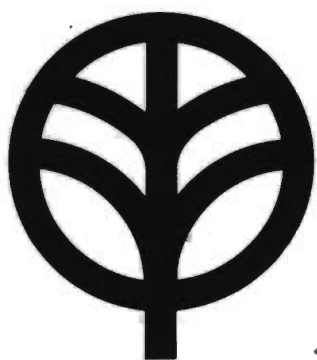




KENWOOD

SERVICE MANUAL

Model TS-820



SSB TRANSCEIVER

TS-820

CONTENTS

TS-820

SPECIFICATIONS	3
BLOCK DIAGRAM	4
FEATURES	5
OUTLINE	6
CIRCUIT DESCRIPTION	6
FUNCTIONAL DESCRIPTION	7
PARTS ALIGNMENT	16
PACKING	19
PARTS LIST	20
DISASSEMBLY	35
TROUBLESHOOTING	38
LEVEL DIAGRAM	42
ADJUSTMENTS	43
Receiver Section	45
Counter (DG-1: Option)	48
Transmitter Section	49
PLL	51
CIRCUIT DIAGRAM/PC BOARD	54
SCHEMATIC DIAGRAM	69
VFO-820 (OPTION)	71
DG-1 (OPTION)	73
YG-88C (OPTION)	82
DS-1 (OPTION)	82

TS-820 SPECIFICATIONS

FREQUENCY RANGE 160 meter band — 1.80 to 2.00 MHz
 80 meter band — 3.50 to 4.00 MHz
 40 meter band — 7.00 to 7.30 MHz
 20 meter band — 14.00 to 14.35 MHz
 15 meter band — 21.00 to 21.45 MHz
 10 meter band — 28.00 to 28.50 MHz (A)
 10 meter band — 28.50 to 29.00 MHz (B)
 10 meter band — 29.00 to 29.50 MHz (C)
 10 meter band — 29.50 to 29.70 MHz (D)
WWV — 15.0 MHz (receive only)

MODE USB, LBS, CW, FSK

POWER REQUIREMENTS

	120/220 VAC, 50/60 Hz operation	13.8V DC operation
Receive	45 watts (heaters on) 26 watts (heaters off)	5A (heaters on) 0.6A (heaters off)*
Transmit	280 watts (maximum)	15A (maximum)

PLATE POWER INPUT

120/220 VAC, 50/60 Hz operation	13.8V DC operation
200 watts PEP for SSB operation	120 watts PEP for SSB operation
160 watts DC for CW operation	90 watts DC for CW operation
100 watts for FSK operation	60 watts for FSK operation

AUDIO INPUT IMPEDANCE 50 k ohms (high impedance)

AUDIO OUTPUT IMPEDANCE 4 to 16 ohms (speaker or headphones)

AUDIO OUTPUT More than 1.5 watts (with less than 10% distortion) into an 8 ohm load.

RF OUTPUT IMPEDANCE 50 ~ 75 ohms

FREQUENCY STABILITY Within 100 Hz during any 30 minute period after warmup
 Within ± 1 kHz during the first hour after 1 minute of warmup

AUDIO FREQUENCY RESPONSE 400 to 2600 Hz, within — 6 db

CARRIER SUPPRESSION Carrier better than 40 db down from the output signal

SIDEBAND SUPPRESSION Unwanted sideband is better than 50 db down from the output signal

IMAGE RATIO Image frequency better than 60 db (50 db for 10 meter band) down from the output signal

HARMONIC RADIATION Better than 40 db down from output signal

SPURIOUS RADIATION Better than 60 db down from output signal (without spurious radiation)

IF REJECTION IF frequency is 80 db or more down from output signal

RECEIVER SENSITIVITY 0.25 μ V S/N 10 db or more

RECEIVER SELECTIVITY SSB: 2.4 kHz bandwidth (— 6 db down)
 4.4 kHz bandwidth (— 60 db down)
 CW*: 0.5 kHz bandwidth (— 6 db down)
 1.8 kHz bandwidth (— 60 db down)
 * (with optional CW filter installed)

TUBE AND SEMICONDUCTOR 3 Tubes
COMPLEMENT 5 IC's
 30 FET's
 74 Transistors
 167 Diodes

DIMENSIONS 13.2" wide $\times$ 5.9" high $\times$ 13.2" deep

WEIGHT 37.4 lbs.

FEATURES

1. HF all-band SSB/CW/RTTY transceiver employing PLL system

This equipment is a SSB/CW/RTTY transceiver covering 1.8 to 29.7 MHz frequency bands (WWV; 15 MHz) in which an ideal circuit configuration has been achieved by employing a newly developed PLL technique.

2. Excellent spurious radiation characteristic and receiving two-signal characteristic

Thanks to employment of a FET balanced type mixer in each of the transmitting and receiving circuits and combination of MOS FET and a single conversion system, excellent performance is obtained in both the spurious radiation characteristic and receiving two-signal characteristic.

3. Built-in IF shift circuit

The IF shift circuit used, also called a pass-band tuning circuit, shifts the pass-band of intermediate frequency without changing the received frequency. Where there is radio interference, the pass-band can be shifted or the receiving frequency response can be set to a desired band only by manipulating one control knob.

4. Built-in RF processor

This transceiver is provided with a unique speech processor developed by KENWOOD. This circuit serves for compression with small time constant at 455 kHz. Due to processing at high frequency, the resulting distortion is minimized and deterioration of the tone quality is prevented unlike clippers.

5. Employment of RF negative feedback

RF negative feedback is applied between the final transmitting stage and the driver stage to suppress cross modulation distortion. The good-reputation high-quality, transmission radio waves are improved further by combination use of the amplifier type ALC and RF negative feedback.

6. Newly developed analogue dial

Due to combination use of the newly developed monoscale dial and subdial, it is very easy to read frequencies. Since such a circuit that a carrier frequency is kept unchanged regardless of change-over of operation mode is employed, each frequency is accurately indicated only by one dial index.

7. Rigid construction and excellent operability

Since die cast is employed for the front panel and the chassis is constructed in the sufficient consideration of strength, the transceiver maintains high mechanical stability even when installed on a vehicle. The reduction gears of the PLATE and LOAD knobs, the shape and arrangement of knobs designed on the base of human engineering permit superb operability together with the dial construction easy to read.

8. Built-in monitoring circuit

Unlike conventional transceivers, TS-820 incorporates a monitoring circuit that permits the operator's speech to be monitored by himself during transmission. This circuit can be used to check the modulated conditions or adjust the RF processor.

9. Audio frequency response change-over circuit to be used during SSB or CW receiving.

During CW receiving, audio frequency band is automatically narrowed to obtain tone quality easy to receive.

10. Built-in fixed channel circuit with RIT (crystal; option)

This transceiver is provided with a fixed channel circuit having RIT. Since cross operation is possible between this circuit and built-in VFO, high technical operation is enjoyable.

11. Transverter connection terminal provided

This transceiver permits combination use with transverter TV-502 (for 2m) only by connector connection. Automatic change-over can also be effected between HF and VHF by using the power switch provided on the transverter.

12. Built-in AC power supply and attachable DC-DC converter

Mobile operation of the transceiver can be performed by equipping a DC-DC converter unit (DS-1) available at option.

13. Wide variety of auxiliary circuits and device

This transceiver is provided with wide variety built-in accessory circuits such as a noise blanker, VOX circuit, side tone circuit, maker circuit, built-in speaker, AGC 3-position change-over switch, heater switch, IF OUT terminal and connection terminals for a linear amplifier.

14. Systematized optional equipment

Optional equipments are fully provided such as remote VFO VFO-820, external speaker SP-520, CW filter YG-88C, digital display DG-1, transverter TV-502 microphone MC-50 and low-pass filter LF-30A.

15. Use of digital display dial DG-1 (option)

1) Digital display dial

The digital dial of TS-820 indicates transmit and receive frequencies using carrier, VFO and local oscillator signals instead of converting VFO frequencies. Thus, accurate frequencies can be read at all times at any band and any operating mode.

Since the accuracy of frequencies is set up only by the 1 MHz standard oscillator, frequencies can be read accurately up to 100 Hz order by calibrating the oscillator with WWV.

The green indication on the dial assures many hours of fatigueless operation.

2) D.H. (display hold) switch

By pressing the D.H. switch, the frequency read on the digital remains on, thus serving as a memory system.

OUTLINE / CIRCUIT DESCRIPTION

OUTLINE

The block diagram of TS-820 is shown on page 4.

The receiver part employs a single superheterodyne system, while the transmitter part employs a single conversion system having a filter type SSB generator. The intermediate frequency used is 8830 kHz.

The local oscillator employs a phase locked loop (PLL) circuit controlled by VFO and the mixer circuit is of a balanced mixer type using dual-gate MOS FET in each of transmission and reception. Thus, spurious radiation is minimized during transmission, and the desired signal can be received without being interfered by large signals of adjacent channel or spurious radiation, thus obtaining superb transmitting and receiving performances.

The IF shift function (electronic pass-band tuning) is also realized by making the most of PLL characteristic and use of one SSB filter permits the same effect as in use of exclusive filters for USB and LSB.

In addition to the conventional accessory functions, the various circuits newly developed such as RF speech processor and transmission monitor are provided.

CIRCUIT DESCRIPTION

TRANSMITTER SECTION

A voice signal applied to the microphone is fed to IF unit and amplified by microphone amplifiers Q19 ~ Q21, which performs faithful amplification using low-noise type transistors. The audio frequency signal, after amplified, is applied to a ring modulator consisting of four diodes D26 ~ D29. The DSB output of the ring modulator is passed through buffer amplifier Q18 and a crystal filter. Then after converted into SSB signal, the output is further IF amplified by Q1 to be applied to the transmitter mixer in RF unit.

The transmitter mixer is of a double balanced mixer configuration using two MOS FETs Q1 and Q8 (3SK41). In turn the output of VCO (voltage controlled oscillator) controlled PLL is used for the local oscillation, thereby minimizing spurious radiation. The SSB signal, the transmission signal converted into the desired frequency, is amplified by transmitter driver tube 12BY7A and then is applied to the final stage power amplifier.

The final stage tubes are operated in AB1 class to amplify SSB signal with low distortion and the output thus obtained is fed to the antenna through a π matching circuit.

RF negative feedback is applied between the final stage and the driver stage to suppress the cross modulation distortion further.

RECEIVER SECTION

The incoming signal is passed through RF ATT switch and after attenuated by approx. 20 dB, if necessary, is applied to RF unit, and then RF amplified by Q2. The amplified signal is passed through buffer amplifier Q3 and is mixed with the VCO output by balanced mixer consisting of two dual-gate MOS FETs Q6 and Q7, thereby being converted in IF signal of 8830 kHz.

This signal is fed to IF unit and, after passing through the noise blanker circuit and crystal filter, is amplified by three stages amplifiers Q1, Q2 and Q3 (3SK35) and then converted into AF signal by a ring detector consisting of four diodes D9 through D12.

The AF signal thus obtained is applied to AF AVR unit and amplified by Q1, Q2 and Q3 to a sufficient level enough to drive the speaker. The frequency response of the AF amplifier is changed over to that for CW or SSB in interlocking with MODE switch.

UNIT

IF UNIT (X48-1150-00)

The IF unit is a very principal unit provided with many functions in both transmission and reception. It consists of a microphone amplifier, ring modulator, crystal filter, transmitter/receiver IF amplifier and ring detector as well as a noise blanker, AGC amplifier, S meter amplifier, speech processor and monitoring circuit.

Crystal filters are equipped only for SSB, but CCW filters available at option can be attached easily.

RF UNIT (X44-1150-00)

This unit includes the ALC amplifier and the block bias circuit, centering around the transmitter and receiver RF amplifier stage and mixer circuit. They are arranged together with the coil pack unit of centralized tuning circuit.

COIL PACK UNIT (X44-1140-00)

Individual interstage coils of each band, band change-over rotary switch and variable capacitors are arranged neatly in this unit, while operating in combination with the RF unit.

PLL ASSEMBLY UNIT (X60-1010-00)

This consists of PD unit (X50-1340-00) and VCO unit (X50-1330-00) to compose transmitter and receiver local oscillators. Oscillation output having the same stability as in the built-in VFO is obtained for each frequency band.

The PD unit consisting of crystal oscillators for respective frequency bands, two mixers, a wave shaper and a phase comparator generates a control voltage for VCO (voltage controlled oscillator) as a reference oscillator, and also configures an electronic IF shift loop arrangement using the carrier signal supplied from outside.

The VCO unit consists of oscillator for respective frequency bands using FET (VCO), buffer amplifier and the oscillation output stopping circuit, which stops the oscillation output when PLL fails, and its output frequency is controlled by the control signal fed from the PD unit.

Both units use diode switches for band change-over.

COUNTER ASSEMBLY UNIT (X60-1020-00) (DG-1: Option)

This unit consists of a counter mixer unit (X54-1150-00) and a counter unit (X54-1160-00); the former mixes VCO output (the local oscillation signal of mixer) with a carrier signal into actual operating frequency and the latter counts the digital value of that frequency.

CIRCUIT DESCRIPTION / FUNCTIONAL DESCRIPTION

- These circuits are strictly housed in a shield case. Since all local oscillator signals are read after combined with carrier signals, actual operating frequency can be always counted. The output of the counter is picked out as a signal for driving the display tube and supplied to the display unit.

DISPLAY UNIT (X54-1170-00) (DG-1: Option)

The operating frequency counted by the counter unit is indicated by a 6-digit fluorescent display tube. Use of blue display color won't weary the operator's eye.

5V AVR UNIT (X43-1220-00) (DG-1: Option)

This unit is a 5-volt stabilized power supply for the counter unit. Due to use of ICs, the specified voltages are obtained without making any adjustment.

CARRIER ASSEMBLY UNIT (X60-1000-00)

This unit consists of a CAR-1 unit X50-1310-00 and CAR-2 unit X50-1320-00. CAR-1 unit includes oscillator circuits for LSB and USB transmission and reception and for CW and FSK reception, while CAR-2 unit includes oscillation circuits for CW and FSK transmission.

These oscillators are crystal oscillators that serve as carrier generator during transmission and as BFO for the ring detection during reception. Part of the output is applied to the PLL unit and counter unit.

AF-AVR UNIT (X49-1080-00)

This unit includes AF amplifier in the final stage of the receiver section and the 9-volt stabilized power supply. The frequency response of the AF amplifier can be automatically changed over to that for CW or CCW with tone switching diodes D1 and D2 by changing over the band switch.

FIX-VOX UNIT (X50-1350-00)

This unit includes a fixed-channel oscillator circuit, VOX circuit for performing stand-by operation by means of voice and —6-volt generator circuit for block bias.

VFO UNIT (X40-1110-00)

Since the PLL circuit is controlled by VFO signal, the frequency stability of TS-820 is essentially determined by that of VFO. The circuit consists of 2 FETs, 2 transistors and 3 diodes, and the oscillation frequency is 5.0 to 5.5 MHz.

MARKER UNIT (X52-0005-01)

A signal of 100 kHz is generated by driving a crystal quartz by Q1. This oscillation frequency can be fine adjusted by ceramic trimmer TC1 inserted into the collector circuit. The output of Q1 is wave-shaped by diode D1 and thereby the free-running multivibrator Q2, Q3 is triggered. Although the free-running oscillation frequency exists around 25 kHz, it is accurately synchronized with 25 kHz by the synchronizing signal of the output of the crystal oscillator. This oscillation frequency is phase inverted by Q4 and then taken out as the output.

FINAL UNIT (X56-1200-00)

This unit includes the final stage power amplifier compartment except for the output-side π matching circuit.

RELAY UNIT (X43-1190-00)

This unit consists of a stand-by relay and smoothing capacitors for DC low-voltage power supply and a 5-volt stabilized power supply for the PLL circuit. The relay in this unit is mainly used to change over DC signal such as block bias or "cross" operation control.

HV UNIT (X43-1110-00)

This unit includes voltage-dividing resistors for measuring the plate voltage of S2001A and voltage dropping resistors for reducing the screen voltage of S2001A with the MODE switch set to TUNE position.

RECTIFIER UNIT (X43-1090-02)

This unit contains all the rectifier circuits of TS-820. The high-voltage line of 800-volt uses voltage doubler rectifier, the 300-volt/210-volt/C line uses a half-wave rectifier and the 14-volt line uses a bridge rectifier.

INDICATOR UNIT (X54-1180-00)

TS-820 permits 16 kinds of the so-called "cross" operations using internal VFO, remote VFO and internal fixed channels to be optionally selected by the operation of the function switch. To perform this operation smoothly it should be able to be checked instantly which is in operation among two VFOs and internal fixed channels. Thus, this unit indicates the individual operations of "VFO", "ATT", "FIX" and "RIT" using GaP light-emitting diodes.

VOX-VR UNIT (X54-1190-00)

Three variable resistors VOX GAIN, ANTI VOX and DELAY are directly mounted onto a printed circuit board.

FUNCTIONAL DESCRIPTION

SINGLE CONVERSION SYSTEM

Almost all conventional transceivers for amateur use employ the double conversion system as shown in Fig. 1, particularly with the first local oscillator fixed and the second local oscillator variable. This double conversion system has also been employed by KENWOOD in the transceivers up to TS-520.

The double conversion system has the following features.

1. Multiple-band arrangement can be obtained comparatively easily by selecting the first local oscillator frequency.
2. The first IF frequency is fairly free to be set.
3. Mixer noise is apt to increase due to twice frequency conversions.
4. Excessive level signals are fed to the second mixer. Thus, the two-signal characteristic might be deteriorated.
5. Due to many internal oscillators and mixers beat interference and spurious radiation are liable to be caused.

FUNCTIONAL DISCRIPTION

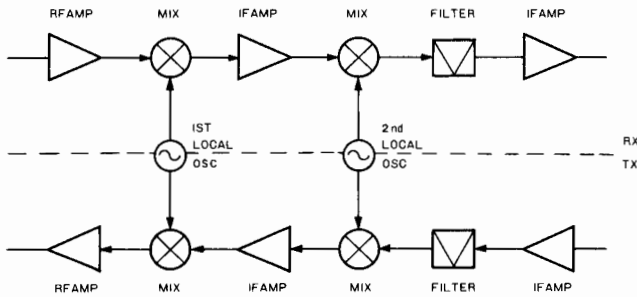


Fig. 1 Typical double conversion type

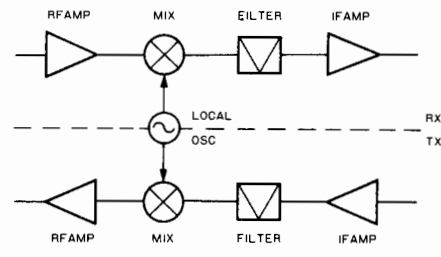


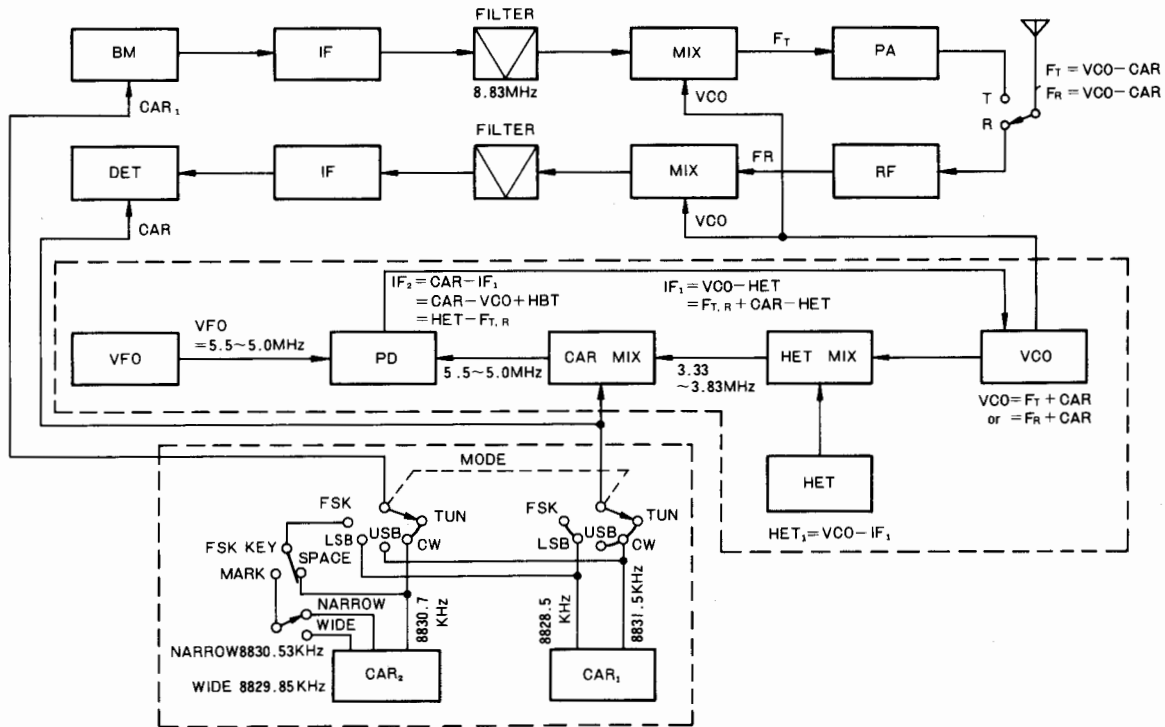
Fig. 2 Single conversion type

In turn the single conversion system has a simple circuit configuration, as compared with the double conversion system, as shown in Fig. 2, and it is considered to be provided with the following features.

1. Since only one mixer is used, mixer noise level is low.
2. Since the number of oscillators can be reduced, beat interference in receiving and spurious radiation in transmitting are eliminated comparatively.
3. It is comparatively difficult to increase the number of bands. Thus, the local oscillator circuit configuration becomes complicated.
4. IF frequency cannot be set to a higher frequency (due to the IF crystal filter used).

TS-820 is designed to enhance the two-signal characteristic in receiving and on suppression of spurious radiation in transmitting. Thus, it employs the single conversion system with PLL type local oscillator. Employment of the PLL system permits various merits such as unification of the dial pointer and IF shift function.

The circuit configuration of TS-820 is as shown in the block diagram. As shown in Fig. 3 (Frequency diagram) TS-820 is of a single conversion type using PLL local oscillator and crystal filters of 8.83 MHz IF frequency.



MODE	FREQ. KHz	OSC
LSB	8828.5	CAR 1
USB	8831.5	"
CW(T)	8830.7	CAR 2
CW(R)	8831.5	CAR 1
FSK(R)	8828.5	"
FSK(S)	8830.7	CAR 2
FSK(M)	8830.53	"
FSK(W)	8829.85	"

BAND	VCO	HET	BAND	VCO	HET
JJY/WWV	23.83~24.33	20.5	29	37.83~38.33	34.5
1.8	10.63~11.13	7.3	29.5	38.33~38.83	35.0
3.5	12.33~12.83	9.0	AUX		
7	15.83~16.33	12.5			
14	22.83~23.33	19.5			
21	29.83~30.33	26.5			
28	36.83~37.33	33.5			
28.5	37.33~37.83	34.0			

Fig. 3 TS-820 frequency diagram

FUNCTIONAL DISCRIPTION

RF SPEECH PROCESSOR

During DX communication, TS-820 can increase talk power by using the speech processor, in which audio frequency signal is converted into 455 kHz SSB signal and compression processing is performed with a small time constant. Thus, signal distortion is minimized and tone quality is prevented from being deteriorated, as compared with the conventional clipper system. The compression level can be adjusted by the COMP LEVEL knob, while watching the meter scale.

The audio frequency signal applied to the microphone is amplified by Q22 to the level required for the balanced modulator circuit D31 to D34 and converted into 455 kHz. Q28 is an oscillator for 455 kHz and Q29 is a buffer amplifier. The voice signal converted into 455 kHz is amplified sufficiently by Q23 and Q24, subjected to automatic gain control by Q26 and Q27, and compression-processed.

The processor level is adjusted by changing the emitter bias of Q23 with the RF PRO variable resistor.

The signal sufficiently compression-processed is buffer amplified by Q25 and balance detected by D35 to D38 to be converted into audio frequency again (refer to Fig. 4).

MONITORING CIRCUIT

Since TS-820 is provided with a monitoring circuit that permits the operator to hear his voice during transmission, it can be used to check the modulated condition or to adjust the RF speech processor. This circuit is incorporated in the IF unit. When the MONI switch mounted on the front panel is turned ON, the monitoring circuit is biased and operated. The signal is passed through the IF crystal filter of 8.83 MHz, amplified by one-stage IF amplifier, buffer amplified by Q12 in the monitoring circuit, further amplified by Q13, product detected by FET Q14, and thereby demodulated into AF signal. The AF signal thus obtained is then applied through VR4 to Q3 in AF AVR unit and thereby power amplified. This circuit is energized only in SSB transmission. D16 and D17 act as a diode switch to prevent the carrier from leaking into IF circuit (refer to Fig. 5).

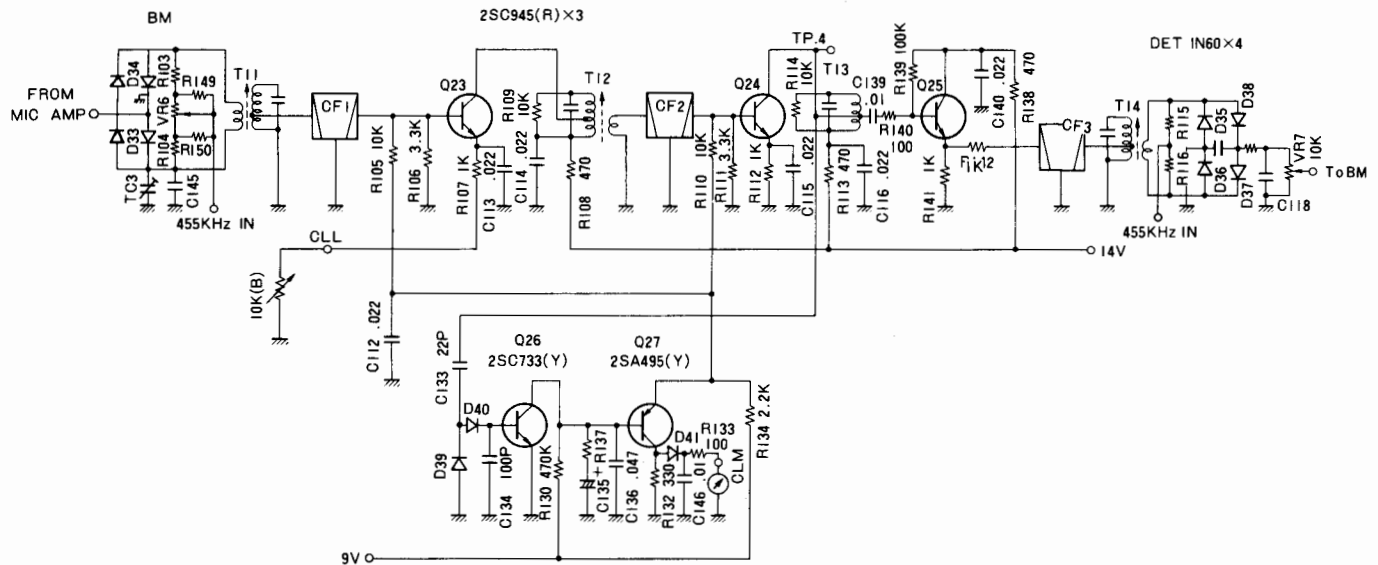


Fig. 4 RF speech processor

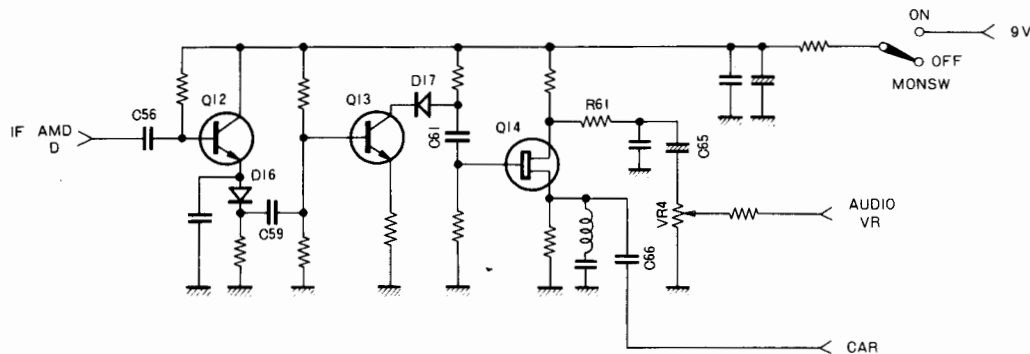


Fig. 5 Monitor circuitry

FUNCTIONAL DESCRIPTION

PLL CIRCUIT

Fig. 6 shows the circuit configuration of the PLL system developed in TS-820. In this system, VCO signal is mixed with HET signal and thereby converted into a signal of 3.33 to 3.83 MHz common to all bands, which is further mixed with a carrier to be converted into 5.5 to 5.0 MHz. This signal is phase compared with VFO signal of 5.5 to 5.0 MHz. The comparison output thus obtained is returned to VCO to lock it.

The HET mixer serves to convert the different frequencies of individual bands into the same frequency, whereas the carrier mixer acts to keep the transmitting and receiving frequencies constant regardless of change-over of the MODE switch by applying a carrier signal to the PLL loop and to perform IF shift. **Fig. 7** shows the block diagram of the PLL part.

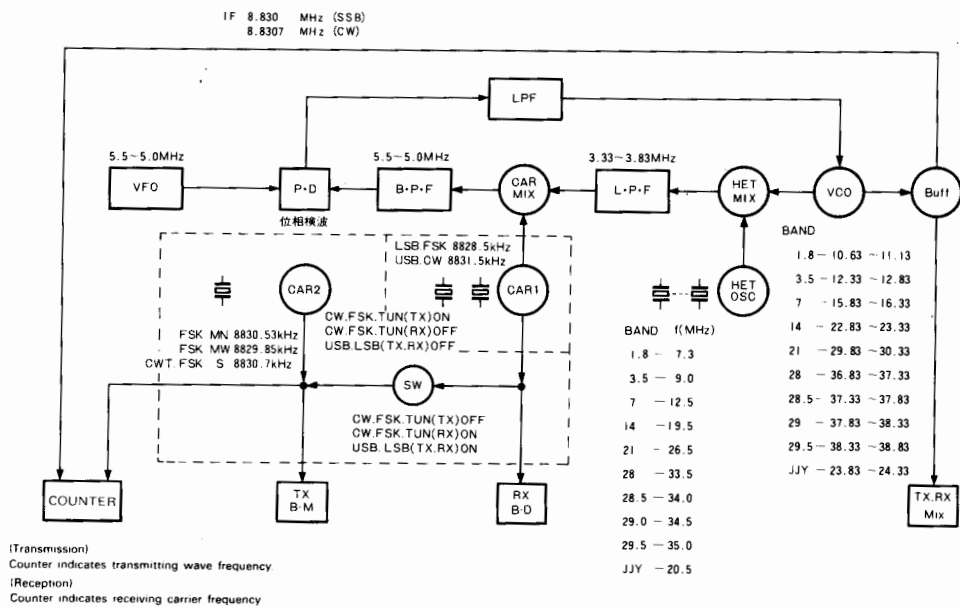


Fig. 6 PLL system

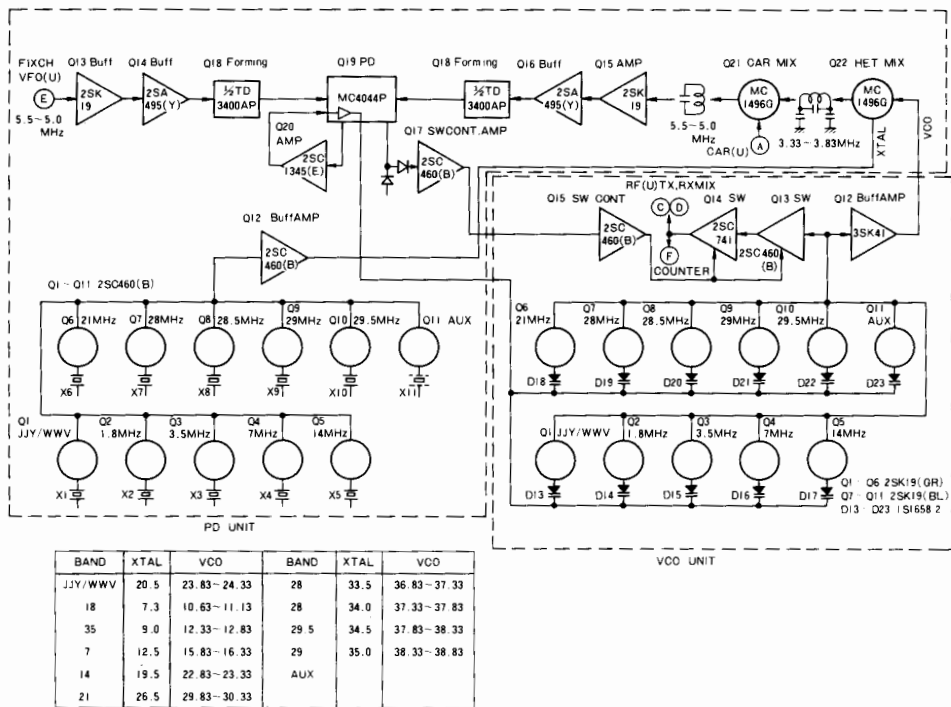


Fig. 7 PLL assy

FUNCTIONAL DISCRIPTION

VCO is provided with independent oscillators for the respective bands up to Q1 to Q11, which can be changed over by the band switch. The stability of this circuit is determined by HET, CAR and VFO. Since HET and CAR are crystal oscillators, it is considered to be determined only by the stability of VCO. The high stability of VCO itself is also essential as the major point in design in order to improve C/N of VCO output and prevent unlocking due to temperature variation. Thus, FET is used as the oscillator transistor to strictly compensate for temperature variation in the coils. The output of this VCO is applied to the transmitter and receiver mixers through Q13 and Q14 which serve as a buffer and also switching amplifier.

As in VCO, HET is provided with independent oscillators for the individual bands, which are changed over by the band switch in interlock with VCO. This change-over is effected by +B power and switching diodes. The oscillator is a Colpitts type non-adjustment circuit.

The CAR mixer preceded by the HET mixer uses MC-1496G for balanced mixer to prevent spurious radiation and a band-pass filter is inserted at its output. If a spurious signal is contained in the output of this carrier mixer, it may be mixed with the output of PD and appear at VCO.

The carrier oscillator circuit is divided into CAR 1 and CAR 2; the former is in charge of CW (receive), USB, LSB, FSK

(receive) and the latter is charge of CW (transmit) and FSK (transmit). The crystal oscillators used are three of 8828.5 kHz, 8831.5 kHz (AR1) and 8830.7 kHz (AR2) and other oscillators are of a variable frequency type using varicap diodes. The signal to be applied to PLL loop is generated at the CAR 1 side. Thus, when CW or FSK signals, the frequencies of which are different between transmitting and receiving, are transmitted, PLL loop is composed of CAR 1 and the transmitting carrier is generated by CAR 2.

The output of the carrier mixer, after amplified by buffer amplifier Q15 and Q16, is wave shaped by NAND gate Q18 (TD3400AP) and applied to MC-4044P. Meanwhile, the output of VFO, after amplified by buffer amplifier Q13, Q14, is wave-shaped by Q18 and fed to MC-4044P.

MC-4044 consists internally of a phase detector (PD), charge pump and amplifier, and it is used in this transceiver as shown in **Fig. 8**. The output of PD #1 is fed to the varicap of VCO through the charge pump and active filter. The output D2 of PD #2 becomes high level (constant) when either (or both) input signal is removed. By utilizing this quality, it is used as OFF circuit for VCO. If the TS-820 function is changed over to remote VFO without connecting remote VFO, PLL is not locked. Thus, under such a condition, VCO output is automatically turned OFF.

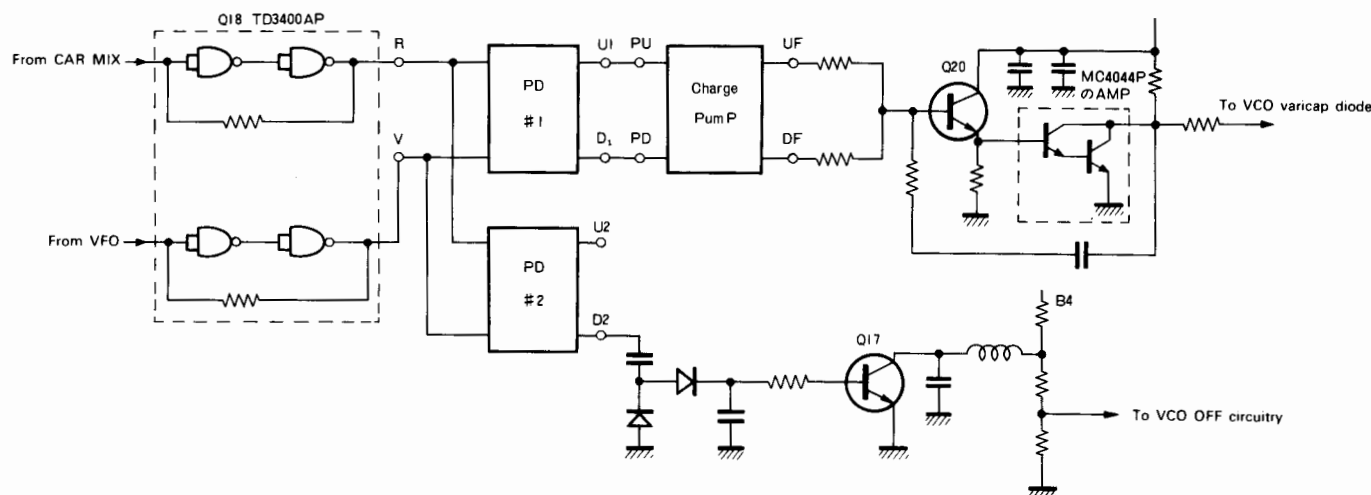


Fig. 8 TS-820 phase detector circuit

FUNCTIONAL DESCRIPTION

This PLL part consists of two printed circuits boards of VCO part and PD/HET part. These printed circuits boards are shielded from each other and the overall unit is housed in a shielding case, thus achieving full shield effect. The PLL circuit of this transceiver is provided with the following features.

1. Since the phase comparison is performed at a frequency as high as 5 MHz, the response speed is rapid and C/N is improved. When "cross" operation is performed together with remote VFO or fixed channels by using VOX, the signal is interrupted at the beginning if the lock time is not long. When the reference frequency is as high as 5 MHz, the cut-off frequency of the active filter can be selected at high frequency and therefore no problem is offered here.
2. Since VCO is used independently in each band, the C/N of the oscillator is improved.
3. Since the output of VCO is applied directly to the transmitter and receiver mixers, the spurious characteristic is excellent. This is one of the large merits, as compared with the premix system.
4. Since MC-4044 is used for phase comparison and therefore the variable range of VCO is narrow, there is no possibility of unlocking.
5. Since VFO uses the conventional range of 5.5 to 5.0 MHz, TS-820 has compatibility with other KENWOOD's transceiver models.

The VFO used is basically the same as the traditional VFO. VFO-520 can be used as remote VFO as it is.

IF SHIFT CIRCUIT

This IF shift operation shifts the carrier frequency by ± 1.7 kHz and thereby moves IF frequency and the pass-band of the crystal filters. Thus, AF output can be received in the frequency response of ± 1.7 kHz high-cut or low-cut. As shown in **Fig. 9**, the IF shift circuit is energized only during receiving and deenergized during transmitting, fixed by VR1 in CAR-1 unit. This function is achieved by employment of use of PLL circuit in the local oscillator part. The feature of the IF shift circuit is as follows:

1. Tone quality adjustment and interference elimination during SSB receiving. During USB mode operation, the receiving characteristics of low-cut and high-cut are obtained by turning the IF SHIFT knob clockwise and counterclockwise respectively. (Opposite to the above during LSB mode operation.) Thus, the received signal can be heard in the desired tone quality, and interference from the sidebands of adjacent channel signals, if any, can be eliminated by using the IF shift circuit.

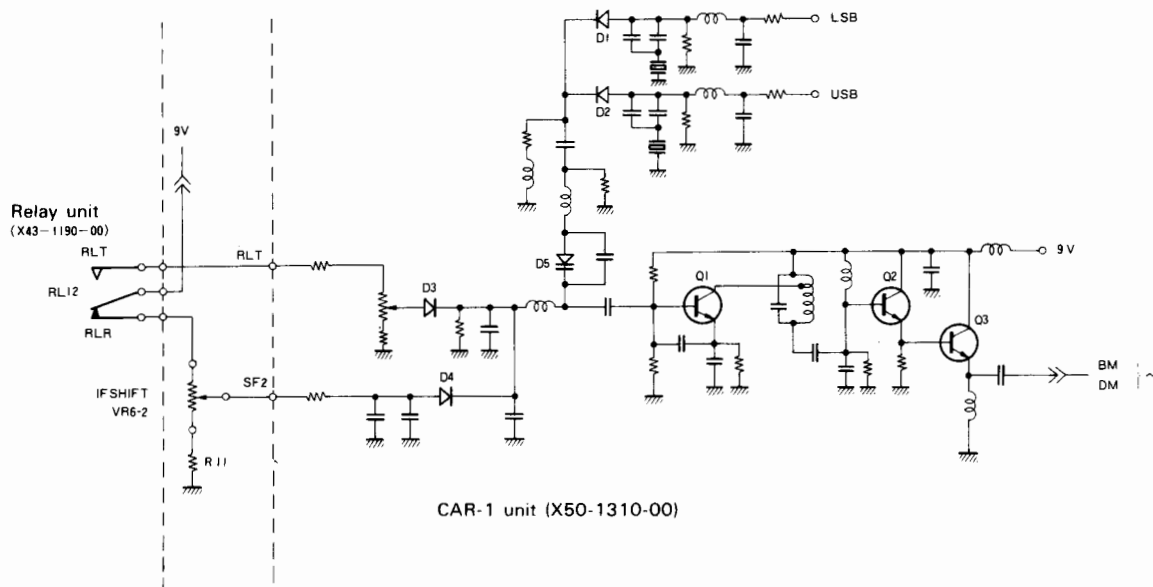


Fig. 9 IF SHIFT circuit

FUNCTIONAL DISCRIPTION

2. Adjustment of tone quality during CW mode operation

○ When no CW filter is installed:

When the main tuning knob is adjusted so that the beat tone becomes approx. 800 Hz while receiving CW signal with the IF SHIFT knob set to the center position and the RIT switch turned OFF, the transmitting frequency of the own station can be set to that of the party station. After this zero-in, turn the RIT switch on and turn the RIT knob to sound clear. When there is interference, it might be eliminated by turning the IF SHIFT knob. However, attaching of the exclusive CW filters is more effective (YG-88C at option).

○ When CW filter is installed:

Set the IF SHIFT knob at the center position and turn OFF the RIT switch. While receiving a signal, set the main tuning knob until S meter indicates maximum. The received tone then becomes approx. 800 Hz and the transmitting frequency is set to that of the party station. Turn ON the RIT switch, adjust the RIT knob to the desired position and set the IF SHIFT knob to the highest receiving level.

○ When the digital display is provided:

The digital display indicates the frequency of carrier signal (BFO signal) and therefore during CW receiving, it indicates the frequency shifted from the transmitting frequency of the party station by the receiving beat frequency (when the IF SHIFT knob is set to the center position, the lower-side beat frequency is indicated). If zero-in operation is performed by using the digital display, follow the procedure shown below.

Turn ON the RIT switch and turn the RIT knob, while operating the stand-by switch, until the frequency indication is kept unchanged regardless of change-over from transmitting mode to receiving mode and vice versa. Leave the RIT knob as it is and turn the main tuning knob until the zero beat is obtained with respect to the transmitting signal of the party station (the zero beat is easy to obtain by turning the IF SHIFT knob). Through the above procedure, the transmitting signal can be set to that of the party station. Turn the RIT knob until the desired position is obtained.

