KENWOOD®

SERVICE MANUAL

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

HF TRANSCEIVER

CONTENTS

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:	50 ohms
With AT-930 antenna tuner	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 × 141 (5-9/16")H × 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 μV for SSB, CW and FSK Less than 10 μV for AM
500 kHz - 1.8 MHz:	Less than 4 μV for SSB, CW and FSK Less than 32 μV for AM
1.8 - 30 MHz:	Less than 0.25 μV for SSB, CW and FSK Less than 2 μV for AM
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):	600 Hz ~ 2.7 kHz/−6 dB
CW(N), FSK(N):	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 quadraple 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.

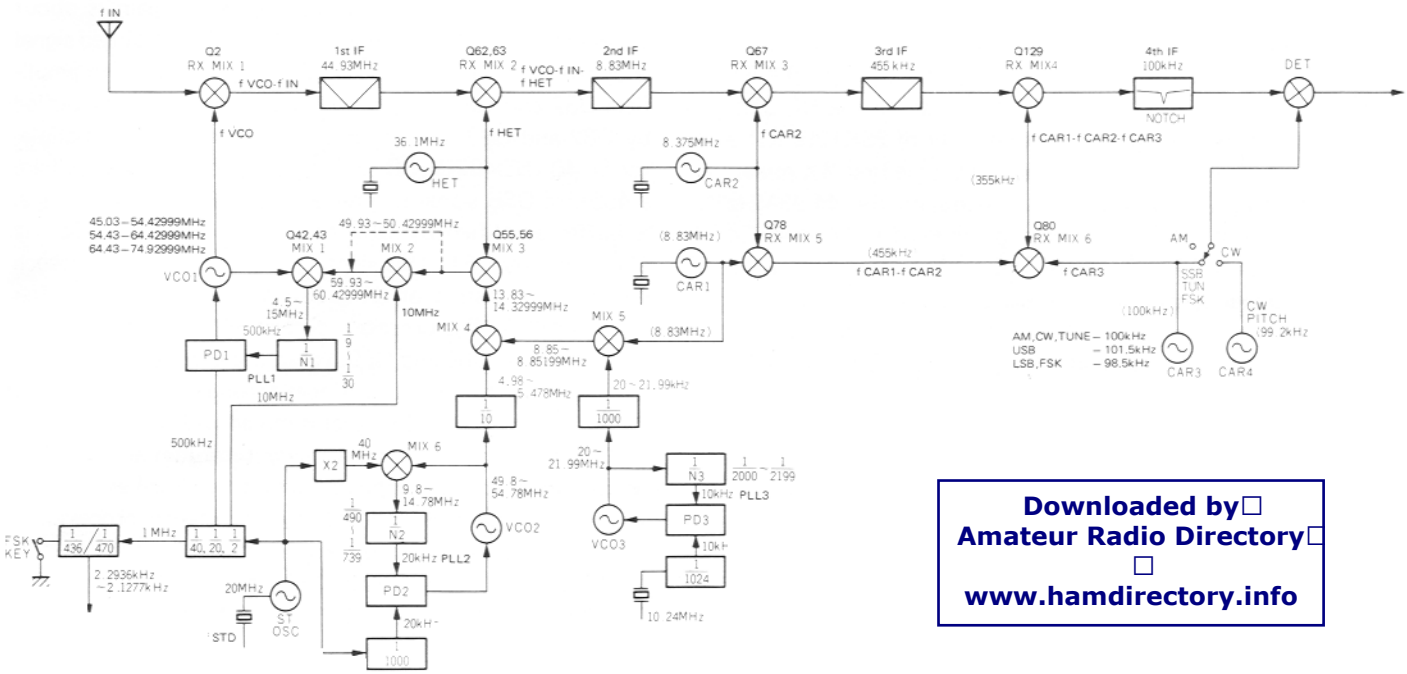


Fig. 1 RX Frequency configuration

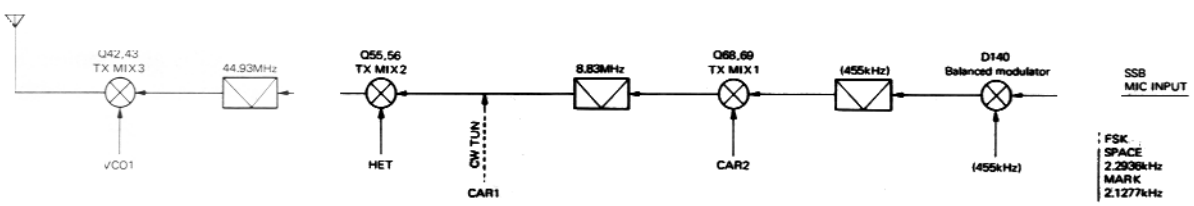


Fig. 2 TX Frequency configuration

● 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 (monolythic 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 dissapation (PC) of 290W and high reliability. 28V DC is applied to each transistor. The bias circuits for the predriver 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 form 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 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.

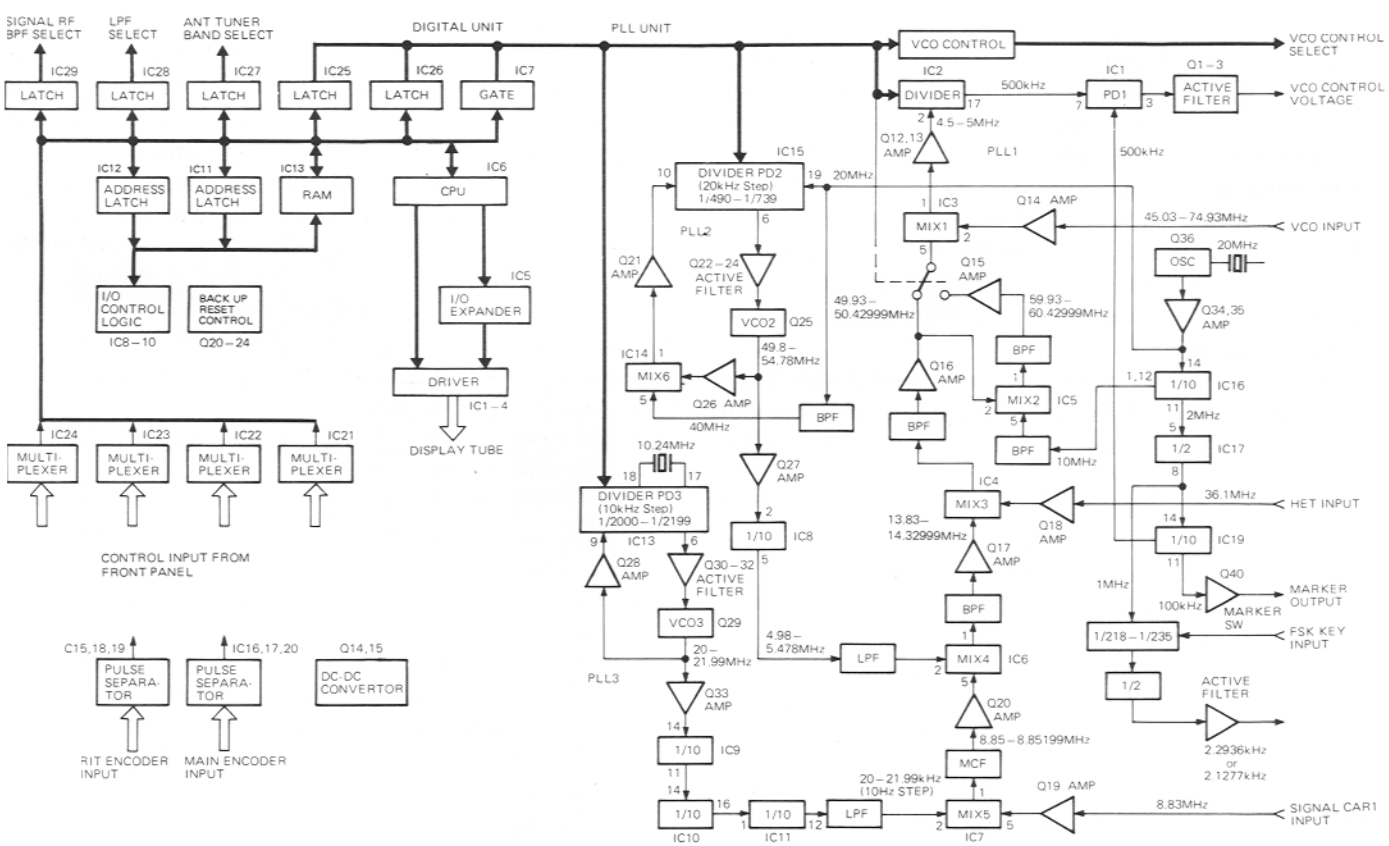


Fig. 3 PLL Block diagram and Digital control system

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, where it is mixed with the 4.98–5.478MHz signal from PLL-2, 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 (÷ 10), IC7 (÷ 2) and IC19 (÷ 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, μPD8049C-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.

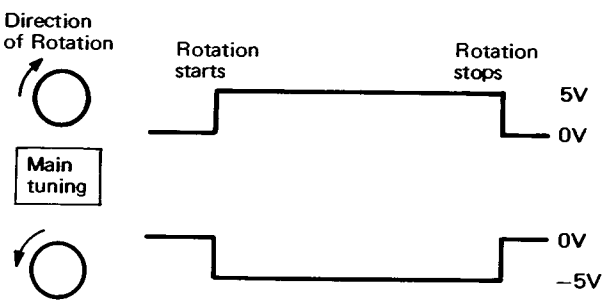


Fig. 4

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 ±9.99kHz.

IC13 (μPD5101LC) 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 10μA, 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 date 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 No.		Name	Functions
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" pluse 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	

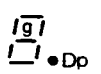
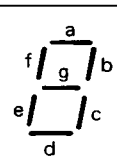
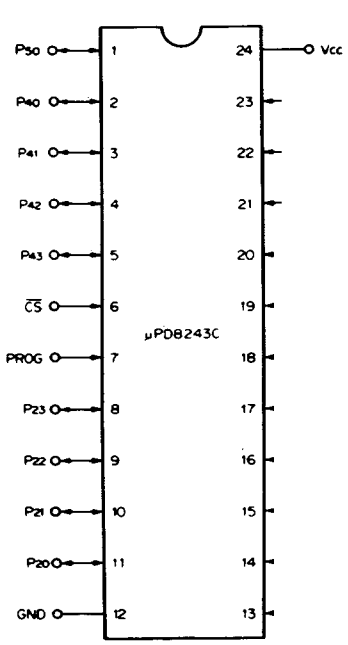
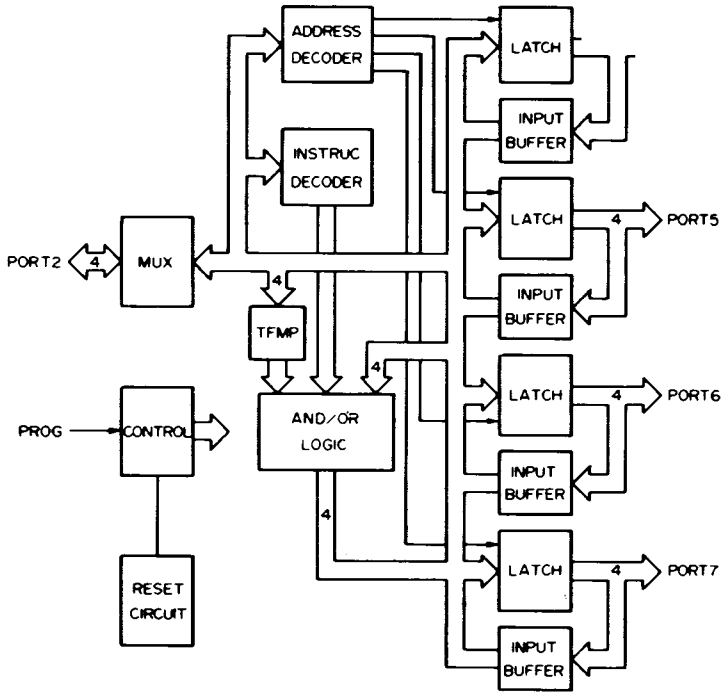
Terminals No.		Name	Functions
⑩	1	PL6	PLL DATA for 500kHz comparison.
	2	PL7	
	3	PL5	
⑪	1	AT1	BAND DATA to ANT tuner.
	2	AT2	
	3	AT3	
	4	AT4	
	5	AT0	
	6	LP2	BAND DATA in transmit to the Filter unit.
	7	LP0	
	8	LP1	
	9	RB3	BAND DATA in receive to the Signal unit.
	10	RB2	
	11	RB0	
	12	RB1	
⑫	1	G	GND
	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	
	5	P2	DATA for analog digit.
	6	P3	
	7	P4	
	8	P1	
	9	P9	
	10	P10	
⑭	1	g	Dot "•" 
	2	DP	
	3	P5	
	4	P6	DATA for analog digit.
	5	P7	
	6	P8	
	7	SK	
	8	G1	GRID DATA.
	9	G2	
	10	G3	
	11	G4	
⑮	1	G5	GRID DATA.
	2	G6	
	3	G7	
	4	G8	
	5	G9	
	6	G10	
	7	FH	Heater for Display tube.
	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

$P_{20} \sim P_{23}$	:	Input Output (Port 2)
$P_{40} \sim P_{43}$	:	Input Output port (Port 4)
$P_{50} \sim P_{53}$	:	Input Output port (Port 5)
$P_{60} \sim P_{63}$	:	Input Output port (Port 6)
$P_{70} \sim P_{73}$	:	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	Vcc	−0.5 ~ +7V
Input voltage	Vi	−0.5 ~ +7V
Output voltage	Vo	−0.5 ~ +7V
Operating temperature	Topt	0 ~ +70°C
Storage temperature	Tstg	−60 ~ +150°C

Fig. 5 μPD8243C (Digital unit IC5)

Pin No.	Name	Functions		
13	P70	G2 } Digit output		
14	P71	G1 } Digit output		
15	P72	H	H } Scale DATA output	L
16	P73	H	L } Scale DATA output	H
2	P40	e	P9	VFO B
3	P41	f	P10	MEMO
4	P42	g		
5	P43	Dp } Segment DATA	Scale DATA	
1	P50	a } Segment DATA	P1	(–)
23	P51	b } Segment DATA	P2	LOCK
22	P52	c } Segment DATA	P3	RIT
21	P53	d } Segment DATA	P4	VFO A
20	P60		P5	
19	P61		P6	
18	P62		P7	
17	P63		P8	

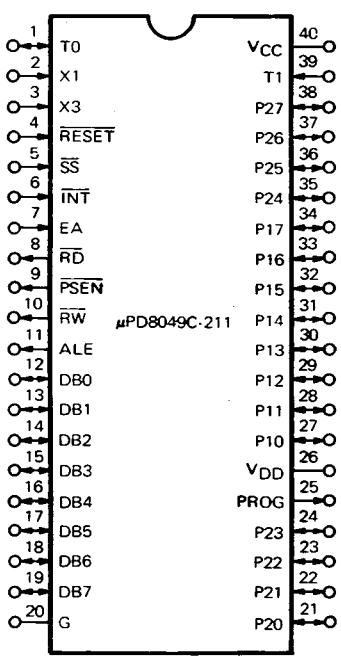
0 100 200 "White" "Red"

Table 4

CIRCUIT DESCRIPTION

Terminals No.	Terminals Name	Functions	Terminals No.	Terminals Name	Functions
1	T0	RIT encoder clock signal, count at "L".	21	P20	I/O Expander control output.
2	X1	Xtal input	22	P21	
3	X3		23	P22	
4	–		24	P23	
5	$\overline{SS}$	Single step.	25	PROG	
6	$\overline{INT}$	Interrupt.	26	VDD	5V
7	EA	External access. Nomally GND.	27	P10	Digit output.
8	$\overline{RD}$	Read	28	P11	
9	–		29	P12	
10	$\overline{RW}$	Read/Write	30	P13	
11	ALE	Address latch enable.	31	P14	
12	DB0	External Data bus.	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		39	T1	Main encoder clock signal, count at "L".
20	G	GND	40	VCC	5V

Table 5 Functions of μPD8049C-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

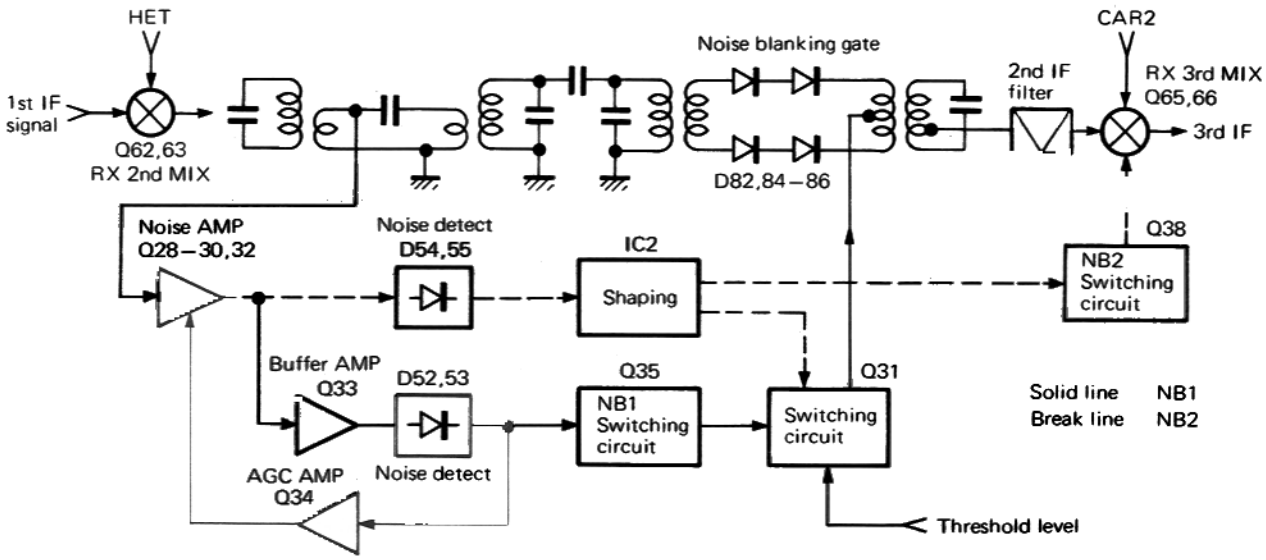


Fig. 6 Noise blanker circuit

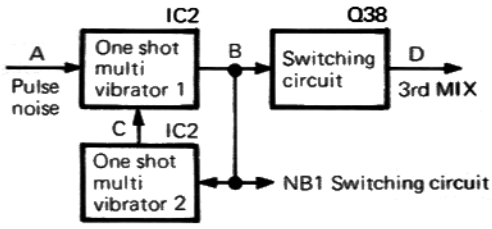


Fig. 7 NB2 circuit

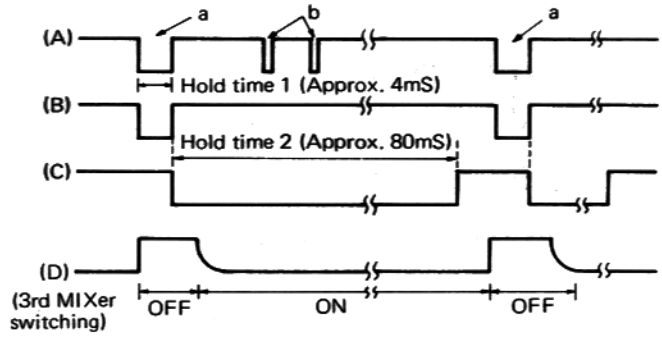


Fig. 8 NB2 timing chart

• 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 logarithmicly 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.

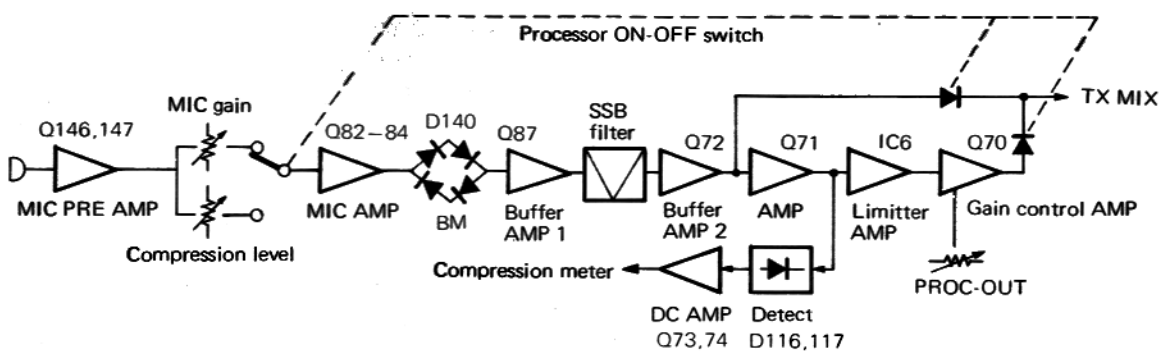


Fig. 9 Speech processor block diagram

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.

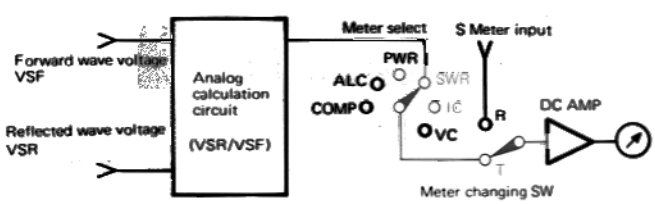


Fig. 10 SWR meter circuit

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 ia an SWR meter adjust for initial setup only.

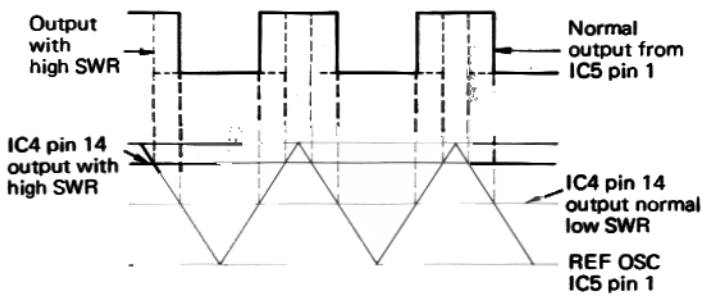


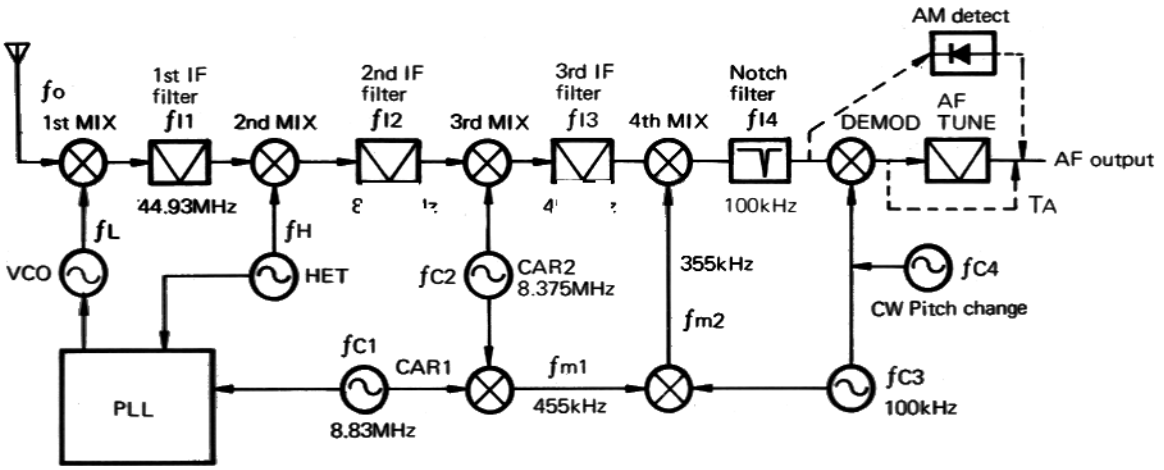
Fig. 11 Automatic SWR computing circuit waveforms

● 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 $\Delta f1$, the overall IF response curve shifts to that at "B". The circuit is designed so the CAR 1 signal lowers the VCO frequency fL by $\Delta f1$. In this case, the IF bandwidth is fully opened, or normal. Whe the CAR 2 frequency is lowered by $\Delta f2$, 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 : $\Delta f2 = 2\Delta f1$. 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 $\Delta f1 = \Delta f2$, only the lower frequency (at the left limit of the overall IF reaponse 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 voltege VF2 are supplied from the Switch unit.

CIRCUIT DESCRIPTION



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

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

$f_{I1} = f_L - f_O$ →: Tuning time
$f_{I2} = f_{I1} - f_H = f_R - f_O + f_{C1} \rightarrow f_{C1}$
$f_{I3} = f_{I2} - f_{C2} = f_R - f_O + f_{C1} - f_{C2} \rightarrow f_{C1} - f_{C2}$
$f_{I4} = f_{I3} - f_{m2} = f_R - f_O + f_{C3} \rightarrow f_{C3}$
$f_A = |f_{I4} - f_{C3}| = |f_R - f_O| \rightarrow O$; SSB, FSK, TUN
$f_A = |f_{I4} - f_{C4}| = \Delta f_P \rightarrow CW$

Fig. 12-A RX configuration Normal (wide) response

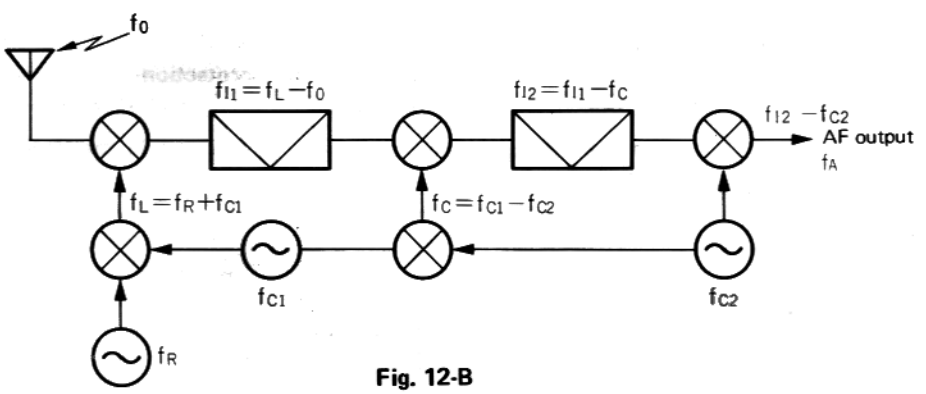


Fig. 12-B

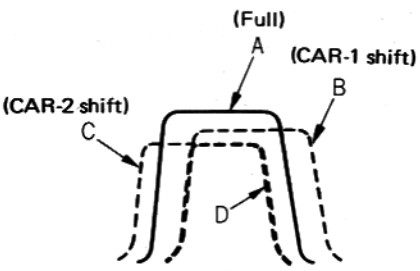


Fig. 12-C CAR-2 shifted

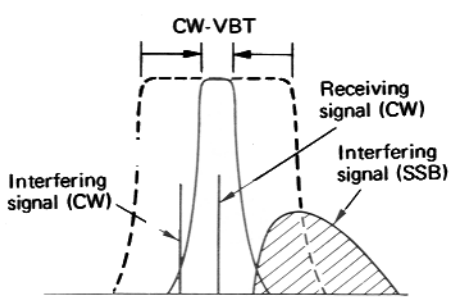


Fig. 12-D CW-VBT

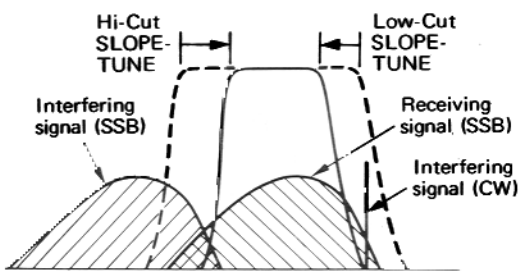


Fig. 12-E SSB-slope-tune

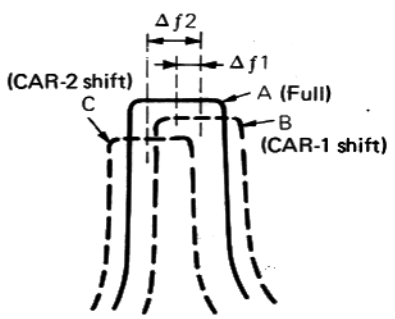


Fig. 13 VCO to bandwidth relationship

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 800Hz ± 400Hz, 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".

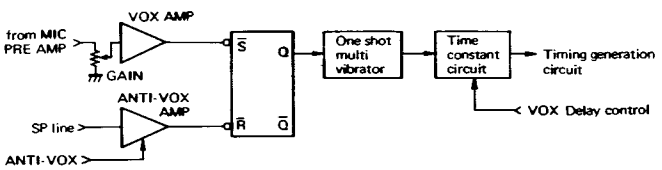


Fig. 14 VOX, ANTI-VOX circuit configuration

• 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°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°C (nominal). After reset, the fan continues to operate until the final heat sink temperature drops below about 45°C. (See Fig. 15.)

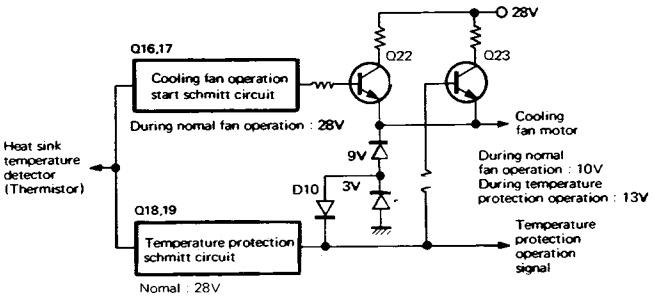


Fig. 15 Fan, temperature protection (Final amps)

• 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 quiscent 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

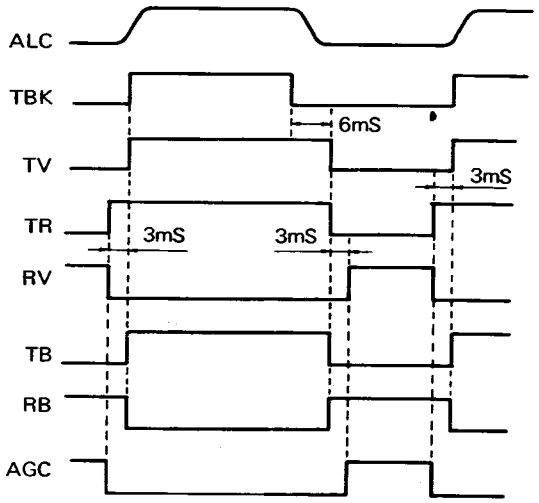


Fig. 16 T-R timing chart
(CW full break-in, SSB, FSK and TUNE modes)

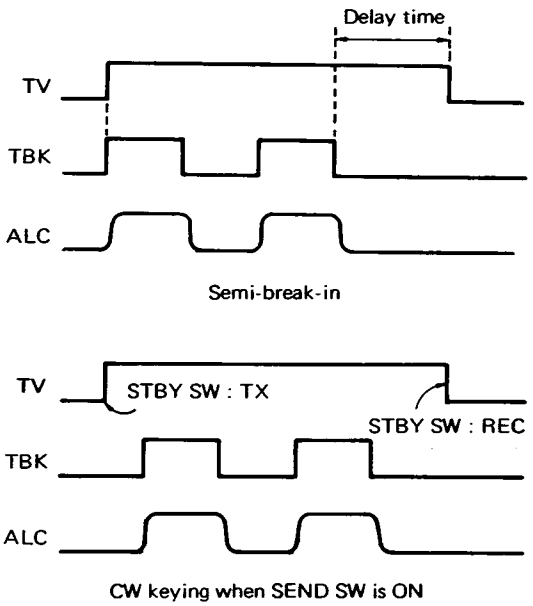


Fig. 17 CW operation timing chart

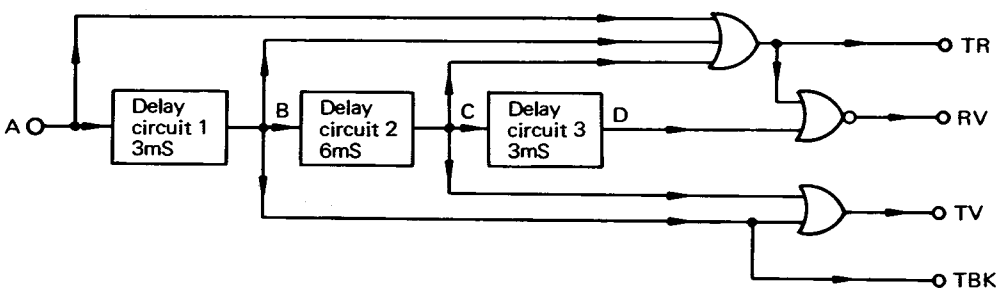


Fig. 18 Timing circuit block diagram

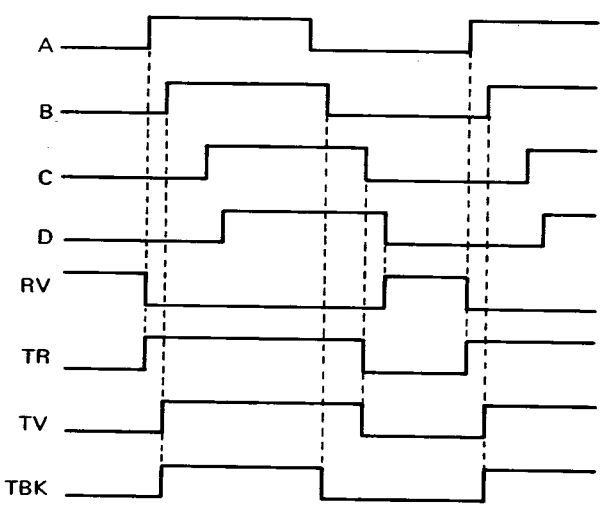


Fig. 19

REFERENCE DATA

SSB, VOX

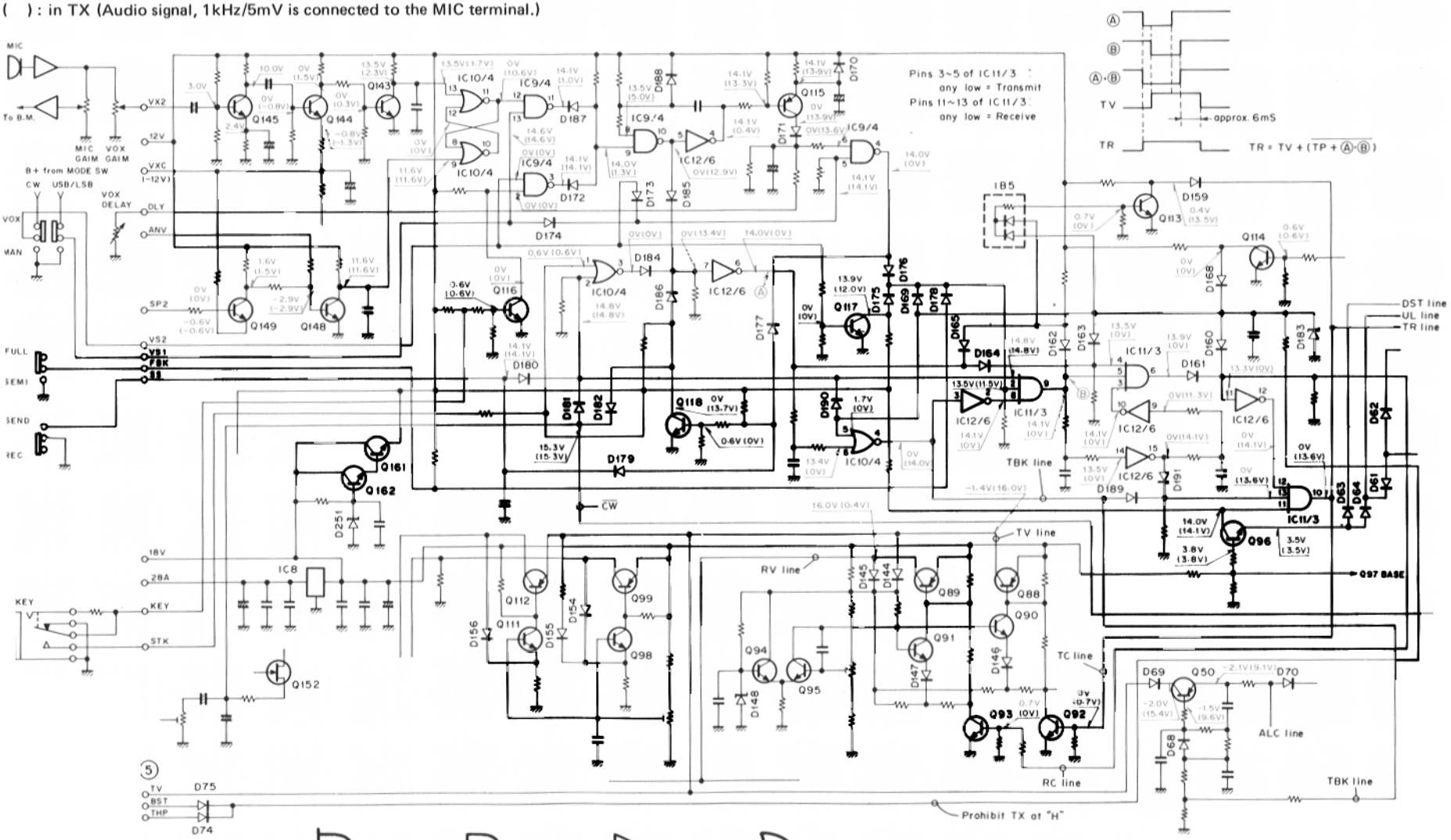
Voltage measurement conditions

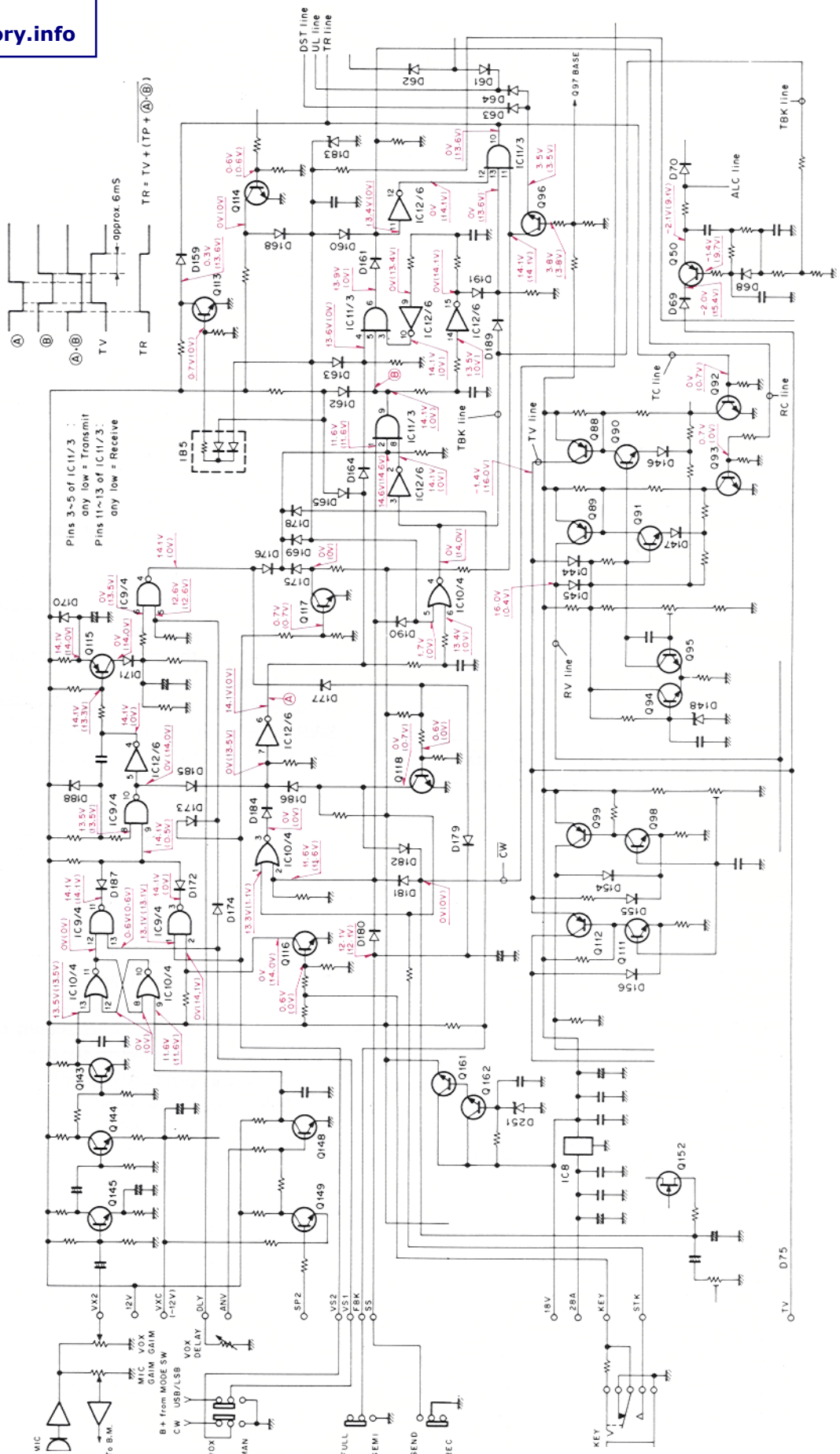
f = 14.175.0MHz MODE : SSB VOX/MAN : VOX MIC CONTROL : Centered

VOX GAIN : Centered STBY : REC MIC INPUT : 1kHz/5mV

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

Note: In SSB and with the standby switch in the "SEND" position, a low is felt then D179 to turn off Q118. This applies a "H" to IC12/6 pin No.7. IC10/4 is not used when the "SEND" switch is.





