



SERVICE MANUAL

TS-930S SP-930, AT-930, SO-1

HF TRANSCEIVER



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Kenwood Parts 213 639.9000 ext 422 or 429
Tech serv 213 639.7140

SPECIFICATIONS

[GENERAL]

Transmitter Frequency Range:

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

Receiver Frequency Range:

150 kHz - 30 MHz
 Mode: A3J (USB, LSB), A1 (CW), F1 (FSK), A3 (AM)

Antenna Impedance: With AT-930 antenna tuner

50 ohms
 20 - 150 ohms (80 - 10 meter Amateur bands only)

Power Requirement:

120/220/240 VAC, 50/60 Hz

Power Dissipation:

Max. 510 W during transmission, 80 W during reception

Dimensions:

374(14-3/4")W x 141 (5-9/16")H x 350(13-13/16")D
 mm (inches)

Weight:

With antenna tuner:
 Approx. 18.5 kg (40.8 lbs)
 Without antenna tuner:
 Approx. 16.8 kg (37.0 lbs)

[TRANSMITTER]

Final Power Input:

SSB/CW/FSK 250 W
 AM 80 W

Carrier Suppression:

Better than 40 dB

Unwanted Sideband Suppression:

Better than 50 dB (with 1 kHz modulation)

Harmonic Content:

Less than -40 dB

Audio Frequency Response:

400 - 2,600 Hz / -6 dB

Modulation:

SSB: Balanced modulation
 AM: Low level modulation (IF stage)

FSK Shift:

170 Hz

Modulation Distortion:

Less than -31 dB

Microphone Impedance:

500 ohms or 50 kohms
 (Connector - switchable)

ALC Input:

-10 V DC MAX

Linear Amplifier Switching:

200 V DC MAX
 100 mA

[RECEIVER]

Circuitry:

Quadruple conversion

Intermediate Frequencies:

1st IF: 44.93 MHz
 2nd IF: 8.83 MHz
 3rd IF: 455 kHz
 4th IF: 100 kHz

Sensitivity

(at 10 dB S+N/N)
 150 - 500 kHz:

Less than 1 μ V for SSB, CW and FSK

500 kHz - 1.8 MHz:

Less than 10 μ V for AM
 Less than 4 μ V for SSB, CW and FSK

1.8 - 30 MHz:

Less than 32 μ V for AM
 Less than 0.25 μ V for SSB, CW and FSK

Image Ratio:

More than 80 dB
 (1.8 MHz ~ 30 MHz)

IF Rejection:

More than 70 dB
 (1.8 MHz ~ 30 MHz)

Selectivity

(W-wide, N-narrow filter selection)

SSB, CW(W), FSK(W), AM(N):

2.7 kHz / -6 dB,
 4.0 kHz / -60 dB

CW(N), FSK(N):

Without optional filter: same as CW(W), FSK(W)

With optional YG-455C-1:

500 Hz / -6 dB,
 820 Hz / -60 dB

With optional YG-455CN-1:

250 Hz / -6 dB,
 480 Hz / -60 dB

With optional YK-88C-1:

500 Hz / -6 dB,
 1.5 kHz / -60 dB

AM(W):

Without optional filter:

6 kHz / -6 dB,
 18 kHz / -60 dB

With optional YK-88A-1:

6 kHz / -6 dB,
 11 kHz / -60 dB

SSB Slope Tune:

High-cut: More than 1500 Hz shift / -6 dB

Low-cut: More than 700 Hz shift / -6 dB

CW VBT

CW(W), FSK(W)

AM(N):

CW(N), FSK(N):

600 Hz ~ 2.7 kHz / -6 dB

Without optional filter: same as CW(W), FSK(W)

With optional YK-88C-1 and YG-455C-1 installed:

150 Hz ~ 500 Hz / -6 dB

AM(W):

With optional YK-88A-1:

4 kHz ~ 6 kHz / -6 dB

Frequency Stability:

Within ± 200 Hz after turn-on

Within ± 30 Hz any 30 minute period there after at constant temperature

Frequency Accuracy:

$\pm 1 \times 10^{-5}$ or better (at normal temperatures)

RIT Variable Range:

± 9.99 kHz

Notch Filter Attenuation:

More than 40 dB

Phone Patch Output Z:

600 Ω

Audio Output Power:

More than 1.5 W across 8 Ω
 (at 10% distortion)

AT-930 (Automatic Antenna Tuner)

Frequency Range:

Amateur bands from
 80 ~ 10 m

Input Impedance:

50 Ω , unbalanced

Output Impedance:

20 ~ 150 Ω unbalanced

Insertion Loss:

Less than 1 dB at 3.5 MHz
 (at optimum match)

Through Power:

150 W max.

Motor Stop SWR Value:

Less than 1.2

*Will transmit on the new 30, 17, and 12 meter bands. Lock-out circuitry installed to prevent accidental transmission before government amateur authorization.

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

CIRCUIT DESCRIPTION

GENERAL

The TS-930S receiver is quadruple conversion and the transmitter is double conversion in the TUNE mode and triple conversion in the SSB, AM and FSK modes. Fig. 1 shows the frequency configuration of the receiver and Fig. 2 shows that of the transmitter.

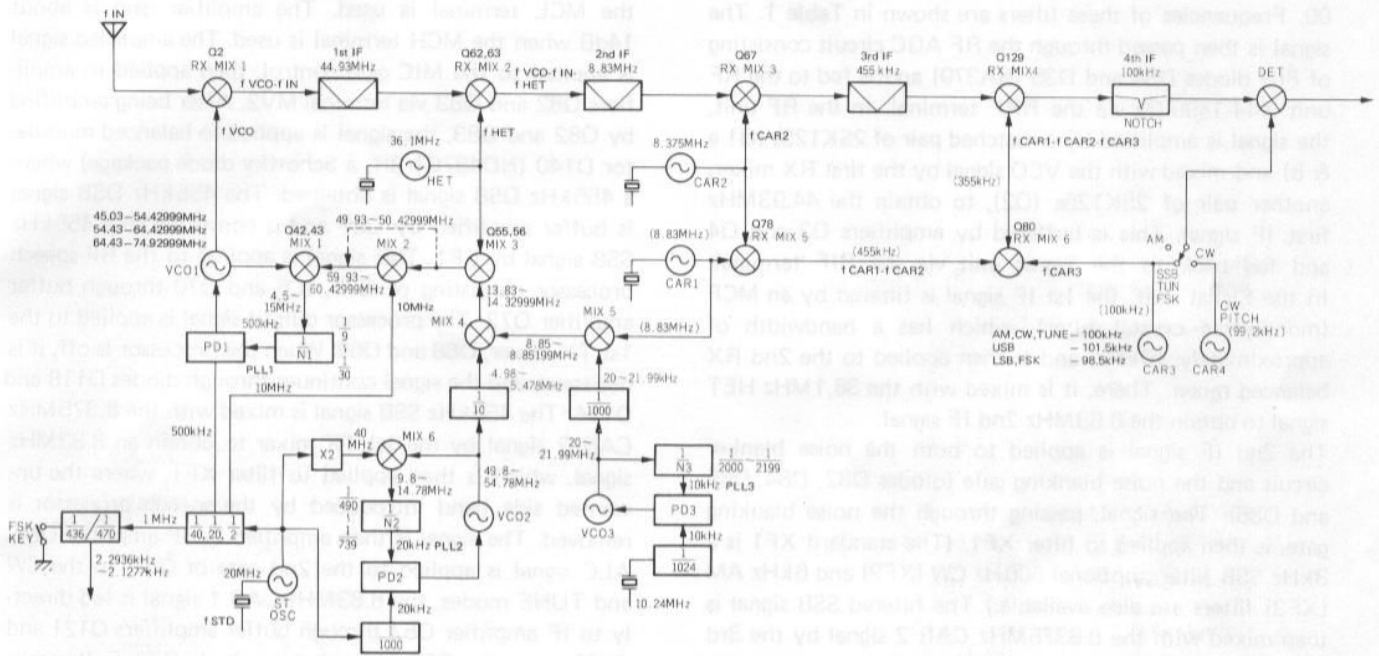


Fig. 1 RX Frequency configuration

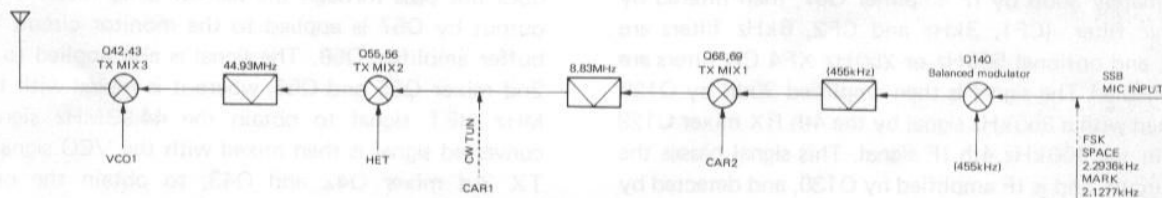


Fig. 2 TX Frequency configuration

• VCOs (voltage controlled oscillators) in the Signal unit

There are three VCOs in the Signal unit X57-1000-11. Q16 operates at 45.03 to 54.42999MHz, Q15 at 54.43 to 64.42999MHz and Q14 at 64.43 to 74.9299MHz, the first VCO is used for operation from 100kHz to 9.49999MHz, the second from 9.5 to 19.49999MHz and the last from 19.5 to 29.99999MHz.

• HET (heterodyne) generation in the Signal unit

Oscillator Q25 uses a 3rd overtone crystal to generate a 36.1MHz heterodyne signal.

• CAR 1 in the Signal unit

Q119 operates at 8.83MHz with crystal X5 for the CW, TUNE and AM modes ; at 8.8315MHz with X3 for the USB mode ; and at 8.8285MHz with X4 for the LSB and FSK modes. (CAR 1 frequency shifts to 8.82779MHz in the

FSK mode.) The CAR 1 oscillator is a VXO (variable crystal oscillator) which, together with the CAR 2 oscillator, forms the SSB-slope-tune and CW-VBT circuits.

• CAR 2 in the Signal unit

Q75 is a VXO, operating at 8.375MHz.

• CAR 3 in the Signal unit

Q140 operates at 100kHz for the CW, TUNE and AM modes ; at 101.5kHz for the USB mode ; and at 98.5kHz for the LSB mode. This output is fed to the 2nd CAR mixer Q80 and to Q152 as signal CAR in the SSB, TUNE and FSK modes and as the carrier in the CW mode.

• CAR 4 in the Signal unit

Q158 operates at 99.2kHz and is used for both demodulating CW signals and generating the CW side tone.

CIRCUIT DESCRIPTION

RX SECTION

The signal from the antenna is applied to the Signal unit X57-1000-11 RAT terminal, then applied to a low pass filter or one of 8 band pass filters through a 10dB or 20dB RF attenuator. The filters are selected according to BAND data (RB0 – RB3) output from the Digital unit X54-1670-00. Frequencies of these filters are shown in Table 1. The signal is then passed through the RF AGC circuit consisting of PIN diodes D34 and D35 (BA379) and is fed to the RF unit X44-1490-00 via the RRF terminal. In the RF unit, the signal is amplified by a matched pair of 2SK125s (Q1 a & b) and mixed with the VCO signal by the first RX mixer, another pair of 2SK125s (Q2), to obtain the 44.93MHz first IF signal. This is buffered by amplifiers Q3 and Q4 and fed back to the Signal unit via the RIF terminal. In the Signal unit, the 1st IF signal is filtered by an MCF (monolithic crystal filter), which has a bandwidth of approximately 10kHz, and is then applied to the 2nd RX balanced mixer. There, it is mixed with the 36.1MHz HET signal to obtain the 8.83MHz 2nd IF signal.

The 2nd IF signal is applied to both the noise blanker circuit and the noise blanking gate (diodes D82, D84, D85 and D86). The signal, passing through the noise blanking gate, is then applied to filter XF1. (The standard XF1 is a 3kHz SSB filter ; optional 500Hz CW (XF2) and 6kHz AM (XF3) filters are also available.) The filtered SSB signal is then mixed with the 8.8375MHz CAR 2 signal by the 3rd RX balanced mixer, Q65 and Q66 (3SK73s), to obtain the 455kHz 3rd IF signal. The 3rd IF signal is amplified approximately 30dB by IF amplifier Q67, then filtered by a ceramic filter. (CF1, 3kHz and CF2, 6kHz filters are built in, and optional 500Hz or 250Hz XF4 CW filters are also available.) The signal is then amplified 30dB by Q128 and mixed with a 355kHz signal by the 4th RX mixer Q129 to obtain the 100kHz 4th IF signal. This signal passes the notch circuit, and is IF amplified by Q130, and detected by either the SSB and CW detector D238 – 241, or the AM detector, depending on the mode. The detected audio signal is amplified by the 2-stage AF amplifier Q159, 160, then power amplified by IC3 to drive the speaker.

BAND	Frequency (MHz)
A	~ 0.5
B	0.5 ~ 1.5
C	1.5 ~ 3
D	3 ~ 4
E	4 ~ 7
F	7 ~ 8.5
G	8.5 ~ 14
H	14 ~ 20
I	20 ~ 30

Table 1 RX BPF frequency

TX SECTION

The microphone signal is applied to the microphone input terminal MCL (for 500Ω microphones). Terminal MCH is provided for 50kΩ microphone and is selected by moving the connector. The MIC amplifier, consisting of Q146 and Q147, amplifies the signal by approximately 34dB when the MCL terminal is used. The amplifier gain is about 14dB when the MCH terminal is used. The amplified signal is applied to the MIC gain control, then applied to amplifiers Q82 and Q83 via terminal MV2. After being amplified by Q82 and Q83, the signal is applied to balanced modulator D140 (ND487C1-3R, a Schottky diode package) where a 455kHz DSB signal is obtained. The 455kHz DSB signal is buffer amplified by Q87 and is converted to a 455kHz SSB signal by CF1. This signal is applied to the RF speech processor consisting of Q71, IC6 and Q70 through buffer amplifier Q72. The processor output signal is applied to the 1st TX mixer, Q68 and Q69. When the processor is off, it is bypassed, and the signal continues through diodes D118 and D114. The 455kHz SSB signal is mixed with the 8.375MHz CAR 2 signal by the 1st TX mixer to obtain an 8.83MHz signal, which is then applied to filter XF1, where the unwanted side band introduced by the speech processor is removed. The signal is then amplified by IF amplifier Q57. ALC signal is applied to the 2nd gate of Q57. In the CW and TUNE modes, the 8.83MHz CAR 1 signal is fed directly to IF amplifier Q57 through buffer amplifiers Q121 and Q123, amplifier Q59 and switching diode D78. Full break-in is possible in these modes because the transmission signal does not pass through the narrow band filter. The signal output by Q57 is applied to the monitor circuit through buffer amplifier Q58. The signal is also applied to the TX 2nd mixer Q55 and Q56, where it is mixed with the 36.1 MHz HET signal to obtain the 44.93MHz signal. The converted signal is then mixed with the VCO signal by the TX 3rd mixer Q42 and Q43, to obtain the operating frequency.

It is then amplified approximately 22dB by wide band amplifiers Q41, Q40 and Q43, after unwanted signal components are removed by one of the TX band pass filters. The amplified signal is output from the DRV terminal and fed to the Final unit X56-1430-00. The drive signal line to the Final unit is automatically disconnected when a cable is connected to the transverter connector on the rear panel.

In the Final unit, the signal is amplified approximately 40dB by a three-stage wide band amplifier consisting of pre-driver Q1 (2SC2075), a push-pull driver (Q2 and Q3 ; MRF485s) and a push-pull final amplifier (Q4 and Q5 ; MRF422s). The amplified signal is then applied to the antenna through the Filter unit X51-1280-00, (optional) AT (antenna tuner) unit X57-1010-00 and Switch unit X41-1410-00. There are two models of the TS-930S : one with and one without the AT unit. The final amplifier uses

CIRCUIT DESCRIPTION

Motorola transistors, having an excellent IMD (intermodulation distortion) characteristic, a maximum collector dissipation (PC) of 290W and high reliability. 28V DC is applied to each transistor. The bias circuits for the pre-driver and driver are regulated by varistors and a transistor. The bias circuit for the final transistors is regulated by IC1 and Q7, and the diode characteristic between the base and emitter of the transistor is used to provide temperature compensation and is controlled by the heat sink temperature in proximity to the final transistors.

PLL CIRCUIT

The TS-930S uses a 10Hz step digital VFO to control the operating frequency. Fig. 3 shows a block diagram of the PLL unit X50-1880-00. The PLL circuit uses three separate PLL loops (PLL-1, PLL-2 and PLL-3) to vary the operating frequency from 100kHz to 30MHz.

PLL-3 consists of IC13 and its peripheral circuitry. VCO-3 (Q29) operates within the 20 to 21.99MHz range. IC13 incorporates a divider and phase detector, and divides (by 1024) the 10.24MHz signal generated by X2 to obtain the 10kHz reference signal. The signal output by VCO-3 is applied to IC13 pin 9 through amplifier Q28 and is divided (by a value ranging from 2000 to 2199) to obtain 10kHz.

The phase of this 10kHz signal is compared with that of the 10kHz reference signal to lock VCO-3. The locked VCO-3 signal is applied to IC9 pin 14 through buffer Q33. The signal is divided by 1000 in IC9, IC10 and IC11 to obtain a signal which varies in 10Hz steps in the 20 to 21.99kHz range. The frequency division data for IC13 is delivered serially from the microprocessor in the Digital unit X54-1670-00.

PLL-2 consists of IC15 and its peripheral circuitry. VCO-2 (Q25) operates in the 49.8 to 54.78MHz range. The 20MHz signal generated by Q36 is applied to IC15 pin 19 through buffer Q34. This signal is divided by 1000 by IC15 to obtain the 20kHz reference signal. The VCO-2 signal is applied to IC14 (MIX 6) pin 2 through buffer Q26, where it is mixed with the 40MHz signal obtained by doubling the 20MHz signal from Q34 so that an output varying from 9.8 to 14.78MHz is obtained. This signal is applied to IC15 pin 10 through amplifier Q21 and is divided by a value ranging from 490 to 739 to obtain the 20kHz signal. The phase of this 20kHz signal is compared with that of the 20kHz reference signal to lock VCO-2. The VCO-2 output signal is applied to IC8 pin 2 through buffer Q27 and is divided by 10 to obtain a signal which varies in 2kHz steps in the 4.98 to 5.478MHz range. The frequency division data for IC15 is also delivered serially from the microprocessor in the Digital unit. The 4.98 to 5.478MHz signal output from IC8 pin 5 is applied to IC6 (MIX 4) pin 2.

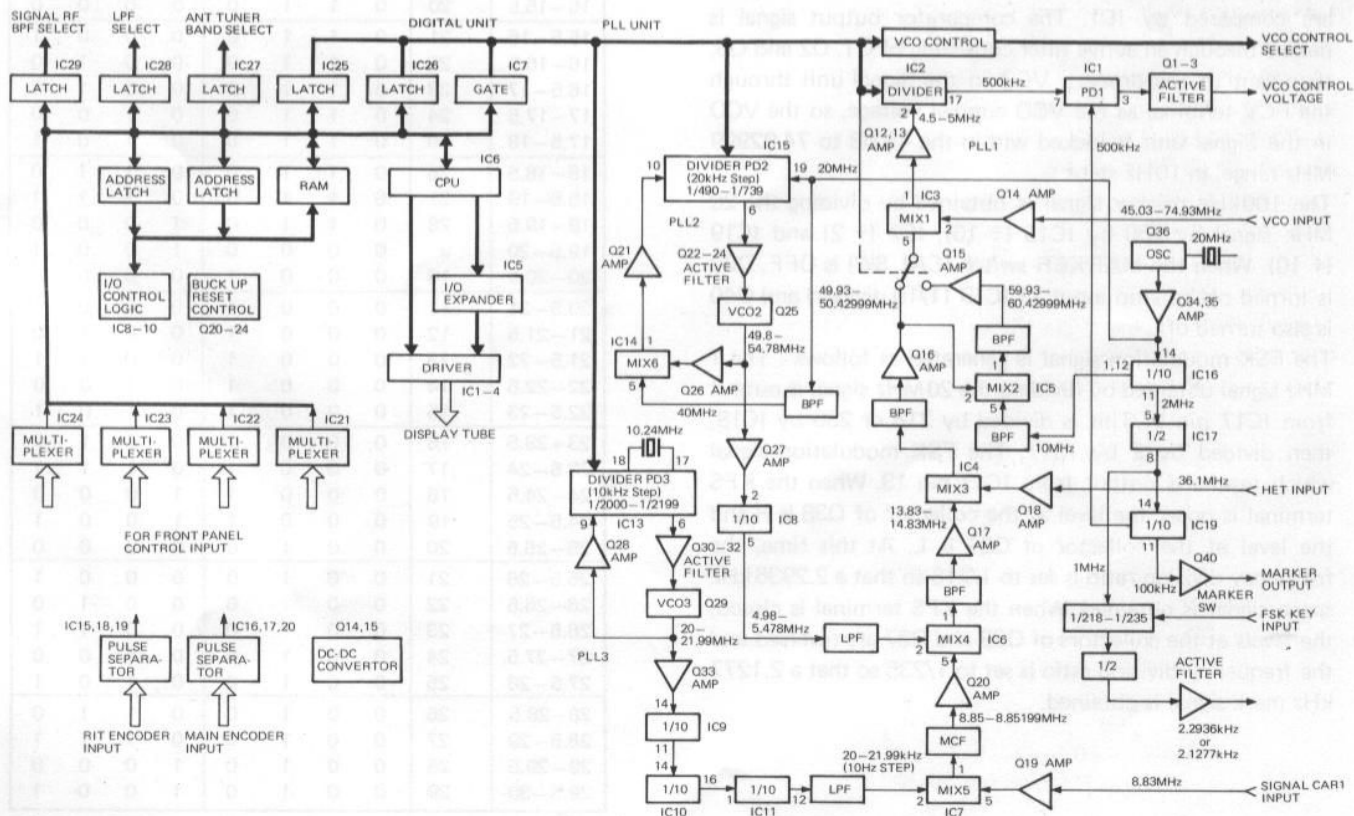


Fig. 3 PLL Block diagram and Digital control system

CIRCUIT DESCRIPTION

The 20 to 21.99kHz signal from IC11 pin 12 is mixed with the 8.83MHz CAR 1 signal to obtain the 8.85 to 8.85199 MHz signal. This signal is applied to IC5 pin 5 through MCF1, MCF2 and buffer Q20. These two signals are mixed by IC6 and the resultant signal varies from 13.83 to 14.32999MHz in 10Hz steps. This is applied to IC4 (MIX 3) through buffer Q17 and is mixed with the 36.1MHz HET signal to obtain a signal which varies from 49.93 to 50.42999MHz in 10Hz steps. After being buffered by Q16, the signal is applied directly to IC3 (MIX 1) pin 5 when the operating frequency is between 9.5 and 19.49999MHz. When the operating frequency is between 100kHz and 9.49999MHz, or between 19.5 and 29.99999MHz, the output signal from Q16 is applied to IC5 (MIX 2) pin 2 through switching diode D15 and is mixed with a 10MHz signal, obtained by dividing the 20MHz signal by 2. The resulting 59.93 to 60.42999MHz signal is applied to IC3 through buffer Q15. Diode switching control, is applied according to the operating frequency by the Digital unit microprocessor.

In IC3, the above signal is mixed with the VCO signal, which varies from 45.03 to 74.92999MHz, so that an output varying from 4.5MHz to 15MHz is obtained. This is applied to IC2 (divider) pin 2 through Q13 and Q12, and is divided by a value ranging from 9 to 30 to obtain a 500 kHz signal. This 500kHz signal is applied to IC1 (phase detector) pin 7. The 500kHz from IC19 pin12 is applied to IC1 pin 8 through Q4. The phases of these 500kHz signals are compared by IC1. The comparator output signal is passed through an active filter consisting of Q1, Q2 and Q3, then sent to the primary VCO in the Signal unit through the FCV terminal as the VCO control voltage, so the VCO in the Signal unit is locked within the 45.03 to 74.92999 MHz range, in 10Hz steps.

The 100kHz marker signal is obtained by dividing the 20 MHz signal by 200 by IC16 ($\div 10$), IC7 ($\div 2$) and IC19 ($\div 10$). When the MARKER switch (CAL SW) is OFF, D20 is turned off to stop input to IC19 (1/10 divider) and Q40 is also turned off.

The FSK modulation signal is generated as follows : The 1 MHz signal obtained by dividing the 20MHz signal is output from IC17 pin 9. This is divided by 218 or 235 by IC18, then divided by 2 by IC17. The FSK modulation signal which results is output from IC17 pin 13. When the KFS terminal is open, the level at the collector of Q38 is H and the level at the collector of Q37 is L. At this time, the frequency division ratio is set to 1/218 so that a 2.2936kHz space signal is obtained. When the KFS terminal is closed, the levels at the collectors of Q38 and Q37 are reversed and the frequency division ratio is set to 1/235 so that a 2.1277 kHz mark signal is obtained.

BAND f (MHz)	1/N	PL7	PL6	PL5	PL4	PL3	PL2	PL1	PL0
0.1-0.5	N=30	1	0	1	1	0	0	0	0
0.5-1	29	1	0	1	0	1	0	0	1
1-1.5	28	1	0	1	0	1	0	0	0
1.5-2	27	1	0	1	0	0	1	1	1
2-2.5	26	1	0	1	0	0	1	1	0
2.5-3	25	1	0	1	0	0	1	0	1
3-3.5	24	1	0	1	0	0	1	0	0
3.5-4	23	1	0	1	0	0	0	1	1
4-4.5	22	1	0	1	0	0	0	1	0
4.5-5	21	1	0	1	0	0	0	0	1
5-5.5	20	1	0	1	0	0	0	0	0
5.5-6	19	1	0	0	1	1	0	0	1
6-6.5	18	1	0	0	1	1	0	0	0
6.5-7	17	1	0	0	1	0	1	1	1
7-7.5	16	1	0	0	1	0	1	1	0
7.5-8	15	1	0	0	1	0	1	0	1
8-8.5	14	1	0	0	1	0	1	0	0
8.5-9	13	1	0	0	1	0	0	1	1
9-9.5	12	1	0	0	1	0	0	1	0
9.5-10	9	0	1	0	0	1	0	0	1
10-10.5	10	0	1	0	1	0	0	0	0
10.5-11	11	0	1	0	1	0	0	0	1
11-11.5	12	0	1	0	1	0	0	1	0
11.5-12	13	0	1	0	1	0	0	1	1
12-12.5	14	0	1	0	1	0	1	0	0
12.5-13	15	0	1	0	1	0	1	0	1
13-13.5	16	0	1	0	1	0	1	1	0
13.5-14	17	0	1	0	1	0	1	1	1
14-14.5	18	0	1	0	1	1	0	0	0
14.5-15	19	0	1	0	1	1	0	0	1
15-15.5	20	0	1	1	0	0	0	0	0
15.5-16	21	0	1	1	0	0	0	0	1
16-16.5	22	0	1	1	0	0	0	1	0
16.5-17	23	0	1	1	0	0	0	1	1
17-17.5	24	0	1	1	0	0	1	0	0
17.5-18	25	0	1	1	0	0	1	0	1
18-18.5	26	0	1	1	0	0	1	1	0
18.5-19	27	0	1	1	0	0	1	1	1
19-19.5	28	0	1	1	0	1	0	0	0
19.5-20	9	0	0	0	0	1	0	0	1
20-20.5	10	0	0	0	1	0	0	0	0
20.5-21	11	0	0	0	1	0	0	0	1
21-21.5	12	0	0	0	1	0	0	1	0
21.5-22	13	0	0	0	1	0	0	1	1
22-22.5	14	0	0	0	1	0	1	0	0
22.5-23	15	0	0	0	1	0	1	0	1
23-23.5	16	0	0	0	1	0	1	1	0
23.5-24	17	0	0	0	1	0	1	1	1
24-24.5	18	0	0	0	1	1	0	0	0
24.5-25	19	0	0	0	1	1	0	0	1
25-25.5	20	0	0	1	0	0	0	0	0
25.5-26	21	0	0	1	0	0	0	0	1
26-26.5	22	0	0	1	0	0	0	1	0
26.5-27	23	0	0	1	0	0	0	1	1
27-27.5	24	0	0	1	0	0	1	0	0
27.5-28	25	0	0	1	0	0	1	0	1
28-28.5	26	0	0	1	0	0	1	1	0
28.5-29	27	0	0	1	0	0	1	1	1
29-29.5	28	0	0	1	0	1	0	0	0
29.5-30	29	0	0	1	0	1	0	0	1

Table 2 PLL data

CIRCUIT DESCRIPTION

DIGITAL CIRCUIT

Fig. 3 shows a block diagram of the Digital unit, which consists of 31 ICs including a custom CPU, μ PD8049C-211 (IC6). The CPU uses a mapped I/O system on a common bus to control many signals. I/O signals are latched by IC25–29 to prevent noise from affecting other circuits. There are two encoder input ports; one for the main tuning control signal and the other for the RIT control signal. Each encoded input is applied to a logic circuit that determines both direction of rotation also sends information to the CPU to indicate the desired frequency change. The output of IC16 pin 3 or 4 determines the direction of rotation of the Main encoder. For example, when the encoder is rotated, the output at pin 4 goes to +5V. This output level is maintained until rotation is stopped. The output then returns to 0V. If the dial is turned in the opposite direction, the output drops to -5V and is maintained until rotation is again stopped. Internal variations in IC16 itself determine which pin (3 or 4) must be connected for proper action of the main tuning dial.

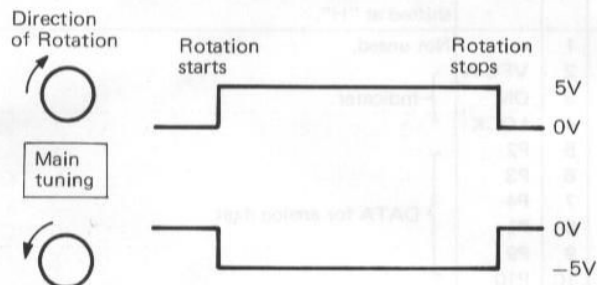


Fig. 4

The RIT rotary encoder operation is similar, but the output of IC19 pin 3 will always be as in Fig. 4, above. Desired frequency change is sent to the CPU via D13, 14 for the Main encoder and via D18, 19 for the RIT encoder. This output data is in the form of data pulses and is at a rate of 4 pulses per encoder disk opening. For example, if the Main encoder is rotated so 10 slots are sensed, 40 pulses will be sent to the CPU. Tuning rate is 10kHz per revolution in 10Hz steps. When the rotational speed of the main tuning knob exceeds 5–6 rev/sec, the step size is automatically increased in geometric progression. In other words the faster the knob is rotated, the greater the step becomes. The RIT control covers ± 9.99 kHz.

IC13 (μ PD5101LC) is a C-MOS RAM which stores frequency data for the 8 memory channels, and VFOs A and B. IC13 back-up power is supplied by three 1.5V AA batteries, through diode D10, when the power switch is OFF. Since the required back-up current is only $10\mu\text{A}$, memories will be maintained for approximately 24hr, even if no batteries are installed, by the discharge current of C21. Power is supplied to IC13 through Q23 and Q24 when the power switch is ON.

IC1 through IC4 are display drivers. Display data is multiplexed from the microprocessor. Connectors 13 through 16 output to the display tube. Terminals a through g and DP are 7 segment and decimal point data for the display. Terminals P1 through P10 are signals for the analog-type display, which approximates a conventional dial pointer. Terminals G1 through G10 are display tube grid signals. Heater voltage at approximately 7 Vpp is generated by DC-DC converter Q14 and Q15 and is supplied to the display tube terminals FH and FG. Q16 is a switching transistor used to blank the display tube if the PLL unlocks. IC21 through IC24 are multiplexers. Whenever the collector of Q25 is "L" low, data from the inputs of IC21–24 (pins D0–D6) is distributed to the appropriate IC. Input data selection is by means of control signal from IC12 the address latch (pins Q1, Q2 and Q3). If the collector of Q25 is held "H" no data transfer can occur.

IC11 and IC12 form an 8-bit address latch and IC25 through IC29 are output data latches: IC25 and IC26 latch 8-bit frequency division data which is sent to the PLL unit (PLL-1) through terminals PL0 through PL7. IC27 and part of IC28 latch the band data which is sent to the Antenna Tuner through terminals AT0 through AT4. The remainder of IC28 latches the band data which is sent to the Low Pass Filter unit through LP0 through LP2. IC29 latches the band data sent to the RX BPF in the Signal unit through terminals RB0 through RB3.

By two gates of IC7, Serial frequency division data is output-gated and is sent to PLL-2 and PLL-3 in the PLL unit via terminals PLL2 and PLL1.

Q20, Q21 and Q22 form a reset circuit. If the voltage at the 5V line accidentally drops, Q21 is turned on and its collector level becomes "H". This turns Q22 on and a "L" pulse is generated at its collector. This pulse signal is applied to the CE terminal IC13 pin 17 to disable read-write functions so that its contents are protected. Simultaneously, Q20 base becomes "H" and Q20 turns on. Therefore the logic "L" at Q20 collector is felt at IC6 pin 4 and the CPU is reset.

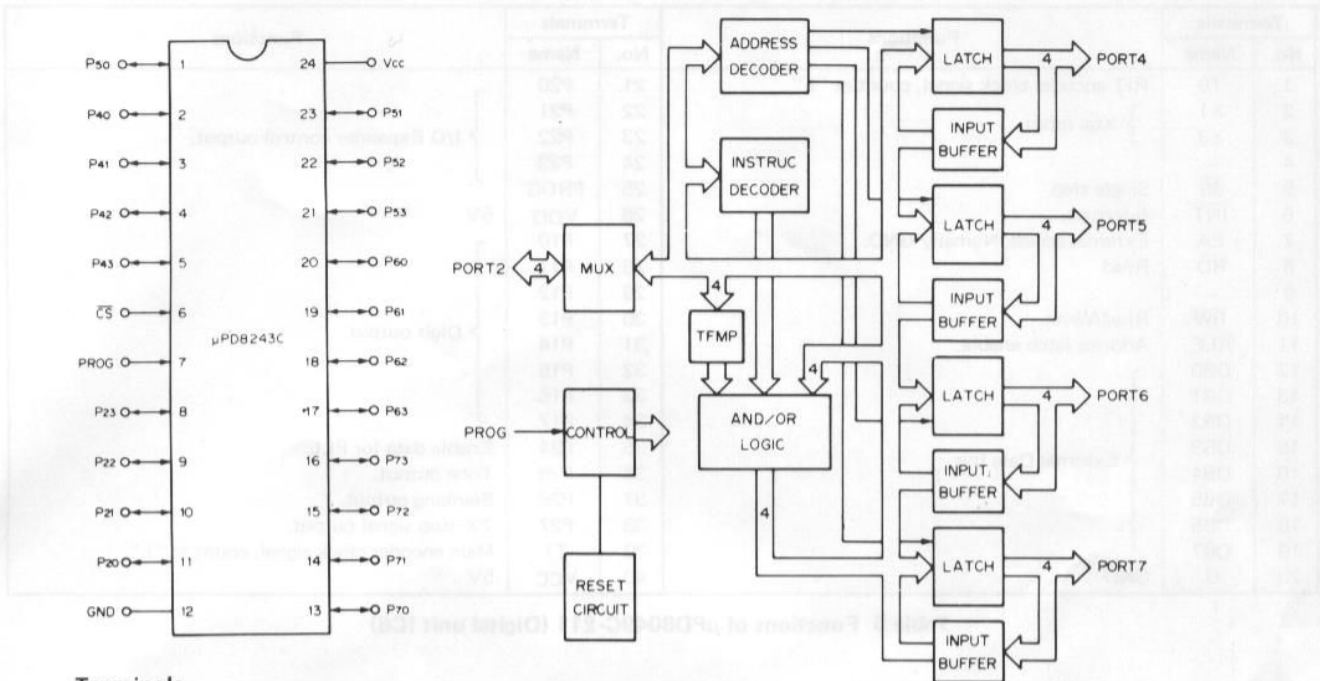
Tables 3 through 5 and Fig. 5 show various data input to and output from the Digital unit.

CIRCUIT DESCRIPTION

Terminals		Functions	Terminals		Functions
No.	Name		No.	Name	
①	1	24I	DC-DC converter input approx. 24V.		
	2	12I	AVR input.		
	3	5I	AVR input.		
②	1	BZ	Signal unit tone oscillator on when "L".		
	2	BRK	When the Main knob is turned, a L pulse is output for the NB gate at every 2kHz step.		
	3	UL	PLL unlock input, L : unlock, display blanks.		
	4	TS	"L" pulse is output when changing BAND, TX stops when "L".		
	5	-C	Approx. -43V.		
	6	TR	TX and RX switching signal input, "L" in RX, "H" in TX.		
③	1	G	GND		
	2	BAT	Back up DC input 1.5V x 3.		
④	1	5V	5V DC.		
	2	ME2	} Main encoder input, 90° phase difference, 50% duty cycle.		
	3	ME1			
	4	G	GND		
⑤	1	5V	5V DC.		
	2	RE2	} RIT encoder input, 90° phase difference, 50% duty cycle.		
	3	RE1			
	4	G	GND		
⑥	1	DM	Dimmer at open, normally GND.		
	2	-	Not used.		
	3	M0	Memory channel M0.		
	4	CLR	Normally "H", RIT f is cleared when "L".		
	5	B0	BAND DATA input B0.		
	6	FR	VFO select on RX, VFO B at "H", VFO A at "L".		
	7	RIT	Normally "H", RIT-ON, OFF state changes at "L".		
	8	BD	1MHz step BAND DATA, f descends 1MHz steps in at "L".		
	9	-	Not used.		
	10	B1	BAND DATA input B1.		
	11	AB	VFO A=B switch, VFO A=B when "L".		
	12	M1	Memory CH M1.		
⑦	1	LOCK	Main dial f is locked when "L".		
	2	MV	Memory and VFO select, VFO at "H", Memory at "L".		
	3	BU	1MHz step BAND UP DATA input, frequency ascends in 1MHz steps when "L" is input.		
	4	MD	MIC DOWN input, "L" : DOWN.		
	5	-	Not used.		
	6	B3	BAND DATA B3.		
	7	MR	Memory recall at "L".		
⑧	1	-	Not used.		
	2	MU	MIC UP input, "L" : UP.		
	3	-	Not used.		
	4	M2	Memory CH M2.		
	5	MIN	Memory in at "L".		
	6	FSK	"H" at FSK mode, increases ref. f 2.29kHz.		
	7	B2	BAND DATA B2.		
	8	FT	VFO select in transmit, VFO B at "H", VFO A at "L".		
⑨	1	12V	12V DC to PLL unit.		
	2	UL	Unlock signal at "L" from PLL unit.		
	3	PL3	} PLL DATA for 500kHz comparison.		
	4	PL2			
	5	PL4			
	6	PL1			
	7	PL0			
⑩	1	PL6	} PLL DATA for 500kHz comparison.		
	2	PL7			
	3	PL5			
⑪	1	AT1	} BAND DATA to ANT tuner.		
	2	AT2			
	3	AT3			
	4	AT4			
	5	AT0	} BAND DATA in transmit to the Filter unit.		
	6	LP2			
	7	LP0			
	8	LP1			
	9	RB3	} BAND DATA in receive to the Signal unit.		
	10	RB2			
	11	RB0			
	12	RB1			
⑫	1	G	GND		
	2	PLL1	Serial division data for PLL1 10Hz steps.		
	3	G	GND		
	4	CK	Clock signal.		
	5	G	GND		
	6	PLL2	Serial division data for PLL2 2kHz steps.		
	7	G	GND		
	8	EN	Division data store signal for PLL IC, data is shifted at "H".		
⑬	1	-	Not used.		
	2	VFO A	} Indicator.		
	3	ON			
	4	LOCK	} DATA for analog digit.		
	5	P2			
	6	P3			
	7	P4			
	8	P1			
	9	P9			
	10	P10			
⑭	1	g	Dot "•" 		
	2	DP	} DATA for analog digit.		
	3	P5			
	4	P6			
	5	P7			
	6	P8			
	7	SK	} GRID DATA.		
	8	G1			
	9	G2			
	10	G3			
	11	G4			
⑮	1	G5	} GRID DATA.		
	2	G6			
	3	G7			
	4	G8			
	5	G9	} Heater for Display tube.		
	6	G10			
	7	FH			
	8	FG			
⑯	1	b	} 		
	2	c			
	3	d			
	4	a			
	5	e			
	6	f			
	7	MEMO	MEMO indicator.		
	8	VFO B	VFO B indicator.		

Table 3 Digital unit terminal function

CIRCUIT DESCRIPTION



Terminals

- P₂₀ ~ P₂₃ : Input Output (Port 2)
- P₄₀ ~ P₄₃ : Input Output port (Port 4)
- P₅₀ ~ P₅₃ : Input Output port (Port 5)
- P₆₀ ~ P₆₃ : Input Output port (Port 6)
- P₇₀ ~ P₇₃ : Input Output port (Port 7)
- \overline{CS} : Chip Select
- PROG : Program pulse
- Input Output port (Port 2)

Maximum Rating (Ta = 25°C)

Item	Symbol	Rating
Operating voltage	V _{cc}	-0.5 ~ +7V
Input voltage	V _i	-0.5 ~ +7V
Output voltage	V _o	-0.5 ~ +7V
Operating temperature	T _{opt}	0 ~ +70°C
Storage temperature	T _{stg}	-60 ~ +150°C

Fig. 5 μPD8243C (Digital unit IC5)

Pin No.	Name	Functions	
13	P70	G2	} Digit output
14	P71	G1	
15	P72	H	} Scale DATA output
16	P73	H	
2	P40	e	} VFO B
3	P41	f	
4	P42	g	
5	P43	Dp	
1	P50	a	} DATA
23	P51	b	
22	P52	c	
21	P53	d	
20	P60		} VFO A
19	P61		
18	P62		
17	P63		

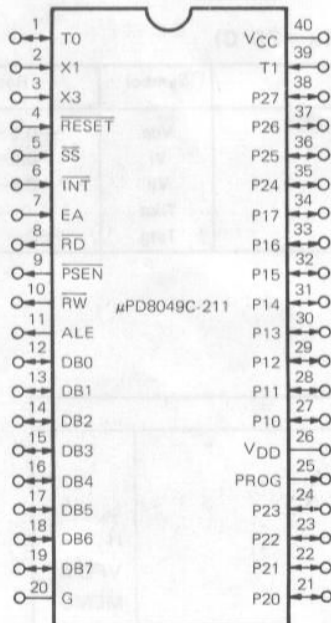
Scale DATA

Table 4

CIRCUIT DESCRIPTION

Terminals		Functions	Terminals		Functions
No.	Name		No.	Name	
1	T0	RIT encoder clock signal, count at "L". } Xtal input	21	P20	I/O Expander control output.
2	X1		22	P21	
3	X3		23	P22	
4	—	24	P23		
5	SS	Single step.	25	PROG	5V
6	INT	Interrupt.	26	VDD	
7	EA	External access. Normally GND.	27	P10	Digit output.
8	RD	Read	28	P11	
9	—	Read/Write	29	P12	
10	RW		Address latch enable.	30		P13
11	ALE	External Data bus.	31	P14	
12	DB0		32	P15	
13	DB1		33	P16	
14	DB2		34	P17	
15	DB3		35	P24	Enable data for PLL.
16	DB4		36	P25	Tone output.
17	DB5		37	P26	Blanking output.
18	DB6	38	P27	TX-stop signal output.	
19	DB7	GND	39	T1	Main encoder clock signal, count at "L".
20	G		40	VCC	5V

Table 5 Functions of μ PD8049C-211 (Digital unit IC6)



ACCESSORY CIRCUITS

• Noise blanker in the Signal unit

Fig. 6, 7 shows the noise blanker. The noise blanker consists of two circuits, NB1 and NB2. Noise sampled from the RX 2nd mixer (Q62 and Q63) output transformer is amplified approximately 70dB by Q28 to Q30 and Q32. The amplified noise signal is applied to both NB1 and NB2 circuits. In NB1, the noise is buffered by Q33 and detected by D52 and D53. The detector output is applied to switching transistor Q35. In NB2, the noise is applied directly to the noise detector circuit consisting of D54 to D56 and Q36. NB1 detects pulse noise included in the input signal and switches the noise blanking gate consisting of D82 and D84 to D86, which is located before the RX 2nd IF filter, XF1. The NB1 system is a conventional noise blanker. Noise detected by D54 to D56 and Q36 is shaped by IC2 so that only high level pulse noise components are extracted in the form of a square wave. This square wave is applied to both the switching transistor Q38, to control the 3rd RX mixer (Q65 and Q66), and to the NB gate through D57 and Q31 to switch the gate. The NB2 system is effective against radar-type pulse noise, commonly called "the woodpecker". The noise blankers are also used to reduce clicks generated by the digital VFO step reset pulse.