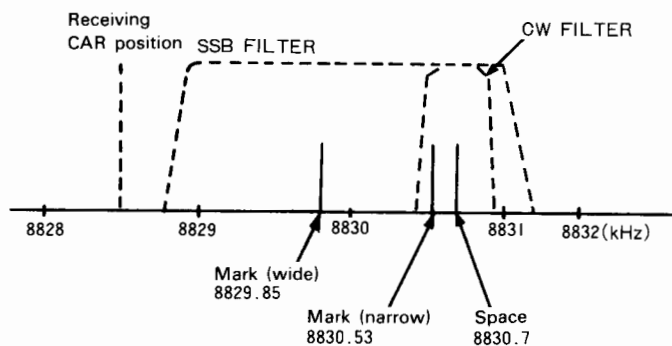


Fig. 10 RTTY frequency

3. When FSK (RTTY) is operated

For the RTTY operation, a demodulator and a teletypewriter are necessary. Demodulators that are operated with audio input signals with filters of 2125/2295 Hz (NARROW, 170 Hz shift) or 2125/2975 Hz (WIDE, 850 Hz shift) incorporated can be all used for this purpose. For keying of the FSK circuit in TS-820, insert a relay coil into the closed loop circuit of the teletypewriter and connect the relay contacts to the RTTY KEY jack on the rear panel.

Fig. 10 shows the relationship between the transmitting and receiving frequencies used in TS-820. Although the frequency deviation in the FSK circuit has been set to the NARROW side in our factory, it can also be set to the WIDE side by switching the connector as shown in **Fig. 11**. When making FSK operation in the WIDE side, turn the IF SHIFT knob counterclockwise by approx. 1.2 kHz until balance between mark signal and space signal can be obtained during receiving.

When the CW filters available at option are equipped, they can be used during the NARROW side operation by switching the connectors in the IF unit.

When the MODE switch is changed over to FSK position, the input voltage of the final stage is automatically reduced. Thus, the continuous transmission of this transceiver can be enjoyed without any anxiety.

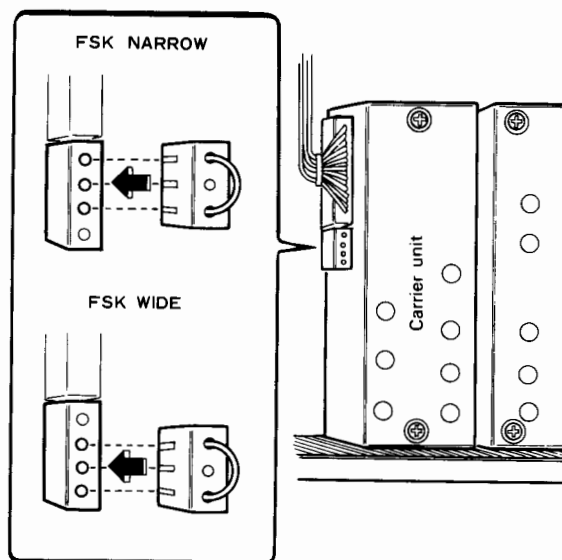


Fig. 11 Switching of FSK, WIDE-NARROW

FUNCTIONAL DISCRIPTION

AGC CIRCUIT

AGC signal is taken from the IF final stage Q3, and after amplified by Q15 and Q16, is fed to Q1, Q2 and Q3 in the IF circuit and the first stage Q2 in the RF amplifier, thereby performing GAIN control. On the collector side of Q16, each control operation of AGC-SLOW, FAST, OFF and RF GAIN is carried out. Q4 and Q5 act as the meter amplifier for AGC in receiving and as the meter amplifier for ALC during transmitting. D20 is used for AGC discharge and D21 for prevention of reverse current flow. During transmission, Q2 and Q3 are cut off since they are reversely biased by the RB line voltage.

RF NEGATIVE FEEDBACK AND NEUTRALIZING CIRCUIT

In TS-820, the tone quality of transmitting signal has been examined more thoroughly. Without careful overall design over the entire circuitry improvement of the tone quality cannot be achieved. For example, distortion in the low frequency stage, its frequency response, distortion in the high frequency stage, level distribution and ALC have been thoroughly examined and in addition overall balance design has been considered.

To minimize the distortion in AF stage, the negative feedback is often employed as general circuit technique. However, the negative feedback for the RF circuit is actually difficult to employ since stable operation is not easily obtained due to restriction by parts arrangement and frequency response. TS-820 applies negative feedback to the so-called tuning type amplifier circuit including interstage LC tuned circuits. (Refer to Fig. 12).

In the tuned type negative feedback, the plate impedance of the final stage tube and the gain are greatly changes when its π matching circuit is adjusted. Thus, it is necessary to prevent possible undesired oscillation from occurring regardless of the set positions of the plate variable capacitor and the drive variable capacitor. TS-820 is designed so that undesired oscillation won't occur when the gain increases up to three times as large as optimum condition.

Neutralization also has large effect on the stability. If it is imperfect, phase variation increases proportionally and it is difficult to have effect from low band to high band in the case of all-band transceivers. Where variable capacitors are used for interstage tuning, sufficient neutralization is said to be difficult as compared with the μ tuning type, thus causing unstable negative feedback.

Although TS-820 employs the variable capacitor type neutralization, the rotors and stators are floated from ground and neutralization is applied and thereby the same effect as the μ tuning type is obtained.

Although the negative feedback has one effect in audio circuits since the bandwidth becomes wide, the selectivity is deteriorated in tuning type amplifiers. Thus, sufficient selectivity is required to be obtained before the driver stage in the case of such transmitter that the spurious characteristic should be improved in the driver and final stages. Since TS-820, employs a balanced mixer in the IF stage, it is not necessary to attenuate adjacent spurious signals in the driver and final stage. Thus, the driver stage is placed immediately after the mixer and negative feedback is applied, there. This transceiver applies negative feedback of approx. 6 dB by C5 and C10 and improvement of approx. 10 dB is effected by the tertiary cross modulation products.

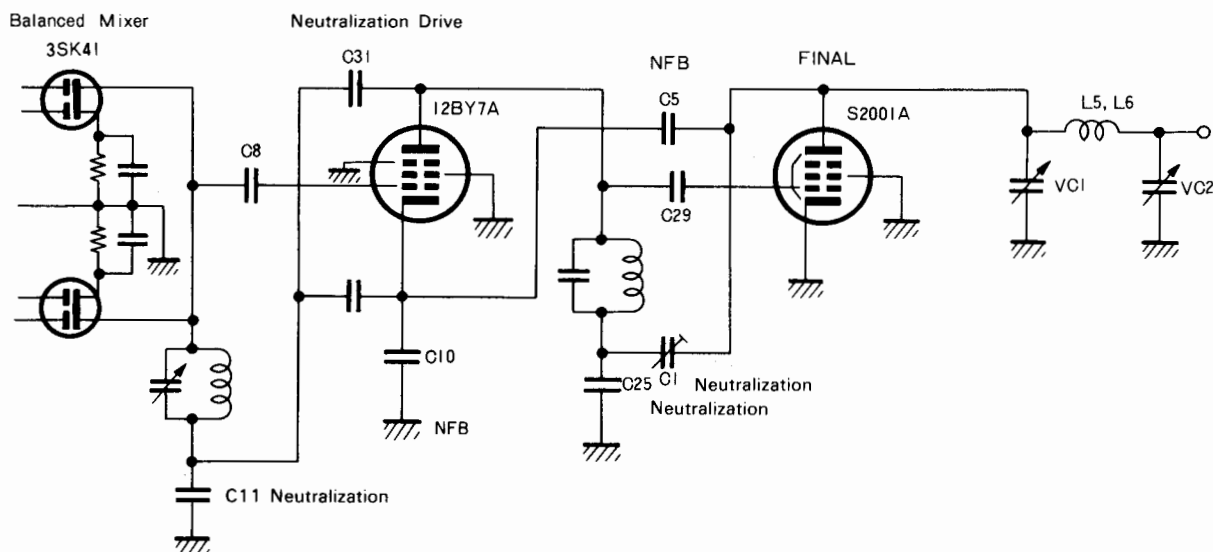


Fig. 12 RF-NFB circuit

FUNCTIONAL DISCRIPTION

NB CIRCUIT

The NB unit roughly consists of a signal system and noise system.

The signal converted into IF signal of 8.83 MHz is purified through a filter for removing adjacent large input interference (± 15 kHz at -6 dB point in case of X1 and X2) and fed to the crystal filter through balanced type blanking gate circuit D1 ~ D4 and matching transformer T4.

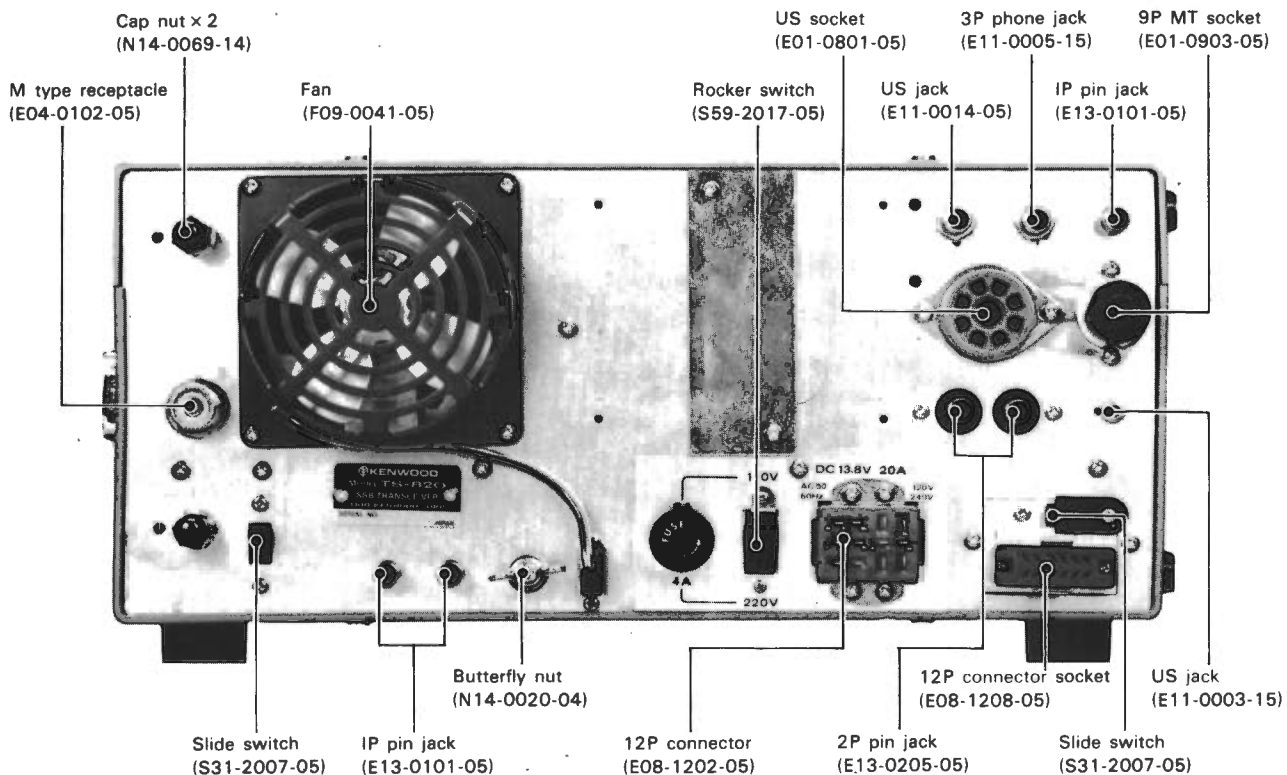
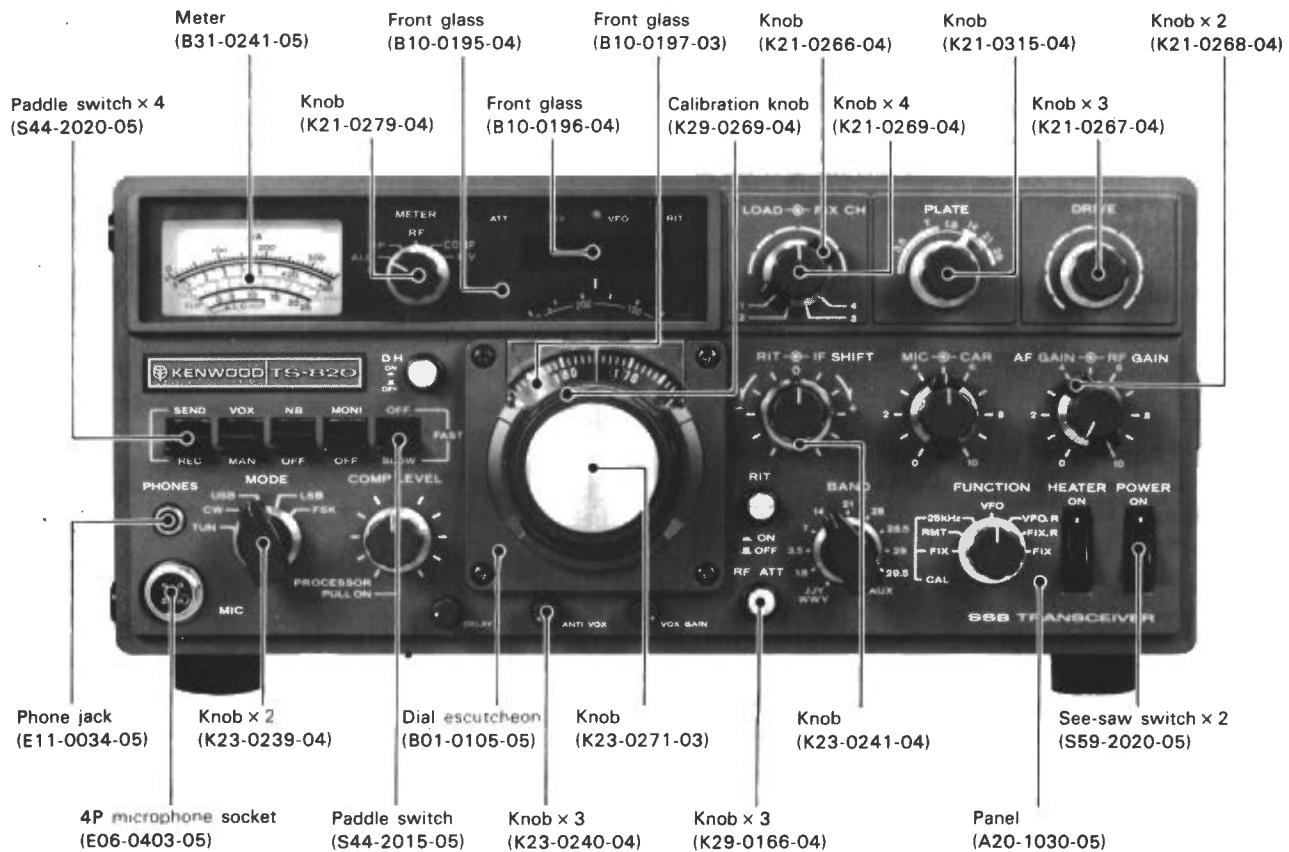
When NB switch is turned ON, the received signal passed through the input filter circuit is buffer amplified by FET and its noise component only is picked out through transistors Q8, Q9 and Q10 and rectified by D13 and D14 to trigger blanking gate D13 to D4 through Q11. Q6 acts as AGC in the noise blanker circuit. The noise amplified by Q8, Q9 and Q10 is rectified by D13 and D14 and applied to the base of Q6, and then applied to Q8, Q9 and Q10 as AGC voltage. AGC time constant circuit Q6 is designed to be inoperative against pulse noise, but operative against continuous signal having short period such as SSB. Thus, Q8, Q9 and Q10 are operated nearly in maximum gain state, and against continuous signals they are operated in the condition that gain is suppressed by AGC voltage. Now, assume that Q11 is turned ON by pulse noise when the NB switch is turned ON. The collector voltage of Q11 is reduced suddenly and D1 through D4 connected to the collector of Q11 are reversely biased for a specified time by the time constant circuit consisting of C8 and R2, thus placing the signal line to OFF state. That is, the pulse noise is then eliminated (such as ignition noise of automobiles) D15 is a diode for setting the switching level.

This NB circuit is incorporated in IF unit.

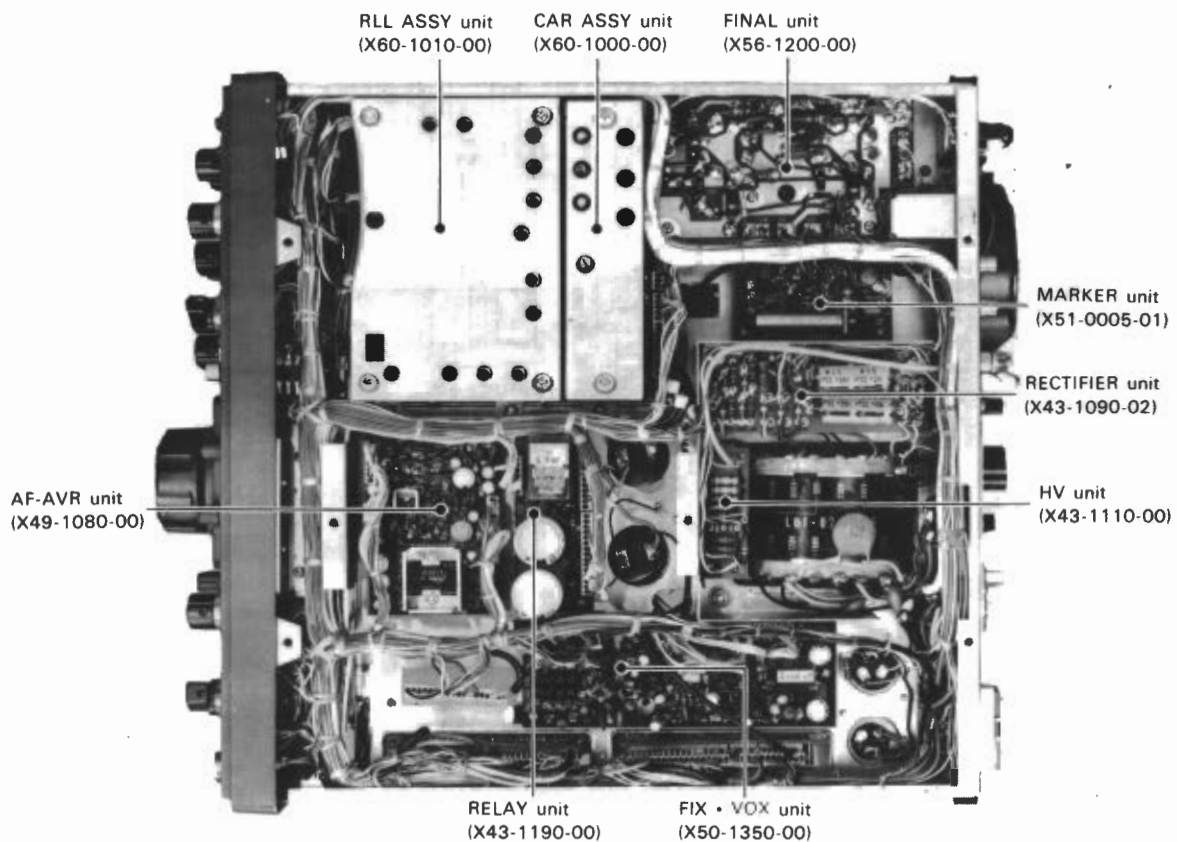
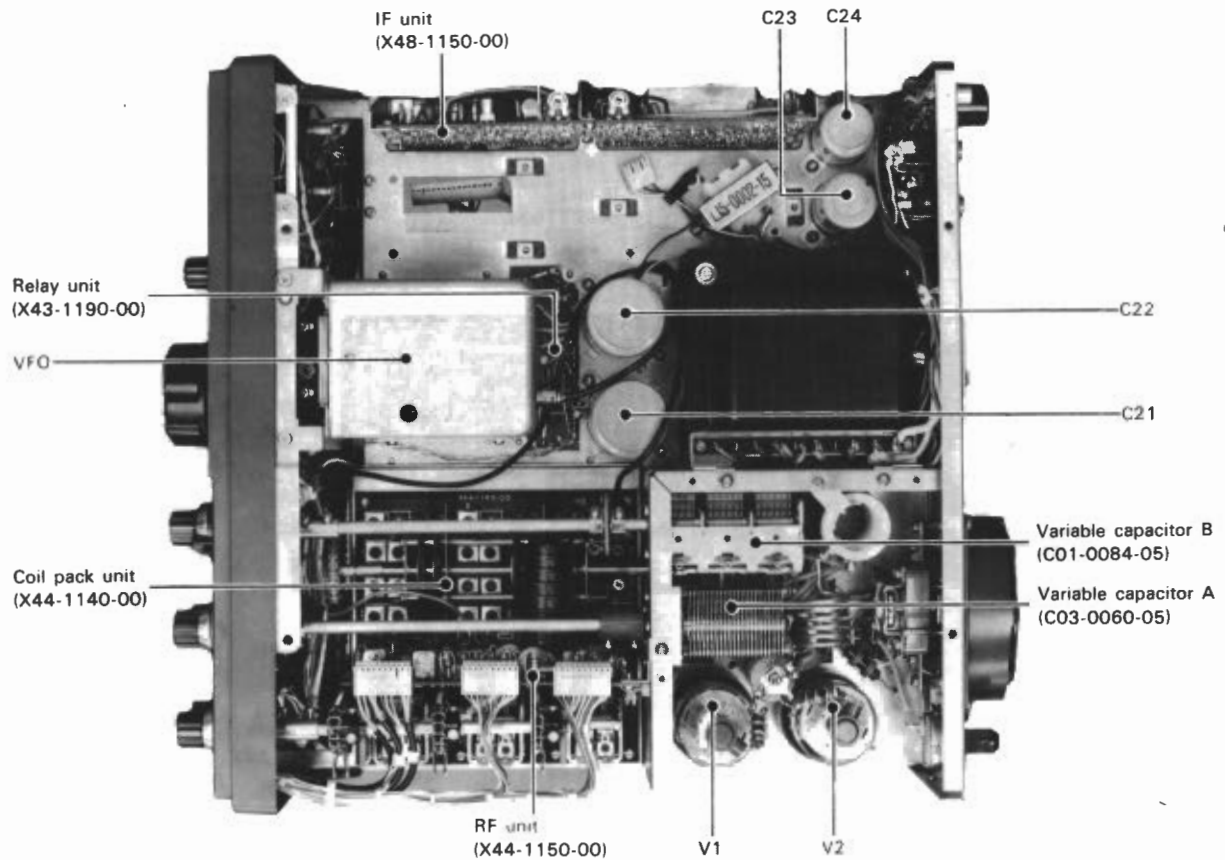
AUX BAND

AUX position in BAND switch is empty channel because of circuit configuration.

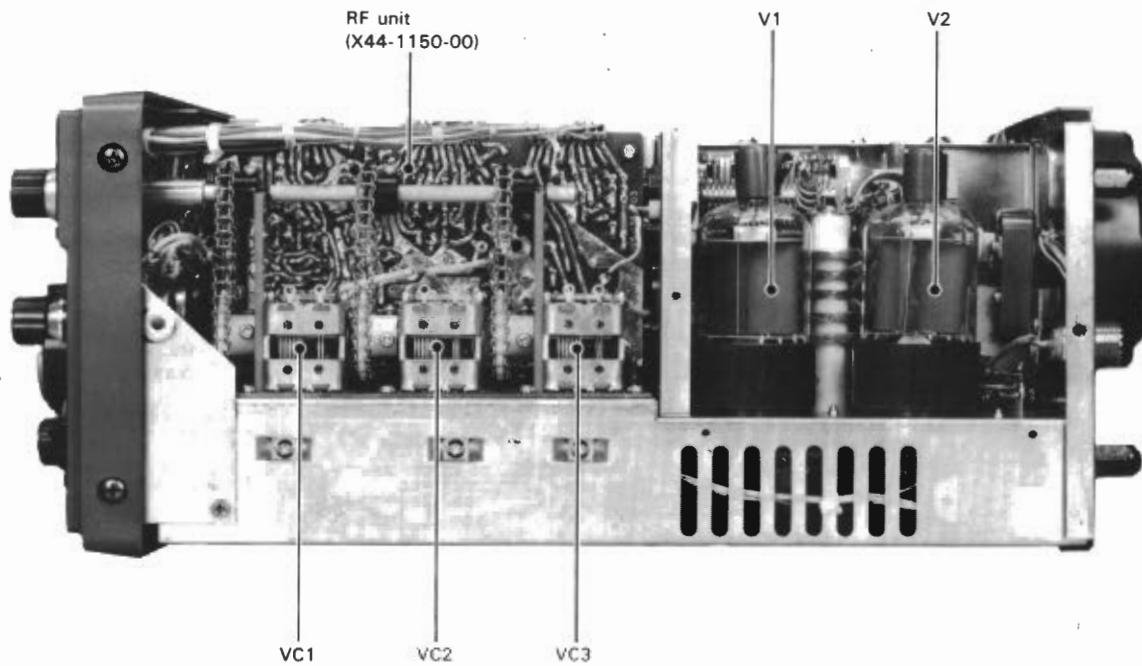
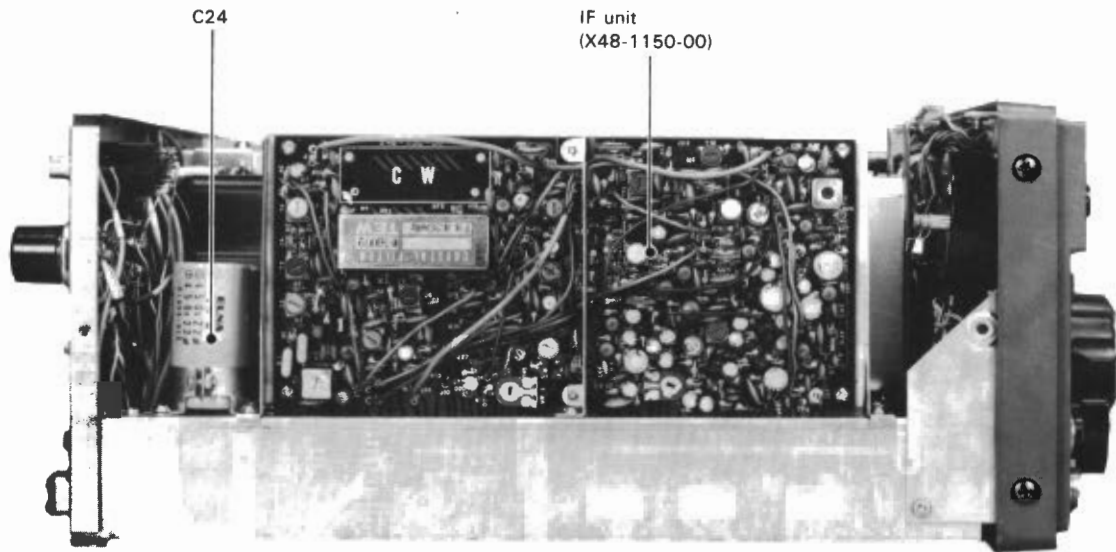
PARTS ALIGNMENT



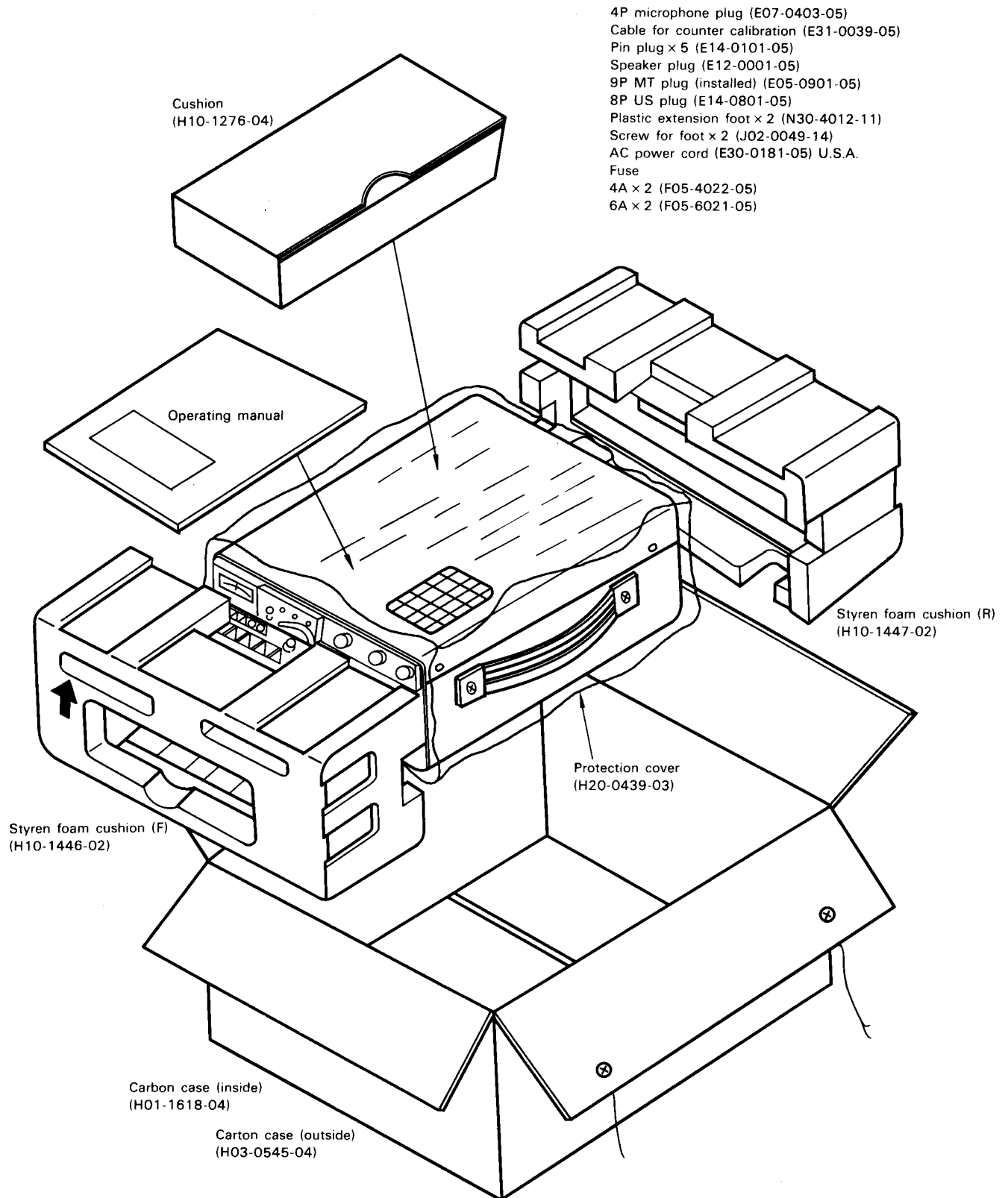
PARTS ALIGNMENT



PARTS ALIGNMENT



PACKING



PARTS LIST

Ref No	Parts No	Description	Re- marks
CAPACITOR			
C1	C90-0186-05	Ceramic 0.001 μ F 3kVW	
C2	C90-0187-05	Ceramic 0.0047 μ F 1.4kVW	
C3	C90-0185-05	Ceramic 100pF 3kVW	
C4	C91-0017-05	Ceramic 390pF	
C5	C91-0016-05	Ceramic 3pF 3kVW	
C6	CC45SL2H821J	Ceramic 820pF $\pm 5\%$	
C7	CC45SL2H102J	Ceramic 0.001 μ F $\pm 5\%$	
C8	CC45SL2H681J	Ceramic 680pF $\pm 5\%$	
C9	CC45SL2H271J	Ceramic 270pF $\pm 5\%$	
C10	CC45SL2H101J	Ceramic 100pF $\pm 5\%$	
C11	C90-0187-05	Ceramic 0.0047 μ F 1.4kVW	
C12,13	C90-0300-05	Ceramic 470pF AC150WV	
C14~17	CK45F1H103Z	Ceramic 0.01 μ F $\pm 80\% - 20\%$	
C18~20	CK45E2H103P	Ceramic 0.001 μ F $\pm 100\% - 0\%$	
C21	C90-0327-05	Electrolytic 100 μ F 500WV	
C22	C90-0327-05	Electrolytic 100 μ F 500WV	
C23,24	C90-0326-05	Electrolytic 22 μ F 450WV	
C25	CC45CH2H470J	Ceramic 47pF $\pm 5\%$	
C26	CC45SL2H221J	Ceramic 220pF 500WV	
RESISTOR			
R1	RD14BY2E102J	Carbon 1k Ω $\pm 5\%$ 1/4W	
R2	RD14BY2E332J	Carbon 3.3k Ω $\pm 5\%$ 1/4W	
R3,4	RC05GF2H560J	Carbon 56 Ω $\pm 5\%$ 1/4W	
R5	RC05GF2H474J	Carbon 470k Ω $\pm 5\%$ 1/2W	
R6,7	RC05GF2H474J	Carbon 470 Ω $\pm 5\%$ 1/2W	
R8	RC05GF3A103K	Carbon 10k Ω $\pm 10\%$ 2W	
R9	PD14BY2B560J	Carbon 56 Ω $\pm 5\%$ 1/8W	
R10	PD14BY2B471J	Carbon 470 Ω $\pm 5\%$ 1/8W	
R11	PD14BY2E182J	Carbon 1.8k Ω $\pm 5\%$ 1/4W	
R12	PD14BY2E221J	Carbon 220 Ω $\pm 5\%$ 1/4W	
R13	PD14BY3E681J	Carbon 680 Ω $\pm 5\%$ 1/4W	
R14	PD14BY2E102J	Carbon 1k Ω $\pm 5\%$ 1/4W	
SEMICONDUCTOR/TUBE			
D1	V11-0051-05	Diode IN60	
D2	V11-0285-05	Diode V06E	
V1,2	V40-0150-00	Final tube S2001A	
POTENTIOMETER			
VR1	R01-3028-05	10k Ω (B), RF-PRO with switch (S10)	
VR2,3	R03-3050-05	10k Ω (B), RF-VOLT, BIAS	
VR4,5	R08-3012-15	10k Ω (A), AF, 10k Ω (B) RF-GAIN	
		10k Ω (A) MIC, 10k Ω (B) CAR	
VR6	R08-9011-05	5k Ω (B) RIT, 10k Ω (F) IF-SHIFT	
SWITCH			
S1	S01-1037-05	Rotary switch METER SW	
S2	S01-1038-05	Rotary switch FIX CH	
S3	S01-1039-05	Rotary switch BAND SW	
S4	S01-3022-05	Rotary switch FINAL	
S5	S01-4017-05	Rotary switch FUNCTION	
S6	S01-5010-05	Rotary switch MODE	
S7~9	S40-2077-05	Push switch RIT, ATT, DH	
S11~14	S44-2020-05	Paddle switch STBY, VOX, NB, MON	
S15	S44-2015-05	Paddle switch AGC	
S16,17	S59-2020-05	See-saw switch POWER, HEATER	
S18,19	S31-2007-05	Slide switch SG, XVTR	
S21	S59-2017-05	Rocker switch (Power source selection)	
COIL/TRIMMER/VARIABLE CAPACITOR			
L1	L33-0032-05	Choke coil	
L3	L33-0218-05	Choke coil	
L4	L33-0259-05	Choke coil, 470 μ H	
L5	L34-0560-05	Final coil (A)	
L6	L34-0561-05	Final coil (B) (28 MHz)	

Ref. No.	Parts No.	Description	Re- marks
TC1	C03-0002-05	Trimmer (Neutralizing)	
VC1	C03-0060-05	Variable capacitor (A) (Final)	
VC2	C01-0084-05	Variable capacitor (B) (Load)	
PS1,2	L39-0046-05	Coil (Parastic suppressor)	
MISCELLANEOUS			
—	A01-0274-05	Casing	
—	A01-0283-02	Case	
—	A10-0488-01	Chassis	
—	A20-1030-05	Panel	
—	A22-0195-02	Sub-panel	
—	A23-0649-02	Rear panel	
—	A40-0151-01	Bottom plate	
—	B01-0105-05	Dial escutcheon	
—	B05-0201-04	Speaker grille cloth	
—	B09-0003-05	Coupling $\times 2$ (Baklite)	
—	B09-0011-04	Rubber cap $\times 3$ (Opening for adjustment)	
—	B10-0195-04	Front glass	
—	B10-0196-04	Front glass (Indicating plate)	
—	B10-0197-03	Front glass (Main dial)	
—	B20-0373-04	Dial scale (Sub-dial)	
—	B20-0374-04	Dial scale (A) (Out side)	
—	B20-0375-04	Dial scale (B) (Inside)	
—	B21-0007-04	Pointer (PLATE knob)	
—	B30-0079-05	Pilot lamp $\times 3$ 12V, 40 mA	
—	B31-0241-05	Meter	
—	B40-1429-04	Model name plate	
—	B41-0222-04	Voltage indication sticker 120/220V	
—	B42-0287-14	Caution sticker (high voltage)	
—	B42-0628-04	Fixed ch. sticker	
—	B42-0452-04	DC terminal indicating sticker	
—	B43-0261-04	Badge (TS-820)	
—	B46-0058-00	Warranty card	U.S.A.
—	B50-1568-00	Operating manual	
—	B58-0181-00	Caution card (Transmitter section)	
—	B58-0187-00	Caution card (Source voltage)	Europe
—	B58-0188-00	Caution sticker (Source voltage)	
—	D13-0055-04	Sprocket $\times 2$	
—	D16-0058-04	Chain ass'y	
—	D21-0326-14	Shaft (A) (LOAD)	
—	D21-0413-05	Band shaft	
—	D21-0414-04	Shaft (B) (DRIVE)	
—	D21-0415-04	Shaft (C) (PLATE)	
—	D22-0004-04	Shaft coupling $\times 2$ (6 ϕ —6 ϕ)	
—	D22-0027-04	Shaft joint (6 ϕ —3 ϕ)	
—	D23-0142-05	Ball retainer	
—	D29-0001-04	Shaft joint (DRIVE)	
—	D32-0051-04	Shaft stopper (3 $\times$ 10)	
—	D32-0064-04	Shaft stopper $\times 2$	
—	D32-0075-04	Switch stopper	
—	D40-0204-04	Vernier mechanism ass'y	
—	D40-0206-05	Fan ass'y	
—	E01-0801-05	US socket	
—	E01-0903-05	9PMT socket	
—	E03-0301-15	3P plug (Power source)	
—	E04-0102-05	M type receptacle	
—	E05-0901-05	9PMT plug	
—	E06-0403-05	4P Microphone socket	
—	E07-0403-05	4P Microphone jack	
—	E08-0204-05	2P plug socket $\times 2$	
—	E08-1202-05	12P plug socket	
—	E08-1207-05	12P plug	
—	E08-1208-05	Connector socket (for transverter)	

PARTS LIST

Ref. No.	Parts No.	Description	Re- marks
—	E09-0204-05	2P plug socket × 3	
—	E11-0003-15	US jack (External speaker)	
—	E11-0005-15	3P phone jack (Key)	
—	E11-0014-05	US jack (RTTY)	
—	E11-0034-05	US jack (2P with SW)	
—	E12-0001-05	Phone plug (SP)	
—	E13-0101-05	1P jack × 3	
—	E13-0205-05	2P jack	
—	E14-0101-05	1P plug × 6	
—	E14-0801-05	US plug	
—	E20-0512-05	5P terminal plate	
—	E20-1003-05	10P terminal plate	
—	E22-0207-05	Lug plate	
—	E23-0014-04	Acme terminal	
—	E23-0056-05	Terminal	
—	E23-0093-05	Terminal (mini connector)	
—	E30-0181-05	AC power cord	U.S.A.
—	E31-0037-05	3P connector with lead (FSK switching)	
—	E31-0038-05	3P connector with coaxial cable	
—	E31-0039-05	Counter cable	
—	E33-0084-00	Wire kit	U.S.A.
—	E33-0085-00	Wire kit	Europe
—	E33-0097-00	Wire kit	U.S.A.
—	E33-0098-00	Wire kit	Europe
—	E90-0004-15	Plate cap × 2	
—	F05-4022-05	Fuse (4A) × 2	
—	F05-6021-05	Fuse (6A) × 2	
—	F09-0041-05	Fan	
—	F10-0402-04	Shield plate (Relay)	
—	F10-0412-04	Shield plate (Final)	
—	F11-0243-03	Final box	
—	F11-0244-03	Final cover	
—	F15-0205-04	Shading plate	
—	F15-0601-04	Shading plate (small)	
—	F19-0133-04	Protecting plate (for DC-DC converter)	
—	G11-0008-04	Cushion (Relay)	
—	H01-1618-04	Carton case (Inside)	
—	H03-0545-04	Carton case (Outside)	
—	H10-1276-04	Cushion	
—	H10-1446-02	Styrene foam cushion (F)	
—	H10-1447-02	Styrene foam cushion (R)	
—	H20-0439-04	Protection cover	
—	H25-0029-04	Polyethylene bag	
—	H25-0120-04	Polyethylene bag	
—	J02-0022-05	Leg (Small) × 4	
—	J02-0049-14	Leg (Large) × 6	
—	J13-0033-15	Fuse holder	
—	J19-0006-04	Switch stopper	
—	J19-1301-04	Diode holder × 4	
—	J21-0392-04	Lead holder	
—	J21-0934-05	Fitting for handle × 2	
—	J21-1144-04	Speaker retainer	
—	J21-1148-04	Variable capacitor stopper	
—	J21-1151-04	Terminal plate stopper	
—	J21-1202-04	Speaker retainer ass'y	
—	J21-1425-04	Retainer	
—	J21-1494-04	Meter stopper	
—	J21-1495-04	Lamp stopper	
—	J21-1496-04	Rotary switch stopper	
—	J21-1497-04	Final coil stopper × 2	
—	J21-1502-04	RF PC board stopper	
—	J21-1503-04	VFO fittings	
—	J21-1504-04	Shaft holder × 2	
—	J31-0141-04	Ring spacer (Microphone)	

Ref. No.	Parts No.	Description	Re- marks
—	J32-0074-04	Hexagonal boss (AF) × 4	
—	J32-0218-04	Hexagonal boss × 8 (Push switch)	
—	J32-0220-04	Hexagonal boss × 2 (Final)	
—	J32-0222-04	Boss for dial scale (A)	
—	J32-0223-04	Boss for dial scale (B)	
—	J32-1030-14	Round boss	
—	J41-0020-04	Knob bushing × 3	
—	J41-0024-15	Cord bushing	
—	J61-0006-04	Free up belt	Europe
—	J61-0019-05	Vinyl tie × 15	
—	K01-0049-05	Handle	
—	K21-0266-04	Knob FIX, CH	
—	K21-0267-04	Knob × 3 DRIVE, FUNCTION, COMP LEVEL	
—	K21-0268-04	Knob × 2 CAR, RF GAIN	
—	K21-0269-04	Knob × 4 LOAD, RIT, MIC, AF GAIN	
—	K21-0279-04	Knob METER	
—	K21-0315-04	Knob PLATE	
—	K23-0239-04	Knob BAND, MODE	
—	K23-0240-04	Knob VOX, ANTI VOX, DELAY	
—	K23-0241-04	Knob IF SHIFT	
—	K23-0271-03	Knob MAIN	
—	K29-0166-04	Knob (Push) × 3 DH, RF ATT, RIT	
—	K29-0269-04	Knob (Calibration)	
—	L01-1056-05	Power transformer	
—	L15-0002-15	Choke coil (Low frequency)	
—	T03-0027-15	Speaker	
—	T40-0022-05	Motor	
—	X40-1110-00	VFO unit	
—	X43-1090-02	Rectifier unit	
—	X43-1110-00	HV unit	
—	X43-1190-00	Relay unit	
—	X44-1140-00	Coil pack unit	
—	X44-1150-00	RF unit	
—	X48-1150-00	IF unit	
—	X49-1080-00	AF-AVR unit	
—	X50-1350-00	FIX-VOX	
—	X52-0005-01	Marker unit	
—	X54-1180-00	Indicator unit	
—	X54-1190-00	VOX-VR unit	
—	X56-1200-00	FINAL unit	
—	X60-1000-00	CAR ass'y unit	
—	X60-1010-00	PLL ass'y unit	

VFO (X40-1110-00)

Ref. No.	Parts No.	Description	Re- marks
CAPACITOR			
C1	CC45PG1H470J	Ceramic 47pF ±5%	
C2,3	CC45LG1H150J	Ceramic 15pF ±5%	
C4	CC45SG1H070J	Ceramic 7pF ±5%	
C5	CC45LG1H470J	Ceramic 47pF ±5%	
C6	CC45LG1H220J	Ceramic 22pF ±5%	
C7,8	CM93F2A151J(DM)	Mica 150pF ±5%	
C9	CC45CH1H030D	Ceramic 3pF ±0.5pF	
C10	CK45F1H203Z	Ceramic 0.02μF +80%—20%	
C11,12	CK45F1H403Z	Ceramic 0.04μF +80%—20%	
C13	CK45F1H203Z	Ceramic 0.02μF +80%—20%	
C14	CC45SL1H330J	Ceramic 33pF ±5%	
C15	CC45SL1H050D	Ceramic 5pF ±0.5pF	
C16	CC45SL1H100D	Ceramic 10pF ±0.5pF	