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 0 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 (0.05Ω). 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

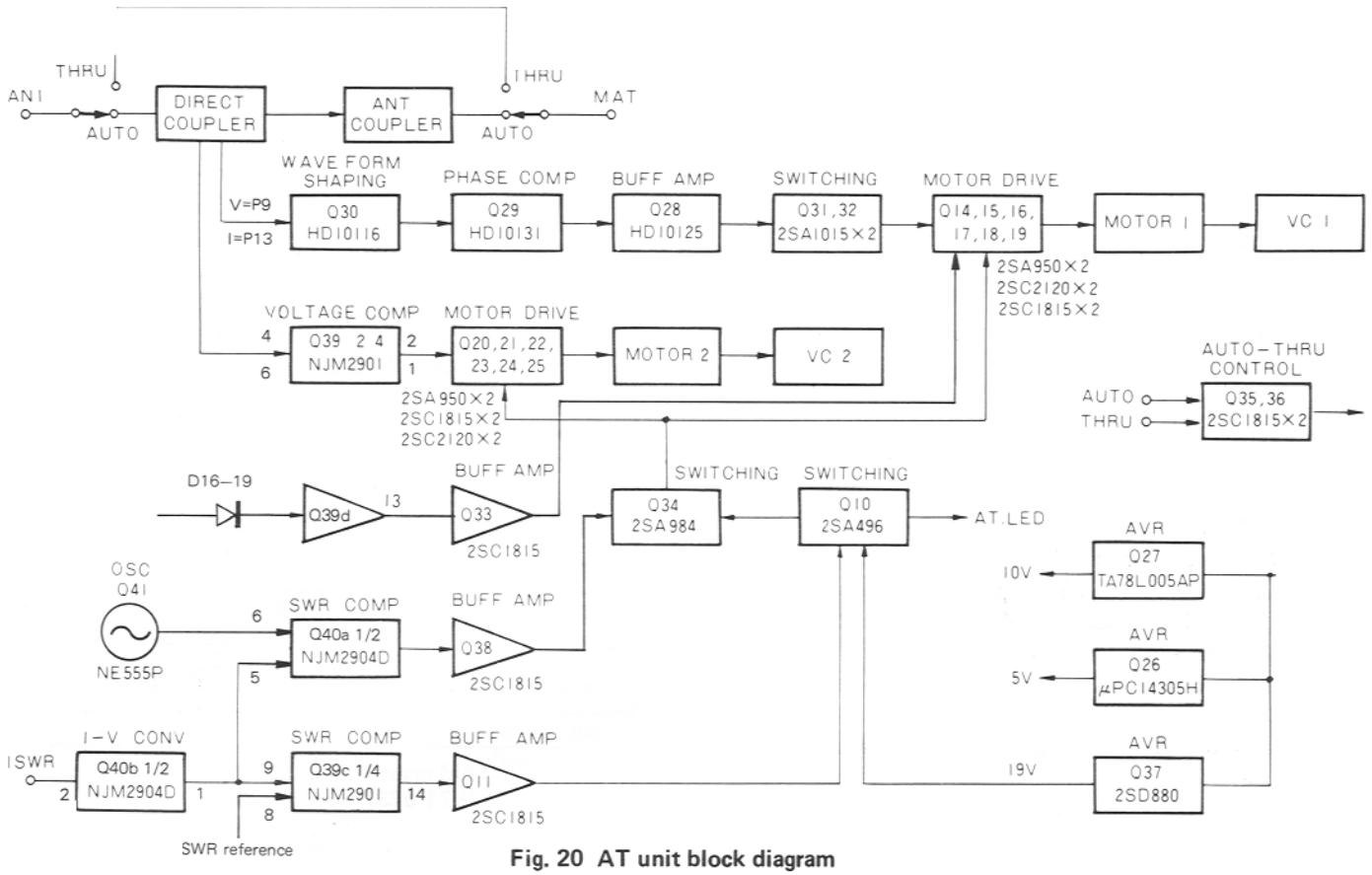


Fig. 20 AT unit block diagram

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 off. Q35 is on because a "H" is applied through D15. The "H" at the collector of Q36 is applied to Q8 through D9 and turnes 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 ingicator 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	O	O	O	O		
7	O		O	O		
10	O			O		
14	O			O		O
18,21	O					
24.5,28	O				O	

O : 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	
Ripple (within 455 ± 2kHz)	
Loss	
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

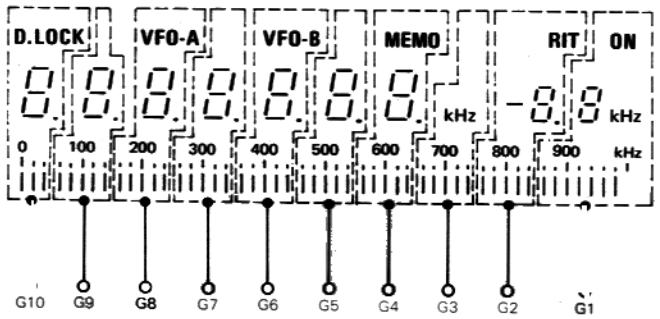
AM crystal filter YK-88A-1 (L71-0237-05) Option

Item	Rating
Center frequency	455kHz
iation	Within 50Hz at 6dB
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%

SEMICONDUCTOR DATA

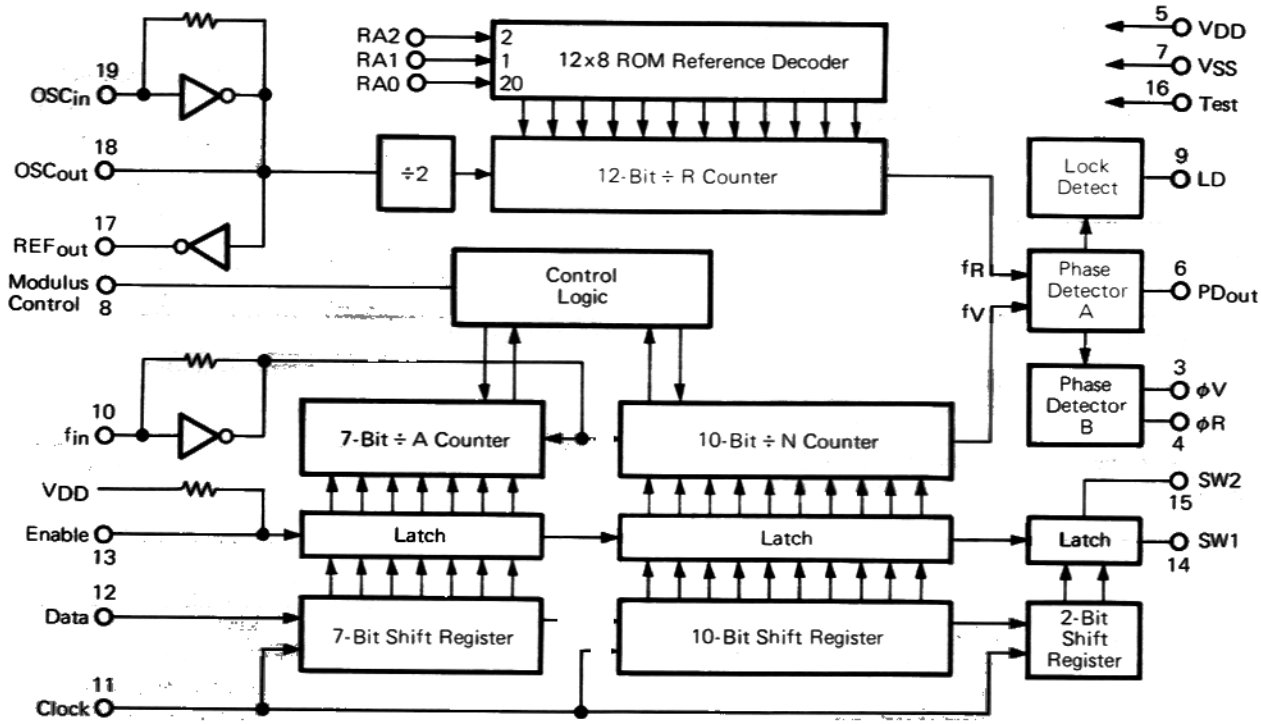


11-BT-03Z (Switch unit V1)

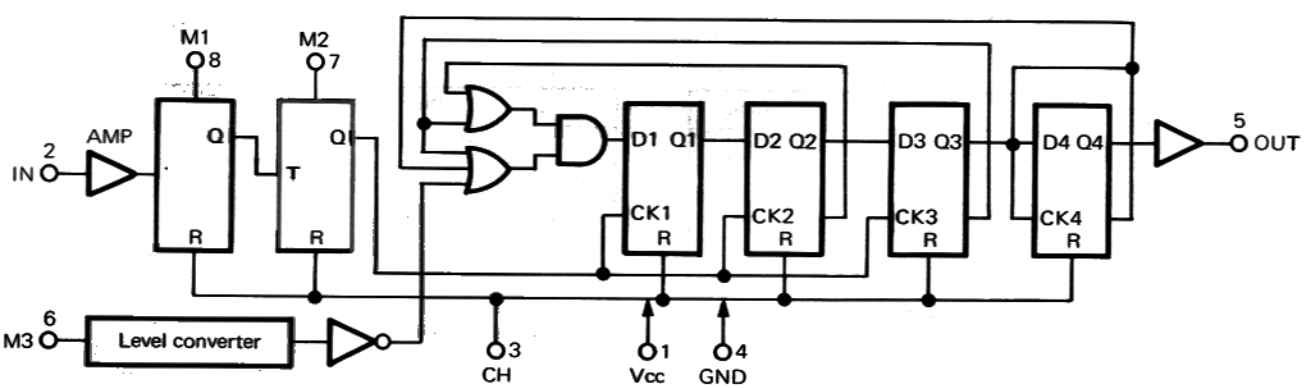
Item	Symbol	Rating
Gate-Drain voltage	V_{CDO}	−25V
Gate-Source voltage	V_{GSO}	−25V
Continuous Drain current	I_D	100mA
Continuous Gate current	I_G	10mA
Power dissipation	Pch	500mW
Channel temperature	Tch	120°C
Storage temperature	Tstg	−50~+120°C

Ta=25°C

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

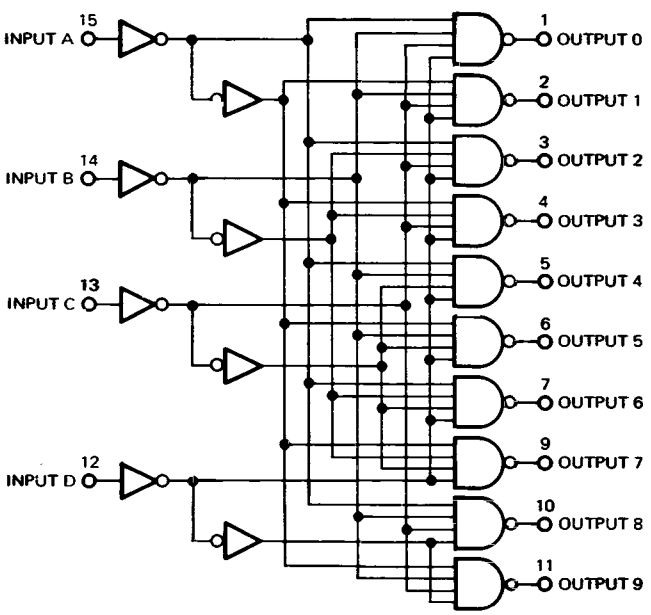


MC145156P Block diagram (PLL unit IC5)



μPB551C Block diagram (PLL unit IC8)

SEMICONDUCTOR DATA

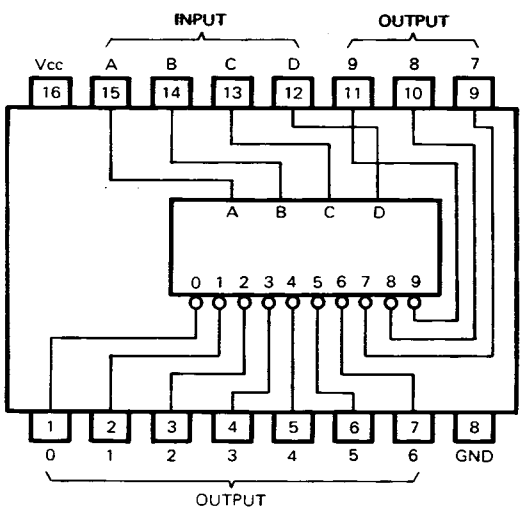


MB74LS42 Block diagram (LPF unit IC1)

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	H	H	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	icp	Pc	Tj	Tstg
Condition						Tc= 25°C		
Rating	−100V	−80V	−5V	−500mA	−800mA	600mW	150°C	−55~ +150°C

Ta=25°C

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

Item	V_{CBO}	V_{CEO}	V_{EBO}	I_C	icp	Pc	Tj	Tstg
Condition						Tc= 25°C		
Rating	100V	80V	5V	500mA	800mA	600mW	150°C	−55~ +150°C

Ta = 25°C

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

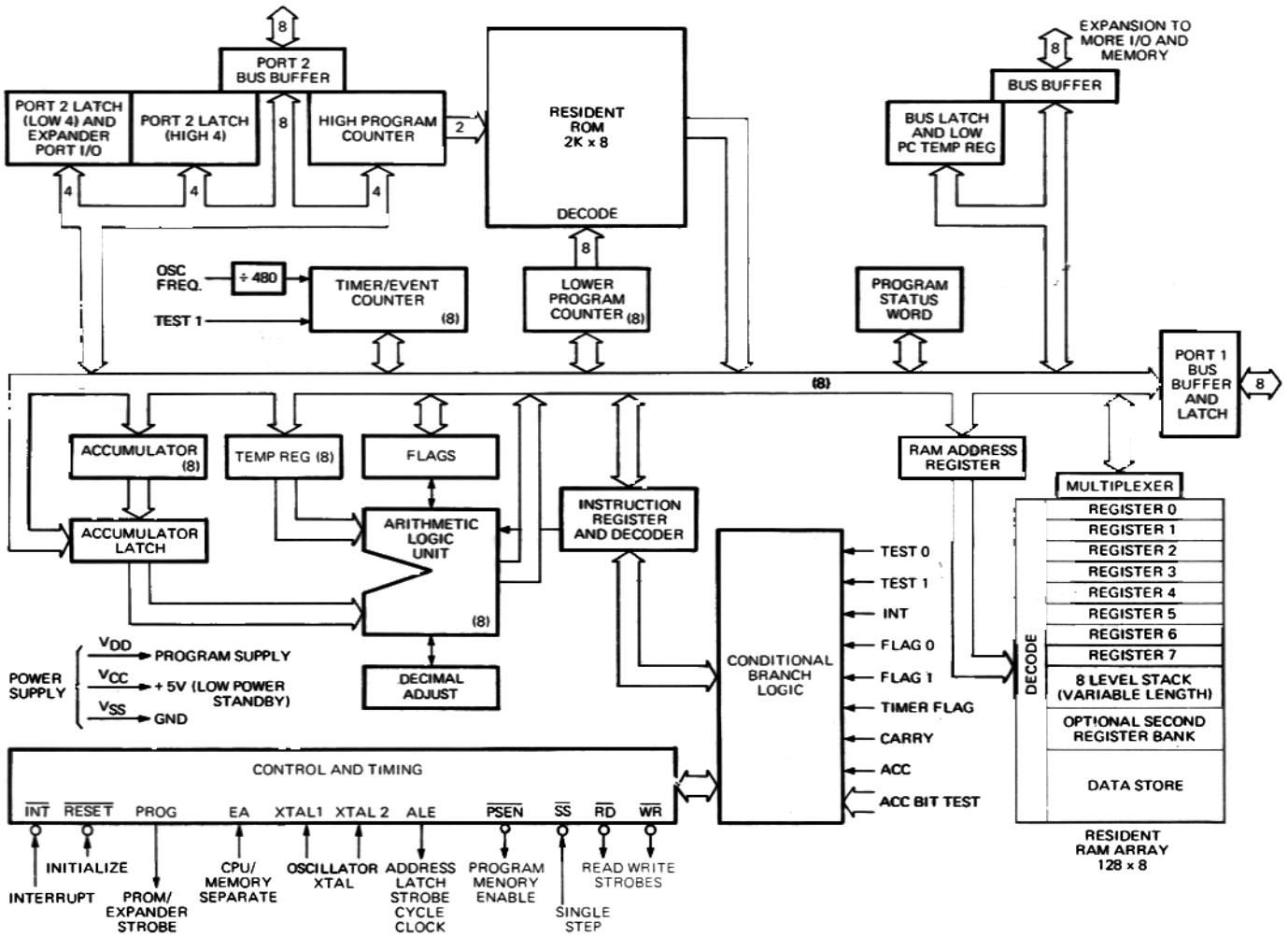
Item	Symbol	Rating
Collector-Emitter voltage	V_{CEO}	35V
Collector-Base voltage	V_{CBO}	65V
Emitter-Base voltage	V_{EBO}	4.0V
Continuous Collector current	I_C	1.0A
Total device dissipation Tc=50°C Derate above 50°C	P_D	30W 0.3W/°C
Storage temperature	Tstg	−65~+150°C

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

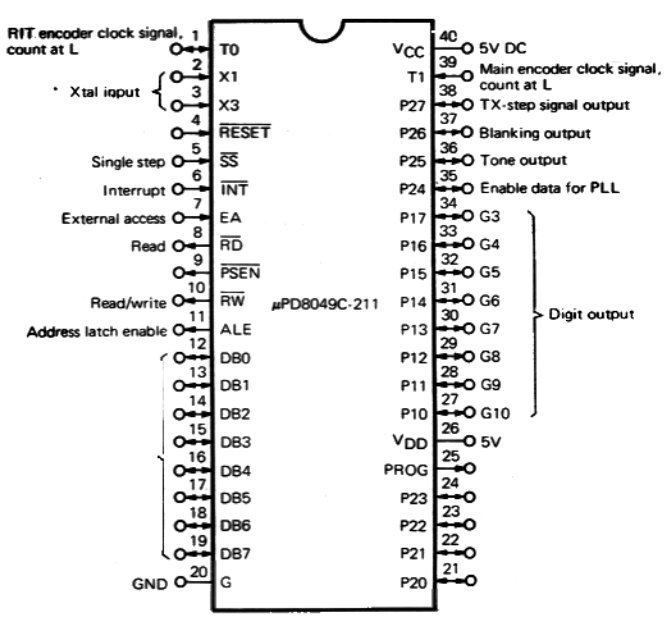
Item	Symbol	Rating
Collector-Emitter voltage	V_{CEO}	40V
Collector-Base voltage	V_{CBO}	85V
Emitter-Base voltage	V_{EBO}	3.0V
Continuous Collector current	I_C	20A
Withstanding current −10s	−	30A
Total device dissipation Tc=25°C Derate above 25°C	P_D	290W 1.66W/°C
Storage temperature	Tstg	−65~+200°C

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

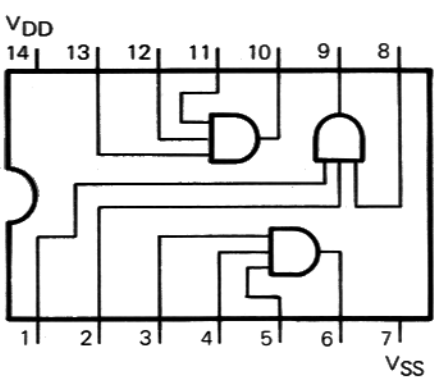
SEMICONDUCTOR DATA



μPD8049C-211 Block diagram (Digital unit IC6)

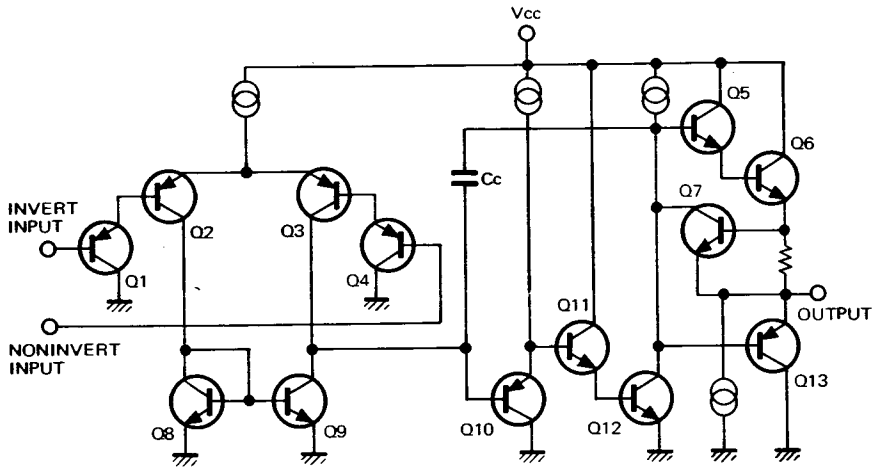


μPD8049C-211

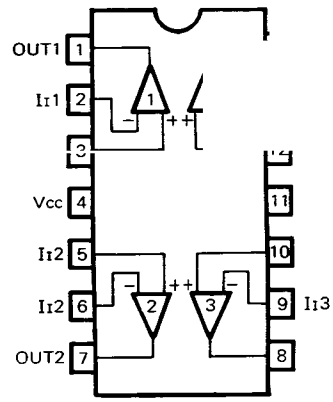


TC4073BP (Signal unit IC11)

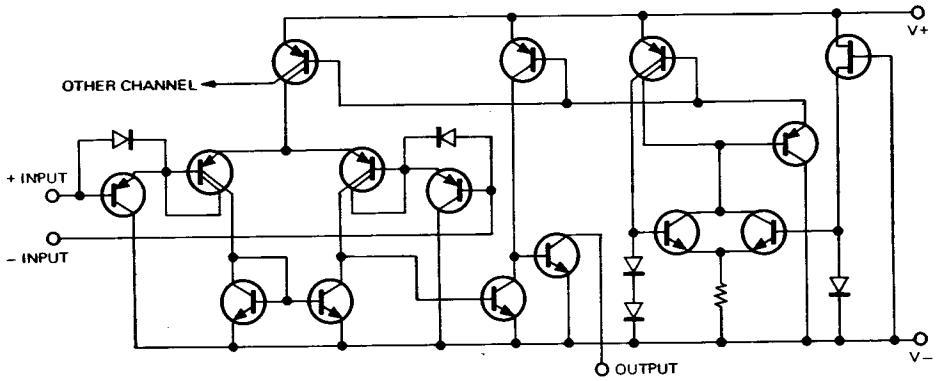
SEMICONDUCTOR DATA



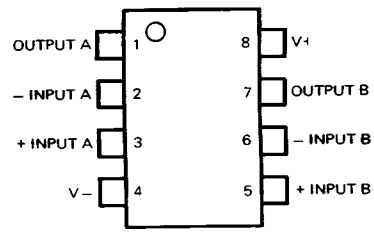
MB3614 Equivalent circuit (Signal unit IC4,7)



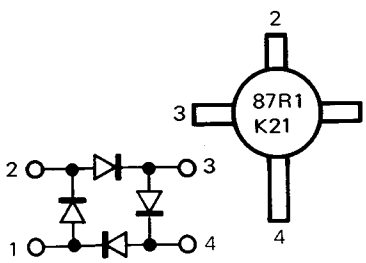
MB3614 (TOP VIEW)



NJM2903D Equivalent circuit (Signal unit IC5)



NJM2903D



ND487R1-3R (Signal unit D140)

Item	V_{CBO}	V_{CEO}	V_{EBO}	I_C	icp	I_B	Pc	Tj	Tstg
Condition							Tc= 25°C		
Rating	500V	400V	10V	0.5A	1.0A	0.75A	10W	150°C	–55~ +150°C

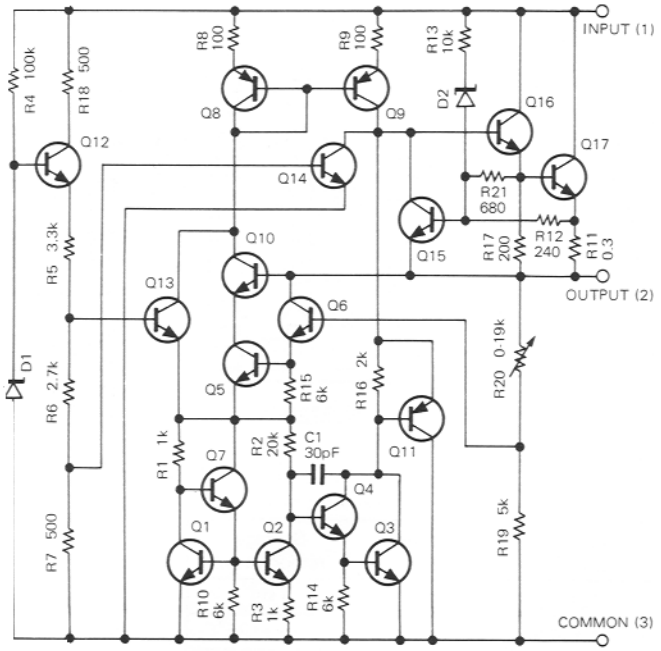
Ta = 25°C

2SC2899 MAX. Rating (Signal unit Q22)

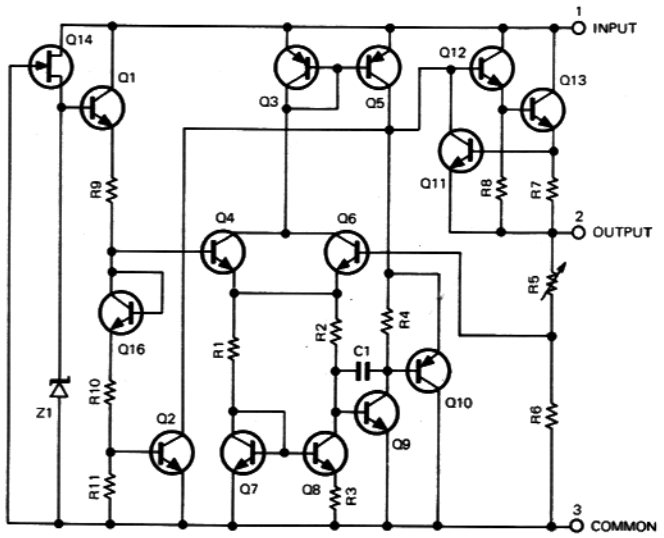
Item	Rating
Maximum permissible voltage	AC 130V rms DC 170V
Varistor voltage	180~255V
Maximum restriction voltage	340V at 10A
Maximum average pulse power	0.25W
Maximum surge current	600A

ERZ-C07DK201 MAX. Rating (Signal unit D101)

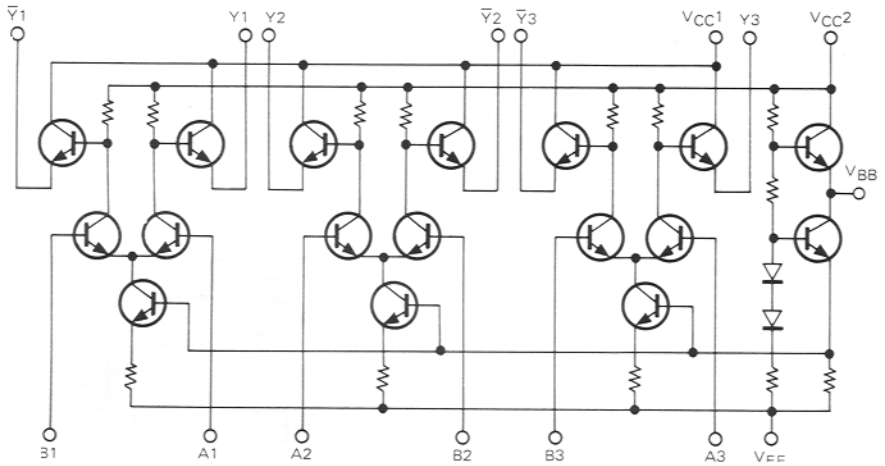
SEMICONDUCTOR DATA



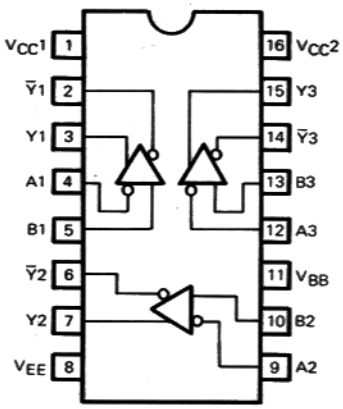
UA7818UC Equivalent circuit (Signal unit IC8)



TA78L005AP Equivalent circuit (AT unit Q27)



HD10116 Equivalent circuit (AT unit Q30)



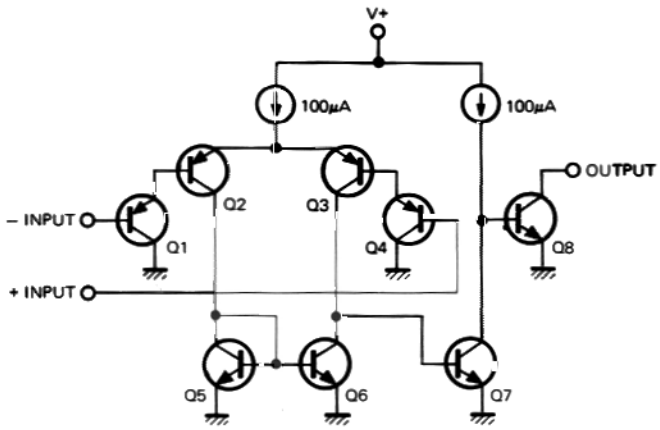
HD10116 (TOP VIEW)

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	Tj	150°C
Storage temperature	Tstg	−55~+150°C

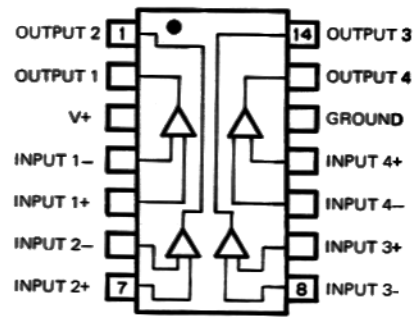
Ta=25°C

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

SEMICONDUCTOR DATA



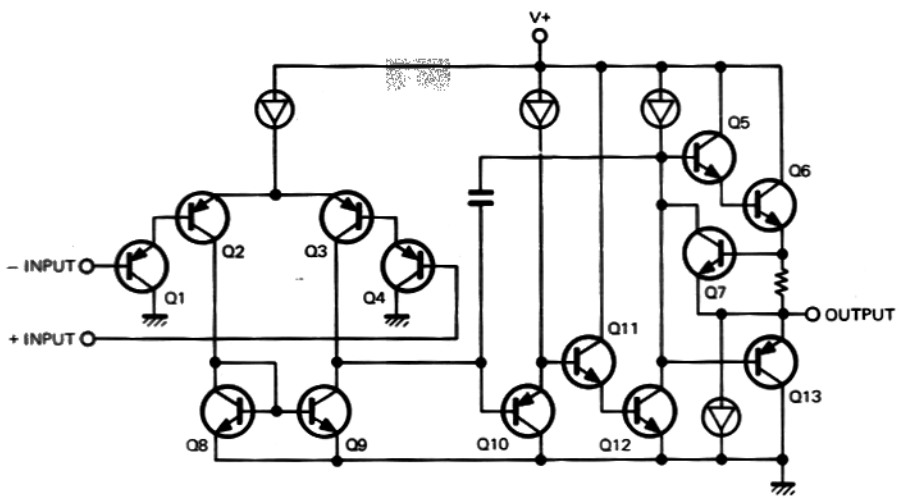
NJM2901 Equivalent circuit (AT unit Q39)



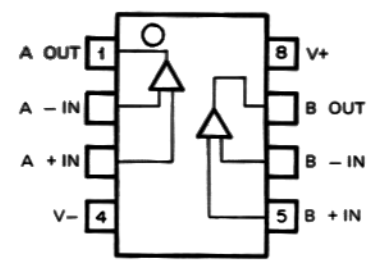
NJM2901

Item	Voltage supply	Power consumption	Differential input voltage	Input voltage	Operating temperature	Storage temperature
Symbol	Vs	P_T	V_{IDR}	V_{ICR}	Topr	Tstg
Rating	36V	570mW	36V	−0.3~+36V	−40~+85°C	−50~+125°C

NJM2901 MAX. Rating



NJM2904D Equivalent circuit (AT unit Q40)

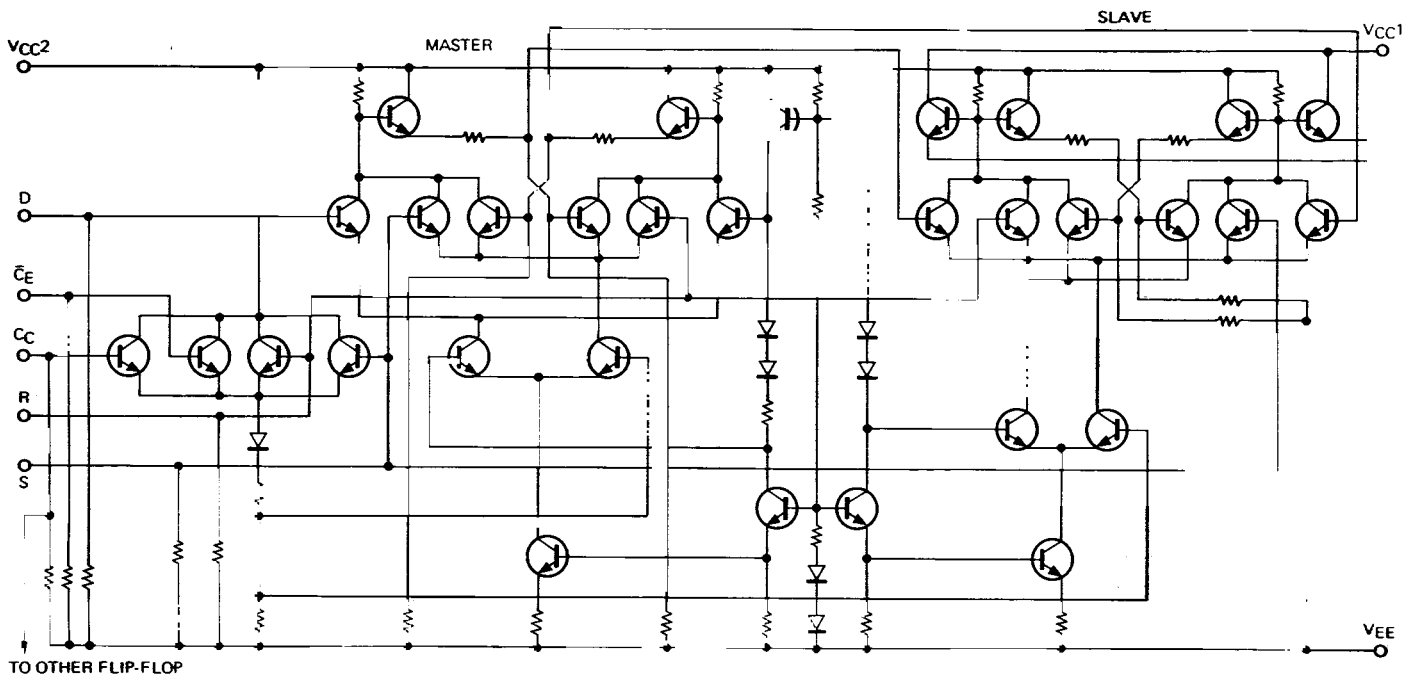


NJM2904D

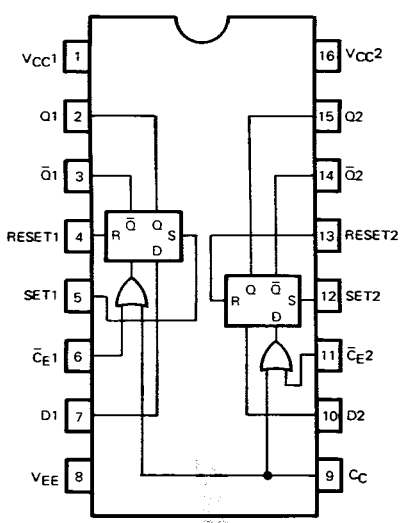
Item	Voltage supply	Power consumption	Differential input voltage	Input voltage	Operating temperature	Storage temperature
Symbol	Vs	P_T	V_{ID}	V_{ICM}	Topr	Tstg
Rating	32±16V	500mW	−0.3~+26V	−0.3~+32V	−20~+75°C	−40~+125°C

NJM2904D MAX. Rating

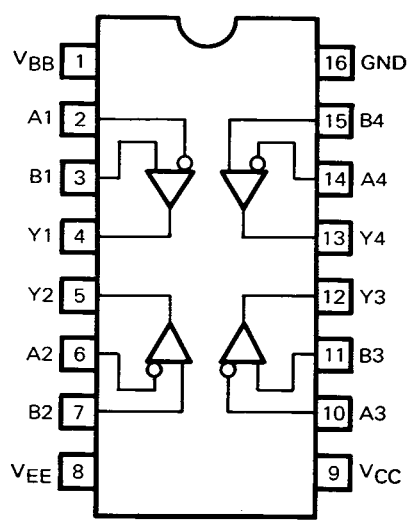
SEMICONDUCTOR DATA



HD10131 Equivalent circuit 1/2 (AT unit Q29)

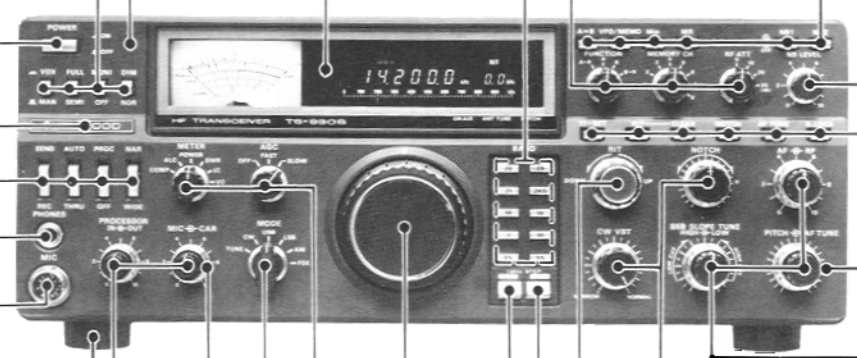


HD10131 (TOP VIEW)



HD10125 (AT unit Q28)
(TOP VIEW)

OUTSIDE VIEWS



Pointer knob x 3
FUNCTION, RF ATT,
MEMORY CH
(K23-0753-04)

Front glass (large)
(B10-0650-03)

Panel
(A20-2440-12)

Push knob BAND
(K29-0760-04)

Push knob x 5 A=B,VFO/MEMO,
MIN,MR,NB1,NB2
(K27-0433-04)

