}=\left(\frac{160-N3}{40}+\frac{N2}{10000}+\frac{N1}{2000000}\right)\cdot f_{STD}-f_{CAR1}+f_{CAR2} \cdots\cdots (8)$$

According to the values of N1, N2 and N3, a frequency of 45.08-75.05MHz is generated in 10Hz steps. If fCAR1 is expressed by N4 and fCP and fCAR2 by N5, fVB and fSTD' respectively, equation (8) becomes the same as equation (8) provided in "Frequency Configuration".

CIRCUIT DESCRIPTION

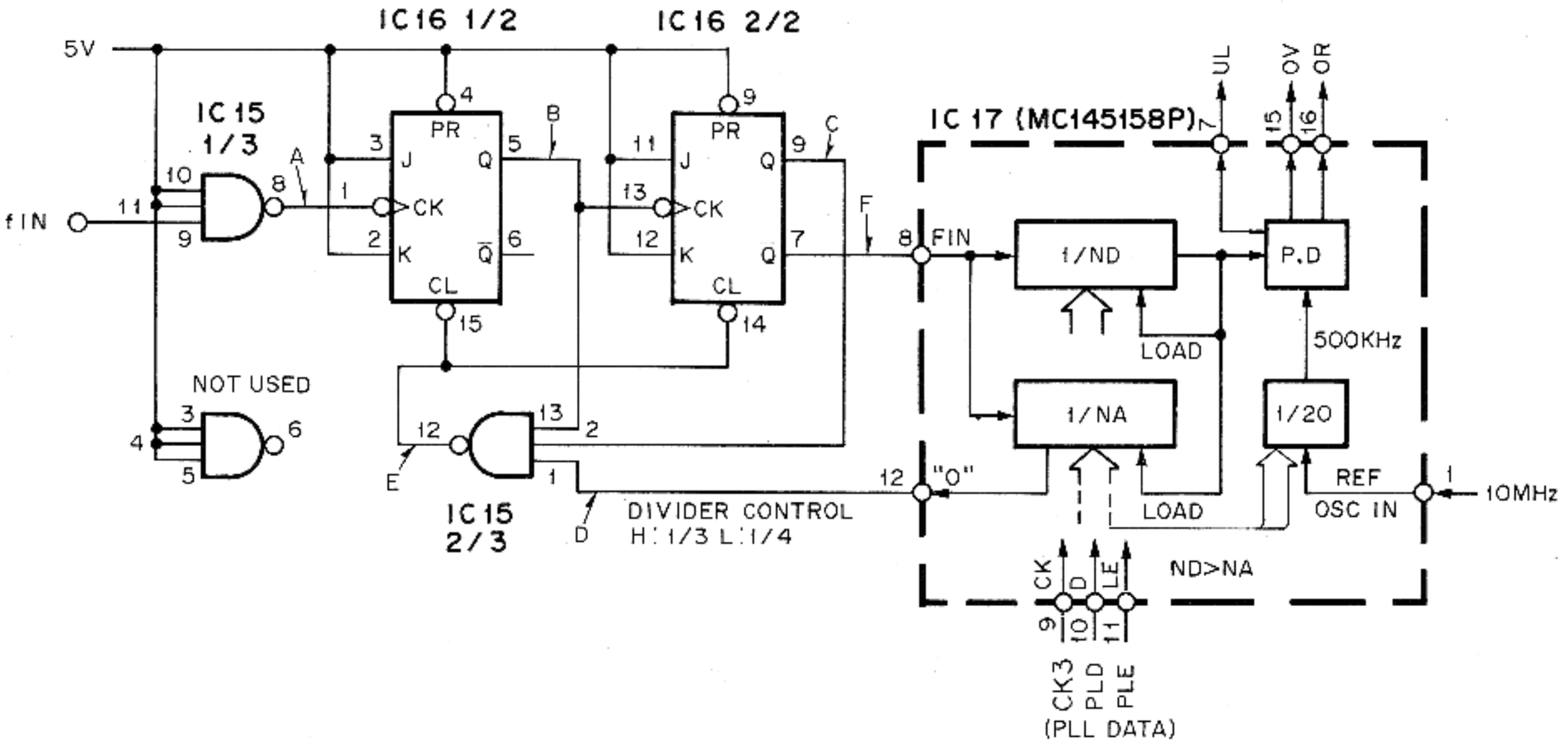


Fig. 5-A Pulse swallow divider circuit

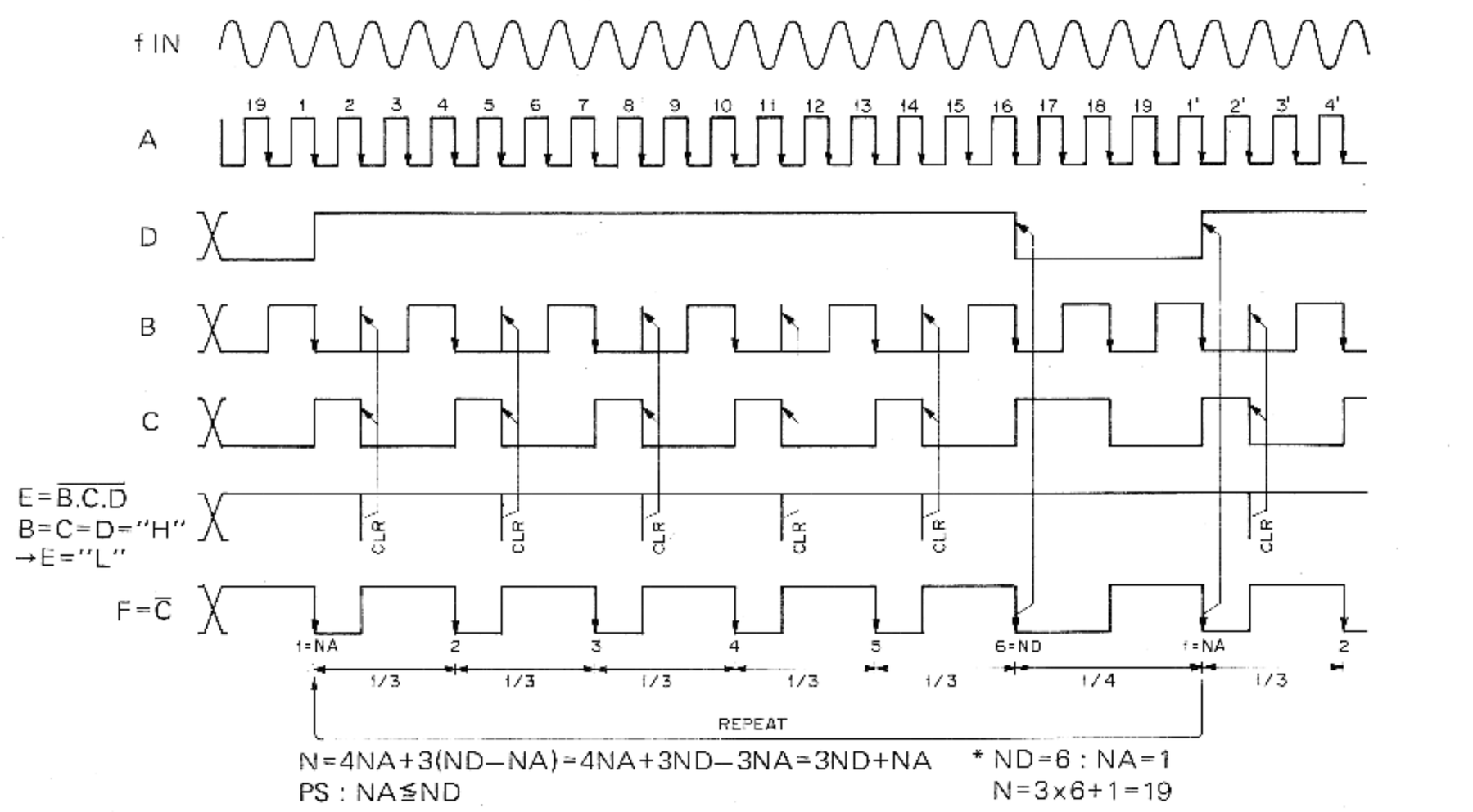


Fig. 5-B Pulse swallow divider timing chart (At 29.0—29.5MHz band, ND=6, NA=1)

- **HET (Heterodyne Oscillator)**

The HET oscillator is provided in the PLL unit, which is a PLL circuit (PLL-0) to generate a constant frequency signal of 36.22MHz. This output signal is connected to the IF unit and supplies the second transmitter/receiver mixer. In FM transmission mode, the audio signal from the micorphone is applied to this PLL to yield FM modulation.

PLL-0 consists mainly of IC19. VCO 0 is Q29 : 2SK129A, locked to 36.22MHz. A signal of 1/2 fSTD (10MHz) is supplied from the reference frequency generator to IC19, where it is divided to 1/500 to make a 20kHz comparison output frequency.

The oscillator output of VCO 0 is applied to IC19 via buffer amplifier Q26 : 2SC2668 and divided to 1/N0 (1/1811 constant) and the output is phase compared with the 20kHz reference signal in the phase comparator. This is used to lock the frequency of VCO 0. N0 (1811) is sent from the Digital A unit to the PLL unit. (DA0-DA3, CK0) The PLL-0 output is sent to the IF unit via buffer amplifiers Q25 : 2SC2668 and Q24 : 2SC1907 and an LPF (Low Pass Filter).

CIRCUIT DESCRIPTION

• CAR1

The CAR1 generator is provided in the digital B (CAR) unit, which makes a signal of approx. 45.5MHz on the basis of the 9MHz crystal oscillator and divides it to 1/100 in the PLL-4 circuit to generate a 455kHz signal. This signal is sent to the IF unit and mixed with the CAR3 signal to becomes a 355kHz signal. This is sent to the fourth receiver mixer in reception mode. In transmission mode, the signal is sent to the balanced modulator to generate a 455kHz DSB (Double Side Band) signal.

PLL-4 consists mainly of IC1 : MN6147. VCO4 (Q4 : 2SC2668) is locked to approx. 45.5MHz. A 9MHz signal is supplied from the f_{CP} oscillator Q1 : 2SC2787 to IC1 and divided to 1/1800 to make a 5kHz comparison output frequency. VCO4 output is applied to IC1 via buffer amplifier Q5 : 2SC2668 and divided to 1/N4, and the output is phase compared with the 5kHz signal and is then used to lock VCO4 in 5kHz steps. The output signal from PLL4 is divided to 1/100 by IC5 : M54459L to become a signal of approx. 455kHz in 50Hz steps. This passes through the LPF and is supplied from output buffer Q14/Q15 : 2SC2458 to the IF unit as the CAR1 signal.

The non-divided 45.5MHz signal is applied to the mixer Q18 : 3SK73, where the PLL-5 output (the base of CAR2 signal) is added to the signal, and the output is sent to the PLL unit to form a part of the digital VFO.

Thus, the operating frequency is not changed even if the CAR1 frequency is changed, i.e., f_{CP} and N4 are optional. When f_{CAR1} is changed, IF shift is effected in both transmission and reception modes. This characteristic is used to realize USB/LSB mode switching functions, variable bandwidth, fine adjustment of carrier point, centering CW/FSK signals in the IF bandpass, etc. Fine adjustment of carrier point is provided by trimmer capacitors TC1 (for USB) and TC2 (for LSB) connected to the f_{CP} crystal oscillator X1.

The other functions are executed by controlling N4 from the microprocessor. N4 is sent from the Digital A unit (a part of it is relayed by the PLL unit) as 4bit serial data. (A0-A3, CL4).

• CAR2

The CAR2 circuit is provided in the digital B (CAR) unit, which generates a signal of approximately 71.5MHz on the basis of the 9MHz crystal oscillator. This is divides to 1/100 in the PLL-5 circuit to generate a 9.285MHz signal. This signal is sent to the IF unit and used as a local oscillation signal for the third receiver mixer in reception mode, and that of the first transmitter mixer in transmission mode. PLL-5 consists mainly of IC2 : MN6147.

A 9MHz signal is supplied from the f_{VB} oscillator Q6 : 2SC2787 to IC1 and divided to 1/1800 to make a 5kHz comparison output frequency. The output of VCO5, Q9 : 2SC2668 is applied to IC2 via buffer amplifier Q10 : 2SC2668 and divided to 1/N5, and the output is compared in phase with the 5kHz signal and used to lock VCO5 to approx. 71.5MHz in 5kHz steps. The PLL-5 output signal is divided to 1/100 by IC3 : M54459L to become a signal of approx. 715kHz in 50Hz steps. It passes through a LPF and goes to IC4 : SN16913P, where it is mixed with 1/2 fSTD (10MHz) from the reference frequency generator to become the CAR2 signal at 9.285MHz. Any mixer spurious components within this signal are eliminated in ceramic filter CF1. The filtered signal is applied to the IF unit via buffer amplifier Q12/Q13 : 2SC2458. The 71.5MHz output signal from PLL-5 is applied to mixer Q18, where the PLL-4 output signal (the basis of the CAR4 signal) is added to the signal, and the output is sent to the PLL unit to form a part of digital VFO. Thus, like CAR1, the operating frequency is not changed even if the CAR2 frequency is changed, i.e., f_{VB} and N5 are optional.

However, if the f_{CAR2} is changed, IF shift is effected across the 8.83MHz filter (the second receiver IF filter) in both transmission and reception. (When the f_{CAR2} is changed, the 455kHz filter is not shifted.) This characteristic is used to realize the variable bandwidth function.

Initialization of the VBT (Variable Bandwidth Tuning) adjustment (making the band center frequencies of the 8.83MHz and 455kHz filters the same) is performed by trimmer capacitor TC3 connected to the f_{VB} crystal oscillator X2. The actual variable bandwidth function is realized by controlling N5 by the microprocessor. N5 is sent from the Digital A unit as A0-A3, and CL5 data.

Mode	N4 Normal	SLOPE TONE or CW VBT : MAX	CAR/FREQ' (kHz)
USB	9070	→ 9039	453.50 → 451.95
LSB	9130	→ 9161	456.50 → 458.05
CW-W	9086	→ 9071	454.30 → 453.55
CW-N	9100	→ 9093	455.00 → 454.65
AM-W	9100	→ 9069	455.00 → 453.45
AM-N	9100	→ 9085	455.00 → 454.25
FM	9100	—	455.00 → —
FSK-W	9144	→ 9175	457.20 → 458.75
FSK-N	9144	→ 9151	457.20 → 457.55

Table 4 N4 data shift

Mode	N5 Normal	SLOPE TONE or CW VBT : MAX	CAR/FREQ' (kHz)
USB	14300	→ 14378	9285.00 → 9281.10
LSB	14300	→ 14222	9285.00 → 9288.90
CW-W	14300	→ 14362	9285.00 → 9281.90
CW-N	14300	→ 14315	9285.00 → 9284.25
AM-W	14300	→ 14362	9285.00 → 9281.90
AM-N	14300	→ 14330	9285.00 → 8293.50
FM	14300	—	9285.00 → —
FSK-W	14300	→ 14238	9285.00 → 9288.10
FSK-N	14300	→ 14285	9285.00 → 9285.75

Table 5 N5 data shift

CIRCUIT DESCRIPTION

• CAR0

CAR0 is a signal of approx. 8.83MHz, which is derived by subtracting CAR1 from CAR2 in mixer IC6 provided on the CAR unit. Any mixer spurious components generated by IC6 : SN16913P are eliminated by ceramic filter CF2. The signal is then applied to both the IF and Control units via Q16 : 2SC2787 and Q17 : 2SC2458.

The signal applied to the IF unit is used as a transmission carrier in the CW and FM modes. The signal applied to the Control unit is used as the demodulation carrier for the monitor circuit in the SSB and FSK modes.

Item	Rating
Nominal center frequency	9.285MHz
3dB Attenuation bandwidth	±50kHz or more at 9.285MHz
Guaranteed attenuation	45dB or more at 8.83MHz (−455kHz) 45dB or more at 9.74MHz (+ 455kHz) 40dB or more at 10.715MHz (+1430kHz)
Insertion loss $20 \cdot \log (\frac{E1}{2.2E})$	6dB or less
Ripple (within 3dB band)	1.0dB or less
Input and output impedance	330Ω
Voltage capacity	DC50V (1 minutes)

Table 6 CAR ceramic filter (L72-0350-05) (CAR unit CF1, IF unit CF3)

Item	Rating
Nominal center frequency	8.830MHz
3dB bandwidth attenuation	±50kHz or more at 8.830MHz
Guaranteed attenuation	35dB or more at 9.285MHz (+ 455kHz) 45dB or more at 9.74MHz (+ 910kHz)
Insertion loss $20 \cdot \log (\frac{E1}{2.2E})$	6dB or less
Ripple (3dB bandwidth)	1.0dB or less
Input and output impedance	330Ω

Table 7 CAR ceramic filter (L72-0351-05) (CAR unit CF2)

• CAR3

CAR3 on the IF unit generates three different frequencies depending on the mode (100kHz = CW, AM and FM, 98.5kHz = USB and 101.5kHz = LSB and FSK.) These are used as the BFO (Beat Frequency Oscillator) in the SSB and FSK modes, as a side tone generating carrier in the CW mode, and as a local oscillators signal for the fourth receiver mixer after being mixed with the CAR1 signal.

In CAR3, the tuning capacitors for each mode are selected by diode switches D69 and D70. Q33 : 3SK92A is the oscillator. The output is supplied from the CAR3 terminal to the side tone generator on the Control unit via buffer amplifier Q32 : 2SC2458, and at the same time, it is mixed with the CAR1 signal from CAR unit in mixer Q34 : 3SK73 to generate a local oscillator signal (fCAR1 − fCAR3) to be applied to the fourth receiver mixer. The output of Q32 is further applied to the SSB and FSK product detectors via buffer amplifiers Q31 and Q14 : 2SC2458.

• CAR4

CAR4 on the IF unit serves as a BFO dedicated to CW demodulation, and as a side tone generating carrier. The oscillator frequency is 99.2kHz, but it is varied by the CW PITCH control so the receiving pitch can be set to the desired frequency in the CW mode. The CAR4 signal is generated by Q16 : 2SK192A and is applied to buffer amplifier Q15 : 2SC2458. The output is supplied from the CAR4 terminal to the Control unit generator side tone and, at the same time, it is applied to buffer amplifier Q14 via diode switches D34 and D68 and connects to the CW detector.

• Reference frequency generator

The reference frequency fSTD' the frequency control base of the TS-940, is generated by the 20MHz crystal oscillator X1 and Q1 : 2SC2668 on the PLL unit, and further applied to buffer amplifier Q2 : 2SC2787. X1 and Q1 are replaceable by the optional TCXO (Temperature Compensated Crystal Oscillator) SO-1.

The output of Q2 is used as the 20MHz fSTD as is. It is also multiplied three times to provide 60MHz 3fSTD. Further, it is divided to 1/2 by half of IC1 : SN74LS73AN to provide 10MHz 1/2 fSTD. This 1/2 fSTD is supplied to the CAR unit via buffer amplifier Q4 : 2SC2787 as well as being used in the PLL unit. The 1/2 fSTD is further divided to 1/2 by the other half of IC1 to provided a 5MHz 1/4 fSTD.

• AFSK signal and marker signal

A part of the 5MHz (1/4 fSTD) signal generated by the PLL unit frequency generator reference is applied to 1/5 divider IC2 : SN74LS90N to provide a 1MHz (1/20 fSTD) signal. This signal is applied to programmable divider IC4 : MC14569BCP. The dividing ratio of this IC is switched between 218/235 interlocked with the FSK key SPACE/MARK setting. The output of IC4 returns to IC2, passes through the 1/2 divider, establishes a 50% duty cycle and is then sent to the microphone amplifier circuit of the IF unit via active LPF Q5 : 2SA1115, where it is converted to an FSK modulation signal.The total dividing ratio is 1/8720 fSTD (2.2936kHz) in SPACE and 1/9400 fSTD (2.1277 kHz) MARK. The shift width is 165.9Hz, which is a slight deviation from the standard value, but no problem in practical use.

The carrier frequency and shift width during transmission are the same in accuracy as fSTD' and are very stable. In modes other than FSK, IC4 stops operation and thus, an AFSK signal is not output.

The marker signal chain divides the 1MHz (1/20 fSTD) signal from the preceding stage IC2 to 1/10 through IC3 : SN74LS90N to generate 100kHz signals (1/200 fSTD). When the marker switch is off, IC3 is reset and the operation is stopped.

CIRCUIT DESCRIPTION

Receiver

The signal received through the antenna is applied to the RF unit (X44-1660-00) ANT terminal. The signal passes through the transmitter/receiver selector circuit and goes out from the EXT terminal. The output is connected to the RF unit RXA terminal via the selector circuit provided on the rear panel. This signal is applied to the receiver BPF through the RF attenuator (0, 10, 20, or 30dB selectable) via relays RL1 and RL2. The BPF divides the received frequency range (up to 30MHz) into nine bands, which are automatically selected by RX BPF control data (RB0–RB3) from the Digital A unit (X54-1830-00).

Received freq' (MHz)	RX BPF select data				RX BPF
	RB0	RB1	RB2	RB3	
– 0.5	0	0	0	0	A
0.5– 1.5	1	0	0	0	B
1.5– 3	0	1	0	0	C
3 – 4	1	1	0	0	D
4 – 7	0	0	1	0	E
7 – 8.5	1	0	1	0	F
8.5–14	0	1	1	0	G
14 –20	0	0	0	1	H
20 –30	1	1	1	0	I

Table 8 Selection of RX BPF

The signal from the BPF runs through the RF AGC circuit composed of PIN diodes D23 and D26 : MI204. It is then amplified by RF amplifier comprising Q10 : 2SK125 pair and applied to the first receiver mixer Q9 : 2SK125 pair, where it is mixed with the VCO signal, and the output is converted to the first IF signal at 45.05MHz. This signal is applied to the grounded gate post amplifier Q7, 8 : 2SK125, and the output is applied from the RIF terminal to IF unit (X48-1430-00).

The unwanted signal components are eliminated from the 45.05MHz first IF signal when it passes through the MCF XF1 with 15kHz bandwidth. The signal is then applied to the second receiver mixer Q4 and Q5 : 2SK125, mixed with the HET signal (36.22MHz) and converted to the second IF signal (8.83MHz). This signal is separated into two channels : one is supplied to the noise blanker on the Control unit (X53-1420-11), and the other is applied to the second IF signal filter circuit via the noise blanking gate comprised of diodes D3—D6 : 1S1587.

This filter circuit is provided with crystal filter XF2 : YK-88S1 with a 2.7kHz bandwidth for SSB (used also for wide CW/FSK and narrow AM), and wide band LC filters L37, L38 for FM (used also for wide AM when the optional AM filter is not provided.) As an option, the filter circuit permits use of two kinds of filters : a YK-88C-1 with 500Hz bandwidth for CW and a YK-88A-1 with 6kHz bandwidth for AM. These four filters types are automatically selected by the W/N-mode information (WN, ND2 and MD1) from the Digital A unit via the keyboard.

MODE	W/N SWITCH	WN	MD2	MD1	2nd IF	3rd IF
SSB	W	0	0	0	2.7kHz	2.7kHz
	N	1	0	0	2.7kHz	2.7kHz
CW, FSK	W	0	0	1	2.7kHz	2.7kHz
	N	1	0	1	2.7kHz (Option : 500Hz)	2.7kHz (Option : 500Hz or 250Hz)
AM	W	0	1	1	Wide band (Option : 6kHz)	6kHz
	N	1	1	1	2.7kHz	2.7kHz
FM	W	0	1	0	Wide band	* 6kHz
	N	1	1	0	Wide band	* 6kHz

* : 12kHz B.W IF Filter used in FM mode.

Table 9 Selection of filters

The received signal, having passes through the second IF filter, is applied to the third receiver mixer Q7,8 : 3SK73 to be mixed with the CAR2 signal (9.285MHz) and then converted to the third IF signal (455kHz). The output is then separated into two channels. One is connected to the Control unit FIN terminal, goes through IF amplifier Q45 : 2SC2787 and third IF filter CF1 : CFV455F. It is then applied to limiter amplifiers IC11 and IC12 : μPC577H for amplitude limiting, and the output is applied to ceramic discriminators L12 : CFY455S for FM detection. The detected output is supplied from the FMV terminal to the IF unit for the FM mode signal via the de-emphasis circuit and, at the same time, the noise component near 40kHz is eliminated. The signal is then connected to the squelch circuit, noise amplifier Q46 and Q47 : 2SC2458, noise rectifier D80 and D81 : 1SS33 and the comparator consisting of IC13 2/2 : NJM4558S.

The above Control unit circuits function not only in the FM mode, but in all modes. Therefore, one noise squelch system is employed in all modes. The squelch control output mutes the IF unit audio amplifier via the MTU terminal. (IF unit Q28)

The third IF signal is amplified by Q10 : 3SK73 on the IF unit and is then applied to the filter circuit as the third IF signal.

This filter circuit is provided with ceramic filter CF1 : CFJ455K12 with a 2.7kHz bandwidth for SSB (used also for wide CW/FSK and narrow AM) and ceramic filter CF2 : CFW455HT with a 6kHz bandwidth for AM wide. As an option, the filter circuit provides for use of either a CW 500Hz crystal filter : YG-455C-1 or 250Hz : YG-455CN-1 bandwidth filter. These three filter types are automatically selected by information from the Digital A unit, like the second IF filters. For selection operaton data, refer to Table. 1. The signal from the third IF filter is amplified by Q11 : 3SK73 and applied to the fourth receiver mixer to be mixed with the 355kHz (CAR1—CAR3) signal and converted to the fourth IF signal. The output is applied to Q13 : 3SK73 via the notch filter circuit. This amplifier output is detected by either the SSB/CW product detector or the AM detector. The detected signal is applied to AF GAIN control via the squalch gate Q28 : 2SC2458 and preamplifier Q29 : 2SC2459. In CW mode, it is also possible to pass the signal through the AF TUNE circuit, IC1 and IC2 :

CIRCUIT DESCRIPTION

BA718. The output of Q3 is also applied to the AGC circuit. The received AF signal from the AF GAIN control is applied to the Control unit, where it is amplified by the audio power amplifier IC15 : HA1368 and used to drive the speaker.

Item	Rating
Nominal center frequency (fo)	45.050kHz
Passband width	±7.5kHz or more at 6dB
Attenuation bandwidth	30dB or more at fo±25kHz 60dB or more at fo±150kHz Spurious level : 20dB or more
Guaranteed attenuation	60dB or more within fo±150kHz–fo±1000kHz
Ripple	1.5dB or less
Insertion loss	4dB or less

Table 10 MCF (L71-0254-05) (IF unit XF1)

Item	Rating
Nominal center frequency	8830kHz
Center frequency deviation	±150Hz within at 6dB
Passband width	±1.35kHz or more at 6dB
Attenuation bandwidth	±1.7kHz or less at 20dB ±2.5kHz or less at 60dB ±3.4kHz or less at 80dB
Ripple	2dB or less
Insertion loss	6dB or less
Guaranteed attenuation	80dB or more within ±3.4kHz–±1MHz
Input and output impedance	600Ω//15pF

Table 11 MCF (L71-0222-05) (IF unit XF2)

Item	Rating
Nominal center frequency	455kHz
6dB bandwidth	±3kHz or more
50dB bandwidth	±9kHz or less
Ripple (within 455 ± 2kHz)	2dB or less
Loss	6dB or less
Guaranteed attenuation (within 455kHz ± 100kHz)	60dB or more
Input and output impedance	2.0kΩ

Table 12 AM ceramic filter (L72-0319-05) (IF unit CF2)

Item	Rating
Center frequency	455 ± 0.20kHz
6dB bandwidth	2.9–3.2kHz
60dB bandwidth	4.7kHz or less
Guaranteed attenuation (0.1–1MHz)	60dB or more
Spurious (600–700kHz)	40dB or more
Ripple	2dB or less
Loss	6dB or less
Input and output impedance	2kΩ

Table 13 SSB ceramic filter (L72-0333-05) (IF unit CF1)

Item	Rating
Nominal center frequency	8830.0kHz
Center frequency deviation	Within ±70Hz at 6dB (25°C)
Pass bandwidth	±250Hz or more at 6dB
Attenuation bandwidth	±900Hz or less at 60dB
Guaranteed attenuation	80dB or more within ±2kHz–±1MHz
Ripple	2dB or less
Loss	Within 5dB ± 2dB
Input and output impedance	600Ω / 15pF

Table 14 CW crystal filter YK-88C-1 (L71-0236-05) Option

Item	Rating
Nominal center frequency	8830.0kHz
Center frequency deviation	Within ±250Hz at 6dB
Pass bandwidth	±3.0kHz or more at 6dB
Attenuation bandwidth	±6kHz or less at 60dB ±10kHz or less at 80dB
Ripple	2dB or less
Loss	Within 3dB ± 2dB
Guaranteed attenuation	80dB or more within ±10kHz–±1MHz
Input and output impedance	600Ω / 15pF

Table 15 AM crystal filter YK-88A-1 (L71-0237-05) Option

Item	Rating
Center frequency	455kHz
Center frequency deviation	Within 50Hz at 6dB
Pass bandwidth	±250Hz or more at 6dB
Attenuation bandwidth	±425Hz or less at 60dB
Ripple	2dB or less
Loss	6dB or less
Guaranteed attenuation	80dB or more within 100Hz–454.4kHz 80dB or more within 455.6kHz–2MHz
Input and output impedance	2kΩ ± 5% / 15pF ± 5%

Table 16 CW crystal filter YG-455C-1 (L72-0238-05) Option

Item	Rating
Center frequency	455kHz
Center frequency deviation	Within 50Hz at 6dB
Pass bandwidth	±125Hz or more at 6dB
Attenuation bandwidth	±250Hz or less at 60dB
Ripple	2dB or less
Loss	6dB or less
Guaranteed attenuation	80dB or more within 100Hz– 454.6kHz 80dB or more within 455.4kHz–2MHz
Input and output impedance	2kΩ ± 5% / 15pF ± 5%

Table 17 CW crystal filter YG-455CN-1 (L72-0239-05) Option

CIRCUIT DESCRIPTION

Additional circuit

- **Noise blanker (provided on the Control circuit)**

Fig. 6 give a block diagram of the noise blanker. This circuit is comprised of two channels, NB1 and NB2. The signal taken from the tuned output circuit of the second receiver mixer, comprised of Q4 and Q5 on the IF unit, is supplied from the NA terminal to the Control unit and amplified approx. 70dB by Q12–Q15.

In the case of the NB1 channel, the noise signal is detected by diodes D64 and D65 through the buffer Q16 and then applied to the switching transistors Q18 and Q22. In the case of the NB2 channel, the noise is directly applied to the noise detector comprising D61 and D62. The NB1 channel takes out only the pulse noise contained in the input signal and switches the noise blanking gate composed of diodes D3–D6, located before the IF unit XF2.

NB1 channel operaion is conventional. On the other hand, the noise output dertected by D61 and D62 in the NB2 channels is waveform shaped by IC5 after running through D63 and Q19, and only the high level pulse component is taken out as a square wave.

This component is switched by Q38 and in turn is used to switch the NB gate via D66 and Q22. At the same time, it is also used for switching the third receiver mixer Q7, Q8 on the IF unit via Q20 and Q21. The NB2 channel is especially effective for that special noise known as " the woodpecker".

In addition, in the TS-940, the "click" noise generated when the frequency is changed one step by the digital VFO is eliminate through the NB2 channel by utilizing the BLK signal from the Digital unit. The functions of the NB circuit are described in detail below.

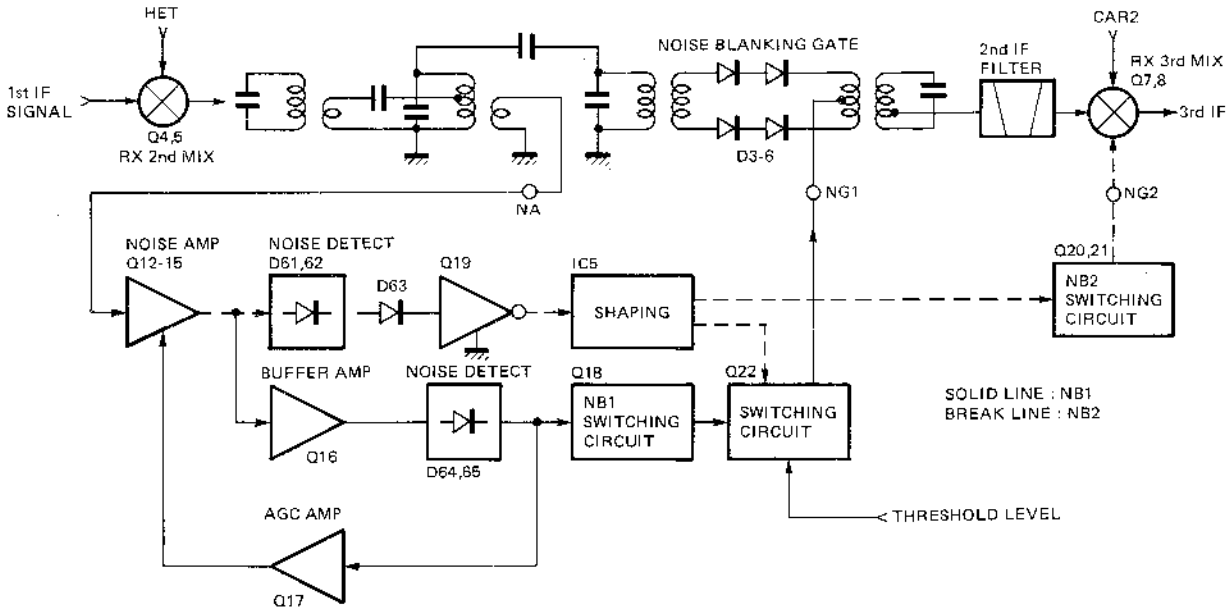


Fig. 6 Noise blanker circuit

In **Fig. 7**, Q18 and Q22 form a conventional NB circuit, which controls the NB gate. When the NB1 switch S14 is turned on, Q18 turns on and controls Q22 according to whether or not a pulse noise exists, and opens or closes the NB gate comprising D3 - D6 on the IF unit.

NB LEVEL (VR7) varies the operating threshold of Q18 so the NB effect can be varied.

Next, NB2 is explained. When a signal corresponding to a noise is applied to Q19, the collector of Q19 is set to a low level (hereafter abbreviated Lo. (and high level to Hi.) IC5, pins 11 and 9 are Hi, because pin 12 is Lo due to R172. As described above, when the collector (IC5, pin 8) of Q19 becomes Lo, IC5, pin 10 becomes Hi. As pin 10 next becomes Hi, a charging current flows in C76, pin 12 becomes Hi and pins 11 and 9 become Lo, in sequence.

As pin 9 becomes Lo, pin 10 is held Hi. This holding time is determined by the charge constant of C76 and R172, approx. 4ms. If this time is exceeded, pins 11 and 9 are returned to their initial states, Hi.

During this period, the conventional NB1 channel is operating through D66, and Q20 and Q21 are operating, whereby the third mixer (Q7 and Q8 on the IF unit) is cut off. Even if pins 11 and 9 become Hi, the base voltage of Q21 is in the state of cutting off the charging voltage determined by R175 and C78, and it continuously cuts off the third mixer. This is the control for NB2.

CIRCUIT DESCRIPTION

IC5, pin 6 is connected by R171 (56kΩ) and returned to Hi when the NB2 control time (about 4ms) elapses. Upon this change from Lo to Hi, a charging current flows in C77 through R173 and changes pins 1 and 2 from Lo to Hi. IC5, pins 3 and 5 become Lo, keeping pin 4 Hi and holding the charging time determined by C77 and R173, approx. 80ms. During this period, IC5, pin 13 is held Lo (pin 11 is Hi) through D68 so the NB2 does not mis-fire with a normal pulse for approx. 80ms from the time the first noise pulse goes out, even if a pulse noise is again entered. This is the operation for periodic woodpecker noise. When the NB2 channel is on, conventional noise is also blanked because one pole of S15 operates the NB1 circuit.

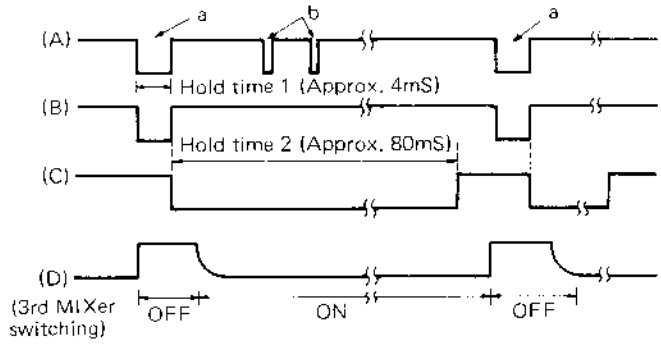


Fig. 8 NB2 timing chart

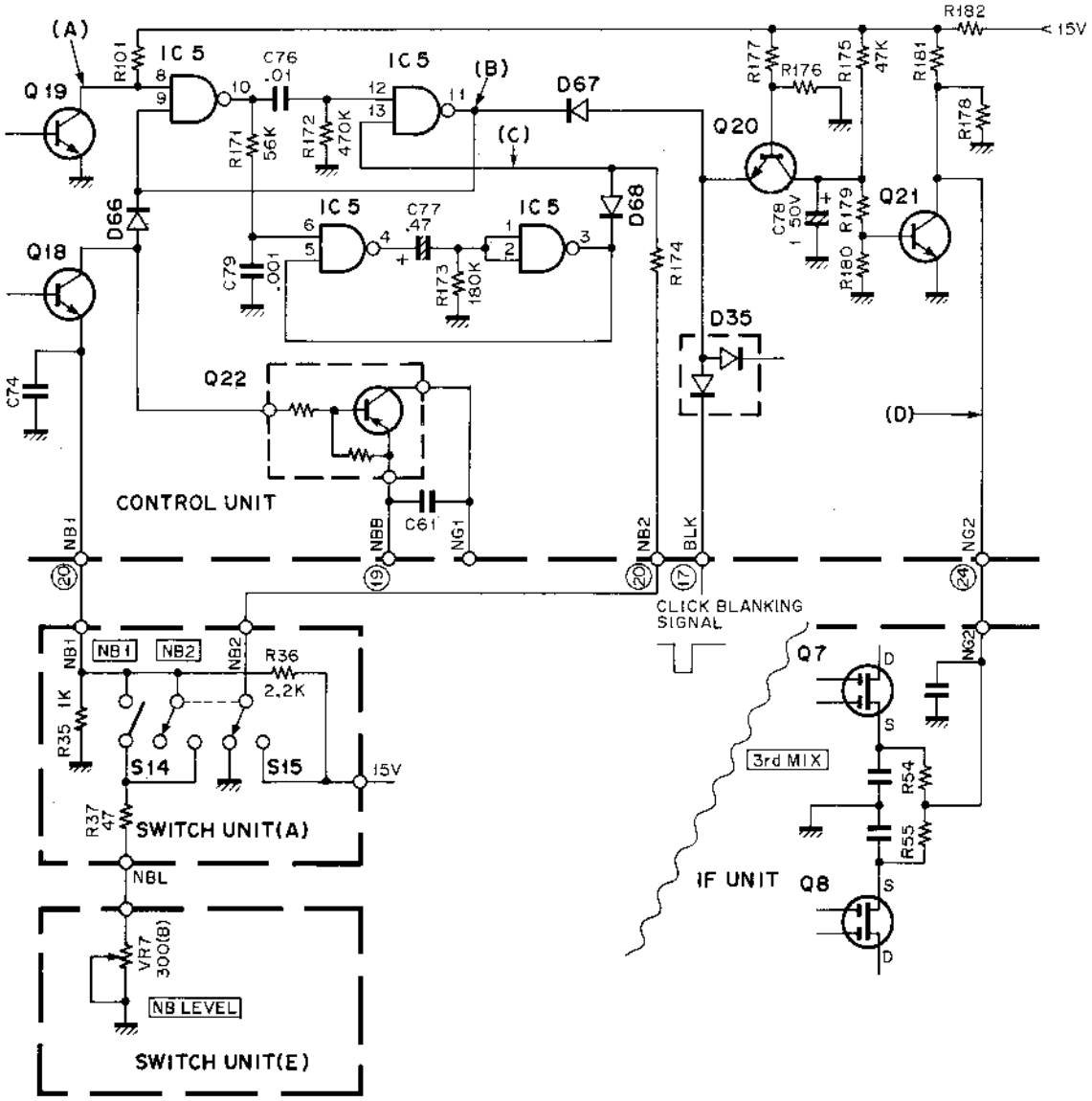


Fig. 7 NB gate control circuit

CIRCUIT DESCRIPTION

- **CW-VBT, SSB-SLOPE-TUNE (RF/IF and PLL/CAR unit)**

Fig. 9 gives a block diagram of the receiver related to CW-VBT (Variable Bandwidth Tuning) and SSB-SLOPE-TUNE. The principle of CW-VBT operation will be explained first. When CAR1 and CAR2 are at their normal frequencies, the overall IF response is indicated by "A". When the CAR1 frequency is shifted by Δf1, the overall IF response curve shifts to that at "B". The circuit is designed so the CAR1 signal lowers the VCO frequency fL by Δf1. In this case, the IF bandwidth is fully opened, or normal. When the frequency of CAR2 is lowered by Δf2, only the second IF filter of 8.8MHz band shifts to position "C". This maybe interpreted that IF shift is acheived by CAR1 and the composite bandwidth is narrowed by CAR2. In the TS-940, CAR1 and CAR2 frequencies are generated by the PLL circuit and controlled by the microprocessor, and the amount of change Δf1 and Δf2 is digitally tracked, allowing only the bandwidth to narrow without changing the center frequency of the composite passband. This is the function of CW-VBT.

Next, the operating principle of SSB-SLOPE-TUNE is explained, Designed so the relation between the frequency changes of CAR1 and CAR2 becomes Δf2 = Δf1,the composite passband can be varied only on the left in **Fig. 10**. If the CAR1 frequency is fixed and the CAR2 frequency is lowered by Δf2, it is possible to vary only the right of the composite passband.

The SSB-SLOPE-TUNE enables these operations independently, using two controls.

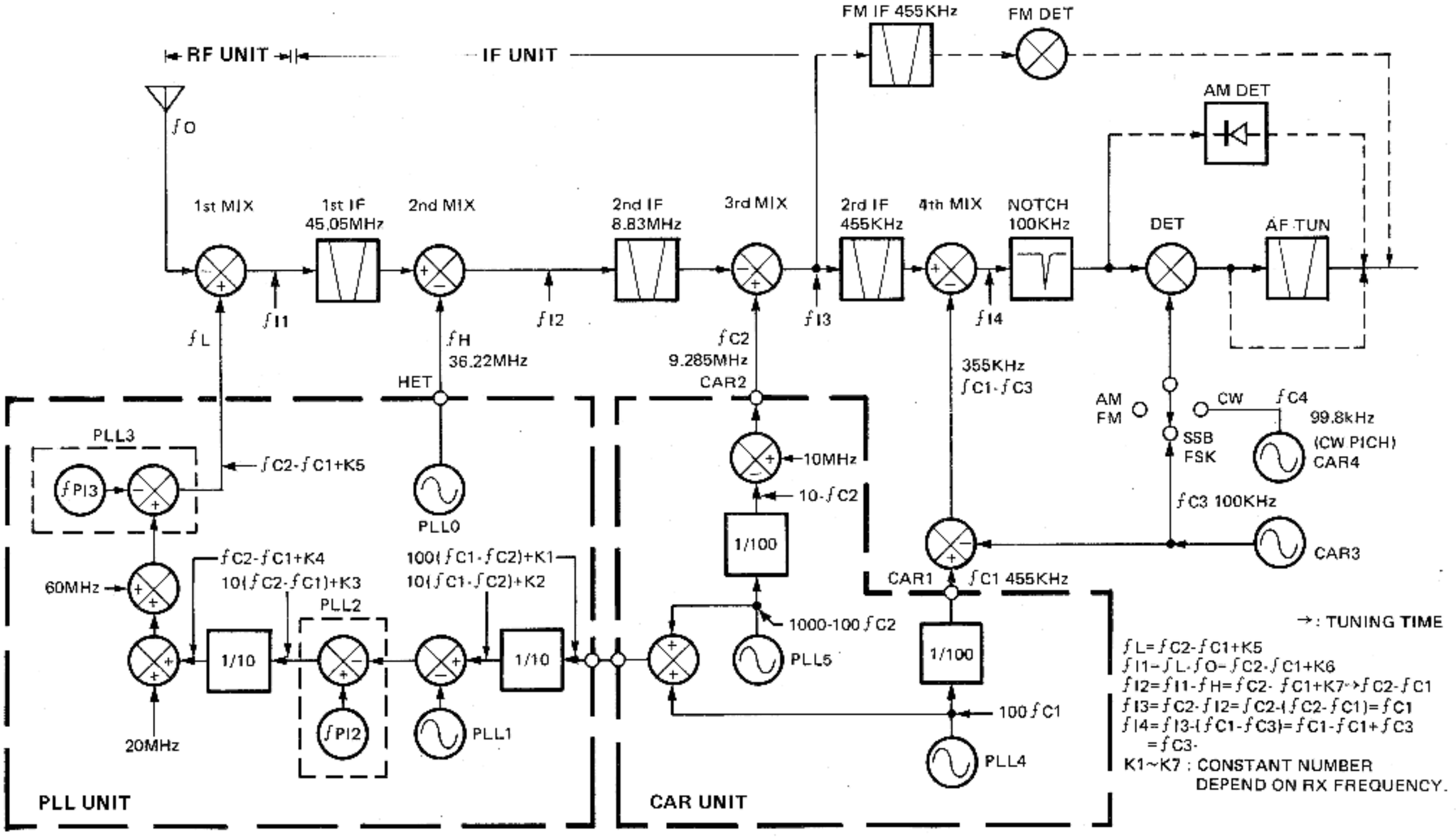


Fig. 9-A RX configuration normal (wide) response

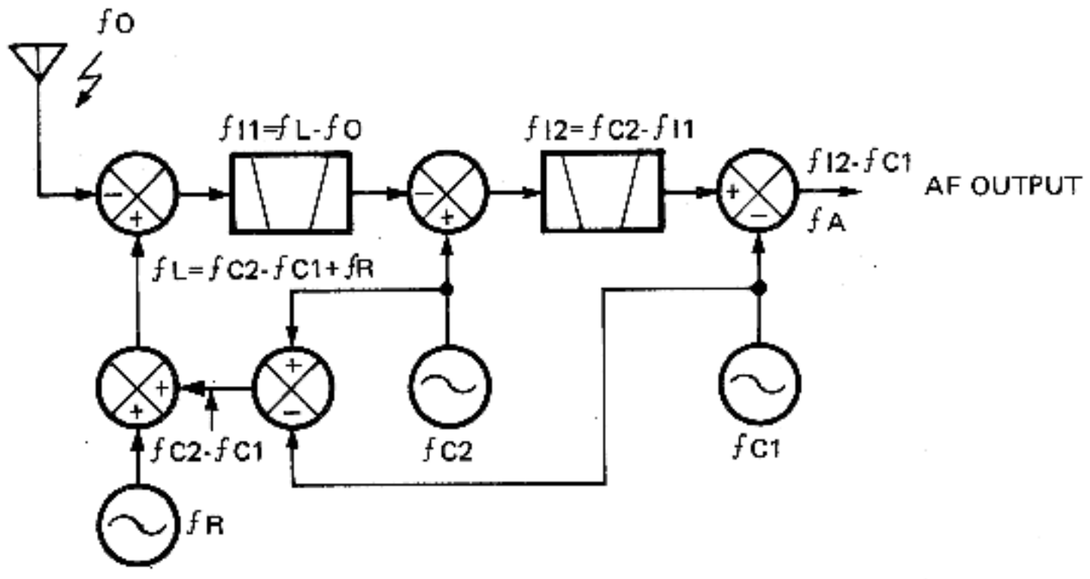


Fig. 9-B

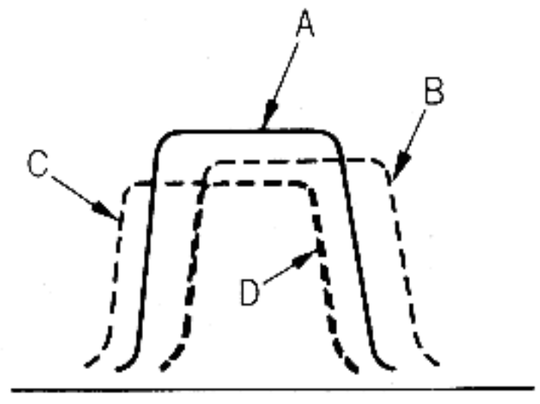


Fig. 9-C CAR2 shifted

CIRCUIT DESCRIPTION

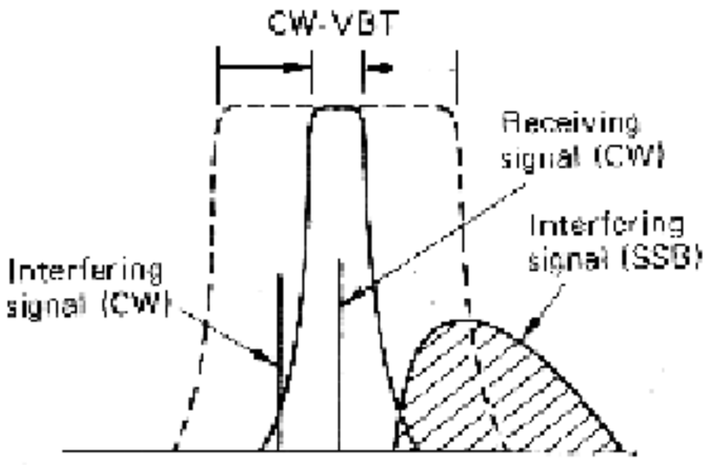


Fig. 9-D CW-VBT

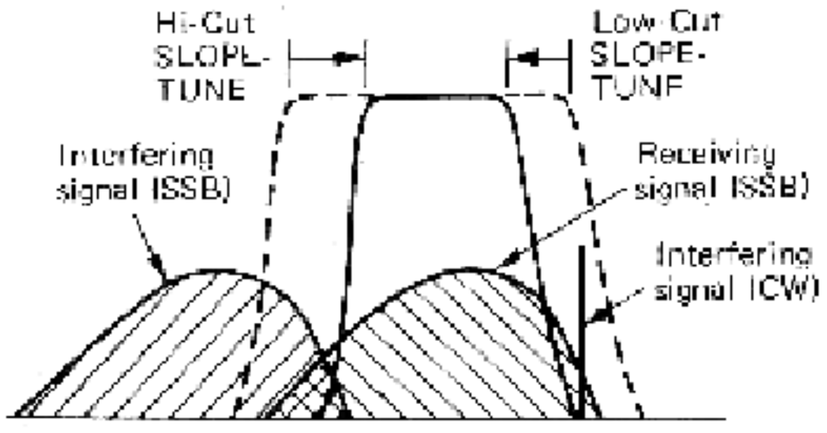


Fig. 9-E SSB-slope tune

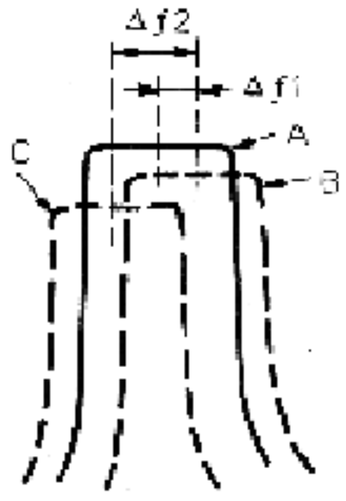


Fig. 10 VCO to bandwidth relationship

- **Notch filter (provided in the IF unit)**

This is a bridge T filter composed of L, C and R elements, which is inserted between the fourth receiver mixer and the 100kHz IF amplifier Q13. It varies the voltage applied to the cathode of varicap diode D38, thereby changing the resonant frequency. The notch filter functions in all modes except FM.

- **AF-TUNE (provided on the IF unit)**

This is an active filter using IC12, which is inserted between the SSB/CW product detector and AF pre-amplifier Q29. The frequency of this filter is over 800 (±400)Hz and functions only in the CW mode. When the AF-TUNE switch is off, the audio signal is bypassed by diode D68.

Transmitter

The audio signal from the microphone is applied to the IF unit MIC terminal and is preamplified by Q36 : 2SC2458. The output is split to the MIC GAIN control (on the front panel), the FM MIC GAIN control (on the top panel) and VOX circuit in the SSB and AM modes. The SSB signal channel is returned to the IF unit, amplified by IC3 : TA7140P and applied to balanced modulator D73 : ND487R1-3R. A diode switch is provided at the input of IC3, which selects the audio signal in the SSB and AM mode, and the AFSK signal (2.2936kHz/2.1277kHz) from the PLL unit in the FSK mode. Balanced modulator D73 is constructed as a package containing four Schottky diodes of matched characteristics, which provides stable modulation characteristic against varying operating conditions such as temperature fluctuation. The 455kHz DSB (Double Side Band) signal from D73 is converted to SSB by filter CF1 (or CF2 in the AM mode), which is shared by the third receiver IF filter after passing through the buffer amplifier Q37 : 3SK73.

The filter output runs through buffer amplifier Q39 : 2SC2458 and is then applied to the RF speech processor circuit Q40: 2SC2458, IC4 : TA7302P and Q43 : 3SK73. When the processor is off, the signal is applied directly to the first transmitter mixer Q44 and Q45 : 3SK73 via diode switch D78 and D79 : 1S1587. In FSK mode, even if the processor switch is off, aprox. 10dB compression is automatically applied. This effectively suppresses any level difference between MARK and SPACE in AFSK. Note, however, that the compression meter does not deflect.

In the AM mode, even if the processor switch is off, the signal runs through D78 and D79 but does not pass through the processor. The processor output signal is applied to the first transmitter mixer via diode switch D83. Here, the audio signal is mixed with the CAR2 signal (9.28bMHz) and converted to 8.83MHz. The 8.83MHz signal runs through SSB filter XF2 (a wide band filter L37, L38 or optional YK-88A-1 in AM mode) shared by the second receiver IF filter, where any adatter component which may be generated in the speech processor is eliminated.

The signal is then applied to the transmitter IF amplifier Q48 : 3SK73. However, in CW and FM modes or during auto antenna tuning, the CAR0 signal is applied to Q48 via buffer amplifier Q46 : 3SK73. Therefore, in these modes, since the transmitter signal does not pass through the narrow band filter, full CW break-in operation is enabled. ALC is applied to transmitter IF amplifier Q48, and a part of its output is supplied from the MON terminal to the monitor circuit on the Control unit via buffer amplifier Q49 : 2SC2787.

The transmitter signal is then applied to the second transmitter mixer Q50 and Q51 : 3SK73, where it is mixed with the HET signal (36.22MHz), yielding a TIF signal at 45.05 MHz, whose output is connected to the RF unit. In the RF unit, the signal is mixed with the VCO signal in the third transmitter mixer Q1 and Q2 : 3SK73, providing the final transmitter frequency.

CIRCUIT DESCRIPTION

Any unwanted components in this signal are eliminated in the transmitter BPF (1.8–30MHz), amplified by wideband amplifier Q3 : 3SK73, Q4 : 2SC1907 and Q5 : 2SC1973 and supplied from the DRV terminal to the Final unit as the drive-level output. This drive output is automatically disconnected from the Final unit input if a connection is plugged into the transverter connector. The signal applied to the Final unit is amplified by wideband drivers Q2, Q3 : MRF485 and finals Q4, Q5 : MRF422.
The output of the Final unit passes through the Filter unit where unwanted the higher harmonic component element is eliminated. The Filter unit divides the transmitter frequency range into bands, and each LPF is automatically selected by TX LPF information (LP0–LP2) supplied from the Digital A unit.
After passing through the Filter unit, the transmitter output runs through the AT (optional) unit, the transmitter/receiver selector circuit and then is connected to the ANT terminal on the rear panel.

Transmit freq' (MHz)	TX-LPF selected data			LPF
	LP2	LP1	LP0	
1.9	0	0	1	A
3.5	0	1	1	B
7	1	1	1	C
10	1	0	1	D
14	1	1	0	E
18	1	0	0	F
21	1	0	0	F
24.5	0	1	0	G
28	0	1	0	G

Table 18 Selection of TX LPF

- **Final temperature protection circuit (provided on the Filter unit)**

If the Final heat sink temperature rises to approx. 90°C, temperature protection comparator IC1B on the Filter unit switches from low to high level, and Q8 turns off. Therefore, approx. 12V, the total voltage of zener diode D11, variable resistor D12 (1.7V) and zener diode D13, is generated at the MOT terminal, the motor speed is increased and the final heat sink is cooled more rapidly.
At the same time, the high level signal from IC1B is sent to the Control unit via the BTP terminal to stop transmission and forably sets the receive mode.
When the sink temperature falls to approx. 65–70°C, this circuit is released and transmit mode is again enabled. thereafter, the fan is driven by the cooling fan driving circuit until the heat sink temperature further lowers to approx. 45°C.

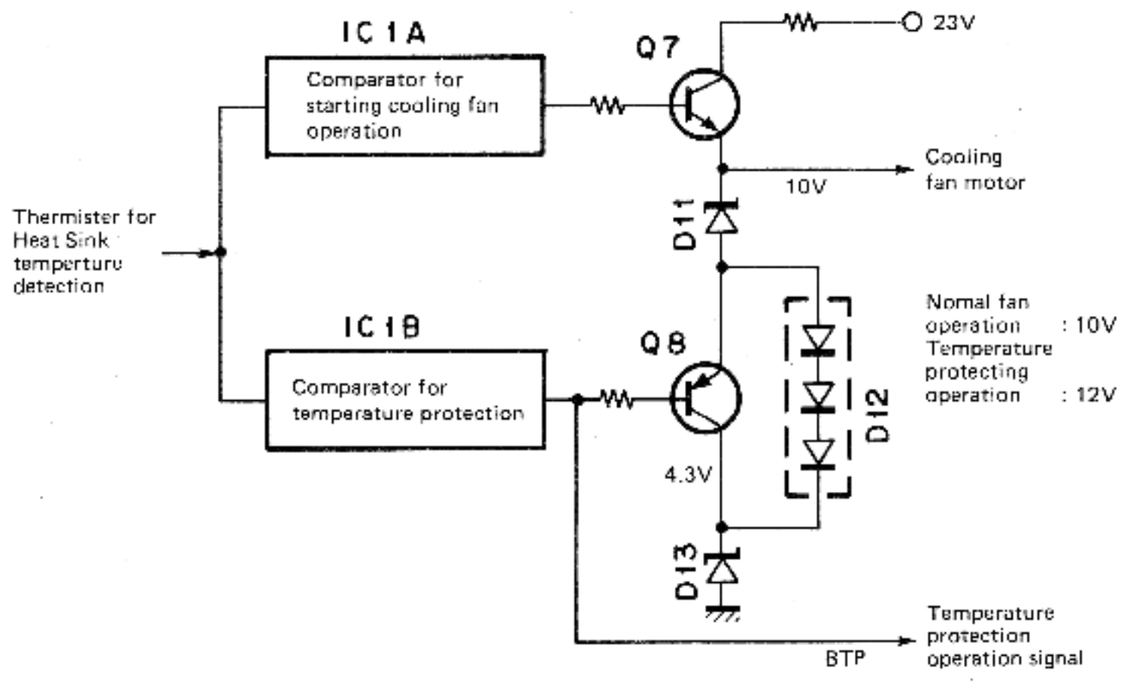


Fig. 11 Fan and temperature protection

Additional transmitter circuits

- **Final cooling fan driving circuit (provided on the Filter unit)**

First, the final heat sink temperature is detected by thermistor TH1 provided on the Final unit. If the heat sink temperature rises to approx. 50°C. comparator IC1A functions (high level) to start cooling fan operation and Q7 turns on. At this time, the temperature protection comparator IC1B is low level, and Q8 is on. Therefore, approx. 10V (D11 : Zener voltage 5.1V, D13 : Zener voltage 4.3V, Q8 : VCF SAT 0.1–0.3V) appears at the MOT terminal and drives the fan motor.
This circuit is designed with hysteresis so the fan stops when the Final heat sink temperature falls to approx. 45°C.

- **ALC circuit (provided on the Control unit)**

Forward wave voltage VSF detected in the Filter unit is applied to the base of Q36 in the Control unit. Q36 and Q37 are differential amplifiers. When the VSF voltage rises, the collector voltage of Q37 rises and that of Q35 lowers. Therefore, the gate voltage of Q33 lowers and the base and emitter voltages of Q34 lower. As a result, the ALC line volatege decreases due to D46 and Q34 being connected to the ALC line, thus controlling TX RF output power.

CIRCUIT DESCRIPTION

The drain (voltege) of Q33 operates the ALC meter. Trim controls VR8, VR9 are the internal set points for the ALC meter circuit. The TBK line voltage delivers the keying signal through active low-pass filter Q32 where any key click components are eliminated, its output becomes ALC voltage, and this is supplied to the ALC line. As seen from this description, the ALC voltage is used not only for controlling transmitter output power, but is also for keying the output in the CW operating mode.

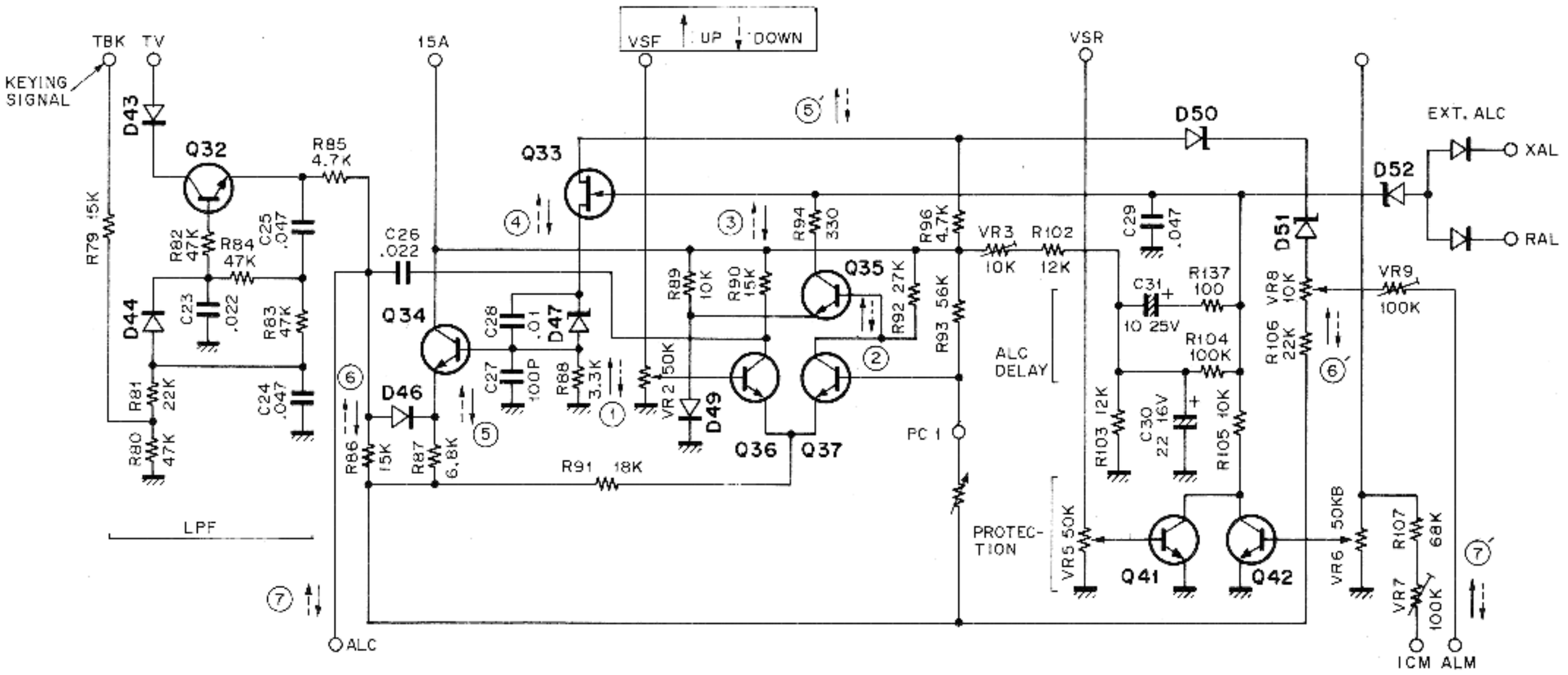


Fig. 12 ALC circuit

- **Power control**

The power control provided on the front panel permits control of transmitter output from full power to 10W or less. The power control is a 2-ganged potentiometer, which controls the first gate voltage of broad band amplifier Q3 in the RF unit to vary the voltage gain. Secondly, it controls the base voltage of ALC circuit differential amplifier Q37 in the Control unit and therefore the threshold level of the ALC amplifier. Therefore, when the Power control is varied, ALC is held nearly constant at any setting.

If the auto antenna tuner were to be used with the transmitter output set to minimum (10W or less) by the Power control, the RF output power might be too low to detect the necessary controlling current and voltage and normal tune operation would not be possible.

To solve this problem, the TS-940 is designed to automatically switch FET Q3 gate voltage the RF unit voltage amplifier to its maximum value, regardless of the power control, set position, and at the same time, switch the base voltage of Q37 to provide a 50W RF output level to properly operate the auto tuner.

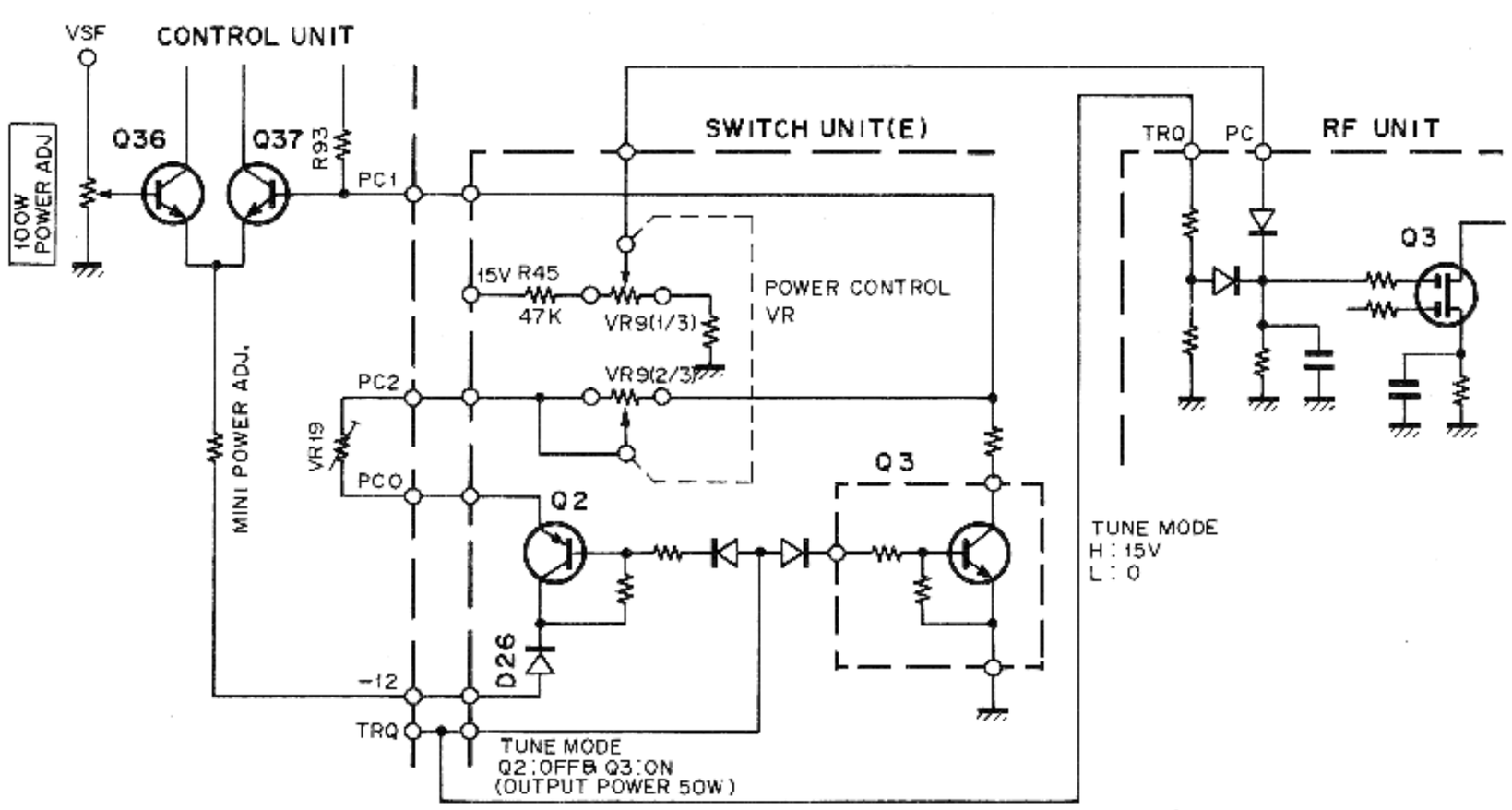


Fig. 13 Power control circuit

CIRCUIT DESCRIPTION

- **Speech processor (provided on the IF unit)**

The block diagram is shown in **Fig.14**. An input signal runs through 455kHz filter CF1 and buffer Q39. The signal is then amplified by Q40 and applied to detector D80 and limiter amplifier IC4. The detector output is applied to DC amplifier Q41 and Q42, where it is compressed logarithmicly. The output signal is coupled to the compression meter, indicating the compression level. The signal applied to IC4 is held constant in output level regardless of the input level. The signal is then applied to the first transmitter mixer via gain controil amplifier Q43.

When the processor is off, the signal is bypassed by switching diodes D78 and D79. In FSK mode, even if the processor is off, approximately load compression is applied to level the amplitude change between the mark and space signals. In the FSK mode, the ALC level is adjusted by the processor OUT control

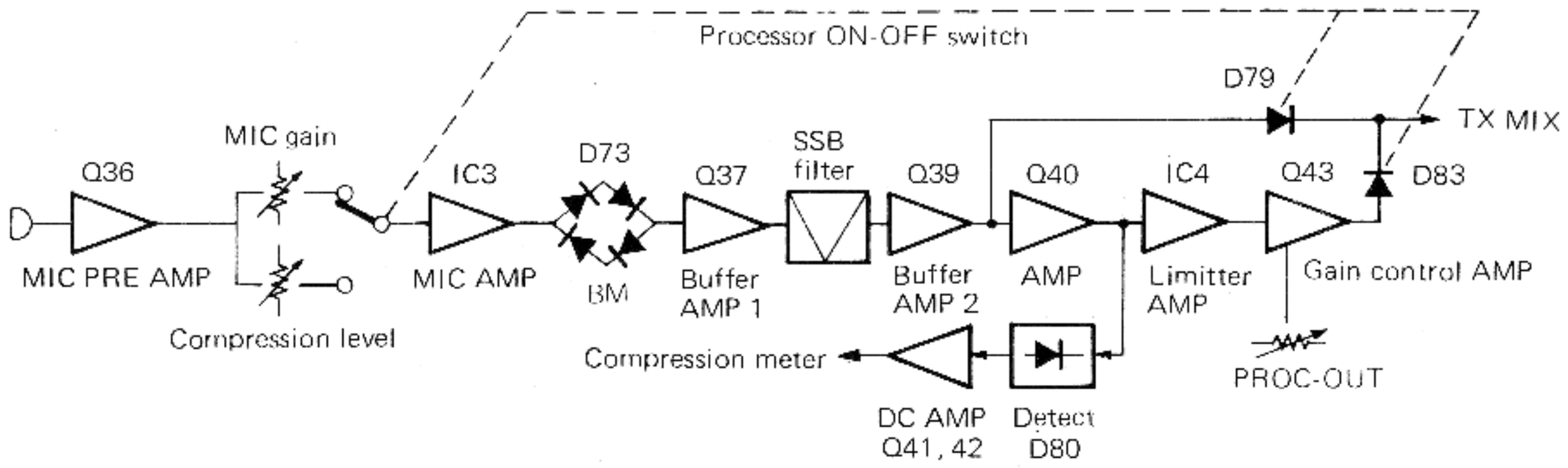


Fig. 14 Speech processor block diagram

- **Monitor circuit (provided on the Control unit)**

SSB/FSK mode

The signal taken from the drain of the second transmitter IF amplifier Q48 on the IF unit is amplified by Q49 and applied to the MON terminal. The output signal from the MON terminal is applied to IC16 : μPC1037H via the Control unit buffer Q58.

In IC16, the CAR0 (8.83MHz) is injected for signal product detection. This is amplified by Q59 and applied to the audio power amplifier IC15 via the monitor level internal adjustment control VR13.

FM mode

The output of the FM microphone amplifier Q64, Q65 and IC14 is amplified by Q62 and supplied to VR13, as in the SSB/FSK mode.