PARTS LIST

Ref. No.	Parts No.	Description	Re- marks
C17	CC45SL1H050D	Ceramic 5pF $\pm 0.5\text{pF}$	
C18	CK45F1H103Z	Ceramic $0.01\mu\text{F}$ $\pm 80\% - 20\%$	
C19	CK45F1H403Z	Ceramic $0.04\mu\text{F}$ $\pm 80\% - 20\%$	
C20	CC45CG1H100D	Ceramic 10pF $\pm 0.5\text{pF}$	

RESISTOR

R1	PD14BY2E105J	Carbon 1M Ω $\pm 5\%$ 1/4W	
R2	PD14BY2E101J	Carbon 100 Ω $\pm 5\%$ 1/4W	
R3.4	PD14BY2E105J	Carbon 1M Ω $\pm 5\%$ 1/4W	
R5	PD14BY2E331J	Carbon 330 Ω $\pm 5\%$ 1/4W	
R6	PD14BY2E333J	Carbon 33k Ω $\pm 5\%$ 1/4W	
R7	PD14BY2E473J	Carbon 47k Ω $\pm 5\%$ 1/4W	
R8	PD14BY2E102J	Carbon 1k Ω $\pm 5\%$ 1/4W	
R9	PD14BY2E101J	Carbon 100 Ω $\pm 5\%$ 1/4W	

SEMICONDUCTOR

Q1	V09-0020-05	FET 2SK22(Y)	
Q2	V09-0011-05	FET 2SK19(Y)	
Q3.4	V03-0079-05	FET 2SC460(B)	
D1	V11-0053-05	Diode SD111	
D2.3	V11-0051-05	Diode IN60	

COIL/VC/TRIMMER

L1	L32-0098-05	Oscillator coil	
L2~4	L40-1021-03	Ferri inductor 1 mH	
L5	L40-2201-03	Ferri inductor 22 μH	
L6.7	L40-1021-03	Ferri inductor 1 mH	
TC1	C03-0001-05	Variable capacitor (Small size)	
TC2	C05-0013-15	Ceramic trimmer	

MISCELLANEOUS

—	A01-0169-23	VFO Case	
—	B42-0010-04	Indication tape	
—	C01-0169-05	Variable capacitor	
—	D22-0011-05	Shaft coupling	
—	D40-0205-05	Dial mechanism	
—	E08-0204-05	2P plug socket	
—	E13-0101-05	1P pin jack	
—	E22-0207-05	Lug plate	
—	E23-0021-04	Terminal $\times 5$	
—	F07-0231-24	VFO cover	
—	F10-0249-14	VFO shield plate	
—	F11-0010-04	VFO box	
—	G03-0009-04	Spring	
—	J21-0895-03	VFO variable capacitor stopper	
—	J25-1505-03	VFO stopper	

HV (X43-1110-00)

Ref. No.	Parts No.	Description	Re- marks
CAPACITOR			
C1	CK45E2H103P	Ceramic $0.01\mu\text{F}$ $\pm 100\% - 0\%$	
RESISTOR			
R1	RC05GF2H104J	Carbon 100k Ω $\pm 5\%$ 1/2W	
R2~4	PD14BY2H684J	Carbon 680k Ω $\pm 5\%$ 1/2W	

Ref. No.	Parts No.	Description	Re- marks
R5.6	RC05GF2H563J	Carbon 56k Ω $\pm 5\%$ 1/2W	
R7	RC05GF2H123J	Carbon 12k Ω $\pm 5\%$ 1/2W	

MISCELLANEOUS

—	E23-0047-04	Terminal (square) $\times 6$	
---	-------------	------------------------------	--

RELAY (X43-1190-00)

Ref. No.	Parts No.	Description	Re- marks
CAPACITOR			
C1.2	C90-0325-05	Electrolytic 2200 μF 25WV	
C3	CK45F1H403Z	Ceramic $0.04\mu\text{F}$ $\pm 80\% - 20\%$	
C4.5	CK45F1H103Z	Ceramic $0.01\mu\text{F}$ $\pm 80\% - 20\%$	
C6	CQ92M1H104K	Mylar $0.1\mu\text{F}$ $\pm 10\%$	

RESISTOR

R1	RN14AB3D221J	Metal film 220 Ω $\pm 5\%$ 2W	
----	--------------	--------------------------------------	--

SEMICONDUCTOR

D1	V11-0418-05	Zener diode BZ-052	
----	-------------	--------------------	--

MISCELLANEOUS

RL1.2	E40-1413-05	Mini connector	
RL3	E40-0613-05	Mini connector	

RECTIFIER (X43-1090-02)

Ref. No.	Parts No.	Description	Re- marks
CAPACITOR			
C1.2	CE02W2C330	Electrolytic 33 μF 160WV	

RESISTOR

R1~4	RC05GF2H474J	Carbon 410k Ω $\pm 5\%$ 1/2W	
R5.6	RN14AB3D471J	Metal film 470 Ω $\pm 5\%$ 2W	
R7	RC05GF2H102J	Carbon 1k Ω $\pm 5\%$ 1/2W	
R8	RC05GF2H104J	Carbon 100k Ω $\pm 5\%$ 1/2W	
R9.10	PD14CY2E104J	Carbon 100k Ω $\pm 5\%$ 1/4W	

SEMICONDUCTOR

D1~6	V11-0282-05	Diode V08J	
D7	V11-0285-05	Diode V06E	
D8~11	V11-0290-05	Diode V03C 600V 1A	

MISCELLANEOUS

—	E23-0047-04	Terminal (square) $\times 17$	
---	-------------	-------------------------------	--

COIL PACK (X44-1140-00)

Ref. No.	Parts No.	Description	Re- marks
CAPACITOR			
C1.2	CC45RH1H560J	Ceramic 56pF $\pm 5\%$	
C3	CC45RH1H470J	Ceramic 47pF $\pm 5\%$	
C4	CC45RH1H560J	Ceramic 56pF $\pm 5\%$	
C5	CC45RH1H470J	Ceramic 47pF $\pm 5\%$	
C6	CC45RH2H560J	Ceramic 56pF $\pm 5\%$	
C7	CC45RH2H390J	Ceramic 39pF $\pm 5\%$	
C8	CC45RH2H330J	Ceramic 33pF $\pm 5\%$	
C9	CC45RH1H151J	Ceramic 150pF $\pm 5\%$	
C10	CC45RH1H101J	Ceramic 100pF $\pm 5\%$	

PARTS LIST

Ref. No.	Parts No.	Description	Re- marks
C11	CC45SL1H561J	Ceramic 560pF ±5%	
C12,13	CK45F1H103Z	Ceramic 0.01μF +80%—20%	
C14	CC45RH1H220J	Ceramic 22pF ±5%	
C15	CC45RH1H221J	Ceramic 220pF ±5%	
C16	CC45RH1H101J	Ceramic 100pF ±5%	
C17	CC45SL1H561J	Ceramic 560pF ±5%	
C18	CC45RH1H330J	Ceramic 33pF ±5%	
C19	CC45RH1H390J	Ceramic 39pF ±5%	
C20	CQ92M1H102J	Ceramic 0.001μF ±5%	
C21	CC45RH1H101J	Ceramic 100pF ±5%	
C22,23	CC45RH2H121J	Ceramic 120pF ±5%	
C24	CC45RH2H330J	Ceramic 33pF ±5%	
C25	CC45SL1H561J	Ceramic 560pF ±5%	
C26,27	CK45E2H103P	Ceramic 0.01μF +100%—0%	
C28	CC45SL1H100D	Ceramic 10pF ±0.5pF	
C29,30	CK24E2H103P	Ceramic 0.01μF +100%—0%	
C32	CC45RH1H330J	Ceramic 33pF ±5%	
C33	CK45F1H103Z	Ceramic 0.01μF +80%—20%	
C34	CC45RH1H270J	Ceramic 27pF ±5%	
C35	CC45RH1H390J	Ceramic 39pF ±5%	
C36	CC45HH1H270J	Ceramic 27pF ±5%	
C37	CC45RH1H390J	Ceramic 39pF ±5%	
C38	CC45RH2H390J	Ceramic 39pF ±5%	
C39	CC45RH1H050D	Ceramic 5pF ±5%	
RESISTOR			
R1	PD14CY2E223J	Carbon 22kΩ ±5% 1/4W	
R2	PD14CY2E102J	Carbon 1kΩ ±5% 1/4W	
R3	PD14CY2E223J	Carbon 22kΩ ±5% 1/4W	
R4	PD14CY2E102J	Carbon 1kΩ ±5% 1/4W	
R5	PD14CY2E820J	Carbon 82Ω ±5% 1/4W	
R6	PD14CY2E103J	Carbon 10kΩ ±5% 1/4W	
R7,8	PD14CY2E153J	Carbon 15kΩ ±5% 1/4W	
COIL/VC			
L1	L34-0545-05	Tuning coil WWV	
L2	L34-0548-05	Tuning coil 1.9	
L3	L34-0549-05	Tuning coil 3.5	
L4	L34-0550-05	Tuning coil 7	
L5	L34-0545-05	Tuning coil 14	
L6	L34-0546-05	Tuning coil 21	
L7	L34-0547-05	Tuning coil 28	
L8	L34-0542-05	Tuning coil 1.9	
L9	L34-0545-05	Tuning coil WWV	
L10	L34-0543-05	Tuning coil 3.5	
L11	L34-0544-05	Tuning coil 7	
L12	L34-0545-05	Tuning coil 14	
L13	L34-0546-05	Tuning coil 21	
L14	L34-0547-05	Tuning coil 28	
L15	L34-0552-05	Tuning coil 1.9	
L16	L34-0553-05	Tuning coil 3.5	
L17	L34-0554-05	Tuning coil 7	
L18	L34-0555-05	Tuning coil 14	
L19	L34-0556-05	Tuning coil 21	
L20	L34-0557-05	Tuning coil 28	
L21~23	L40-0711-03	Ferri-indicator	
L24	L34-0558-05	Trap coil	
L25	L34-0559-05	Trap coil	
VC1~3	001-0127-05	Variable capacitor	
—	D13-0032-03	Sprocket × 3	
—	D13-0055-04	Sprocket × 3	
—	D16-0021-04	Chain ass'y	

Ref. No.	Parts No.	Description	Re- marks
—	D21-0412-04	Shaft	
MISCELLANEOUS			
—	E23-0015-04	Lug (ground)	
—	E23-0047-04	Terminal (square)	
—	E40-0315-05	Mini connector × 2	
—	E40-0401-05	Connector × 3	
—	F10-0399-04	Shield plate × 2	
—	J19-0486-04	VC stopper × 2	
—	S29-6003-05	Rotary wafer ass'y	

RF (X44-1150-00)

Ref. No.	Parts No.	Description	Re- marks
CAPACITOR			
C1	CC45SL1H330J	Ceramic 33pF ±5%	
C2,3	CK45F1H103Z	Ceramic 0.01μF +80%—20%	
C4	C90-0262-05	Ceramic 0.047μF ±10%	
C5,6	CK45K1H102M	Ceramic 0.001μF ±20%	
C7	C90-0262-05	Ceramic 0.0047μF ±10%	
C8	CC45SL2H151J	Ceramic 150pF ±5%	
C9	CQ93M2A473K	Mylar 0.047μF ±10%	
C10	C91-0022-05	Ceramic 0.001μF ±5%	
C11	C90-0262-05	Ceramic 0.047μF ±10%	
C12	CK45E2H103P	Ceramic 0.01μF +100%—0%	
C13,14	CK45F1H103Z	Ceramic 0.01μF +80%—20%	
C15	CQ93M2A473K	Mylar 0.047μF ±10%	
C16,17	CK45E2H103P	Ceramic 0.01μF +100%—0%	
C18	C90-0262-05	Ceramic 0.047μF ±10%	
C20	CK45F1H103Z	Ceramic 0.01μF +80%—20%	
C21	C90-0162-05	Ceramic 0.047μF ±10%	
C22	CC45SL1H100D	Ceramic 10pF ±0.5pF	
C23	CK45F1H103Z	Ceramic 0.01μF +80%—20%	
C24	CC45RH1H150J	Ceramic 15pF ±5%	
C25	CC45RH1H330J	Ceramic 33pF ±5%	
C26,27	CK45F1H103Z	Ceramic 0.01μF +80%—20%	
C29	C90-0262-05	Ceramic 0.047μF ±10%	
C30	CK45F1H103Z	Ceramic 0.01μF +80%—20%	
C31	C90-0262-05	Ceramic 0.047μF ±10%	
C32,33	CK45D1H102M	Ceramic 0.001μF ±20%	
C34	CK45F1H103Z	Ceramic 0.01μF +80%—20%	
C35	CQ93M2A224M	Mylar 0.22μF ±20%	
C36	CK45D1H102M	Ceramic 0.01μF ±20%	
C37	C90-0262-05	Ceramic 0.047μF ±10%	
C38	CE04W1H010(RL)	Electrolytic 1μF 50WV	
C39	CE04W1HR47(RL)	Electrolytic 0.47μF 20WV	
C40	C90-0262-05	Ceramic 0.047μF ±10%	
C41	CK45E2H103P	Ceramic 0.01μF +100%—0%	
C43~45	CK45F1H103Z	Ceramic 0.01μF +80%—20%	0.0
C46~48	C90-0262-05	Ceramic 0.047μF ±10%	
C49	CC45SL1H220J	Ceramic 22pF ±5%	
C50	CC45SL1H150J	Ceramic 15pF ±5%	
C51,52	CK45F1H103Z	Ceramic 0.01μF +80%—20%	
RESISTOR			
R1	PD14CY2E101J	Carbon 100Ω ±5% 1/4W	
R2,3	PD14CY2E104J	Carbon 100kΩ ±5% 1/4W	

PARTS LIST

Ref. No.	Parts No.	Description	Re- marks
R4	PD14CY2E471J	Carbon 470Ω ±5% 1/4W	
R5	PD14CY2E822J	Carbon 8.2kΩ ±5% 1/4W	
R6	PD14CY2E682J	Carbon 6.8kΩ ±5% 1/4W	
R7	PD14CY2E273J	Carbon 27kΩ ±5% 1/4W	
R8	PD14CY2E333J	Carbon 33kΩ ±5% 1/4W	
R9	PD14CY2E104J	Carbon 100kΩ ±5% 1/4W	
R10	PD14CY2E820J	Carbon 82Ω ±5% 1/4W	
R11	RC05GF2H680J	Carbon 68Ω ±5% 1/2W	
R12	PD14CY2E563J	Carbon 56Ω ±5% 1/4W	
R13	RC04GF2H823J	Carbon 82kΩ ±5% 1/2W	
R14	RC05GF2H392J	Carbon 3.9kΩ ±5% 1/2W	
R15	PD14CY2E822J	Carbon 8.2kΩ ±5% 1/4W	
R16	PD14CY2E472J	Carbon 4.7kΩ ±5% 1/4W	
R17,18	PD14CY2E392J	Carbon 3.9kΩ ±5% 1/4W	
R19	PD14CY2E472J	Carbon 4.7kΩ ±5% 1/4W	
R20	PD14CY2E561J	Carbon 560Ω ±5% 1/4W	
R21,22	PD14CY2E333J	Carbon 33kΩ ±5% 1/4W	
R23	PD14CY2E123J	Carbon 12kΩ ±5% 1/4W	
R24	PD14CY2E104J	Carbon 100kΩ ±5% 1/4W	
R25	PD14CY2E123J	Carbon 12kΩ ±5% 1/4W	
R26	PD14CY2E101J	Carbon 100Ω ±5% 1/4W	
R27	PD14CY2E221J	Carbon 220Ω ±5% 1/4W	
R28	PD14CY2E393J	Carbon 39kΩ ±5% 1/4W	
R29	PD14CY2E474J	Carbon 470kΩ ±5% 1/4W	
R30	PD14CY2E473J	Carbon 47kΩ ±5% 1/4W	
R31	PD14CY2E222J	Carbon 2.2kΩ ±5% 1/4W	
R32	PD14CY2E182J	Carbon 1.8kΩ ±5% 1/4W	
R33	PD14CY2E102J	Carbon 1kΩ ±5% 1/4W	
R34	PD14CY2E182J	Carbon 1.8kΩ ±5% 1/4W	
R35	PD14CY2E470J	Carbon 47Ω ±5% 1/4W	
R36	PD14CY2E474J	Carbon 470kΩ ±5% 1/4W	
R37	PD14CY2E105J	Carbon 1MΩ ±5% 1/4W	
R38,39	PD14CY2E103J	Carbon 10kΩ ±5% 1/4W	
R40	PD14CY2E331J	Carbon 330Ω ±5% 1/4W	
R41	PD14CY2E103J	Carbon 10kΩ ±5% 1/4W	
R42	PD14CY2E274J	Carbon 270kΩ ±5% 1/4W	
R43	PD14CY2E103J	Carbon 10kΩ ±5% 1/4W	
R44	RC05GF2H225J	Carbon 2.2MΩ ±5% 1/2W	
R45	PD14CY2E101J	Carbon 100Ω ±5% 1/4W	
R46	PD14CY2E104J	Carbon 100kΩ ±5% 1/4W	
R47	PD14CY2E154J	Carbon 150kΩ ±5% 1/4W	
R48	PD14CY2E184J	Carbon 180kΩ ±5% 1/4W	
R49,50	PD14CY2E271J	Carbon 270Ω ±5% 1/4W	
R51	PD14CY2E101J	Carbon 100Ω ±5% 1/4W	
R52	PD14CY2E471J	Carbon 470Ω ±5% 1/4W	
R53	PD14CY2E222J	Carbon 2.2kΩ ±5% 1/4W	
SEMICONDUCTOR			
Q1	V09-0057-05	FET 3SK41(L)	
Q2	V09-0036-05	FET 3SK35(GR)	
Q3	V09-0057-05	FET 3SK41(L)	
Q4	V03-0123-05	Transistor 2SC733(Y)	
Q5	V03-0450-05	Transistor 2SC1515(K)	
Q6~8	V09-0577-05	FET 3SK41(L)	
D1	V11-0240-05	Zener diode WZ-090	
D2,3	V11-0219-05	Diode V06B	
D4	V11-0414-05	Diode IS2588	
D5	V11-0076-05	Diode IS1555	
D6	V11-0414-05	Diode IS2588	
D7	V11-0076-05	Diode IS1555	
D8	V11-0250-05	Zener diode WZ-090	
D9,10	V11-0219-05	Diode V06B	

Ref. No.	Parts No.	Description	Re- marks
COIL/TRANSFORMER			
L1,2	L40-1511-03	Ferri-indicator 150μH	
L3~5	L40-4711-03	Ferri-indicator 470μH	
L6,7	L40-1511-03	Ferri-indicator 150μH	
L8	L33-0074-05	Heater choke 0.22μH	
L9	L40-4782-02	Ferri-indicator 0.47μH	
L10	L40-1511-03	Ferri-indicator 150μH	
T1,2	L34-0527-05	Tuning coil	
T3,4	L34-0524-05	Transformer (wide range)	
TUBE			
V1	V40-0114-00	Tube 12BY7A	
MISCELLANEOUS			
J8,9	R92-0150-05	Short jamper × 2	
J10	R92-0152-05	Short jamper	
RF1~3	E40-1026-05	Type U. Wafer pin	
—	E10-1902-05	Tube socket	
—	E23-0047-04	Terminal (square)	
—	E40-0406-05	Connector	
—	F11-0249-05	Shield case	

IF (X48-1150-00)

Ref. No.	Parts No.	Description	Re- marks
CAPACITOR			
C1	CC45SL1H221J	Ceramic 220pF ±5%	
C2	CC45SL1H100D	Ceramic 10pF ±0.5pF	
C3	CC45SL1H050D	Ceramic 5pF ±0.25pF	
C4,5	CC45SL1H470J	Ceramic 47pF ±5%	
C6,7	CK45F1H103Z	Ceramic 0.01μF +80%—20%	
C8	CE04W1C100(RL)	Electrolytic 10μF 16WV	
C9~11	CK45F1H103Z	Ceramic 0.01μF +80%—20%	
C12,13	C90-0254-05	Ceramic 0.022μF 25WV	
C14,15	CK45F1H103Z	Ceramic 0.01μF +80%—20%	
C16,17	C90-0254-05	Ceramic 0.022μF 25WV	
C18~20	CK45F1H103Z	Ceramic 0.01μF +80%—20%	
C21,22	C90-0254-05	Ceramic 0.022μF 25WV	
C24	C90-0254-05	Ceramic 0.022μF 25WV	
C25	CC45SL1H470J	Ceramic 47pF ±5%	
C26,27	CK45F1H103Z	Ceramic 0.01μF +80%—20%	
C28,29	C90-0254-05	Ceramic 0.022μF 25WV	
C30	CC45SL1H470J	Ceramic 47pF ±5%	
C31	CL45F1J103Z	Ceramic 0.01μF +80%—20%	
C32	C90-0162-05	Ceramic 0.047μF 25WV	
C33	C90-0254-05	Ceramic 0.022μF 25WV	
C34	CC45SL1H100D	Ceramic 10pF ±0.5pF	
C35	C90-0254-05	Ceramic 0.022μF 25WV	
C36	CK45F1H103Z	Ceramic 0.01μF +80%—20%	
C37	CC45SL1H101J	Ceramic 100pF ±5%	
C38	CK45F1H103Z	Ceramic 0.01μF +80%—20%	
C39	C90-0262-05	Ceramic 0.047μF 25WV	
C40~41	C90-0254-05	Ceramic 0.022μF 25WV	
C42	CK45F1H103Z	Ceramic 0.01μF +80%—20%	
C43	CE04W1H010(RL)	Ceramic 1μF 50WV	
C44	CK45F1H103Z	Ceramic 0.01μF +80%—20%	

PARTS LIST

Ref. No.	Parts No.	Description	Re- marks	Ref. No.	Parts No.	Description	Re- marks
C45	CK45D1H102M	Ceramic 0.001μF ±20%		C122	C90-0262-05	Ceramic 0.047μF 25WV	
C46	CK45F1H103Z	Ceramic 0.01μF +80% - 20%		C123	C092M1H102K	Mylar 0.001μF ±10%	
C47	C90-0254-05	Ceramic 0.022μF 25WV		C124	C90-0262-05	Ceramic 0.047μF ±5%	
C48	CK45F1H103Z	Ceramic 0.01μF +80% - 20%		C125	CC45RH1H151J	Ceramic 150pF ±5%	
C49	CC45SL1H030C	Ceramic 3pF ±0.25pF		C127	CC45PG1H151J	Ceramic 150pF ±5%	
C50.51	C90-0254-05	Ceramic 0.22μF 25WV		C128	CC45SL1H100D	Ceramic 10pF ±0.5pF	
C52	CK45D1H102M	Ceramic 0.001μF ±20%		C129	CC45SL1H220J	Ceramic 22pF ±5%	
C53	CC45SL1H331J	Ceramic 330pF ±5%		C130	CK45F1H103Z	Ceramic 0.01μF +80% - 20%	
C54	C90-0254-05	Ceramic 0.022μF 25WV		C131	CC45SL1H101J	Ceramic 100pF ±5%	
C55	CK45F1H103Z	Ceramic 0.01μF +80% - 20%		C132	C90-0254-05	Ceramic 0.022μF 25WV	
C56	CC45SL1H010C	Ceramic 1pF ±0.25pF		C133	CC45SL1H220J	Ceramic 22pF ±5%	
C57	CC45SL1H470	Ceramic 47pF ±5%		C134	CC45SL1H101J	Ceramic 100pF ±5%	
C58	C90-0254-05	Ceramic 0.022μF 25WV		C135	CE04W1H010(RL)	Electrolytic 1μF 50WV	
C59	CC45SL1H101J	Ceramic 100pF ±5%		C136	C90-0262-05	Ceramic 0.047μF 25WV	
C61	CC45SL1H100D	Ceramic 10pF ±0.5pF		C138	CE04W1E4R7(RL)	Electrolytic 47μF 4.7μF	
C62	CE04W1C100(RL)	Electrolytic 10μF 16WV		C139	CK45F1H103Z	Ceramic 0.01μF +80% - 20%	
C64	CK45F1H103Z	Ceramic 0.01μF +80% - 20%		C140	C90-0254-05	Ceramic 0.022μF 25WV	
C65	CE04W1C010(RL)	Electrolytic 1μF 50WV		C141	CE04W1C470(RL)	Electrolytic 47μF 16WV	
C66	CK45D1H102M	Ceramic 0.001μF ±20%		C142	CC45SL1H470J	Ceramic 47pF ±5%	
C67	CE04W1C330(RL)	Electrolytic 33μF 16WV		C144	CE04W1H010(RL)	Electrolytic 1μF 50WV	
C68	C90-0254-05	Ceramic 0.022μF 25WV		C145	CC45CH1H680J	Ceramic 68pF ±5%	
C69	CC45SL1H470J	Ceramic 47pF ±5%		RESISTOR			
C70	CC45SL1H221J	Ceramic 220pF ±5%		R1	PD14CY2B392J	Carbon 3.9kΩ ±5% 1/8W	
C71	C90-0254-05	Ceramic 0.022μF 25WV		R2	PD14CY2B102J	Carbon 1kΩ ±5% 1/8W	
C72	CK45F1H103Z	Ceramic 0.01μF +80% - 20%		R3	PD14CY2B472J	Carbon 4.7kΩ ±5% 1/8W	
C73	CE04W1H010(RL)	Electrolytic 1μF 50WV		R4	PD14CY2B102J	Carbon 1kΩ ±5% 1/8W	
C74	C90-0262-05	Ceramic 0.047 25WV		R5	PD14CY2B392J	Carbon 3.9kΩ ±5% 1/8W	
C75.76	CK45F1H103Z	Ceramic 0.01μF +80% - 20%		R6	PD14CY2B221J	Carbon 220Ω ±5% 1/8W	
C77	CK45D1H102M	Ceramic 0.001μF ±20%		R7	PD14CY2B473J	Carbon 47kΩ ±5% 1/8W	
C79	CC45SL1H470J	Ceramic 47pF ±5%		R8	PD14CY2B221J	Carbon 220Ω ±5% 1/8W	
C81	C90-0254-05	Ceramic 0.022μF 25WV		R9	PD14CY2B471J	Carbon 470Ω ±5% 1/8W	
C82.83	CK45F1H103Z	Ceramic 0.01μF +80% - 20%		R10	PD14CY2B221J	Carbon 220Ω ±5% 1/8W	
C84	CC45UJ1H220J	Ceramic 22pF ±5%		R11	PD14CY2B392J	Carbon 3.9kΩ ±5% 1/8W	
C85.86	CK45F1H103Z	Ceramic 0.01μF +80% - 20%		R12	PD14CY2B473J	Carbon 47kΩ ±5% 1/8W	
C87	CC45SL1H101J	Ceramic 100pF ±5%		R13	PD14CY2B221J	Carbon 220Ω ±5% 1/8W	
C8.89	C90-0245-05	Ceramic 0.047μF 25WV		R14	PD14CY2B471J	Carbon 470Ω ±5% 1/8W	
C90	C90-0262-05	Ceramic 0.022μF 25WV		R15	PD14CY2B472J	Carbon 4.7kΩ ±5% 1/8W	
C91	CK45F1H103Z	Ceramic 0.01μF +80% - 20%		R16	PD14CY2B103J	Carbon 10kΩ ±5% 1/8W	
C92	CC45SL1H050D	Ceramic 5pF ±0.5pF		R17	PD14CY2B123J	Carbon 12kΩ ±5% 1/8W	
C93.94	CC45SL1H101J	Ceramic 100pF ±5%		R18	PD14CY2B473J	Carbon 47kΩ ±5% 1/8W	
C95	CE04W1H010(RL)	Electrolytic 1μF 50WV		R19	PD14CY2B102J	Carbon 1kΩ ±5% 1/8W	
C96	C90-0163-05	Electrolytic 220μF 16WV		R21	PD14CY2B101J	Carbon 100Ω ±5% 1/8W	
C97	CC45SL1H470J	Ceramic 47pF ±5%		R22	PD14CY2B104J	Carbon 100kΩ ±5% 1/8W	
C99	CE04W1H010(RL)	Electrolytic 1μF 50WV		R23	PD14CY2B153J	Carbon 15kΩ ±5% 1/8W	
C100	CQ92M1H153K	Mylar 0.015μF ±10%		R24	PD14CY2B122J	Carbon 1.2kΩ ±5% 1/8W	
C101	CE04W1E4R7(RL)	Electrolytic 4.7μF 25WV		R25	PD14CY2B152J	Carbon 1.5Ω ±5% 1/8W	
C102	C90-0162-05	Ceramic 0.047μF 25WV		R26	PD14CY2B102J	Carbon 1kΩ ±5% 1/8W	
C103	CE04W1A470(RL)	Electrolytic 47μF 10WV		R27	PD14CY2B103J	Carbon 10kΩ ±5% 1/8W	
C104	CE04W1H010(RL)	Electrolytic 1μF 50WV		R28	PD14CY2B473J	Carbon 47kΩ ±5% 1/8W	
C105	CE04W1H3R3(RL)	Electrolytic 3.3μF 50WV		R29	PD14CY2B471J	Carbon 470Ω ±5% 1/8W	
C106	CE04WE4R7(RL)	Electrolytic 4.7μF 25WV		R30	PD14CY2B101J	Carbon 100Ω ±5% 1/8W	
C107.108	CE04W1H010(RL)	Electrolytic 1μF 50WV		R31	PD14CY2B103J	Carbon 10kΩ ±5% 1/8W	
C109	CE04W1C100(RL)	Electrolytic 10μF 16WV		R32	PD14CY2B274J	Carbon 270kΩ ±5% 1/8W	
C110	CK45F1H103Z	Ceramic 0.01μF +80% - 20%		R33	PD14CY2B471J	Carbon 470Ω ±5% 1/8W	
C111	C90-0262-05	Ceramic 0.047μF 25WV		R34	PD14CY2B101J	Carbon 100Ω ±5% 1/8W	
C112~116	C90-0254-05	Ceramic 0.022μF 25WV		R35.36	PD14CY2B472J	Carbon 4.7kΩ ±5% 1/8W	
C117	CK45F1H103Z	Ceramic 0.01μF +80% - 20%		R37	PD14CY2B682J	Carbon 6.8kΩ ±5% 1/8W	
C118	C90-0254-05	Ceramic 0.022μF 25WV		R38.39	PD14CY2B103J	Carbon 10kΩ ±5% 1/8W	
C119.120	CE04W1H010(RL)	Electrolytic 1μF 50WV		R40	PD14CY2B102J	Carbon 1kΩ ±5% 1/8W	
C121	CE04W1C100(RL)	Electrolytic 10μF 16WV					

PARTS LIST

Ref. No.	Parts No.	Description	Re- marks
R41	PD14CY2B472J	Carbon 4.7kΩ ±5% 1/8W	
R42	PD14CY2B102J	Carbon 1kΩ ±5% 1/8W	
R43	PD14CY2B822J	Carbon 8.2kΩ ±5% 1/8W	
R44	PD14CY2B221J	Carbon 220Ω ±5% 1/8W	
R45	PD14CY2B333J	Carbon 33kΩ ±5% 1/8W	
R46	PD14CY2B683J	Carbon 68kΩ ±5% 1/8W	
R47	PD14CY2B102J	Carbon 1kΩ ±5% 1/8W	
R48	PD14CY2B471J	Carbon 470Ω ±5% 1/8W	
R49	PD14CY2B333J	Carbon 33kΩ ±5% 1/8W	
R50	PD14CY2B103J	Carbon 10kΩ ±5% 1/8W	
R51	PD14CY2B222J	Carbon 2.2Ω ±5% 1/8W	
R52	PD14CY2B224J	Carbon 220kΩ ±5% 1/8W	
R53	PD14CY2B222J	Carbon 2.2kΩ ±5% 1/8W	
R54	PD14CY2B154J	Carbon 150kΩ ±5% 1/8W	
R55	PD14CY2B333J	Carbon 33kΩ ±5% 1/8W	
R56	PD14CY2B331J	Carbon 330Ω ±5% 1/8W	
R57	PD14CY2B152J	Carbon 1.5Ω ±5% 1/8W	
R58	PD14CY2B104J	Carbon 110kΩ ±5% 1/8W	
R59	PD14CY2B103J	Carbon 10kΩ ±5% 1/8W	
R60	PD14CY2B183J	Carbon 18kΩ ±5% 1/8W	
R61	PD14CY2B102J	Carbon 1kΩ ±5% 1/8W	
R63	PD14CY2B103J	Carbon 10kΩ ±5% 1/8W	
R64	PD14CY2B224J	Carbon 220kΩ ±5% 1/8W	
R65	PD14CY2B222J	Carbon 2.2kΩ ±5% 1/8W	
R66	RC05GFH225J	Carbon 2.2MΩ ±5% 1/2W	
R67	PD14CY2B103J	Carbon 10kΩ ±5% 1/8W	
R68	PD14CY2B332J	Carbon 3.3kΩ ±5% 1/8W	
R69	PD14CY2B683J	Carbon 68kΩ ±5% 1/8W	
R70	PD14CY2B561J	Carbon 560Ω ±5% 1/8W	
R71	PD14CY2B471J	Carbon 470Ω ±5% 1/8W	
R72	PD14CY2B330J	Carbon 33Ω ±5% 1/8W	
R73,74	PD14CY2B221J	Carbon 220Ω ±5% 1/8W	
R75,76	PD14CY2B474J	Carbon 470kΩ ±5% 1/8W	
R77	PD14CY2B274J	Carbon 270kΩ ±5% 1/8W	
R78	PD14CY2B394J	Carbon 390kΩ ±5% 1/8W	
R79	PD14CY2B221J	Carbon 220Ω ±5% 1/8W	
R80	PD14CY2B102J	Carbon 1kΩ ±5% 1/8W	
R81	PD14CY2B273J	Carbon 2.7kΩ ±5% 1/8W	
R82	PD14CY2B104J	Carbon 100kΩ ±5% 1/8W	
R83	PD14CY2B103J	Carbon 10kΩ ±5% 1/8W	
R84	PD14CY2B104J	Carbon 100kΩ ±5% 1/8W	
R85	PD14CY2B223J	Carbon 22kΩ ±5% 1/8W	
R86	PD14CY2B101J	Carbon 100Ω ±5% 1/8W	
R87	PD14CY2B102J	Carbon 1kΩ ±5% 1/8W	
R88	PD14CY2B562J	Carbon 5.6Ω ±5% 1/8W	
R89	PD14CY2B103J	Carbon 10kΩ ±5% 1/8W	
R90	PD14CY2B154J	Carbon 150kΩ ±5% 1/8W	
R91	PD14CY2B102J	Carbon 1kΩ ±5% 1/8W	
R92	PD14CY2B331J	Carbon 330Ω ±5% 1/8W	
R93,94	PD14CY2B223J	Carbon 22kΩ ±5% 1/8W	
R95	PD14CY2B221J	Carbon 220Ω ±5% 1/8W	
R96	PD14CY2B102J	Carbon 1kΩ ±5% 1/8W	
R97	PD14CY2B183J	Carbon 18kΩ ±5% 1/8W	
R98	PD14CY2B103J	Carbon 10kΩ ±5% 1/8W	
R99	PD14CY2B683J	Carbon 68kΩ ±5% 1/8W	
R100	PD14CY2B223J	Carbon 22kΩ ±5% 1/8W	
R101	PD14CY2B102J	Carbon 1kΩ ±5% 1/8W	
R102	PD14CY2B221J	Carbon 220Ω ±5% 1/8W	
R103,104	PD14CY2B331J	Carbon 330Ω ±5% 1/8W	
R105	PD14CY2B103J	Carbon 10kΩ ±5% 1/8W	
R106	PD14CY2B332J	Carbon 3.3kΩ ±5% 1/8W	
R107	PD14CY2B102J	Carbon 1kΩ ±5% 1/8W	

Ref. No.	Parts No.	Description	Re- marks
R108	PD14CY2B471J	Carbon 470Ω ±5% 1/8W	
R109,110	PD14CY2B103J	Carbon 10kΩ ±5% 1/8W	
R111	PD14CY2B332J	Carbon 3.3kΩ ±5% 1/8W	
R112	PD14CY2B102J	Carbon 1kΩ ±5% 1/8W	
R113	PD14CY2B470J	Carbon 470Ω ±5% 1/8W	
R114	PD14CY2B103J	Carbon 10kΩ ±5% 1/8W	
R115,116	PD14CY2B471J	Carbon 470Ω ±5% 1/8W	
R117	PD14CY2B472J	Carbon 4.7kΩ ±5% 1/8W	
R118	PD14CY2B104J	Carbon 100kΩ ±5% 1/8W	
R119	PD14CY2B223J	Carbon 22kΩ ±5% 1/8W	
R120	PD14CY2B562J	Carbon 5.6kΩ ±5% 1/8W	
R121	PD14CY2B102J	Carbon 1kΩ ±5% 1/8W	
R122	PD14CY2B473J	Carbon 47kΩ ±5% 1/8W	
R123	PD14CY2B221J	Carbon 220Ω ±5% 1/8W	
R124	PD14CY2B562J	Carbon 5.6kΩ ±5% 1/8W	
R125	PD14CY2B392J	Carbon 3.9kΩ ±5% 1/8W	
R126	PD14CY2B102J	Carbon 1kΩ ±5% 1/8W	
R127	PD14CY2B332J	Carbon 3.3Ω ±5% 1/8W	
R128	PD14CY2B101J	Carbon 100Ω ±5% 1/8W	
R129	PD14CY2B104J	Carbon 100kΩ ±5% 1/8W	
R130	PD14CY2B474J	Carbon 470kΩ ±5% 1/8W	
R131	PD14CY2B472J	Carbon 4.7kΩ ±5% 1/8W	
R132	PD14CY2B331J	Carbon 330Ω ±5% 1/8W	
R133	PD14CY2B101J	Carbon 100Ω ±5% 1/8W	
R134	PD14CY2B222J	Carbon 2.2kΩ ±5% 1/8W	
R137	PD14CY2B223J	Carbon 22kΩ ±5% 1/8W	
R138	PD14CY2B471J	Carbon 470Ω ±5% 1/8W	
R139	PD14CY2B104J	Carbon 100kΩ ±5% 1/8W	
R140	PD14CY2B101J	Carbon 100Ω ±5% 1/8W	
R141	PD14CY2B102J	Carbon 1kΩ ±5% 1/8W	
R142	PD14CY2B102J	Carbon 1kΩ ±5% 1/8W	
R143	PD14CY2B561J	Carbon 560Ω ±5% 1/8W	
R145	PD14CY2B102J	Carbon 1kΩ ±5% 1/8W	
R146	PD14CY2B472J	Carbon 4.7kΩ ±5% 1/8W	
R147	PD14CY2B103J	Carbon 10kΩ ±5% 1/8W	
R148	PD14CY2B221J	Carbon 220Ω ±5% 1/8W	
R149,150	PD14CY2B270J	Carbon 27Ω ±5% 1/8W	
R151	PD14CY2B822J	Carbon 8.2kΩ ±5% 1/8W	
SEMICONDUCTOR			
Q1~3	V09-0036-05	FET 3SK35GR	
Q4	V09-0012-05	FET 2SK19(GR)	
Q5	V01-0027-05	Transistor 2SA495(Y)	
Q6	V03-0123-05	Transistor 2SC733(Y)	
Q7	V09-0012-05	FET 2SK19(GR)	
Q8~10	V03-0079-05	Transistor 2SC460(B)	
Q11	V03-0123-05	Transistor 2SC733(Y)	
Q12,13	V03-0079-05	Transistor 2SC460(B)	
Q14	V09-0012-05	FET 2SK19(GR)	
Q15,16	V03-0123-05	Transistor 2SC733(Y)	
Q17	V03-0079-05	Transistor 2SC460(B)	
Q18	V09-0036-05	FET 3SK35(GR)	
Q19	V03-0299-05	Transistor 2SC1000(GR)	
Q20,21	V03-0123-05	Transistor 2SC733(Y)	
Q22	V03-0299-05	Transistor 2SC1000(GR)	
Q23~25	V03-0270-05	Transistor 2SC945(R)	
Q26	V03-0079-05	Transistor 2SC733(Y)	
Q27	V01-0037-05	Transistor 2SA495(Y)	
Q28,29	V03-0270-05	Transistor 2SC945(R)	
Q30	V03-0123-05	Transistor 2SC733(Y)	
D1~8	V11-0370-05	Diode IS1587	

PARTS LIST

Ref. No.	Parts No.	Description	Re- marks
D9~14	V11-0051-05	Diode IN60	
D15	V21-0004-05	Varistor MV-13	
D16~19	V11-0051-05	Diode IN60	
D20,21	V11-0076-05	Diode IS1555	
D22	V11-0240-05	Zener diode WZ090	
D23	V11-0076-05	Diode IS1555	
D24	V11-0370-05	Diode IS1587	
D26~29	V11-0051-05	Diode IN60	
D30	V11-0076-05	Diode IS1555	
D31~41	V11-0051-05	Diode IN60	
D42	V11-0240-05	Zener diode WZ090	
D43	V11-0076-05	Diode IS1555	
POTENTIOMETER			
VR1	R12-3025-05	Fixed resistor 10k Ω	
VR2	R12-7013-05	Semi-fixed resistor 500k	
VR3	R12-1012-05	Semi-fixed resistor 1k Ω	
VR4	R12-4015-05	Semi-fixed resistor 50k Ω	
VR5	R12-0056-05	Semi-fixed resistor 100 Ω (solid)	
VR6	R12-0045-05	Semi-fixed resistor 100 Ω	
VR7	R12-3025-05	Semi-fixed resistor 10k Ω	
COIL/TRIMMER/FILTER			
L1~4	L40-1511-03	Ferri inductor	
L5	L40-1021-03	Ferri inductor	
L6~11	L40-1511-03	Ferri inductor	
L13	L40-1511-03	Ferri inductor	
L15	L40-1511-03	Ferri inductor	
L16	L40-1021-03	Ferri inductor	
L17	L40-4711-03	Ferri inductor	
L18	L40-1021-03	Ferri inductor	
L20	L40-6825-04	Ferri inductor	
L21	L40-1021-03	Ferri inductor	
T1	L34-0534-05	Tuning coil	
T2	L34-0536-05	Tuning coil	
T3	L34-0537-05	Tuning coil	
T4	L34-0538-05	Tuning coil	
T5,6	L34-0353-05	Tuning coil	
T7	L34-0536-05	Tuning coil	
T8	L34-0535-05	Tuning coil	
T9	L34-0536-05	Tuning coil	
T10	L34-0567-05	Tuning coil	
T11	L34-0539-05	Tuning coil	
T12,13	L34-0540-05	Tuning coil	
T14	L34-0539-05	Tuning coil	
T15	L34-0202-05	Oscillator coil	
TC1,2	C05-0030-05	Ceramic trimmer	
TC3	C05-0048-05	Ceramic trimmer	
TC4	C05-0009-05	Ceramic trimmer	
TC5	C05-0030-05	Ceramic trimmer	
CF1~3	L72-0038-05	Ceramic filter	
CRYSTAL QUARTZ			
X1	L77-0499-05	NB filter	
X2	L77-0500-05	NB filter	
MISCELLANEOUS			
XF1	L71-0023-05	Crystal quartz filter SSB8.83MHz	
—	E23-0046-04	Terminal (square)	
—	E23-0047-04	Terminal (square) $\times$ 5	
IF1	E40-0714-05	Mini-connector	
IF2	E40-0512-05	Mini-connector	
IF3	E40-1714-05	Mini-connector	
IF4,5	E40-1414-05	Mini-connector	

Ref. No.	Parts No.	Description	Re- marks
—	J21-1499-04	PC board stopper (A)	
—	J21-1500-04	PC board stopper (B)	
—	J21-0501-04	PC board stopper (C)	

AF-AVR (X49-1080-00)