Push knob x 4 VOX/MAN,
FULL/SEMI,MONI,DIM/NOR
(K27-0434-04)

Push knob POWER
(K29-0757-04)

Name plate
(B43-0669-04) T
(B43-0670-04) K,M,W,X

Knob NB LEVEL
(K23-0721-04)

Push knob x 6 T-F SET,
RIT,CLEAR,NOTCH,
AF TUNE,D.LOCK
(K27-0433-04)

Paddle switch x 4 STBY,
AT,PRO.,TONE
(S36-2408-05)

3P phone jack PHONES
(E11-0404-05)

Knob (outside) x 3
AF TUNE,RF,LOW
(K23-0740-04)

8P metal socket MIC
(E06-0853-05)

Foot x 2
(J02-0423-04)

Knob (inside) x 3
PITCH,AF,HIGH
(K21-0764-04)

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

Knob (6) x 2
NOTCH,CW VBT
(K29-0738-04)

Knob (outside) x 2 CAR,OUT
(K21-0765-04)

Main knob
(K21-0766-05)

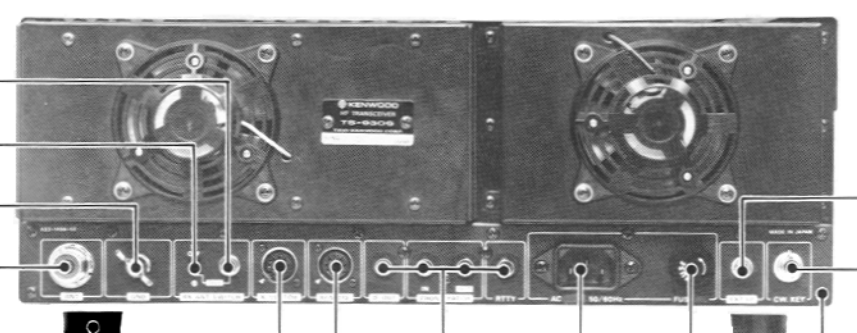
Knob RIT
(K21-0763-04)

Pointer knob MODE
(K29-0715-04)

Push knob 1MHz STEP UP
(K27-0431-04)

Pointer knob x 2
METER,AGC
(K23-0753-04)

Push knob 1MHz STEP DOWN
(K27-0432-04)



1P pin jack RX ANT
(E13-0101-05)

Slide switch RX ANT
(S31-1407-05)

Wing nut
(N14-0509-05)

UHF type receptacle ANT
(E04-0152-05)

Foot (large) x 2
(J02-0049-14)

Phone jack EXT. SP
(E11-0410-05)

3P phone jack KEY
(E11-0404-05)

Rear panel
(A23-1466-22)

8P DIN socket X. VERTER
(E06-0851-05)

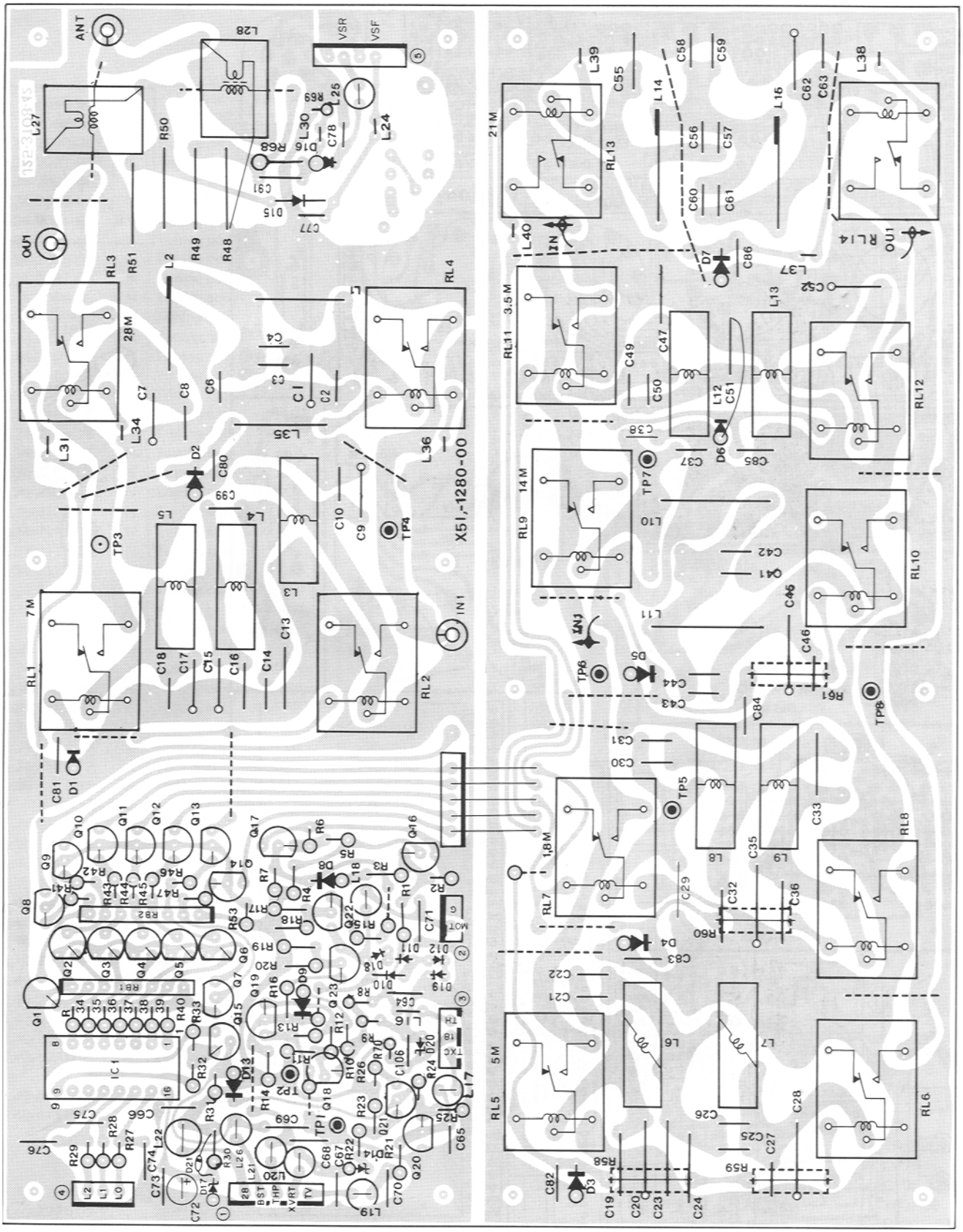
4P pin jack
(E13-0461-05)

Fuse 4A (F05-4022-05) M,T,W,X
Fuse 6A (F05-6021-05) K

7P DIN socket REMOTE
(E06-0751-05)

3P inlet AC power
(E18-0351-05)

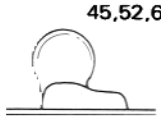
LPF UNIT (X51-1: **Component side view**



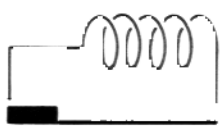
Q1–7,15–19 : 2SC1815(Y) Q8–14,20,22,23 : 2SC1959(Y) Q21 : 2SA733(P) IC1 : MB74LS42M-G
D1–7,10,12,13,18,19,21 : 1S1555 D8,9 : 1N60 D11 : XZ-090 D14 : WZ-120 D15 : 1S1007 D16 : 1S1587 D17 : XZ-055 D20 : XZ-180

< Attachment method of L27,28 >

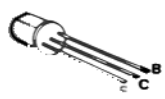
< Attachment method of C2,7,9,15,17,20,35, 45,52,62 >



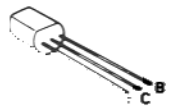
< Attachment method of L2,14,15 >



2SA733

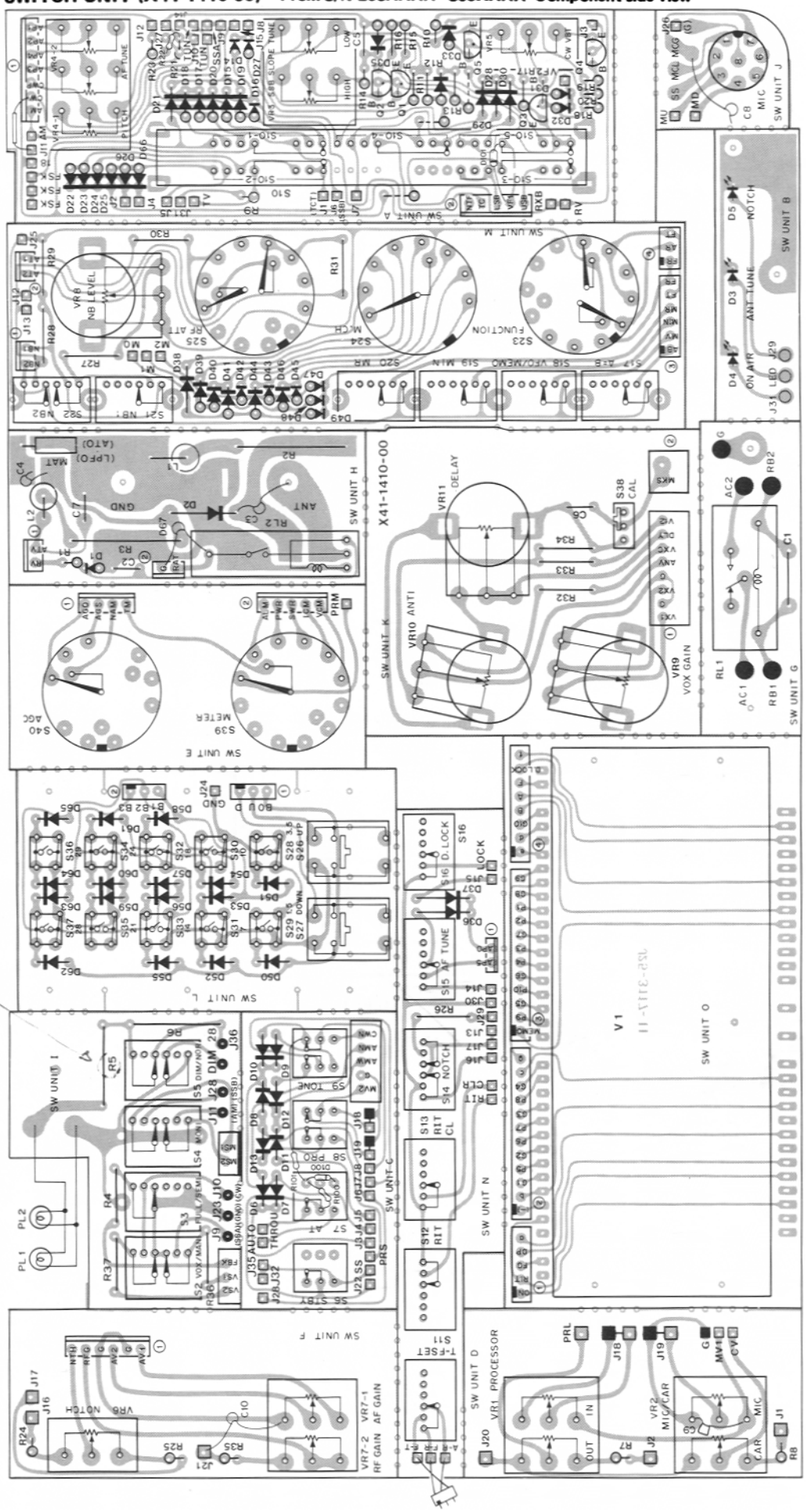


2SC1815
2SC1959

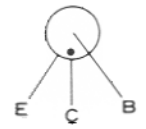


TS-930S PC BOARD VIEW

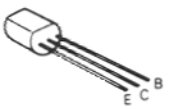
SWITCH UNIT (X41-1410-00) From S/N 208XXXX–309XXXX Component side view



Transistor terminal indication



2SA1015
2SC1815

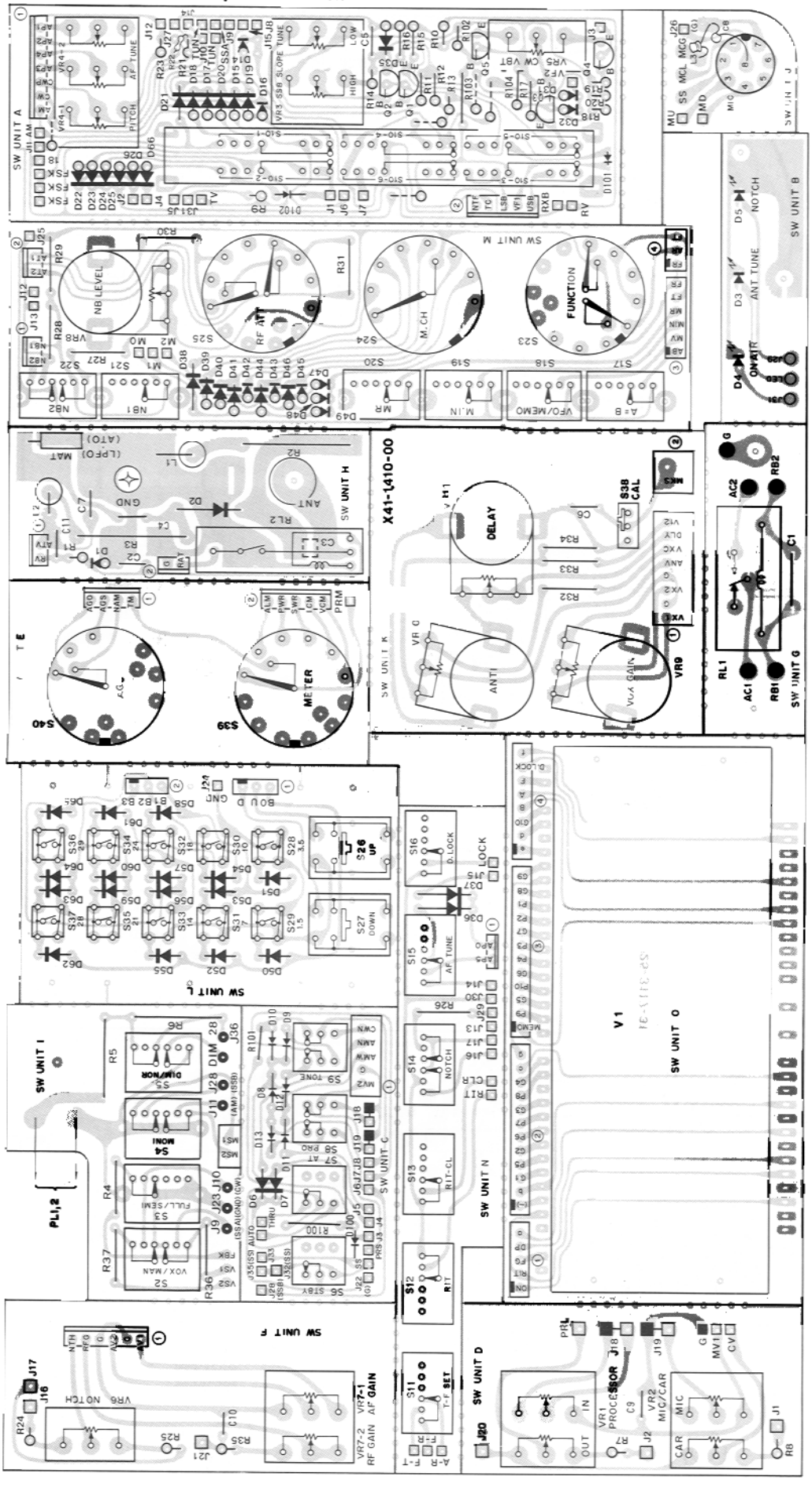


BG5532K
PR5532K

Q1–4 : 2SC1815(Y) Q5 : 2SA1015(Y)
D1,6–34,36–66,100,101 : 1S1555 D2 : GM-3A D3 : BG5532K

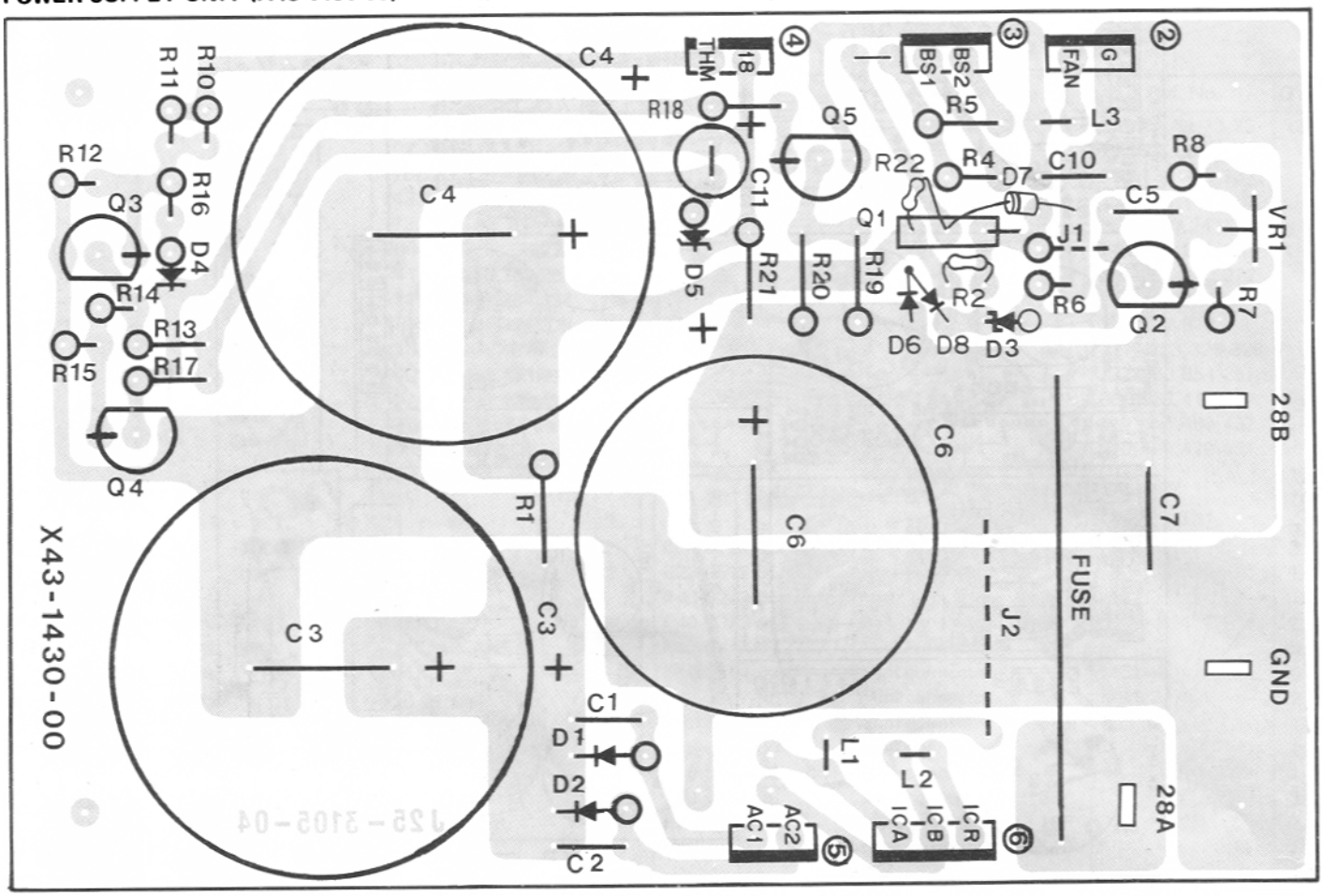
SWITCH UNIT (X41-1410-00)

From S/N 310XXXX– Component side view



Q1–4 : 2SC1815(Y) Q5 : 2SA1015(Y)
D1,6–26,31,32,36–66,100–102 : 1S1555 D2 : GM-3B
D3 : BG5532K D4,5 : PR5532K D35 : XZ-060
D67 : D5A-441LA V1 : 11-BT-03Z

POWER SUPPLY UNIT (X43-1430-00) From S/N 208XXXX–309XXXX Component side view

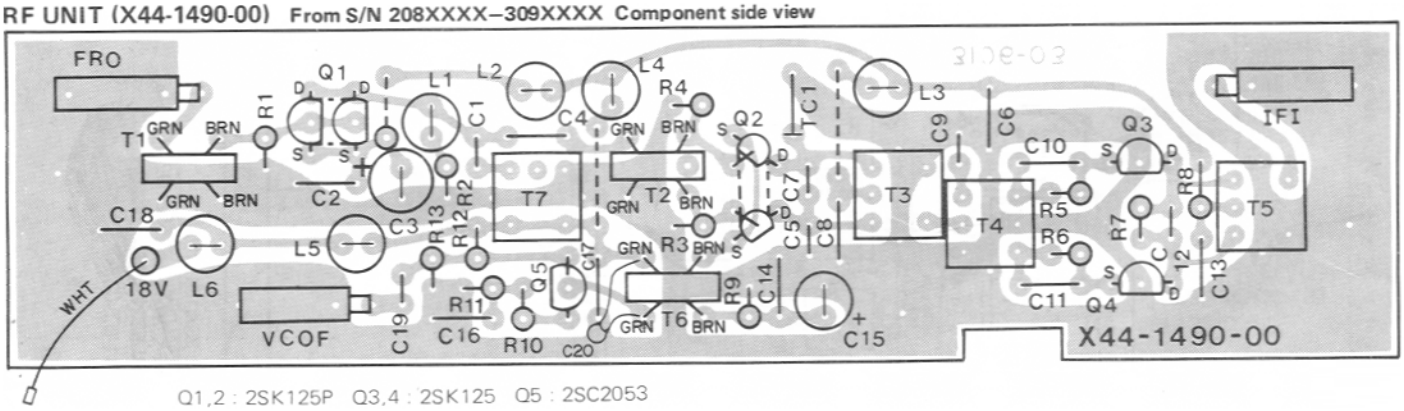


Q1 : 2SA1021(O) Q2–4 : 2SC1815(Y) Q5 : 2SC1959(Y)
D1,2 : V03(C) D3 : XZ-122 D4,6 : 1S1555 D5 : WZ-182 D7 : BZ-320 D8 : SV-03Y

< Attachment method of D6,8 >

< Attachment method of Q1,D6,8 >

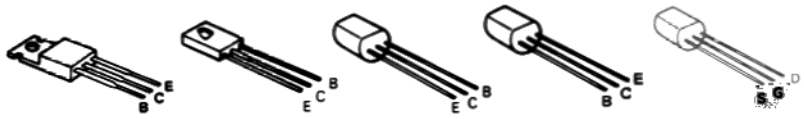
RF UNIT (X44-1490-00) From S/N 208XXXX–309XXXX Component side view



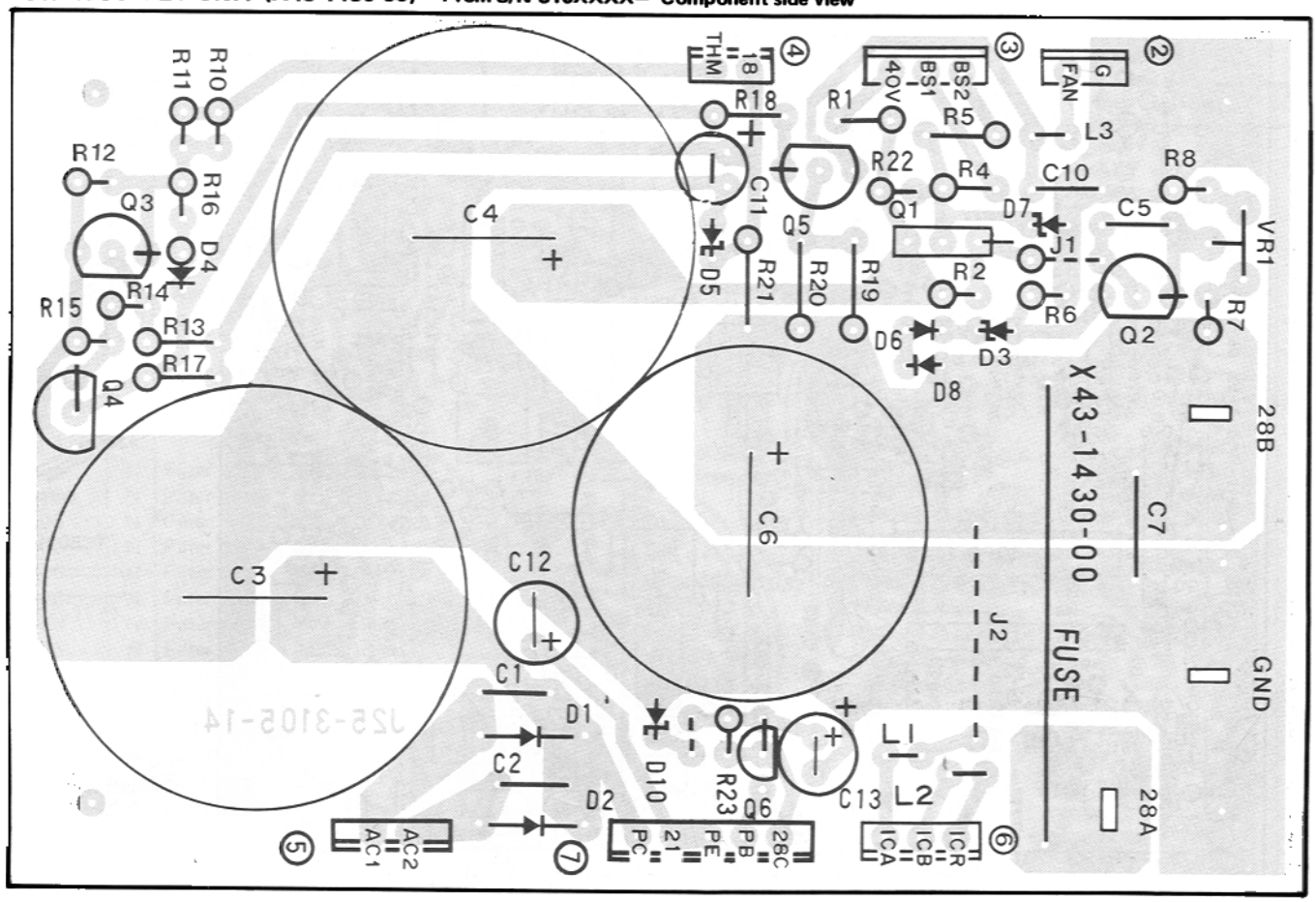
Q1,2 : 2SK125P Q3,4 : 2SK125 Q5 : 2SC2053

< Attachment method of TC1 >

2SB861 2SA1021 2SC1815 2SC1959 2SC2235 2SC2053 2SK125

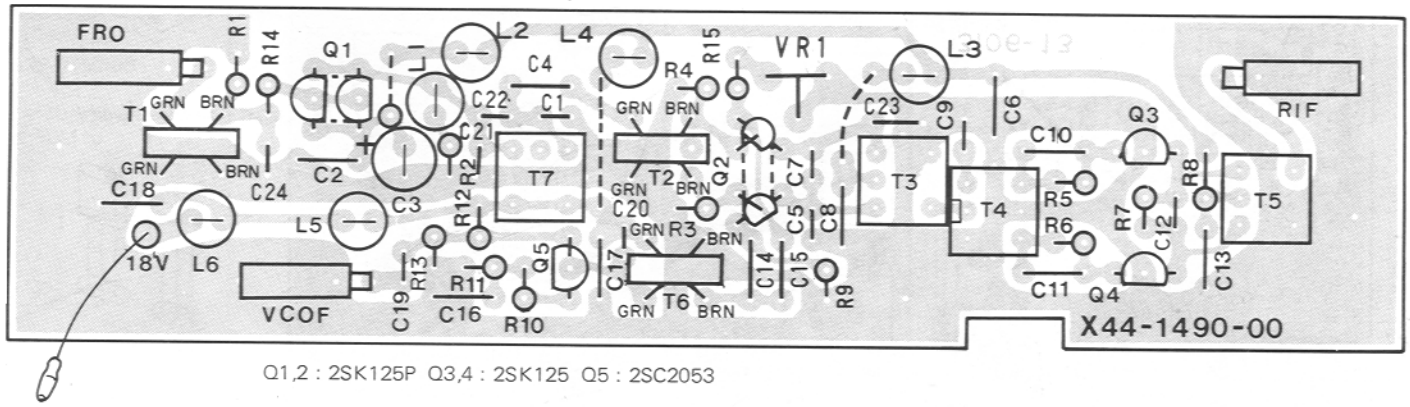


POWER SUPPLY UNIT (X43-1430-00) From S/N 310XXXX– Component side view



Q1 : 2SB861(C) Q2–4 : 2SC1815(Y) Q5 : 2SC1959(Y) Q6 : 2SC2235(O)
D1,2 : U05B D3 : XZ-122 D4,6 : 1S1555 D5 : WZ-182 D7 : RD33FBD-B1
D8 : SV-03Y D10 : XZ-225

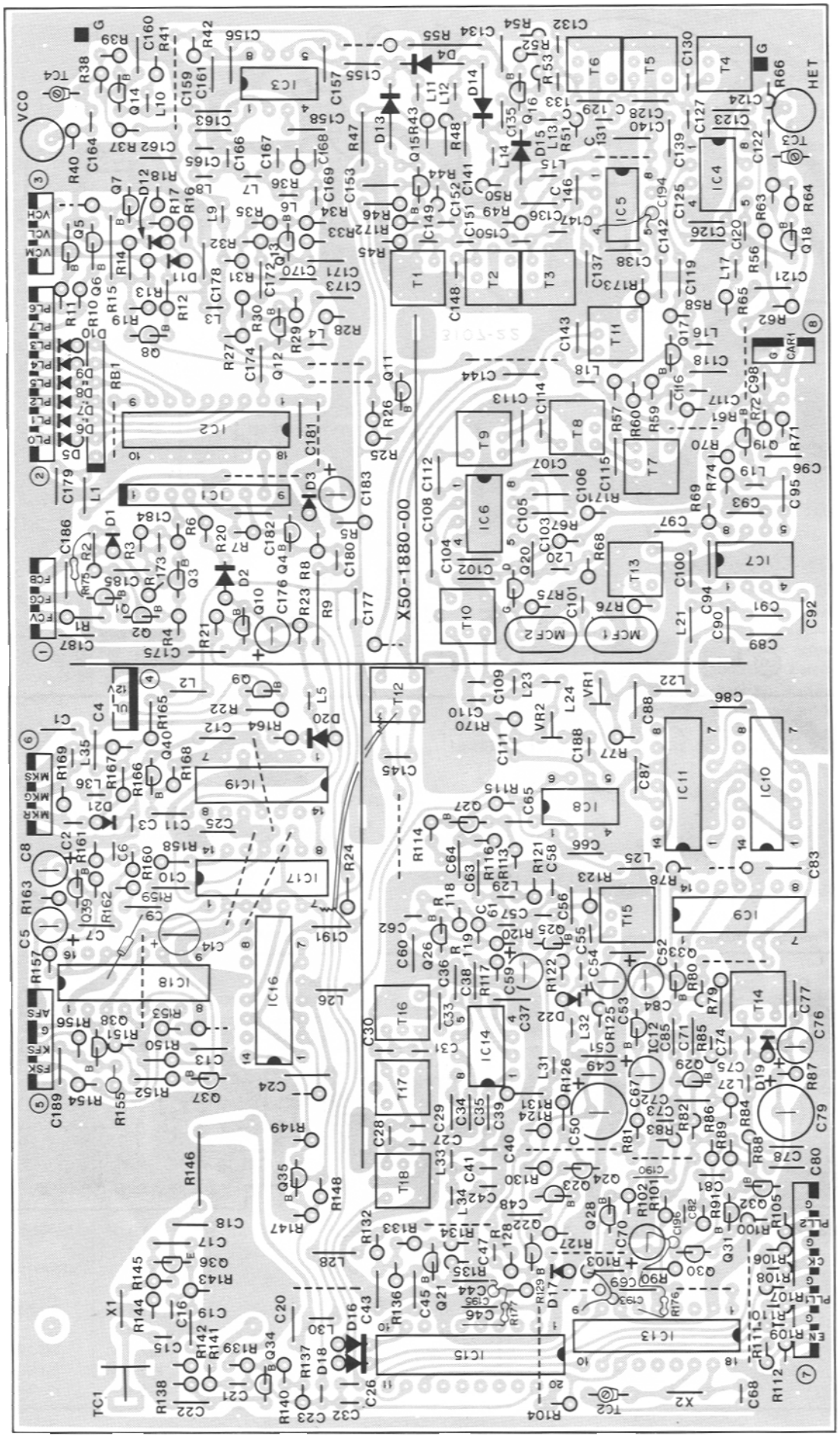
RF UNIT (X44-1490-00) From S/N 310XXXX– Component side view



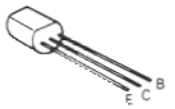
Q1,2 : 2SK125P Q3,4 : 2SK125 Q5 : 2SC2053

TS-930S PC BOARD VIEW

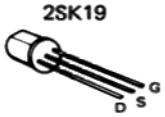
PLL UNIT (X50-1880-00) **Component side view**



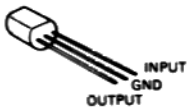
2SA1015
2SC1775
2SC1815
2SC1923



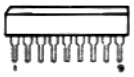
2SK19



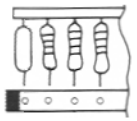
TA78L005AP



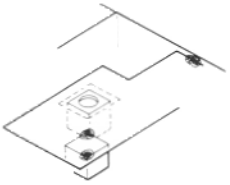
TC5081P



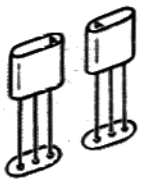
< Attachment direction of RB1 >



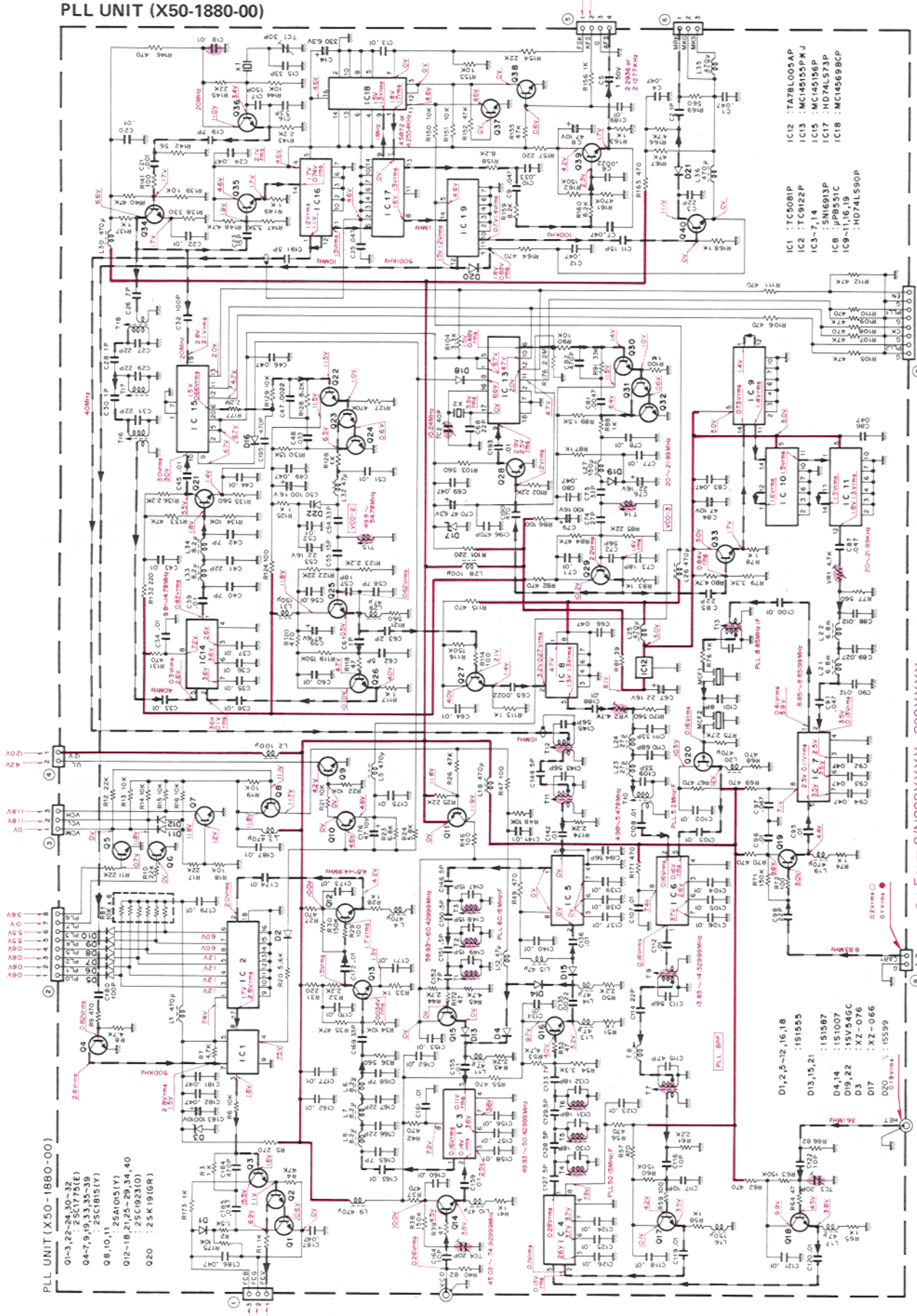
< Attachment method of shield plate >



< Attachment direction of MCF >

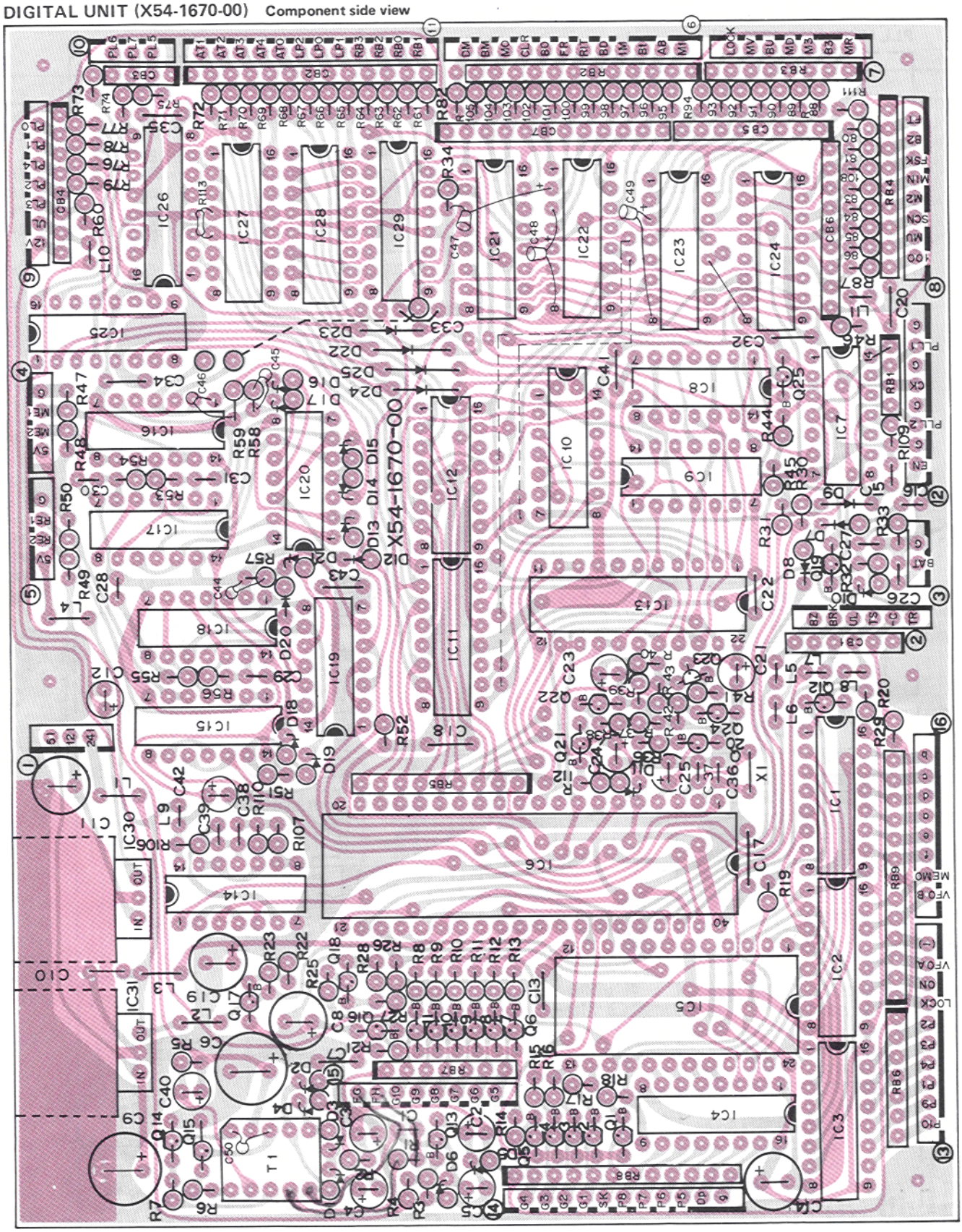


PLL UNIT (X50-1880-00)