CW mode

Side tone circuit (provided on the Control unit)

CAR3 and CAR4 signals of 100kHz and 99.2kHz are product detected by Q57 to generate an audio beat at 800Hz. Q57 is switched by the STK line through diode D71 and turned on when the key is closed, generating side tone. The 99.2kHz CAR4 signal is frequency controlled by the pitch control on the front panel, allowing simultaneous variation of the CW side tone frequency and receiver CW tone pitch. Zero-beat adjustment with a received signal is acheived by simply making the receiving tone pitch equal to the side tone pitch.

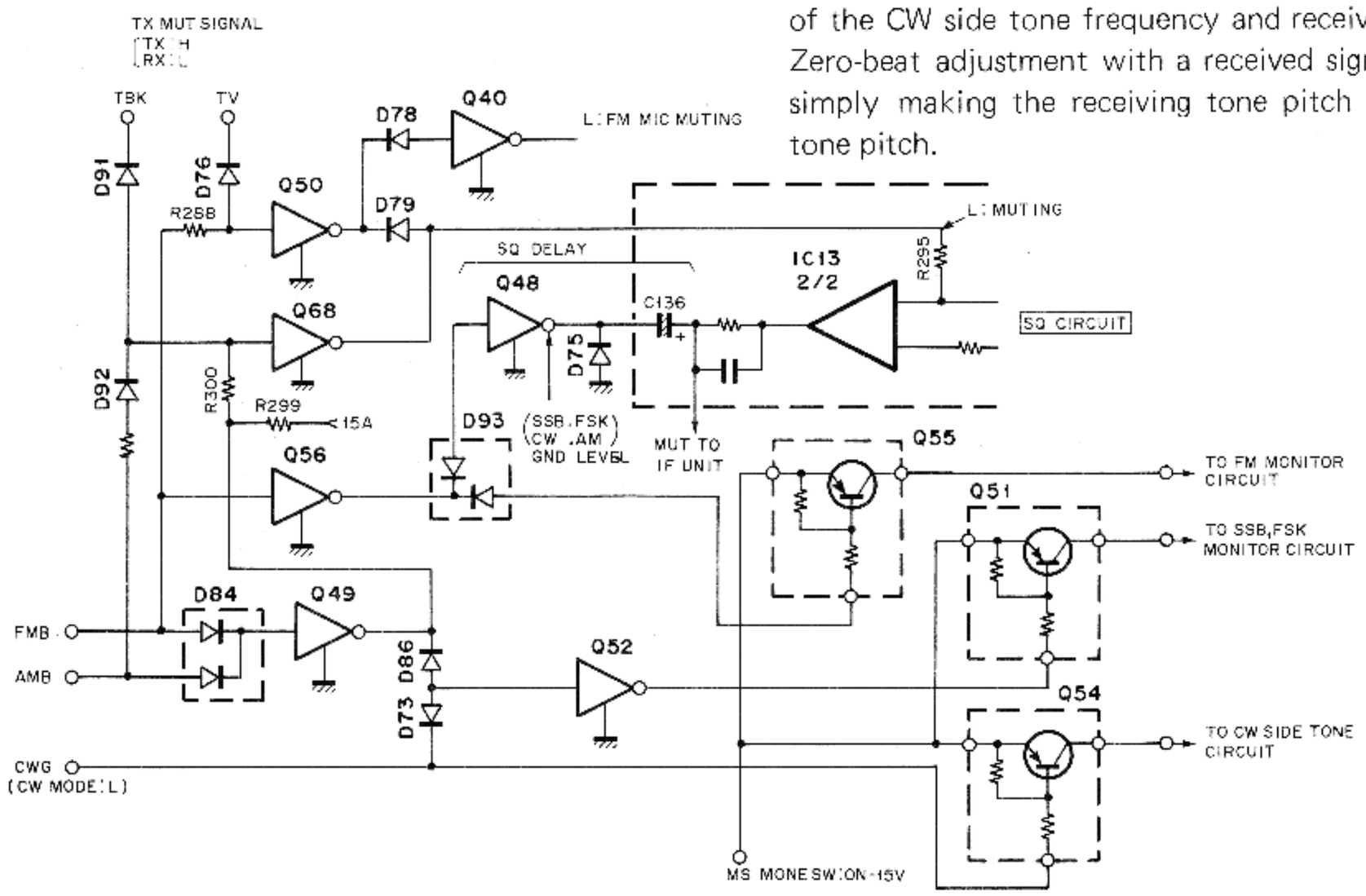


Fig. 15 Monitor, audio muting and FM mic muting circuit

CIRCUIT DESCRIPTION

- **SWR automatic arithmetic circuit (provided on the Control unit)**

The automatic SWR arithmetic computation circuit has been adopted from the original circuit first used in the TS-930. The forward wave voltage VSF and reflected wave voltage VSR from the Filter unit are applied to an analog arithmetic circuit on the Control unit, output from IC9, pin 1 as VSR/VSF level, and indicated by the SWR meter. IC9 contains an integrating circuit and V–I converter for the auto tuner, while IC10 contains a triangular wave generator and voltage comparator. Q43 and Q44 are used for switching the forward and reflected wave input signals at an equal duty ratio.

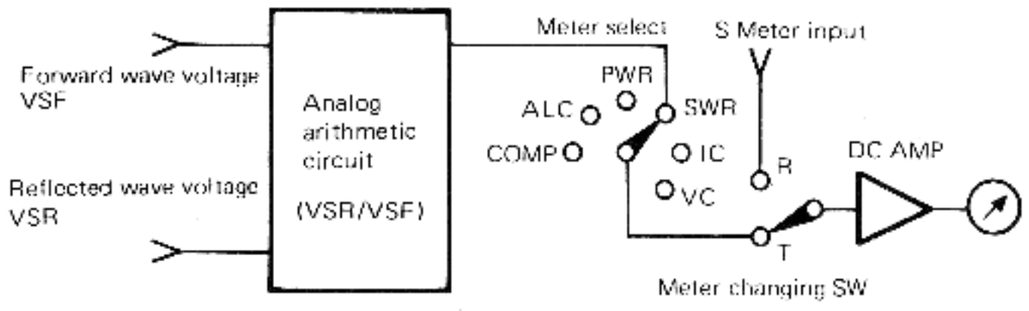


Fig. 16 SWR meter circuit

The VSF voltage is compared with a REF voltage on IC9 pin 12. If VSF decreases (i.e. SWR increases) the voltage level at pin 14 increases. The output of IC10 pin 1 is a triangular reference signal and is mixed with the voltage from IC9 pin 14. Changes in the outuput of IC9 pin 14 affect the reference level of this triangular wave. IC10 computes the change and sends a square wave signal, whose pulse width and spacing are proportional to the change, to control conduction of switching transistors Q43, Q44. See **Fig. 17.**

The voltage at IC9 pin 1 is a level proportional to VSR/VSF, and is used to drive the SWR meter and also for AT-940 control purposes. VR18 is an SWR meter adjust for initial setup only.

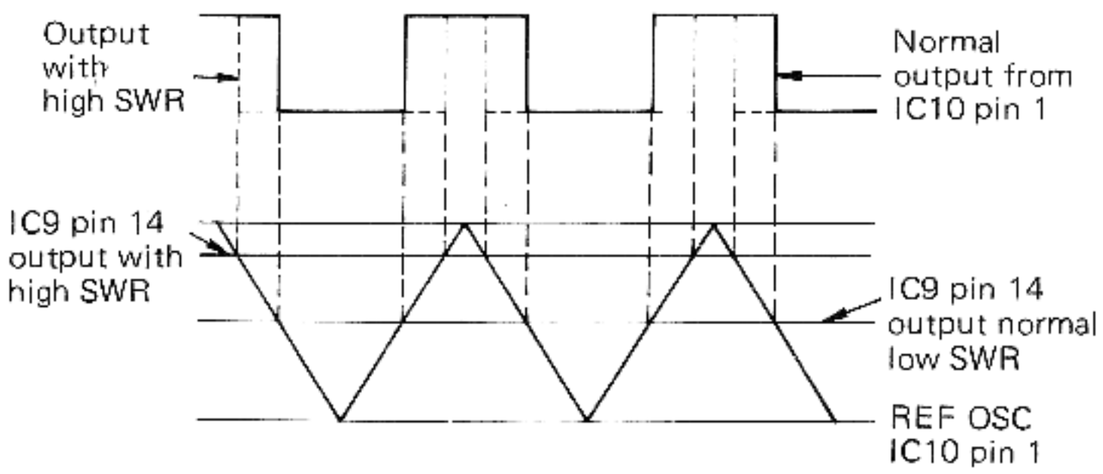


Fig.17

- **Timing circuit**

The TS-940 has five kinds of timing signals for switching between transmission and reception; TV, RV, TR, TBK and ALC. **Fig. 18** shows the timing relationship between there signals. This is the timing chart for SSB, MF, FSK and CW full break-in keying. The timing charts for CW keying in the CW semi-break-in and standby modes are shown in **Fig. 19**, (a) and (b).

TV and RV are the supply voltage to be applied to each of the various transmitter and receiver channel circuits. A pause of approx. 3ms is designed between the switching of each voltage.

The transient state of each circuit stabilizes within this period. The TR live information the PLL channel of the transmit/receive status, and is used to switch transmitter and receiver frequencies during "cross band" mode operation. the transient state of this signal is also stabilized within the 3ms pause time.

TBK is the keying signal in the CW operating mode. This signal is allowed to pass through the active low filter to eliminate any key click component and then, the output is used to generate ALC voltage. Therefore, ALC voltage is used not only for controlling the transmitter output, but also for output keying in the CW mode.

In modes other than CW, output keying is unnecessary, but the timing remains the same. **Fig. 19**, (a) and (b) give the timing charts for CW semi-break-in operation and CW mode with just the standby switch. If Fig. 19, the timing of RV, TR, etc. are omitted, as they are the same as those in **Fig. 18.**

The trailing edge of TV is approx. 6ms after that of TBK. During this period, the transmitter output breaks together with ALC voltage. TB and RB are the transmitter and receiver channel bias voltage ; the timing is synchronized with the TV signal. RB is inverted. **Fig. 20** gives the basic block diagram to generate each of these timing signal previsouly discussed.

Fig. 21 shows the operating timing chart in this configuration. The actual operation of the timing chart will now be described. (See **Fig. 22** "Block diagram")

This circuit is operated by the keying input, standby switch (PTT) input, VOX input, ANTI-VOX input, etc. In the block diagram (**Fig. 22**), STBY SW Gate 3 (IC1 4/4) opens (D30, goes Hi) only at keying by the standby switch in CW mode. Operation by the standby switch in modes other than CW makes transistor Q6 turn off as D26 drops to GND in send mode. Thus, a high voltage is applied to inverter IC3 2/6 via D31. (In CW mode, since the cathode of D27 becomes low, a high voltage is not applied to D31.)

CIRCUIT DESCRIPTION

When the VOX is on, a high voltage is applied to inverter IC3 2/6 from the one-shot multivibrator via D4. (The VOX circuit is explained in a following section.) The output of inverter IC3 2/6 (pin 6) goes low, the cathode of D14 becomes low, and TR switching transistor Q7 turns off.
Thus, a high voltage is supplied to the TR terminal via D9. (**Fig. 18**– Ⓐ) (As Q7 is on in the receive mode, the TR terminal is low.)
At the same time, the RV AND gate 5 (IC4 2/3), pin 4 goes low (TX protection OFF → BTR terminal L), the output terminal, pin 6 becomes low and the RV switching circuit (Q30, Q28) turns off.
Therefore, as soon as the transistor level becomes high RV voltage level becomes low. (**Fig. 18**– Ⓑ)
The output of inverter IC3 2/6 enters the delay circuit I composed of IC1 3/4, R29 and C13. The output signal delayed approx. 3ms (H level) is applied to IC1 3/4, pin 4. (**Fig. 18**– Ⓒ). This signal becomes the TBK keying signal in the CW operating mode.
When the TBK signal is applied to the YV gate IC4 3/3 (pin 13) via Q24, a TV switchihg signal synchronized with the leading edge of the TBK voltage is generated at pin 10 as an output. At this time, as the RV gate output (IC4 2/3, pin 6) is at low level (D21 is off), IC4 2/3, pin 12 is at high level, like the output of inverter IC3 6/6. IC4 3/3, pin 11 is usually at high level when the PLL is in the lock states.
When this signal (IC3 3/3, pin 10) is applied to the TV switching circuit, a TV voltage is generated. (See **Fig. 22**, "Block diagram".)
Based on the TV voltage, an in-phase TB voltage and inverted RB voltage are generated. (**Fig. 18**– Ⓓ and Ⓔ).
The leading edge (RX → TX) of the timing circuit will now be discussed. When the key is up in the CW operating mode, as the output (pin 13) of the STBY switch gate 3 changes from high to low level and the output (pin 3) of gate 2 changes from low to high level, the output (pin 10) of one-shot multivibrator IC2 3/4 goes low and D4 turns off.
Since the cathode of D27 is at low level due to the CWG signal, the anode of D31 is held at low level, i.e., D4, D30 and D31 turn off. Thus, the input to inverter IC3 2/6 changes from high to low level, and the output of IC3 2/6, pin 6 changes from low to high level. When the VOX turns off during VOX operation or the standby switch is set to the REC position, the output of inverter IC3 2/6 becomes high level as in the previous narrative.
This signal is applied to the delay circuit I and after 3ms. The TBK line voltage breaks. (**Fig. 18**– Ⓕ)
TBK voltage is inverted by inverter IC3 3/6, and is used to change the input signal level of BK gate 7 (IC4 1/3, pin 8) from low to high.
Since pin 2 is at high level at break-in, gate 7 changes the output level at pin 9 from low to high at the trailing edge of the TBK timing signal. During semi-break-in, since pin 2 is held low during the delay time, output pin 9 changes from a low to a high level stage after the delay. At this time, the BK gate 7, pin 1 is high because the key is up. The BK gate 7 output signal is applied to delay circuit II and after approx. 5ms, the signal becomes low level, and D23 turns off to change the TV gate 6, pin 13 from a high to a low logic level. Therefore, the output (pin 10) of TV gate 6 changes from high to low, and the TV voltage is lowered. (**Fig. 18**– Ⓖ)
At the same time, the TB voltage breaks and inversely, the RB voltage rises. (**Fig. 18**– Ⓘ and Ⓙ) In addition, as the TV voltage being supplied from D36 to the TR line breaks at the same time, the TR voltage changes from high to low level. (**Fig. 18**– Ⓗ)
Further, the output signal of delay circuit II is applied to the integrating circuit of delay circuit III, where it becomes a 3ms delayed signal, and this output changes the RV gate 5, pin 3 from a low to a high logic level. (At this time, pin 4 and pin 5 are high level.) Thus, the output of RV gate 5 changes from low to high and RV voltage rises. (**Fig. 18**– Ⓚ) When a temperature protection signal or band protection signal are applied from the filter unit to the BTP terminal, the RV switching circuit functions via D21 and generates RV voltage. At the same time as TV gate 6, pin 12 is changed from high to low level by inverter IC3 6/6, the output signal level is also changed from high to low and the TV switching circuit turns off. Thus, TV voltage drops and the transceiver goes into the receiving state.

- **VOX, ANTI-VOX circuit (provided on the Control unit)**

In **Fig. 22**, "Timing circuit configuration", the MIC preamplifier output is applied to the VXZ terminal on the Control unit via the VOX gain control, amplified by VOX amplifier Q1~Q3 and applied to the following stage R-S flip-flop (IC1 1/4, pin 13). On the other hand, the AF output signal (SP2 signal) from the speaker is applied to ANTI-VOX amplifier Q10, Q11 to be DC rectification, and this output is applied the R-S flip-flop IC1 2/4, pin 9.
By using this logic function, the faster input either VOX or ANTI-VOX, is given priority. When the VOX input is given priority, a signal pulse is applied to VOX gate 1 (IC2 1/4, pin 12) and the gate is opened. However, gate 1, pin 13 is high when the VOX switch is on in SSB, FM or AM mode. When ANTI-VOX is given priority, VOX gate 1 (IC2 1/4, pin 12) is low and the gate is closed.
In CW mode, the STK terminal signal (low at key down) is applied to VOX gate 2 (IC2 2/4, pin 2) after being switched by Q9. thus, a high level signal is applied to VOX gate 2 (IC2 2/4, pin 2) and the gate is opened when the key closed. Gate 2, pin 1 is high when the VOX switch is on in CW mode. Gate 1 or 2 signal goes through one-shot multivibrator IC2 3/4 and IC3 1/6 and enters the VOX Delay circuit composed of C9, R18 and Q4, where the VOX hold time is established. Use of this type of logic circuitry increases response the speed of the VOX and eliminates VOX/ANTI-VOX cycling.

CIRCUIT DESCRIPTION

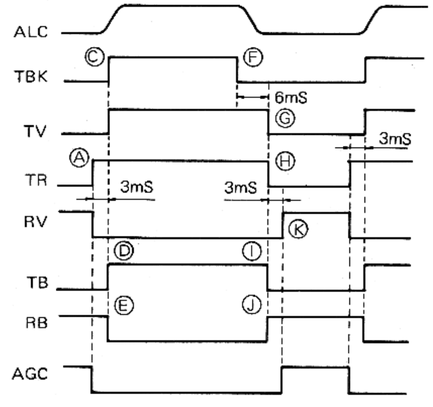


Fig. 18 T-R timing chart (CW full break-in, SSB, FSK and TUNE modes)

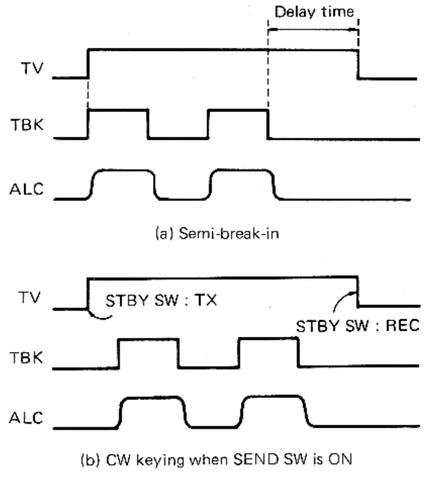


Fig. 19 CW operation timing chart

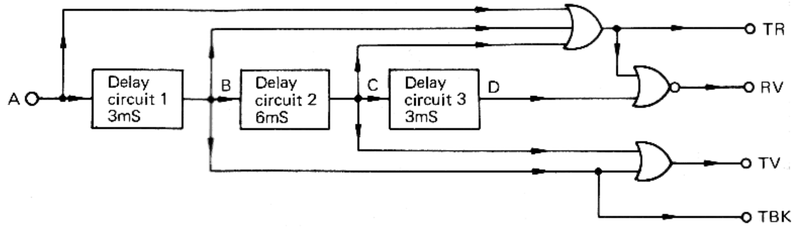


Fig. 20 Timing circuit basic block diagram

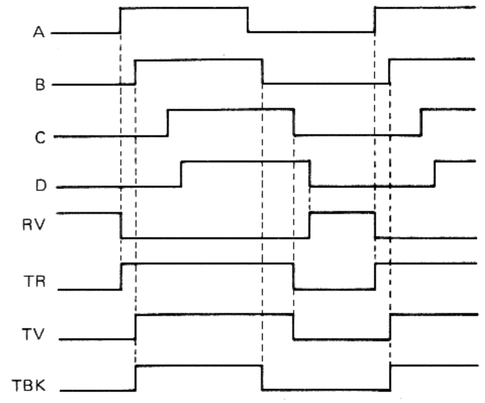


Fig. 21

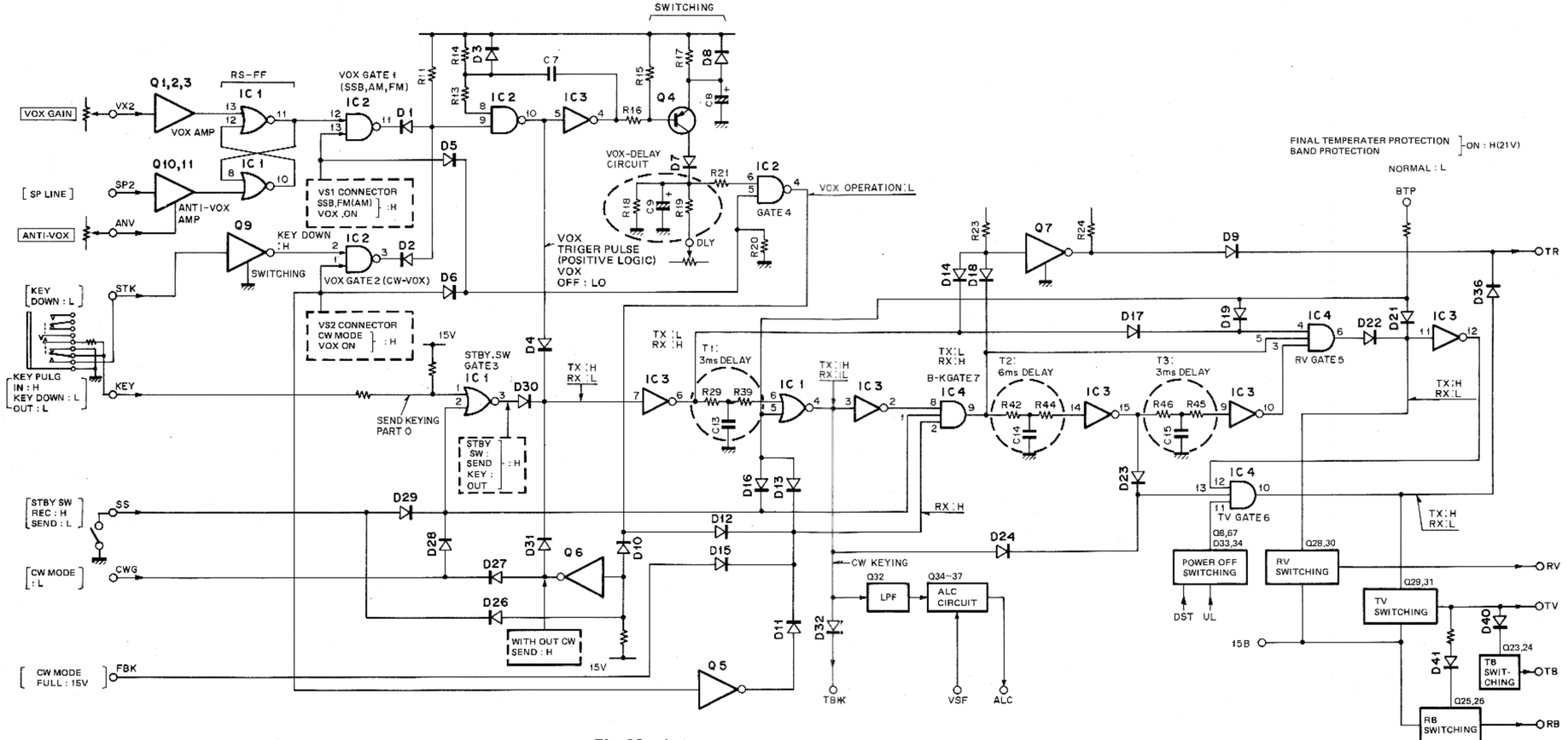


Fig. 22 Timing circuit block diagram

CIRCUIT DESCRIPTION

- **Antenna tuner**

The block diagram is shown in **Fig. 23**. The AT-940 operates in the 1.8–29MHz bands and is automatically adjusted so that the SWR becomes 1.2 : 1 or less. For smooth antenna tuning, the mode is stored before antenna tuning and set again after tuning. **Fig. 26** shows the antenna tuner timing chart.

The AUTO-THRU relay protective circuit (Q120, Q121, 122, 123 and 126) holds the AUTO-THRU relay condition during transmission. This circuit monitors the AUTO-THRU switch condition and the TV line (Transmit-high level/receiver-low level) and allows a change in the AUTO-THRU switch to affect the relay condition only when the TS-940 is in the receiver mode.

A change in the AUTO-THRU switch during transmission change the relay only after the TS-940 returns to recieve. (See **Fig. 24** "Relay protection circuit diagram.)

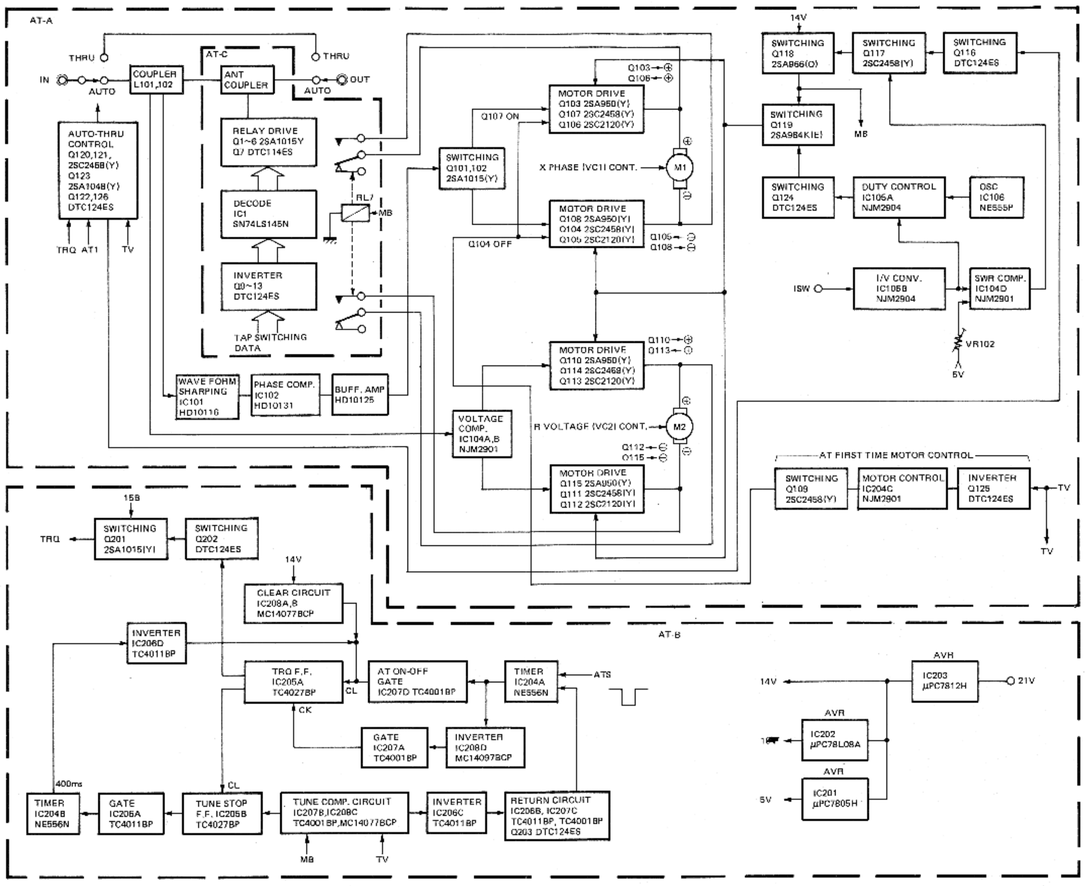
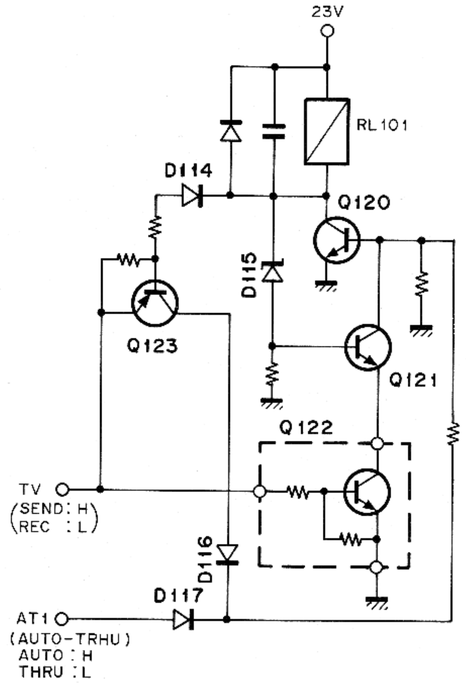


Fig. 23 AT unit block diagram



REC	Q122 : OFF	Q120 : OFF	RL101 : OFF
	Q121 : OFF	Q123 : OFF	
↓			
AUTO-THRU	Q120 : ON		RL101 : ON
AUTO			
↓			
STBY SW	Q122 : OFF	Q123 : ON	
SEND	Q121 : OFF	Q120 : ON	RL101 : ON
↓	(Relay protection operation)		
AUTO-THRU	Q122 : OFF	Q123 : ON	
THRU	Q121 : OFF	Q120 : ON	RL101 : ON
↓			
STBY SW	Q122 : OFF	Q123 : OFF	
REC	Q121 : OFF	Q120 : OFF	RL101 : OFF
↓			
STBY SW	Q122 : ON	Q123 : OFF	
SEND	Q121 : ON	Q120 : OFF	RL101 : OFF
↓	(Relay protection operation)		
AUTO-THRU	Q122 : ON	Q123 : OFF	RL101 : OFF
AUTO	Q121 : ON	Q120 : OFF	

Fig. 24 Relay protection circuit diagram

CIRCUIT DESCRIPTION

To operate, the AUTO-THRU switch must be set to the AUTO position. when the ATT switch is pressed, the antenna tuner start pulse (At start pulse) of 40–50μs, from the digital unit A microprocessor, triggers the AT-B unit timer IC204a (pin 6) generating an approx. 3 second pulse. Through inverter IC208d and gate IC207a, this pulse clocks JK flip-flop IC205a at pin 3 so that the pin 1 output level toggles from low to high (approx. 14V). A clear pulse, generated by IC205a and b when the power switch is tunred on, sets IC205a pin 1 to its initial low level. The IC205a pin 1 high level turns on Q202 and Q201 to switch approx. 15V to the TRQ terminal (AT ready signal.)

At this AT Ready state, the microprocessor sets tune mode (MODE LED goes out) and, at the same time, the power down circuit for setting the power to 50W operates (in the Control unit)

If, during the 3 second timer operation, the STBY (or mic. PTT) switch is not set to the SEND position, gate IC207d switches at the trailing edge of the timer and clears IC205a (pin 4). This sets the pin1 output to a low level which switches the TRQ terminal to a low level. When the TRQ terminal goes low, the microprocessor returns the radio to the original mode and the power down circuit is released. (**Fig. 26**– Ⓐ)

If during this 3 second period, the STBY switch is set to the send position, the TV line goes high at IC207d input pin 13.

The gate closes and the IC205a pin 1 output is held high. At that time, the antenna tuner circuit starts tuning. When tuning is finished, the capacitor variable antenna coupler motor stops. This state is monitored at the MB terminal and JK flip-flop : IC205b is toggles to a high level by the gates IC208c and IC207b.

This flip-flop is in the clear state when the AT Ready signal is not generated. Gate IC206a detect the leading edge of this JK flip-flop signal and triggers another timer (IC204b). IC206d detects the trailing edge of this approx. 400ms pulse and clears IC205a at pin 4.

This starts the sequence of the TRQ terminal switching to a low level, the microprocessor restoring the mode, the power down circuit being released, and completion of tuning. (**Fig. 26**– Ⓑ)

The timer IC204b works as a tuning delay circuit when a momentary rattling of the motor stop realy occrus.

If the STBY switch is set to the REC position during the tuning operaiton, the AT Ready signal is generated for three seconds. The tuning operaiton is started if the STBY switch is again set to the SEND position.

The MB and TV terminals are monitored by IC206c, IC206b and IC207c and when these terminal levels are changed quickly from high to low (when the STBY switch is set to the REC position before the tuning operation is finished), the first timer (IC204a) is again triggered to operate. Therefore, when the STBY switch is held in the REC position for more than 3 seconds, the AT Ready signal goes low and the original mode is returned. (**Fig. 26**– Ⓒ)

CIRCUIT DESCRIPTION

The antenna tuning circuit is explained next. When the AUTO-THRU selector switch is set to the AUTO position, the ATT switch is pressed and the STBY switch is set to the SEND position, transmit power is supplied from the final via the Filter unit. It passes through the current and voltage detecting transformers (L101 and L102) which use toroidal cores. the current and voltage components are applied to IC101 (pins 9 and 13) and waveform shaped. The output signal is applied to IC102 (D type master-slave flip-flop), where the phase is compared. The output of IC102 (pin 14) runs through the buffer IC103 (pins 10 and 15) and switches the emitter coupled circuit Q101 and Q102

The motor driving circuit Q103–Q108 is operated by this ON-OFF signal, and the variable capacitor (VC1) is rotated forward or backward by the motor M1. The current and voltage components from L101 and L102 are also applied to the voltage comparator IC104a and b (pins 6 and 4), and the output operates the motor driving circuit Q110–Q115 so that the variable capacitor (VC2) is rotated forward or backward by the motor M2 to minimize the amplitude difference.

Therefore, the phase control variable capacitor (VC1) is controlled so that the phases of current and voltage coincide with each other. The voltage control variable capacitor (VC2) is controlled so that the amplitude difference between current and voltage is minimized. (SWR1 with coincidental phases and zero amplitude difference)

VC1 and VC2 are designed to rotate independently. However, since the phase and voltage influence each other, the voltage changes as the phase is changed and the rotations of VC1 and VC2 change accordingly. Also the forward and reflected wave detected in the Filter unit are applied to the Control unit SWR arithmetic circuit, from which they are sent to the AT-A unit ISW terminal as an SWR signal.

this SWR signal is in the currnet mode and is converted in the AT-A unit (IC105b) to make an SWR signal of voltage mode. The signal is then applied to the SWR comparator IC104d (pin 9). The voltage equivalent to SWR 1.2 : 1 is applied to the reference voltage terminal (IC104d, pin 8) through the semi-fixed resistor. Thus, when the SWR is greater than 1.2 : 1 the IC104d output terminal (pin 14) is high and switch Q118 turns the motor voltage supply on. The motor driving circuit is actuated. When the SWR is lowered to below 1.2 : 1 the output terminal (pin 14) of IC104d switches to low, and the switching transistors Q117 and Q118 turn off (motor stop signal), the motor driving circuit turns off and the motor stops.

High motor speed is desired for fast antenna tuning. However, this can cause the match point of SWR less than 1.2 : 1 to be overrun due to increased inertia, the capacitors reversing and tuning past the match point continuously. A slower speed prolonges the operation. Therefore, the TS-940 uses the following method to vary the speed with the SWR. That is, faster with an SWR increase, and slower with an SWR reduction.

The SWR signal sent to the SWR comparator IC104d is also sent to the variable duty motor voltage circuit (IC105a, pin 5). The variable duty circuit uses timer IC106 as a triangle wave oscillator andits outputis applied comparator (IC105a, pin 6) to vary the duty of the output pulse (pin 7). (**Fig. 25**)

Therefore, when the SWR is higher than 5 : 1, the motor driving voltage is at 100% duty, and the motor rotates at high speed. When the SWR value is lowered to 2 : 1, the duty ratio is also lowered (50%) and the motor speed becomes low. As soon as the SWR lowers to below 1.2 : 1 and the motor driving voltage disappears, the motor brake circuit RL7 operates to immediately stop the motor rotation.

The antenna coupler of the TS-940 is a T type and the tap positions from 1.8MHz to 30MHz are switched by eight relays (RL1–6 and 8). The tap switching data is given in **Table 19**.

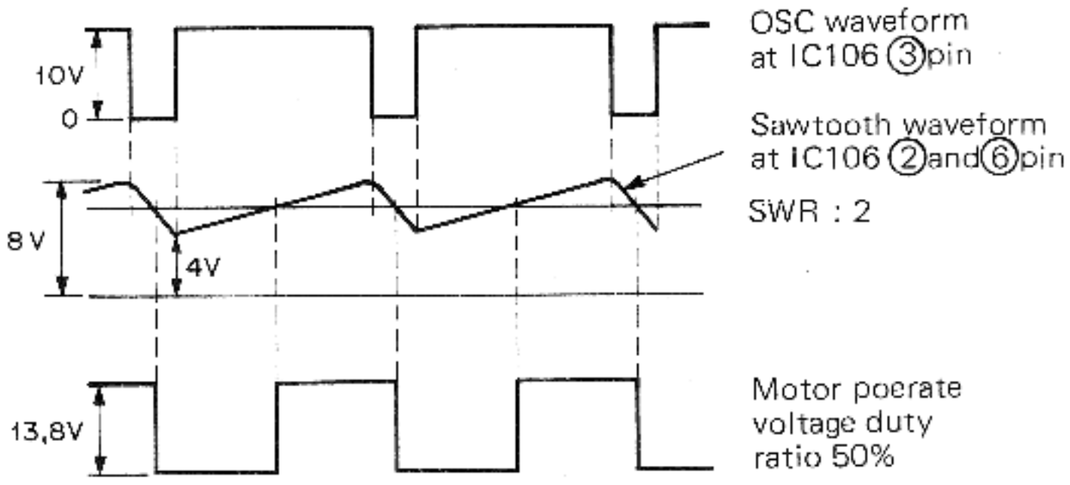
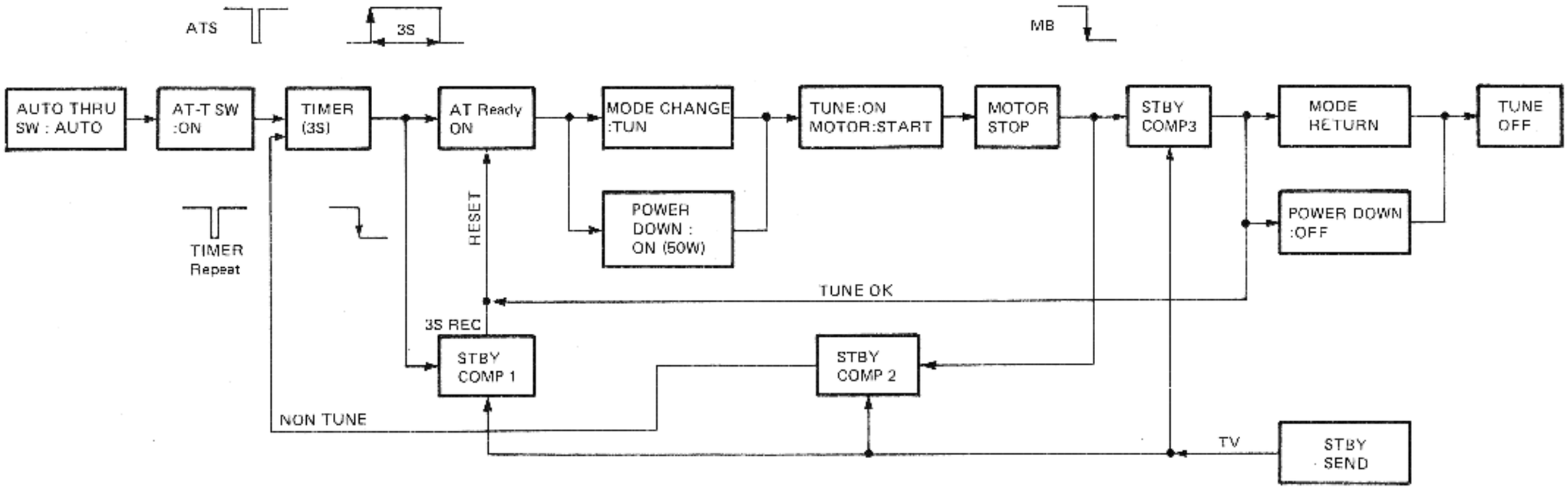


Fig. 25 Tuning motor speed control

BAND	WRC	AT0	AT1	AT2	AT3	RL1	RL2	RL3	RL4	RL5	RL6	RL8
1.8	0	1	0	1	1	○	○	○	○			
3.5	0	0	0	1	1		○	○	○			
7	0	0	1	0	1			○	○			
10	1	1	0	0	1				○			
14	0	0	0	0	1							
18	1	1	1	1	0					○		
21	0	1	1	1	0					○		
24.5	1	0	1	1	0						○	
28	0	0	1	1	0						○	○

Table 19 AT tuner band selection data

CIRCUIT DESCRIPTION



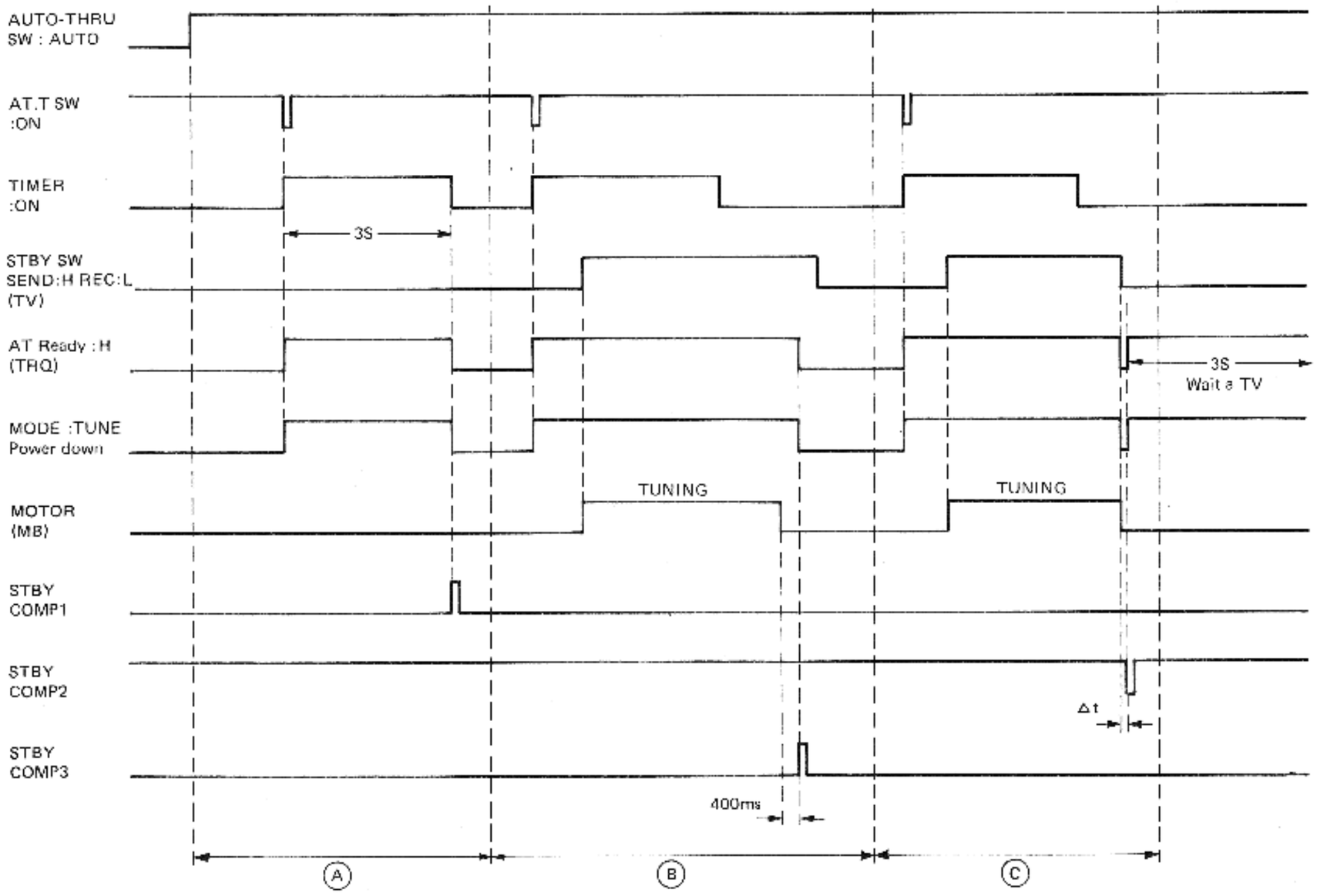


Fig. 26 AT tuner timing chart

CIRCUIT DESCRIPTION

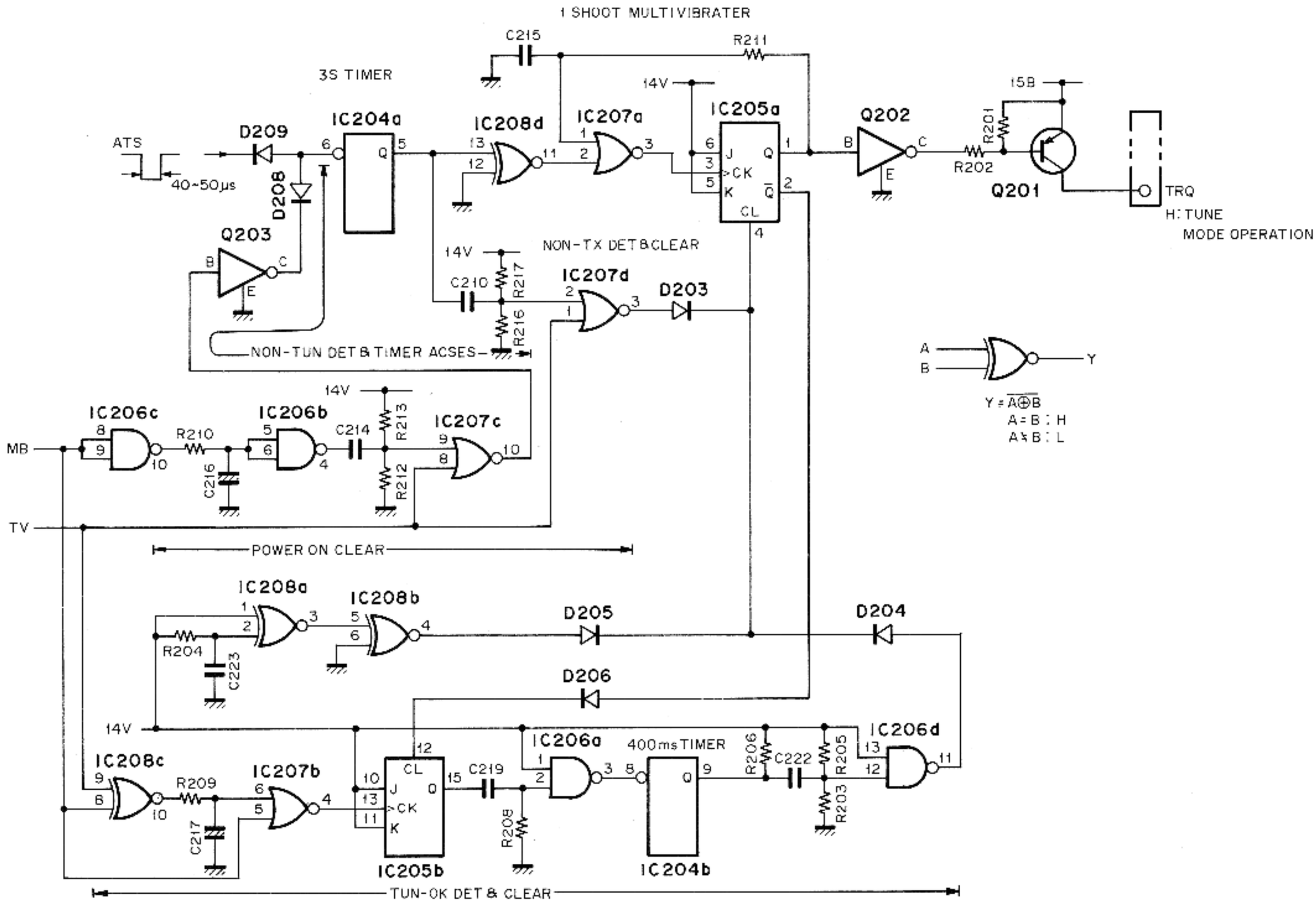


Fig. 27 AT tuner operate detection

Digital Circuit

As shown by the block diagram in **Fig. 28**, the digital control section is the heart of the TS-940 and controls all its units. The digital section consists of the Digital A unit (X54-1830-00), Digital B unit (X54-1840-00 B/2), Digital C unit (X54-1850-00), DC-DC unit (X46-1030-00), Switch unit (X41-1600-00), Main Encoder ass'y (W02-0328-10), RIT Encoder unit (X54-1690-01) and Keyboard ass'y (S59-0433-05), a total of units. The TS-940 is capable of versatile functions, using the latest microprocessor technology. Consequently, about 50 data for the input and about 70 data for the output are handled, requiring an input/output function with much greater capacity than conventional models. To meet this requirement, the microprocessor has an 8-bit multichip construction designed to minimize the number of ICs used : the input/output uses a series of three I/O control ICs 8255 and three LC7800 (Sanyo) are used for multiplexing the input signal for the input data.
Separate descriptions for each unit now follow.

CIRCUIT DESCRIPTION

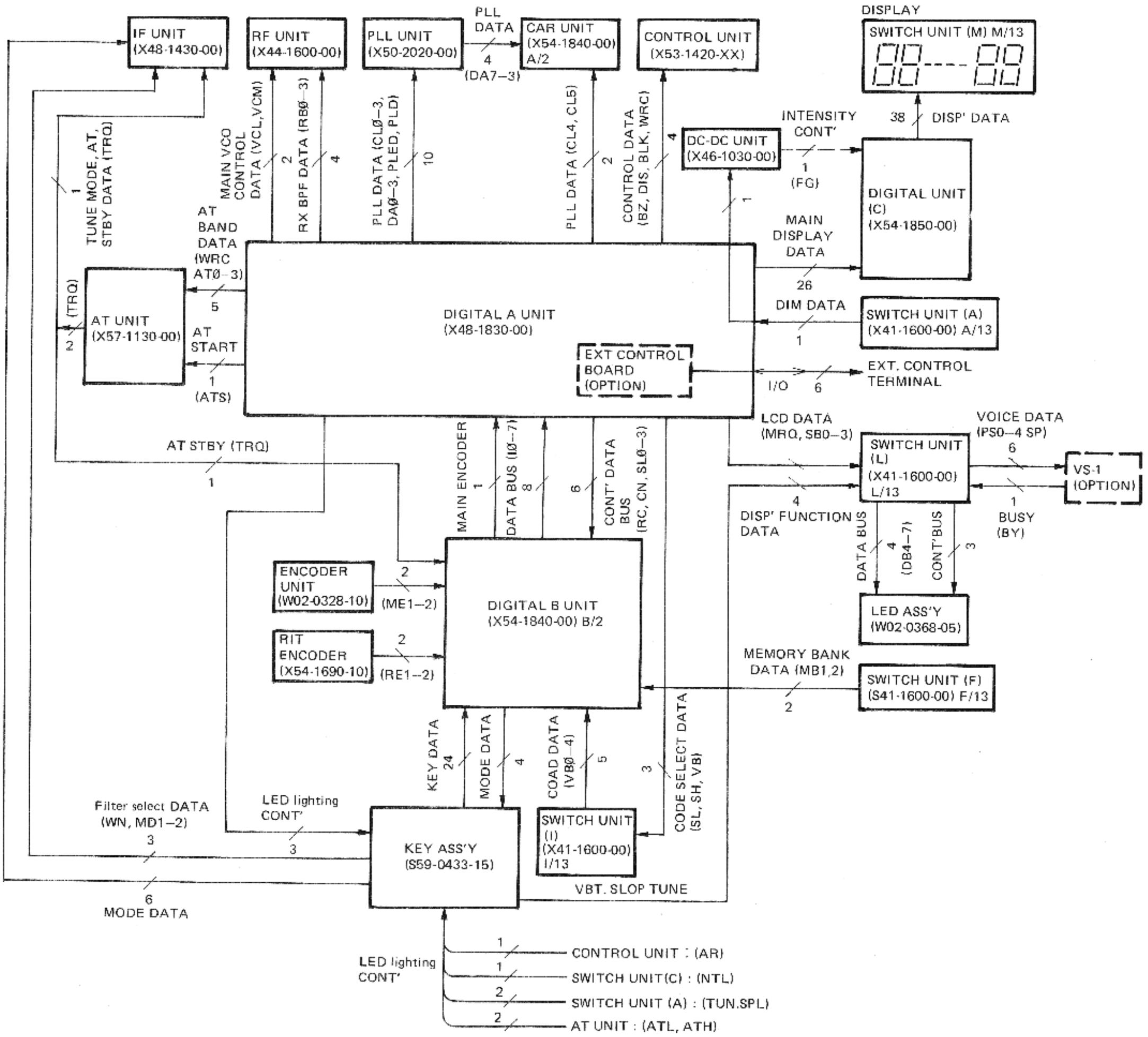


Fig. 28 Digital control block diagram

1) Digital B unit

This unit performs multiplexing of the input, waveform shaping of encoder pulses and detection of AT In/Through (detection of the presence of the AT unit in export models.) The input SW data in the Digital B unit goes to ICs 109, 110 and 111, selected by the port select signal from the Digital A unit, and supplied to the Digital A unit.

As with the TS-930, two optical encoders, for the main VFO and for RIT, are provided. Each converts one dial rotation into pulses and shapes the waveform. In the main encoder, 250 pulses are converted to 1000 pulses; one rotation corresponds to the encoder signal of 10kHz with a resolution of 10Hz. In the fast tuning mode with more than 2 or 3 rotations per second, the variation of frequency progressively increases thanks to a "speed-up" function. (Main encoder ICs 101, 102, 103, 2/4, IC7. RIT encoder ICs 104, 105, 106, 2/4, 107.)

CIRCUIT DESCRIPTION

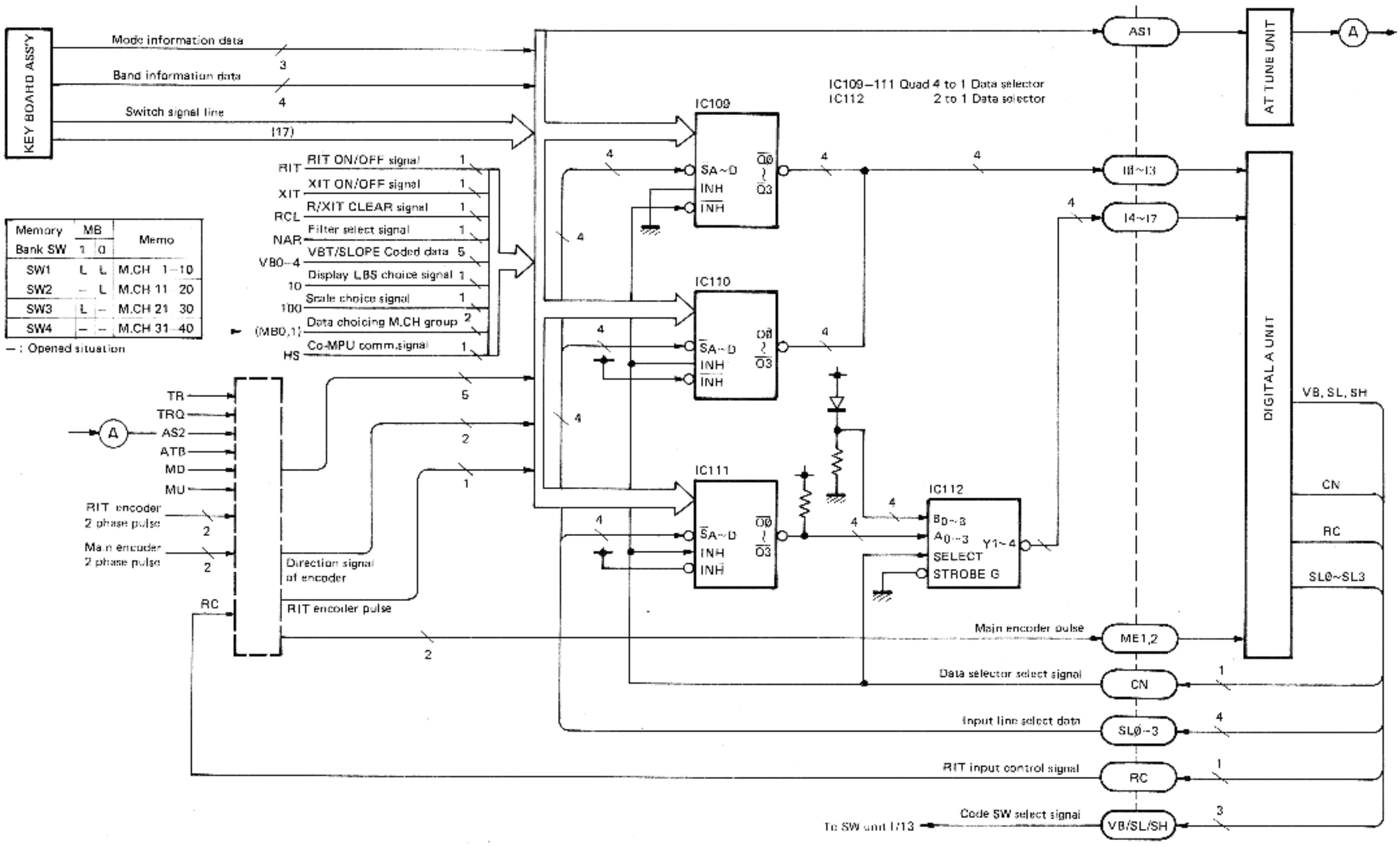


Fig. 29 Digital-B unit block diagram

2) Digital C unit

This unit is used to drive the fluorescent display tube along with the analog dial scale.

As the display data supplied from the Digital A unit has TTL level voltage, the display tube cannot be directly driven. To light the display tube, the drive voltages (heater voltage and display tube drive voltage) from the DC-DC unit is used together with the control data. The display data consists of time-division multiplexing of three data ; the 7-segment data for digits, indicator data such as VFOA, MEMO, RIT, etc., and analog dial scale data. These data are also separated at this occasion.

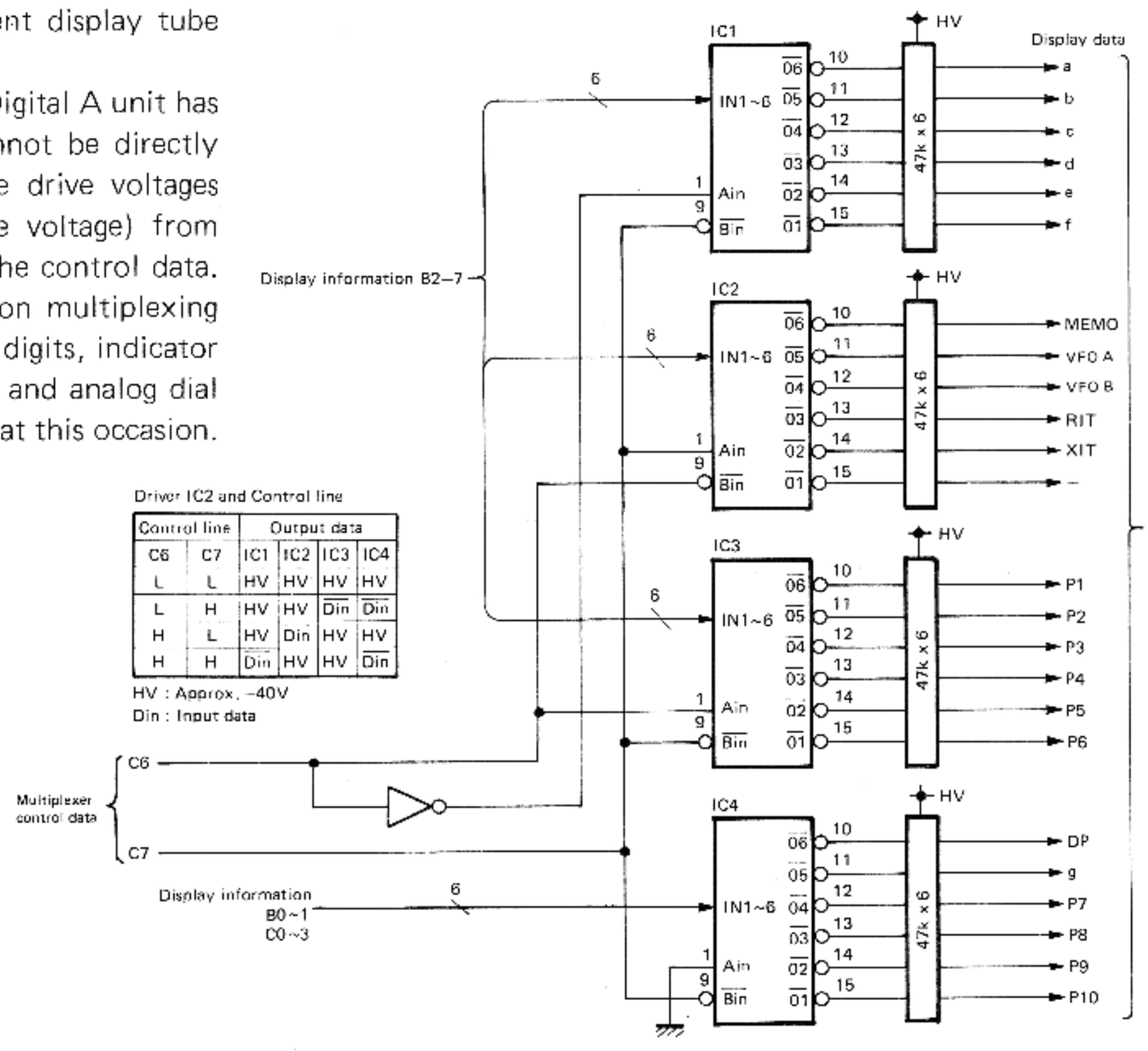


Fig. 30 Dispaly data

CIRCUIT DESCRIPTION

3) DC-DC unit

This unit generates the filament voltage for driving the fluorescent tube and the negative high voltage.

The 21V voltage from the Control unit is converted into —40V by the DC-DC converter.

4) Main Encoder ass'y and RIT Encoder unit

These optical encoders consisting of photoetched disks slit, and a photo-interrupter, both output 2-phase pulses with a phase difference of 90°C. The direction of rotation is judged from this phase difference.

5) Switch unit

Description will be given for the circuitry around the liquid crystal display (hereafter abbreviated LCD.) The TS-940 uses a dual-display system using a newly-developed dot matrix LCD, in addition to a fluorescent tube : in addition to the operating frequency, the display can be switched for the frequency and mode of the alternate VFO, frequencies and modes of the memory channels, bandwidth of VBT/ SLOPE TUNE systems, and clock/timer display. The LCD ass'y consists of the dot matrix LCD and drive IC and is driven from the 4 bit/8 bit data bus. A new 4 bit microprocessor is used for this model and interfacing to the drive IC is performed in 4 bits. The 4 bit microprocessor performs operations such as switching of the display mode, setting of the clock and timer, switching of various displays, data communication with the main microprocessor, outputting of the audio data output from the optional voice synthesizer unit (VS-1), etc.

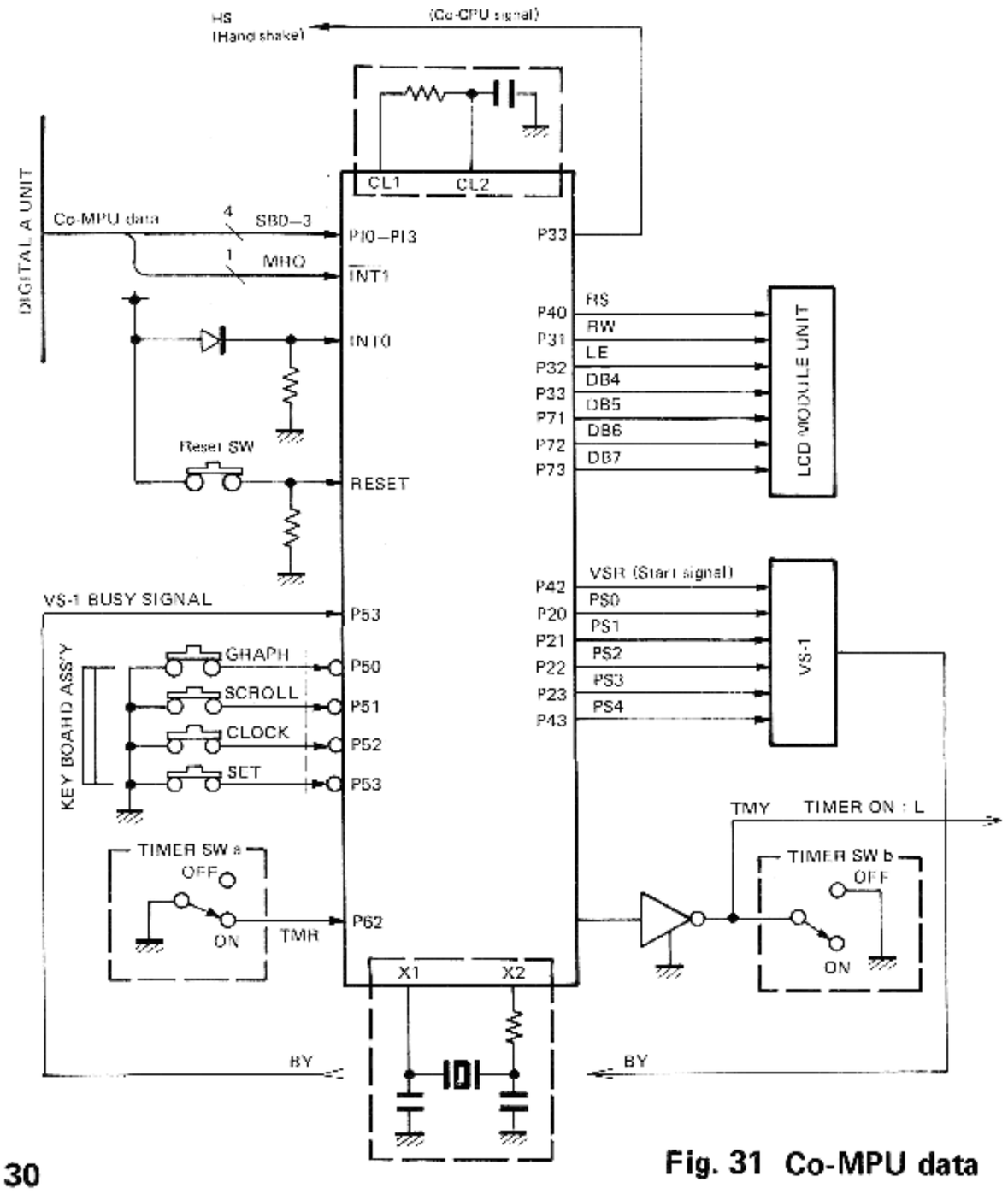


Fig. 31 Co-MPU data

6) Digital A unit

This unit is the control center of units 1) to 5) and for data communications between them. It has a multitip 8-bit construction and the CPU uses a Z-80 operated at a clock rate of 2.5MHz.

The main memory has a large 8-kByte capacity and the 2-kByte RAM backs up several data including the 40-ch memory data, VFO data, RIT frequency, and ON/OFF condition using a lithium battery. The backup timing is controlled by the system reset IC (IC20, PST5184), which interrupts execution at the instant the supply voltage falls below 4.2V to activate the backup mode. (**Fig. 32**)

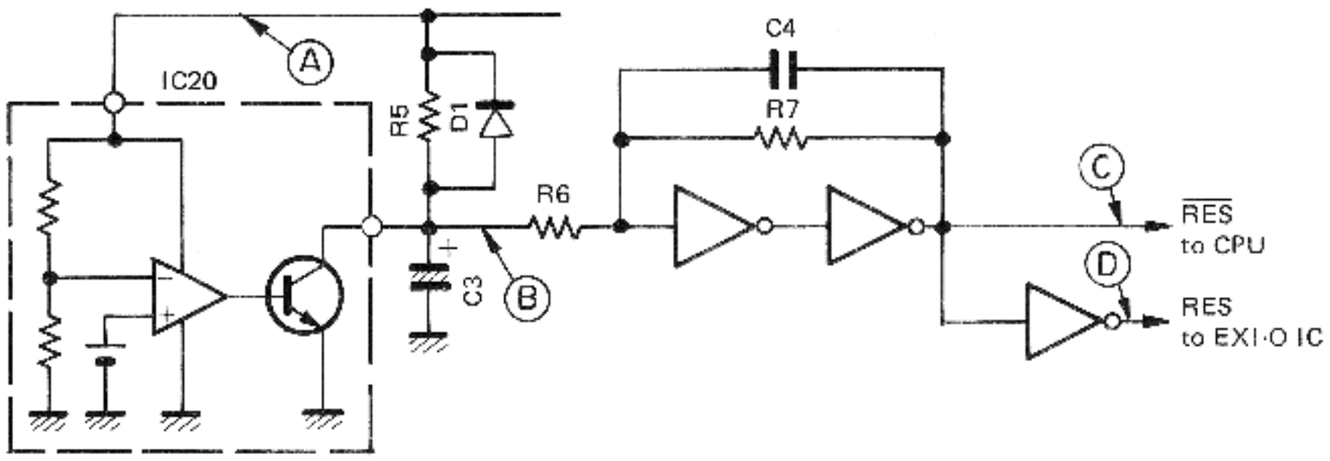
The I/O system uses the memory-mapped I/O system : the 1st 8255 outputs the display data : the 2nd 8255 outputs the AT band data, LPF band data, data outputs for the three main loop PLL ICs and data outputs for the two carrier PLL ICs ; and the 3rd 8255 inputs the switch data and outputs the switch data output and the outputs for the LEDs.

The terminals for the RX bandpass data output and LCD-use submicroprocessor data output are also provided by using the latch output method.

For the antenna tuner standby operation, the AT In/Through condition (and also the presence of an AT in export models) is judged when the ATT SW is pressed : when the condition is OK, the AT standby pulse (active low, about 100μs) is output to the AT unit, which then stands by and sends back the AT Ready signal.

The microprocessor detects this Ready signal, automatically changes the mode to TUN. The mode changes back to the previous mode when tuning is complete. The AT coupler is always supplied with current band data for band switching. (**Fig. 35**) The standby signal is also supplied to the submicroprocessor so that the AT standby message is also output on the sub display. Other circuits used include the mode announce circuit (which indicates the switching of mode by CW codes) the PLL noise blanking circuit which suppresses noise during PLL reset pulse, and the "beep" sound control circuit which indicates when the various tactile switches are pressed.