Ref. No.	Parts No.	Description	Re- marks
CAPACITOR			
C1	CE04W1C221(RL)	Electrolytic 220 μ F 16WV	
C2	CQ92M1H273K	Mylar 0.027 μ F $\pm$ 10%	
C3	CK45B1H471K	Ceramic 470pF $\pm$ 10%	
C4	CQ92M1H273K	Mylar 0.027 μ F $\pm$ 10%	
C5	CE04W1E4R7(RL)	Electrolytic 4.7 μ F 25WV	
C6,7	CQ92M1H273K	Mylar 0.027 μ F $\pm$ 10%	
C8,9	CQ92M1H473K	Mylar 0.047 μ F $\pm$ 10%	
C10	CE04W1C100(RL)	Electrolytic 10 μ F 16WV	
C11	CE04W1HR47(RL)	Electrolytic 0.47 μ F 50WV	
C12	CK45F1H103Z	Ceramic 0.01 μ F $+80\% - 20\%$	
C13,14	CE03W1C100(RL)	Electrolytic 10 μ F 16WV	
C15	CK45F1H103Z	Ceramic 0.01 μ F $+80\% - 20\%$	
C16	CQ92M1H473K	Mylar 0.047 μ F $\pm$ 10%	
C17	CE04W1H010(RL)	Electrolytic 1 μ F 50WV	
C18	CC45SLH101J	Ceramic 100pF $\pm$ 5%	
C19	CE04W1C100(RL)	Electrolytic 10 μ F 16WV	
C20	CK45F1H103Z	Ceramic 0.01 μ F $+80\% - 20\%$	
C21	CE04W1H010(RL)	Electrolytic 1 μ F 50WV	
C22	CC45SLH101J	Ceramic 100pF $\pm$ 5%	
C23	CE04W1C100(RL)	Electrolytic 10 μ F 16WV	
C24	CE04W0J101(RL)	Electrolytic 100 μ F 6.3WV	
C25	CK45B1H331K	Ceramic 330pF $\pm$ 10%	
C26	CQ92M1H473K	Mylar 0.047 μ F $\pm$ 10%	
C27	CE04W1A470(RL)	Electrolytic 47 μ F 10WV	
C28	CC45SL1H101J	Ceramic 100pF $\pm$ 5%	
C29	CE04W1C221(RL)	Electrolytic 220 μ F 16WV	
C30	CK45F1H103Z	Ceramic 0.01 μ F $+80\% - 20\%$	
C31	CE04W2HR47(RL)	Electrolytic 0.47 μ F $\pm$ 10%	
C32	CQ92M1H473K	Mylar 0.047 μ F $\pm$ 10%	
RESISTOR			
R1,2	PD14CY2E103J	Carbon 10k Ω $\pm$ 5% 1/4W	
R3	PD14CY2E473J	Carbon 47k Ω $\pm$ 5% 1/4W	
R4	PD14CY2E221J	Carbon 220 Ω $\pm$ 5% 1/4W	
R5	PD14CY2E102J	Carbon 1k Ω $\pm$ 5% 1/4W	
R6	PD14CY2E562J	Carbon 5.6k Ω $\pm$ 5% 1/4W	
R7	PD14CY2E472J	Carbon 4.7k Ω $\pm$ 5% 1/4W	
R8	PD14CY2E103J	Carbon 10k Ω $\pm$ 5% 1/4W	
R9	PD14CY2E332J	Carbon 3.3k Ω $\pm$ 5% 1/4W	
R10	PD14CY2E182J	Carbon 1.8 Ω $\pm$ 5% 1/4W	
R11	PD14CY2E103J	Carbon 10k Ω $\pm$ 5% 1/4W	
R12	PD14CY2E102J	Carbon 1k Ω $\pm$ 5% 1/4W	
R13	PD14CY2E332J	Carbon 3.3k Ω $\pm$ 5% 1/4W	
R14	PD14CY2E103J	Carbon 10k Ω $\pm$ 5% 1/4W	
R15	PD14CY2E223J	Carbon 22k Ω $\pm$ 5% 1/4W	
R16	PD14CY2E562J	Carbon 5.6k Ω $\pm$ 5% 1/4W	
R17	PD14CY2E273J	Carbon 27k Ω $\pm$ 5% 1/4W	
R18	PD14CY2E392J	Carbon 3.9k Ω $\pm$ 5% 1/4W	
R19	PD14CY2E222J	Carbon 2.2k Ω $\pm$ 5% 1/4W	
R20	PD14CY2E221J	Carbon 220 Ω $\pm$ 5% 1/4W	
R21	PD14CY2E222J	Carbon 2.2k Ω $\pm$ 5% 1/4W	
R22	PD14CY2E821J	Carbon 820 Ω $\pm$ 5% 1/4W	

PARTS LIST

Ref. No.	Parts No.	Description	Re- marks
R23	PC14CY2E471J	Carbon 470Ω ±5% 1/4W	
R24	PC14CY2E682J	Carbon 6.8kΩ ±5% 1/4W	
R25	PC14CY2E473J	Carbon 47kΩ ±5% 1/4W	
R26	PC14CY2E471J	Carbon 470Ω ±5% 1/4W	
R27	PC14CY2E102J	Carbon 1kΩ ±5% 1/4W	
R28	PC14CY2E392J	Carbon 3.9kΩ ±5% 1/4W	
R29	PC14CY2E471J	Carbon 470Ω ±5% 1/4W	
R30	PC14CY2E222J	Carbon 2.2kΩ ±5% 1/4W	
R31	PC14CY2E212J	Carbon 2.7kΩ ±5% 1/4W	
R32	PC14CY2E222J	Carbon 2.2kΩ ±5% 1/4W	
R33	PC14CY2E821J	Carbon 820Ω ±5% 1/4W	
R34	PC14CY2E471J	Carbon 470Ω ±5% 1/4W	
R35	PC14CY2E331J	Carbon 330Ω ±5% 1/4W	
R36	PC14CY2E683J	Carbon 68kΩ ±5% 1/4W	
R37	PC14CY2E103J	Carbon 10kΩ ±5% 1/4W	
R38	RN14AB3A680J	Metal film 68Ω ±5% 1W	
R39	PD14CY2E224J	Carbon 220kΩ ±5% 1/4W	
R40	PD14CY2E820J	Carbon 82Ω ±5% 1/4W	
R41	PD14CY2E332J	Carbon 3.3kΩ ±5% 1/4W	
R42	PD14CY2E471J	Carbon 470Ω ±5% 1/4W	
R43	PD14CY2E223J	Carbon 22kΩ ±5% 1/4W	
R44	PD14CY2E103J	Carbon 10kΩ ±5% 1/4W	
R45	PD14CY2E563J	Carbon 56kΩ ±5% 1/4W	
R46	PD14CY2E472J	Carbon 4.7kΩ ±5% 1/4W	
SEMICONDUCTOR			
Q1.2	V03-0299-05	Transistor 2SC1000(GR)	
Q3	V30-0172-05	IC TA7201P	
Q4~6	V03-0099-05	Transistor 2SC372	
Q7	V11-0113-05	Transistor 2SA496	
D1.2	V11-0076-05	Diode 1S1555	
D3.4	V11-0051-05	Diode 1N60	
D5	V11-0243-05	Zener diode WZ-061	
POTENTIOMETER/COIL			
VR1	R12-4020-05	Semi-fixed resistor 50kΩ	
VR2	R12-3036-05	Semi-fixed resistor 10kΩ	
VR3	R12-3004-05	Semi-fixed resistor 47kΩ	
VR4	R12-0042-05	Semi-fixed resistor 500Ω	
L1	L40-3391-03	Ferri inductor 3.3μH	
MISCELLANEOUS			
AF1.2	E40-0613-05	Mini-connector	
AF3	E40-1113-05	Mini-connector	
—	F01-0242-04	IC heat sink	
—	F01-0243-04	AVR heat sink	

FIX-VOX (X50-1350-00)

Ref. No.	Parts No.	Description	Re- marks
C1~4	CC45CH1H220J	Ceramic 22pF ±5%	
C5~7	CK45F1H103Z	Ceramic 0.01μF +80%—20%	
C8	CC45CH1H330J	Ceramic 33pF ±5%	
C9	CC45CH1H680J	Ceramic 68pF ±5%	
C10	CK45F1H403Z	Ceramic 0.04μF +80%—20%	
C11	CC45CH1H050D	Ceramic 5pF ±0.5pF	
C12	CC45CH1H070D	Ceramic 7pF ±0.5pF	
C13.14	CC45CH1H120J	Ceramic 12pF ±5%	
C15	CK45F1H403Z	Ceramic 0.04μF +80%—20%	
C16.17	CK45F1H103Z	Ceramic 0.01μF +80%—20%	
C18	CE04W1H010(RL)	Electrolytic 1μF 50WV	

Ref. No.	Parts No.	Description	Re- marks
C19	CK45B1H331K	Ceramic 330pF ±10%	
C20	CE04W1H3R3(RL)	Electrolytic 3.3μF 50WV	
C21	CQ92M1H472K	Mylar 0.047μF ±10%	
C22	CK45F1H403Z	Ceramic 0.04μF +80%—20%	
C23	CE04W1H3R3(RL)	Electrolytic 3.3μF 50WV	
C24	CK45F1H103Z	Ceramic 0.01μF +80%—20%	
C25	CE04W1HR47(RL)	Electrolytic 0.47μF 50WV	
C26	CE04W1E221(RL)	Electrolytic 220μF 25WV	
C27	CE04W1C101(RL)	Electrolytic 100μF 16WV	
C28	CE04W0J470(RL)	Electrolytic 47μF 6.3WV	
C29	CK45F1H223Z	Ceramic 0.022μF +80%—20%	
C30	CE04W1H3R3(RL)	Electrolytic 3.3μF 50WV	
C31	CQ92M1H472K	Ceramic 0.01μF +80%—20%	
C32	CE04W1H3R3(RL)	Electrolytic 3.3μF 50WV	
C33	CE04W1C100(RL)	Electrolytic 10μF 16WV	
C34~37	CQ92M1H123K	Mylar 0.012μF ±10%	
C38	CK45F1H223Z	Ceramic 0.022μF +80%—20%	
C39	CK45F1H403Z	Ceramic 0.04μF +80%—20%	
RESISTOR			
R1~4	PD14CY2E473J	Carbon 47kΩ ±5% 1/4W	
R5	PD14CY2E102J	Carbon 1kΩ ±5% 1/4W	
R6~9	PD14CY2E104J	Carbon 100kΩ ±5% 1/4W	
R10	PD14CY2E101J	Carbon 100Ω ±5% 1/4W	
R11	PD14CY2E333J	Carbon 33kΩ ±5% 1/4W	
R12	PD14CY2E473J	Carbon 47Ω ±5% 1/4W	
R13	PD14CY2E101J	Carbon 100Ω ±5% 1/4W	
R14	PD14CY2E102J	Carbon 1kΩ ±5% 1/4W	
R15	PD14CY2E101J	Carbon 100Ω ±5% 1/4W	
R16	PD14CY2E472J	Carbon 4.7Ω ±5% 1/4W	
R17	PD14CY2E473J	Carbon 47kΩ ±5% 1/4W	
R18	PD14CY2E563J	Carbon 56kΩ ±5% 1/4W	
R19	PD14CY2E334J	Carbon 330kΩ ±5% 1/4W	
R20	PD14CY2E102J	Carbon 1kΩ ±5% 1/4W	
R21	PD14CY2E562J	Carbon 5.6kΩ ±5% 1/4W	
R22	PD14CY2E683J	Carbon 68kΩ ±5% 1/4W	
R23	PD14CY2E222J	Carbon 2.2kΩ ±5% 1/4W	
R24	PD14CY2E102J	Carbon 1kΩ ±5% 1/4W	
R25	PD14CY2E103J	Carbon 10kΩ ±5% 1/4W	
R26	PD14CY2E153J	Carbon 15kΩ ±5% 1/4W	
R27	PD14CY2E472J	Carbon 4.7kΩ ±5% 1/4W	
R28	PD14CY2E102J	Carbon 1kΩ ±5% 1/4W	
R29	PD14CY2E472J	Carbon 4.7kΩ ±5% 1/4W	
R30	PD14CY2E471J	Carbon 470Ω ±5% 1/4W	
R31	PD14CY2E4R7J	Carbon 4.7Ω ±5% 1/4W	
R32	PD14CY2E472J	Carbon 4.7kΩ ±5% 1/4W	
R33	PD14CY2E103J	Carbon 10kΩ ±5% 1/4W	
R34	PD14CY2E471J	Carbon 470Ω ±5% 1/4W	
R35	PD14CY2E104J	Carbon 100kΩ ±5% 1/4W	
R36	PD14CY2E223J	Carbon 22kΩ ±5% 1/4W	
R37	PD14CY2E334J	Carbon 330kΩ ±5% 1/4W	
R38	PD14CY2E472J	Carbon 4.7kΩ ±5% 1/4W	
R39	PD14CY2E474J	Carbon 470kΩ ±5% 1/4W	
R40	PD14CY2E274J	Carbon 270kΩ ±5% 1/4W	
R41	PD14CY2E223J	Carbon 22kΩ ±5% 1/4W	
R42	PD14CY2E102J	Carbon 1kΩ ±5% 1/4W	
R43	PD14CY2E105J	Carbon 1MΩ ±5% 1/4W	
R44	PD14CY2E104J	Carbon 100kΩ ±5% 1/4W	
R45.46	PD14CY2E103J	Carbon 10kΩ ±5% 1/4W	
R47	PD14CY2E124J	Carbon 120kΩ ±5% 1/4W	
R48	PD14CY2E103J	Carbon 10kΩ ±5% 1/4W	
R49	PD14BY2E103J	Carbon 10kΩ ±5% 1/4W	

PARTS LIST

Ref. No.	Parts No.	Description	Re- marks
SEMICONDUCTOR			
Q1	V09-0012-05	FET 2SK19(GR)	
Q2,3	V03-0079-05	Transistor 2SC460(B)	
Q4,5	V03-0123-05	Transistor 2SC733(Y)	
Q6	V01-0032-05	Transistor SA562(Y)	
Q7,8	V03-0123-05	Transistor 2SC733(Y)	
Q9	V01-0032-05	Transistor 2SA562(Y)	
Q10~12	V03-0123-05	Transistor 2SC733(Y)	
Q13	V03-0241-05	Transistor 2SC735(Y)	
D1~4	V11-0370-05	Diode 1S1587	
D5,6	V11-0293-05	Vari-cap diode 1S1658-2	
D7,8	V11-0051-05	Diode 1N60	
D9	V11-0076-05	Diode 1S1555	
D10~15	V11-0051-05	Diode 1N60	
D16	V11-0076-05	Diode 1S1555	
D17	V11-0051-05	Diode 1N60	
D18	V11-0297-05	Zener diode WZ-13	
D19~23	V11-0076-05	Diode 1S1555	
D24	V11-0297-05	Zener diode WZ-061	
TRANSFORMER			
T1	L13-0001-05	Input transformer	
T2	L12-0013-05	Oscillation transformer	
TRIMMER			
TC1~4	C05-0030-15	Ceramic trimmer 20pF	
MICELLANEOUS			
	E18-0401-05	Crystal quarts socket	
FIX1	E40-1413-05	Mini-connector	
FIX2	E40-0613-05	Mini-connector	
FIX3	E40-1413-05	Mini-connector	

Ref. No.	Parts No.	Description	Re- marks
SEMICONDUCTOR			
Q1~4	V03-0042-05	Transistor 2SC373	
D1	V11-0051-05	Diode 1N60	
COIL/TRIMMER			
L1	L40-1235-05	Ferri inductor	
TC	C05-0029-15	Ceramic trimmer	
CRYSTAL QUARTZ			
X1	L77-0009-05	Crystal quartz	
MISCELLANEOUS			
—	E23-0005-04	Terminal × 6	

INDICATOR (X54-1180-00)

Ref. No.	Parts No.	Description	Re- marks
RESISTOR			
R1	PD14BY2E471J	Carbon 470Ω ±5% 1/4W	
R2	PD14BY2E681J	Carbon 680Ω ±5% 1/4W	
SEMICONDUCTOR			
D~4	V11-0430-05	LED SEL-103W	
MISCELLANEOUS			
J1	R92-0150-05	Short jumper	
—	E23-0040-040	Terminal × 3	
—	F20-0501-040	Insulator × 2	

MARKER (X52-0005-01)

Ref. No.	Parts No.	Description	Re- marks
CAPACITOR			
C1	CM93M1H103K	Mylar 0.01μF ±10%	
C2	CC45CH1H151J	Ceramic 150pF ±5%	
C3	CC45CH1H101J	Ceramic 100pF ±5%	
C4	CC45CH1H330	Ceramic 33pF ±5%	
C5	CK45F1H403Z	Ceramic 0.04pF +80%—20%	
C6	CC45CH1H390J	Ceramic 39pF ±5%	
C7,C7	CC45CH1H330J	Ceramic 33pF ±5%	
C8	CC45SL1H101J	Ceramic 100pF ±5%	
C9	CC45SL1H221K	Ceramic 220pF ±10%	
C10	CC94SL1H470K	Ceramic 47pF ±10%	
C11	CC94SL2H050D	Ceramic 5pF ±0.5pF	
C12	CK45F1H403Z	Ceramic 0.04μF +80%—20%	
C13	CC45CH1H470J	Ceramic 47pF ±5%	
RESISTOR			
R1	PD14CY2E473J	Carbon 47kΩ ±5% 1/4W	
R2	PD14CY2E103J	Carbon 10kΩ ±5% 1/4W	
R3	PD14CY2E101J	Carbon 100Ω ±5% 1/4W	
R4	PD14CY2E473J	Carbon 47kΩ ±5% 1/4W	
R5	PD14CY2E472J	Carbon 4.7kΩ ±5% 1/4W	
R6	PD14CY2E224J	Carbon 220kΩ ±5% 1/4W	
R7	PD14CY2E105J	Carbon 1kΩ ±5% 1/4W	
R8~10	PD14CY2E472J	Carbon 4.7kΩ ±5% 1/4W	

VOX-VR (X54-1190-00)

Ref. No.	Parts No.	Description	Re- marks
CAPACITOR			
C1	CK45F1H103Z	Ceramic 0.01μF +80%—20%	
POTENTIOMETER			
VR1	R01-6013-05	250kΩ(B) VOX DELAY	
VR2	R01-0043-05	300Ω(B) ANTI VOX	
VR3	R01-4025-05	50kΩ(B) VOX GAIN	
MISCELLANEOUS			
—	E23-0046-04	Terminal (square) × 8	

FINAL (X56-1200-00)

Ref. No.	Parts No.	Description	Re- marks
CAPACITOR			
C1	CC45SL2H101J	Ceramic 100pF ±5%	
C2	CK45E2H102P	Ceramic 0.001μF +100%—0%	
C3~10	CK45F1H403Z	Ceramic 0.04μF +80%—20%	
C11~13	CK45E2H103P	Ceramic 0.01μF +100%—0%	
C14	CK45F1H103Z	Ceramic 0.01μF +80%—20%	
RESISTOR			
R1	PD14BY2E101J	Carbon 100Ω ±5% 1/4W	
R2,3	RC05GF3A100J	Carbon 10Ω ±5% 1W	

PARTS LIST

Ref. No.	Parts No.	Description	Re- marks
R4	PD14BY2E332J	Carbon 3.3k Ω $\pm$ 5% 1/4W	
R5,6	RC05GF2H101J	Carbon 100 Ω $\pm$ 5% 1/2W	
COIL			
L1,2	L40-4711-03	Ferri-inductor 470 μ H	
L3,4	L40-1511-03	Ferri-inductor 150 μ H	
PS1.2	L33-0010-05	Parastic supressor	
MISCELLANEOUS			
V1,2	E01-0801-05	US socket	
—	E23-0047-04	Terminal (square) $\times$ 9	

CAR ASS'Y (X60-1000-00)

Ref. No.	Parts No.	Description	Re- marks
—	E40-1025-05	Chassis mount wafer	
—	F11-0235-03	CAR shield box	
—	F11-0236-04	CAR shield box cover (upper)	
—	F11-0237-04	CAR shield box cover (lower)	
—	J32-0216-04	Hexagonal boss $\times$ 2 (long)	
—	J32-0217-04	Hexagonal boss $\times$ 3 (medium)	
—	J32-0217-04	Hexagonal boss $\times$ 3 (short)	
—	X50-1310-00	CAR-1 unit	
—	X50-1320-00	CAR-2 unit	

CAR-1 (X50-1310-00)

Ref. No.	Parts No.	Description	Re- marks
CAPACITOR			
C1	CK45F1H103Z	Ceramic 1 μ F $\pm$ 80%—20%	
C2	CC45CH1H220J	Ceramic 22pF $\pm$ 5%	
C3	CC45TH1H270J	Ceramic 27pF $\pm$ 5%	
C4	CK45D1H102M	Ceramic 0.001 μ F $\pm$ 20%	
C5	CC45CH1H220J	Ceramic 22pF $\pm$ 5%	
C6	CK45F1H103Z	Ceramic 0.01 μ F $\pm$ 80%—20%	
C7	CC45TH1H030C	Ceramic 3pF $\pm$ 0.25pF	
C8	CS15E1VR22M	Tantalum 0.22 μ F $\pm$ 20%	
C9	CK45F1H103Z	Ceramic 0.01 μ F $\pm$ 80%—20%	
C10	CK45B1H471K	Ceramic 470pF $\pm$ 10%	
C11	CC45SL1H101J	Ceramic 100pF $\pm$ 5%	
C12	CC45CH1H020C	Ceramic 2pF $\pm$ 0.25pF	
C13	CC45CH1H330J	Ceramic 33pF $\pm$ 5%	
C14	C90-0262-05	Ceramic 0.047 μ F 25WV	
C15	CK45F1H103Z	Ceramic 0.01 μ F $\pm$ 80%—20%	
C16	CC45SL1H151K	Ceramic 150pF $\pm$ 10%	
C17,18	CK45F1H223Z	Ceramic 0.022 μ F $\pm$ 80%—20%	
RESISTOR			
R1,2	PD14CY2B331J	Carbon 330 Ω $\pm$ 5% 1/8W	
R3	PD14CY2B473J	Carbon 47k Ω $\pm$ 5% 1/8W	
R4	PD14CY2B272J	Carbon 2.7k Ω $\pm$ 5% 1/8W	
R5,6	PD14CY2B473J	Carbon 47k Ω $\pm$ 5% 1/8W	
R4,8	PD14CY2B152J	Carbon 1.5k Ω $\pm$ 5% 1/8W	
R9	PD14CY2B153J	Carbon 15k Ω $\pm$ 5% 1/8W	
R10	PD14CY2B333J	Carbon 33k Ω $\pm$ 5% 1/8W	
R11	PD14CY2B682J	Carbon 6.8k Ω $\pm$ 5% 1/8W	
R12	PD14CY2B102J	Carbon 1k Ω $\pm$ 5% 1/8W	
R13	PD14CY2B823J	Carbon 82k Ω $\pm$ 5% 1/8W	

Ref. No.	Parts No.	Description	Re- marks
R14	PD14CY2B333J	Carbon 33k Ω $\pm$ 5% 1/8W	
R15	PD14CY2B102J	Carbon 1k Ω $\pm$ 5% 1/8W	
R16	PD14CY2B101J	Carbon 100 Ω $\pm$ 5% 1/8W	
R17	PD14CY2B331J	Carbon 330 Ω $\pm$ 5% 1/8W	
SEMICONDUCTOR			
Q1,2	V03-0079-05	Transistor 2SC460(B)	
Q3	V03-0241-05	Transistor 2SC735(Y)	
D1~4	V11-0076-05	Diode 1S1555	
D5	V11-0432-05	Diode 1TT310	
POTENTIOMETER			
VR1	R12-1012-05	1k Ω	
COIL/TRIMMER			
L1~4	L40-1511-03	Ferri-indicator 150 μ H	
L5	L33-0266-06	Choke coil 28 μ H	
L6~8	L40-1511-03	Ferri-indicator 150 μ H	
T1	L32-0201-05	Oscillating coil	
TC1,2	C05-0049-05	Trimmer 20pF	
CRYSTAL QUARTZ			
X1	L77-0486-05	8828.5kHz LSB	
X2	L77-0485-05	8831.5kHz USB	
MISCELLANEOUS			
J1	R92-0152-05	Short jumper	
—	E23-0046-04	Terminal (square)	
CJ1	E40-0427-05	Type U pin wafer	
CJ2	E40-0726-05	Type U pin wafer	
CJ3	E40-0826-05	Type U pin wafer	

CAR-2 (X50-1320-00)

Ref. No.	Parts No.	Description	Re- marks
CAPACITOR			
C1	CL45F1H103Z	Ceramic 0.01 μ F $\pm$ 80%—20%	
C2	CC45CH1H180J	Ceramic 18pF $\pm$ 5%	
C3	CC45CH1H020C	Ceramic 2pF $\pm$ 0.25pF	
C4	CK45F1H103Z	Ceramic 0.01 μ F $\pm$ 80%—20%	
C5	CC45CH1H050D	Ceramic 5pF $\pm$ 0.5pF	
C6	CK45F1H103Z	Ceramic 0.01 μ F $\pm$ 80%—20%	
C7	CK45B1H471K	Ceramic 470pF $\pm$ 10%	
C8	CC45SL1H101J	Ceramic 100pF $\pm$ 5%	
C9	CC45SL1H020C	Ceramic 2pF $\pm$ 0.25pF	
C10	CC45CH1H330J	Ceramic 33pF $\pm$ 5%	
C11	C90-0262-05	Ceramic 0.047 μ F	
C12,13	CK45F1H103Z	Ceramic 0.01 μ F $\pm$ 80%—20%	
C14	CC45SL1H150J	Ceramic 15pF $\pm$ 5%	
C15	CC45SL1H221K	Ceramic 220pF $\pm$ 10%	
C16	CC45SL1H100D	Ceramic 10pF $\pm$ 0.5pF	
C17	C90-0262-05	Ceramic 0.047 μ F	
C18	CC45CH1H020C	Ceramic 2pF $\pm$ 0.25pF	
C19	C90-0262-05	Ceramic 0.047 μ F	
RESISTOR			
R1,2	PD14CY2E392J	Carbon 3.9k Ω $\pm$ 5% 1/4W	
R3	PD14CY2E333J	Carbon 33 Ω $\pm$ 5% 1/4W	
R4	PD14CY2E682J	Carbon 6.8k Ω $\pm$ 5% 1/4W	
R5	PD14CY2E333J	Carbon 33k Ω $\pm$ 5% 1/4W	
R6	PD14CY2E102J	Carbon 1k Ω $\pm$ 5% 1/4W	
R7	PD14CY2E683J	Carbon 68k Ω $\pm$ 5% 1/4W	

PARTS LIST

Ref. No.	Parts No.	Description	Re- marks
R8	PD14CY2E101J	Carbon 100Ω ±5% 1/4W	
R9	PD14CY2E561J	Carbon 560Ω ±5% 1/4W	
R10	PD14CY2E472J	Carbon 4.7kΩ ±5% 1/4W	
R11	PD14CY2E332J	Carbon 3.3kΩ ±5% 1/4W	
R12	PD14CY2E101J	Carbon 100Ω ±5% 1/4W	
SEMICONDUCTOR			
Q1~3	V03-0079-05	Transistor 2SC460(B)	
D1.2	V11-0076-05	Diode 1S1555	
D~5	V11-0051-05	Diode 1N60	
D6.7	V11-0076-05	Diode 1S1555	
D8.9	V11-0414-05	Diode 1S2588	
COIL			
L1~12	L40-1511-03	Ferri-inductor 150μH	
T1	L32-0211-05	Oscillating coil	
TC1	C05-0010-15	Trimmer 10pF	
TC2	C05-0009-15	Trimmer 6pF	
TC3	C05-0010-15	Trimmer 10pF	
CRYSTAL QUARTZ			
X1	L77-0487-05	8830.7kHz	
MISCELLANEOUS			
—	E23-0076-04	Terminal (square)	
—	E40-1007-05	Connector	

PLL ASS'Y (X60-1010-00)

Ref. No.	Parts No.	Description	Re- marks
—	E40-0625-05	Chassis mount wafer × 2	
—	E40-0825-05	Chassis mount wafer	
—	F11-0239-03	PLL shield box	
—	F11-0240-04	PLL shield cover (upper)	
—	F11-0241-04	PLL shield cover (lower)	
—	J32-0216-04	Hexagonal boss × 4	
—	J32-0217-04	Hexagonal boss × 5	
—	J32-0218-04	Hexagonal boss × 6	
—	X50-1330-00	VCO unit	
—	X50-1340-00	PD unit	

VCO (X50-1330-00)

Ref. No.	Parts No.	Description	Re- marks
CAPACITOR			
C1	CC45TH1H180J	Ceramic 18pF ±5%	
C2	CC45TH1H220J	Ceramic 22pF ±5%	
C3	CC45TH1H270J	Ceramic 27pF ±5%	
C4	CC45TH1H150J	Ceramic 15pF ±5%	
C5	CK45F1H103Z	Ceramic 0.01μF +80%—20%	
C6	CC45F1H103Z	Ceramic 0.01μF +80%—20%	
C7	CC45TH1H390J	Ceramic 39pF ±5%	
C8.9	CC45RH1H220J	Ceramic 22pF ±5%	
C10	CC45RH1H330J	Ceramic 33pF ±5%	
C11	CK45F1H103Z	Ceramic 0.01μF +80%—20%	
C12	CC45RH1H150J	Ceramic 15pF ±5%	
C13	CC45TH1H270J	Ceramic 27pF ±5%	
C14	CC45RH1H180J	Ceramic 18pF ±5%	
C15	CC45RK1H220J	Ceramic 22pF ±5%	

Ref. No.	Parts No.	Description	Re- marks
C16	CC45RH1H270J	Ceramic 27pF ±5%	
C17	CK45F1H103Z	Ceramic 0.01μF +80%—20%	
C18	CC45RH1H150J	Ceramic 15pF ±5%	
C19	CC45TH1H270J	Ceramic 27pF ±5%	
C20	CC45SH1H180J	Ceramic 18pF ±5%	
C21	CC45SH1H220J	Ceramic 22pF ±5%	
C22	CC45SH1H150J	Ceramic 15pF ±5%	
C23	CK45F1H103Z	Ceramic 0.01μF +80%—20%	
C24	CC45TH1H180J	Ceramic 18pF ±5%	
C25	CC45TH1H220J	Ceramic 22pF ±5%	
C26	CC45TH1H270J	Ceramic 27pF ±5%	
C27	CC45TH1H150J	Ceramic 15pF ±5%	
C28	CK45F1H103Z	Ceramic 0.01μF +80%—20%	
C29	CC45RH1H050D	Ceramic 5pF ±0.5pF	
C30	CC45TH1H180J	Ceramic 18pF ±5%	
C31	CC45RH1H180J	Ceramic 18pF ±5%	
C32	CC45RH1H150J	Ceramic 15pF ±5%	
C33	CC45RH1H330J	Ceramic 33pF ±5%	
C34	CK45F1H103Z	Ceramic 0.01μF +80%—20%	
C35	CC45TH1H180J	Ceramic 18pF ±5%	
C36	CC45SH1H680J	Ceramic 68pF ±5%	
C37	CC45SH1H470J	Ceramic 47pF ±5%	
C38	CC45SH1H560J	Ceramic 56pF ±5%	
C39	CK45F1H103Z	Ceramic 0.01μF +80%—20%	
C40	CC45TH1H180J	Ceramic 18pF ±5%	
C41	CC45SH1H680J	Ceramic 68pF ±5%	
C42	CC45SH1H470J	Ceramic 47pF ±5%	
C43	CC45SH1H560J	Ceramic 56pF ±5%	
C44	CK45F1H103Z	Ceramic 0.01μF +80%—20%	
C45	CC45TH1H180J	Ceramic 18pF ±5%	
C46	CC45SH1H680J	Ceramic 68pF ±5%	
C47	CC45SH1H470J	Ceramic 47pF ±5%	
C48	CC45SH1H560J	Ceramic 56pF ±5%	
C49	CK45F1H103Z	Ceramic 0.01μF ±5%	
C50	CC45TH1H180J	Ceramic 18pF ±5%	
C51	CC45SH1H680J	Ceramic 68pF ±5%	
C52	CC45SH1H470J	Ceramic 47pF ±5%	
C53	CC45SH1H560J	Ceramic 56pF ±5%	
C54.55	CK45F1H103Z	Ceramic 0.01μF +80%—20%	
C56	CK45D1H102M	Ceramic 0.001μF ±20%	
C57	CC45CH1H020C	Ceramic 2pF ±0.25pF	
C58	CC45CH1H030C	Ceramic 3pF ±0.25pF	
C59	CK45F1H103Z	Ceramic 0.01μF +80%—20%	
C60	C90-0262-05	Ceramic 0.047μF	
C61	CK45D1H102M	Ceramic 0.001μF ±20%	
C62.63	CC45SL1H120J	Ceramic 12pF ±5%	
C64	CC45SL1H220J	Ceramic 22pF ±5%	
C65	CC45CH1H150J	Ceramic 15pF ±5%	
C66	CK45F1H103Z	Ceramic 0.01μF +80%—20%	
C67	CC45CH1H030C	Ceramic 3pF ±0.25pF	
C68	CK45F1H103Z	Ceramic 0.01μF +80%—20%	
C69	CC45SL1H151J	Ceramic 150pF ±5%	
C70.71	C90-0262-05	Ceramic 0.047μF	
C72	CS15E1A3R3M	Tantalum 3.3μF ±20%	
C73	CK45F1H103Z	Ceramic 0.01μF +80%—20%	
C74	CC45SL1H271J	Ceramic 270pF ±5%	
C75	CC45SL1H121J	Ceramic 120pF ±5%	
C76~86	CK45F1H103Z	Ceramic 0.01μF +80%—20%	
C87	CL45D1J102M	Ceramic 0.001μF ±20%	
RESISTOR			
R1	PD14CY2B104J	Carbon 100kΩ ±5% 1/8W	

PARTS LIST

Ref. No.	Parts No.	Description	Re- marks
R2	PD14CY2B101J	Carbon 100Ω ±5% 1/8W	
R3	PD14CY2B330J	Carbon 33Ω ±5% 1/8W	
R4	PD14CY2B104J	Carbon 100kΩ ±5% 1/8W	
R5	PD14CY2B101J	Carbon 100Ω ±5% 1/8W	
R6	PD14CY2B151J	Carbon 150Ω ±5% 1/8W	
R7	PD14CY2B104J	Carbon 100kΩ ±5% 1/8W	
R8	PD14CY2B101J	Carbon 100Ω ±5% 1/8W	
R9	PD14CY2B151J	Carbon 150Ω ±5% 1/8W	
R10	PD14CY2B104J	Carbon 100kΩ ±5% 1/8W	
R11,12	PD14CY2B101J	Carbon 100Ω ±5% 1/8W	
R13	PD14CY2B104J	Carbon 100kΩ ±5% 1/8W	
R14	PD14CY2B101J	Carbon 100Ω ±5% 1/8W	
R15	PD14CY2B330J	Carbon 33Ω ±5% 1/8W	
R16	PD14CY2B104J	Carbon 100kΩ ±5% 1/8W	
R17	PD14CY2B101J	Carbon 100Ω ±5% 1/8W	
R18	PD14CY2B104J	Carbon 100kΩ ±5% 1/8W	
R19	PD14CY2B101J	Carbon 100Ω ±5% 1/8W	
R20	PD14CY2B104J	Carbon 100kΩ ±5% 1/8W	
R21	PD14CY2B101J	Carbon 100Ω ±5% 1/8W	
R22	PD14CY2B104J	Carbon 100kΩ ±5% 1/8W	
R23	PD14CY2B101J	Carbon 100Ω ±5% 1/8W	
R24	PD14CY2B104J	Carbon 100kΩ ±5% 1/8W	
R25	PD14CY2B101J	Carbon 100Ω ±5% 1/8W	
R26	PD14CY2B104J	Carbon 100kΩ ±5% 1/8W	
R27	PD14CY2B101J	Carbon 100Ω ±5% 1/8W	
R28	PD14CY2B470J	Carbon 47Ω ±5% 1/8W	
R29	PD14CY2B391J	Carbon 390Ω ±5% 1/8W	
R30	PD14CY2B104J	Carbon 100kΩ ±5% 1/8W	
R31	PD14CY2B333J	Carbon 33kΩ ±5% 1/8W	
R32	PD14CY2B330J	Carbon 33Ω ±5% 1/8W	
R33	PD14CY2B123J	Carbon 12kΩ ±5% 1/8W	
R34	PD14CY2B103J	Carbon 10kΩ ±5% 1/8W	
R35	PD14CY2B221J	Carbon 220Ω ±5% 1/8W	
R36	PD14CY2B393J	Carbon 390Ω ±5% 1/8W	
R37	PD14CY2B473J	Carbon 47kΩ ±5% 1/8W	
R38	PD14CY2B331J	Carbon 330Ω ±5% 1/8W	
R39	PD14CY2B330J	Carbon 33Ω ±5% 1/8W	
R40	PD14CY2B681J	Carbon 680Ω ±5% 1/8W	
R41	PD14CY2B470J	Carbon 47Ω ±5% 1/8W	
R42	PD14CY2B102J	Carbon 1kΩ ±5% 1/8W	
R43	PD14CY2B101J	Carbon 100Ω ±5% 1/8W	
R44	PD14CY2B822J	Carbon 8.2kΩ ±5% 1/8W	
R45	PD14CY2B332J	Carbon 3.3kΩ ±5% 1/8W	
R46	PD14CY2B122J	Carbon 1.2kΩ ±5% 1/8W	
R47	PD14CY2B103J	Carbon 10kΩ ±5% 1/8W	
SEMICONDUCTOR			
Q1~6	V09-0012-05	FET 2SK19(GR)	
Q7~11	V09-0013-05	FET 2SK19(BL)	
Q12	V09-0057-05	FET 3SK41(L)	
Q13	V03-0079-05	Transistor 2SC460(B)	
Q14	V03-0283-05	Transistor 2SC741	
Q15	V03-0079-05	Transistor 2SC460(B)	
D1~12	V11-0414-05	Diode 1S2588	
D13~23	V11-0293-05	Diode 1S1658-2	
COIL			
L1~15	L40-1511-02	Ferri-inductor 150μH	
L16	L40-1592-02	Ferri-inductor 1.5μH	
L17~18	L40-1092-02	Ferri-inductor 1μH	
L20	L40-1292-02	Ferri-inductor 1.2μH	
L21	L40-1511-03	Ferri-inductor 150μH	
L22	L40-1292-02	Ferri-inductor 1.2μH	
L23	L40-1511-03	Ferri-inductor 150μH	

Ref. No.	Parts No.	Description	Re- marks
T1	L32-0199-05	Oscillating coil 15MHz	
T2,3	L32-0193-05	Oscillating coil 1.8MHz, 3.5MHz	
T4	L32-0195-05	Oscillating coil 7MHz	
T5	L32-0196-05	Oscillating coil 14MHz	
T6	L32-0197-05	Oscillating coil 21MHz	
T7~10	L32-0198-05	Oscillating coil 28MHz	
T12	L34-0529-05	Trap coil 8.83MHz	
SWITCH			
S1	S31-1005-05	Slide switch	
MISCELLANEOUS			
J1~6	R92-0150-05	Short jumper × 6	
	E23-0046-04	Terminal (square) × 6	
	E40-0607-05	Connector × 2 6p	
	E40-0807-05	Connector 8p	

PD (X50-1340-00)

Ref. No.	Parts No.	Description	Re- marks
CAPACITOR			
C1,2	CC45SL1H100D	Ceramic 10pF ±0.5pF	
C3	CK45F1H103Z	Ceramic 0.01μF +80% -20%	
C4	CK45F1H223Z	Ceramic 0.022μF +80% -20%	
C5,6	CK45F1H103Z	Ceramic 0.01μF +80% -20%	
C7	CE04W1A101(RL)	Electrolytic 100μF 10WV	
C8	CK45F1H103Z	Ceramic 0.01μF +80% -20%	
C9~12	CK45F1H223Z	Ceramic 0.022μF +80% -20%	
C13	CE04W1A101(RL)	Electrolytic 100μF 10WV	
C14,15	CS15E1VR22M	Tantalum 0.22μF ±20%	
C16	CC45SL1H470J	Ceramic 47pF ±5%	
C17	CK450D1H102M	Ceramic 0.001μF ±20%	
C18,19	CK45F1H103Z	Ceramic 0.01μF +80% -20%	
C20	CC45RH1H820J	Ceramic 82pF ±5%	
C21	CQ09S1H391J	Ceramic 390pF ±5%	
C22	CC45RH1H101J	Ceramic 100pF ±5%	
C23	C90-0262-05	Ceramic 0.047μF	
C24,25	CK45F1H223Z	Ceramic 0.022μF +80% -20%	
C26	CS15E1V010M	Tantalum 1μF ±20%	
C27	CC45SL1H050C	Ceramic 5pF ±0.25pF	
C28	CC45SL1H100D	Ceramic 10pF ±0.5pF	
C29,30	CC45SL1H330J	Ceramic 33pF ±5%	
C31	CC45SL1H100D	Ceramic 10pF ±0.5pF	
C32	CC45SL1H050C	Ceramic 5pF ±0.25pF	
C33	CK45D1H102M	Ceramic 0.001μF ±20%	
C34,35	CK45F1H223Z	Ceramic 0.022μF +80% -20%	
C37	CS15E1V010M	Tantalum 1μF ±20%	
C38	CC45CH1H470J	Ceramic 47pF ±5%	
C39	CC45CH1H470J	Ceramic 47pF ±5%	
C40	CC45SL1H151J	Ceramic 150pF ±5%	
C41	CK45F1H103Z	Ceramic 0.01μF +80% -20%	
C42,43	CC45SL1H331J	Ceramic 330pF ±5%	
C44	CK45F1H103Z	Ceramic 0.01μF +80% -20%	
C45,46	CC45SL1H331J	Ceramic 330pF ±5%	
C47	CK45F1H103Z	Ceramic 0.01μF +80% -20%	
C48	CC45SL1H151J	Ceramic 150pF ±5%	
C49	CC45SL1H221J	Ceramic 220pF ±5%	
C50	CL45F1H103Z	Ceramic 0.01μF +80% -20%	
C51	CC45CH1H470J	Ceramic 47pF ±5%	
C52	CC45SL1H151J	Ceramic 150pF ±5%	