CIRCUIT DESCRIPTION

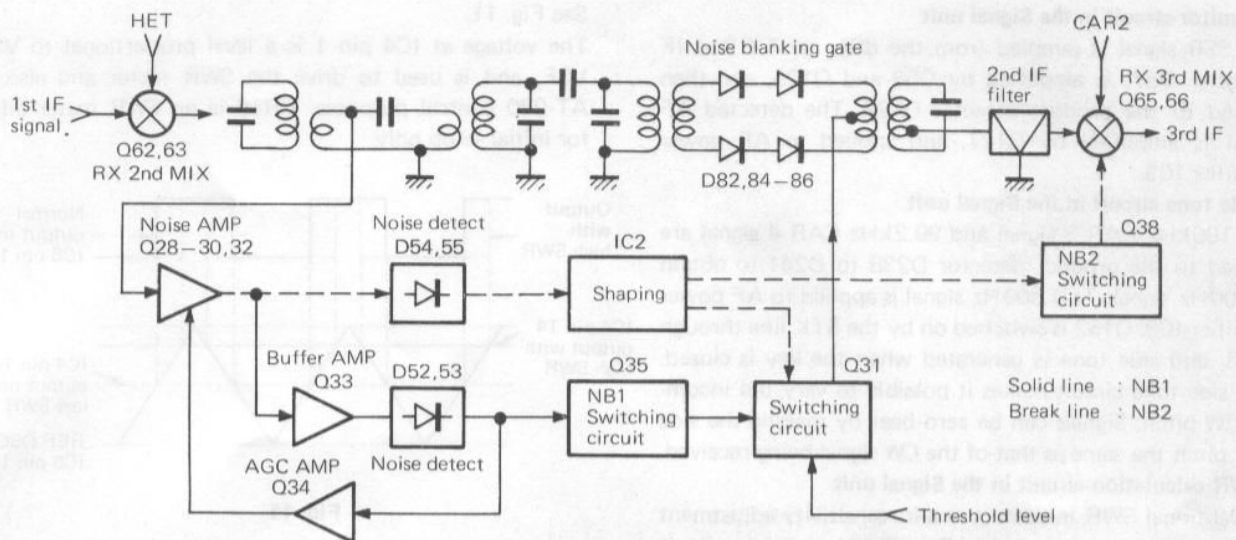


Fig. 6 Noise blanker circuit

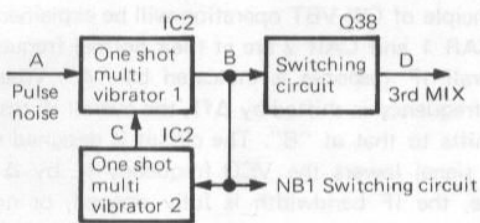


Fig. 7 NB2 circuit

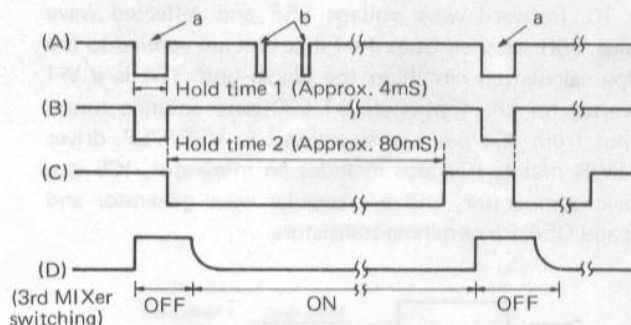


Fig. 8 NB2 timing chart

● Speech processor in the Signal unit

A block diagram of the speech processor is shown in Fig. 9. An SSB signal, having passed 455kHz filter CF1 and buffer Q72, is amplified by Q71 and applied both to the detector consisting of D116 and D117, and to limiting amplifier IC6. The detected signal is applied to DC amplifiers Q73 and Q74, where it is logarithmically compressed, and is then applied to the multi-meter to indicate compression level. The output level of IC6 is constant regardless of input level.

The output signal is applied to gain control amplifier Q70, then input to the TX 1st mixer. When the processor is off, it is bypassed through switching diodes D118 and D114. In the FSK mode, the signal is automatically compressed approximately 10dB (even if the processor switch is off) to equalize any variations in level between mark and space signals. In the FSK mode, the transmission power and ALC are adjusted with the PROC-OUT control.

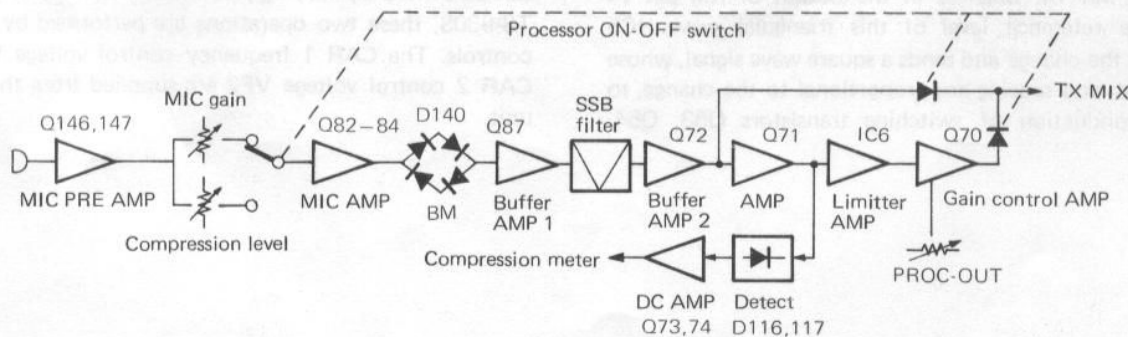


Fig. 9 Speech processor block diagram

CIRCUIT DESCRIPTION

● Monitor circuit in the Signal unit

The SSB signal is sampled from the drain of TX 2nd IF amplifier Q57, is amplified by Q58 and Q125, and then applied to the product detector Q126. The detected AF signal is amplified by Q127, and applied to AF power amplifier IC3.

● Side tone circuit in the Signal unit

The 100kHz CAR 3 signal and 99.2kHz CAR 4 signal are applied to the product detector D238 to D241 to obtain an 800Hz signal. This 800Hz signal is applied to AF power amplifier IC3. Q152 is switched on by the STK line through D233, and side tone is generated when the key is closed. This side tone circuit makes it possible to vary the incoming CW pitch. Signals can be zero-beat by making the side tone pitch the same as that of the CW signal being received.

● SWR calculation circuit in the Signal unit

Conventional SWR indicators require sensitivity adjustment for the forward wave level. The SWR metering circuit incorporated in the TS-930S makes this adjustment automatically. This new SWR calculation circuit is shown in Fig. 10. Forward wave voltage VSF and reflected wave voltage VSR sampled from the Filter unit are applied to the analog calculation circuit in the Signal unit. IC4 is a V-I converter for the (optional) AT-930 auto antenna tuner. Output from IC4 pin 1, proportional to VSR/VSF, drives the SWR meter. IC4 also includes an integrator, IC5 is a voltage comparator, and a triangular wave generator and Q53 and Q54 are switching transistors.

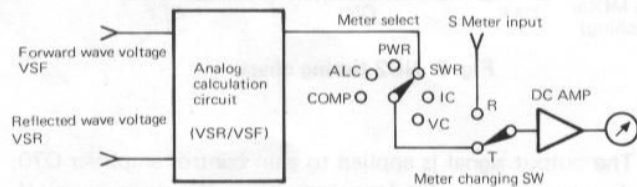


Fig. 10 SWR meter circuit

The VSF voltage is compared with a 0.5V REF voltage on IC4 pin 12. If VSF decreases (i.e. SWR increases) the voltage level at pin 14 increases. The output of IC5 pin 1 is a triangular reference signal and is mixed with the voltage from IC4 pin 14. Changes in the output of IC4 pin 14 affect the reference level of this triangular wave. IC5 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 Q53, Q54.

See Fig. 11.

The voltage at IC4 pin 1 is a level proportional to VSR/VSF, and is used to drive the SWR meter and also for AT-930 control purposes. VR16 is an SWR meter adjust for initial setup only.

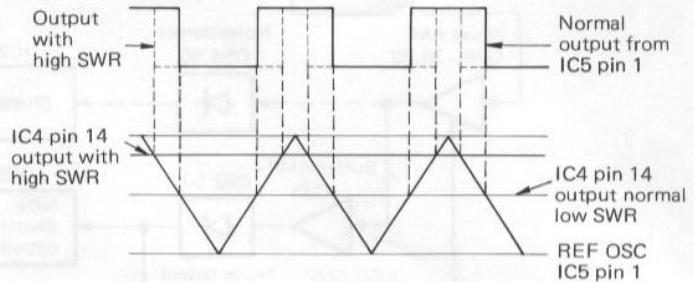


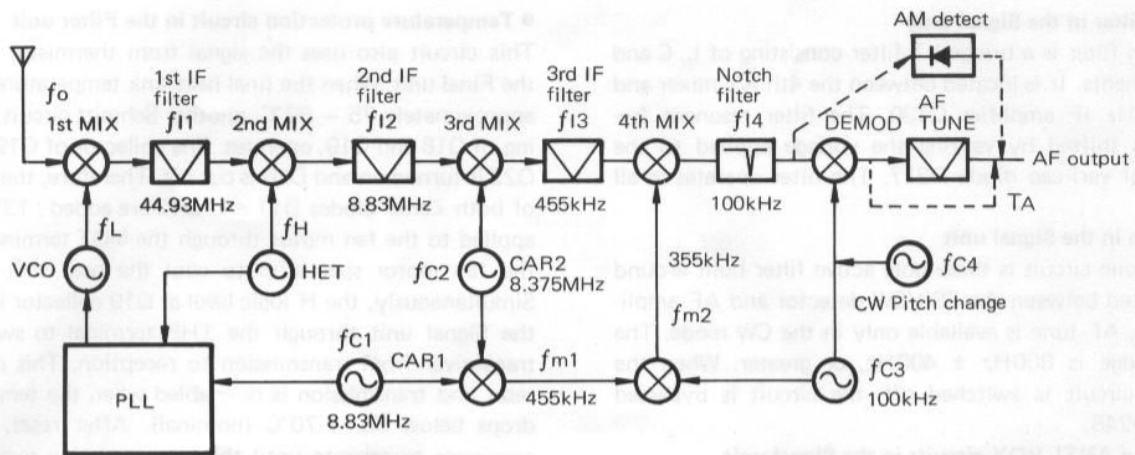
Fig. 11

● CW-VBT (variable bandwidth tuning) and SSB-slope-tune in the Signal unit

Fig. 12 shows the CW-VBT and SSB-slope-tune circuits. The principle of CW-VBT operation will be explained first. When CAR 1 and CAR 2 are at their normal frequencies, the overall IF response is indicated by "A". When the CAR 1 frequency is shifted by Δf_1 , the overall IF response curve shifts to that at "B". The circuit is designed so the CAR 1 signal lowers the VCO frequency f_L by Δf_1 . In this case, the IF bandwidth is fully opened, or normal. When the CAR 2 frequency is lowered by Δf_2 , the 3rd IF filter frequency response curve shifts to that indicated by "C". Thus, the overall IF bandwidth is narrowed. The TS-930S VBT function is designed to operate as: $\Delta f_2 = 2\Delta f_1$. The overall IF bandwidth is narrowed by varying the CAR 1 and CAR 2 frequencies without shifting the overall IF response center frequency.

Next, the SSB-slope-tune function will be explained. When the circuit is designed so that variations in the CAR 1 and CAR 2 frequencies have the relationship $\Delta f_1 = \Delta f_2$, only the lower frequency (at the left limit of the overall IF response curve, shown in Fig. 13) can be shifted by varying these frequencies. The higher frequency (at the right limit) can be shifted by varying just the CAR 2 frequency. In the TS-930S, these two operations are performed by separate controls. The CAR 1 frequency control voltage VF1 and CAR 2 control voltage VF2 are supplied from the Switch unit.

CIRCUIT DESCRIPTION



$$\begin{cases} f_L = f_H + f_{C1} + f_R \\ f_{m2} = f_{C1} - f_{C2} - f_{C3} \\ f_{C4} = f_{C3} - \Delta f_P \end{cases}$$

f_R : Dial displayed frequency
 f_O : CAR frequency (SSB, AM, CW)
 \therefore Tuning point : $f_R = f_O$

$$\begin{cases} f_{i1} = f_L - f_O \rightarrow \text{Tuning time} \\ f_{i2} = f_{i1} - f_H = f_R - f_O + f_{C1} \rightarrow f_{C1} \\ f_{i3} = f_{i2} - f_{C2} = f_R - f_O + f_{C1} - f_{C2} \rightarrow f_{C1} - f_{C2} \\ f_{i4} = f_{i3} - f_{m2} = f_R - f_O + f_{C3} \rightarrow f_{C3} \\ f_A = |f_{i4} - f_{C3}| = |f_R - f_O| \rightarrow O ; \text{SSB, FSK, TUN} \\ f_A = |f_{i4} - f_{C4}| = \Delta f_P \rightarrow \text{CW} \end{cases}$$

Fig. 12-a RX configuration

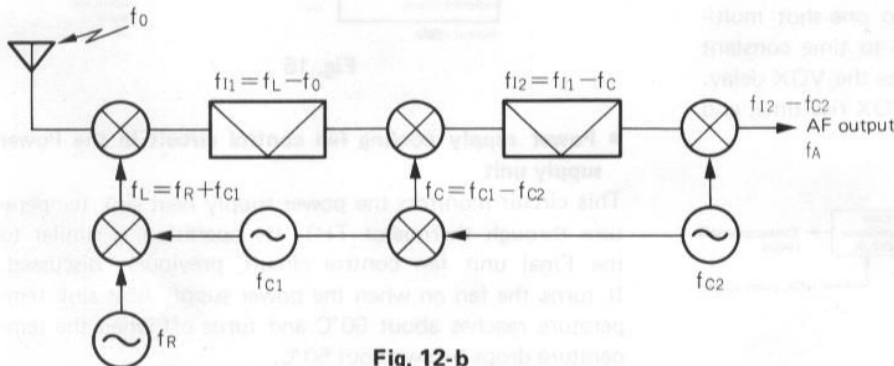


Fig. 12-b

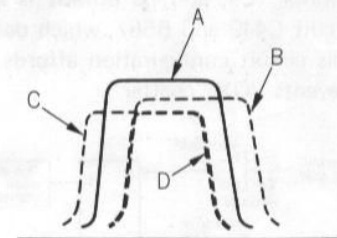


Fig. 12-c

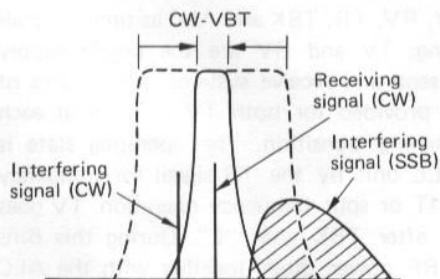


Fig. 12-d CW-VBT

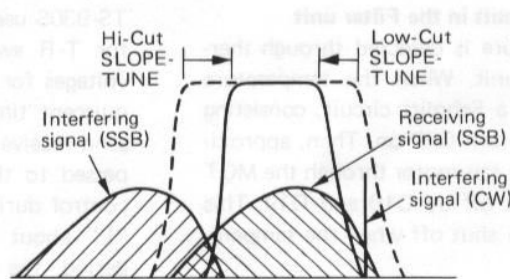


Fig. 12-e SSB-slope-tune

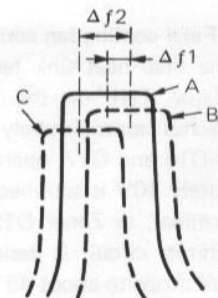


Fig. 13

CIRCUIT DESCRIPTION

● Notch filter in the Signal unit

The notch filter is a bridged-T filter consisting of L, C and R components. It is located between the 4th RX mixer and the 100kHz IF amplifier Q130. The filter resonant frequency is shifted by varying the voltage applied to the cathode of vari-cap diode D217. The filter operates in all modes.

● AF-tune in the Signal unit

The AF-tune circuit is three-pole active filter built around IC7, located between the SSB/CW detector and AF amplifier Q160. AF-tune is available only in the CW mode. The tuning range is $800\text{Hz} \pm 400\text{Hz}$, or greater. When the AF-tune circuit is switched off, the circuit is bypassed through D248.

● VOX and ANTI-VOX circuits in the Signal unit

Fig. 14 shows the VOX and ANTI-VOX circuits. The signal output by MIC preamplifier Q146 is applied to VOX amplifier Q145 through the VOX gain control. The AF output, sampled from the speaker line, is applied to the ANTI-VOX amplifiers Q149 and Q148. An adjustable DC bias voltage is applied to the base of Q148 to control the ANTI-VOX operating level. The digital signals output from these amplifiers are applied to the RS flip-flop IC10. The signal which is first input to the flip-flop has priority. Output from the flip-flop is applied to one-shot multivibrator IC9, and its output is applied to time constant circuit C449 and R567, which determines the VOX delay. This circuit configuration affords fast VOX rise time, and prevents VOX "chatter".

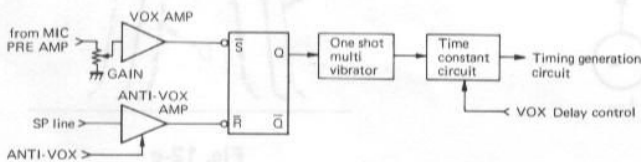


Fig. 14 VOX, ANTI-VOX circuit configuration

● Final cooling fan control circuit in the Filter unit

The final heat sink temperature is detected through thermistor TH1 on the Final unit. When the temperature reaches approximately 50°C , a Schmitt circuit, consisting of Q16 and Q17, operates to turn Q22 on. Then, approximately 10V is supplied to the fan motor through the MOT terminal, as Zener D12 is cut off by D10 and Q19. This Schmitt circuit is designed to shut off when the temperature drops to about 45°C .

● Temperature protection circuit in the Filter unit

This circuit also uses the signal from thermistor TH1 on the Final unit. When the final heat sink temperature reaches approximately $75 - 80^{\circ}\text{C}$, another Schmitt circuit, consisting of Q18 and Q19, operates. The collector of Q19 goes H, Q23 is turned on and D10 is cut off. Therefore, the voltages of both Zener diodes D11 and D12 are added; 13V is now applied to the fan motor through the MOT terminal. Thus, the fan motor speeds-up to cool the heat sink rapidly. Simultaneously, the H logic level at Q19 collector is sent to the Signal unit through the THP terminal to switch the transceiver from transmission to reception. This circuit is reset and transmission is re-enabled when the temperature drops below $65 - 70^{\circ}\text{C}$ (nominal). After reset, the fan continues to operate until the final heat sink temperature drops below about 45°C . (See Fig. 15.)

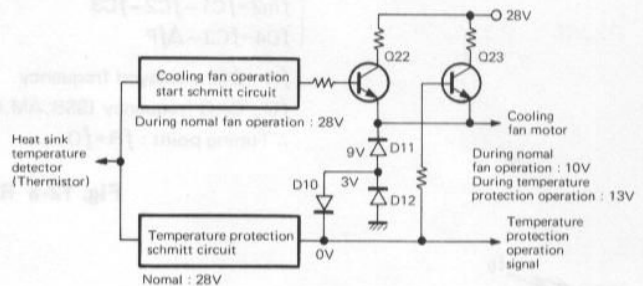


Fig. 15

● Power supply cooling fan control circuit in the Power supply unit

This circuit monitors the power supply heat sink temperature through thermistor TH1. Its operation is similar to the Final unit fan control circuit, previously discussed. It turns the fan on when the power supply heat sink temperature reaches about 60°C and turns off when the temperature drops below about 50°C .

● CW full break-in timing circuit in the Signal unit

Fig. 16 is the timing chart for CW full break-in and send-receive switching in the SSB, FSK and TUNE modes. The TS-930S uses TV, RV, TR, TBK and ALC as timing signals for T-R switching. TV and RV are the power supply voltages for the send and receive systems. About 3ms of quiescent time is provided for both TV and RV at each send-receive switching transition. The operating state is passed to the PLL unit by the TR signal for frequency control during RIT or split frequency operation. TV goes "L" about 6ms after TBK goes "L". During this 6ms period, the TX RF power drops together with the ALC voltage. TB is the bias voltage for the send system and RB is that for the receive system. TB and TV are switched simultaneously. RB is on when TB is off, and vice versa. Fig. 17 shows the timing for CW semi-break-in and for CW keying after the standby switch has been placed to SEND. Note: Omitted signals (such as RV and TR) are the same as shown in Fig. 16.

CIRCUIT DESCRIPTION

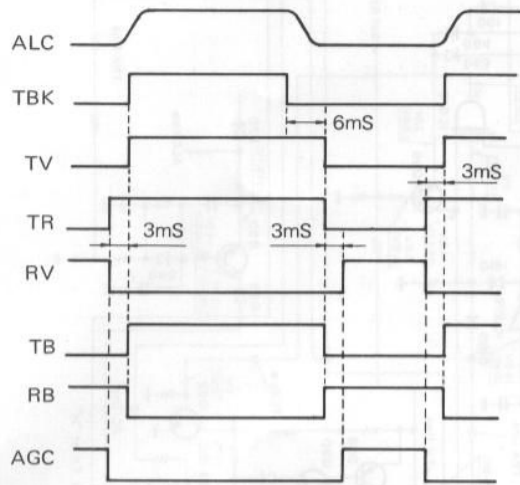


Fig. 16 T-R timing chart (CW full break-in, SSB, FSK and TUNE modes)

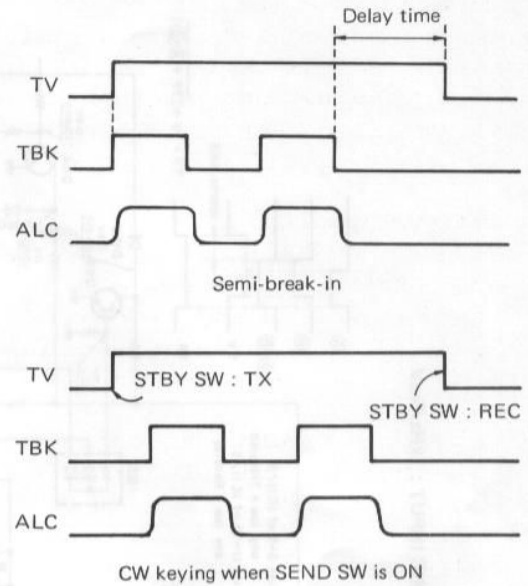


Fig. 17 CW operation timing chart

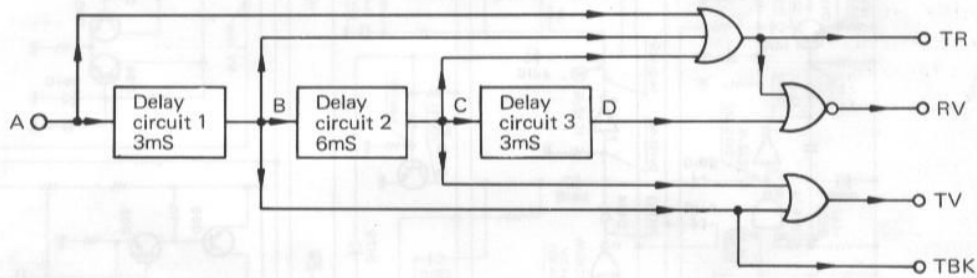


Fig. 18

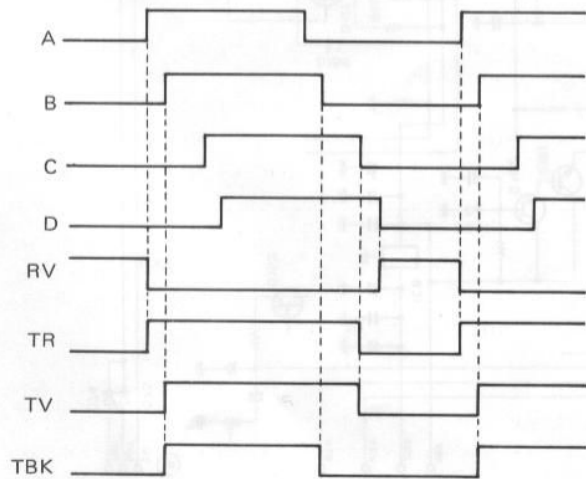


Fig. 19

TS-930S CIRCUIT DESCRIPTION

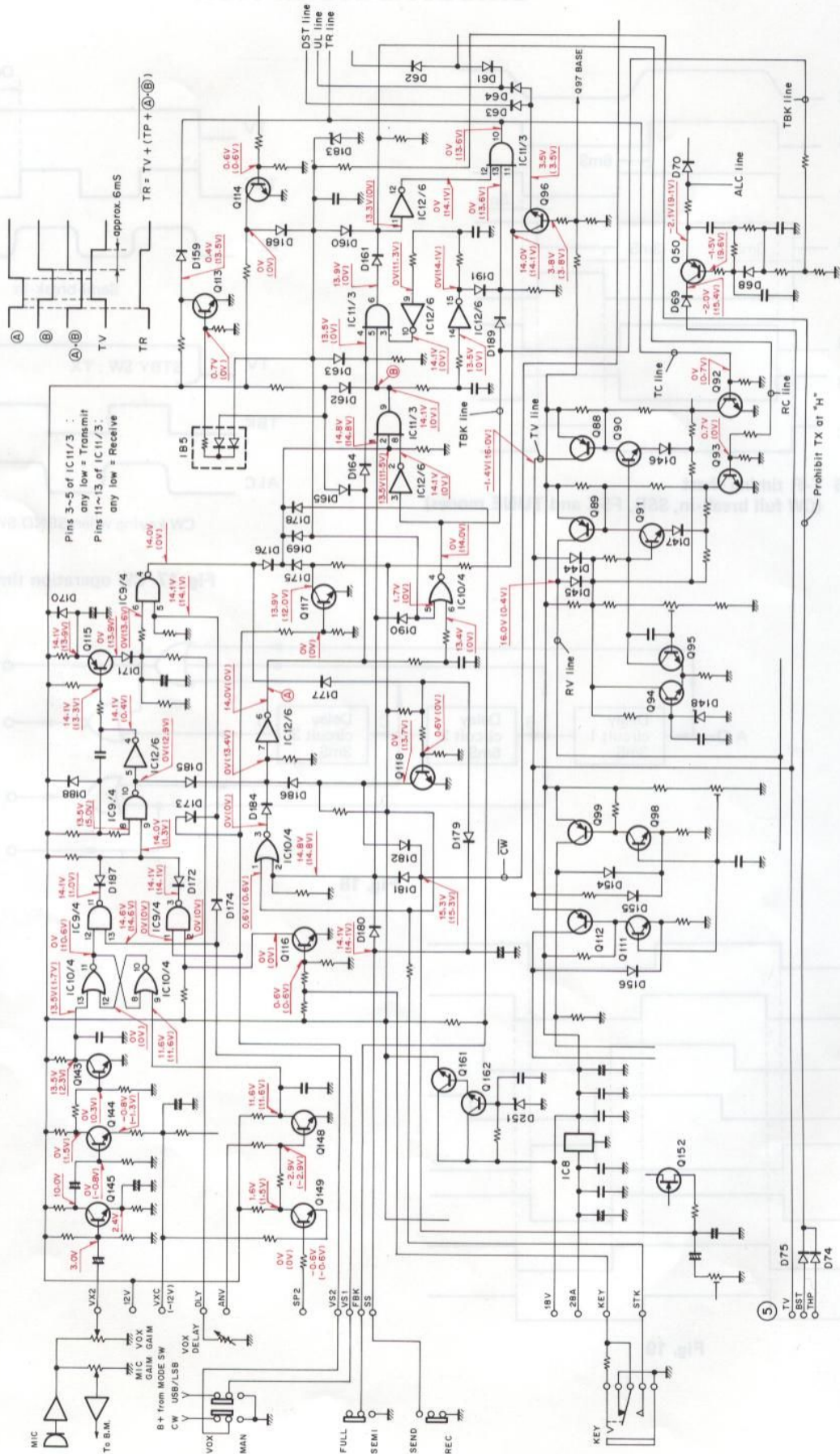
REFERENCE DATA

SSB, VOX

Voltage measurement conditions

f = 14.175.0MHz MODE : SSB VOX/MAN : VOX MIC CONTROL : Centered VOX GAIN : Centered STBY : REC MIC INPUT : 1kHz/5mV

() : in TX (Audio signal, 1kHz/5mV is connected to the MIC terminal.)



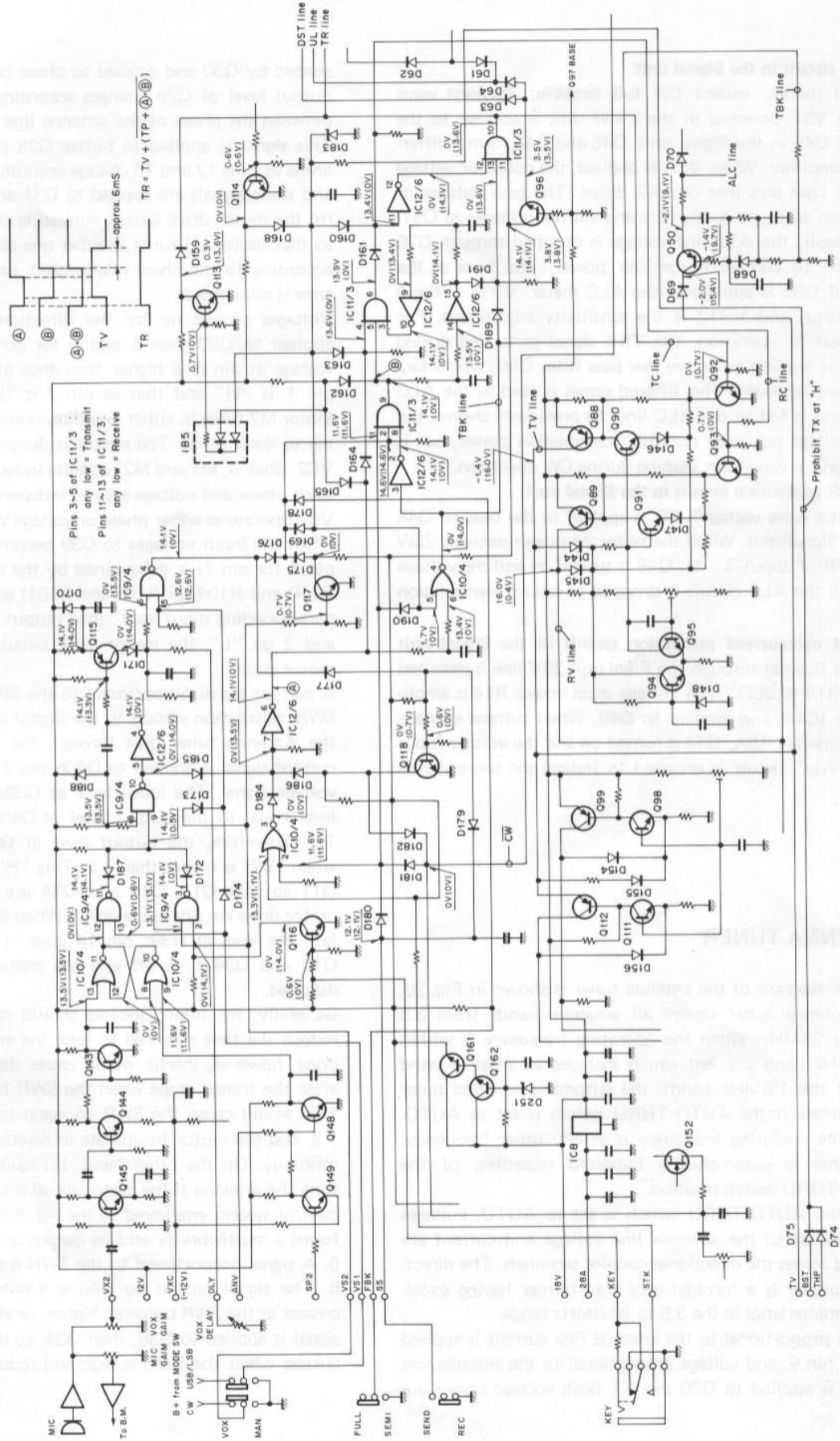
REFERENCE DATA

CW FULL BRAKE IN

Voltage measurement conditions

f = 14.175.0MHz MODE : CW VOX/MAN : VOX FULL/SEMI : FULL CAR CONTROL : MIN STBY : REC

KEY OPEN (in RX) () : KEY CLOSED (in TX)



CIRCUIT DESCRIPTION

● **ALC circuit in the Signal unit**

For all modes, except CW full break-in, forward wave voltage VSF detected in the Filter unit is applied to the base of Q45 in the Signal unit. Q45 and Q44 form a differential amplifier. When VSF is applied, the collector voltage of Q44 rises and that of Q47 drops. The gate voltage of Q52 then drops, as do the base and emitter voltages of Q51. As a result, the ALC line voltage is dropped through D70 and Q51 to control transmitter power. The level at the drain of Q52 is applied to the ALC meter. VR11 is the ϕ adjustment, and VR12 is the sensitivity adjustment. For full break-in operation, the TBK signal generated during keying is applied to active low pass filter Q50, where key clicks are removed. This filtered signal is used as the ALC signal and is fed to the ALC line. As previously shown, the ALC voltage not only controls transmission power, but is also used for waveform shaping during CW operation.

● **VSWR protection circuit in the Signal unit**

Reflected wave voltage VSR is applied to the base of Q48 in the Signal unit. When the reflected power exceeds 25W (an SWR of about 3 : 1), Q48 is turned on and the voltage input to the ALC circuit is dropped to reduce transmission power.

● **Final overcurrent protection circuit in the Signal unit**

Current flowing through the Final unit 28V line is detected across R14 (0.05 Ω). The voltage drop across R14 is amplified by IC4/4 and applied to Q49. When current exceeds approximately 15A, Q49 is turned on and the voltage input to the ALC circuit is dropped to reduce the transmission power.

ANTENNA TUNER

A block diagram of the antenna tuner is shown in Fig. 20. This antenna tuner covers all amateur bands from 3.5 through 29MHz. When the operating frequency is within a 500kHz band segment which includes an amateur band (except the 1.8MHz band), the automatic antenna tuner will operate if the AUTO-THRU switch is set to AUTO. When the operating frequency is at any other frequency, the tuner is automatically bypassed regardless of the AUTO-THRU switch position.

When the AUTO-THRU switch is set to AUTO, voltages proportional to the antenna line voltage and current are induced across the directional coupler terminals. The directional coupler is a toroidal core transformer having excellent characteristics in the 3.5 to 30.0MHz range.

Voltage proportional to the antenna line current is applied to Q30 pin 9, and voltage proportional to the antenna line voltage is applied to Q30 pin 13. Both voltage signals are

shaped by Q30 and applied to phase comparator Q29. The output level of Q29 changes according to the relationship between the phase of the antenna line current and voltage. This signal is applied to buffer Q28 pins 10 and 15. The levels at pins 12 and 13 change according to the input level, and these signals are applied to Q31 and Q32 (which control the motor drive circuit consisting of Q14 through Q19) so that motor M1 turns in either one direction or the other, according to the phase relationship, until the phase difference is minimized.

Voltages picked up by the directional coupler are also applied to Q39 pins 4 and 6 for comparison. When the voltage at pin 6 is higher than that at pin 4, the level at pin 1 is "H" and that at pin 2 is "L" (and vice versa). Motor M2 turns in either one direction or the other, according to these levels. The circuit is designed so that VC1 and VC2 (that is, M1 and M2) operate independently. However, since phase and voltage are not independent, both VC1 and VC2 operate as either phase or voltage varies.

When the input voltages to Q39 become equal, the level at pin 5 (or pin 7) is determined by the divider consisting of R100 and R104 (or R105 and R101) so it is lower than the corresponding input level; then output levels at both pins 1 and 2 go "L", the motor drive circuit turns off and the motor stops.

A current signal proportional to the SWR is derived by the SWR calculation circuit in the Signal unit, and is input to the Antenna tuner unit through the ISW terminal. This current signal is applied to Q40b pin 2 and converted to a voltage signal. The input level at Q39c pin 8 is set to the level equal to the output level of Q40b when the SWR is 1.2. Therefore, the output level at Q39c pin 14 is "H" when SWR is higher than 1.2. This "H" signal is applied to Q11 so that Q11, Q10 and Q34 are turned on and the motor drive circuits are enabled. When SWR becomes 1.2 or less, the level at Q39c pin 14 goes "L". Therefore, Q11, Q10 and Q34 turn off and the motor drive circuits are disabled.

Generally, the tuning motors should run at high speed to reduce the time required to tune the antenna. If this were done, however, inertia would cause the motor to overrun after the motor stops when the SWR becomes 1.2 or less. This would cause the SWR to again become greater than 1.2, and the motor to operate in reverse. This might repeat infinitely. On the other hand, it requires a longer time to tune the antenna if the motor speed is too slow. The motor control system employed in the AT-930 is as follows. Q41 forms a multivibrator and its output is applied to Q40a pin 6. A signal proportional to the SWR is applied to Q40a pin 5. The signal output by Q40 is a pulse whose width increases as the SWR becomes higher, or vice versa. This pulse signal is applied to Q38, then Q34, so that motor speed increases when the SWR is high and reduces when it is low.

CIRCUIT DESCRIPTION

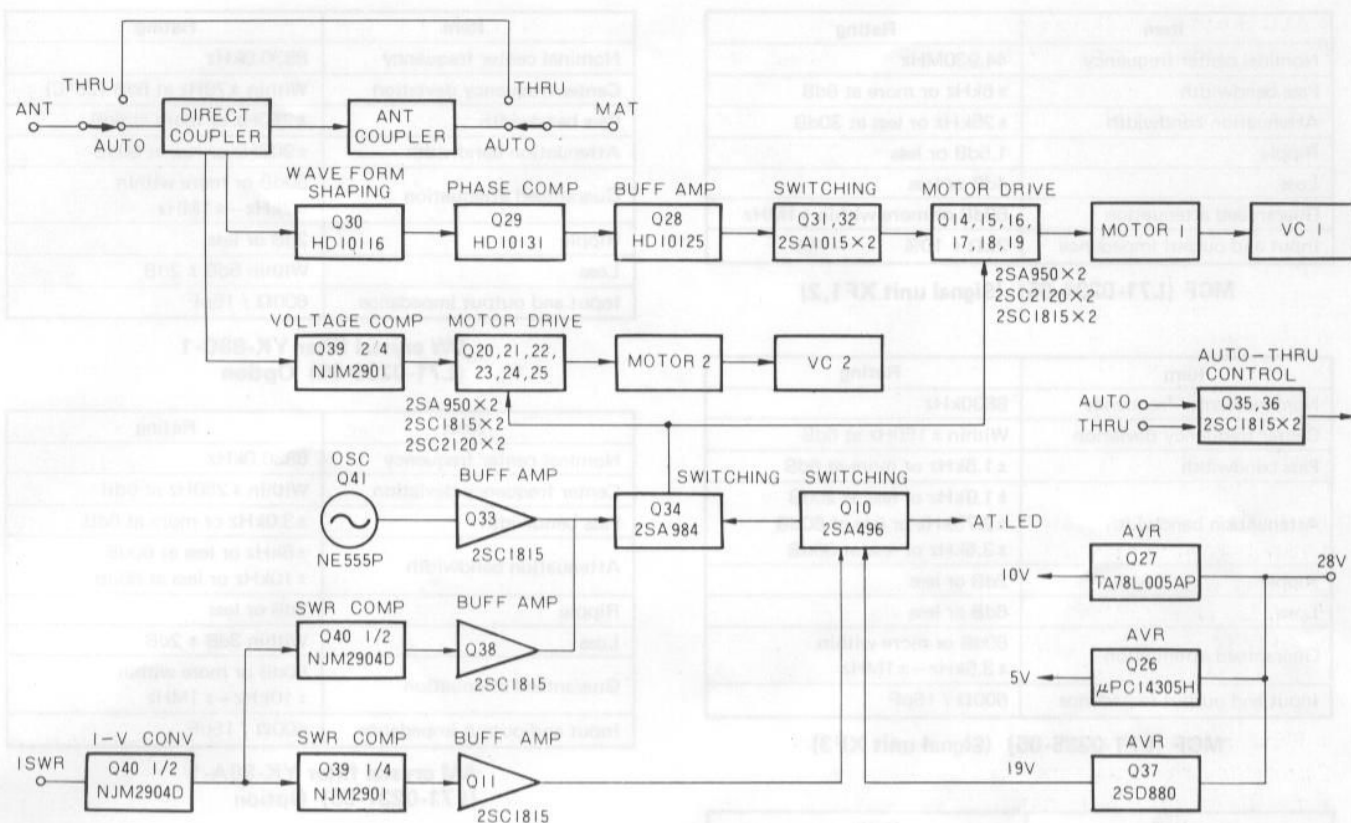


Fig. 20 AT unit block diagram

The antenna tuner is provided with a protection circuit which disables the AUTO-THRU switch during transmission. When the AUTO-THRU switch is at THRU, D13 is on, D14 is off and Q36 is on because a "H" is applied through D15. The "H" at the collector of Q36 is applied to Q8 through D9 and turns Q8 on. Thus, Q7 is on and relay RL1 is actuated. When the AUTO-THRU switch is at AUTO, D12 is on, so D11 and Q35 are off. The collector level at Q35 is applied to Q36 through D10 so Q36 is on. Therefore, Q36 collector level is "L" and Q8 is off. Thus, Q7 and RL1 are off. During transmission, RXB is "L" and both D12 and D13 are turned off, so the AUTO-THRU switch is disconnected from Q35 and Q36. Therefore, the AUTO-THRU switch has no affect.

The BAND data signals for the 3.5MHz to 29MHz Amateur bands are sent from the Digital unit through terminals AT1 to AT6. (See Table 6.) The AT1 signal is used for automatic antenna tuner control ; its level is "H" when the operating frequency is within a 500kHz Amateur band segment. At such time, Q9 is on and D8 is off. This allows Q8 to be controlled through D9. When the level is "L", Q9 is off and D8 is on. Therefore, the level at the base of Q8 is maintained at "H" through R17. (Q8 is always on ; that is, the tuner is in the THRU state.)