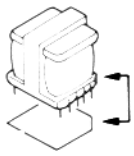


TS-930S PC BOARD VIEW

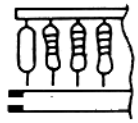
DIGITAL UNIT (X54-1670-00) Component side view



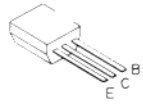
< Attachment direction of T1>



< Attachment direction of RB,CB >

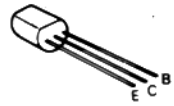


2SA1049

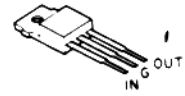


2SA984K 2SA1015 2SC1815

2SC1923 2SC1959 2SC2274K



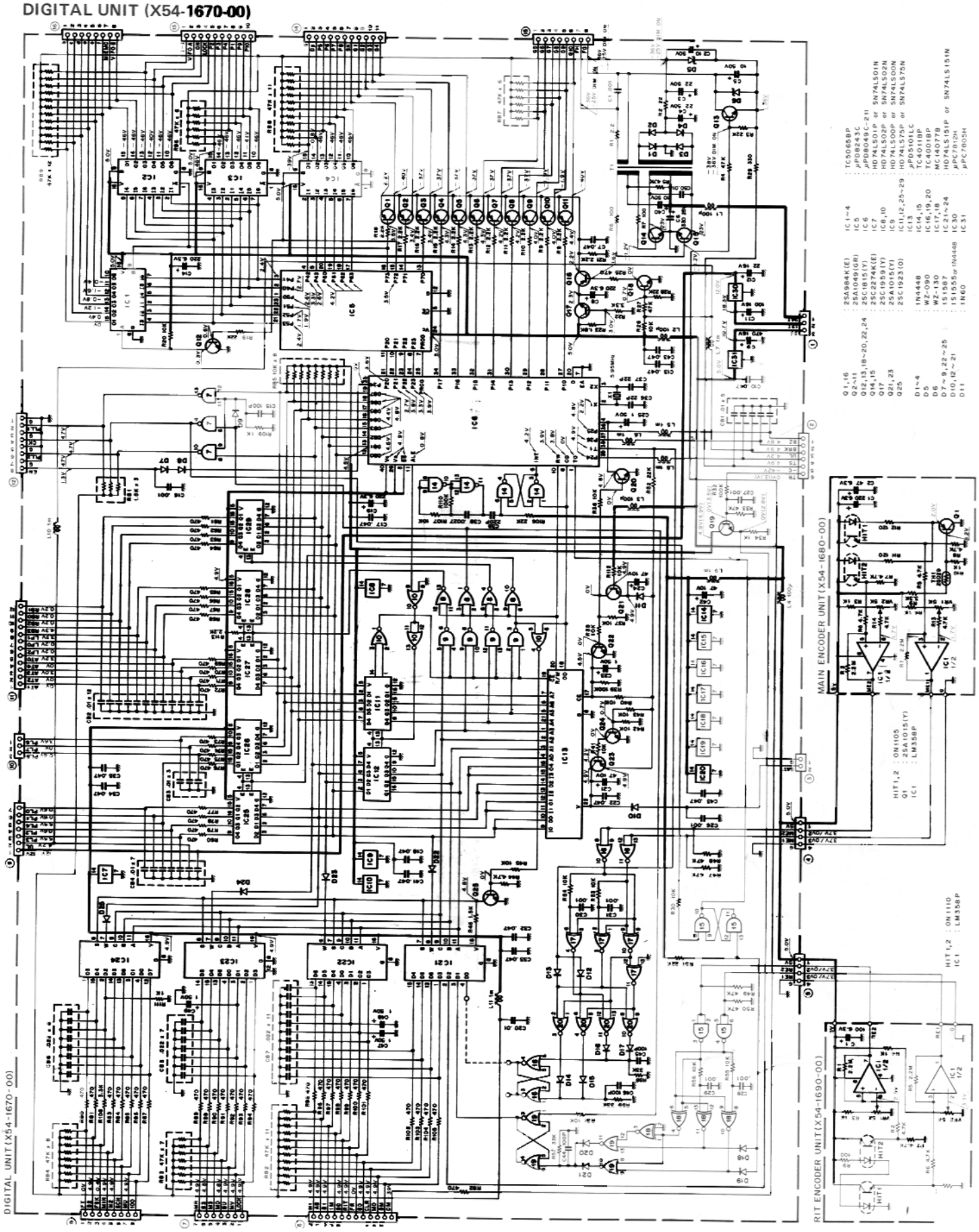
µPC14305 µPC14312



A C E

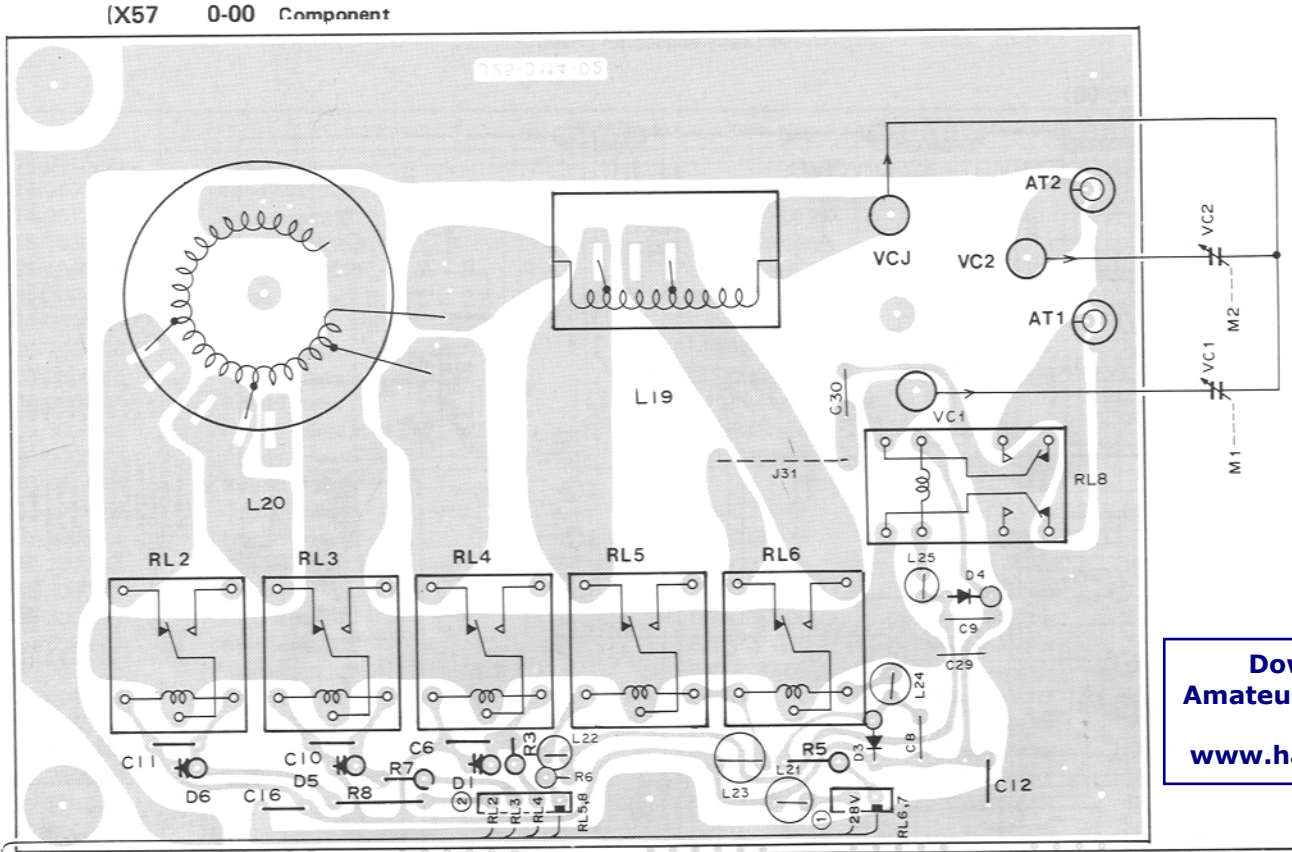
Note: Data transfer from IC21–24 only occurs when the latch signal on "S" & "W" are vertically aligned (in phase).

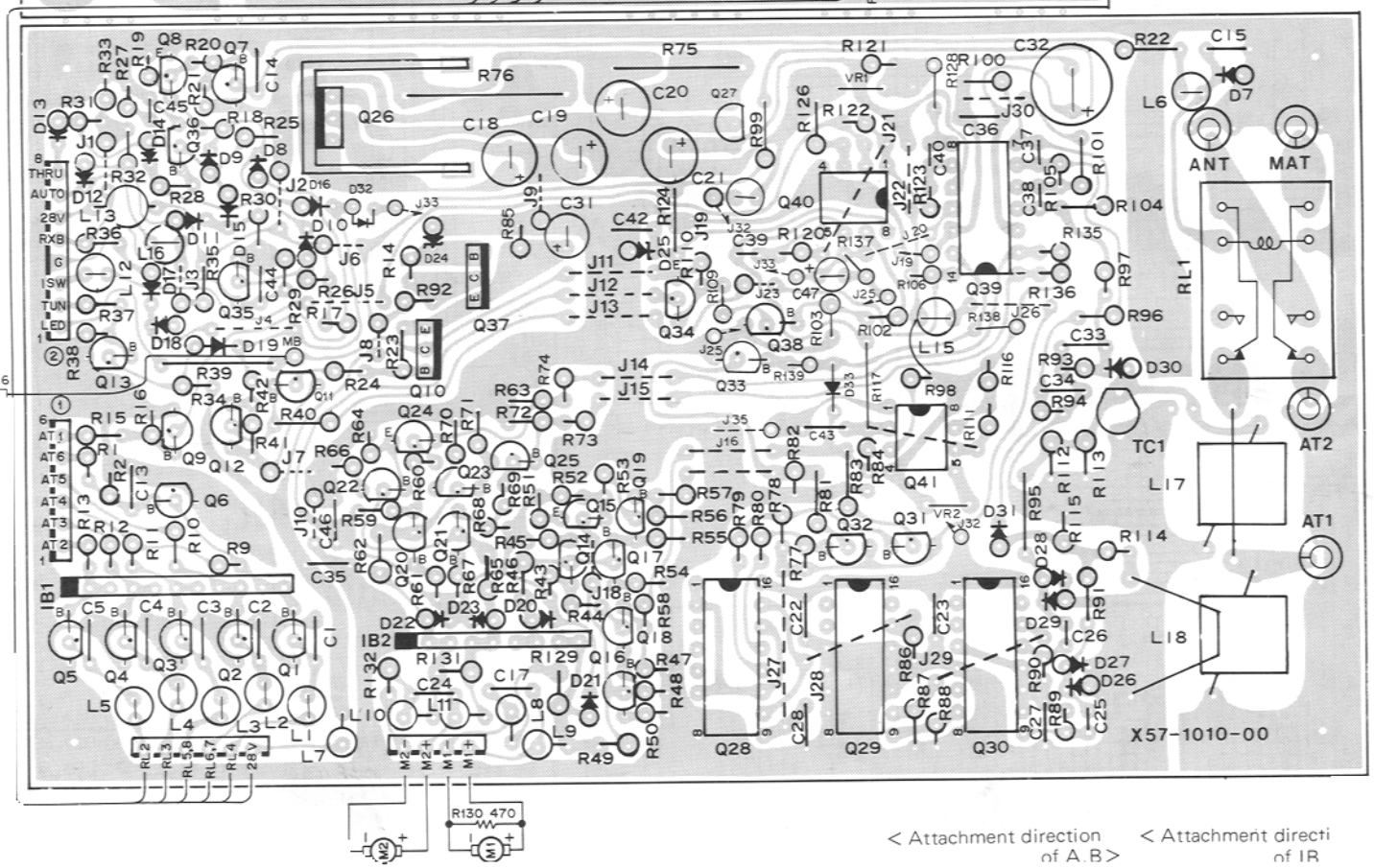
DIGITAL UNIT (X54-1670-00)



TS-930S PC BOARD V W

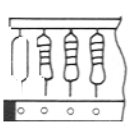
(X57 0-00 Component



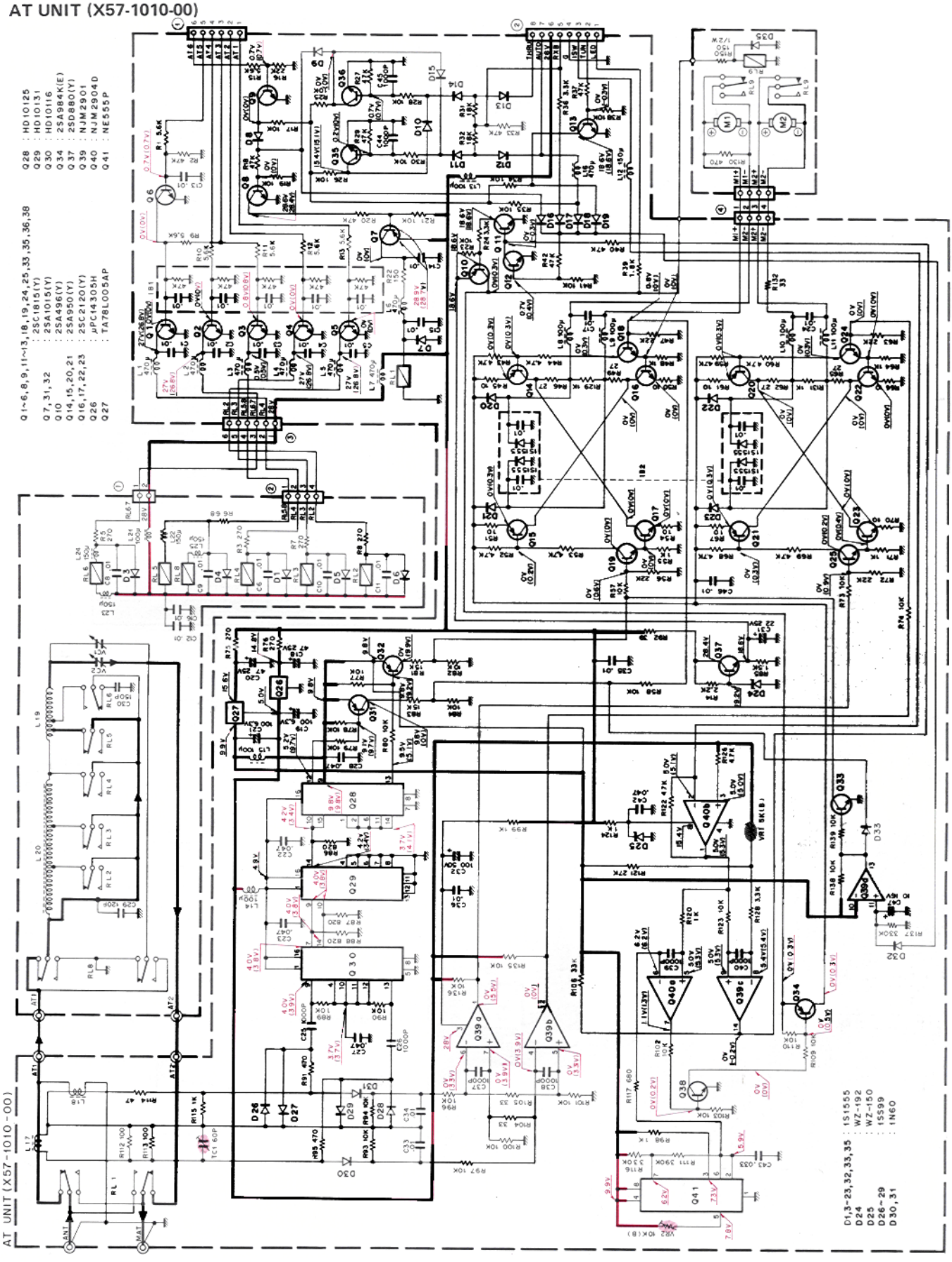


< Attachment direction of A,B >

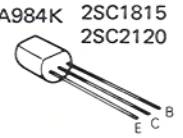
< Attachment direction of IB



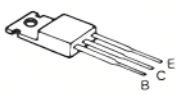
AT UNIT (X57-1010-00)



2SA950 2SA1015
2SA984K 2SC1815
2SC2120

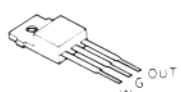


2SD880



2SA496

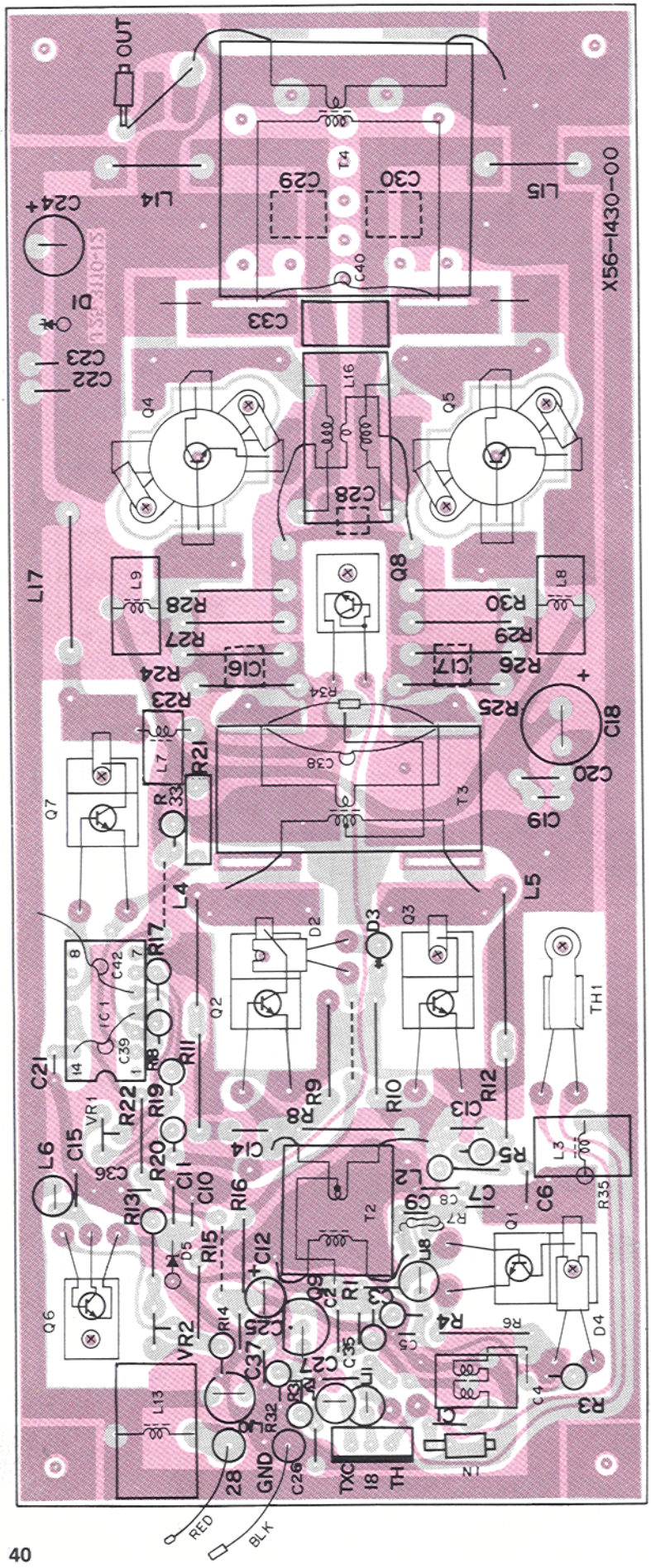
μPC14305H



TA78L005AP

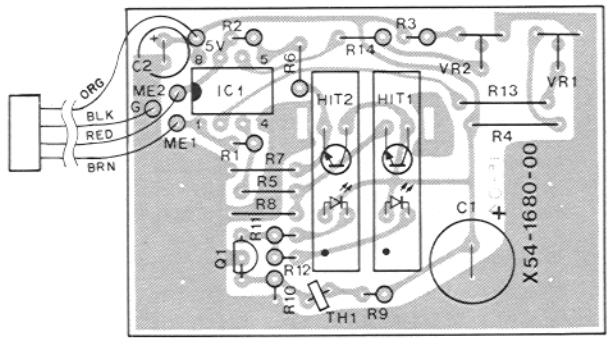
TS-930S PC BOARD VIEWS

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



MAIN ENCODER UNIT (X54-1680-00)

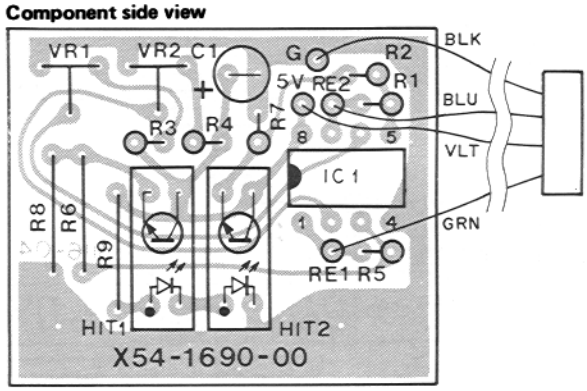
Component side view



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

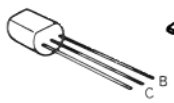
RIT ENCODER UNIT (X54-1690-00)

Component side view

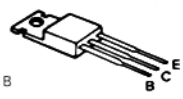


HIT1,2 : ON1110 IC1 : LM358P

2SA1015
2SC1959

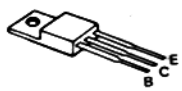


2SC2075
2SD880

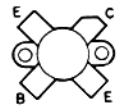


2SC496

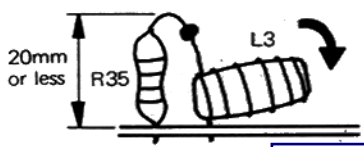
MRF485



MRF422

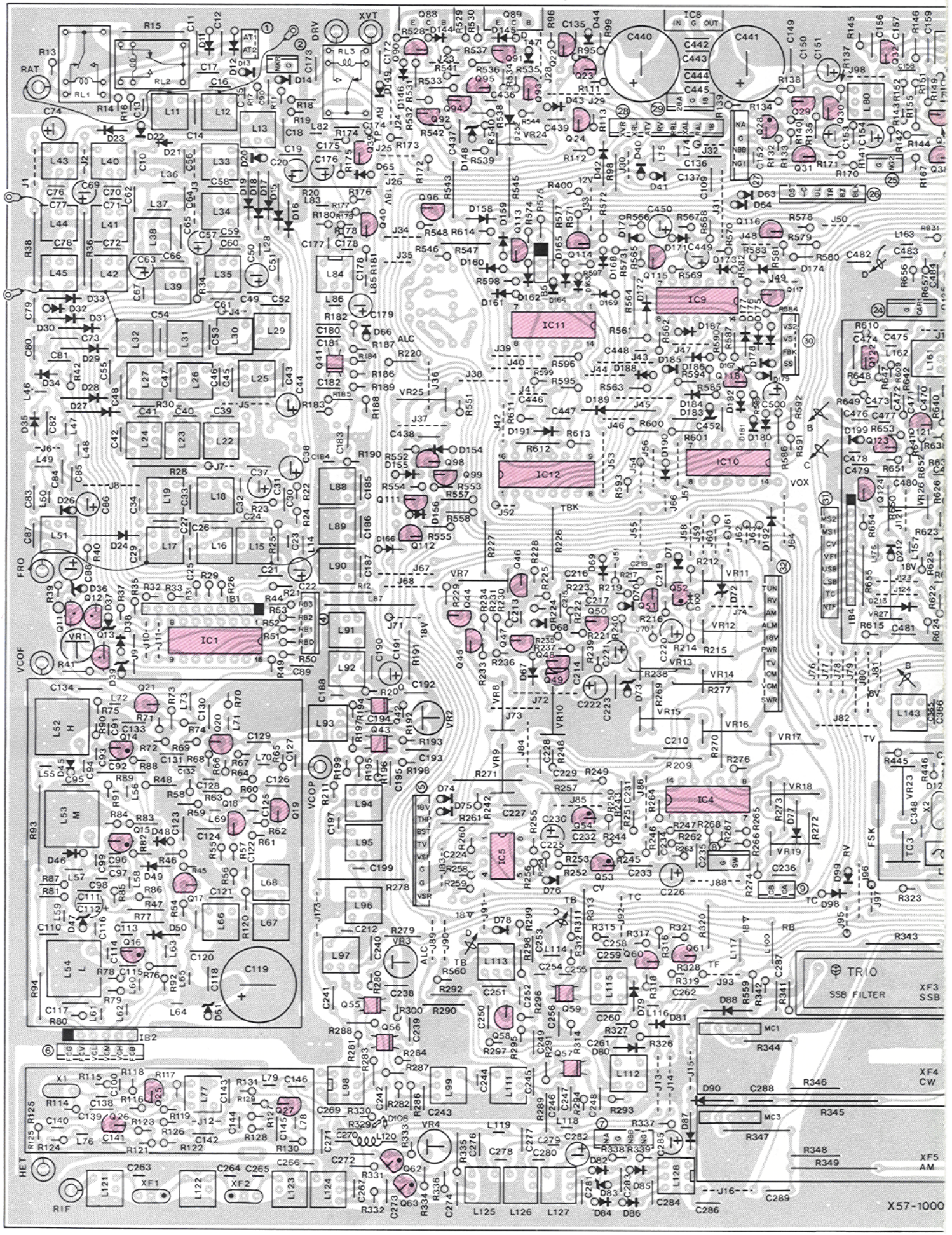


< Attachment method of R35 and L3 >

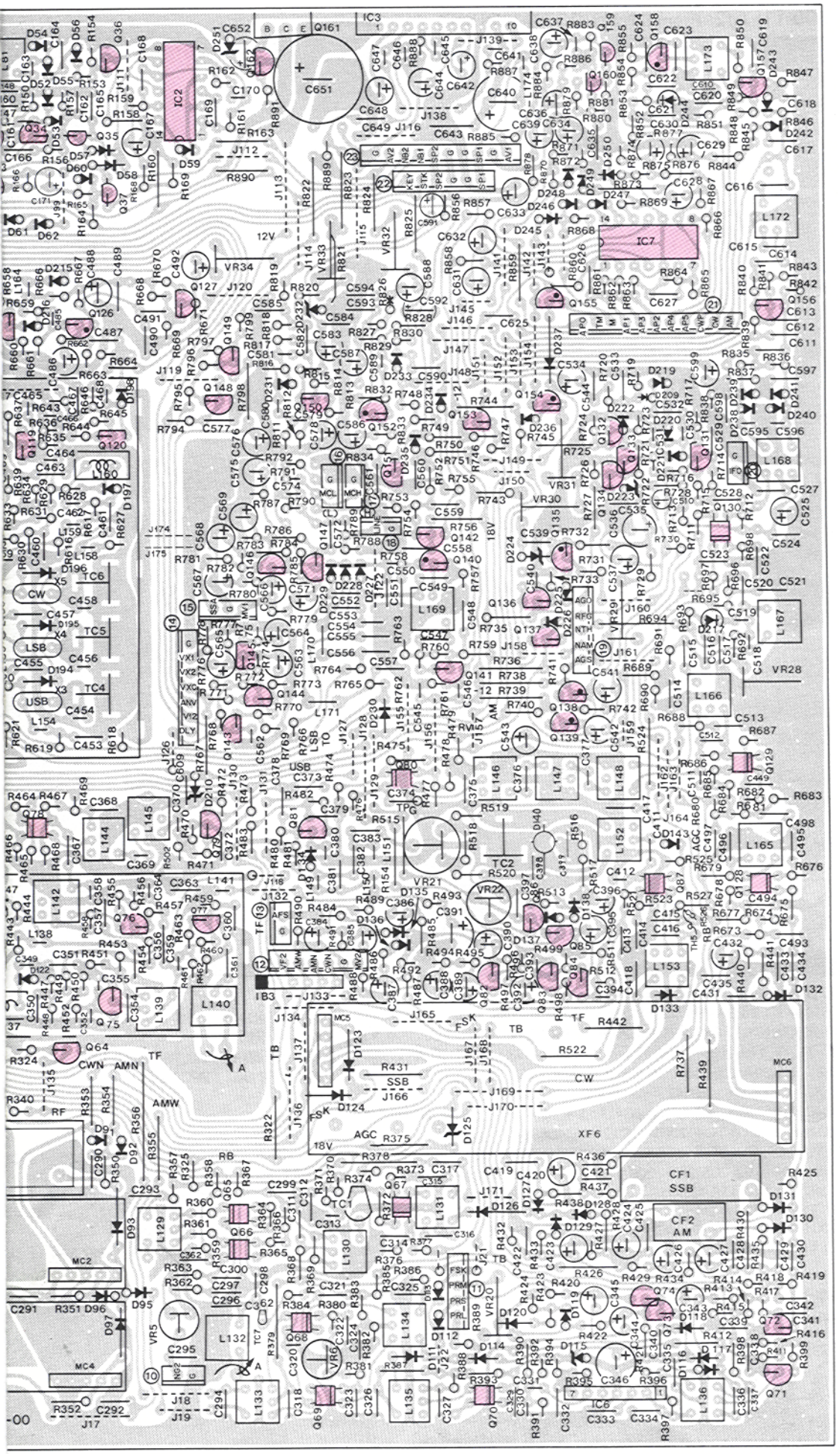


Q1 : 2SC2075 Q2,3 : MRF485 Q4,5 : MRF422
Q6,8 : 2SC496(Y) Q7 : 2SD880(Y) Q9 : 2SC1959(Y)
IC1 : MC1723CL
D1 : BZ-350 D2,4 : STV3H(O) D3 : 1S1555 D5 : BZ-192

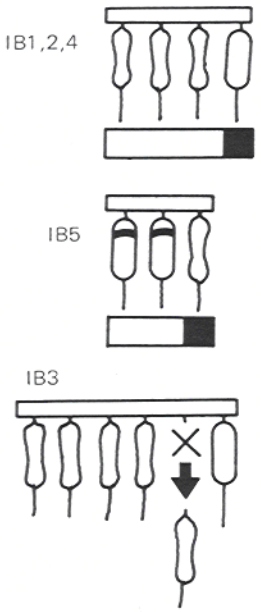
SIGNAL UNIT (X57-1000-11) A/2 From S/N208XXXX–309XXXX Component side view



B D

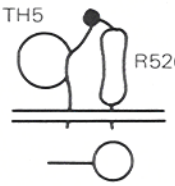


< Attachment direction of IB >

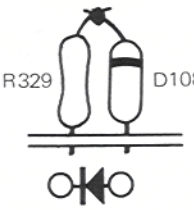


< Attachment direction of D217,244 >

< Attachment method of R526,TH5 >

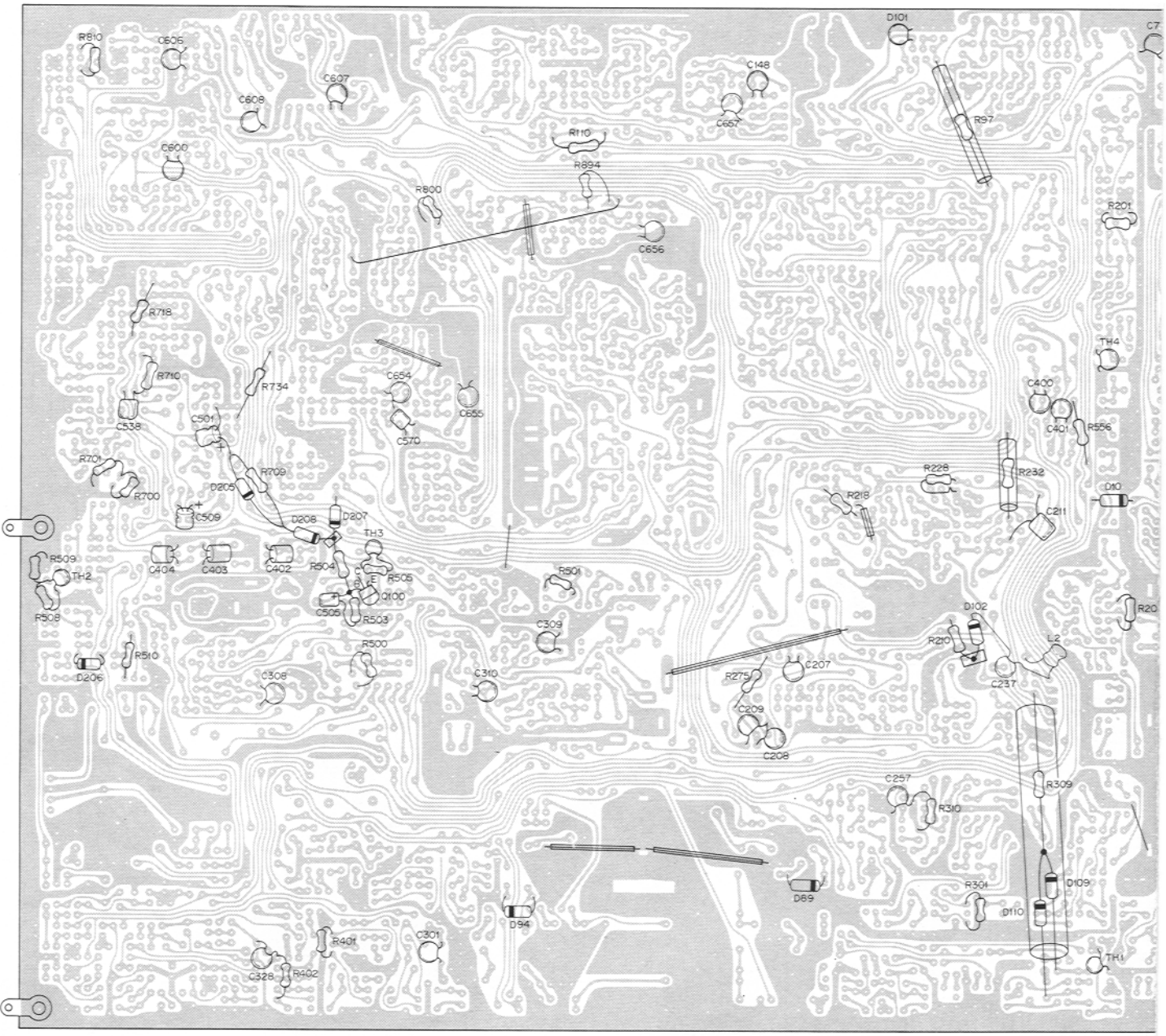


< Attachment method of R329,D108 >



TS-930S PC BOARD VIEWS

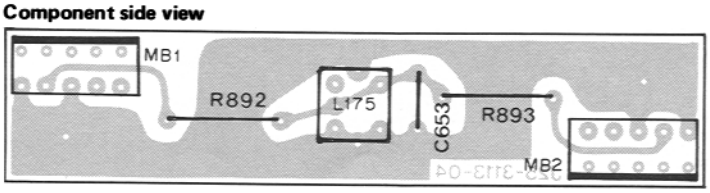
SIGNAL UNIT (X57-1000-11) A/2 From S/N208XXXX–309XXXX Foil side view



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 : 3SK
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 D11,12,38,40–43,57–66,68–70,74–76,78,91,92,98,99,108–110,112,113,116,117,119,121,123,124,135–138,1
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 : 1S2588 D34,35 : BA379
D36,37 : XZ-033 D39 : XZ-051 D44 : 1JZ61 D45 : 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 D47,122,197 : 1SV54GE D140 : ND487R1-3R D148 : WZ-061 D217,244 : FC6

SIGNAL UNIT (X57-1000-11) B/2

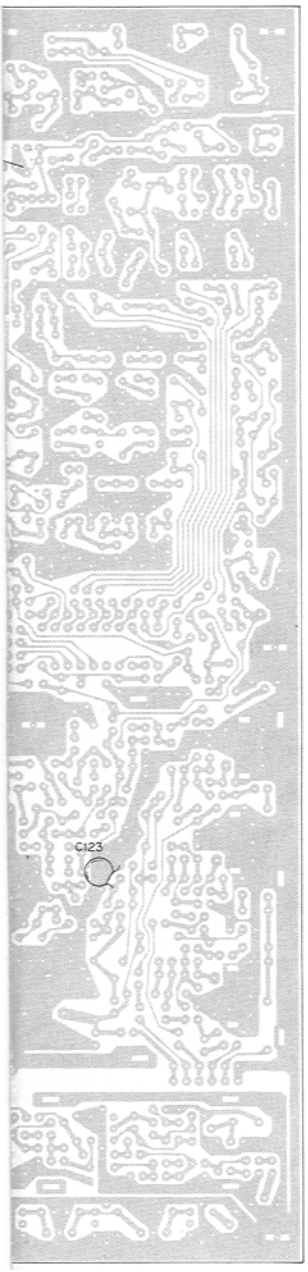
Component side view



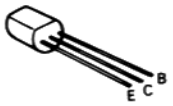
A B C D E

TR, FET, IC and Terminals address from S/N 310XXXX–

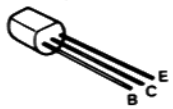
TR,FET	Address	TR,FET	Address	TR,FET	Address	Terminal	Address
Q1	Not used	Q71	G–6	Q141	F–3	①	A,B–1
Q2	Not used	Q72	G–6	Q142	F–3	②	B–1
Q3	Not used	Q73	G–6	Q143	E–4	③	B–2
Q4	Not used	Q74	G–6	Q144	E–3	④	B–3,4
Q5	Not used	Q75	E–5	Q145	E–3	⑤	B–4,5
Q6	Not used	Q76	E–4	Q146	E–3	⑥	A–6
Q7	Not used	Q77	E–4	Q147	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	F–4			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	IC13	E-2		
Q54	C–4,5	Q124	D–3				
Q55	B–5	Q125	E–2				
Q56	B–6	Q126	Not used				
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				



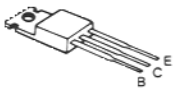
2SA984K
2SA1015
2SC1775
2SC1815
2SC1907
2SC1973
2SC2240