PARTS LIST

Ref. No.	Parts No.	Description	Re- marks
C53	CK45F1H103Z	Ceramic 0.01 μ F $\pm$ 80% - 20%	
C54	CC45CH1H100D	Ceramic 10pF $\pm$ 0.5pF	
C55	CC45SL1H151J	Ceramic 150pF $\pm$ 5%	
C56	CK45F1H103Z	Ceramic 0.01 μ F $\pm$ 80% - 20%	
C57	CC45CH1H101J	Ceramic 100pF $\pm$ 5%	
C58	CK45F1H103Z	Ceramic 0.01 μ F $\pm$ 80% - 20%	
C59	CC45CH1H101J	Ceramic 100pF $\pm$ 5%	
C60	CK45F1H103Z	Ceramic 0.01 μ F $\pm$ 80% - 20%	
C61	CC45CH1H101J	Ceramic 100pF $\pm$ 5%	
C62	CK45F1H103Z	Ceramic 0.01 μ F $\pm$ 80% - 20%	
C63	CC45CH1H101J	Ceramic 100pF $\pm$ 5%	
C64,65	CK45F1H103Z	Ceramic 0.01 μ F $\pm$ 80% - 20%	
C66	CC45SL1H020C	Ceramic 2pF $\pm$ 0.25pF	
C67	CC45SL1H180J	Ceramic 18pF $\pm$ 5%	
C68	C90-0262-05	Ceramic 0.047 μ F	
C69	CK45D1H102M	Ceramic 0.001 μ F $\pm$ 80% - 20%	
C70	C90-0262-05	Ceramic 0.047 μ F	
C72	CK45D1H102M	Ceramic 0.001 μ F $\pm$ 80% - 20%	
RESISTOR			
R1	PD14CY2B151J	Carbon 150 Ω $\pm$ 5% 1/8W	
R2	PD14CY2B331J	Carbon 330 Ω $\pm$ 5% 1/8W	
R3	PD14CY2B391J	Carbon 390 Ω $\pm$ 5% 1/8W	
R4	PD14CY2B472J	Carbon 4.7 Ω $\pm$ 5% 1/8W	
R5	PD14CY2B183J	Carbon 18k Ω $\pm$ 5% 1/8W	
R6	PD14CY2B472J	Carbon 4.7k Ω $\pm$ 5% 1/8W	
R7	PD14CY2B562J	Carbon 5.6k Ω $\pm$ 5% 1/8W	
R8	PD14CY2B391J	Carbon 390 Ω $\pm$ 5% 1/8W	
R9	PD14CY2B332J	Carbon 3.3k Ω $\pm$ 5% 1/8W	
R11	PD14CY2B183J	Carbon 18 Ω $\pm$ 5% 1/8W	
R12	PD14CY2B472J	Carbon 4.7 Ω $\pm$ 5% 1/8W	
R13,14	PD14CY2B332J	Carbon 3.3 Ω $\pm$ 5% 1/8W	
R15	PD14CY2B102J	Carbon 1k Ω $\pm$ 5% 1/8W	
R16	PD14CY2B222J	Carbon 2.2k Ω $\pm$ 5% 1/8W	
R17	PD14CY2B102J	Carbon 1k Ω $\pm$ 5% 1/8W	
R18	PD14CY2B821J	Carbon 820 Ω $\pm$ 5% 1/8W	
R19	PD14CY2B472J	Carbon 4.7k Ω $\pm$ 5% 1/8W	
R20	PD14CY2B472J	Carbon 4.7k Ω $\pm$ 5% 1/8W	
R21	PD14CY2B182J	Carbon 1.8k Ω $\pm$ 5% 1/8W	
R22	PD14CY2B561J	Carbon 560 Ω $\pm$ 5% 1/8W	
R23	PD14CY2B333J	Carbon 33k Ω $\pm$ 5% 1/8W	
R24	PD14CY2B102J	Carbon 1k Ω $\pm$ 5% 1/8W	
R25	PD14CY2B101J	Carbon 100 Ω $\pm$ 5% 1/8W	
R26	PD14CY2B103J	Carbon 10k Ω $\pm$ 5% 1/8W	
R27	PD14CY2B471J	Carbon 470 Ω $\pm$ 5% 1/8W	
R28	PD14CY2B122J	Carbon 1.2k Ω $\pm$ 5% 1/8W	
R29	PD14CY2B471J	Carbon 470 Ω $\pm$ 5% 1/8W	
R30,31	PD14CY2B470J	Carbon 47 Ω $\pm$ 5% 1/8W	
R32~34	PD14CY2B102J	Carbon 1k Ω $\pm$ 5% 1/8W	
R35	PD14CY2B821J	Carbon 820 Ω $\pm$ 5% 1/8W	
R36	PD14CY2B101J	Carbon 100 Ω $\pm$ 5% 1/8W	
R37	PD14CY2B152J	Carbon 1.5k Ω $\pm$ 5% 1/8W	
R38	PD14CY2B103J	Carbon 10k Ω $\pm$ 5% 1/8W	
R39	PD14CY2B152J	Carbon 1.5k Ω $\pm$ 5% 1/8W	
R40	PD14CY2B471J	Carbon 470 Ω $\pm$ 5% 1/8W	
R41	PD14CY2B122J	Carbon 1.2k Ω $\pm$ 5% 1/8W	
R42,43	PD14CY2B470J	Carbon 47 Ω $\pm$ 5% 1/8W	
R44	PD14CY2B471J	Carbon 470 Ω $\pm$ 5% 1/8W	
R45	PD14CY2B102J	Carbon 1k Ω $\pm$ 5% 1/8W	
R46,47	PD14CY2B471J	Carbon 470 Ω $\pm$ 5% 1/8W	
R48	PD14CY2B472J	Carbon 4.7k Ω $\pm$ 5% 1/8W	
R49	PD14CY2B272J	Carbon 2.7k Ω $\pm$ 5% 1/8W	
R50	PD14CY2B101J	Carbon 100 Ω $\pm$ 5% 1/8W	

Ref. No.	Parts No.	Description	Re- marks
R51	PD14CY2B393J	Carbon 39k Ω $\pm$ 5% 1/8W	
R52	PD14CY2B562J	Carbon 5.6k Ω $\pm$ 5% 1/8W	
R53	PD14CY2B101J	Carbon 100 Ω $\pm$ 5% 1/8W	
R54	PD14CY2B473J	Carbon 47k Ω $\pm$ 5% 1/8W	
R55	PD14CY2B562J	Carbon 5.6k Ω $\pm$ 5% 1/8W	
R56	PD14CY2B101J	Carbon 100 Ω $\pm$ 5% 1/8W	
R57	PD14CY2B273J	Carbon 27k Ω $\pm$ 5% 1/8W	
R58	PD14CY2B562J	Carbon 5.6k Ω $\pm$ 5% 1/8W	
R59	PD14CY2B101J	Carbon 100 Ω $\pm$ 5% 1/8W	
R60	PD14CY2B472J	Carbon 4.7k Ω $\pm$ 5% 1/8W	
R61	PD14CY2B272J	Carbon 2.7k Ω $\pm$ 5% 1/8W	
R62	PD14CY2B101J	Carbon 100 Ω $\pm$ 5% 1/8W	
R63	PD14CY2B682J	Carbon 6.8 Ω $\pm$ 5% 1/8W	
R64	PD14CY2B332J	Carbon 3.3k Ω $\pm$ 5% 1/8W	
R65	PD14CY2B101J	Carbon 100 Ω $\pm$ 5% 1/8W	
R66	PD14CY2B103J	Carbon 10k Ω $\pm$ 5% 1/8W	
R67	PD14CY2B562J	Carbon 5.6k Ω $\pm$ 5% 1/8W	
R68	PD14CY2B101J	Carbon 100 Ω $\pm$ 5% 1/8W	
R69	PD14CY2B103J	Carbon 10k Ω $\pm$ 5% 1/8W	
R70	PD14CY2B562J	Carbon 5.6k Ω $\pm$ 5% 1/8W	
R71	PD14CY2B101J	Carbon 100 Ω $\pm$ 5% 1/8W	
R72	PD14CY2B103J	Carbon 10k Ω $\pm$ 5% 1/8W	
R73	PD14CY2B562J	Carbon 5.6k Ω $\pm$ 5% 1/8W	
R74	PD14CY2B101J	Carbon 100 Ω $\pm$ 5% 1/8W	
R75	PD14CY2B103J	Carbon 10k Ω $\pm$ 5% 1/8W	
R76	PD14CY2B562J	Carbon 5.6k Ω $\pm$ 5% 1/8W	
R77,78	PD14CY2B101J	Carbon 100 Ω $\pm$ 5% 1/8W	
R79	PD14CY2B471J	Carbon 470 Ω $\pm$ 5% 1/8W	
R80	PD14CY2B683J	Carbon 68k Ω $\pm$ 5% 1/8W	
R81	PD14CY2B330J	Carbon 33 Ω $\pm$ 5% 1/8W	
R82	PD14CY2B101J	Carbon 100 Ω $\pm$ 5% 1/8W	
R83	PD14CY2B471J	Carbon 470 Ω $\pm$ 5% 1/8W	
R84	PD14CY2B151J	Carbon 150 Ω $\pm$ 5% 1/8W	
R85	PD14CY2B821J	Carbon 820 Ω $\pm$ 5% 1/8W	
R86,87	PD14CY2B103J	Carbon 10k Ω $\pm$ 5% 1/8W	
SEMICONDUCTOR			
Q1~12	V03-0079-05	Transistor 2SC460(B)	
Q13	V09-0012-05	FET 2SK19(GR)	
Q14	V01-0037-05	Transistor 2SA495(Y)	
Q15	V09-0012-05	FET 2SK19(GR)	
Q16	V01-0037-05	Transistor 2SA495(Y)	
Q17	V03-0079-05	Transistor 2SC460(B)	
Q18	V03-0132-05	IC TD3400AP	
Q19	V30-0173-05	IC MC4044P	
Q20	V03-0271-05	Transistor 2SC1345(E)	
Q21,22	V30-0174-05	IC MC1496G	
D1~24	V11-0076-05	Diode 1S1555	
POTENTIOMETER			
VR1	R12-4021-05	Semi-fixed resistor 5k Ω (B)	
COIL			
L1,2	L40-1511-03	Ferri-inductor 150 μ H	
L3	L40-2201-03	Ferri-inductor 22 μ H	
L4	L40-1021-03	Ferri-inductor 1mH	
L5~12	L40-1511-03	Ferri-inductor 150 μ H	
T1	L34-0518-05	BPF coil	
T2	L34-0519-05	BPF coil	
T3	L34-0518-05	BPF coil	
T4	L34-0520-05	LPF coil	
T5	L34-0521-05	LPF coil	
T6	L34-0520-05	LPF coil	

PARTS LIST

Ref. No.	Parts No.	Description	Re- marks
CRYSTAL QUARTZ			
X1	L77-0497-05	20.5MHz	
X2	L77-0488-05	7.3MHz	
X3	L77-0489-05	9.0MHz	
X4	L77-0490-05	12.5MHz	
X5	L77-0491-05	19.5MHz	
X6	L77-0492-05	26.5MHz	
X7	L77-0493-05	33.5MHz	
X8	L77-0494-05	34MHz	
X9	L77-0495-05	34.5MHz	
X10	L77-0496-05	35.0MHz	
MISCELLANEOUS			
J1~6	R92-0150-05	Short jumper	
—	E23-0046-04	Terminal (square) × 16	
—	E40-0607-05	Connector × 2 6p	
—	E40-0626-05	Type U pin wafer × 4 6p	
—	E40-0807-05	Connector 8p	
—	E40-0826-05	Type U pin wafer 8p	
—	F10-0401-04	Shield plate	
—	F10-0404-04	Shield plate	
—	F11-0238-04	Shield plate	

DISASSEMBLY

1. How to remove panel

- 1) Remove all the knobs from the front panel.
- 2) Remove the dial escutcheon and front glass according to **Fig. 14**.
- 3) Remove the screws from both sides of the panel according to **Fig. 13**.

2. How to remove VFO

- 1) Remove upper and lower cases.
- 2) Disconnect the VFO output cable and 2P plug behind the VFO case.
- 3) Remove the four mounting screws from the VFO unit and subchassis of the body front according to **Fig. 14**.
- 4) Lift the VFO unit and extract it from the body, while taking care not to damage the subdial plate.

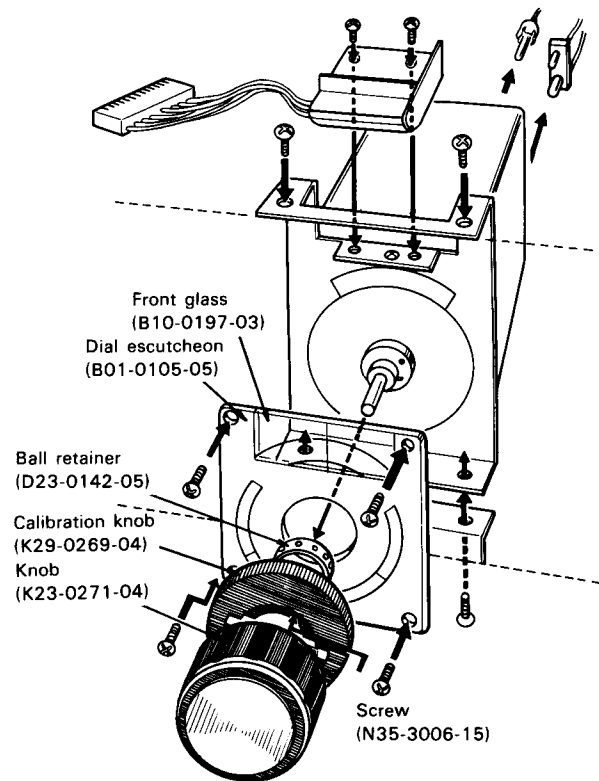


Fig. 14 Removing VFO

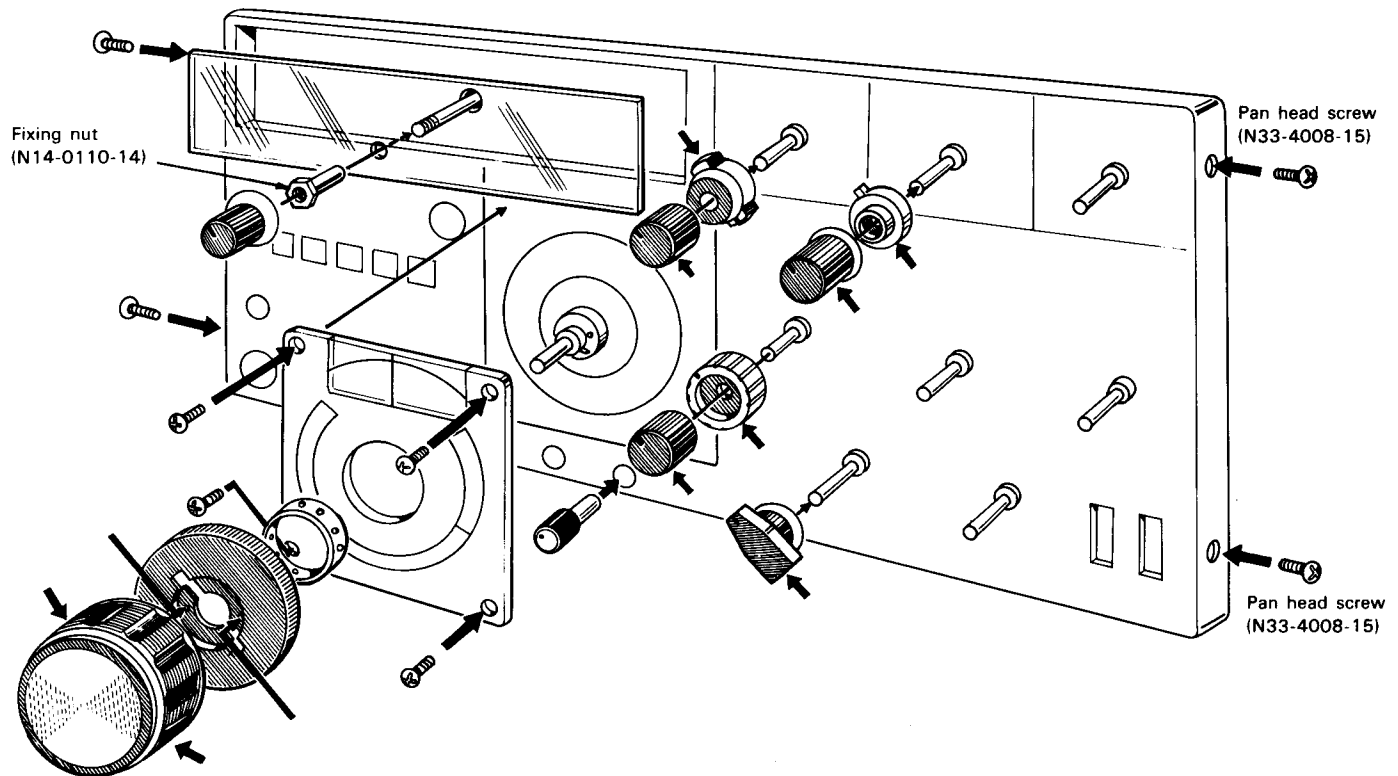


Fig. 13 Removing the panel

DISASSEMBLY

3. How to check counter assembly (DG-1: Option)

- 1) For the mounting procedure of the counter assembly, refer to **Fig. 15** "Modification first option mounting procedure".

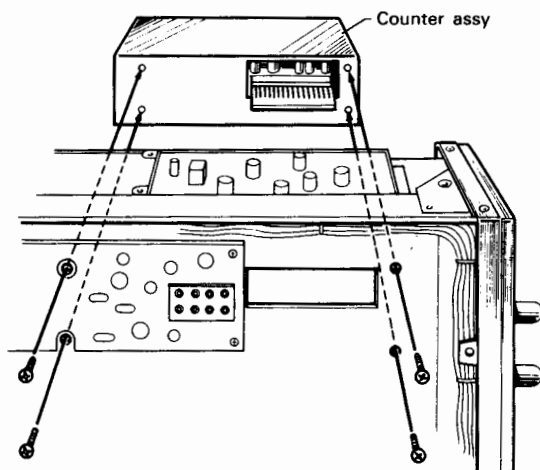


Fig. 15

- 2) When checking each voltage, attach the printed circuit boards, as shown in **Fig. 16**.

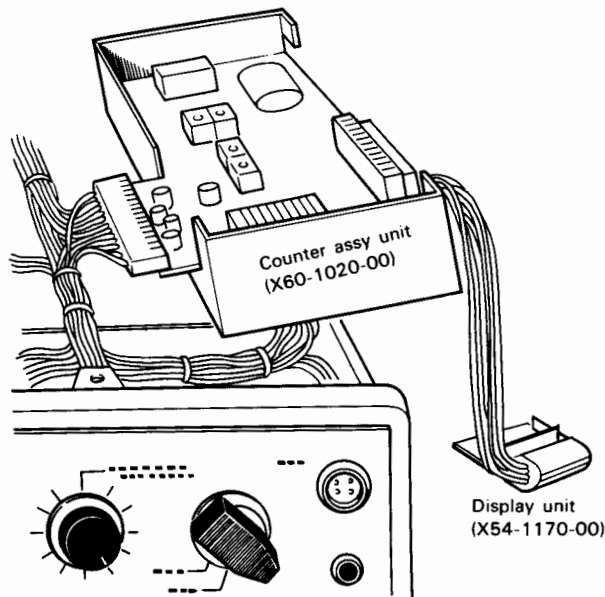


Fig. 16

- 3) Since the patterns in the counter assembly unit are thin and subject to heat, use a soldering iron with a small capacity of approx. 20W and carry out unsoldering quickly.

4. How to remove VOX/VR unit

- 1) Remove the panel according to the instruction mentioned in Item 1 above.
- 2) Remove the upper and lower cases.
- 3) Remove the two each screws, by which the individual switches are attached to the subpanel.

5. How to remove RIT and RF ATT switches

- 1) Remove the panel according to the instruction shown in Item 1 above.
- 2) Remove the upper and lower cases.
- 3) Remove from the subpanel the chassis, on which the VOX/VR unit is mounted, according to **Fig. 17** and detach the unit.

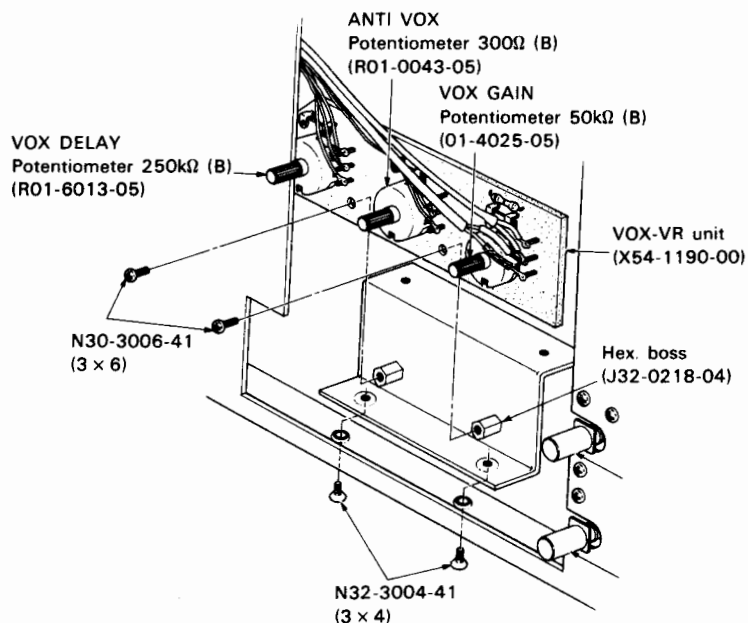


Fig. 17(a) Removing the VOX · VR unit

6. How to remove meter

- 1) Remove the upper and lower cases.
- 2) Remove the two screws, by which the meter is attached to the subpanel.

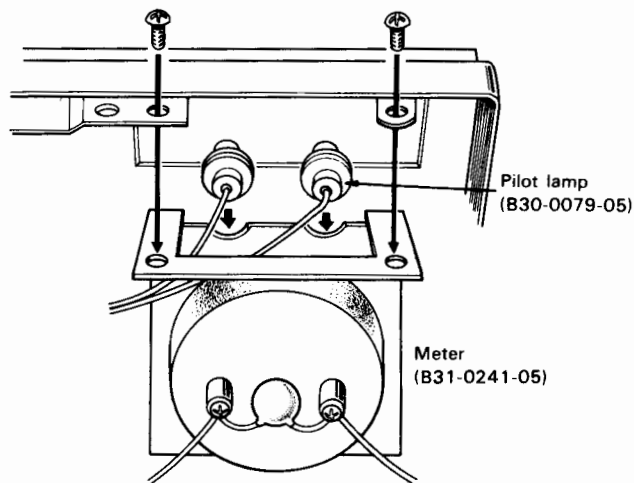


Fig. 17(b) Removing the meter

DISASSEMBLY

7. How to remove paddel switch

- 1) Remove all the knobs and dial plates from the front panel according to Item 1.
- 2) Remove the meter according to Item 6.
- 3) Extract the spring plate of the paddel switch up to the subpanel front, while pushing its tip with a screwdriver (refer to **Fig. 18**).
- 4) When the normal paddel switch is inserted into the subpanel from the front, it is fixed to the subpanel by means of the spring plate. To replace the knob of the paddel switch, insert the tip of a thin driver into a gap of the switch and detach the knob by utilizing the principle of the lever and then insert a normal knob (refer to **Fig. 18**).

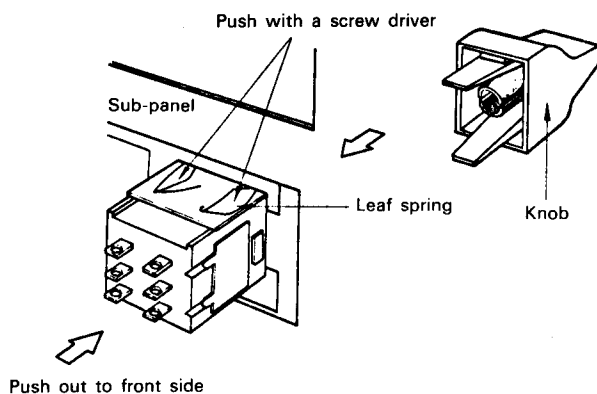


Fig. 18

8. How to disconnect lead from miniplug

According to the figure shown below, hold the pin with a thin screwdriver through the miniplug hole and pull the lead. The lead will be able to be disconnected from the miniplug.

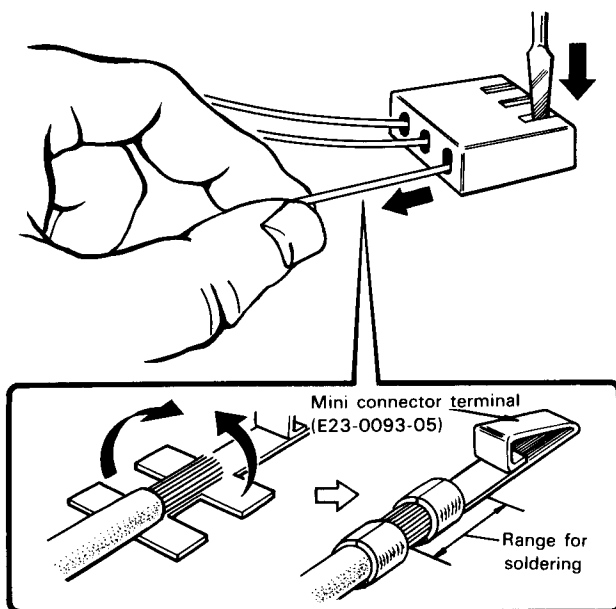
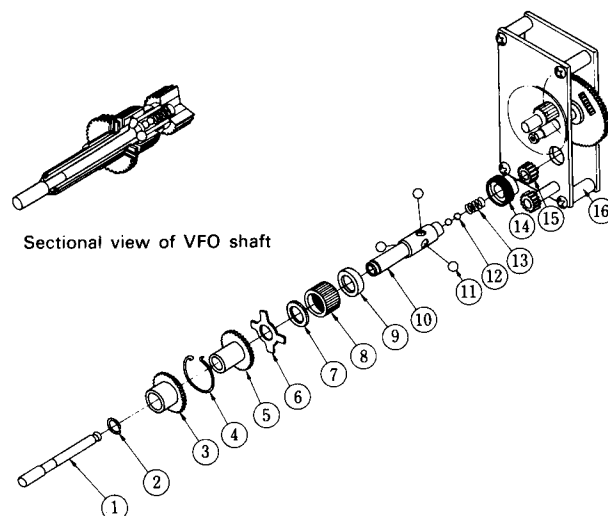


Fig. 19

9. Sectional view of VFO shaft



- | | |
|------------------------|--------------------|
| 1. Knob axle | 9. Taper collar |
| 2. Coil washer | 10. Reduction axle |
| 3. Differential gear B | 11. Steel ball A |
| 4. Coil spring | 12. Steel ball |
| 5. Differential gear A | 13. Spring C |
| 6. Plate spring | 14. Bearing |
| 7. Washer A | 15. First gear |
| 8. Cap ring | 16. Gear assembly |

TROUBLESHOOTING

RECEIVER SECTION

Symptom	Condition	Service Point	Cause	Remedy
1. No power from power supply		1) Fuse 2) Power switch 3) AC cord	• Blown fuse • Defective switch • Broken wire around plug	• Refer to the next item. • Continuity check • Continuity check
2. Blown fuse		1) Low frequency unit (X49-1080-00) 2) B circuit	• Q7 2SA496, Q3 TA72dP defective • In contact with chassis.	• Disconnect B terminal lead and check • Check and repair
3. Non-receiving	• Noise can not be heard. • Noise can be heard.	1) Speaker 2) AF-AVR unit 3) Phone jack 1) AF GAIN variable resistor 2) Each transistor 3) VCO 4) IF circuit (X48-1150-00) 5) RF, ANT circuit 6) Detector circuit (X48-1150-00)	• Speaker defective • Q3 TA7201P defective • Poor contact • AF GAIN variable resistor VR4-1 10k Ω defective. • Defective transistor • Regulated voltage power supply defective. • Deteriorated Q1, Q2, Q3 • IFT, T1, T2, T3, T4, T6, T7 mistuned or broken wire. • BPF mistuned or broken wire. • Bias circuit defective • Defective diode switch circuit for crystal filter. • ANT and RF coil mistuned. • Poor contact of rotary switch • Broken wire of coaxial cable or RF ATT in ANT circuit • Poor contact of XVTR switch S19 • Short circuit of tuning variable capacitor • Deteriorated Q2, Q3, Q6, Q7 • Unbalanced received carrier	• Replace • Disconnect B terminal lead and check. • Continuity check • Continuity check • Voltage check, replace • Refer to PLL trouble-shooting. • Voltage check and operation check according to level diagram. • Readjust and continuity check. • Check X'TAL X1, X2 • Check voltage in 14V line and AGC line. • Voltage check or operation check according to level diagram. • Adjustment • Continuity check Continuity check • Continuity check • Disconnect lead from MD terminal in drive unit coil pack and check continuity of variable capacitor. • Bias check • Operation check according to level diagram • Adjust
4. S meter	• Pointer won't deflect • Pointer is kept deflected	1) IF unit (X48-1150-00) 2) Relay unit (X43-1190-00) 1) AF-AVR unit (X49-1080-00) 2) IF unit (X48-1150-00)	• Misadjusted semi-fixed variable resistor VR1 (10k Ω) for zero setting • Misadjusted semi-fixed variable resistor VR2 (500k Ω) for sensitivity setting • Malfunction of Q15 and Q16 (2SC733) in AGC circuit • Broken wire of RFC L10 and L11 (150 μ H) • Defective relay RL • Reduced RF1 reference bias voltage • Deviated carrier balance VR3, TC3	• Adjust • Adjustment • Voltage check and replace • Continuity check • Continuity check • Readjust RF1 to 3.3V • Adjustment

TROUBLESHOOTING

Symptom	Condition	Service Point	Cause	Remedy
5. Marker is inoperative		1) Marker unit (X52-0005-01)	- Poor contact in FUNCTION switch S5-4 - Broken wire of coaxial cable connected to MO terminal - Broken wire of RFC, L1 (12mH) - Defective crystal oscillator element X1 (100kHz)	- Continuity check and voltage check at terminal 9 - Continuity check - Continuity check and voltage check of Q1, 2SC373 - Replace

TRANSMITTER SECTION

Symptom	Condition	Service Point	Cause	Remedy
1. No output is obtained		1) Final stage 2) Oscillation stop in each oscillator 3) RF unit 4) IF unit (X48-1150-00)	- Deterioration of or malfunction of S2001 - Poor contact of relay RL1 - Poor contact of rotary switch S4 - Short circuit in loading variable capacitor VC2 - Defective carrier VF0, heterodyne or crystal, etc. - Deteriorated drive tube V1 (12BY7A) or broken heater filament - Broken wire of CAR-2 coaxial cable - Defective FET Q13SK35 (GR) - Poor contact or broken lead of MIC GAIN VR (10kΩ)	- Voltage check or replacement check - Continuity check - Continuity check - Continuity check - Refer to item of symptom of receiver section. - Voltage check - Continuity check - Voltage check - Continuity check
2. No output is obtained		1) Final stage 2) RF unit (X44-1150-00) 3) IF unit and RF unit (X48-1150-00)	- Deterioration or malfunction of S2001 - Deteriorated vacuum tube - Mistuned IFT coil pack	- Voltage check or replacement check - Voltage check of replacement check - Refer to the receiver section troubleshooting and the level diagram of transmitter section.
3. No Ip meter reading		1) Final stage	- Malfunction of S2001 - Poor contact in SG switch - Defective meter circuit	- Voltage check - Voltage check - Continuity check
4. No ALC meter reading		1) RF unit (X44-1150-00) 2) ALC circuit	- Defective Q5 2SC1515 - Low drive voltage - Short circuit in ALC circuit - Poor contact in relay of relay unit	- Voltage check - Refer to Symptoms 1 and 2. - Continuity check - Continuity check
5. No HV meter reading		1) Power supply section 2) Meter circuit	- Defective power supply - Broken lead or voltage dividing resistors	- Check power voltages - Continuity check
6. Standby switch is inoperative	(Including PTT)	1) FIX-VOX unit (X50-1350-00) 2) Standby switch	- Broken lead connected to VS or SS terminal - Defective Q9, 2SA562 or short circuit in D17, IN60 - Poor contact in switch	- Continuity check and voltage check - Voltage check - Continuity check and voltage check

TROUBLESHOOTING

COUNTER (DG-1: Option)

Symptom	Condition	Service Point	Cause	Remedy
1. Counter mal-functions (main body operation also abnormal)	• No lighting	1) COF terminal 2) VCO signal terminal	• DC 1.2V appears due to defect in PLL circuit • Disconnect COF lead from terminal. If lights up, the counter is normal. • No signal comes in • No carrier signal comes in	• Voltage check • Check • Defective VCO oscillator circuit • Check signal system
	• Display becomes 9.000.0/ 19.000.0/ 29.000.0 • Display won't be stabilized		• Level down of carrier or VCO signal • Unlocking of PLL circuit	• Level check • Readjust PLL coil
2. Counter mal-functions (main body normally operated)	• No lighting		• Interrupted 5V power source • Defective 5V supply line • Defective DC-DC converter • Poor contact with display unit • Defective decoder unit IC6, Q12-20 in counter mixer unit	• Check • Check • Check • Check • Check
	• Display becomes 9.000.0/ 19.000.0/ 29.000.0	1) No input is applied to counter circuit	• Defect around 7.83MHz mixer circuit • Defect around SN76514N mixer circuit • Defective parts in LPF circuit • Defective wide-band amplifier (Q5~Q8)	• Check • Check • Check • Check
	• Display won't be stabilized	1) Insufficient input to counter circuit (X54-1160-00) 2) Defective gate and reset latch pulse generator circuit	• Defect around 7.83MHz mixer circuit • Defective IC3~IC5 in counter circuit (X54-1160-00)	• Check circuit • Check circuit
	• Only one digit lights up	1) Oscillation stop of reference oscillator 2) Stop of time base frequency divider 3) Stop of scanning control circuit in multiplexer 4) Stop of multiplexer circuit in multiplexer	• Defect around IC2 in X54-1150-00 • Defect around IC3~IC5 in X54-1150-00 • Defect around IC24~IC26 in X54-1160-00 • Defect around IC17~IC23 in X54-1160-00	• Operation check • Operation check • Operation check • Operation check

TROUBLESHOOTING

PLL

Symptom	Condition	Service Point	Cause	Remedy
1. None of receiving input and transmitting output are obtained regardless of turning of VFO	- Frequency is unchanged and no VCO output is obtained regardless of turning of VFO - In S type, counter display goes out	1) Each unit of PLL, CAR, and VFO 2) Lead of connector 3) VOF terminal voltage in PLL unit (0.1V or less normal)	- VOF (abbreviation for VCO-OFF) circuit is energized since no signal pulse is applied to phase detector in PD unit. - Oscillation stop of VCO - Oscillation stop of VFO or no input to PD unit - Oscillation stop of VFO or no input to PD unit - Oscillation stop of CAR or no input to PD unit	- Check pulse waveform and level at pin (1) and (3) of Q19MC 4044 - With pin (1), defective VCO and CAR systems, mixers and crystal oscillators in PD unit - With pin (3), defective VFO system - Check lead for continuity - Check lead for continuity - Check lead for continuity
2. Unlocking in S type, the counter is operative	- Frequency is unchanged regardless of turning of VFO - VCO output is obtained	1) Each unit and varicap voltages in PLL unit	- Low level in each oscillator - Defective IC Q18, Q19 and Q20 in PD unit - Defective variable capacitance diodes in VCO unit - Defective 5V power supply	- Check each oscillator for proper level and waveform - Replace diode - Check 5V power supply (zener) in PL unit - Voltage check
3. Unlocking near the band edges	Frequency is unchanged near the upper and lower band edges regardless of turning of VFO	1) Each unit and varicap voltages in PLL unit	Core deviation in VCO coil	- Adjust VCO coil - Adjust BPF - Refer to their adjusting procedure.
4. VOF circuit is inoperative regardless of stopping of VFO oscillation (for example, remote VFO is removed)	The same condition as in unlocking	1) Waveform measurement of Q15, pin 6 in PD unit 2) Operation check of Q15 in VCO unit	- Defective IC Q19 in PD unit - Defective D12, D13 and Q17 - Defective Q15 in VCO unit	Replace IC, transistor and diode

ADJUSTMENTS

GENERAL

The contents of the adjustment procedures of this transceiver are classified into formal adjustment at service benches and simplified adjustment using a voltmeter, AF and RF vacuum-tube voltmeters AG, and dummy load (AF and RF). The following adjustments require high precision measuring instruments such as a frequency counter, SSG, and sweep generator and so on. Thus, if such measuring instruments are unavailable, it is necessary to bring the transceiver to a place where such instruments are available and make adjustment while taking care not to touch the parts to be adjusted.

1. 2-1 carrier frequency adjustment (adjustment inside the CAR unit).
2. 2-5 IF trap coil adjustment and 5-2-2 trap coil adjustment (L24 and L25 in coil pack unit and T12 in VCO unit).
3. 2-8 S meter sensitivity adjustment (VR2 in IF unit).
4. 3-1 Standard oscillator adjustment of counter (trimmer TC1 in counter unit).
5. 5-1-1 BPF adjustment of PLL (T1, T2 and T3 in PD unit).

TEST EQUIPMENT REQUIRED

1. Voltmeter

- 1) Input resistance: More than $1\text{M}\Omega$
- 2) Voltage range: FS = AC/DC 1.5 to 1000V

NOTE:

High-precision circuit testers may be used. However, be careful since accurate reading is not obtained in high-impedance circuit measurement.

2. RF vacuum-tube voltmeter (RF VTVM)

- 1) Input impedance: More than $1\text{M}\Omega$ and less than 20pF
- 2) Voltage range: FS = 10mV to 300V
- 3) Measurable frequency range: More than 50 MHz

NOTE:

When special accuracy is not required during adjustment (such as input level or carrier oscillation output in PLL circuit), a voltmeter or circuit tester may be substituted for RF VTVM by connecting it to the output of detector as mentioned later.

3. AF voltmeter

- 1) Measurable frequency: 50 Hz to 10 kHz
- 2) Input resistance: More than $1\text{M}\Omega$
- 3) Voltage range: FS = 10mV to 30V

4. AF generator (AG)

- 1) Frequency range: 200 Hz to 5 kHz
- 2) Output: Maximum 1V

NOTE:

The distortion factor of AF generator should be small.

5. AF dummy load

- 1) Impedance: 8Ω
- 2) Power: More than 3W

6. RF dummy load

- 1) Impedance: 50 to 75Ω
- 2) Power: Endurable against power of more than 100W
- 3) Applicable frequency: 1.8 to 30 MHz

The above-mentioned instruments may be used for simplified adjustment. For the precise adjustment, the following measuring instruments are additionally necessary.

7. Oscilloscope

Select equipment that has as high sensitivity as possible and permits external synchronization.

8. Slow sweep generator

- 1) Center frequency: 8.83 MHz
- 2) Frequency deviation: Maximum $\pm 5\text{ kHz}$
- 3) Output voltage: More than 0.1V
- 4) Sweep rate: At least 0.5 sec/cm

9. SSG

- 1) Oscillation frequency: 1.8 to 30 MHz
- 2) Output: 0 dB/ μV ~ 120 dB/ μV

NOTE:

Select an equipment that the oscillation frequency is stable in non-modulation and there are small level of frequency modulation components.

10. Frequency counter

- 1) Minimum input voltage: 50mV
- 2) Measurable frequency range: More than 40 MHz

11. Noise generator

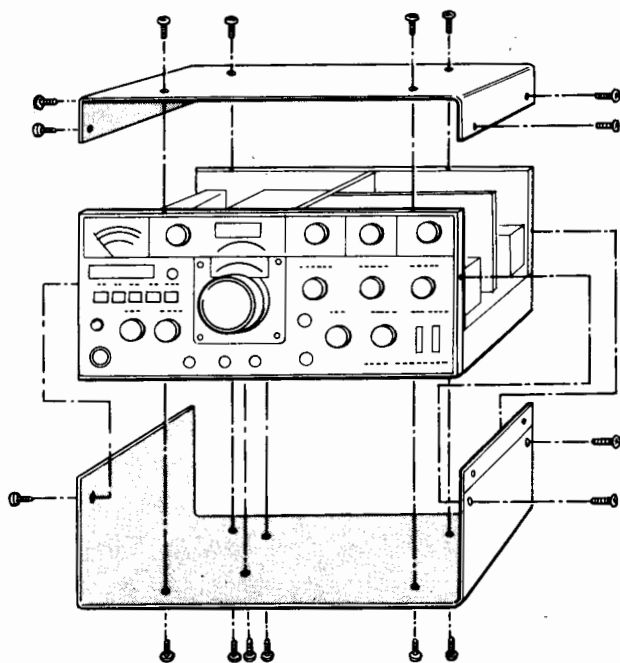
Select an equipment that generates ignition-like noise containing high harmonics up to 30 MHz or more.

12. Directional coupler

ADJUSTMENTS

PREPARATORY WORK

1. Remove the upper and lower cases according to the figure below. When making adjustment with the side face of the set up, be sure to position the final stage at the upper side. Otherwise, the ventilation effect of the final stage, cooling effect, is deteriorated and the final tube may be deteriorated.



2. Unless otherwise specified, set the respective knobs to the following positions.

- 1) Front panel

MODE	USB
FUNCTION	VFO
RF GAIN	MAX
HEATER	OFF
VOX	MAN
NB	OFF
MONI	OFF
AGC	FAST
PROCESSOR	OFF
RF ATT	OFF
RIT	OFF
IF SHIFT	0 (Center)
DH	OFF
STBY	REC
POWER	ON
- 2) Rear panel

SG SW	OFF
X VERTER SW	OFF

1. Adjustment of Power Supply

1-1. 9V adjustment

1. Measuring instrument used: Voltmeter
2. Adjusting procedure

Connect the voltmeter between the 9V terminal and chassis on AF-AVR unit (X49-1080-00) and adjust VR4 on AF AVR unit until 9V is obtained (refer to **Fig. 20**).

AF-AVR

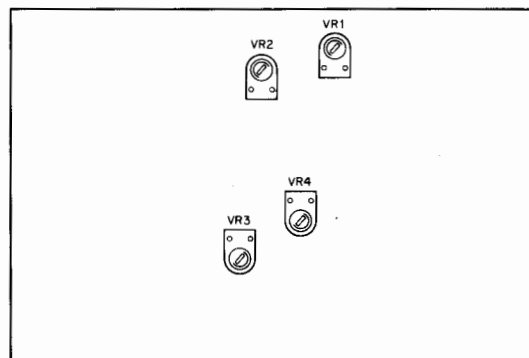
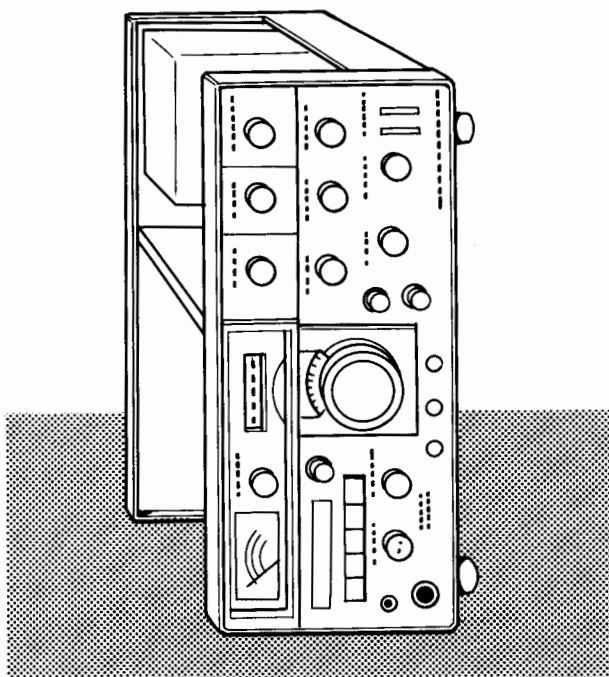


Fig. 20 AF-AVR unit

1-2. RF1 (3.3V) adjustment

1. Measuring instrument used: Voltmeter
2. Adjusting procedure

Connect the voltmeter between RF1 terminal and chassis on AF-AVR unit (X49-1080-00) and adjust VR1 on AF-AVR unit until the meter reads 3.3V.



ADJUSTMENTS

2. Adjustment of Receiver Section

2-1. Carrier unit adjustment

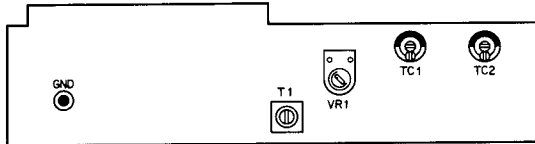
1. Measuring instruments used
 - 1) RF VTVM
 - 2) Frequency counter

2. Adjusting procedure

DRIVE: Center (12 o'clock position)

- 1) Connect RF VTVM to TP5 in IF unit (X48-1150-00) and adjust oscillation coil T1 in CAR-1 unit (X50-1310-00) until the meter reads 50mV (refer to Fig. 21). (refer to Fig. 24 IF unit)

CAR-1



CAR-2

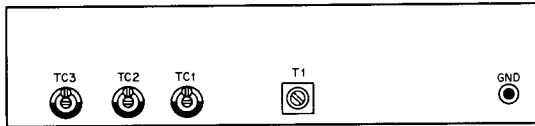


Fig. 21 CAR unit

- 2) Set the MODE switch to CW and the STBY switch to SEND and adjust oscillation coil T1 in CAR 1 unit (X50-1320-00) similarly.
- 3) Connect the frequency counter to TP5 in IF unit and make adjustment as shown below, while changing over the MODE and STBY switches.

MODE SW	STBY SW	ADJ	ADJ FREQ
U S B	R E C	USB(TC2)	8831.500KHz
L S B	R E C	LSB(TC1)	8828.500 "
FSK SPC	SEND	T C 1	8830.700 "
FSK NARROW	SEND	T C 2	8830.530 "
FSK MRK			
FSK WIDE	SEND	T C 3	8829.850 "
FSK MRK			

NOTE:

When changing over from FSK SPC to FSK MRK, or vice versa, open or short the RTTY key on the rear panel. For change-over from NARROW to WIDE, or vice versa, use the switching connector (E31-0037-05) in CAR ASSY unit (X60-1000-00) and after adjustment set it to NARROW (refer to Fig. 11).

2-2. Voltage adjustment of VCO

1. Measuring instrument used: Voltmeter
2. Adjusting procedure
 - 1) Connect the voltmeter to TP4 in VCO unit (X50-1330-00) of PLL unit (X60-1010-00) (refer to Fig. 22).
 - 2) Set VFO scale to 250 and check if the voltmeter reading is within 2.9 to 3.2V, while changing over bands.

NOTE:

For the detailed adjusting procedure, refer to the adjusting method of PLL ASSY unit described later.