The matching circuit used is a "T" configuration when the operating frequency is between 3.5MHz and 14MHz, and a π configuration when the operating frequency is 18MHz or above. Switching between the two is performed by relay RL8. When the motors are operating, the green LED indicator on the front panel lights. This indicator goes off when the motors stop at best match.

BAND	AT1	AT2	AT3	AT4	AT5	AT6
3.5	○	○	○	○		
7	○		○	○		
10	○			○		
14	○			○		○
18,21	○					
24.5,28	○				○	

○ : High Level

Table 6

FILTER DATA

Item	Rating
Nominal center frequency	44.930MHz
Pass bandwidth	±6kHz or more at 6dB
Attenuation bandwidth	±25kHz or less at 30dB
Ripple	1.5dB or less
Loss	4dB or less
Guaranteed attenuation	60dB or more within ±1MHz
Input and output impedance	2kΩ ± 10%

MCF (L71-0234-05) (Signal unit XF1,2)

Item	Rating
Nominal center frequency	8830kHz
Center frequency deviation	Within ±150Hz at 6dB
Pass bandwidth	±1.5kHz or more at 6dB
Attenuation bandwidth	±1.9kHz or less at 20dB ±2.75kHz or less at 60dB ±3.5kHz or less at 80dB
Ripple	2dB or less
Loss	6dB or less
Guaranteed attenuation	80dB or more within ±3.5kHz—±1MHz
Input and output impedance	600Ω / 15pF

MCF (L71-0235-05) (Signal unit XF3)

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

AM ceramic filter (L72-0319-05) (Signal 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

SSB ceramic filter (L72-0334-05) (Signal 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

**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

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

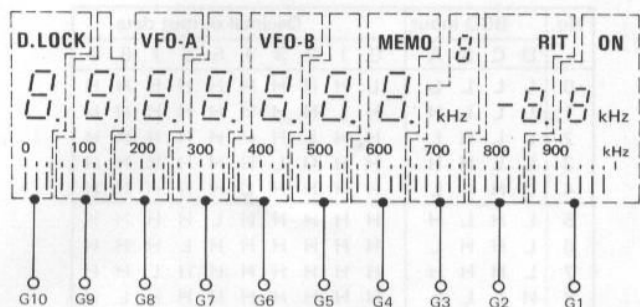
Item	Rating
Center frequency	455kHz
Center frequency deviation	Within 50Hz at 6dB
Pass bandwidth	±250Hz or more at 6dB
Attenuation bandwidth	±425Hz or less at 60dB
Ripple	2dB or less
Loss	6dB or less
Guaranteed attenuation	80dB or more within 100Hz—454.4kHz 80dB or more within 455.6kHz—2MHz
Input and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

**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%

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

SEMICONDUCTOR DATA

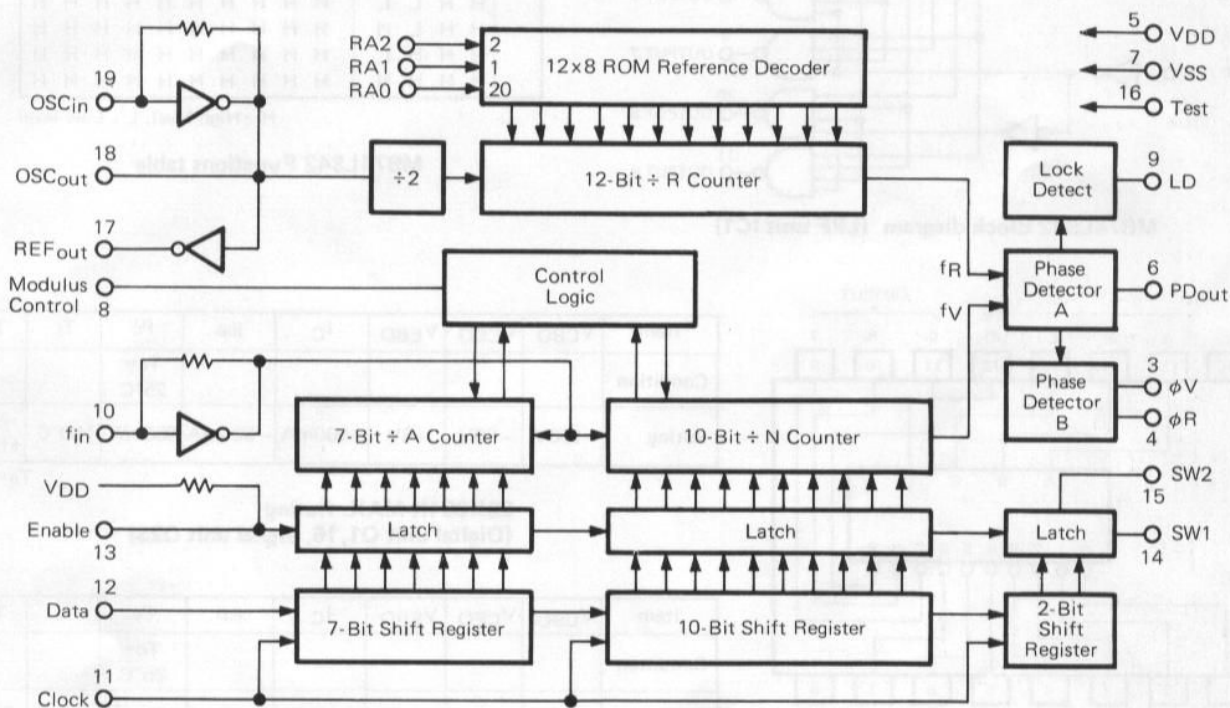


11-BT-03Z (Switch unit V1)

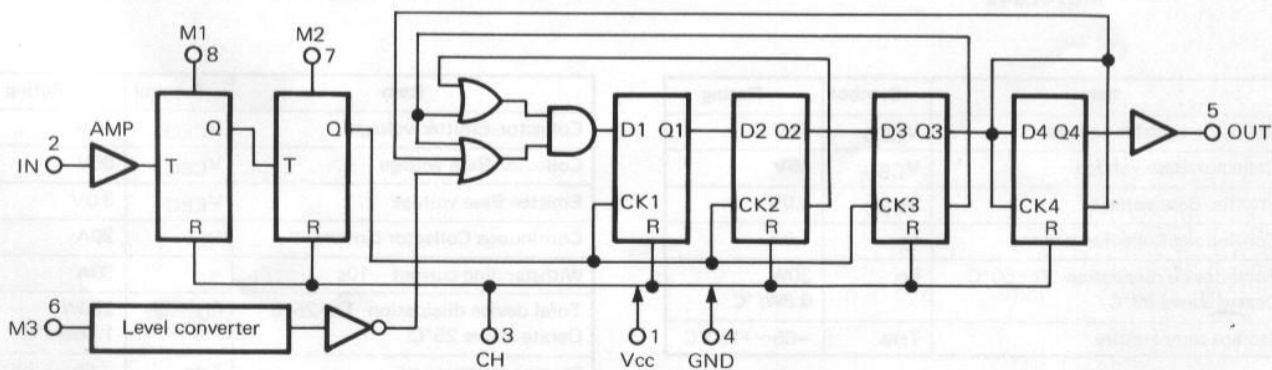
Item	Symbol	Rating
Gate-Drain voltage	V _{CDO}	-25V
Gate-Source voltage	V _{GSO}	-25V
Continuous Drain current	I _D	100mA
Continuous Gate current	I _G	10mA
Power dissipation	P _{ch}	500mW
Channel temperature	T _{ch}	120°C
Storage temperature	T _{stg}	-50~+120°C

2SK125P MAX. Rating (RF unit Q1,2)

T_a=25°C

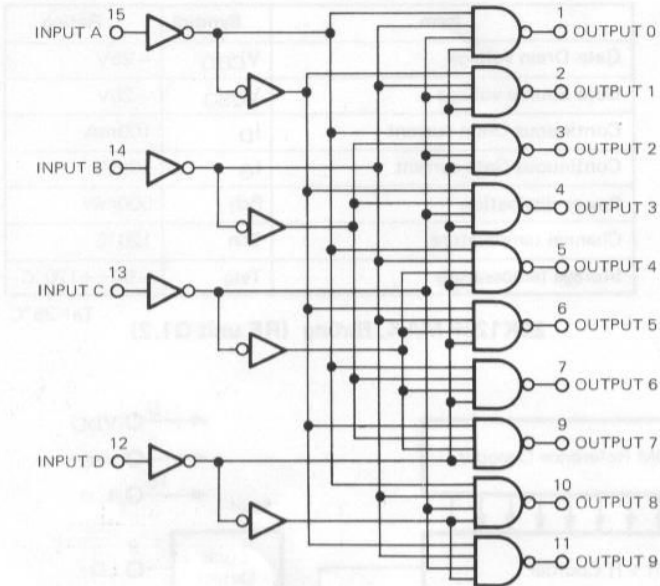


MC145156P Block diagram (PLL unit IC5)



μPB551C Block diagram (PLL unit IC8)

SEMICONDUCTOR DATA

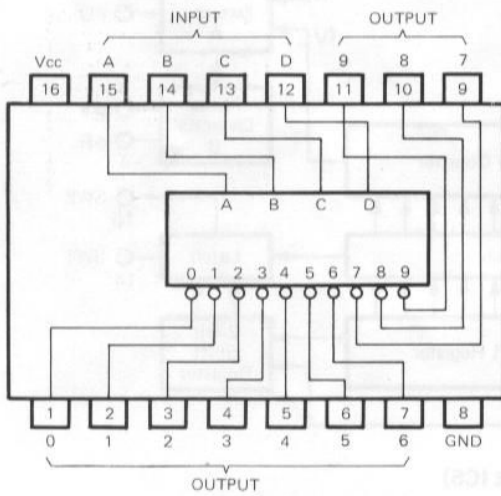


MB74LS42 Block diagram (LPF unit IC1)

No.	BCD input				Decimal output data									
	D	C	B	A	0	1	2	3	4	5	6	7	8	9
0	L	L	L	L	L	H	H	H	H	H	H	H	H	H
1	L	L	L	H	H	L	H	H	H	H	H	H	H	H
2	L	L	H	L	H	H	L	H	H	H	H	H	H	H
3	L	L	H	H	H	H	H	L	H	H	H	H	H	H
4	L	H	L	L	H	H	H	H	L	H	H	H	H	H
5	L	H	L	H	H	H	H	H	H	L	H	H	H	H
6	L	H	H	L	H	H	H	H	H	H	L	H	H	H
7	L	H	H	H	H	H	H	H	H	H	H	L	H	H
8	H	L	L	L	H	H	H	H	H	H	H	H	L	H
9	H	L	L	H	H	H	H	H	H	H	H	H	H	L
	H	L	H	L	H	H	H	H	H	H	H	H	H	H
	H	L	H	H	H	H	H	H	H	H	H	H	H	H
	H	H	L	L	H	H	H	H	H	H	H	H	H	H
	H	H	L	H	H	H	H	H	H	H	H	H	H	H
	H	H	H	L	H	H	H	H	H	H	H	H	H	H
	H	H	H	H	L	H	H	H	H	H	H	H	H	H
	H	H	H	H	H	L	H	H	H	H	H	H	H	H

H : High level, L : Low level

MB74LS42 Functions table



MB74LS42

Item	V _{CBO}	V _{CEO}	V _{EBO}	I _C	i _{cp}	P _c	T _j	T _{stg}
Condition						T _c = 25°C		
Rating	-100V	-80V	-5V	-500mA	-800mA	600mW	150°C	-55~+150°C

T_a = 25°C

2SK984K MAX. Rating (Digital unit Q1,16, Signal unit Q23)

Item	V _{CBO}	V _{CEO}	V _{EBO}	I _C	i _{cp}	P _c	T _j	T _{stg}
Condition						T _c = 25°C		
Rating	100V	80V	5V	500mA	800mA	600mW	150°C	-55~+150°C

T_a = 25°C

2SC2274K MAX. Rating (Digital unit Q14,15)

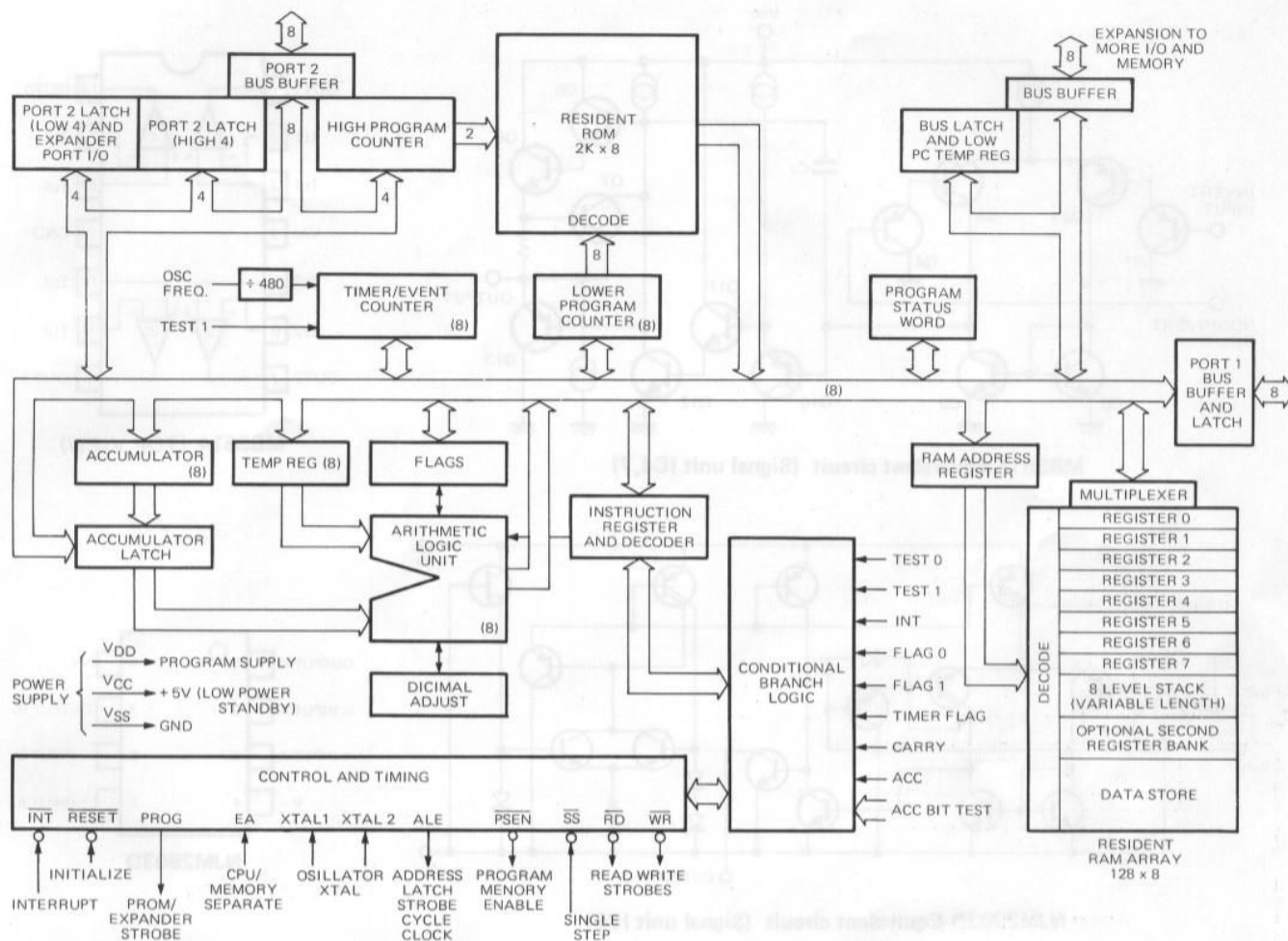
Item	Symbol	Rating
Collector-Emitter voltage	V _{CEO}	35V
Collector-Base voltage	V _{CBO}	65V
Emitter-Base voltage	V _{EBO}	4.0V
Continuous Collector current	I _C	1.0A
Total device dissipation T _c = 50°C Derate above 50°C	P _D	30W 0.3W/°C
Storage temperature	T _{stg}	-65~+150°C

MRF485 MAX. Rating (100W Final unit Q2,3)

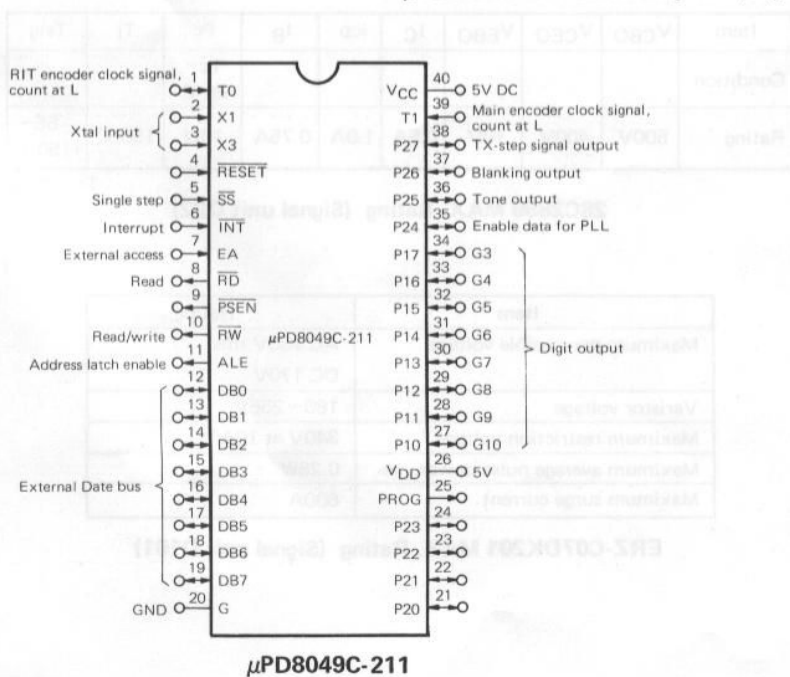
Item	Symbol	Rating
Collector-Emitter voltage	V _{CEO}	40V
Collector-Base voltage	V _{CBO}	85V
Emitter-Base voltage	V _{EBO}	3.0V
Continuous Collector current	I _C	20A
Withstanding current -10s	-	30A
Total device dissipation T _c = 25°C Derate above 25°C	P _D	290W 1.66W/°C
Storage temperature	T _{stg}	-65~+200°C

MRF422 MAX. Rating (100W Final unit Q4,5)

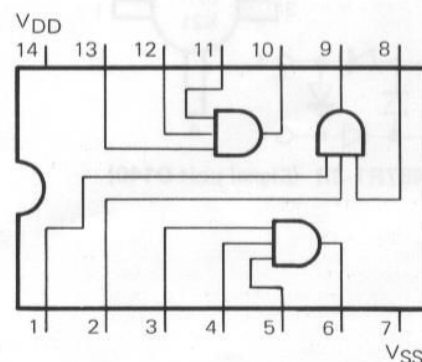
SEMICONDUCTOR DATA



μPD8049C-211 Block diagram (Digital unit IC6)

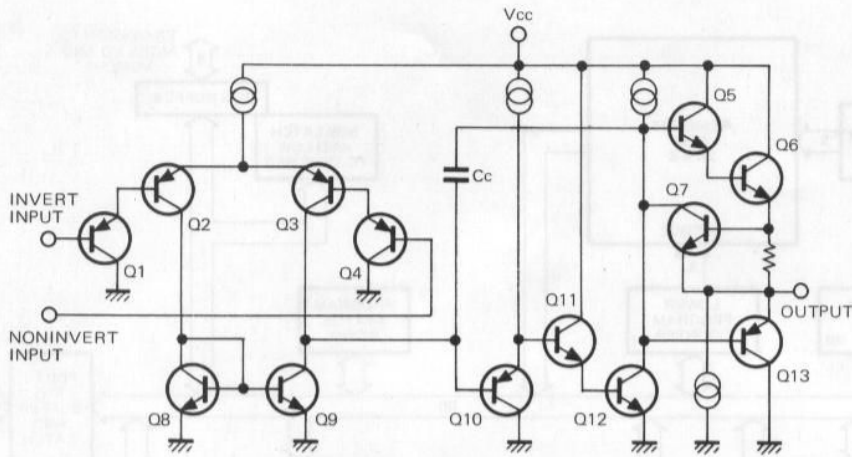


μPD8049C-211

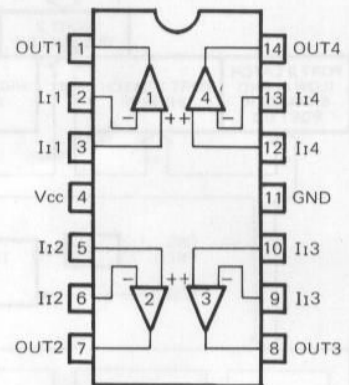


TC4073BP (Signal unit IC11)

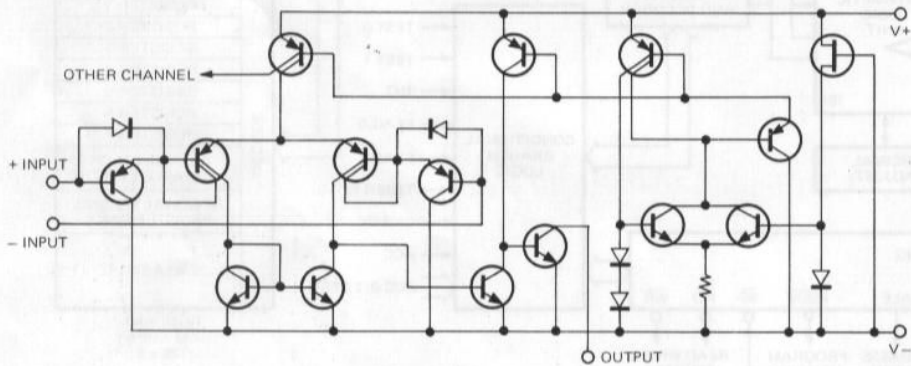
SEMICONDUCTOR DATA



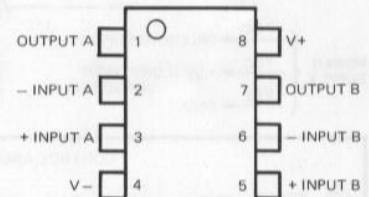
MB3614 Equivalent circuit (Signal unit IC4,7)



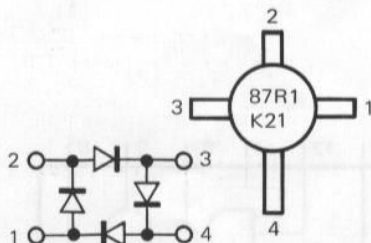
MB3614 (TOP VIEW)



NJM2903D Equivalent circuit (Signal unit IC5)



NJM2903D



ND487R1-3R (Signal unit D140)

Item	V _{CB0}	V _{CEO}	V _{EB0}	I _C	i _{cp}	I _B	P _c	T _j	T _{stg}
Condition							T _c = 25°C		
Rating	500V	400V	10V	0.5A	1.0A	0.75A	10W	150°C	-55~ +150°C

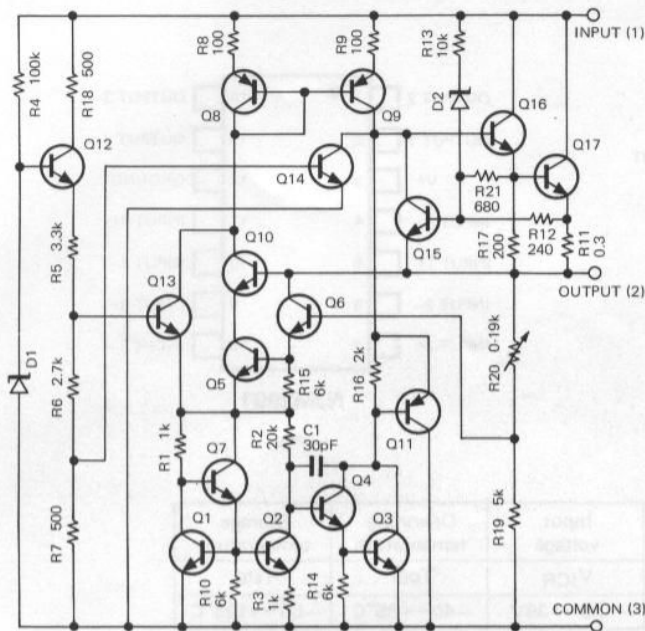
T_a = 25°C

2SC2899 MAX. Rating (Signal unit Q22)

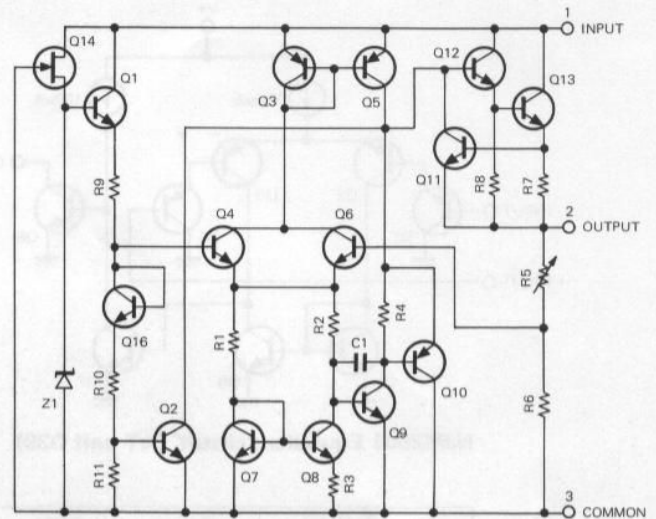
Item	Rating
Maximum permissible voltage	AC 130V rms DC 170V
Varistor voltage	180~255V
Maximum restriction voltage	340V at 10A
Maximum average pulse power	0.25W
Maximum surge current	600A

ERZ-C07DK201 MAX. Rating (Signal unit D101)

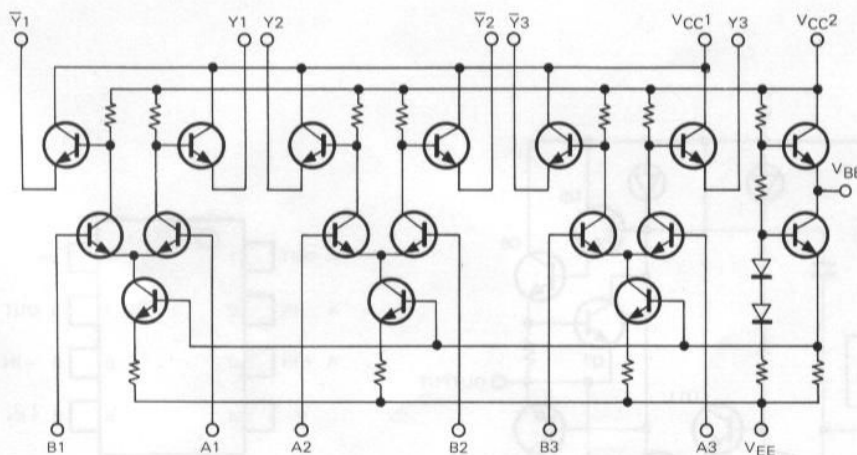
SEMICONDUCTOR DATA



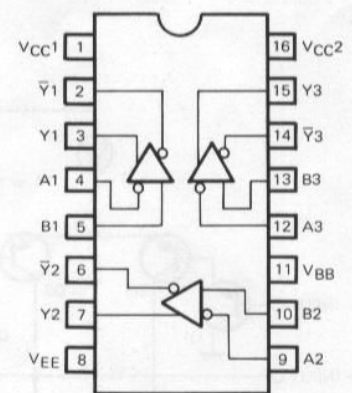
UA7818UC Equivalent circuit (Signal unit IC8)



TA78L005AP Equivalent circuit (AT unit Q27)



HD10116 Equivalent circuit (AT unit Q30)



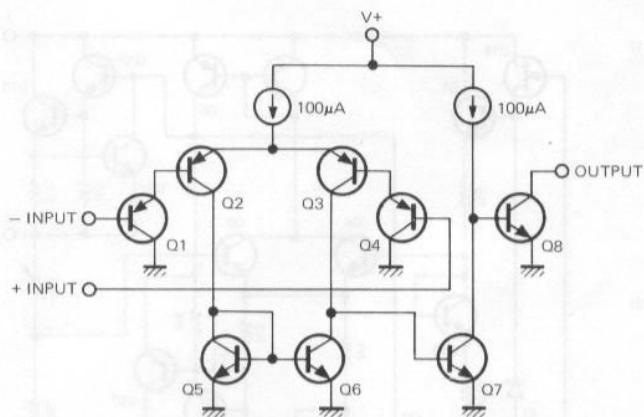
HD10116 (TOP VIEW)

Item	Symbol	Rating
Collector-Base voltage	V_{CBO}	-35V
Collector-Emitter voltage	V_{CEO}	-30V
Emitter-Base voltage	V_{EBO}	-5V
Continuous Collector current	I_C	-800mA
Continuous Emitter current	I_E	800mA
Collector dissipation	P_C	600mW
Operating temperature	T_j	150°C
Storage temperature	T_{stg}	-55~+150°C

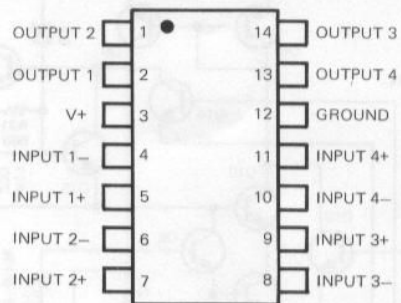
$T_a = 25^\circ\text{C}$

2SA950 MAX. Rating (AT unit Q14, 15, 20, 21)

SEMICONDUCTOR DATA



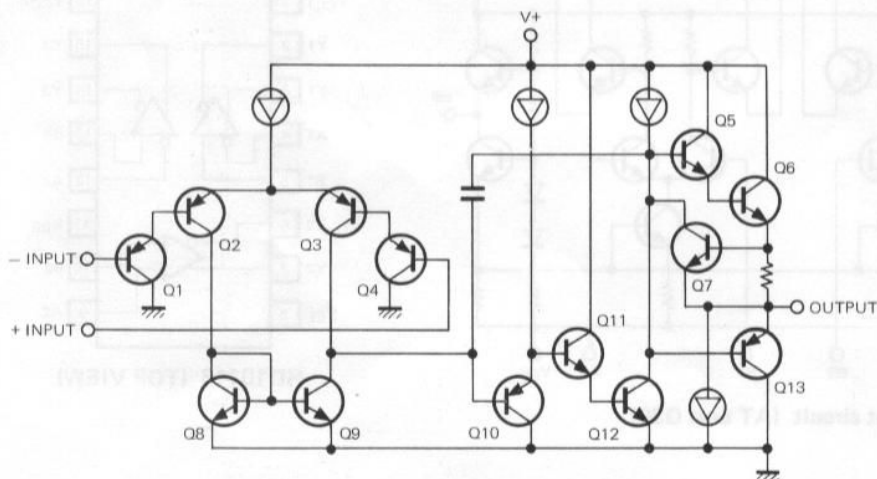
NJM2901 Equivalent circuit (AT unit Q39)



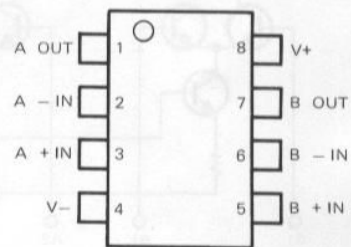
NJM2901

Item	Voltage supply	Power consumption	Differential input voltage	Input voltage	Operating temperature	Storage temperature
Symbol	V_s	P_T	V_{IDR}	V_{ICR}	T_{opr}	T_{stg}
Rating	36V	570mW	36V	-0.3~+36V	-40~+85°C	-50~+125°C

NJM2901 MAX. Rating



NJM2904D Equivalent circuit (AT unit Q40)

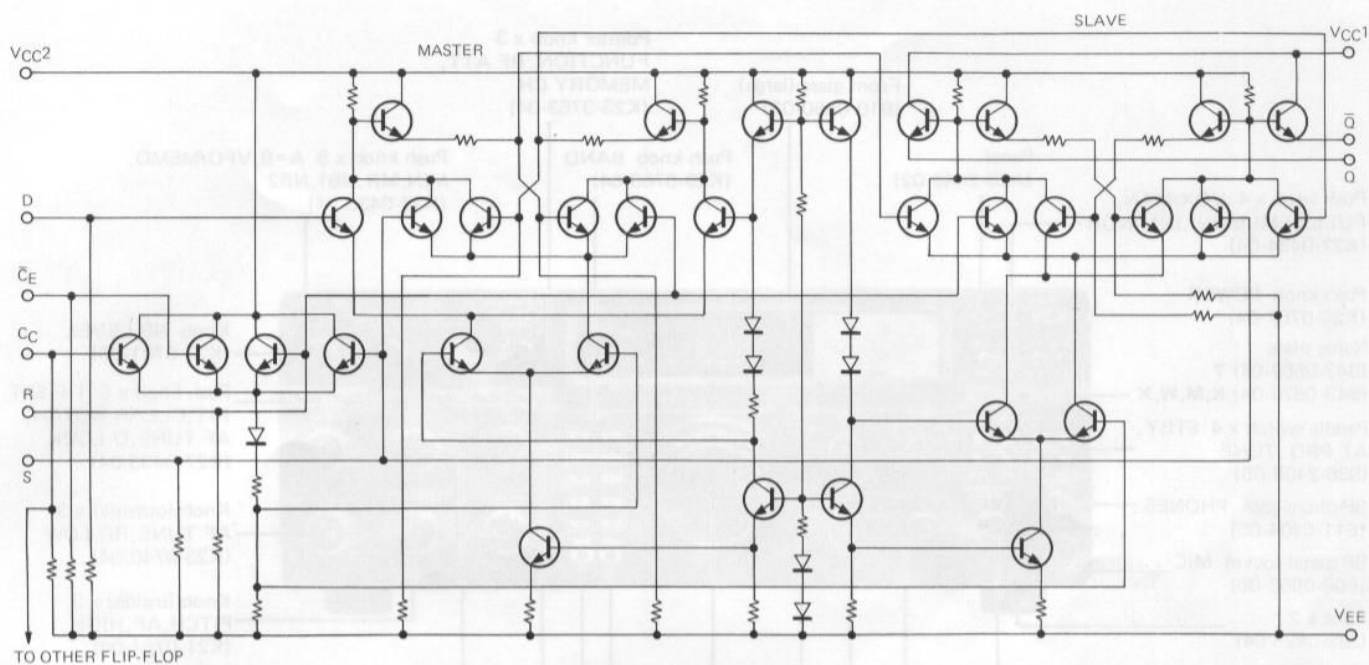


NJM2904D

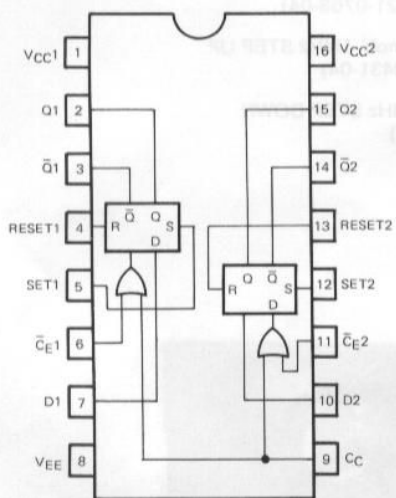
Item	Voltage supply	Power consumption	Differential input voltage	Input voltage	Operating temperature	Storage temperature
Symbol	V_s	P_T	V_{ID}	V_{ICM}	T_{opr}	T_{stg}
Rating	32±16V	500mW	-0.3~+26V	-0.3~+32V	-20~+75°C	-40~+125°C

NJM2904D MAX. Rating

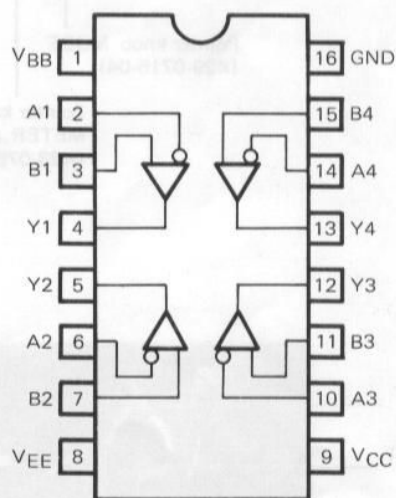
SEMICONDUCTOR DATA



HD10131 Equivalent circuit 1/2 (AT unit Q29)

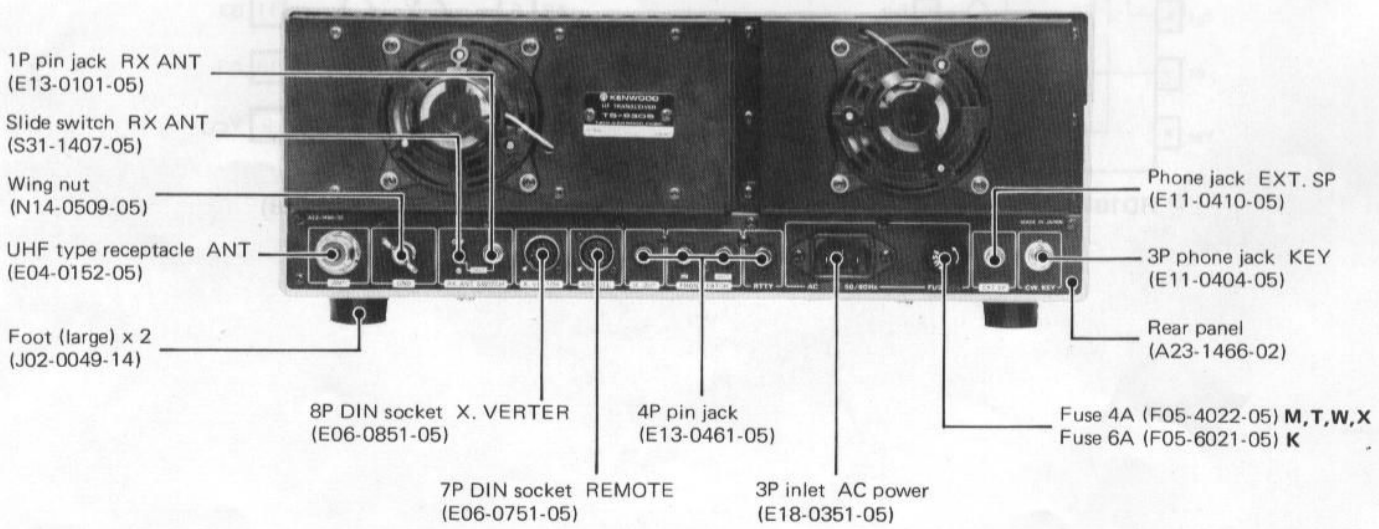
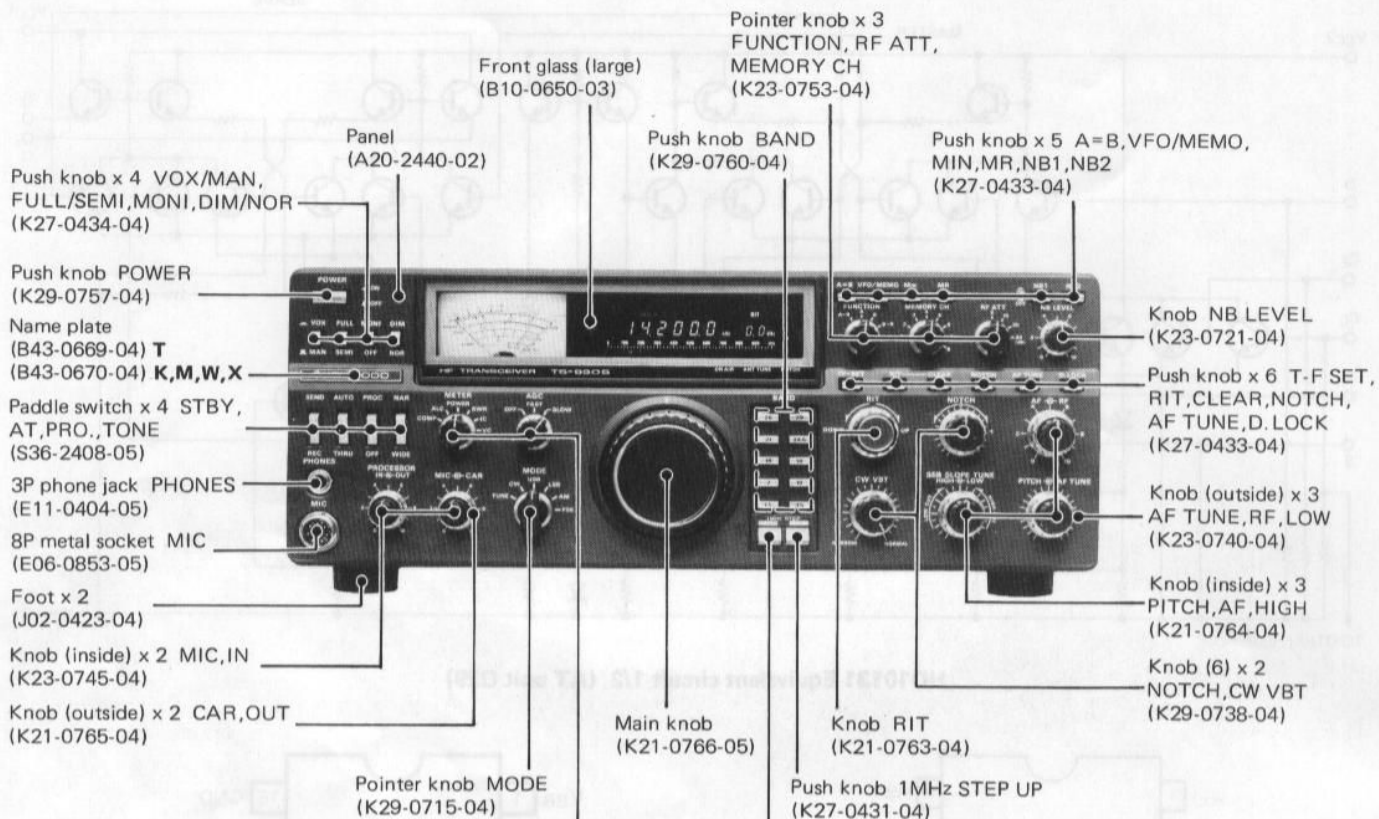


HD10131 (TOP VIEW)