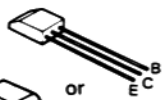
2SC2086



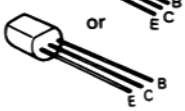
2SA473
2SD880



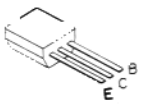
2SB460



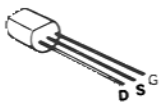
or



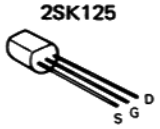
2SC2458



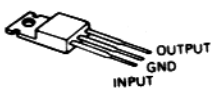
2SK192A*J



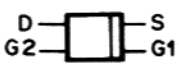
2SK30A
2SK125



UA8718UC

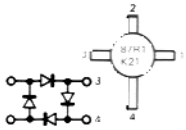


3SK73

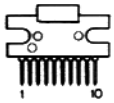


TA7302P
μPC1037H

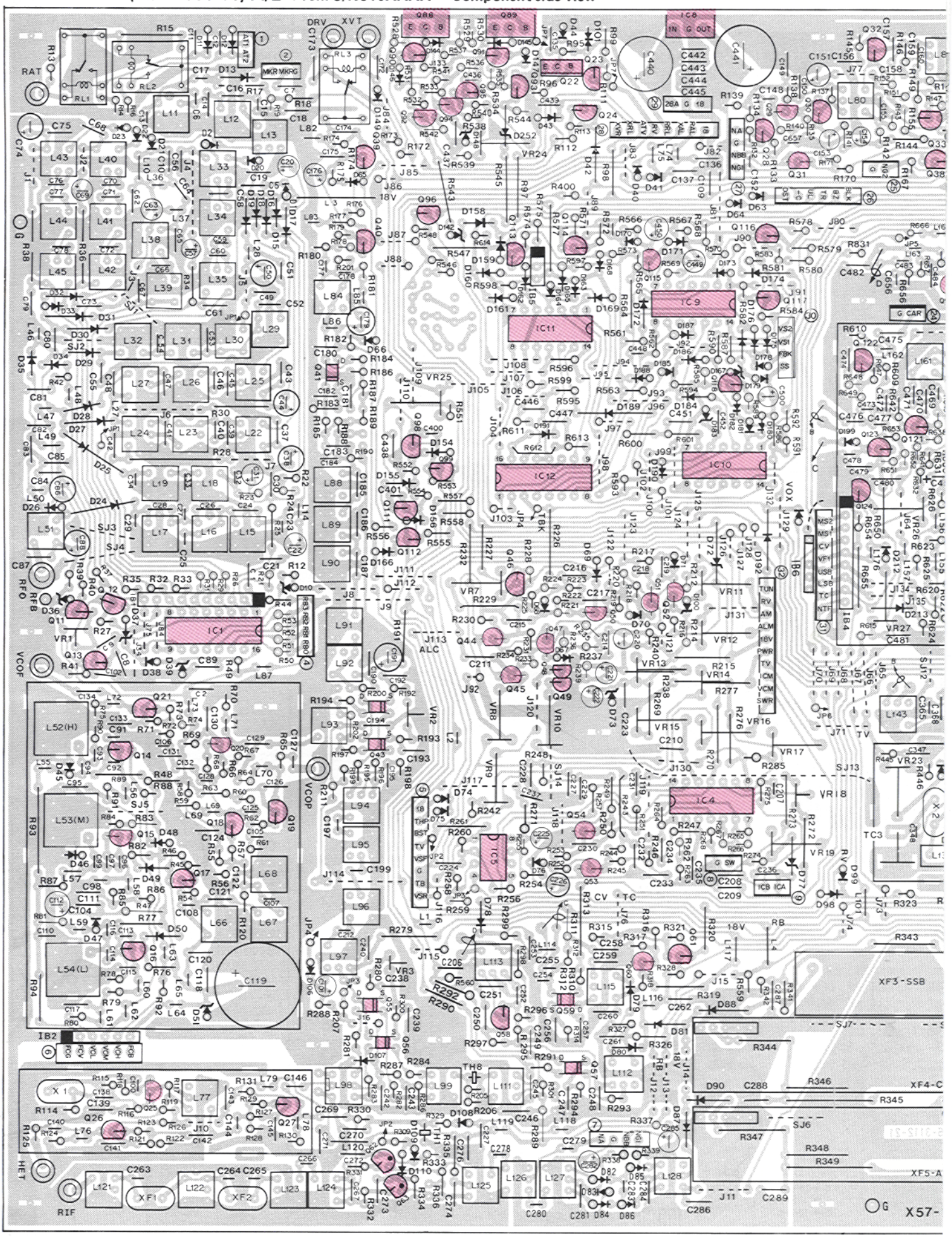
ND487R1-3R

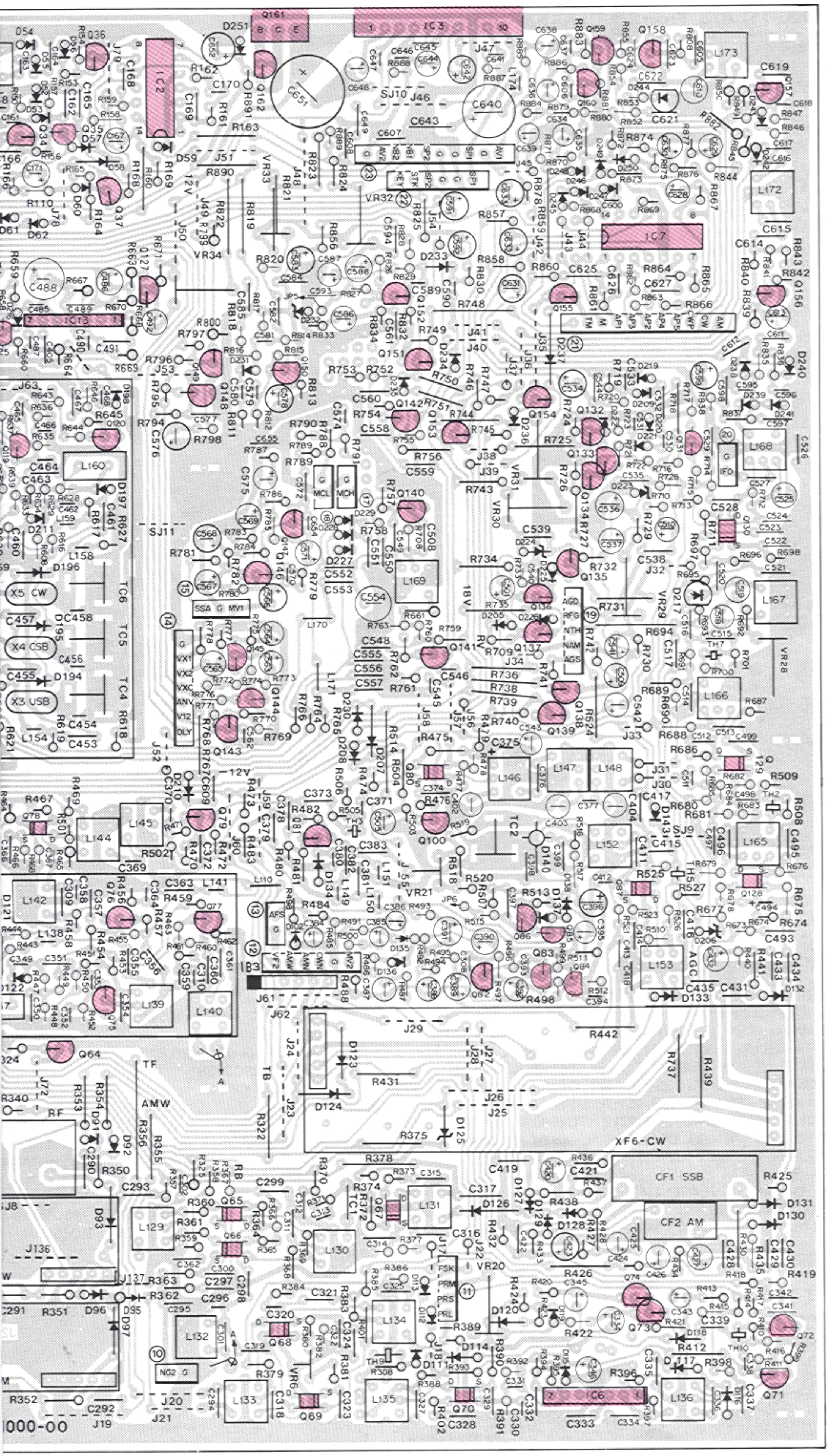


HA1368



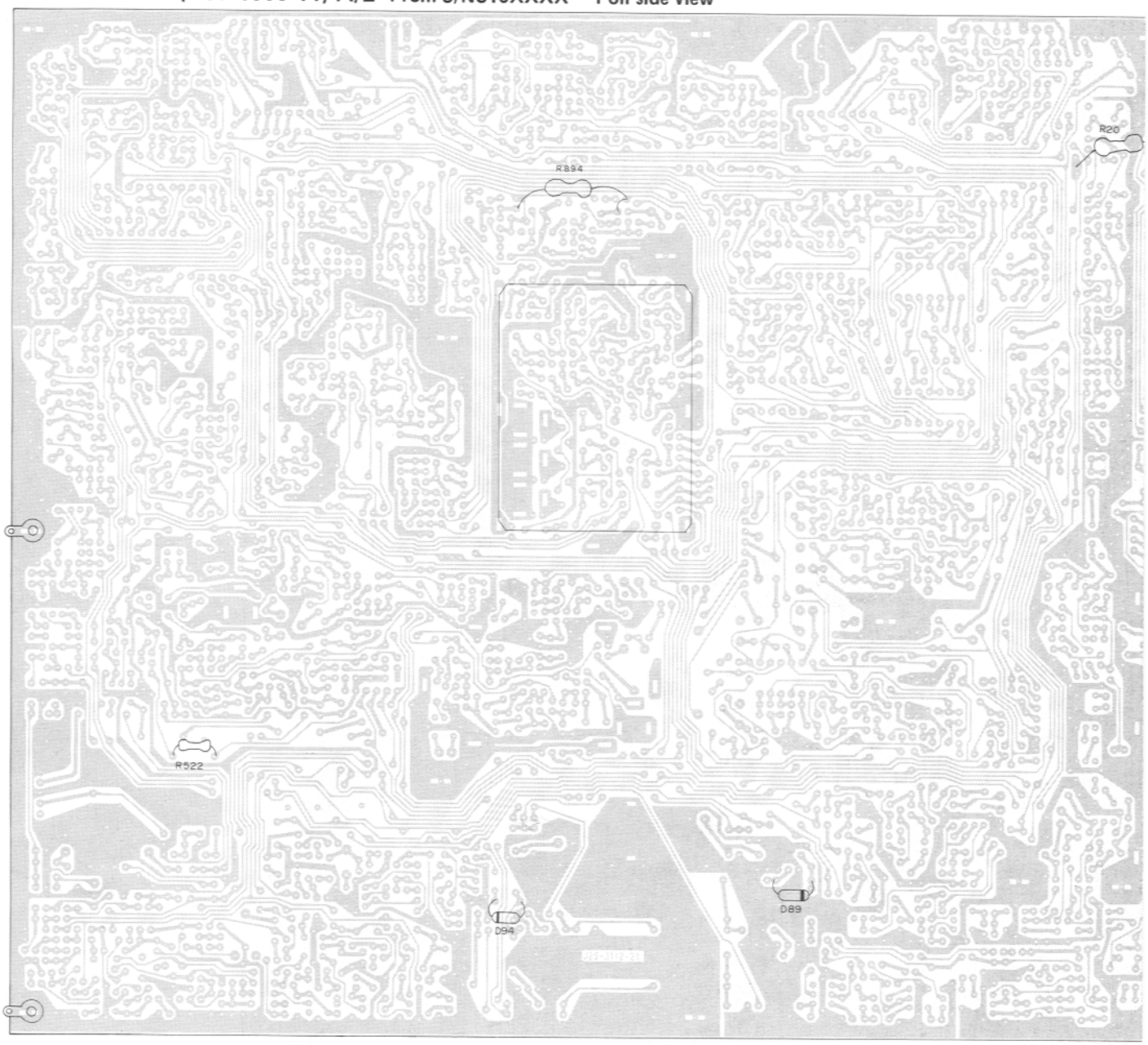
SIGNAL UNIT (X57-1000-11) A/2 From S/N310XXXX– Component side view




IC3
IC7
IC13
XF6-CW
CF1 SSB
CF2 AM
X5 CW
X4 CSB
X3 USB
L169
L167
L166
L165

TS-930S PC BOARD VIEWS

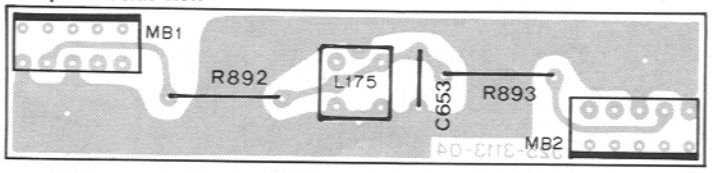
SIGNAL UNIT (X57-1000-11) A/2 From S/N310XXXX– Foil side view



Q11,12,24,31,74,84,85,99,112,115,127,137,153,160 : 2SA1015(Y)
Q13,34–38,44–47,50,51,60,61,64,73,83,86,90–98,100,111,113,114,116–118,124,132–134,136,141–145,148–151,156,157,162 : 2SC1815(Y)
Q14–16,28,140,152,158 : 2SK192A*J(GR) Q17–21,25,26,40 : 2SC1907 Q22 : 2SD799 Q23 : 2SA984K(E)
Q27,29,30,32,33,58,71,72,75–77,79,119–123,125,131 : 2SC460(B) Q39 : 2SC1973(T) Q41–43,55–57,59,65–70,78,80,87,128–130 : 3SK73(G
Q48,49 : 2SC2458(Y) Q52 : 2SK30A(O) Q53,54,138,139,154,155 : 2SK30A(GR) Q62,63 : 2SK125 Q81 : 2SC2086
Q82 : 2SC2240(GR) Q88,89 : 2SA473(Y) Q135 : 2SK30A(Y) Q146,147,159 : 2SC1775(E) 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 IC13 : μPC1037H
D1,2,15–33 : 1S2588 D10,71,125,206 : WZ-040 D11,12,38,40–43,57–66,68–70,74–76,78,91,92,98,99,106,108–110,112,113,116,117,119,
121,123,124,135–138,143–147,149–166,168–182,184–192,205,207–209,212,213,219,226–231,234–237,242,243,246–250 : 1S1555 or 1N44
D13,48–50,79,82,84–87,89,94–96,111,114,118,126–134,194–196,198–200,216,221,233 : 1S1587 D34,35 : BA379 D36,37 : XZ-033
D39 : XZ-051 D44 : 1JZ61(W) D45,46 : 1SV54GC D47,122,197 : 1SV54GE 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 D80,81,88,90,93,97 : 1S1007 D83,167 : WZ-090 D100,115,224 : W
D101 : ERZC07DK201 D102,148 : WZ-061 D107 : MV-203 D140 : ND487R1-3R D142,252 : WZ-070 D211 : MV-12 D217,244 : FC65M

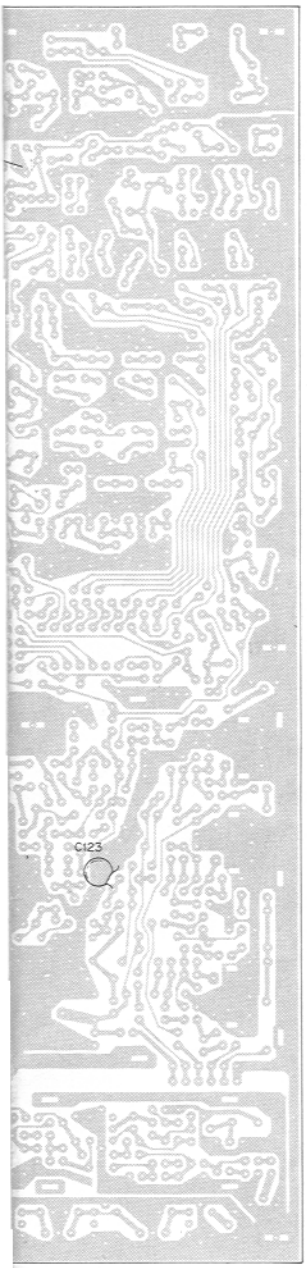
SIGNAL UNIT (X57-1000-11) B/2

Component side view

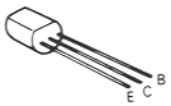


TR, FET, IC and Terminals address from S/N 310XXXX–

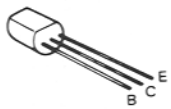
TR,FET	Address	TR,FET	Address	TR,FET	Address	Terminal	Address
Q1	Not used	Q71	G–6	Q141	F–3	①	A,B–1
Q2	Not used	Q72	G–6	Q142	F–3	②	B–1
Q3	Not used	Q73	G–6	Q143	E–4	③	B–2
Q4	Not used	Q74	G–6	Q144	E–3	④	B–3,4
Q5	Not used	Q75	E–5	Q145	E–3	⑤	B–4,5
Q6	Not used	Q76	E–4	Q146	E–3	⑥	A–6
Q7	Not used	Q77	E–4	Q147	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	F–4			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	IC13	E-2		
Q54	C–4,5	Q124	D–3				
Q55	B–5	Q125	E–2				
Q56	B–6	Q126	Not used				
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				



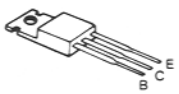
2SA984K
2SA1015
2SC1775
2SC1815
2SC1907
2SC1973
2SC2240



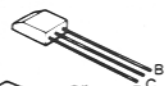
2SC2086



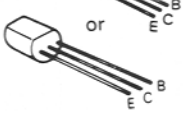
2SA473
2SD880



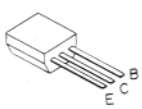
2SB460



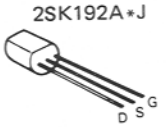
or



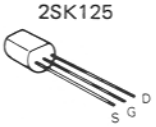
2SC2458



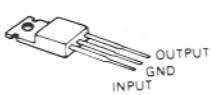
2SK192A*J



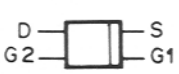
2SK30A
2SK125



UA8718UC

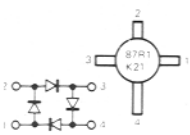


3SK73

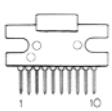


TA7302P
μPC1037H

ND487R1-3R



HA1368



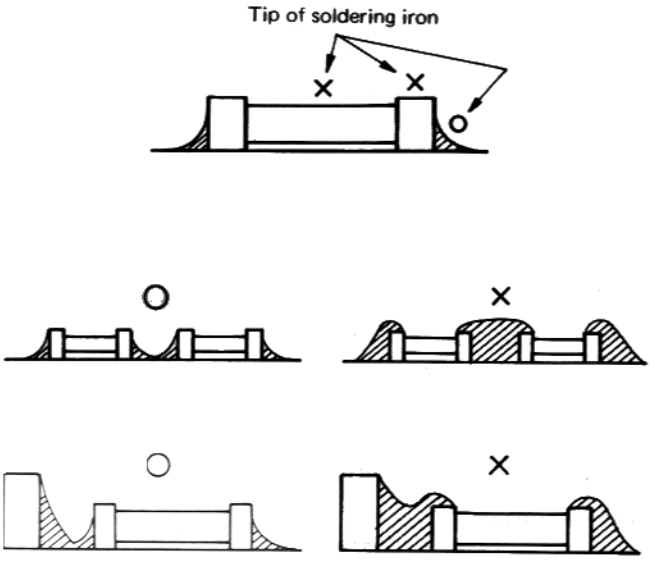
PARTS LIST

Note :

Soldering procedure for the chip capacitor

- Tools and materials
  Soldering iron
  1/8"–3/32" wide wedge tip
  Solder (Silver solder or low temperature solder)
  Soft jaw tweezers
  Hot plate or drier
- Soldering procedure
  1) Pre-heat the surface of chip capacitor up to around 150°C with the hot plate or drier.
  2) Apply solder to the tip of soldering iron.
  3) Hold and place the chip capacitor on the installation place with the tweezers.
  4) Solder one end of the chip capacitor using the tip of soldering iron.
  5) Solder the other end similarly.
- Caution
  1) Do not use too much solder. Use only enough solder to secure the component.

2) Length of soldering time :
   In case of silver solder : Within 6 – 8 sec.
   In case of low temperature solder : Within 3 – 4 sec.
3) Keep the temperature of tip of soldering iron below 280°C.



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

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

TS-930S SEMICONDUCTOR

N : New part not previously stocked for any model.

Name		Re marks	Parts No.
Diode	1JZ61	N	V11-3179-06
	1N60		V11-0051-05
	1N4448		V11-7766-06
	1S1007		V11-4160-66
	1S1555		V11-0076-05
	1S1587		V11-0370-05
	1S2588		
	1SS99	N	V11-1277-86
	BA379		V11-1263-06
	GM-3B		
	ND487R1-3R	N	V11-1266-16
	S15VB10	N	V11-1366-06
	V03(C)		V11-0290-05
	V06E		V11-0285-05
Varistor	MV-13		V21-0004-05
	STV-3H(O)	N	V21-0016-05
	SV-03Y		V21-0007-05
Vari-Cap	1SV54GC		V11-4173-46
	1SV54GE		V11-4173-56
	FC65M	N	V11-7776-86
Zener diode	BZ-192		V11-0311-05
	BZ-350 CZ-078 RD33FBD-B1		V11-4166-86
	WZ-040		V11-4161-56
	WZ-061		V11-0243-05
	WZ-071		V11-4160-86
	WZ-090		V11-0240-05
	WZ-120		V11-0249-05
	WZ-130		V11-0297-05
	WZ-150		V11-0307-05

PARTS LIST

Name		Re. marks	Parts No.
	WZ-182		V11-4100-10
	WZ-192		V11-0308-05
	XZ-033		V11-4176-96
	XZ-051		V11-4103-60
	XZ-055		V11-4105-51
	XZ-066		V11-4106-70
	XZ-076		V11-4126-36
	XZ-090		V11-4167-06
	XZ-122		
	XZ-200		V11-4101-70
LED	BG5532K (Green)	N	V11-7261-16
	LT8001P	N	V11-4360-76
	PR5532K (Blue)		V11-7272-36
Surge absorber	ERZC07DK201	N	V11-1163-26
	ERZD03DK331		V11-1163-16
Thermistor	25D29		V11-3360-16
	SDT500		
	SDT1000		
	5T-35		V11-2262-06
	5T-41		V11-2263-06
Photo interruptor	ON1110	N	V11-1173-86
	ON1105		V11-1173-76
Display tube	11-BT-03Z	N	V40-7760-66
TR	2SA473(Y)		V01-0473-06
	2SA496(Y)		V01-0113-05
	2SA733(P)		V01-0733-16
	2SA950(Y)	N	V01-0950-16
	2SA984K(E)	N	V01-0984-10
	2SA1015(Y)		V01-1015-06
	2SA1021(O)	N	V01-1021-16
	2SA1049(GR)	N	V01-1049-16
	2SB861(C)		
	2SC460(B)		V03-0079-05
	2SC496(Y)		V03-0336-05
	2SC1775(E)		V03-1775-06
	2SC1815(Y)		V03-1815-06
	2SC1907		V03-1907-06
	2SC1923(O)		V03-1923-06
	2SC1959(Y)		V03-1959-06
	2SC1973(T)		V03-1973-16
	2SC2053		V03-2053-06
	2SC2075		V03-2075-06
	2SC2086		V03-2086-06
	2SC2120(Y)		V03-2120-06
	2SC2274K(E)	N	V03-2274-26
	2SC2458(Y)		V03-2458-06
	2SC2899	N	V03-2899-06
	2SD880(Y)		V04-0880-16
	2N5885		V08-1012-06
	MRF422	N	V08-1008-46
	MRF485	N	V08-1008-56
FET	2SK19(GR)		V09-0012-05
	2SK30A(GR)		V09-0060-05
	2SK30A(O)		V09-0056-05
	2SK30A(Y)		V09-0058-05
	2SK125		V09-1004-26
	2SK125P	N	V09-1004-36
	2SK192A*J(GR)		
	3SK73(GR)		V09-1002-46
IC	HA1368	N	V30-1129-16
	HD10116	N	V30-1243-06
	HD10125	N	V30-1243-16
	HD10131	N	V30-1243-26
	HD74LS00P		V30-1046-06
	HD74LS01P		V30-1009-36
	HD74LS02P		V30-1007-36
	HD74LS73P		V30-1076-16
	HD74LS75P		V30-1008-96
	HD74LS90P		V30-1083-06
	HD74LS151P		V30-1008-26
	LM358P		V30-1024-56
	MB74LS42		V30-1241-46
	MB3614	N	V30-1242-16
	MC1723CL		V30-0199-05
	MC14077B	N	V30-1211-36
	MC145155P*J	N	
	MC145156P	N	V30-1203-36
	MC14569BCP		V30-1100-06
	MD74LS90P		
	NE555P	N	V30-0686-10
	NJM2901	N	V30-1020-56
	NJM2903D	N	V30-1020-96
	NJM2904D	N	V30-1021-06
	SN74LS00N		V30-1005-66
	SN74LS01N		V30-1041-16
	SN74LS02N		V30-1041-06
	SN74LS73N		V30-1117-06
	SN74LS75N		V30-1005-16
	SN74LS90N		V30-1005-26
	SN74LS145N	N	V30-1152-26
	SN74LS151N		V30-1240-16
	SN16913P		V30-1048-06
	TA78L005AP	N	V30-1189-36
	TA7302P		V30-1134-06
	TC4001BP		V30-1066-06
	TC4011BP		V30-1030-66
	TC4049BP		V30-1009-26
	TC4073BP	N	V30-1167-16
	TC5065BP		V30-1056-16
	TC5081P		V30-1132-06
	TC9122P		V30-1036-16
	UA7818UC	N	V30-1022-46
	μPB551C	N	V30-0170-16
	μPC14305		V30-1029-26
	μPC14305H		V30-1029-36
	μPC14312		V30-1029-56
	μPD5101LC		V30-1177-36
	μPD8049C-211	N	V30-1176-46
	μPD8243C	N	V30-1177-16

PARTS LIST

o : From S/N208XXXX–309XXXX
● : From S/N310XXXX–

Parts No.	Remarks	Description	Ref. No.
TS-930S GENERAL			
A01-0922-21	N	Case (upper)	
A01-0927-21	N	Case (lower) o	
A01-0927-31	N	Case (lower) ●	
A20-2440-12	N	Panel	
A23-1466-22	N	Rear panel	
B03-0525-04	N	Switch mask x 2 RIT	
B03-0526-04	N	Switch mask POWER	
B05-0722-04	N	SP grill cloth	
B06-0504-04	N	Front glass grill cloth	
B07-0638-04	N	Band escutcheon	
B09-0011-04		Rubber cap	
B10-0650-13	N	Front glass (large)	
B10-0651-04	N	Front glass (small)	
B30-0826-05	N	Pilot lamp x 2 28V	PL1,2
B31-0635-05	N	Meter	
B40-2605-04	N	Name plate TS-930S T	
B40-2606-04	N	Name plate TS-930S K,M,W,X	
B41-0629-04	N	Caution plate	
B42-1727-04	N	Adj. seal	
B42-1728-04	N	Adj. seal VOX CONTROL	
B42-1729-04	N	Name plate	
B42-1777-04		Adj. seal o	
B42-1794-04	N	Adj. seal ●	
B43-0669-04		Name plate TRIO T	
B43-0670-04		Name plate KENWOOD K,M,W,X	
B43-0676-04	N	Name plate	
B46-0407-00		Warranty card K	
B50-3959-20	N	Instruction manual K,M,W,X	
B50-3961-10	N	Instruction manual T	
B58-0644-11	N	Instruction sheet	
CE04W2C3R3		E 3.3 160V	C14
CK45E2H103P		C 0.01 500V x 4	C4–7
CK45F1H103Z		C 0.01 x 4	C10–13
C90-0857-05	N	E 22000 50V x 2	C8,9
C91-0079-05		C 0.01 2kV	C1
C91-0496-05		C 470pF AC 150V x 2	C2,3
E06-0751-05		7P DIN socket REMOTE	
E06-0851-05		8P DIN socket X. VERTER	
E07-0751-05		7P DIN plug Accessory	
E07-0852-05		8P metal socket Accessory **K,T,W**	
E11-0404-05		3P phone jack x 2 KEY,PHONE	
E11-0410-05		Phone jack EXT. SP	
E12-0001-15		Phone plug EXT. SP Accessory	
E13-0101-05		1P pin jack RX ANT	
E13-0461-05		4P pin jack	
E18-0351-05		3P inlet AC Power	
E20-0315-05		Terminal plate	
E23-0015-04		Lug plate x 2 GND	
E29-0407-05		Bridge connector	
E30-1643-15		AC cord ass'y K,M	
E30-1644-15		AC cord ass'y T	
E30-1645-05		AC cord ass'y W	
E30-1647-05		AC cord ass'y X	
E31-2102-05		Connector with lead	
F01-0776-23	N	Heat sink Power supply	
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 No.	Remarks	Description	Ref. No.
F07-0841-14	N	Slide cover	
F07-0842-13	N	Heat sink cover	
F09-0405-24		Fan	
F20-0525-05		Insulating sheet ●	
F20-0527-05	N	Insulating sheet x 2 TR	
F29-0014-05		Shoulder washer ●	
F29-0401-04		Capacitor mounting hardware x 2	
F29-0406-03		Fan motor mounting hardware	
F29-0421-04	N	Protective sheet x 5	
G01-0817-04	N	Coil spring x 4	
G09-0405-05		Knob fixed spring	
G09-0410-05		Knob fixed spring x 3	
G13-0662-04	N	Cushion Speaker	
G53-0510-04		Packing x 2 Case	
G53-0511-04		Packing x 2	
H01-4409-14	N	Packing carton (inside) K,M,W,X	
H01-4410-14	N	Packing carton (inside) T	
H10-1276-04		Cushion M,X	
H10-2558-02	N	Packing fixture (F)	
H10-2559-02	N	Packing fixture (R)	
H12-0491-04	N	Cushion K,T,W,X	
H20-1403-03		Protective cover	
H25-0105-04		Protective bag 150 x 350	
H25-0120-04		Protective bag	
J02-0049-14		Foot (large) x 2 Rear	
J02-0423-04		Foot x 2 Front	
J02-0424-04		Foot x 2	
J02-0426-05	N	Foot (small) x 4	
J13-0033-15		Fuse holder	
J19-1354-05		Battery case	
J61-0019-05		Vinyle tie x 20	
J61-0401-05		Nylon band x 30	
K01-0409-05	N	Handle	
K21-0763-04	N	Knob RIT	
K21-0764-04	N	Knob x 3 PITCH,AF,HIGH	
K21-0765-04	N	Knob x 2 CAR,OUT	
K21-0766-05	N	Main knob	
K23-0721-04		Knob NB LEVEL	
K23-0740-04		Knob x 3 AF TUNE,RF,LOW	
K23-0745-04		Knob x 5 MIC,VOX GAIN,ANTI, DELAY,IN	
K23-0753-04	N	Pointer knob x 5 METER,RF ATT, AGC,FUNCTION,MEMORY CH	
K27-0431-04	N	Push knob 1MHz STEP UP	
K27-0432-04	N	Push knob 1MHz STEP DOWN	
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	
K27-0434-04	N	Push knob x 4 VOX/MAN,MONI, FULL/SEMI,DIM/NOR	
K29-0715-04		Pointer knob MODE	
K29-0738-04		Knob (6) x 2 NOTCH,CW VBT	
K29-0757-04		Push knob POWER	
K29-0760-04	N	Push knob BAND	
K29-0761-04	N	Knob ring	
L01-8156-25	N	Power transformer	T1
N09-0256-05		Gnd. screw x 4	
N09-0642-04	N	Hex. head screw x 4	
N10-2030-46		Nut x 7	

PARTS LIST

Parts No.	Re-marks	Description	Ref. No.
N14-0115-05		Flange nut	
N14-0509-05		Wing nut	
N14-0512-05		Speed nut x 5	
N15-1030-41		Flat washer x 6	
N15-1040-41		Flat washer x 5	
N30-2004-41		Round screw x 6	
N30-2604-41		Round screw x 5	
N30-2605-46		Round screw x 8	
N30-2606-45		Round screw x 4	
N30-2606-46		Round screw x 3	
N30-3004-46		Round screw x 15	
N30-3006-46		Round screw x 11	
N30-3014-41		Round screw x 4	
N30-4016-46		Round screw	
N32-2006-41		Flat screw x 2	
N32-3006-41		Flat screw x 15	
N33-3006-45		Round flat screw x 2	
N35-3006-41		Bind screw x 7	
N35-3006-45		Bind screw x 5	
N35-3008-45		Bind screw x 6	
N35-4006-46		Bind screw x 2 Handle	
N35-4008-41		Bind screw x 16	
N87-2608-41		Self tapping screw x 6	
N87-2608-46		Self tapping screw x 6	
N87-3006-41		Self tapping screw x 81	
N87-3008-41		Self tapping screw x 4	
N87-3012-46		Self tapping screw x 9	
N87-3014-46		Self tapping screw x 6	
N87-4010-41		Self tapping screw x 4	
N88-2606-46		Flat tapping screw x 2	
N89-3006-45		Bind tapping screw x 15	
RC05GF2H101J		Solid 100Ω 1/2W x 2	R11,12
RC05GF2H221J		Solid 220Ω 1/2W	R13
RD05GF2H472J		Solid 4.7kΩ 1/2W	R15
RS14AB3D181J		MF 180Ω 2W x 3	R5–7
RS14AB3D220J		MF 22Ω 2W •	R7
RS14AB3D270J		MF 27Ω 2W x 4	R1–4
RS14AB3D330J		MF 33Ω 2W	R10
RS14AB3D820J		MF 82Ω 2W x 2	R8,9
RS14AB3D822J		MF 8.2kΩ 2W	R16
R92-0619-05		Cement 0.05Ω 5W	R14
S29-2406-05	N	Voltage selector	
S31-1407-05	N	Slide switch	
S40-2437-05	N	Push switch	S38
S50-1406-05		Tact switch x 2 M,X	
S51-1416-05		Relay	RL1
S90-0401-05	N	Remote switch shaft MODE	
T07-0221-05	N	Speaker	
T42-0302-05		Fan motor	
T91-0316-15		Microphone M,X	
X41-1410-00	N	Switch unit	
X43-1430-00	N	Power supply unit	
X44-1490-00	N	RF unit	
X50-1880-00	N	PLL unit	
X51-1280-00	N	LPF unit	
X54-1670-00	N	Digital unit	
X54-1680-00	N	Main encoder unit	
X54-1690-00	N	RIT encoder unit	
X56-1430-00	N	100W final unit	
X57-1000-11	N	Signal unit	
X57-1010-00		AT unit	

Parts No.	Re-marks	Description	Ref. No.	Q'ty
SWITCH UNIT (X41-1410-00)				
CK45B1H012K		C 0.001	C10	1
CK45E2H103P		C 0.01	C1	1
CK45F1H103Z		C 0.01	C2,5,6	3
CK45F1H103Z		C 0.01 ○	C8	1
CK45F1H473Z		C 0.047	C3,4	2
CQ92M1H153K		ML 0.015	C9	1
C91-0456-05		C 0.047	C7	1
C91-0456-05		C 0.047 ●	C8	1
E04-0152-05		UHF type receptacle ANT		1
E04-0157-05		Mini pin jack A		1
E06-0853-05		8P metal socket MIC		1
E23-0047-04		Square terminal		5
E40-0273-05		Mini connector 2P		3
E40-0274-05		Mini connector 2PL ●		2
E40-0277-05		Mini connector 2PL ○		2
E40-0473-05		Mini connector 4P		1
E40-0573-05		Mini connector 5P		2
E40-0574-05		Mini connector 5PL ●		1
E40-0577-05		Mini connector 5PL ○		1
E40-0673-05		Mini connector 6P		1
E40-0773-05		Mini connector 7P		1
E40-0874-05		Mini connector 8PL ●		1
E40-0877-05		Mini connector 8PL ○		1
G53-0511-04		Packing		2
J61-0019-05		Vinyle tie		1
L33-0658-05	N	Choke coil	L1,2	2
L40-1511-03		Ferri-inductor ●	L3	1
N14-0115-05		Flange nut		1
N15-1040-46		Flat washer		1
N30-4025-46		Round screw GND		1
R01-0406-05	N	Pot. 300Ω(B) NB LEVEL	VR8	1
R01-3422-05	N	Pot. 10kΩ(B) VOX GAIN	VR9	1
R01-3423-05	N	Pot. 10kΩ(F) NOTCH	VR6	1
R01-3424-05	N	Pot. 10kΩ(B) CW VBT	VR5	1
R01-6403-05	N	Pot. 470kΩ(B) ANTI, DELAY	VR10,11	2
R19-3413-05	N	Pot. 10kΩ(A), 10kΩ(B) AF/RF	VR7	1
R19-3414-05	N	Pot. 10kΩ(B)x2 SSB SLOPE TUNE	VR3	1
R19-9407-05	N	Pot. 10kΩ(A), 50kΩ(C) PRO., MIC/CAR	VR1,2	2
R24-9402-05	N	Pot. 10kΩ(F), 100kΩ(C)x2 PITCH/AF TUNE	VR4	1
RC05GF2H102J		Solid 1kΩ 1/2W	R26	1
RC05GF2H680J		Solid 68Ω 1/2W	R6	1
RS14AB3D470J		MF 47Ω 2W	R2,3	2
R92-0150-05		Short jumper		4
S01-1429-05	N	Rotary switch M.CH	S24	1
S01-1430-05	N	Rotary switch METER	S39	1
S01-1431-05	N	Rotary switch AGC	S40	1

PARTS LIST

Parts No.	Re-marks	Description	Ref. No.	Q'ty
S01-1432-05	N	Rotary switch FUNCTION, RF ATT	S23,25	2
S36-1408-05	N	Paddle switch CAL	S38	1
S36-2408-05	N	Paddle switch STBY, AT,PRO,TONE	S6–9	4
S40-2422-05		Push switch NOTCH,D.LOCK	S14,16	2
S40-2431-05	N	Push switch RIT	S12	1
S40-2432-05	N	Push switch T.F SET,RIT.CL	S11,13	2
S40-2433-05	N	Push switch VOX/MAN DIM/NOR,AF TUNE	S2,5,15	3
S40-2434-05	N	Push switch FULL/SEMI, MONI,VFO/MEMO, NB1,NB2	S3,4,18,21,22	5
S40-2435-05	N	Push switch A=B, MIN,MR	S17,19,20	3
S50-1409-05		Tact switch 1MHz STEP	S26,27	2
S50-1411-05	N	Tact switch BAND	S28–37	10
S51-1414-05	N	Lead relay ANT	RL2	1
S51-2412-15	N	Relay POWER	RL1	1
S90-0402-15	N	Slide switch MODE	S10	1

POWER SUPPLY UNIT (X43-1430-00)

CE04W1E100M		E 10 25V	C11	1
CE04W1E101M		E 100 25V ●	C12	1
CE04W1E220M		E 22 25V ●	C13	1
CK45E2H472P		C 0.0047	C1,2	2
CK45F1H103Z		C 0.01	C5	1
CQ92M1H104K		ML 0.1	C7	1
C90-0858-05	N	E 2200 50V	C3,4	2
C90-0859-05	N	E 2200 35V	C6	1
C91-0456-05		C 0.047	C10	1
E40-0273-05		Mini connector 2P		3
E40-0373-05		Mini connector 3P		2
E40-0573-05		Mini connector 5P ●		1
F05-1534-05	N	Fuse 32V 15A		1
J31-0502-04		PC board collar		4
J42-0428-05		PC board bushing		4
L40-1511-03		Ferri-inductor 150μH	L1–3	3
N87-3012-46		Self tapping screw		4
R12-0427-05		Trim. pot. 500Ω(B)	VR1	1
RC05GF2H122J		Solid 1.2kΩ 1/2W	R19	1
RC05GF2H2R2J		Solid 2.2Ω 1/2W	R1,4,5	3
R92-0150-05		Short jumper		3

Parts No.	Re-marks	Description	Ref. No.	Q'ty
RF UNIT (X44-1490-00)				
C05-0030-15		Ceramic trimmer 20pF ○	TC1	1
CC45CH1H020C		C 2pF ●	C24	1
CC45RH1H050C		C 5pF	C7	1
CC45RH1H100D		C 10pF	C5,9,12	3
CC45RH1H100D		C 10pF ●	C23	1
CC45RH1H100D		C 10pF ○	C1	1
CC45RH1H560J		C 56pF ●	C22	1
CC45SL1H220J		C 22pF	C20	1
CC45SL1H470J		C 47pF ●	C1,21	2
CE04W1A470M		E 47 10V ○	C15	1
CE04W1E470M		E 47 25V	C3	1
CK45B1H102K		C 0.001	C10,11,19	3
CK45F1H103Z		C 0.01	C6,8,13,16–18	6
C91-0456-05		C 0.047	C2,4,14	3
C91-0456-05		C 0.047 ●	C15	1
E04-0157-05		Mini pin jack A		3
E29-0432-05	N	1P connector (female)		1
L19-0333-05	N	Wide bandwidth transf.	T1	1
L19-0334-05	N	Wide bandwidth transf.	T2	1
L19-0335-05	N	Wide bandwidth transf.	T6	1
L32-0199-05		OSC coil ○	T7	1
L34-0858-05		Tuning coil	T3,5	2
L34-2074-05	N	Tuning coil	T4	1
L34-2161-15		Tuning coil ●	T7	1
L40-1021-03		Ferri-inductor 1mH	L1,2	2
L40-4701-03		Ferri-inductor 47μH	L3–6	4
N87-3006-46		Self tapping screw		3
R12-0420-05		Trim. pot. 500Ω ●	VR1	1
R91-0150-05		Short jumper		3
PLL UNIT (X50-1880-00)				
C05-0030-15		Ceramic trimmer 20pF	TC3,4	2
C05-0044-05		Ceramic trimmer 30pF	TC1	1
C05-0309-05		Ceramic trimmer 40pF	TC2	1
CC45CH1H010C		C 1pF	C2,28,30,61	4
CC45CH1H020C		C 2pF	C63	1
CC45CH1H030C		C 3pF	C191	1
CC45CH1H050C		C 5pF	C62,144	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