CIRCUIT DESCRIPTION



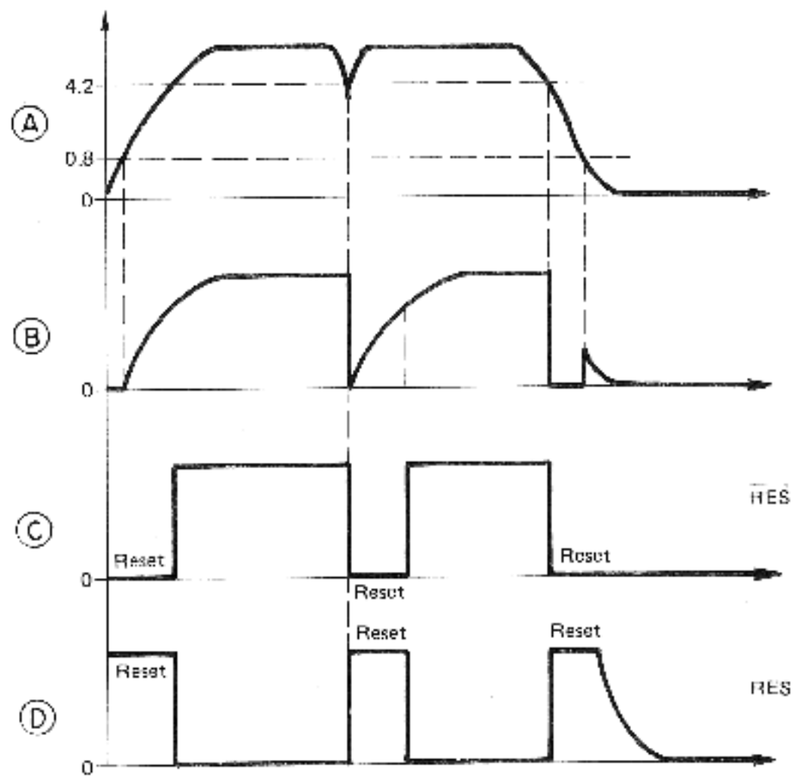


Fig. 32 Reset circuit

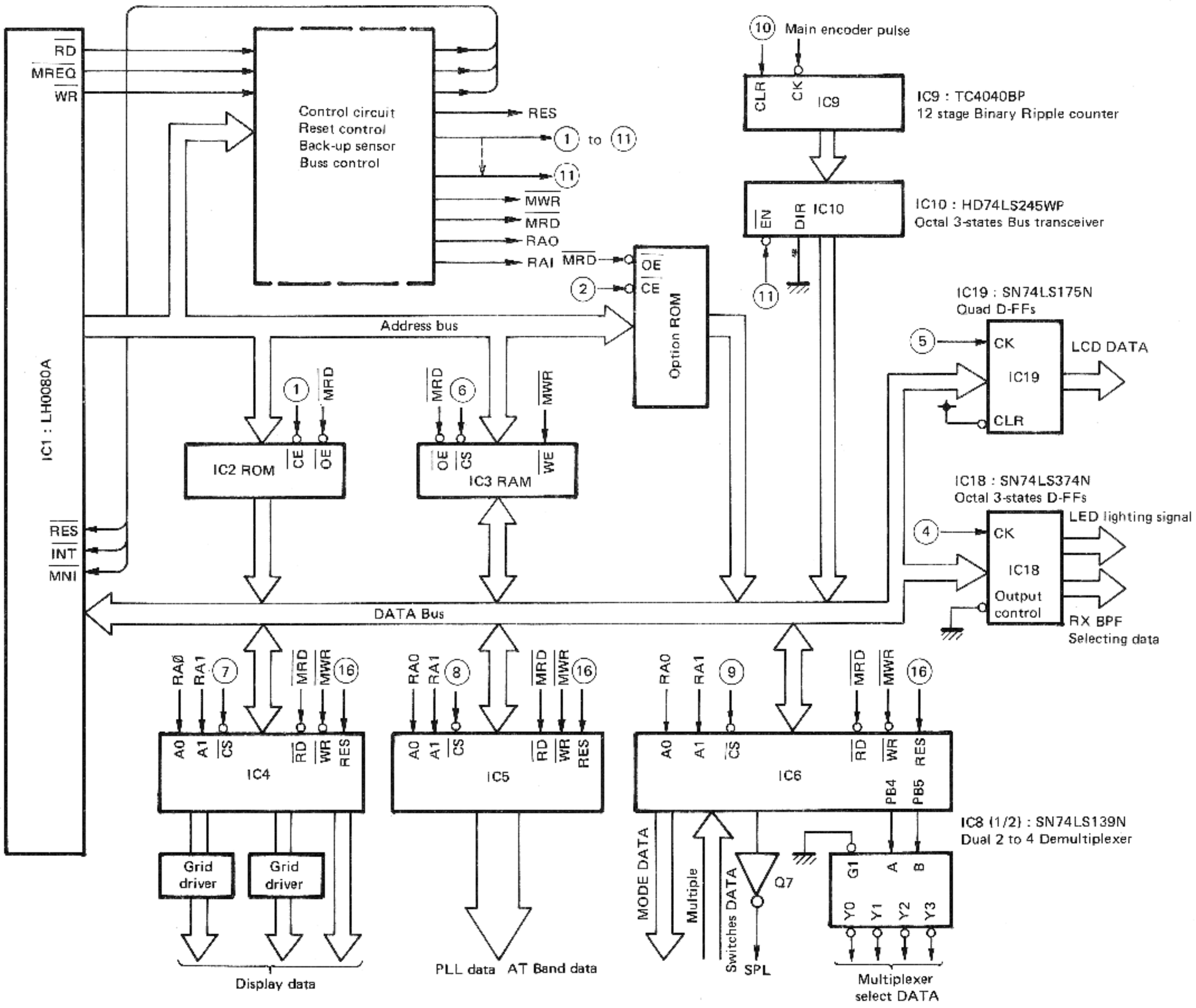


Fig. 33 Digital-A unit block diagram

CIRCUIT DESCRIPTION

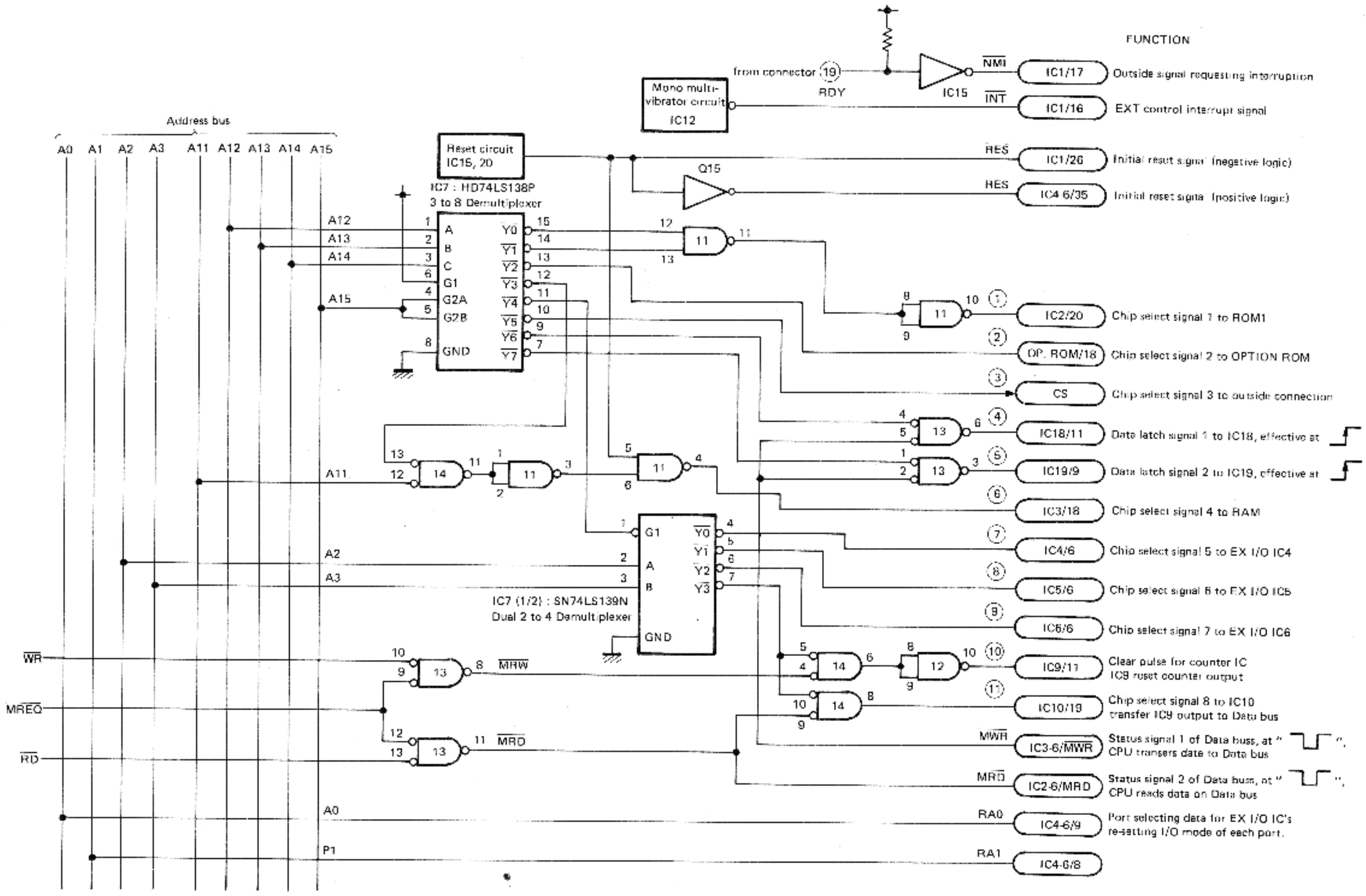
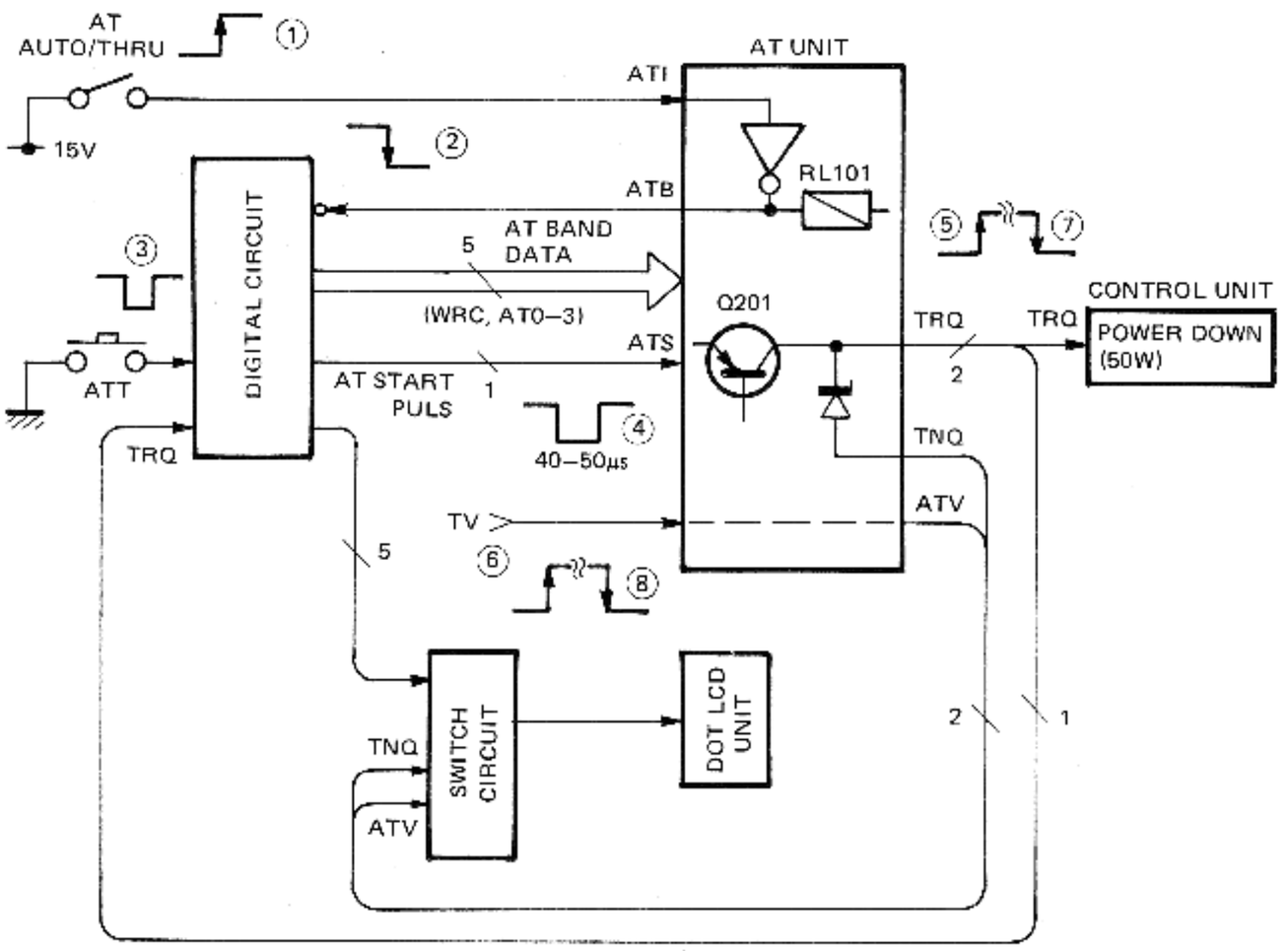


Fig. 34 Digital-A unit control rogic diagram



① AT switch → AUTO
② ATB output → LOW
AT UNIT RL101 → ON
③ ATT switch → 1 push
④ AT start signal out
⑤ TRQ } (AT STBY signal)
TNQ } → Hi level
- LCD DISPLAY
  "ANTENNA TUNER"
  "AUTO TUNE READY"
- TUNE LED → Light ON
- MODE LED → Light OFF
- POWER → 50W

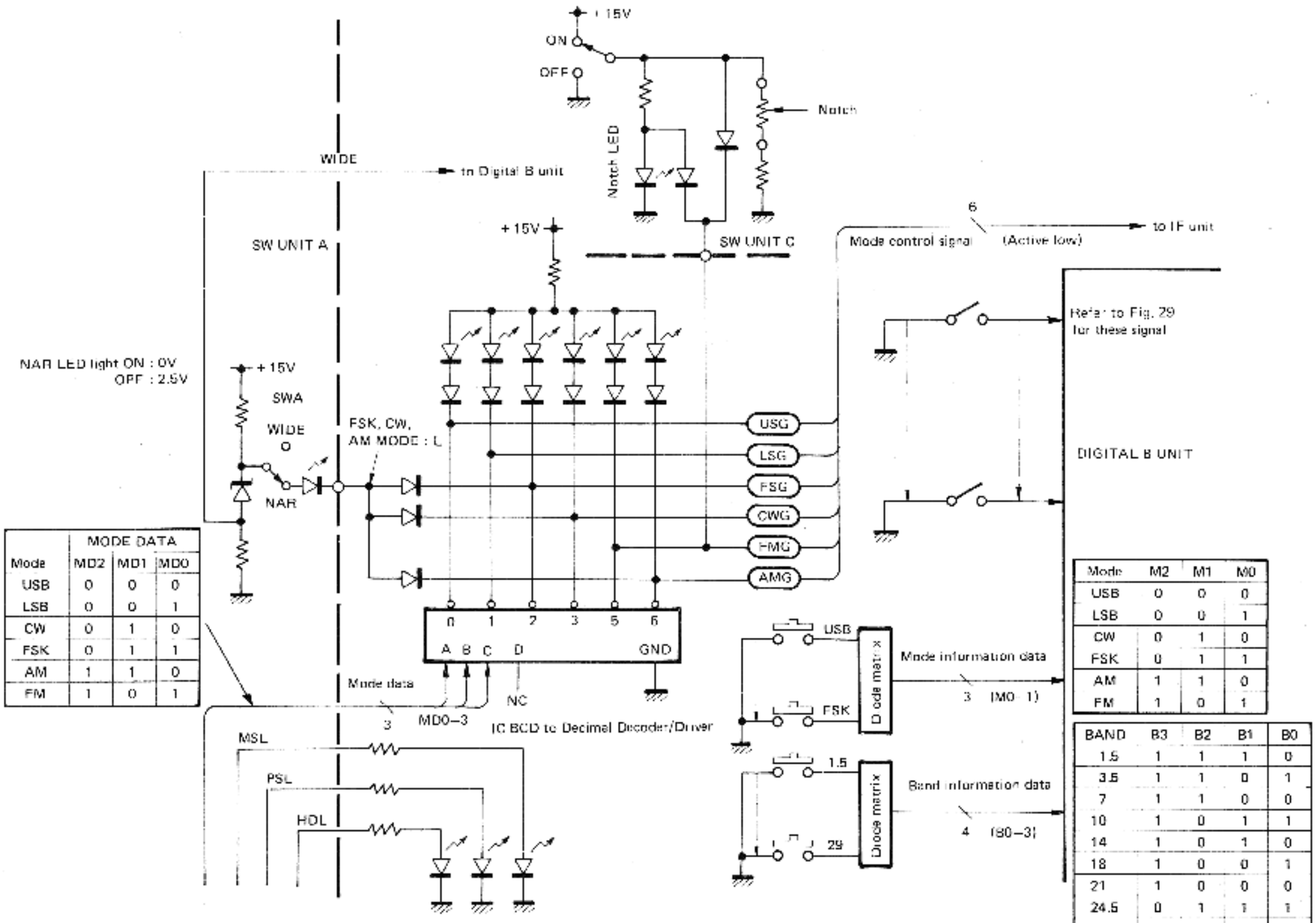
⑥ STBY SW →SEND
- TV → Hi level
- LCD DISPLAY
  "ANTENNA TUNER TUNING ---!!"
- TUNING
- TUN OK

⑦ TRQ } → Low level
TNQ }
- LCD DISPLAY
  "ANTENNA TUNING FINISHED
  TX READY"
- MODE LED → Light ON
- TUNE LED → Light OFF
- POWER → 100W

⑧ STBY SW → REC

Fig. 35 Power control and AT unit

CIRCUIT DESCRIPTION



	MODE DATA		
Mode	MD2	MD1	MD0
USB	0	0	0
LSB	0	0	1
CW	0	1	0
FSK	0	1	1
AM	1	1	0
FM	1	0	1

Mode	M2	M1	M0
USB	0	0	0
LSB	0	0	1
CW	0	1	0
FSK	0	1	1
AM	1	1	0
FM	1	0	1

BAND	B3	B2	B1	B0
1.5	1	1	1	0
3.5	1	1	0	1
7	1	1	0	0
10	1	0	1	1
14	1	0	1	0
18	1	0	0	1
21	1	0	0	0
24.5	0	1	1	1
28	0	1	1	0
29	0	1	0	1

Fig. 36 Keyboard ass'y

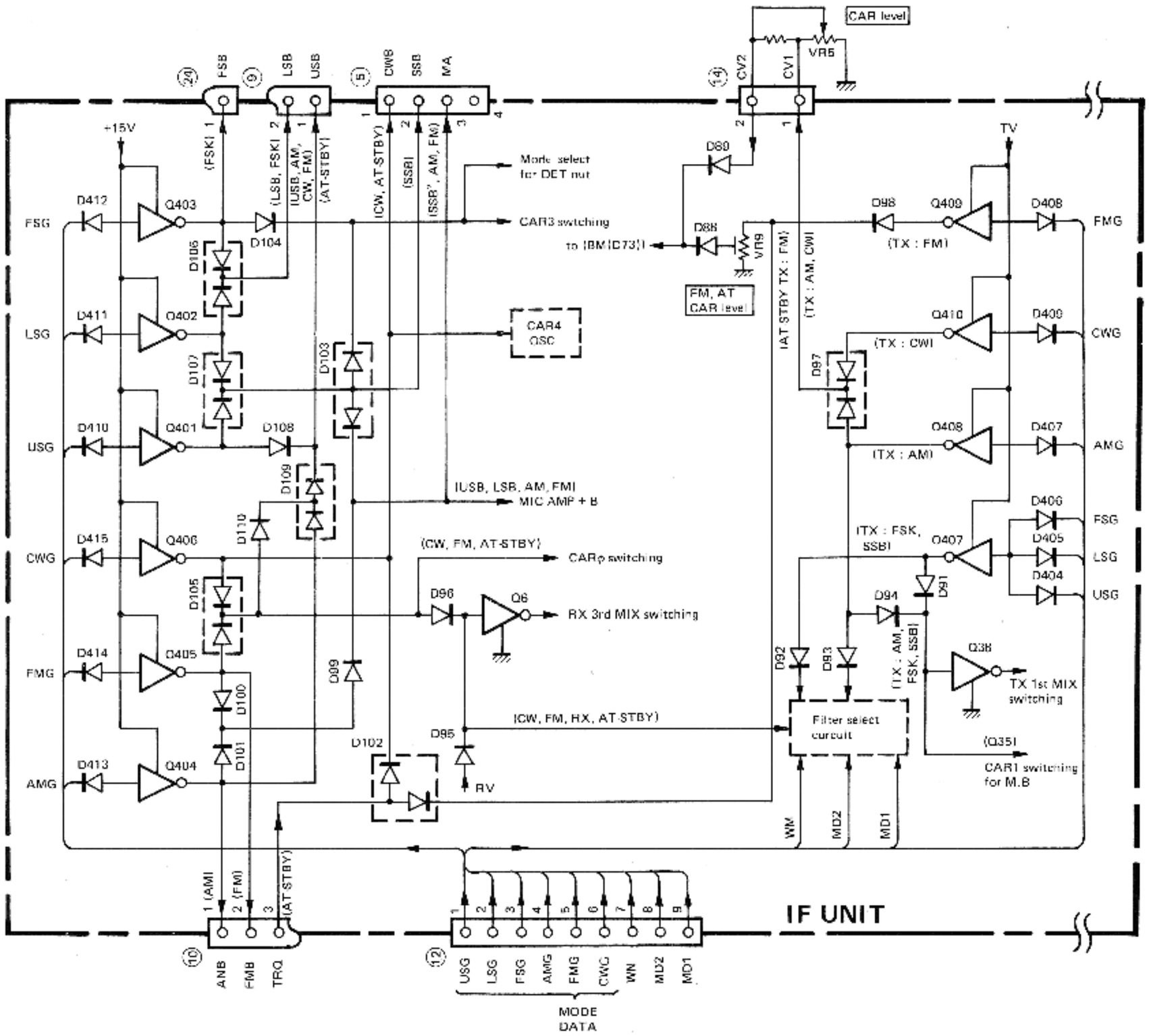


Fig. 37 Mode selector signal block diagram

CIRCUIT DESCRIPTION

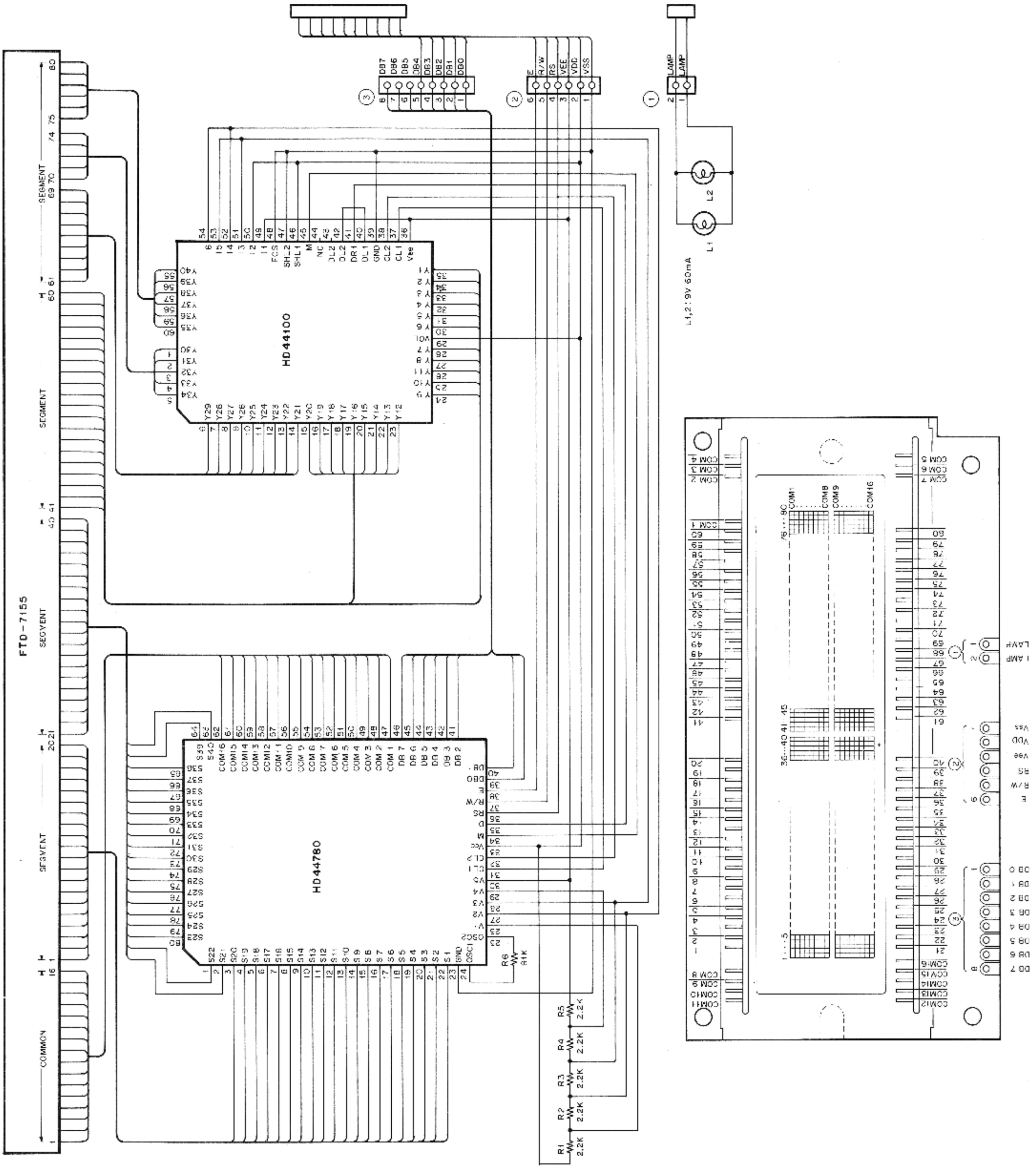
——: BPF cover range

f (MHz)	N3	ND	NA	VCO		RX BPF				LPF			WRC	AT. BAND				
				VC		RB				LP				AT				
				1	0	3	2	1	0	2	1	0		3	2	1	0
0.0– 0.5	77	25	2	0	1	0	0	0	0	0	0	0	0	1	1	0	1
0.5– 1.0	76	25	1	0	1	0	0	0	1	0	0	0	0	1	1	0	1
1.0– 1.5	75	25	0	0	1	0	0	1	0	0	0	1	0	1	1	0	1
1.5– 2.0	74	24	2	0	1	0	0	1	0	0	0	1	0	1	1	0	1
2.0– 2.5	73	24	1	0	1	0	0	1	0	0	0	1	0	1	1	0	1
2.5– 3.0	72	24	0	0	1	0	0	1	0	0	1	1	0	1	1	0	0
3.0– 3.5	71	23	2	0	1	0	0	1	1	0	1	1	0	1	1	0	0
3.5– 4.0	70	23	1	0	1	0	0	1	1	0	1	1	0	1	1	0	0
4.0– 4.5	69	23	0	0	1	0	1	0	0	0	1	1	0	1	1	0	0
4.5– 5.0	68	22	2	0	1	0	1	0	0	1	1	1	0	1	1	0	0
5.0– 5.5	67	22	1	0	1	0	1	0	0	1	1	1	0	1	1	0	0
5.5– 6.0	66	22	0	0	1	0	1	0	0	1	1	1	0	1	0	1	0
6.0– 6.5	65	21	2	0	1	0	1	0	0	1	1	1	0	1	0	1	0
6.5– 7.0	64	21	1	0	1	0	1	0	0	1	1	1	0	1	0	1	0
7.0– 7.5	63	21	0	0	1	0	1	0	1	1	1	1	0	1	0	1	0
7.5– 8.0	62	20	2	0	1	0	1	0	1	1	1	1	0	1	0	1	0
8.0– 8.5	61	20	1	0	1	0	1	0	1	1	1	1	0	1	0	1	0
8.5– 9.0	60	20	0	0	1	0	1	1	0	1	1	0	0	1	0	1	0
9.0– 9.5	59	19	2	0	1	0	1	1	0	1	1	0	1	1	0	0	1
9.5–10.0	58	19	1	1	0	0	1	1	0	1	1	0	1	1	0	0	1
10.0–10.5	57	19	0	1	0	0	1	1	0	1	0	1	1	1	0	0	1
10.5–11.0	56	18	2	1	0	0	1	1	0	1	1	0	1	1	0	0	1
11.0–11.5	55	18	1	1	0	0	1	1	0	1	1	0	1	1	0	0	1
11.5–12.0	54	18	0	1	0	0	1	1	0	1	1	0	1	1	0	0	1
12.0–12.5	53	17	2	1	0	0	1	1	0	1	1	0	1	1	0	0	1
12.5–13.0	52	17	1	1	0	0	1	1	0	1	1	0	0	1	0	0	0
13.0–13.5	51	17	0	1	0	0	1	1	0	1	1	0	0	1	0	0	0
13.5–14.0	50	16	2	1	0	0	1	1	0	1	1	0	0	1	0	0	0
14.0–14.5	49	16	1	1	0	1	0	0	0	1	1	0	0	1	0	0	0
14.5–15.0	48	16	0	1	0	1	0	0	0	1	1	0	0	1	0	0	0
15.0–15.5	47	15	2	1	0	1	0	0	0	1	1	0	0	1	0	0	0
15.5–16.0	46	15	1	1	0	1	0	0	0	1	0	0	0	1	0	0	0
16.0–16.5	45	15	0	1	0	1	0	0	0	1	0	0	1	0	1	1	1
16.5–17.0	44	14	2	1	0	1	0	0	0	1	0	0	1	0	1	1	1
17.0–17.5	43	14	1	1	0	1	0	0	0	1	0	0	1	0	1	1	1
17.5–18.0	42	14	0	1	0	1	0	0	0	1	0	0	1	0	1	1	1
18.0–18.5	41	13	2	1	0	1	0	0	0	1	0	0	1	0	1	1	1
18.5–19.0	40	13	1	1	0	1	0	0	0	1	0	0	1	0	1	1	1
19.0–19.5	39	13	0	1	0	1	0	0	0	1	0	0	1	0	1	1	1
19.5–20.0	38	12	2	0	0	1	0	0	0	1	0	0	1	0	1	1	1
20.0–20.5	37	12	1	0	0	1	0	0	0	1	0	0	0	0	1	1	1
20.5–21.0	36	12	0	0	0	1	0	0	0	1	0	0	0	0	1	1	1
21.0–21.5	35	11	2	0	0	0	1	1	1	1	0	0	0	0	1	1	1
21.5–22.0	34	11	1	0	0	0	1	1	1	1	0	0	0	0	1	1	1
22.0–22.5	33	11	0	0	0	0	1	1	1	0	1	0	0	0	1	1	1
22.5–23.0	32	10	2	0	0	0	1	1	1	0	1	0	0	0	1	1	1
23.0–23.5	31	10	1	0	0	0	1	1	1	0	1	0	1	0	1	1	0
23.5–24.0	30	10	0	0	0	0	1	1	1	0	1	0	1	0	1	1	0
24.0–24.5	29	9	2	0	0	0	1	1	1	0	1	0	1	0	1	1	0
24.5–25.0	28	9	1	0	0	0	1	1	1	0	1	0	1	0	1	1	0
25.0–25.5	27	9	0	0	0	0	1	1	1	0	1	0	1	0	1	1	0
25.5–26.0	26	8	2	0	0	0	1	1	1	0	1	0	1	0	1	1	0
26.0–26.5	25	8	1	0	0	0	1	1	1	0	1	0	1	0	1	1	0
26.5–27.0	24	8	0	0	0	0	1	1	1	0	1	0	1	0	1	1	0
27.0–27.5	23	7	2	0	0	0	1	1	1	0	1	0	0	0	1	1	0
27.5–28.0	22	7	1	0	0	0	1	1	1	0	1	0	0	0	1	1	0
28.0–29.5	21	7	0	0	0	0	1	1	1	0	1	0	0	0	1	1	0
28.5–29.0	20	6	2	0	0	0	1	1	1	0	1	0	0	0	1	1	0
29.0–29.5	19	6	1	0	0	0	1	1	1	0	1	0	0	0	1	1	0
29.5–30.0	18	6	0	0	0	0	1	1	1	0	1	0	0	0	1	1	0
30.0–30.5	17	5	2	0	0	0	1	1	1	0	1	0	0	0	1	1	0

*N3 = 3ND + NA

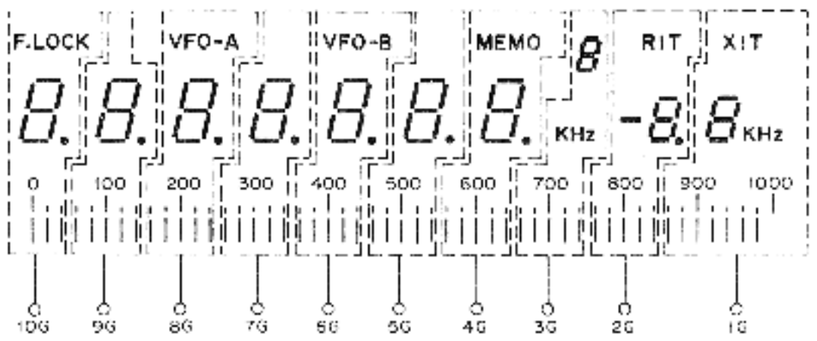
Table 20 Frequency control data

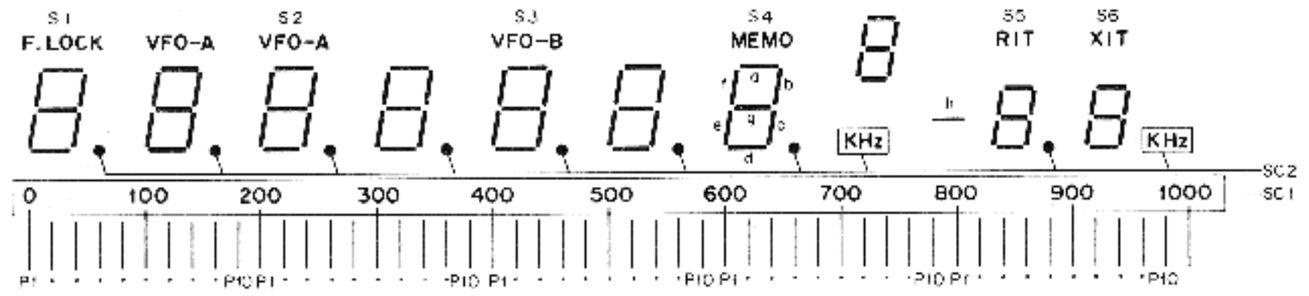
SEMICONDUCTOR DATA



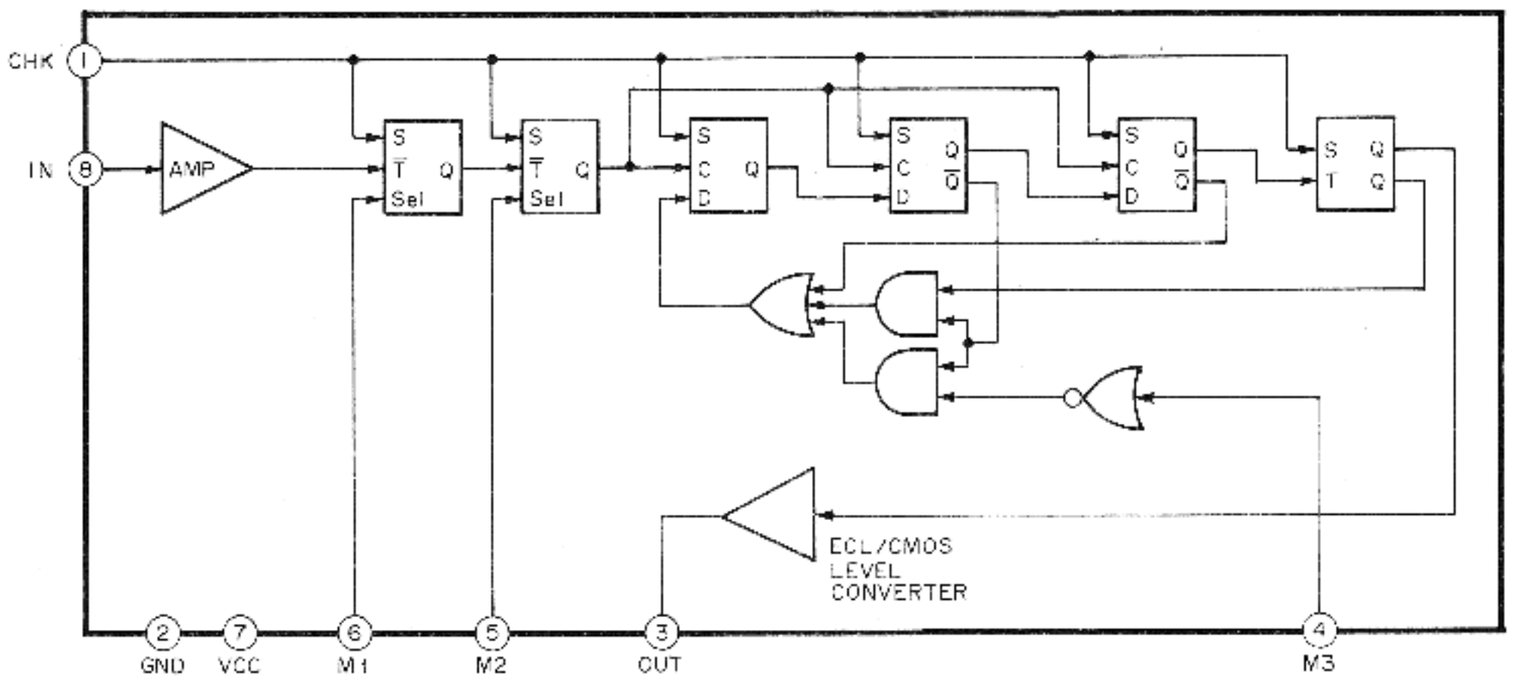
FTD-7155 (LCD unit V1)

SEMICONDUCTOR DATA

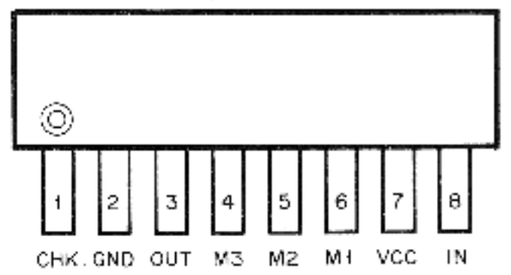




11-BT-05Z (SW unit-M V1)



HD10551 Block diagram (PLL unit IC5, 11)

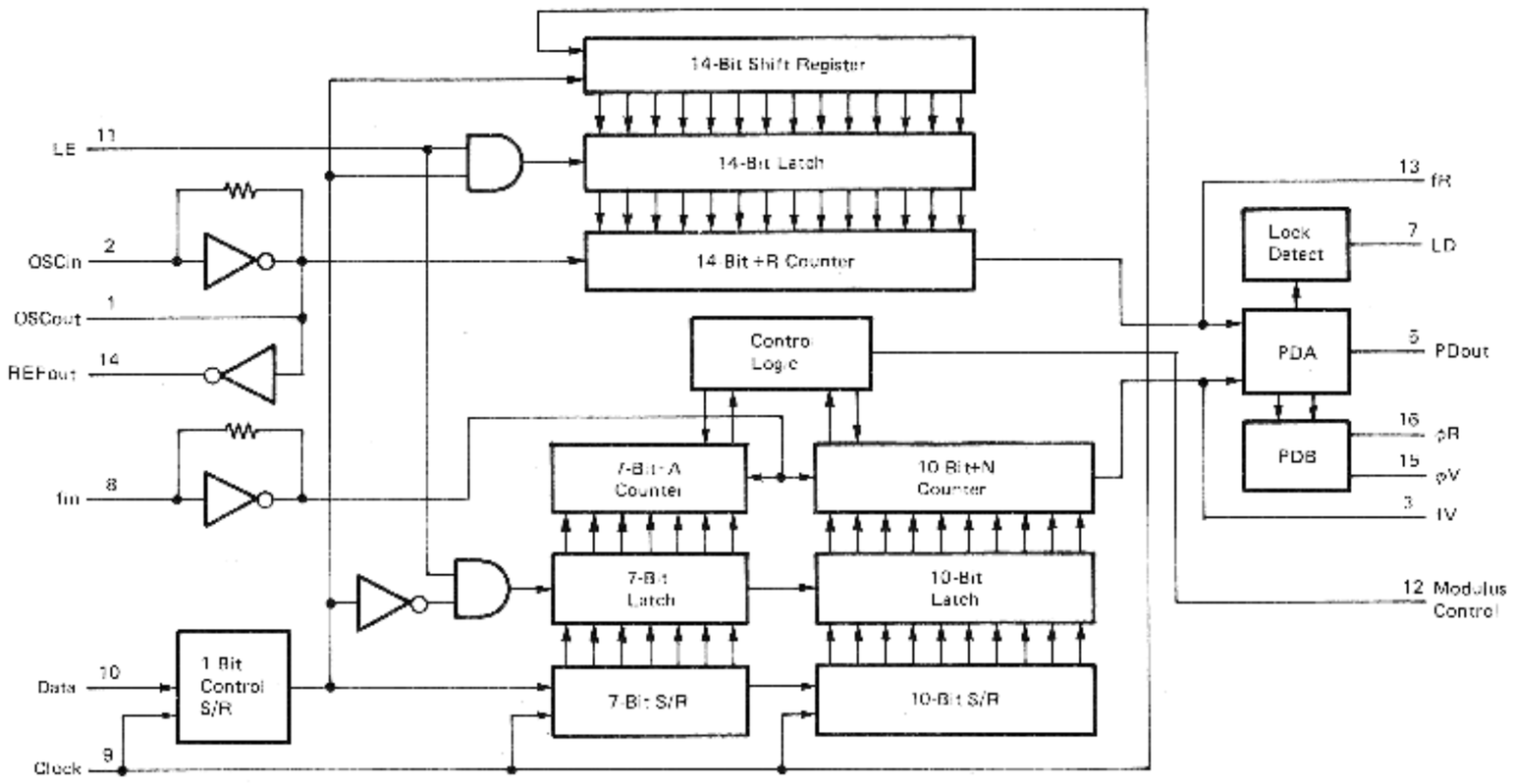


HD10551 Terminal

Symbol	Value	Unit
Vcc	8	V
Vin	8	V
PT	350 (at 75°C)	mW
Topr	−30~ + 75	°C
Tstg	−55~ + 125	°C

HD10551 Max. rating

Divid	CHK 1 pin	M1 6 pin	M2 5 pin	M3 4 pin
1/10	GND	Vcc	Vcc	GND
1/11	GND	Vcc	Vcc	Vcc
1/20	GND	GND	Vcc	GND
1/22	GND	GND	Vcc	Vcc
1/40	GND	GND	GND	GND
1/44	GND	GND	GND	Vcc

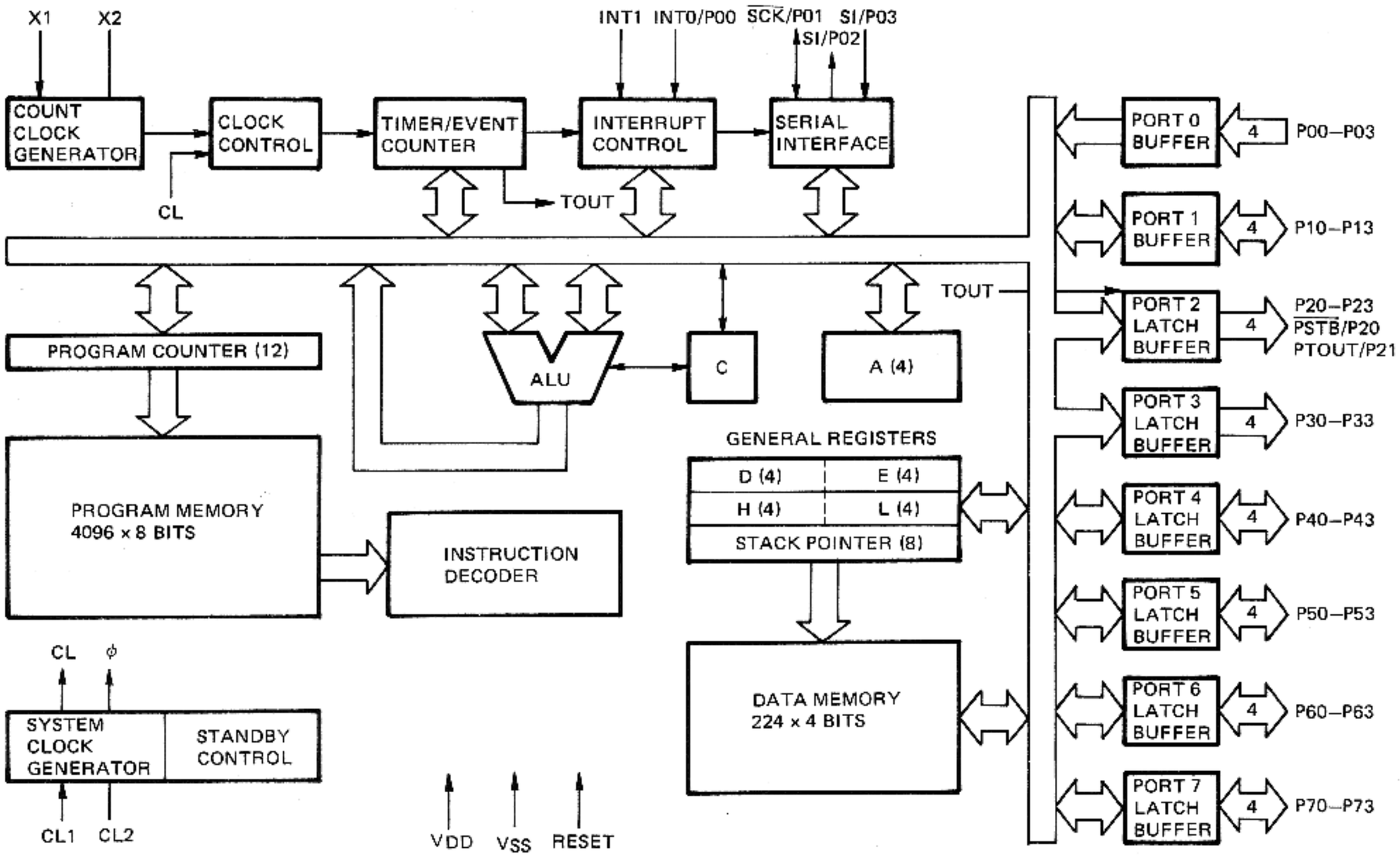


MC145158P Block diagram (PLL unit IC17)

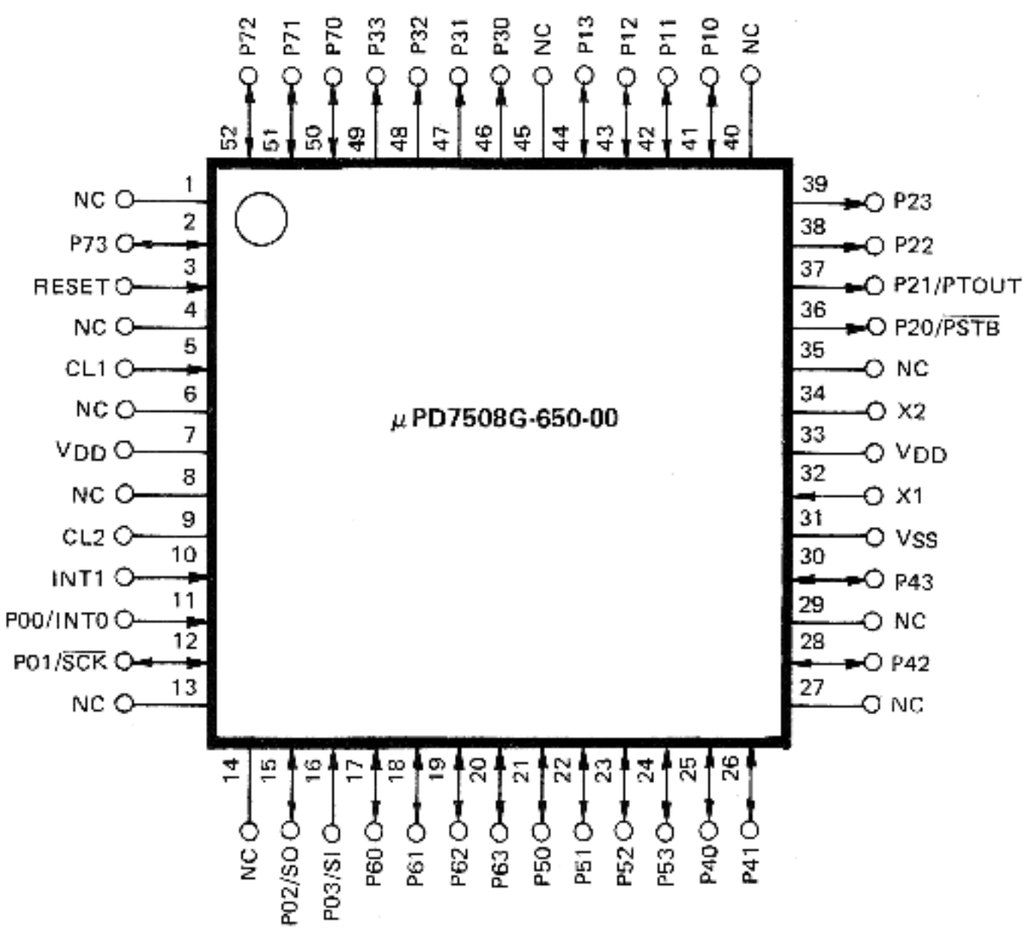
Symbol	Value	Unit
VDD	−0.5 to + 10	V
Vin	−0.5 to VDD + 0.5	V
I	10	mA
I	30	mA
TA	−40 to + 85	°C
Tstg	−65 to + 150	°C

MC145158P Max. rating

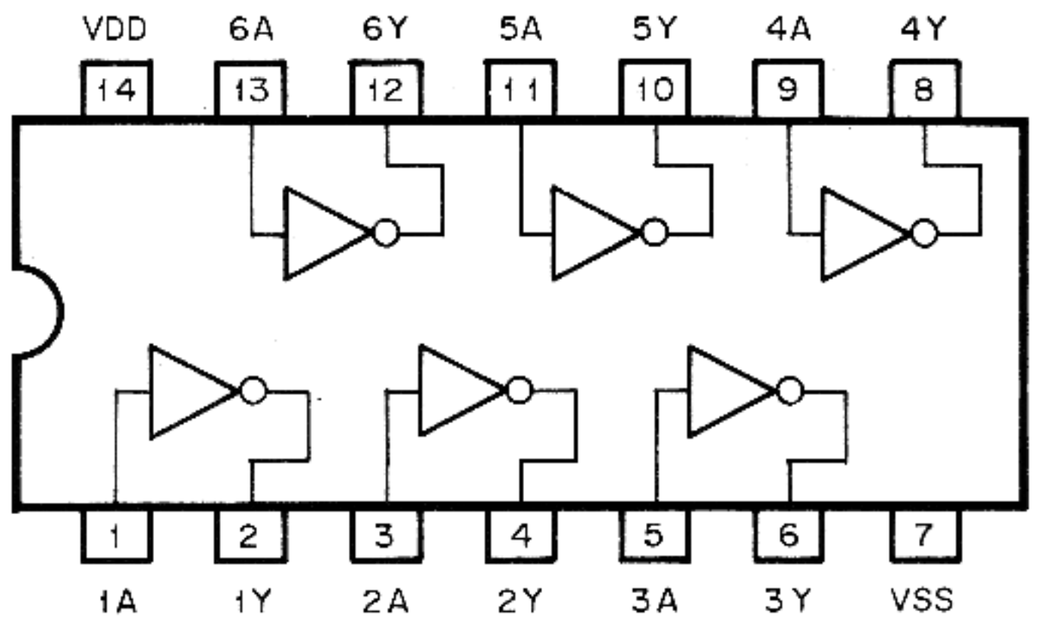
SEMICONDUCTOR DATA



μPD7508G-650-00 Block diagram (SW unit (L) IC1)



μPD7508G-650-00 (Top view)

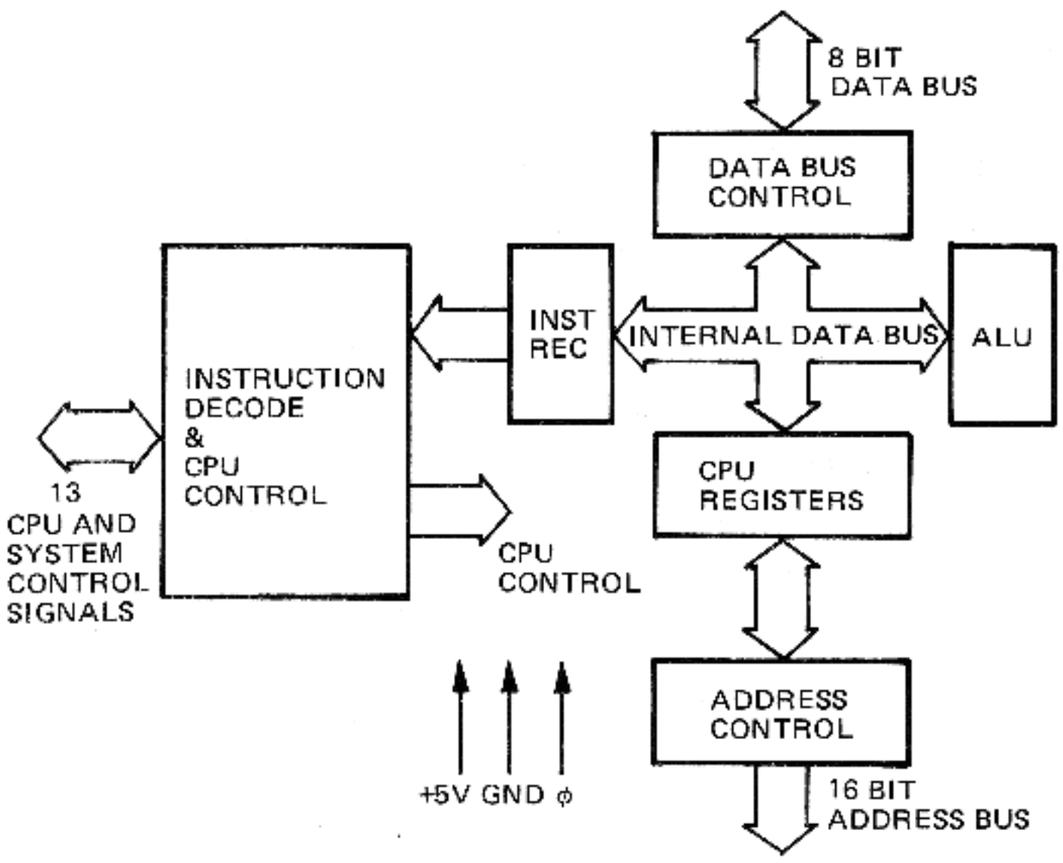


TC40H004P (DG-A unit IC15)

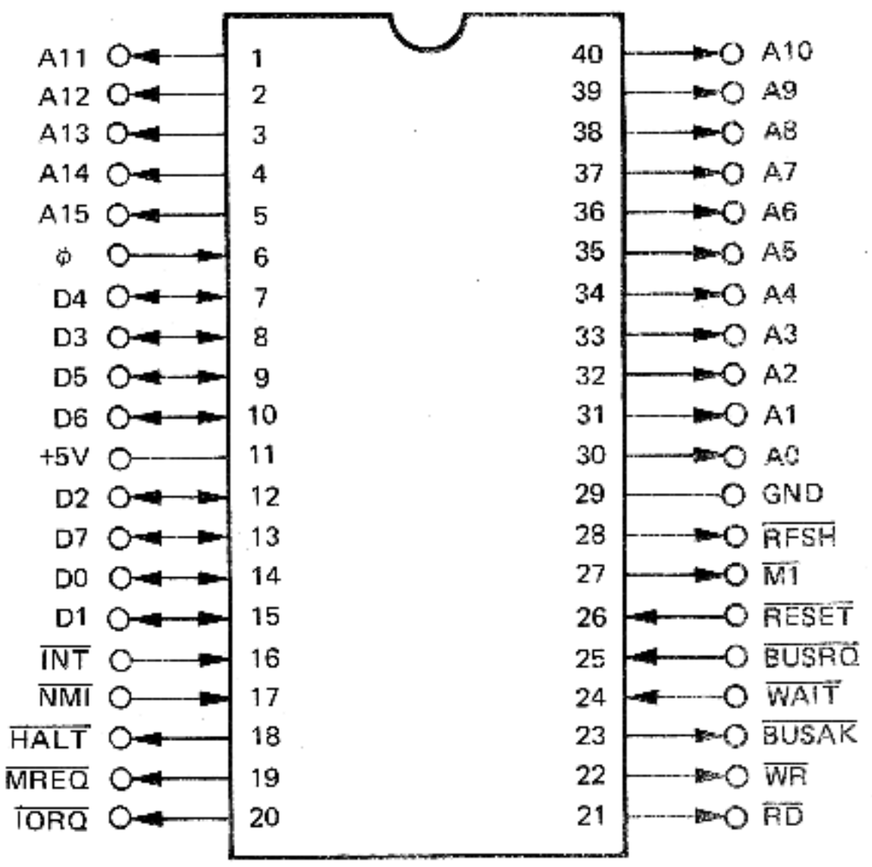
Symbol	Rating	Unit
V_{DD}	Vss–0.5~Vss + 10	V
V_{IN}	Vss–0.5~V_{DD} + 0.5	V
V_{OUT}	Vss–0.5~V_{DD} + 0.5	V
I_{IN}	±10	mA
P_D	300 (DIP)/180 (MFP)	mW
Totg	–65~150	°C
Tsol	260°C · 10sec	

TC40H004P Max. rating

SEMICONDUCTOR DATA



LH-0080A Block diagram (DG-A unit IC1)



LH-0080A (Top view)

MAIN REG SET / ALTERNATE REG SET

ACCUMULATOR	FLAGS	ACCUMULATOR	FLAGS
A	F	A	F′
B	C	B	C′
D	E	D′	E
H	L	H′	L′

GENERAL PURPOSE REGISTERS

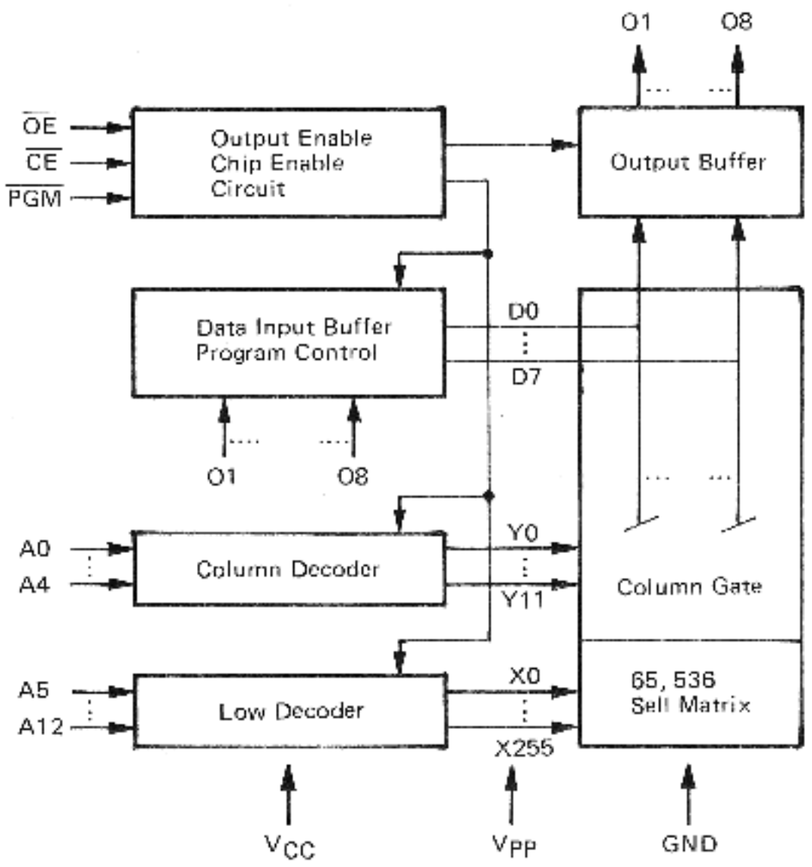
INTERRUPT VECTOR I	MEMORY REFRESH R
INDEX REGISTER IX	
INDEX REGISTER IV	
STACK POINTER SP	
PROGRAM COUNTER PC	

SPECIAL PURPOSE REGISTERS

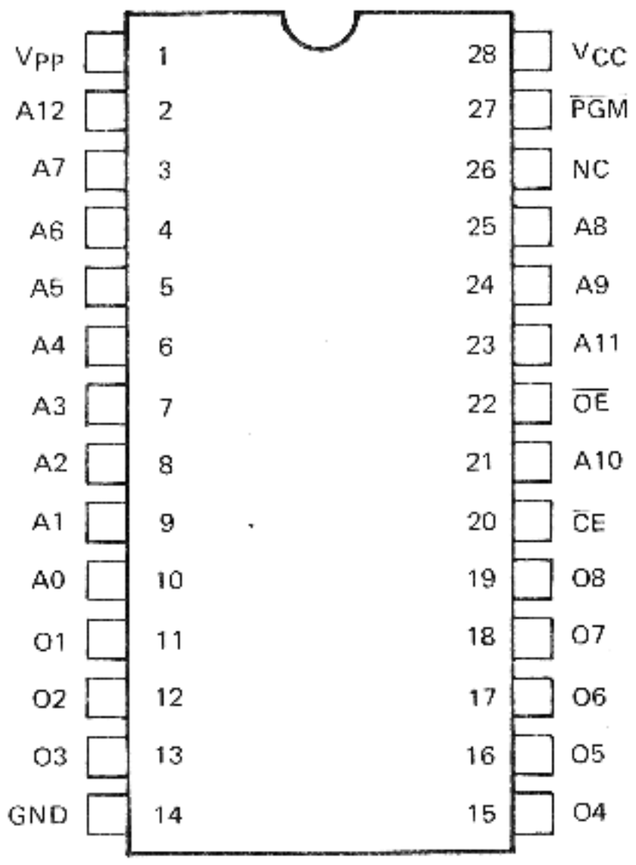
Terminal No.	Terminal Name	Terminal Function
1	A11	Address bus
2	A12	
3	A13	
4	A14	
5	A15	
6	φ	Clock input approx. 2.5MHz
7	D4	Data bus
8	D3	
9	D5	
10	D6	
11	+ 5V	Power supply
12	D2	Data bus
13	D7	
14	D0	
15	D1	
16	$\overline{INT}$	Interrupt input
17	$\overline{MNI}$	External control interrupt input
18	$\overline{HALT}$	Not used.
19	$\overline{MREQ}$	External access. signal output
20	$\overline{IORQ}$	Not used.
21	RD	Read strobe output
22	WR	Write strobe output
23	$\overline{BUSAK}$	Not used
24	$\overline{WAIT}$	Not used.
25	$\overline{BUSRQ}$	Not used.
26	$\overline{RESET}$	Reset input (active : L)
27	$\overline{M1}$	Not used.
28	$\overline{RFSH}$	Not used.
29	GND	GND
30	A0	Address bus
31	A1	
32	A2	
33	A3	
34	A4	
35	A5	
36	A6	
37	A7	
38	A8	
39	A9	
40	A10	

LH-0080A Terminal function

SEMICONDUCTOR DATA



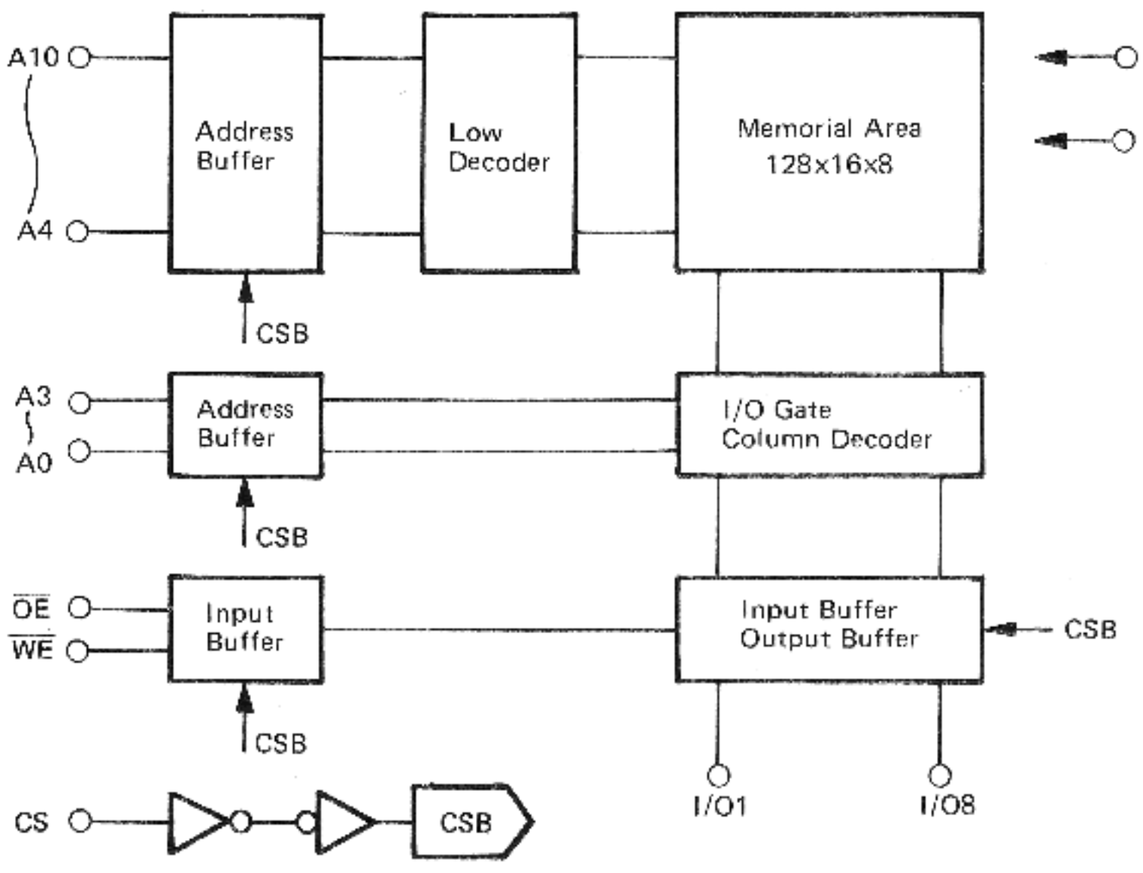
MBM2764-30 Block diagram (DG-A unit IC2)



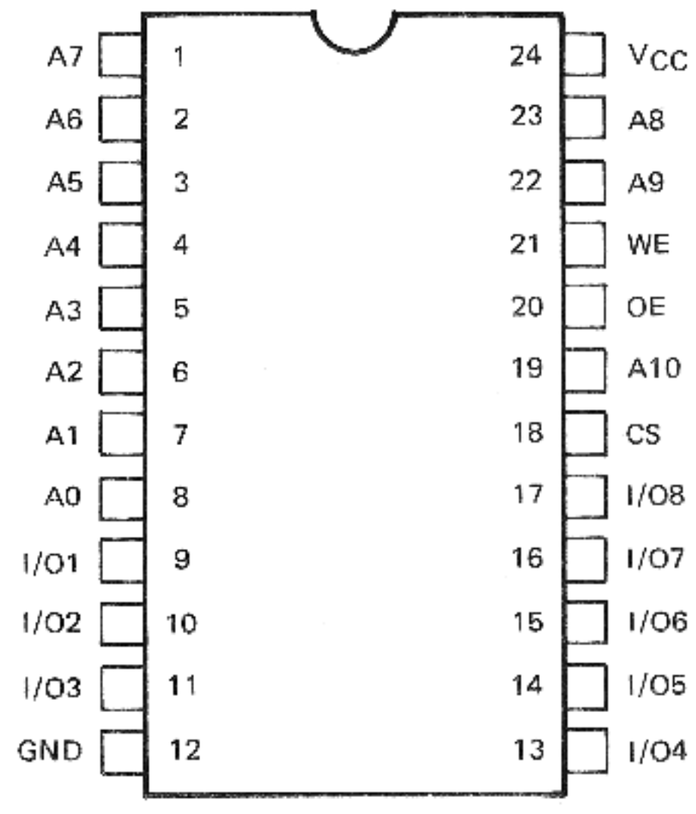
MBM2764-30 (Top view)

Symbol	Terminal Name	Symbol	Terminal Name
A0—A12	Address input	Vpp	Program power supply
O1—O8	Data output (input)	Vcc	Power supply (+ 5V)
$\overline{CE}$	Chip enable	GND	Ground
$\overline{OE}$	Output enable	NC	No connection
$\overline{PGM}$	Program input·output enable		

MBM2764-30 Terminal name



MB8416-20LP-GRA Block diagram (DG-A unit IC3)

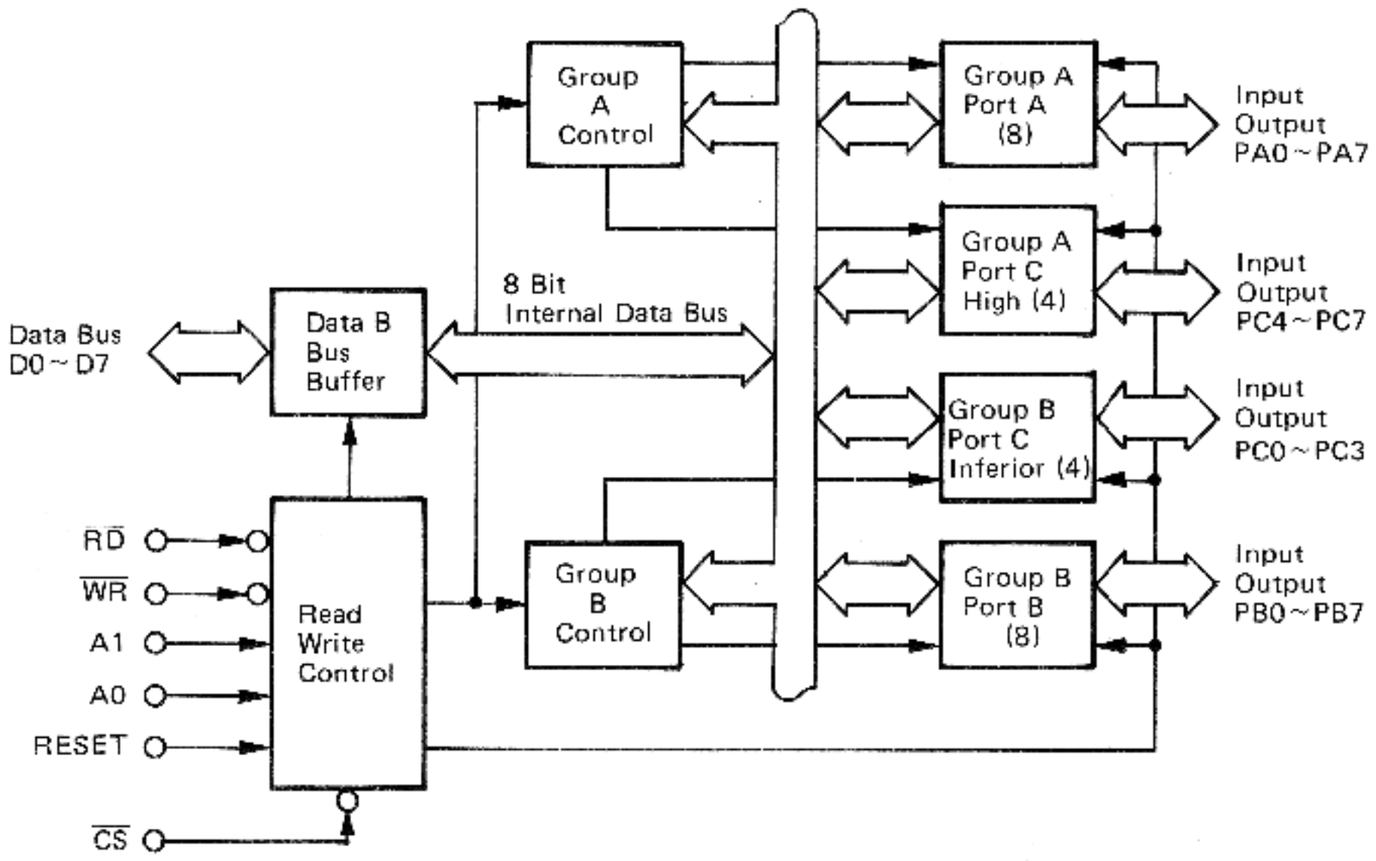


MB8416-20LP-GRA (Top view)

Symbol	Terminal Functions	Symbol	Terminal Functions
A0—A10	Address input	WE	Write enable
I/01—I/08	Data input, output	Vcc	Power supply (+5V)
CS	Chip select	GND	Ground
OE	Output enable	NC	Not connected.

MB8416-20LP-GRA Terminal name

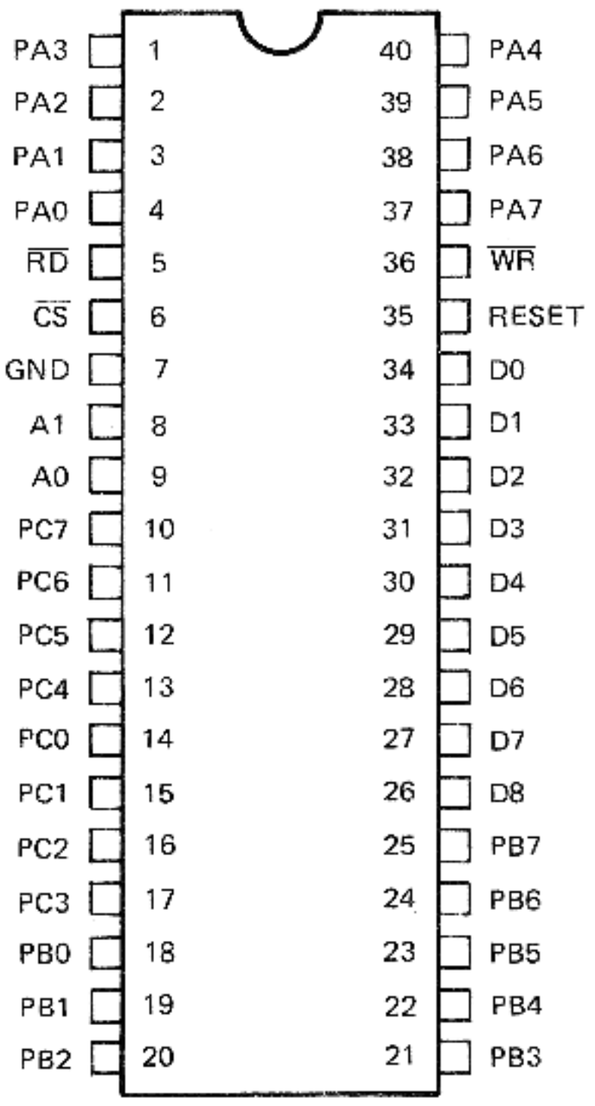
SEMICONDUCTOR DATA



Terminal name

D0—D7 :	Data bus (each direction)	A0,A1 :	Port address
CS :	Chip select	PA0—PA7 :	Port A input, output
RESET :	Reset	PB0—PB7 :	Port B input, output
RD :	Read control	PC0—PC7 :	Port C input, output
WR :	Write control		

μPD8255AC-5 Block diagram (DG-A unit IC4—6)



μPD8255AC-5 (Top view)

Terminal No.	Terminal Name	Terminal Function	Terminal No.	Terminal Name	Terminal Function
1	PA3	Display tube grid drive signal G4	21	PB3	Segment data b/VFO A/P2
2	PA2	Display tube grid drive signal G3	22	PB4	Segment data c/VFO B/P3
3	PA1	Display tube grid drive signal G2	23	PB5	Segment data d/RIT/P4
4	PA0	Display tube grid drive signal G1	24	PB6	Segment data e/XIT/P5
5	RD	Read strobe input	25	PB7	Segment data f/—/P6
6	CS	Chip select input	26	Vcc	+ 5V
7	GND	GND	27	D7	Data bus
8	A1	Address signal input	28	D6	
9	A0	Address signal input	29	D5	
10	PC7	Segment data control bit	30	D4	
11	PC6		31	D3	
12	PC5	Display tube grid drive signal G10	32	D2	
13	PC4	Display tube grid drive signal G9	33	D1	
14	PC0	Analog data P7	34	D0	
15	PC1	Analog data P8	35	Reset	Reset input (Active : H)
16	PC1	Analog data P9	36	WR	Write strobe input
17	PC3	Analog data P10	37	PA7	Display tube grid drive signal G8
18	PB0	Segment data dp	38	PA6	Display tube grid drive signal G7
19	PB1	Segment data g	39	PA5	Display tube grid drive signal G6
20	PB2	Segment data a/MEMO/P1	40	PA4	Display tube grid drive signal G5

Note) Each data of pins 20—26 is choosen by the three types data of pins 10,11.