VCO

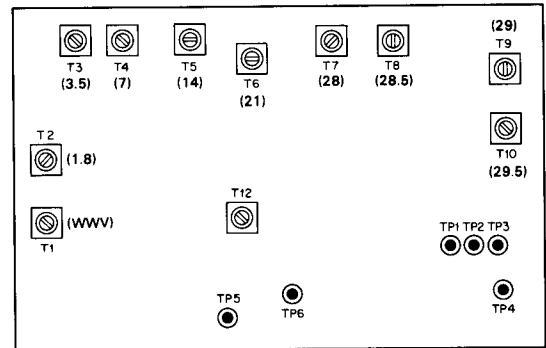


Fig. 22 VCO unit

2-3. Adjustment of antenna and MIX coil

1. Measuring instrument used: SSG (or built-in marker)

Since the tuned point may be deviated due to the shift of antenna impedance, be sure to terminate the antenna with 50 ohms.
2. Adjusting procedure

DRIVE: Center (12 o'clock position)

Apply SSG output (or marker signal) at 60 dB to the antenna terminal and adjust the coil pack unit (X44-1140-00) in the following procedure of bands for maximum AF output (S meter reading) and maximum sensitivity. Reduce the SSG output suitably as the sensitivity increases (refer to Table 1, Fig. 23).

ADJUSTMENTS

COIL PACK

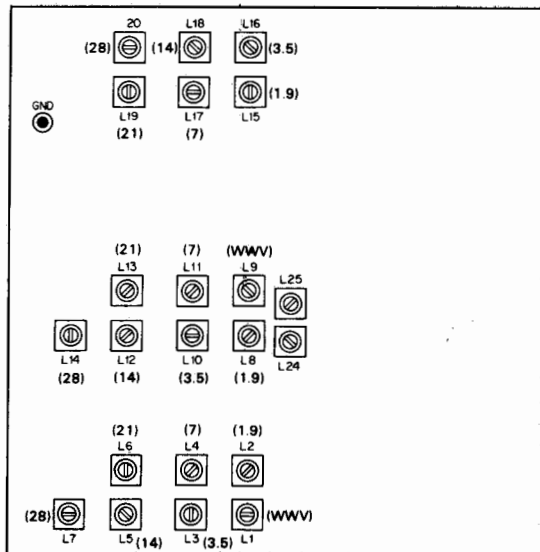


Fig. 23 Coil pack unit

Adjusting sequence	BAND	VFO scale
1	1.8	100
2	3.5	250
3	7	150
4	14	175
5	WWV	0 (15.0MHz)
6	21	225
7	28.5	500

Table 1

2-4. IFT adjustment

1. Measuring instrument used: SSG (or marker)
2. Adjusting procedure
 - 1) Apply a signal of 14.175 MHz at 40 dB (or marker) to the antenna terminal from SSG.
 - 2) Adjust T1 to T7 in IF unit (X48-1150-00) and T2 in RF unit (X44-1150-00) until S meter reads maximum value (refer to Fig. 24 and Fig. 25).

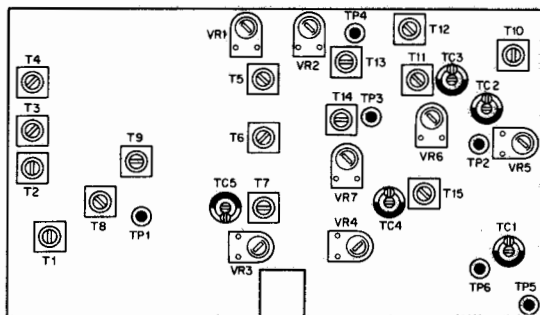


Fig. 24 IF unit

RF

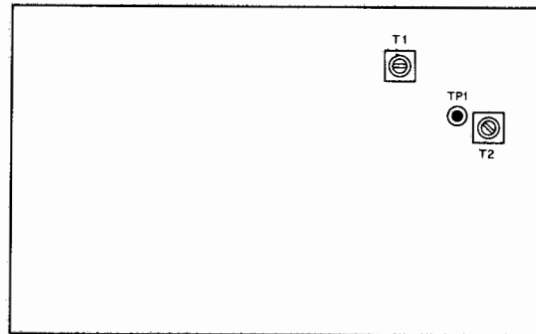


Fig. 25 RF unit

2-5. Adjustment of IF trap coil

1. Measuring instruments used
 - 1) SSG
 - 2) AF VTVM
 - 3) Dummy load for AF
2. Adjusting procedure

BAND: 7 MHz
VFO scale: 300

 - 1) Make connection as shown in Fig. 26, and adjust receiving sensitivity at maximum. Then, while applying a signal of 8830 kHz at approx. 100 dB from SSG, adjust L24 and L25 in the coil pack unit (X44-1140-00) alternately and repeat the same procedure two or three times. Until S meter reading becomes minimum. When S meter pointer does not deflect, make adjustment until AF output becomes minimum (refer to Fig. 23 "Coil pack unit").

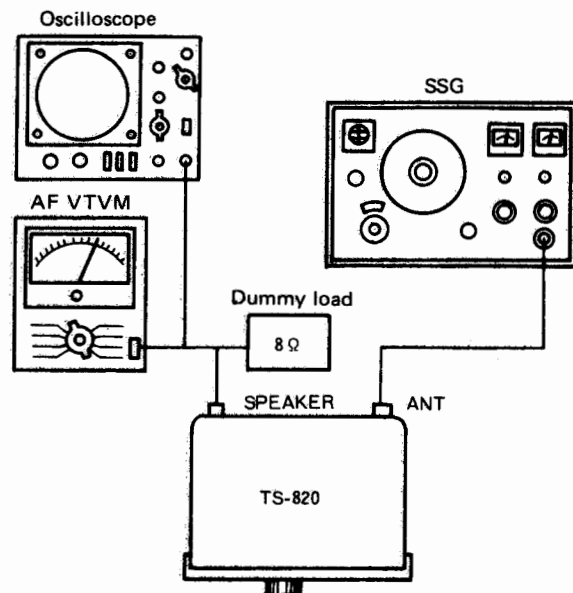


Fig. 26 Adjustment of IF trap coil

ADJUSTMENTS

2-6. Carrier balance adjustment

1. Measuring instrument used: RF VTVM
2. Adjusting procedure
IF SHIFT: O (center)
 - 1) Connect RF VTVM to IF OUT terminal on the rear panel.
 - 2) Turn the RF GAIN knob fully counterclockwise and adjust VR3 and TC5 in IF unit (X48-1150-00) alternately until the output becomes minimum (refer to Fig. 24).

2-7. Adjustment of noise blanker (NB) circuit

1. Measuring instrument used
 - 1) Voltmeter
 - 2) Noise generator
 - 3) Oscilloscope
2. Adjusting procedure

Simplified adjustment:

- 1) After receiving marker signal and turning ON NB switch, adjust T8 and T9 until the terminal voltage at TP1 on IF unit (X48-1150-00) becomes minimum (refer to Fig. 24).

Formal adjustment:

- 1) After making the simplified adjustment, connect the noise generator to the antenna and adjust drive VC until the noise output becomes maximum. In this case, set the S meter reading within S5 to S7.
- 2) Turn ON NB switch and connect the oscilloscope to the cathode side of D13 in IF unit. Adjust T1 in IF unit until the waveform changes from Figure A to Figure B (refer to Fig. 27).

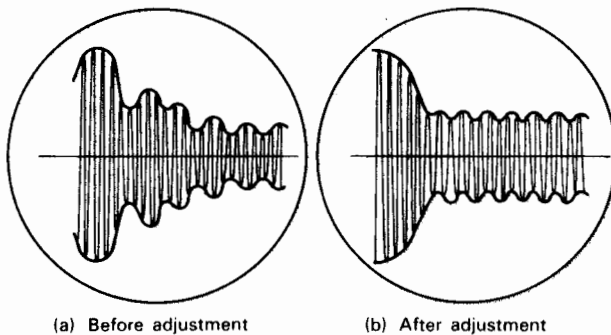


Fig. 27 Adjustment of noise blanker

- 3) Then, fine adjust T1, T3, T8 and T9 so that noise from the speaker becomes small, while taking care not to make waveform on the oscilloscope deviate from that shown in Fig. B greatly.
- 4) Turn ON RF switch and ATT switch and further fine readjust T1, T3, T8 and T9. Even when the RF and ATT switches are ON, the noise blanker should be effective.
- 5) In final stage, make sure that the receiving gain is not reduced greatly.

2-8. Adjustment of S meter

1. Measuring instrument used: SSG
2. Adjusting procedure
 - 1) After adjusting each section until sensitivity becomes minimum, adjust VR1 in IF unit (X48-1150-00) under no signal condition, thus making zero point adjustment of S meter (refer to Fig. 24).
 - 2) Connect SSG to the antenna terminal and apply 0 dB input. Adjust T6 in IF unit until S meter just starts deflecting at 0 dB.
 - 3) Set the output of SSG to 40 dB and adjust VR2 in IF unit until S meter reads S9.

2-9. RIT adjustment

1. Measuring instrument use: Unnecessary (use the built-in marker)
2. Adjusting procedure
 - 1) Set the RIT knob just to O (center) and turn ON RIT switch.
 - 2) Receive the maker signal and turn VFO until a beat of approx. 1 kHz is generated.
 - 3) Turn OFF RIT switch and adjust VR2 in AF AVR unit (X49-1080-00) until the beat frequency is kept unchanged when RIT switch is turned ON and OFF (refer to Fig. 28).

AF-AVR

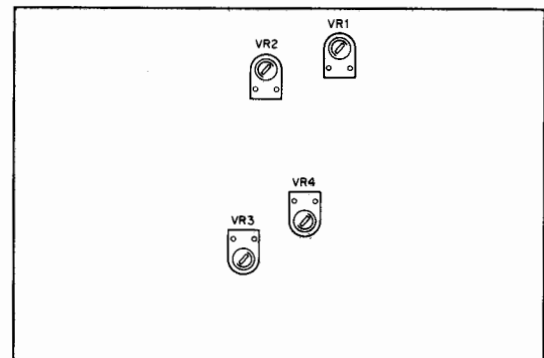


Fig. 28 AF • AVR unit

2-10. Adjustment of marker frequency

1. Measuring instrument used: Frequency counter
2. Adjusting procedure
 - 1) Connect the counter to the collector of Q4 in the marker unit (X52-0005-01) and open the MS terminal.
 - 2) Set the FUNCTION switch to CAL 25 kHz and adjust TC1 in the marker unit for 100,000 Hz $\pm$ 1 Hz (refer to Fig. 29).

ADJUSTMENTS

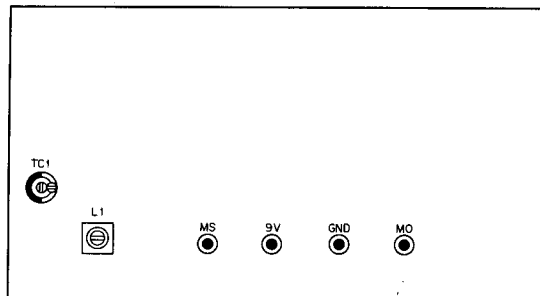


Fig. 29 MARKER unit

2-11. VFO adjustment

1. Measuring instruments used
 - 1) TF VTVM
 - 2) Frequency counter
2. Adjusting procedure

Adjustment of oscillation frequency

Set the FUNCTION switch to VFO and connect the frequency counter to VFO terminal (No. 13) on FIX VOX unit (X50-1350-00). Set VFO to 0 division and check if the oscillation frequency is 5.50 MHz. Then, set VFO to 500 division and check if the oscillation frequency is 5.00 MHz. If the frequency deviates from 5.50 MHz, correct it with TC1 in VFO unit; if the frequency deviates from 5.00 MHz correct it with L1 in VFO unit. Since TC1 and L1 affect mutual oscillation frequencies, repeat the above-mentioned adjustment three or four times (refer to Fig. 30 and 31).

Adjustment of output voltage

Set the VFO to the 250 division. Then, connect RF VTVM to VFO (No. 13) terminal in FIX-VOX unit and adjust trimmer TC2 in VFO unit until the output voltage becomes 0.6V.

FIX • VOX

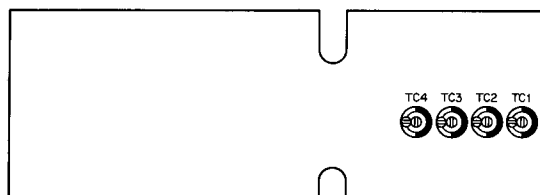


Fig. 30 FIX • VOX unit

VFO

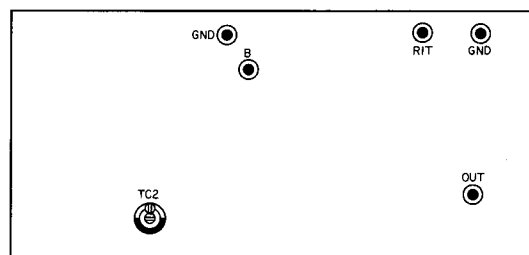


Fig. 31 VFO unit

3. Adjustment of Counter (DG-1: Optional)

3-1. Frequency adjustment of counter standard oscillator

Simplified adjustment:

1. Measuring instrument used: Counter and calibration cable
2. Adjusting procedure
 - 1) Insert the 1 pin plug side of the accessory counter calibration cable into X-VERTER IN terminal on the body rear panel and its 3-pin terminal side into the 3-pin terminal at the top of counter.

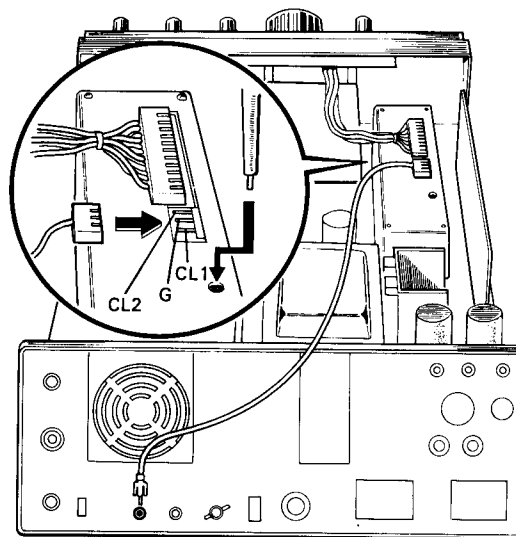


Fig. 32 Adjustment of counter standard oscillator frequency

- 2) Set the BAND switch to WWV and connect the antenna to the set. While receiving a WWV signal of 15 MHz adjust trimmer TC1 at the top of the counter unit so that zero beat is obtained between this signal and 1 MHz signal connected in Item 1).

NOTE:

- (1) Although zero beat can be checked through the speaker, adjustment by watching S meter reading is more accurate. S meter pointer vibrates on both near sides of the actual zero beat point. This corresponds to approx. 1 to 3 Hz. At the zero beat point, the pointer vibration becomes slowest.

ADJUSTMENTS

- (2) The adjustable range by TC1 is $1 \text{ MHz} \pm 20 \text{ Hz}$. In rough adjustment, receive a WWV signal of 15 MHz and set the counter reading within 15.000.0 and 14.999.9.

Formal adjustment:

1. Measuring instrument used: Frequency counter
2. Adjusting procedure
 - 1) Short circuit between CL2 and G in counter unit (X60-1020-00) and connect the output between G and CL1 to the frequency counter.
 - 2) Adjust the trimmer TC1 in the counter mix unit for $1 \text{ MHz} \pm 5 \text{ Hz}$ (refer to **Fig. 33**).

COUNTER MIXER

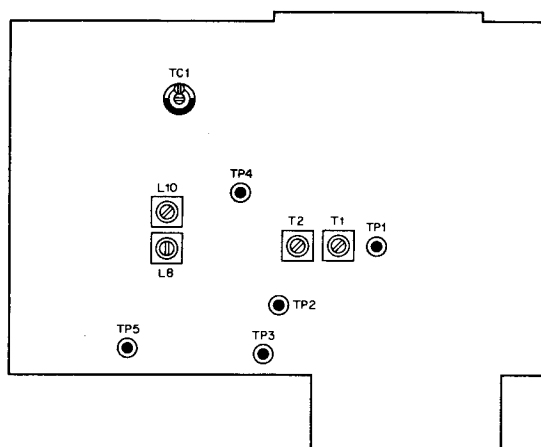


Fig. 33 Counter mixer unit (DG-1: Option)

3-2. Adjustment of counter input level

1. Measuring instrument used: RF VTVM
2. Adjusting procedure
 - 1) Connect RF VTVM to TP6 in IF unit (X48-1150-00) and adjust TC1 in IF unit for 0.1V (refer to **Fig. 24**).
 - 2) Connect RF VTVM to TP2 in the counter-mixer unit (X48-1150-00) and adjust T1 and T2 in the same unit until the peak value is obtained (output is approx. 0.12 to 0.2V) (refer to **Fig. 33**).

NOTE:

In this case, apply a carrier voltage of 0.1V to the CCR terminal of the counter unit (by adjusting TC1 in IF unit).

4. Adjustment of Transmitter Section

4-1. Adjustment of drive coil

1. Measuring instrument used
RF dummy load (50Ω)
Since the tuned point deviates due to shift of the antenna impedance, be sure to connect this unit.
2. Adjusting procedure
MODE: CW
DRIVE: Center (12 o'clock position)
METER: ALC

- 1) Set BAND switch to 1.8 MHz and set STBY switch to SEND. Adjust T10 in IF unit (X48-1150-00), T1 in RF unit (X44-1150-00) and 1.8 MHz band drive coil in the coil pack unit (X44-1140-00) until ALC meter reads maximum (refer to **Fig. 23, 24, 25**).
- 2) Adjust the drive coil of each band until ALC meter reads maximum. The adjusting sequence and adjustment frequency are the same as in Item 2-3 "Adjustment of Antenna MIX coil".

NOTE:

Make this adjustment at the same time as the adjustment of the receiving coil pack until the peak values of transmitting and receiving signals do not deviate from each other.

4-2. BIAS adjustment

1. Measuring instrument used: Unnecessary
2. Adjusting procedure
Set the meter switch to IP and adjust the BIAS VR on the rear panel to 60mA.

4-3. Adjustment of carrier suppression

1. Measuring instrument used
 - 1) RF VTVM
 - 2) RF dummy load
 - 3) Directional coupler
2. Adjusting procedure
 - 1) Make connection as shown in **Fig. 34** and adjust 14.175 MHz EW until full power is obtained.

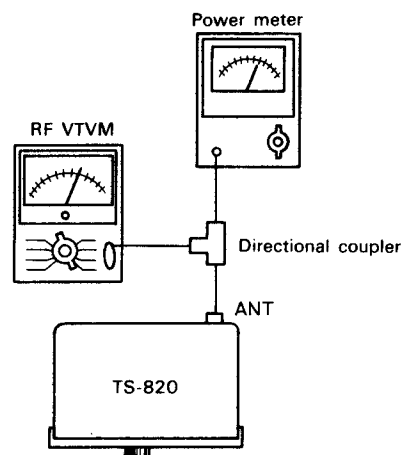


Fig. 34 Adjustment of carrier suppression

- 2) Switch over MODE switch to USB and adjust VR5 and TC2 in IF unit (X48-1150-00) alternately until RF VTVM reads minimum. Also, make adjustment until the USB and LSB levels become the same (refer to **Fig. 24**).

4-4. Neutralization adjustment

1. Measuring instruments used
 - 1) RF VTVM
 - 2) RF dummy load

ADJUSTMENTS

2. Adjusting procedure

MODE: CW

SG SW: ON

Neutralizing variable capacitor: Half-inserted position

- 1) In **Fig. 34**, make adjustment until maximum output is obtained at 21.225 MHz.
- 2) Turn OFF the SG switch and adjust the neutralizing capacitor until RF VTVM reads minimum.

4-5. Adjustment of carrier point

1. Measuring instruments used

- 1) AG
- 2) RF VTVM
- 3) RF dummy load
- 4) Directional coupler

2. Adjusting procedure

- 1) In **Fig. 35**, connect AG to MIC terminal and apply an input of 1500 Hz at 5 mV.

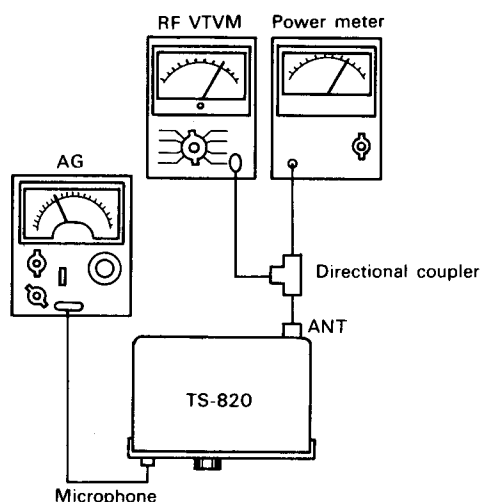


Fig. 35 Adjustment of carrier point

- 2) Adjust DRIVE, PLATE and LOAD until maximum output is obtained.
- 3) Adjust MIN GAIN until output becomes 50W and set the AG frequency to 250 Hz. Adjust VR1 in CAR1 unit (X50-1310-00) until RF VTVM reading is kept unchanged even when the MODE switch is changed over from USB to LSB and vice versa (refer to **Fig. 36**).
- 4) Apply 5mV (at 1.5 kHz) signal to the microphone terminal and adjust MIC GAIN VR to obtain 50 Watts output. Then, shifting the signal frequency to 300 Hz or 2800 Hz and adjust TC1 (in LSB) and TC2 (in USB) so that RF VTVM reading is the same level.

CAR-1

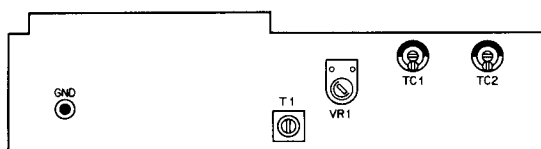


Fig. 36 CAR 1 unit

4-6. Adjustment of speech processor

1. Measuring instruments used

- 1) AG
- 2) AF VTVM
- 3) Oscilloscope
- 4) RF VTVM

2. Adjusting procedure

MIC VR: 12 o'clock position

PRD VR: MAX

- 1) In **Fig. 37**, turn ON PRO switch and adjust T11 to T14 until the output voltage at TP2 becomes maximum.

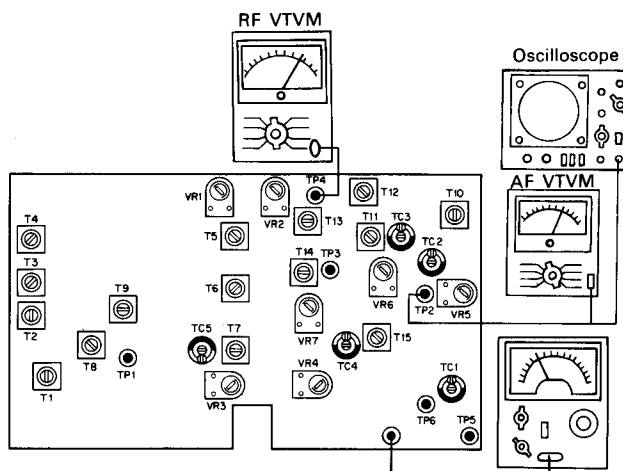


Fig. 37 Adjustment of speech processor

- 2) Connect RF VTVM to TP4 and adjust TC3 and VR6 until output becomes minimum.
- 3) Disconnect RF VTVM and set MIC input to 0.1 mV. Adjust TC4 until the output at TP2 is kept unchanged even when the MIC input is changed from 500 Hz to 2500 Hz.
- 4) Since the carrier frequency deviates by moving TC4, readjust T11 to T14, TC3 and VR6.
- 5) Set AG to 10 mV, 1000 Hz, and adjust VR7 until the output at TP2 is kept unchanged by turning ON and OFF PRO switch.

NOTE:

When AG is reduced by 0.3 mV by adjustment 5), the output at TP2 is reduced by 10 dB or less.

4-7. Adjustment of monitoring level

1. Measuring instruments used

- 1) RF dummy load
- 2) AG
- 3) AF VTVM
- 4) AF dummy load

2. Adjusting procedure

ADJUSTMENTS

Simplified adjustment:

- 1) Set the FUNCTION switch to CAL 25 kHz and take a beat of approx. 1000 Hz. Set AF variable resistor to a desired volume.
- 2) Apply a voice signal to the MIC terminal, turn ON the MON switch, and set STBY switch to SEND. Adjust VR4 in IF unit (X48-1150-00) until the monitor output level becomes nearly the same as the maximum output during calibration (refer to Fig. 24).

Formal adjustment:

- 1) If Fig. 38, make adjustment until full power is obtained at 14.175 MHz, CW, and set the MODE switch to SSB ϕ (or LSB).

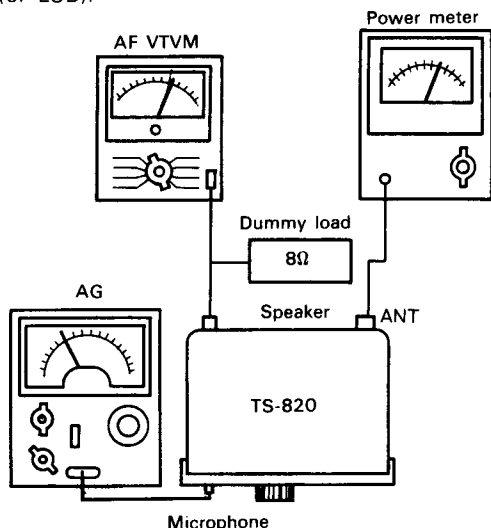


Fig. 38 Adjustment of monitor level

- 2) Apply a signal of 1000 Hz at 5 mV from AG to the MIC terminal and set the FUNCTION switch to CAL 25 kHz. Adjust AF GAIN until the AF output level becomes 0.63V when AGC is turned ON in receiving condition.
- 3) Then, turn ON the MON switch and set the STBY switch to SEND. Adjust VR4 in IF unit (X48-1150-00) until the monitor output level becomes 0.63V.

4-8. Adjustment of VOX operation

1. Measuring instruments used
 - 1) AG
 - 2) Microphone
 - 3) RF dummy load
2. Adjusting procedure

SG SW: OFF
VOX: ON
MODE: SSB

 - 1) Connect AG to the MIC terminal and apply a signal of 1500 Hz at 5 mV. Adjust VOX GAIN VR until the relay is operated.
 - 2) Adjust VOX DELAY VR, and make sure that the time constant changes in VOX. Then, adjust the time constant for approx. 1 sec.

- 3) Connect the microphone to the MIC terminal and keep the microphone approx. 10 cm or less away from the speaker. Set the FUNCTION switch to CAL 25 kHz and receive a signal. Turn ANTI VOX VR until VOX fluctuation is stopped.

4-9. Adjustment of side tone

1. Measuring instruments used
 - 1) AF VTVM
 - 2) Oscilloscope
 - 3) AF dummy load (8Ω)
 - 4) Key (shorting lead also usable)
2. Adjusting procedure

SG SW: OFF
MODE: CW
AF VR: 12 o'clock position
STBY: SEND

 - 1) In Fig. 39, adjust VR3 in AF • AVR unit (X49-1080-00) until AF output becomes 50 mW (0.63 V/8Ω) with the key down (refer to Fig. 28).

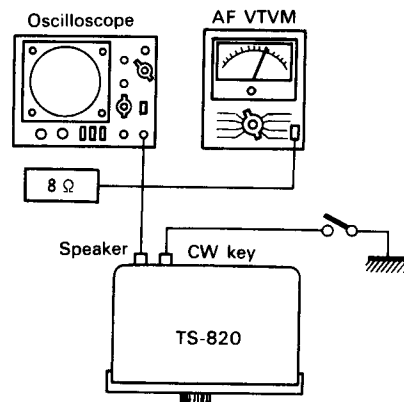


Fig. 39 Adjustment of side tone

4-10. Adjustment of RF meter

1. Measuring instrument used: RF dummy load
2. Adjusting procedure

SG SW: ON
MODE: CW
BAND: 14

 - 1) Connect the RF dummy load to the antenna and make adjustment until the transmitting output becomes maximum at 14.175 MHz.
 - 2) Set the meter switch to RF and adjust RF VR on the rear panel until the RF meter reads 250 mA on the IP scale.

5. PLL Adjustment

5-1. Adjustment of PD unit

5-1-1. BPF adjustment

1. Measuring instruments used
 - 1) Oscilloscope
 - 2) Sweep generator
 - 3) Detector (refer to Fig. 40)

ADJUSTMENTS

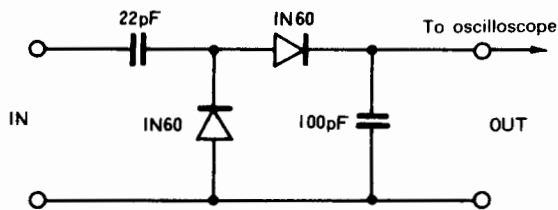


Fig. 40 Detector

2. Preparatory work

Extract PLL unit from the body, remove the shield cover and disconnect connector PLL-1. When this connector is disconnected, the ground of the unit is floated partially. Thus, connect the shielding case in PD unit to the body (TS-820) with a suitable clip wire. Set the band to the desired position.

3. Adjusting procedure

- 1) Connect the detector to TP1 (or TP2) in PD unit (X50-1340-00) and connect its output to the oscilloscope (refer to **Fig. 41**).
- 2) Ground TP3 in PD unit and connect the sweep generator output to CIB-BND connector terminals.
- 3) Adjust T1 (red), T2 (yellow) and T3 (red) in PD unit until the output waveform becomes as shown in **Fig. 42**.

PD

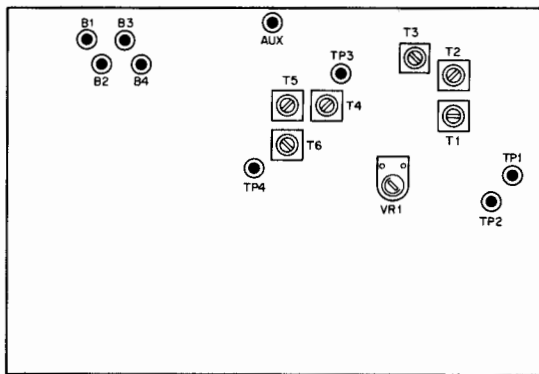


Fig. 41 PD unit

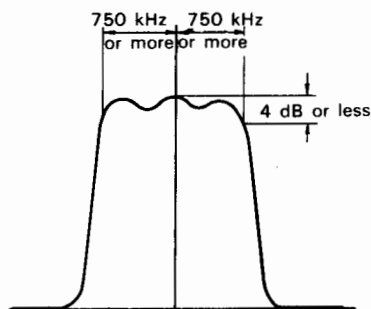


Fig. 42 Output waveform

NOTE:

- (1) This band width should be $5.25 \text{ MHz} \pm 750 \text{ kHz}$ or more and the valley depth should be 4 dB or less.
- (2) Set the oscilloscope to maximum sensitivity and set the sweep output to as low output level as possible.

5-1-2. Adjustment of balance VR

1. Measuring instruments used

- 1) SSG
- 2) RF VTVM

2. Preparatory work

- 1) Follow the same procedure as in 5-1-1.
- 2) Disconnect connect PLL-3 and set the band to the desired position within 21 to 29.5.

3. Adjusting procedure

Apply a signal of 8.83 MHz within 106 to 108 dB from SSG between connector terminals CIB and GND and adjust VR1 until the output of RF VTVM connected to TP1 (or TP2) becomes minimum dip (refer to **Fig. 41**).

5-2. Adjustment of VCO unit

5-2-1. Adjustment of VCO coil

Simplified adjustment:

1. Measuring instrument used: Voltmeter

2. Adjusting procedure

- 1) Connect the voltmeter to TP4 in VCO unit (X50-1330-00). Keep the slide switch in VCO unit to NOR side (refer to **Fig. 22**).
- 2) Set the VFO scale to 250 and adjust oscillation coils T1 through T10 until the voltmeter reads 3.2V.

NOTE:

- (1) When VFO is changed from 0 to 500, the voltmeter reading should changed proportionally.
- (2) In a band more than 21 MHz, there are two tuned points of 3.2V. The proper tuned point is obtained when the core is inserted into the printed circuit board side. In an improper tuned point, the voltage is kept unchanged regardless of turning of VFO.

Formal adjustment:

1. Measuring instrument used: Frequency counter

2. Adjusting procedure

- 1) Turn the slide switch S1 in VCO unit (X50-1330-00) to TUN side and connect the counter between TP5 and TP6 (GND).
- 2) Adjust the individual coils shown in the following list to the relevant set frequencies.
- 3) Short circuit between TP1 and TP2 in VCO unit and measure frequency. Then, short circuit between TP2 and TP3 and readjust frequency, and check if the difference between two frequencies lies in the variable range shown in the following list.

ADJUSTMENTS / REFERENCE DATA

Band	Coil	Set frequency	Variable range
WWV	T 1	24.08 MHz	±450 kHz or more
1.8	T 2	10.88 MHz	±330 kHz or more
3.5	T 3	12.58 MHz	±350 kHz or more
7	T 4	16.08 MHz	±400 kHz or more
14	T 5	23.08 MHz	±500 kHz or more
21	T 6	30.08 MHz	±500 kHz or more
28	T 7	37.08 MHz	±500 kHz or more
28.5	T 8	37.58 MHz	±500 kHz or more
29	T 9	38.08 MHz	±500 kHz or more
29.5	T10	38.58 MHz	±500 kHz or more
AUX	T11	Received signal +8.83 MHz	±500 kHz or more

Table 2

5-2-2. Adjustment of trap coil

1. Measuring instruments used
 - 1) SSG
 - 2) AF VTVM
2. Adjusting procedure
 - 1) Connect SSG through a capacitor to the cathode side (the line connected to R28, 47Ω) of diodes D1 to D11 in VCO unit (X50-1330-00) under receiving condition.
 - 2) Set the BAND switch to 29.5 position, and receive a signal of 8.83 MHz from SSG and then make arrangement so that a suitable beat comes out of AF output. Adjust TR in VCO unit until the beat output becomes minimum.

REFERENCE DATA

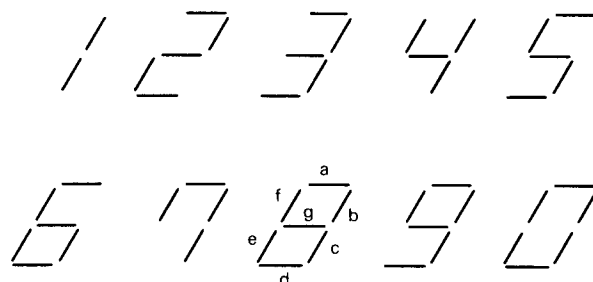
Counter Mix Unit IC6 (μPB2490)

Truth Value List (8 segments)

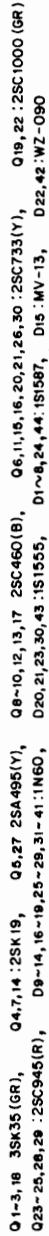
	Input					Output							
	BI	D	C	B	A	a	b	c	d	e	f	g	h
B	L	×	×	×	×	L	L	L	L	L	L	L	L
0	H	L	L	L	L	H	H	H	H	H	H	L	L
1	H	L	L	L	H	L	L	L	L	L	L	L	H
2	H	L	L	H	L	H	H	L	H	H	L	H	L
3	H	L	L	H	H	H	H	H	H	L	L	H	L
4	H	L	H	L	L	L	L	L	L	L	H	H	H
5	H	L	H	L	H	H	L	H	H	L	H	H	L
6	H	L	H	H	L	H	L	H	H	H	H	H	L
7	H	L	H	H	H	H	H	H	L	L	H	L	L
8	H	H	L	L	L	H	H	H	H	H	H	H	L
9	H	H	L	L	H	H	H	H	H	L	H	H	L
10	H	H	L	H	L	L	L	L	L	L	L	L	L
11	H	H	L	H	H	L	L	L	L	L	L	L	L
12	H	H	H	L	L	L	L	L	L	L	L	L	L
13	H	H	H	L	H	L	L	L	L	L	L	L	L
14	H	H	H	H	L	L	L	L	L	L	L	L	L
15	H	H	H	H	H	L	L	L	L	L	L	L	L

× = H or L

Character shape



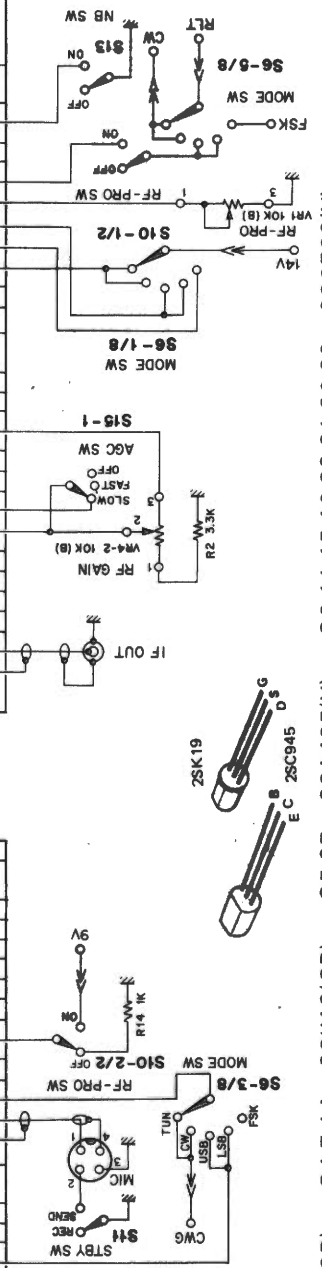
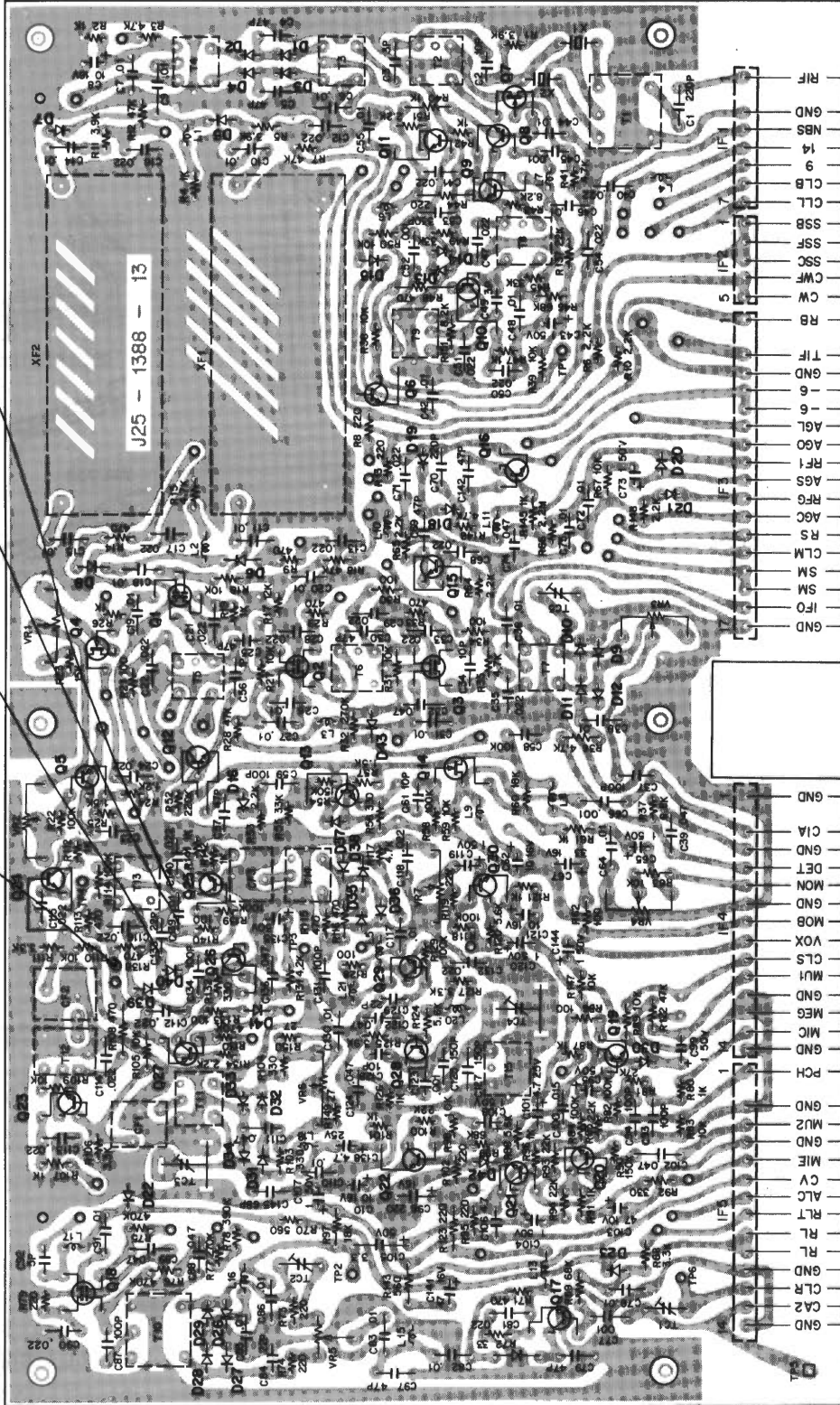
▼ IF (X48-1150-00)



CIRCUIT DIAGRAM / PC BOARD

▼ IF (X48-1150-00)

to 14V
Q102
Q101
Q100
Q99
Q98
Q97
Q96
Q95
Q94
Q93
Q92
Q91
Q90
Q89
Q88
Q87
Q86
Q85
Q84
Q83
Q82
Q81
Q80
Q79
Q78
Q77
Q76
Q75
Q74
Q73
Q72
Q71
Q70
Q69
Q68
Q67
Q66
Q65
Q64
Q63
Q62
Q61
Q60
Q59
Q58
Q57
Q56
Q55
Q54
Q53
Q52
Q51
Q50
Q49
Q48
Q47
Q46
Q45
Q44
Q43
Q42
Q41
Q40
Q39
Q38
Q37
Q36
Q35
Q34
Q33
Q32
Q31
Q30
Q29
Q28
Q27
Q26
Q25
Q24
Q23
Q22
Q21
Q20
Q19
Q18
Q17
Q16
Q15
Q14
Q13
Q12
Q11
Q10
Q9
Q8
Q7
Q6
Q5
Q4
Q3
Q2
Q1



2SC460 (B)

3SK35



2SK19

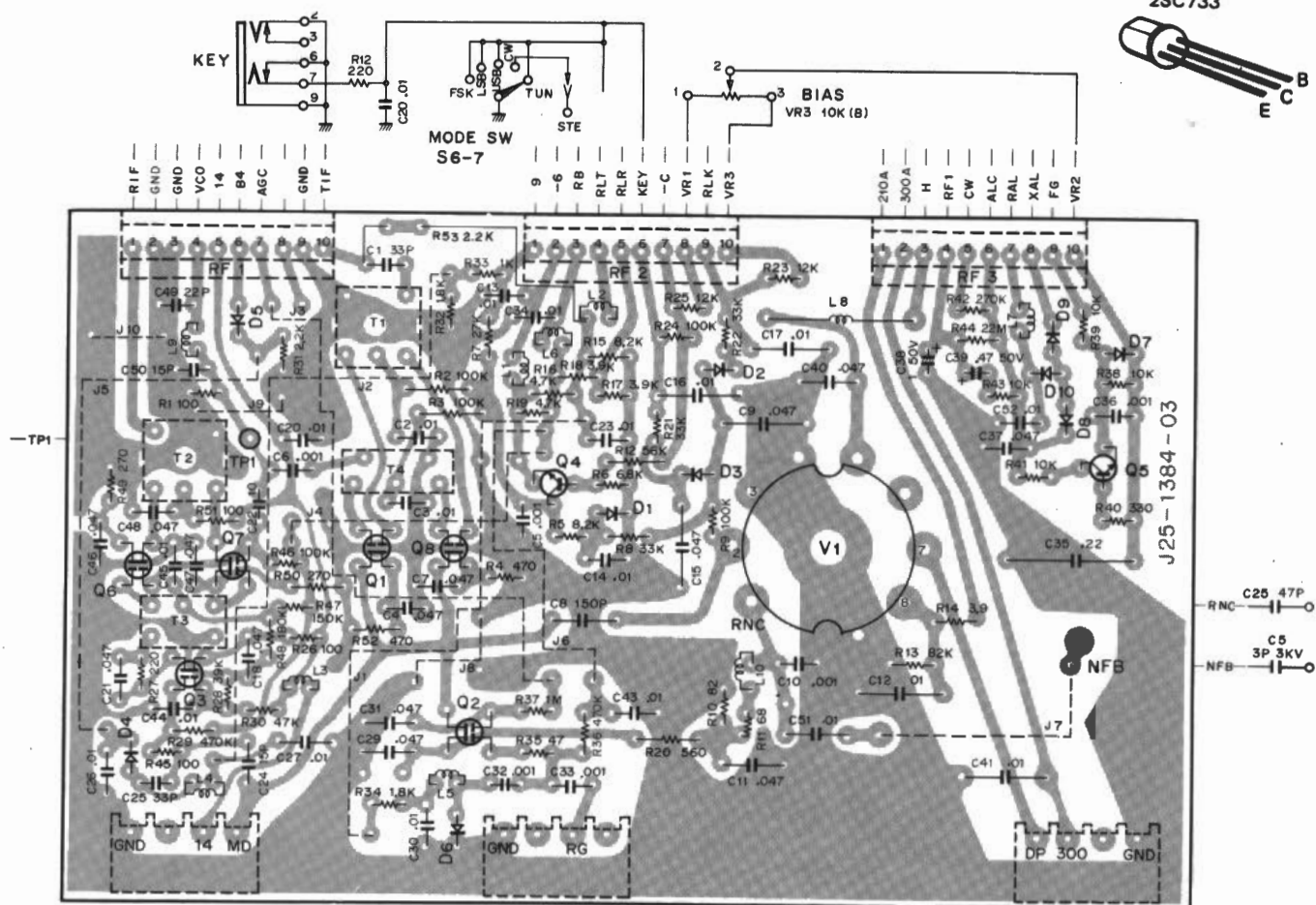
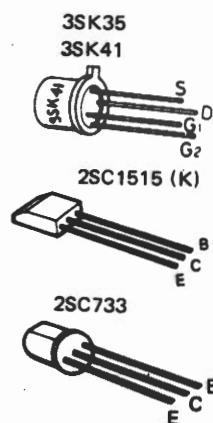