PARTS LIST

Parts No.	Re-marks	Description	Ref. No.	Q'ty
CC45SL1H070D		C 7pF	C26,40,42,165,168	5
CC45SL1H100D		C 10pF	C23,99,116,117, 122,164	6
CC45SL1H101J		C 100pF	C32,180	2
CC45SL1H150J		C 15pF	C11	1
CC45SL1H151J		C 150pF	C17	1
CC45SL1H220J		C 22pF	C3,41,68,85,98, 166,167	7
CC45SL1H330J		C 33pF	C15,109,169	3
CC45SL1H560J		C 56pF	C194	1
CC45SL1H680J		C 68pF	C110	1
CC45UJ1H070D		C 7pF	C58	1
CC45UJ1H150J		C 15pF	C55	1
CC45UJ1H180J		C 18pF	C57,73	2
CC45UJ1H270J		C 27pF	C74	1
CC45UJ1H330J		C 33pF	C54,75	2
CC45UJ1H470J		C 47pF	C190	1
CC45UJ1H560J		C 56pF	C72	1
CE04W0J331M		E 330 6.3V	C14	1
CE04W1A101M		E 100 10V	C183	1
CE04W1A470M		E 47 10V	C8,70,84,176	4
CE04W1C101M		E 100 16V	C50,79	2
CE04W1C220M		E 22 16V	C53,67,76	3
CE04W1C470M		E 47 16V	C59	1
CE04W1H010M		E 1 50V	C5	1
CK45B1H102K		C 0.001	C21	1
CK45B1H222K		C 0.0022	C47,65,135	3
CK45B1H471K		C 470pF	C82,184,195,196	4
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
CQ92M1H123K		ML 0.012	C88,90	2
CQ92M1H222K		ML 0.0022	C6	1
CQ92M1H273K		ML 0.027	C89	1
CQ92M1H333K		ML 0.033	C10,48	2
CQ92M1H472K		ML 0.0047	C81	1
CQ92M1H473K		ML 0.047	C7,185	2
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
E04-0154-05	N	Coax. connector		2
E23-0047-04		Square terminal		2
E40-0273-05		Mini connector 2P		2
E40-0373-05		Mini connector 3P		3
E40-0473-05		Mini connector 4P		1
E40-0873-05		Mini connector 8P		2
J31-0502-04		PC board collar		7
J42-0428-05		PC board bushing		7

Parts No.	Re-marks	Description	Ref. No.	Q'ty
L32-0196-05		OSC coil 20M	T14	1
L32-0649-05	N	OSC coil 50M	T15	1
L34-0709-05		Tuning coil 10M	T11,12	2
L34-0711-05		Tuning coil 14M	T7	1
L34-0712-05		Tuning coil 14M	T9	1
L34-0713-15		Tuning coil 14M	T8	1
L34-2075-05	N	Tuning coil 50M,60M	T1–6	6
L34-2076-05	N	Tuning coil 40M	T16–18	3
L34-2077-05	N	Tuning coil 8.83M	T13	1
L34-2078-05	N	Tuning coil 5M	T10	1
L40-1011-04		Ferri-inductor 100μH	L2,28	2
L40-1511-03		Ferri-inductor 150μH	L16,27,31	3
L40-2701-03		Ferri-inductor 27μH	L23,24	2
L40-4701-03		Ferri-inductor 47μH	L10–15,17,29,32	9
L40-4711-03		Ferri-inductor 470μH	L1,3–5,9,18–20, 25,26,30,35,36	13
L40-6825-04		Ferri-inductor 6.8mH	L21,22	2
L40-8291-02		Ferri-inductor 8.2μH	L6–8,33,34	5
L71-0233-05	N	MCF 8.8495MHz	MCF1,2	1A
L77-0720-05		Crystal 10.24MHz	X2	1
L77-0963-05	N	Crystal 20MHz	X1	1
R12-1408-05	N	Trim. pot. 4.7kΩ(B)	VR1,2	2
RC05GF2H390J		Solid 39Ω 1/2W	R81	1
R90-0536-05	N	Inline block 6.8kΩx6	IB1	1
R92-0150-05		Short jumper		31

LPF UNIT (X51-1280-00)

CC45SL1H101J		C 100pF	C91	1
CC45SL2H050C		C 5pF 500V	C56	1
CC45SL2H070D		C 7pF 500V	C57	1
CC45SL2H101J		C 100pF 500V	C1,7,18,26,37, 38,55,63	8
CC45SL2H120J		C 12pF 500V	C60	1
CC45SL2H121J		C 120pF 500V	C15,25,27	3
CC45SL2H150J		C 15pF 500V	C43,61	2
CC45SL2H151J		C 150pF 500V	C6,10,21,22,31, 42	6
CC45SL2H181J		C 180pF 500V	C14,30,41	3
CC45SL2H220J		C 22pF 500V	C4	1
CC45SL2H221J		C 220pF 500V	C9,17,50,58	4
CC45SL2H330J		C 33pF 500V	C3,8,99	3
CC45SL2H331J		C 330pF 500V	C13,19,20,28,47, 52	6
CC45SL2H390J		C 39pF 500V	C100	1
CC45SL2H391J		C 390pF 500V	C16,23,33	3
CC45SL2H470J		C 47pF 500V	C2,44,45,49,59	5
CC45SL2H471J		C 470pF 500V	C24	1
CC45SL2H560J		C 56pF 500V	C62	1
CC45SL2H680J		C 68pF 500V	C46	1
CC45SL2H681J		C 680pF 500V	C36	1
CE04W1A221M		E 220 10V	C72	1
CK45F1H103Z		C 0.01	C74–78,80–86, 106	13
CK45F1H473Z		C 0.047	C66	1
CM93D2H102J		MC 0.001 500V	C51	1

PARTS LIST

Parts No.	Re-marks	Description	Ref. No.	Q'ty
CM93D2H152J		MC 0.0015 500V	C29	1
CM93D2H222J		MC 0.0022 500V	C32	1
CM93D2H821J		MC 820pF 500V	C35	1
C91-0456-05		C 0.047	C64,65,67–71,73	8
E04-0154-05		Coax. connector		3
E23-0401-05		Round terminal		8
E40-0273-05		Mini connector 2P		1
E40-0373-05		Mini connector 3P		2
E40-0473-05		Mini connector 4P		1
E40-0573-05		Mini connector 5P		2
L34-3038-05	N	Filter coil A 1.5–2.5	L9	1
L34-3039-05	N	Filter coil B 1.5–2.5	L8	1
L34-3040-05	N	Filter coil C 2.5–4.0	L12	1
L34-3041-05	N	Filter coil D 2.5–4.0	L13	1
L34-3042-05	N	Filter coil E 4.0–6.0	L6,7	2
L34-3043-05	N	Filter coil F 6.0–10.5	L3–5	3
L34-3046-05	N	Filter coil I 10.5–15.5	L10	1
L34-3047-05	N	Filter coil J 10.5–15.5	L11	1
L34-3048-15	N	Filter coil K 15.5–22.0	L14,15	2
L34-3050-05	N	Filter coil M 22.0–30.0	L1	1
L34-3051-15	N	Filter coil N 22.0–30.0	L2	1
L39-0414-05	N	Detector coil	L27,28	2
L40-1011-03		Ferri-inductor 100μH	L31,34–40	8
L40-1011-04		Ferri-inductor 100μH	L22	1
L40-1021-03		Ferri-inductor 1mH	L24,25	2
L40-1511-03		Ferri-inductor 150μH	L16–21,26	7
L40-4791-02		Ferri-inductor 4.7μH	L30	1
N30-3006-41		Round screw		2
N32-3006-41		Flat screw		2
N87-3006-46		Self tapping screw		12
RC05GF2H101J		Solid 100Ω 1/2W	R48–51	4
RC05GF2H121J		Solid 120Ω 1/2W	R53	1
RC05GF2H182J		Solid 1.8kΩ 1/2W	R30	1
RC05GF2H2R2J		Solid 2.2Ω 1/2W	R58–61	4
RC05GF2H681J		Solid 680Ω 1/2W	R17,18	2
RC05GF2H821J		Solid 820Ω 1/2W	R19,20	2
R90-0535-05	N	Resistor block 22kΩx7	RB1,2	2
R92-0150-05		Short jumper		14
S51-1412-05	N	Relay	RL1–14	14

DIGITAL UNIT (X54-1670-00)

CC45SL1H101J		C 100pF	C15,44–46	4
CC45SL1H220J		C 22pF	C36,37	2
CC45SL1H221J		C 220pF	C39	1
CE04W0J221M		E 220 6.3V	C8,14,19	3
CE04W1A470M		E 47 10V	C21,24,42	3
CE04W1C101M		E 100 16V	C11	1
CE04W1C220M		E 22 16V	C12	1
CE04W1C471M		E 470 16V	C9	1
CE04W1E331M		E 330 25V	C6	1
CE04W1H010M		E 1 50V	C23,25	2
CE04W1H100M		E 10 50V	C2,5,40	3
CE04W1H220M		E 22 50V	C3,4	2
CK45B1H102K		C 0.001	C1,16,26–31	8
CK45F1H103Z		C 0.01	C20,50	2
CQ92M1H272K		ML 0.0027	C38	1
C90-0824-05		E 1 50V	C47–49	3
C91-0456-05		C 0.047	C7,10,13,17,18, 22,32–35,41,43	12
E29-0413-05		1P connector (female)		1
E40-0273-05		Mini connector 2P		1
E40-0373-05		Mini connector 3P		2
E40-0473-05		Mini connector 4P		2
E40-0673-05		Mini connector 6P		1
E40-0773-05		Mini connector 7P		2
E40-0873-05		Mini connector 8P		4
E40-1073-05		Mini connector 10P		1
E40-1173-05		Mini connector 11P		1
E40-1273-05		Mini connector 12P		2
J31-0502-04		PC board collar		6
J42-0404-05		PC board bushing		6
L19-0336-05	N	DC-DC transf.	T1	1
L40-1011-04		Ferri-inductor 100μH	L1–4	4
L40-1021-03		Ferri-inductor 1mH	L5–11	7
L77-0964-05	N	Crystal 5.59MHz	X1	1
N35-3006-46		Bind screw		2
N88-3008-46		Flat tapping screw		2
R90-0158-05	N	Inline block 47kΩx7	RB3	1
R90-0162-05	N	Inline block 47kΩx8	RB4	1
R90-0537-05	N	Inline block 10kΩx8	RB5	1
R90-0538-05	N	Inline block 1.5kΩx3	RB1	1
R90-0539-05	N	Inline block 47kΩx6	RB6,7	2
R90-0542-05	N	Inline block 47kΩx12	RB9	1
R90-0543-05	N	Inline block 47kΩx11	RB2,8	2
R90-0544-05	N	Inline block 0.01x3	CB3	1
R90-0545-05	N	Inline block 0.01x5	CB1	1
R90-0546-05	N	Inline block 0.01x7	CB4	1
R90-0547-05	N	Inline block 0.01x12	CB2	1
R90-0548-05	N	Inline block 0.022x7	CB5	1
R90-0549-05	N	Inline block 0.022x8	CB6	1
R90-0550-05	N	Inline block 0.022x11	CB7	1

PARTS LIST

Parts No.	Re-marks	Description	Ref. No.	Q'ty
MAIN ENCODER UNIT (X54-1680-00)				
CE04W0J221M		E 220 6.3V	C1	1
CE04W0J470M		E 47 6.3V	C2	1
D09-0304-04		Encoder slit		1
D21-0823-05	N	Shaft ass'y		1
E23-0015-04		Earth lug		2
G02-0519-04		Spring plate		1
J19-1342-04		Senser mounting hardware (A)		1
J19-1343-04		Senser mounting hardware (B)		1
N30-3006-46		Round screw		4
N32-3020-46		Flat screw		1
N89-3005-46		Bind tapping screw		3
R12-2409-05		Trim. pot. 5kΩ(B)	VR1,2	2
RIT ENCODER UNIT (X54-1690-00)				
CE04W0J101M		E 100 6.3V	C1	1
D09-0305-04	N	Encoder slit		1
D21-0824-05	N	Shaft ass'y		1
N30-2606-46		Round screw		2
R12-2409-05		Trim. pot. 5kΩ(B)	VR1,2	2
100W FINAL UNIT (X56-1430-00)				
CC45SL1H271J		C 270pF	C35	1
CC45SL1H331J		C 330pF	C2,9	2
CC45SL2H101J		C 100pF 500V	C8,40,42	3
CE04W1A471M		E 470 10V	C18	1
CE04W1H100M		E 10 50V	C12	1
CE04W1H101M		E 100 50V	C24	1
CK45B1H102K		C 0.001	C4,10,19,23,39	5
CK45F1H473Z		C 0.047	C6,7,15,22	4
CM73F2H331J	N	MC 330pF 500V	C33	1
CM73F2H391J	N	MC 390pF 500V	C38	1
CM73F2H681J	N	MC 680pF 500V	C28	1
CQ92M1H473K		ML 0.047	C21	1
C91-0456-05		C 0.047	C1,3,5,11,13,14, 20,25–27,36,37	12
C91-0491-05	N	Cap. 0.0047	C16,17	2
C91-0493-05	N	Cap. 0.47	C29,30	2

Parts No.	Re-marks	Description	Ref. No.	Q'ty
E04-0157-05		Mini pin jack A		2
E23-0433-05	N	Terminal		8
E40-0373-05		Mini connector 3P		1
F01-0771-15	N	Heat sink		1
F07-0839-03	N	Heat sink cover		1
F09-0405-24		Fan		1
F20-0078-05	N	Insulating sheet		6
F29-0014-05		Shoulder washer		10
F29-0406-03		Fan motor ass'y		1
L19-0337-05	N	Input transf.	T3	1
L19-0338-05	N	Input matching transf.	T2	1
L19-0339-05	N	Output transf. B	T4	1
L19-0340-05	N	RF transf. A	T1	1
L33-0025-05		RFC 1μH	L4,5	2
L33-0032-05		RFC 3μH	L2	1
L33-0617-05		RFC	L3,7–9	4
L33-0644-05		Choke coil 2.2μH	L17	1
L33-0651-05	N	Choke coil	L14,15	2
L33-0653-05	N	Choke coil	L16	1
L33-0655-05	N	RFC	L13	1
L40-1011-04		Ferri-inductor 100μH	L10	1
L40-1511-03		Ferri-inductor 150μH	L6,11,12,18	4
N09-0623-04		Sems screw		5
N09-0643-04	N	Sems screw w. cross head		1
N09-0658-04		Round screw Fan motor		2
N15-1030-41		Washer Fan motor		4
N30-2604-41		Round screw Fan motor		5
N30-3006-46		Round screw Thermistor		1
N35-3008-46		Round screw TR		4
N87-3006-46		Self tapping screw PC board		4
N89-3006-45		Bind tapping screw Cover		10
R12-0072-05		Trim. pot. 470Ω(B)	VR1	1
R12-1406-05		Trim. pot. 1kΩ(B)	VR2	1
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
SIGNAL UNIT (X57-1000-11) From S/N208XXXX–309XXXX				
C05-0013-15		Ceramic trimmer 20pF	TC3–6	4
C05-0030-15		Ceramic trimmer 20pF	TC1	1
C05-0314-05		Ceramic trimmer 100pF	TC2	1
C05-0320-05		Ceramic trimmer 30pF	TC7	1
CC45CH1H010C		C 1pF	C255	1
CC45CH1H020C		C 2pF	C471	1
CC45CH1H030C		C 3pF	C105,125,142, 280,473	5
CC45CH1H050C		C 5pF	C476	1
CC45CH1H0R5C		C 0.5pF	C199,249,356, 359,477	5
CC45CH1H070D		C 7pF	C106	1
CC45CH1H100D		C 10pF	C6,128,132,144, 310	5
CC45CH1H150J		C 15pF	C320,469	2
CC45CH1H220J		C 22pF	C340,454,456, 458,364	5
CC45RH1H010C		C 1pF	C107,121	2
CC45RH1H020C		C 2pF	C108,197,212	3
CC45RH1H030C		C 3pF	C178	1
CC45RH1H050C		C 5pF	C264	1
CC45RH1H070D		C 7pF	C184,267	2
CC45RH1H100D		C 10pF	C113–115	3
CC45RH1H101J		C 100pF	C51,66,398,308	4
CC45RH1H120J		C 12pF	C93,96,97,263, 265,296	6
CC45RH1H121J		C 120pF	C14,54,185,187, 552	5
CC45RH1H180J		C 18pF	C186	1
CC45RH1H181J		C 180pF	C45,47	2
CC45RH1H220J		C 22pF	C76,78,92,98, 266	5
CC45RH1H221J		C 220pF	C39,41	2
CC45RH1H241J		C 240pF	C301,309,553	3
CC45RH1H270J		C 27pF	C91,358	2
CC45RH1H330J		C 33pF	C348,411	2
CC45RH1H390J		C 39pF	C70,72	2
CC45RH1H470J		C 47pF	C65	1
CC45RH1H560J		C 56pF	C16,53,55,64, 71,77,370	7
CC45RH1H680J		C 68pF	C52	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, 654	16
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	1
CC45SL1H331J		C 330pF	C28,162,164, 653	4
CC45SL1H391J		C 390pF	C46,622	2
CC45SL1H470J		C 47pF	C15,67,138,278, 313,472,530,656, 657	9
CC45SL1H680J		C 68pF	C13,59	2
CC45SL1H820J		C 82pF	C58,60	2
CC45TH1H030C		C 3pF	C349,462	2
CC45TH1H220J		C 22pF	C94	1
CC45TH1H270J		C 27pF	C99	1
CC45TH1H330J		C 33pF	C116	1
CC45TH1H680J		C 68pF	C464	1
CE04AW1H0R1M		E 0.1 50V	C386,510,534, 542,578	5
CE04AW1HR22M		E 0.22 50V	C86,171,486,509, 636	5
CE04W1A101M		E 100 10V	C488	1
CE04W1C100M		E 10 16V	C537,630	2
CE04W1C102M		E 1000 16V	C651	1
CE04W1C220M		E 22 16V	C151,167,221, 225,226,282,344, 392,396,450,505, 567–569,576, 583,587,631,632	19
CE04W1C221M		E 220 16V	C640	1
CE04W1C470M		E 47 16V	C222,345,346, 391,395,536,642, 648	8
CE04W1E100M		E 10 25V	C112,220,285, 343,384,387,389, 543,564,571,586, 629,633,634,639, 644,652	17
CE04W1E220M		E 22 25V	C20,22,31,38,44, 50,57,63,69,74 88	11
CE04W1E471M		E 470 25V	C440,441	2
CE04W1H010M		E 1 50V	C154,191,390, 420,423,424,426, 427,432,492,525, 541,563,565,588, 599,628,638	18
CE04W1H3R3M		E 3.3 50V	C388,449,566, 575	4
CE04W1HR47M		E 0.47 50V	C153,385,501, 591,592	5
CE04W1H4R7M		E 4.7 50V	C176,179,500	3
CK45B1H102K		C 0.001	C122,127,140, 148,152,161,163, 177,207,400,401, 436,490,532,562, 600,645,646	18
CK45B1H181K		C 180pF	C100	1
CK45B1H221K		C 220pF	C412,531,595, 596,618	5
CK45B1H222K		C 0.0022	C227,228,533, 549,614,623	6
CK45B1H331K		C 330pF	C465	1
CK45B1H391K		C 390pF	C32,34	2
CK45B1H471K		C 470pF	C339,353,434	3
CK45B1H681K		C 680pF	C33,330,394,570	4
CK45B1H821K		C 820pF	C23,29,40	3
CK45E2H102P		C 0.001 500V	C135	1

PARTS LIST

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, 208,209,219,236,237, 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, 655	77
CQ09S1H122J		S 0.0012	C402–404	3
CQ09S1H182J		S 0.0018	C518,519	2
CQ09S1H392J		S 0.0039	C554,610	2
CQ92M1H102K		ML 0.001	C26,170,213	3
CQ92M1H103K		ML 0.01	C168,447,448,451	4
CQ92M1H104K		ML 0.1	C643	1
CQ92M1H152K		ML 0.0015	C25,27,616	3
CQ92M1H222K		ML 0.0022	C545,546,637	3
CQ92M1H223K		ML 0.022	C215,229,230,232, 446,538,572,649	8
CQ92M1H332K		ML 0.0033	C579–581	3
CQ92M1H392K		ML 0.0039	C512,615	2
CQ92M1H472K		ML 0.0047	C110,589	2
CQ92M1H473K		ML 0.047	C214,216,217,231, 233–235,491,582, 598,625,635	12
CQ92M1H562K		ML 0.0056	C224,590	2
CQ92M1H682K		ML 0.0068	C626,627	2
C90-0817-05		E 1000 16V	C119	1
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, 314–317,325,327,329 332–334,341,342, 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	118

Parts No.	Re-marks	Description	Ref. No.	Q'ty
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
C91-0458-05		Laminated cap. 0.47	C169	1
C91-0472-05		ML 0.1	C211	1
E04-0154-05		Coax. connector		8
E23-0512-05		Round terminal		1
E40-0273-05		Mini connector 2P		12
E40-0373-05		Mini connector 3P		2
E40-0473-05		Mini connector 4P		5
E40-0511-05		Mini connector 5P	MC1–6	6
E40-0517-05		Mini connector 5P	MB1,2	2
E40-0573-05		Mini connector 5P		1
E40-0673-05		Mini connector 6P		4
E40-0773-05		Mini connector 7P		1
E40-0873-05		Mini connector 8P		3
E40-1073-05		Mini connector 10P		2
E40-1173-05		Mini connector 11P		1
F20-0525-05		Insulating sheet		3
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-marks	Description	Ref. No.	Q'ty
L34-2089-05	N	Tuning coil	L26	1
L34-2090-05	N	Tuning coil	L27	1
L34-2091-05	N	Tuning coil	L29	1
L34-2092-05	N	Tuning coil	L30	1
L34-2093-05	N	Tuning coil	L31,32	2
L34-2094-05	N	Tuning coil	L33	1
L34-2095-15	N	Tuning coil	L34	1
L34-2096-05	N	Tuning coil	L35	1
L34-2097-05	N	Tuning coil	L17	1
L34-2098-05	N	Tuning coil	L19	1
L34-2099-05	N	Tuning coil	L38,39	2
L34-2100-25	N	Tuning coil	L40	1
L34-2101-05	N	Tuning coil	L41	1
L34-2102-25	N	Tuning coil	L42	1
L34-2103-15	N	Tuning coil	L43	1
L34-2104-05	N	Tuning coil	L44	1
L34-2105-15	N	Tuning coil	L45	1
L34-2106-05	N	Tuning coil	L66,68	2
L34-2107-05	N	Tuning coil	L67	1
L34-2108-15	N	Tuning coil	L77	1
L34-2109-15	N	Tuning coil	L84	1
L34-2111-05	N	Tuning coil	L88,92	2
L34-2112-05	N	Tuning coil	L89,91	2
L34-2113-05	N	Tuning coil	L90	1
L34-2114-15	N	Tuning coil 44.93MHz	L94	1
L34-2115-15	N	Tuning coil 44.93MHz	L95	1
L34-2116-15	N	Tuning coil 44.93MHz	L96,97	2
L34-2117-15	N	Tuning coil	L98	1
L34-2118-15	N	Tuning coil 8.83MHz	L112	1
L34-2121-05	N	Tuning coil 455kHz	L131	1
L34-2122-05	N	Tuning coil 455kHz	L134	1
L34-2123-15	N	Tuning coil	L132,142	2
L34-2124-05	N	Tuning coil 455kHz	L165	1
L34-2125-15	N	Tuning coil 355kHz	L146–148	3
L34-2127-15	N	Tuning coil	L167	1
L34-2128-15	N	Tuning coil	L168	1
L34-2129-05	N	Tuning coil	L175	1
L40-1011-03		Ferri-inductor 100μH	L83	1
L40-1011-04		Ferri-inductor 100μH	L82,87,101	3
L40-1021-03		Ferri-inductor 1mH	L149–151	3
L40-1511-03		Ferri-inductor 150μH	L2,118,119	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, 75,100,114,116, 117,138,141,154–159, 162–164,176	27
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
L40-8291-02		Ferri-inductor 8.2μH	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
L72-0334-05	N	Ceramic filter 455kHz	CF1	1

Parts No.	Re-marks	Description	Ref. No.	Q'ty
L77-0965-15	N	Crystal 36.1MHz	X1	1
L77-0966-05	N	Crystal 8375kHz	X2	1
L77-0967-05	N	Crystal 8828.5kHz	X4	1
L77-0968-05	N	Crystal 8830kHz	X5	1
L77-0969-05	N	Crystal 8831.5kHz	X3	1
N10-2030-41		Nut		6
N30-3008-41		Round screw		4
N30-3010-41		Round screw		8
N87-3006-41		Self tapping screw		3
R12-0401-05		Trim. pot. 100Ω	VR21	1
R12-0420-05		Trim. pot. 500Ω	VR2,6	2
R12-0430-05	N	Trim. pot. 470Ω	VR3–5	3
R12-1405-05		Trim. pot. 1kΩ	VR18	1
R12-1424-05	N	Trim. pot. 4.7kΩ	VR23,24,27	3
R12-2409-05		Trim. pot. 5kΩ	VR1	1
R12-3411-05		Trim. pot. 47kΩ	VR8–10,15,16 26,32–34	9
R12-3413-05		Trim. pot. 10kΩ	VR11,13,25,30	4
R12-3430-05		Trim. pot. 10kΩ	VR22	1
R12-3438-05	N	Trim. pot. 22kΩ	VR7,28,29	3
R12-5414-05	N	Trim. pot. 100kΩ	VR12,17,31	3
R12-5415-05	N	Trim. pot. 150kΩ	VR20	1
R12-6404-05		Trim. pot. 470kΩ	VR14,19	2
RN14BK2E103F		MF 10kΩ 1/4W	R277	1
RN14BK2E271F		MF 270Ω 1/4W	R519,520	2
RN14BK2E333F		MF 33kΩ 1/4W	R272,275	2
RN14BK2E912F		MF 9.1kΩ 1/4W	R273	1
RN14BK2E1503F		MF 150kΩ 1/4W	R276	1
RS14AB3A331J		MF 330Ω 1W	R20	1
R90-0163-05	N	Inline block 47kΩ×9	IB1	1
R90-0549-05	N	Inline block 0.022×8	IB4	1
R90-0551-05	N	Inline block 0.01×4	IB2,3	2
R90-0553-05	N	Inline block	IB5	1
R92-0150-05		Short jumper		157
S51-1404-05		Relay	RL1–3	3

SIGNAL UNIT (X57-1000-11) From S/N310XXXX–

C05-0013-15		Ceramic trimmer 20pF	TC3–6	4
C05-0030-15		Ceramic trimmer 20pF	TC1	1
C05-0314-05		Ceramic trimmer 100pF	TC2	1
CC45CH1H010C		C 1pF	C255,476	2
CC45CH1H020C		C 2pF	C471	1
CC45CH1H030C		C 3pF	C105,125,142, 280,469	5
CC45CH1H0R5C		C 0.5pF	C199,249,356, 359,473,477	6
CC45CH1H070D		C 7pF	C106	1
CC45CH1H100D		C 10pF	C6,128,132,144, 310	5
CC45CH1H150J		C 15pF	C254	1
CC45CH1H220J		C 22pF	C454,456,458, 364	4

PARTS LIST

Parts No.	Re-marks	Description	Ref. No.	Q'ty
CC45RH1H010C		C 1pF	C107,121	2
CC45RH1H020C		C 2pF	C108,197,212	3
CC45RH1H030C		C 3pF	C178	1
CC45RH1H050C		C 5pF	C264	1
CC45RH1H070D		C 7pF	C184,267	1
CC45RH1H100D		C 10pF	C113–115	3
CC45RH1H101J		C 100pF	C51,66,398	3
CC45RH1H120J		C 12pF	C93,96,97,263, 256,296	6
CC45RH1H121J		C 120pF	C14,54,185,187, 552	5
CC45RH1H180J		C 18pF	C186	1
CC45RH1H181J		C 180pF	C45,47	2
CC45RH1H220J		C 22pF	C76,78,92,98 266,319,320	7
CC45RH1H221J		C 220pF	C39,41	2
CC45RH1H241J		C 240pF	C301,309,553	3
CC45RH1H270J		C 27pF	C91,358	2
CC45RH1H330J		C 33pF	C348,411	2
CC45RH1H390J		C 39pF	C70,72	2
CC45RH1H470J		C 47pF	C65	1
CC45RH1H560J		C 56pF	C16,53,55,64, 71,77,370	7
CC45RH1H680J		C 68pF	C52	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, 308,331,352,369, 380,393,466,483, 485,511,540,574, 606,654	17
CC45SL1H120J		C 12pF	C641,647	2
CC45SL1H121J		C 120pF	C24	1
CC45SL1H150J		C 15pF	C377	1
CC45SL1H151J		C 150pF	C338,365,373, 376,498,520,528	7
CC45SL1H220J		C 22pF	C279	1
CC45SL1H221J		C 220pF	C335	1
CC45SL1H330J		C 33pF	C254	1
CC45SL1H331J		C 330pF	C28,162,164, 653	4
CC45SL1H391J		C 390pF	C46,622	2
CC45SL1H470J		C 47pF	C15,67,138,278, 313,472,530,657	8
CC45SL1H680J		C 68pF	C13,59	2
CC45SL1H820J		C 82pF	C58,60	2
CC45TH1H030C		C 3pF	C349,462	2
CC45TH1H220J		C 22pF	C94	1
CC45TH1H270J		C 27pF	C99	1
CC45TH1H330J		C 33pF	C116	1
CC45UJ1H820J		C 82pF	C464	1
CE04AW1H0R1M		E 0.1 50V	C385,386,510, 534,542,578	6
CE04AW1HR22M		E 0.22 50V	C86,171,509,636	4
CE04W1HR33M		E 0.33 50V	C355,459	2
CE04W1A101M		E 100 10V	C488	1
CE04W1C100M		E 10 16V	C396,537,630	3
CE04W1C101M		E 100 16V	C525	1
CE04W1C102M		E 1000 16V	C651	1

Parts No.	Re-marks	Description	Ref. No.	Q'ty
CE04W1C220M		E 22 16V	C151,167,221, 225,226,282,344, 392,396,450,505, 567–596,576, 583,587,631,632	19
CE04W1C221M		E 220 16V	C640	1
CE04W1C470M		E 47 16V	C222,345,346, 391,395,536,613, 642,648	9
CE04W1E100M		E 10 25V	C112,220,285, 343,384,387,389, 543,564,571,586, 629,633,634,639, 644,652	17
CE04W1E220M		E 22 25V	C20,22,31,38,44, 50,57,63,69,74, 88	11
CE04W1E471M		E 470 25V	C440,441	2
CE04W1H010M		E 1 50V	C154,191,375, 390,420,423,424, 426,427,432,486, 492,494,541,563, 565,588,599,628, 638	20
CE04W1H3R3M		E 3.3 50V	C388,449,566, 575	4
CE04W1HR47M		E 0.47 50V	C153,101,501, 591,592	5
CE04W1H4R7M		E 4.7 50V	C176,179,500	3
CK45B1H102K		C 0.001	C17,122,127,140, 146,148,152,161, 163,177,207,367, 371,400,401,436, 487,490,532,562, 600,645,646	23
CK45B1H181K		C 180pF	C100	1
CK45B1H221K		C 220pF	C531,595,596, 618	4
CK45B1H222K		C 0.0022	C227,228,533, 549,614,623	6
CK45B1H331K		C 330pF	C412,465	2
CK45B1H391K		C 390pF	C32,34	2
CK45B1H471K		C 470pF	C339,353,434	3
CK45B1H681K		C 680pF	C33,330	2
CK45B1H821K		C 820pF	C23,29,40	3
CK45E2H102P		C 0.001 500V	C135	1
CK45F1H103Z		C 0.01	C1,7,11,12,95,102, 104,111,117,118, 120,123,129,134, 141,143,145,166, 172–174,183, 194,195,208,209, 219,236,237,242, 253,262,269,271, 277,281,284,324, 351,361,378,413, 430,435,437,439, 443,444,452,453, 455,457,461,475, 493,497,515,521, 527,535,539,544, 559,561,577,584, 607–609,655	70

PARTS LIST

Parts No.	Re-marks	Description	Ref. No.	Q'ty
CQ09S1H122J		S 0.0012	C402–404	3
CQ09S1H182J		S 0.0018	C518,519	2
CQ09S1H392J		S 0.0039	C544,610	2
CQ92M1H102K		ML 0.001	C26,170,	2
CQ92M1H103K		ML 0.01	C168,447,448,451	4
CQ92M1H104K		ML 0.1	C643	1
CQ92M1H152K		ML 0.0015	C25,27,616	3
CQ92M1H222K		ML 0.0022	C546,637	2
CQ92M1H223K		ML 0.022	C215,229,230,232, 446,538,572,649	8
CQ92M1H332K		ML 0.0033	C394,570,579– 581	5
CQ92M1H392K		ML 0.0039	C512,615	2
CQ92M1H472K		ML 0.0047	C110,589	2
CQ92M1H473K		ML 0.047	C214,216,217,231, 233–235,491,582, 598,625,635	12
CQ92M1H562K		ML 0.0056	C224,590	2
CQ92M1H682K		ML 0.0068	C626,627	2
C90-0817-05		E 10000 16V	C119	1
C90-0878-05		T 1 35V	C700–702	3
C91-0456-05		C 0.047	C2,5,8,9,18,19,21,30, 37,42,43,48,49,62, 80–85,87,89,109,149, 156,157,165,175,180– 182,190,192,193,206, 210,223,245,248,256, 258,259,274,295,297, 300,302,311,314–317, 325,327,329,332–334, 341,342,347,362,366, 368,372,374,379,381– 383,397,399,405,414– 418,421,422,425,428, 429,433,438,463,480, 482,484,489,495,496, 499,508,513,514,516, 517,522–524,526,529, 548,550,551,555–558, 560,585,593,594,597, 605,611,612,617,619, 621,624	122
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, 321–323,328,337, 350,354,357,360, 363,419,431,442, 445,460,467,470, 474,479,481	64
C91-0458-05		Laminated cap. 0.47	C169	1
C91-0472-05		ML 0.1	C211	1
E04-0154-05		Coax. connector		8
E23-0512-05		Round terminal		1
E40-0273-05		Mini connector 2P		12

Parts No.	Re-marks	Description	Ref. No.	Q'ty
E40-0373-05		Mini connector 3P		2
E40-0473-05		Mini connector 4P		5
E40-0511-05		Mini connector 5P	MC1–6	6
E40-0517-05		Mini connector 5P	MB1,2	2
E40-0573-05		Mini connector 5P		1
E40-0673-05		Mini connector 6P		4
E40-0773-05		Mini connector 7P		1
E40-0873-05		Mini connector 8P		3
E40-1073-05		Mini connector 10P		2
E40-1173-05		Mini connector 11P		1
F11-0813-04	N	Shield cover	CAR1	1
F20-0525-05		Insulating sheet		3
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
L34-2087-05	N	Tuning coil	L24	1
L34-2088-05	N	Tuning coil	L25	1
L34-2089-05	N	Tuning coil	L26	1
L34-2090-05	N	Tuning coil	L27	1
L34-2091-05	N	Tuning coil	L29	1
L34-2092-05	N	Tuning coil	L30	1
L34-2093-05	N	Tuning coil	L31,32	2
L34-2094-05	N	Tuning coil	L33	1
L34-2095-15	N	Tuning coil	L34	1
L34-2096-05	N	Tuning coil	L35	1
L34-2097-05	N	Tuning coil	L17	1
L34-2098-05	N	Tuning coil	L19	1
L34-2099-05	N	Tuning coil	L38,39	2
L34-2100-25	N	Tuning coil	L40	1
L34-2101-05	N	Tuning coil	L41	1
L34-2102-25	N	Tuning coil	L42	1
L34-2103-15	N	Tuning coil	L43	1
L34-2104-05	N	Tuning coil	L44	1
L34-2105-15	N	Tuning coil	L45	1
L34-2106-05	N	Tuning coil	L66,68	2
L34-2107-15	N	Tuning coil	L67	1

PARTS LIST

Parts No.	Re-marks	Description	Ref. No.	Q'ty
L34-2108-15	N	Tuning coil	L77	1
L34-2109-15	N	Tuning coil	L84	1
L34-2111-05	N	Tuning coil	L88,92	2
L34-2112-05	N	Tuning coil	L89,91	2
L34-2113-05	N	Tuning coil	L90	1
L34-2114-15	N	Tuning coil 44.93MHz	L94	1
L34-2115-15	N	Tuning coil 44.93MHz	L95	1
L34-2116-15	N	Tuning coil 44.93MHz	L96,97	2
L34-2117-15	N	Tuning coil	L98	1
L34-2118-15	N	Tuning coil 8.83MHz	L112	1
L34-2121-05	N	Tuning coil 455kHz	L131	1
L34-2122-05	N	Tuning coil 455kHz	L134	1
L34-2123-15	N	Tuning coil	L132,142	2
L34-2124-05	N	Tuning coil 455kHz	L165	1
L34-2125-15	N	Tuning coil 355kHz	L146–148	3
L34-2127-15	N	Tuning coil	L167	1
L34-2128-15	N	Tuning coil	L168	1
L34-2129-05	N	Tuning coil	L175	1
L40-1011-03		Ferri-inductor 100μH	L83	1
L40-1011-04		Ferri-inductor 100μH	L82,87,101	3
L40-1021-03		Ferri-inductor 1mH	L3,149–151	4
L40-1511-03		Ferri-inductor 150μH	L2,118,119	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	L1,4,46–50, 61–64,74,75,110, 114,116,117,138, 141,154–159, 162–164,176	29
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
L40-8291-02		Ferri-inductor 8.2μH	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
L72-0334-05	N	Ceramic filter 455kHz	CF1	1
L77-0965-15	N	Crystal 36.1MHz	X1	1
L77-0966-05	N	Crystal 8375kHz	X2	1
L77-0967-05	N	Crystal 8828.5kHz	X4	1
L77-0968-05	N	Crystal 8830kHz	X5	1
L77-0969-05	N	Crystal 8831.5kHz	X3	1
N10-2030-41		Nut		6
N30-3008-41		Round screw		4
N30-3010-41		Round screw		8
N87-3006-41		Self tapping screw		3
R12-0401-05		Trim. pot. 100Ω	VR21	1
R12-0420-05		Trim. pot. 500Ω	VR2,6	2
R12-0430-05	N	Trim. pot. 470Ω	VR3	1
R12-0531-05		Trim. pot. 500Ω	VR18	1
R12-1405-05		Trim. pot. 1kΩ	VR33	1
R12-1424-05	N	Trim. pot. 4.7kΩ	VR23,24,27	3
R12-2409-05		Trim. pot. 5kΩ	VR1	1
R12-3411-05		Trim. pot. 47kΩ	VR8–10,15,16 26,28,32,34	9
R12-3413-05		Trim. pot. 10kΩ	VR11,13,25,30	4
R12-3438-05	N	Trim. pot. 22kΩ	VR7,29	2
R12-5414-05	N	Trim. pot. 100kΩ	VR12,17,31	3
R12-5415-05	N	Trim. pot. 150kΩ	VR20	1
R12-6404-05		Trim. pot. 470kΩ	VR14,19	2
RN14BK2E103F		MF 10kΩ 1/4W	R272,275,277	3
RN14BK2E271F		MF 270Ω 1/4W	R519,520	2
RN14BK2E912F		MF 9.1kΩ 1/4W	R273	1
RN14BK2E1503F		MF 150kΩ 1/4W	R276	1
RS14AB3A331J		MF 330Ω 1W	R20	1
R90-0163-05	N	Inline block 47kΩx9	IB1	1
R90-0549-05	N	Inline block 0.022x8	IB4	1
R90-0551-05	N	Inline block 0.01x4	IB2,3	2
R90-0553-05	N	Inline block	IB5	1
R92-0150-05		Short jumper		142
S51 1404-05		Relay	RL1–3	3