Terminal function (IC4)

SEMICONDUCTOR DATA

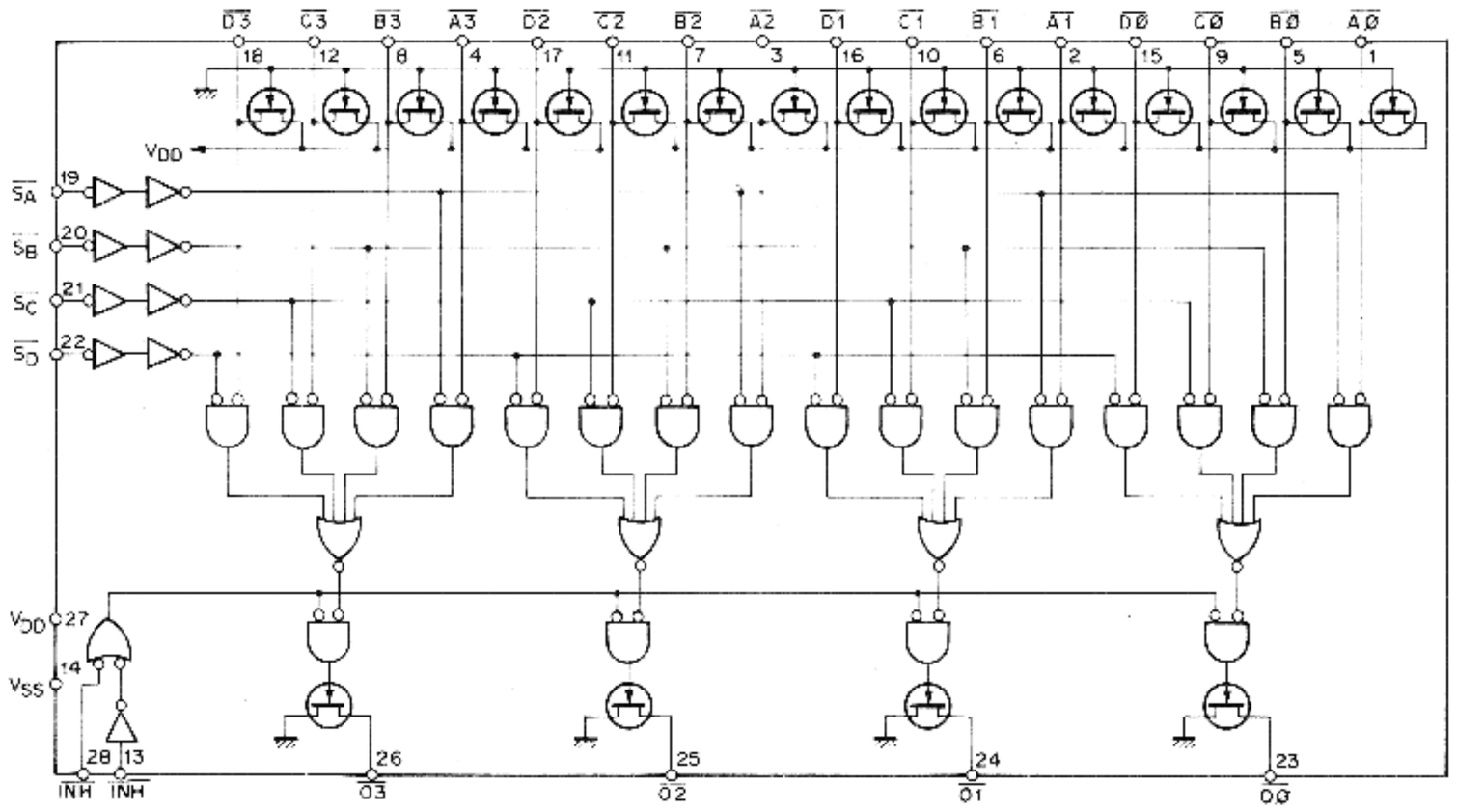
Terminal No.	Terminal Name	Terminal Function	Terminal No.	Terminal Name	Terminal Function
1	PA3	AT3	21	PB3	DA3 PLL data for MN6147 bit 3
2	PA2	AT2 } AT band data	22	PB4	CL0 HET 36M PLL clock
3	PA1	AT1 } AT band data	23	PB5	CL1 Main loop 10Hz PLL clock
4	PA0	AT0 } AT band data	24	PB6	CL2 Main loop 10kHz
5	RD	Read strobe input	25	PB7	CL3 Main loop 500k
6	CS	Chip select input	26	Vcc	+ 5V
7	GND	GND	27	D7	} Data bus
8	A1	Address signal input	28	D6	} Data bus
9	A0	Address signal input	29	D5	} Data bus
10	PC7	PLD Main loop 500k PLL data	30	D4	} Data bus
11	PC6	PLE Main loop 500k PLL latch enable	31	D3	} Data bus
12	PC5	CL5 CAR PLL clock for 71.5MHz	32	D2	} Data bus
13	PC4	CL4 CAR PLL clock for 45.5MHz	33	D1	} Data bus
14	PC0	VBT Cord SW select output	34	D0	} Data bus
15	PC1	SPL Cord SW select output	35	Reset	Reset input (Active : H)
16	PC2	SPH Cord SW select output	36	WR	Write strobe input
17	PC3	BLK Blamking puse	37	PA7	LP2 } LPF Band data
18	PB0	DA0 } PLL data for MN6147 bit 0	38	PA6	LP1 } LPF Band data
19	PB1	DA1 } PLL data for MN6147 bit 1	39	PA5	LP0 } LPF Band data
20	PB2	DA2 } PLL data for MN6147 bit 2	40	PA4	WRC AT Band data

Terminal function (IC5)

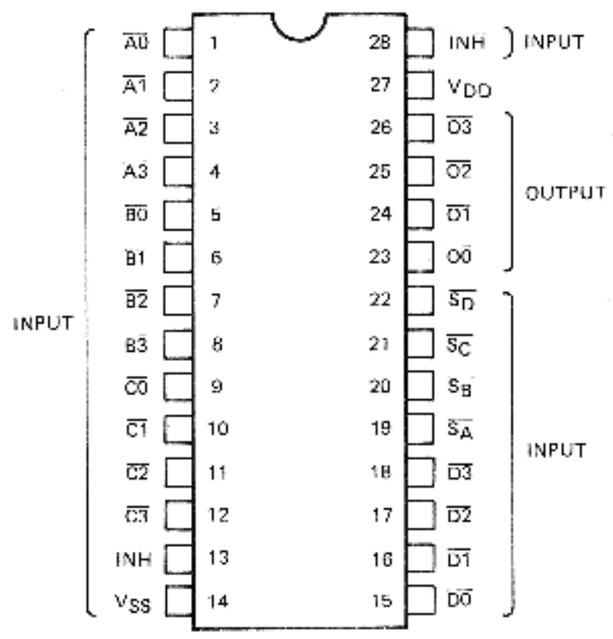
Terminal No.	Terminal Name	Terminal Function	Terminal No.	Terminal Name	Terminal Function
1	PA3	N/W, Narrow, wide output	21	PB3	Lock indicator output
2	PA2	ML2	22	PB4	SW select output A
3	PA1	ML1 Mode LED output	23	PB5	SW select output B
4	PA0	ML0	24	PB6	SW control output
5	$\overline{RD}$	Read strobe input	25	PB7	RIT Clear pulse
6	$\overline{CS}$	Chip select input	26	Vcc	+ 5V
7	GND	GND	27	D7	} Data bus
8	A1	Address signal input	28	D6	} Data bus
9	A0	Address signal input	29	D5	} Data bus
10	PC7	} SW data input port	30	D4	} Data bus
11	PC6	} SW data input port	31	D5	} Data bus
12	PC5	} SW data input port	32	D2	} Data bus
13	PC4	} SW data input port	33	D1	} Data bus
14	PC0	} SW data input port	34	D0	} Data bus
15	PC1	} SW data input port	35	Reset	Reset input (Active : H)
16	PC2	} SW data input port	36	$\overline{WR}$	Write strobe input
17	PC3	} SW data input port	37	PA7	Buzzer pulse
18	PB0	TX standby output	38	PA6	Band data
19	PB1	Split LED output	39	PA5	VC1 } VCO select output
20	PB2	AT start pulse output	40	PA4	VC0 } VCO select output

Terminal function (IC6)

SEMICONDUCTOR DATA



LC7800 Equivalent circuit (DG-B unit IC109—111)



LC7800 (Top view)

Input																				Output			
Data input																Select input				Inhibit input					
A				B				C				D													
A0	A1	A2	A3	B0	B1	B2	B3	C0	C1	C2	C3	D0	D1	D2	D3	SA	SB	SC	SD	INH	INH	00	01	02	03
0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	1	0	1	1	1
1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	1	1	0	1	1
1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	1	1	1	0	1
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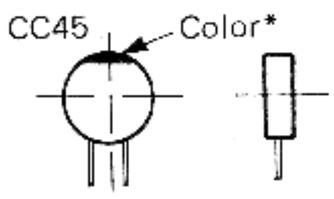
1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	0	1	1	0	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	0	0	1	1	1	0	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	0	0	1	1	1	1	0
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	0	1	1	1	1	0
*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	1	0	1	1	1	1
*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	1	*	1	1	1	1
*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	0	1	1	1	1

(Note) 1 : H level/0 : L level/* : don't care

LC7800 Truth table

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

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



- **Capacitor value**

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

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

- **Temperature Coefficient**

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

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

Example CC45TH = −470±60 ppm/°C

- **Tolerance**

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

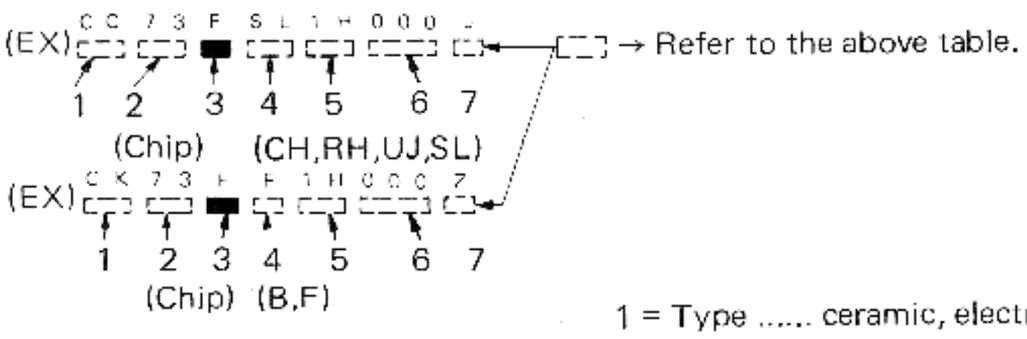
Code	B	C	D	F	G
(pF)	± 0.1	± 0.25	± 0.5	± 1	± 2

Less than 10 pF

- **Rating voltage**

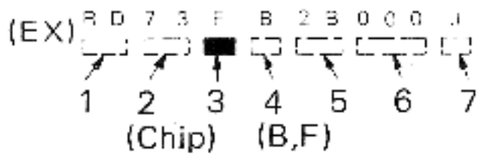
2nd word / 1st word	A	B	C	D	E	F	G	H	J	K	V
0	1.0	1.25	1.6	2.0	2.5	3.15	4.0	5.0	6.3	8.0	–
1	10	12.5	16	20	25	31.5	40	50	63	80	35
2	100	125	160	200	250	315	400	500	630	800	–
3	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	–

- **Chip capacitors**

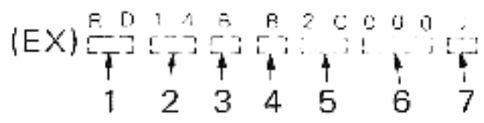


1 = Type ..... ceramic, electrolytic, etc.
2 = Shape ..... round, square, etc.
3 = Dimension
4 = Temp. coefficient
5 = Voltage rating
6 = Value
7 = Tolerance.

- **Chip resistor (Carbon)**



- **Carbon resistor (Normal type)**



Dimension

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

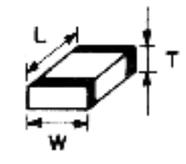
Dimension

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

Rating wattage

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

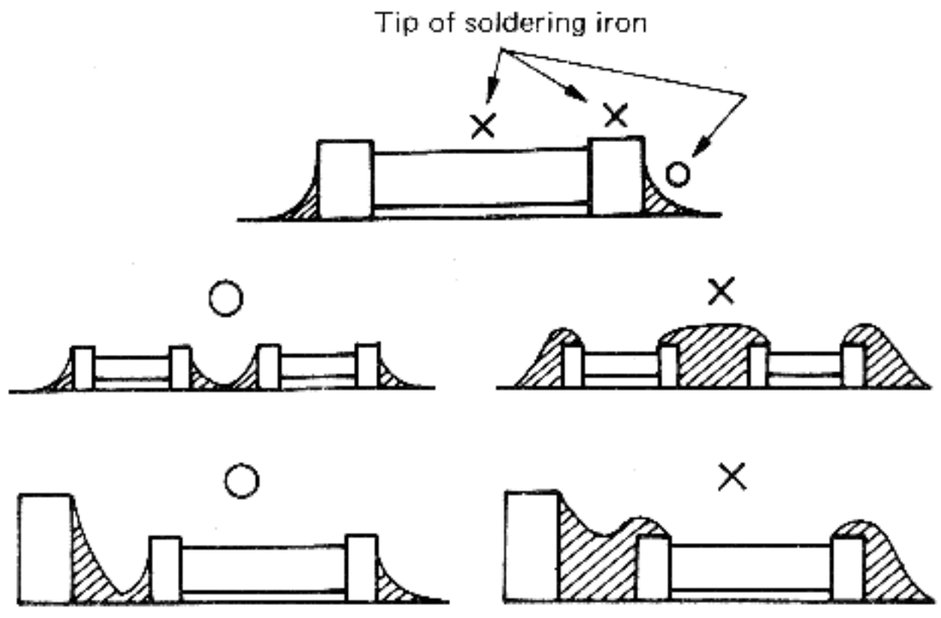
Dimension



Note :

Soldering procedure for the tip condenser

- Tools and materials
  Soldering iron
  Slit tip
  Solder (Silver solder or low temperature solder)
  Pincers made of bamboo
  Hot plate or drier
- Soldering procedure
  1) Pre-heat the surface of tip condenser up to around 150°C with the hot plate or drier.
  2) Put the solder on the tip of soldering iron.
  3) Hold and place the tip condenser on the installation place with the pincers made of bamboo.
  4) Solder one end of the tip condenser using the tip of soldering iron.
  5) Solder the other end similarly.
- Caution
  1) Flatten the solder on the pattern where the tip condenser is to be installed. Do not swell it.
  2) Length of soldering time :
  In case of silver solder : Within 6 – 8 sec.
  In case of low temperature solder : Within 3 – 4 sec.
  3) Keep the temperature of tip of soldering iron below 280°C.



Note: If you damage the silver plating on the ends of the capacitors, they should be discarded as they are no longer capable of performing correctly.
Use care when soldering. Liberal use of additional flux will ease the task of soldering.

SEMICONDUCTOR

N : New parts
* : Please note that parts are sometimes not in stock and it takes much time to deliver.

Item	Re-marks	Part No.
Diode		1N60
		1N4448
		1S1007
		1S1555
		1S1587
		1S2588
		1SS99
		1SS133
		GM-3B
		MC911
		MC921
		MC931
		MI204
		S15VB10
		U05B
D.B.M.		ND487R1-3R
Varistor		MV-203
		STV-3H(O,Y)
		SV03YS
Varactor		1SV123
Voltage variable		1SV54GC
		1SV149A
Zener diode		BZ-192
		BZ-320
		BZ-350
		MTZ3.0JB
		MTZ3.6JB
		MTZ3.9J
		MTZ3.9JB
		MTZ4.3J
		MTZ5.1J(A,B)
		MTZ5.1JA
		MTZ5.6J
		MTZ5.6JA
		MTZ5.6JB
		MTZ6.2JB
		MTZ6.8J
		MTZ9.1J
		MTZ9.1JA
		MTZ9.1JC
		MTZ10J
		MTZ10J(A,B)
		MTZ10JC
		MTZ11JC
		MTZ12J
		MTZ12JC
		MTZ16J(A,B)
		MTZ16JA
		MTZ16JC
		MTZ18JA
		MTZ18JC
		MTZ20J
		MTZ20JC
		MTZ24JD

Item	Re-marks	Part No.
LED		LN66(S)
		LN01201C
		LN01301C
		LN01401C
		LT8001P
		SG238D
Sarge absorber		DSA441LA
Thermister		25D29
		112-103-2
		112-501-2
		112-503-2
		5TP-41L
Display tube	N	11-BT-05Z
LCD	N	FTD-7155
Photo TR		ON1110
		PN126S
Digital TR		DTA114ES
		DTA124ES
	N	DTA143EF
	N	DTA143ES
	N	DTA143XS
		DTC114ES
		DTC124EF
		DTC124ES
	N	DTC144WS
TR		2N5885
		2SA950(Y)
		2SA966(O)
		2SA984K(E)
		2SA1015(Y)
		2SA1048(Y)
		2SA1049(GR)
		2SA1115(E)
		2SB861(C)
		2SC496(Y)
		2SC1907
		2SC1959(Y)
		2SC1973(T)
		2SC2053
		2SC2075
		2SC2120(Y)
		2SC2235(O)
		2SC2274K(E)
		2SC2458(Y)
		2SC2459(BL)
		2SC2668(Y)
		2SC2787(L)
		2SC3113(B)
		2SD880(Y)
		2SD1266(P,O)
		2SD1406(Y)
		MRF422
		MRF485

Item	Re-marks	Part No.
FET		2SK30A(GR)
		2SK30A(O)
		2SK125
		2SK125P
		2SK192A(GR)
		2SK192A(GR)*J
		3SK73(Y)
IC		BA718
		BU4001B
		HA1368
		HD74LS138P
		HD74LS245P
		HD74LS245WP
	N	HD4410
	N	HD4478
		HD10116
		HD10125
		HD10131
	N	HD10551
		LC7800
		LM358P
		M5L8255AP-5
		M74LS32P
		M54459L
		M54561P
		MB3614
		MB8416-20LP-GRA
		MBM2764-30T2
		MC74HC157N
		MC1723C
		MC10116L
		MC10125L
		MC10131L
		MC14077BCP
		MC14569BCP
	N	MC145158P
		MN6147
		MN6147C
		NE555P
	N	NE556N
		NJM2901
		NJM2903D
		NJM2904D
		NJM4558S
		PST518A

Item	Re-marks	Part No.
		SN74LS32N
		SN74LS73AN
		SN74LS90N
		SN74LS138N
		SN74LS139N
		SN74LS145N
		SN74LS175N
		SN74LS245N
		SN74LS374N
		SN74S10N
		SN74S112N
		SN16913P
		TA78L008AP
		TA7140P
		TA7302P
	N	TC40H004P
		TC4001BP
		TC4011BP
		TC4027BP
		TC4040BP
		TC4049BP
		TC4073BP
		TC5065BP
		TMP8255AP-5
		μA7818UC
		μPC78L05A
		μPC78L08A
		μPC577H
		μPC1037H
		μPC7805H
		μPC7812H
		μPC7815H
		μPD8255AC-5
Micro-processor		LH0080A
		μPD780C-1
	N	μPD7508G-650-00

TS-940S GENERAL

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
A01-0988-01	N*	METALLIC CASE UPPER	1	
A01-0989-11	N*	METALLIC CASE LOWER	1	
A20-2542-02	N*	PANEL	1	
A23-1486-02	N*	REAR PANEL	1	
BU4001B		C.MOS IC 2-INPUT NOR X4	1	IC 102
B03-0525-04	*	SWITCH MASK	1	
B03-0539-04	N*	SWITCH MASK POWER,TIMER	1	
B03-0540-04	N*	SWITCH MASK SEND/REC	1	
B03-0541-04	N*	SWITCH MASK RIT,XIT	1	
B05-0722-04	*	SP GRILE	1	
B10-0673-03	N	FRONT GLASS	1	
B10-0674-04	N	FRONT GLASS LCD	1	
B11-0426-04	N	LIGHT GUIDING PLATE METER	1	
B30-0817-15		LAMP 14V 80MA	2	PL 1, 2
B31-0656-05	N	METER	1	
B40-3571-04	N*	MODEL NAME PLATE TS-940S KMTW	1	
B40-3572-04	N*	MODEL NAME PLATE TS-94X X	1	
B42-1729-04	*	PLATE"WITH ANTENNA TUNER"	1	
B42-1739-14	*	VOLTAGE IND' PLATE:120V K	1	
B42-1740-04	*	VOLTAGE IND' PLATE:220V MW	1	
B42-1741-04	*	VOLTAGE IND' PLATE:240V TX	1	
B42-2388-14	N*	ADJ SEAL VOX CONTROL	1	
B42-2389-04	N*	ADJ SEAL SIDE-TONE/BUZ/MONI	1	
B42-2390-04	N*	ADJ SEAL CAR BALANCE	1	
B42-2391-23	N*	TS-940S HF TRANSCEIVER KMTW	1	
B42-2392-23	N*	TS-940X HF TRANS	1	
B42-2399-04	*	FACE PLATE	1	
B43-1045-04	N*	BADGE KENWOOD KMWX	1	
B43-1046-04	N*	BADGE TRIO T	1	
B46-0415-00		USER & WARRANTY CARD K	1	
B48-0443-04	N*	LABEL FOR PACKAG	2	
B48-0444-04	N*	LABEL FOR PACKAG	2	
B48-0445-04	N*	LABEL FOR PACKAG	2	
B48-0446-04	N*	LABEL FOR PACKAG	2	
B50-8001-00	N	INSTRUCTION MANUAL KMWX	1	
B50-8002-00	N	INSTRUCTION MANUAL T	1	
CE04W1H010M		ELECTRO 1 50V	1	C 119
C90-0857-05		ELECTRO 22000 50V	2	C 108,109
C91-0496-05		CERAMIC 470P AC125V	2	C 102,103
C91-0647-05		CERAMIC 0.01 2KV	1	C 101
DSA441LA		SARGE ABSOBER	1	D 105
DTC124ES		DIGITAL TR NPN	1	Q 105
E04-0152-05		UHF TYPE RECEPTACLE:ANT	1	J 102
E06-0655-05	N	DIN RECEPTACLE 6P ACC1	1	J 109
E06-0753-05	N	DIN RECEPTACLE 7P REMOTE	1	J 105
E06-0851-05		DIN RECEPTACLE 8P X.VERTER	1	J 104
E07-0751-05		DIN PLUG 7P (ACCESARY)	1	
E07-0852-05		METAL PLUG 8P MIC MX	1	
E07-1351-05		PLUG ACC2 13P(ACCESSARY)	1	
E11-0404-05		PHONE JACK KEY,PHONE	2	J 101,108
E11-0410-05		PHONE JACK EXT SP	1	J 107
E13-0101-05		RCA JACK RX ANT,RTTY	2	J 103,106

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
E18-0351-05		3P AC SOCKET	1	J 110
E23-0015-04		LUG PLATE	3	
E23-0043-04		EARTH LUG ANT	1	
E23-0420-05		TERMINAL(INSIDE)	2	
E23-0425-05		LUG TERMINAL	1	
E30-1643-15		AC CORD ASS'Y M	1	
E30-1644-15		AC CORD ASS'Y T	1	
E30-1645-05		AC CORD ASS'Y W	1	
E30-1647-05		AC CORD ASS'Y X	1	
E30-2013-05	N	AC CORD ASS'Y K	1	
E40-0273-05		MINI CONNECTOR 2P	2	
E40-0773-05		MINI CONNECTOR 7P	1	
E40-3007-05		MINI CONNECTOR 2P	1	
F05-4022-05		FUSE 4A MTWX	2	
F05-6021-05		FUSE 6A KM	2	
F07-0862-04	N*	SLIDE COVER :ON TOP CASE	1	
F07-0863-03	N*	HEAT SINK COVER	1	
F09-0405-34		FAN :POWER TRANS SIDE	1	
F15-0656-14	N*	SWITCH MASK VOX	1	
F15-0657-04	N*	FILTER DISPLAY	1	
F19-0620-04	*	SHIELDING SLIDE COVER	2	
F20-0520-04		INSULATING SHEET(BATT TOP)	1	
F20-0521-04		INSULATING SHEET(SP BOTTOM)	2	
F20-0527-05		INSULATING BOARD :TRANSISTOR	2	
F29-0421-14	*	INSULATOR	5	
G01-0817-04	*	COILED SPRING	4	
G02-0549-04		SPRING MOTOR	1	
G09-0405-05		SPRING FOR KNOB NB	1	
G09-0410-05		SPRING FOR KNOB VBT	1	
G11-0609-04	*	CUSHION MIC MX	2	
G13-0649-04	*	CUSHION (A) METER	2	
G13-0662-04	*	CUSHION SPEAKER	1	
G13-0810-04	N*	CUSHION CHEMI-CON BLOCK	2	
G13-0818-04		CUSHION	1	
G13-0819-04	N*	CUSHION	1	
G53-0510-04	*	PACKING PANEL	2	
G53-0511-04	*	PACKING LED	3	
G53-0524-04	N*	PACKING TOP CASE	1	
G53-0525-04	N*	PACKING FILTER CASE	1	
H01-4643-24	N*	CARTON (INSIDE) KMW	1	
H01-4644-24	N*	CARTON (INSIDE) T	1	
H01-4645-24	N*	CARTON (INSIDE) X	1	
H03-2248-24	N*	CARTON (OUTSIDE) KMTW	1	
H03-2252-24	N*	CARTON (OUTSIDE) X	1	
H10-1276-04	*	ACCESSARY BOX M	1	
H10-2602-02	N*	POLY' FIXTURE FRONT	1	
H10-2603-02	N*	POLY' FIXTURE REAR	1	
H12-0491-04	*	CUSHION KTWX	1	
H20-1426-03	N	PROTECTIVE BAG	1	
H25-0105-04	*	POLY.BAG,DC CABLE	1	
H25-0120-04	*	BAG(CHARGER)	1	
J02-0049-14		FOOT REAR	2	
J02-0423-04		FOOT FRONT(OUT SIDE)	2	

PARTS NO.	NOTE	NAME & DESCRIPTION		QTY	REFERENCE NO.
J02-0424-04		FOOT	FRONT(IN SIDE)	2	
J02-0426-05		FOOT	SMOLL TYPE	4	
J13-0033-15		FUSE HOLDER		1	F 101
J19-1363-05		LEAD HOLDER		2	
J21-4165-04	N*	HARDWARE FIXTURE(SLIDE COVER)		4	
J32-0762-04	*	STUD & BOSS (STICK TYPE)		1	
J32-0767-04	*	STUD & BOSS (STICK TYPE)		2	
J32-0789-04	N	STUD & BOSS	MOTOR	1	
K01-0409-05		HANDLE		1	
K21-0764-04		KNOB	RF,SQL,*---ETC	4	
K21-0765-04		KNOB	PWR,PRO*OUT	2	
K21-0766-05		KNOB	MAIN	1	
K23-0721-04		KNOB	SQL	1	
K23-0740-04		KNOB	AF,NOTCH,---ETC	4	
K23-0745-04		KNOB	MIC,PRO-IN	2	
K23-0753-04		KNOB	AGC,ATT,METER	3	
K23-0778-04	N	KNOB	RIT/XIT	1	
K27-0433-04		PUSH KNOB	NB	3	
K27-0435-04		PUSH KNOB	RIT	5	
K29-0738-04		KNOB	CW-VBT	1	
K29-0757-04		PUSH KNOB	POWER	1	
K29-0761-04		KNOB LING	MAIN	1	
K29-3002-04		PUSH KNOB	VOX	4	
K29-3036-04		PUSH KNOB	TIMER	1	
K29-3038-04	N	PUSH KNOB	SEND/REC	3	
L01-0256-15	N	POWER TRANSFORME		1	T 101
L19-0356-05	N	TRANSFORMER		1	T 102
N09-0256-05		SCREW		2	
N09-0626-04		SEMS SCREW	M3X10	3	
N09-0646-04		SCREW	M4X4 HANDLE	2	
N09-0658-04		SCREW	M2.6X3 MOTOR	2	
N10-2030-46		NUT,TR	M3	4	
N14-0115-05		NUT	GND	1	
N14-0509-05		NUT	GND	1	
N14-0512-05		SPEED NUT	SLIDE COVER	1	
N15-1026-46		FLAT WASHER	M2.6	4	
N15-1030-41		FLAT WASHER	ﾌﾛｰﾄﾓ	2	
N15-1030-46		FLAT WASHER,TR,SP		4	
N15-1040-46		FLAT WASHER	M4	2	
N30-2004-45		PAN HD SCREW	M2X4	2	
N30-2604-45		PAN HD SCREW	M2.6X4	8	
N30-2604-46		PAN HD SCREW	M2.6X4	24	
N30-2605-46		PAN HD SCREW	M2.6X5	8	
N30-2606-46		PAN HD SCREW		2	
N30-2608-46		PAN HD SCREW	M2.6X8	5	
N30-3004-46		PAN HD SCREW	M3X4	1	
N30-3006-46		PAN HD SCREW	M3X6	2	
N30-3014-46		PAN HD SCREW	M3X14	4	
N30-4014-46		PAN HD SCREW	M4X14	1	
N30-4016-46		PAN HD SREW	M4X16 GND	1	
N32-2606-46		FLAT HD SCREW	M2.6X6	4	
N32-3006-46		FLAT HD SCREW	M3X6	14	
N32-3008-46		FLAT HD SCREW	M3X8	2	
N33-3006-45		ROUND FLAT SCREW	M3X6	2	

PARTS NO.	NOTE	NAME & DESCRIPTION		QTY	REFERENCE NO.
N35-3004-45		BIND SCREW	M3X4	1	
N35-3006-41		BIND SCREW,SUB PANEL		4	
N35-3006-45		BIND SCREW	M3X6	2	
N35-3008-45		BIND SCREW	M3X8	3	
N35-4008-41		BIND SCREW	M4X8	17	
N87-2606-46		TAPPING SCREW	M2.6X6	18	
N87-3006-46		TAPPING SCREW,FOOT		61	
N87-3010-46		TAPPING SCREW	M3X10	3	
N87-3012-46		TAPPING SCREW	FINAL UNIT	29	
N87-4010-46		TAPPING SCREW	M4X10	4	
N88-3006-46		FLAT TAPPING SCREW	M3X6	6	
N89-3005-46		BIND TAPPING SCREW	M3X5	9	
N89-3006-45		BIND TAPPING SCREW	M3X6	15	
R90-0241-05		CAP. BLOCK	0.01UF X6	2	IB 101,102
SG238D		LED	GREEN	1	D 102
S15VB10		DIODE		1	D 101
S29-2406-05		SWITCH	AC SELECTOR	1	S 103
S31-1407-05		SLIDE SWITCH		1	S 102
S40-2418-05		PUSH SWITCH	POWER	1	S 101
S50-1406-05		TACT SWITCH MIC (UP,DOWN)	MX	2	
S59-0433-15	N	KEYBOARD ASS'Y		1	
TC4001BP		C.MOS IC			IC 102
T07-0221-05		SPEAKER		1	
T42-0302-05		DC MOTOR	FAN	1	M 3
T91-0352-05	N	MIC	MX	1	
UPC7805H		AVR IC	5 V	1	IC 101
W02-0328-10		MAIN ENCODER ASS'Y		1	
W02-0368-05	N	LCD ASS'Y		1	
W09-0326-05		LITHIUM BATTERY	BR2032	3	
X41-1600-00	N*	SW UNIT	A/13 TO M/13	1	
X43-1500-00	N*	AVR UNIT		1	
X44-1660-00	N*	RF UNIT		1	
X45-1400-00	N*	100W FINAL UNIT		1	
X46-1030-00	N*	DC-DC UNIT		1	
X48-1430-00	N*	IF UNIT	A/2,B/2 UNIT	1	
X50-2020-00	N*	PLL UNIT		1	
X51-1330-00	N*	FILTER UNIT		1	
X53-1420-11	N*	CONTROL UNIT		1	
X54-1690-01	N*	RIT ENCODER		1	
X54-1830-00	N*	DIGITAL A UNIT		1	
X54-1840-00	N*	DIGITAL B UNIT	A/2,B/2 UNIT	1	
X54-1850-00	N*	DIGITAL C UNIT		1	
X57-1130-00	N*	AT UNIT	"WITH/AT"ONLY	1	
1SS133		DIODE		3	D 103,104,106
2N5885		TR		2	Q 101,102
2SD1266(P,Q)				1	Q 103
2SD1406(Y)	N	TR		1	Q 104
5TP-41L				1	TH 101

SW UNIT (X41-1600-00)

PARTS NO.	NOTE	NAME & DESCRIPTION		QTY	REFERENCE NO.
CC45CH1H220J		CERAMIC	22P 50V	2	C 3, 4
CC45SL1H330J		CERAMIC	33P 50V	1	C 1
CE04W1A100M		ELECTRO	10 10V	1	C 8
CE04W1E220M		ELECTRO	22 25V	1	C 7
CE04W1H2R2M		ELECTRO	2.2 50V	1	C 10
CK45F1H103Z		CERAMIC	0.01 50V	3	C 9, 11, 12
CS15E1A100M		TANTALUM	10 10V	1	C 2
C91-0117-05		CERAMIC	0.01 50V	1	C 6
C91-0119-05		CERAMIC	0.047 50V	1	C 5
DTA143ES	N	DIGITAL TR	PNP	1	Q 5
DTC124EF		DIGITAL TR	NPN	1	Q 4
DTC124ES		DIGITAL TR	NPN	2	Q 1, 3
E06-0858-05		8P METAL SOCKET		1	J 2
E06-1351-05		ROUND TYPE CONNECTOR	13P	1	J 3
E13-0462-05	N	JACK	4P	1	J 1
E23-0512-05		TERMINAL	1P	3	
E40-0273-05		MINI CONNECTOR	2P	10	
E40-0274-05		MINI CONNECTOR	2P	2	
E40-0373-05		MINI CONNECTOR	3P	8	
E40-0473-05		MINI CONNECTOR	4P	5	
E40-0573-05		MINI CONNECTOR	5P	3	
E40-0673-05		MINI CONNECTOR	6P	4	
E40-0773-05		MINI CONNECTOR	7P	2	
E40-0873-05		MINI CONNECTOR	8P	4	
E40-0973-05		MINI CONNECTOR	9P	1	
E40-0974-05		MINI CONNECTOR	9P	1	
E40-1073-05		MINI CONNECTOR	10P	1	
J31-0502-04	*	COLLAR	PC BOAD	7	
J42-0428-05	*	BUSHING	PC BOAD	7	
L40-1001-12		INDUTOR	10 UH	1	L 2
L40-4701-14		INDUCTOR	47 UH	1	L 3
L77-1256-05		XTAL	32.758KHZ	1	X 1
MC911		DIODE		1	D 29
MTZ10J		ZENER DIODE	10 V	1	D 20
MTZ11JC		ZENER DIODE	11 V	1	D 26
RC05GF2H100J		RES. SOLID	10 OHM 1/2W	1	R 56
RS14AB3A180J		METAL FILM	18 OHM 1W	1	R 55
RO1-0407-05	N	POTENTIOMETER	300(B)	1	R 7
R12-1434-05		TRIM.POT.	3K OHM	1	VR 13
R13-3403-05	N	SLIDE POT.	10K(B)	2	R 4, 5
R13-3404-05	N	SLIDE POT.	10K(A)	1	R 6
R13-6402-05	N	SLIDE POT.	470K(B)	2	R 2, 3
R19-3413-05		POTENTIOMETER	10K(A),10K(B)	1	R 12
R19-3421-05	N	POTENTIOMETER	100K(C)X2	1	R 10
R19-3422-05	N	POTENTIOMETER	10K(A),10K(B)	1	R 8
R24-3403-05	N	POTENTIOMETER	10K(A)10K(B)X2	1	R 9
R24-9402-05		POTENTIOMETER	10K(B),10K(F)	1	R 11
R90-0515-05		RESISTOR BLOCK	10K OHM X4	2	IB 4, 6
R90-0534-05		RESISTOR BLOCK	10K OHM X5	1	IB 5
R90-0545-05		CAP. BLOCK	0.001 X4	1	IB 3
R90-0546-05		CAP. BLOCK	0.01 X7	1	IB 1
R90-0585-05	N	DIODE BLOCK	1S1555 X5	1	IB 7
S01-1430-05		ROTARY SWITCH		1	S 13
S01-1431-05		ROTARY SWITCH		1	S 12
S01-1432-05		ROTARY SWITCH		1	S 11
S29-1434-05	N	ROTARY SWITCH		1	S 2
S29-2410-05	N	ROTARY SWITCH		1	S 3
S31-2412-05	N	SLIDE SWITCH		3	S 22, 23, 24
S31-2413-05	N	SLIDE SWITCH		1	S 25
S40-2434-05		PUSH SWITCH		3	S 14, 15, 16
S40-2438-15		PUSH SWITCH		2	S 20, 21
S40-2439-15		PUSH SWITCH		3	S 17, 18, 19
S40-2440-15		PUSH SWITCH		7	S 4, 5, 6, 7, 8, 9, 10
S40-2453-05	N	PUSH SWITCH		1	S 26
S50-1411-05		TACT SWITCH		1	S 1
UPC78L05A		AVR IC	5 V	1	IC 2
UPD7508G-650-00	N	MICRO-PROCESSOR		1	IC 1
1N60		DIODE		3	D 30, 31, 32
1SS133		DIODE		25	D 1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 22, 23, 24, 25, 27, 28, 33
11-BT-05Z		DISPLAY TUBE		1	V 1
2SA1048(Y)		TR		1	Q 2

AVR UNIT (X43-1500-00)

PARTS NO.	NOTE	NAME & DESCRIPTION			QTY	REFERENCE NO.
BZ-320		ZENER DIODE	32 V		1	D 3
CE04W1A470M		ELECTRO	47	10V	3	C 9, 10, 11
CE04W1E100M		ELECTRO	10	25V	1	C 8
CE04W1E101M		ELECTRO	100	25V	1	C 14
CE04W1E220M		ELECTRO	22	25V	1	C 13
C90-0858-05		ELECTRO	2200	50V	2	C 3, 4
C90-0859-05		ELECTRO	2200	35V	1	C 6
C90-2014-05		ELECTRO	6800	16V	1	C 12
C91-0117-05		CERAMIC	0.01	50V	1	C 5
C91-0119-05		CERAMIC	0.047	50V	1	C 7
E23-0453-05		TERMINAL			2	
E23-0462-05	N	TERMINAL			5	
E40-0273-05		MINI CONNECTOR	2P		7	
E40-0373-05		MINI CONNECTOR	3P		4	
E40-0473-05		MINI CONNECTOR	4P		1	
E40-0873-05		MINI CONNECTOR	8P		1	
F05-1534-05		FUSE	15A		1	F 1
J31-0502-04	*	COLLAR	PC BOAD		4	
J42-0428-05	*	BUSHING	PC BOAD		4	
L40-1511-03		INDUCTOR	150 UH		3	L 1, 2, 3
MTZ12JC		ZENER DIODE	12 V		1	D 4
MTZ18JC		ZENER DIODE	18 V		1	D 8
MTZ22JD		ZENER DIODE	22 V		1	D 14
MTZ9.1JA		ZENER DIODE	9.1V		1	D 9
RC05GF2H561J		RES. SOLID	560 OHM	1/2W	1	R 21
RS14AB3A2R2J		METAL FILM	2.2 OHM	1W	3	R 1, 2, 4
RS14GB3A821J		METAL FILM	820 OHM	1W	1	R 19
R12-0429-05		TRIM.POT.	500 OHM		1	VR 1
R92-0620-05		CEMENT RESISTOR	15M OHM	5W	1	R 9
SV03YS		VARISTOR			1	D 6
U05B		DIODE			6	D 1, 2, 10, 11, 12, 13
1SS133		DIODE			2	D 5, 6
2SB861(C)		TR			1	Q 1
2SC1959(Y)		TR			1	Q 5
2SC2235(O)		TR			1	Q 6
2SC2458(Y)		TR			3	Q 2, 3, 4

RF UNIT (X44-1660-00)

PARTS NO.	NOTE	NAME & DESCRIPTION			QTY	REFERENCE NO.
CC45CH1H010C		CERAMIC	1P	50V	1	C 106
CC45CH1H101J		CERAMIC	100P	50V	1	C 4
CC45CH1H150J		CERAMIC	15P	50V	1	C 3
CC45CH1H220J		CERAMIC	22P	50V	3	C 183,185,186
CC45CH1H470J		CERAMIC	47P	50V	1	C 2
CC45CH1H560J		CERAMIC	56P	50V	1	C 6
CC45RH1H010C		CERAMIC	1P	50V	1	C 89
					3	96,154,155
CC45RH1H020C		CERAMIC	2P	50V	1	C 152
CC45RH1H030C		CERAMIC	3P	50V	1	C 125
CC45RH1H070D		CERAMIC	7P	50V	1	C 119
CC45RH1H100D		CERAMIC	10P	50V	5	C 50, 52, 64, 93,138
					1	137
CC45RH1H120J		CERAMIC	12P	50V	3	C 142,143,147
CC45RH1H121J		CERAMIC	120P	50V	4	C 14, 40,116,118
CC45RH1H180J		CERAMIC	18P	50V	1	C 117
CC45RH1H181J		CERAMIC	180P	50V	2	C 31, 33
CC45RH1H220J		CERAMIC	22P	50V	2	C 144,148
CC45RH1H221J		CERAMIC	220P	50V	2	C 25, 27
CC45RH1H270J		CERAMIC	27P	50V	4	C 58, 62,139,149
CC45RH1H390J		CERAMIC	39P	50V	2	C 51, 56
CC45RH1H470J		CERAMIC	47P	50V	2	C 5, 85
CC45RH1H560J		CERAMIC	56P	50V	3	C 39, 41, 57
CC45RH1H680J		CERAMIC	68P	50V	3	C 38, 45, 63
CC45RH1H820J		CERAMIC	82P	50V	2	C 44, 46
CC45SL1H020C		CERAMIC	2P	50V	1	C 104
CC45SL1H030C		CERAMIC	3P	50V	2	C 108, 67
CC45SL1H101J		CERAMIC	100P	50V	3	C 37, 91,180
CC45SL1H150J		CERAMIC	15P	50V	1	C 105
CC45SL1H220J		CERAMIC	22P	50V	1	C 92
CC45SL1H330J		CERAMIC	33P	50V	3	C 159,162,168
CC45SL1H331J		CERAMIC	330P	50V	1	C 18
CC45SL1H680J		CERAMIC	68P	50V	1	C 99
CC45SL1H681J		CERAMIC	680P	50V	1	C 23
CC45SL1H820J		CERAMIC	82P	50V	1	C 90
CC45TH1H220J		CERAMIC	22P	50V	1	C 146
CC45TH1H270J		CERAMIC	27P	50V	1	C 141
CC45TH1H330J		CERAMIC	33P	50V	1	C 136
CE04BW1E010M		ELECTRO	1	25V	1	C 191
CE04W1E220M		ELECTRO	22	25V	11	C 7, 12, 21, 29, 35, 43, 48, 54, 60, 66
						80
CE04W1E4R7M		ELECTRO	4.7	25V	1	C 127
CE04W1E470M		ELECTRO	47	25V	2	C 83,121
CE04W1H010M		ELECTRO	1	50V	1	C 114
CK45B1H471K		CERAMIC	470P	50V	4	C 187,188,189,190
CQ92M1H102K		MYLAR	0.001	50V	1	C 16
CQ92M1H152K		MYLAR	0.0015	50V	2	C 15, 17
C90-0506-05		ELECTRO	0.22	50V	1	C 75
C90-0817-05		ELECTRO	1000	16V	1	C 134
C91-0117-05		CERAMIC	0.01	50V	2	C 100,101
C91-0119-05		CERAMIC	0.047	25V	45	C 8, 9, 10, 11, 20, 28, 30, 34, 36, 42
						47, 49, 53, 55, 59, 61, 65, 67, 68, 69
						70, 72, 73, 74, 76, 77, 78, 79, 81, 82
						84, 86, 87,109,112,113,115,122,123,124
						128,166,169,177,178
C91-0667-05		CERAMIC	0.0047	50V	3	C 94, 95,107

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
C91-1008-05		CERAMIC 0.022 50V	5	C 131, 132, 133, 157, 158
			1	163
DTA143XS		DIGITAL TR PNP	1	Q 14
E04-0154-05		RF COAX. CONNECTOR	9	
E23-0430-05		TERMINAL	1	
E40-0211-05		MINI CONNECTOR 2P	1	
E40-0273-05		MINI CONNECTOR 2P	4	
E40-0373-05		MINI CONNECTOR 3P	1	
E40-0473-05		MINI CONNECTOR 4P	3	
E40-0573-05		MINI CONNECTOR 5P	1	
GM-38		DIODE	1	D 44
L19-0324-05		TOROIDAL	3	T 1, 2, 3
L19-0335-05		TOROIDAL	1	T 4
L19-0347-05		TRANSFORMER 5.5T	1	T 5
L32-0651-05		OSC COIL	1	L 65
L32-0652-05		OSC COIL	1	L 68
L32-0653-05		OSC COIL	1	L 71
L33-0658-05		CHOKE COIL	2	L 82, 83
L33-0685-05	N	CHOKE COIL	1	L 84
L34-0691-05		TUNING COIL	1	L 86
L34-1124-05		COIL 5 6.5T	2	L 1, 42
L34-2074-05		TUNING COIL	1	L 45
L34-2080-05		TUNING COIL	1	L 2
L34-2081-05		TUNING COIL	1	L 5
L34-2082-05		TUNING COIL	1	L 6
L34-2083-05		TUNING COIL	1	L 9
L34-2085-05		TUNING COIL	1	L 11
L34-2086-05		TUNING COIL	1	L 12
L34-2087-05		TUNING COIL	1	L 13
L34-2088-05		TUNING COIL	1	L 14
L34-2089-05		TUNING COIL	1	L 15
L34-2090-05		TUNING COIL	1	L 16
L34-2091-05		TUNING COIL	1	L 18
L34-2092-05		TUNING COIL	1	L 19
L34-2093-05		TUNING COIL	2	L 20, 21
L34-2094-05		TUNING COIL	1	L 22
L34-2095-15		TUNING COIL	1	L 23
L34-2096-05		TUNING COIL	1	L 24
L34-2097-05		TUNING COIL	1	L 7
L34-2098-05		TUNING COIL	1	L 10
L34-2101-05		TUNING COIL	1	L 29
L34-2106-05		TUNING COIL	2	L 74, 76
L34-2107-05		TUNING COIL	1	L 75
L34-2109-15		TUNING COIL	1	L 60
L34-2111-05		TUNING COIL	2	L 53, 57
L34-2112-05		TUNING COIL	2	L 54, 56
L34-2113-05		TUNING COIL	1	L 55
L34-2114-15		TUNING COIL	3	L 50, 51, 52
L34-2161-15		TUNING COIL	1	L 40
L34-2241-05	N	TUNING COIL	2	L 25, 27
L34-2242-05	N	TUNING COIL	1	L 26
L34-2243-05	N	TUNING COIL	2	L 28, 30
L34-2244-05	N	TUNING COIL	2	L 31, 33

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
L34-2245-05	N	TUNING COIL	1	L 32
L34-2247-05		TUNING COIL	2	L 44, 46
L40-1011-03		INDUCTOR 100 UH	2	L 61, 62
L40-1021-03		INDUCTOR 1 MH	2	L 3, 41
L40-1092-13		INDUCTOR 1 UH	1	L 85
L40-1811-03		INDUCTOR 180 UH	1	L 59
L40-2201-03		INDUCTOR 22 UH	2	L 70, 72
L40-2701-03		INDUCTOR 27 UH	2	L 67, 69
L40-3301-03		INDUCTOR 33 UH	2	L 64, 66
L40-3391-03		INDUCTOR 3.3 UH	1	L 80
L40-4701-03		INDUCTOR 47 UH	6	L 47, 63, 73, 77, 78, 79
L40-4701-14		INDUCTOR 47 UH	1	L 43
L40-4711-03		INDUCTOR 470 UH	6	L 4, 34, 35, 37, 38, 39
L40-5691-02		INDUCTOR 5.6 UH	1	L 58
L40-8291-02		INDUCTOR 8.2 UH	1	L 17
MC911		DIODE	1	D 40
MI204		DIODE	2	D 23, 26
MTZ16JA		ZENER DIODE 16 V	1	D 34
MTZ3.0JB		ZENER DIODE 3.0V	1	D 27
MTZ3.6JB		ZENER DIODE 3.6V	1	D 22
MTZ5.1JA		ZENER DIODE 5.1V	1	D 48
MV-203		VARISTOR	1	D 25
RC05GF2H221J		RES. SOLID 220 OHM 1/2W	2	R 6, 15
RC05GF2H331J		RES. SOLID 330 OHM 1/2W	1	R 5
RC05GF2H471J		RES. SOLID 470 OHM 1/2W	1	R 144
RC05GF2H821J		RES. SOLID 820 OHM 1/2W	1	R 31
RS14AB3D470J		METAL FILM 47 OHM 2W	2	R 134, 135
R12-1429-05		TRIM.POT. 500 OHM	2	VR 2, 3
R12-3443-05		TRIM.POT. 10K OHM	1	VR 1
R90-0593-05	N	RESISTOR BLOCK 2.2KOHM X9	1	RB 1
SN74LS145N		TTL IC: BCD DECIMAL DECODER	1	IC 1
S51-1414-05		RELAY	1	RL 4
S51-1420-05		RELAY	3	RL 1, 2, 3
1SS133		DIODE	11	D 28, 29, 30, 31, 32, 41, 42, 43, 45, 46, 47
1SV54GC		VOLTAGE VARIABLE	3	D 33, 36, 38
1S1587		DIODE	3	D 35, 37, 39
1S2588		DIODE	21	D 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21
2SA1048(Y)		TR	2	Q 13, 26
2SC1907		TR	5	Q 4, 19, 20, 22, 23
2SC1973(T)		TR	1	Q 5
2SC2053		TR	1	Q 6
2SC2458(Y)		TR	5	Q 15, 24, 25, 27, 28
2SC2668(Y)		TR	1	Q 21
2SK125		FET	2	Q 7, 8
2SK125P		FET PAIR	2	Q 9, 10
2SK192A(GR)*J		FET	3	Q 16, 17, 18
3SK73(GR)		FET	3	Q 1, 2, 3

100W FINAL UNIT (X45-1400-00)

PARTS NO.	NOTE	NAME & DESCRIPTION			QTY	REFERENCE NO.
BZ-192		ZENAR DIODE	19 V		1	D 5
BZ-350		ZENAR DIODE	35 V		1	D 1
CC45SL1H271J		CERAMIC	270P	50V	1	C 35
CC45SL1H331J		CERAMIC	330P	50V	2	C 2, 9
CC45SL2H101J		CERAMIC	100P	500V	2	C 8, 42
CE04W1A471M		ELECTRO	470	10V	1	C 18
CE04W1H100M		ELECTRO	10	50V	1	C 12
CE04W1H101M		ELECTRO	100	50V	1	C 24
CK45F1H103Z		CERAMIC	0.01	50V	2	C 23, 43
CM73F2H331J		CHIP CAP.	330P	500V	1	C 33
CM73F2H391J		CHIP CAP.	390P	500V	1	C 38
CM73F2H681J		CHIP CAP.	680P	500V	1	C 28
C91-0456-05		CERAMIC	0.047	25V	11	C 1, 3, 5, 11, 20, 21, 25, 26, 27, 36 37
C91-0491-05		CHIP CAP.	0.0047		2	C 16, 17
C91-0493-05		CHIP CAP.	0.47		2	C 29, 30
E23-0015-04		LUG PLATE			1	
E23-0433-05		LUG			8	
F01-0927-05	N*	HEAT SINK			1	
F07-0864-03	N*	HEAT SINK COVER			1	
F09-0410-04	N*	FAN			1	
F19-0644-04	N*	SHIELDING MESH			1	
F20-0078-05		INSULATING PLATE			6	
F29-0014-05		INSULATING WASHER :TRANSISTOR			10	
G02-0549-04		SPRING	MOTOR		1	
J21-4167-14	N*	HARDWARE FIXTURE			1	
J21-4168-14	N*	HARDWARE FIXTURE			1	
L19-0337-05		TRANSFORMER			1	T 2
L19-0338-05		TRANSFORMER			1	T 3
L19-0339-05		TRANSFORMER B			1	T 4
L19-0340-05		TRANSFORMER A			1	T 1
L33-0025-05		CHOKE COIL	1 UH		2	L 4, 5
L33-0032-05		CHOKE COIL	3 UH		1	L 2
L33-0617-05		RFC COIL			4	L 3, 7, 8, 9
L33-0644-05		CHOKE COIL	2.2 UH		1	L 17
L33-0651-05		CHOKE COIL			2	L 14, 15
L33-0653-05		CHOKE COIL			1	L 16
L33-0655-05		CHOKE COIL			1	L 13
L40-1011-04		INDUCTOR	100 UH		1	L 10
L40-1511-03		INDUCTOR	150 UH		4	L 6, 11, 12, 18
MC1723CL		AVR IC			1	IC 1
MRF422		TR			2	Q 4, 5
MRF485		TR			2	Q 2, 3
N09-0623-04		SEMS SCREW	M3X8		4	
N09-0643-04		SCREW SEMUSE			1	
N09-0658-04		SCREW	M2.6X3 MOTOR		2	
N35-3006-46		BIND SCREW,CASE(BOTTOM)			5	
N35-3008-46		BIND SCREW	M3X8		5	

PARTS NO.	NOTE	NAME & DESCRIPTION			QTY	REFERENCE NO.
N87-3006-46		TAPPING SCREW,FOOT			4	
N89-3006-45		BIND TAPPING SCREW M3X6			10	
N89-3006-46		BIND TAPPING SCREW M3X6			3	
RS14AB3A220J		METAL FILM	22 OHM 1W		2	R 9, 10
RS14AB3D33QJ		METAL FILM	33 OHM 2W		1	R 35
R12-0072-05		SEMI FIXED	470 OHM		1	VR 1
R12-1406-05		TRIM.POT.	1K OHM		1	VR 2
R92-0041-25		FIXED RESISTOR	.47 OHM 1W		1	R 21
SDT1000F		THERMISTER	10K OHM		1	TH 1
STV-3H(O,Y)		VARISTOR			2	D 2, 4
T42-0302-05		DC MOTOR	FAN		1	M 4
1N4448		DIODE			1	D 3
1S1555		DIODE				D 3
2SC1959(Y)		TR			1	Q 9
2SC2075		TR			1	Q 1
2SC496(Y)		TR			2	Q 6, 8
2SD880(Y)		TR			1	Q 7

DC-DC UNIT (X46-1030-00)

PARTS NO.	NOTE	NAME & DESCRIPTION			QTY	REFERENCE NO.
CE04W1H010M		ELECTRO	1	50V	1	C 2
CE04W1H100M		ELECTRO	10	50V	2	C 6, 7
CE04W1H220M		ELECTRO	22	50V	2	C 4, 5
C90-2005-05		ELECTRO	1000	25V	1	C 1
C90-2016-05	N	ELECTRO	47	25V	1	C 10
C91-0117-05		CERAMIC	0.01	50V	1	C 9
DTC124ES		DIGITAL TR	NPN		1	Q 3
E40-0273-05		MINI CONNECTOR	2P		1	
E40-0373-05		MINI CONNECTOR	3P		1	
E40-0573-05		MINI CONNECTOR	5P		1	
J31-0502-04	*	COLLAR	PC BOAD		2	
J42-0428-05	*	BUSHING	PC BOAD		2	
L19-0336-05		TRANSFORMER			1	T 1
L40-1011-12		INDUCTOR	100 UH		1	L 1
MTZ12JC		ZENER DIODE	12 V		1	D 6
MTZ9.1JC		ZENER DIODE	9.1V		1	D 5
RC05GF2H2R2J		RES. SOLID	2.2 OHM 1/2W		1	R 8
1N4448		DIODE			4	D 1, 2, 3, 4
2SC2274K(E)		TR			2	Q 1, 2

IF UNIT (X48-1430-00)

PARTS NO.	NOTE	NAME & DESCRIPTION			QTY	REFERENCE NO.
BA718		DUAL OP-AMP			2	IC 1, 2
CC45CH1H0R5C		CERAMIC	0.5P	50V	2	C 15,265
CC45CH1H010C		CERAMIC	1P	50V	1	C 282
CC45CH1H020C		CERAMIC	2P	50V	2	C 23,278
CC45CH1H100D		CERAMIC	10P	50V	3	C 1,178,256
CC45CH1H330J		CERAMIC	33P	50V	2	C 7, 22
CC45RH1H010C		CERAMIC	1P	50V	3	C 8, 9, 10
CC45RH1H121J		CERAMIC	120P	50V	1	C 165
CC45RH1H241J		CERAMIC	240P	50V	1	C 163
CC45SL1H101J		CERAMIC	100P	50V	8	C 3, 4, 26,131,181,187,189,224
CC45SL1H121J		CERAMIC	120P	50V	2	C 118,211
CC45SL1H151J		CERAMIC	150P	50V	2	C 91,220
CC45SL1H221J		CERAMIC	220P	50V	2	C 125,176
CC45SL1H391J		CERAMIC	390P	50V	1	C 113
CC45SL1H470J		CERAMIC	47P	50V	1	C 124
CC45SL1H560J		CERAMIC	56P	50V	1	C 11
CC45UJ1H101J		CERAMIC	100P	50V	1	C 185
CE04W1A470M		ELECTRO	47	10V	1	C 25
CE04W1C330M		ELECTRO	33	16V	17	C 21, 28, 97,105,137,138,145,150,153,190 194,196,207,208,227,232,275
CE04W1E220M		ELECTRO	22	25V	1	C 206
CE04W1HR47M		ELECTRO	0.47	50V	2	C 132,144
CE04W1H0R1M		ELECTRO	0.1	50V	3	C 123,126,128
CE04W1H010M		ELECTRO	1	50V	18	C 61, 63, 65, 68, 70, 72, 75,103,130,139 149,188,192,195,197,199,209,281
CE04W1H100M		ELECTRO	10	50V	8	C 140,141,142,151,191,198,201,202
CE04W1H4R7M		ELECTRO	4.7	50V	1	C 226
CQ09FS1H122J	N	POLYSTYRENE	1200P	50V	3	C 174,177,179
CQ09FS1H182J	N	POLYSTYRENE	1800P	50V	2	C 87, 88
CQ09FS1H392J	N	POLYSTYRENE	3900P	50V	2	C 112,162
CQ92M1H273K		MYLAR	0.027	50V	1	C 146
CQ92M1H392K		MYLAR	0.0039	50V	2	C 83,107
CQ92M1H473K		MYLAR	0.047	50V	1	C 147
CQ92M1H683K		MYLAR	0.068	50V	1	C 143
C05-0314-05		TRIMMER	100P		1	TC 1
C90-0495-05		FIXED ELECTRO	47	6.3V	1	C 402
C91-0117-05		CERAMIC	0.01	50V	28	C 2, 12, 13, 18, 20, 24, 27, 41, 48, 53 66, 78, 89,106,122,148,152,172,200,241 247,249,261,272,273,276,277,401
C91-0119-05		CERAMIC	0.047	25V	62	C 19, 43, 44, 45, 49, 55, 56, 57, 58, 60 62, 64, 67, 69, 71, 76, 77, 82, 84, 86 90, 93, 95, 96,101,104,109,111,114,116 117,119,134,156,159,160,164,166,167,168 169,171,173,175,182,183,184,186,213,214 215,217,221,223,228,229,230,231,236,238 238 239,280
C91-0457-05		CERAMIC	0.022	50V	22	C 16, 17, 40, 42, 59, 81, 94, 98,102,127 154,157,158,216,246,248,252,257,260,267 269,274
C91-0667-05		CERAMIC	0.0047	50V	2	C 14,204
C91-0671-05		CERAMIC	0.0068	50V	3	C 135,136,193
C91-1008-05		CERAMIC	0.022	50V	41	C 5, 6, 29, 30, 31, 32, 34, 35, 36, 37 39, 47, 51, 52, 54, 74, 79, 80, 85, 92

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
				180,212,219,235,237,240,242,243,244,250 251,253,254,258,259,262,263,264,266,270 271
DTA143EF	N	DIGITAL TR PNP	14	Q 401,402,403,404,405,406,407,408,409,410 411,412,413,414
DTC114ES		DIGITAL TR NPN	5	Q 3, 6, 18, 20, 38
E04-0154-05		RF COAX. CONNECTOR	3	
E29-0440-14		GND WAFER	2	
E40-0211-05		MINI CONNECTOR 2P	1	
E40-0273-05		MINI CONNECTOR 2P	7	
E40-0373-05		MINI CONNECTOR 3P	2	
E40-0473-05		MINI CONNECTOR 4P	9	
E40-0573-05		MINI CONNECTOR 5P	3	
E40-0611-05		MINI CONNECTOR 6P	1	
E40-0618-05		CONNECTOR 6P	1	
E40-0711-05		MINI CONNECTOR 7P	2	
E40-0718-05		CONNECTOR 7P	2	
E40-0811-05		MINI CONNECTOR 8P	1	
E40-0818-05		CONNECTOR 8P	1	
E40-0873-05		MINI CONNECTOR 8P	1	
E40-0973-05		MINI CONNECTOR 9P	2	
E40-5059-05	N	MINI CONNECTOR 5P	6	
J32-0761-04	*	STUD & BOSS (STICK TYPE)	6	
LT8001P		LED RED	2	D 48, 51
L32-0650-15		OSCILLATING COIL	4	L 15, 18, 19, 20
L34-0536-05		TUNING COIL	5	L 1, 8, 37, 38, 41
L34-0781-05		TUNING COIL	5	L 2, 35, 40, 42, 43
L34-0942-05		TUNING COIL	2	L 9, 10
L34-0943-05		TUNING COIL	4	L 7, 11, 36, 44
L34-2114-15		TUNING COIL	1	L 46
L34-2117-15		TUNING COIL	1	L 45
L34-2121-05		TUNING COIL	1	L 13
L34-2124-05		TUNING COIL	7	L 12, 14, 29, 31, 32, 33, 34
L34-2125-15		TUNING COIL	3	L 23, 24, 25
L34-2127-15		TUNING COIL	1	L 16
L34-2128-15		TUNING COIL	1	L 17
L34-2247-05	N	TUNING COIL	4	L 3, 4, 5, 6
L40-1021-03		INDUCTOR 1 MH	3	L 26, 27, 28
L40-1211-03		INDUCTOR 120 UH	1	L 39
L40-1541-27		INDUCTOR 150 MH	2	L 21, 22
L40-4715-25		INDUCTOR 10 UH	1	L 30
L71-0222-05		MCF YK-88S1	1	XF 2
L71-0254-05	N	MCF 45.05MHZ	1	XF 1
L72-0319-05		CERAMIC FILTER CFW455HT	1	CF 2
L72-0333-05		CERAMIC FILTER CFJ455K12	1	CF 1
L72-0350-05		CERAMIC FILTER 9285KHZ	1	CF 3
MC911		DIODE	2	D 102,103
MC921		DIODE	5	D 43, 60, 69, 76, 82
			5	63, 97,105,106,107
MC931		DIODE	5	D 46, 47, 74, 80,109
MTZ10J		ZENER DIODE 10 V	3	D 45, 66, 71
MTZ12JC		ZENER DIODE 12 V	1	D 112

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
MTZ3.9J		ZENER DIODE 3.9V	2	D 25, 37
MTZ4.3J		ZENER DIODE 4.3V	1	D 75
MTZ5.1J(A,B)		ZENER DIODE 5.1V	1	D 401
MTZ6.2JB		ZENER DIODE 6.2V	1	D 55
MTZ6.8J		ZENER DIODE 6.8V	1	D 2
MV203		VARISTOR	2	D 65, 90
ND487R1-3R		D.B.M	1	D 73
N30-3010-46		PAN HD SCREW TR	6	
RN14BK2E271F		METAL FILM 270 OHM 1/4W	2	R 232,233
R12-0421-05		TRIM.POT. 100 OHM	1	VR 6
R12-1428-05		TRIM.POT. 1K OHM	1	VR 1
R12-1429-05		TRIM.POT. 500 OHM	2	VR 8, 10
R12-3443-05		TRIM.POT. 10K OHM	2	VR 3, 9
R12-3450-05		TRIM.POT. 20K OHM	1	VR 5
R12-4413-05		TRIM.POT. 50K OHM	3	VR 2, 4, 7
R90-0588-05	N	RESISTOR BLOCK 2.2KOHM X6	1	R 403
R90-0589-05	N	RESISTOR BLOCK 2.2KOHM X4	1	R 402
SN74LS145N		TTL IC: BCD DECIMAL DECODER	1	IC 401
TA7140P		IC MIC AMP	1	IC 3
TA7302P		IC PROC AMP	1	IC 4
1N60		DIODE	4	D 39, 40, 41, 42
1SS133		DIODE	54	D 14, 15, 16, 17, 30, 31, 32, 33, 49, 50
			8	52, 53, 54, 56, 57, 58, 59, 61, 62, 64 17, 50, 52, 54, 58, 59, 61, 64 67, 68, 70, 81, 88, 89, 91, 92, 93, 94
				95, 96, 98, 99,100,101,104,108,110,111 402,403,404,405,406,407,408,409,410,411 412,413,414,415
1SV149A	N	VOLTAGE VARIABLE	2	D 38, 44
1S1587		DIODE	34	D 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 13, 18, 19, 20, 21, 22, 23, 24, 26, 27 28, 29, 34, 35, 36, 72, 77, 78, 79, 83 84, 85, 86, 87
112-103-2		THERMISTER 10K OHM	4	TH 1, 2, 4, 6
112-501-2		THERMISTER 500 OHM	1	TH 5
112-503-2		THERMISTER 50K OHM	1	TH 3
2SA1048(Y)		TR	1	Q 25
			1	42
2SC1959(Y)		TR	1	Q 35
2SC2458(Y)		TR	8	Q 14, 15, 17, 19, 24, 31, 32, 39
			4	28, 40, 41, 47
2SC2459(BL)		TR OR 2SC2240(GR)	3	Q 29, 30, 36
2SC2668(Y)		TR	1	Q 1
2SC2787(L)		TR	2	Q 9, 49
2SK125		FET	2	Q 4, 5
2SK192A(GR)		FET	2	Q 16, 33
2SK30A(GR)		FET	5	Q 21, 22, 23, 26, 27
3SK73(Y)		FET	16	Q 2, 7, 8, 10, 11, 12, 13, 34, 37, 43 44, 45, 46, 48, 50, 51

PLL UNIT (X50-2020-00)

PARTS NO.	NOTE	NAME & DESCRIPTION			QTY	REFERENCE NO.
BA718	N	DUAL OP-AMP			1	IC 18
CC45CH1H010C		CERAMIC	1P	50V	1	C 198
CC45CH1H020C		CERAMIC	2P	50V	1	C 84
					1	140
CC45CH1H030C		CERAMIC	3P	50V	1	C 13
					4	40, 59,139, 30
CC45CH1H050C		CERAMIC	5P	50V	2	C 6,150
CC45CH1H060D		CERAMIC	6P	50V	1	C 204
CC45CH1H070D		CERAMIC	7P	50V	1	C 104
CC45CH1H080D		CERAMIC	8P	50V	1	C 149
					1	156
CC45CH1H090D		CERAMIC	9P	50V	1	C 191
CC45CH1H100D		CERAMIC	10P	50V	6	C 7,132,141,153,155,203
					1	31
CC45CH1H120J		CERAMIC	12P	50V	1	C 39
					2	45,114
CC45CH1H150J		CERAMIC	15P	50V	2	C 10,151
CC45CH1H180J		CERAMIC	18P	50V	3	C 12, 14,154
					2	217,219
CC45CH1H220J		CERAMIC	22P	50V	4	C 2, 60,122,199
					4	125,127,136,200
CC45CH1H270J		CERAMIC	27P	50V	1	C 41
CC45CH1H330J		CERAMIC	33P	50V	2	C 17, 58
					3	134,144,218
CC45CH1H390J		CERAMIC	39P	50V	1	C 135
CC45SL1H101J		CERAMIC	100P	50V	5	C 4,123,176,178,179
					1	177
CC45SL1H121J		CERAMIC	120P	50V	2	C 157,158
CC45SL1H151J		CERAMIC	150P	50V	2	C 3,164
					1	100
CC45SL1H181J		CERAMIC	180P	50V	1	C 42
CC45SL1H271J		CERAMIC	270P	50V	1	C 103
CC45SL1H390J		CERAMIC	39P	50V	2	C 101,117
					1	113
CC45SL1H560J		CERAMIC	56P	50V	2	C 190,192
CC45SL1H680J		CERAMIC	68P	50V	1	C 126
CC45SL1H820J		CERAMIC	82P	50V	1	C 115
CC45UJ1H020C		CERAMIC	2P	50V	1	C 64
					1	107
CC45UJ1H030C		CERAMIC	3P	50V	4	C 68, 85, 88,108
CC45UJ1H040C		CERAMIC	4P	50V	1	C 63
CC45UJ1H050C		CERAMIC	5P	50V	1	C 65
CC45UJ1H150J		CERAMIC	15P	50V	1	C 86
CC45UJ1H390J		CERAMIC	39P	50V	1	C 66
CE04W1A470M		ELECTRO	47	10V	8	C 20, 21, 27, 95, 97,111,170,172
CE04W1C330M		ELECTRO	33	16V	7	C 49, 71, 82, 93,143,201,208
CE04W1H0R1M		ELECTRO	0.1	50V	1	C 22
CQ92M1H123K		MYLAR	0.012	50V	1	C 73
CQ92M1H223K		MYLAR	0.022	50V	1	C 90
CS15E1E010M		TANTALUM	1	25V	1	C 209
CS15E1VR22M		TANTALUM	0.22	35V	2	C 184,185
CS15E1VR33M		TANTALUM	0.33	35V	2	C 186,187
CS15E1VR47M		TANTALUM	0.47	35V	1	C 206
C05-0044-05		TRIM. CAP.	30P		1	TC 1
C91-0084-05		CERAMIC	0.0047	50V	1	C 215