2SA495
2SC733
2SC1000



Q1~3,18: 3SK35(GR), Q4,7,14: 2SK19(GR), Q5,27: 2SA495(Y), Q6,11,15,16,20,21,26,30: 2SC733(Y),
Q8~10,12,13,17: 2SC460(B), Q19,22: 2SC1000(GR), Q23~25,28,29: 2SC945(R), D1~8,24: 1S1587,
D9~14,16~19,26~29,31~41: 1N60, D15: MV-13, D20,21,23,30,43: 1S1555, D22,42: WZ-090

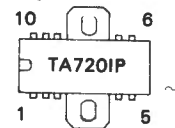
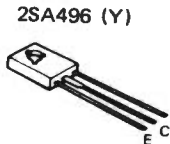
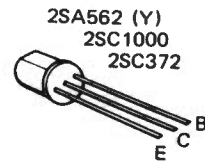
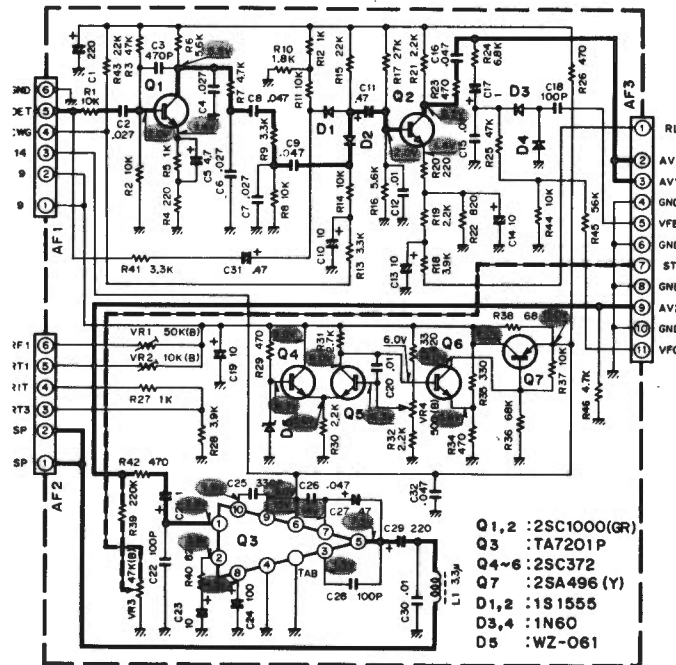
▼ RF (X44-1150-00)



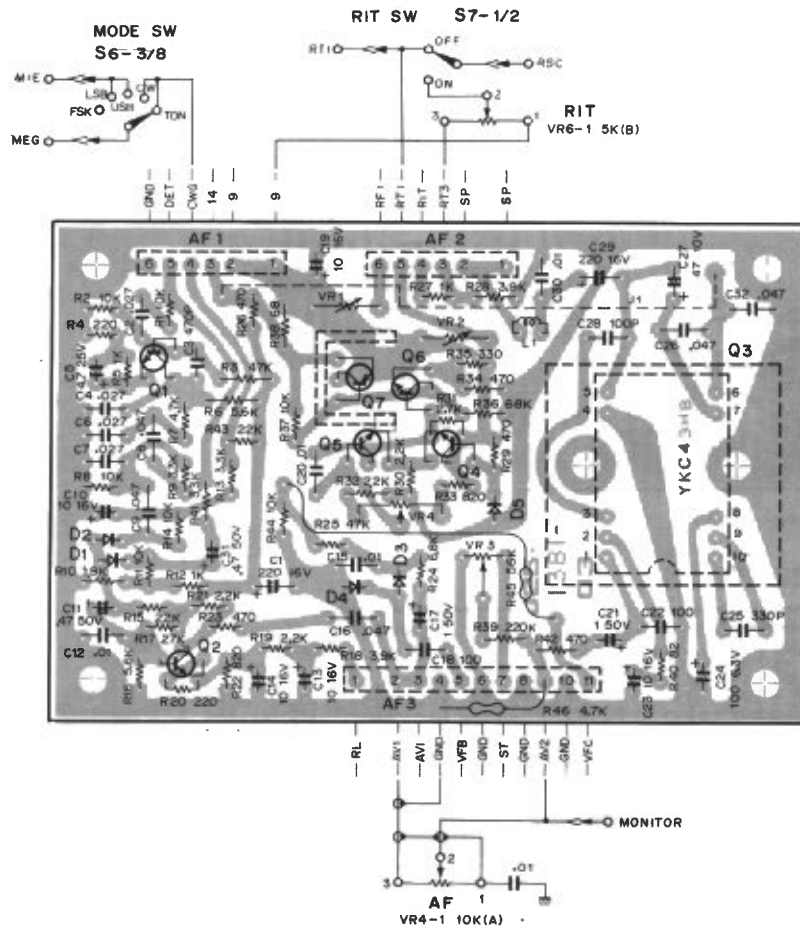
56

CIRCUIT DIAGRAM / PC BOARD

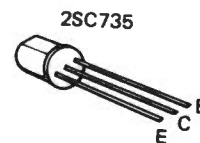
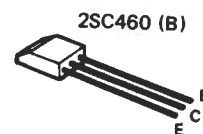
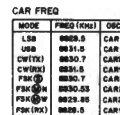
▼ AF-AVR (X49-1080-00)



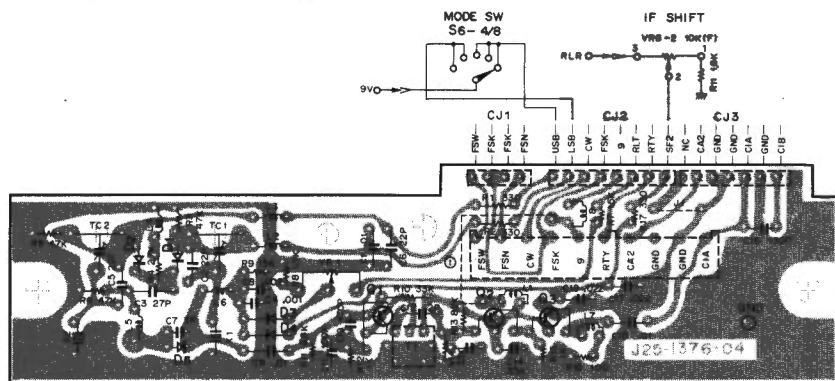
▼ AF-AVR (X49-1080-00)



▼ CAR ASSY (X60-1000-00)

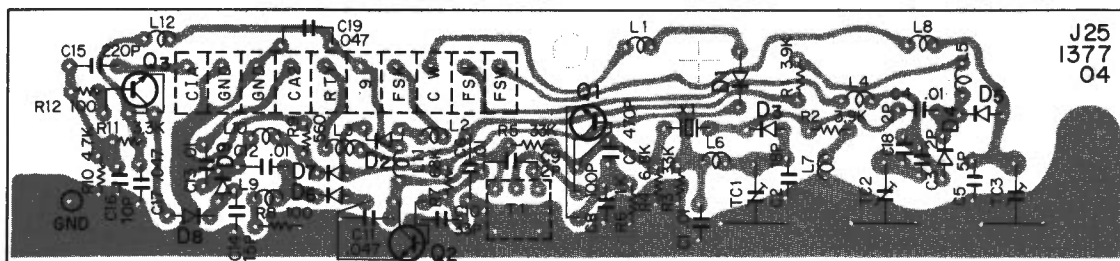


▼ **CAR-I (X50-1310-00)**



Q1,2: 2SC460(B). Q3: 2SC735(Y). D1~4: 1S1555. D5: ITT310

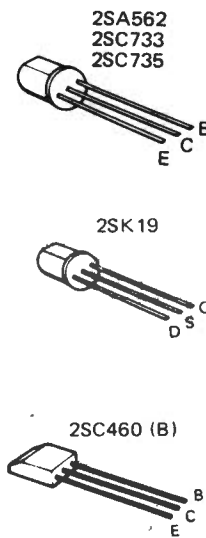
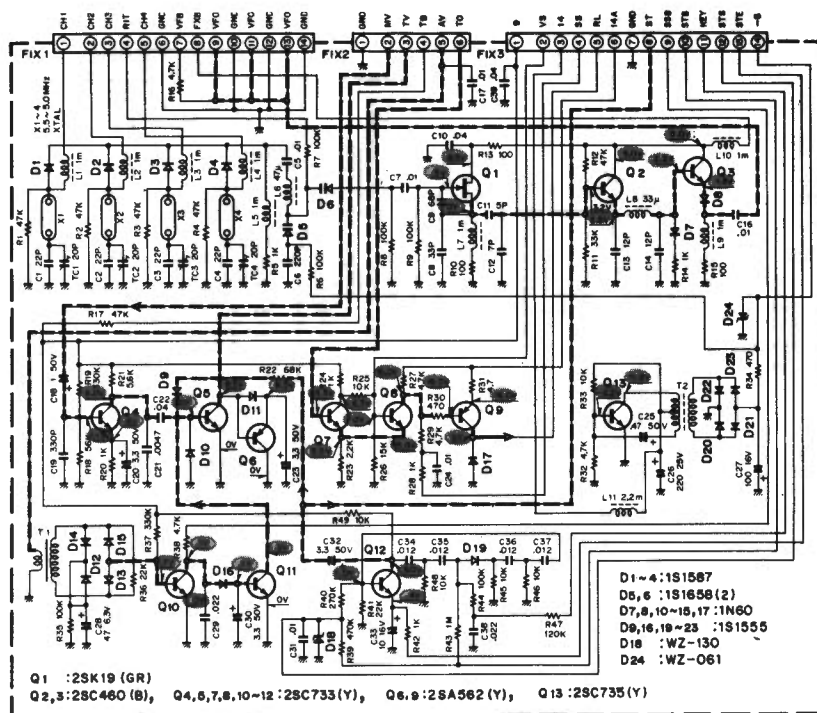
▼ CAR-II (X50-1320-00)



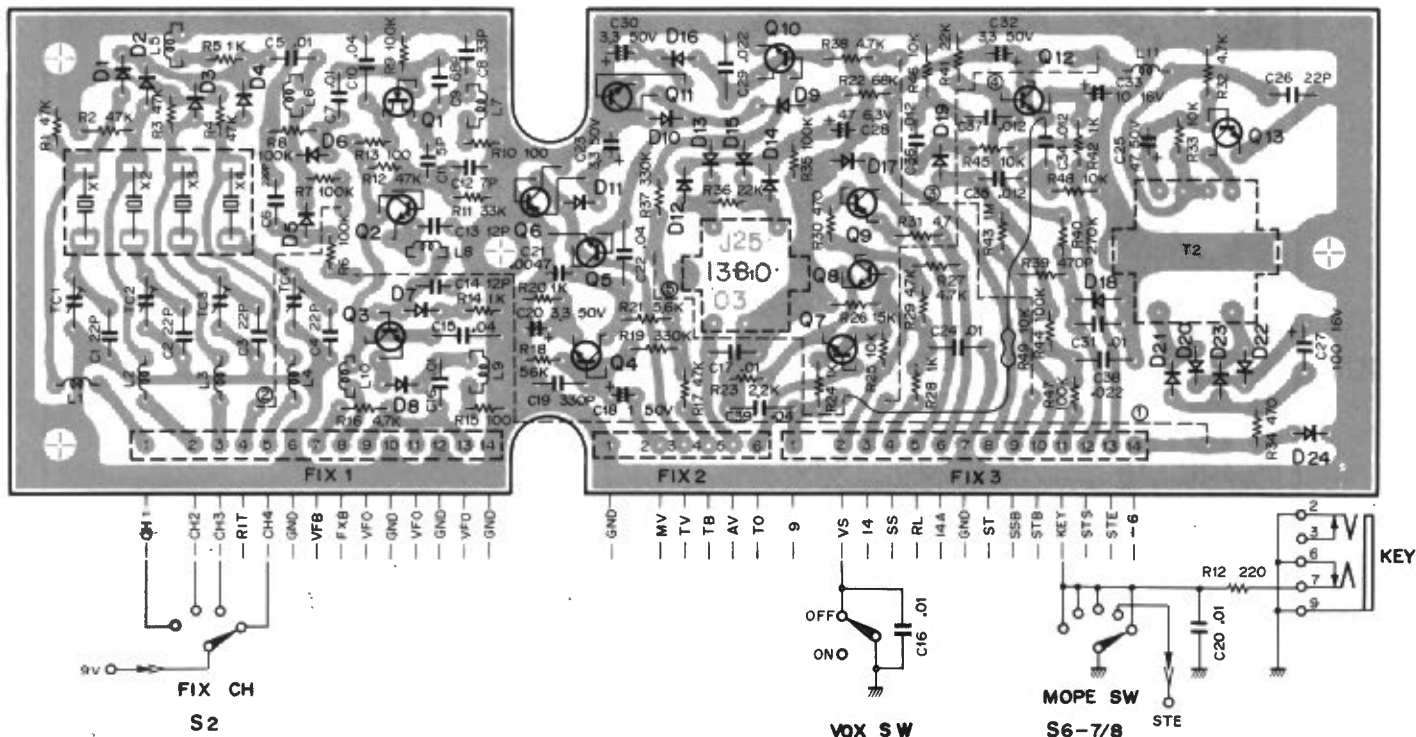
Q1~3: 2SC460(B), D1,2,6,7: 1S1555, D3~5: 1N60, D8,9: 1S2588

CIRCUIT DIAGRAM / PC BOARD

▼ FIX • VOX (X50-1350-00)



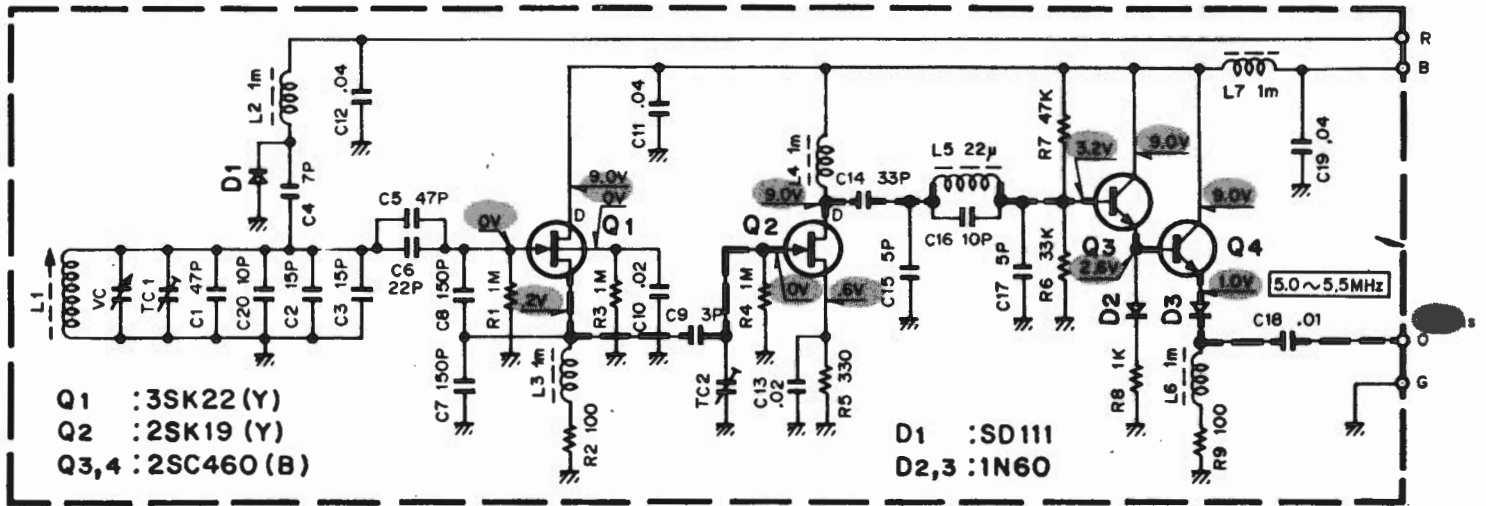
▼ FIX VOX (X50-1350-00)



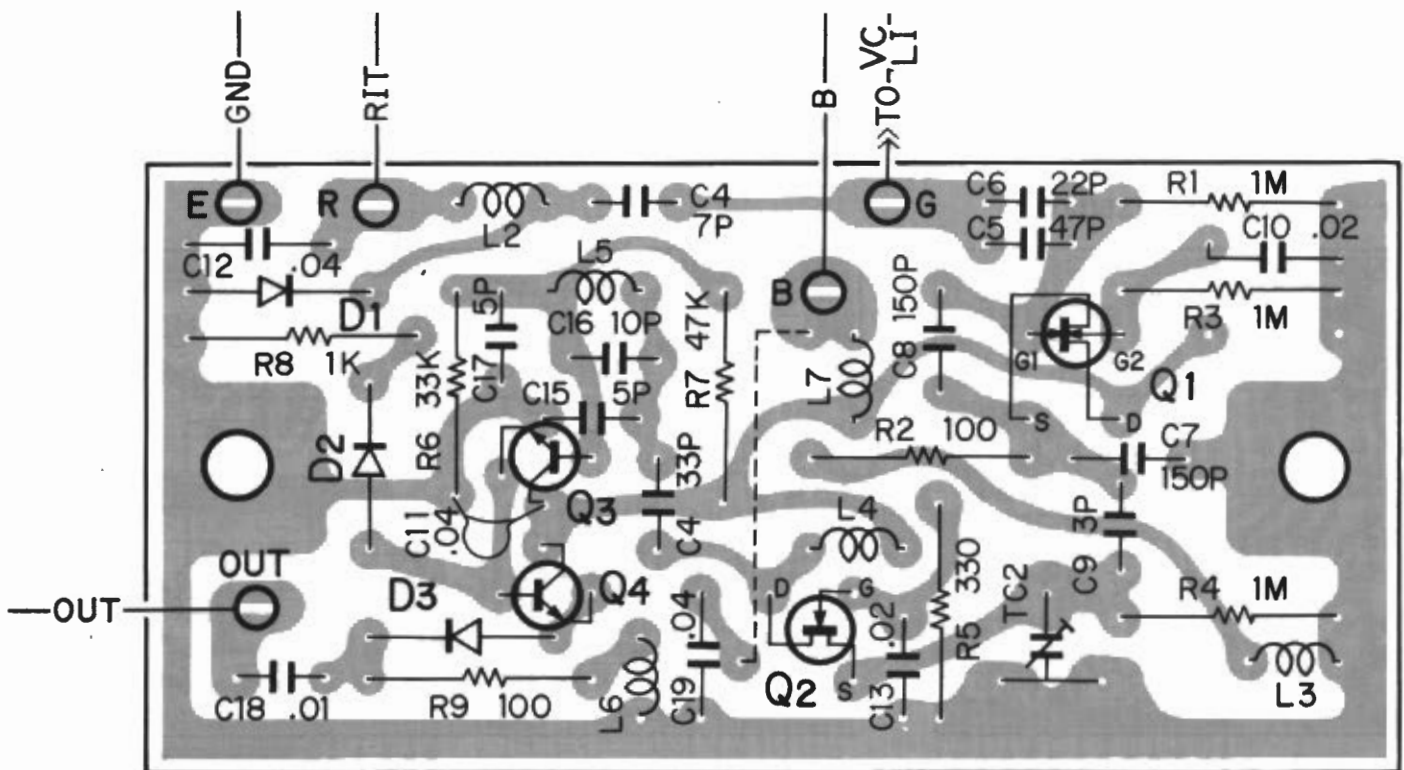
Q1 : 2SK19 (GR), Q2,3 : 2SC460, Q4,5,7,8,10~12 : 2SC733 (Y), Q6,9 : 2SA562 (Y), Q13 : 2SC735 (Y), D1~4 : 1S1587, D5,6 : 1S1658-2, D7,8,10,15,17 : 1N60, D9,16,19~23 : 1S1555, D18 : WZ-130, D24 : WZ-061

CIRCUIT DIAGRAM / PC BOARD

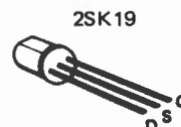
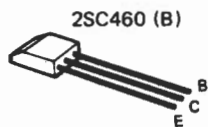
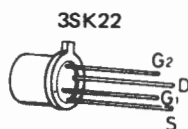
▼ VFO (X40-1110-00)



▼ VFO (X40-1110-00)

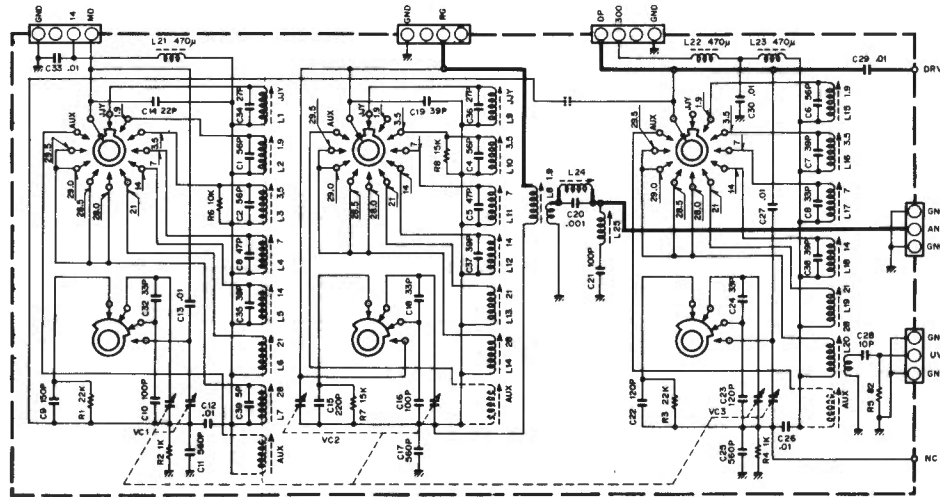


Q1: 3SK22(Y), Q2: 2SK19(Y), Q3,4: 2SC460(B), D1: SD111, D2,3: 1N60

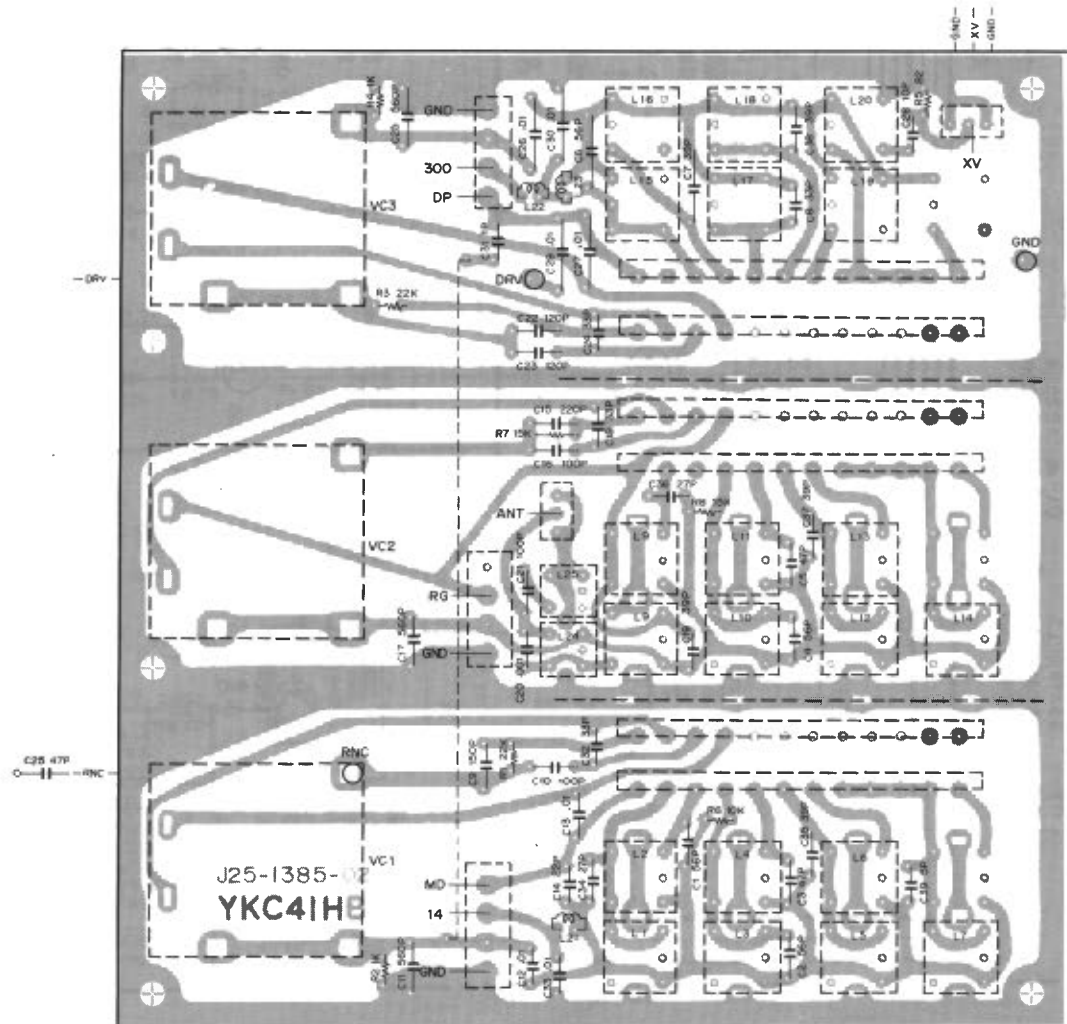


CIRCUIT DIAGRAM / PC BOARD

▼ COIL PACK (X44-1140-00)

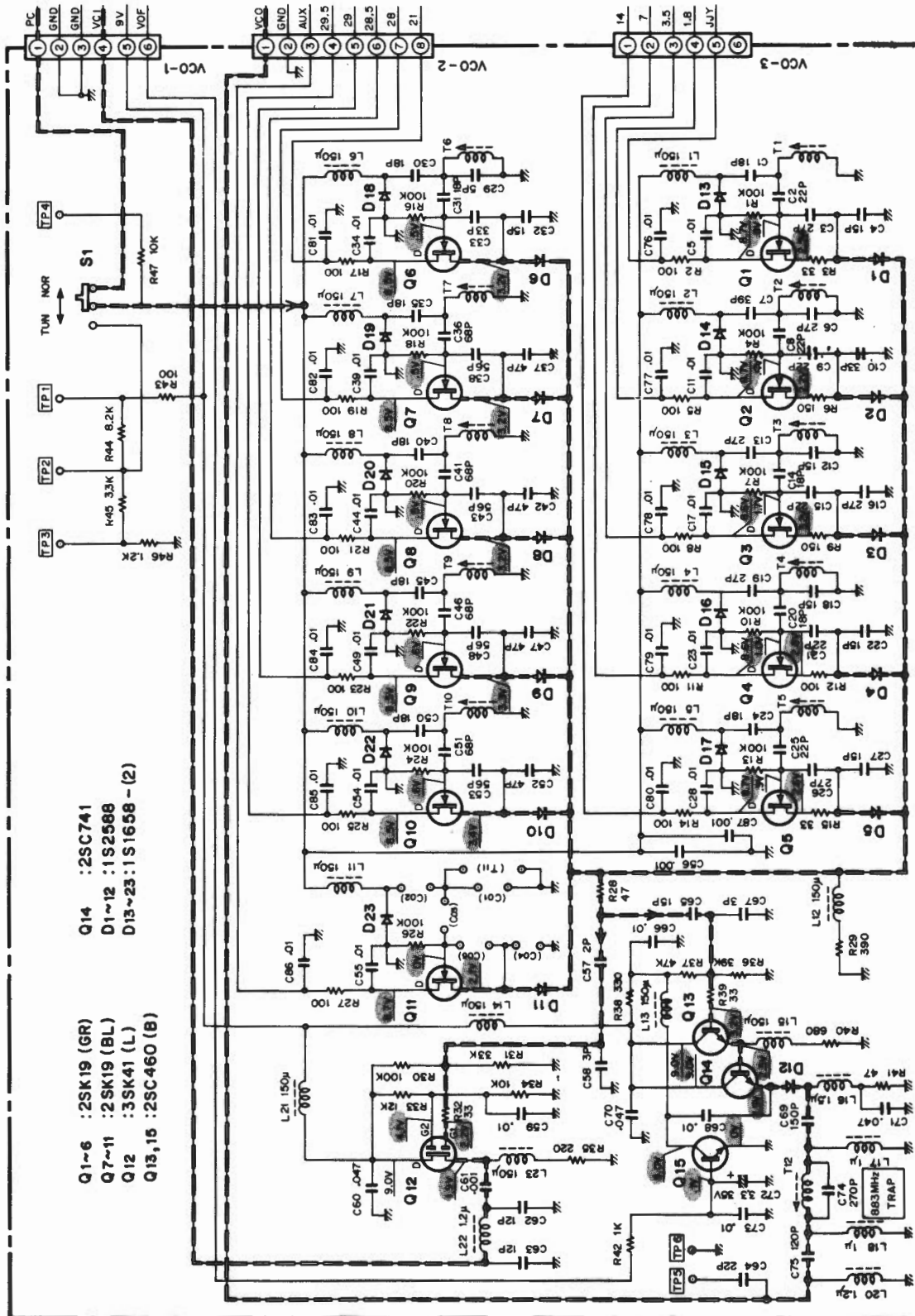


▼ COIL PACK (X44-1140-00)



CIRCUIT DIAGRAM / PC BOARD

▼ VCO (X50-1330-00)



Q14 : 2SC741
D1~12 : 1S2568
D13~23 : 1S1658 - (2)

Q1~6 : 2SK19 (GR)
Q7~11 : 2SK19 (BL)
Q12 : 3SK41 (L)
Q13, 15 : 2SC460 (B)

2SC741



2SK19



3SK41

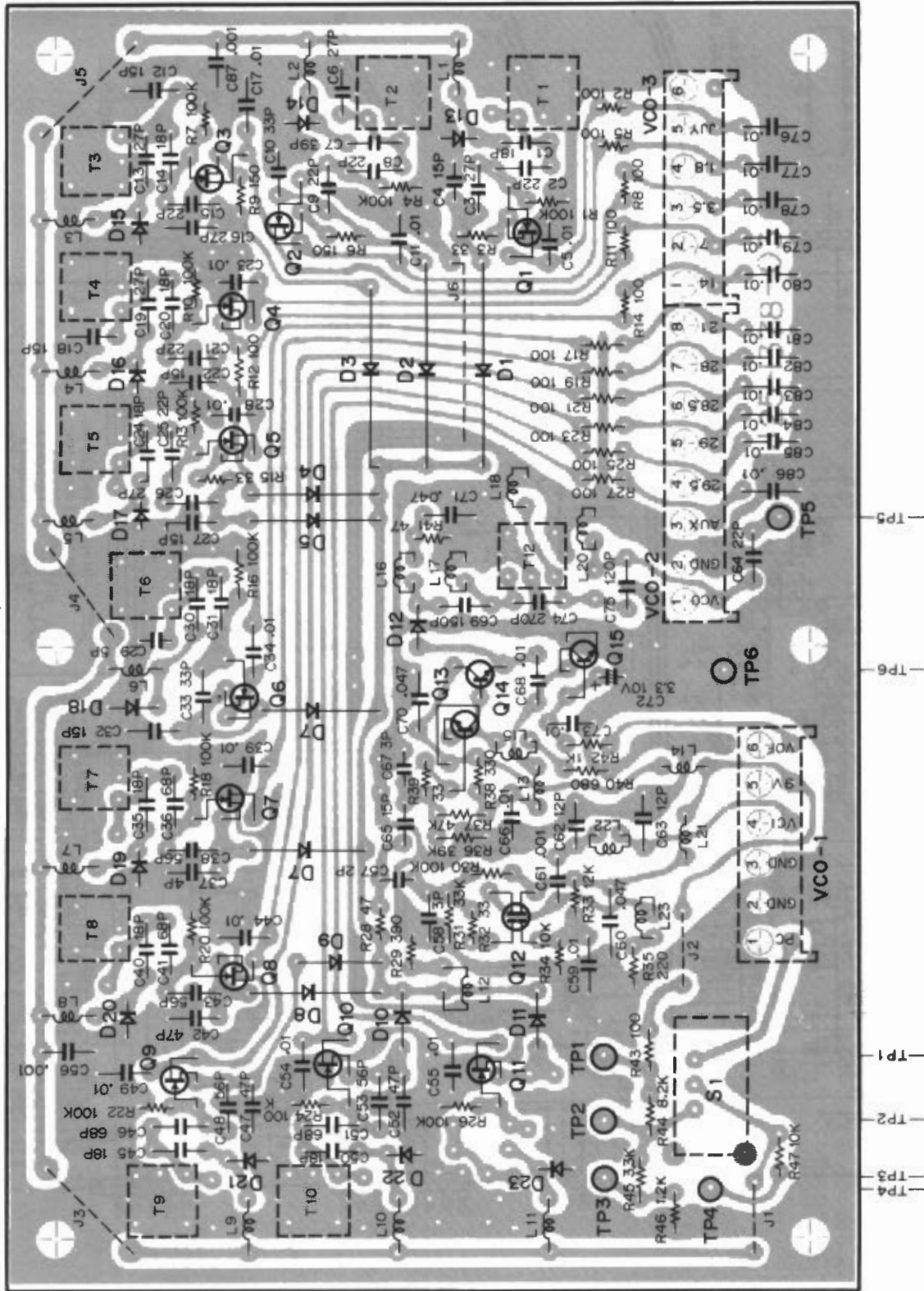


2SC460 (B)



CIRCUIT DIAGRAM / PC BOARD

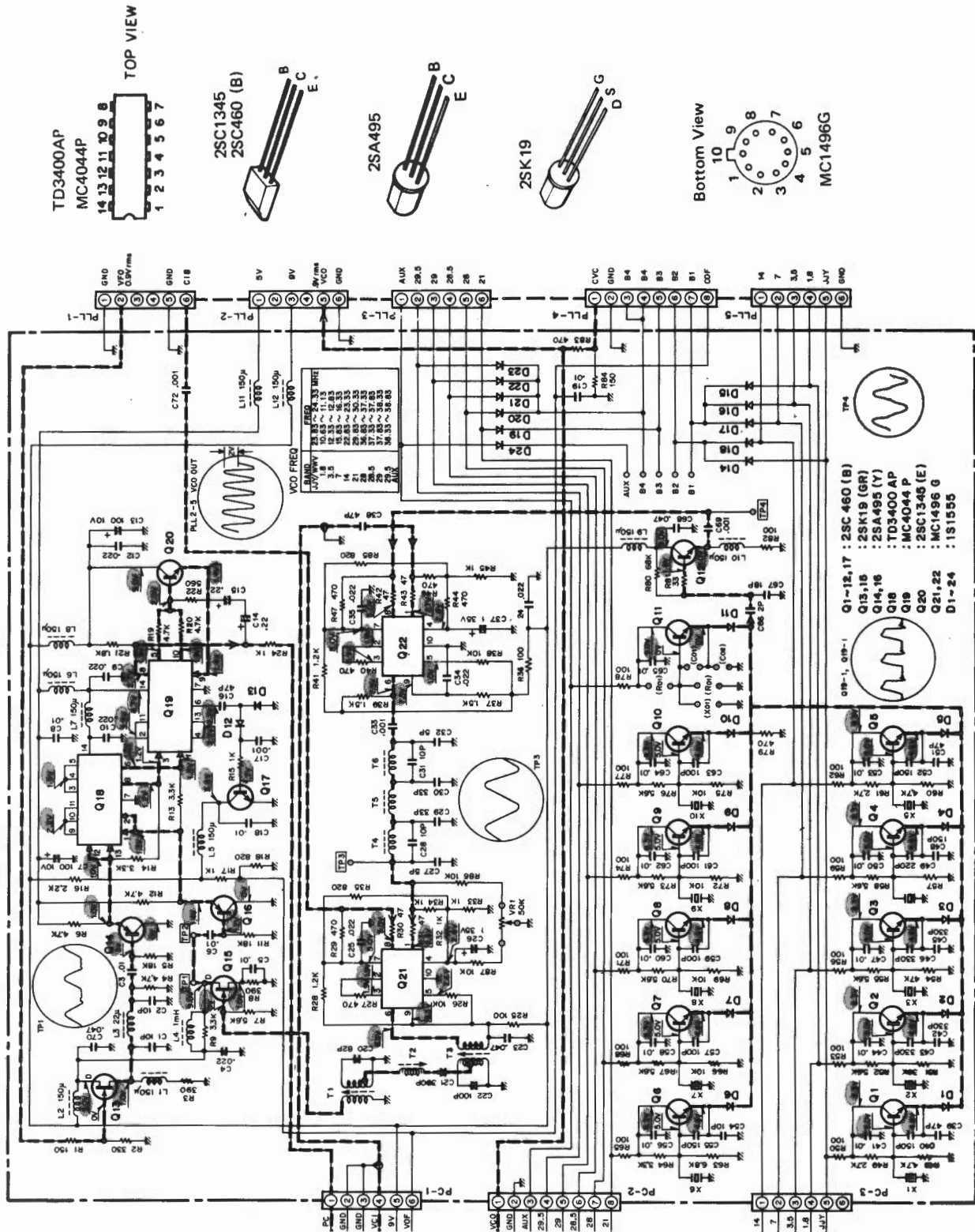
▼ VCO (X50-1330-00)



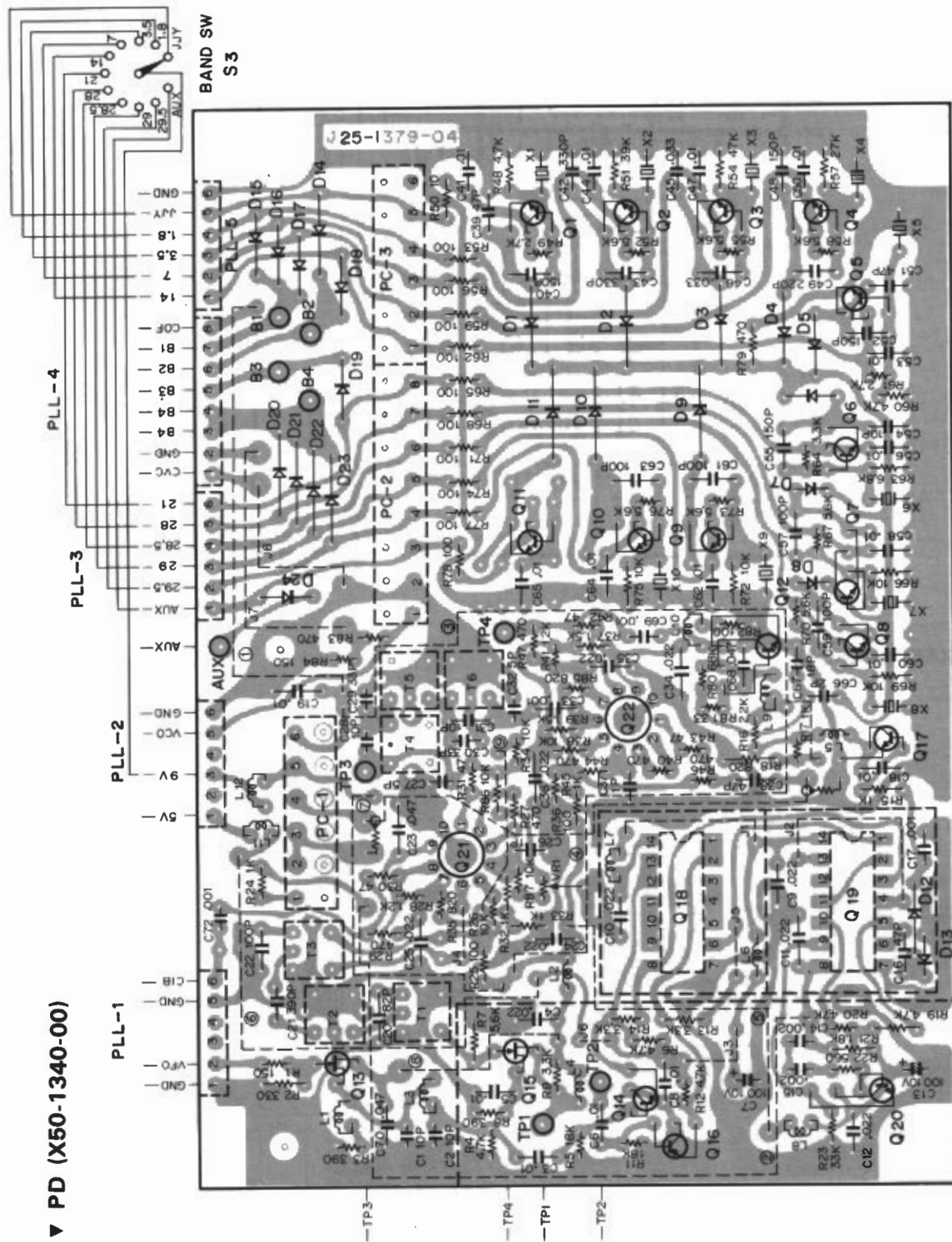
Q1~11: 2SK19(BL), Q12: 3SK41(L), Q13,15: 2SC460(B), Q14: 2SC741, D1~12: 1S2588, D13~23: 1S1658-2

CIRCUIT DIAGRAM / PC BOARD

▼ PD (X50-1340-00)