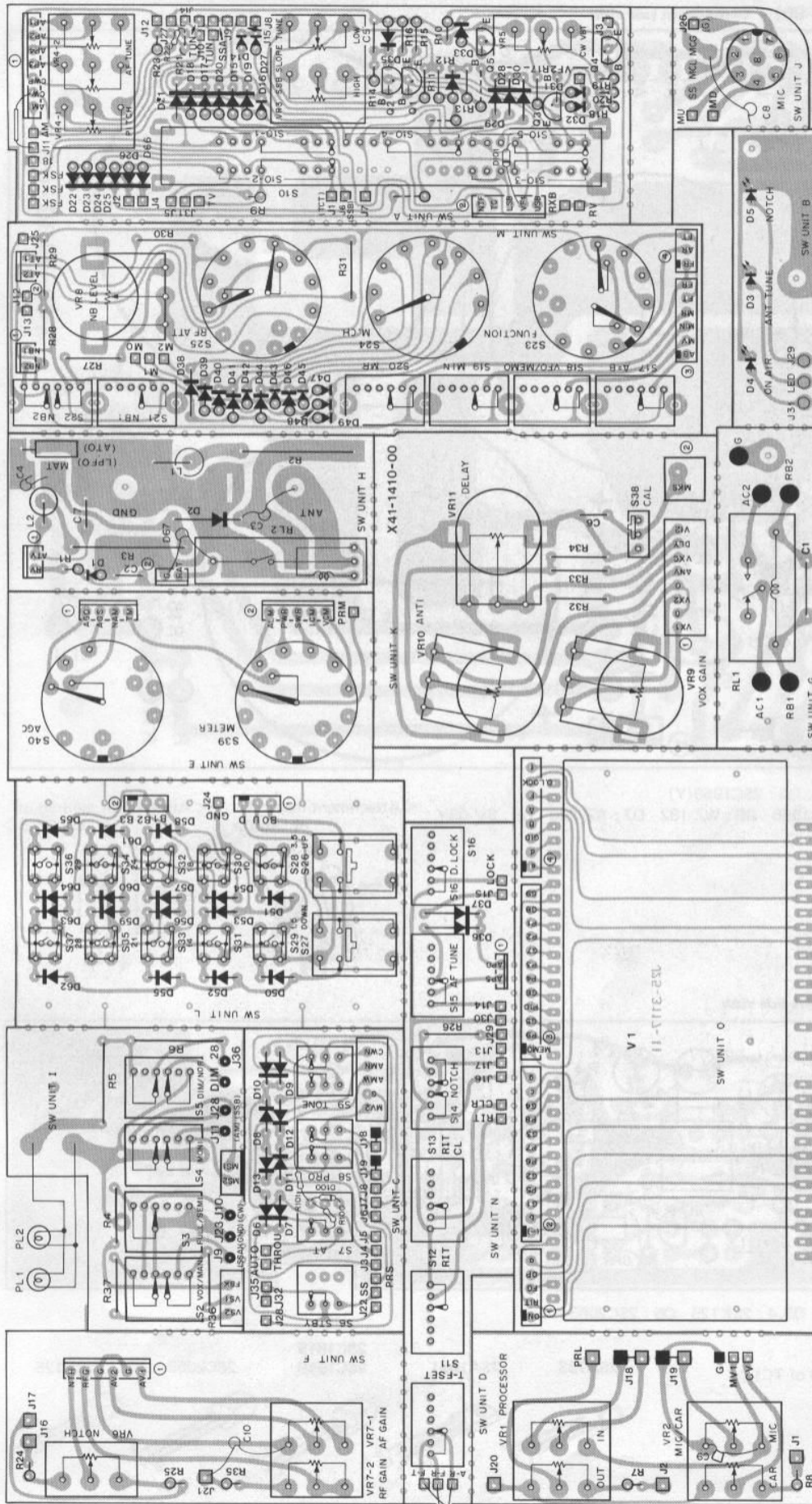


HD10125 (AT unit Q28)
(TOP VIEW)

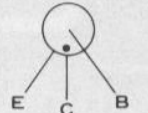
ATA OUTSIDE VIEWS



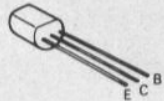
SWITCH UNIT (X41-1410-00) Component side view



Transistor terminal indication



2SA1015
2SC1815

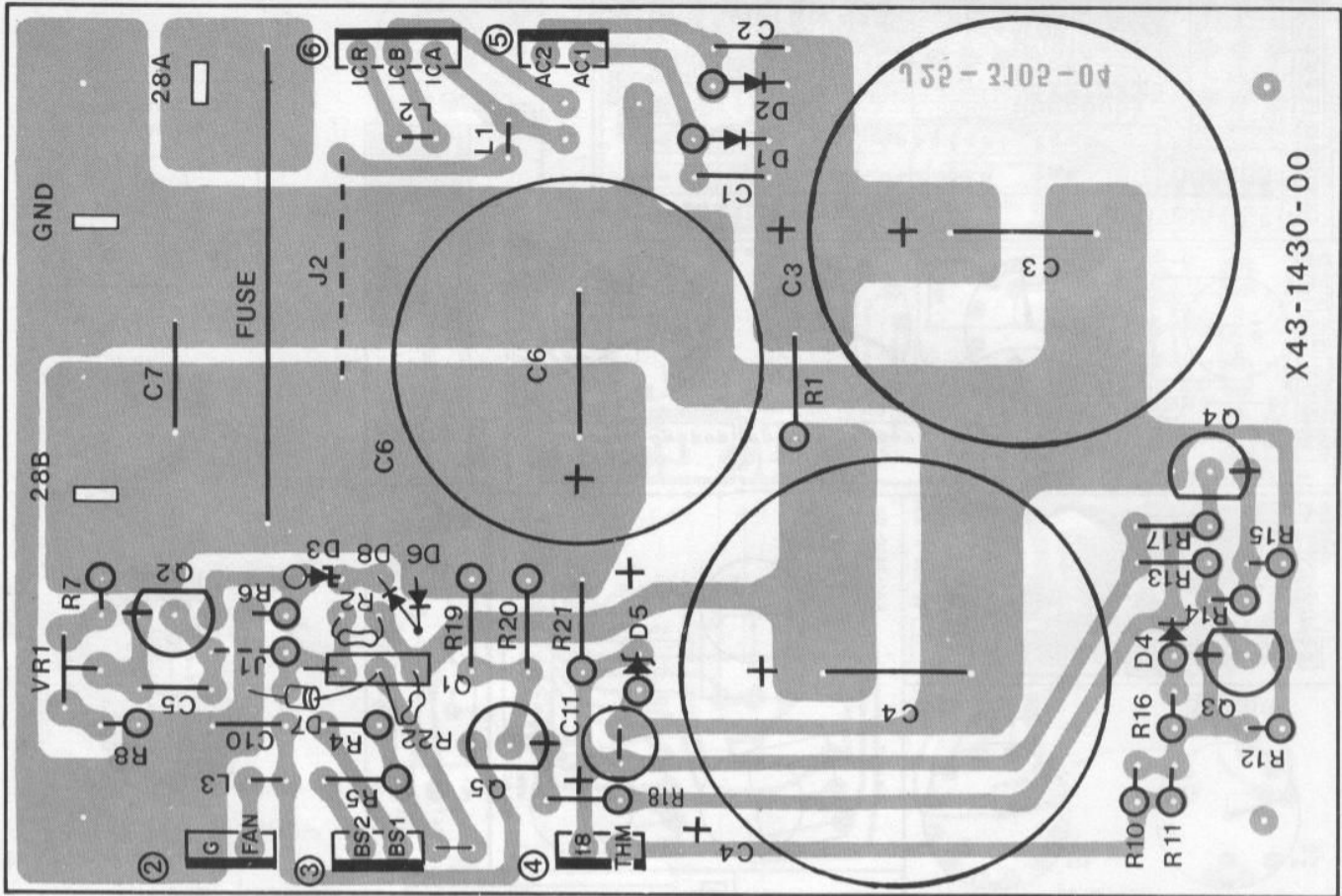


BG5532K
PR5532K



- O1-4 : 2SC1815(Y) O5 : 2SA1015(Y)
- D1,6-34,36-66,100,101 : 1S1555 D2 : GM-3A D3 : BG5532K
- D4,5 : PR5532K D35 : XZ-051 D67 : ERZD03DK331 V1 : 11-BT-03Z

POWER SUPPLY UNIT (X43-1430-00) Component side view

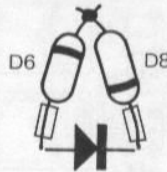


X43-1430-00

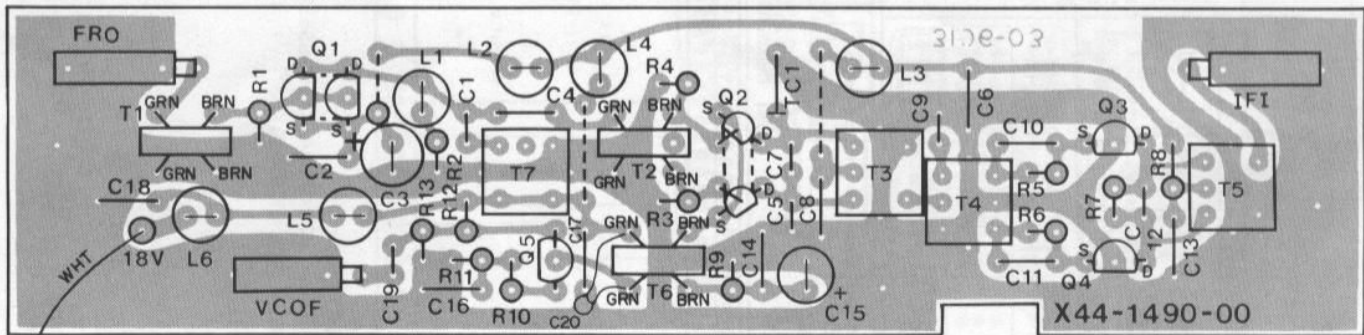
Q1: 2SA1021(O) Q2-4: 2SC1815(Y) Q5: 2SC1959(Y)
 D1,2: V03(C) D3: XZ-122 D4,6: 1S1555 D5: WZ-182 D7: BZ-320 D8: SV-03Y

< Attachment method of D6,8 >

< Attachment method of Q1,D6,8 >



RF UNIT (X44-1490-00) Component side view



Q1,2: 2SK125P Q3,4: 2SK125 Q5: 2SC2053

< Attachment method of TC1 >



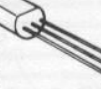
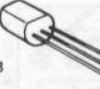
2SA733

2SA1021

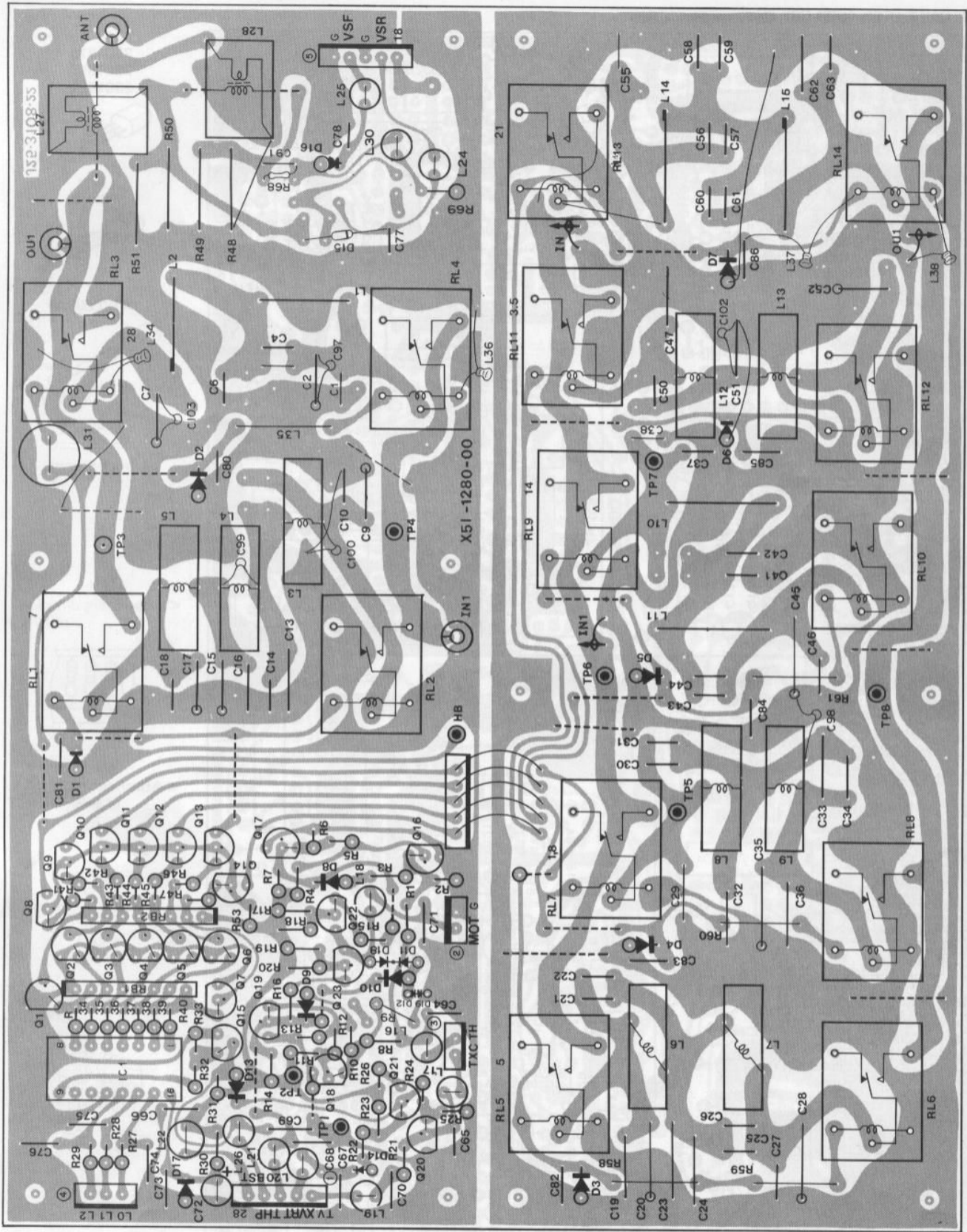
2SC1815
2SC1959

2SC2053

2SK125



LPF UNIT (X51-1280-00) Component side view



< Attachment method of L27,28 >



< Attachment method of C2,7,9,15,17,20,35,45,52,62 >



< Attachment method of D11,18 >



< Attachment method of D19,12 >



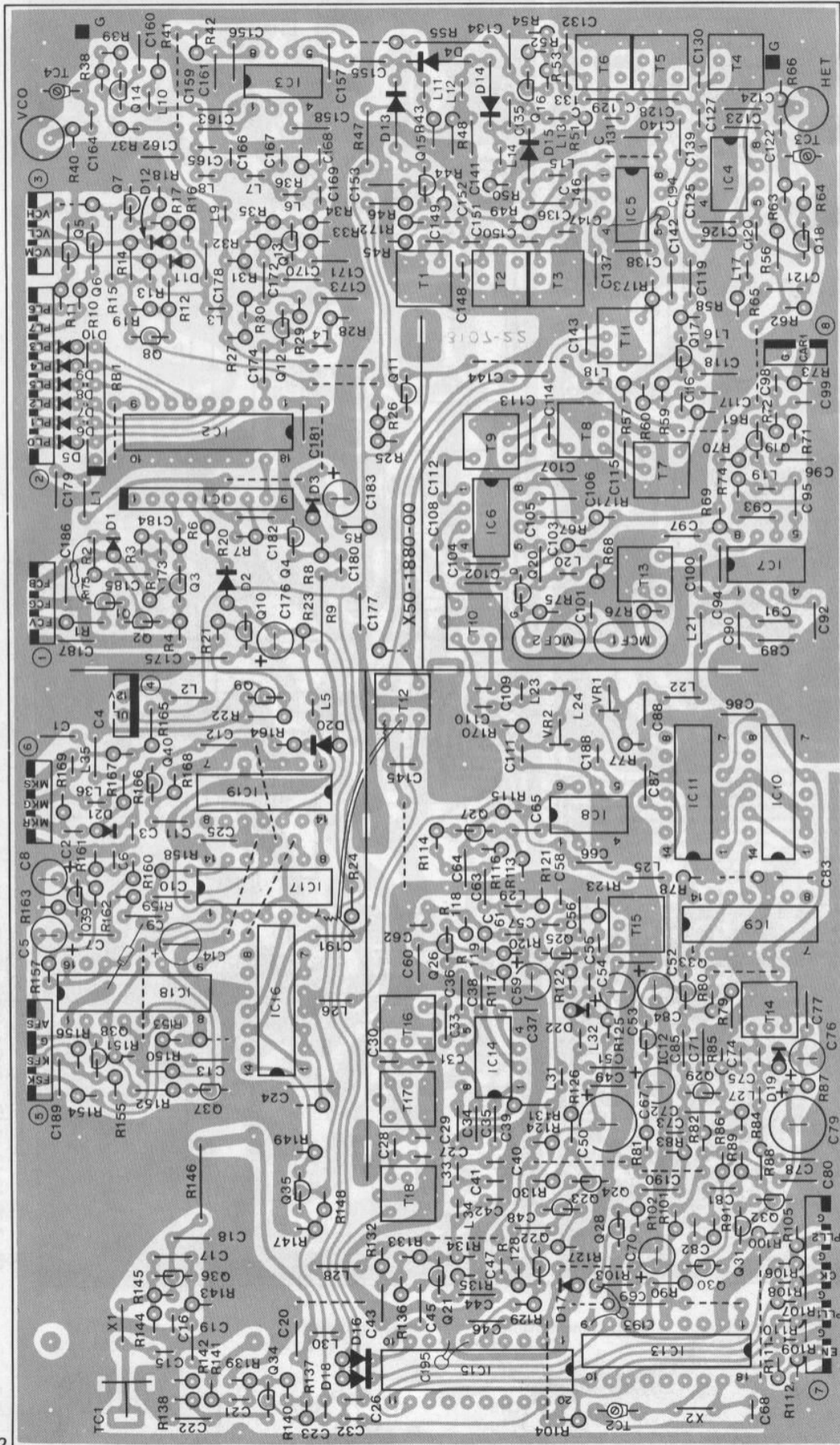
< Attachment method of L2,14,15 >



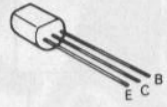
Q1-7,15-19: 2SC1815(Y) Q8-14,20,22,23: 2SC1959(Y) Q21: 2SA733(Y) IC1: MB74LS42
 D1-7,10,12,13,18,19: 1S1555 D8,9: 1N60 D11: XZ-090 D14: WZ-120 D15: 1S1007 D16: 1S1587 D17: XZ-055

TS-930S PC BOARD VIEW

PLL UNIT (X50-1880-00) Component side view



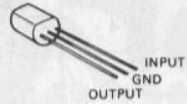
- 2SA1015
- 2SC1775
- 2SC1815
- 2SC1923



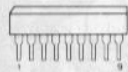
2SK19



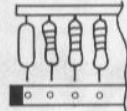
TA78L005AP



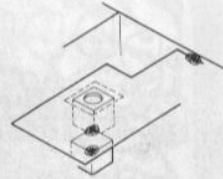
TC5081P



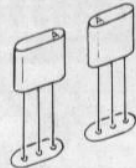
< Attachment direction of RB1 >

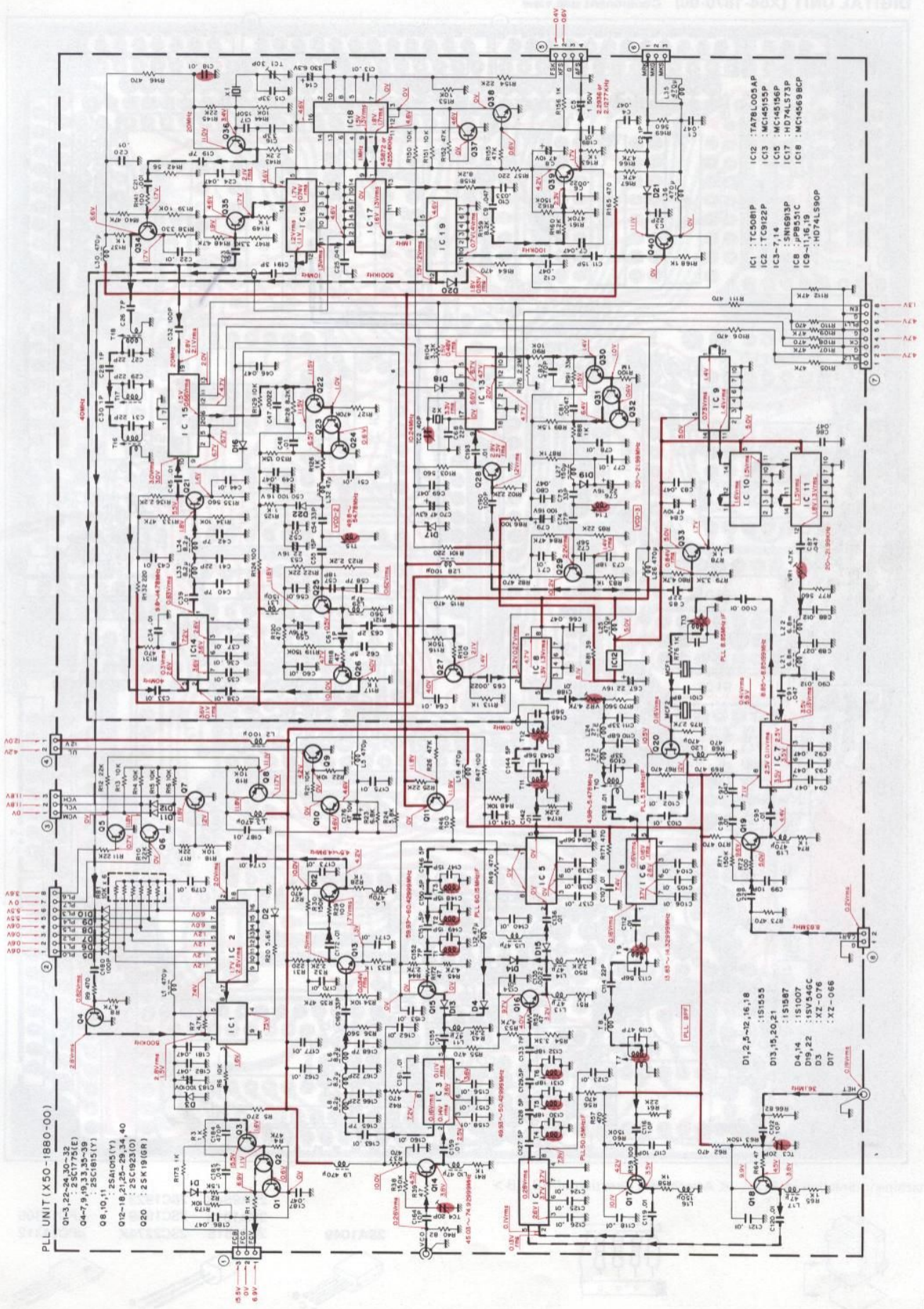


< Attachment method of shield plate >



< Attachment direction of MCF >





- IC1 : TC508BP
 IC2 : TC9122P
 IC3-7,14 : MC145156P
 IC8 : 5N683P
 IC9 : JPB531C
 IC10 : HD74LS73P
 IC11 : MC14569BCP
 IC12 : TA78L005AP
 IC13 : MC145155P
 IC15 : MC145156P
 IC16 : HD74LS73P
 IC17 : HD74LS73P
 IC18 : MC14569BCP
 IC19 : HD74LS90P

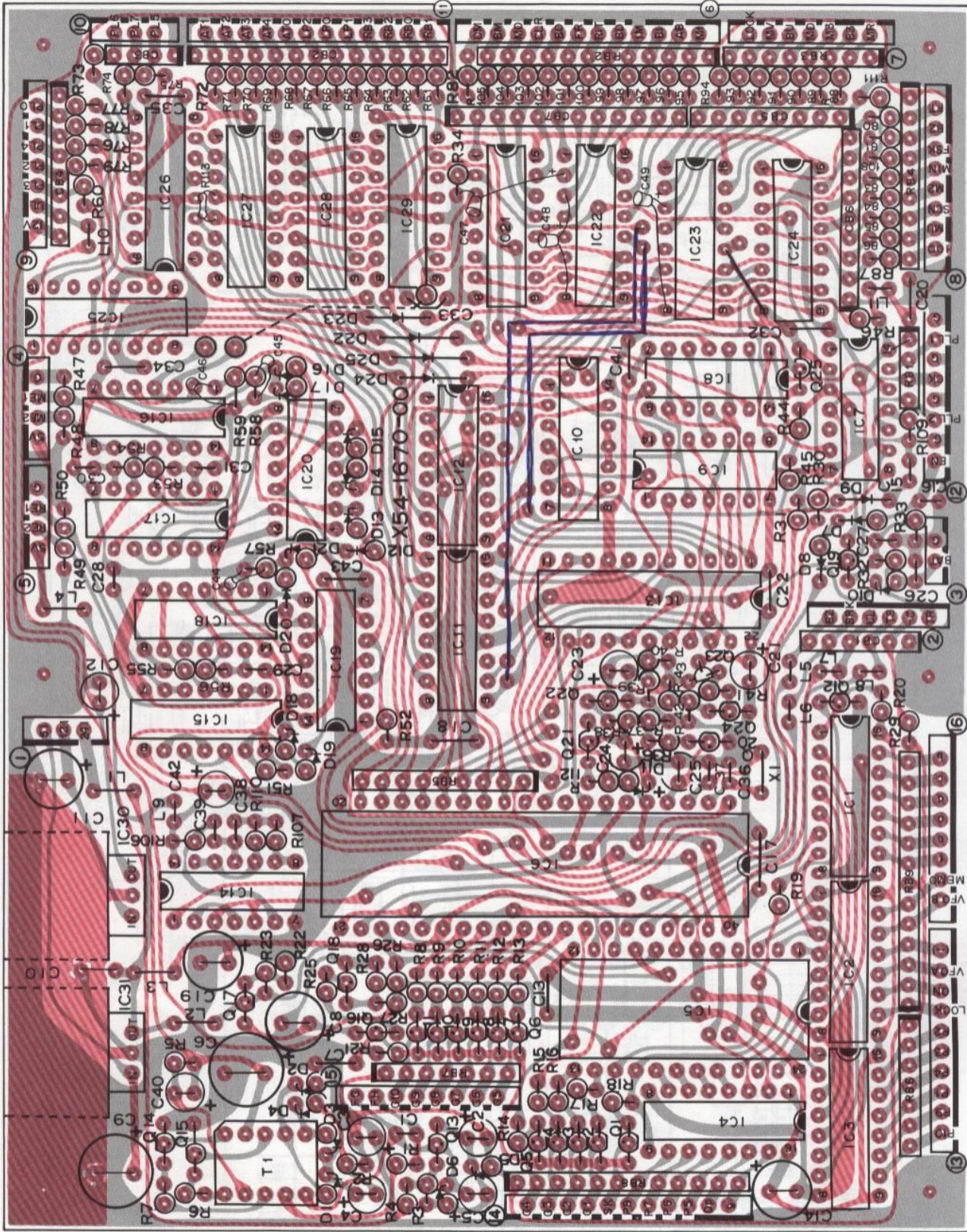
- PLL UNIT (X50-1880-00)
 01-3,22-24,30-32 : 25C1775(E)
 04-7,9,33,35-39 : 25C1815(F)
 08,10,11 : 25A105(Y)
 012-18,21,25-29,34,40 : 25C1823(O)
 020 : 25K19(GR)

- D1,2,5-12,15,18 : 1S1595
 D13,15,20,21 : 1S1587
 D4,14 : 1S1007
 D9,22 : 1SV546C
 D3 : XZ-076
 D17 : XZ-068

TS-930S PC BOARD VIEW

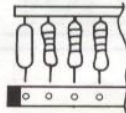
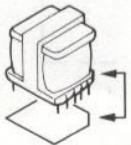
DIGITAL UNIT (X54-1670-00) Component side view

100-0001-02(X) TIRU 1.14

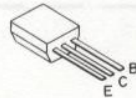


*WARC mod IC23 TO IC24
Full TRANSCIENCE mod IC11+IC12
TO IC22*

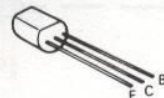
< Attachment direction of T1 > < Attachment direction of RB, CB >



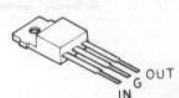
2SA1049



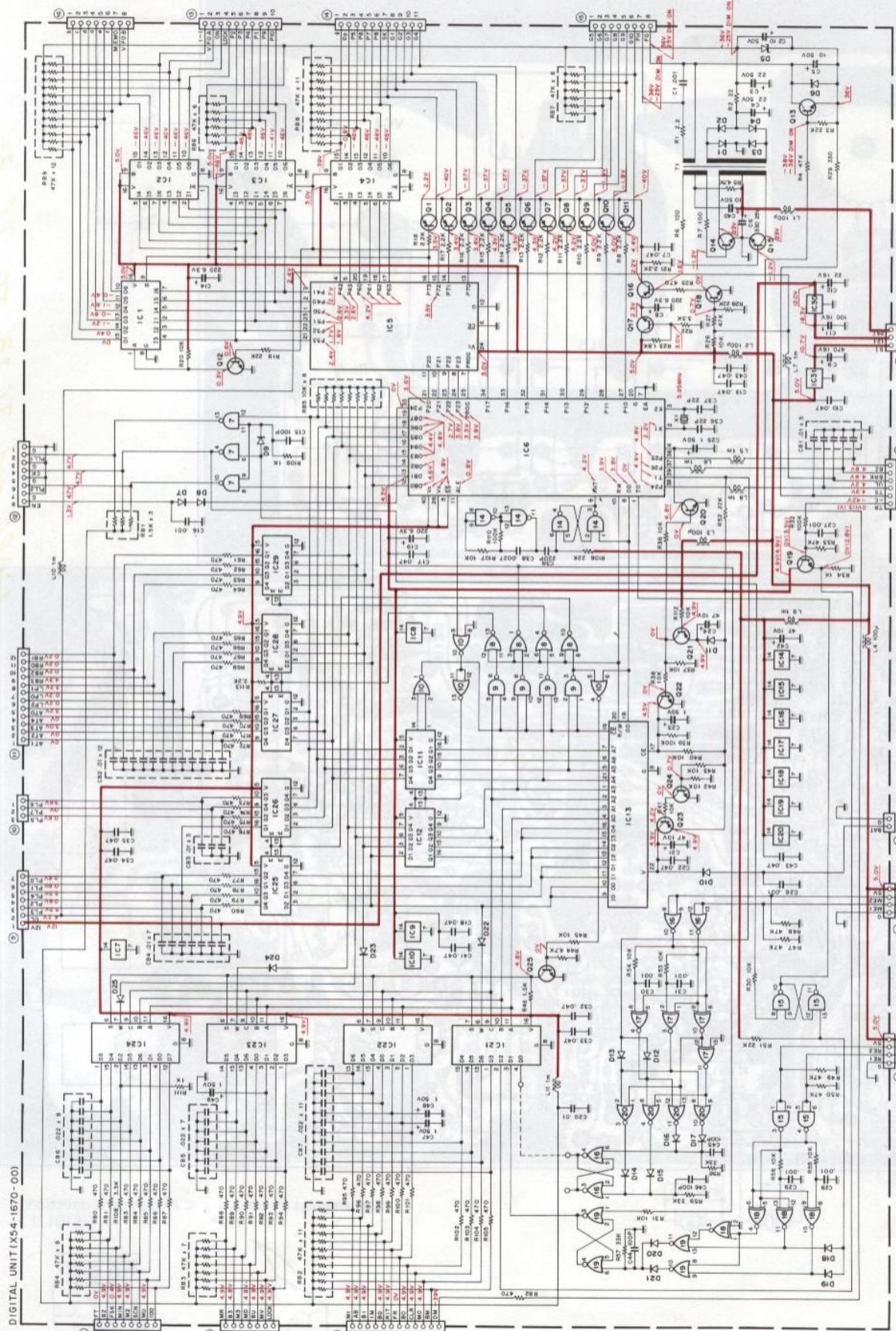
2SA984K 2SC1923
2SA1015 2SC1959
2SC1815 2SC2274K



μPC14305
μPC14312

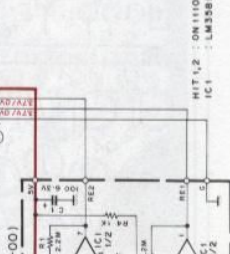
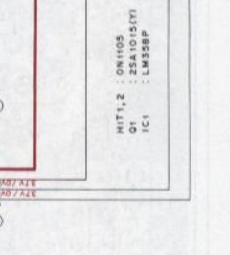
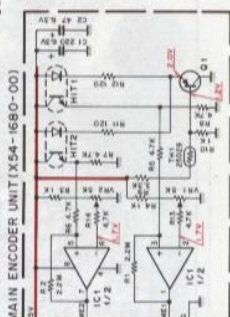


DIGITAL UNIT (X54-1670-00)



- IC1-4 : TC5088P
- IC5 : PD023C
- IC6 : PD0849C-211
- IC7 : HD74LS01P or SN74LS01N
- IC8,10 : HD74LS02P or SN74LS02N
- IC9 : SN74LS00P or SN74LS00N
- IC11,12,25-29 : HD74LS15P or SN74LS15N
- IC13 : PD0101LC
- IC14,15 : TC4011BP
- IC16 : TC4001BP
- IC17,18,20 : SN74LS10P or SN74LS10N
- IC21~24 : HD74LS151P or SN74LS151N
- IC30 : JPC4312
- IC31 : JPC4305

- Q1-16 : 2SA984K(E)
- Q2~11 : 2SA1049(ER)
- IC12,13,18~20,22,24 : 25C1815(Y)
- Q14,15 : 25C2274K(E)
- IC18 : 25C1959(Y)
- Q21,23 : 25C1959(Y)
- Q25 : 25C1923(L)
- D1~4 : 1N4448
- D5 : TC4001BP
- D6 : WS-130
- D7~9,22~25 : 1S1587
- IC30 : 1S1555
- D10,12~21 : IN60
- D11 : IN60

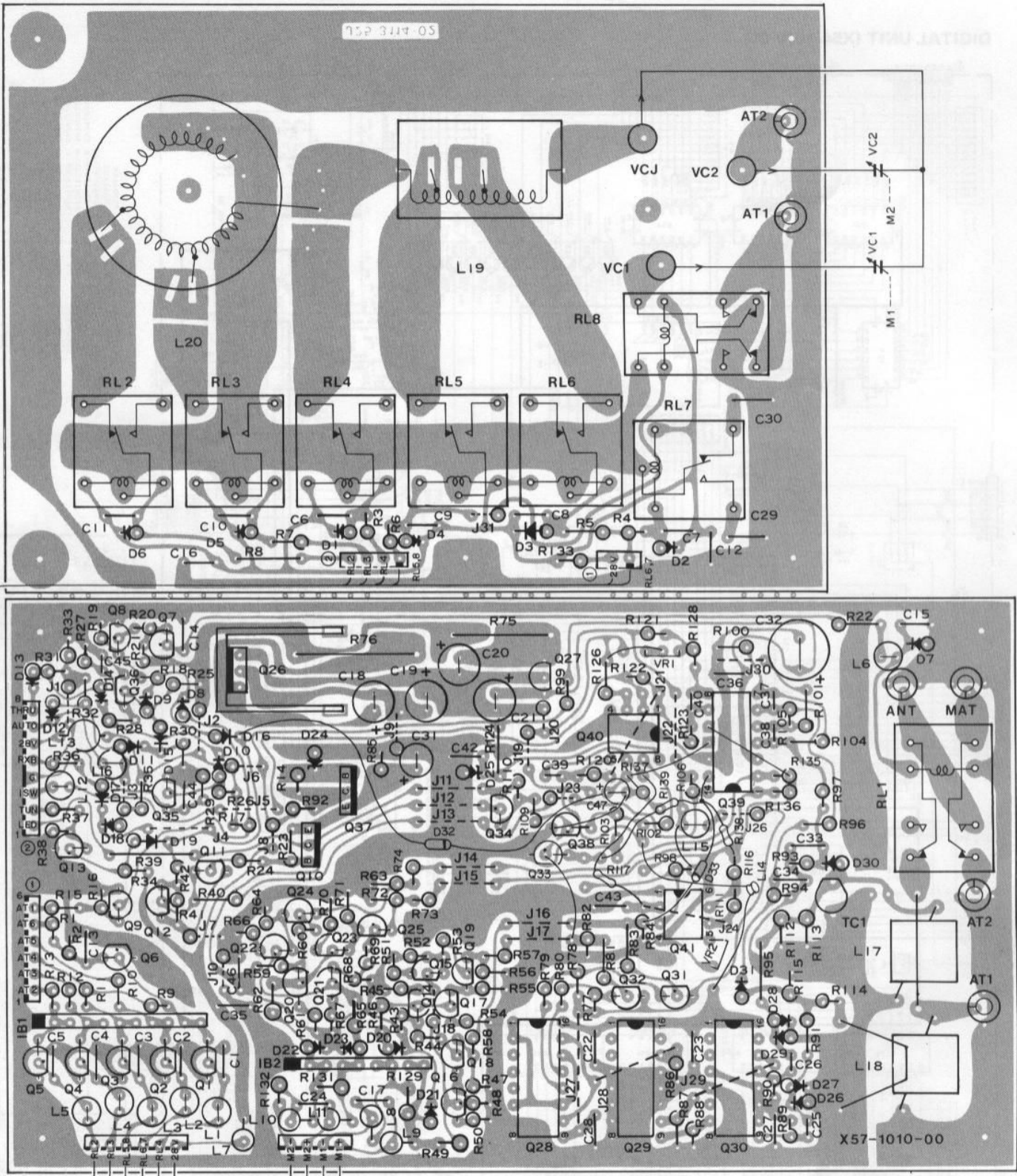


DIGITAL UNIT (X54-1670-00)

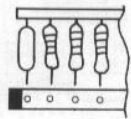
RIT ENCODER UNIT (X54-1690-00)

TS-930S PC BOARD VIEW

AT UNIT (X57-1010-00) Component side view

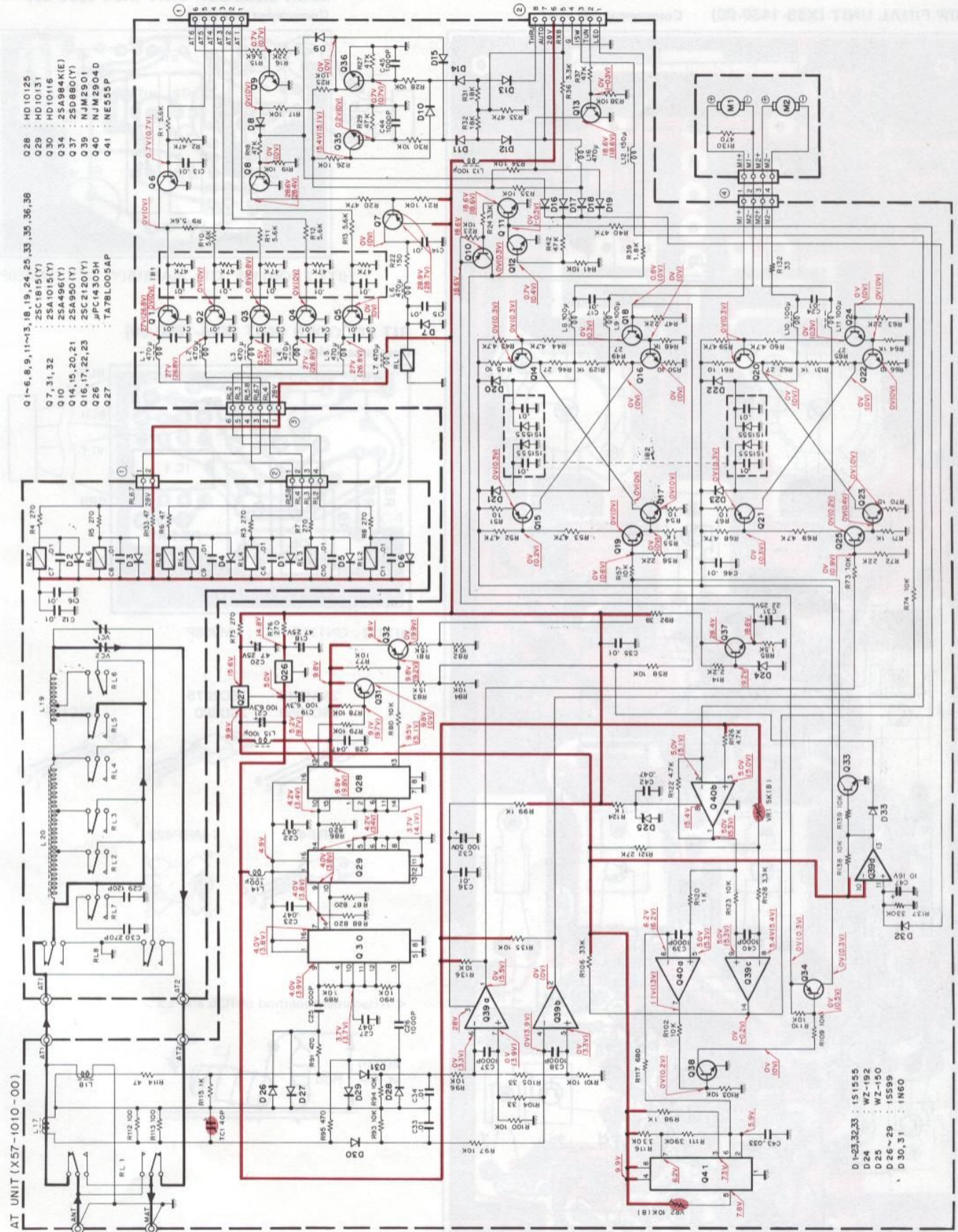


< Attachment direction of A, B > < Attachment direction of IB1, 2 >



CIRCUIT DIAGRAM TS-930S

AT UNIT (X57-1010-00)



- 028 HD 10135
- 029 HD 10131
- 030 HD 10116
- 031 2SA984K(E)
- 032 2SD880(Y)
- 033 2SC1815(Y)
- 034 2SA984K(E)
- 035 2SD880(Y)
- 036 NJM2901
- 037 NJM2904
- 038 NJM2904D
- 039 NJM2904
- 040 NJM2904D
- 041 NE555P

- 01-6, 9, 11-13, 18, 19, 24, 25, 35, 36, 36, 36
- 07, 31, 32
- 010 2SA1015(Y)
- 011 2SA984K(E)
- 012 2SA984K(E)
- 013 2SC1815(Y)
- 014, 15, 20, 21
- 016, 17, 22, 23
- 026 PC14305H
- 027 TA78L005AP

- D 1-23, 32, 33 : 1S1555
- D 24 : WZ-192
- D 25 : WZ-150
- D 26 ~ 29 : 1S559
- D 30, 31 : 1N60

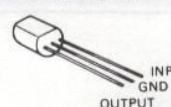
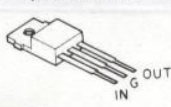
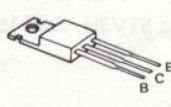
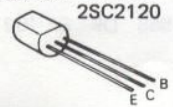
2SA950 2SA1015
2SA984K 2SC1815
2SC2120