PARTS NO.	NOTE	NAME & DESCRIPTION			QTY	REFERENCE NO.
C91-0117-05		CERAMIC	0.01	50V	30	C 5, 9, 16, 33, 34, 50, 76, 79, 81, 91
						94, 98,102,110,128,130,131,133,145,146
					6	106,124,129,147,159,214
					2	148,162,167,173,180,181,182,183,205,211
C91-0119-05		CERAMIC	0.047	25V	5	C 1, 29, 32,188,189
					1	169
C91-0457-05		CERAMIC	0.022	50V	1	C 77
					1	212
C91-0667-05		CERAMIC	0.0047	50V	9	C 23, 67, 70, 74,137,165,194,195,202
					3	62, 69,138
C91-1008-05		CERAMIC	0.022	50V	19	C 8, 18, 26, 28, 37, 46, 47, 48, 53, 54
						55, 56, 80,118,119,120,121,160,168
					5	15, 44,105,174,210
DTA124ES		DIGITAL TR	PNP		1	Q 32
DTC124ES		DIGITAL TR	NPN		2	Q 30, 31
E29-0434-05		CONNECTOR & TERM			1	
E40-0273-05		MINI CONNECTOR	2P		2	
E40-0373-05		MINI CONNECTOR	3P		1	
E40-0473-05		MINI CONNECTOR	4P		2	
E40-0573-05		MINI CONNECTOR	5P		2	
E40-0673-05		MINI CONNECTOR	6P		1	
E40-0873-05		MINI CONNECTOR	8P		1	
HD10551	N	DIVIDER IC 1/10 ,11,20,22,40,44			2	IC 5, 11
J31-0502-04	*	COLLAR	PC BOAD		8	
J42-0428-05	*	BUSHING	PC BOAD		8	
L32-0675-05	N	OSCILLATING COIL	38MHZ		1	L 7
L32-0676-05	N	OSCILLATING COIL	105MHZ		1	L 10
L32-0677-05	N	OSCILLATING COIL	36MHZ		1	L 34
L34-0692-05		COIL	5 4T		1	L 39
L34-0749-05		TUNING COIL			2	L 17, 18
L34-0859-05		TUNING COIL			3	L 25, 26, 27
L34-1124-05	N	COIL	5 6.5T		1	L 30
L34-2026-05		TUNING COIL			2	L 20, 21
L34-2116-15		TUNING COIL			2	L 5, 6
L34-2249-05	N	TUNING COIL			3	L 22, 23, 24
L40-1001-03		INDUCTOR	10 UH		6	L 4, 11, 14, 31, 32, 33
L40-1001-12		INDUTOR	10 UH		3	L 36, 37, 38
L40-1011-03		INDUCTOR	100 UH		1	L 12
L40-1011-12		INDUCTOR	100 UH		1	L 29
L40-1092-02		INDUCTOR	1 UH		1	L 9
L40-1211-03		INDUCTOR	120 UH		1	L 13
L40-2205-25		INDUCTOR	22 UH		2	L 8, 35
L40-2701-03		INDUCTOR	27 UH		1	L 15
L40-2791-02		INDUCTOR	2.7 UH		1	L 28
L40-3301-03		INDUCTOR	33 UH		1	L 16
L40-3382-01		INDUCTOR	0.33UH		1	L 19
L40-4711-03		INDUCTOR	470 UH		1	L 2
L40-8291-02		INDUCTOR	8.2 UH		2	L 1, 3
L72-0349-05	N	CERAMIC FILTER	SFJ10.7MA-D		1	CF 1
L77-0963-05		CRYSTAL	20MHZ		1	X 1
MC145158P	N	PLL IC			1	IC 17

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
MC145698CP		C.MOS IC PROG' DIVIDER	1	IC 4
MC921		DIODE	1	D 5
MN6147		PLL IC OR MN6147C	3	IC 8, 9, 19
MN6147C		PLL IC		IC 8, 9, 19
MTZ12J		ZENER DIODE 12 V	2	D 1, 14
MTZ5.1JA/B		ZENER DIODE 5.1V	1	D 12
MV-203		VARISTOR	3	D 20, 21, 22
M54459L		IC: DIVIDER 1/20 OR 1/100	1	IC 10
R90-0581-05	N	DIODE BLOCK 1S1555 X5	1	D 19
R90-0582-05	N	DIODE BLOCK 1S1555 X5	1	D 18
R90-0583-05	N	DIODE BLOCK 1S1555 X3	1	D 17
R90-0584-05	N	CAP. BLOCK 100P X7	1	C 213
R90-0591-05	N	RESISTOR BLOCK 4.7KOHM X5	1	R 34
SN16913P		D.B.M IC	5	IC 6, 7, 12, 13, 14
SN74LS73AN		TTL IC JK FLIP-FLOP X2	1	IC 1
SN74LS90N		TTL IC COUNTER	2	IC 2, 3
SN74S10N		TTL IC 3-INPUT NAND X3	1	IC 15
SN74S112N		TTL IC JK FLIP-FLOP X2	1	IC 16
1SS133		DIODE	4	D 2, 3, 13, 16
			3	4, 8, 9
1SV123		VOLTAGE VARIABLE	5	D 6, 7, 10, 11, 15
2SA1115(E)		TR	1	Q 5
2SC1907		TR	2	Q 20, 24
2SC2459(BL)		TR OR 2SC2240(GR)	2	Q 28, 29
2SC2668(Y)		TR	15	Q 1, 6, 7, 10, 11, 12, 15, 17, 18, 19
				21, 22, 23, 25, 26
2SC2787(L)		TR	4	Q 2, 3, 4, 16
2SC3113(B)		TR	4	Q 8, 9, 13, 14
2SK192A(GR)*J		FET	1	Q 27

FILTER UNIT (X51-1330-00)

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
CC45CH1H220J		CERAMIC 22P 50V	1	C 55
CC45CH1H470J		CERAMIC 47P 50V	1	C 54
CC45SL2H030C		CERAMIC 3P 500V	1	C 76
CC45SL2H050C		CERAMIC 5P 500V	1	C 23
CC45SL2H070D		CERAMIC 7P 500V	1	C 24
CC45SL2H101J		CERAMIC 100P 500V	6	C 11, 22, 30, 33, 38, 39
CC45SL2H120J		CERAMIC 12P 500V	1	C 27
CC45SL2H121J		CERAMIC 120P 500V	1	C 32
CC45SL2H150J		CERAMIC 15P 500V	2	C 28, 42
CC45SL2H151J		CERAMIC 150P 500V	4	C 10, 35, 37, 41
CC45SL2H181J		CERAMIC 180P 500V	2	C 31, 40
CC45SL2H220J		CERAMIC 22P 500V	4	C 8, 9, 74, 75
CC45SL2H221J		CERAMIC 220P 500V	5	C 14, 16, 25, 36, 46
CC45SL2H330J		CERAMIC 33P 500V	1	C 12
CC45SL2H331J		CERAMIC 330P 500V	3	C 2, 13, 49
CC45SL2H390J		CERAMIC 39P 500V	2	C 21, 48
CC45SL2H391J		CERAMIC 390P 500V	3	C 4, 34, 50
CC45SL2H470J		CERAMIC 47P 500V	4	C 15, 26, 43, 44
CC45SL2H471J		CERAMIC 470P 500V	3	C 18, 19, 53
CC45SL2H560J		CERAMIC 56P 500V	2	C 29, 52
CC45SL2H680J		CERAMIC 68P 500V	4	C 6, 45, 47, 51
CC45SL2H681J		CERAMIC 680P 500V	1	C 17
CC45SL2H820J		CERAMIC 82P 500V	2	C 7, 20
CE04W1H010M		ELECTRO 1 50V	1	C 63
CE04W1H100M		ELECTRO 10 50V	1	C 64
CM93D2H152J		MICA 1500P 500V	2	C 1, 5
CM93D2H222J		MICA 2200P 500V	1	C 3
C91-0119-05		CERAMIC 0.047 50V	3	C 58, 59, 60
DTC124ES		DIGITAL TR NPN	5	Q 1, 2, 3, 5, 9
E04-0154-05		RF COAX. CONNECTOR	1	
E04-0157-05		RF COAX. CABLE RECEPTACLE	1	
E40-0273-05		MINI CONNECTOR 2P	2	
E40-0373-05		MINI CONNECTOR 3P	2	
E40-0473-05		MINI CONNECTOR 4P	2	
F11-0891-02	N*	SHIELDING CASE	1	
J31-0502-04	*	COLLAR PC BOAD	8	
J42-0428-05	*	BUSHING PC BOAD	8	
L34-3038-05		FILTER COIL A 1.5- 2.5 MHZ	1	L 2
L34-3039-05		FILTER COIL B 1.5- 2.5 MHZ	1	L 1
L34-3041-05		FILTER COIL D 2.5- 4.5 MHZ	1	L 6
L34-3043-05		FILTER COIL F 4.5- 7.5 MHZ	1	L 14
L34-3051-15		FILTER COIL N 22 - 30 MHZ	1	L 4
L34-3124-05	N	FILTER COIL P 2.5- 4.5 MHZ	1	L 5
L34-3125-05	N	FILTER COIL Q 4.5-7.5/7.5-10	2	L 10, 13
L34-3126-05	N	FILTER COIL R 7.5-10.5 MHZ	1	L 9
L34-3127-05	N	FILTER COIL S 22 - 30 MHZ	1	L 3
L34-3128-05	N	FILTER COIL T 10.5-15.5 MHZ	1	L 11
L34-3129-05	N	FILTER COIL U 10.5-15.5 MHZ	1	L 12
L34-3130-05	N	FILTER COIL V 15.5-22.0 MHZ	2	L 7, 8
L39-0419-05		DETECTOR COIL	1	L 15
L39-0420-05	N	DETECTOR COIL C	1	L 16

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
L40-1011-12		INDUCTOR 100 UH	8	L 21, 22, 23, 24, 25, 26, 27, 28
L40-1021-03		INDUCTOR 1 MH	2	L 19, 20
L40-4791-02		INDUCTOR 4.7 UH	2	L 17, 18
MTZ12J		ZENER DIODE 12 V	1	D 10
MTZ16JC		ZENER DIODE 16 V		D 3, 4, 5
MTZ18JA		ZENER DIODE 18 V	3	D 3, 4, 5
MTZ18JC		ZENER DIODE 18 V	1	D 16
MTZ20JC		ZENER DIODE 20 V	1	D 8
MTZ24JD		ZENER DIODE 24 V	1	D 7
MTZ3.9JB		ZENER DIODE 3.9V	1	D 13
MTZ5.1JA		ZENER DIODE 5.1V	1	D 11
MTZ5.6J		ZENER DIODE 5.6V	1	D 6
M54561P		IC INVERTER X7	1	IC 3
NJM2904D		LINER IC DUAL	1	IC 1
N87-3012-46		TAPPING SCREW FINAL UNIT	8	
R90-0510-05		RESISTOR BLOCK 4.7KOHM X8	1	RB 2
R90-0560-05		CAP.BLOCK 0.022 X5	1	IB 1
R90-0575-05		RESISTOR BLOCK 10K OHM X3	1	RB 1
SN74LS145N		TTL IC: BCD DECIMAL DECODER	1	IC 2
SV03YS		VARISTOR	1	D 12
S51-1424-05	N	RELAY DS-1 24V	14	RL 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 11, 12, 13, 14
1N4448		DIODE	7	D 17, 18, 19, 20, 21, 22, 23
1SS133		DIODE	4	D 9, 14, 15, 24
1S1007		DIODE	2	D 1, 2
1S1555		DIODE		D 17, 18, 19, 20, 21, 22, 23
2SA1015(Y)		TR	1	Q 8
2SA1048(Y)		TR	1	Q 6
2SC1959(Y)		TR	2	Q 4, 7

CONTROL UNIT (X53-1420-11)

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
CC45SL1H050C		CERAMIC 5P 50V	1	C 65
CC45SL1H100D		CERAMIC 10P 50V	1	C 66
CC45SL1H101J		CERAMIC 100P 50V	3	C 127,156,185
CC45SL1H120J		CERAMIC 12P 50V	2	C 107,108
CC45SL1H221J		CERAMIC 220P 50V	1	C 164
CC45SL1H330J		CERAMIC 33P 50V	2	C 126,130
CC45SL1H331J		CERAMIC 330P 50V	2	C 69, 72
CC45SL1H470J		CERAMIC 47P 50V	2	C 55,132
CE04W1A470M		ELECTRO 47 10V	1	C 89
CE04W1C100M		ELECTRO 10 16V	5	C 91,105,134,142,160
CE04W1C102M		ELECTRO 1000 16V	1	C 111
CE04W1C220M		ELECTRO 22 16V	6	C 4, 8, 30, 48, 50, 60
CE04W1C221M		ELECTRO 220 16V	1	C 157
CE04W1C330M		ELECTRO 33 16V	7	C 90, 97,129,136,153,155,159
CE04W1C470M		ELECTRO 47 16V	5	C 92,109,112,168,178
CE04W1E100M		ELECTRO 10 25V	3	C 2, 31,149
CE04W1E470M		ELECTRO 47 25V	4	C 175,176,177,179
CE04W1HR33M		ELECTRO 0.33 50V	1	C 180
CE04W1HR47M		ELECTRO 0.47 50V	7	C 11, 12, 17, 62, 77,145,158
CE04W1HOR1M		ELECTRO 0.1 50V	3	C 78, 96,172
CE04W1H010M		ELECTRO 1 50V	11	C 1, 3, 32, 33, 63,135,140,141,146,161 171
CE04W1H3R3M		ELECTRO 3.3 50V	1	C 9
CE04W1H470M		ELECTRO 47 50V	1	C 49
CK45B1H152K		CERAMIC 1500P 50V	1	C 133
CQ92M1H102K		MYLAR 0.001 50V	2	C 104,124
CQ92M1H103K		MYLAR 0.01 50V	5	C 13, 15, 76, 84, 85
CQ92M1H104K		MYLAR 0.1 50V	1	C 110
CQ92M1H152K		MYLAR 0.0015 50V	2	C 138,139
CQ92M1H153K		MYLAR 0.015 50V	1	C 127
CQ92M1H182K		MYLAR 0.0018 50V	2	C 128,162
CQ92M1H222K		MYLAR 0.0022 50V	1	C 137
CQ92M1H223K		MYLAR 0.022 50V	3	C 14, 23, 88
CQ92M1H333K		MYLAR 0.033 50V	2	C 98,152
CQ92M1H392K		MYLAR 0.0039 50V	3	C 100,101,102
CQ92M1H472K		MYLAR 0.0047 50V	6	C 86,125,131,148,163,166
CQ92M1H473K		MYLAR 0.047 50V	6	C 24, 25, 29, 87, 99,103
CQ92M1H562K		MYLAR 0.0056 50V	2	C 45,151
CQ92M1H683K		MYLAR 0.068 50V	1	C 167
C90-0478-05		ELECTRO 10 16V	1	C 165
C90-0506-05		ELECTRO 0.22 50V	1	C 26
C90-0825-05		ELECTRO 22 16V	3	C 75,147,154
C91-0117-05		CERAMIC 0.01 50V	10	C 5, 7, 10, 16, 28, 35, 73, 95,113,174
C91-0119-05		CERAMIC 0.047 25V	16	C 21, 38, 39, 40, 43, 44, 74,144 22, 58, 64, 67,118,122,148,173
C91-0457-05		CERAMIC 0.022 50V	2	C 53, 54
C91-1008-05		CERAMIC 0.022 50V	18	C 19, 37, 42, 47, 57, 70, 81, 82, 83, 94 114,115,116,117,119,120,121,170
DTA143XS	N	DIGITAL TR PNP	3	Q 22, 51, 54
DTC124ES		DIGITAL TR NPN	8	Q 39, 48, 49, 50, 56, 60, 61, 68
DTC144WS	N	DIGITAL TR NPN	4	Q 30, 31
	N			40, 52
E23-0512-05		TERMINAL 1P	1	
E40-0273-05		MINI CONNECTOR 2P	22	

PARTS NO.	NOTE	NAME & DESCRIPTION		QTY	REFERENCE NO.
E40-0373-05		MINI CONNECTOR	3P	5	
E40-0473-05		MINI CONNECTOR	4P	8	
E40-0573-05		MINI CONNECTOR	5P	4	
E40-0673-05		MINI CONNECTOR	6P	3	
E40-0873-05		MINI CONNECTOR	8P	1	
G53-0511-04		PACKING	LED	1	
HA1368		IC	AF PA	1	IC 15
LT8001P		LED	RED	2	D 49, 63
L30-0199-05		IFT	455 KHZ	1	L 10
L30-0503-05		IFT	455 KHZ	1	L 11
L34-0535-05		TUNING COIL	8.83MHZ	1	L 2
L34-0536-05		TUNING COIL		1	L 3
L40-1011-13		INDUCTOR	100 UH	1	L 6
L40-1021-03		INDUCTOR	1 MH	1	L 8
L40-3325-04		INDUCTOR	3.3 MH	1	L 9
L40-3391-13		INDUCTOR	3.3 UH	1	L 7
L40-4711-13		INDUCTOR	470 UH	3	L 1, 4, 5
L72-0342-05		CERAMIC FILTER	CFV455F	1	CF 1
L79-0446-05		CERAMIC DISCRI.	CFY455S	1	L 12
MB3614		LINEAR IC	QUADRUPLE	1	IC 9
MC911		DIODE		2	D 35, 60
MC921		DIODE		2	D 41, 84
				1	45
MTZ10JC		ZENER DIODE	10 V	1	D 37
MTZ12J		ZENER DIODE	12 V	1	D 52
MTZ12JC		ZENER DIODE	12 V	1	D 20
MTZ20JC		ZENER DIODE	20 V	1	D 54
MTZ3.6JB		ZENER DIODE	3.6V	1	D 47
MTZ5.6JA		ZENER DIODE	5.6V	1	D 51
MTZ9.1J		ZENER DIODE	9.1V	1	D 25
MV-203		VARISTOR		1	D 42
NJM2903D		LINEAR IC	DUAL	1	IC 10
NJM4558S		LINEAR IC	DUAL	2	IC 13, 14
N10-2030-41		HEX.NUT		5	
N30-3008-41		PAN HD SCREW	M3X8,IC	3	
N30-3010-41		PAN HD SCREW	M3X10	2	
N87-2606-41		TAPPING SCREW	M2.6X6	3	
N87-3006-41		TAPPING SCREW	M3X6	2	
RN14BK2E1002F		METAL FILM	10K OHM 1/4W	1	R 113
RN14BK2E1802F		METAL FILM	18K OHM 1/4W	2	R 111,112
RN14BK2E9301F		METAL FILM	9.3KOHM 1/4W	1	R 100
RS14AB3A911J		METAL FILM	910 OHM 1W	1	R 52
R12-1428-05		TRIM.POT.	1K OHM	1	VR 14
R12-1429-05		TRIM.POT.	500 OHM	1	VR 10
R12-3443-05		TRIM.POT.	10K OHM	5	VR 1, 3, 8, 16, 19
R12-3450-05		TRIM.POT.	20K OHM	1	VR 4
R12-4413-05		TRIM.POT.	50K OHM	7	VR 2, 5, 6, 12, 13, 15, 18
R12-5420-05		TRIM.POT.	100KOHM	2	VR 7, 9
R12-7408-05		TRIM.POT.	500KOHM	2	VR 11, 17
SV03YS		VARISTOR		1	D 57

PARTS NO.	NOTE	NAME & DESCRIPTION		QTY	REFERENCE NO.
S51-1404-05		RELAY	G2E DC12V	1	RL 2
S51-2416-05	N	RELAY	DS-2 DC24V	1	RL 1
TA78L008AP		AVR IC	8 V	1	IC 17
TC4001BP		C.MOS IC		1	IC 1
TC4011BP		C.MOS IC	2-INPUT NAND X4	2	IC 2, 5
TC40498P		C.MOS IC	BUFFER X6	1	IC 3
TC4073BP		C.MOS IC	3-INPUT AND X3	1	IC 4
UA7818UC		AVR IC	18V	1	IC 8
UPC1037H		IC	D.B.M	1	IC 16
UPC577H		IC	RF/IF AMP.	2	IC 11, 12
UPC7815H		AVR IC	15V	2	IC 6, 7
1N60		DIODE		7	D 61, 62, 64, 65, 78, 82, 83
1SS133		DIODE		63	D 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 11, 12, 13, 14, 15, 16, 17, 18, 19, 21 22, 23, 24, 26, 27, 28, 29, 30, 31, 32 33, 34, 36, 39, 40, 43, 44, 46, 50, 53 56, 58, 59, 66, 67, 68, 69, 70, 72, 73 74, 75, 76, 77, 79, 80, 81, 86, 88, 89 90, 91, 92
1SS99		DIODE		1	D 55
1S1587		DIODE		2	D 71, 94
2SA1048(Y)		TR		5	Q 4, 59 23, 25, 27
2SA984K(E)		TR		2	Q 28, 29
2SC2458(Y)		TR		7	Q 2, 6, 9, 10, 24, 37, 38
				20	3, 5, 7, 8, 11, 17, 18, 19, 20, 21 26, 32, 34, 35, 36, 41, 42, 46, 47, 63
2SC2459(BL)		TR	OR 2SC2240(GR)	1	Q 1
				3	62, 64, 65
2SC2787(L)		TR		6	Q 13, 15, 16, 45, 58 14
2SK192A(GR)*J		FET		2	Q 12, 57
2SK30A(O)		FET		3	Q 33, 43, 44

RIT ENCODER UNIT (X54-1690-01)

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
CE04W0J101M		ELECTRO 100 6.3V	1	C 1
LM358P		LINEAR IC DUAL	1	IC 1
N32-2606-46		FLAT HD SCREW M2.6X6	2	
ON1110		PHOTO TR	2	HIT 1, 2
R12-2409-05		TRIM. POT. 5K OHM	2	VR 1, 2

DIGITAL A UNIT (X54-1830-00)

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
CC45SL1H270J		CERAMIC 27P 50V	2	C 5, 6
CE04W1A221M		ELECTRO 220 10V	1	C 12
CE04W1H010M		ELECTRO 1 50V	1	C 3
CQ92M1H104K		MYLAR 0.1 50V	1	C 7
CS15E1A100M		TANTALUM 10 10V	1	C 10
C90-2001-05		ELECTRO 470 16V	1	C 1
C91-0119-05		CERAMIC 0.047 50V	6	C 8, 9, 14, 15, 16, 30
C91-0757-05		CERAMIC 0.001 50V	2	C 17, 18
C91-0761-05		CERAMIC 0.0022 50V	1	C 20
C91-0769-05		CERAMIC 0.01 50V	11	C 11, 13, 21, 22, 23, 24, 25, 26, 27, 28 29
C91-1008-05		CERAMIC 0.022 50V	1	C 19
DTA114ES		DIGITAL TR PNP	1	Q 8
			2	9, 10
DTA124ES		DIGITAL TR PNP	1	Q 7
E02-0122-05		IC SOCKET 24P	1	
E02-0123-05	N	IC SOCKET 28P	1	
E23-0437-05		TERMINAL (INSIDE	1	
E23-0512-05		TERMINAL 1P	1	
E40-0273-05		MINI CONNECTOR 2P	3	
E40-0373-05		MINI CONNECTOR 3P	4	
E40-0673-05		MINI CONNECTOR 6P	3	
E40-0773-05		MINI CONNECTOR 7P	1	
E40-0873-05		MINI CONNECTOR 8P	1	
E40-0973-05		MINI CONNECTOR 9P	1	
E40-1073-05		MINI CONNECTOR 10P	2	
E40-1173-05		MINI CONNECTOR 11P	1	
E40-1273-05		PIN ASS'Y 12P	1	
HD74LS138P		TTL IC: 3 TO 8 DEMULTIPLEXER	1	IC 7
HD74LS245P		TTL IC 3STATES BUS X8	1	IC 10
HD74LS245WP		TTL IC 3STATES BUS X8	1	IC 10
J31-0502-04	*	COLLAR PC BOAD	6	
J31-0503-05		BEADS	8	
J32-0767-04		STUD & BOSS (STICK TYPE)	2	
J42-0428-05	*	BUSHING PC BOAD	6	
LH0080A		MICRO-PROCESSOR	1	IC 1
L78-0011-05	N	CERAMIC RESONATOR 2.45MHZ	1	X 1
MBM2764-30T2	N	N.MOS IC EP.ROM (8KX8)	1	IC 2
MB8416-20LP-GRA		C.MOS IC SR.RAM (2K X8)	1	IC 3
M5L8255AP-5		IC:PROGRAMABLE EXPANDER I/O	3	IC 4, 5, 6
M74LS32P		TTL IC 2-INPUT OR X4	2	IC 13, 14
N10-2026-46		HEX.NUT	2	
PST518A		SYSTEM RESET IC (VS=4.0-4.4V)	1	IC 21
R90-0188-05		CAP. BLOCK 0.01UF X4	1	IB 9
R90-0241-05	N	CAP. BLOCK 0.01UF X6	1	IB 1
R90-0510-05		RESISTOR BLOCK 4.7KOHM X8	1	RB 2
R90-0533-05		RESISTOR BLOCK 10K OHM X10	1	RB 1

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
R90-0545-05		CAP. BLOCK 0.001 X4	1	IB 10
R90-0552-05		CAP. BLOCK 0.01UF X8	4	IB 2, 3, 5, 6
R90-0586-05	N	CAP. BLOCK 0.01UF X10	1	IB 4
SN74LS138N		TTL IC: 3 TO 8 DEMULTIPLEXER	1	IC 7
SN74LS139N		TTL IC 2 TO 4 DEMULTIPLEX' X2	1	IC 8
SN74LS175N		TTL IC D FLIP-FLOP X4	1	IC 19
SN74LS245N		TTL IC 3STATES BUS X8	1	IC 10
SN74LS32N		TTL IC 2-INPUT OR X4	2	IC 13, 14
SN74LS374N		TTL IC: 3STATES D FLIP-FLOP X8	1	IC 18
TA57		TR. ARRAY NPN X5	2	IC 16, 17
TC40H004P	N	C.MOS IC INVERTER X6	1	IC 15
TC40118P		C.MOS IC 2-INPUT NAND X4	2	IC 11, 12
TC4040BP		C.MOS IC:12STG BINARY COUNTER	1	IC 9
TMP8255AP-5		IC:PROGRAMABLE EXPANDER I/O	3	IC 4, 5, 6
UPD780C-1		MICRO-PROCESSOR	1	IC 1
UPD8255AC-5		IC:PROGRAMABLE EXPANDER I/O	3	IC 4, 5, 6
1SS133		DIODE	1	D 1
			2	3, 4
2SA1049(GR)		TR	3	Q 4, 5, 6
2SC1959(Y)		TR	1	Q 3

DIGITAL B UNIT (X54-1840-00)

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
CC45CH1H030C		CERAMIC 3P 50V	1	C 22
			1	43
CC45CH1H100D		CERAMIC 10P 50V	2	C 5, 26
			1	53
CC45CH1H220J		CERAMIC 22P 50V	1	C 89
CC45CH1H330J		CERAMIC 33P 50V	3	C 10, 19, 30
			1	40
CC45RH1H030C		CERAMIC 3P 50V	1	C 92
CC45RH1H050C		CERAMIC 5P 50V	1	C 93
CC45SL1H121J		CERAMIC 120P 50V	1	C 74
CC45SL1H151J		CERAMIC 150P 50V	2	C 8, 27
CC45SL1H331J		CERAMIC 330P 50V	2	C 7, 28
CC45SL1H390J		CERAMIC 39P 50V	1	C 76
CC45SL1H560J		CERAMIC 56P 50V	1	C 52
CC45UJ1H030C		CERAMIC 3P 50V	3	C 17, 38, 44
CC45UJ1H050C		CERAMIC 5P 50V	1	C 23
CC45UJ1H220J		CERAMIC 22P 50V	1	C 41
CC45UJ1H330J		CERAMIC 33P 50V	1	C 20
CE04W1A101M		ELECTRO 100 10V	2	C 111,113
CE04W1A470M		ELECTRO 47 10V	2	C 47, 72
CE04W1C330M		ELECTRO 33 16V	2	C 16, 37
CQ92M1H393K		MYLAR 0.039 50V	1	C 35
CQ92M1H473K		MYLAR 0.047 50V	1	C 14
C05-0044-05		TRIM. CAP 30P	3	TC 1, 2, 3
C91-0117-05		CERAMIC 0.01 50V	10	C 1, 2, 3, 4, 9, 13, 32, 34, 70, 80
			5	11, 51, 78, 90, 91
C91-0119-05		CERAMIC 0.047 25V	3	C 79,101,112
			1	106
C91-0457-05		CERAMIC 0.022 50V	4	C 31, 55, 67, 69
			2	48, 77
C91-0667-05		CERAMIC 0.0047 50V	2	C 15, 36
			5	18, 21, 39, 42, 49
C91-0757-05		CERAMIC 0.001 50V	1	C 102
			7	103,104,105,107,108,109,110
C91-1008-05		CERAMIC 0.022 50V	12	C 6, 12, 29, 33, 56, 66, 71, 82, 83, 84
			4	85, 87 57, 58, 60, 63
DTC114ES		DIGITAL TR NPN	1	Q 105
DTC124ES		DIGITAL TR NPN	2	Q 104,107
DTC144WS		DIGITAL TR NPN	2	Q 103,106
E40-0273-05		MINI CONNECTOR 2P	1	
E40-0373-05		MINI CONNECTOR 3P	1	
E40-0473-05		MINI CONNECTOR 4P	5	
E40-0573-05		MINI CONNECTOR 5P	2	
E40-0873-05		MINI CONNECTOR 8P	1	
E40-0973-05		MINI CONNECTOR 9P	1	
E40-1073-05		MINI CONNECTOR 10P	1	
E40-1174-05		MINI CONNECTOR 11P L TYPE	1	
E40-1274-05		MINI CONNECTOR 12P L TYPE	1	
E40-1373-05		MINI CONNECTOR 13P	1	
E40-3007-05		MINI CONNECTOR 2P	1	
J31-0502-04	*	COLLAR PC BOAD	5	
J42-0428-05	*	BUSHING PC BOAD	5	

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
LC7800		IC:4 TO 1 DATA SELECTOR X4	3	IC 109,110,111
L30-0516-05		IFT	1	L 15
L32-0678-05	N	OSCILLATING COIL 45.5MHZ	1	L 6
L32-0679-05	N	OSCILLATING COIL 71.5MHZ	1	L 10
L33-0684-05	N	CHOKE COIL 33 UH	2	L 4, 8
L34-0536-05		TUNING COIL	1	L 14
L34-0683-05		TUNING COIL	2	L 19, 20
L40-1001-12		INDUTOR 10 UH	1	L 21
L40-1011-03		INDUCTOR 100 UH	2	L 102,103
L40-1011-13		INDUCTOR 100 UH	1	L 101
L40-1211-03		INDUCTOR 120 UH	4	L 1, 2, 3, 18
L40-1511-03		INDUCTOR 150 UH	1	L 12
L40-1592-02		INDUCTOR 1.5 UH	1	L 11
L40-1811-03		INDUCTOR 180 UH	1	L 13
L40-2201-03		INDUCTOR 22 UH	1	L 9
L40-2215-25		INDUCTOR 10 UH	1	L 16
L40-2715-25		INDUCTOR 10 UH	1	L 17
L40-4701-03		INDUCTOR 47 UH	1	L 5
L40-5691-02		INDUCTOR 5.6 UH	1	L 7
L72-0350-05	N	CERAMIC FILTER 9285KHZ	1	CF 1
L72-0351-05	N	CERAMIC FILTER 8.83MHZ	1	CF 2
L77-1271-05	N	CRYSTAL 9MHZ	2	X 1, 2
MC74HC157N		IC:2 TO 1 DATA SELECTOR X4	1	IC 112
MN6147		PLL IC OR MN6147C	2	IC 1, 2
MN6147C		PLL IC		IC 1, 2
MV-203		VARISTOR	2	D 11, 12
M54459L		IC: DIVIDER 1/20 OR 1/100	2	IC 3, 5
N87-2606-46		TAPPING SCREW M2.6X6	4	
N87-3006-46		TAPPING SCREW,FOOT	3	
N87-3012-46		TAPPING SCREW FINAL UNIT	5	
R90-0123-05		RESISTOR BLOCK 4.7KOHM X4	1	RB 101
R90-0584-05		CAP. BLOCK 100P X7	1	C 94
SN16913P		D.B.M IC	2	IC 4, 6
TC4011BP		C.MOS IC 2-INPUT NAND X4	8	IC 101,102,103,104,105,106,107,108
1SS133		DIODE	11	D 101,103,104,105,116,118,122,125,126,128
				137
			26	102,105,106,107,108,109,110,111,112,113
				114,117,119,120,121,123,124,127,129,130
				131,132,133,134,135,136
1SV123		VOLTAGE VARIABLE	4	D 4, 5, 7, 8
1S1587		DIODE	4	D 1, 2, 3, 6
			2	9, 10
2SC2458(Y)		TR	7	Q 12, 13, 14, 15, 17,101,102
2SC2668(Y)		TR	4	Q 4, 5, 9, 10
2SC2787(L)		TR	4	Q 1, 6, 11, 16
2SC3113(B)		TR	4	Q 2, 3, 7, 8
3SK73(GR)		FET	1	Q 18

DIGITAL C UNIT (X54-1850-00)

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
CE04W1A101M		ELECTRO 100 10V	1	C 2
CE04W1H101M		ELECTRO 100 50V	1	C 5
C91-0119-05		CERAMIC 0.047 50V	1	C 1
E23-0512-05		TERMINAL 1P	1	
E40-3007-05		MINI CONNECTOR 2P	1	
E40-3008-05		MINI CONNECTOR 3P	1	
E40-3010-05		MINI CONNECTOR 5P	1	
E40-3011-05		MINI CONNECTOR 6P	2	
E40-3012-05		MINI CONNECTOR 7P	1	
E40-3013-05		MINI CONNECTOR 8P	2	
E40-3017-05		MINI CONNECTOR 12P	2	
J31-0502-04	*	COLLAR PC BOAD	2	
J42-0428-05	*	BUSHING PC BOAD	2	
L40-4711-13		INDUCTOR 470 UH	2	L 1, 2
MTZ9.1JC		ZENER DIODE 9.1V	1	D 1
R90-0520-05		RESISTOR BLOCK 47K OHM X5	1	RB 5
R90-0521-05		RESISTOR BLOCK 47K OHM X7	1	RB 6
R90-0522-05		RESISTOR BLOCK 47K OHM X6	4	RB 1, 2, 3, 4
TC5065BP		C.MOS IC INVERTER X6	4	IC 1, 2, 3, 4
2SC2458(Y)		TR	1	Q 1

AT UNIT (X57-1130-00)

PARTS NO.	NOTE	NAME & DESCRIPTION		QTY	REFERENCE NO.
CC45CH2H270J		CERAMIC	27P 500V	1	C 13
CE04W0J101M		ELECTRO	100 6.3V	2	C 206,208
CE04W1A101M		ELECTRO	100 10V	1	C 203
CE04W1C100M		ELECTRO	10 16V	4	C 108,111,112,224
CE04W1C101M		ELECTRO	100 16V	3	C 204,205,207
CE04W1C470M		ELECTRO	47 16V	1	C 116
CE04W1HR33M		ELECTRO	0.33 50V	1	C 217
CE04W1H0R1M		ELECTRO	0.1 50V	1	C 220
CE04W1H010M		ELECTRO	1 50V	3	C 114,212,216
CE04W1H100M		ELECTRO	10 50V	2	C 1, 3
CQ92FM1H103K		MYLAR	0.01 50V	4	C 210,215,219,222
CQ92FM1H104K		MYLAR	0.1 50V	1	C 223
CQ92FM1H473K		MYLAR	0.047 50V	1	C 218
CQ92M1H333K		MYLAR	0.033 50V	1	C 214
CQ92M1H473K		MYLAR	0.047 50V	1	C 115
C02-0022-05		VARIABLE CAP.	300P 1.2KV	2	VC 1, 2
C05-0324-05		TRIMMER	60P	1	TC 101
C90-0840-05		ELECTRO	10 16V	1	C 117
C90-2015-05		ELECTRO	330 25V	1	C 209
C91-0456-05		CERAMIC	0.047 25V	2	C 12,107
				2	105,119
DTC114ES		DIGITAL TR	NPN	1	Q 7
DTC124ES		DIGITAL TR	NPN	12	Q 9, 10, 11, 12, 13,116,122,124,125,126 202,203
D40-0623-25		MECHANISM ASS'Y	1/200		
D40-0624-25		MECHANISM ASS'Y	1/300		
D40-0625-15		MECHANISM ASS'Y		1	
E04-0157-05	*	RF COAX. CABLE RECEPTACLE		3	
E40-0273-05	*	MINI CONNECTOR	2P	6	
E40-0373-05	*	MINI CONNECTOR	3P	3	
E40-0473-05	*	MINI CONNECTOR	4P	5	
E40-0573-05	*	MINI CONNECTOR	5P	3	
F20-0078-05		INSULATING PLATE		1	
F29-0014-05		INSULATING WASHER :TRANSISTOR		1	
HD10116		ECL IC	DIFF' AMP X3	1	IC 101
HD10125		ECL IC	LEVEL CONVT X4	1	IC 103
HD10131		ECL IC	D FLIP-FLOP X2	1	IC 102
J31-0502-04	*	COLLAR	PC BOAD	8	
J42-0428-05	*	BUSHING	PC BOAD	8	
LT8001P		LED	RED	4	D 119,201,202,210
L34-2250-05	N	TUNING COIL A		1	L 1
L34-2251-05	N	TUNING COIL B		1	L 2
L34-2252-05	N	TUNING COIL C		1	L 3
L34-2253-05	N	TUNING COIL D		1	L 4
L39-0415-15		DETECTOR COIL A		1	L 102
L39-0416-05		DETECTOR COIL B		1	L 103
L40-1011-04		INDUCTOR	100 UH	1	L 5
L40-1011-12		INDUCTOR	100 UH	9	L 103,104,105,109,110,201,202,203,204
L40-1011-13		INDUCTOR	100 UH	1	L 106
L40-1011-14		INDUCTOR	100 UH	2	L 107,108

PARTS NO.	NOTE	NAME & DESCRIPTION		QTY	REFERENCE NO.
MC10116L		ECL IC	DEFF' AMP X3	1	IC 101
MC10125L		ECL IC	LEVEL CONVT X4	1	IC 103
MC10131L		ECL IC	D FLIP-FLOP X2	1	IC 102
MC14077BCP		C.MOS IC	2INP' EX-NOR X4	1	IC 208
MTZ10J(A,B)		ZENER DIODE	10 V	5	D 11, 12, 13, 14,207
MTZ11JC		ZENER DIODE	11 V	1	D 211
MTZ16J(A,B)		ZENER DIODE	16 V	1	D 27
MTZ20J		ZENER DIODE	20 V	1	D 115
MTZ5.6JB		ZENER DIODE	5.6V	1	D 10
NE555P		TIMER IC		1	IC 106
NE556N	N	TIMER IC	DUAL	1	IC 204
NJM2901		LINER IC	QUADRUPLE	1	IC 104
NJM2904D		LINER IC	DUAL	1	IC 105
N10-2030-46		NUT,TR	M3	2	
RC05GF2H101J		RES. SOLID	100 OHM 1/2W	2	R 101,102
RC05GF2H821J		RES. SOLID	820 OHM 1/2W	1	R 9
RS14GB3D330J		METAL FILM	33 OHM 2W	3	R 221,222,223
R12-2410-05		TRIM.POT.	5K OHM	1	VR 102
R12-3434-05		TRIM.POT.	10K OHM	1	VR 101
R90-0515-05		RESISTOR BLOCK	10K OHM X4	1	RB 1
R90-0560-05		CAP.BLOCK	0.022 X5	1	IB 1
R90-0561-05		RESISTOR BLOCK	22K OHM X6	1	RB 2
R90-0570-05		DIODE BLOCK		2	IB 101,102
R90-0592-05	N	RESISTOR BLOCK	4.7KOHM X6	1	RB 3
SN74LS145N		TTL IC: BCD	DECIMAL DECODER	1	IC 1
S51-1424-05		RELAY	DS-1 24V	7	RL 1, 2, 3, 4, 5, 5, 6, 8
S51-2411-05		RELAY	321D024	1	RL 101
S51-2414-05		RELAY	FBR244D012	1	RL 7
TC4001BP		C.MOS IC		1	IC 207
TC4011BP		C.MOS IC	2-INPUT NAND X4	1	IC 206
TC4027BP		C.MOS IC	JK FLIP-FLOP X2	1	IC 205
T42-0303-05		MOTOR		2	M 1, 2
UPC78L08A		AVR IC	8 V	1	IC 202
UPC7805H		AVR IC	5 V	1	IC 201
UPC7812H		AVR IC	12V	1	IC 203
1N4448		DIODE		9	D 1, 2, 3, 4, 5, 6, 7, 8,112
1N60		DIODE		2	D 101,102
1SS133		DIODE		29	D 9, 15, 16, 17, 18, 19, 20, 21, 22, 23 24, 25, 26,107,108,109,110,111,113,114 116,117,118,203,204,205,206,208,209
1SS99		DIODE		4	D 103,104,105,106
1S1555		DIODE			D 1, 2, 3, 4, 5, 6, 7, 8,112
2SA1015(Y)		TR		7	Q 1, 2, 3, 4, 5, 6,201
2SA1048(Y)		TR		3	Q 101,102,123
2SA950(Y)		TR		4	Q 103,108,110,115
2SA966(O)		TR		1	Q 118
2SA984K(E)		TR		1	Q 119
2SC2120(Y)		TR		4	Q 105,106,112,113
2SC2458(Y)		TR		8	Q 104,107,109,111,114,117,120,121

KEYBOARD ASS'Y (S59-0433-15)

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
E40-0373-05		MINI CONNECTOR 3P	2	
E40-0473-05		MINI CONNECTOR 4P	2	
E40-0573-05		MINI CONNECTOR 5P	3	
E40-0673-05		MINI CONNECTOR 6P	1	
E40-0773-05		MINI CONNECTOR 7P	2	
E40-0873-05		MINI CONNECTOR 8P	1	
LN01201C		LED RED	3	D 39, 46, 48
LN01301C		LED GREEN	6	D 37, 40, 41, 42, 45, 47
LN01401C		LED UMBER	5	D 38, 43, 44, 49, 50

LCD ASS'Y (W02-0368-05)

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
B11-0427-08	N	REFLECTOR	1	
B11-0428-08	N	LIGHT GUIDING PLATE	1	
B30-0835-08	N	LAMP	2	
E29-0461-08	N	LCD CONNECTOR	2	
E31-3099-08	N	CONNECTOR WITH WIRE 2P	1	
E31-3100-08	N	INSIDE CONNECTING WIRE 10P	1	
FTD-7155	N	LCD	1	
HD44100	N	C.MOS IC LCD DRIVER	1	IC 2
HD44780	N	C.MOS IC LCD DRIVER	1	IC 1
J19-1416-08	N	LCD HOLDER	1	
RD73EB2B222J		CHIP RESISTOR 2.2KOHM 1/8W	5	R 1, 2, 3, 4, 5
RD73EB2B913J		CHIP RESISTOR 91K OHM 1/8W	1	R 6

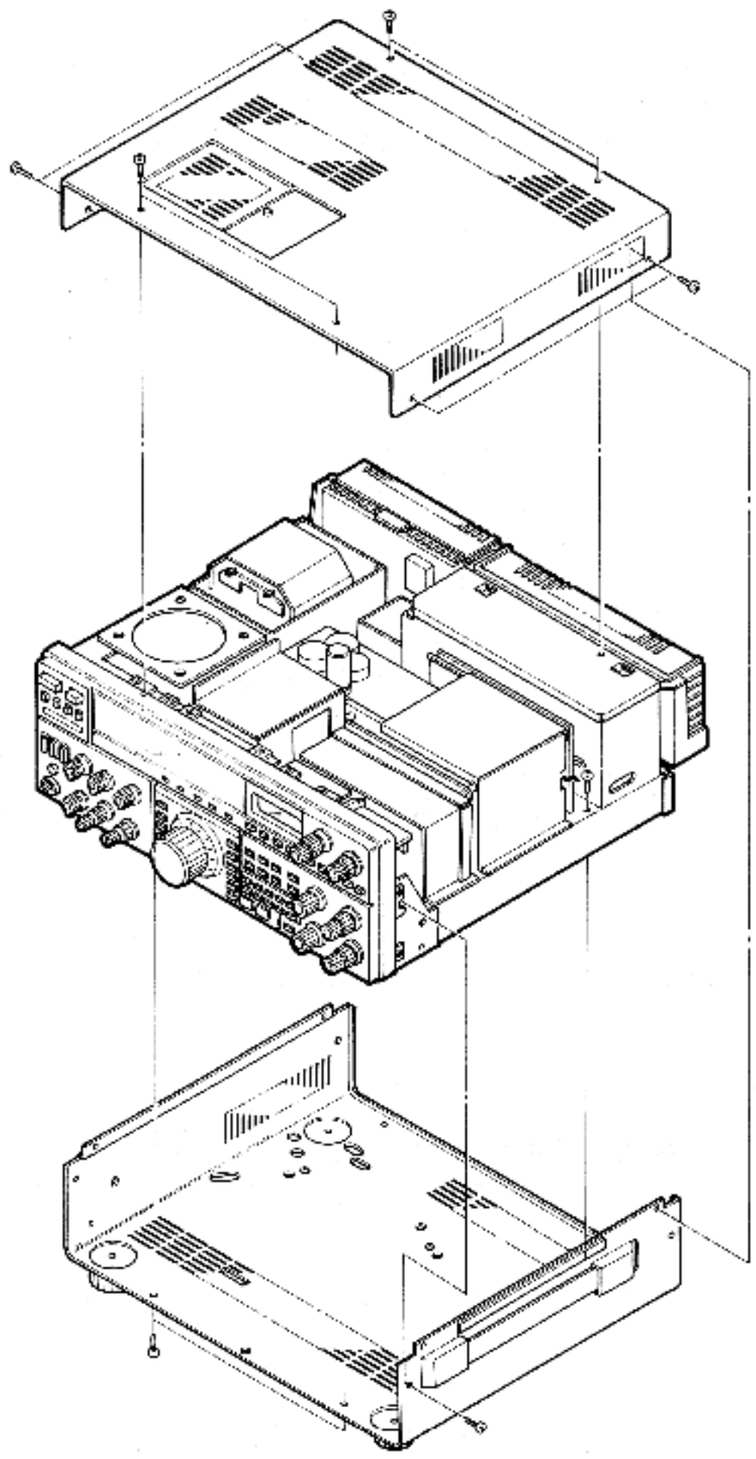
MAIN ENCODER ASS'Y (W02-0328-10)

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
CE04W1A470M		ELECTRO 47 10V	1	C 1
E40-0474-05		MINI CONNECTOR 4P L TYPE	1	
LM358P		LINEAR IC DUAL	1	IC 1
LN66(S)		DIODE	2	D 1, 2
PN126S		PHOTO TRANSISTOR	2	Q 2, 3
R12-2411-05		TRIM.POT. 5K OHM	2	VR 1, 2
2SA1015(Y)		TR	1	Q 1
25D29		THERMISTOR 500 OHM	1	TH 1

TS-940S DISASSEMBLY

Disassembly and assembly for upper and bottom case

1) When removing the top and bottom case take round head screws, eight from upper case and nine from bottom case, cautions on removing case from scratches slightly shift the case to rear side.
2) When assemble the case take back words process of disassembly with pay attention for pinched wire between case and chassis.



Disassembly and cautions for rear panel

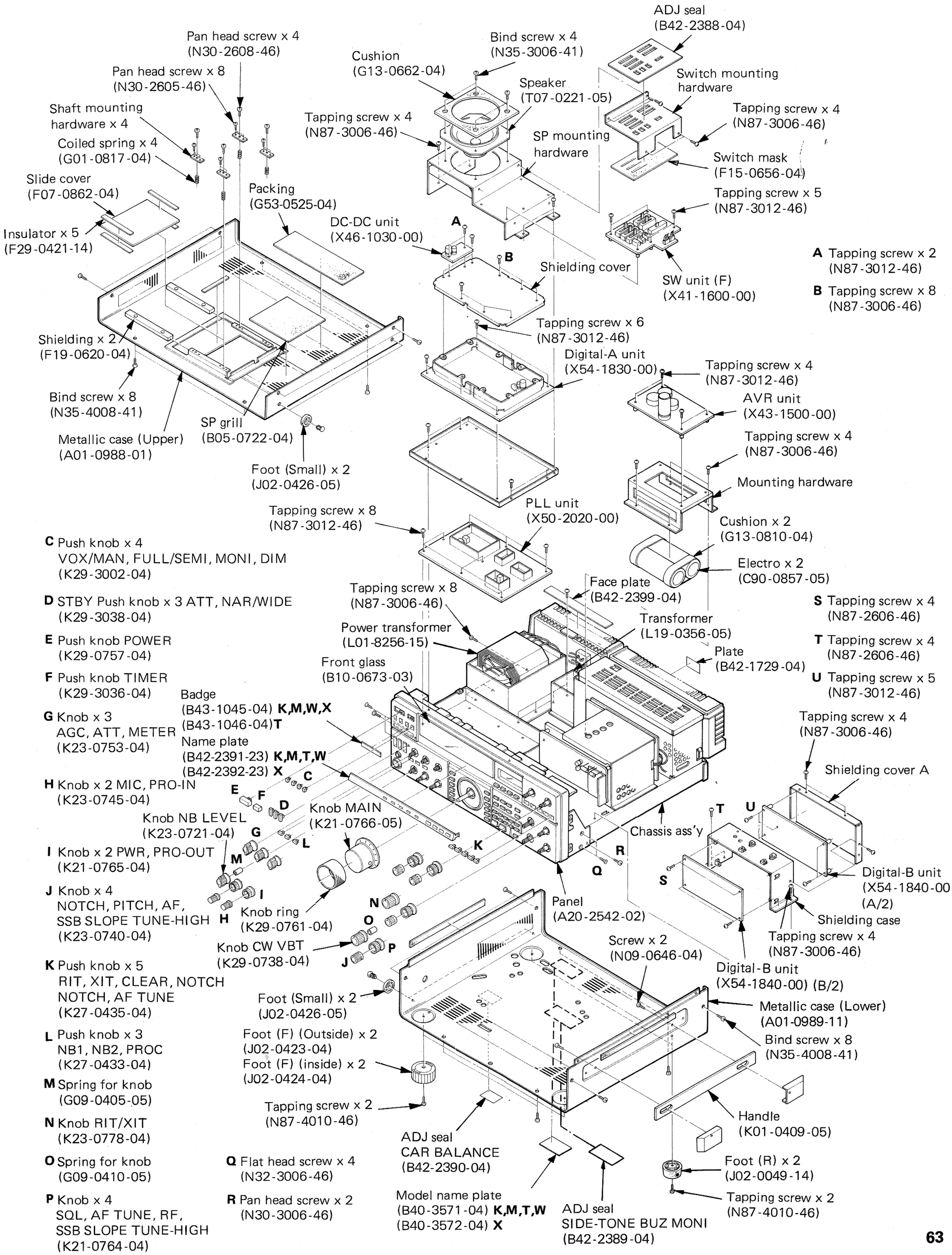
1) Take care not to damage terminals ANT and GND on the rear panel since they are soldered or screwed to the PC board.
2) When repairing the final seciton, remove the upper and lower cases, then the final heatsink and shield case for the Filter unit. (When repairing the Filter unit, remove the above parts, too.)

Disassembly and cautions for internal mechanism

1) Cautions on replacement of transformer
   Tighten the hexagon socket head bolts to torque of 20kg-cm. Check the transformer for shock, looseness, and correspondence.
2) Removing mounting hardware for electric capacitor. The mounting hardware for electric capacitor can be removed by removing four screws.
3) The speaker is installed to the mounting hardware on the chassis, different from the models in the past.

Disassembly for front panel

1) To incline the front panel, remove two flat screws from the mounting hardware which securing the chassis and panel, and loosen two round screws. The panel at chasssis side will incline more than 90°, and the parts at inside of the panel can be inspected and repaired easily.
2) Removing main knob
   If the dial ring fit to the rim of main knob is removed, the hexagon socket head bolt can be seen which is securing the main knob. The main knob can be removed by loosening this bolt.
3) When removing the KEY BOARD ASS'Y (MODE, FUNCTION, MEMORY, BAND KEY), remove the main encoder and eleven flat screws (M2.6 x 4)
4) When replacing the name plate on the display window for display and meter, push each end and two middle of the name plate from rear with a thin screw driver through the square hole on the panel.
5) When replacing the front glass, remove the name plate and two flat screws (M2 x 6)
6) When removing the display take from the mounting hardware, insert a thin screw driver, etc. into the mounting hardware at both sides. Remove the display tube with the screw driver from the projection of the mounting hardware for display tube.



A Tapping screw x 2
(N87-3012-46)

B Tapping screw x 8
(N87-3006-46)

C Push knob x 4
VOX/MAN, FULL/SEMI, MONI, DIM
(K29-3002-04)

D STBY Push knob x 3 ATT, NAR/WIDE
(K29-3038-04)

E Push knob POWER
(K29-0757-04)

F Push knob TIMER
(K29-3036-04)

G Knob x 3
AGC, ATT, METER
(K23-0753-04)

H Knob x 2 MIC, PRO-IN
(K23-0745-04)

I Knob x 2 PWR, PRO-OUT
(K21-0765-04)

J Knob x 4
NOTCH, PITCH, AF,
SSB SLOPE TUNE-HIGH
(K23-0740-04)

K Push knob x 5
RIT, XIT, CLEAR, NOTCH
NOTCH, AF TUNE
(K27-0435-04)

L Push knob x 3
NB1, NB2, PROC
(K27-0433-04)

M Spring for knob
(G09-0405-05)

N Knob RIT/XIT
(K23-0778-04)

O Spring for knob
(G09-0410-05)

P Knob x 4
SQL, AF TUNE, RF,
SSB SLOPE TUNE-HIGH
(K21-0764-04)

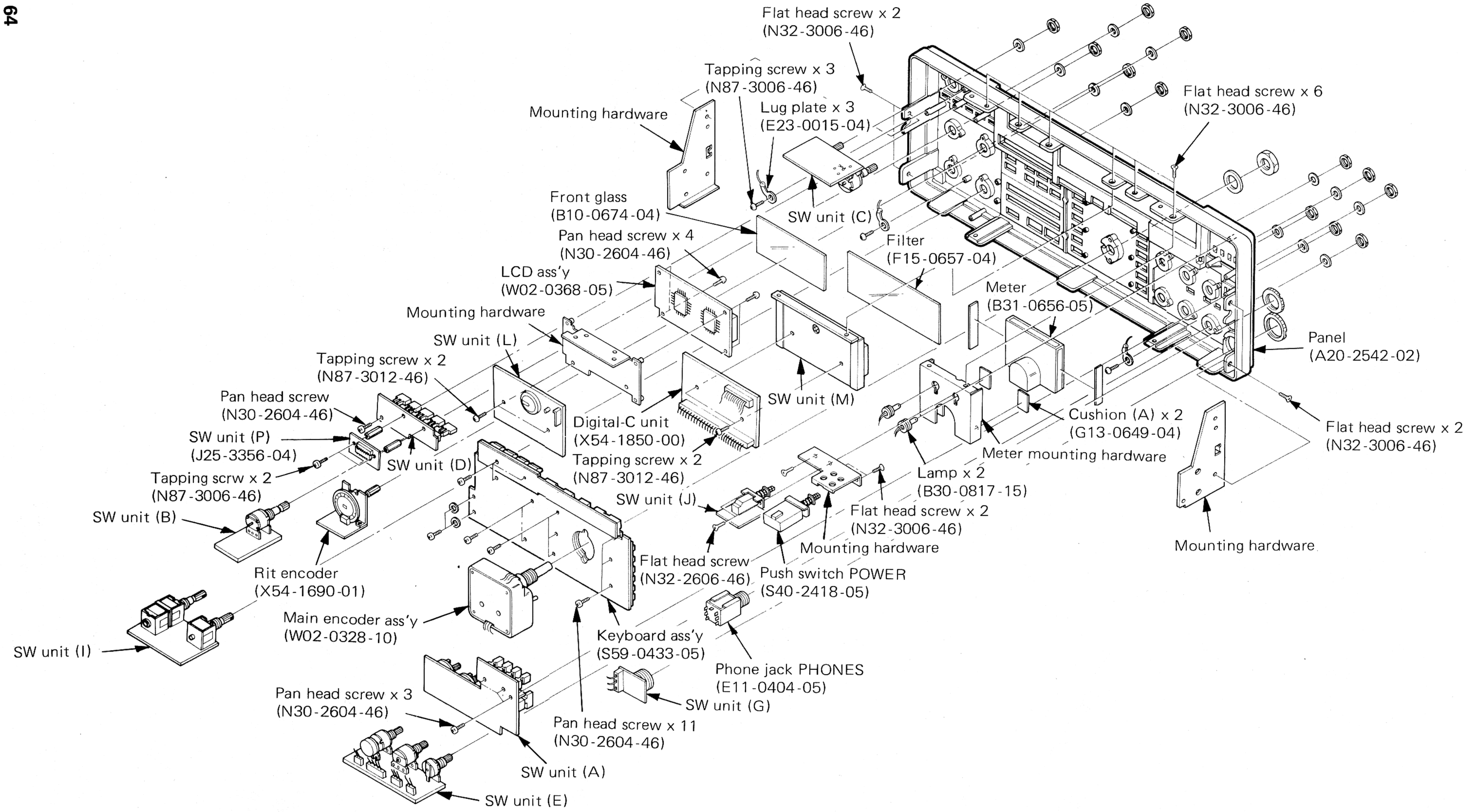
Q Flat head screw x 4
(N32-3006-46)

R Pan head screw x 2
(N30-3006-46)

S Tapping screw x 4
(N87-2606-46)

T Tapping screw x 4
(N87-2606-46)

U Tapping screw x 5
(N87-3012-46)



SW unit (X41-1600-00)

A	S4—10	(S40-2440-15)	Push switch	VOX/MAN,FULL/SEMI,MONI,DIM,SEND/REC,AT·T,NAR/WIDE
	S11	(S01-1432-05)	Rotary switch	ATT
	S12	(S01-1431-05)	Rotary switch	AGC
	S13	(S01-1430-05)	Rotary switch	METER
	S14—16	(S40-2434-05)	Push switch	NB1, NB2, PROC
B	VR12	(R19-3413-05)	Pot.	AF/RF
C	VR10	(R19-3421-05)	Pot.	PITCH/AF TUNE
	VR11	(R24-9402-05)	Pot.	NOTCH/SQL
D	S17—19	(S40-2439-15)	Push switch	RIT, XIT, CLEAR
	S20, 21	(S40-2438-15)	Push switch	NOTCH, AF TUNE
E	VR7	(R01-0407-05)	Pot.	NB LEVEL
	VR8	(R19-3422-05)	Pot.	PROC-IN/OUT
G	J2	(E06-0858-05)	8P metal socket	MIC
I	S2	(S29-1434-05)	Rotary switch	CW VBT
	S3	(S29-2410-05)	Rotary switch	SSB SLOPE TUNE-HIGH/LOW
J	S26	(S40-2453-05)	Rotary switch	TIMER
L	S1	(S50-1411-05)	Tact switch	
M	V1	(11-BT-05Z)	Display tube	—

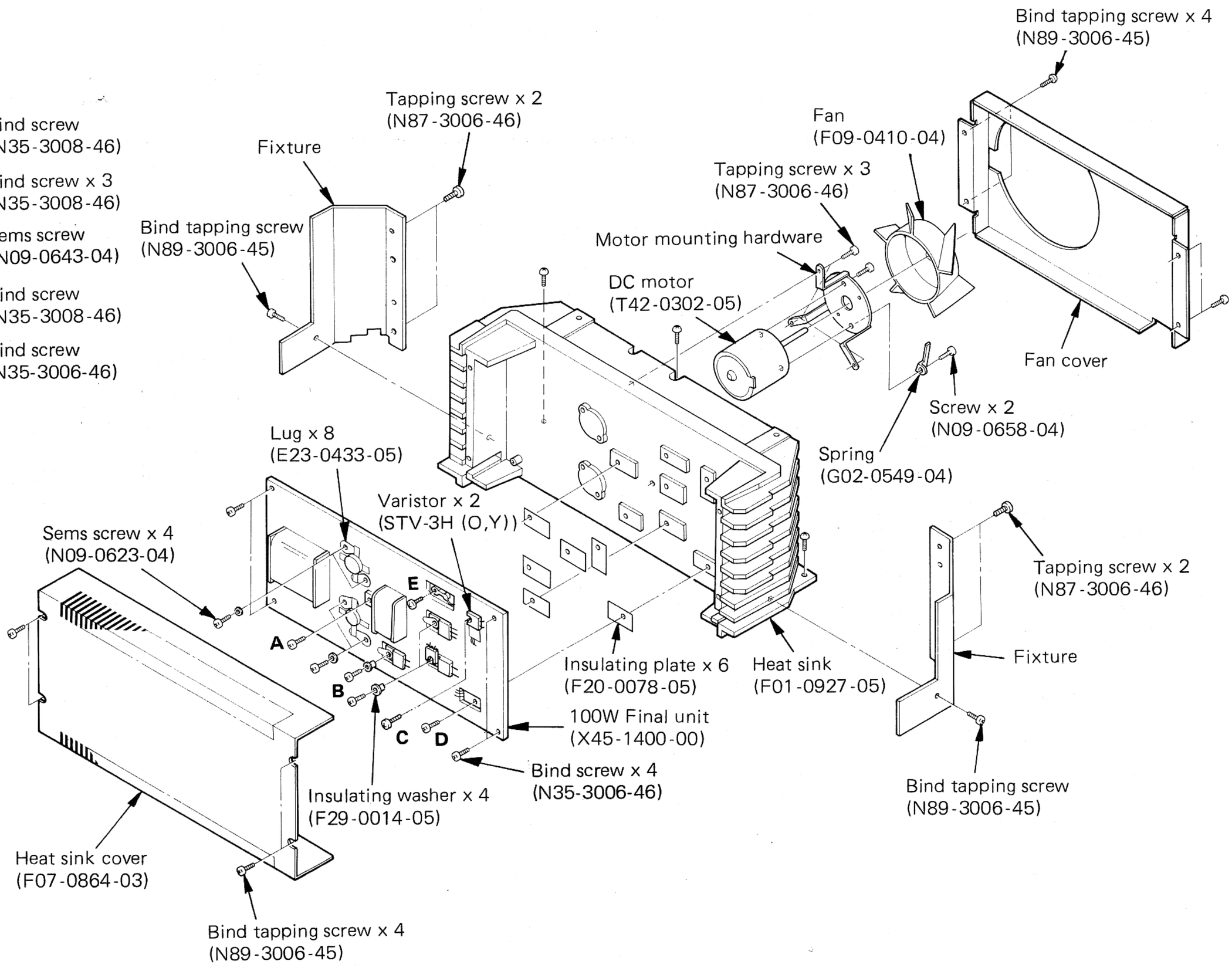
A Bind screw (N35-3008-46)

B Bind screw x 3 (N35-3008-46)

C Sems screw (N09-0643-04)

D Bind screw (N35-3008-46)

E Bind screw (N35-3006-46)



A Pan head screw x 2 (N30-2004-45)

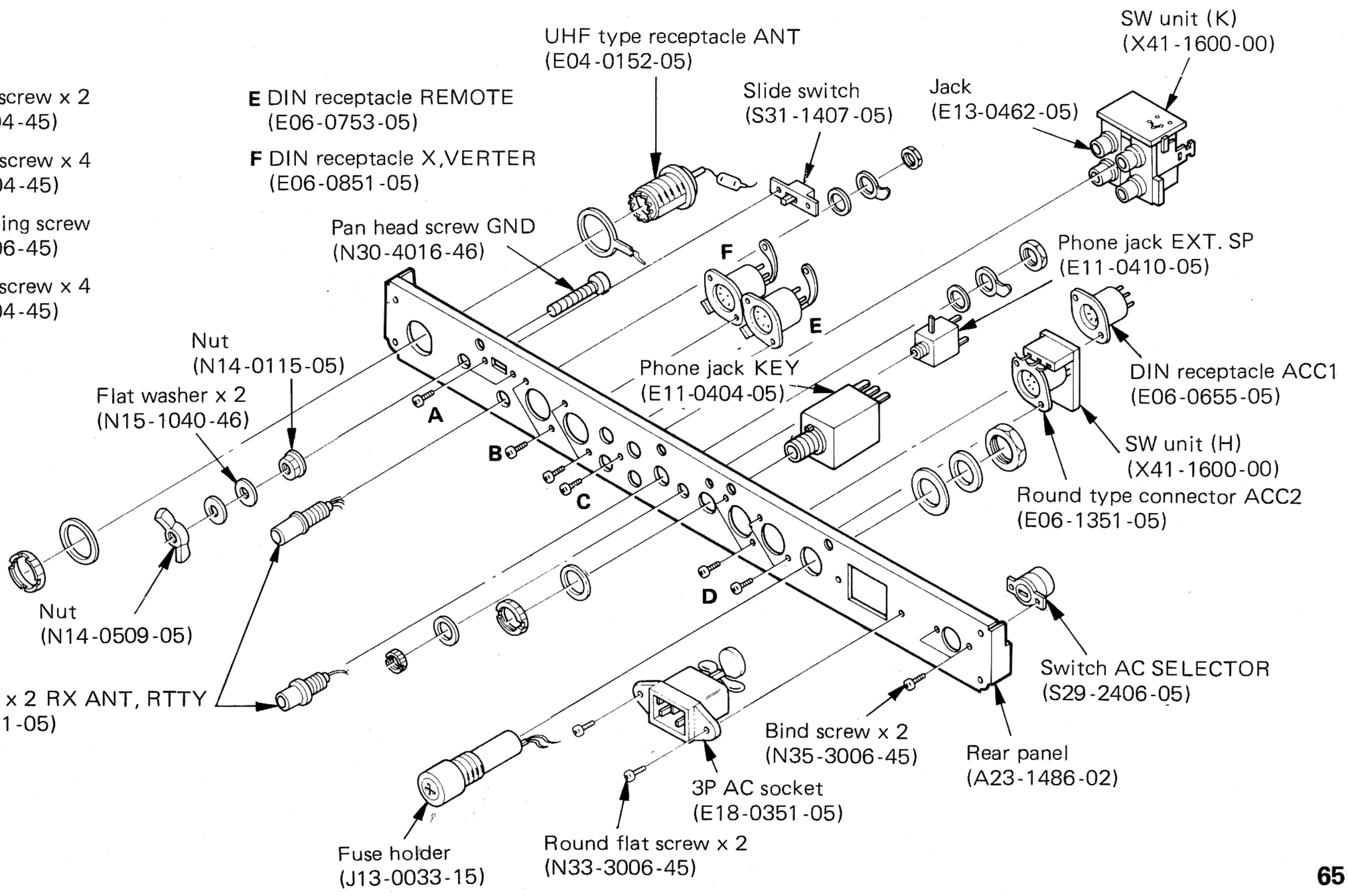
B Pan head screw x 4 (N30-2604-45)

C Bind tapping screw (N89-3006-45)

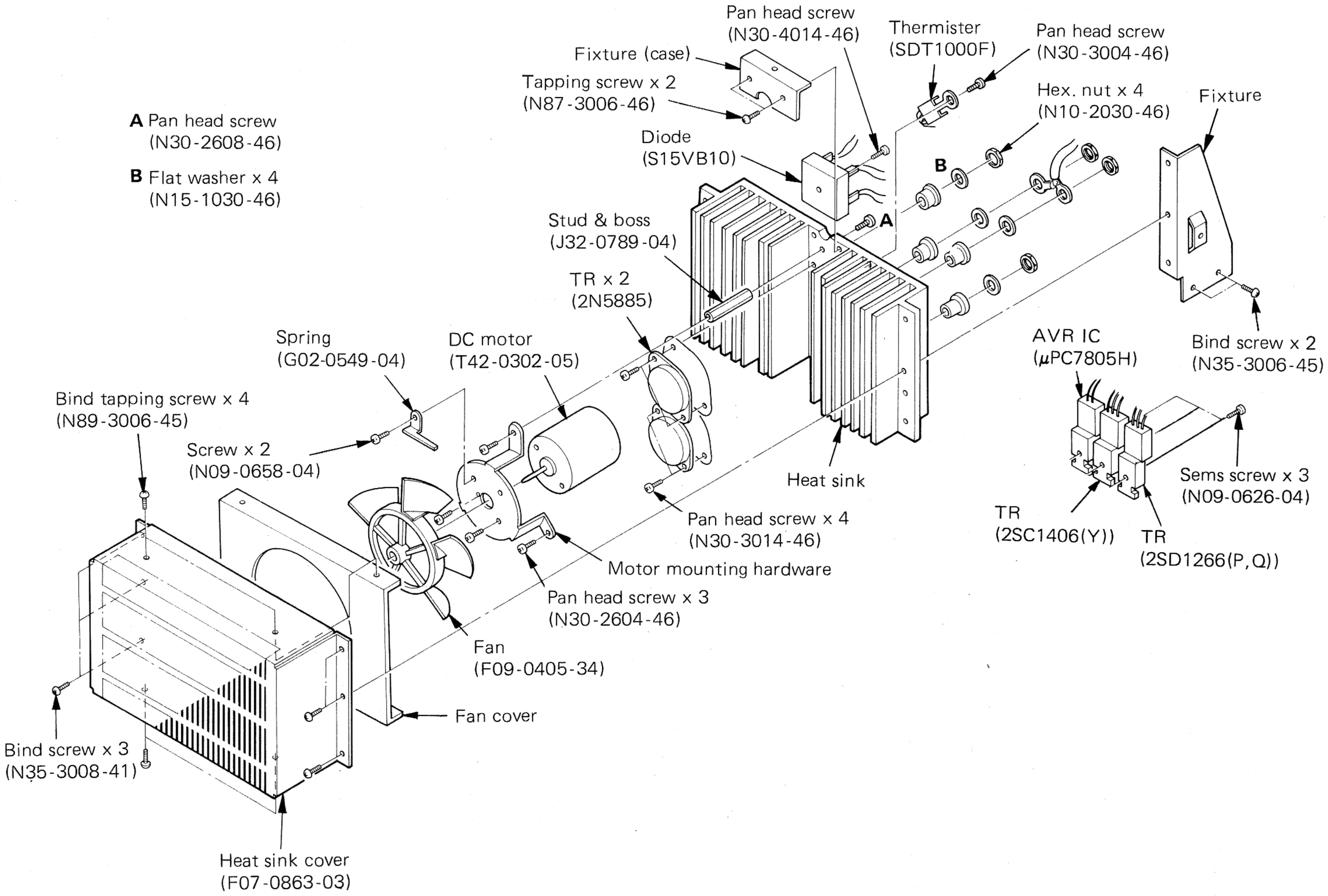
D Pan head screw x 4 (N30-2604-45)

E DIN receptacle REMOTE (E06-0753-05)

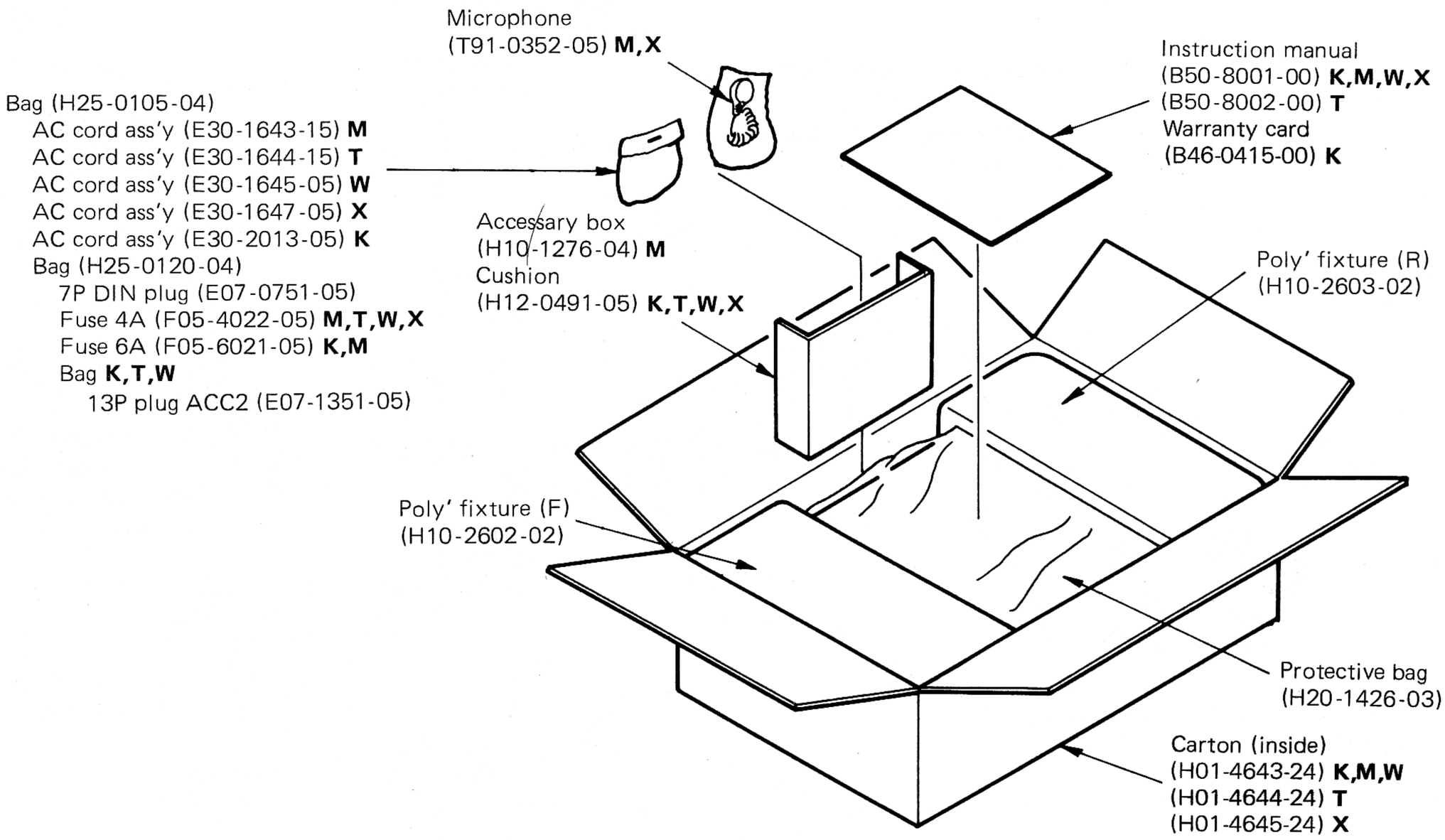
F DIN receptacle X,VERTER (E06-0851-05)



TS-940S DISASSEMBLY/PACKING



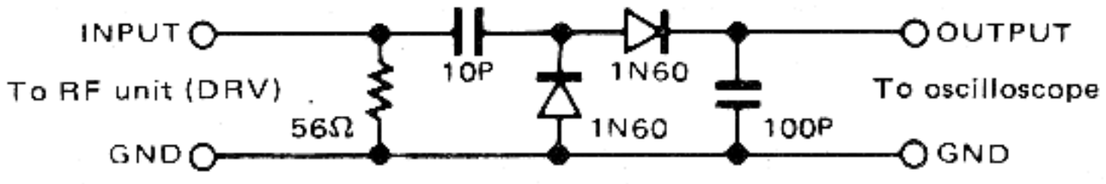
PACKING



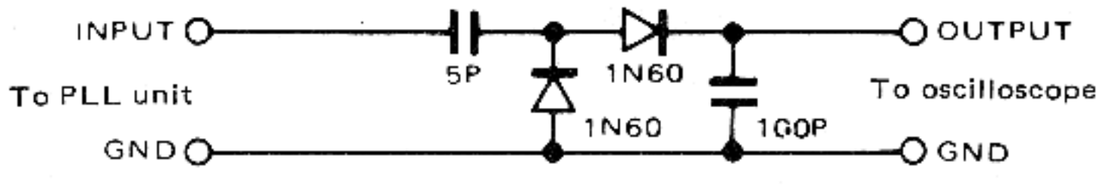
ADJUSTMENT

REQUIRED TEST EQUIPMENT

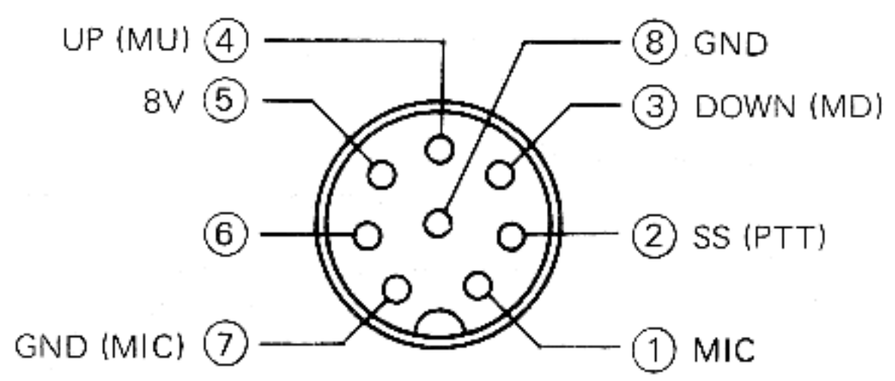
1. DC Voltmeter (DC V.M)
   1) Input resistance : More than 1MΩ
   2) Voltage range : 1.5 to 1000V AC/DC
   NOTE : A high-precision multimeter may be used. However, accurate readings can not be obtained for high-impedance circuits.
2. DC Ammeter
   1) Current range : 100mA, 1.5A, 15A, High-precision ammeter may be used.
3. RF VTVM (RF V.M)
   1) Input impedance : 1MΩ and less than 3pF, min.
   2) Voltage range : 10mV to 300V
   3) Frequency range : 10kHz to 100MHz or greater
4. AF Voltmeter (AF V.M)
   1) Frequency range : 50Hz to 10kHz
   2) Input resistance : 1MΩ or greater
   3) Voltage range : 10mV to 30V
5. AF Generator (AG)
   1) Frequency range : 200Hz to 5kHz
   2) Output : 1mV or less to 1V, low distortion
6. AF Dummy Load
   1) Impedance : 8Ω
   2) Dissipation : 3W or greater
7. Oscilloscope (SCOPE)
   Requires high sensitivity, and external synchronization capability.
8. Sweep Generator (SWEEP)
   1) Center frequency : 50kHz to 90MHz
   2) Frequency deviation : Maximum ±35MHz
   3) Output voltage : 0.1V or greater
   4) Sweep rate : At least 0.5sec/cm
9. Standard Signal Generator (SSG)
   1) Frequency range : 50kHz to 50MHz
   2) Output : −20dB/0.1μV to 120dB/1V
   3) Output impedance : 50Ω
   4) AM and FM modulation can be possible.
   NOTE : Generator must ve frequency stable.
10. Frequency Counter (FREQ.C)
    1) Minimum input voltage : 50mV
    2) Frequency range : 50MHz or greater
    3)
11. Noise Generator
    Must generate ignition noise containing harmonics beyond 30MHz.
12. RF Dummy Load
    1) Impedance : 150Ω and 20Ω
    2) Dissipation : 150W or greater
13. Power Meter
    1) Impedance : 50Ω
    2) Dissipation : 150W cintinuous or greater
    3) Frequency limits : 60MHz or greater
14. Spectrum Analyzer (SPE-ANA)
    1) Frequency range : 100kHz to 110MHz or greater
    2) Bandwidth : 1kHz to 3MHz
15. Detector
    1) For adjustment of TX BPF



    2) For adjustment of PLL/VCO BPF



16. Directional Coupler
17. Monitor Receiver
    R-1000 class
18. Microphone
    MC-60S8 or MC-42S



MIC terminals (view from front panel side)

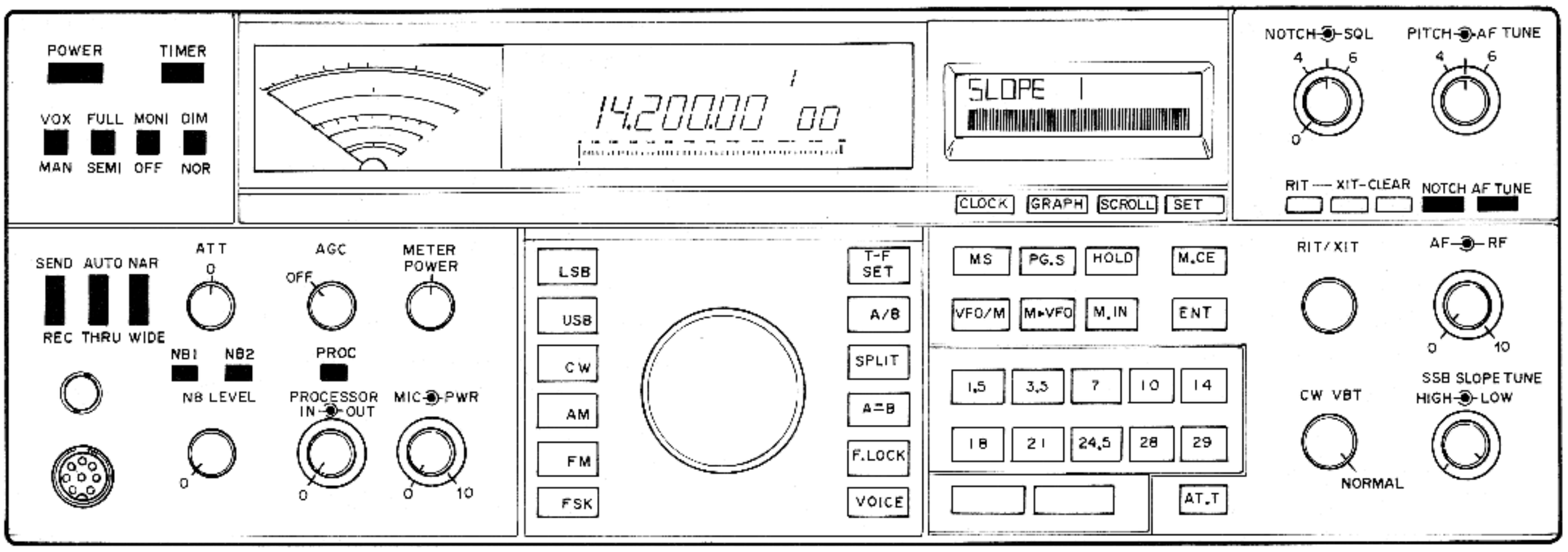
ADJUSTMENT

PREPARATION

Unless otherwise specified, set the controls as follows :

1. Power ON, holding A=B SW, keep ⊓⊔ condition from ⊓⊔ or ⊓⊔ SW's which marked ■ .
   (other push SW's are nonlock type or tact SW.)