AT UNIT (X57-1010-00)

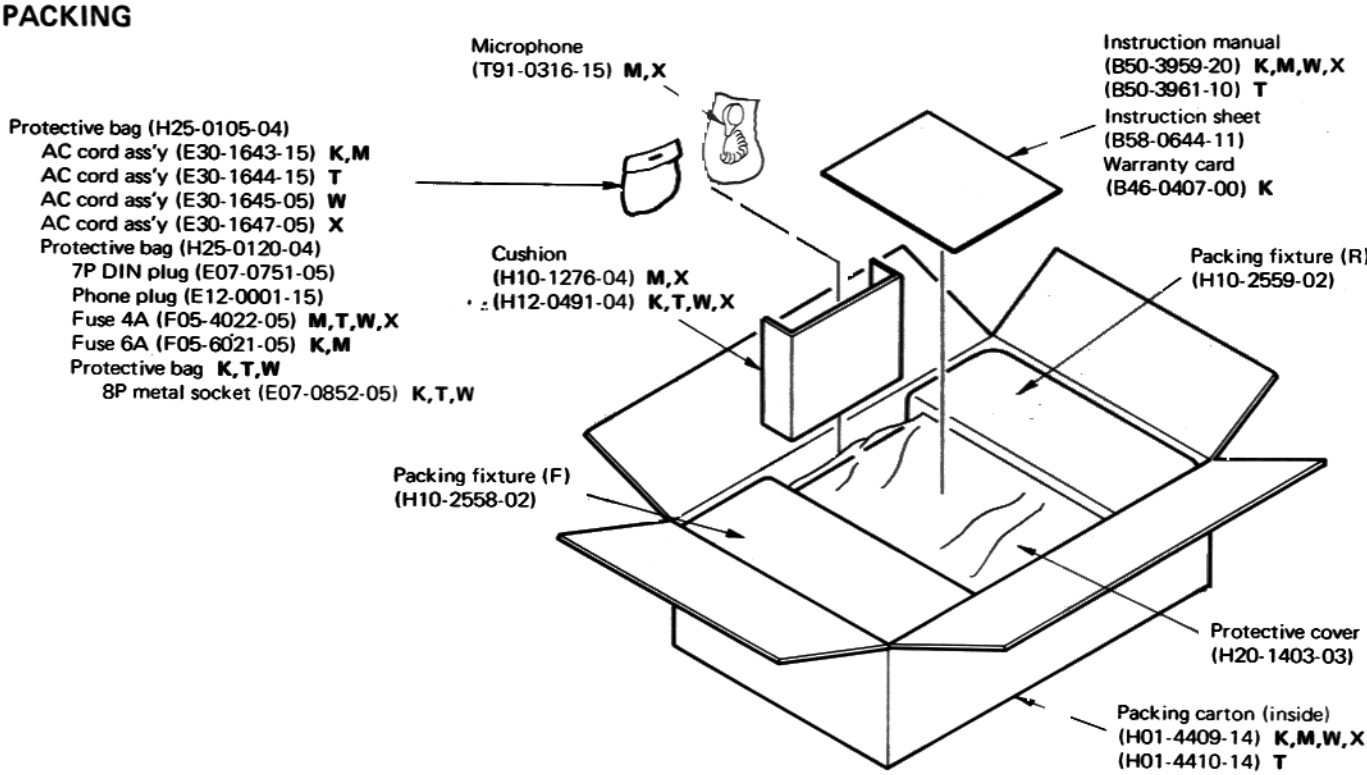
C02-0022-05	N	Variable cap.	VC1,2	2
C05-0315-05		Ceramic trimmer 60pF	TC1	1
CE04W0J101M		E 100 6.3V	C19,21	2
CE04W1C100M		E 10 16V	C47	1
CE04W1E220M		E 22 25V	C31	1
CE04W1E470M		E 47 25V	C18,20	2
CE04W1H101M		E 100 50V	C32	1
CC45SL2H121J		C 120pF 500V	C29	1
CC45SL2H151J		C 150pF 500V	C30	1
CK45B1H102K		C 0.001	C25,26,37–40, 44,45	8

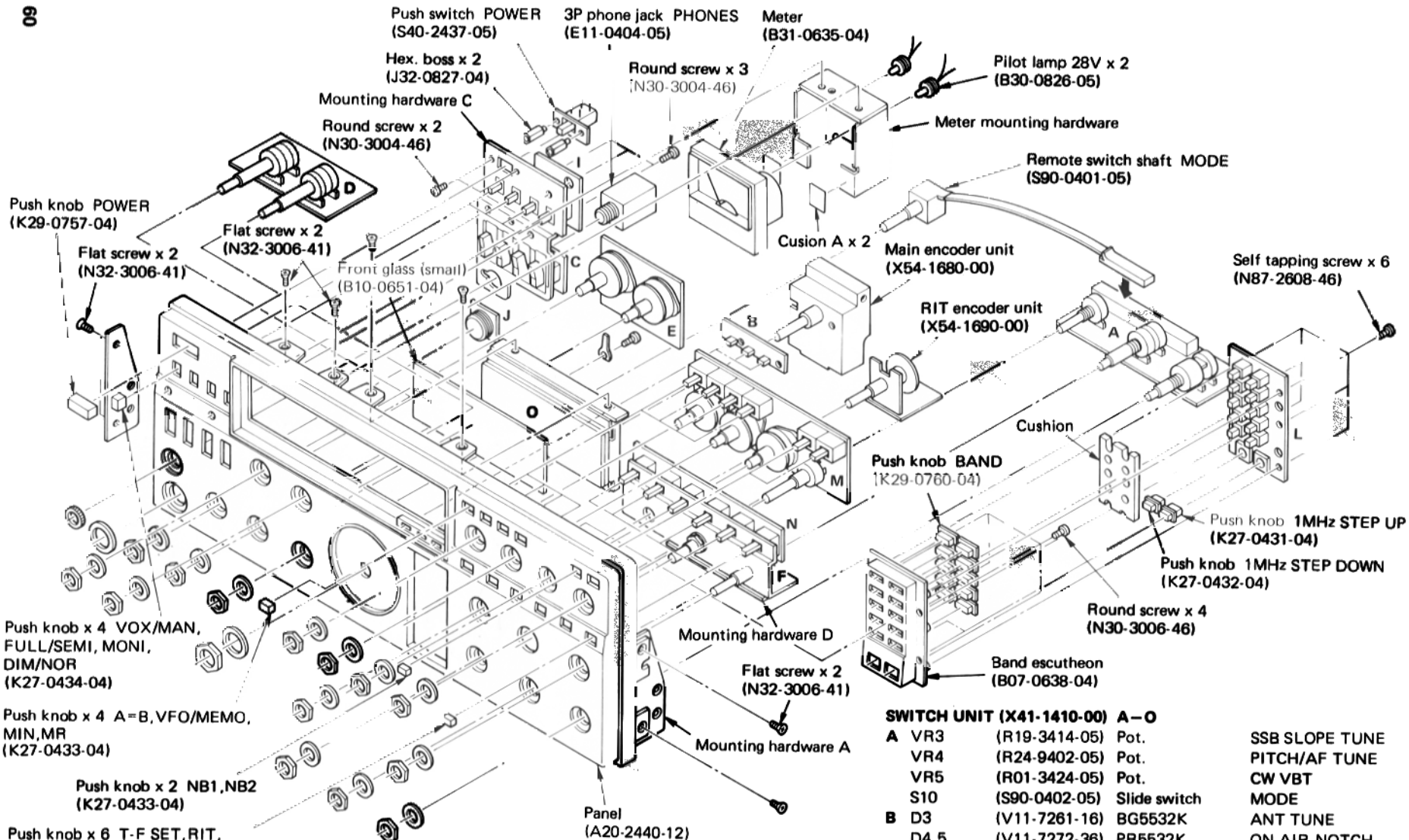
PARTS LIST/PACKING

Parts No.	Re-marks	Description	Ref. No.	Q'ty
CK45F1H103Z		C 0.01	C1–6,8–17 33–36,46	22
CQ92M1H333K		ML 0.033	C43	1
C91-0456-05		C 0.047	C22,23,27,28,42	5
D22-0408-05	N	Coupling		2
D40-0623-25	N	Gear ass'y		1
D40-0624-25	N	Gear ass'y		1
E04-0154-05		Coax. connector		6
E40-0473-05		Mini connector 4P		2
E40-0673-05		Mini connector 6P		2
E40-0873-05		Mini connector 8P		1
J31-0502-04		PC board collar		6
J42-0428-05		PC board bushing		6
L34-2133-15	N	Tuning coil A	L20	1
L34-2134-05	N	Tuning coil B	L19	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	L13,14,21	3
L40-1011-12		Ferri-inductor 100μH	L8–11	4
L40-1511-03		Ferri-inductor 150μH	L12,22–25	5
L40-4711-03		Ferri-inductor 470μH	L1–6,15	7
L40-4711-12		Ferri-inductor 470μH	L7,16	2
L92-0103-05		Toroid core		2
L92-0115-05	N	Toroid core		1
N09-0256-05		Gnd. screw		1
N10-2030-46		Nut		1

Parts No.	Re-marks	Description	Ref. No.	Q'ty
N30-3006-46		Round screw		1
N35-3006-41		Bind screw		4
N87-3006-41		Self tapping screw		7
N87-3012-41		Self tapping screw		6
N88-3008-41		Flat tapping screw		10
R12-2401-05		Trim. pot. 5kΩ	VR1	1
R12-3401-05		Trim. pot. 10kΩ	VR2	1
RC05GF2H101J		Solid 100Ω 1/2W	R112,113	2
RC05GF2H151J		Solid 150Ω 1/2W	R150	1
RC05GF2H270J		Solid 27Ω 1/2W	R46,49,62,65	4
RN14BK2E103F		MF 10kΩ 1/4W	R96,97,100,101	4
RS14AB3A102J		MF 1kΩ 1W	R129,131	2
RS14AB3A271J		MF 270Ω 1W	R75	1
RS14AB3A330J		MF 33Ω 1W	R132	1
RS14AB3A390J		MF 39Ω 1W	R92	1
RS14AB3D271J		MF 270Ω 2W	R76	1
R90-0554-05		Inline block	IB1	1
R90-0555-05	N	Inline block	IB2	1
	N			
R92-0150-05		Short jumper		37
S51-1412-05		Relay	RL2–6	5
S51-2408-05		Relay	RL9	1
S51-2411-05	N	Relay	RL1,8	2
T42-0303-05	N	Motor		2

PACKING



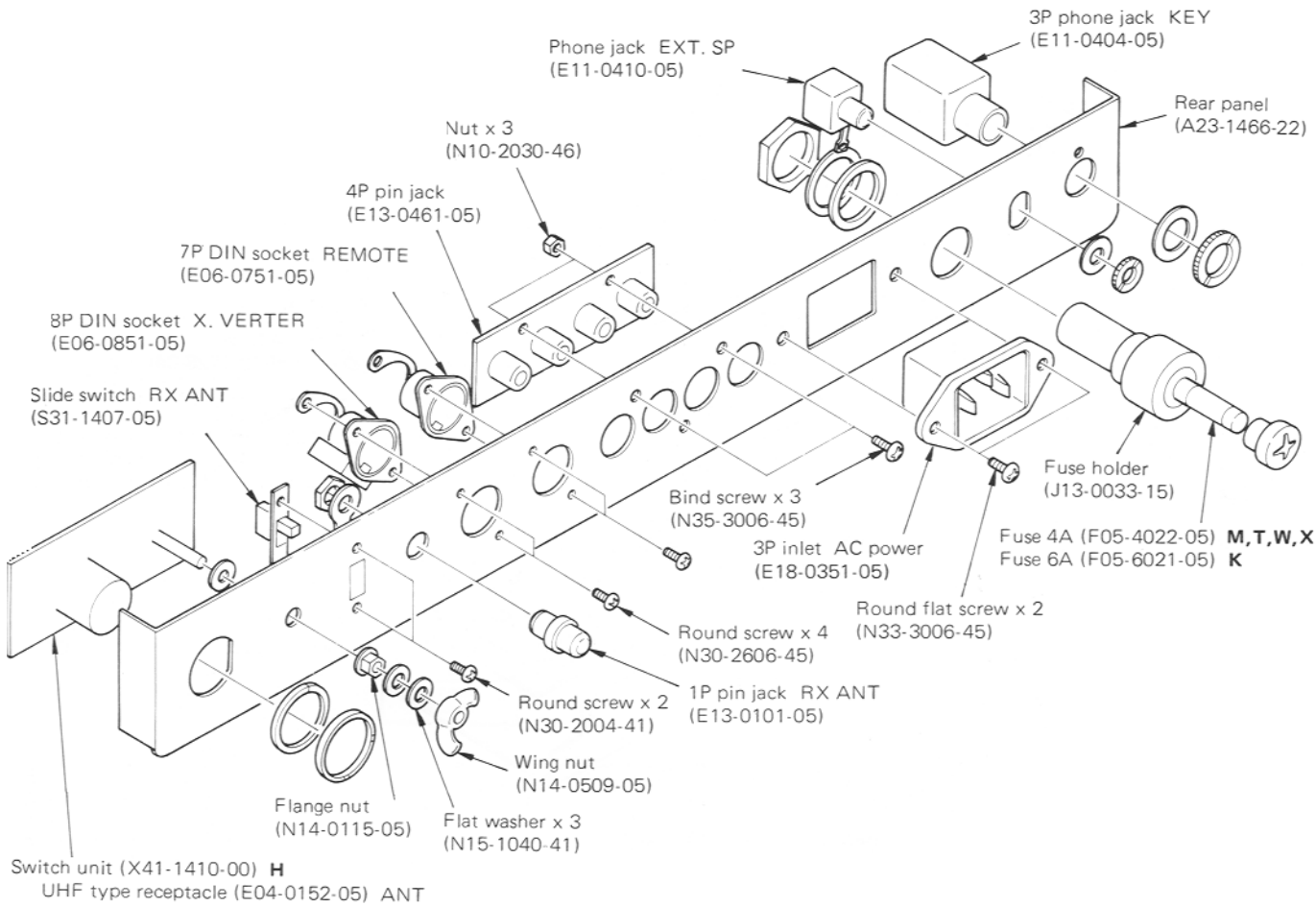


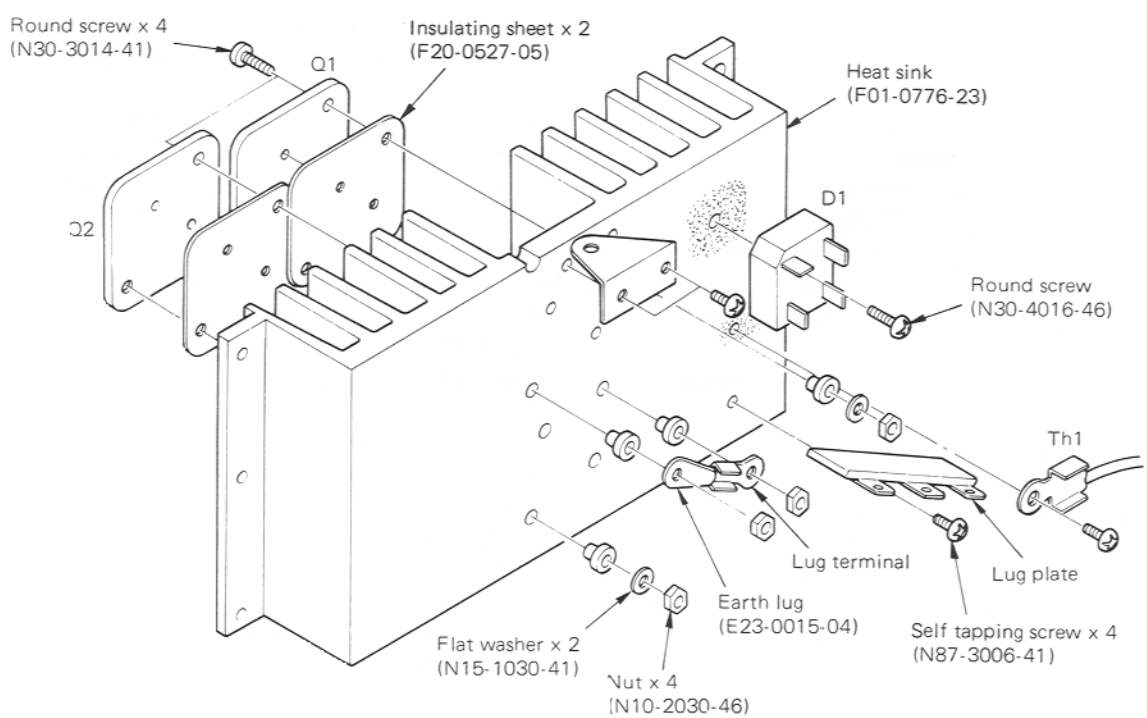
M	VR8	(R01-0406-05)	Pot.	NB LEVEL
	S17,19,20	(S40-2435-05)	Push switch	A=B, M_{IN}, MR
	S18,21,22	(S40-2434-05)	Push switch	VFO/MEMO, NB1, NB2
	S23,25	(S01-1432-05)	Rotary switch	FUNCTION, RF ATT
	S24	(S01-1429-05)	Rotary switch	M. CH
N	S11,13	(S40-2432-05)	Push switch	T-F SET, RIT-CL
	S12	(S40-2431-05)	Push switch	RIT
	S14,16	(S40-2422-05)	Push switch	NOTCH, D. LOCK
	S15	(S40-2433-05)	Push switch	AF TUNE
O	V1	(V40-7760-66)	11-BT-03Z	Display tube

SWITCH UNIT (X41-1410-00) A–O

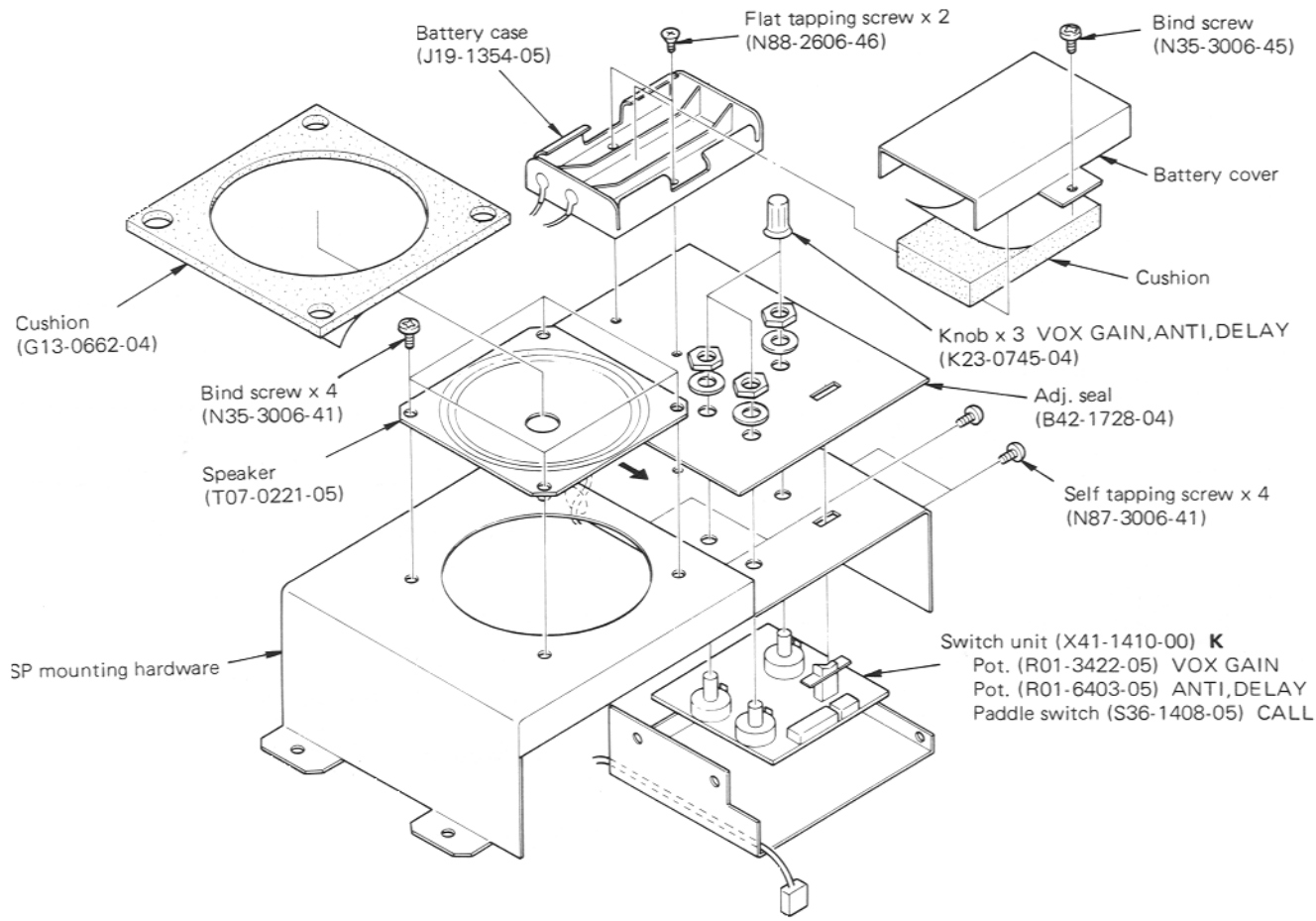
A	VR3	(R19-3414-05)	Pot.	SSB SLOPE TUNE
	VR4	(R24-9402-05)	Pot.	PITCH/AF TUNE
	VR5	(R01-3424-05)	Pot.	CW VBT
	S10	(S90-0402-05)	Slide switch	MODE
B	D3	(V11-7261-16)	BG5532K	ANT TUNE
	D4,5	(V11-7272-36)	PR5532K	ON AIR, NOTCH
C	S6–9	(S36-2408-05)	Paddle switch	STBY, AT, PRO., TONE
D	VR1,2	(R19-9407-05)	Pot.	PROCESSOR, MIC/DAR
E	S39	(S01-1430-05)	Rotary switch	METER
	S40	(S01-1431-05)	Rotary switch	AGC
F	VR6	(R01-3423-05)	Pot.	NOTCH
	VR7	(R19-3413-05)	Pot.	AF/RF
I	S2,5	(S40-2433-05)	Push switch	VOX/MAN, DIM/NOR
	S3,4	(S40-2434-05)	Push switch	FULL/SEMI, MONI
J	–	(E06-0853-05)	8P metal socket	MIC
L	S26,27	(S50-1409-05)	Tact switch	1MHz STEP
	S28–37	(S50-1411-05)	Tact switch	BAND

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 a 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 the electrolytic 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) The front panel may be tilted for servicing by removing the 2 flat head screws at the top sides of the panel, and loosening the 2 round head screws at the bottom. Use caution as the panel is heavy and may fall forward.

(2) When replacing the name plate on the display window for display tube and meter,1st 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 bracket, insert a thin screw driver, etc. into the bracket at both sides. Remove the display tube with the screw driver form the projection of the mounting hardware for display tube.

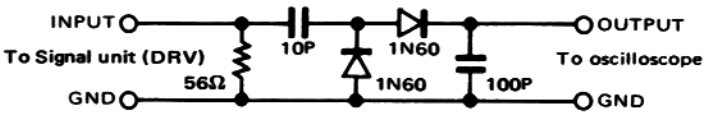
(4) Removing main knob
Slip the outside rubber ring from the knob. The allen set screw can now be loosened and the knob removed.

(5) Removing band switch assembly
Remove the six screws securing the PC board. Then, remove push knobs (1.5 3.5 .....), cushions, and the four round screws which secure the escutcheon to the front panel.

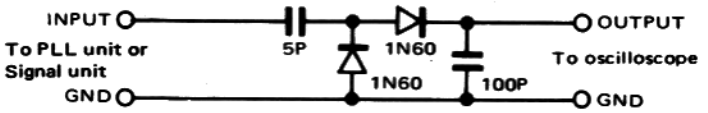
ADJUSTMENT

REQUIRED TEST EQUIPMENT

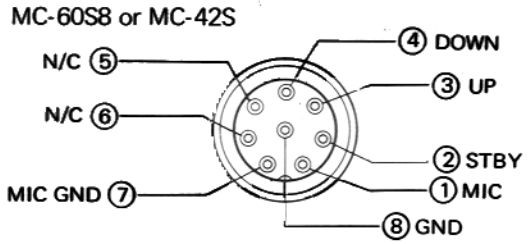
1. **DC Voltmeter (DC V.M)**
   1) Input resistance : More than 1MΩ
   2) Voltage range : 1.5 to 1000V AC/DC
   NOTE : A high-precision multimeter may be used. However, accurate readings can not be obtained for high-impedance circuits.
2. **DC Ammeter**
   1) Current range : 100mA, 1.5A, 15A, High-precision ammeter may be used.
3. **RF VTVM (RF V.M)**
   1) Input impedance : 1MΩ and less than 3pF, min.
   2) Voltage range : 10mV to 300V
   3) Frequency range : 10kHz to 100MHz or greater
4. **AF Voltmeter (AF V.M)**
   1) Frequency range : 50Hz to 10kHz
   2) Input resistance : 1MΩ or greater
   3) Voltage range : 10mV to 30V
5. **AF Generator (AG)**
   1) Frequency range : 200Hz to 5kHz
   2) Output : 1mV or less to 1V, low distortion
6. **AF Dummy Load**
   1) Impedance : 8Ω
   2) Dissipation : 3W or greater
7. **Oscilloscope (Dual trace)**
   Requires high sensitivity, and external synchronization capability.
8. **Sweep Generator**
   1) Center frequency : 50kHz to 90MHz
   2) Frequency deviation : Maximum±35MHz
   3) Output voltage : 0.1V or greater
   4) Sweep rate : At least 0.5sec/cm
9. **Standard Signal Generator (SSG)**
   1) Frequency range : 50kHz to 50MHz
   2) Output : −20dB/0.1μV to 120dB/1V
   3) Output impedance : 50Ω
   4) AM and FM modulation can be possible.
   NOTE : Generator must 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-like 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 limit : 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



MIC terminals (View from front panel side)

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

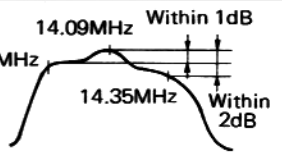
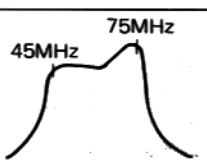
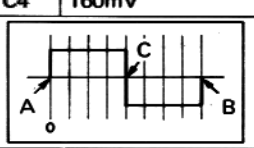
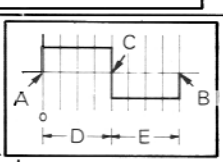
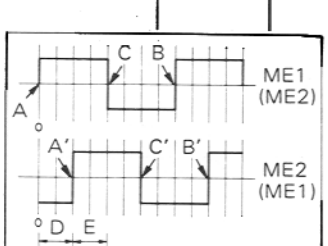
VOLTAGE ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
1.Voltage	1) POWER : ON RF GAIN : MAX (Full CW)	DC V.M	AVR	28B	AVR	VR1	28.5V	± 0.3V
			SIG-NAL	Connec-tor 28-RV	SIG-NAL	VR24	16.0V	± 0.1V
	MODE : USB			R375 (AGC)		VR29	3.20V	± 0.01V
	STBY : REC			Jumper wire J13		VR25	2.20V	± 0.01V
2.TX Control voltage	1) STBY : REC	DC V.M	SIG-NAL	Connec-tor 5-TV			Check	Less than –0.8V
	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.

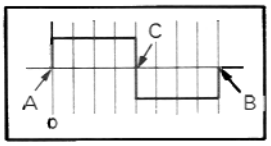
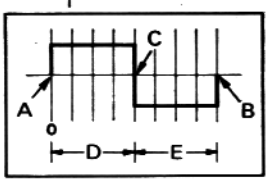
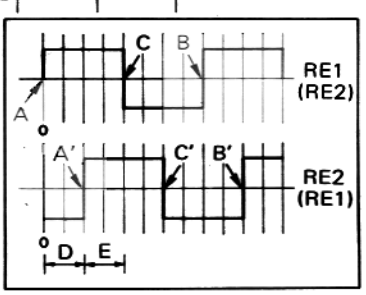
PLL ADJUSTMENT

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 : □□.□□1.9[9] kHz To obtain this frequency 1st set dial to □2.0[0]. Then using mic pushbutton depress button (DWN) one step at a time until the display just changes to □1.9[9] frequency changes in 10Hz steps are obtained in this manner.	DC V.M		Q32-C		T14	4.2V	± 0.05V □ DENOTES STEP 9 (90Hz) or one step before the next 100Hz (.xxx.1) Transition
	3) FREQ : □□.□□0.0[0] kHz Use similar method in step 3. 2) PLL adjustment						Check	9.5V ± 0.5V
4. VCO-2	1) FREQ : □□,999.9[9] kHz Use similar method in step 3. 2) PLL adjustment.	DC V.M	PLL	Q24-C	PLL	T15	3.5V	± 0.05V
	2) FREQ : □□,000.0[0] kHz For 10Hz level, tune VFO one step before □□,999.□□						Check	8.5V ± 0.5V
5. VCO-1L (Low)	1) FREQ : 100.0kHz Tune VFO fully CCW	DC V.M	SIG-NAL	R81	SIG-NAL	L54	13.50V	± 0.1V
	2) FREQ : 9,499.9[9] kHz						Check	6.0V ± 1.0V
6. VCO-1M (Medium)	1) FREQ : 9,500.0[0] kHz For 10Hz level, tune VFO to one step before 9,499.9[9]	DC V.M	SIG-NAL	R81	SIG-NAL	L53	3.00V	± 0.1V
	2) FREQ : 19,499.9[9] kHz						Check	12.0V ± 1.0V
7. VCO-1H (High)	1) FREQ : 29,999.9[9] kHz Tune VFO fully CW to 29,999.99[9] kHz.	DC V.M	SIG-NAL	R81	SIG-NAL	L52	13.00V	± 0.1V
	2) FREQ : 19,500.0[0] 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)			IC6-2		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	Connector 4-ME1				Point C may be located anywhere. When a motor is not available, manually turn the VFO to check the duty ratio. (AC=CB)
	2) ME1 duty ratio adjustment : Turn 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 : (Check as for ME1)			Connector 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 alignement 			Connector 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 90° phase shift)	ME1 (ME2) : Within 90° ± 10% (The difference between CW and CCW rotation must also be within this specification.) Either ME1 or ME2 may lead, the important point is phase difference.

ADJUSTMENT

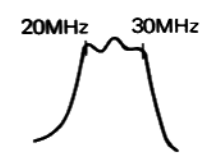
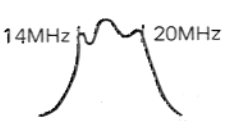
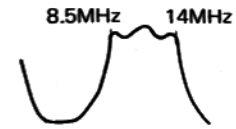
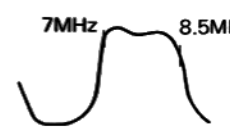
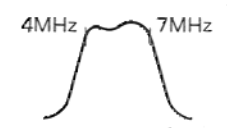
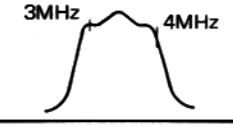
Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
17. RIT encoder	1) Remove the RIT knob and motor-drive the encoder at approx 300 rpm.	Oscillo-scope	Digital	Connector 5-RE1				Point C may be located anywhere. When a motor is not available, manually turn the RIT to check the duty ratio. (AC=CB)
	2) RE1 duty ratio adjustment : Turn a 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 motor in both directions.			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				Either RE1 or RE2 may lead, the important point is the phase difference. It should be 90° ±10% .

RX ADJUSTMENT

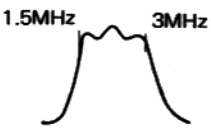
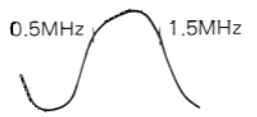
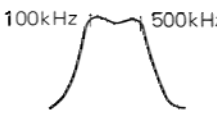
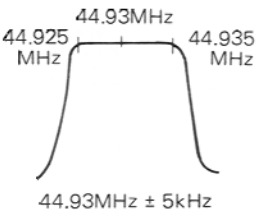
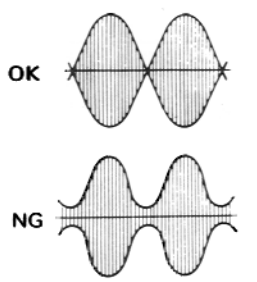
○ : From S/N 208XXXX–309XXXX
● : From S/N 310XXXX–

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
1. CAR-1	1) MODE : USB STBY : REC	RF V.M	SIG-NAL	Connector 24-CAR1	SIG-NAL	L161	0.21V : ○, 0.1V : ● (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	These are preliminary adjutments. 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 NAR/WIDE : NARROW 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	SIGNAL	Q79-E (R472)	SIGNAL	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 TX to RX.	
	4) MODE : USB STBY : REC					TC3	8.375MHz	
3. CAR-3	1) MODE : CW STBY : REC	f. counter	SIGNAL	Q141-E	SIGNAL	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	SIGNAL	R836	SIGNAL	L172	MAX	0.27–0.47V (reference)
		f. counter				L173	99,200Hz	± 20Hz
5. 355kHz BPF	1) MODE : CW STBY : REC	RF V.M	SIGNAL	Q129-G2	SIGNAL	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, FRO connector, and connect this plug to detector.	Sweep generator Detector Oscilloscope	Body RF	ANT RIF	SIGNAL	L43–45	Adjust as shown at right.	
	2) BAND : 14.0–20.0MHz FREQ : 18,000.0kHz					L40–42		
	3) BAND : 8.5–14.0MHz FREQ : 10,000.0kHz					L38–39		
	4) BAND : 7.0–8.5MHz FREQ : 7,000.0kHz					L33–35		
	5) BAND : 4.0–7.0MHz FREQ : 6,900.0kHz					L29–32		
	6) BAND : 3.0–4.0MHz FREQ : 3,900.0kHz					L25–27		

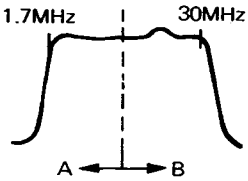
ADJUSTMENT

Item	Condition	Measurement: Test equipment	Measurement: Unit	Measurement: Terminal	Adjustment: Unit	Adjustment: Part	Adjustment: Method	Specification/Remarks
	7) BAND : 1.5–3.0MHz FREQ : 1,900.0kHz	Sweep generator Detector Oscillo-scope	Body RF	ANT RIF	SIG-NAL	L22–24	Adjust as shown at right.	
	8) BAND : 0.5–1.5MHz FREQ : 1,000.0kHz					L18,19		
	9) BAND : 100–500kHz DISPLAY : 300.0kHz					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 Oscillo-scope	RF SIG-NAL	VCOF R336	SIG-NAL	L121–124	1) Crest value : MAX 2) Ripple : MIN Adjust as shown at right.	
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.	
	2) NAR-WIDE SW : WIDE Remove jig PC board from XF-6 and reinstall 2P connector.				SIG-NAL	TC3	Adjust as shown at right.	
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, TC1 L125–132, 146–148, 165–168,	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.  TC1 Mechanical center Note: TC1 ; From S/N 208XXXX–309XXXX
	2) Disconnect SSG	RF VTVM	RF	RIF	RF	VR1	MIN	Note: VR1; from S/N310XXXX–
10. NOTCH (If Step 9 ad-justments are perfomed, 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 f. counter	Rear panel	ANT EXT.SP			Adjust for 1500Hz/0.63V AF output.	
	2) NOTCH SW : ON SSG output : 40dB/μ				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.

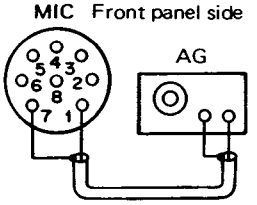
ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
11. IF trap (If Step 6-1 adjustment is perfomed, 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 wave-form 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 Oscillo-scope AF dummy load	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					VR31	S9	40dB ± 6dB
	5) SSG output : 100dB/μ						SSG output : 100dB Repeat step 1) th-rough 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 out-put : 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 Oscillo-scope AF dummy load	Rear panel	EXT.SP	SIG-NAL	VR33	50mV/8Ω	± 3dB

TX ADJUSTMENT

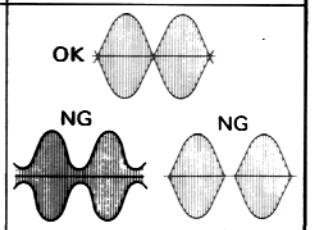
Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
1. TX-BPF	1) FREQ : 14,175.0kHz STBY : SEND Disconnect DRV connector and terminate with a 50Ω dummy load. (After adjustment, re-move and reconnect DRV con-nector).	Sweep generator Detector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

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, 132	MAX 1) Adjust in order; L115, 112–94 and 132. 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.	MIC Front panel side 
4. IC METER ϕ point	1) METER SW : IC Disconnect 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	70mA Note: Stabilization requires approximately 20 seconds.	± 10mA
	2) FINAL unit VR1 : MIN Disconnect connector in FINAL unit, 28V line and connect ammeter in its place. STBY : SEND (Disconnect ammeter and reconnect this connector after adjustment.)					VR1	1.3A	1.1–1.5A
6. IC meter	1) FREQ : 14,175.0kHz MODE : CW Disconnect 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 2A	± 0.3A Check
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 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

○ : From S/N 208XXXX–309XXXX
● : From S/N 310XXXX–

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	Not to exceed 125W
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 From S/N 208XXXX–309XXXX	1) FREQ : 28.1MHz MODE : AM MIC CONTROL : MAX STBY : SEND	Power meter	Rear panel	ANT	SIG-NAL	L175 VR22	Adjust for MAX power with L175, then set to 30W with VR22.	± 3W Note : AM power can be adjusted by CAR control at front panel from S/N 310XXXX.
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 ; ○, 300Hz, 2900Hz ; ● Adjust MIC control for 50W. STBY : SEND	Power meter Oscillo-scope AG	Rear panel Front panel	ANT (Direc-tional coupler) MIC	SIG-NAL	TC4	Adjust as shown at right. (Equal 300Hz, 2700Hz ; ○ , 300Hz, 2900Hz ; ● amplitude within 5W).	
	2) MODE : LSB STBY : SEND					TC5		
	3) MODE : USB, LSB AG output : 1500Hz, 5mV STBY : SEND						Calibrate oscillo-scope.	
	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.

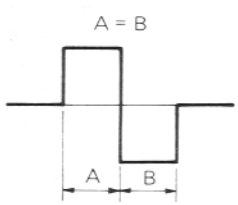
ADJUSTMENT

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)	SIGNAL	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	SIGNAL	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	SIGNAL	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 : 1kHz, 10mV MIC CONTROL : within ALC zone. AGC : FAST STBY : SEND	Power meter AG	Rear panel Front panel	ANT MIC	SIGNAL	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	SIGNAL	VR6	21.555MHz : MIN (S meter and AF output.)	
	2) MODE : CW STBY : SEND					VR3	21.900MHz : MIN (S meter and AF output.)	
						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	SIGNAL	VR32	0.63V/8Ω 800Hz	± 100Hz
	2) PITCH CONTROL : MIN ↔ MAX						Check	800Hz ± 300Hz or more.