2SD880

2SA496

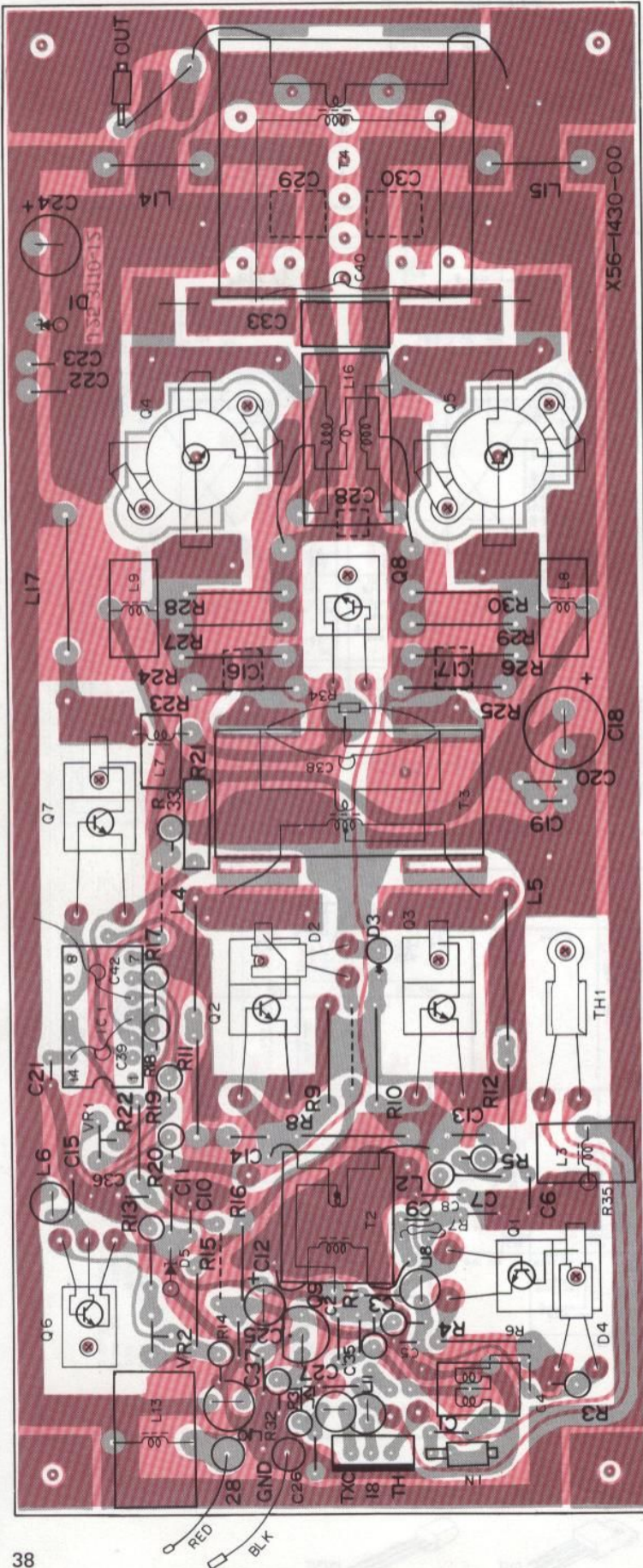
μPC14305H

TA78L005AP



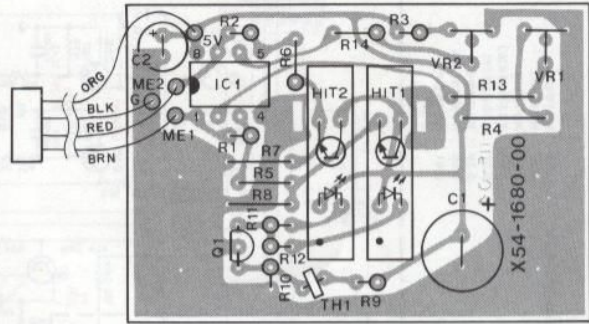
TS-930S PC BOARD VIEWS

100W FINAL UNIT (X56-1430-00) Component side view



MAIN ENCODER UNIT (X54-1680-00)

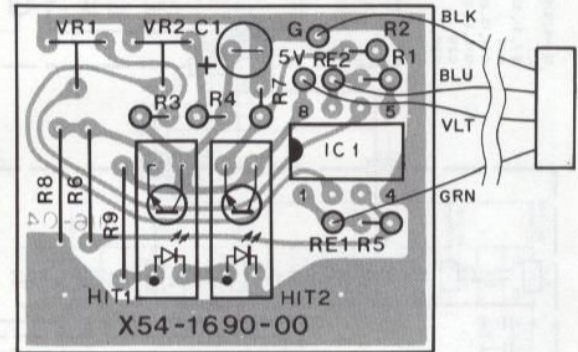
Component side view



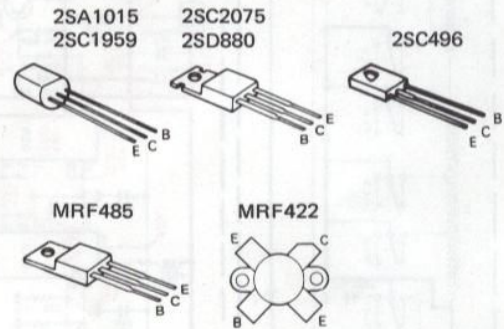
HIT1,2: ON1105 Q1: 2SA1015(Y) IC1: LM358P

RIT ENCODER UNIT (X54-1690-00)

Component side view



HIT1,2: ON1110 IC1: LM358P

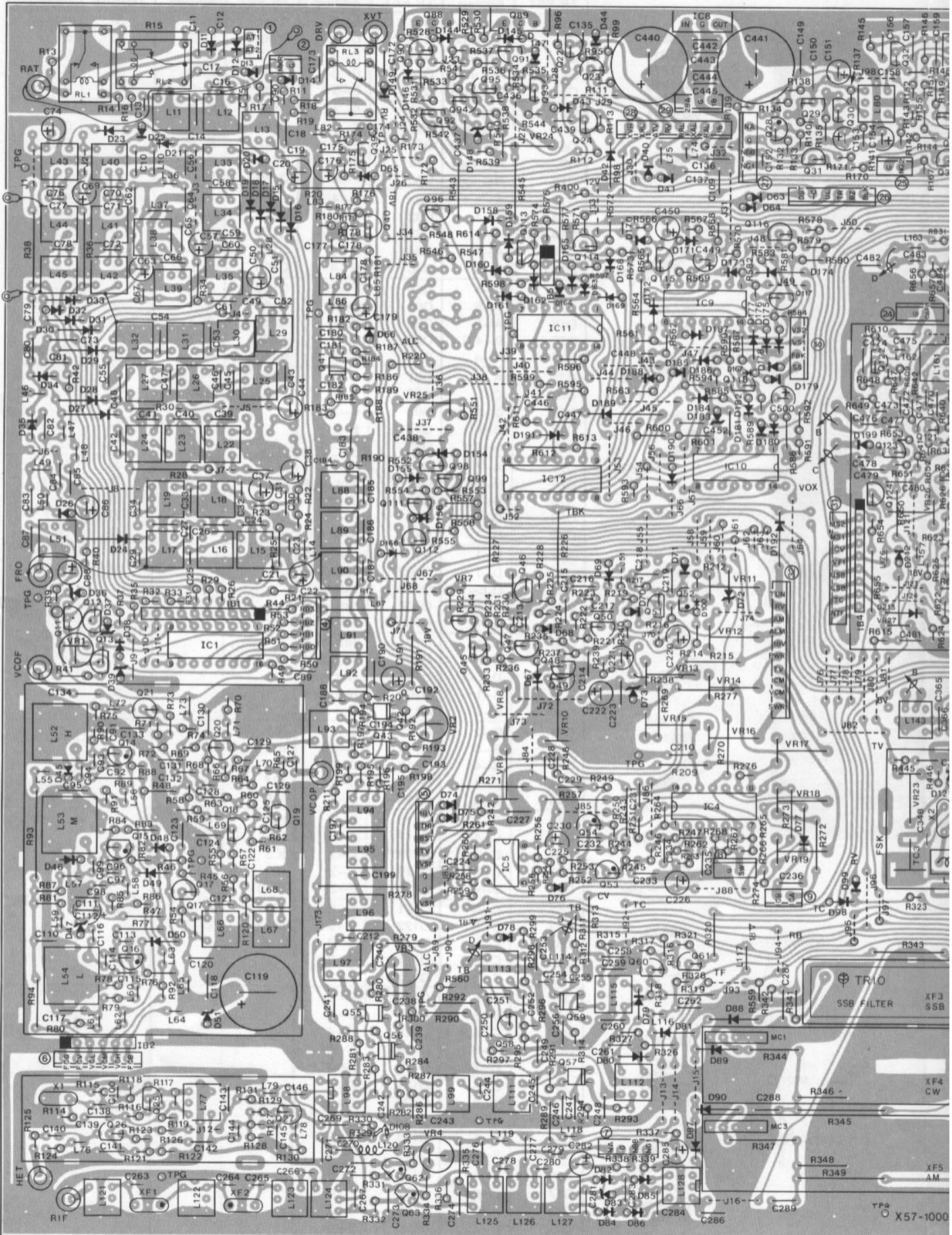


< Attachment method of R35 and L3 >



Q1: 2SC2075 Q2,3: MRF485 Q4,5: MRF422
 Q6,8: 2SC496(Y) Q7: 2SD880(Y) Q9: 2SC1959(Y)
 IC1: MC1723CL
 D1: BZ-350 D2,4: STV3H D3: 1S1555 D5: BZ-192

SIGNAL UNIT (X57-1000-11) A/2 Component side view



A

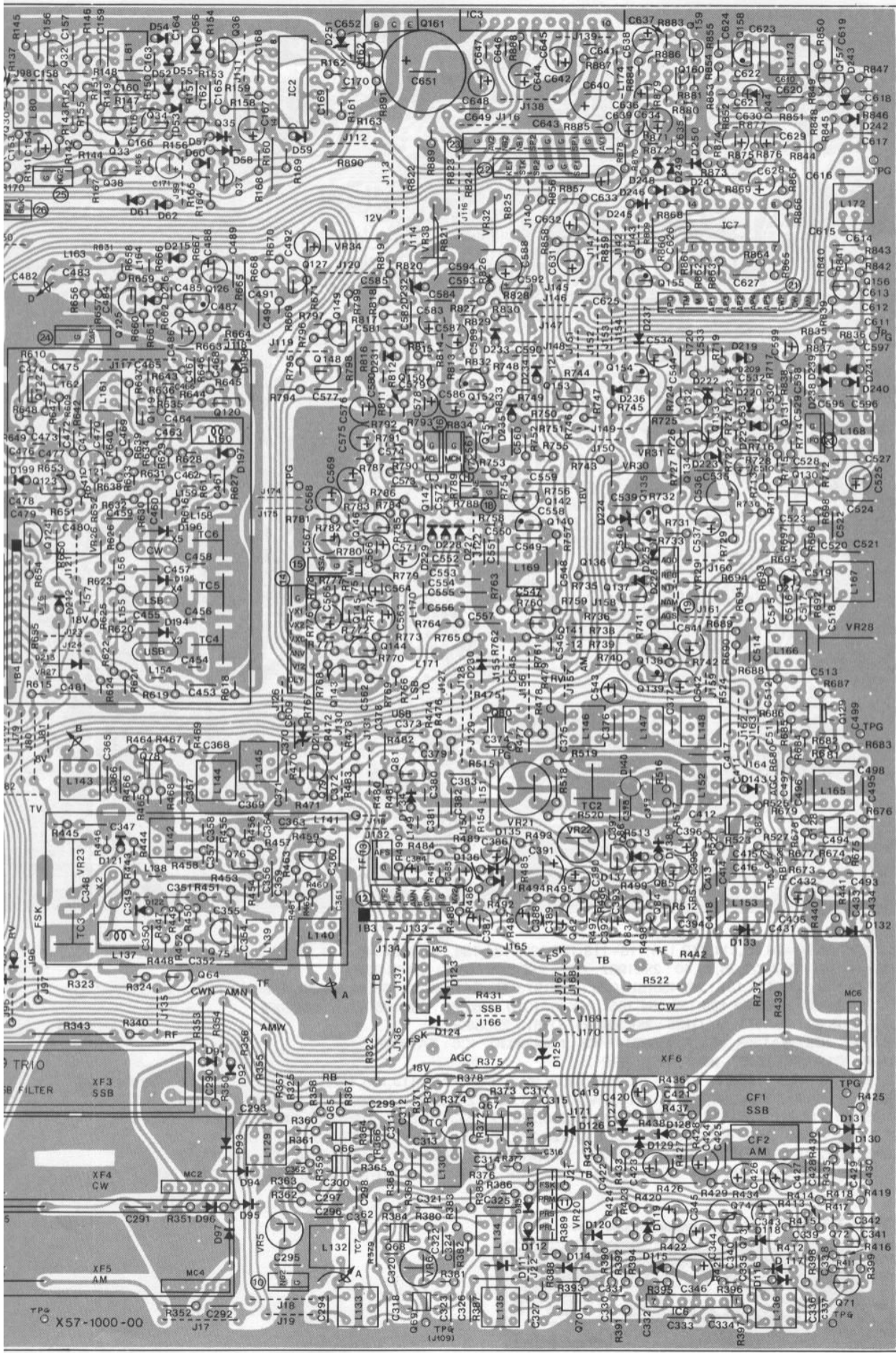
B

C

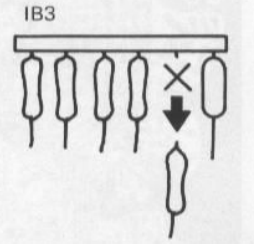
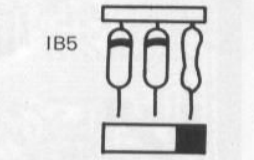
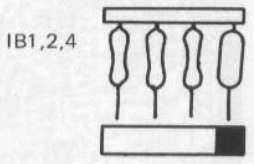
D

X57-1000

PC BOARD VIEWS TS-930S



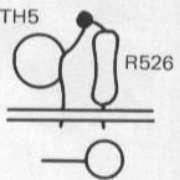
< Attachment direction of IB >



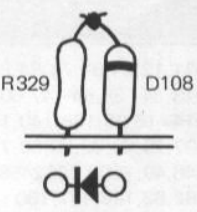
< Attachment direction of D217, 244 >



< Attachment method of R526, TH5 >

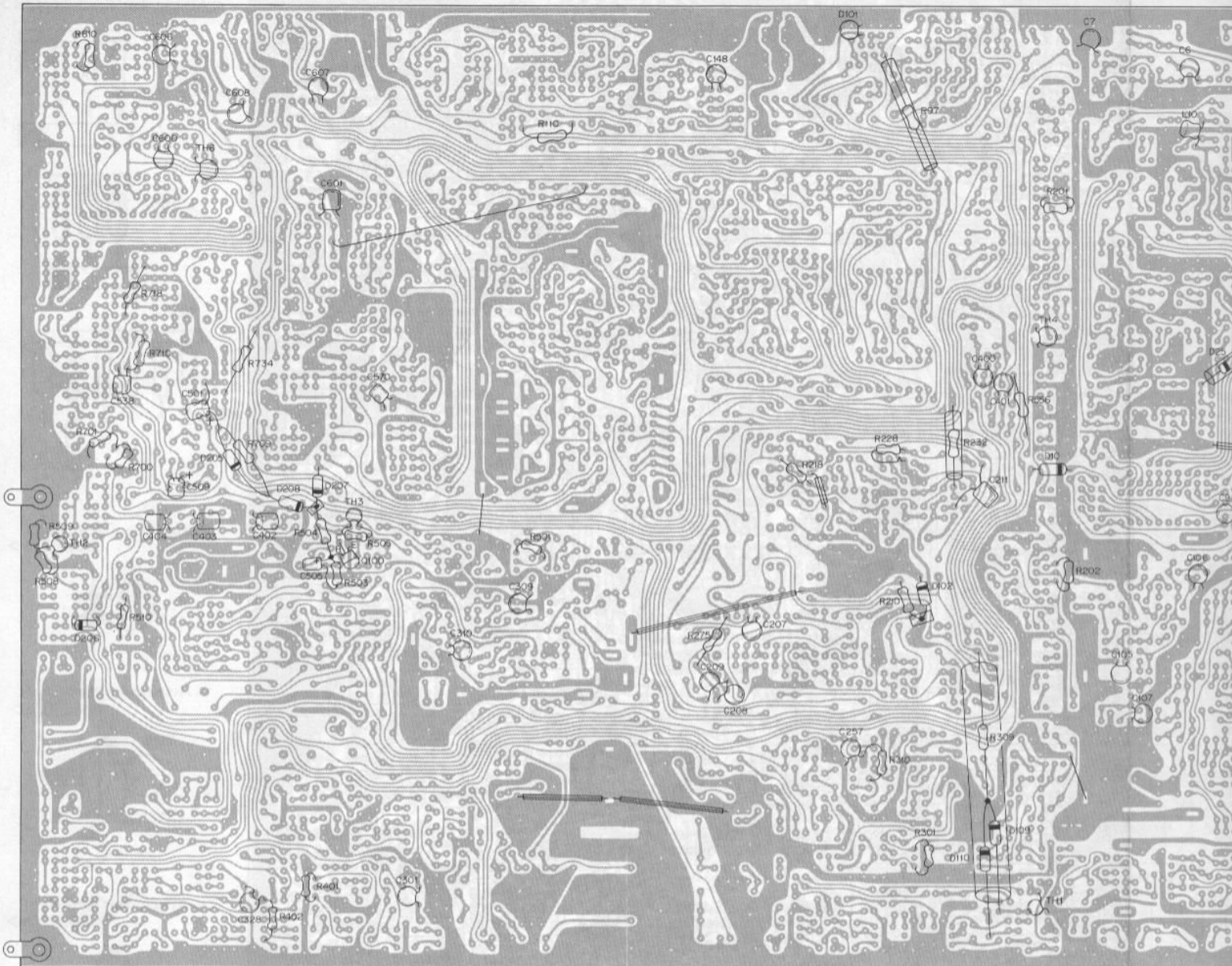


< Attachment method of R329, D108 >



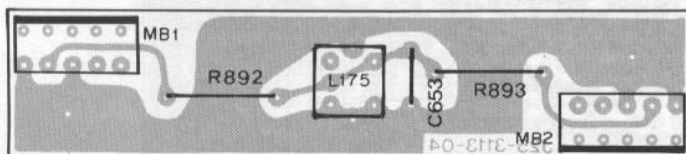
TS-930S PC BOARD VIEW

SIGNAL UNIT (X57-1000-11) A/2 Foil side view



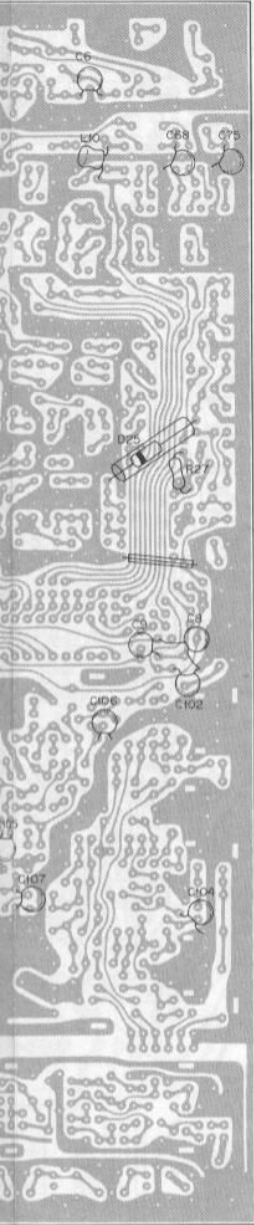
- Q11,12,24,31,74,84,85,99,112,115,127,137,153,159 : 2SA1015(Y)
Q13,34-38,44-47,50,51,60,61,64,73,86,90-96,98,111,113,114,116-118,124,132-134,136,141-145,148-151,156,157,162 : 2SC1815(Y)
Q14-16,28,126,140,152,158 : 2SK19(GR) Q17-21,25,26,40 : 2SC1907 Q22 : 2SC2899 Q23 : 2SA984K(E)
Q27,29,30,32,33,58,71,72,75-77,79,119-123,125,131 : 2SB460(B) Q39 : 2SC1973(T) Q41-43,55-57,59,65-80,78,80,87,128-130 : 3SK73(GR)
Q48,49,100 : 2SC2458(Y) Q52 : 2SK30A(O) Q53,54,138,139,154,155 : 2SK30A(GR) Q62,63 : 2SK125 Q81 : 2SC2086
Q82,83,146,147,160 : 2SC1775(E) Q88,89 : 2SA473(Y) Q135 : 2SK30A(Y) Q161 : 2SD880(Y)
IC1 : SN74LS145N IC2,9 : TC4011BP IC3 : HA1368 IC4,7 : MB3614 IC5 : NJM2903D IC6 : TA7302P
IC8 : UA7818UC IC10 : TC4001BP IC11 : TC4073BP IC12 : TC4049BP
D10,71,125,205 : WZ-040 D11,12,38,40-43,57-66,68-70,74-76,78,91,92,98,99,108-110,112,113,116,117,119,121,123,124,135-138,143-147,
149,154-156,158-166,168-182,184-192,205,207-209,212,213,215,219,226-231,234-237,242,243,246-250 : 1S1555 or 1N4448
D13,14,48-50,79,82,84-87,94,95,111,114,118,126-134,194-196,198,199,216,220,221,233 : 1S1587 D15-33 : BA282 D34,35 : BA379
D36,37 : XZ-033 D39 : XZ-051 D44 : 1JZ61 D45-47 : 1SV54GC D51,73,223,232,251 : WZ-150 D52-55,238-241 : 1N60
D56,67,120,222,225,245 : LT8001P D72,183,210 : WZ-120 D77 : XZ-200 D80,81,88-90,93,96,97 : 1S1007 D83,167 : WZ-090
D100,115,224 : WZ-071 D101 : ERZC07DK201 D102 : MV-13 D122,197 : 1SV54GE D140 : ND487R1-3R D148 : WZ-061 D217,244 : FC65M

SIGNAL UNIT (X57-1000-11) B/2 Component side view

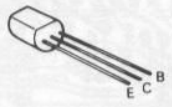


TR,FET,IC and Terminals address

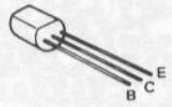
TR,FET	Address	TR,FET	Address	TR,FET	Address	Terminal	Address
Q1	Not used	Q71	G-6	Q141	F-3	①	A,B-1
Q2	Not used	Q72	G-6	Q142	F-3	②	B-1
Q3	Not used	Q73	G-6	Q143	E-4	③	B-2
Q4	Not used	Q74	G-6	Q144	E-3	④	B-3,4
Q5	Not used	Q75	E-5	Q145	E-3	⑤	B-4,5
Q6	Not used	Q76	E-4	Q146	E-3	⑥	A-6
Q7	Not used	Q77	E-4	Q147	F-3	⑦	C-6
Q8	Not used	Q78	E-4	Q148	E-2	⑧	C,D-5
Q9	Not used	Q79	E-4	Q149	E-2	⑨	D-5
Q10	Not used	Q80	F-4	Q150	F-2	⑩	E-6
Q11	A-3,4	Q81	F-4	Q151	F-2,3	⑪	F-6
Q12	A-4	Q82	F-5	Q152	F-2	⑫	F-4,5
Q13	A-4	Q83	F,G-5	Q153	F-2	⑬	E,F-4
Q14	A-4	Q84	G-5	Q154	F,G-2	⑭	E-3,4
Q15	A-5	Q85	G-4	Q155	F,G-2	⑮	E-3
Q16	A-5	Q86	F-4	Q156	G-2	⑯	F-2,3
Q17	A-5	Q87	G-4	Q157	G-1	⑰	F-2,3
Q18	A-5	Q88	B-1	Q158	G-1	⑱	F-3
Q19	B-4,5	Q89	C-1	Q159	G-1	⑲	G-3
Q20	A-4	Q90	B-1	Q160	G-1	⑳	G-2
Q21	A-4	Q91	C-1	Q161	F-1	㉑	G-2
Q22	C-1	Q92	B-1	Q162	E-1	㉒	F-1
Q23	C-1	Q93	C-1			㉓	F-1
Q24	C-1	Q94	B-1			㉔	D-2
Q25	A-6	Q95	B,C-1			㉕	D-1
Q26	A-6	Q96	B-1,2			㉖	D-1
Q27	B-6	Q97	Not used			㉗	D-1
Q28	D-1	Q98	B-3			㉘	C-1
Q29	D-1	Q99	B-3			㉙	C-1
Q30	D-1	Q100	B-3 (Foil side)			㉚	D-2
Q31	D-1	Q101	Not used			㉛	D-3
Q32	D-1	Q102	Not used			㉜	D-3,4
Q33	D,E-1	Q103	Not used				
Q34	E-1	Q104	Not used				
Q35	E-1	Q105	Not used				
Q36	E-1	Q106	Not used				
Q37	E-1	Q107	Not used				
Q38	D,E-1	Q108	Not used				
Q39	B-1	Q109	Not used				
Q40	B-2	Q110	Not used				
Q41	B-2	Q111	B-3	IC1	A-4		
Q42	B-4	Q112	B-3	IC2	E-1		
Q43	B-4	Q113	C-2	IC3	F-1		
Q44	B-4	Q114	C-2	IC4	C-4		
Q45	B-4	Q115	C-2	IC5	C-5		
Q46	C-3	Q116	D-2	IC6	G-6		
Q47	C-4	Q117	D-2	IC7	G-1,2		
Q48	C-4	Q118	D-2	IC8	C-1		
Q49	C-4	Q119	E-2	IC9	C-2		
Q50	C-4	Q120	E-2	IC10	C,D-3		
Q51	C-3	Q121	D-3	IC11	C-2		
Q52	C-3	Q122	D-2	IC12	C-3		
Q53	C-5	Q123	D-3				
Q54	C-4,5	Q124	D-3				
Q55	B-5	Q125	E-2				
Q56	B-6	Q126	E-2				
Q57	C-6	Q127	E-2				
Q58	C-5,6	Q128	G-4				
Q59	C-5	Q129	G-4				
Q60	C-5	Q130	G-3				
Q61	C-5	Q131	G-2				
Q62	B-6	Q132	G-2				
Q63	B-6	Q133	G-2				
Q64	E-5	Q134	G-2,3				
Q65	E-6	Q135	G-3				
Q66	E-6	Q136	F-3				
Q67	F-6	Q137	F,G-3				
Q68	F-6	Q138	G-3				
Q69	F-6	Q139	G-4				
Q70	F-6	Q140	F-3				



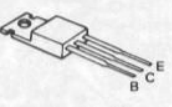
2SA984K
2SA1015
2SC1775
2SC1815
2SC1907
2SC1973



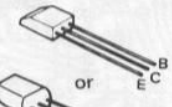
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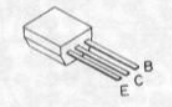
2SA473
2SD880



2SB460



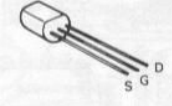
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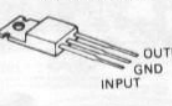
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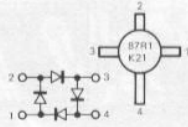
2SK30A
2SK125



UA8718UC



ND487R1-3R



3SK73



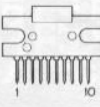
TA7302P



MV-13



HA1368



(GR)

-147,

5M

F

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PARTS LIST

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.

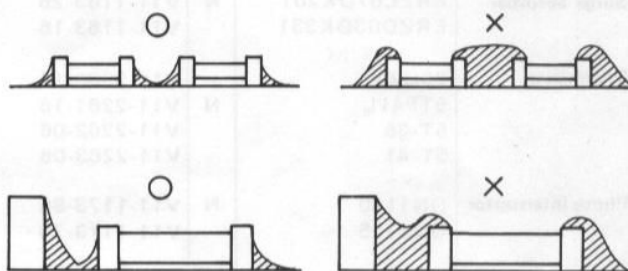
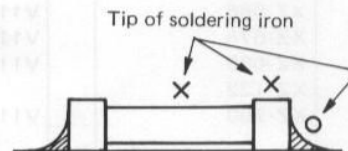


2) Length of soldering time :

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.



Abbreviation		Abbreviation	
Cap.	Capacitor	ML	Mylar
C	Ceramic	S	Styren
E	Electrolytic	T	Tantalum
MC	Mica		

TS-930S SEMICONDUCTOR

N : New parts

Name	Re- marks	Parts No.	Name	Re- marks	Parts No.
Diode					
1JZ61	N	V11-3179-06	SV-03Y		V21-0007-05
1N60		V11-0051-05	Vari-Cap		
1N4448		V11-7766-06	1SV54GC		V11-4173-46
1S1007		V11-4160-66	1SV54GE		V11-4173-56
1S1555		V11-0076-05	FC65M	N	V11-7776-86
1S1587		V11-0370-05	Zener diode		
1SS99		V11-1277-86	BZ-192	X	V11-0311-05
BA282	N	V11-7776-56	BZ-320		V11-4166-76
BA379		V11-1263-06	BZ-350		V11-4166-86
GM-3A					
ND487R1-3R	N	V11-1266-16	WZ-040		V11-4161-56
S15VB10	N	V11-1366-06	WZ-061		V11-0243-05
V03(C)		V11-0290-05	WZ-071		V11-4160-86
V06E		V11-0285-05	WZ-090		V11-0240-05
Varistor			WZ-120		V11-0249-05
MV-13		V21-0004-05	WZ-130		V11-0297-05
STV-3H(O)	N	V21-0016-05	WZ-150		V11-0307-05

PARTS LIST

Name		Re- marks	Parts No.	Name		Re- marks	Parts No.
	WZ-182		V11-4100-10		2SK125		V09-1004-26
	WZ-192		V11-0308-05		2SK125P	N	V09-1004-36
	XZ-033		V11-4176-96		3SK73(GR)		V09-1002-46
	XZ-051		V11-4103-60	IC	HA1368	N	V30-1129-16
	XZ-055		V11-4105-51		HD10116	N	V30-1243-06
	XZ-066		V11-4106-70		HD10125	N	V30-1243-16
	XZ-076		V11-4126-36		HD10131	N	V30-1243-26
	XZ-090		V11-4167-06		HD74LS00P		V30-1046-06
	XZ-122				HD74LS01P		V30-1009-36
	XZ-200		V11-4101-70		HD74LS02P		V30-1007-36
LED	BG5532K (Green)	N	V11-7261-16		HD74LS73P		V30-1076-16
	LT8001P	N	V11-4360-76		HD74LS75P		V30-1008-96
	PR5532K (Blue)		V11-7272-36		HD74LS90P		V30-1083-06
Surge absorber	ERZC07DK201	N	V11-1163-26		HD74LS151P		V30-1008-26
	ERZD03DK331		V11-1163-16		LM358P		V30-1024-56
Thermistor	25D29		V11-3360-16		MB74LS42		V30-1241-46
	5TP41L	N	V11-2261-16		MB3614	N	V30-1242-16
	5T-35		V11-2262-06		MC1723CL		V30-0199-05
	5T-41		V11-2263-06		MC14077B	N	V30-1211-36
Photo interruptor	ON1110	N	V11-1173-86		MC145155P		V30-1203-26
	ON1105		V11-1173-76		MC145156P	N	V30-1203-36
Display tube	11-BT-03Z	N	V40-7760-66		MC14569BCP		V30-1100-06
TR	2SA473(Y)		V01-0473-06		MD74LS90P		
	2SA496(Y)		V01-0113-05		NE555P	N	V30-0686-10
	2SA733(P)		V01-0733-16		NJM2901	N	V30-1020-56
	2SA950(Y)	N	V01-0950-16		NJM2903D	N	V30-1020-96
	2SA984K(E)	N	V01-0984-10		NJM2904D	N	V30-1021-06
	2SA1015(Y)		V01-1015-06		SN74LS00N		V30-1005-66
	2SA1021(O)	N	V01-1021-16		SN74LS01N		V30-1041-16
	2SA1049(GR)	N	V01-1049-16		SN74LS02N		V30-1041-06
	2SC460(B)		V03-0079-05		SN74LS73N		V30-1117-06
	2SC496(Y)		V03-0336-05		SN74LS75N		V30-1005-16
	2SC1775(E)		V03-1775-06		SN74LS90N		V30-1005-26
	2SC1815(Y)		V03-1815-06		SN74LS145N	N	V30-1152-26
	2SC1907		V03-1907-06		SN74LS151N		V30-1240-16
	2SC1923(O)		V03-1923-06		SN16913P		V30-1048-06
	2SC1959(Y)		V03-1959-06	TA78L005AP	N	V30-1189-36	
	2SC1973(T)		V03-1973-16	TA7302P		V30-1134-06	
	2SC2053		V03-2053-06	TC4001BP		V30-1066-06	
	2SC2075		V03-2075-06	TC4011BP		V30-1030-66	
	2SC2086		V03-2086-06	TC4049BP		V30-1009-26	
	2SC2120(Y)		V03-2120-06	TC4073BP	N	V30-1167-16	
	2SC2274K(E)	N	V03-2274-26	TC5065BP		V30-1056-16	
	2SC2458(Y)		V03-2458-06	TC5081P		V30-1132-06	
	2SC2899	N	V03-2899-06	TC9122P		V30-1036-16	
	2SD880(Y)		V04-0880-16	UA7818UC	N	V30-1022-46	
	2N5885		V08-1012-06	μPB551C	N	V30-0170-16	
	MRF422	N	V08-1008-46	μPC14305		V30-1029-26	
FET	MRF485	N	V08-1008-56	μPC14305H		V30-1029-36	
	2SK19(GR)		V09-0012-05	μPC14312		V30-1029-56	
	2SK30A(GR)		V09-0060-05	μPD5101LC		V30-1177-36	
	2SK30A(O)		V09-0056-05	μPD8049C-211	N	V30-1176-46	
	2SK30A(Y)		V09-0058-05	μPD8243C	N	V30-1177-16	

PARTS LIST

Parts No.	Re- marks	Description	Ref. No.	Parts No.	Re- marks	Description	Ref. No.
TS-930S GENERAL							
A01-0922-21	N	Case (upper)		F07-0841-14	N	Slide cover	
A01-0927-11	N	Case (lower)		F07-0842-03	N	Heat sink cover	
A20-2440-02	N	Panel		F09-0405-24		Fan	
A23-1466-12	N	Rear panel		F20-0527-05	N	Insulating sheet x 2 TR	
B03-0525-04	N	Switch mask x 2 RIT		F29-0401-04		Capacitor mounting hardware x 2	
B03-0526-04	N	Switch mask POWER		F29-0406-03		Fan motor mounting hardware	
B05-0722-04	N	SP grill cloth		F29-0421-04	N	Protective sheet x 5	
B06-0504-04	N	Front glass grill cloth		G01-0817-04	N	Coil spring x 4	
B07-0638-04	N	Band escutcheon		G09-0405-05		Knob fixed spring	
B09-0011-04		Rubber cap		G09-0410-05		Knob fixed spring x 3	
B10-0650-03	N	Front glass (large)		G13-0662-04	N	Cushion Speaker	
B10-0651-04	N	Front glass (small)		G53-0510-04		Packing x 2 Case	
B30-0826-05	N	Pilot lamp x 2 28V	PL1,2	G53-0511-04		Packing x 2	
B31-0635-05	N	Meter		G53-0516-14	N	Packing Filter	
B40-2605-04	N	Name plate TS-930S T		H01-4409-14	N	Packing carton (inside) K,M,W,X	
B40-2606-04	N	Name plate TS-930S K,M,W,X		H01-4410-14	N	Packing carton (inside) T	
B41-0629-04	N	Caution plate		H10-1276-04		Cushion M,X	
B42-1727-04	N	Adj. seal		H10-2558-02	N	Packing fixture (F)	
B42-1728-04	N	Adj. seal VOX CONTROL		H10-2559-02	N	Packing fixture (R)	
B42-1729-04	N	Name plate		H12-0491-04	N	Cushion K,T,W,X	
B43-0669-04	N	Name plate TRIO T		H20-1403-03		Protective cover	
B43-0670-04	N	Name plate KENWOOD K,M,W,X		H25-0105-04		Protective bag 150 x 350	
B43-0676-04	N	Name plate		H25-0120-04		Protective bag	
B46-0407-00		Warranty card K		J02-0049-14		Foot (large) x 2 Rear	
B50-3959-00	N	Instruction manual K,W,X		J02-0423-04		Foot x 2 Front	
B50-3960-00	N	Instruction manual M		J02-0424-04		Foot x 2	
B50-3961-00	N	Instruction manual T		J02-0426-05	N	Foot (small) x 4	
B58-0644-11	N	Instruction sheet		J13-0033-15		Fuse holder	
CE04W2C3R3	E	3.3 160V	C14	J19-1354-05		Battery case	
CK45E2H103P	C	0.01 500V x 4	C4-7	J61-0019-05		Vinyle tie x 20	
CK45F1H103Z	C	0.01 x 4	C10-13	J61-0401-05		Nylon band x 30	
C90-0857-05	N	E 22000 50V x 2	C8,9	K01-0409-05	N	Handle	
C91-0079-05	C	0.01 2kV	C1	K21-0763-04	N	Knob RIT	
C91-0496-05	C	470pF AC 150V x 2	C2,3	K21-0764-04	N	Knob x 3 PITCH,AF,HIGH	
E06-0751-05		7P DIN socket REMOTE		K21-0765-04	N	Knob x 2 CAR,OUT	
E06-0851-05		8P DIN socket X. VERTER		K21-0766-05	N	Main knob	
E07-0751-05		7P DIN plug Accessory		K23-0721-04		Knob NB LEVEL	
E07-0852-05		8P metal socket Accessory K,T,W		K23-0740-04		Knob x 3 AF TUNE,RF,LOW	
E11-0404-05		3P phone jack x 2 KEY,PHONE		K23-0745-04		Knob x 5 MIC,VOX GAIN,ANTI, DELAY,IN	
E11-0410-05		Phone jack EXT. SP		K23-0753-04	N	Pointer knob x 5 METER,RF ATT, AGC,FUNCTION,MEMORY CH	
E12-0001-15		Phone plug EXT. SP Accessory		K27-0431-04	N	Push knob 1MHz STEP UP	
E13-1010-05		1P pin jack RX ANT		K27-0432-04	N	Push knob 1MHz STEP DOWN	
E13-0461-05		4P pin jack		K27-0433-04	N	Push knob x 12 RIT,CLEAR,MR, TF-SET,NOTCH,AF TUNE,MIN, D. LOCK,A=B,VFO/MEMO, NB1,NB2	
E18-0351-05		3P inlet AC Power		K27-0434-04	N	Push knob x 4 VOX/MAN,MONI, FULL/ SEMI, DIM/NOR	
E20-1003-05		Terminal plate x 2		K29-0715-04		Pointer knob MODE	
E23-0015-04		Lug plate x 2 GND		K29-0738-04		Knob (6) x 2 NOTCH,CW VBT	
E29-0407-05		Bridge connector		K29-0757-04		Push knob POWER	
E30-1643-15		AC cord ass'y K,M		K29-0760-04	N	Push knob BAND	
E30-1644-15		AC cord ass'y T		K29-0761-04	N	Knob ring	
E30-1645-05		AC cord ass'y W		L01-8156-05	N	Power transformer T1	
E30-1647-05		AC cord ass'y X		N09-0256-05		Gnd. screw x 4	
E31-2102-05		Connector with lead		N09-0642-04	N	Hex. head screw x 4	
F01-0776-03	N	Heat sink Power supply		N10-2030-46		Nut x 7	
F05-4022-05		Fuse 4A x 2 M,T,W,X	F1				
F05-6021-05		Fuse 6A M	F1				
F05-6021-05		Fuse 6A x 2 K	F1				

PARTS LIST

Parts No.	Re- marks	Description	Ref. No.	Parts No.	Re- marks	Description	Ref. No.	Q'ty	
N14-0115-05		Flange nut		SWITCH UNIT (X41-1410-00)					
N14-0509-05		Wing nut		CK45B1H102K	C	0.001	C10	1	
N14-0512-05		Speed nut x 5		CK45E2H103P	C	0.01	C1	1	
N15-1030-41		Flat washer x 6		CK45F1H103Z	C	0.01	C2,5,6,8	4	
N15-1040-41		Flat washer x 5		CK45F1H473Z	C	0.047	C3,4	2	
N30-2004-41		Round screw x 6		CO92M1H153K	ML	0.015	C9	1	
N30-2604-41		Round screw x 5		C91-0456-05	C	0.047	C7	1	
N30-2605-46		Round screw x 8		E04-0152-05		UHF type receptacle	ANT	1	
N30-2606-45		Round screw x 4		E04-0157-05		Mini pin jack	A	1	
N30-2606-46		Round screw x 3		E06-0853-05		8P metal socket	MIC	1	
N30-3004-46		Round screw x 15		E23-0047-04		Square terminal		5	
N30-3006-46		Round screw x 11		E40-0273-05		Mini connector	2P	3	
N30-3014-41		Round screw x 4		E40-0277-05		Mini connector	2PL	2	
N30-4016-46		Round screw		E40-0473-05		Mini connector	4P	1	
N32-2006-41		Flat screw x 2		E40-0573-05		Mini connector	5P	2	
N32-3006-41		Flat screw x 15		E40-0577-05		Mini connector	5PL	1	
N33-3006-45		Round flat screw x 2		E40-0673-05		Mini connector	6P	1	
N35-3006-41		Bind screw x 7		E40-0773-05		Mini connector	7P	1	
N35-3006-45		Bind screw x 5		E40-0877-05		Mini connector	8PL	1	
N35-3008-45		Bind screw x 6		G53-0511-04		Packing		2	
N35-4006-46		Bind screw x 2	Handle	J61-0019-05		Vinyle tie		1	
N35-4008-41		Bind screw x 16		L33-0658-05	N	Choke coil	L1,2	2	
N87-2608-41		Self tapping screw x 6		N14-0115-05		Flange nut		1	
N87-2608-46		Self tapping screw x 6		N15-1040-46		Flat washer		1	
N87-3006-41		Self tapping screw x 81		N30-4025-46		Round screw	GND	1	
N87-3008-41		Self tapping screw x 4		R11,12					
N87-3012-46		Self tapping screw x 9		R13					
N87-3014-46		Self tapping screw x 6		R15					
N87-4010-41		Self tapping screw x 4		R5-7					
N88-2606-46		Flat tapping screw x 2		R1-4					
N89-3006-45		Bind tapping screw x 15		R10					
RC05GF2H101J		Solid 100Ω 1/2W x 2	R11,12	R8,9					
RC05GF2H221J		Solid 220Ω 1/2W	R13	R16					
RD05GF2H472J		Solid 4.7kΩ 1/2W	R15	R14					
RS14AB3D181J		MF 180Ω 2W x 3	R5-7	R01-0406-05	N	Pot. 300Ω(B)	VR8	1	
RS14AB3D270J		MF 27Ω 2W x 4	R1-4			NB LEVEL			
RS14AB3D330J		MF 33Ω 2W	R10	R01-3422-05	N	Pot. 10kΩ(B)	VR9	1	
RS14AB3D820J		MF 82Ω 2W x 2	R8,9			VOX GAIN			
RS14AB3D822J		MF 8.2kΩ 2W	R16	R01-3423-05	N	Pot. 10kΩ(F) NOTCH	VR6	1	
R92-0619-05		Cement 0.05Ω 5W	R14	R01-3424-05	N	Pot. 10kΩ(B) CW VBT	VR5	1	
S29-2406-05	N	Voltage selector		R01-6403-05	N	Pot. 470kΩ(B)	VR10,11	2	
S31-1407-05	N	Slide switch				ANTI,DELAY			
S40-2437-05	N	Push switch	S38	R19-3413-05	N	Pot. 10kΩ(A),10kΩ(B)	VR7	1	
S50-1406-05		Tact switch x 2	M,X			AF/RF			
S90-0401-05	N	Remote switch shaft	MODE	R19-3414-05	N	Pot. 10kΩ(B) x2	VR3	1	
T07-0221-05	N	Speaker				SSB SLOPE TUNE			
T42-0302-05		Fan motor		R19-9407-05	N	Pot. 10kΩ(A),50kΩ(C)	VR1,2	2	
T91-0316-15		Microphone	M,X			PRO.,MIC/CAR			
X41-1410-00	N	Switch unit		R24-9402-05	N	Pot. 10kΩ(F), 100kΩ(C) x2	VR4	1	
X43-1430-00	N	Power supply unit				PITCH/AF TUNE			
X44-1490-00	N	RF unit		RC05GF2H102J		Solid 1kΩ 1/2W	R26	1	
X50-1880-00	N	PLL unit		RC05GF2H680J		Solid 68Ω 1/2W	R6	1	
X51-1280-00	N	LPF unit		RS14AB3D470J		MF 47Ω 2W	R2,3	2	
X54-1670-00	N	Digital unit							
X54-1680-00	N	Main encoder unit		R92-0150-05		Short jumper		4	
X54-1690-00	N	RIT encoder unit		S01-1429-05	N	Rotary switch	M.CH	S24	1
X56-1430-00	N	100W final unit		S01-1430-05	N	Rotary switch	METER	S39	1
X57-1000-11	N	Signal unit		S01-1431-05	N	Rotary switch	AGC	S40	1
X57-1010-00		AT unit		S01-1432-05	N	Rotary switch		S23,25	2
				S36-1408-05	N	Paddle switch	CAL	S38	1