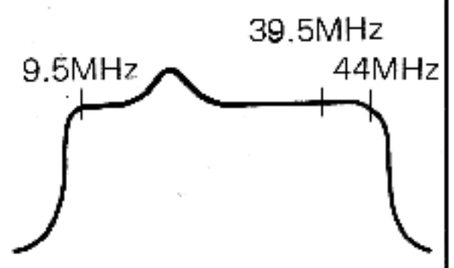
2. ATT . . . . . 0 NOTCH/SQL CENTER/0
   AGC . . . . . OFF PITCH/AF TUNE . . . CENTER
   METER . . . . . POWER AF/RF 0/10
   NB LEVEL . . . . . 0 CW VBT . . . . . NORMAL
   PROCESSOR . . . . . 0 SSB SLOP TUNE
   MIC/PWR . . . . . 0/10 HIGH/LOW . . . CW/CCW, MAX



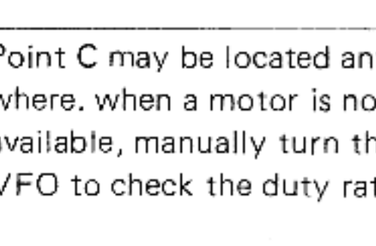
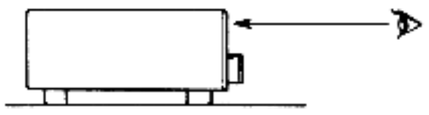
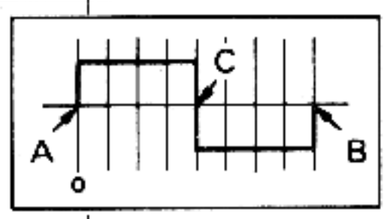
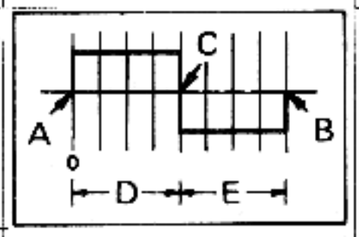
VOLTAGE ADJUSTMENT AND CONFIGURATION

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test-equipment	Unit	Terminal	Unit	Part	Method	
1. Voltage adjustment and confirmation	1) POWER SW : ON STBY : REC MODE : CW WIDE/NAR : NAR	DC V.M	AVR	FB	AVR	VR1	ADJ to 28.5V	28.5V±0.5V
			IF	RV ⑬ -2			Confirm	14.0—16.0V
				RB ⑩ -5	CONT	VR1	ADJ to 2.1V	2.1V±0.01V
			RF	AGC ④ -2	IF	VR5	ADJ to 3.2V	3.2V±0.01V
			IF	W31			Confirm	About 14V
				W22				About 12V
				W21				About 11V

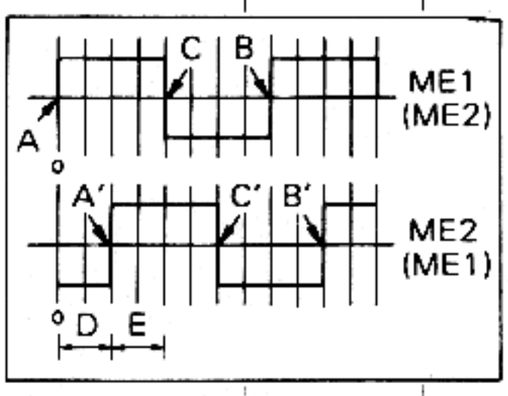
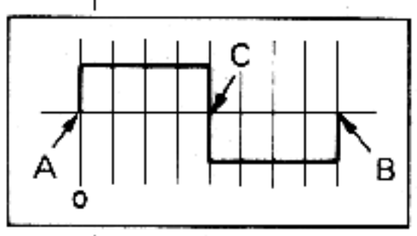
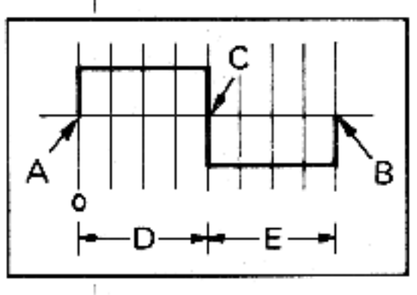
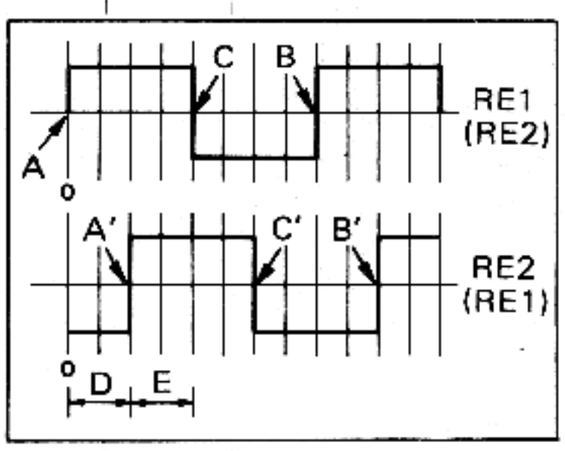
CONTROL ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
1. PLL-BPF	1) POWER SW : ON STBY : REC MODE : CW WIDE/NAR : NAR	SWEEP Detector SCOPE	PLL	TP4 TP5	PLL	L25—27	ADJ as shown at right.	
2. PLL-1 100—110 MHz		RF V.M FREQ. C	PLL	TP1	PLL	L10	ADJ to 8V at 110MHz.	110MHz : 8V 100MHz : 3.5—4.5V

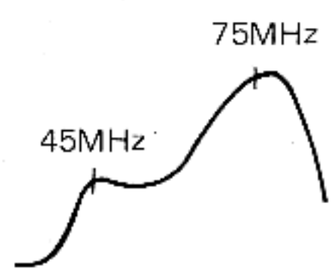
ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
3. PLL-2 35.5–40.5 MHz	1) POWER SW : ON STBY : REC MODE : CW WIDE/NAR : NAR	RF V.M FREQ. C	PLL	TP3	PLL	L5–6 L7	ADJ L5 and L6 for MAX. ADJ to 8V at 40.399.00MHz.	40.399.00MHz : 8V 35.499.00MHz : 3.5–4.5V
4. PLL-IF		RF V.M FREQ. C	PLL	TP5	PLL	L17, 18, 20–24	ADJ to MAX.	100–170mV
5. Standard oscillator adjustment and the marker check	1) CAL : ON BAND : 20.000.00MHz	SSG SCOPE	PLL	⑧-1	PLL	TC1	Receive the 10MHz and make the zero beet waveform as shown at right. (HET : 36.220.000 MHz)	Waveform on scope 
6. Adjustment of TX control voltage	1) Display : 14.600.00	DC V.M	IF	TV ⑬-1			Confirm	Under –0.5V.
	2) STBY : SEND						Confirm	14.0–16.0V
	3) STBY : REC after ADJ.		IF	ALC ⑥-1	CONT	VR3	ADJ to 3.2V	3.20V±0.01V
7. LCD Contrast			LCD		SW	VR13	Confirm LCD letters can see from as shown at right.	LCD control changes. 
8. VCO Adjustment	1) VCO1 Display : 9.499.99MHz	DC V.M	RF	VC1 ⑨-4	RF	L65	ADJ to 12V and confirm the VC1 voltage changes from about 2.5V to 4.0V with the display frequency from 30kHz to 9.5MHz and VC2 voltage changes also with the display from 20MHz to 29.5MHz.	12.00V±0.01V
	2) VCO2 Display : 19.499.99MHz					L68		12.00V±0.01V
	3) VCO3 Display : 30.000.00MHz			VC2 ⑨-2		L71		12.00V±0.01V
9. Main encoder	1) Remove the VFO knob and motor-drive the encoder at approx. 300rpm.	SCOPE	Digital B	Connector ①ME 1–2				Point C may be located anywhere. when a motor is not available, manually turn the VFO to check the duty ratio.
	2) ME1 duty ratio adjustment : Turn a motor CW and CCW				Main encoder	VR1		After adjusting with the VFO control tuned CW, check that intervals D and E are also identical when the VFO control is turned CCW.
	3) ME2 duty ratio adjustment : Turn a motor in the both direction.			Connector ①ME 2–3		VR2	Adjust until intervals D and E are equal to each other with point C placed at the center.	

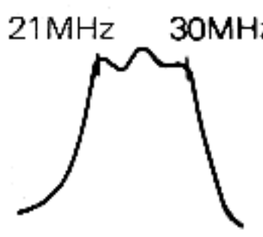
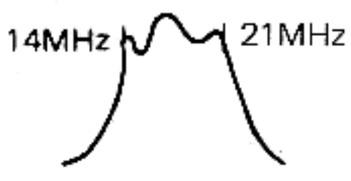
ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
9. Main encoder	4) ME1, ME2 phase difference alignement : Same as above. 	SCOPE	Digital B	Connector ⑪ ME1, ME2	Main encoder	Phase adjustment screw	Adjust until intervals D and E are equal to each other (point A' on ME2 is located in the middle of points A and C on ME1.)	ME1 (ME2) : Within 90° ± 10% (The difference between CW and CCW rotation must also be within this specification.) The phases of ME1 and ME2 may be replaced with each other,as indicated in the brackets.
10. RIT encoder	1) Remove the RIT knob and motor-drive the encoder at approx. 300rpm.	SCOPE	Digital B	Connector ⑫ RE1–3				Point C may be located anywhere. When a motor is not available, manually turn the RIT to check the duty ratio.
	2) RE1 duty ratio adjustment : Turn a motor CW and CCW				RIT encoder	VR1 		After adjusting with the RIT control tuned CW, check that intervals D and E are also identical when the RIT control is turned CCW.
	3) RE2 duty ratio adjustment : Turn a motor in the both direction			Connector ⑫ RE2–2		VR2	Adjust until intervals D and E are equal to each other with point C placed at the center.	
	4) RE1, RE2 phase difference alignment : Same as above.			Connector ⑫ RE1, RE2				The phases of RE1 and RE2 may be replaced with each other as indicated in the brackets.
11. CAR1 adjustment	1) MODE : USB	FREQ. C DC V.M	IF	CR1 ⑱ -2	CAR	TC1	ADJ to 453.50kHz	453.50kHz±50Hz
			CAR	TP1		L6	ADJ to 7.0V	7.00±0.04V
	2) STBY : SEND		IF	CR1 ⑱ -2			Confirm	Same frequency as REC.
	3) STBY : REC MODE : LSB					TC2	ADJ to 456.50kHz	456.50kHz±50Hz

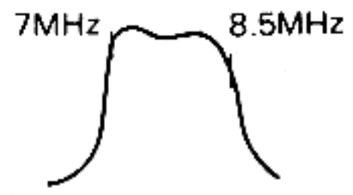
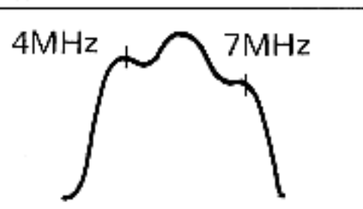
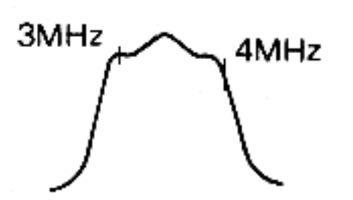
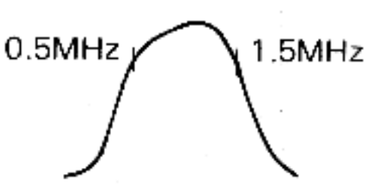
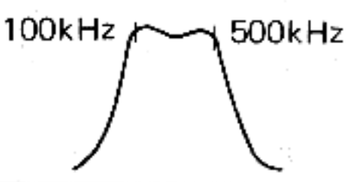
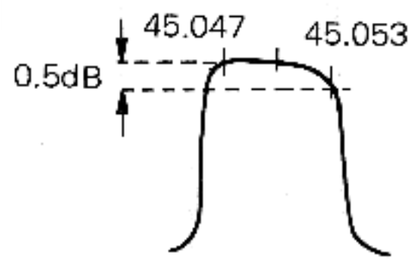
ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
11. CAR1 adjustment	4) STBY : SEND	FREQ. C DC V.M	IF	CR1 ⑱ -2	CAR		Confirm	Same frequency as REC.
	5) MODE : CW WIDE/NAR : WIDE STBY : REC						Confirm at REC & SEND	454.30kHz±50Hz
	6) WIDE/NAR : NAR						Confirm green LED light on.	
	7) MODE : AM							455.00kHz±50Hz
	8) MODE : FM							
	9) MODE : FSK WIDE/NAR : WIDE	FREQ. C	IF	CR1 ⑱ -2	CAR		Confirm	457.20kHz±50Hz
12. CAR2 Adjustment	1) MODE : CW		IF	W25	CAR	TC3	ADJ to 9.285.0MHz	9.285.00±50Hz (0.3Vrms)
			CAR	TP2		L10	ADJ to 7.0V	7.00V±0.04V
	2) STBY : SEND		IF	W25			Confirm	Same frequency as REC.
13. CAR3 Adjustment and confirmation	1) MODE : CW		CONT	CR3 ㉟ -4	IF	L20	ADJ to 100.0kHz	100.0kHz±20Hz
	2) MODE : USB : LSB : AM : FM : FSK						Confirm	USB : 98.5kHz±250Hz LSB : 101.5kHz±200Hz AM : 100.0kHz±100Hz FM : 100.0kHz±100Hz FSK : 101.5kHz±200Hz
14. CAR4 Adjustment	1) MODE : CW	FREQ. C	CONT	CR4 ㉟ -1	IF	L19	ADJ to 99.20kHz	99.20kHz±20Hz
	2) CW PITCH : MAX	RF V.M	IF	Q14 (E)		L18	ADJ to MAX.	About 0.3Vrms.
15. CAR AMP	1)	RF V.M	CAR	PLUG ② -4	CAR	L19 L20	ADJ to MAX.	(REF. 100mV±50mV)
16. VCO BPF		SWEEP SCOPE Detector	RF	Q17-G Q21-E	RF	L74 –76	ADJ as shown at right.	

RX ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
1. 0.1–30MHz BPF	1) BAND : 20.0–30.0MHz FREQ : 29.500.0kHz RF ATT : 0dB STBY : REC Disconnect RF unit, RIF connector, and connect this plug to detector.	SWEEP Detector SCOPE	Body RF	ANT RIF	RF	L2, L31– 33,40, 44	Adjust as shown at right.	
	2) BAND : 14.0–20.0MHz FREQ : 18.000.0kHz					L28– 30		
	3) BAND : 8.5–14.0MHz FREQ : 10.000.0kHz					L25– 27		

ADJUSTMENT

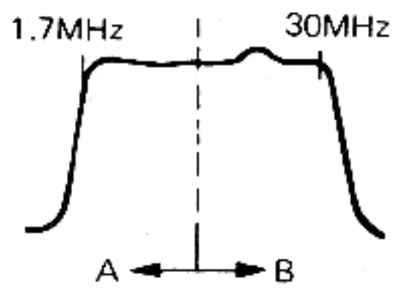
Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
1. 0.1–30MHz BPF	4) BAND : 7.0–8.5MHz FREQ : 7.000.0kHz	SWEEP Detector SCOPE	Body RF	ANT RIF	RF	L22–24	Adjust as shown at right.	
	5) BAND : 4.0–7.0MHz FREQ : 6.900.0kHz					L18–21		
	6) BAND : 3.0–4.0MHz FREQ : 3.900.0kHz					L14–16		
	7) BAND : 1.5–3.0MHz FREQ : 1.900.0kHz	SWEEP Detector SCOPE	Body RF	ANT RIF	RF	L11–13	Adjust as shown at right.	
	8) BAND : 0.5–1.5MHz FREQ : 1.000.0kHz					L9, 10		
	9) BAND : 100–500kHz DISPLAY : 300.0kHz					L5–7		
2. MCF	1) BAND : 14.250MHz MODE : CW	SWEEP SPE- ANA	RF IF	TP1 TP1	RF IF	L44–46 L3–5	ADJ to MAX as shown at right. Center frequency 45.050MHz	
3. RX IF AMP	1) MODE : CW BAND : 14.175MHz VR1 on RF unit : Center AF VR : As desire	SSG AF V.M SP SCOPE		EXT. SP	RF IF	VR2 L44–46 L7–15,17, 23–25	VR2 ADJ to center and other L's ADJ to MAX AF output. **Note** : Repeat ADJ L7–10 and 23–25.	
	2) SSG : 15dB	DC V.M	CONT	TP1 (R153)	CONT	L2,3	ADJ to MIN	
4. NOTCH	1) NOTCH VR : Center SSG : 0dB	SSG AF V.M SP SCOPE					ADJ the AV VR to 800Hz/0.63V.	
	2) NOTCH SW : ON SSG : 40dB				IF	L16 VR2	Repeat ADJ for MIN AF output.	Dip point should be in between 11–1 o'clock position.
5. IF TRAP Coil	BAND : 1.400MHz SSG : 45.05MHz 80dB				RF	L2 L40	Set the core all the way inside. ADJ for MIN AF output.	
6. S meter	BAND : 14.175MHz SSG : 0dB	SSG AF V.M SP SCOPE			IF RF	VR3 VR1	ADJ meter needle for mechanical ϕ point. Set the VR1 to CCW.	

ADJUSTMENT

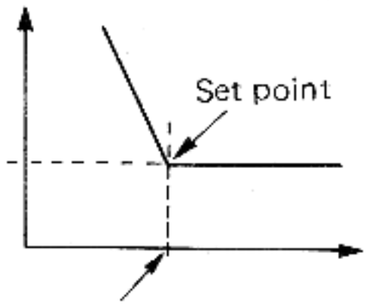
Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
6. S meter	SSG : 8dB AGC : FAST				IF	VR1	ADJ to S1	S1 : 8dB +6dB −4dB
	SSG : 40dB					VR4	ADJ to S9	S9 : 40dB±6dB
							Repeat ADJ S1 and S9.	S9 + 60dB : 100dB±10dB
7. ATT Confirmation	BAND : 14.175MHz	SSG AF V.M SP			PAN-EL	ATT	ATT : SSG 10dB 50dB 20dB 60dB 30dB 70dB	 10dB±3dB 20dB±6dB 30dB±9dB
8. FM IF	MODE : FM BAND : 14.175MHz SSG : 40dB f : 1kHz DEV : 5kHz				IF	L3–12, 35–38	ADJ to MAX. Repeat ADJ L3–5 and L7–10 for MAX S meter reading.	
					CONT	L11		
9. NB	1) FREQ : 14.175.0kHz MODE : USB SSG output : 14.175.0kHz	SSG DC V.M.	Rear panel	ANT	CONT	L2,3	MIN (SSG output : 20dB) Lower SSG output to the point where DC voltage falls slightly, and again reset to MIN.	
	2) MODE : USB NB LEVEL : CCW	Noise GEN. S meter	Rear panel	ANT			Adjust Noise GEN. level to read to S1.	
	3) NB 1 SW : ON Adjust NB LEVEL control to the point where N.B. action begins. (After checking, turn NB1 SW : OFF)				CONT	L2,3	MIN (If NB level has insufficient effect, adjust L8 core slightly CCW (out) from peak.	Noise desappears.
	4) NB 2 SW : ON (After checking, shut NB 2 SW OFF)						Confirm	The same effect as NB 1 is obtained.
	5) Raise Noise GEN. level to S9. NB1 SW : ON (After checking, turn NB1 SW OFF.)						If any noise remains adjust NB LEVEL to find the point where NB operates.	Noise disappears.
10.Buzzer	1) AF VR : MIN RF VR : MAX (CW) R290 (R205 side) connect to GND on CONT unit. (After ADJ disconnect.)				CONT	VR14	ADJ for 50mV/8Ω	50mV/8Ω±3dB
	2) AF VR : MAX RF VR : MIN (CCW)						Confirm	8.0mV/8Ω or less.

ADJUSTMENT

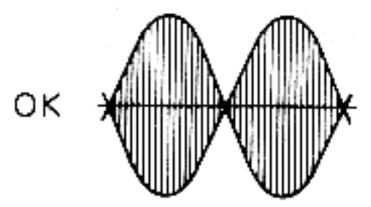
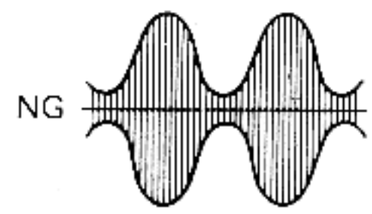
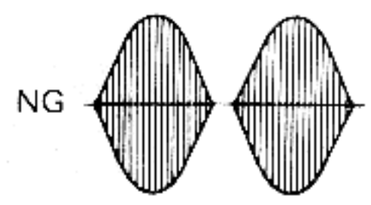
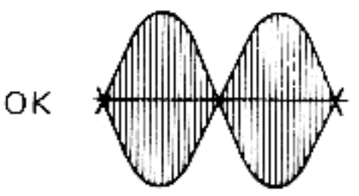
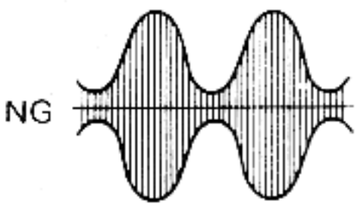
TX ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
1. Base current confirmation	1) Display : 14.250MHz MODE : USB STBY : SEND	DC V.M	AVR	FB			Connect DC V.M in FINAL DC cable and confirm the flow current.	1.1—1.5A
2. Drive	1) Display : 14.250MHz AG : 2.0mV, 1.5kHz Disconnect DRV connector and terminate with a 50Ω dummy load. (After ADJ, remove and reconnect DRV connector.)	AG SCOPE	RF	DRV	IF	L29, 31, 34—36 41,42, 44—46	ADJ to MAX. **Note :** While adjusting each coil, be keep output less than 2Vp-p by MIC GAIN or CAR VR control. 2) Repeat ADJ L46, 50, 51 and 52.	Greater than 2.3V p-p
					RF	L50—52		
	2) MODE : CW				IF	L40		
3. TX BPF 1.7—30MHz	1) RF ATT : 0dB FREQ : 14.175MHz STBY : SEND Disconnect DRV connector and terminate with a 50Ω dummy load (After ADJ, reconnected DRV)	SWEEP SCOPE Detector	RF	R49	RF	VR3 L50—57, 60	ADJ to center. L50, 51, 52 ADJ to MAX. L53, 55, 57 ADJ for 1.7MHz side (A). L54, 56, 60, ADJ for 30MHz side (B). ADJ in upon order, so that wave form shown at right is obtained. (ADJ sweep band A and B separately.)	
4. Final bias	1) FREQ : 14,175.0kHz MODE : USB MIC CONTROL : MIN Desolder L7 lead and connect ammeter in its place, minus to L7 side. STBY : SEND (After adjustment, resolder L7 lead.)	DC am meter	FINAL	L7	FINAL	VR2	50mA **Note :** Stabilization requires approximately 20 seconds.	50mA±10mA
	2) FINAL unit VR1 : MIN Disconnect relay connector in FINAL unit, 28V line and connect ammeter in its place. STBY : SEND (Disconnect ammeter and reconnect this connector after ADJ.)					VR1	Read the meter when VR1 is at MIN. Then ADJ VR1 so that the current is increased by 1.3A.	1.3A±0.2A
5. TX IF AMP	1) FREQ : 14.175MHz MODE : USB AG : 1500Hz, 2mV METER : ALC STBY : SEND	RF V.M AG 8Ω Dummy load	Rear panel	ANT	IF	L40—42, 44—46	ADJ for MAX ALC meter reading. Repeat ADJ.	

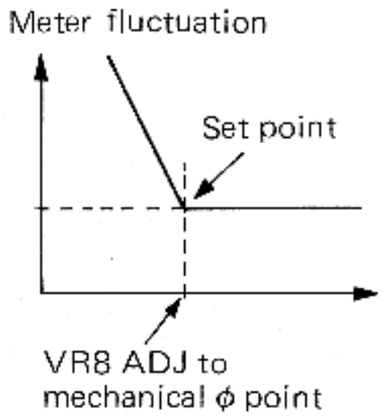
ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
6. VC, IC METER and current limiter	1) METER : IC STBY : SEND		Meter		CONT	VR10	Set for mechanism start point.	IC meter Meter fluetuation 
	2) ANT : Connect dummy load METER : VC CONT VR2 : MAX MODE : FSK STBY : SEND PROCESSOR OUT : Set to 10A IC meter reading. (After ADJ, STBY : REC)	DC V.M	AVR	FB	AVR	VR1	ADJ to 28.5V	28.5V±0.5V
					CONT	VR11	ADJ to 28.5V	28.5V±1V
	3) METER : IC (After ADJ, STBY : REC)					VR7	ADJ to 10A	10A±1A
	4) MODE : CW CAR LEVEL : 10 (After ADJ, STBY : REC)		AVR	FB		VR6	Disconnect the FB terminal and connect the current meter between the FB lead and the FB terminal. ADJ to 14A.	14A±1A
7. Power	1) BAND : 14.175MHz MODE : CW CAR LEVEL : 10 METER : POWER STBY : SEND (After ADJ, STBY : REC)	Power meter	Rear panel	ANT	CONT	VR2	ADJ to 110W	
						VR17	ADJ meter reading to 110W.	110W±10W
8. Power (Low)	1) PWR VR : MIN CCW STBY : SEND (After ADJ, STBY : REC PWR VR : MAX CW)				CONT	VR19	ADJ to 5W	
9. AM Power	MODE : AM METER : POWER STBY : SEND (After ADJ, STBY : REC)				SW	CAR VR	AM power is adjustable with CAR VR.	
10. Protection and SWR	1) ANT : OPEN METER : Power				CONT	VR5	ADJ to 10W	10W±2.5W
	2) ANT : 150Ω Dummy load BAND : 3.750MHz METER : SWR	DC V.M 150Ω Dummy load	CONT	IC9- (12)		VR12	ADJ to 0.5V	0.5V±0.01V
						VR18	ADJ to "3".	SWR : 3
	3) ANT : OPEN						Confirm	SWR : ∞
	4) ANT : 50Ω Dummy load	Power meter					Confirm	SWR less than 1.2

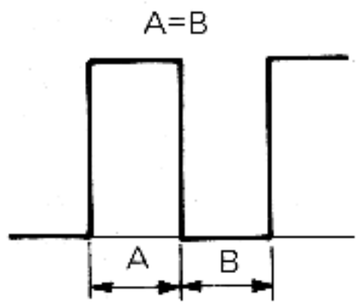
ADJUSTMENT

Item	Condition	Measurement: Test equipment	Measurement: Unit	Measurement: Terminal	Adjustment: Unit	Adjustment: Part	Adjustment: Method	Specification/Remarks
11. SSB mode Frequency response	1) BAND : 14.175MHz MODE : USB AG output : 2 tone, 7mV 300Hz, 2700Hz STBY : SEND MIC VR : 50W output	Power meter SCOPE AG	Rear panel	ANT (Directional coupler) MIC	DG-B (CAR)	TC1	ADJ as shown at right. (Equal 300Hz, 2.700Hz amplitude within 5W.)	OK  NG 
	2) MODE :LSB					TC2	Calibrate scope.	NG 
	3) MODE : USB, LSB AG : 1500Hz, 5mV STBY : SEND							
	4) MODE : USB, LSB AG : 2600Hz, 5mV STBY : SEND						Confirm	Within 6dB (from 1500Hz)
	5) MODE : USB, LSB AG : 400Hz, 5mV STBY : SEND							
	6) Check carrier suppression after this ADJ.				IF	TC1 VR6		−50dB or less.
12. FSK	1) MODE : FSK COMP OUT : MIN AG : 2 tone 0.3V 1000Hz, 3400Hz STBY : SEND	AG SCOPE	IF	AFS ㉔ -3 ANT (Direcnal coupler)	DG-B (CAR)	TC2 TC3	Turn comp VR CW until get enough signal to measure. ADJ TC2 and TC3 as shown at right.	OK  NG 
13. CAR suppression	1) FREQ : 14.175.0kHz MODE : USB ↔ LSB MIC CONTROL : MIN STBY : SEND	SCOPE (SPE-ANA)	Rear panel	ANT (through Direcional coupler)	IF	TC1 VR6	MIN (Adjust alternately.) Adjust for no difference between USB and LSB.	
	2) MODE : CW CAR CONTROL : MAX STBY : SEND						Calibrate Oscilloscope (SPE-ANA)	
	3) MODE : USB ↔ LSB STBY : SEND						Check If less than −50dB, repeat adjustment 1).	−50dB or less.
14. FM Deviation	1) MODE : FM BAND : 29.25MHz MIC : 1kHz, 50mV FM MIC GAIN : MAX	AG Linear detector			CONT	VR16	1. Linear detector SET ex.) MS-57A/MS-61A HPF : OFF LPF : 20kHz 4101 FILTER : 25kHz/15kHz De-emphasis : OFF 2. ADJ to ±4.5kHz	DEV ±3kHz with less than 5mV MIC input. DEV ±4.0−6.0kHz with less than 50mV MIC input.

ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remark
		Test equipment	Unit	Terminal	Unit	Part	Method	
15. ALC Meter	1) MODE : USB METER SW : ALC MIC VR : MAX AG : 1.5kHz, 5mV STBY : SEND	AG AF V.M Dummy load	S-meter		CONT	VR8	ADJ to the mechanical zero point.	
	2) ALC Meter zero ADJ				SW	MIC GAIN	ADJ for ALC meter zero point.	
	3) AG : 6dB up (After ADJ, STBY : REC)				CONT	VR9	ADJ for ALC zero MAX.	
	4) MODE : FM BAND : 29.25MHz (After ADJ, STBY : REC)				IF	VR9	ADJ for ALC zero MAX.	
16. Speech Processor	1) BAND : 14.250MHz MODE : USB METER : COMP MIC VR : MIN PRO : ON PROCESSOR : 9 o'clock AG (MIC) : 1.5kHz, 1mV STBY : SEND	AG AF V.M Dummy load	Panel Rear panel	MIC ANT	IF	L29, 31—34, 36,41, 42, 44—46	ADJ for MAX comp meter reading.	
						VR10	ADJ for MIN comp meter reading.	
	2)				Panel	Processor IN	ADJ for S1, S-meter reading.	
	3) AG (MIC) : 20dB up (10mV)				IF	VR7	ADJ for S1 + 20dB comp meter reading. Repeat ADJ 2), 3).	
	4) AG (MIC) : 10dB up (32mV)						Confirm the meter reading is increase.	
	5) METER : ALC (After ADJ, STBY : REC)				IF	L33	ADJ for MAX ALC meter reading.	
17. Monitor Level	1) AGC : ON MONI : ON AF VR : Set to 0.63V/8Ω point with CAL marker signal. AG (MIC) : 1kHz, 10mV MIC VR : Within ALC zero. STBY : SEND	AF V.M SCOPE	Panel Rear-panel	MIC ANT	IF	L43	ADJ for MAX ALC meter reading.	
					CONT	VR13	ADJ to 0.63V/8Ω	0.63V/8Ω±3dB
	2) MIC terminate with 50kΩ MIC VR : MIN (After ADJ, STBY : REC, MONI : OFF)						Don't move AF VR and confirm the hum and noise.	Less than 1.5mV/8Ω
18. MIX Balance	1) BAND : 21,100.0kHz MODE : AM MIC VR : MIN STBY : SEND	Power meter Monitor receiver (SPE-ANA)	Rear panel	ANT	IF	VR8	21.555MHz : MIN (S meter and AF output.)	
	2) MODE : CW STBY : SEND					VR10	29.930MHz : MIN (S meter and AF output.)	
					RF	VR3	23.950MHz : MIN (S meter and AF output.)	

ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
19. Side tone	1) MODE : CW AF VR : AF output 0.63V/ 8Ω with CAL marker signal. MONI : ON KEY JACK : KEY IN	SCOPE FREQ. C			CONT	VR15	0.2V/8Ω 800Hz	0.2V/8Ω±6dB 800Hz±100Hz
	2) PITCH CONTROL : MIN ↔ MAX						Confirm	800Hz±300Hz or more.
20. AT-940 Auto antenna tuner (If installed.)	1) BAND : 1.500.00MHz TC1 : Preset to center Disconnect the ③ on AT-B unit, the ⑭ on AT-A unit and jumper between TRQ and TV at the ④ on AT-B unit. CAR VR : MAX, METER : SWR, STBY : SEND Turn VFO frequency (up) until SWR becomes "3" (After ADJ, STBY : REC) STBY : SEND	Oscillo-scope	AT	JP124	AT-A	VR101	ADJ as shown at right.	
	2) Turn VFO frequency (down) until SWR becomes "1.15" (After ADJ, STBY : REC)					VR102	ADJ VR102 until ANT TUN indicator just goes off.	
	3) BAND : 18,000.0MHz STBY : SEND (After ADJ, STBY : REC Re-connect the ③ on AT-B and remove jumper between TRQ and TV on connector ④ .)	20Ω & 150Ω Dummy load				TC1	ADJ for motor stops and SWR reads MIN.	
	4) Check at the each center frequencyof the HAM BAND						Confirm	SWR 1.2 or less.

Microprocessor operation check

Item	Condition	Operation check
1. Reset	1) POWER SW : ON ↔ OFF Then, pressing A=B SW, power SW on. Push S1 on LCD unit	Display : VFO A 14.000.00 USB Sub display : "TRIO-KENWOOD"
2. RIT/XIT	1) Turn RIT, XIT encoder knob UP ↔ DOWN	Display frequency in-crease or decrease smooth.
	2) Push RIT SW (ON) once	Display RIT and tone sounds.
	3) STBY : SEND (After check, STBY : REC)	Same frequency as RIT off.
	4) Push RIT SW (off) once.	Display RIT light off and tone sounds.
	5) Push XIT SW (on) once.	Display XIT on and tone sounds.

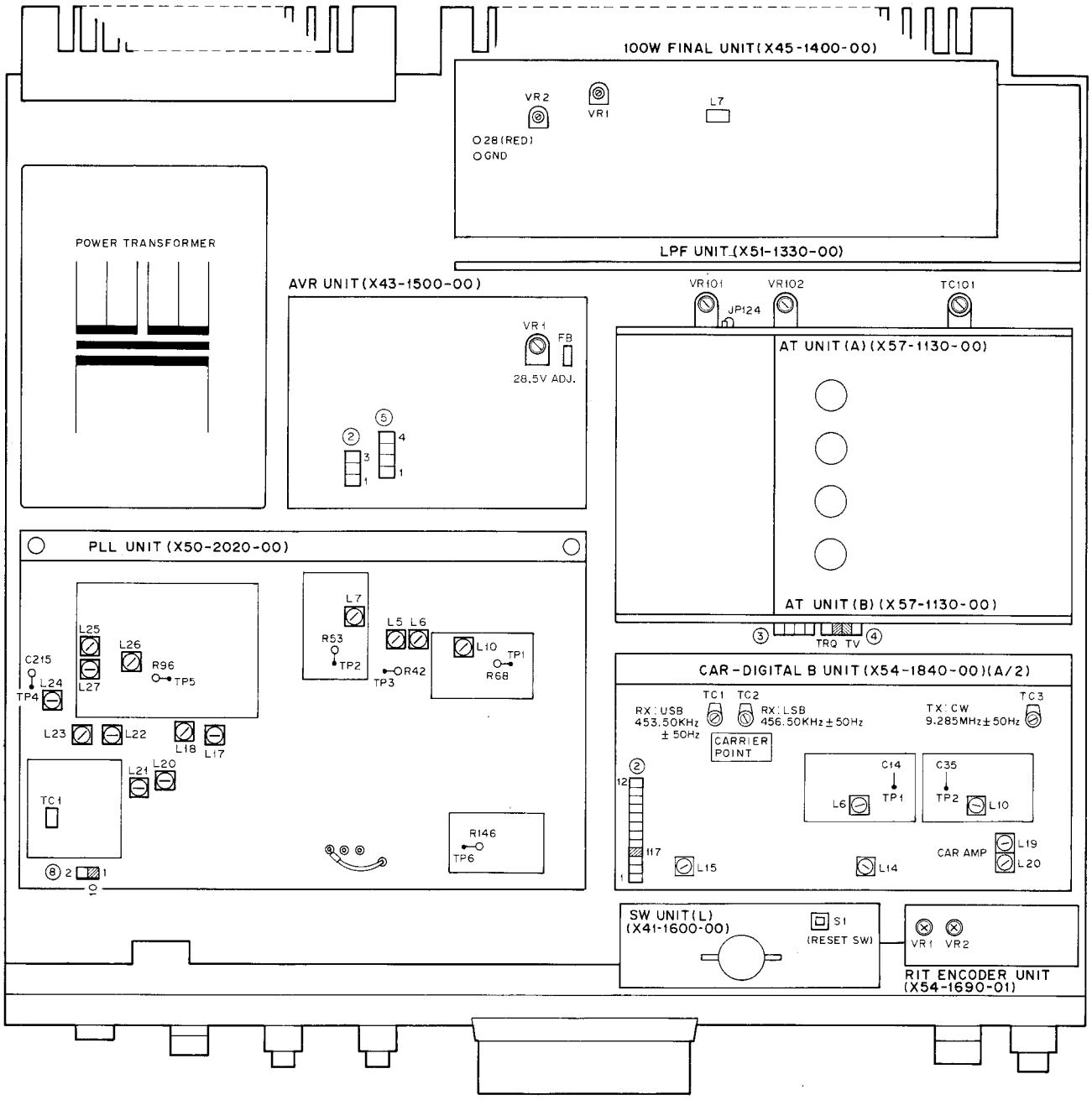
Item	Condition	Operation check
2. RIT/XIT	6) Push XIT SW (off) once.	Display XIT light off and tone sounds.
	7) Push clear SW	RIT frequency display changes to "00".
3. Function	1) Push SPLIT SW once.	SPLIT light on (orange).
	2) Push T-F SET SW once.	Display : VFO B " 14.000.00 " While pressing.
	3) Push A/B SW once.	Display : "VFO B" " 14.000.00 " and tone sounds.
	4) STBY : SEND	Display : "VFO A"
	5) STBY : REC	Display : "VFO B"

ADJUSTMENT

Item	Condition	Operation check
3. Function	6) Push A=B SW once.	Tone sounds.
	7) Push A/B SW once.	Display : "VFO A" "14.000.00" and tone sounds.
	8) Push F.LOCK SW (on) once.	Display : F.LOCK and tone sounds.
	9) Turn VFO knob.	Confirm the display frequency doesn't change.
	10) Push 1.5 SW.	Doesn't change any.
	11) Push F.LOCK SW (off) once.	Display F.LOCK light off and tone sounds.
	12) Push ENT → 1 → 2 → 3 → 4 → 5 → 6 → 7 SW's	Display : "1 2 3 4 5 6 7"
	13) Push VOICE SW. (Install the option voice synthesizer unit VS-1.)	Sounds verifies displaced frequency.
	14) Push SPLIT SW once.	Display : SPLIT, orange light off.
4. Memory	1) Push 29 SW	CH / FREQ / MODE
	2) Push both SW M.IN and 1 once then enter the MEMO as on right chart.	1 29.000.00 CW 2 28.000.00 CW 3 27.000.00 USB 4 26.000.00 USB 5 25.000.00 LSB 6 24.000.00 LSB 7 23.000.00 AM 8 22.000.00 AM 9 21.000.00 FM 10 21.005.00 FSK
	3) Push PG.S SW (on) once.	Orange light on and scans from "21.000.00" to "21.005.00" on "FM" mode.
	4) Push HOLD SW (on) once and turn main VFO knob.	Red LED light on and tone sounds. Scans manually by VFO knobs.
	5) Push HOLD SW (off) once.	Red LED light off and tone sounds, then, starts auto-scan.
	6) Push PG.S SW (off) once.	Orange LED light off and tone sounds.
	7) Push MS SW (on) once.	Green LED and MEM light on and tone sounds. Scans MEMO from MEMO1 to MEMO0, (skips memorized channels.)
	8) Push MS SW (off) once.	Green LED light off and tone sounds.
	9) Push both M.CE and 1 switches.	Tone sounds.

Item	Condition	Operation check
4. Memory	10) Push VFO/M → 1 SW	Display : " . . " "MEMO 1"
	11) Push 4 SW	Display : "26.000.00" "MEMO 4"
	12) Push M►VFO SW	Display : "26.000.00" "VFO A"
5. Timer	1) Push "S1" on LCD unit.	Display : "TRIO-KENWOOD"
	2) Push "CLOCK" SW once.	Display : 0 : 00 off 0 : 00 on 0 : 00
	3) Push "SET" SW once.	0 ? 00 off 0 : 00 on 0 : 00
	4) Push "MODE" SW once.	0 : 00 off 0 ? 00 on 0 : 00
	5) Push "MINUTE" SW once.	0 : 00 off 0 ? 00 on 0 : 00
	6) Push "MODE" SW once.	0 : 00 off 0 : 01 on 0 ? 00
	7) Push "MINUTE" SW twice.	0 : 00 off 0 : 01 on 0 : 02
	8) Push "MODE" SW once.	0 : 00 off 0 : 01 on 0 : 02
	9) Push "TIMER" SW (on).	
	10) Push " SCROLL" SW once.	Display : V-B 14.000.00 US 1M1 . .
	11) Push "SCROLL" SW once and confirm the display changes as shown at right. Ten times round one cycle.	V-B 14.000.00 US 1M2 28.000.00 CW V-B 14.000.00 US 1M3 27.000.00 US V-B 14.000.00 US 1M4 26.000.00 US V-B 14.000.00 US 1M5 25.000.00 LS V B 14.000.00 US 1M6 24.000.00 LS V-B 14.000.00 US 1M7 23.000.00 AM V-B 14.000.00 US 1M8 22.000.00 AM V-B 14.000.00 US 1M9 21.000.00 FM V-B 14.000.00 US 1M0 21.005.00 FS V-B 14.000.00 US V-A 14.000.00 US
	12) Switch to "MEMORY BAND 2"	V-B 14.000.00 US 2M1 . .
	13) Switch to "MEMORY BAND 3"	V-B 14.000.00 US 3M1 . .
	14) Switch to "MENORY BAND 4"	V-B 14.000.00 US 4M1 . .

TOP VIEW



PLL UNIT (X50-2020-00)

L5–7 : PLL-2 adj. (35.5–40.5MHz)
L10 : PLL-1 adj. (100–110MHz)
L17,18,20–24
: PLL IF adj.
L25–27 : PLL BPF adj. (9.5–44MHz)
TC-1 : STD freq' adj (20MHz)

AT UNIT (A) (X57-1130-00)

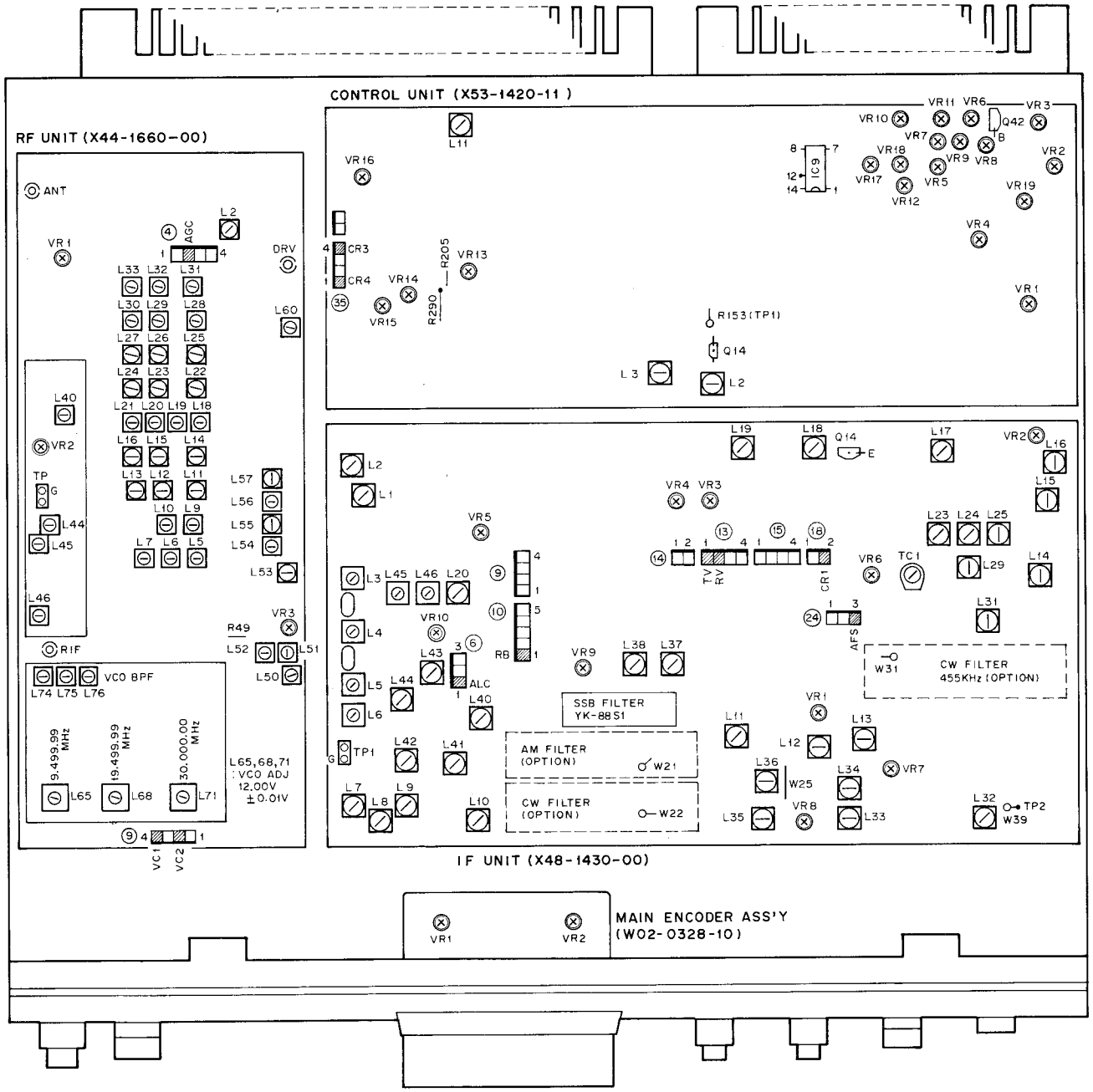
VR101 : Waveform ratio (A=B)
VR102 : ANT TUNE indicator goes off

TC101 : Motor stop and SWR reads MIN

100W FINAL UNIT (X45-1400-00)

VR1 : 130mA +100mA, –50mA (100W Final bias)
VR2 : 50mA ± 10mA (10W Final bias)

BOTTOM VIEW



RF UNIT (X44-1660-00)

L2,40	: IF TRAP adj. (BAND 1.400MHz, SSG : 45.05MHz 80dB)
L5–7	: BPF 100–500kHz (Freq. : 300.0kHz)
L9,10	: BPF 0.5–1.5MHz (Freq. : 1,000.0kHz)
L11–13	: BPF 1.5–3.0MHz (Freq. : 1,900.0kHz)
L14–16	: BPF 3.0–4.0MHz (Freq. : 3,900.0kHz)
L18–21	: BPF 4.0–7.0MHz (Freq. : 6,900.0kHz)
L22–24	: BPF 7.0–8.5MHz (Freq. : 7,000.0kHz)
L25–27	: BPF 8.5–14MHz (Freq. : 10,000.0kHz)
L28–30	: BPF 14.0–20.0MHz (Freq. : 18,000.0kHz)
L31–33	: BPF 20.0–31.0MHz (Freq. : 29,500.0kHz)
L44–46	: MCF (Center freq. : 45.050MHz)
L50–52	: DRIVE adj.
L53,55,57	: TX BPF 1.7MHz Side (A)
L54,56,60	: TX BPF 30MHz Side (B)
L65	: VCO1 adj. (9.499.99MHz) } 12.00V±0.01V
L68	: VCO2 adj. (19.499.99MHz) } 12.00V±0.01V
L71	: VCO3 adj. (30.000.00MHz) } 12.00V±0.01V
L74–76	: VCO BPF
VR1	: RF AGC adj. (AF output 0.2dB down)
VR2	: MIXER BALANCE adj.
VR3	: MIXER BALANCE adj. (CW 23.950MHz)

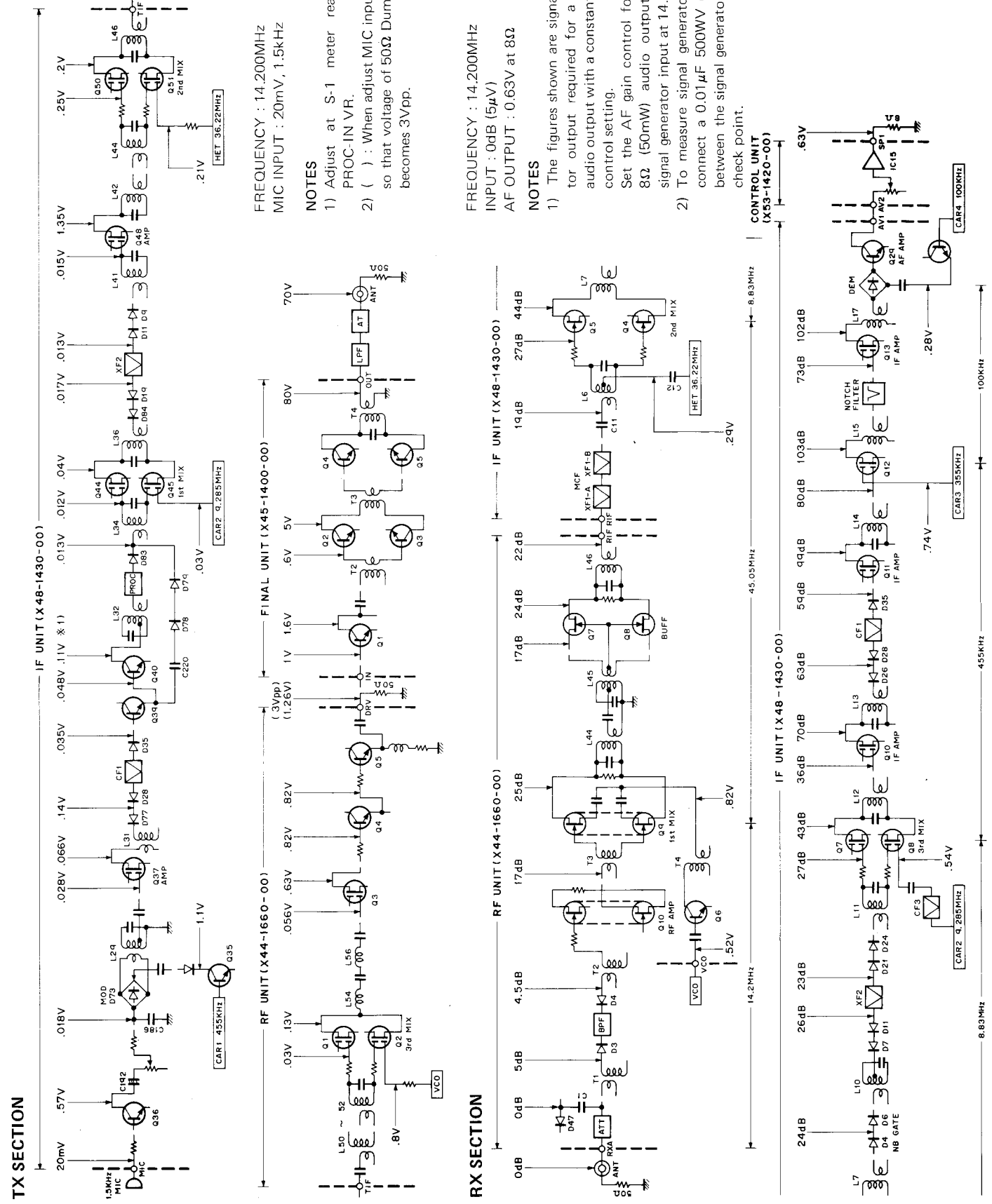
IF UNIT (X48-1430-00)

L1,2	: IF OUT adj. (8.83MHz)
L3–6	: MCF adj. (RF unit : L44–46)
L7–15,17,23–25	: SSB IF GAIN adj.
L16	: NOTCH adj.
L18,19	: CAR4 adj. (99.20kHz±20Hz)
L20	: CAR3 adj. (100.0kHz±20Hz)
L29,31,34–36,40–42,44–46	: DRIVE adj.
L32	: COMP LEVEL adj.
L33	: ALC LEVEL adj.
L43	: MONI LEVEL adj.
L37,38	: FM IF GAIN adj.
VR1	: RX S-meter Sens. S-1
VR2	: NOTCH adj. (VR2 and L16)
VR3	: RX S-meter ϕ adj.
VR4	: RX S-meter Sens. S-9
VR5	: AGC adj. 3.2V
VR6	: CARRIER SUPPRESSION adj. (VR6 and TC1)
VR7	: COM LEVEL adj. (VR7 and L32)
VR8	: MIXER BALANCE adj. 21.555MHz (AM 21.1MHz)
VR9	: ALC LEVEL adj. (FM 29.25MHz)
VR10	: MIXER BALANCE adj. (CW 29.930MHz)

CONTROL UNIT (X53-1420-11)

L2,3	: SSB IF GAIN (MIN. adj.)
L11	: FM IF GAIN
VR1	: RB adj. 2.1V
VR2	: MAX POWER adj. (110W)
VR3	: ALC adj. 3.2V
VR5	: SWR protection adj. (100W)
VR6	: Current protection adj. 14A
VR7	: IC meter adj. 10A
VR8	: ALC-ϕ adj.
VR9	: ALC meter adj.
VR10	: IC-ϕ adj.
VR11	: VC meter adj. 28.5V
VR12	: SWR standerd adj. 0.5V
VR13	: MONITOR LEVEL adj.
VR14	: BUZZER LEVEL adj.
VR15	: Side tone level
VR16	: DEV.
VR17	: Power meter adj.
VR18	: SWR meter adj.
VR19	: MIN. power adj. (5W)

LEVEL DIAGRAM



Terminal No.		Name	I/O	Terminal Function
SWITCH UNIT (L)				
①	1	VBY	I	VS-1 Busy signal
	2	VSR	O	VS-1 voice synthesizer start signal
	3	PS4	O	VS-1 voice synthesizer data
	4	PS0	O	
	5	PS1	O	
	6	PS2	O	
	7	PS3	O	
	8	5C1	O	+ 5V for VS-1
②	1	21T	I	+ 21V
	2	GND		GND
③	1	SB0	I	Display data for LCD
	2	SB1	I	
	3	SB2	I	
	4	SB3	I	
	5	MRQ	I	Clock for data
	6	GND		GND
④	1	GND		GND
	2	RS	O	Resister, select signal (LCD ass'y control data)
	3	RW	O	Write/Read signal (LCD ass'y control data)
	4	LE	O	Latch signal (LCD ass'y control data)
	5	DB4	O	Data (LCD ass'y control data)
	6	DB5	O	
	7	DB6	O	
	8	DB7	O	
	9	5L		+ 5V for LCD ass'y
	10	LG	O	LCD Intensity control bias, −3V approx.
⑤	1	GND		GND
	2	HS	O	LCD data accept signal message
	3	5C	O	+ 5V for Digital B unit
	4	8B	O	+ 8V for Digital B unit
⑥	1	8C	I	+ 8V
	2	GND		GND
	3	TMY	O	Timer output, Timer SW ON, Timer SW OFF : H
⑦	1	TMY	I	Timer SW OFF : L
	2	TMR	I	Timer SW ON : L
⑧	1	ATV	I	AT unit TX data
	2	TNQ	I	AT unit STBY signal
⑨	1	5K	I	+ 5V
	2	SET		SET KEY (Key on : L)
	3	GRP	I	GRAPH KEY (Key on : L)
	4	SCR	I	SCROLL KEY (Key on : L)
	5	CLK	I	CLOCK KEY (Key on : L)
	6	GND		GND
⑭⑨	1	GND		GND
	2	LG		Sub diaplay contrast
	3	VE		
SWITCH UNIT (I)				
⑩	1	VB0	O	Bit 0 (Code, data for VBT, SLOPE TUNE)
	2	VB1	O	Bit 1
	3	VB2	O	Bit 2
	4	VB3	O	Bit 3
	5	VB4	O	Bit 4
⑪	1	VB		VBT (Code select data)
	2	SH	I	SLOPE HIGH cut (Code select data)
	3	SL	I	SLOPE LOW cut (Code select data)
SWITCH UNIT (A)				
⑫	1	TM	O	Meter SW common
	2	SSB	I	SSB mode : 15V
	3	CWB	I	CW mode : 15V
	4	MA	I	AM, SSB mode : 15V
⑬	1	15B	I	+ 15V
	2	MS	O	Power supply for monitor, MONI SW ON : 15V
	3	FBK	O	CW mode FULL/SEMI SW, FULL : 15V
	4	VS2	O	CW mode VOX SW ON : 15V
	5	VS1	O	AM, SSB mode VOX SW ON : 15V
	6	SS	O	STBY SW, MIC PTT ON : 0V

Terminal No.		Name	I/O	Terminal Function
⑭	1	SPL	I	SPLIT LED light on
	2	DIM	O	DIM SW output, OFF : 0V
	3	TX	I	STBY control by μ-com, SEND : H, REC : L
⑮	1	ATT1	O	ATT relay drive 0, 20dB : 15V
	2	ATT2	O	ATT relay drive 0, 10dB : 15V
⑯	1	NAR	I	NAR LED control for Mode
	2	15V		+ 15V
	3	CWB	I	CW mode : 15V
	4	SS	I	MIC PTT ON : 0V
	5	WIDE	O	NAR SW OFF : 5V (approx.)
⑰	1	ATI	O	AUTO/THRU SW AUTO : 15V
	2	TUN	I	AT tuning : H
⑱	1	15B	I	+ 15V
	2	NB1	O	NB1 SW
	3	NB2	O	NB2 SW ON : H
⑲	1	PRM	I	COMP meter
	2	MVG		Mic line GND
	3	PRS	O	SSB mode PROC SW ON : 15V
	4	MV2	O	MIC GAIN/PROC-IN VR
⑳	1	GND		GND
	2	PIL	I	PROC-IN VR OUT
	3	MVG		MIC line GND
	4	MVG		
	5	MG	I	MIC GAIN VR OUT
	6	NBL	O	NB LEVEL VR
	7	15	O	+ 15V for SW unit (E)
㉑	1	ALM	I	ALC meter
	2	PWR	I	Power meter
	3	SWR	I	SWR meter
	4	ICM	I	IC meter
	5	VCM	I	VC meter
	6	AG0	O	AGC OFF : 15V
	7	NAF	I	SSB, FSK, CW mode : 15V
	8	AGS	O	AGC SLOW : 15V, Normally : −12V
		NAI	O	NAR SW ON : H
		NAR	I	NAR LED control for MODE
		TUN	O	TUNE LED light ON
		SPL	O	SPLIT LED light ON
		PL	O	Power supply for meter lamp
		G		GND for meter lamp
SWITCH UNIT (D)				
㉒	1	CWB	I	CW mode : 15V
	2	GND		GND
	3	15V	I	+ 15V
㉓	1	AP5	O	CW mode AF TUNE ON : 15V
	2	AP0	O	CW mode AF TUNE OFF : 15V
	3	NTH	O	NOTCH SW ON : 15V
	4	15V	O	+ 15V for SW unit (C)
㉔	1	GND		GND
	2	RCL	O	CLEAR SW (ON : L)
	3	XIT	O	XIT SW (ON : L)
	4	RIT	O	RIT SW (ON : L)
SWITCH UNIT (K)				
㉕	1	IO2	I	IF OUT2 (4th IF 100kHz)
	2	GND		GND
	3	LO1	I	PHONE OUT
	4	GND		GND
	5	GND		GND
	6	IO1	I	IF OUT 1 (8.83MHz)
	7	GND		GND
	8	LN1	I	PHONE IN

TS-940S TERMINAL FUNCTION

Terminal No.		Terminal Name	I/O	Terminal Function
SWITCH UNIT (F)				
(26)	1	V15	I	+ 15V
	2	VXC	I	ANTI VOX VR
	3	VXG		GND
	4	ANV	O	ANTI VOX VR
	5	MVG		Mic line GND
	6	FMC	O	FM MIC GAIN VR
	7	DLY	I	VOX DELAY VR
	8	VXG		GND
	9	VX2	O	VOX GAIN VR
(27)	1	MVG		Mic line GND
	2	MV1	I	FM MIC GAIN VR, VOX GAIN VR
(28)	1	CV2	O	} CAR VR
	2	CV1	I	
(29)	1	MB0	O	Memory bank SW data, 2, 3 : H
	2	MB1	O	Memory bank SW data, 1, 3 : H
	3	100	O	VFO : 100kHz SCALE DATA : L
	4	10	O	VFO : 10kHz DIGIT DATA : L
(30)	1	GND		GND
	2	MKS	O	MARKER SW ON : L
(48)	1	GND		GND
	2	LG		} Sub display contrast
	3	VE		
SWITCH UNIT (J)				
(31)	1	TMY	O	TIMER SW OFF : L
	2	GND		GND
	3	TMR	O	TIMER SW ON : L
SWITCH UNIT (G)				
(32)	1	8V	I	+ 8V
	2	MD	O	MIC DOWN SW
	3	MU	O	MIC UP SW
	4	SS	O	PTT SW
	5	MIC	O	MIC COM
	6	GND		MIC GND
	7	GND		GND
SWITCH UNIT (H)				
(33)	1	GND		GND } ACC2
	2	REC	O	RX AFSK signal
	3	MSL	O	MIC select
	4	SS	I	STBY control
	5	MIN	I	TX AFSK signal
	6	GND		GND
	7	GND		GND
SWITCH UNIT (M)				
(34)	1	XIT	I	XIT display data
	2	RIT	I	RIT display data
	3	FG	I	Heater for display tube
	4	DP	I	Dot display data
	5	a	I	Segment data a
	6	SC	I	Scale display data
(35)	1	MEMO	I	MEMO display data
	2	P9	I	Analog digit data
	3	G5	I	Grid data No. 5
	4	P10	I	Analog digit data
	5	G6	I	Grid data No. 6
	6	P4	I	} Analog digit data
	7	P3	I	
	8	G7	I	Grid data No. 7
	9	P2	I	} Analog digit data
	10	P1	I	
	11	G8	I	Grid data No. 8
	12	G9	I	Grid data No. 9