ANTENNA TUNER

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
AT-930 Auto antenna tuner (If installed)	1) FREQ : 29,700.0kHz MODE : TUNE CAR VR : MAX METER : SWR STBY : SEND Adjust VR1 so that the motors do not stop at all.	150Ω RF dummy load	Rear panel	ANT	AT	TC1	Adjust TC1 to minimize the angle of motor rotation between points at which the motors are alternately reversed.	
	2) FREQ : 3,500.0kHz First tune, then REC							
	Disconnect the ④ connector. STBY : SEND Turn VFO frequency (up) untill SWR becomes "2".	Oscilloscope	AT	J12	AT	VR2	Adjust as shown at right.	
	3) STBY : SEND Turn VFO frequency (down) untill 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 (μPD5101LC) 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 □□,100.0. 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 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 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	

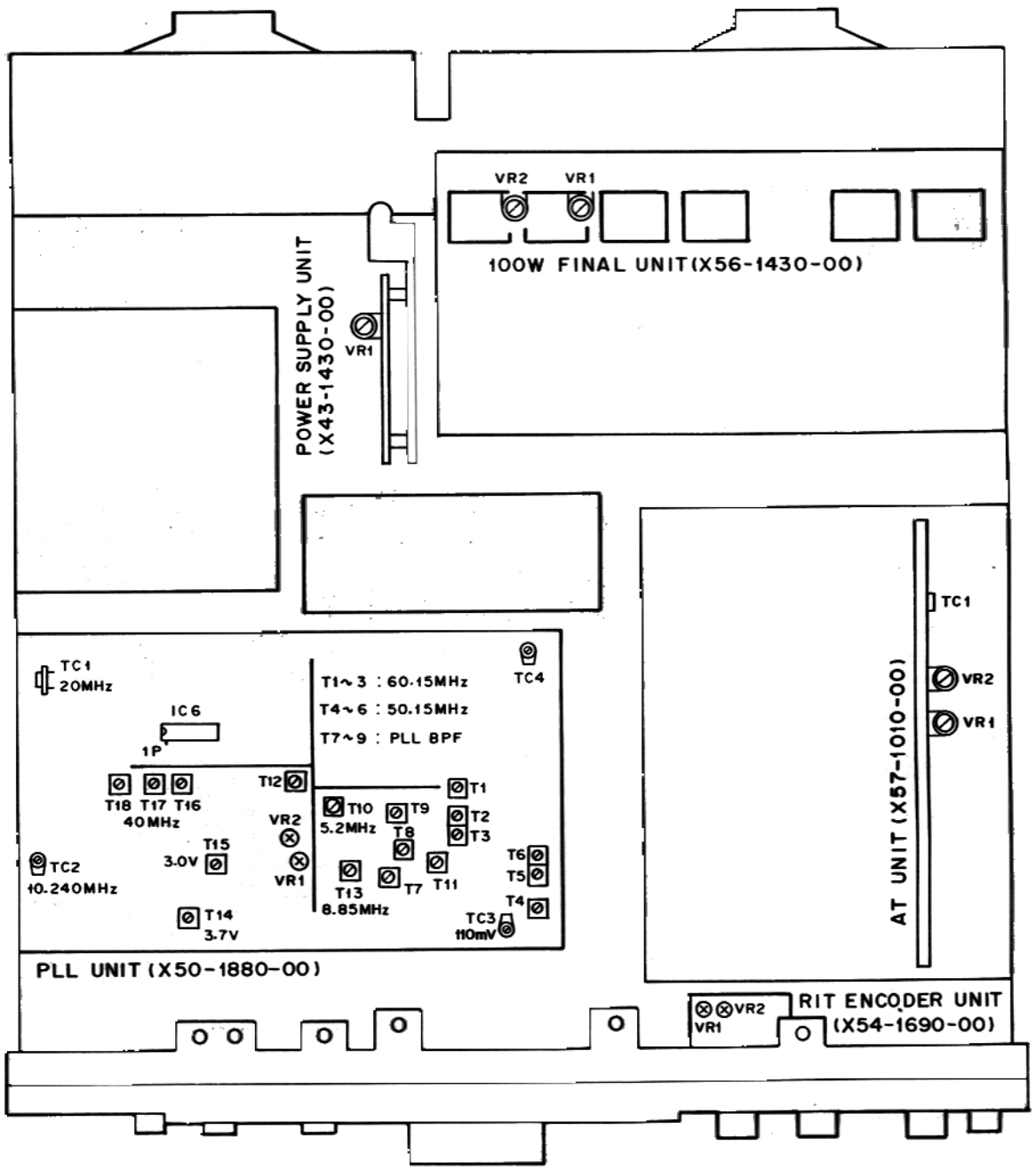
ADJUSTMENT

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 FUNCTION SW : A	FREQ : 21,225.0kHz ANALOG : 220 When A=B SW is depressed, tone sounds.
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

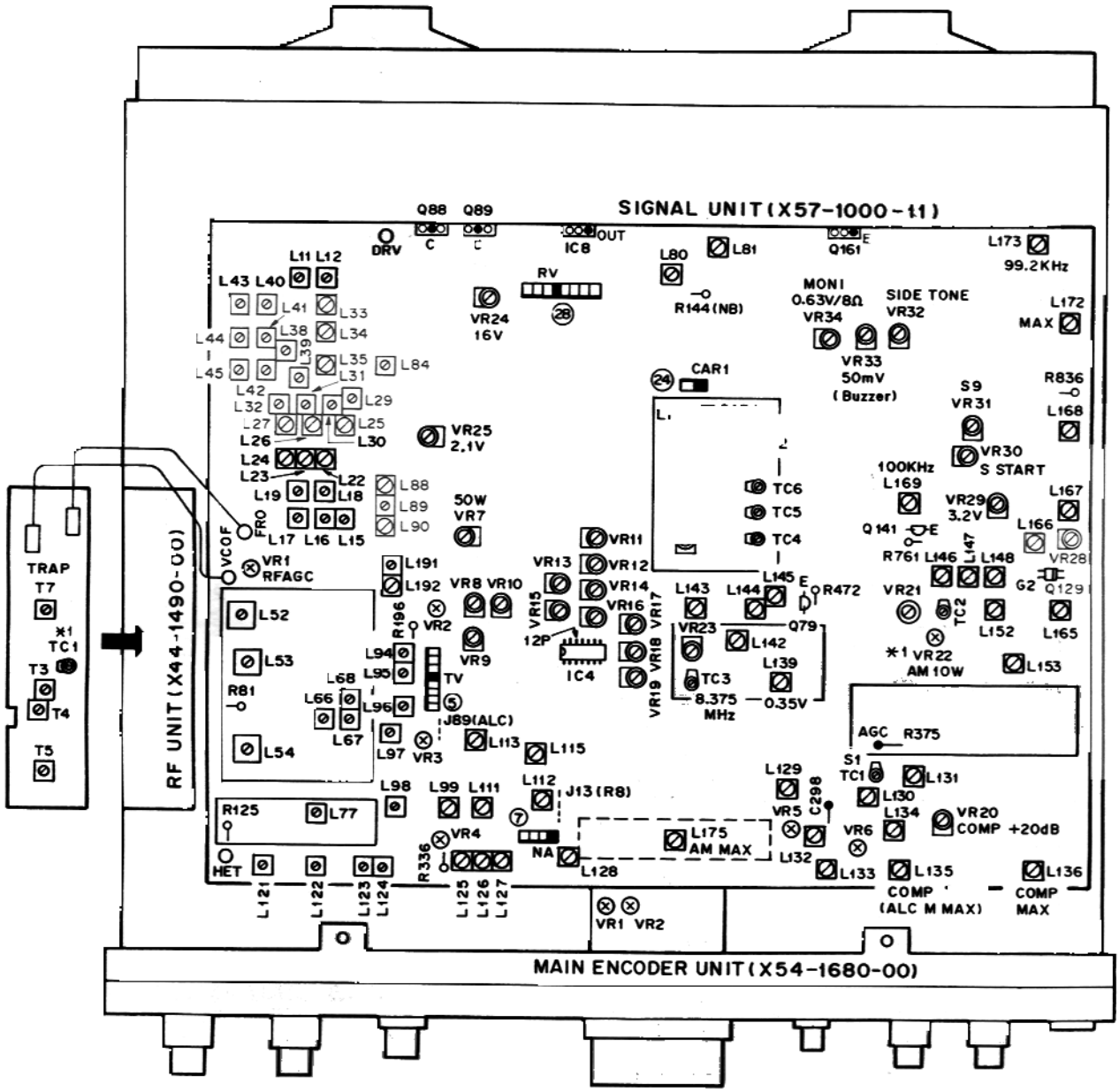


Caution: Use extreme care when working on energized equipment in the areas of the power transformer, and the ON/OFF switch, as there is voltage present even with the ON/OFF switch in the OFF position.

ADJUSTMENT

BOTTOM VIEW

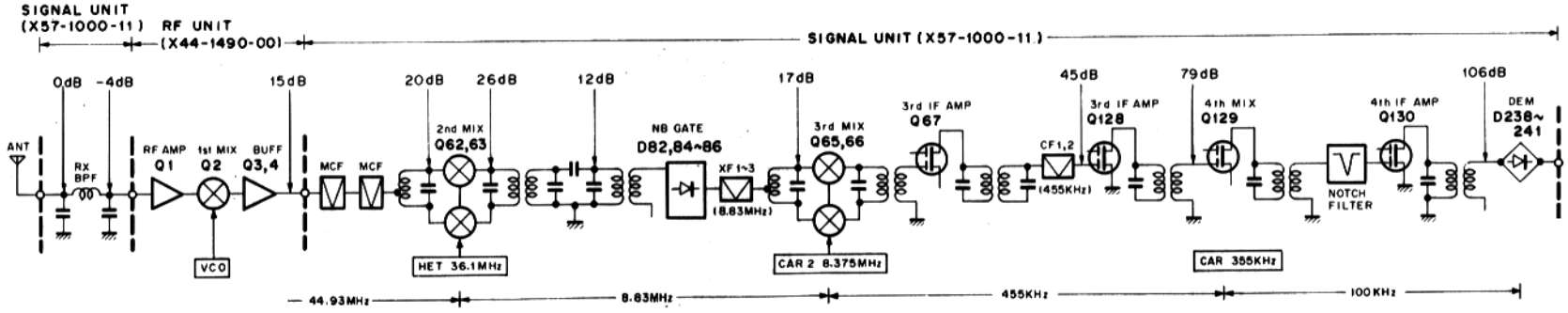
*1 : From S/N208XXXX-309XXXX
*2 : From S/N310XXXX-



L15–17	: 100–500kHz
L18,19	: 0.5–1.5MHz
L22–24	: 1.5–3.0MHz
L25–27	: 3–4MHz
L29–32	: 4–7MHz
L33–35	: 7–8.5MHz
L38,39	: 8.5–14MHz
L40–42	: 14–20MHz
L11,12,43–45	: 20–30MHz
L52	: 29.9999MHz, 13.0V
L53	: 9.5000MHz
L54	: 45.03MHz±1kHz
L66–68	: 45–75MHz BPF
L113	: MONI MAX
L122	: 44.93MHz MCF
TC2	: TX CAR SUPPRESSION
TC4	: USB FREQUENCY RESPONSE (TX)
TC5	: LSB FREQUENCY RESPONSE (TX)
TC6	: CW 8.830MHz

VR2	23.85MHz (TX)
VR3	21.900MHz (TX)
VR6	21.555MHz (TX)
VR8	POWER (TX)
VR9	PROTECTION (TX)
VR10	0.42V (TX)
VR11	ALCϕ
VR12	ALC ZONE
VR13	3.2V
VR14	POWER METER
VR15	SWR STD 0.5V
VR16	SWR
VR17	10A
VR18	ICϕ (TX)
VR19	28.5V
VR21	TX CAR SUPPRESSION
VR26	8827.79kHz FSK

RECEIVER SECTION



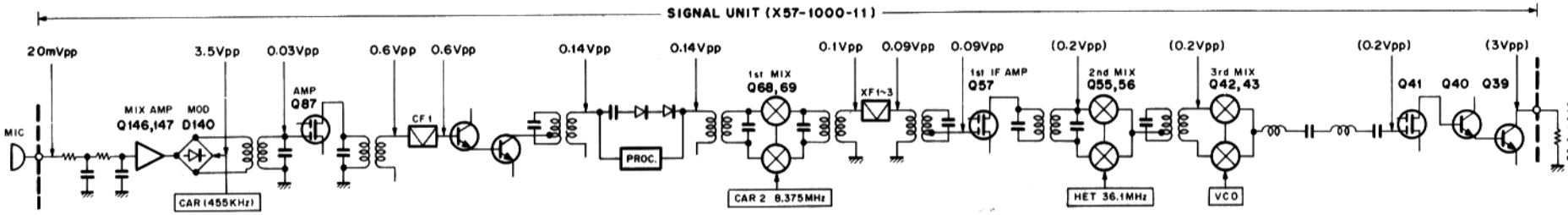
FREQUENCY : 14.200MHz
INPUT : Japanese SSG 0dB
American SSG 0.5μV
AF OUTPUT : 0.63V at 8Ω

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.

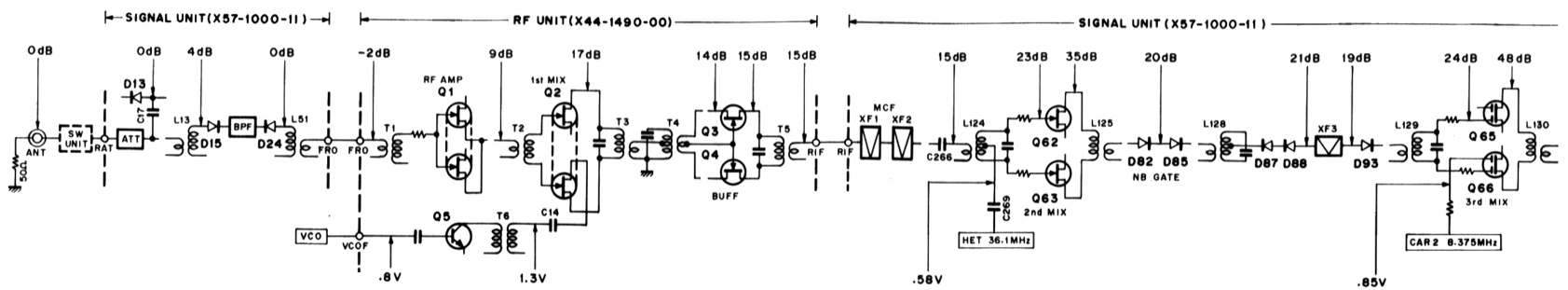
TRANSMITTER SECTION



FREQUENCY : 14.200MHz
MIC INPUT : 20mVpp 1.5kHz

Adjust MIC input level so that the voltage at the 50Ω dummy load is 3VPP.

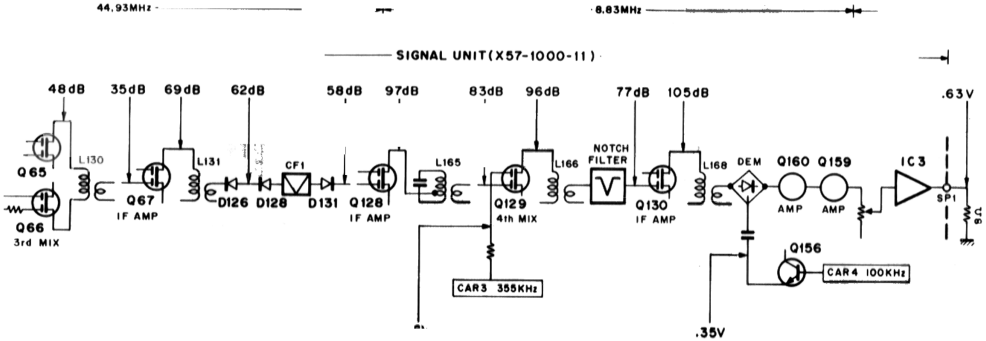
RECEIVER SECTION



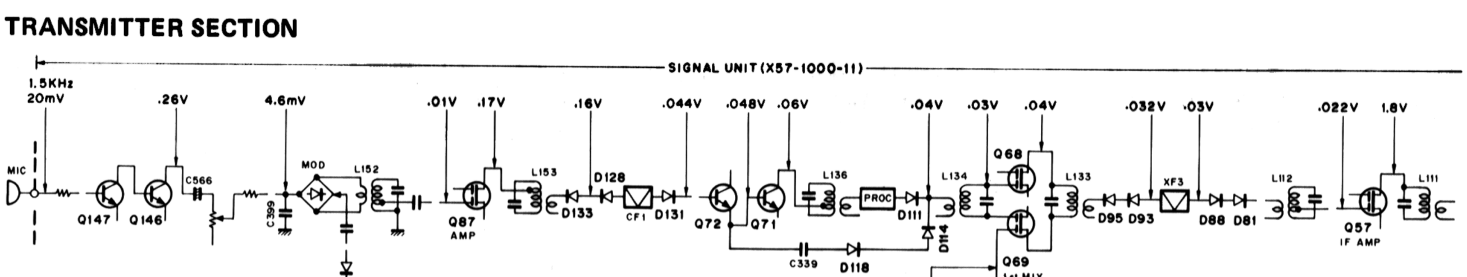
FREQUENCY : 14.200MHz
INPUT : Japanese SSG 0dB (American SSG 0.5μV)
AF OUTPUT : 0.63V/8Ω

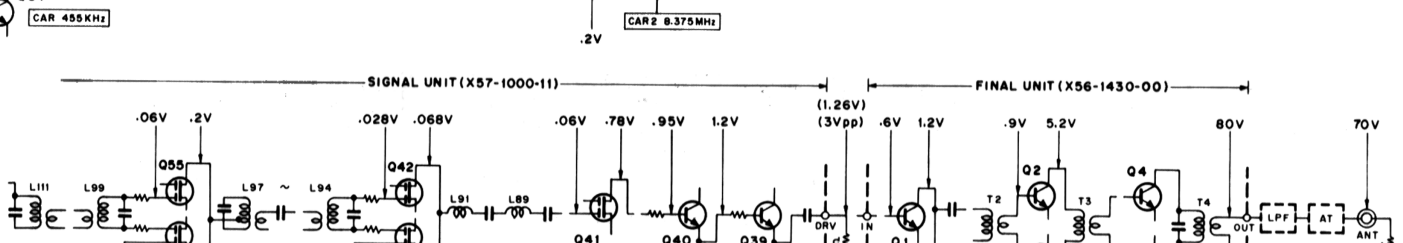
NOTES

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

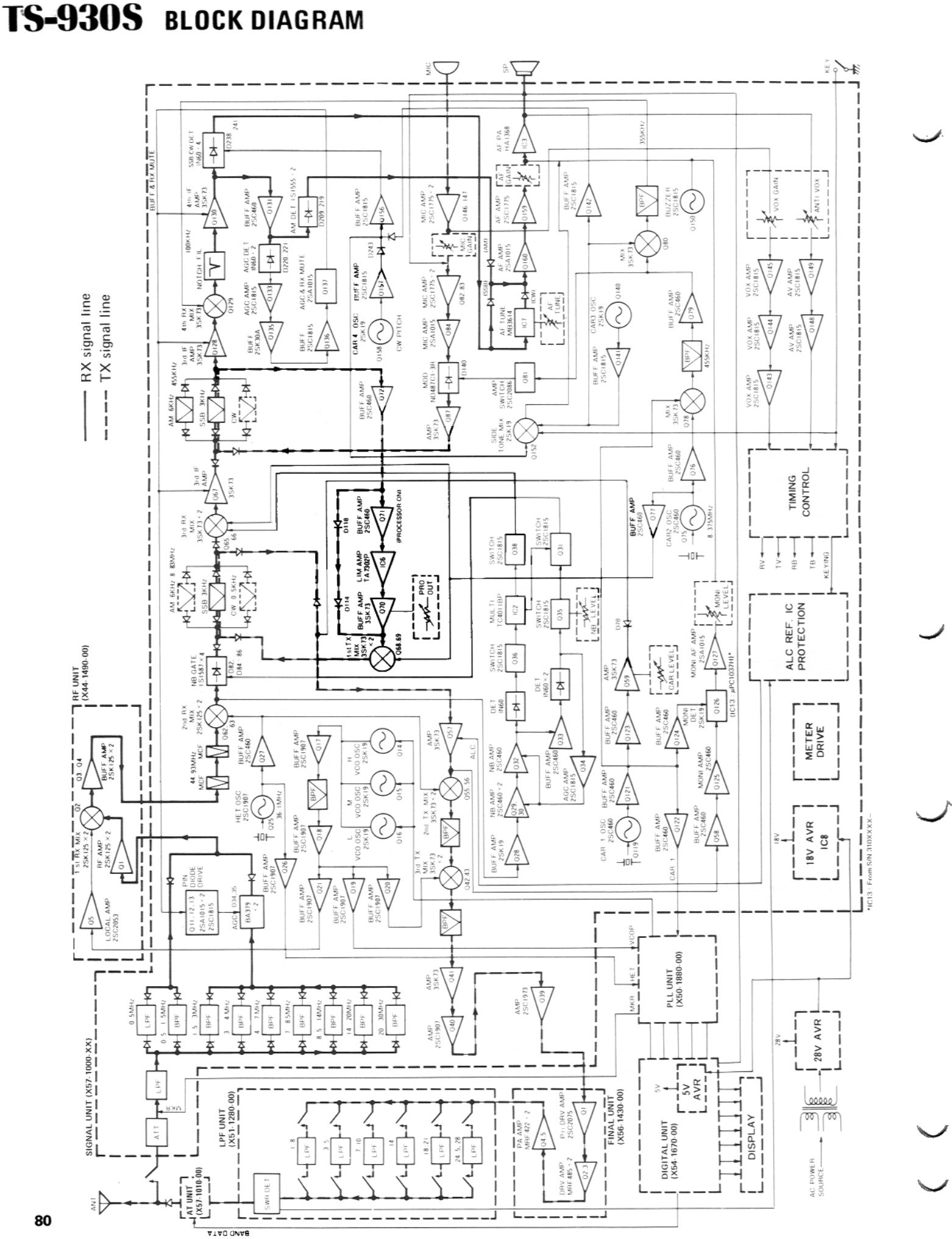




FREQUENCY : 14.200MHz
MIC INPUT : 20mV 1.5kHz

( ) : Adjust MIC input level so that the voltage at the 50Ω dummy is 3Vpp (1.26Vrms).

TS-930S BLOCK DIAGRAM



SP-930

SP-930 SPECIFICATIONS

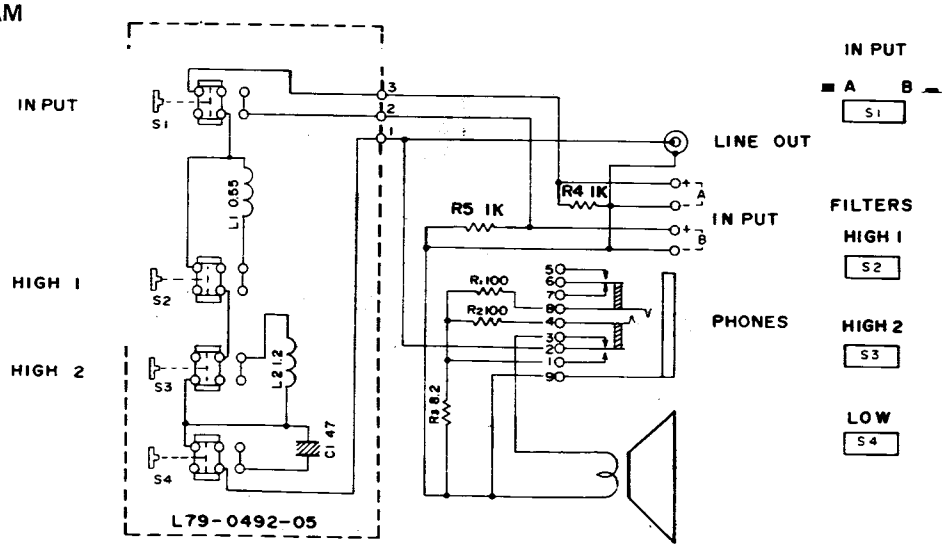
Speaker used:	10 cm dia.
Rated Input:	1.5 Watts
Impedance:	8Ω
Frequency response:	160 Hz to 8kHz.
Filter cut-off frequency,	
LOW:	430Hz, −3dB.
HIGH 1:	2.3 kHz, −3dB.
HIGH 2:	1.0kHz, −3dB.
HIGH 1 + HIGH 2:	730Hz, −3dB.
Filter attenuation:	−6dB/oct.
Dimensions:	W 180 mm (7-1/16")
	H 140 mm (5-1/2")
	D 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

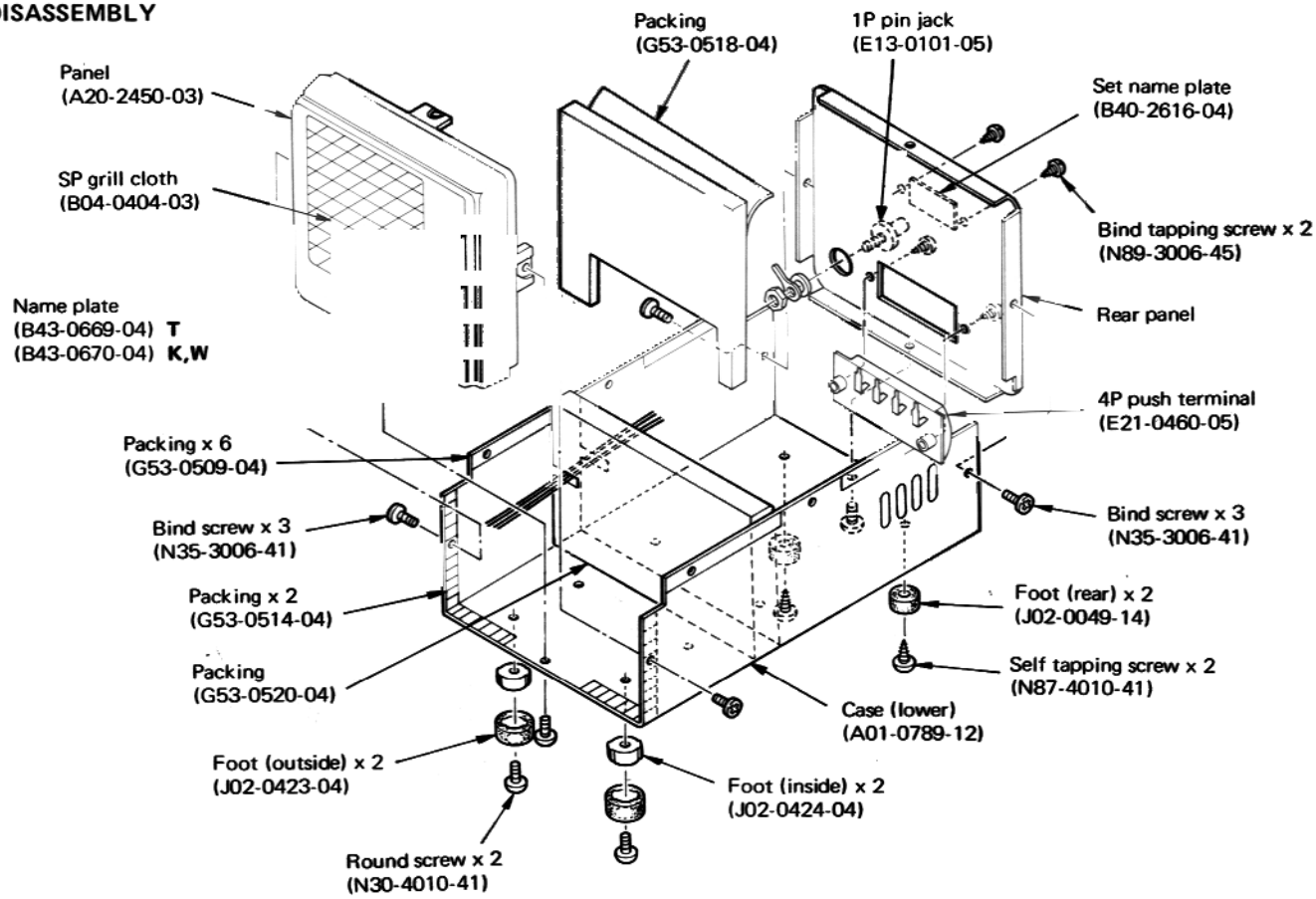
Parts No.	Re-marks	Description		Ref. No.
A01-0789-12		Case (lower)		
A01-0928-03	N	Case (upper)		
A20-2450-03	N	Panel		
B04-0404-03	N	SP grill cloth		
B40-2616-04	N	Set name plate		
B43-0669-04		Name plate	T	
B43-0670-04		Name plate	K,W	
B46-0404-00	N	Warranty card	K	
B50-3980-00	N	Instruction manual	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		
E30-1711-15	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 8.2Ω 2W		R3
S40-2436-05		Push switch		
S42-3405-05		Push switch		
T07-0222-05	N	Speaker		

SCHEMATIC DIAGRAM

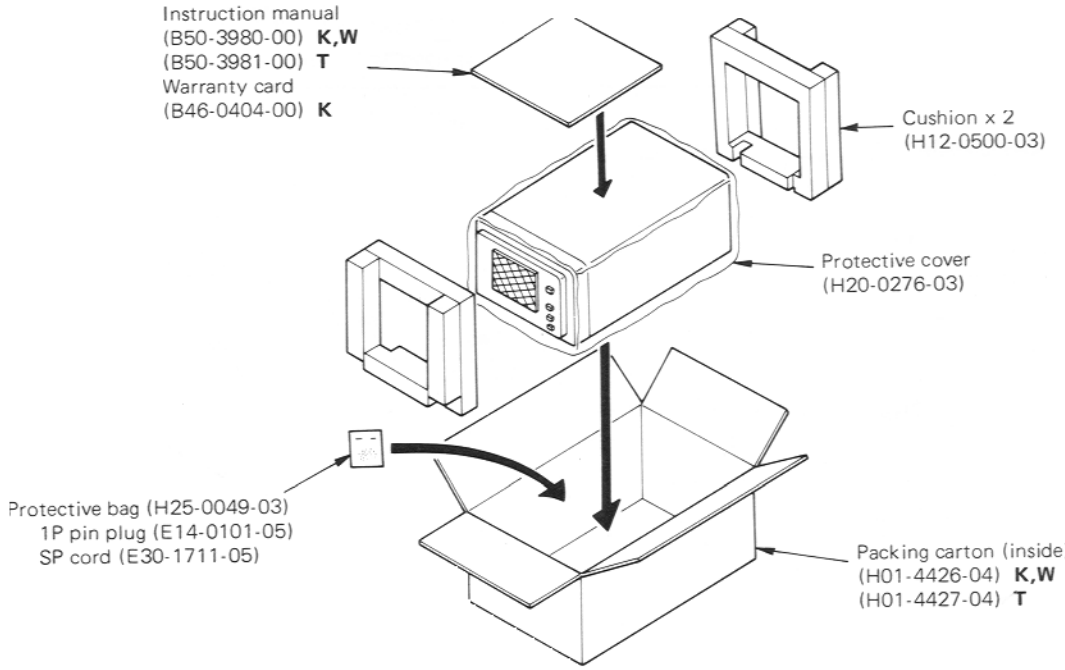


SP-930

DISASSEMBLY



PACKING



AT-930

AT-930 SPECIFICATIONS

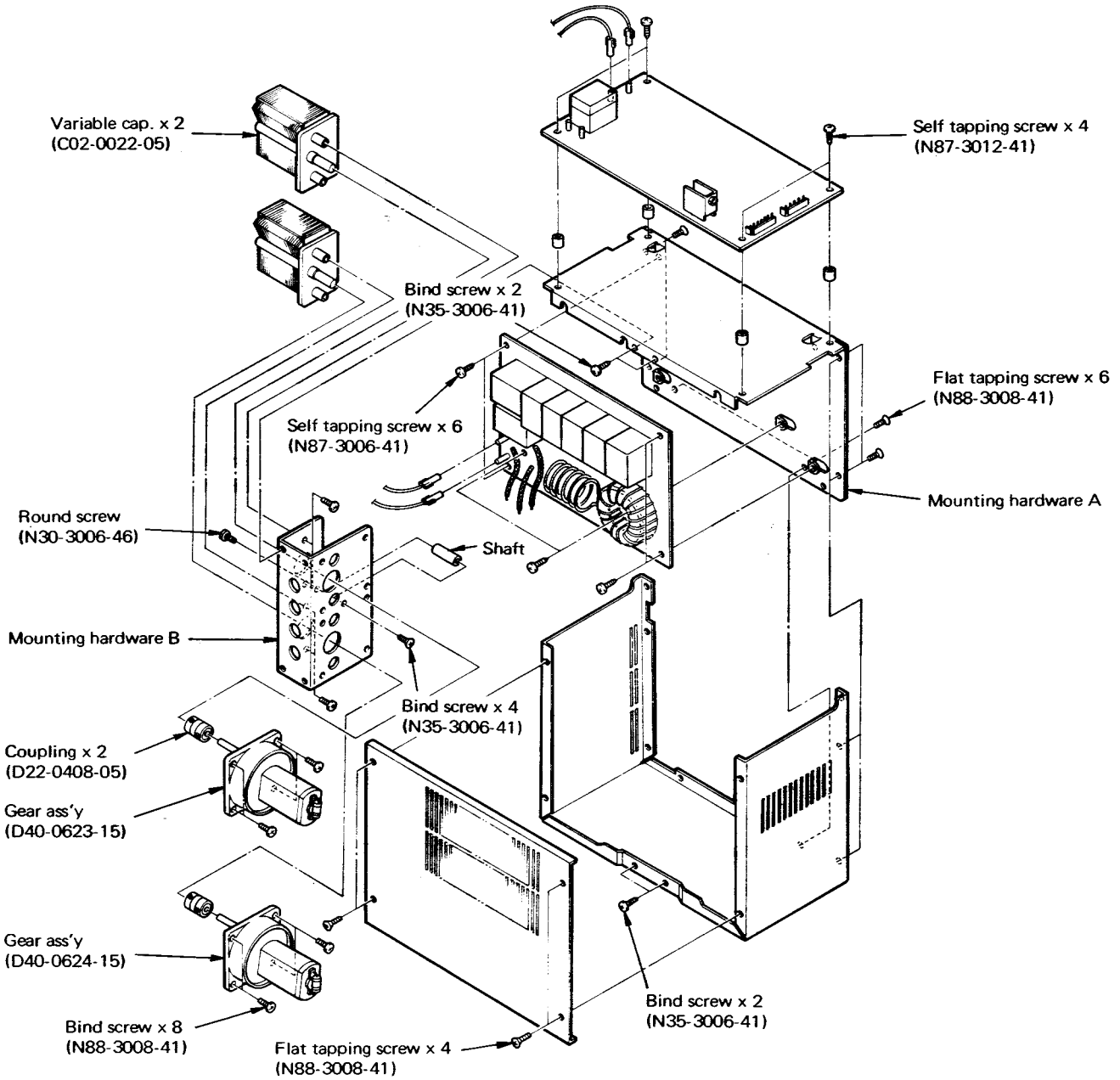
Frequency range:	3.5–29.7 MHz, all amateur bands
Band Selection:	Automatic, by band information from the transceiver.
Input impedance:	50 ohms, unbalanced
Output impedance:	20–150 ohms, unbalanced
Insertion loss:	Less than 1 dB at 29.7 MHz (at best match)
Max. input power:	150W
Motor stop SWR:	Less than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

PARTS LIST

N : New parts

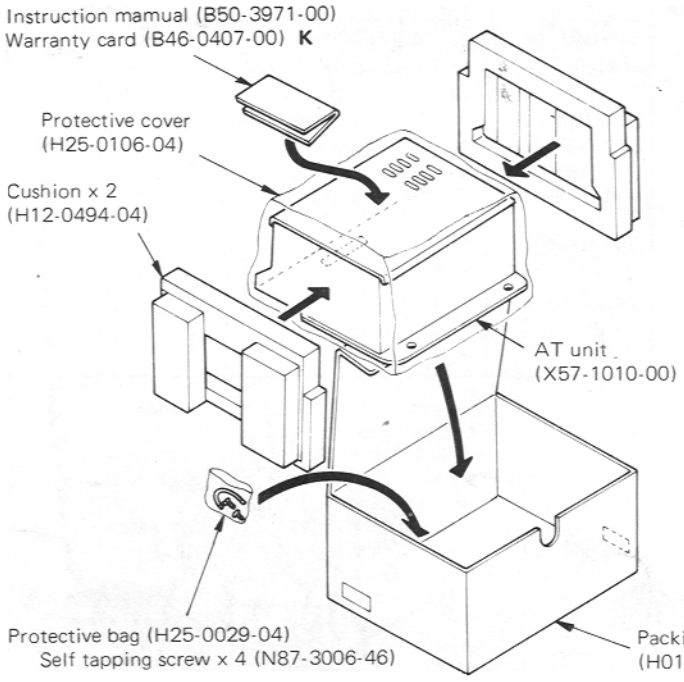
Parts No.	Remarks	Description	Ref. No.
B46-0407-00	N	Warranty card K	
B50-3971-00	N	Instruction manual	
H01-4419-03	N	Packing carton (inside)	
H12-0494-04	N	Cushion x 2	
H25-0029-04		Protective bag Accessory	
H25-0106-04		Protective cover	
N87-3006-46		Self tapping screw x 4	
X57-1010-00	N	AT unit	

DISASSEMBLY



AT-930/SO-1

AT-930 PACKING



SO-1 SPECIFICATIONS

Oscillating frequency 20MHz
Frequency stability (long period) . . . . . $\pm 1 \times 10^{-6}$/Year
Temperature stability . . . . . $\pm 5 \times 10^{-7}$ ($-10^{\circ}C \sim +50^{\circ}C$)
Adjustable frequency range . . . . . More than ± 60Hz
Output . . . . . More than 0dBm at 50Ω
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 oscillotor	1) FREQ : 10,000.0kHz MODE : USB CAL : ON Connect reference signal output of the f-counter to ANT terminal.	f. counter Osillo-scope SP	Rear panel	ANT EXT.SP	SO-1 (PLL)	Poten-tiome-ter	Receive reference signal and marker signal, then adjust so that the AF audio signal becomes the same tone.	Oscilloscope wave NG OK

A product of
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TRIO-KENWOOD (AUSTRALIA) PTY. LTD.
4E Woodcock Place, Lane Cove N.S.W. 2066, Australia

SERVICE BULLETIN

MODEL: TS-930 S	NO.: 0045	DATE: D	M	Y
VON/FROM/DE: TRIO-KENWOOD COMMUNICATIONS Division of TRIO KENWOOD ELECTRONICS GMBH		21	10	83

SUBJECT:

Digital Unit through-plated hole defects and their symptoms

CONTENTS:

The unit shows symptoms as listed below, when any of the 56 Digital Unit through-plated holes are open. These examples were compiled by Mr. Negishi of the Kanto service center. Make full use of the Material as a technical reference for repair.

Through-hole No.	Symptom
1	(GND)
2	(GND)
3	Transmit mode not entered.
4	N/C
5	No display. However, pressing the BAND switch operates the BAND changeover relay.
6	Transmit mode not entered.
7	N/C
8	RIT operates in transmit mode.
9	Continuous tone and no display.
10	RIT operates in transmit mode.
11	(GND)
12	(GND)
13	Continuous sound. All indications are displayed.
14	(GND)
15	(GND)

SERVICE BULLETIN

MODEL: TS-930 S	NO.: 0045	DATE: D	M	Y
VON/FROM/DE: TRIO-KENWOOD COMMUNICATIONS Division of TRIO KENWOOD ELECTRONICS GMBH		21	10	83

16 & 17 No display, display disappears when main dial is turned, or display appears when main dial is turned (when nothing is displayed).

18 Turning the main dial generates an abnormal sound. The abnormal sound increases as the receive frequency is approached.

19 No display. However, 80.888.8 .88 is displayed when connector 9 is removed.

20 No display or 54.444.4 is displayed.

21 36.222.2 or 14.444.4 is displayed.

22 RIT-1.1 kHz is displayed when an odd numbered frequency is displayed.

23 Only the 'g' segment of the display lights; "-"

24

25

26 No display or only segments "egf" light. "1-"

27 & 28 The main dial and UP and DOWN switches do not operate.

29

30 Only segments "g, DP" light.

31 Many analog pointers light. The brightness of the pointers varies widely.

32 All 'g' segments light. "----- "

33 The "DP" segment remains continuously it.

34 Analog values from 0 to 700 are displayed, but values from 700 to 1000 are not.

35 Segments "b,g" only are not displayed. Some of the analog pointers do not light.

36

37 No display because UL.

SERVICE BULLETIN

MODEL: TS-930 S	NO.: 0045	DATE: D	M	Y
VON/FROM/DE: TRIO-KENWOOD COMMUNICATIONS Division of TRIO KENWOOD ELECTRONICS GMBH		21	10	83

38 No display, continuous tone.

39 Three digits of values are not displayed

40 ex. 14.XXX.5

41

42

43

44

45

46

47

48 (The main dial does not operate.) 14.000.0 is displayed. Turning on the RIT switch displayes 14.100.00.

49 Continuous tone. Display is locked, RIT is turned ON and 14.001.4 is continuously displayed. Transmission in no possible.

50 Frequency varies.

51 As if scanning were being performed. Transmission is possible.

52

53

54

55

56