PARTS LIST

Parts No.	Re- marks	Description	Ref. No.	Q'ty	Parts No.	Re- marks	Description	Ref. No.	Q'ty
S36-2408-05	N	Paddle switch STBY, AT,PRO,TONE	S6-9	4	RF UNIT (X44-1490-00)				
S40-2422-05		Push switch NOTCH,D.LOCK	S14,16	2	C05-0030-15		Ceramic trimmer 20pF	TC1	1
S40-2431-05	N	Push switch RIT	S12	1	CC45SL1H220J	C	22pF	C20	1
S40-2432-05	N	Push switch T.F SET,RIT,CL	S11,13	2	CC45RH1H050C	C	5pF	C7	1
S40-2433-05	N	Push switch VOX/MAN DIM/NOR,AF TUNE	S2,5,15	3	CC45RH1H100D	C	10pF	C1,5,9,12	4
S40-2434-05	N	Push switch FULL/SEMI, MONI,VFO/MEMO, NB1,NB2	S3,4,18,21,22	5	CE04W1A470M	E	47 10V	C15	1
S40-2435-05	N	Push switch A=B, MIN,MR	S17,19,20	3	CE04W1E470M	E	47 25V	C3	1
S50-1409-05		Tact switch 1MHz STEP	S26,27	2	CK45B1H102K	C	0.001	C10,11,19	3
S50-1411-05	N	Tact switch BAND	S28-37	10	CK45F1H103Z	C	0.01	C6,8,13,16-18	6
S51-1414-05	N	Lead relay ANT	RL2	1	C91-0456-05	C	0.047	C2,4,14	3
S51-2412-05	N	Relay POWER	RL1	1	E04-0157-05		Mini pin jack A		3
S90-0402-05	N	Slide switch MODE	S10	1	E29-0432-05	N	1P connector (femal)		1
POWER SUPPLY UNIT (X43-1430-00)					L19-0333-05	N	Wide bandwidth transf.	T1	1
CE04W1E100M		E 10 25V	C11	1	L19-0334-05	N	Wide bandwidth transf.	T2	1
CK45E2H472P	C	0.0047	C1,2	2	L19-0335-05	N	Wide bandwidth transf.	T6	1
CK45F1H103Z	C	0.01	C5	1	L32-0199-05		OSC coil	T7	1
CQ92M1H104K		ML 0.1	C7	1	L34-0858-05		Tuning coil	T3,5	2
C90-0858-05	N	E 2200 50V	C3,4	2	L34-2074-05	N	Tuning coil	T4	1
C90-0859-05	N	E 2200 35V	C6	1	L40-1021-03		Ferri-inductor 1mH	L1,2	2
C91-0456-05	C	0.047	C10	1	L40-4701-03		Ferri-inductor 47μH	L3-6	4
E40-0273-05		Mini connector 2P		4	N87-3006-46		Self tapping screw		3
E40-0373-05		Mini connector 3P		1	R92-0150-05		Short jumper		3
F05-1534-05	N	Fuse 32V 15A		1	PLL UNIT (X50-1880-00)				
J31-0502-04		PC board collar		4	C05-0030-15		Ceramic trimmer 20pF	TC3,4	2
J42-0428-05		PC board bushing		4	C05-0044-05		Ceramic trimmer 30pF	TC1	1
L40-1511-03		Ferri-inductor 150μH	L1-3	3	C05-0309-05		Ceramic trimmer 40pF	TC2	1
N87-3012-46		Self tapping screw		4	CC45CH1H010C	C	1pF	C2,28,30,61	4
R12-0427-05		Trim. pot. 500Ω(B)	VR1	1	CC45CH1H020C	C	2pF	C63	1
RC05GF2H122J		Solid 1.2kΩ 1/2W	R19	1	CC45CH1H030C	C	3pF	C191	1
RC05GF2H2R2J		Solid 2.2Ω 1/2W	R1,4,5	3	CC45CH1H050C	C	5pF	C62,144	2
R92-0150-05		Short jumper		2	CC45CH1H0R5C	C	0.5pF	C128,129,150, 151	4
					CC45CH1H070D	C	7pF	C19	1
					CC45CH1H080D	C	8pF	C101	1
					CC45CH1H330J	C	33pF	C16,111	2
					CC45RH1H050C	C	5pF	C127,146	2
					CC45RH1H070D	C	7pF	C133,152	2
					CC45RH1H150J	C	15pF	C147-149	3
					CC45RH1H180J	C	18pF	C130-132	3
					CC45RH1H220J	C	22pF	C27,29,31,114	4
					CC45RH1H470J	C	47pF	C115	1
					CC45RH1H560J	C	56pF	C113,143,145	3
					CC45SH1H180J	C	18pF	C73	1
					CC45SH1H270J	C	27pF	C74	1
					CC45SH1H330J	C	33pF	C75	1
					CC45SH1H560J	C	56pF	C72	1
					CC45SL1H070D	C	7pF	C26,40,42,165, 168	5

PARTS LIST

Parts No.	Re- marks	Description	Ref. No.	Q'ty	Parts No.	Re- marks	Description	Ref. No.	Q'ty
CC45SL1H100D		C 10pF	C23,99,116,117, 122,164	6	L34-0711-05		Tuning coil 14M	T7	1
CC45SL1H101J		C 100pF	C32,180,190	3	L34-0712-05		Tuning coil 14M	T9	1
CC45SL1H150J		C 15pF	C11	1	L34-0713-05		Tuning coil 14M	T8	1
CC45SL1H151J		C 150pF	C17	1	L34-2075-05	N	Tuning coil 50M,60M	T1-6	6
CC45SL1H220J		C 22pF	C3,41,68,85,98, 166,167	7	L34-2076-05	N	Tuning coil 40M	T16-18	3
CC45SL1H330J		C 33pF	C15,109,169	3	L34-2077-05	N	Tuning coil 8.83M	T13	1
CC45SL1H560J		C 56pF	C194	1	L34-2078-05	N	Tuning coil 5M	T10	1
CC45SL1H680J		C 68pF	C110	1	L40-1011-04		Ferri-inductor 100μH	L2,28	2
CC45UJ1H070D		C 7pF	C58	1	L40-1511-03		Ferri-inductor 150μH	L16,27,31	3
CC45UJ1H150J		C 15pF	C55	1	L40-2701-03		Ferri-inductor 27μH	L23,24	2
CC45UJ1H180J		C 18pF	C57	1	L40-4701-03		Ferri-inductor 47μH	L10-15,17,29,32	9
CC45UJ1H330J		C 33pF	C54	1	L40-4711-03		Ferri-inductor 470μH	L1,3-5,9,18-20, 25,26,30,35,36	13
CE04W0J331M	E	330 6.3V	C14	1	L40-6825-04		Ferri-inductor 6.8mH	L21,22	2
CE04W1A101M	E	100 10V	C183	1	L40-8291-02		Ferri-inductor 8.2μH	L6-8,33,34	5
CE04W1A470M	E	47 10V	C8,70,84,176	4	L71-0233-05	N	MCF 8.8495MHz	MCF1,2	1A
CE04W1C101M	E	100 16V	C50,79	2	L77-0720-05		Crystal 10.24MHz	X2	1
CE04W1C220M	E	22 16V	C53,67,76	3	L77-0963-05	N	Crystal 20MHz	X1	1
CE04W1C470M	E	47 16V	C59	1	R12-1425-05	N	Trim. pot. 4.7kΩ(B)	VR1,2	2
CE04W1H010M	E	1 50V	C5	1	RC05GF2H390J		Solid 39Ω 1/2W	R81	1
CK45B1H102K	C	0.001	C21	1	R90-0536-05	N	Inline block 6.8kΩ x6	IB1	1
CK45B1H222K	C	0.0022	C47,65,135	3	R92-0150-05		Short jumper		31
CK45B1H471K	C	470pF	C82,184,195	3	LPF UNIT (X51-1280-00)				
CK45F1H103Z	C	0.01	C13,18,20,22, 33-39,43-45,51, 52,56,60,64,71, 77,78,95,96,100, 102-108,112, 118-121,123-126, 134,136-142,153, 155-163,170-175, 177-179,188,189, 193	71	CC45SL1H101J	C	100pF	C91	1
CO92M1H103K	ML	0.01	C48	1	CC45SL2H050C	C	5pF 500V	C56	1
CO92M1H123K	ML	0.012	C88,90	2	CC45SL2H070D	C	7pF 500V	C57	1
CO92M1H222K	ML	0.0022	C6	1	CC45SL2H101J	C	100pF 500V	C7,18,26,37,38, 55,63	7
CO92M1H273K	ML	0.027	C89	1	CC45SL2H120J	C	12pF 500V	C60	1
CO92M1H333K	ML	0.033	C10	1	CC45SL2H121J	C	120pF 500V	C10,15,25,27	4
CO92M1H472K	ML	0.0047	C81	1	CC45SL2H150J	C	15pF 500V	C43,61	2
CO92M1H473K	ML	0.047	C7,185	2	CC45SL2H151J	C	150pF 500V	C6,21,22,31,42	5
C91-0456-05	C	0.047	C1,4,9,12,24,25, 46,49,66,69,80, 83,86,87,91-94, 97,181,182,186, 187	23	CC45SL2H181J	C	180pF 500V	C14,30,41	3
E04-0154-05	N	Coax. connector		2	CC45SL2H220J	C	22pF 500V	C4	1
E23-0047--4		Square terminal		2	CC45SL2H221J	C	220pF 500V	C9,17,50,58	4
E40-0273-05		Mini connector 2P		2	CC45SL2H330J	C	33pF 500V	C3,97,99,103	4
E40-0373-05		Mini connector 3P		3	CC45SL2H331J	C	330pF 500V	C13,19,20,28,47, 52,102	7
E40-0473-05		Mini connector 4P		1	CC45SL2H390J	C	39pF 500V	C100	1
E40-0873-05		Mini connector 8P		2	CC45SL2H391J	C	390pF 500V	C16,23,33	3
J31-0502-04		PC board collar		7	CC45SL2H470J	C	47pF 500V	C1,44,45,59	4
J42-0428-05		PC board bushing		7	CC45SL2H471J	C	470pF 500V	C24,98	2
L32-0196-05		OSC coil 20M	T14	1	CC45SL2H560J	C	56pF 500V	C62	1
L32-0649-05	N	OSC coil 50M	T15	1	CC45SL2H680J	C	68pF 500V	C2,46	2
L34-0709-05		Tuning coil 10M	T11,12	2	CC45SL2H681J	C	680pF 500V	C36,51	2
					CE04W0J101M	E	100 6.3V	C72	1
					CK45F1H103Z	C	0.01	C74-78,80-86	12
					CK45F1H473Z	C	0.047	C66	1
					CM93D2H152J	MC	0.0015 500V	C29	1
					CM93D2H182J	MC	0.0018 500V	C32	1
					CM93D2H821J	MC	820pF 500V	C35	1

PARTS LIST

Parts No.	Re- marks	Description	Ref. No.	Q'ty	Parts No.	Re- marks	Description	Ref. No.	Q'ty
C91-0456-05		C 0.047	C64,65,67-71,73	8	CE04W1C220M	E	22 16V	C12	1
E04-0154-05		Coax. connector		3	CE04W1C471M	E	470 16V	C9	1
E23-0401-05		Round terminal		9	CE04W1E331M	E	330 25V	C6	1
E40-0273-05		Mini connector 2P		2	CE04W1H010M	E	1 50V	C23,25	2
E40-0373-05		Mini connector 3P		1	CE04W1H100M	E	10 50V	C2,5,40	3
E40-0473-05		Mini connector 4P		1	CE04W1H220M	E	22 50V	C3,4	2
E40-0573-05		Mini connector 5P		2	CK45B1H102K	C	0.001	C1,16,26-31	8
F29-0014-05		Shoulder washer		1	CK45F1H103Z	C	0.01	C20	1
L34-3038-05	N	Filter coil A 1.5-2.5	L9	1	CQ92M1H272K	ML	0.0027	C38	1
L34-3039-05	N	Filter coil B 1.5-2.5	L8	1	C90-0824-05	E	1 50V	C47-49	3
L34-3040-05	N	Filter coil C 2.5-4.0	L12	1	C91-0456-05	C	0.047	C7,10,13,17,18, 22,32-35,41,43	12
L34-3041-05	N	Filter coil D 2.5-4.0	L13	1	E29-0413-05		1P connector (female)		1
L34-3042-05	N	Filter coil E 4.0-6.0	L6,7	2	E40-0273-05		Mini connector 2P		1
L34-3043-05	N	Filter coil F 6.0-10.5	L3-5	3	E40-0373-05		Mini connector 3P		2
L34-3046-05	N	Filter coil I 10.5-15.5	L10	1	E40-0473-05		Mini connector 4P		2
L34-3047-05	N	Filter coil J 10.5-15.5	L11	1	E40-0673-05		Mini connector 6P		1
L34-3048-15	N	Filter coil K 15.5-22.0	L14,15	2	E40-0773-05		Mini connector 7P		2
L34-3050-05	N	Filter coil M 22.0-30.0	L1	1	E40-0873-05		Mini connector 8P		4
L34-3051-15	N	Filter coil N 22.0-30.0	L2	1	E40-1073-05		Mini connector 10P		1
L39-0414-05	N	Detector coil	L27,28	2	E40-1173-05		Mini connector 11P		1
L40-1011-04		Ferri-inductor 100μH	L22,31,34-38	7	E40-1273-05		Mini connector 12P		2
L40-1021-03		Ferri-inductor 1mH	L24,25	2	J31-0502-04		PC board collar		6
L40-1511-03		Ferri-inductor 150μH	L16-21,26	7	J42-0404-05		PC board bushing		6
L40-4791-02		Ferri-inductor 4.7μH	L30	1	L19-0336-05	N	DC-DC transf.	T1	1
N30-3006-41		Round screw		2	L40-1011-04		Ferri-inductor 100μH	L1-4	4
N32-3006-41		Flat screw		2	L40-1021-03		Ferri-inductor 1mH	L5-11	7
N87-3006-46		Self tapping screw		12	L77-0964-05	N	Crystal 5.59MHz	X1	1
RC05GF2H101J		Solid 100Ω 1/2W	R48-51	4	N35-3006-46		Bind screw		2
RC05GF2H121J		Solid 120Ω 1/2W	R53	1	N88-3008-46		Flat tapping screw		2
RC05GF2H182J		Solid 1.8kΩ 1/2W	R30	1	R90-0158-05	N	Inline block 47kΩ x7	RB3	1
RC05GF2H2R2J		Solid 2.2Ω 1/2W	R58-61	4	R90-0162-05	N	Inline block 47kΩ x8	RB4	1
RC05GF2H681J		Solid 680Ω 1/2W	R17,18	2	R90-0537-05	N	Inline block 10kΩ x8	RB5	1
RC05GF2H821J		Solid 820Ω 1/2W	R19,20	2	R90-0538-05	N	Inline block 1.5kΩ x3	RB1	1
R90-0535-05	N	Resistor block 22kΩ x7	RB1,2	2	R90-0539-05	N	Inline block 47kΩ x6	RB6,7	2
R92-0150-05		Short jumper		31	R90-0542-05	N	Inline block 47kΩ x12	RB9	1
S51-1412-05	N	Relay	RL1-14	14	R90-0543-05	N	Inline block 47kΩ x11	RB2,8	2
DIGITAL UNIT (X54-1670-00)					R90-0544-05	N	Inline block 0.01 x3	CB3	1
CC45SL1H101J	C	100pF	C15,44-46	4	R90-0545-05	N	Inline block 0.01 x5	CB1	1
CC45SL1H220J	C	22pF	C36,37	2	R90-0546-05	N	Inline block 0.01 x7	CB4	1
CC45SL1H221J	C	220pF	C39	1	R90-0547-05	N	Inline block 0.01 x12	CB2	1
CE04W0J221M	E	220 6.3V	C8,14,19	3	R90-0548-05	N	Inline block 0.022 x7	CB5	1
CE04W1A470M	E	47 10V	C21,24,42	3	R90-0549-05	N	Inline block 0.022 x8	CB6	1
CE04W1C101M	E	100 16V	C11	1	R90-0550-05	N	Inline block 0.022 x11	CB7	1

PARTS LIST

Parts No.	Re- marks	Description	Ref. No.	Q'ty	Parts No.	Re- marks	Description	Ref. No.	Q'ty
MAIN ENCODER UNIT (X54-1680-00)									
CE04W0J221M		E 220 6.3V	C1	1	E04-0157-05		Mini pin jack A		2
CE04W0J470M		E 47 6.3V	C2	1	E23-0433-05	N	Terminal		8
D09-0304-04		Encoder slit		1	E40-0373-05		Mini connector 3P		1
D21-0823-05	N	Shaft ass'y		1	F01-0771-05	N	Heat sink		1
E23-0015-04		Earth lug		2	F07-0839-03	N	Heat sink cover		1
G02-0519-04		Spring plate		1	F09-0405-24		Fan		1
J19-1342-04		Senser mounting hardware (A)		1	F20-0525-05	N	Insulating sheet		6
J19-1343-04		Senser mounting hardware (B)		1	F29-0014-05		Shoulder washer		10
N30-3006-46		Round screw		4	F29-0406-03		Fan motor ass'y		1
N32-3020-46		Flat screw		1	L19-0337-05	N	Input transf.	T3	1
N89-3005-46		Bind tapping screw		3	L19-0338-05	N	Input matching transf.	T2	1
R12-2409-05		Trim. pot. 5kΩ(B)	VR1,2	2	L19-0339-05	N	Output transf. B	T4	1
RIT ENCODER UNIT (X54-1690-00)									
CE04W0J101M		E 100 6.3V	C1	1	L19-0340-05	N	RF transf. A	T1	1
D09-0305-04	N	Encoder slit		1	L33-0025-05		RFC 1μH	L4,5	2
D21-0824-05	N	Shaft ass'y		1	L33-0032-05		RFC 3μH	L2	1
N30-2606-46		Round screw		2	L33-0617-05		RFC	L3,7-9	4
R12-2409-05		Trim. pot. 5kΩ(B)	VR1,2	2	L33-0644-05		Choke coil 2.2μH	L17	1
100W FINAL UNIT (X56-1430-00)									
CC45CH1H101J		C 100pF	C42	1	L33-0651-05	N	Choke coil	L14,15	2
CC45SL1H271J		C 270pF	C35	1	L33-0653-05	N	Choke coil	L16	1
CC45SL1H331J		C 330pF	C2,9	2	L33-0655-05	N	RFC	L13	1
CC45SL2H101J		C 100pF 500V	C8,40	2	L40-1011-04		Ferri-inductor 100μH	L10	1
CE04W1A471M		E 470 10V	C18	1	L40-1511-03		Ferri-inductor 150μH	L6,11,12,18	4
CE04W1H100M		E 10 50V	C12	1	N09-0623-04		Sems screw		5
CE04W1H101M		E 100 50V	C24	1	N09-0643-04	N	Sems screw w. cross head		1
CK45B1H102K		C 0.001	C4,10,19,23,39	5	N15-1030-41		Washer Fan motor		4
CK45F1H473Z		C 0.047	C6,7,15,22	4	N30-2604-41		Round screw Fan motor		5
CM73F2H331J	N	MC 330pF 500V	C33	1	N30-3006-46		Round screw Thermistor		1
CM73F2H391J	N	MC 390pF 500V	C38	1	N35-3008-46		Round screw TR		4
CM73F2H681J	N	MC 680pF 500V	C28	1	N87-3006-46		Self tapping screw PC board		4
CQ92M1H473K		ML 0.047	C21	1	N89-3006-45		Bind tapping screw Cover		10
C91-0456-05		C 0.047	C1,3,5,11,13,14,20,25-27,36,37	12	R12-0072-05		Trim. pot. 470Ω(B)	VR1	1
C91-0491-05	N	Cap. 0.0047	C16,17	2	R12-1406-05		Trim. pot. 1kΩ(B)	VR2	1
C91-0493-05	N	Cap. 0.47	C29,30	2	RC05GF2H151J		Solid 150Ω 1/2W	R7	1
					RC05GF2H220J		Solid 22Ω 1/2W	R9,10	2
					RC05GF2H221J		Solid 220Ω 1/2W	R11,12	2
					RC05GF2H3R9J		Solid 3.9Ω 1/2W	R23-26	4
					RC05GF2H4R7J		Solid 4.7Ω 1/2W	R6	1
					RC05GF2H5R6J		Solid 5.6Ω 1/2W	R27-30	4
					RC05GF2H560J		Solid 56Ω 1/2W	R34	1
					RS14AB3D330J		MF 33Ω 2W	R35	1
					R92-0041-25		Cement 0.47Ω 1W	R21	1
					R92-0150-05		Short jumper		3
					T42-0302-05	N	Fan motor		1

PARTS LIST

Parts No.	Re- marks	Description	Ref. No.	Q'ty	Parts No.	Re- marks	Description	Ref. No.	Q'ty
SIGNAL UNIT (X57-1000-11)									
C05-0013-15		Ceramic trimmer 20pF	TC3-6	4	CC45SL1H820J	C	82pF	C58,60	2
C05-0030-15		Ceramic trimmer 20pF	TC1	1	CC45TH1H030C	C	3pF	C349,462	2
C05-0314-15		Ceramic trimmer 100pF	TC2	1	CC45TH1H220J	C	22pF	C94	1
C05-0320-05		Ceramic trimmer 30pF	TC7	1	CC45TH1H270J	C	27pF	C99	1
					CC45TH1H330J	C	33pF	C116	1
					CC45TH1H680J	C	68pF	C464	1
CC45CH1H010C	C	1pF	C255	1	CE04AW1H0R1M	E	0.1 50V	C386,510,534, 542,578	5
CC45CH1H020C	C	2pF	C471	1	CE04AW1HR22M	E	0.22 50V	C86,171,509,636	4
CC45CH1H030C	C	3pF	C105,125,142, 280,473	5	CE04W1C100M	E	10 16V	C486,492,537, 630	4
CC45CH1H050C	C	5pF	C476	1	CE04W1C102M	E	1000 16V	C651	1
CC45CH1H0R5C	C	0.5pF	C119,249,356, 359,477	5	CE04W1C220M	E	22 16V	C151,167,221, 225,226,282,344, 392,396,450,488, 505,567-569, 576,583,587,631, 632	20
CC45CH1H070D	C	7pF	C106	1					
CC45CH1H100D	C	10pF	C6,128,132,144, 310,364	6	CE04W1C221M	E	220 16V	C640	1
CC45CH1H150J	C	15pF	C320,469	2	CE04W1C470M	E	47 16V	C222,345,346, 391,395,536,642, 648	8
CC45CH1H220J	C	22pF	C340,454,456, 458	4	CE04W1E100M	E	10 25V	C112,220,285, 343,384,387,389, 543,564,571,586, 629,633,634,639, 644,652	17
CC45RH1H010C	C	1pF	C107,121	2					
CC45RH1H020C	C	2pF	C108,197,212	3	CE04W1E220M	E	22 25V	C20,22,31,38,44, 50,57,63,69,74, 88	11
CC45RH1H030C	C	3pF	C178	1	CE04W1E471M	E	470 25V	C440,441	2
CC45RH1H050C	C	5pF	C264	1	CE04W1H010M	E	1 50V	C154,191,390, 420,423,424,426, 427,432,525,541, 563,565,588,599, 628,638	17
CC45RH1H070D	C	7pF	C184,267	2	CE04W1H3R3M	E	3.3 50V	C388,449,566, 575	4
CC45RH1H100D	C	10pF	C113-115	3	CE04W1HR47M	E	0.47 50V	C153,385,501, 592	4
CC45RH1H101J	C	100pF	C51,66,398	3	CE04W1H4R7M	E	4.7 50V	C176,179,500	3
CC45RH1H120J	C	12pF	C93,96,97,263, 265,296	6	CK45B1H102K	C	0.001	C122,127,140, 148,152,161,163, 177,207,400,401, 436,490,532,562, 900,645,646	18
CC45RH1H121J	C	120pF	C14,54,185,187, 552	5					
CC45RH1H180J	C	18pF	C186	1	CK45B1H181K	C	180pF	C100	1
CC45RH1H181J	C	180pF	C45,47	2	CK45B1H221K	C	220pF	C531,595,596,618	4
CC45RH1H220J	C	22pF	C76,78,92,98, 266	5	CK45B1H222K	C	0.0022	C227,228,533, 549,614,623	6
CC45RH1H221J	C	220pF	C39,41	2	CK45B1H331K	C	330pF	C330,465	2
CC45RH1H241J	C	240pF	C301,309,553	3	CK45B1H391K	C	390pF	C32,34	2
CC45RH1H270J	C	27pF	C91,358	2	CK45B1H471K	C	470pF	C339,353,412, 434	4
CC45RH1H330J	C	33pF	C70,72,348,411	4	CK45B1H681K	C	680pF	C33,394,570	3
CC45RH1H470J	C	47pF	C52,65	2	CK45B1H821K	C	820pF	C23,29,40	3
CC45RH1H560J	C	56pF	C16,53,55,64, 71,77,370	7	CK45E2H102P	C	0.001 500V	C135	1
CC45RH1H820J	C	82pF	C10	1					
CC45SL1H050C	C	5pF	C158,252	2					
CC45SL1H100D	C	10pF	C159,336,468, 478	4					
CC45SL1H101J	C	100pF	C218,283,298, 331,352,369,380, 393,466,485,487, 511,540,574,606	15					
CC45SL1H120J	C	12pF	C641,647	2					
CC45SL1H121J	C	120pF	C24	1					
CC45SL1H150J	C	15pF	C244,377	2					
CC45SL1H151J	C	150pF	C338,365,373, 376,498,520,528	7					
CC45SL1H220J	C	22pF	C279,483	2					
CC45SL1H221J	C	220pF	C335	1					
CC45SL1H330J	C	33pF	C254	2					
CC45SL1H331J	C	330pF	C28,162,164, 653	4					
CC45SL1H391J	C	390pF	C46,622	2					
CC45SL1H470J	C	47pF	C15,67,138,278, 313,472,530	7					
CC45SL1H680J	C	68pF	C13,59	2					

PARTS LIST

Parts No.	Re- marks	Description	Ref. No.	Q'ty	Parts No.	Re- marks	Description	Ref. No.	Q'ty
CK45F1H103Z		C 0.01	C7, 11, 12, 17, 90, 95, 102, 104, 111, 117, 118, 120, 123, 129, 134, 141, 143, 145, 146, 166, 172, 173, 174, 183, 194, 195, 208, 209, 219, 236, 241, 242, 253, 262, 269, 271, 277, 281, 284, 324, 351, 355, 361, 367, 378, 413, 430, 435, 437, 439, 443, 444, 452, 453, 455, 457, 459, 461, 475, 493, 497, 515, 521, 527, 535, 539, 544, 547, 559, 561, 577, 584, 607-609	75	C91-0457-05		C 0.022	C56, 61, 68, 73, 75 79, 124, 126, 130, 131, 133, 136, 137, 139, 150, 155, 160, 238-240, 243, 246 247, 250, 251, 257 260, 261, 270, 272, 273, 276, 286-294, 299, 312, 318, 321-323, 326, 328, 337, 350, 354, 357, 360, 363, 419, 431, 442, 445, 460, 467, 470, 474, 479, 481	65
CQ09S1H122J	S	0.0012	C402-404	3	C91-0458-05		Laminated cap. 0.47	C169	1
CQ09S1H182J	S	0.0018	C518, 519	2	C91-0472-05		ML 0.1	C211	1
CQ09S1H392J	S	0.0039	C554, 610	2	E04-0154-05		Coax. connector		8
CQ92M1H102K	ML	0.001	C26, 170, 213, 573	4	E23-0512-05		Round terminal		1
CQ92M1H103K	ML	0.01	C168, 447, 448, 451	4	E40-0273-05		Mini connector 2P		12
CQ92M1H104K	ML	0.1	C643	1	E40-0373-05		Mini connector 3P		2
CQ92M1H152K	ML	0.0015	C25, 27, 616	3	E40-0473-05		Mini connector 4P		5
CQ92M1H222K	ML	0.0022	C545, 546, 637	3	E40-0511-05		Mini connector 5P	MC1-6	6
CQ92M1H223K	ML	0.022	C215, 229, 230, 232, 446, 538, 572, 601, 649	9	E40-0517-05		Mini connector 5P	MB1, 2	2
CQ92M1H332K	ML	0.0033	C579-581	3	E40-0573-05		Mini connector 6P		1
CQ92M1H392K	ML	0.0039	C512, 615	2	E40-0673-05		Mini connector 6P		4
CQ92M1H472K	ML	0.0047	C110, 589	2	E40-0773-05		Mini connector 7P		1
CQ92M1H473K	ML	0.047	C214, 216, 217, 231, 233-235, 491, 582, 598, 625, 635	12	E40-0873-05		Mini connector 8P		3
CQ92M1H562K	ML	0.0056	C224, 590	2	E40-1073-05		Mini connector 10P		2
CQ92M1H682K	ML	0.0068	C626, 627	2	E40-1173-05		Mini connector 11P		1
C90-0817-05	E	1000 16V	C119	1	F20-0525-05		Insulating sheet		3
C91-0456-05	C	0.047	C8, 9, 18, 19, 21, 30, 37, 42, 43, 48, 49, 62, 80-85, 87, 89, 109, 149, 156, 157, 165, 175, 180-182, 190, 192, 193, 210, 223, 245, 248, 256, 258, 259, 274, 295, 297, 300, 311, 314-317, 325, 327, 332-334, 341, 342, 347, 362, 366, 368, 372, 374, 375, 379, 381-383, 397, 399, 414-418, 421, 422, 425, 428, 429, 433, 438, 463, 480, 482, 484, 489, 494-496, 499, 513, 514, 516, 517, 522-524, 529, 548, 550, 551, 555-558, 560, 585, 593, 594, 597, 611-613, 617, 619-621, 624	117	F29-0014-05		Shoulder washer		3
					L19-0324-05		Wide bandwidth transf.	L13, 51, 93	3
					L30-0516-05	N	IFT	L140	1
					L32-0201-05		OSC coil CAR1, CAR2	L139, 161	2
					L32-0650-15	N	OSC coil 100kHz	L166, 169, 172, 173	4
					L32-0651-05	N	OSC coil VCO-L	L54	1
					L32-0652-05	N	OSC coil VCO-M	L53	1
					L32-0653-05	N	OSC coil VCO-H	L52	1
					L33-0656-05	N	Choke coil 25μH	L160	1
					L33-0657-05	N	Choke coil 27μH	L137	1
					L34-0535-05		Tuning coil	L80, 111, 115	3
					L34-0536-05		Tuning coil 8.83MHz	L81, 113, 126, 143	4
					L34-0540-05		Tuning coil	L135, 136, 144, 145, 152	5
					L34-0664-05		Tuning coil 455kHz	L130, 153	2
					L34-0858-05		Tuning coil	L124	1
					L34-0859-05		Tuning coil	L121, 123	2
					L34-0860-15		Tuning coil	L122	1
					L34-0941-05		Tuning coil 8.83MHz	L127	1
					L34-0943-05		Tuning coil	L99, 125, 129, 133	4
					L34-0997-05		Tuning coil	L128	1
					L34-2079-05	N	Tuning coil	L11	1
					L34-2080-05	N	Tuning coil	L12	1
					L34-2081-05	N	Tuning coil	L15	1
					L34-2082-05	N	Tuning coil	L16	1
					L34-2083-05	N	Tuning coil	L18	1
					L34-2085-05	N	Tuning coil	L22	1
					L34-2086-05	N	Tuning coil	L23	1
					L24-2087-05	N	Tuning coil	L24	1
					L34-2088-05	N	Tuning coil	L25	1

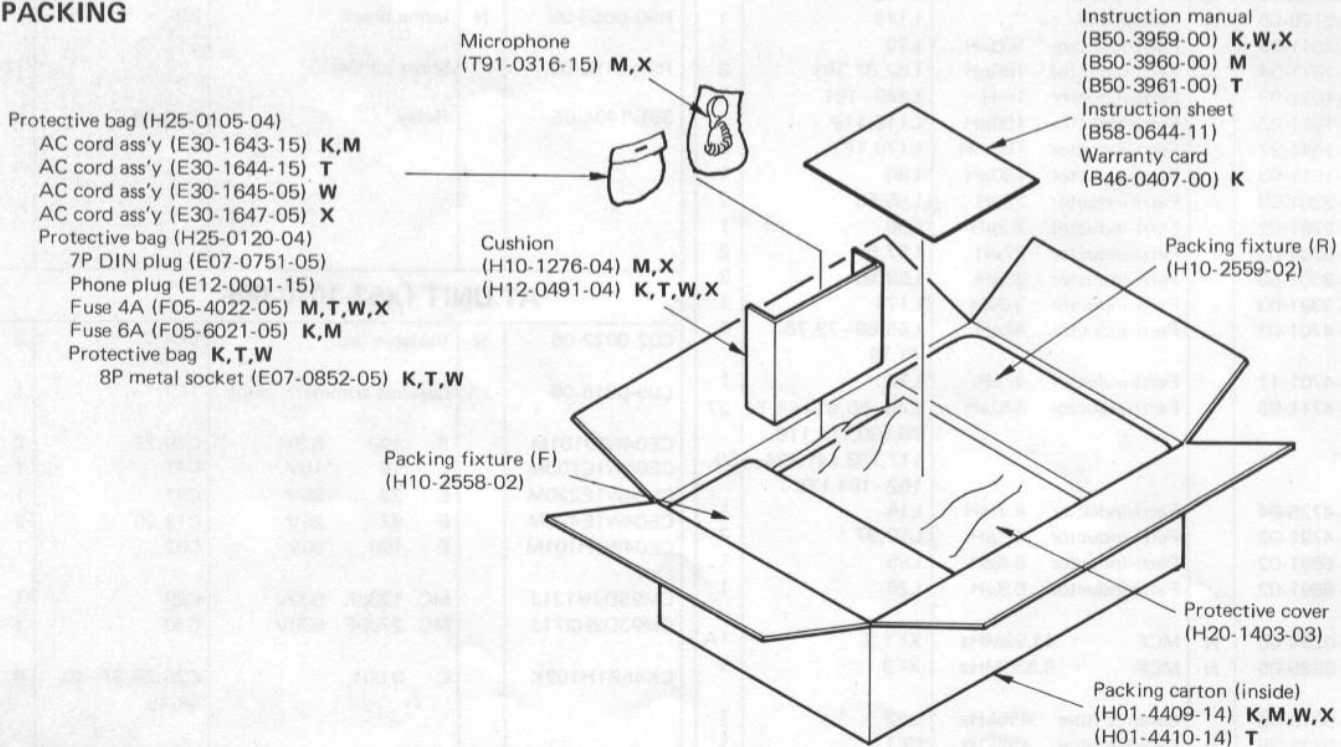
PARTS LIST

Parts No.	Re-remarks	Description	Ref. No.	Q'ty	Parts No.	Re-remarks	Description	Ref. No.	Q'ty
L34-2089-05	N	Tuning coil	L26	1	L77-0965-05	N	Crystal 36.1MHz	X1	1
L34-2090-05	N	Tuning coil	L27	1	L77-0966-05	N	Crystal 8375kHz	X2	1
L34-2091-05	N	Tuning coil	L29	1	L77-0967-05	N	Crystal 8828.5kHz	X4	1
L34-2092-05	N	Tuning coil	L30	1	L77-0968-05	N	Crystal 8830kHz	X5	1
L34-2093-05	N	Tuning coil	L31,32	2	L77-0969-05	N	Crystal 8831.5kHz	X3	1
L34-2094-05	N	Tuning coil	L33	1					
L34-2095-05	N	Tuning coil	L34	1	N10-2030-41		Nut		6
L34-2096-05	N	Tuning coil	L35	1	N30-3008-41		Round screw		4
L34-2097-05	N	Tuning coil	L17	1	N30-3010-41		Round screw		8
L34-2098-05	N	Tuning coil	L19	1	N87-3006-41		Self tapping screw		3
L34-2099-05	N	Tuning coil	L38,39	2					
L34-2100-15	N	Tuning coil	L40	1	R12-0401-05		Trim. pot. 100Ω	VR21	1
L34-2101-05	N	Tuning coil	L41	1	R12-0420-05		Trim. pot. 500Ω	VR2,6	2
L34-2102-15	N	Tuning coil	L42	1	R12-0430-05	N	Trim. pot. 470Ω	VR3-5	3
L34-2103-15	N	Tuning coil	L43	1	R12-1405-05		Trim. pot. 1kΩ	VR18	1
L34-2104-05	N	Tuning coil	L44	1	R12-1424-05	N	Trim. pot. 4.7Ω	VR23,24,27	3
L34-2105-15	N	Tuning coil	L45	1	R12-2409-05		Trim. pot. 5kΩ	VR1	1
L34-2106-05	N	Tuning coil	L66,68	2	R12-3411-05		Trim. pot. 47kΩ	VR8-10,15,16 26,32-34	9
L34-2107-05	N	Tuning coil	L67	1					
L34-2108-15	N	Tuning coil	L77	1	R12-3413-05		Trim. pot. 10kΩ	VR11,13,25,29 30	5
L34-2109-15	N	Tuning coil	L84	1					
L34-2111-05	N	Tuning coil	L88,92	2	R12-3430-05		Trim. pot. 10kΩ	VR22	1
L34-2112-05	N	Tuning coil	L89,91	2	R12-3438-05	N	Trim. pot. 22kΩ	VR7,28	2
L34-2113-05	N	Tuning coil	L90	1	R12-5414-05	N	Trim. pot. 100kΩ	VR12,17,31	3
L34-2114-15	N	Tuning coil 44.93MHz	L94	1	R12-5415-05	N	Trim. pot. 150kΩ	VR20	1
L34-2115-15	N	Tuning coil 44.93MHz	L95	1	R12-6404-05		Trim. pot. 470kΩ	VR14,19	2
L34-2116-15	N	Tuning coil 44.93MHz	L96,97	2					
L34-2117-15	N	Tuning coil	L98	1	RN14BK2E103F		MF 10kΩ 1/4W	R277	1
L34-2118-15	N	Tuning coil 8.83MHz	L112	1	RN14BK2E271F		MF 270Ω 1/4W	R519,520	2
L34-2121-05	N	Tuning coil 455kHz	L131	1	RN14BK2E333F		MF 33kΩ 1/4W	R272,275	2
L34-2122-05	N	Tuning coil 455kHz	L134	1	RN14BK2E912F		MF 9.1kΩ 1/4W	R273	1
L34-2123-15	N	Tuning coil	L132,142	2	RS14AB3A331J		MF 330Ω 1W	R20	1
L34-2124-05	N	Tuning coil 455kHz	L165	1					
L34-2125-15	N	Tuning coil 355kHz	L146-148	3	R90-0163-05	N	Inline block 47kΩ x9	IB1	1
L34-2127-15	N	Tuning coil	L167	1	R90-0549-05	N	Inline block 0.022 x 8	IB4	1
L34-2128-15	N	Tuning coil	L168	1	R90-0551-05	N	Inline block 0.01 x 4	IB2,3	2
L34-2129-05	N	Tuning coil	L175	1	R90-0553-05	N	Inline block	IB5	1
L40-1011-03		Ferri-inductor 100μH	L83	1					
L40-1011-04		Ferri-inductor 100μH	L82,87,101	3	R92-0150-05		Short jumper		174
L40-1021-03		Ferri-inductor 1mH	L149-151	3					
L40-1511-03		Ferri-inductor 150μH	L118,119	2	S51-1404-05		Relay	RL1-3	3
L40-1541-27		Ferri-inductor 150mH	L170,171	2					
L40-1811-03		Ferri-inductor 180μH	L86	1					
L40-2201-03		Ferri-inductor 22μH	L55,56	2					
L40-2291-02		Ferri-inductor 2.2μH	L36	1					
L40-2701-03		Ferri-inductor 27μH	L57,58	2					
L40-3301-03		Ferri-inductor 33μH	L59,60	2					
L40-3391-03		Ferri-inductor 3.3μH	L174	1					
L40-4701-03		Ferri-inductor 47μH	L65,69-73,76, 78,79	9					
L40-4701-11		Ferri-inductor 47μH	L120	1					
L40-4711-03		Ferri-inductor 470μH	L46-50,61-64,74, 27 75,100,114,116, 117,138,141,154-159, 162-164,176						
L40-4725-04		Ferri-inductor 4.7mH	L14	1					
L40-4791-02		Ferri-inductor 4.7μH	L10,37	2					
L40-5691-02		Ferri-inductor 5.6μH	L85	1					
L40-6891-02		Ferri-inductor 6.8μH	L28	1					
L71-0234-05	N	MCF 44.93MHz	XF1,2	1A					
L71-0235-05	N	MCF 8.830MHz	XF3	1					
L72-0319-05		Ceramic filter 455kHz	CF2	1					
L72-0333-05	N	Ceramic filter 455kHz	CF1	1					
AT UNIT (X57-1010-00)									
C02-0022-05	N	Variable cap.						VC1,2	2
C05-0315-05		Ceramic trimmer 60pF						TC1	1
CE04W0J101M	E	100 6.3V						C19,21	2
CE04W1C100M	E	10 16V						C47	1
CE04W1E220M	E	22 25V						C31	1
CE04W1E470M	E	47 25V						C18,20	2
CE04W1H101M	E	100 50V						C32	1
CM93D2H121J	MC	120pF 500V						C29	1
CM93D2H271J	MC	270pF 500V						C30	1
CK45B1H102K	C	0.001						C25,26,37-40, 44,45	8