Terminal No.		Terminal Name	I/O	Terminal Function
(36)	1	—	I	— (minus) display data
	2	b	I	Segment data b
	3	G1	I	Grid data No. 1
	4	P5	I	Analog digit data
	5	G2	I	Grid data No. 2
	6	P6	I	} Analog digit data
	7	P7	I	
	8	G3	I	Grid data No. 3
	9	P8	I	Analog digit data
	10	G4	I	Grid data No. 4
	11	c	I	Segment data c
	12	g	I	Segment data g
(37)	1	e	I	Segment data e
	2	d	I	Segment data d
	3	G10	I	Grid data No. 10
	4	VFO B	I	VFO B display data
	5	VFO A	I	VFO A display data
	6	FH	I	Heater for display tube
	7	LOCK	I	LOCK display data
	8	f	I	Segment data f
SWITCH UNIT (E)				
(38)	1	PC0	O	TRQ-H : H, Normally : —12V
	2	—12	I	—12V
	3	TRQ	I	AT STBY signal (For power control OFF)
(39)	1	PRL	O	PROC-OUT VR (DC)
	2	SFT	I	PROC-OUT VR, SSB, FSK mode TX : 15V
	3	MVG		Mic line GND
	4	MV1	I	MIC GAIN VR
(40)	1	NBL	O	NB LEVEL VR
	2	GND		GND
	3	MVG		Mic line GND
	4	PIL	O	PROC-IN VR
	5	15	I	+ 15V
	6	MVG		Mic line GND
	7	MG	O	MIC GAIN VR
	8	MVG		Mic line GND
	9	MV1	O	MIC GAIN VR
(41)	1	GND		GND
	2	PC	O	Power control VR
(42)	1	PC1	O	} Power control VR
	2	PC2	I	
SWITCH UNIT (C)				
(43)	1	AP1	I	} CW PITCH VR
	2	AP2	O	
	3	AP3	O	} AF TUNE VR
	4	AP4	I	
	5	CWP	O	CW PITCH VR
	6	NTH	O	NOTCH VR
	7	AP0	O	CW mode AF TUNE OFF : 15V
	8	AP5	O	CW mode AF TUNE ON : 15V
(44)	1	AP5	I	CW mode AF TUNE ON : 15V
	2	AP0	I	CW mode AF TUNE OFF : 15V
	3	15V	I	+ 15V
	4	GND		GND
	5	NTH	I	NOTCH SW ON : 15V
(45)	1	NTL	O	NOTCH LED light on, NOTCH SW ON : H
	2	FMG	I	FM mode : 0V
(46)	1	SQ2	O	} SQL VR
	2	SQ1	I	
SWITCH UNIT (B)				
(47)	1	GND		GND
	2	AVG		AF line GND
	3	AV2	O	AF GAIN VR
	4	AVG		AF line GND
	5	AV1	I	AF GAIN VR
	6	RFG	O	RF GAIN VR

Terminal No.		Name	I/O	Terminal Function
AVR UNIT (X43-1500-00)				
①	1	AC2	I	AC LINE for AVR (21T)
	2	AC1	I	
②	1	PE	I	Q103 Emitter
	2	PC	O	Q103 Collector
	3	PB	O	Q103 Base
③	1	28C	O	+ 28V to POWER SW
	2	28B	I	+ 28V from POWER SW
④	1	21T	O	+ 21V for Control unit
	2	GND		GND
⑤	1	21T	O	+ 21V for Control unit
	2	28C	O	+ 28V for Control unit
	3	21B	I	+ 21V for AVR unit
	4	GND		GND
⑥	1	10E	I	Q104 Emitter
	2	10C	O	Q104 Collector
	3	10B	O	Q104 Base
⑦	1	10V	I	+ 10V for IC101 : 5V AVR IC
	2	GND		GND
	3	5V	O	+ 5V AVR output
⑧	1	10L	O	+ 10V for LCD ass'y
	2	GND		GND
⑨	1	5CO	O	+ 5V for Control unit
	2	5IF	O	+ 5V for IF unit
	3	GND		GND
	4	5KE	O	+ 5V for key board ass'y
	5	GND		GND
	6	5DA	O	+ 5V for Digital A unit
	7	GND		GND
	8	10DA	O	+ 10V for Digital A unit
⑩	1	ICA	O	Detect terminal for VC, IC meter
	2	ICB	O	Detect terminal for IC meter
⑪	1	FAN	O	Fan motor control output
	2	GND		GND
⑫	1	40V	I	40V DC inline
	2	BS1	O	Q102 Base
	3	BS2	O	Q101 Base
⑬	1	THM	I	Thermister TH101 output
	2	18	O	+ 18V for thermister TH101
		28A	I	Q101, 102 output
		FB	O	+ 28V for Final unit
		5G		5V LINE GND
		CG		Chassis GND
		FG	O	FINAL GND
RF UNIT (X44-1660-00)				
①	1	ATT1	I	ATT SW data, 0, 20dB : H
	2	ATT2	I	ATT SW data, 0, 10dB : H
②	1	GND		GND
	2	MKR	I	Marker signal (100kHz)
③	1	ATV	I	Bias for ANT switching (TX : H)
	2	RV	I	RX : 15V
④	1	RV	O	RV (RX : 15V) for IF unit
	2	AGC	I	AGC voltage for RF AGC circuit
	3	TB	O	TB (TX : 2.1V) for IF unit
	4	TV	O	TV (TX : 15V) for IF unit
⑤	1	GND		GND
	2	PC	I	Power control (Q3 GAIN control)
	3	TRQ	I	AT STBY signal (Q3 GAIN DOWN)
⑥	1	VCH	O	NC
	2	TB	I	TX : + 15V, RX : −12V
	3	18	I	+ 18V
	4	NC		NC
	5	TV	I	TX : + 15V

Terminal No.		Name	I/O	Terminal Function
⑦	1	RB0	I	RX BPF band data
	2	RB1	I	
	3	RB2	I	
	4	RB3	I	
⑧	1	VCL	I	Main VCO select signal
	2	VCM	I	
⑨	1	TCB	O	Power supply for PLL unit IC18
	2	VC2	I	VCO3 control voltage
	3	GND		GND
	4	VC1	I	VCO1, VCO2 control voltage
		RIF	O	RX 1st IF (45.05MHz)
		TIF	I	TX IF (45.05MHz)
		XVTR	O	TX drive output to X.VERTER 7 pin
		RXA	I	RX signal input
		EXTA	O	To EXT. ANT SW
		ANT	I	From Antenna connector
		XVR	I	X.VERTER 4 pin
		TXA	I	TX POWER
		DRV	O	Drive output to Final unit
		VCO	O	VCO signal output to PLL unit
100W FINAL UNIT (X45-1400-00)				
①	1	TXC	I	TX control, TX : 15V
	2	GND		GND
	3	TH	O	Final thermal sensor
		IN	I	Drive power input
		OUT	O	Power output
		28	I	+ 28V
		GND	I	GND
DC-DC UNIT (X46-1030-00)				
①	1	HV	O	High voltage for display drive (approx. −40V)
	2	FG	O	Filament voltage for display
	3	FH	O	
	4	5V	O	+ 5V for Digital C unit
	5	GND		GND
②	1	DIM	I	DIM SW OFF : 0V
	2	GND		GND
	3	5V	I	+ 5V
③	1	21B	I	+ 21V for AVR UNIT
	2	−C	O	−40V for −12V power supply for Control unit
IF UNIT (X48-1430-00)				
①	1	101	O	IF OUT1 (8.83MHz)
	2	GND		GND
	3	LN1	I	PHONE IN
	4	GND		GND
	5	MSL	I	Mic select signal for ACC2-9 pin
	6	GND		GND
	7	MIN	I	TX AFSK signal for ACC2-11 pin
	8	GND		GND
	9	REC	O	RX AFSK signal for ACC2-3 pin
②	1	MIC	I	Mic input
	2	GND		GND
③	1	MV1	O	MIC GAIN VR
	2	MVG		Mic line GND
	3	SFT	O	To PROC-OUT VR (SSB, FSK mode TX : 15V)
	4	PRL	I	PROC-OUT VR (DC)
④	1	TBK	I	TX : 15V
	2	−12	I	−12V
	3	CR3	O	CR3 for SIDE TONE (100kHz)
	4	GND		GND
	5	CWG	O	CWG for Control unit, CW mode : 0V
⑤	1	TM	I	TX meter amp
	2	MA	O	AM, SSB mode : 15V
	3	SSB	O	MOD data for SW unit (A), SSB mode : 15V
	4	CWB	O	MOD data for SW unit (A), CW mode : 15V
⑥	1	ALC	I	ALC for TX IF control
	2	GND		GND
	3	MON	O	TX IF for SSB, FSK, AM monitor (8.83MHz)

TS-940S TERMINAL FUNCTION

Terminal No.		Name	I/O	Terminal Function
⑦	1	NG1	I	Noise blanker gate input
	2	NBB	O	+ B for Noise blanker circuit
	3	GND		GND
	4	NA	O	IF output for Noise blanker
⑧	1	GND		GND
	2	5IF	I	+ 5V
⑨	1	USB	O	USB, CW, AM, FM, TUNE : H } CAR 1
	2	LSB	O	LSB, FSK : H } f shift
	3	5V	O	+ 5V for CAR unit
	4	15V	O	+ 15V for CAR UNIT
⑩	1	RB	I	Bias for RX circuit, RX : 2.1V
	2	15V	I	+ 15V
	3	TRQ	I	AT STBY signal
	4	FMB	O	FM : 15V } Mode data
	5	AMB	O	AM : 15V } for Control unit
⑪	1	GND		GND
	2	CR0	I	Carrier for TX CW, FM (8.83MHz)
⑫	1	USG	I	USB KEY }
	2	LSG	I	LSB KEY
	3	FSG	I	FSK KEY
	4	AMG	I	AM KEY } KEY ON : L
	5	FMG	I	FM KEY
	6	CWG	I	CW KEY }
	7	WN	I	WIDE/NAR & IF Filter switching data
	8	MD2	I	IF Filter switching data
	9	MD1	I	IF Filter switching data
⑬	1	TV	I	TX : 15V
	2	RV	I	RX : 15V
	3	TB	I	Low voltage for TX circuit
	4	AGC	O	AGC output for RF unit RF AGC
⑭	1	CV1	O	DC for CAR VR, CW, AM mode TX : 15V
	2	CV2	I	CAR VR output
⑮	1	M	O	Meter output
	2	NAF	O	DC for AGC SW, SSB, FSK, CW mode : 15V
	3	AGS	I	AGC SLOW : 15V, Normally : −12V
	4	AG0	I	AGC OFF : 15V
⑯	1	FMI	O	FM IF (455kHz)
	2	GND		GND
	3	GND		GND
	4	NG2	I	Noise gate (3rd MIX) control signal for NB2
⑰	1	GND		GND
	2	CR2	I	CAR2 input (9.285MHz)
⑱	1	GND		GND
	2	CR1	I	CAR1 input (455kHz)
⑲	1	PRS	I	SSB mode PROC SW ON : 15V
	2	PRM	O	PROC meter
	3	MVG		GND
	4	MV2	I	MIC GAIN/PROC-IN VR
⑳	1	GND		GND
	2	IO2	O	IF OUT 2 (100kHz)
㉑	1	GND		GND
	2	CR4	O	CAR4 for SIDE TONE (99.2kHz)
	3	MUT	I	SQL MUT signal, Muting : H
	4	FMV	I	FM Detector signal
	5	GND		GND
㉒	1	AP0	I	CW mode AF TUNE OFF : 15V
	2	AP5	I	CW mode AF TUNE ON : 15V
	3	AP4	O	AF TUNE VR
	4	AP2	I	} CW PITCH VR
	5	AP1	O	
	6	AP3	I	AF TUNE VR
	7	NTH	I	NOTCH VR
	8	CWP	I	CW PITCH VR
㉓	1	AV1	O	AF GAIN VR
	2	AVG		GND
	3	GND		GND
	4	RFG	O	RF GAIN VR

Terminal No.		Name	I/O	Terminal Function
㉔	1	FSB	O	FSK mode data, FSK : 15V
	2	GND		GND
	3	AFS	I	AFSK modulate signal (2290/2125Hz)
		TIF	O	TX IF signal (45.05MHz)
		RIF	I	RX 1st IF signal (45.05MHz)
		HET	I	HET (36.22MHz)
PLL UNIT (X50-2020-00)				
②	1	DA0	O	} PLL data for CAR1, CAR2
	2	DA1	O	
	3	DA2	O	
	4	DA3	O	
	5	UL1	I	Unlock signal
③	1	GND		GND
	2	DA0	I	} PLL data
	3	DA1	I	
	4	DA2	I	
	5	DA3	I	
	6	CL2	I	Data clock for IC8
	7	CL1	I	Data clock for IC9
	8	CL0	I	Data clock for IC19
④	1	GND		GND
	2	117	I	117MHz from CAR unit
⑤	1	FMM	I	FM modulate signal
	2	GND		GND
	3	15A	I	+ 15V
	4	UL	O	PLL unlock signal
	5	5	I	+ 5V
⑥	1	KFS	I	RTTY KEY signal, KEY DOWN : L
	2	GND		GND
	3	MKR	O	100kHz marker signal output
	4	MKG		NC
	5	GND		GND
	6	MKS		Marker ON : L, Normally : H
⑦	1	AFS	O	AFSK signal (2290/2125Hz)
	2	GND		NC
	3	FSB	I	FSK mode data, FSK : 15V
⑧	1	10	O	10MHz for CAR unit
	2	GND		GND
⑩	1	TCB	I	Power supply for IC18
	2	VC2	O	Control voltage for RF unit VCO3
	3	GND		GND
	4	VC1	O	Control voltage for RF unit VCO1, 2
⑪	1	GND		GND
	2	PLE	I	Data latch for IC17
	3	CL3	I	Clock for IC17
	4	PLD	I	PLL data IC17
		HET	O	HET for RF unit (36.22MHz)
		VCO	I	Output signal of RF unit, VCO1, 2 and 3
LPF UNIT (X51-1330-00)				
①	1	VSF	O	Forward detect for SWR
	2	GND		GND
	3	VSR	O	Reverse detect for SWR
	4	GND		GND
②	1	ANT	O	LPF unit output
③	1	GND		GND
	2	XVR	I	X. VERTER 4 pin
④	1	TXC	O	TX control for Final unit, TX : 15V
	2	GND		GND
	3	TH	I	Final thermal sensor
⑤	1	LP2	I	} LPF band data
	2	LP0	I	
	3	LP1	I	
⑥	1	M0	O	Fan control
	2	GND		GND

Terminal No.		Name	I/O	Terminal Function
⑦	1	21B	I	+ 21V for AVR unit
	2	28	I	+ 28V
	3	TV	I	TX : 15V
	4	BTP	O	PROTECTION signal (H : TX OFF)
		IN	I	LPF unit input
CONTROL UNIT (X53-1420-11)				
①	1	VCH	I	NC
	2	TB	O	TB for RF unit, TX : 2.1V
	3	GND		GND
	4	TV	O	TV for RF unit, TX : 15V
	5	18	O	+ 18V for RF unit
②	1	TRQ	I	AT STBY signal, TUNE : Power down
	2	15B	O	+ 15V for AT unit
	3	21B	O	+ 21V for AT unit
	4	TV	O	TV for AT unit
③	1	GND		GND
	2	28C	I	+ 28V
	3	21B	O	+ 21V for AVR unit
	4	21T	I	+ 21V
④	1	EX2		For REMOTE connector,
	2	EX1		TX : Connecto to EX1, EX2
⑤	1	8C		+ 8V for SW unit (L)
	2	TMY		TIMER SW ON : 0V
	3	GND		GND
⑥	1	RV	O	RV for RF unit, TX : 15V
	2	ATV	O	ANT switching output for RF unit (TX : H)
⑦	1	AT0	I	NC
	2	WRC	I	NC
⑧	1	GND		GND
	2	VSF	I	Forward detect for SWR
	3	GND		GND
	4	VSR	I	Reverse detect for SWR
	5	BTP	I	Protection input
	6	TV	O	TV for LPF unit, TX : 15V
	7	28	O	+ 28V for LPF unit
	8	21B	O	+ 21V for LPF unit
⑨	1	GND		GND
	2	TRQ	O	AT STBY signal for RF unit
⑩	1	15B	O	+ 15V for IF unit
	2	TBK	O	TBK for IF unit, TX : 15V
	3	RB	O	RB for IF unit, RX : 2.1V
	4	−12	O	−12V for IF unit
⑪	1	−12	O	−12V for SW unit
	2	TRQ	O	AT STBY signal for SW unit
	3	PC0	I	TRQ-H : H, Normally : −12V
	4	PC1	I	Power control VR
	5	PC2	O	
⑫	1	ALC	O	ALC for IF unit
	2	GND		GND
⑬	1	VCM	O	VC meter
	2	ALM	O	ALC meter
	3	ICM	O	IC meter
	4	GND		GND
	5	SWR	O	SWR meter
	6	PWR	O	POWER meter
⑭	1	GND		GND
	2	VX2	I	VOX GAIN VR
⑮	1	NC		NC
	2	ISW	O	SWR voltage for AT unit
	3	GND		GND

Terminal No.		Name	I/O	Terminal Function
⑯	1	RRL	I	Connect to TV — When remote plug IN
	2	RLT	O	TX : GND, Normally : OPEN — When remote plug IN
	3	TV	O	TX : 15V
	4	RAL	I	ALC input
	5	XAL	I	ALC input — X. VERTER
	6	XRL	O	Relay control — X. VERTER
⑰	1	BLK	I	Dial click blanking pulse
	2	−C	I	−40V for −12V power supply
	3	21B	O	+ 21V for DC-DC unit
	4	BZ	I	Buzzer pulse
	5	DST	I	BAND data for TX.OFF
⑱	1	UL	O	PLL unlock signal for Digital B unit
	2	TR	O	TR (TX : 15V) for Digital B unit
⑲	1	NG1	O	Noise blanker gate
	2	NBB	I	+ B for noise blanker circuit
	3	GND		GND
	4	NA	I	IF for noise blanker (8.83MHz)
⑳	1	15B	I	+ 15V
	2	NB2	I	NB2 SW
	3	NB1	I	NB1 SW
㉑	1	UL	I	Unlock signal (L : TX.OFF)
	2	15A	O	+ 15V for PLL unit
	3	5	O	+ 5V for PLL unit
	4	GND		GND
㉒	1	DLY	O	DLAY VR
	2	VXC	O	ANTI VOX VR
	3	V15	O	+ 15V for SW unit
㉓	1	GND		GND
	2	5CO	I	+ 5V
㉔	1	NG2	O	NB2 blanking signal
	2	GND		GND
㉕	1	GND		GND
	2	MON	I	TX IF for SSB, FSK, AM monitor (8.83MHz)
㉖	1	15B	O	+ 15V for SW unit
	2	MS	I	Power supply for monitor circuit
㉗	1	SS	I	SEND or PTT switch data (L : TX)
	2	FBK	I	CW mode FULL/SEMI SW FULL : 15V
	3	VS1	I	AM, SSB mode VOX SW ON : 15V
	4	VS2	I	CW mode VOX SW ON : 15V
㉘	1	MUT	O	SQL MUT signal (Muting : H)
	2	AMB	I	AM mode data, AM : 15V
	3	CWG	I	CW mode data, CW : 0V
	4	FMB	I	FM mode data, FM : 15V
	5	TRQ	O	AT STBY signal for IF unit
㉙	1	SQ1	O	SQL VR output
	2	SQ2	I	SQL VR input
㉚	1	GND		GND
	2	CR0	I	CAR0 for SSB, FSK, AM monitor (8.83MHz)
㉛	1	ANV	I	ANTI VOX VR
	2	GND		GND
㉜	1	FMC	I	FM MIC GAIN VR
	2	MVG		GND
㉝	1	FMM	O	FM Mic amp
	2	GND		GND
㉞	1	FIN	I	FM IF input (455kHz)
	2	GND		GND
㉟	1	CR4	I	CAR4 for side tone (99.2kHz)
	2	GND		GND
	3	GND		GND
	4	CR3	I	CAR3 for side tone (100kHz)

TS-940S TERMINAL FUNCTION

Terminal No.		Name	I/O	Terminal Function
㊱	1	SP1	O	Audio signal for REMOTE 1pin
	2	GND		GND
	3	GND		GND
	4	SP2	O	Audio signal for EXT. SP
	5	KEY	I	KEY UP : H, Normally : L
	6	STK	I	KEY DOWN : L, Normally : H
㊲	1	AV2	I	AF GAIN VR
	2	AVG		GND
㊳	1	SP2	I	Audio signal from PHONE
	2	GND		GND
	3	GND		GND
	4	SP1	O	Audio signal from PHONE
㊴	1	VO	I	VS-1 (option) voice signal
	2	GND		GND
㊵	1	GND		GND
	2	FMV	O	FM detector output
㊶	1	ICB	I	Detect terminal for IC meter
	2	ICA	I	Detect terminal for VC, IC meter
㊷	1	AR	O	ON AIR LED light on
	2	GND		GND
㊹	1	8V	O	+ 8V for VS-1 (option)
	2	GND		GND
		SS	I	REMOTE 4 pin, EXT. STBY
DIGITAL A UNIT (X54-1830-00)				
①	1	LOCK	O	F. LOCK segment data
	2	SC	O	Scale display data
	3	G5	O	Grid data
	4	G4	O	
	5	G3	O	
	6	G2	O	
	7	G1	O	
	8	G9	O	
	9	G10	O	
	10	G8	O	
	11	G7	O	
	12	G6	O	
②	1	B2	O	Multiplex segment data
	2	B3	O	
	3	B4	O	
	4	B5	O	
	5	B6	O	
	6	B7	O	
③	1	B1	O	Segment data DP
	2	B0	O	Segment data g
	3	C3	O	Segment data P10
	4	C2	O	Segment data P9
	5	C1	O	Segment data P8
	6	C0	O	Segment data P7
	7	C6	O	Segment data control
	8	C7	O	
④	1	LP2	O	LPF BAND data
	2	LP1	O	
	3	LP0	O	
	4	WRC	O	NC
	5	WRC	O	AT BAND data
	6	AT0	O	NC
	7	AT0	O	AT BAND data
	8	AT1	O	
	9	AT2	O	
	10	AT3	O	

Terminal No.		Name	I/O	Terminal Function
⑤	1	DA0	O	PLL data for PLL, CAR unit
	2	DA1	O	
	3	DA2	O	
	4	PLD	O	PLL data for PLL unit IC17
	5	PLE	O	Data latch for PLL unit IC17
	6	CL3	O	Clock for PLL unit IC17
	7	CL2	O	Clock for PLL unit IC8
	8	CL1	O	Clock for PLL unit IC9
	9	CL0	O	Clock for PLL unit IC19
	10	DA3	O	PLL data for PLL, CAR unit
	11	GND		GND
⑥	1	SH	O	SLOPE HIGH cut
	2	SL	O	SLOPE LOW cut — Code select data
	3	VB	O	VBT
⑦	1	CL4	O	PLL clock for CAR1 (455kHz)
	2	CL5	O	PLL clock for CAR2 (9.285MHz)
⑧	1	BZ	O	Buzzer pulse
	2	DST	O	BAND data
	3	BLK	O	Dial click blanking pulse
⑨	1	DIM	I	DIM SW OFF: 0V
	2	SPL	O	SPLIT LED light on
	3	TX	O	STBY control
	4	VCL	O	Main VCO select signal
	5	VCM	O	
	6	MDD	O	MODE LED light ON
	7	MD1	O	
	8	MD2	O	
	9	WN	O	WIDE, NAR data, NAR : H
	10	GND		GND
⑩	1	ATS	O	AT start pulse
	2	GND		GND
⑪	1	RC	O	RIT CLEAR pulse
	2	CN	O	Multiplex control data for switches
	3	SL0	O	Multiplex select data for switches
	4	SL1	O	
	5	SL2	O	
	6	SL3	O	
⑫	1	GND		GND
	2	13	I	Multiplex switch data
	3	12	I	
	4	11	I	
	5	10	I	
	6	14	I	
	7	15	I	
	8	16	I	
	9	17	I	
⑬	1	RB0	O	RX BPF band data
	2	RB1	O	
	3	RB2	O	
	4	RB3	O	
	5	HDL	O	HOLD LED light on
	6	PSL	O	PG.S LED light on
	7	MSL	O	M.S LED light on
⑭	1	SB1	O	LCD display data
	2	SB2	O	
	3	MRQ	O	Data clock for sub μ-processor
	4	SB3	O	LCD display data
	5	SB0	O	
	6	GND		GND
⑮	1	GND		GND
	2	5DA	I	+ 5V
	3	10DA	I	+ 10V
⑯	1	5V	O	+ 5V for DC-DC unit
	2	GND		GND
	3	DIM	O	DIM data for DC-DC unit, DIM SW OFF : 0V
⑰	1	GND		GND
	2	ENC	I	Main encoder pulse

Terminal No.		Name	I/O	Terminal Function
⑱	1	VDD	O	+ 5V for photo coupler
	2	GND		GND
	3	TXD	O	TX data
	4	RXD	I	RX data
	5	CTS	I	Clear to SEND
	6	RTS	O	Request to SEND
				} ACC1
⑲	1	CLK	O	Clock
	2	B	O	+ 10V for interface
	3	RDY	I	RADY
	4	CD	O	Control data
	5	CS	O	Chip select
	6	R	O	Read
	7	WR	O	Write
	8	GND		GND
				} EXT Control board (option)
⑳	1	RES	O	Reset
	2	D0	I/O	Data 0
	3	D1	I/O	Data 1
	4	D2	I/O	Data 2
	5	D3	I/O	Data 3
	6	D4	I/O	Data 4
	7	D5	I/O	Data 5
	8	D6	I/O	Data 6
	9	D7	I/O	Data 7
				} EXT control board (option)

CAR UNIT (X54-1840-00 : A/2)

①	1	15V	I	+ 15V
	2	5V	I	+ 5V
	3	UL1	O	Unlock signal
	4	CL4	I	PLL clock for CAR1 (455kHz)
	5	DA3	I	} PLL data for CAR1, CAR2
	6	DA2	I	
	7	DA1	I	
	8	DA0	I	
	9	CL5	I	PLL clock for CAR2 (9.285MHz)
	10	LSB	I	LSB, FLS : H } CAR1 f shift
	11	USB	I	USB, CW, AM, FM, TUNE : H
②	1	GND		GND
	2	CR2	O	CAR2 for IF unit (455kHz)
	3	GND		GND
	4	117	O	117MHz for PLL unit
	5	GND		GND
	6	10	I	10MHz
	7	GND		GND
	8	CR0	O	CAR0 for SSB, FSK AM monitor (8.83MHz)
	9	GND		GND
	10	CR0	O	Carrier for TX, CW, FM (8.83MHz)
	11	GND		GND
	12	CR1	O	CAR1 for IF unit (455kHz)

DIGITAL B UNIT (X54-1840-00 : B/2)

①	1	GND		GND
	2	ME1	I	} Main encoder pulse input
	3	ME2	I	
	4	5V	O	+ 5V for main encoder
②	1	TRQ	I	AT STBY signal, Tuning : H
	2	AS1	O	} ATT SW data
	3	AS2	I	
	4	ATB	I	ATT-THRU : 21V
③	1	GND		GND
	2	17	O	} Multiplex switch data
	3	16	O	
	4	15	O	
	5	14	O	
④	1	UL	I	Unlock signal
	2	TR	I	TX : 15V
⑤	1	MU	I	MIC UP
	2	MD	I	MIC DOWN
	3	8C	O	+ 8V for MIC connector

Terminal No.		Name	I/O	Terminal Function
⑥	1	M►V	I	M ► VFO KEY
	2	MIN	I	M. IN KEY
	3	LOK	I	F. LOCK KEY
	4	SPT	I	SPLIT KEY
	5	A/B	I	A/B KEY
	6	BD	I	BAND DOWN KEY
	7	BU	I	BAND UP KEY
	8	ATT	I	ATT KEY
	9	GND		GND
				} SW ON : L
⑦	1	10	I	10Hz digit display data
	2	100	I	1MHz 100kHz switching signal
	3	MB0	I	Memory bank SW, 2, 3 : H
	4	MB1	I	Memory bank SW, 1, 3 : H
⑧	1	B3	I	} 10 KEY (BAND) matrix data
	2	B2	I	
	3	B1	I	
	4	B0	I	
	5	M/V	I	M/V KEY
	6	TFS	I	TFS KEY
	7	A=B	I	A=B KEY
	8	VRC	I	VOICE KEY
				} KEY ON : L
⑨	1	VB0	I	Bit 0
	2	VB1	I	Bit 1
	3	VB2	I	Bit 2
	4	VB3	I	Bit 3
	5	VB4	I	Bit 4
				} Code data for VBT, SLOPE TUNE
⑩	1	ENT	I	ENT KEY
	2	MCE	I	MCE KEY
				} KEY ON : L
	3	NRQ	O	NRQ output for keyboard ass'y
	4	WIDE	I	NAR/WIDE SW, WIDE : 15V
	5	M2	I	} MODE KEY matrix data
	6	M1	I	
	7	M0	I	
	8	RCL	I	RIT CLEAR KEY
	9	XIT	I	XIT KEY
	10	RIT	I	HOLD KEY
	11	HLD	I	HOLD KEY
	12	PSC	I	PG.S KEY
	13	MS	I	MS KEY
				} KEY ON : L
⑪	1	RC	I	RIT CLEAR pulse
	2	CN	I	Multiplex control data for switches
	3	13	O	} Multiplex switch data
	4	12	O	
	5	11	O	
	6	10	O	
	7	SL3	I	} Multiplex select data for switches
	8	SL2	I	
	9	SL1	I	
	10	SL0	I	
⑫	1	GND		GND
	2	RE2	I	RIT encoder pulse 2
	3	RE1	I	RIT encoder pulse 1
	4	5V	O	+ 5V for RIT encoder
⑬	1	HS	I	LCD DATA accept message
	2	8B	I	+ 8V for MIC connector
	3	5C	I	+ 5V
	4	GND		GND
⑭	1	GND		GND
	2	ENC	O	Main encoder pulse output

DIGITAL C UNIT (X54-1850-00)

①	1	B2	I	} Multiplex segment data
	2	B3	I	
	3	B4	I	
	4	B5	I	
	5	B6	I	
	6	B7	I	

Terminal No.		Name	I/O	Terminal Function
②	1	G1	I	} Grid data
	2	G2	I	
	3	G3	I	
	4	G4	I	
	5	SC	I	Scale data
③	1	5V	I	+ 5V
	2	GND		GND
	3	HV	I	–40V for drive display tube
④	1	B0	I	Segment data DP
	2	B1	I	Segment data g
	3	C0	I	Segment data P10
	4	C1	I	Segment data P9
	5	C2	I	Segment data P8
	6	C3	I	Segment data P7
	7	C6	I	} Segment control data
	8	C7	I	
⑤	1	G5	I	} Grid data
	2	G6	I	
	3	G7	I	
	4	G8	I	
	5	G9	I	
	6	G10	I	
	7	LOCK	I	Segment data F. LOCK
⑥	1	FH	I	} Filament voltage for display
	2	FG	I	
⑦	1	f	O	Segment data f
	2	LOCK	O	LOCK display data
	3	FH	O	Heater for display tube
	4	VFO A	O	VFO A display data
	5	VFO B	O	VFO B display data
	6	G10	O	Grid data No. 10
	7	d	O	Segment data d
	8	e	O	Segment data e
⑧	1	G9	O	Grid data No. 9
	2	G8	O	Grid data No. 8
	3	P1	O	} Analog digit data
	4	P2	O	
	5	G7	O	Grid data No. 7
	6	P3	O	} Analog digit data
	7	P4	O	
	8	G6	O	Grid data No. 6
	9	P10	O	Analog digit data
	10	G5	O	Grid data No. 5
	11	P9	O	Analog digit data
	12	MEMO	O	MEMO display data
⑨	1	g	O	Segment data g
	2	c	O	Segment data c
	3	G4	O	Grid data No. 4
	4	P8	O	Analog digit data
	5	G3	O	Grid data No. 3
	6	P7	O	} Analog digit data
	7	P6	O	
	8	G2	O	Grid data No. 2
	9	P5	O	Analog digit data
	10	G1	O	Grid data No. 1
	11	b	O	Segment data b
	12	–	O	– (minus) display data
⑩	1	SC	O	Scale display data
	2	a	O	Segment data a
	3	DP	O	Dot display data
	4	FG	O	Heater for display tube
	5	RIT	O	RIT display data
	6	XIT	O	XIT display data

AT UNIT (B) (X57-1130-00)

①	1	GND		GND
	2	ATS	I	AT start pulse

Terminal No.		Name	I/O	Terminal Function
②	1	15B	I	+ 15V
	2	TRQ	O	AT STBY signal for Control unit
	3	TV	I	TX : 15V
③	1	TRQ	O	AT STBY signal for Digital B unit
	2	AS1	I	} ATT KEY signal (ATT ON : L)
	3	AS2	O	} confirmation signal for AT installed.
	4	ATB	O	AT THRU : 21V
④	1	ATB	I	AT THRU : 21V
	2	TRQ	O	AT STBY signal for MB control
	3	TV	O	TX : 15V
	4	MB	I	Tuning : 14V
⑤	1	GND		GND
	2	10	O	+ 10V
	3	5	O	+ 5V
	4	14	O	+ 14V
	5	21B	O	+ 21V
⑥	1	28		NC
	2	21B	I	+ 21V
⑦	1	ATV	O	TX : 15V
	2	TNQ	O	AT STBY signal for SW unit (L)

AT UNIT (B) (X57-1130-00)

⑧	1	ATH	O	AT LED anode
	2	ATL	I	AT LED cathode
⑨	1	ATB	I	AT THRU : 21V
	2	TRQ	I	AT STBY signal for MB control
	3	TV	I	TX : 15V
	4	MB	O	Tuning : 14V
⑩	1	MB	O	Tuning : 14V
	2	GND		GND
	3	21B	O	+ 21V for AT unit (C)
⑪	1	ATI	I	AT IN : 15V
	2	LED	O	TUNE LED light on
⑫	1	21B	I	+ 21V
	2	5	I	+ 5V
	3	10	I	+ 10V
	4	14	I	+ 14V
	5	GND		GND
⑬	1	GND		GND
	2	ISW	I	SWR level
⑭	1	M1–	O	} Tuning motor control
	2	M1+	O	
	3	M2–	O	
	4	M2+	O	

AT UNIT (C)

⑮	1	WRC	I	} AT BAND data
	2	AT0	I	
	3	AT1	I	
	4	AT2	I	
	5	AT3	I	
⑯	1	21B	I	+ 21V
	2	GND		GND
	3	MB	I	Tuning : H
⑰	1	M1–	O	} Magnetic brake relay terminal for AT tune finish
	2	M1+	O	
	3	M2–	O	
	4	M2+	O	

TS-940S PC BOARD VIEWS

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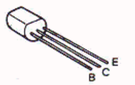

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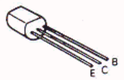

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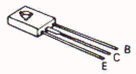

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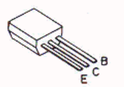

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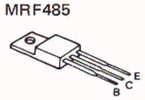

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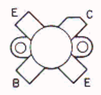

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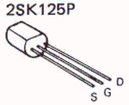

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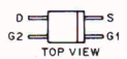
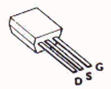
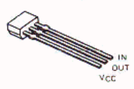


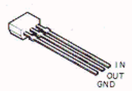
2SK192A



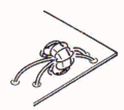
DTA143XS



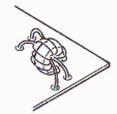
DTC124ES



LPF unit
[Attachment method of L15]

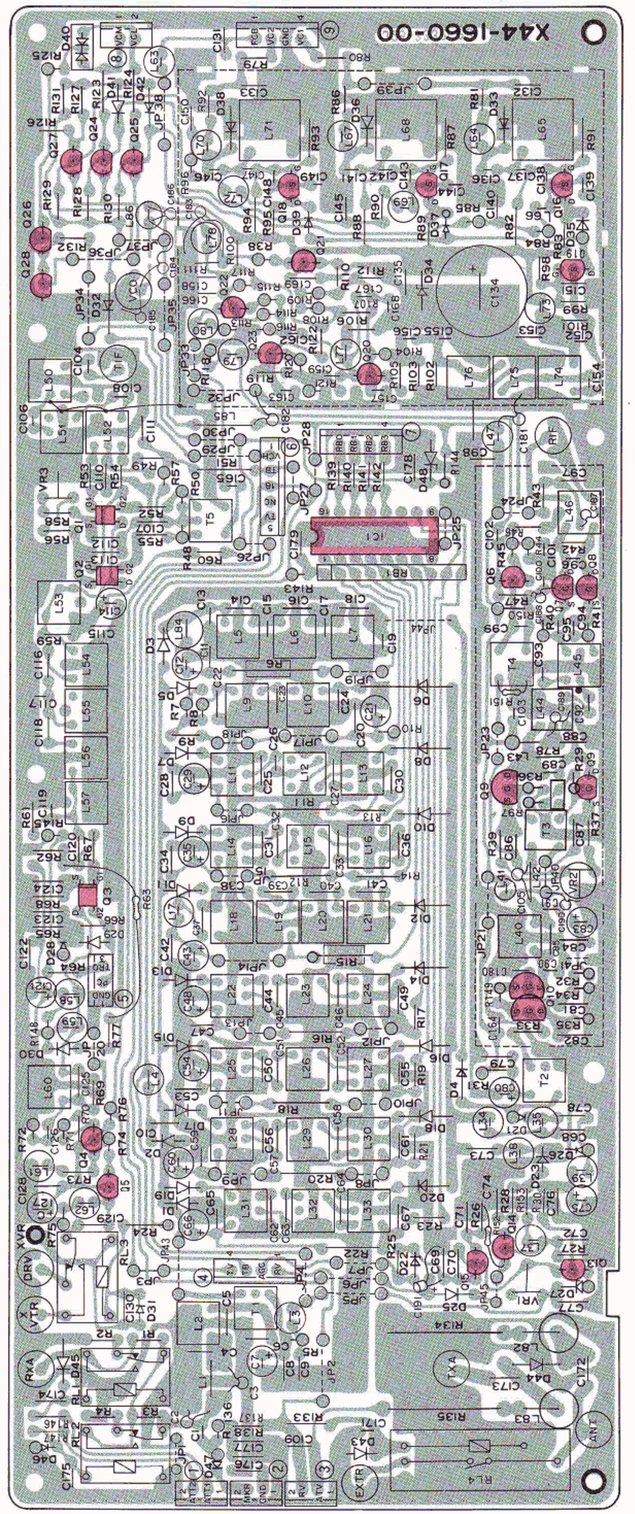


LPF unit
[Attachment method of L16]

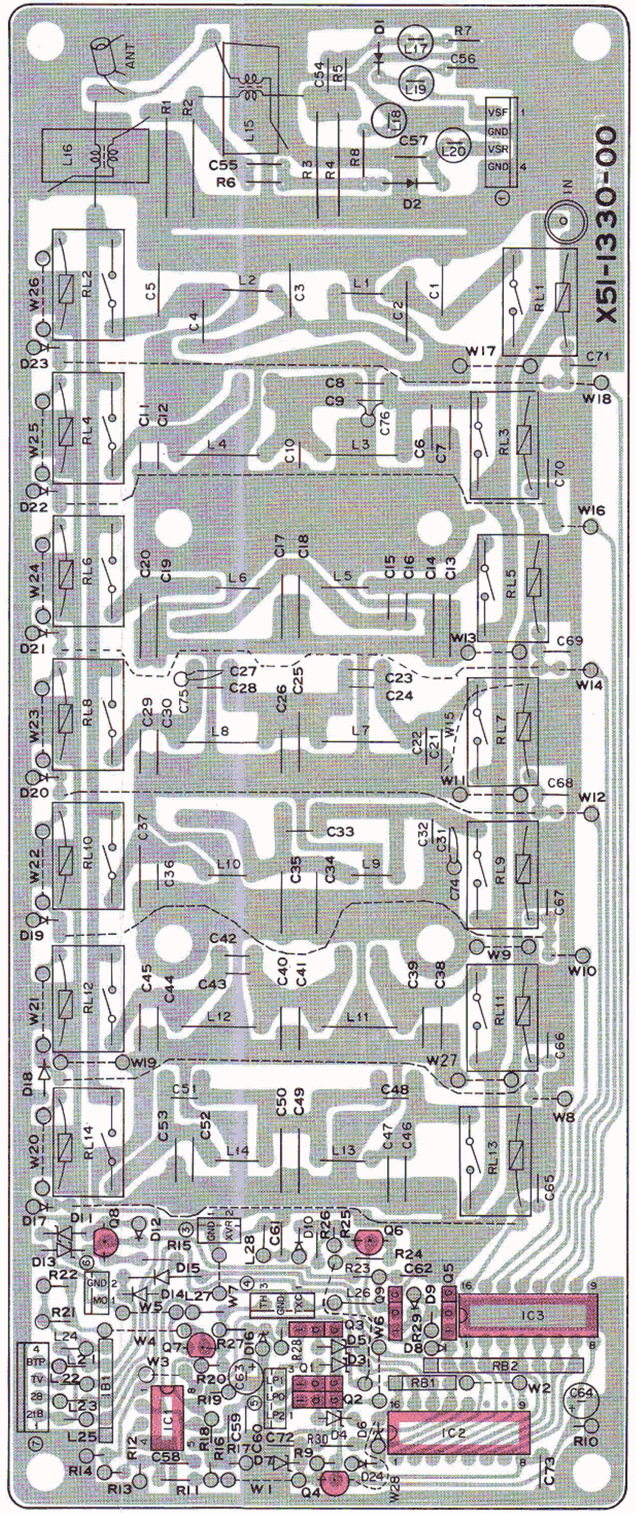


100W FINAL unit
[Attachment method of R35 and L3]

RF UNIT (X44-1660-00) Component side view

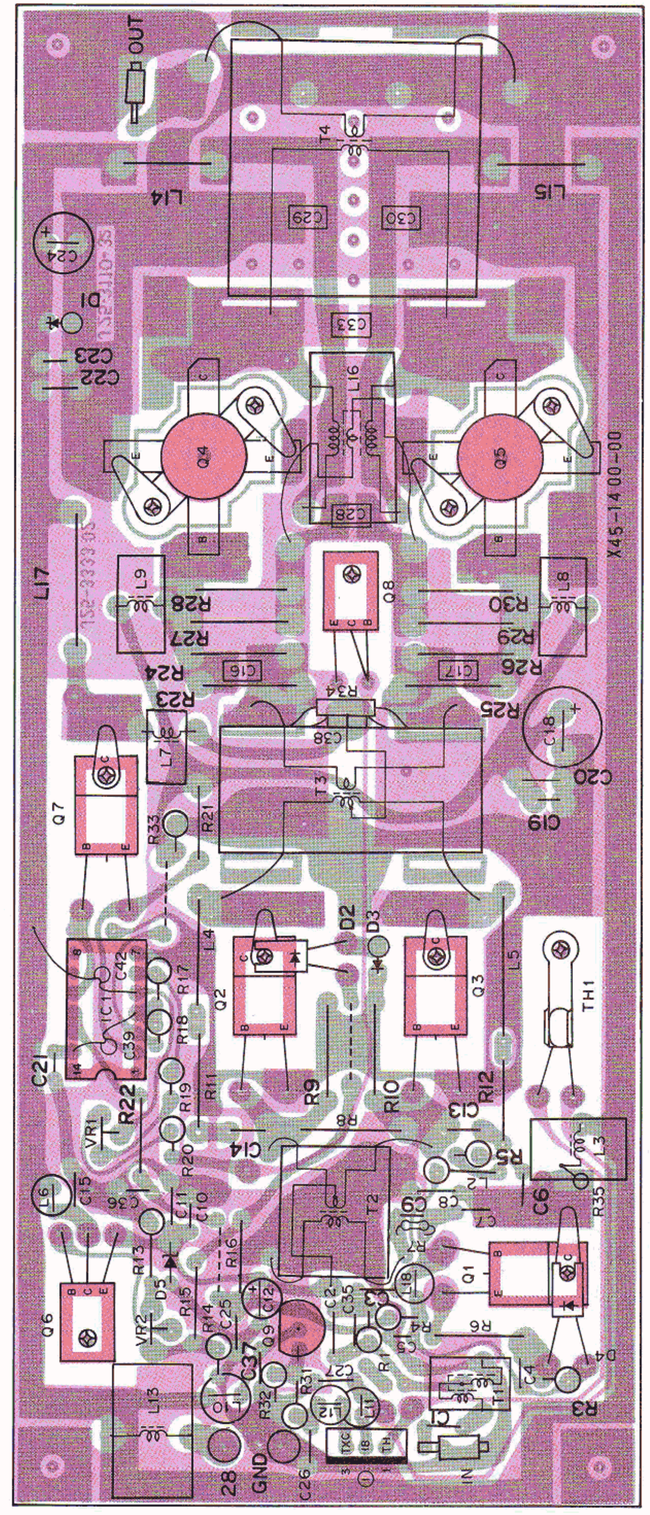


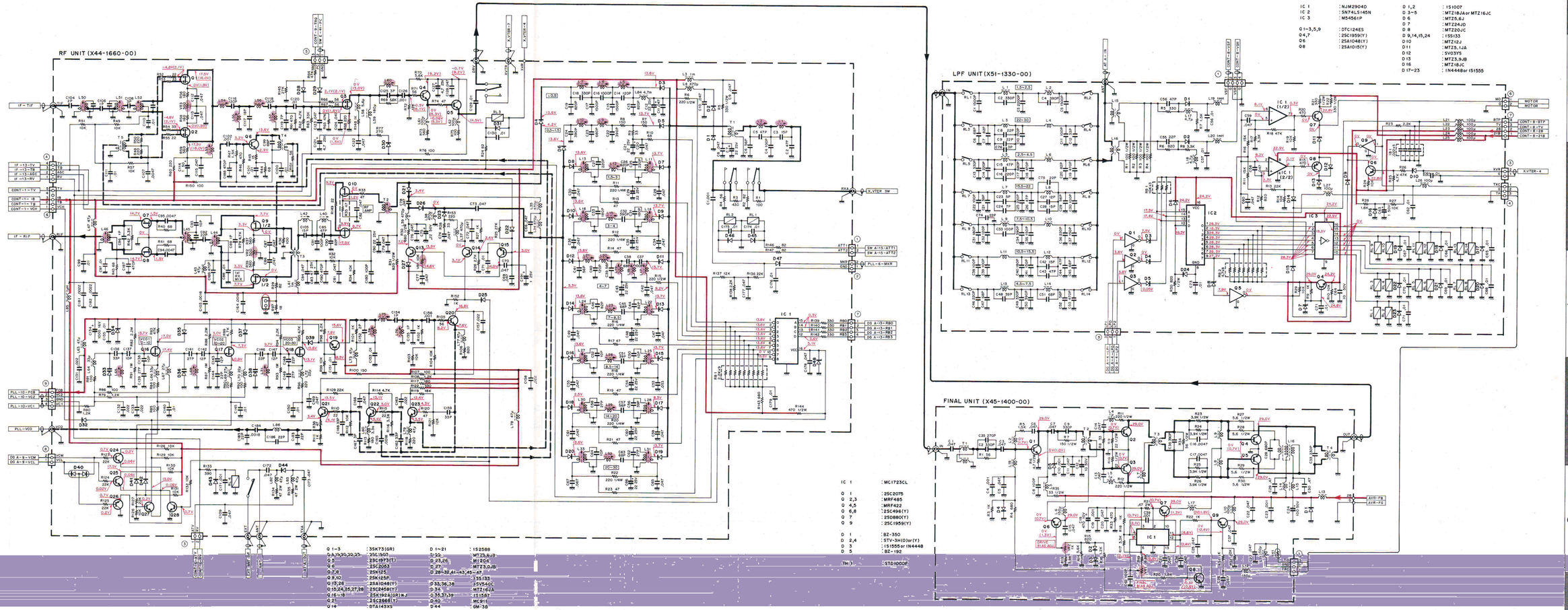
LPF UNIT (X51-1330-00) Component side view



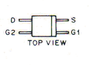
Component side Foil side

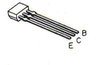
100W FINAL UNIT (X45-1400-00) Component side view

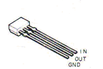



RF UNIT (X44-1660-00)
LPF UNIT (X51-1330-00)
FINAL UNIT (X45-1400-00)
IC 1 : NJM2904D
IC 2 : SN74LS145N
IC 3 : M54561P
Q 1~3,5,9 : DTC124ES
Q 4,7 : 2SC1959(Y)
Q 6 : 2SA1048(Y)
Q 8 : 2SA1015(Y)
D 1,2 : 1S1007
D 3~5 : MTZ16JA or MTZ16JC
D 6 : MTZ5.6J
D 7 : MTZ24JD
D 8 : MTZ20JC
D 9,14,15,24 : 1SS133
D 10 : MTZ12J
D 11 : MTZ5.1JA
D 12 : SV03YS
D 13 : MTZ3.9JB
D 16 : MTZ18JC
D 17~23 : 1N4448 or 1S1555
IC 1 : MC1723CL
Q 1 : 2SC2075
Q 2,3 : MRF485
Q 4,5 : MRF422
Q 6,8 : 2SC4961(Y)
Q 7 : 2SD880(Y)
Q 9 : 2SC1959(Y)
D 1 : BZ-350
D 2,4 : STV-3H(03)(Y)
D 3 : 1S1555 or 1N4448
D 5 : BZ-192
TH 1 : STD1000F
Q 1~3 : 3SK73(GR)
Q 4,19,20,22~ : 2SC1900
Q 5 : 2SC1973(T)
Q 6 : 2SC2053
Q 7,8 : 2SK125
Q 9,10 : 2SK125P
Q 11,26 : 2SA1048(Y)
Q 12,24,25,27,28 : 2SC2458(Y)
Q 16~18 : 2SK192A(GR) or J
Q 21 : 2SC2668(T)
Q 29 : DTA143XS
IC 1 : SN74LS145N
D 1~21 : 1S2588
T 22 : MTZ3.6JB
D 23,26 : MTZ10J
D 27 : MTZ3.0JB
D 28~32,41~43,45~47 : 1SS133
D 33,36,38 : 1SV54C
D 34 : MTZ16JA
D 35,37,39 : 1S1587
D 40 : MC911
D 44 : GM-38
D 48 : MTZ5.1JA
D 25 : MV-203

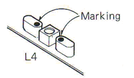
TS-940S CIRCUIT DIAGRAM

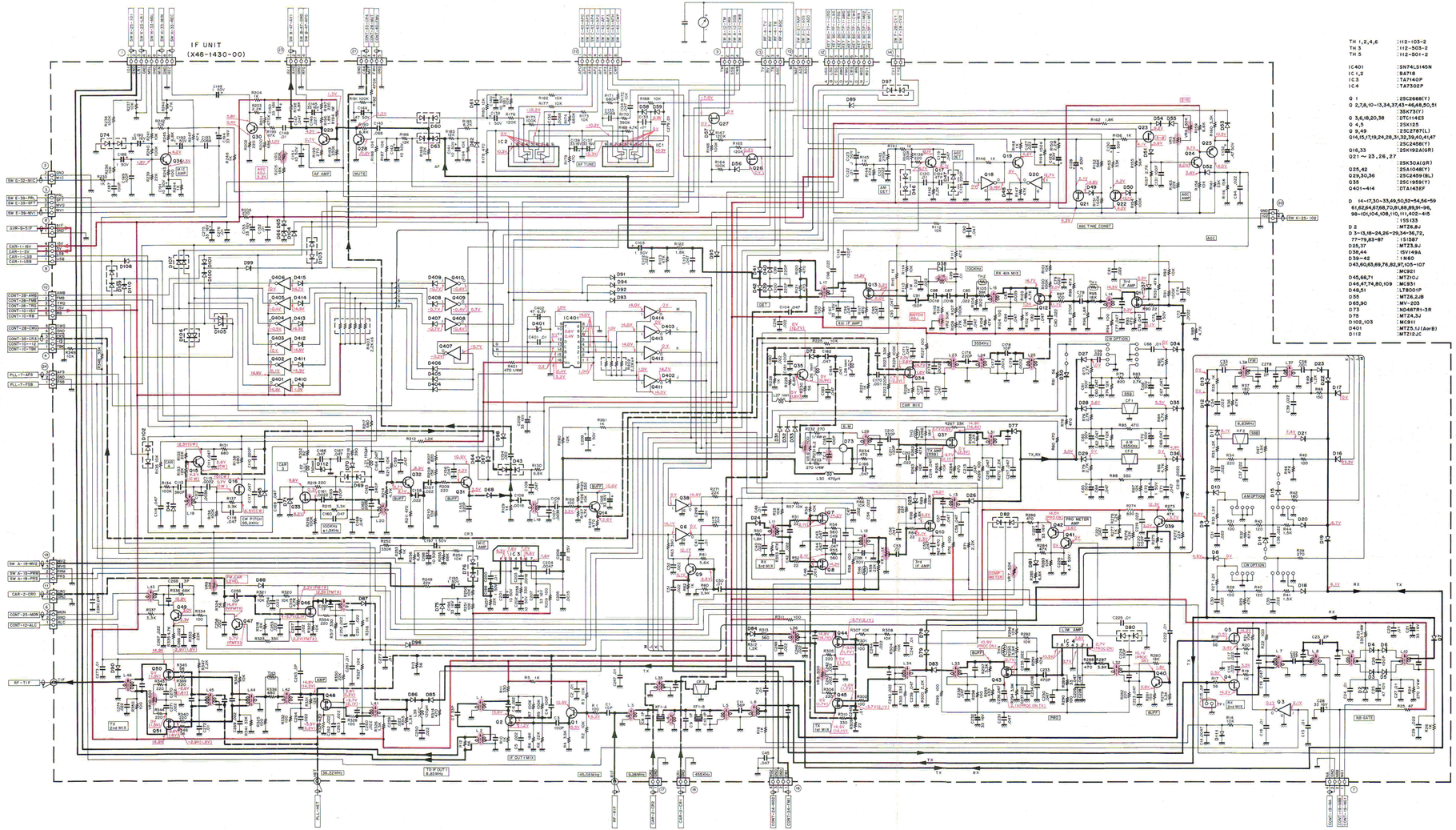




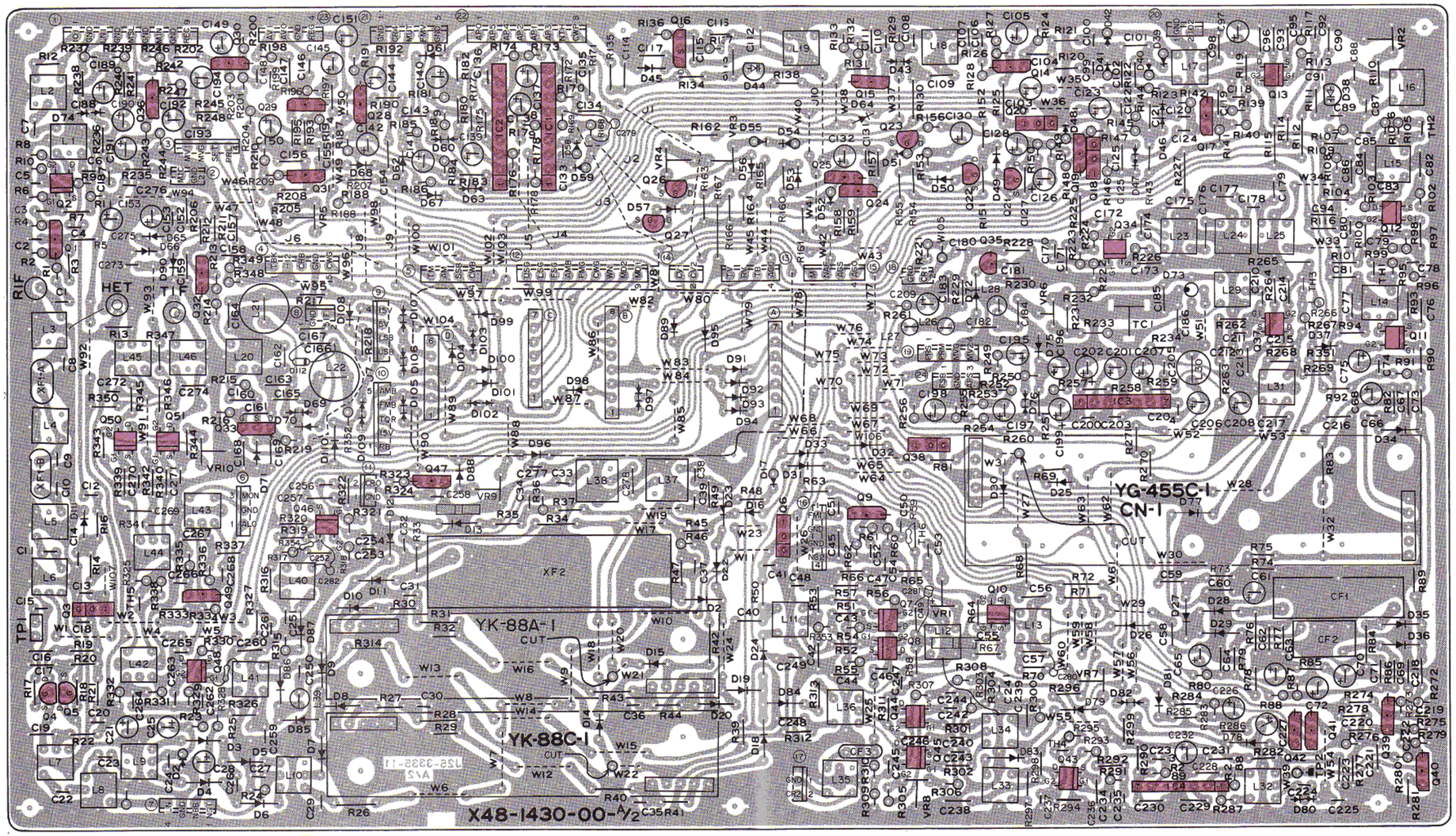


[Attachment method of XF 1-A, B]

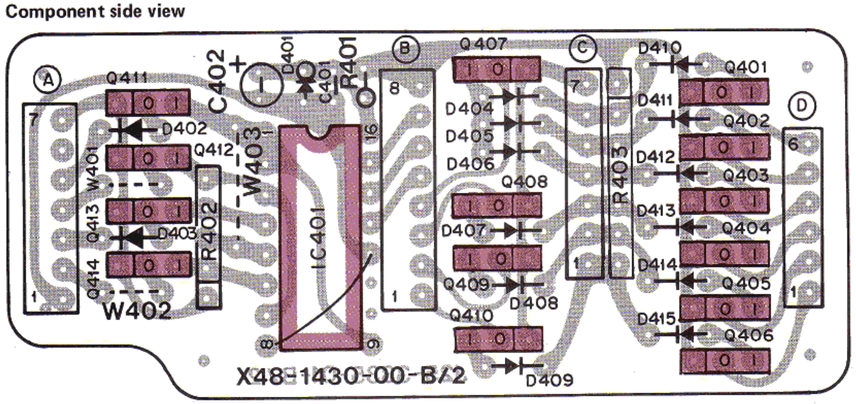




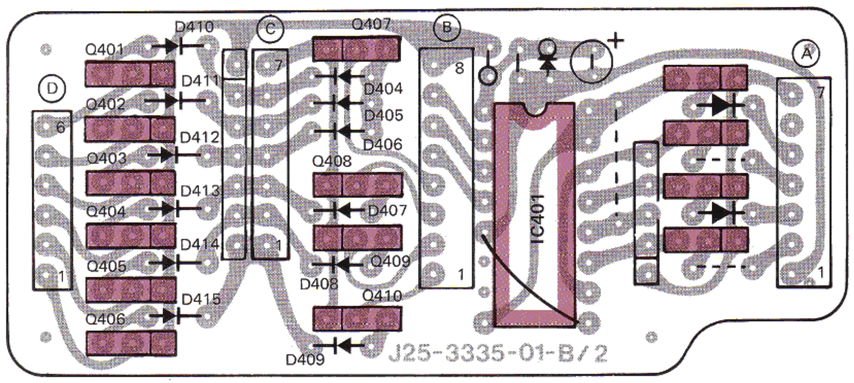
IF UNIT (X48-1430-00) Component side view



Component side view

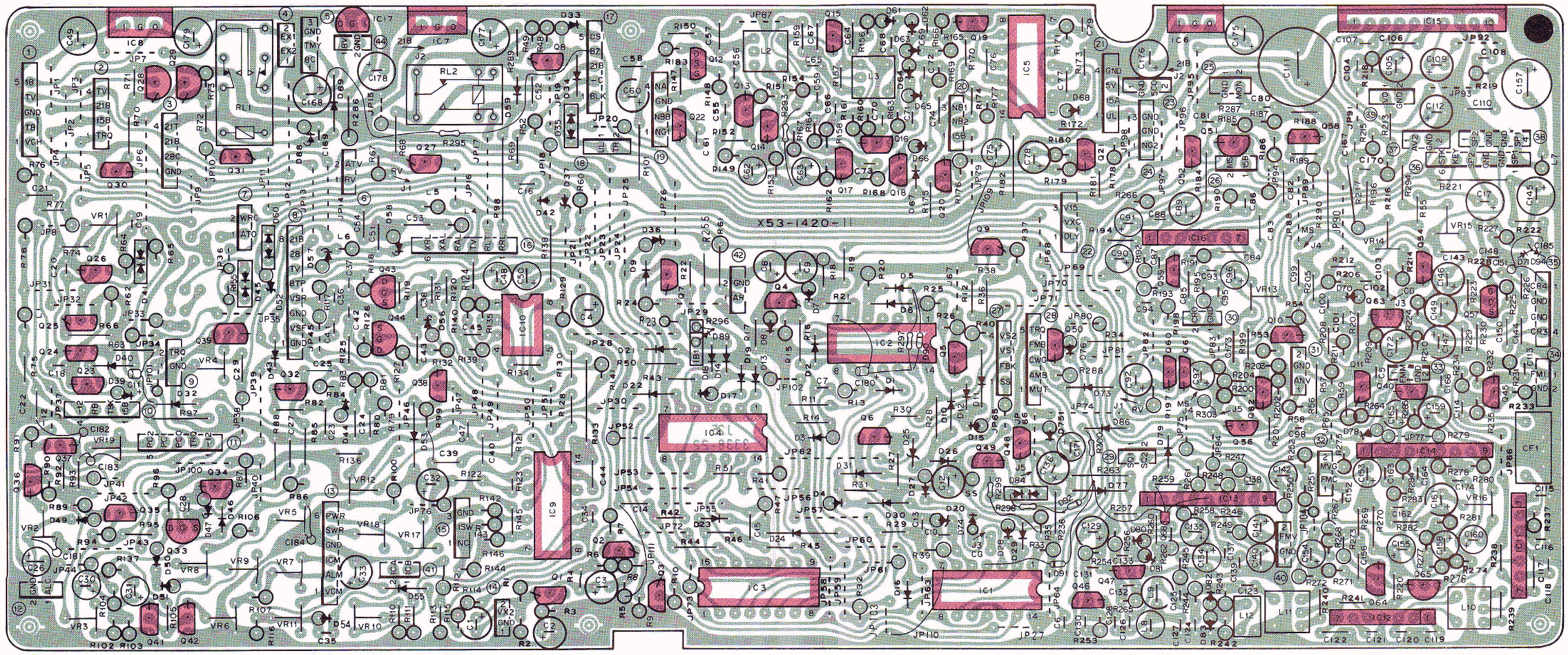


Foil side view

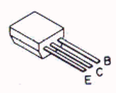


TS-940S PC BOARD VIEW

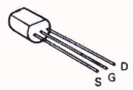
CONTROL UNIT (X53-1420-11) Component side view



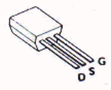
2SA1048
2SA984K
2SC2458
2SC2459



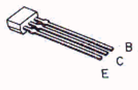
2SK30A



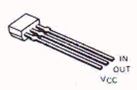
2SK192A



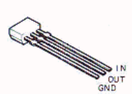
2SC2787



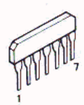
DTA143XS



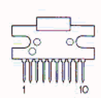
DTC124ES
DTC144WS



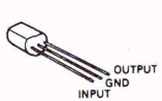
μPC1037H
μPC577H



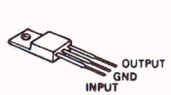
HA1368



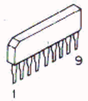
TA78L008AP



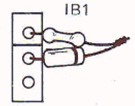
μA7818UC
μPC7815H



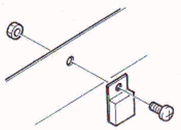
NJM4558S



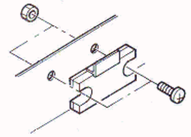
[Attachment method of R296, D89]



[Attachment method of IC6–7]



[Attachment method of IC15]

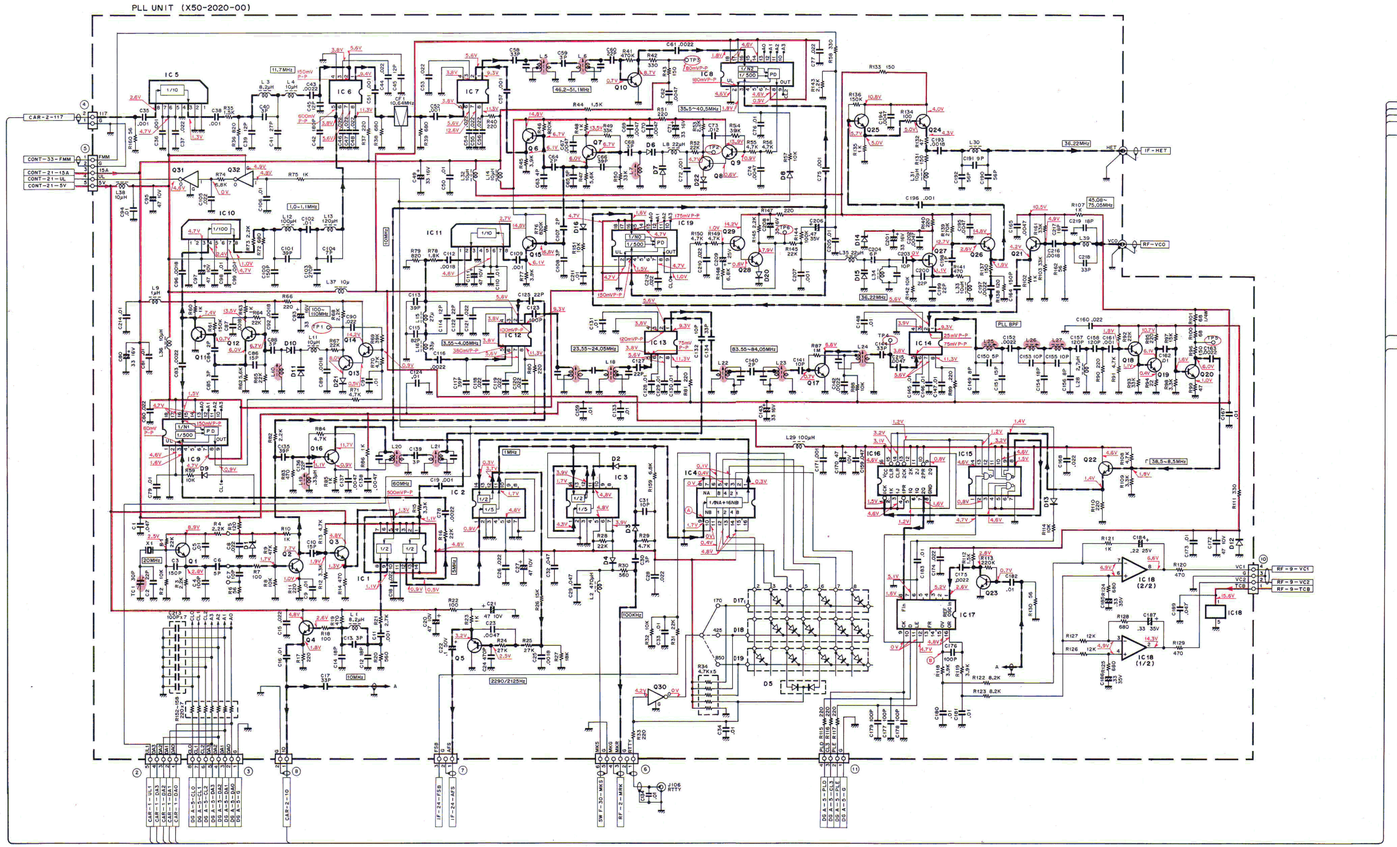


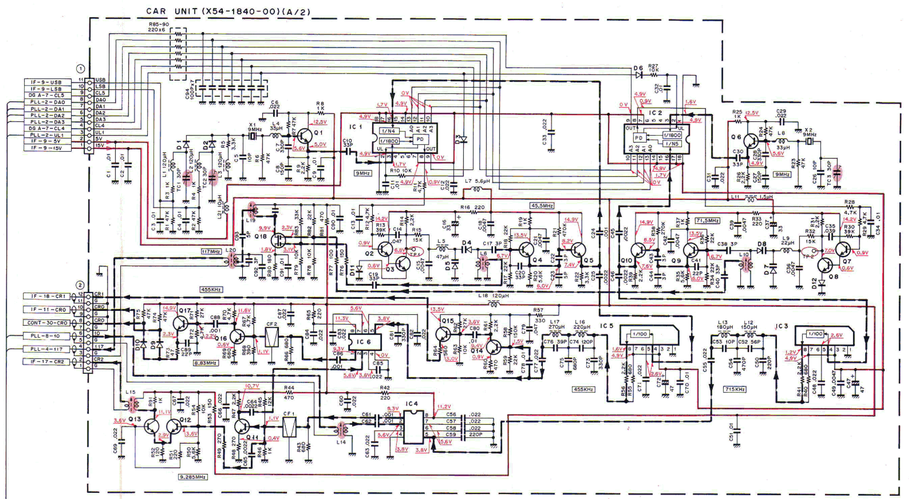
Q 1	: 2SC2459(BL)
Q 2,3,5~11,17~21,24,26,32,34~38,41,42,46, 47,63	: 2SC2458(Y)
Q 4,23,25,27,28,59	: 2SA1048(Y)
Q 12,57	: 2SK192A(GR)XJ
Q 13~16,45,58	: 2SC2787(L)
Q 22,51,54	: DTA143X5
Q 28,29	: 2SA984K(E)
Q 30,31,40,52	: DTC144WS
Q 33,43,44	: 2SK30A(C)
Q 39,48~50,56,60,61, 68	: DTC124ES
Q 62,64,65	: 2SC2459(BL)

IC 1	: TC4001BP
IC 2,5	: TC4011BP
IC 3	: TC4049BP
IC 4	: TC4073BP
IC 6,7	: μPC7815H
IC 8	: UA7818UC
IC 9	: MB3614
IC 10	: NJM2903D
IC 11,12	: μPC577H
IC 13,14	: NJM4558S
IC 15	: HA1368
IC 16	: μPC1037H
IC 17	: TA78L008AP

D 1~19,21~24,26~34,36,39,40,43,44,46,50,53,56, 58,59,66~70,73~77,79~81,85,86,88~92	: 1SS133
D 20	: MTZ12JC
D 25	: MTZ9.1JC
D 35,60	: MC911
D 37	: MTZ10JC
D 41,45,84	: MC921
D 42	: MV-203
D 47	: MTZ3.6JB
D 49,63	: LT8001P
D 50	: MTZ11JC
D 51	: MTZ5.6JA
D 52	: MTZ12J
D 54	: MTZ20JC
D 55	: 1S599
D 57	: 5V03YS
D 61,62,64,65,78,82,83	: 1N60
D 71,94	: 1S1587

TS-940S CIRCUIT DIAGRAM

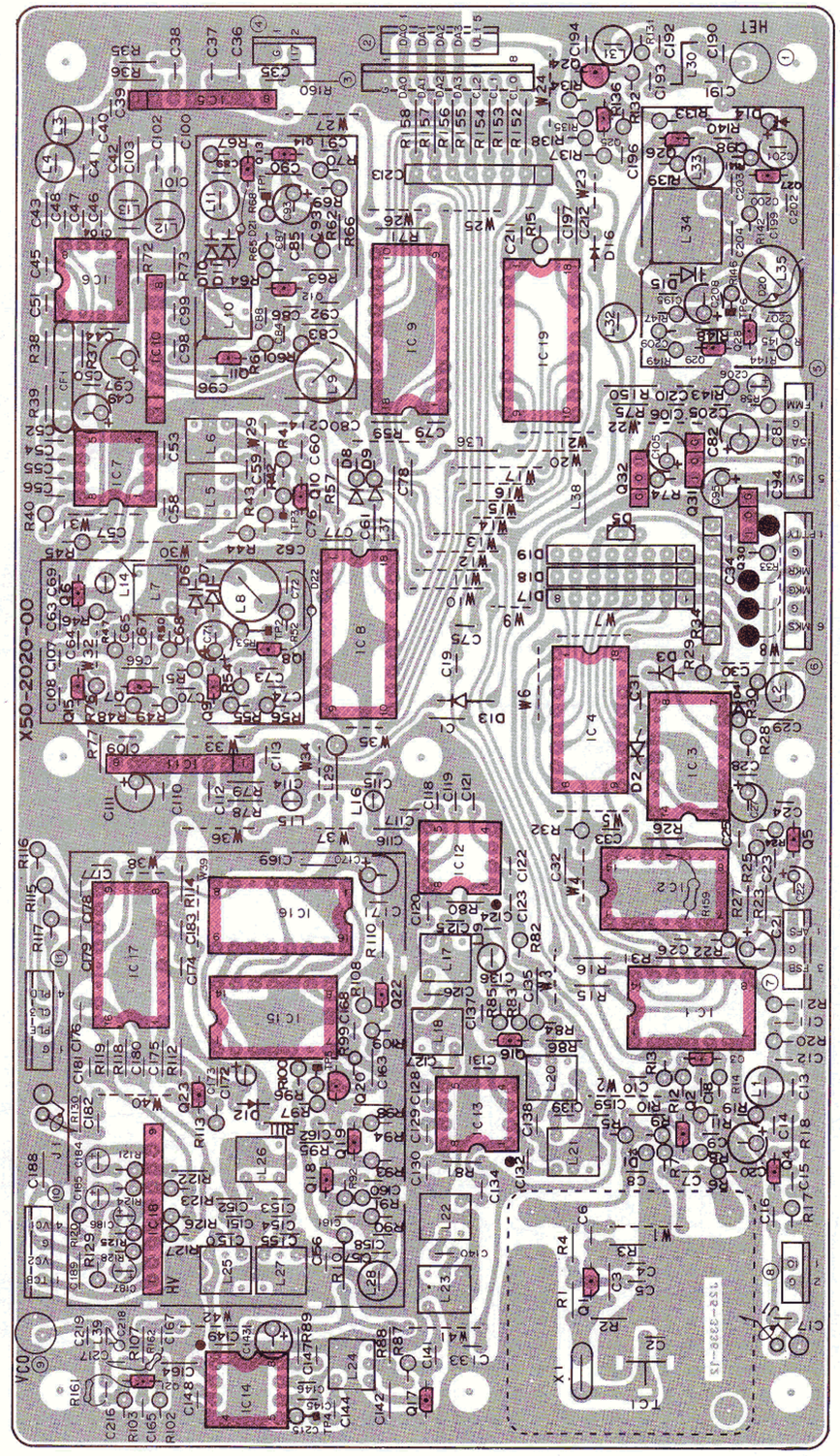




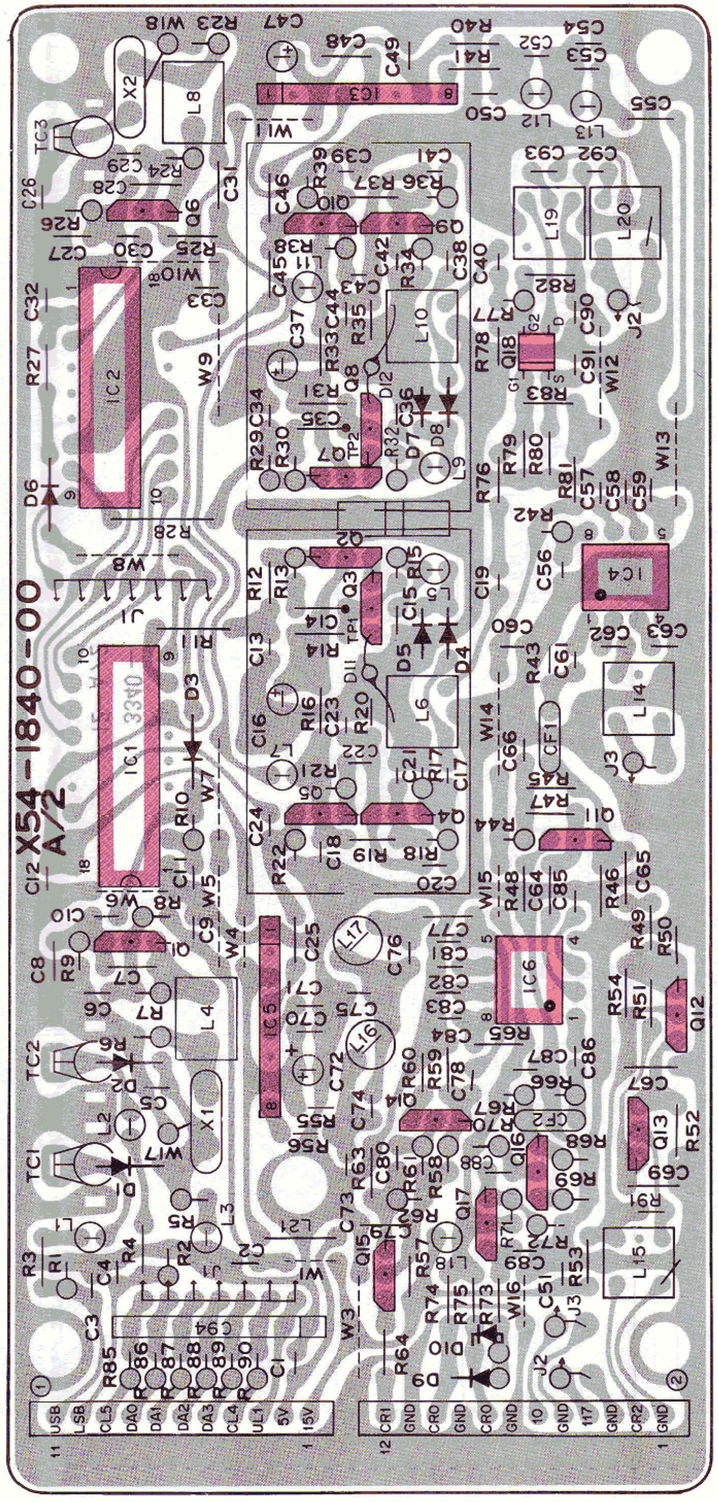
IC 1	: SN74LS73AN	Q 1,6,7,10-15,17-19,21-23,		D 1,14	: MTZ12J
IC 2,3	: SN74LS90N	25,26	: 2SC2668(Y)	D 2-4,8,9,13,16	: 1SS133
IC 4	: MC14569BCP	Q 2-4,16	: 2SC2787(L)	D 5	: MC921
IC 5,11	: HD10551	Q 5	: 2SA1115(E)	D 6,7,10,11,15	: 1SV123
IC 6,7,12-14	: SN16913P	Q 8,9,13,14	: 2SA1313(B)	D 12	: MTZ5.1J(A,B)
IC 8,9,19	: MN6147	Q 20,24	: 2SC1907	D 17	: R90-0583-05
IC 10	: M54459L	Q 27	: 2SK192A(GR)※J	D 18	: R90-0582-05
IC 15	: SN74S10N	Q 28,29	: 2SC2459(BL)	D 19	: R90-0581-05
IC 16	: SN74S112N	Q 30,31	: DTC124ES	D 20,21,22	: MV-203
IC 17	: MC14515BP	Q 32	: DTA124ES		
IC 18	: BA718				

IC 1,2	: MN6147	D 1-3,6,9,10	: 1S1587		
IC 3,5	: M54459L	D 4,5,7,8	: 1SV123		
IC 4,6	: SN16913P	D 11,12	: MV-203		
Q 1,6,11,16	: 2SC2787(L)				
Q 2,3,7,8	: 2SC3113(B)				
Q 4,5,9,10	: 2SC2668(Y)				
Q 12-15,17	: 2SC2458(Y)				
Q 18	: 3SK73(GR)				

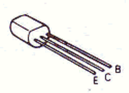
PLL UNIT (X50-2020-00) Component side view



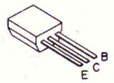
CAR UNIT (X54-1840-00) (A/2) Component side view



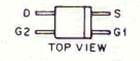
2SC1907



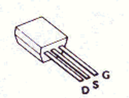
2SC2458
2SC2459
2SC2668
2SC3113



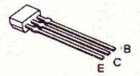
3SK73



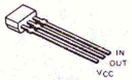
2SK192A



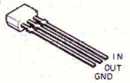
2SC2787



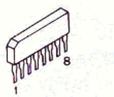
DTA124ES



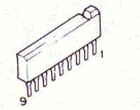
DTC124ES



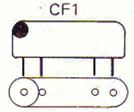
HD10551
M54459L



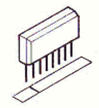
BA718



PLL unit
[Attachment direction of CF1]



CAR unit
[Attachment direction of IC3–5]



CIRCUIT DIAGRAM TS-940S

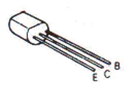
AT UNIT (X57-1130-00) (A/3)

AT UNIT (X57-1130-00) (B/3)

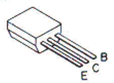
AT UNIT (X57-1130-00) (C/3)

IC 101	: HD10116	Q 101,102,123	: 2SA1048(Y)	D 101,102	: 1N60
IC 102	: HD10131	Q 103,108,110,115	: 2SA950(Y)	D 103~106	: 1SS99
IC 103	: HD10125	Q 105,106,112,113	: 2SC2120(Y)	D 112	: 1N4448
IC 104	: NJM2901	Q 118	: 2SA966(O)	D 107~111,113,114, 116~118	: 1SS133
IC 105	: NJM2904D	Q 119	: 2SA984K(E)		
IC 106	: NE555P	Q 104,107,109,111,114, 117,120,121	: 2SC2458(Y)	D 115	: MTZ20J
IC 201	: μPC7805H	Q 116,122,124~126	: DTC124ES	D 119,201,202,210	: LT8001P
IC 202	: μPC78L08A			D 203~206,208,209	: 1SS133
IC 203	: μPC7812H	Q 201	: 2SA1015(Y)	D 207	: MTZ10J(A,B)
IC 204	: NE556N	Q 202,203	: DTC124ES	D 211	: MTZ11JC
IC 205	: TC4027BP				
IC 206	: TC4011BP	Q 1~6	: 2SA1015(Y)	D 1~8	: 1N4448
IC 207	: TC4001BP	Q 9~13	: DTC124ES	D 9,15~26	: 1SS133
IC 208	: MC14077BCP	Q 7	: DTC114ES	D 10	: MTZ5.6JB
				D 11~14	: MTZ10J(A,B)
IC 1	: SN74LS145N			D 27	: MTZ16J(A,B)

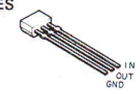
2SA1015
2SA950
2SA966
2SA984K
2SC2120



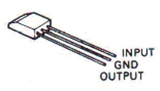
2SA1048
2SC2458



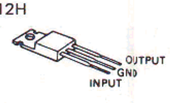
DTC114ES
DTC124ES



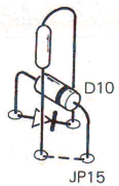
μPC78L08A



μPC7805H
μPC7812H

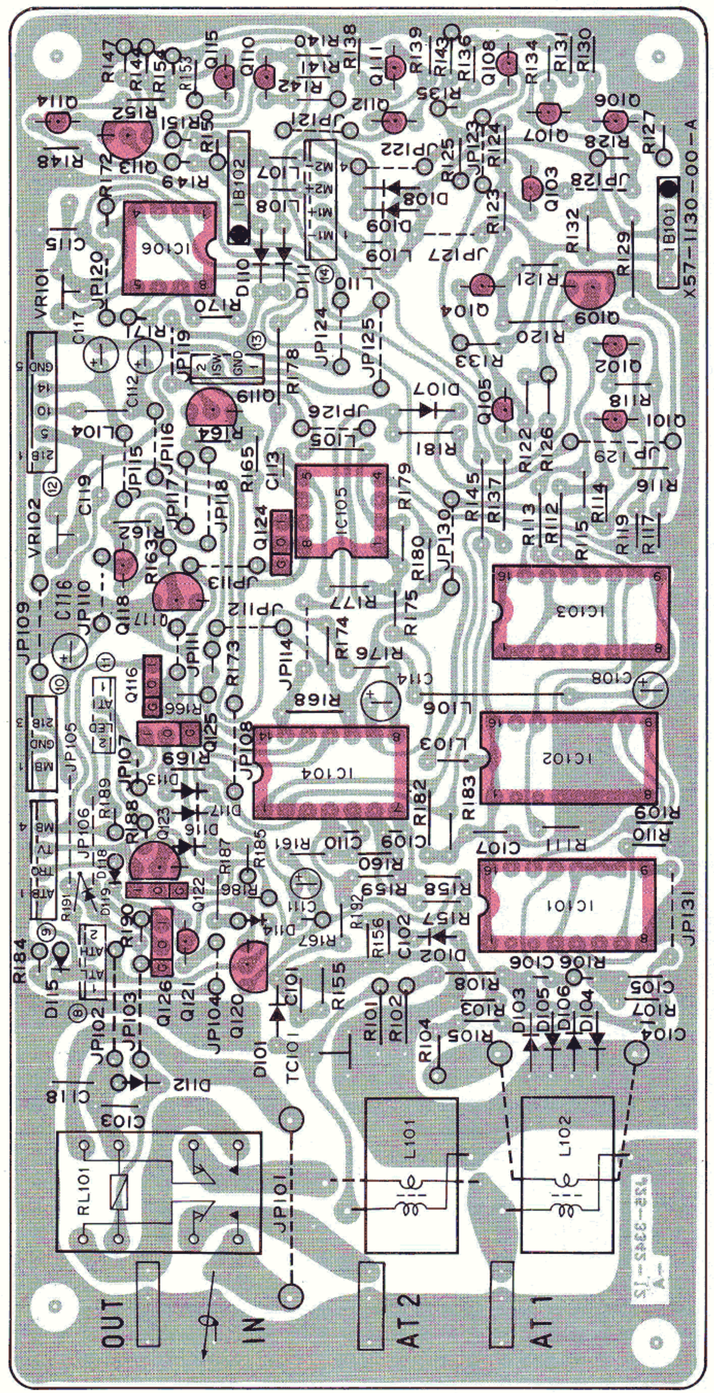


[Attachment method of JP15, D10]

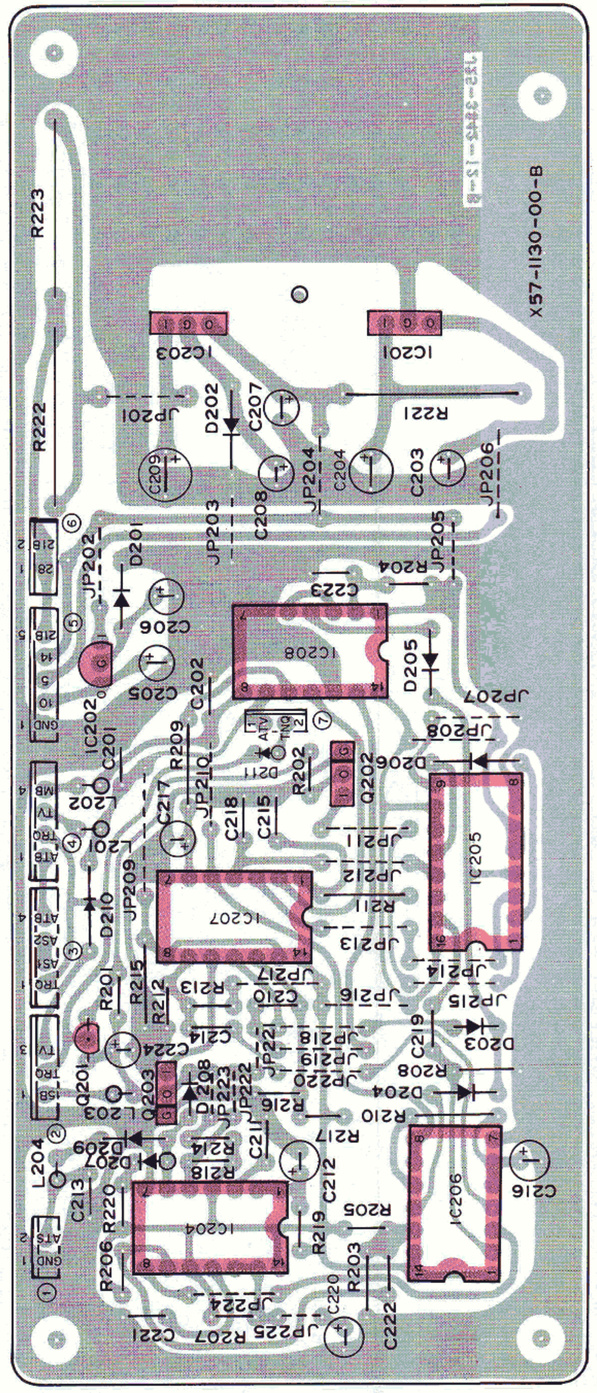


TS-940S PC BOARD VIEWS

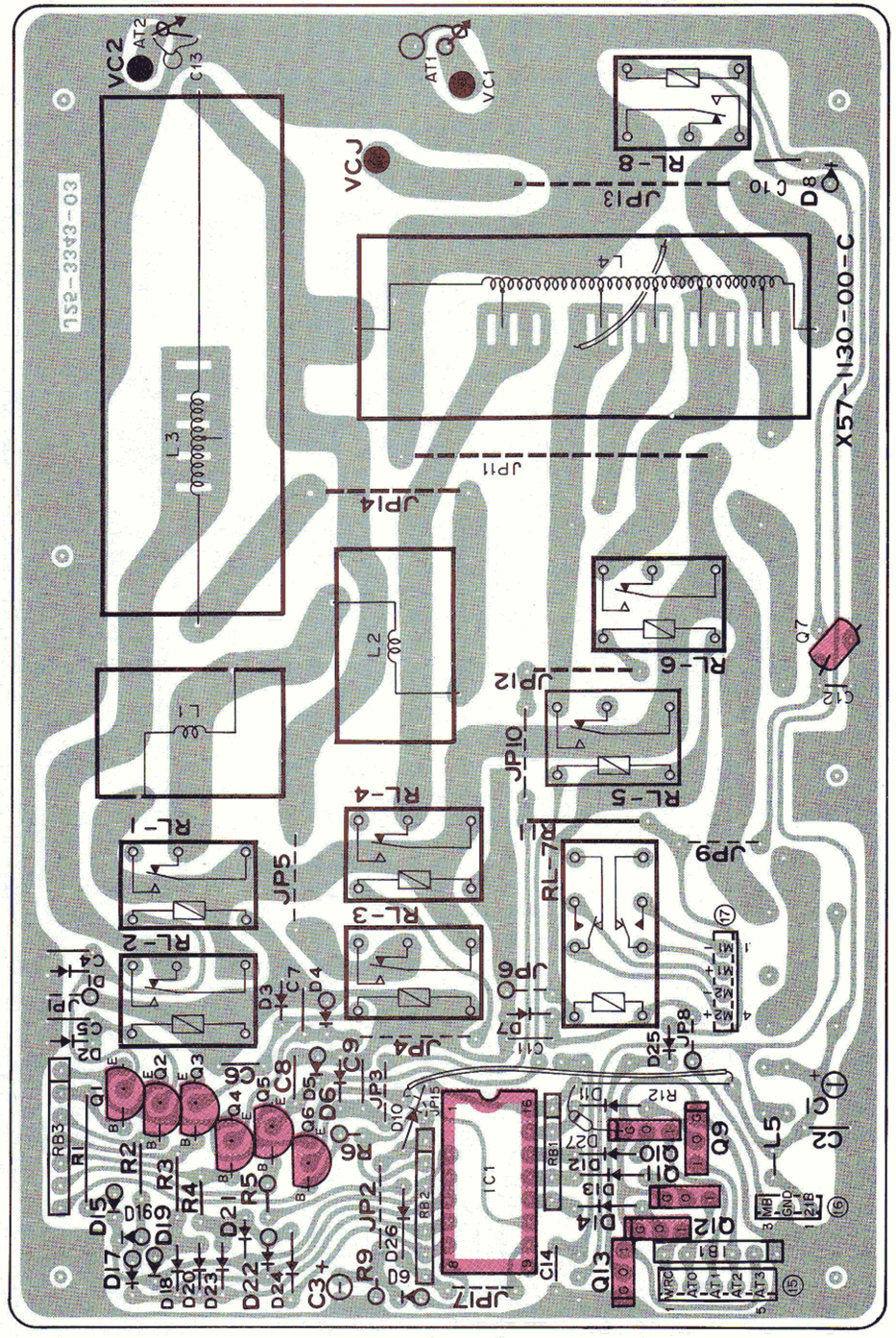
AT UNIT (A) (X57-1130-00) Component side view



AT UNIT (B) (X57-1130-00) Component side view



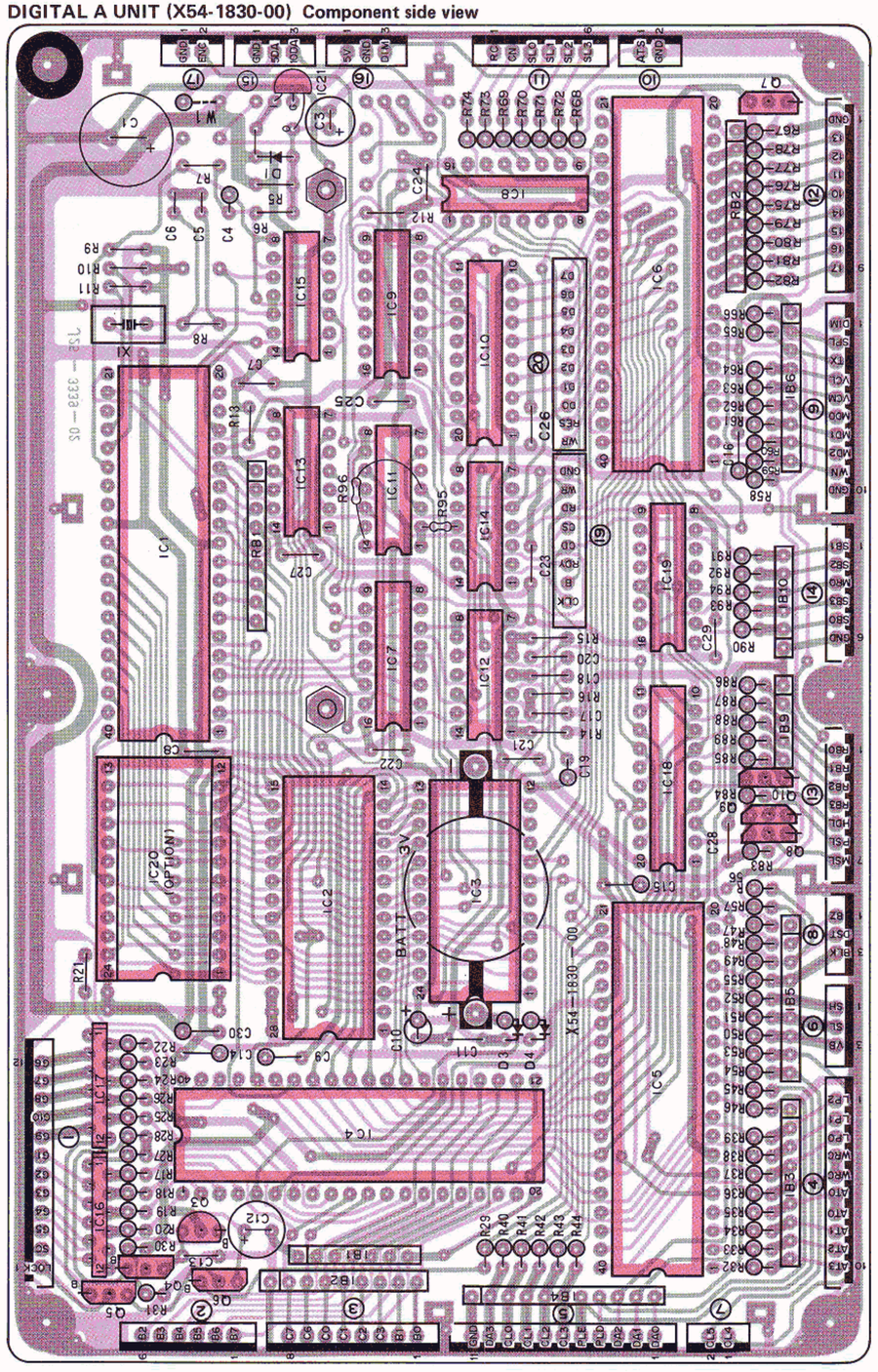
AT UNIT (C) (X57-1130-00) Component side view



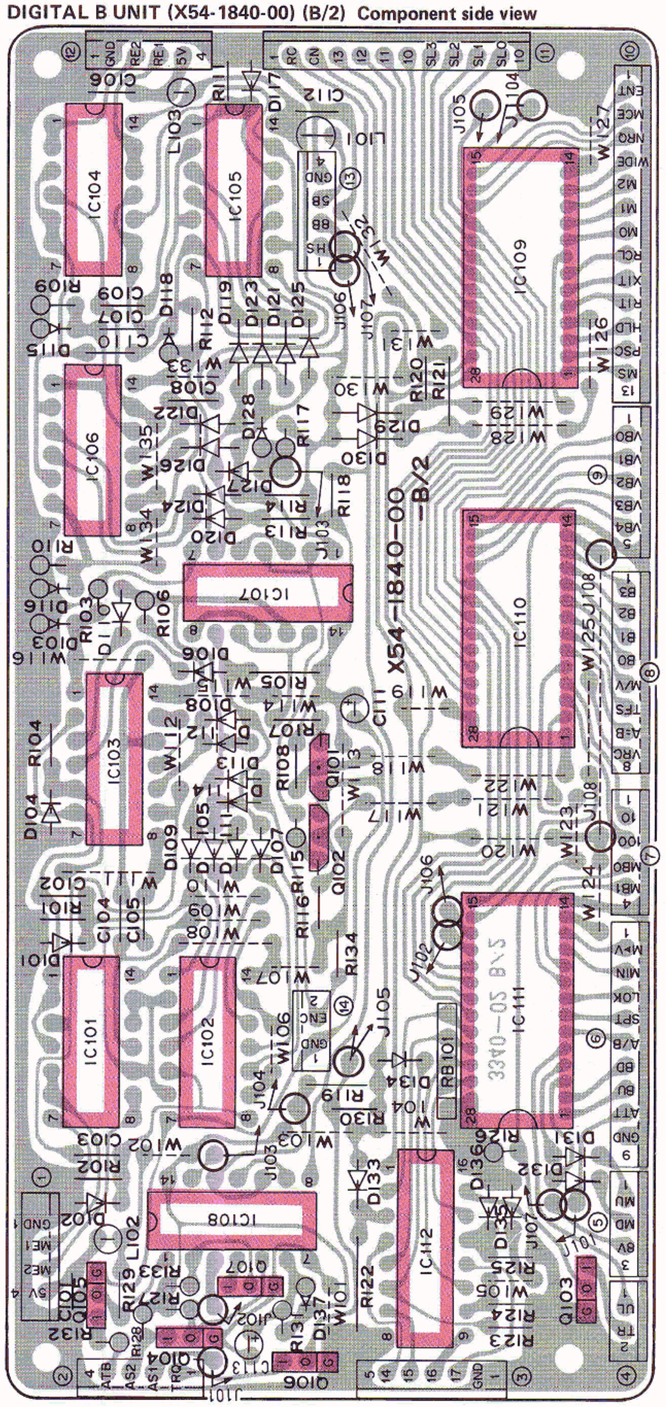
TS-940S PC BOARD VIEWS

Component side Foil side

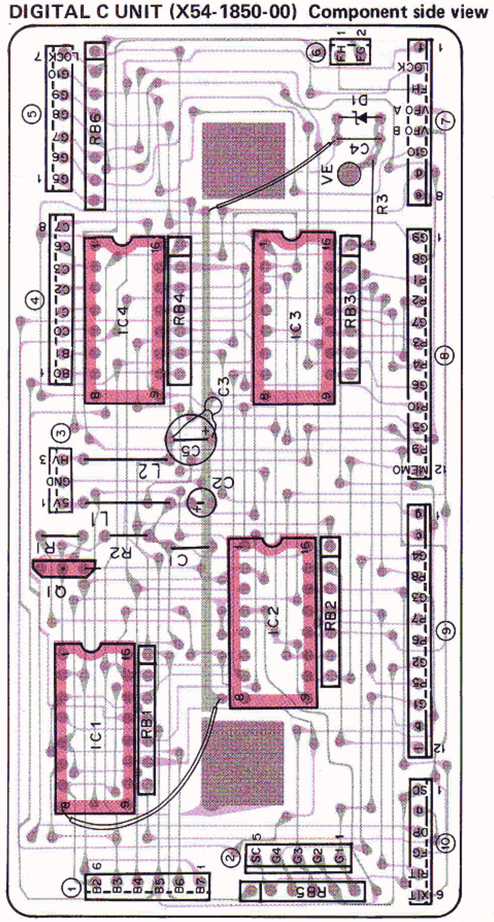
DIGITAL A UNIT (X54-1830-00) Component side view



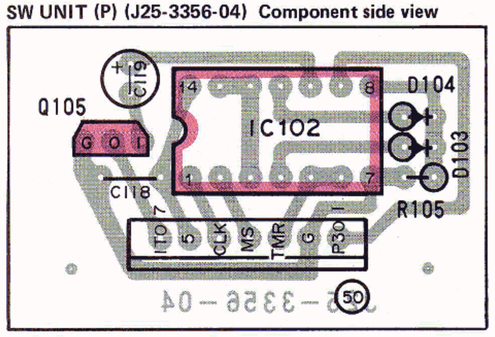
DIGITAL B UNIT (X54-1840-00) (B/2) Component side view



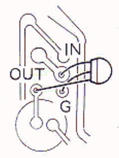
DIGITAL C UNIT (X54-1850-00) Component side view

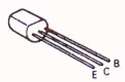


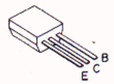
SW UNIT (P) (J25-3356-04) Component side view

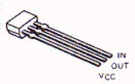


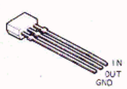
DIGITAL A unit
[Attachment direction of IC21]

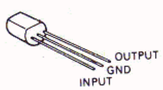


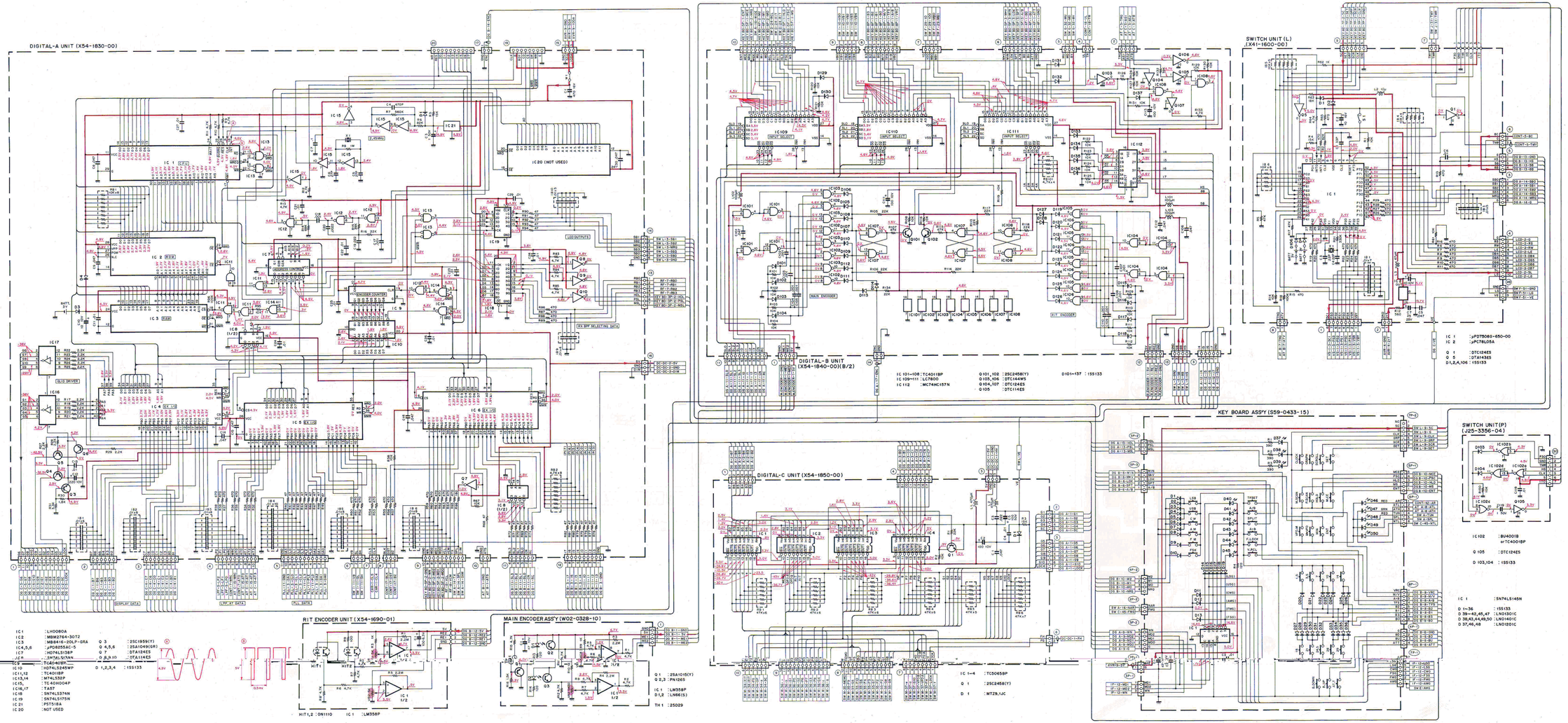
2SC1959 

2SA1049
2SC2458 

DTA114ES
DTA124ES 

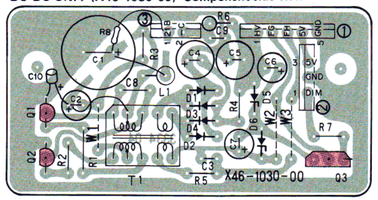
DTC114ES
DTC124ES
DTC144ES 

PST518A 

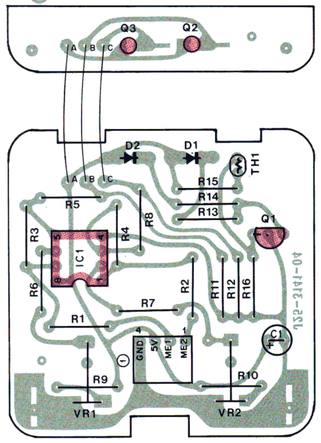

DIGITAL-A UNIT (X54-1830-00)
DIGITAL-B UNIT (X54-1840-00)(B/2)
DIGITAL-C UNIT (X54-1850-00)
SWITCH UNIT (L) (X41-1600-00)
SWITCH UNIT (P) (J25-3356-04)
KEY BOARD ASSY (S59-0433-15)
RIT ENCODER UNIT (X54-1690-01)
MAIN ENCODER ASS'Y (W02-0328-10)
IC 1 : LH0080A
IC 2 : MB8264-30T2
IC 3 : MB8416-20LP-GRA
IC 4,5,6 : μPD8255AC-5
IC 7 : HD74LS138P
IC 8 : SN74ALS174N
IC 9 : TC40H018P
IC 10 : HD74LS245WP
IC 11,12 : TC4011BP
IC 13,14 : M74LS32P
IC 15, : TC 40H004P
IC16,17 : TA57
IC 18 : SN74LS374N
IC 19 : SN74LS175N
IC 21 : PST518A
IC 20 : NOT USED
Q 3 : 2SC1959(Y)
Q 4,5,6 : 2SA1049(GR)
Q 7 : DTA124ES
Q 8,9,10 : DTA114ES
D 1,2,3,4 : 1SS133
IC 101-108 : TC4011BP
IC 109-111 : LC7800
IC 112 : MC74HC157N
Q 101, 102 : 2SC2458(Y)
Q 103, 106 : DTC144WS
Q 104,107 : DTC124ES
Q 105 : DTC114ES
D101-137 : 1SS133
IC 1 : μPD75083-650-00
IC 2 : μPC78L05A
Q 1 : DTC124ES
Q 2 : DTA143ES
D 1,2,4,106 : 1SS133
IC 1-4 : TC5065BP
Q 1 : 2SC2458(Y)
D 1 : MTZ9.1JC
IC 102 : BU4001B
: μTC4001BP
Q 105 : DTC124ES
D 103,104 : 1SS133
IC 1 : SN74LS145N
D 1~36 : 1SS133
D 39~42,45,47 : LN013O1C
D 38,43,44,48,50 : LN014O1C
D 37,46,48 : LN012O1C
Q 1 : 2SA1015(Y)
Q 2,3 : PN1265
IC 1 : LM358P
D 1,2 : LN961G
TH 1 : 25029
HIT 1,2 : DN1110
IC 1 : LM358P

TS-940S PC BOARD VIEWS

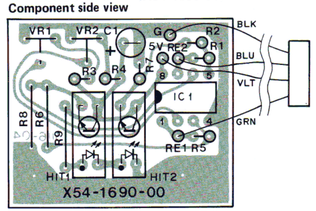
DC-DC UNIT (X46-1030-00) Component side view



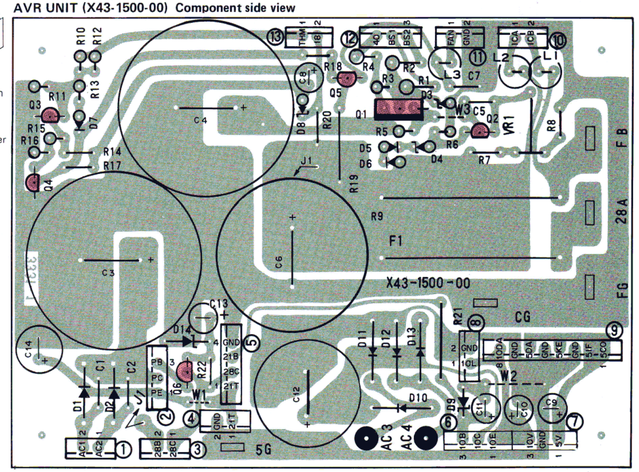
MAIN ENCODER ASS'Y (W02-0328-10)
Component side view



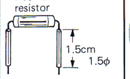
RIT ENCODER UNIT (X54-1690-01)
Component side view



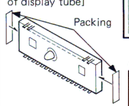
AVR UNIT (X43-1500-00) Component side view



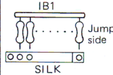
AVR unit
[Attachment method of F1 and R9]



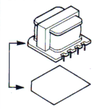
SW unit
[Attachment method of display tube]



SW unit
[Attachment direction of IB1]



DC-DC unit
[Attachment method of T1]



2SA1015
2SC1959
2SC2235
2SC2274K

2SA1048
2SC2458

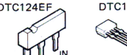
2SB861

PN126S

μPC78L05A

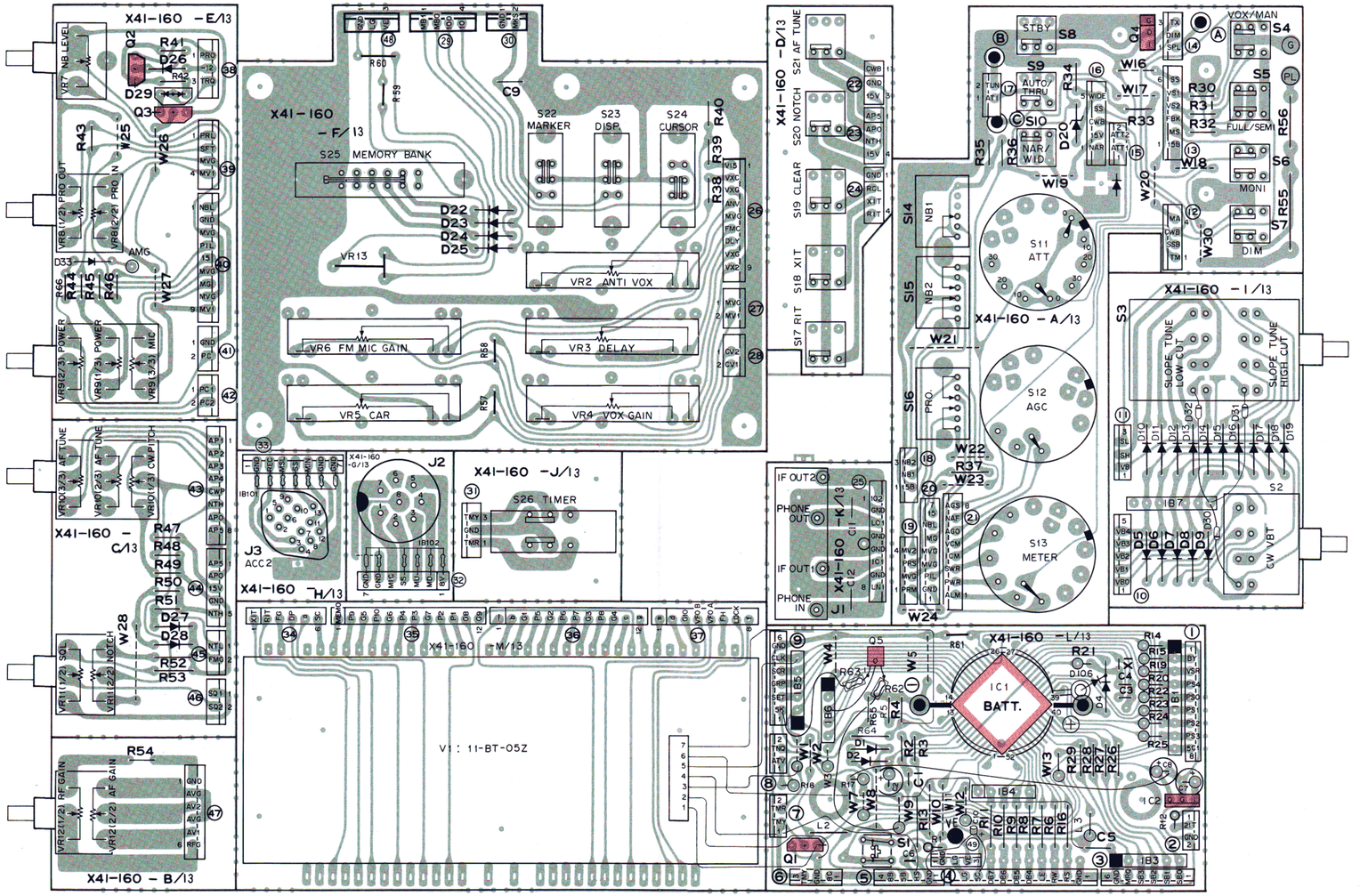
DTA143ES

DTC124EF



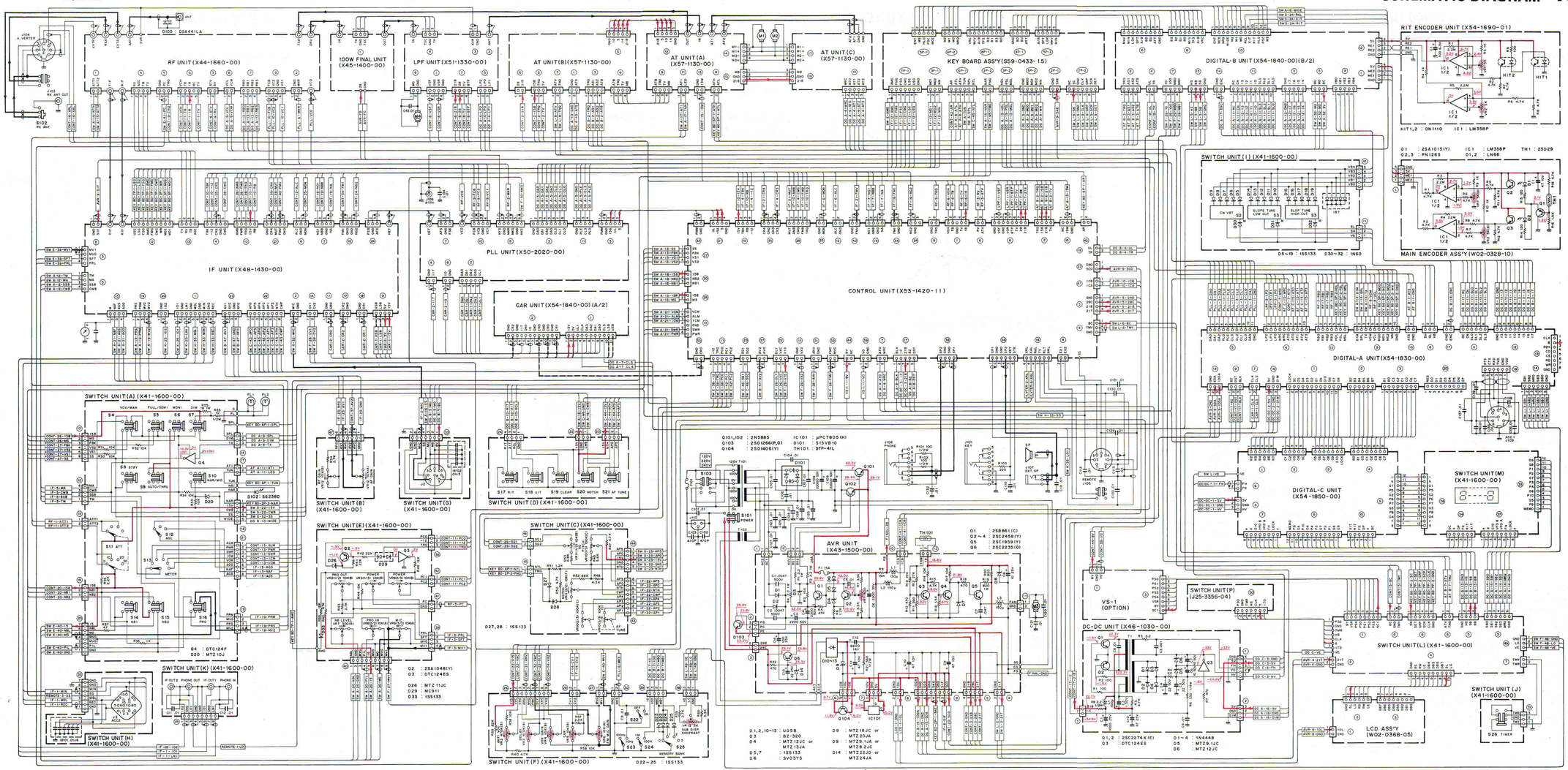
DTC124ES

SW UNIT (X41-1600-00) Component side view



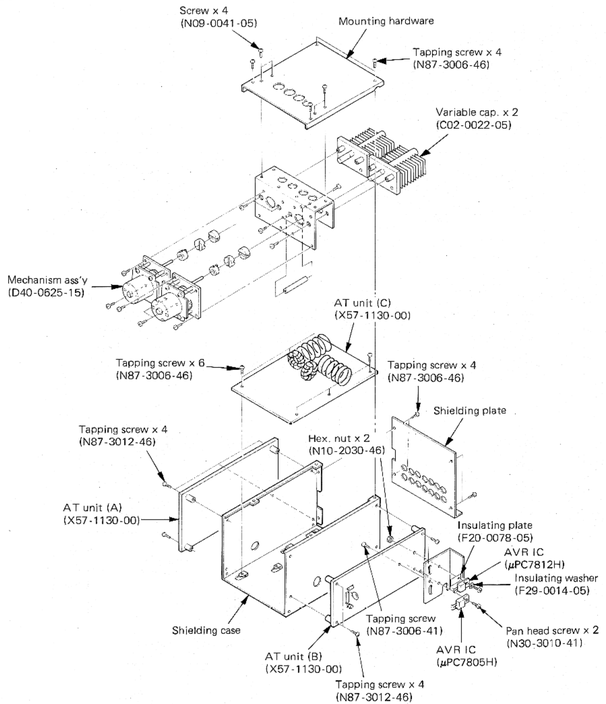
Signal line — Control line — Common DC line

Voltage measurement conditions f=14.150MHz, RX no signal, ( ) : TX.



AT-940 (ANTENNA TUNER)

DISASSEMBLY

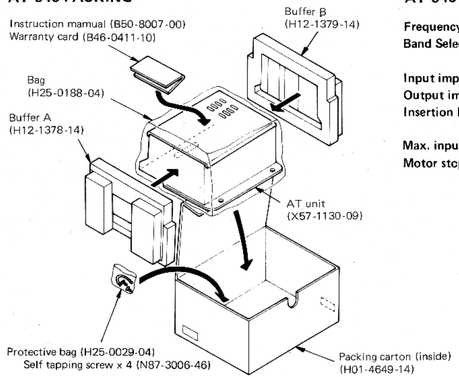


PARTS LIST

PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
B46-0415-00	*	WARRANTY CARD K	1	
B50-8007-00	N	INSTRUCTION MANUAL	1	
H01-4649-14	N	CARTON(INSIDE)	1	
H12-1378-14	N	BUFFER(A)	1	
H12-1379-14	N	BUFFER(B)	1	
H25-0029-04		BAG	1	
H25-0103-04		BAG	2	
H25-0588-04		BAG	1	
N87-3006-46		TAPPING SCREW M3X6	4	
N87-3012-46		TAPPING SCREW M3X12	8	
X57-1130-09	N*	AT UNIT	1	

AT-940 (ANTENNA TUNER)/SO-1 (STANDARD OSCILLATOR UNIT)

AT-940 PACKING



AT-940 SPECIFICATIONS

Frequency range:	1.8–29.7 MHz, all amateur bands
Band Selection:	Automatic, by band information from the transceiver.
Input impedance:	50 ohms, unbalanced
Output impedance:	20–150 ohms, unbalanced
Insertion loss:	Less than 1 dB at 29.7 MHz (at best match)
Max. input power:	150W
Motor stop SWR:	Less than 1.2

SO-1 SPECIFICATIONS

Oscillating frequency 20MHz
Frequency stability (long period) . . . . . $\pm 1 \times 10^{-6}$/Year
Temperature stability . . . . . $\pm 5 \times 10^{-7}$ ($-10^{\circ}C \sim +50^{\circ}C$)
Adjustable frequency range . . . . . More than ± 60Hz
Output . . . . . More then 0dBm at 50Ω
Weight 25g

SO-1 PARTS LIST

N : New parts

Parts No.	Re-marks	Description	Ref. No.
B50-3992-00	N	Instruction manual	
H25-0029-04		Protective bag	

SO-1 ADJUSTMENT

Required f-counter frequency stability (ageing rate) : Better than 2×10^{-8}/day
The f-counter must be preheated enough before use.

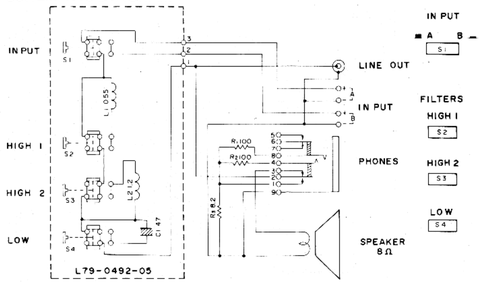
Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
Reference frequency oscillator	1) FREQ : 10,000.0kHz MODE : USB CAL : ON Connect reference signal output of the f-counter to ANT terminal.	f. counter Osillo-scope SP	Rear panel	ANT EXT.SP	SO-1 (PLL)	Poten-tiome-ter	Receive reference signal and marker signal, then adjust so that the AF audio signal becomes the same tone.	Oscilloscope wave NG OK

SP-940 (SPEAKER)

SPECIFICATIONS

Speaker used:	10 cm dia.
Rated Input:	1.5 Watts
Impedance:	8Ω
Frequency response:	160 Hz to 8kHz.
Filter cut-off frequency,	
LOW:	430Hz, –3dB.
HIGH 1:	2.3 kHz, –3dB.
HIGH 2:	1.0kHz, –3dB.
HIGH 1 + HIGH 2:	730Hz, –3dB.
Filter attenuation:	–6dB/oct.
Dimensions:	W 180 mm (7-1/16")
	H 140 mm (5-1/2")
	D 288 mm (11-1/3")
Net weight:	1.9 kg. (4.2 lbs.)
Accessories furnished:	Speaker cord, 1pc. (E14-0101-05)
	1 pin plug, 2 pcs. (E20-1610-05)

SCHEMATIC DIAGRAM

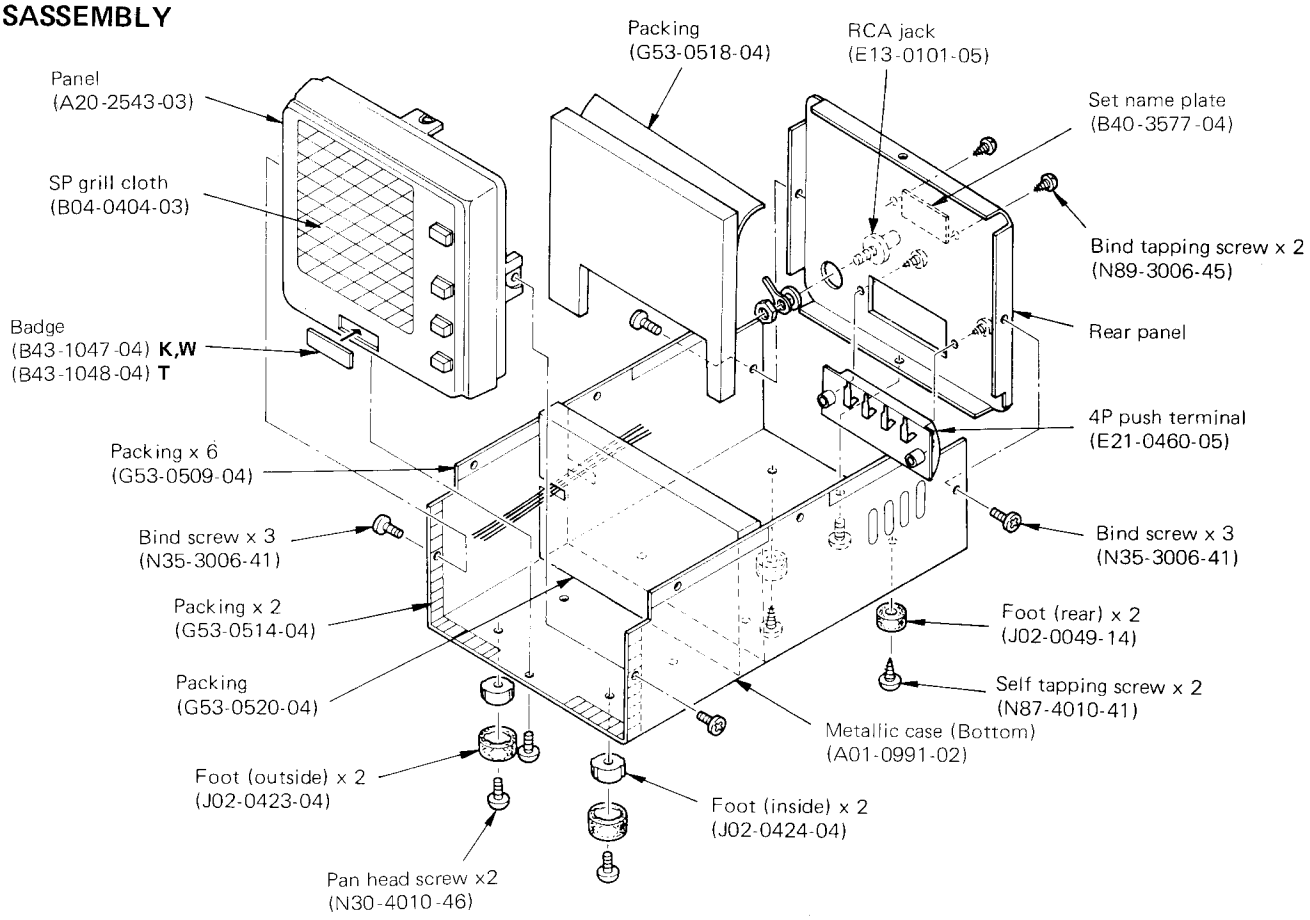


PARTS LIST

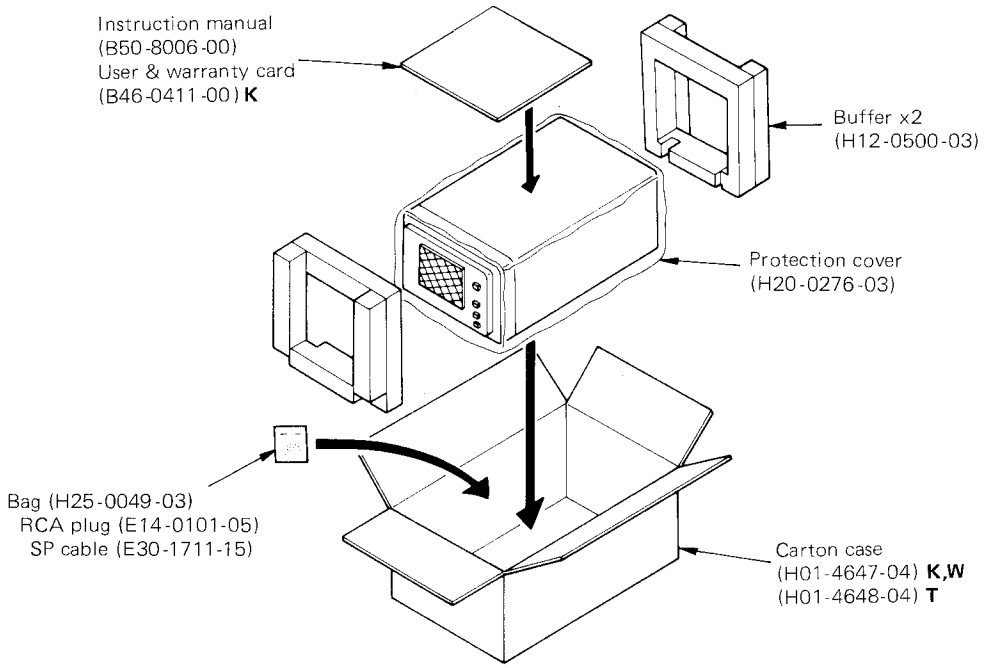
PARTS NO.	NOTE	NAME & DESCRIPTION	QTY	REFERENCE NO.
A01-0990-03	N*	METALLIC CASE UPPER	1	
A01-0991-02	N*	METALLIC CASE BOTTOM	1	
A20-2543-03	N*	PANEL	1	
B04-0404-03		SP GRILE	1	
B40-3577-04	N*	MODEL NAME PLATE	1	
B43-1047-04	N*	BADGE KENWOOD K,W	1	
B43-1048-04	N*	BADGE TRIO T	1	
B46-0431-00	*	WARRANTY CARD K	1	
B50-8006-00	N	INSTRUCTION MANUAL	1	
CE04BW1E470M		ELECTRO NONPOLE 47 25V	1	C 1
E11-0404-05		PHONE JACK	1	
E13-0101-05		RCA JACK LINE OUT	1	
E14-0101-05		RCA PLUG 1P	1	
E21-0460-05	N	PUSH TERMINAL 4P	1	
E30-1711-15	N	SP CABLE	1	
E40-0373-05		MINI CONNECTOR 3P	1	
G53-0509-04		PACKING	6	
G53-0514-04		PACKING	2	
G53-0517-04	N	PACKING	8	
G53-0518-04	N	PACKING	1	
G53-0520-04	N	PACKING	1	
H01-4647-04		CARTON CASE K,W	1	
H01-4648-04		CARTON CASE T	1	
H12-0500-03		BUFFER	2	
H20-0276-03		PROTECTION COVER	1	
H25-0049-03		BAG	1	
J02-0049-14		FOOT REAR	2	
J02-0423-04		FOOT FRONT(OUT SIDE)	2	
J02-0424-04		FOOT FRONT(IN SIDE)	2	
J61-0019-05		VINYL TIE	3	
K29-0757-04		PUSH KNOB INPUT A/B	1	
K29-0758-04		PUSH KNOB FILTER	3	
L79-0492-05		FILTER	1	
N30-4010-46		PAN HD SCREW M4X10	2	
N35-3006-41		BIND SCREW M3X6	14	
N87-3008-41		TAPPING SCREW M3X8	4	
N87-4008-46		TAPPING SCREW M4X8	4	
N87-4010-41		TAPPING SCREW M4X10	2	
N89-3006-45		BIND TAPPING SCREW M3X6	2	
N89-3008-45		BIND TAPPING SCREW M3X8	2	
RS14AB3D8R2J		METAL FILM 8.2 OHM 2W	1	R 3
S40-2436-05		PUSH SWITCH	1	
S42-3405-05		PUSH SWITCH	1	
T07-0222-05		SPEAKER	1	

SP-940 (SPEAKER)

DISASSEMBLY



PACKING



VS-1 (VOICE SYNTHESIZER UNIT)

TALK SPEED SELECTION

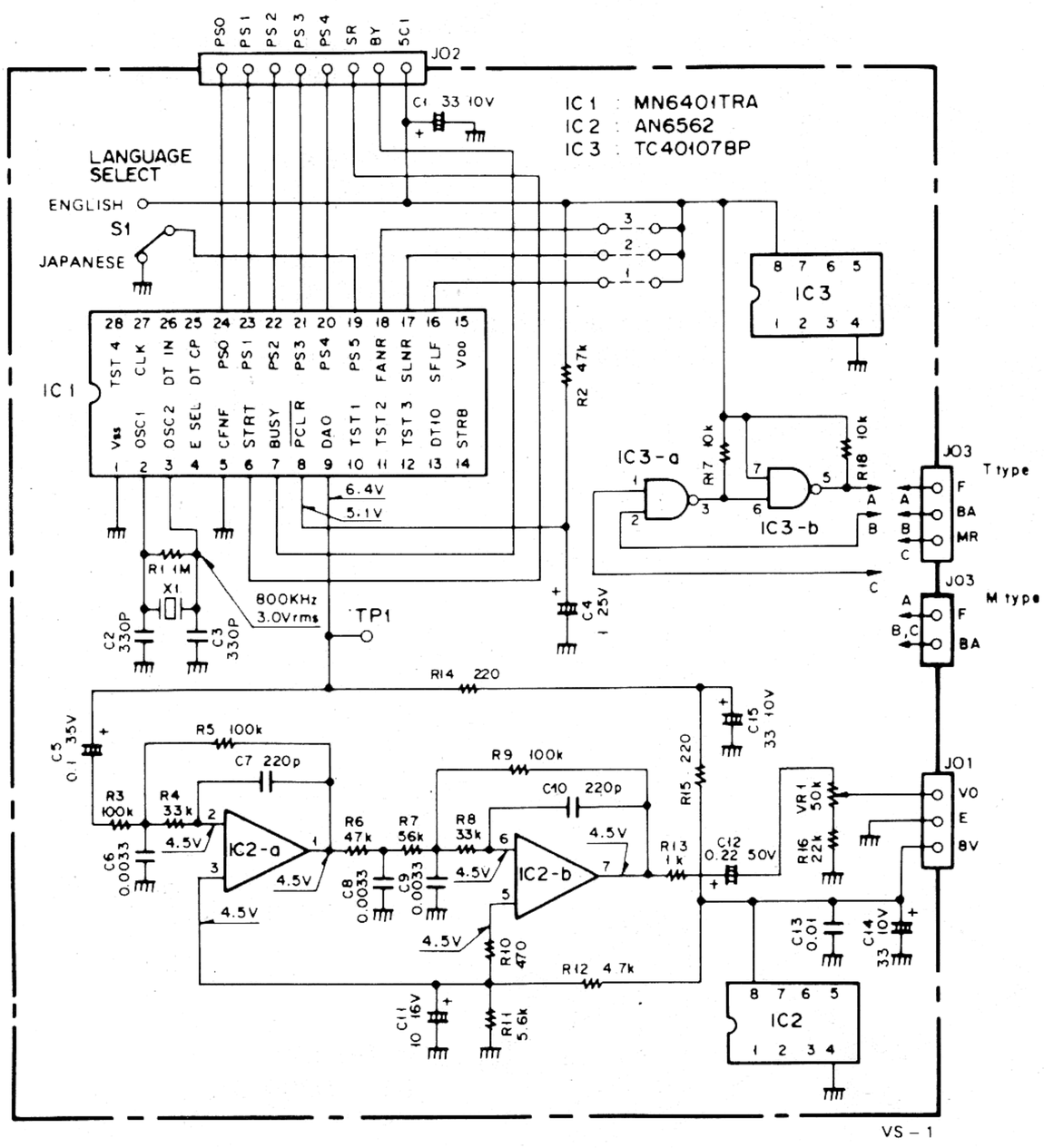
Speed is factory set at "standard" talk speed. Three different speeds can be selected.

Note: When placing the jumper, solder carefully.

Speed / Jumper place	Std. speed	30% more than Std.	60% more than Std.
1	X	X	O
2	X	X	O
3	X	O	X

Symbol O, denotes the place in which a jumper wire is placed.

SCHEMATIC DIAGRAM



PARTS LIST

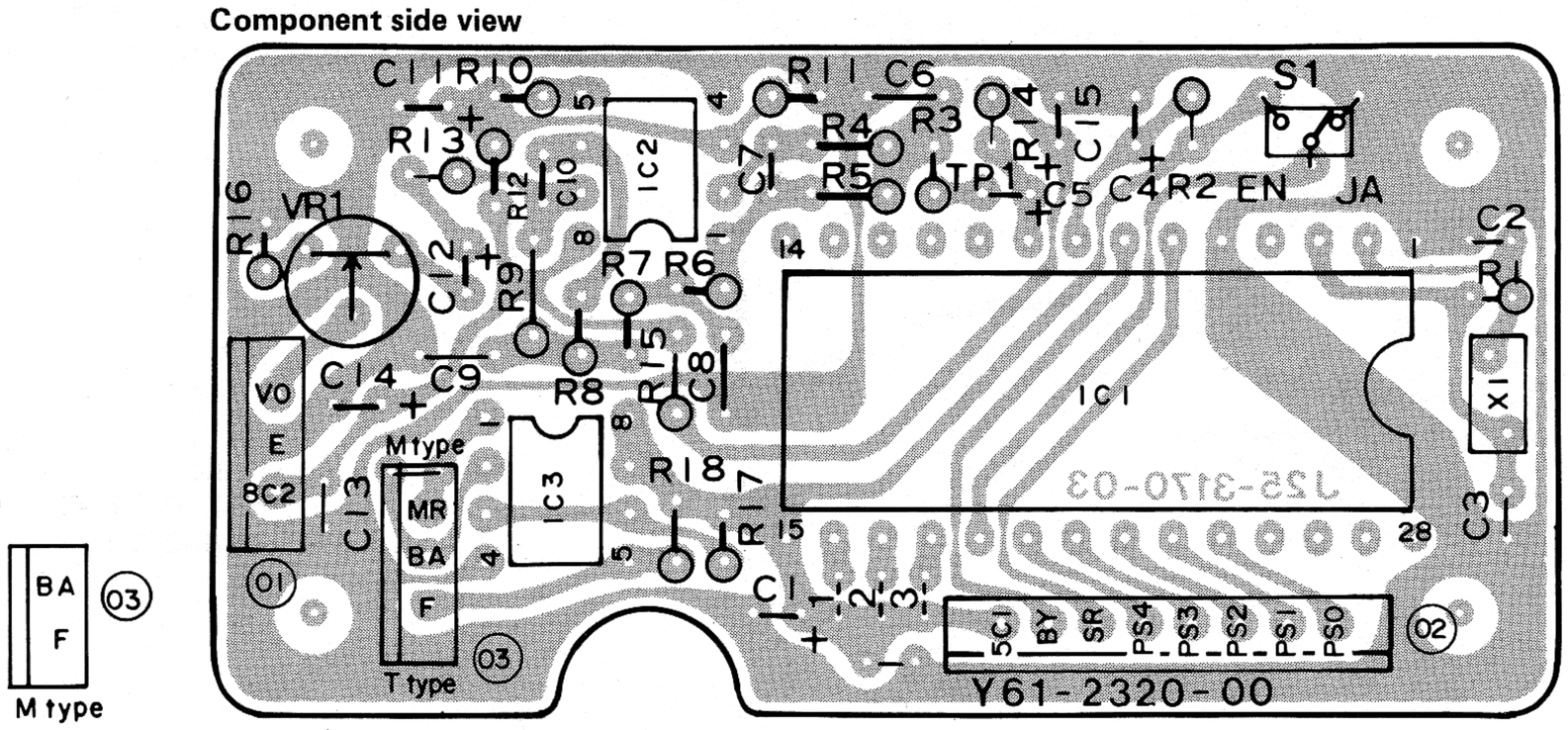
Part No.	Re-marks	Description	Ref. No.
B50-4035-00	N	Instruction manual	
CC45SL1H331J		C 330P x 2	C2,3
CE04W1A330M		E 33 10V	C1,14,15
CE04W1C100M		E 10 16V	C11
CE04W1HR22M		E 0.22 50V	C12
CK45B1H221K		C 220P x 2	C7,10
CQ92M1H332K		ML 0.0033 x 3	C6,8,9
CS15E1E010M		T 1 25V	C4
CS15E1V0R1M		T 0.1 35V	C5
C91-0131-05		C 0.01 (SP)	C13
E40-0273-05	△	Mini connector 2P **M**	
E40-0373-05	△	Mini connector 3P **M**	
E40-0373-05	△	Mini connector x 2 3P **T**	
E40-0873-05	△	Mini connector 8P	
H01-4481-03	N△	Packing carton (inside) **M**	
H01-4501-03	N△	Packing carton (inside) **T**	
H25-0029-04		Protective bag x 2	
L78-0006-05	N	Ceramic OSC	X1
N89-3006-46		Tapping screw x 4	
R12-4408-05		Trim. pot. 50kΩ	VR1
S31-1411-05	N	Slide switch	S1
AN6562	N	IC	IC2
MN6401TRA	N	IC	IC1
TC40107BP	N	IC	IC3

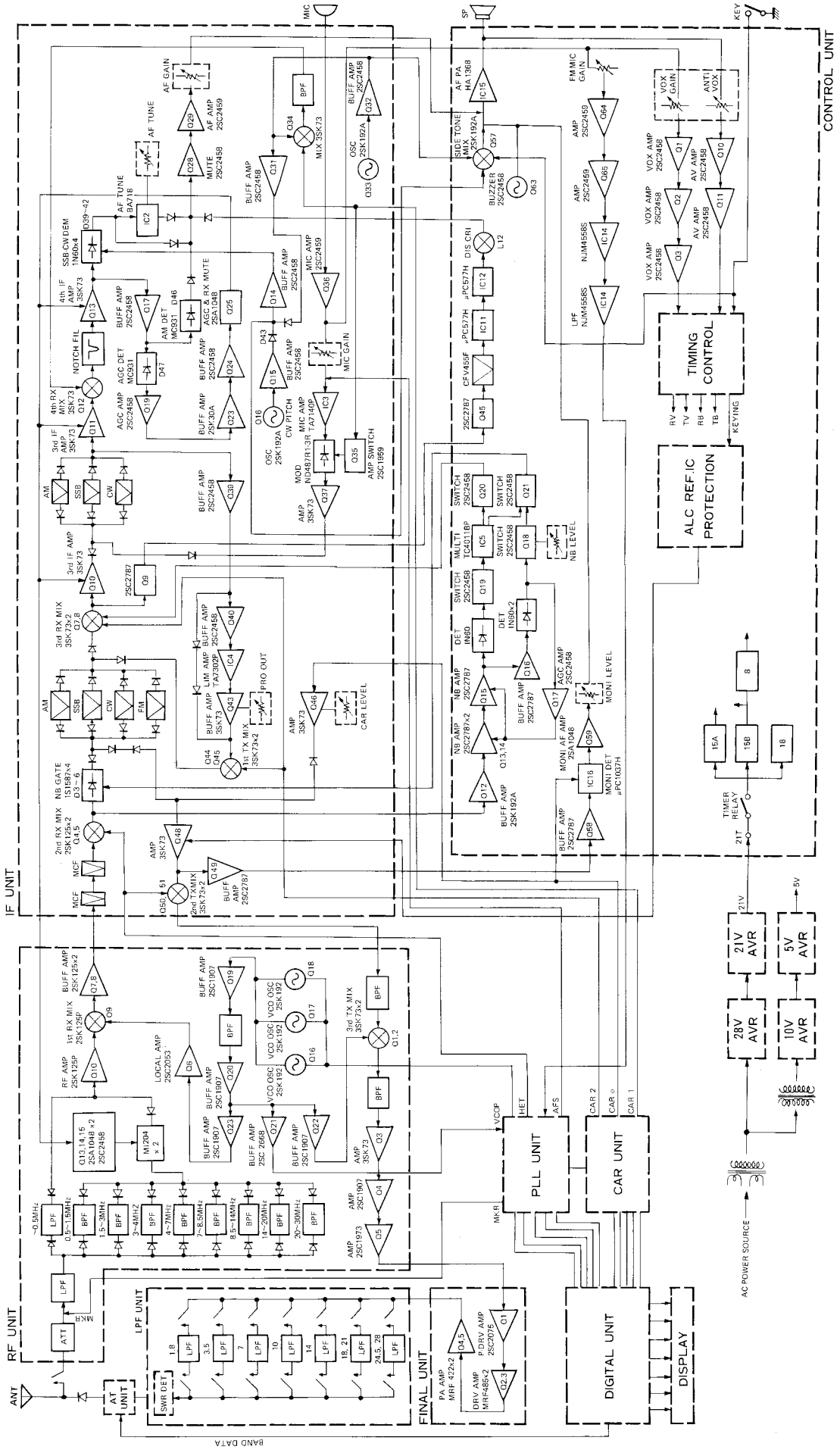
N : New parts

△ : Please note that these parts are sometimes not in stock and it takes much time to deliver.

PC BOARD VIEW

Component side view




IF UNIT
RF UNIT
CONTROL UNIT
PLL UNIT
CAR UNIT
DIGITAL UNIT
DISPLAY
FINAL UNIT
LPF UNIT
TIMING CONTROL
ALC REF.IC PROTECTION
MIC
SP
KEY
ANT
AT UNIT
21V AVR
5V AVR
28V AVR
10V AVR
AC POWER SOURCE
BAND DATA