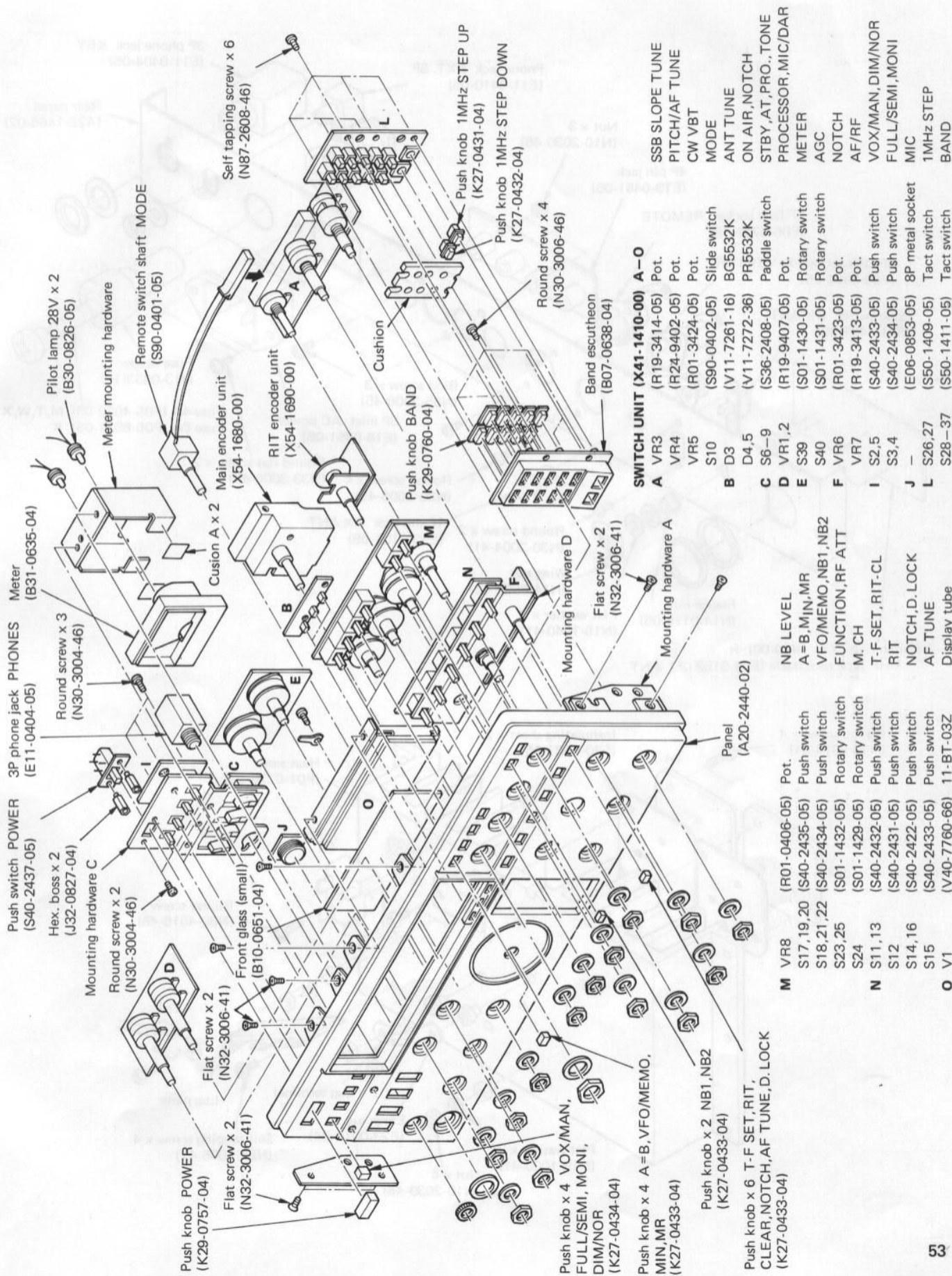
PARTS LIST/PACKING

Parts No.	Re- marks	Description	Ref. No.	Q'ty	Parts No.	Re- marks	Description	Ref. No.	Q'ty
CK45F1H103Z		C 0.01	C1-17,24, 33-36,46	23	N30-3006-46		Round screw		1
					N35-3006-41		Bind screw		4
CQ92M1H333K		ML 0.033	C43	1	N87-3006-41		Self tapping screw		6
					N87-3012-41		Self tapping screw		4
C91-0456-05		C 0.047	C22,23,27,28,42	5	N88-3008-41		Flat tapping screw		10
D22-0408-05	N	Coupling		2	R12-2401-05		Trim. pot. 5kΩ	VR1	1
D40-0623-15	N	Gear ass'y		1	R12-3401-05		Trim. pot. 10kΩ	VR2	1
D40-0624-15	N	Gear ass'y		1					
E04-0154-05		Coax. connector		6	RC05GF2H101J		Solid 100Ω 1/2W	R112,113	2
E40-0473-05		Mini connector 4P		1	RC05GF2H270J		Solid 27Ω 1/2W	R46,49,62,65	4
E40-0673-05		Mini connector 6P		2	RC05GH2H470J		Solid 47Ω 1/2W	R133	1
E40-0873-05		Mini connector 8P		1	RN14BK2E103F		MF 10kΩ 1/4W	R96,97,100,101	4
					RS14AB3A102J		MF 1kΩ 1W	R129,131	2
					RS14AB3A271J		MF 270Ω 1W	R75	1
J31-0502-04		PC board collar		4	RS14AB3A330J		MF 33Ω 1W	R132	1
J42-0428-05		PC board bushing		4	RS14AB3A390J		MF 39Ω 1W	R92	1
					RS14AB3A471J		MF 470Ω 1W	R130	1
					RS14AB3D271J		MF 270Ω 2W	R76	1
L34-2133-05	N	Tuning coil A	L20	1	R90-0554-05	N	Inline block	IB1	1
L34-2134-05	N	Tuning coil B	L19	1	R90-0555-05	N	Inline block	IB2	1
L39-0415-15	N	Detector coil A	L18	1					
L39-0416-05	N	Detector coil B	L17	1					
L40-1011-04		Ferri-inductor 100μH	L13,14	2	R92-0150-05		Short jumper		35
L40-1011-12		Ferri-inductor 100μH	L8-11	4					
L40-1511-03		Ferri-inductor 150μH	L12	1	S51-1412-05		Relay	RL2-7	6
L40-4711-03		Ferri-inductor 470μH	L1-6,15	7	S51-2411-05	N	Relay	RL1,8	2
L40-4711-12		Ferri-inductor 470μH	L7,16	2					
L92-0103-05		Toroid core		2	T42-0005-15	N	Motor		2
L92-0115-05	N	Toroid core		1					
N09-0256-05		Gnd. screw		1					
N10-2030-46		Nut		1					

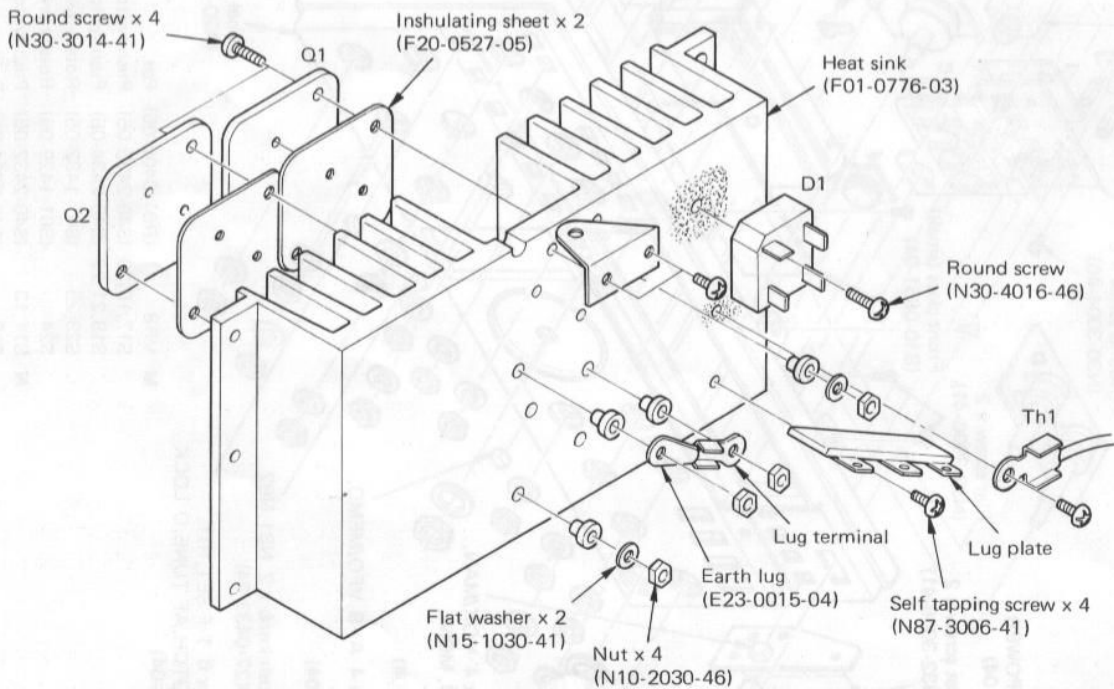
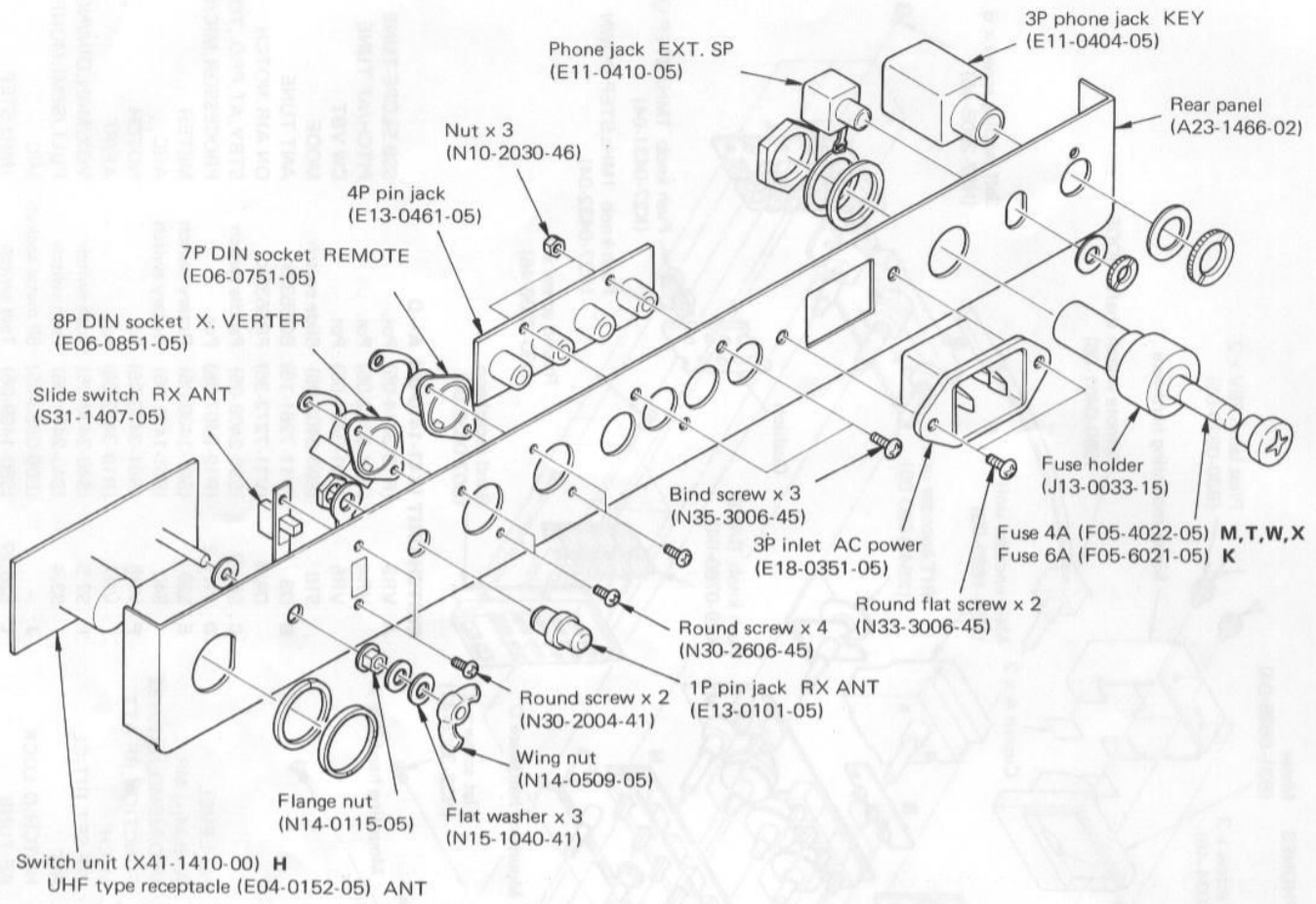
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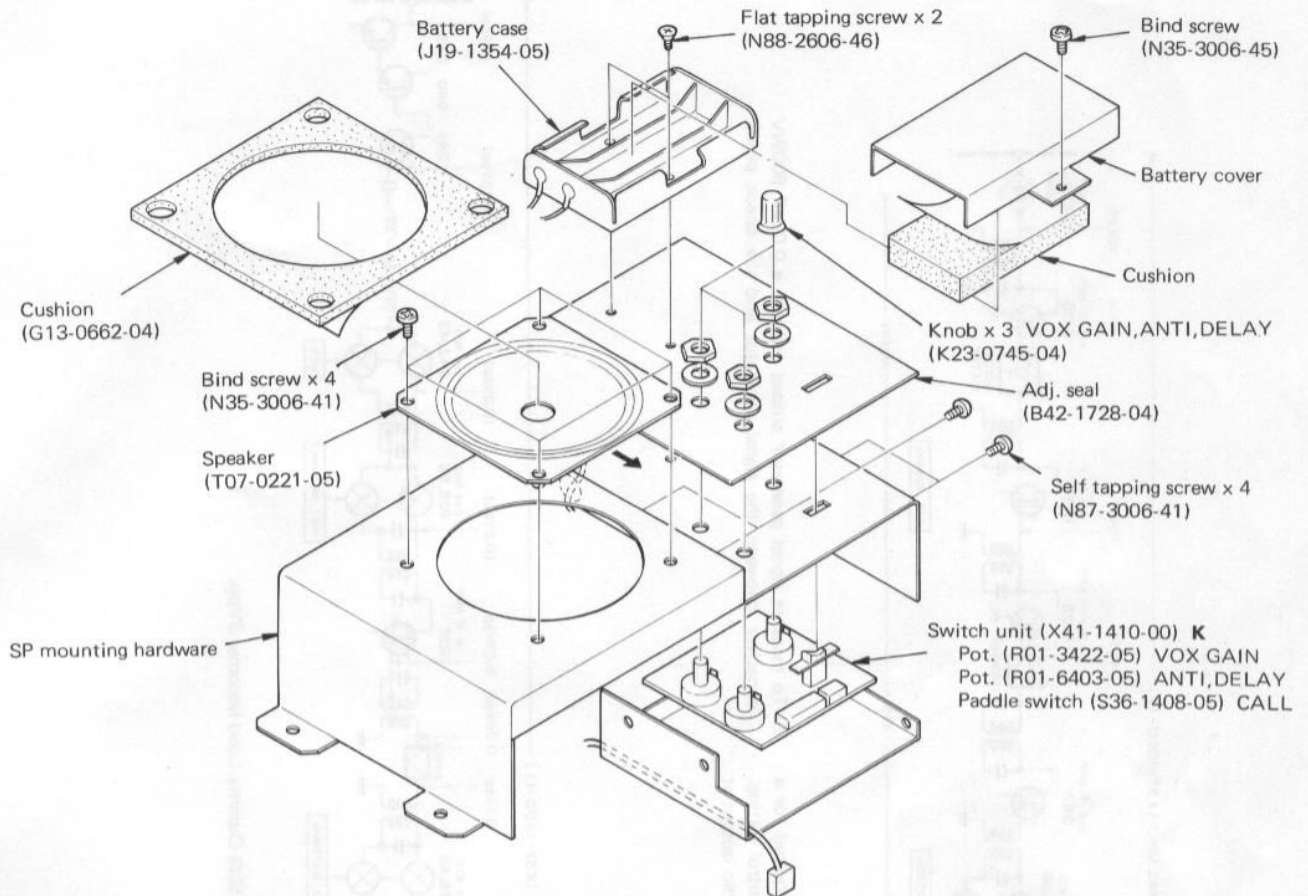
DISASSEMBLY



DISASSEMBLY



DISASSEMBLY



● 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 section, 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) When repairing the Signal unit under the chassis, take much care.
 - 1) To remove the PC board from the chassis, remove 19 screws.
 - 2) The weight of PC board and radiator plate is about 1kg in total.

However, the optional filter can be installed easily without removing the Signal PC board.
- (3) Removing mounting hardware for electric capacitor

The mounting hardware for electric capacitor can be removed by removing two screws from one side of the mounting hardware and sliding it toward the screws (to left side when viewed from the front panel).
- (4) The speaker is installed to the mounting hardware on the chassis, different from the models in the past.

● Disassembly for front panel

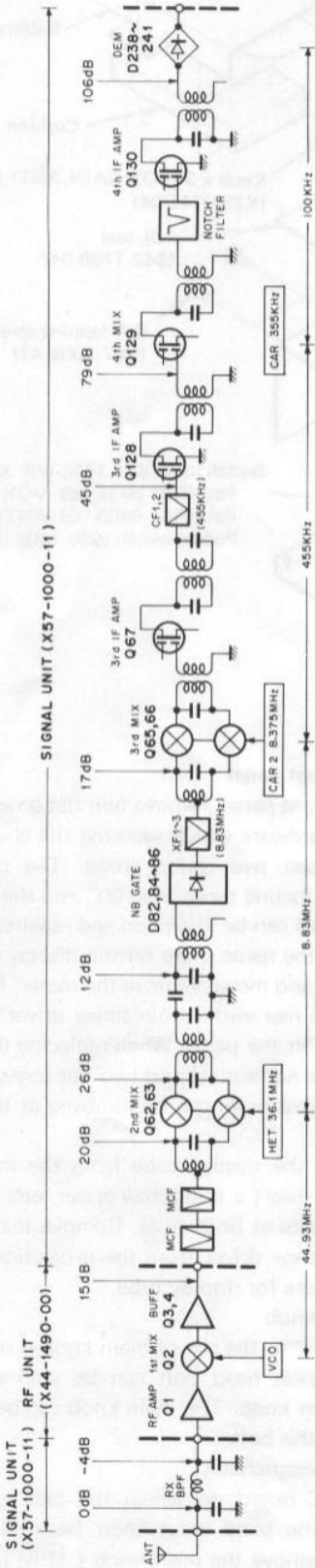
- (1) To incline the front panel, remove two flat screws from the mounting hardware which securing the chassis and panel, and loosen two round screws. The panel at chassis side will incline more than 90°, and the parts at inside of the panel can be inspected and repaired easily.
- (2) When replacing the name plate on the display window for display tube and meter, remove the meter. Push the name plate from rear with a thin screw driver through the square hole on the panel. When replacing the front glass, remove the name plate and two flat screws (M2 x 6). (The front glass grille can be removed at the same time.)
- (3) When removing the display tube from the mounting hardware for it, 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.
- (4) 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.
- (5) Removing band escutcheon

Remove the PC board on which the tact switch is installed from the band escutcheon (secured by six screws). Then, remove the push knob (1.5 3.5 ...), cushions, and the four round screws which is securing the escutcheon to the front panel.

TS-930S LEVEL DIAGRAM

RECEIVER SECTION

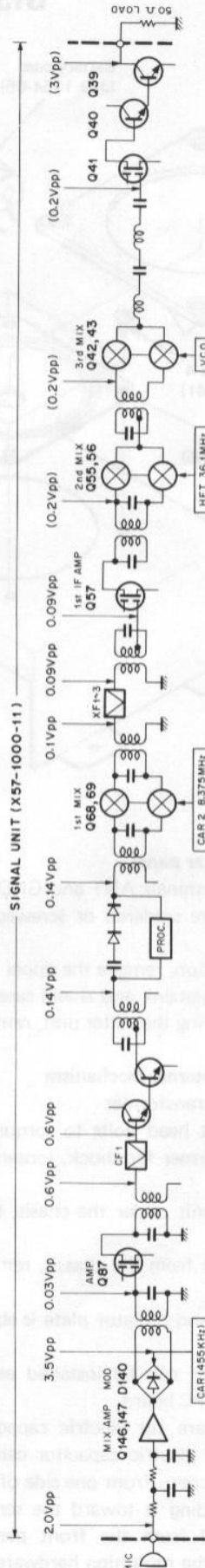


FREQUENCY : 14.200MHz
 INPUT : 0dB (5μV)
 AF OUTPUT : 0.63V at 8Ω

NOTES

- 1) The figures shown are signal generator output required for a constant audio output with a constant AF gain control setting. Set the AF gain control for 0.63V/8Ω (50mW) audio output at 0dB signal generator input at 14.200MHz.
- 2) To measure signal generator output connect a 0.01μF 500WV capacitor between the signal generator and the check point.

TRANSMITTER SECTION



FREQUENCY : 14.200MHz
 AF INPUT : 2.00Vpp

() : When adjust MIC input voltage so that voltage of 50Ω Dummy Load becomes 3Vpp.

ADJUSTMENT

REQUIRED TEST EQUIPMENT

1. **DC Voltmeter (DC V.M)**
 - 1) Input resistance : More than $1\text{M}\Omega$
 - 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 : $1\text{M}\Omega$ 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 : $1\text{M}\Omega$ 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**
Requires high sensitivity, and external synchronization capability.
8. **Sweep Generator**
 - 1) Center frequency : 50kHz to 90MHz
 - 2) Frequency deviation : Maximum $\pm 35\text{MHz}$
 - 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 : $-20\text{dB}/0.1\mu\text{V}$ to $120\text{dB}/1\text{V}$
 - 3) Output impedance : 50Ω
 - 4) AM and FM modulation can be possible.

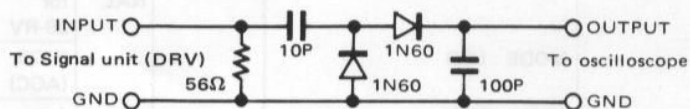
NOTE : Generator must be frequency stable.
10. **Frequency Counter (f. counter)**
 - 1) Minimum input voltage : 50mV
 - 2) Frequency range : 50MHz or greater
 - 3)
11. **Noise Generator**
Must generate ignition noise containing harmonics beyond 30MHz.
12. **RF Dummy Load**
 - 1) Impedance : 150Ω
 - 2) Dissipation : 150W or greater
13. **Power Meter**
 - 1) Impedance : 50Ω
 - 2) Dissipation : 150W continuous or greater
 - 3) Frequency limits : 60MHz or greater

14. Spectrum Analyzer

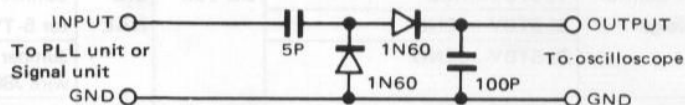
- 1) Frequency range : 100kHz to 110MHz or greater
- 2) Bandwidth : 1kHz to 3MHz

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

PREPARATION

Unless otherwise specified, set the controls as follows.

Front panel

POWER	ON	RIT SW	OFF
BAND . . . . .	.14	NB1	OFF
AF . . . . .	.MIN	NB2	OFF
RF . . . . .	.MAX	D. LOCK	OFF
MIC . . . . .	.MIN	AF TUNE	OFF
PROCESSOR IN . .	.MIN	VFO/MEMO	VFO
PROCESSOR OUT .	.MIN	MONI	OFF
CAR . . . . .	.MIN	DIM/NOR	NOR
FUNCTION . . . .	.A	SEND/REC	REC
CW VBT . . . . .	.NORM.	FULL/SEMI	SEMI
SSB SLOPE		MODE	USB
TUNE LOW . . . .	.MIN	NOTCH SW	OFF
SSB SLOPE		VOX/MAN	MAN
TUNE HIGH . . . .	.MAX	AUTO/THRU	THRU
PITCH . . . . .	.CEN	PROCESSOR SW . .	OFF
AF TONE . . . . .	.CEN	NAR/WIDE	WIDE
NOTCH . . . . .	.CEN	AGC SW	FAST
MEMORY CH. . . .	.1	RF ATT . . . . .	.0
METER SW . . . .	.POWER	NB LEVEL . . . . .	.MIN

Rear panel

RX ANT OFF

ADJUSTMENT

VOLTAGE ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
1. Voltage	1) POWER : ON RF GAIN : MAX (Full CW) MODE : USB STBY : REC	DC V.M	AVR	28B	AVR	VR1	28.5V	± 0.3V
			SIG-NAL	Connector 28-RV	SIG-NAL	VR24	16.0V	± 0.1V
				R375 (AGC)		VR29	3.20V	± 0.01V
				Jumper wire J13		VR25	2.20V	± 0.01V
2. TX Control voltage	1) STBY : REC	DC V.M	SIG-NAL	Connector 5-TV			Check	about -4.0V
	2) STBY : SEND						Check	16.0V ± 0.3V
	3) STBY : SEND				Jumper wire J89	SIG-NAL	VR13	3.20V	± 0.01V
3. SWR standard voltage	1) STBY : REC	DC V.M	SIG-NAL	IC4-12	SIG-NAL	VR15	0.5V	± 0.01V This is a reference level for the SWR circuitry. It will effect the auto antenna tuner.

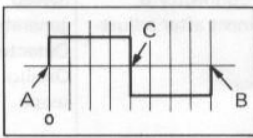
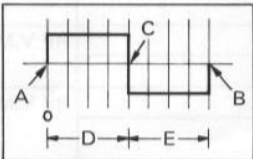
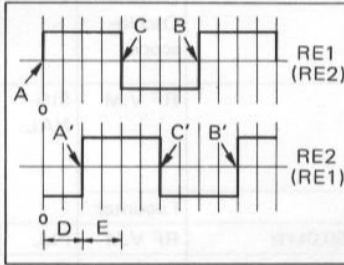
PLL ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
1. Standard Oscillator		f. counter	PLL	IC16-1	PLL	TC1	10,000,000Hz	± 5Hz
2. 40MHz multiplier		RF V.M	PLL	IC14-5	PLL	T16-18	MAX	
3. VCO-3	1)	f. counter	PLL	IC13-15	PLL	TC2	10,240,000Hz	± 10Hz
	2) FREQ : <input type="text"/> . <input type="text"/> <input type="text"/> 1.9 <input type="text"/> kHz To obtain this frequency 1st set dial to <input type="text"/> 2.0 <input type="text"/> . Then using mic pushbutton depress button (DWN) one step at a time until the display just changes to <input type="text"/> 1.9 <input type="text"/> by this method can step frequency in each 10Hz steps.	DC V.M		Q32-C		T14	3.70V	± 0.05V □ DENOTES STEP 9 (90Hz) or one step before the next 100Hz (.xxx.1) Transition
	3) FREQ : <input type="text"/> . <input type="text"/> <input type="text"/> 0.0 <input type="text"/> kHz Use similar method in step 3. 2) PLL adjustment					Check	9.5V ± 0.5V	
4. VCO-2	1) FREQ : <input type="text"/> . <input type="text"/> 999.9 <input type="text"/> kHz Use similar method in step 3. 2) PLL adjustment. 2) FREQ : <input type="text"/> . <input type="text"/> 000.0 <input type="text"/> kHz For 10Hz level, tune VFO one step before <input type="text"/> . <input type="text"/> 999. <input type="text"/> <input type="text"/>		DC V.M		PLL	Q24-C	PLL	T15	3.00V	± 0.05V
	Check	8.0V ± 0.5V						
5. VCO-1L (Low)	1) FREQ : 100.0kHz Tune VFO fully CCW to 15kHz	DC V.M	SIG-NAL	R81	SIG-NAL	L54	13.50V	± 0.1V
	2) FREQ : 9,499.9 <input type="text"/> kHz						Check	6.0V ± 1.0V
6. VCO-1M (Medium)	1) FREQ : 9,500.0 <input type="text"/> kHz For 10Hz level, tune VFO to one step before 9,499.99	DC V.M	SIG-NAL	R81	SIG-NAL	L53	3.00V	± 0.1V
	2) FREQ : 19,499.9 <input type="text"/> kHz						Check	12.0V ± 1.0V
7. VCO-1H (High)	1) FREQ : 29,999.9 <input type="text"/> kHz Tune VFO fully CW to 29,999.99 kHz.	DC V.M	SIG-NAL	R81	SIG-NAL	L52	13.00V	± 0.1V
	2) FREQ : 19,500.0 <input type="text"/> kHz						Check	3.0V + 1.0V, -0.5V

ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks			
		Test equipment	Unit	Terminal	Unit	Part	Method				
8. PLL-BPF	1) Disconnect connector 8, CAR 1. Reconnect after adjustment.	Sweep generator Detector Oscilloscope	PLL	IC6-2 Q17-E	PLL	T7-9	Adjust as shown at right.				
9. PLL 8.85MHz IF	1)	RF V.M	PLL	IC6-5 or IC7-2	PLL	T13	MAX	(Ref. 100mV-120mV)			
	2)					VR1	100mV	± 5mV			
10. PLL 5.2MHz IF	1)	RF V.M	PLL	Q17-E	PLL	T10	MAX				
	2)					VR2	100mV	± 5mV			
11. PLL 50.15MHz IF	1)	RF V.M	PLL	Q18-E	PLL	TC3	110mV	± 5mV			
	2)					Q16-E	T4-6	MAX	(Ref. 100mV)		
12. PLL 60.15MHz IF	1)	RF V.M	PLL	IC3-5	PLL	T1-3	MAX				
	2)						T11,12	MAX			
	3)					Q17-E		Check If above 150mV, lower to below 150 mV with VR1. (Must remove VCO shield).	100-150mV		
13. VCO-BPF		Sweep generator Detector Oscilloscope	SIG- NAL	Q16-G Q20-E	SIG- NAL	L66- 68	Adjust as shown at right.				
14. 36.1MHz HET	1)	RF V.M	SIG- NAL	R125	SIG- NAL	L77	0.21V (Adjust CW from MAX in direction [core is inserted].)	0.5dB			
	2)	f.counter					Check	36.100MHz ± 1kHz			
15. VCO level	1) FREQ : 15,250.0kHz	RF V.M	PLL	Q14-E	PLL	TC4	160mV	± 10%			
16. Main encoder	1) Remove the VFO knob and motor-drive the encoder at approx 300 rpm.	Oscilloscope	Digital	Conne- ctor 4-ME1					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 turned 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.							Conne- ctor 4-ME2	VR2	Adjust until intervals D and E are equal to each other with point C placed at the center.	
	4) ME1, ME2 phase difference alignment : Same as above.							Conne- ctor 4-ME1 and ME2	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.

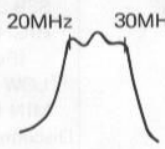
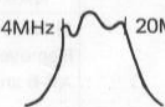
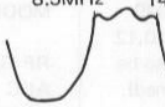
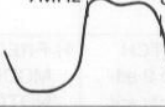
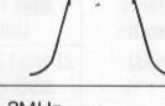
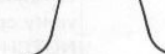
ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
17. RIT encoder	1) Remove the RIT knob and motor-drive the encoder at approx 300 rpm.	Oscilloscope	Digital	Connector 5-RE1				Pont 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 turned 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 5-RE2		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 5-RE1 and RE2				The phases of RE1 and RE2 may be replaced with each other as indicated in the brackets.


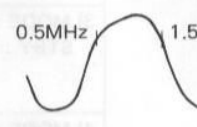
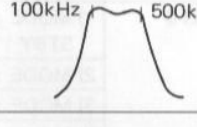
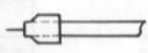
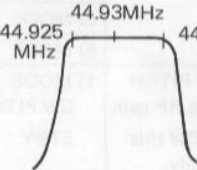
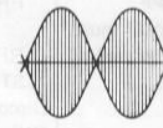
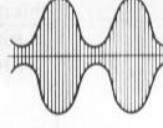
RX ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
1. CAR-1	1) MODE : USB STBY : REC	RF V.M	SIGNAL	Connector 24-CAR1	SIGNAL	L161	0.21V (Adjust CCW from MAX)	± 1dB
	2) STBY : REC ↔ SEND	f.counter				VR27	No change in frequency when switched from TX to RX.	
	3) STBY : REC					TC4	8831.5kHz	There are preliminary adjustment. Do not forget to perform the transmitter frequency response portion steps 15, 1) through 6).
	4) MODE : LSB STBY : REC					TC5	8828.5kHz	
	5) MODE : FSK STBY : SEND					VR26	8827.79kHz	
	6) MODE : CW STBY : SEND					TC6	8830.000kHz	± 10Hz

ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks				
		Test equipment	Unit	Terminal	Unit	Part	Method					
2. CAR-2 If TC3 is adjusted, Step 8 adjustments must be performed.	1) MODE : USB STBY : REC	RF V.M	SIG-NAL	Q79-E (R472)	SIG-NAL	L142-145	MAX					
						L139	0.35V (Adjust CCW from MAX)	± 1dB				
	2) MODE : USB ↔ LSB STBY : REC					L144, 145	Same level, When switched from USB to LSB.	± 0.5dB				
	3) MODE : USB STBY : REC ↔ SEND	f. counter		C298		VR23	No change in frequency, when switched from USB to LSB.					
	4) MODE : USB STBY : REC					TC3	8.375MHz					
3. CAR-3	1) MODE : CW STBY : REC	f. counter	SIG-NAL	Q141-E	SIG-NAL	L169	100,000Hz (100kHz)	± 20Hz				
	2) MODE : USB						Verify	101.5kHz ± 200Hz				
	3) MODE : LSB							98.5kHz ± 200Hz				
	4) MODE : AM							100.0kHz ± 100Hz				
	5) MODE : FSK							98.5kHz ± 200Hz				
	6) MODE : TUNE							100.0kHz ± 20Hz				
4. CW PITCH Rotate RF gain full CCW this step only.	1) MODE : CW CW PITCH : 12 o'clock STBY : REC	RF V.M	SIG-NAL	R836	SIG-NAL	L172	MAX	0.27-0.47V (reference)				
		f. counter				L173	99,200Hz	± 20Hz				
5. 355kHz BPF	1) MODE : CW STBY : REC	RF V.M	SIG-NAL	Q129-G2	SIG-NAL	L146-148	MAX	0.4V ± 0.1V (reference)				
6. 0.1-30MHz BPF (Step 11 must also be performed).	1) BAND : 20.0-30.0MHz FREQ : 29,500.0kHz RF ATT : 0dB STBY : REC Disconnect SIGNAL unit, RIF connector, and connect this plug to detector.	Sweep generator	Body	ANT	SIG-NAL	L43-45	Adjust as shown at right.					
								Detector Oscilloscope	RF	RIF	L40-42	
											L38-39	
											L33-35	
											L29-32	
											L25-27	
2) BAND : 14.0-20.0MHz FREQ : 18,000.0kHz												
3) BAND : 8.5-14.0MHz FREQ : 10,000.0kHz												
4) BAND : 7.0-8.5MHz FREQ : 7,000.0kHz												
5) BAND : 4.0-7.0MHz FREQ : 6,900.0kHz												
6) BAND : 3.0-4.0MHz FREQ : 3,900.0kHz												

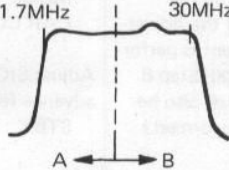
ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
	7) BAND : 1.5–3.0MHz FREQ : 1,900.0kHz	Sweep generator Detector Oscilloscope	Body RF	ANT RIF	SIG- NAL	L21– 24	Adjust as shown at right.	
	L18,19							
	L15– 17							
7. 44.93MHz MCF	1) STBY : REC Disconnect SIGNAL unit, VCOF connector, and connect plug to Sweep GEN. Sweep G.  To RF unit Detector must be grounded near R336. Reconnect VCOF connector after adjustment.	Sweep generator Detector Oscilloscope	RF SIG- NAL	VCOF R336	SIG- NAL	L121– 124	1) Crest value : MAX 2) Ripple : MIN Adjust as shown at right.	 44.925 MHz 44.93MHz 44.935 MHz 44.93MHz ± 5kHz
8. SSB SLOPE TUNE	1) MODE : CW SSB SLOPE TUNE HIGH CUT CONTROL : MAX (Full CW) LOW CUT CONTROL : MIN (Full CCW) Disconnect XF-6 2P connector and insert set-up jig PC board. NAR-WIDE SW : NAR	VBT-1 Oscillo- scope	SIG- NAL Rear panel	Connec- tor 7-1P IF OUT			Adjust VBT-1 f VR to obtain waveform shown at right.	OK 
	2) NAR-WIDE SW : WIDE Remove jig PC board from XF-6 and reinstall 2P connector.				SIG- NAL	TC3	Adjust as shown at right.	NG 
9. RX IF-AMP (Steps 10,12 must also be performed).	1) FREQ : 14,175.0kHz MODE : USB RF GAIN : CW MAX AGC : OFF SSG output : 14.175MHz	SSG AF V.M Oscillo- scope AF dummy load	Rear panel	ANT EXT.SP	RF SIG- NAL	T3–5 L125– 132, 146– 148, 165– 168, TC1	MAX (AF output) Rotate L126 core out by 30° from peak. T4 : 2.5 turns down from flush then TC1 mechani- cal center. Then T3 for MAX	S/N : better than 10dB/0.63V (8Ω) with (–6dB) SSG output.
10. NOTCH (If Step 9 ad- justments are performed, these adjustments must also be performed).	1) FREQ : 14,175.0kHz MODE : USB NOTCH CONTROL : 1 o'clock SSG output : 14.175MHz 0dB/μ	SSG AF V.M Oscillo- scope AF dummy load	Rear panel	ANT EXT.SP			Adjust for 1500Hz/0.63V AF output.	
	2) NOTCH SW : ON SSG output : 40dB/μ	load f. counter			SIG- NAL	L167 VR28	MIN Adjust while slowly raising SSG output.	
	3) Adjust NOTCH control to verify operating point turn NOTCH SW off after checking.							Dip point must occur between 12 : 30 and 1 : 30.

ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks	
		Test equipment	Unit	Terminal	Unit	Part	Method		
11. IF trap (If Step 6-1 adjustment is performed, this adjustment must also be performed).	1) BAND : 28 MODE : USB SSG output : 44.93MHz 80dB/μ	SSG	Rear panel	ANT	SIG-NAL RF	L11,12 T7	MIN	Almost all received waveform must disappear.	
12. S meter (If TC1 is adjusted in step 9 perform this adjustment).	1) AGC : OFF METER SW : POWER	S meter			SIG-NAL	VR30	Set to S meter starting point.		
	2) FREQ : 14,175.0kHz AGC : FAST SSG output : 14.175MHz 0dB/μ	SSG S meter AF V.M Oscilloscope	Rear panel	ANT EXT.SP			VR1	Adjust CCW to the point where AF V.M reading decreases by 0.5dB.	
	3) SSG output : 8dB/μ						TC1	S1	8dB ± 4dB
	4) SSG output : 40dB/μ	AF					VR31	S9	40dB ± 6dB
	5) SSG output : 100dB/μ	dummy load						SSG output : 100dB Repeat step 1) through 4) if necessary.	S9 + 60dB ± 6dB Check
13. NB	1) FREQ : 14,175.0kHz MODE : USB SSG output : 14,175.0kHz	SSG DC V.M	Rear panel SIG-NAL	ANT R144	SIG-NAL	L80,81	1) 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	Moise 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 NB 1 SW : OFF)					SIG-NAL	L80,81	MIN (If NB level has insufficient effect, adjust L126 core slightly CCW (out) from peak.	Noise disappears.
	4) NB 2 SW : ON (After checking, shut NB 2 SW OFF)							Check	The same effect as NB 1 is obtained.
	5) Raise Noise GEN. level to S9. NB 1 SW : ON (After checking, turn NB 1 SW OFF).							If any noise remains adjust NB LEVEL to find the point where NB operates.	Noise disappears.
14. Micro-processor Audio-Tone indicator	1) AF GAIN : MIN CLEAR SW : Push	AF V.M Oscilloscope AF dummy load	Rear panel	EXT.SP	SIG-NAL	VR33	50mV/8Ω	± 3dB	

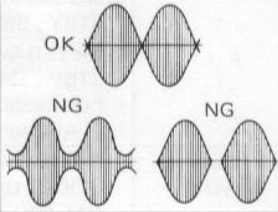
TX ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
1. TX-BPF	1) FREQ : 14,175.0kHz STBY : SEND Disconnect DRV connector and terminate with a 50Ω dummy load. (After adjustment, remove and reconnect DRV connector).	Sweep generator Detector Oscilloscope	SIG-NAL	R196 DRV	SIG-NAL	L92-88, L84	Adjust in order, L92-88,84 so that waveform shown at right is obtained when crest value is MAX. (Adjust sweep band A and B separately).	1.7MHz 30MHz 

ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
2. Drive	1) FREQ : 14,175.0kHz MODE : CW Disconnect DRV connector and terminate with a 50Ω dummy load. Adjust CAR control for DRV terminal voltage is less than 1.5V. STBY : SEND	RF V.M	SIG-NAL	DRV	SIG-NAL	L94-99, 111, 112, 115	MAX 1) Adjust in order; L115, and 112-94. 2) Repeat in order; L99, 111, and 94-97.	
3. TX IF-AMP	1) FREQ : 14,175.0kHz MODE : USB Disconnect DRV connector and terminate with a 50Ω dummy load. Adjust MIC control so voltage at DRV terminal is 1.0V ± 0.5V. AG output : 1500Hz, 2mV STBY : SEND	RF V.M AG	SIG-NAL Front panel	DRV MIC	SIG-NAL	L152, 153, 134, 133, 112	MAX 1) Adjust in order ; L152,153,134,133 and 112. 2) Repeat in order ; L152 and 153.	<p>MIC Front panel side</p>
4. IC METER φ point	1) METER SW : IC Disconnect relay connector in the FINAL unit, 28V line. STBY : SEND (After adjustment, reconnect this connector).	S meter			SIG-NAL	VR18	IC meter reads φ (start) point.	
5. 100W 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 ammeter	FINAL	L7	FINAL	VR2	50mA Note: Stabilization requires approximately 20 seconds.	± 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 adjustment.)					VR1	Read the meter when VR1 is at MIN. then adjust VR1 so that the current is increased by 150mA.	500mA +100mA -50mA
6. IC meter	1) FREQ : 14,175.0kHz MODE : CW Disconnect relay connector in FINAL unit, 28V line (Plus side) and connect ammeter in its place. STBY : SEND (Adjust CAR control to draw 10A current.)	DC ammeter			SIG-NAL	VR17	10A	
	2) Adjust CAR control for 2A current. (Disconnect ammeter and reconnect this connector after adjustment.)						IC meter 2	± 0.3A
7. Current limiter (If this adjustment is performed, Step 8 must also be performed.)	1) FREQ : 14,175.0kHz MODE : CW CAR CONTROL : MAX	DC ammeter	FINAL	28V line relay connector				
	Adjust SIGNAL unit, VR8 in advance for 10A current. STBY : SEND	DC V.M	SIG-NAL	Q49-B	SIG-NAL	VR10	0.42V	

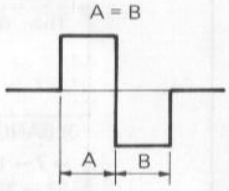
ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
8. Power	1) FREQ : 14,175.0kHz MODE : CW CAR CONTROL : MAX STBY : SEND	Power meter	Rear panel	ANT	SIG-NAL	VR8	110W	
9. Power meter	1) FREQ : 14,175.0kHz MODE : CW STBY : SEND CAR CONTROL : Set for external power meter reading of 100W.	Power meter S meter	Rear panel	ANT	SIG-NAL	VR14	110W	± 5W
10. AM power	1) FREQ : 3,575.0kHz MODE : AM MIC CONTROL : MAX STBY : SEND	Power meter	Rear panel	ANT	SIG-NAL	L175 VR22	Adjust for power MAX with L175, then set to 10W with VR22.	± 2W
	2) Connect AG to MIC terminal : 1.5kHz, 7mV.							Approximately 35W.
11. Tune power setting	1) FREQ : 14,175.0kHz MODE : TUNE CAR CONTROL : MAX STBY : SEND	Power meter	Rear panel	ANT	SIG-NAL	VR7	55W	
12. Protection	1) FREQ : 14,175.0kHz MODE : CW CAR CONTROL : MAX METER SW : POWER ANT : OPEN STBY : SEND	S meter			SIG-NAL	VR9	10W	± 2.5W
13. SWR meter	1) FREQ : 3,575.0kHz MODE : CW CAR CONTROL : MAX STBY : SEND	150Ω dummy load S meter	Rear panel	ANT	SIG-NAL	VR16	SWR 3	
	2) STBY : SEND	Power meter (50Ω) S meter						Check	SWR 1.2 or less
14. Vc meter	1) FREQ : 14,175.0kHz MODE : USB MIC CONTROL : MIN METER SW : VC STBY : SEND	Power meter S meter	Rear panel	ANT	SIG-NAL	VR19	28.5V (Power voltage)	± 0.5V
15. SSB mode Frequency response.	1) FREQ : 14,175.0kHz MODE : USB AG output : 2 tone, 7mV 300Hz, 2700Hz. Adjust MIC control for 50W. STBY : SEND	Power meter Oscilloscope AG	Rear panel	ANT (Directional coupler) MIC	SIG-NAL	TC4	Adjust as shown at right. (Equal 300Hz, 2700Hz amplitude within 5W).	
	2) MODE : LSB STBY : SEND		Front panel						TC5
	3) MODE : USB, LSB AG output : 1500Hz, 5mV STBY : SEND						Calibrate oscilloscope.	
	4) MODE : USB, LSB AG output : 2600Hz, 5mV STBY : SEND						Check	Within 6dB. (at 1500Hz).
	5) MODE : USB, LSB AG output : 400Hz, 5mV STBY : SEND							
	6) Check carrier suppression after this adjustment.							SIG-NAL	TC2 VR21	MIN	-40dB or less.

ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
16. Carrier suppression (If step 15 is performed, this adjustment must also be performed.)	1) FREQ : 14,175.0kHz MODE : USB ↔ LSB MIC CONTROL : MIN STBY : SEND	Oscilloscope (Spectrum analyzer)	Rear panel	ANT (through Directional coupler)	SIG-NAL	TC2 VR21	MIN (Adjust alternately.) Adjust for no difference between USB and LSB.	
	2) MODE : CW CAR CONTROL : MAX STBY : SEND						Calibrate Oscilloscope (Spectrum analyzer.)	
	3) MODE : USB ↔ LSB STBY : SEND						Check If less than -40dB, repeat adjustment 1).		-40dB or less
17. ALC meter	1) FREQ : 14,175.0kHz MODE : USB METER SW : ALC MIC CONTROL : MIN AG output : 1500Hz, 5mV STBY : SEND	S meter Power meter AG	Rear panel Front panel	ANT MIC	SIG-NAL	VR11	Set to starting point of ALC meter.	
	2) MIC CONTROL : Adjust for ALC meter start point. STBY : SEND							
	3) AG output : 10mV STBY : SEND						VR12 Adjust for maximum ALC zone reading.	
18. Speech processor	1) FREQ : 14,175.0kHz MODE : USB METER SW : COMP PROC SW : ON AG output : 1500Hz, 1mV PROCESSOR OUT CONTROL : MIN MIC CONTROL : MIN STBY : SEND Adjust meter with PROCESSOR IN Control.	S meter Power meter AG	Rear panel Front panel	ANT MIC	SIG-NAL	L136	Adjust for maximum COMP meter reading.	
	2) PROCESSOR IN CONTROL : Set to COMP meter starting point. STBY : SEND							
	3) AG output : + 20dB (10mV) STBY : SEND						VR20 Adjust for 20dB COMP meter.	
	4) METER SW : ALC STBY : SEND PROCESSOR IN CONTROL : ALC zone maximum.						L135 Adjust for maximum ALC zone reading.	
19. Monitor level	1) FREQ : 14,200.0kHz MODE : USB CAL SW : ON	AF V.M Oscilloscope AF dummy load	Rear panel	EXT. SP			Receive marker, and adjust AF gain for 0.63V/8Ω output.	
	2) METER SW : ALC MONI SW : ON AG output : 100Hz, 10mV MIC CONTROL : within ALC zone. AGC : FAST STBY : SEND	Power meter AG	Rear panel Front panel	ANT MIC	SIG-NAL	L113 VR34	1) L113 : Monitor output maximum. 2) VR32 : 0.63V/8Ω.	± 3dB

ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks			
		Test equipment	Unit	Terminal	Unit	Part	Method				
	3) MIC VR : MIN Remove AG from MIC terminal STBY : SEND						Check hum and noise.	1.5mV/8Ω or less			
20. MIX balance	1) FREQ : 21,100.0kHz MODE : AM MIC CONTROL : MIN STBY : SEND	Power meter Monitor receiver (Spectrum analyzer)	Rear panel	ANT	SIG-NAL	VR6	21.555MHz : MIN (S meter and AF output.)				
	2) MODE : CW					VR3	21.900MHz : MIN (S meter and AF output.)				
	STBY : SEND					VR2	23.850MHz : MIN (S meter and AF output.)				
21. Side tone	1) MODE : CW AF GAIN : 12 O'clock PITCH CONTROL : 12 O'clock MONI SW : ON	AF V.M Oscilloscope f. counter	Rear panel	EXT. SP	SIG-NAL	VR32	0.63V/8Ω 800Hz	± 100Hz			
	2) PITCH CONTROL : MIN ↔ MAX						Check	800Hz ± 300Hz or more.			
22. AT-930 Auto antenna tuner (If installed)	1) FREQ : 29,700.0kHz MODE : TUNE CAR VR : MAX METER : SWR STBY : SEND	150Ω RF dummy load	Rear panel	ANT	AT	TC1	Motor stops. SWR reads minimum.	Adjust for minimum SWR reading when motor stops.			
	2) FREQ : 3,500.0kHz First tune, then REC										
	Disconnect the ④ connector. STBY : SEND Turn VFO frequency (up) until SWR becomes "2".	Oscilloscope				AT	J12	AT	VR2	Adjust as shown at right.	
	3) STBY : SEND Turn VFO frequency (down) until SWR becomes "1.15" After adjustment. STBY : REC Reconnect the ④ connector.								VR1	Adjust VR1 until ANT TUN indicator just goes off.	
4) FREQ : Check at the following frequencies.						Check	SWR 1.2 or less.				
	Order	Frequency									
	1	1,900.0kHz									
	2	3,750.0									
	3	7,150.0									
	4	14,175.0									
	5	21,225.0									
	6	28,800.0									

ADJUSTMENT

MICROPROCESSOR OPERATION CHECK

Item	Condition	Operation check			
1. Reset	1) Turn POWER SW off and (If installed remove backup batteries, then ground IC13 (μ PD5101LC) pin 22 on Digital unit to reset. If backup batteries are not installed, and POWER SW has been off 24 hours or more, reset is complete. (In all other cases, functions set before POWER SW was turned off are backed up. FUNCTION SW : A POWER SW : ON	FREQ : 14,000.0kHz 20kHz display : 0kHz VFO-A is displayed.			
	2) FUNCTION SW : B Same as 1).	FREQ : 14,000.0kHz VFO-B is displayed.			
	3) VFO/MEMO SW : MEMO M.CH SW : 1-8 Same as 1).	FREQ : 14,000.0kHz MEMO is displayed.			
	4) FUNCTION SW : A VFO/MEMO SW : VFO				
2. BAND	1) BAND SW : 1MHz Depress STEP UP once.	1|5|,000.0 is displayed and tone sounds. (sounds continuously if SW is continuously depressed.)			
	Then, depress repeatedly	□□, MHz display advances in 1MHz steps and stops at 29. Tone sounds at each step.			
	2) BAND SW : 1MHz Depress STEP DOWN once.	2|8|,000.0 is displayed and tone sounds.			
	Then, depress repeatedly.	□□, MHz display decreases in 1MHz steps and stops at □□,150.0. tone sounds at each step.			
	3) BAND SW : 1.5 → 3.5 → 7 → 10 → 14 → 18 → 21 → 24.5 → 28 → 29 → 21 → 28 → 14	Depress each of the amateur band switches in the order as shown at the right. Insure that display is as shown in the table.	SW	FREQ. Display	20kHz Analog Display
			1.5	1,600.0	600
			3.5	3,600.0	600
			7	7,100.0	100
			10	10,100.0	100
			14	14,100.0	100
18			18,100.0	100	
21			21,100.0	100	
24.5			24,600.0	600	
28			28,600.0	600	
29	29,600.0	600			
21	21,100.0	100			
28	28,100.0	100			
14	14,100.0	100			

Item	Condition	Operation check
3. Dial step	1) FREQ. (Display) : 150kHz Confirm that the display does not change when the VFO is turned counterclockwise. Turn VFO slowly clockwise.	VFO Scale 1 division : 500Hz 1 turn : 10kHz When VFO is advanced two turns, the 20kHz scale advances one step.
	2) Turn VFO knob at a speed of 5-6 turns/sec. (or faster.)	Confirm that the step speed of both the display and analog scale (Rate of change) increases.
	3) Repeat test for counterclockwise rotation.	Confirm alternate tuning direction operation.
4. RIT	1) RIT SW : ON	RIT <input type="checkbox"/> ON is displayed and tone sounds. (Tone is continuous while SW is depressed.)
	2) FREQ : □□,□10.0kHz RIT SW : ON RIT CONTROL : Clockwise Counterclockwise	Display indicates: 1) Upper limit VFO : □□,□20.0kHz RIT : 9.9kHz 2) Lower limit VFO : □□,□00.0kHz RIT : -9.9kHz
	3) RIT SW : ON/OFF RIT FREQ : 9.9kHz	RIT : ON (Tone sounds.) VFO : □□,□20.0kHz RIT : 9.9kHz RIT : OFF (Tone sounds.) VFO : □□,□10.0kHz RIT : 9.9kHz
	4) RIT SW : ON RIT FREQ : +9.9kHz RIT CLEAR SW : ON	VFO : □□,□10.0kHz RIT : 0.0kHz (Tone sounds.)
	5) RIT SW : OFF	RIT <input type="checkbox"/> ON display goes off and tone sounds.
5. Memory write	1) FREQ : 1,900.0kHz M.CH SW : 1 MIN SW : ON	When MIN SW is depressed, tone sounds. (If continuously depressed tone sounds continuously.)
	2) FREQ : 3,575.0kHz M.CH SW : 2 MIN SW : ON	
	3) FREQ : 7,150.0kHz M.CH SW : 3 MIN SW : ON	
	4) FREQ : 10,125.0kHz M.CH SW : 4 MIN SW : ON	
	5) FREQ : 14,175.0kHz M.CH SW : 5 MIN SW : ON	
	6) FREQ : 21,225.0kHz M.CH SW : 6 MIN SW : ON	
	7) FREQ : 24,950.0kHz M.CH SW : 7 MIN SW : ON	
	8) FREQ : 28,800.0kHz M.CH SW : 8 MIN SW : ON	

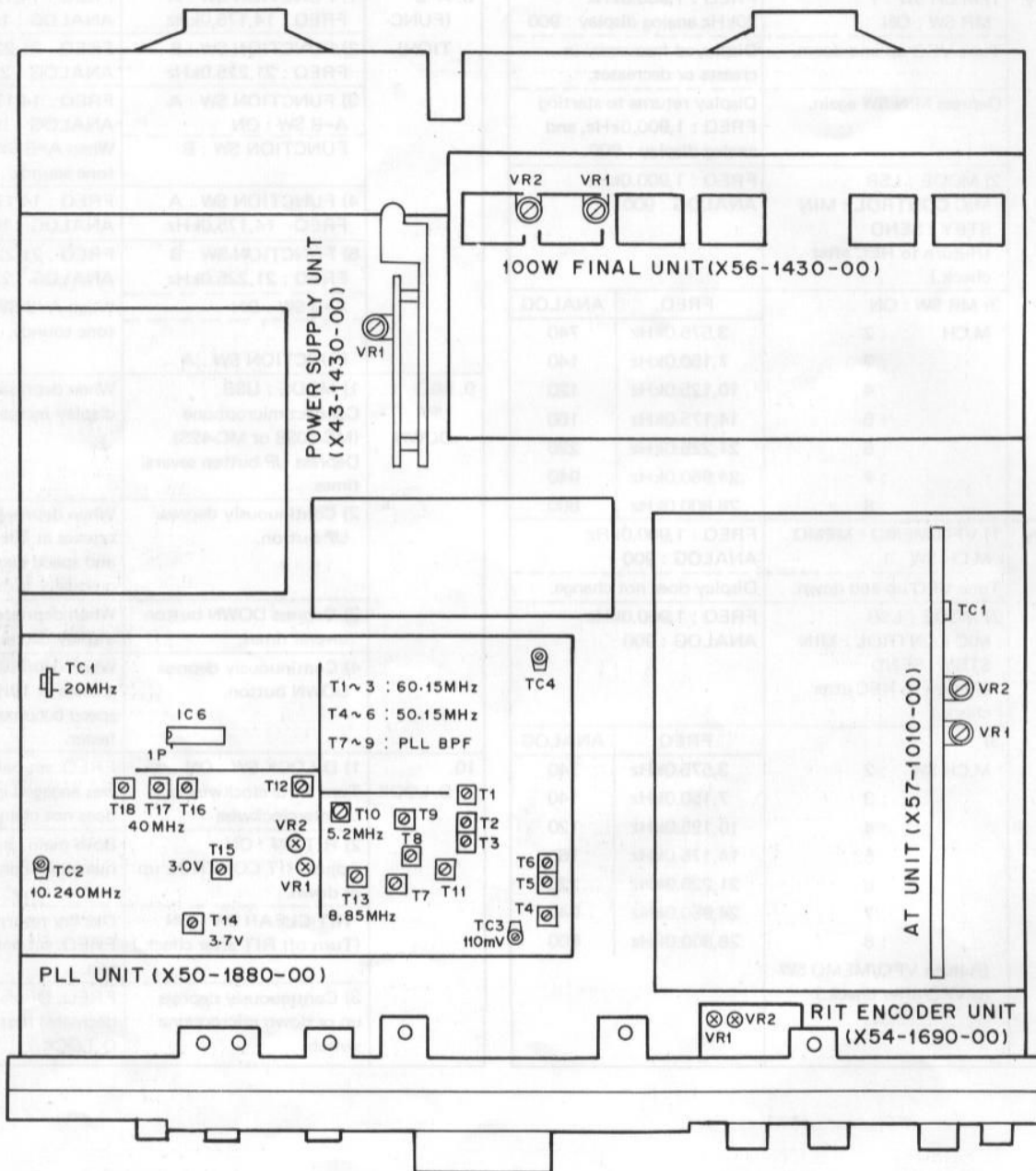
ADJUSTMENT

Item	Condition	Operation check	
6. Memory Recall (1)	1) M.CH SW : 1 MR SW : ON	FREQ : 1,900.0kHz 20kHz analog display : 900	
	Tune VFO up and down.	Displayed frequency increases or decreases.	
	Depress MIN SW again.	Display returns to starting FREQ : 1,900.0kHz, and analog display : 900.	
	2) MODE : LSB MIC CONTROL : MIN STBY : SEND (Return to REC after check.)	FREQ : 1,900.0kHz ANALOG : 900	
	3) MR SW : ON	FREQ.	ANALOG
M.CH : 2	3,575.0kHz	740	
: 3	7,150.0kHz	140	
: 4	10,125.0kHz	120	
: 5	14,175.0kHz	160	
: 6	21,225.0kHz	220	
: 7	24,950.0kHz	940	
: 8	28,800.0kHz	800	
7. Memory Recall (2)	1) VFO/MEMO : MEMO M.CH SW : 1	FREQ : 1,900.0kHz ANALOG : 900	
	Tune VFO up and down.	Display does not change.	
	2) MODE : LSB MIC CONTROL : MIN STBY : SEND (Return to REC after check.)	FREQ : 1,900.0kHz ANALOG : 900	
	3)	FREQ	ANALOG
	M.CH SW : 2	3,575.0kHz	740
: 3	7,150.0kHz	140	
: 4	10,125.0kHz	120	
: 5	14,175.0kHz	160	
: 6	21,225.0kHz	220	
: 7	24,950.0kHz	940	
: 8	28,800.0kHz	800	
	(Return VFO/MEMO SW to VFO after check.)		

Item	Condition	Operation check
8. A=B (FUNCTION)	1) FUNCTION SW : A FREQ : 14,175.0kHz	FREQ : 14,175.0kHz ANALOG : 160
	2) FUNCTION SW : B FREQ : 21,225.0kHz	FREQ : 21,225.0kHz ANALOG : 220
	3) FUNCTION SW : A A=B SW : ON FUNCTION SW : B	FREQ : 14,175.0kHz ANALOG : 160 When A=B SW is depressed, tone sounds.
	4) FUNCTION SW : A FREQ : 14,175.0kHz	FREQ : 14,175.0kHz ANALOG : 160
	5) FUNCTION SW : B FREQ : 21,225.0kHz A=B SW : ON	FREQ : 21,225.0kHz ANALOG : 220 When A=B SW is depressed, tone sounds.
	FUNCTION SW : A	
9. MIC UP/DOWN	1) MODE : USB Connect microphone (MC-60S8 or MC-42S). Depress UP button several times.	When depressed ten times, display increases by 100Hz.
	2) Continuously depress UP button.	When depressed, display increases at 10Hz intervals, and speed becomes gradually faster.
	3) Depress DOWN button several times.	When depressed ten times, display decreases by 100Hz.
	4) Continuously depress DOWN button.	When depressed, display increases at 10Hz intervals and speed becomes gradually faster.
10. D.LOCK	1) D.LOCK SW : ON Turn VFO clockwise or counterclockwise	FREQ. set before D.LOCK was engaged is displayed and does not change.
	2) RIT SW : ON Adjust RIT CONTROL up or down.	Both main, and RIT frequencies change.
	RIT CLEAR SW : ON (Turn off RIT after check.)	Display returns to original FREQ. set before RIT test.
	3) Continuously depress up or down microphone switch.	FREQ. Display increases or decreases regardless of D. LOCK.

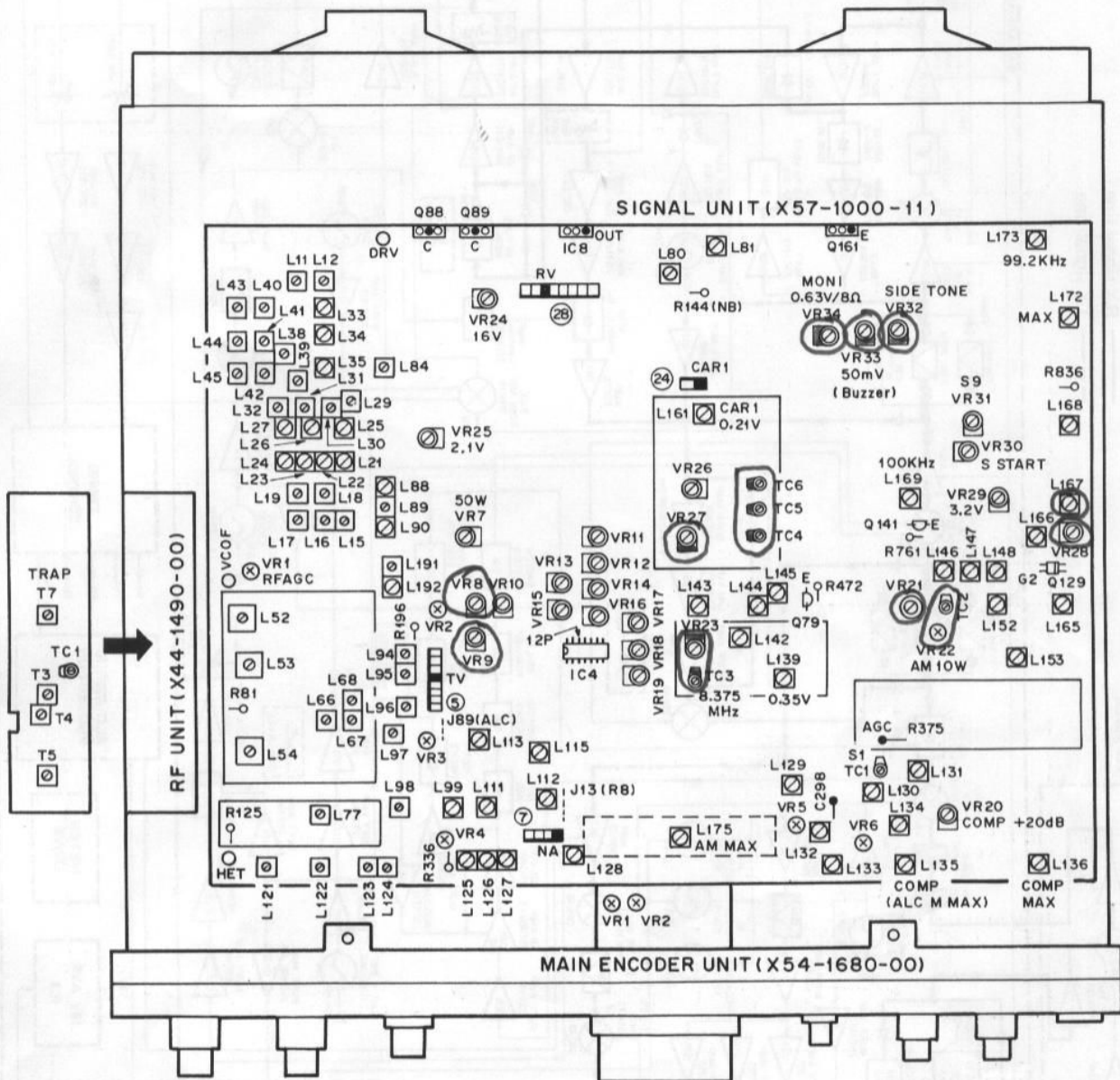
ADJUSTMENT

TOP VIEW



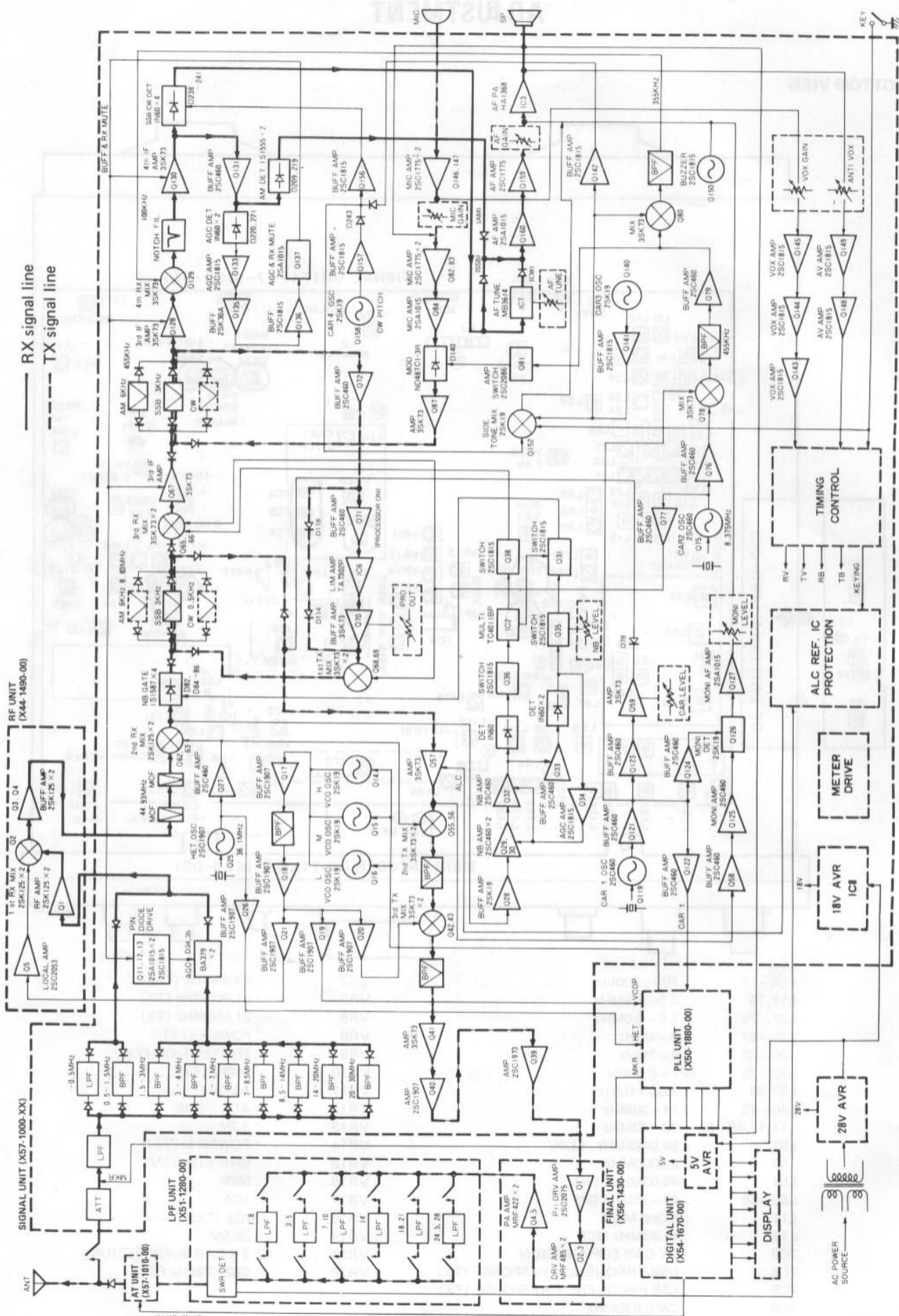
ADJUSTMENT

BOTTOM VIEW



- | | | | |
|--------------|-------------------------------|------|----------------------|
| L15-17 | : 100-500kHz | VR2 | : 23.85MHz (TX) |
| L18,19 | : 0.5-1.5MHz | VR3 | : 21.900MHz (TX) |
| L21-24 | : 1.5-3.0MHz | VR6 | : 21.555MHz (TX) |
| L25-27 | : 3-4MHz | VR8 | : POWER (TX) |
| L29-32 | : 4-7MHz | VR9 | : PROTECTION (TX) |
| L33-35 | : 7-8.5MHz | VR10 | : 0.49V (TX) |
| L38,39 | : 8.5-14MHz | VR11 | : ALCφ |
| L40-42 | : 14-20MHz | VR12 | : ALC ZONE |
| L11,12,43-45 | : 20-30MHz | VR13 | : 3.2V |
| L52 | : 29.9999MHz, 13.0V | VR14 | : POWER METER |
| L53 | : 9.5000MHz | VR15 | : SWR STD 0.5V |
| L54 | : 45.03MHz±1kHz | VR16 | : SWR |
| L66-68 | : 45-75MHz BPF | VR17 | : 10A |
| L113 | : MONI MAX | VR18 | : ICφ (TX) |
| L122 | : 44.93MHz MCF | VR19 | : 28.5V |
| TC2 | : TX CAR SUPPRESSION | VR21 | : TX CAR SUPPRESSION |
| TC4 | : USB FREQUENCY RESPONSE (TX) | VR26 | : 8827.79kHz FSK |
| TC5 | : LSB FREQUENCY RESPONSE (TX) | | |
| TC6 | : CW 8.830MHz | | |

TS-930S BLOCK DIAGRAM



SP-930

SP-930 SPECIFICATIONS

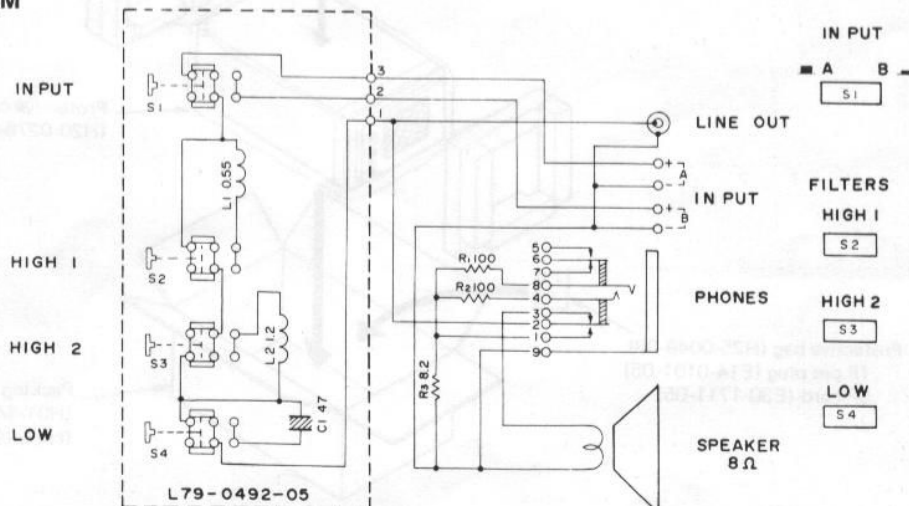
Speaker used: 10 cm dia.
Rated Input: 1.5 Watts
Impedance: 8Ω
Frequency response: 160 Hz to 8kHz.
Filter cut-off frequency,
 LOW: 430Hz, -3dB .
 HIGH 1: 2.3 kHz, -3dB .
 HIGH 2: 1.0kHz, -3dB .
 HIGH 1 + HIGH 2: 730Hz, -3dB .
Filter attenuation: -6dB/oct .
Dimensions: W 180 mm (7-1/16")
 H 140 mm (5-1/2")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

PARTS LIST

N : New parts

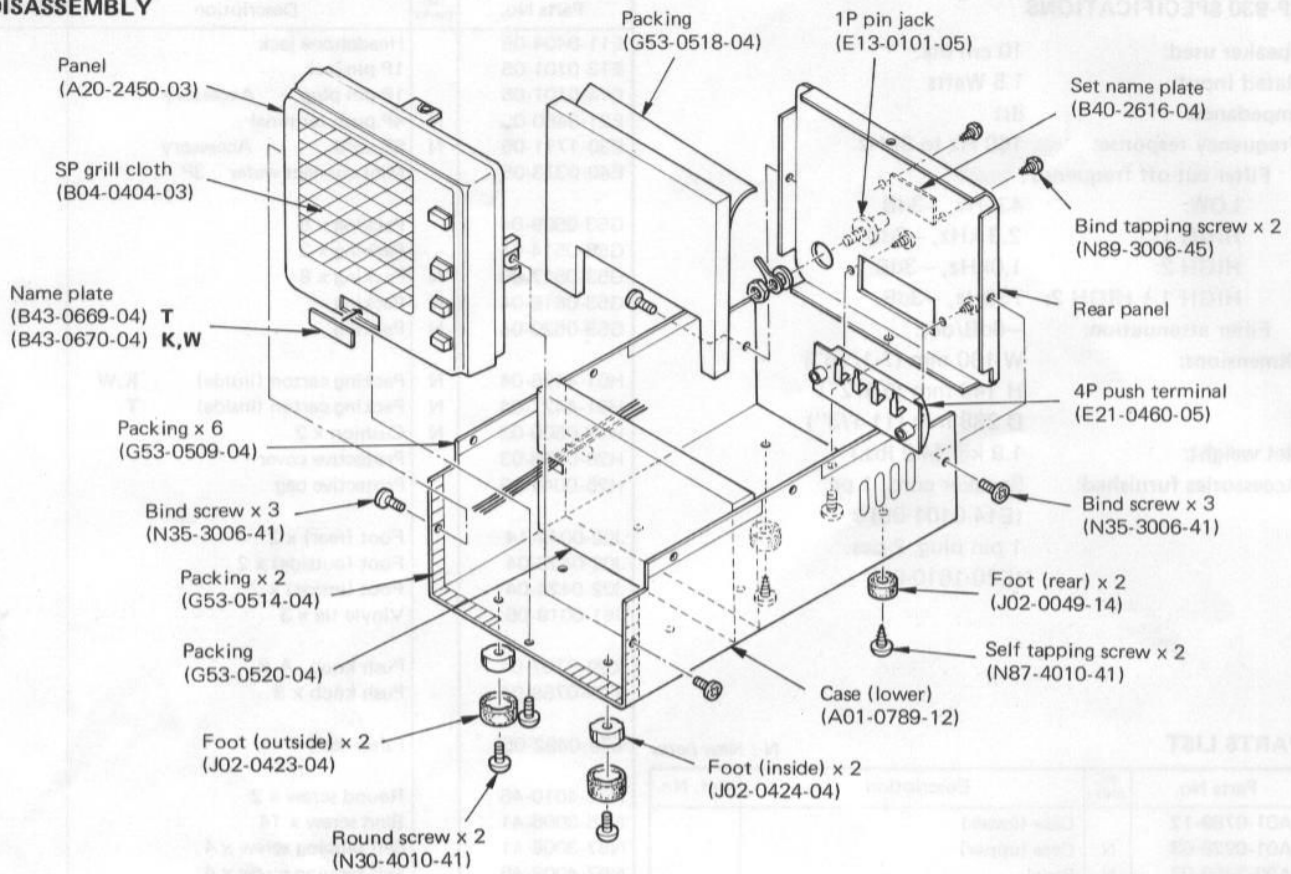
Parts No.	Re- marks	Description	Ref. No.
A01-0789-12		Case (lower)	
A01-0928-03	N	Case (upper)	
A20-2450-03	N	Panel	
B04-0404-03	N	SP grill cloth	
B40-2616-04	N	Set name plate	
B43-0669-04		Name plate	T
B43-0670-04		Name plate	K,W
B46-0404-00	N	Warranty card	K
B50-3980-00	N	Instruction manual	K,W
B50-3981-00	N	Instruction manual	T
CE04BW1E470	E	47 25V	
E11-0404-05		Headphone jack	
E13-0101-05		1P pin jack	
E14-0101-05		1P pin plug Accessory	
E21-0460-05	N	4P push terminal	
E30-1711-05	N	SP cord Accessory	
E40-0373-05		Mini connect wafer 3P	
G53-0509-04		Packing x 6	
G53-0514-04		Packing x 2	
G53-0517-04	N	Packing x 8	
G53-0518-04	N	Packing	
G53-0520-04	N	Packing	
H01-4426-04	N	Packing carton (inside)	K,W
H01-4427-04	N	Packing carton (inside)	T
H12-0500-03	N	Cushion x 2	
H20-0276-03		Protective cover	
H25-0049-03		Protective bag	
J02-0049-14		Foot (rear) x 2	
J02-0423-04		Foot (outside) x 2	
J02-0424-04		Foot (inside) x 2	
J61-0019-05		Vinyle tie x 3	
K29-0757-04		Push knob A,B	
K29-0758-04		Push knob x 3	
L79-0492-05		Filter ass'y	
N30-4010-46		Round screw x 2	
N35-3006-41		Bind screw x 14	
N87-3008-41		Self tapping screw x 4	
N87-4008-46		Self tapping screw x 4	
N87-4010-41		Self tapping screw x 2	
N89-3006-45		Bind tapping screw x 2	
N89-3008-45		Bind tapping screw x 2	
RS14AB3D8R2J		MF 8.2 Ω 2W	R3
S40-2436-05		Push switch	
S42-3405-05		Push switch	
T07-0222-05	N	Speaker	

SCHEMATIC DIAGRAM

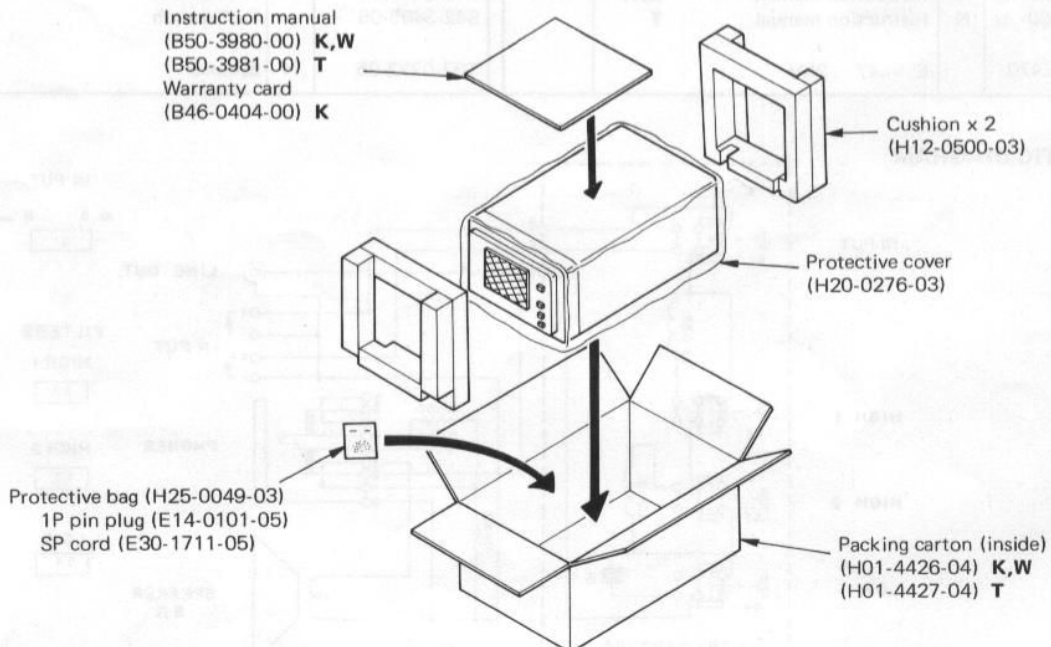


SP-930

DISASSEMBLY



PACKING



AT-930

AT-930 SPECIFICATIONS

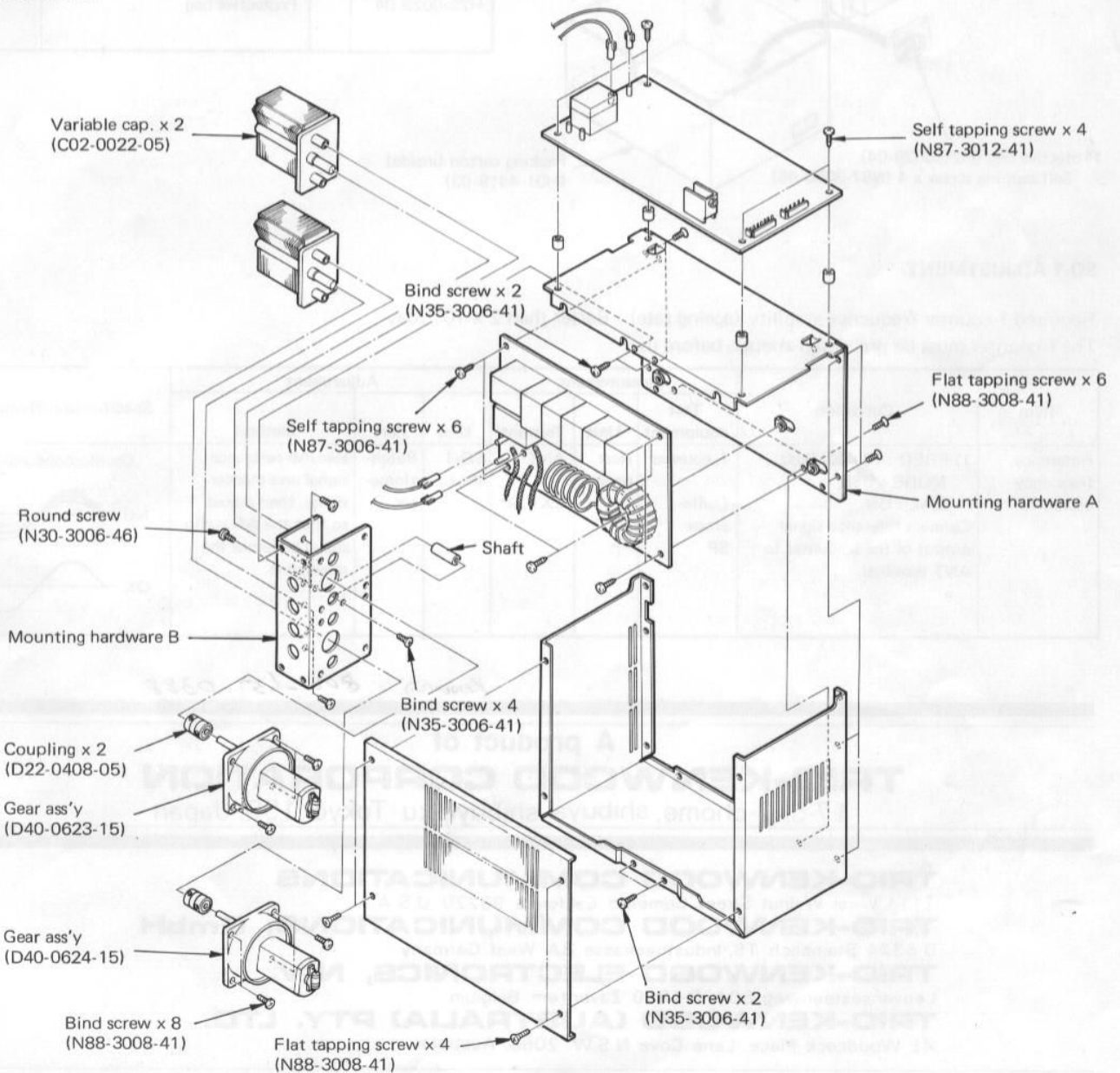
Frequency range:	3.5–29.7 MHz, all amateur bands
Band Selection:	Automatic, by band information from the transceiver.
Input impedance:	50 ohms, unbalanced
Output impedance:	20–150 ohms, unbalanced
Insertion loss:	Less than 1 dB at 29.7 MHz (at best match)
Max. input power:	150W
Motor stop SWR:	Less than 1.2

PARTS LIST

N : New parts

Parts No.	Re- marks	Description	Ref. No.
B46-0407-00	N	Warranty card	K
B50-3971-00	N	Instruction manual	
H01-4419-03	N	Packing carton (inside)	
H12-0494-04	N	Cushion x 2	
H25-0029-04		Protective bag	Accessory
H25-0106-04		Protective cover	
N87-3006-46		Self tapping screw x 4	
X57-1010-00	N	AT unit	

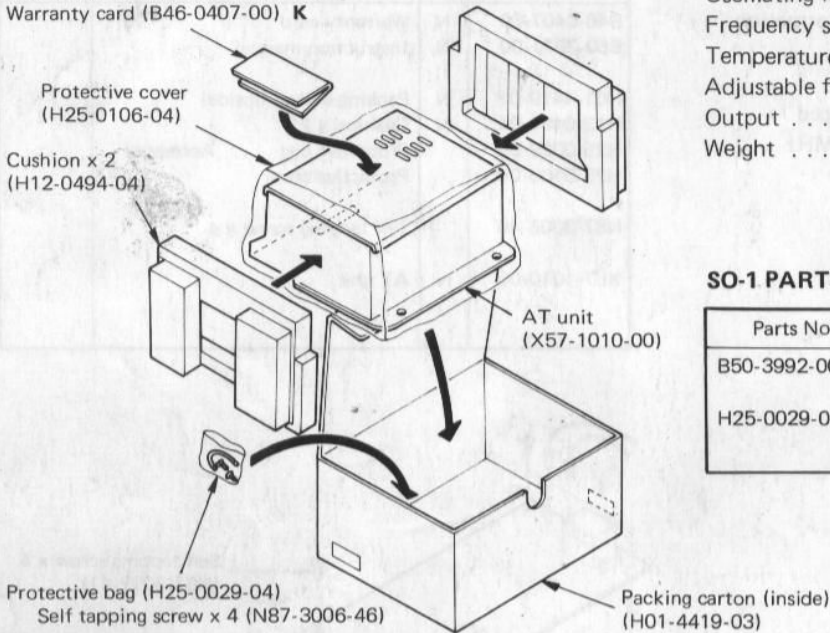
DISASSEMBLY



AT-930/SO-1

AT-930 PACKING

Instruction manual (B50-3971-00)
Warranty card (B46-0407-00) K



SO-1 SPECIFICATIONS

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

SO-1 PARTS LIST

N : New parts

Parts No.	Remarks	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 Oscilloscope SP	Rear panel	ANT EXT.SP	SO-1 (PLL)	Potentiometer	Receive reference signal and marker signal, then adjust so that the AF audio signal becomes the same tone.	Oscilloscope wave NG OK

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