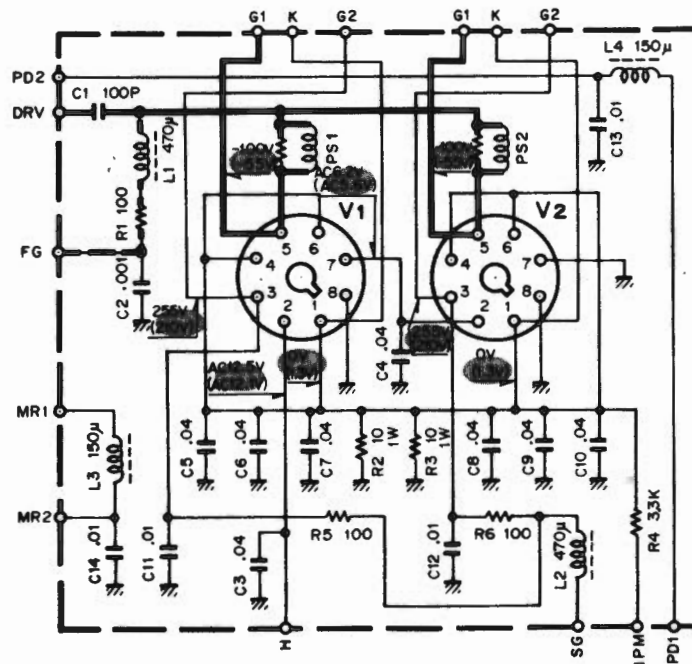
CIRCUIT DIAGRAM / PC BOARD



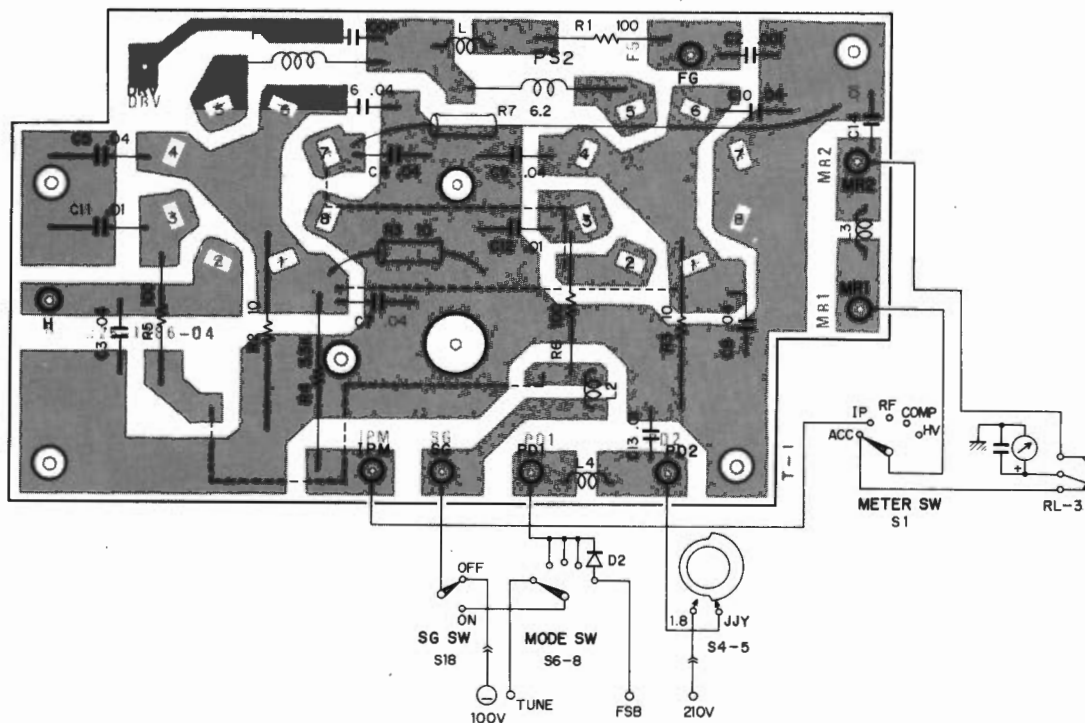
Q1~12,17: 2SC460(B), Q13,15: 2SK19(GR), Q14,16: 2SA495(Y), Q18: TD3400AP, Q19: MC4044P, Q26: 2SC1345(E), Q21,22: MC1496G, D1~24: 1S1555

CIRCUIT DIAGRAM / PC BOARD

▼ FINAL (X56-1200-00)

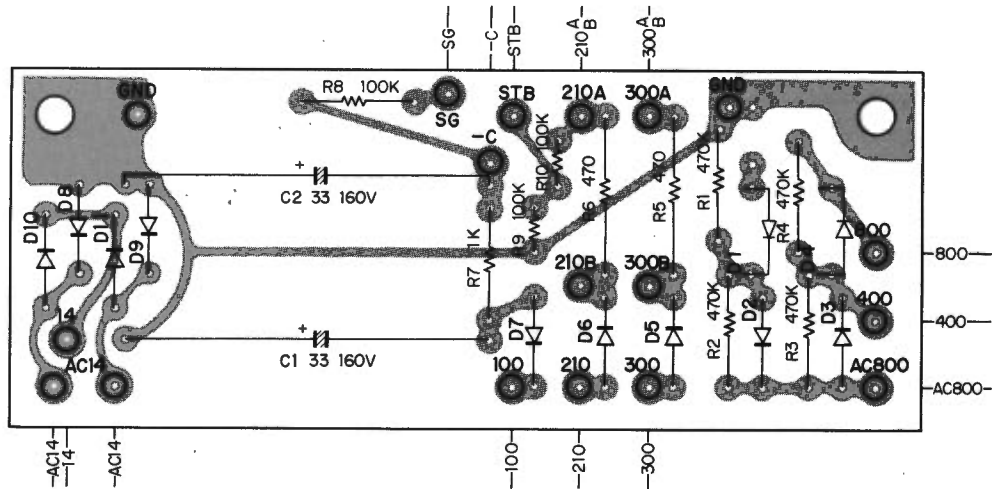


▼ FINAL (X56-1200-00)



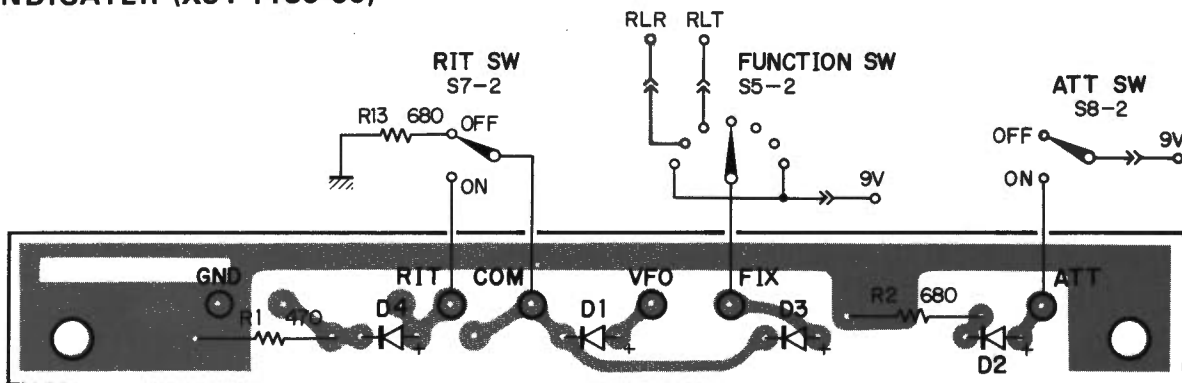
PC BOARD

▼ RECTIFIER (X43-1090-02)



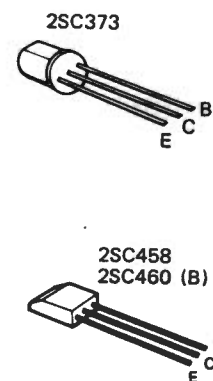
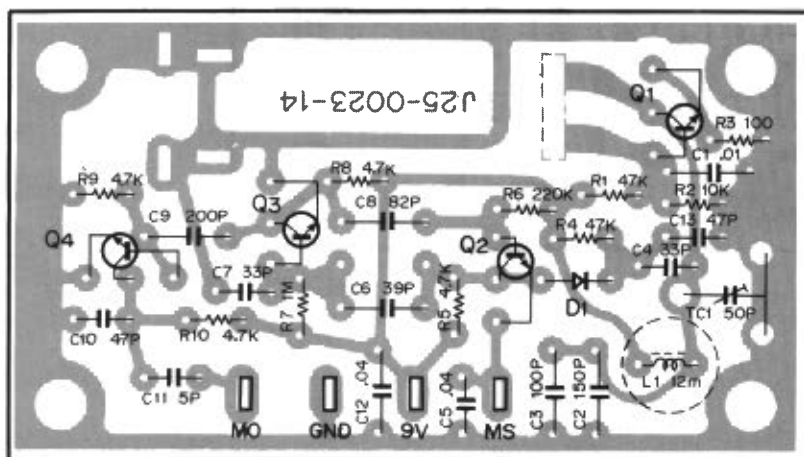
D1~6: V08J, D7: V06E, D8~11: V03C

▼ INDICATER (X54-1180-00)

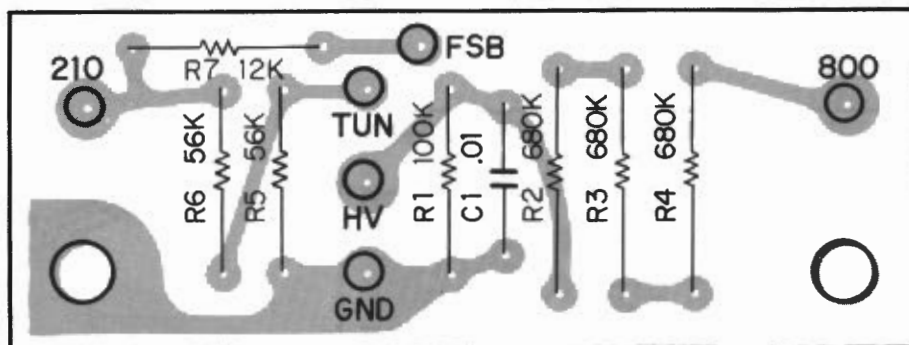
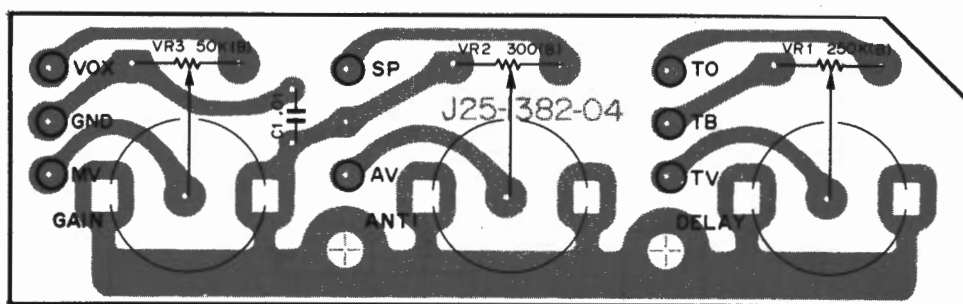


D1~4: SEL-103W

▼ MARKER (X52-0005-01)



Q1,4: 2SC373 or 2SC458(B). Q2,3: 2SC373, D1: 1N60



VFO-820



SPECIFICATIONS

OSCILLATION FREQUENCY:

5.0 to 5.5 MHz

OSCILLATION CIRCUIT:

VFO: Clapp Oscillator

OUTPUT VOLTAGE:

1 volt $\pm$ 3 dB (across a 470 ohm load).

FREQUENCY STABILITY:

Within ± 100 Hz per 30 minutes after 3 minutes of warm-up.

SOLID STATE COMPLEMENT:

2 transistors

2 FET's

6 diodes

POWER REQUIREMENTS:

The VFO-820 receives power from the TS-820.

12.6 VAC, 40 ma. 12.6 VDC, 40 ma. 9.0 VDC, 25 ma.

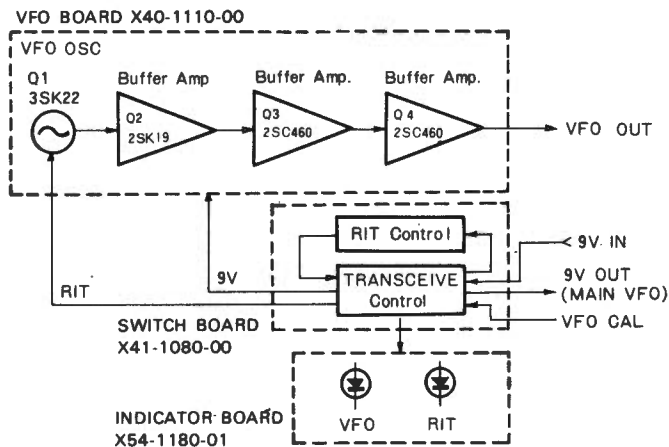
DIMENSIONS:

6.5" wide $\times$ 6.0" high $\times$ 7.5" deep (excluding feet).

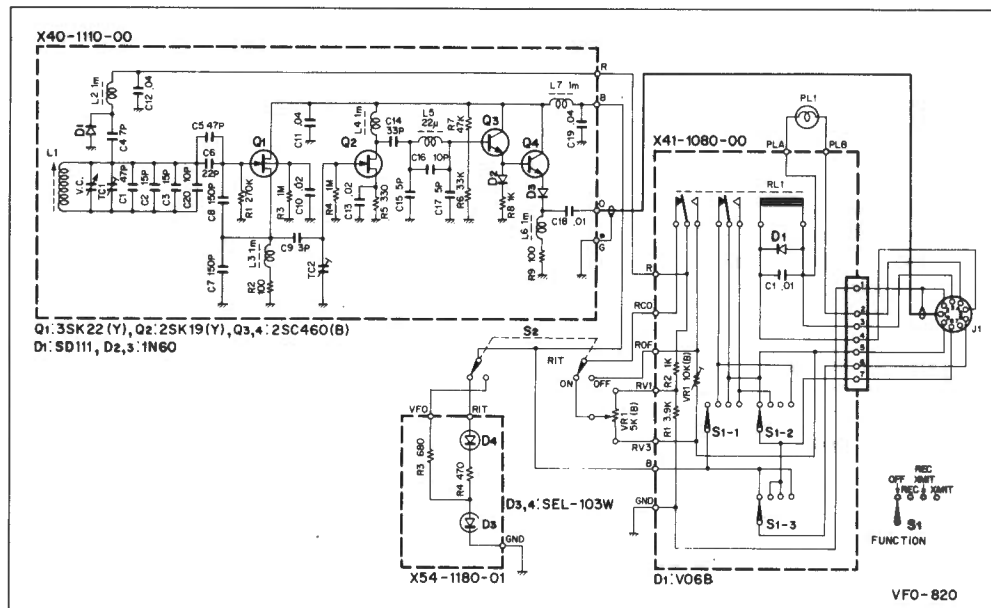
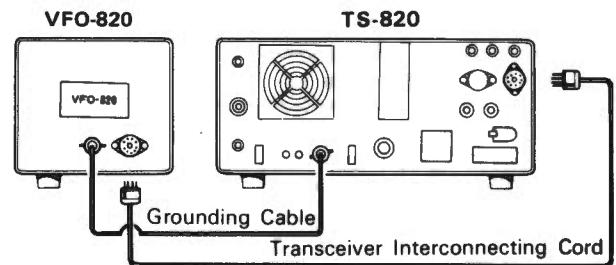
WEIGHT:

6.6 lbs. (shipping weight 8.36 lbs.)

BLOCK DIAGRAM



CONNECTION WITH TS-820



VFO-820

VFO-820

With regard to VFO unit (X40-1110-00),
refer to that of TS-820

Ref. No.	Parts No.	Description	Re- marks
MISCELLANEOUS			
S2	S40-2077-05	Push switch RIT	
	A01-0300-03	Case	
	A20-1071-05	Panel	
	A22-0200-02	Sub-panel	
	A23-0430-03	Rear panel	
	A40-0156-03	Bottom plate	
	B01-0105-05	Dial escutcheon	
	B09-0012-04	Rubber cap	
	B10-0212-04	Front glass	
	B10-0197-03	Front glass (dial)	
	B20-0373-04	Dial scale	
	B20-0374-04	Dial scale (A) mono-scale (front)	
	B20-0375-04	Dial scale (B) mono-scale (back)	
	B30-0079-05	Pilot lamp 12V, 40 mA	
	B40-1410-04	Model name plate	
	B50-1538-00	Operating manual	
	D23-0142-05	Ball retainer	
	E01-0903-05	9P MT socket	
	E05-0901-05	9P MT plug with lead × 2	
	E09-0204-05	2P plug socket	
	E14-0101-05	1P plug	
	E23-0046-04	Terminal (square) × 6	
	E23-0047-04	Terminal (square) × 9	
	E23-0069-05	Terminal (for earth cable) × 2	
	E31-0035-05	7P connector with lead	
	F15-0210-04	Blinding plate	
	H01-1587-04	Carton case (inside)	
	H03-0528-04	Carton case (outside)	
	H12-0047-03	Cushion (F)	
	H10-0968-03	Cushion (R)	
	H20-0372-04	Protection cover	
	H25-0103-04	Polyethylene bag	
	H25-0029-04	Polyethylene bag	
	J01-0025-04	Leg (small)	
	J02-0049-14	Leg (28φ) × 4	
	J21-1495-04	Lamp stopper	
	J21-1503-04	VFO stopper	
	J21-1570-04	PC board stopper	
	J32-0222-04	Boss A (for dial scale A)	
	J32-0223-04	Boss B (for dial scale B)	
	J32-1030-14	Round boss (holding leg)	
	J41-0020-04	Knob bushing	
	J61-0019-05	Vinyl tie × 7	
	K21-0267-04	Knob × 2, RIT, Function	
	K23-0271-03	Knob, MAIN	
	K29-0166-04	Knob, push	
	K29-0269-04	Knob, calibration	
	X40-1110-00	VFO unit	
	X41-1080-00	Switch unit	
	X54-1180-01	Indicator unit	

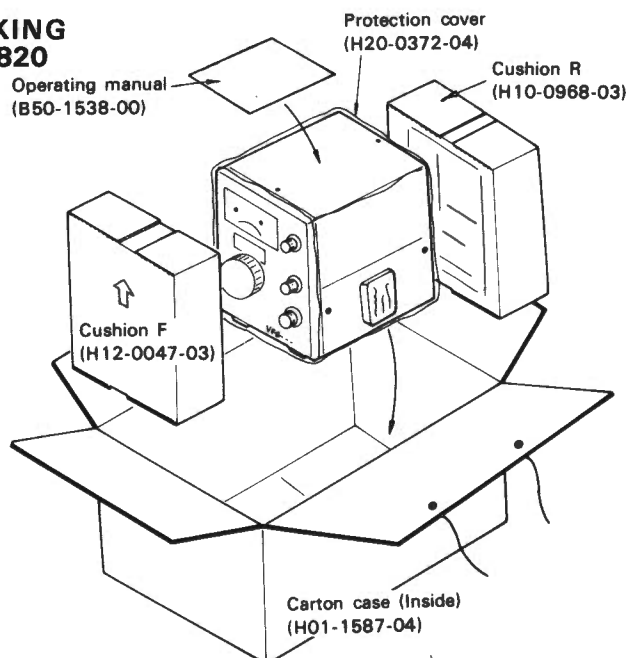
SWITCH UNIT (X41-1080-00)

Ref. No.	Parts No.	Description	Re- marks
CAPACITOR			
C1	CK45F1H103Z	Ceramic 0.01μF ±80%—20%	
RESISTOR			
R1	PD14BY2E392J	Carbon 3.9kΩ ±5% 1/4W	
R2	PD14BY2E102J	Carbon 1kΩ ±5% 1/4W	
SEMICONDUCTOR			
D1	V11-0219-05	Diode V06B	
POTENTIOMETER			
VR1	R12-3022-05	10kΩ (B)	
SWITCH/RELAY			
S1	S29-1093-05	Rotary switch	
RL1	S51-4030-05	Relay	
MISCELLANEOUS			
—	E23-0047-04	Terminal (square)	
—	E40-0713-05	Mini-connector	
—	J12-0048-05	Relay crammer	

INDICATOR UNIT (X54-1180-01)

Ref. No.	Parts No.	Description	Re- marks
RESISTER			
R3	PD14BY2E681J	Carbon 680Ω ±5% 1/4W	
R4	PD14BY2E471J	Carbon 470Ω ±5% 1/4W	
SEMICONDUCTOR			
D3.4	V11-0430-05	LED SEL-103W	
MISCELLANEOUS			
—	E23-0046-04	Terminal (square) × 3	
—	F20-0501-04	Insulator × 2	
—	R92-0150-05	Short jumper	

PACKING VFO-820



DG-1 SPECIFICATIONS

RANGE OF FREQUENCIES DISPLAYED:

Displays all the transmit/receive frequencies of TS-820 to the accuracy of 0.1 kHz order.

ACCURACY OF STANDARD OSCILLATOR:

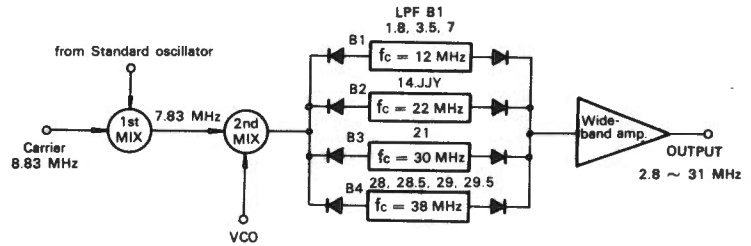
Within $\Delta f = 1 \times 10^{-6}$ after one month of ageing under ambient temperatures of $0^{\circ}\text{C} \sim 50^{\circ}\text{C}$.

OPERATING TEMPERATURE:

$-10^{\circ}\text{C} \sim +50^{\circ}\text{C}$

SEMICONDUCTORS AND INDICATOR:

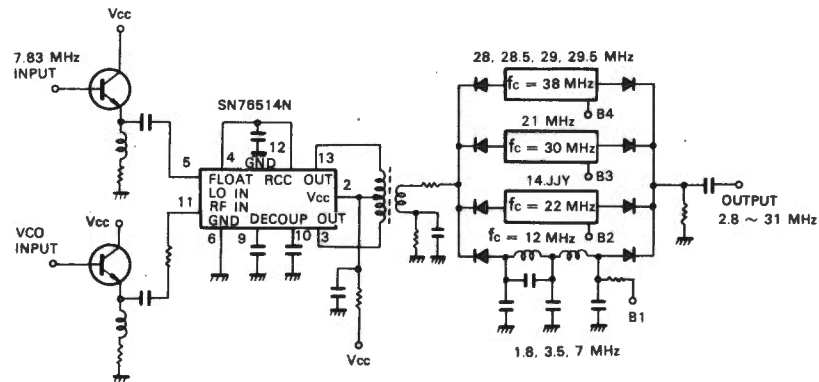
IC	33
Transistor	22
Diode	28
Fluorescent indicating tube (6 digits)	1



BAND MHz	VCO Freq. (MHz)	Output freq. (MHz)	LPF BAND
1.8	10.63 ~ 11.13	2.8 ~ 3.3	B1
3.5	12.33 ~ 12.83	4.5 ~ 5.0	
7	15.83 ~ 16.33	8.0 ~ 8.5	
14	22.83 ~ 23.33	15.0 ~ 15.5	B2
JJY (15)	23.83 ~ 24.33	16.0 ~ 16.5	
21	29.83 ~ 30.33	22.0 ~ 22.5	B3
28	36.83 ~ 37.33	29.0 ~ 29.5	
28.5	37.33 ~ 37.83	29.5 ~ 30.0	
29	37.83 ~ 38.33	30.0 ~ 30.5	
29.5	38.33 ~ 38.83	30.5 ~ 31.0	B4

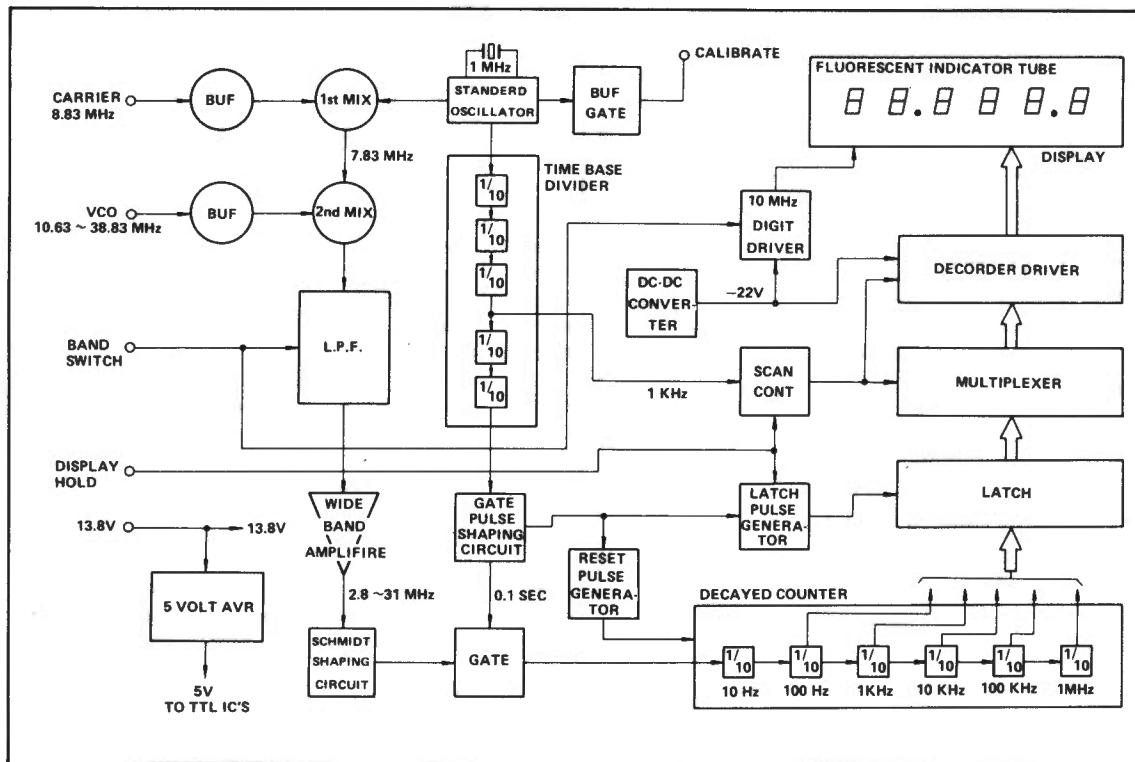
Digital counter mixer and frequency

With regard to adjustment and installation of DG-1, refer to page 36, 48 and the operating manual.



Second mixer circuit diagram

BLOCK DIAGRAM



Ref. No.	Parts No.	Description	Re- marks
MISCELLANEOUS			
	B50-1566-00	Operating manual	
	E31-0039-05	Cable (for counter calibration)	
	H01-1614-03	Carton case (inside)	
	H03-0543-04	Carton case (outside)	
	H12-0048-04	Cushion E	
	H12-0049-04	Cushion C	
	H12-0050-04	Cushion A	
	H12-0051-04	Cushion B	
	H12-0052-04	Cushion D	
	H12-0002-03	Protection sheet	
	H25-0077-03	Protection cover × 3	
	H25-0112-04	Protection cover	
	J32-0221-04	Hexagonal boss × 2	
	X43-1220-00	5V-AVR unit	
	X54-1170-00	Display unit	
	X60-1020-00	Counter ass'y unit	

5V-AVR (X43-1220-00)

Ref. No.	Parts No.	Description	Re- marks
CAPACITOR			
C1	CE04W1E470(RL)	Electrolytic 47 μ F $\pm$ 10%	
C2	CQ93M1H104K	Mylar 0.1 μ F $\pm$ 10%	
C3	CQ93M1H104K	Mylar 0.1 μ F $\pm$ 10%	
RESISTOR			
R1	RW98G3H5R6K	Cement 5.6 Ω $\pm$ 10% 5W	
SEMICONDUCTOR			
Q1	V30-0171-05	IC MC7805CP	
MISCELLANEOUS			
—	E40-0413-05	Mini-connector	
—	F01-0244-04	Heat sink	
—	F01-0253-04	Heat sink (resistor)	

DISPLAY (X54-1170-00)

Ref. No.	Parts No.	Description	Re- marks
MISCELLANEOUS			
—	E31-0021-15	Connector 16P with lead	
—	G13-0107-04	Sponge	
—	J19-0485-04	Indicating tube stopper	
—	J21-1493-04	Indicating tube stopper	
—	V11-0429-05	Indicating tube LD8109	

Ref. No.	Parts No.	Description	Re- marks
MISCELLANEOUS			
—	E40-0625-05	Chassis mounter	
—	E40-1225-05	Chassis mounter	
—	F11-0231-03	Counter shield box	
—	F11-0232-03	Counter shield case	
—	X54-1150-00	Counter mixer unit	
—	X54-1160-00	Counter unit	

COUNTER MIXER (X54-1150-00)

Ref. No.	Parts No.	Description	Re- marks
CAPACITOR			
C1	CK45F1H103Z	Ceramic 0.01 μ F $\pm$ 80%—20%	
C2	CK45F1H223Z	Ceramic 0.022 μ F $\pm$ 80%—20%	
C3	KC45B1H102K	Ceramic 0.001 μ F $\pm$ 10%	
C4	CK45F1H223Z	Ceramic 0.022 μ F $\pm$ 80%—20%	
C5	CC45RH1H220J	Ceramic 22pF $\pm$ 5%	
C6	CK45F1H223Z	Ceramic 0.022 μ F $\pm$ 80%—20%	
C7	CC45CH1H020C	Ceramic 2pF $\pm$ 0.25pF	
C8	CC45RH1H220J	Ceramic 22pF $\pm$ 5%	
C9	CC45CH1H330J	Ceramic 33pF $\pm$ 80%—20%	
C10,11	CK45F1H223Z	Ceramic 0.022 μ F $\pm$ 80%—20%	
C12	CK45F1H103Z	Ceramic 0.01 μ F $\pm$ 80%—20%	
C13	CK45F1H223Z	Ceramic 0.022 μ F $\pm$ 80%—20%	
C14	CK45F1H103Z	Ceramic 0.01 μ F $\pm$ 80%—20%	
C15~19	CK45F1H223Z	Ceramic 0.022 μ F $\pm$ 80%—20%	
C20	CC45CH1H470J	Ceramic 47pF $\pm$ 5%	
C21	CC45CH1H390J	Ceramic 39pF $\pm$ 5%	
C22	CC45SL1H121J	Ceramic 120pF $\pm$ 5%	
C23	CC45SL1H680J	Ceramic 68pF $\pm$ 5%	
C24	CK45F1H223Z	Ceramic 0.022 μ F $\pm$ 80%—20%	
C25,26	CC45CH1H220J	Ceramic 22pF $\pm$ 5%	
C27	CC45SL1H560J	Ceramic 56pF $\pm$ 5%	
C28	CC45CH1H390J	Ceramic 39pF $\pm$ 5%	
C29	CK45F1H223Z	Ceramic 0.022 μ F $\pm$ 80%—20%	
C30,31	CC45CH1H180J	Ceramic 18pF $\pm$ 5%	
C32	CC45CH1H470J	Ceramic 47pF $\pm$ 5%	
C33	CC45CH1H330J	Ceramic 33pF $\pm$ 5%	
C34	CK45F1H223Z	Ceramic 0.022 μ F $\pm$ 80%—20%	
C35	CC45CH1H120J	Ceramic 12pF $\pm$ 5%	
C36	CC45CH1H150J	Ceramic 15pF $\pm$ 5%	
C37	CC45CH1H330J	Ceramic 33pF $\pm$ 5%	
C38	CC45CH1H220J	Ceramic 22pF $\pm$ 5%	
C39	CK45F1H223Z	Ceramic 0.022 μ F $\pm$ 80%—20%	
C40	CK45B1H102K	Ceramic 0.001 μ F $\pm$ 10%	
C41	CK45F1H223Z	Ceramic 0.022 μ F $\pm$ 80%—20%	
C42	CK45B1H102K	Mylar 0.001 μ F $\pm$ 10%	
C43	CQ92M1H472K	Ceramic 0.0047 μ F $\pm$ 10%	
C44	CK45B1H102K	Ceramic 0.001 μ F $\pm$ 10%	
C45,46	CK45F1H223Z	Ceramic 0.022 μ F $\pm$ 80%—20%	
C47	CC45CH1H220J	Ceramic 22pF $\pm$ 5%	
C48	C90-0262-05	Ceramic 0.047 μ F	
C49	CC45CH1H100D	Ceramic 10pF $\pm$ 0.5pF	
C50	CK45B1H681K	Ceramic 680pF $\pm$ 10%	
C51	CC45CH1H1010C	Ceramic 1pF $\pm$ 0.25pF	
C52	CK45F1H223Z	Ceramic 0.022 μ F $\pm$ 80%—20%	
C53	CK45F1H103Z	Ceramic 0.01 μ F $\pm$ 80%—20%	

Ref. No.	Parts No.	Description	Re- marks
C54	CK45B1H331K	Ceramic 330pF $\pm 10\%$	
C55	CK45B1H681K	Ceramic 680pF $\pm 10\%$	
C56	CK45B1H331K	Ceramic 330pF $\pm 10\%$	
C57	CQ92M1H104K	Mylar 0.1 μ F $\pm 10\%$	
C59	CS15E1VR33M	Tantalum 0.033 μ F $\pm 20\%$	
C60	CK45B1H102K	Ceramic 0.001 μ F $\pm 10\%$	
C61	CE04W1H100(RL)	Electrolytic 10 μ F 50WV	
C62	CK45F1H223Z	Ceramic 0.022 μ F $\pm 80\% - 20\%$	
C63,64	CE04W1E100(RL)	Electrolytic 10 μ F 25WV	
C65	C90-0262-05	Ceramic 0.047 μ F	
C66,67	CK45F1H103Z	Ceramic 0.01 μ F $\pm 80\% - 20\%$	
C68	CE04W1A101(RL)	Electrolytic 100 μ F 10WV	
C69	C90-0262-05	Ceramic 0.047 μ F	
C70	CK45B1H102K	Ceramic 0.001 μ F $\pm 10\%$	
RESISTOR			
R1	PD14CY2B101J	Carbon 100 Ω $\pm 5\%$ 1/8W	
R2	PD14CY2B154J	Carbon 150k Ω $\pm 5\%$ 1/8W	
R3	PD14CY2B221J	Carbon 220 Ω $\pm 5\%$ 1/8W	
R4	PD14CY2B471J	Carbon 470 Ω $\pm 5\%$ 1/8W	
R5	PD14CY2B104J	Carbon 100k Ω $\pm 5\%$ 1/8W	
R6	PD14CY2B332J	Carbon 3.3k Ω $\pm 5\%$ 1/8W	
R7	PD14CY2B471J	Carbon 470 Ω $\pm 5\%$ 1/8W	
R8,9	PD14CY2B101J	Carbon 100 Ω $\pm 5\%$ 1/8W	
R10	PD14CY2B154J	Carbon 150k Ω $\pm 5\%$ 1/8W	
R11	PD14CY2B101J	Carbon 100 Ω $\pm 5\%$ 1/8W	
R12	PD14CY2B471J	Carbon 470 Ω $\pm 5\%$ 1/8W	
R13,14	PD14CY2B101J	Carbon 100 Ω $\pm 5\%$ 1/8W	
R15	PD14CY2B224J	Carbon 220k Ω $\pm 5\%$ 1/8W	
R16	PD14CY2B101J	Carbon 100 Ω $\pm 5\%$ 1/8W	
R17	PD14CY2B471J	Carbon 470 Ω $\pm 5\%$ 1/8W	
R18,19	PD14CY2B101J	Carbon 100 Ω $\pm 5\%$ 1/8W	
R20	PD14CY2B332J	Carbon 3.3k Ω $\pm 5\%$ 1/8W	
R21	PD14CY2B101J	Carbon 100 Ω $\pm 5\%$ 1/8W	
R22~25	PD14CY2B181J	Carbon 180 Ω $\pm 5\%$ 1/8W	
R26	PD14CY2B332J	Carbon 3.3k Ω $\pm 5\%$ 1/8W	
R27	PD14CY2B101J	Carbon 100 Ω $\pm 5\%$ 1/8W	
R28	PD14CY2B154J	Carbon 150k Ω $\pm 5\%$ 1/8W	
R29	PD14CY2B101J	Carbon 100 Ω $\pm 5\%$ 1/8W	
R30	PD14CY2B331J	Carbon 330 Ω $\pm 5\%$ 1/8W	
R31	PD14CY2B102J	Carbon 1k Ω $\pm 5\%$ 1/8W	
R32	PD14CY2B100J	Carbon 10 Ω $\pm 5\%$ 1/8W	
R33	PD14CY2B221J	Carbon 220 Ω $\pm 5\%$ 1/8W	
R34	PD14CY2B104J	Carbon 100k Ω $\pm 5\%$ 1/8W	
R35	PD14CY2B271J	Carbon 270 Ω $\pm 5\%$ 1/8W	
R36	PD14CY2B102J	Carbon 1k Ω $\pm 5\%$ 1/8W	
R37	PD14CY2B221J	Carbon 220 Ω $\pm 5\%$ 1/8W	
R38	PD14CY2B561J	Carbon 560 Ω $\pm 5\%$ 1/8W	
R39	PD14CY2B221J	Carbon 220 Ω $\pm 5\%$ 1/8W	
R40	PD14CY2B182J	Carbon 1.8k Ω $\pm 5\%$ 1/8W	
R41	PD14CY2B472J	Carbon 4.7k Ω $\pm 5\%$ 1/8W	
R42	PD14CY2B182J	Carbon 1.8k Ω $\pm 5\%$ 1/8W	
R43	PD14CY2B472J	Carbon 4.7k Ω $\pm 5\%$ 1/8W	
R44	PD14CY2B471J	Carbon 470 Ω $\pm 5\%$ 1/8W	
R45	PD14CY2B561J	Carbon 560 Ω $\pm 5\%$ 1/8W	
R46	PD14CY2B101J	Carbon 100 Ω $\pm 5\%$ 1/8W	
R47	PD14CY2B100J	Carbon 10 Ω $\pm 5\%$ 1/8W	
R48~55	PD14CY2B472J	Carbon 4.7k Ω $\pm 5\%$ 1/8W	
R56	PD14CY2B821J	Carbon 820 Ω $\pm 5\%$ 1/8W	
R57,58	PD14CY2B472J	Carbon 4.7k Ω $\pm 5\%$ 1/8W	
R59,60	PD14CY2B471J	Carbon 470 Ω $\pm 5\%$ 1/8W	
R61	PD14CY2B102J	Carbon 1k Ω $\pm 5\%$ 1/8W	

Ref. No.	Parts No.	Description	Re- marks
BB1,2	R90-0112-05	Carbon 47k Ω $\times 7$	
RB3	R90-0113-05	Carbon 47k Ω $\times 6$	
SEMICONDUCTOR			
IC1	V30-0153-05	IC SN76514N	
IC2	V30-0132-05	IC TD3400AP	
IC3~5	V30-0151-05	IC TD3490BP	
IC6	V30-0170-05	IC μ PB249D	
Q1	V03-0079-05	Transistor 2SC460(B)	
Q2	V09-0023-05	FET 2SK22(GR)	
Q3~7	V03-0079-05	Transistor 2SC460(B)	
Q8	V01-0084-05	Transistor 2SA733(R)	
Q9	V03-0079-05	Transistor 2SC460(B)	
Q10,11	V03-0270-05	Transistor 2SC945(R)	
Q12~19	V01-0084-05	Transistor 2SA733(R)	
Q20	V03-0270-05	Transistor 2SC945(R)	
D1~8	V11-0414-05	Diode 1S2588	
D9~12	V11-0076-05	Diode 1S1555	
D13,14	V21-0007-05	Varistor SV-03	
D15	V11-0076-05	Diode 1S1555	
D16	V11-0482-05	Zener diode BZ-220	
C17	V21-0007-05	Varistor SV03	
D18~28	V11-0076-05	Diode 1S1555	
COIL/TRIMMER			
L1,2	L40-4711-03	Ferri-inductor 470 μ H	
L3	L40-6801-03	Ferri-inductor 68 μ H	
L4	L40-2792-02	Ferri-inductor 2.7 μ H	
L5	L40-4719-02	Ferri-inductor 4.7 μ H	
L6	L40-1592-02	Ferri-inductor 1.5 μ H	
L7	L40-2792-02	Ferri-inductor 2.7 μ H	
L8	L34-0523-05	Tuning coil 1 μ H	
L9	L40-1892-02	Ferri-inductor 1.8 μ H	
L10	L34-0526-05	Tuning coil 0.28 μ H	
L11	L40-1592-02	Ferri-inductor 1.5 μ H	
L12~	L40-4711-03	Ferri-inductor 470 μ H	
L18,19	L40-6801-03	Ferri-inductor 68 μ H	
L20~22	L40-4711-03	Ferri-inductor	
L23	L33-0601-05	Choke coil 2.2 μ H	
T1,2	L34-0522-05	Tuning coil 7.83MHz	
T3	L34-0524-05	Wide range transformer (BM output)	
T4	L19-0020-05	Oscillating transformer (DC-DC converter)	
TC1	C05-0035-05	Trimmer 50pF	
MISCELLANEOUS			
J1~3	R92-0152-05	Short jumper	
—	E40-0327-05	Type U pin ass'y	
—	E40-0607-05	Mini-connector $\times 3$	
—	E40-0826-05	Type U pin ass'y $\times 2$	
—	E40-1714-05	Mini-connector	

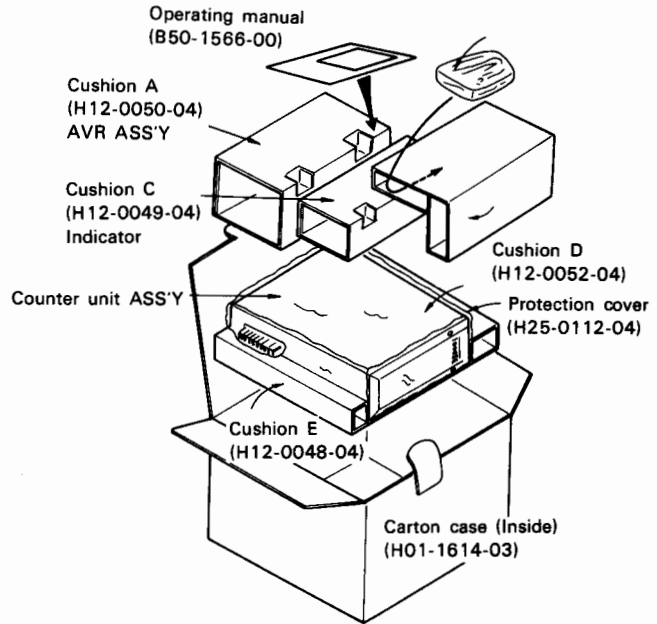
COUNTER (X54-1160-00)

Ref. No.	Parts No.	Description	Re- marks
CAPACITOR			
C1	CC45CH1H101J	Ceramic 100pF $\pm 5\%$	
C2	CK45B1H102K	Ceramic 0.001 μ F $\pm 10\%$	
C3	CE04W1C220(RL)	Electrolytic 22 μ F 16WV	
C4,5	C90-0262-05	Ceramic 0.047 μ F	

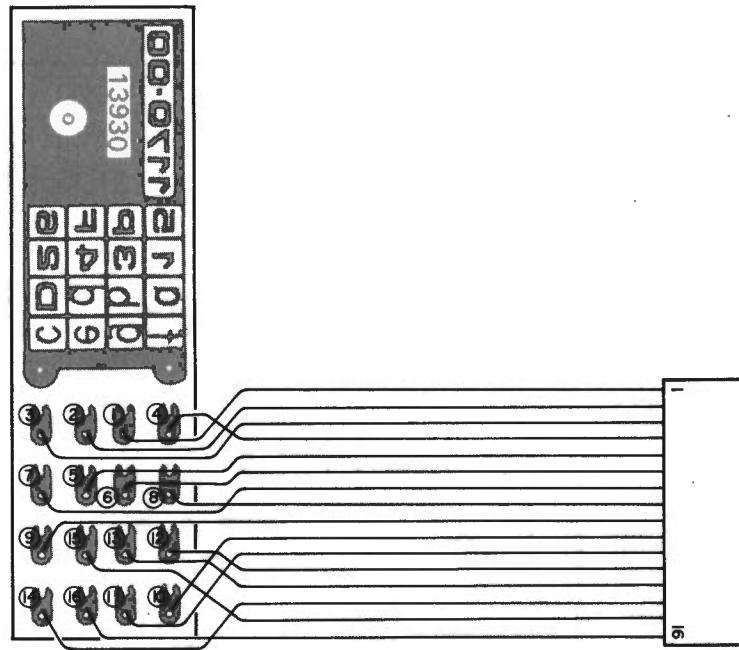
DG-1

PACKING

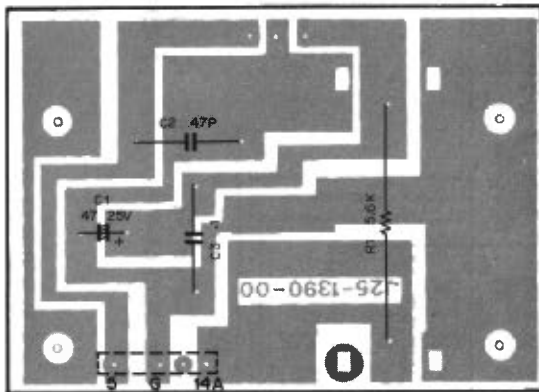
Ref. No.	Parts No.	Description	Re- marks
C6	CE04W1A101(RL)	Electrolytic 100 μ F 10WV	
C7~9	C90-0262-05	Ceramic 0.047 μ F	
RESISTOR			
R1,2	PD14CY2B272J	Carbon 2.7k Ω $\pm$ 5% 1/8W	
R3	PD14CY2B472J	Carbon 4.7k Ω $\pm$ 5% 1/8W	
R4,5	PD14CY2B104J	Carbon 100k Ω $\pm$ 5% 1/8W	
R6,7	PD14CY2B821J	Carbon 820 Ω $\pm$ 5% 1/8W	
R8,9	PD14CY2B103J	Carbon 10k Ω $\pm$ 5% 1/8W	
SEMICONDUCTOR			
Q1,2	V03-0270-05	Transistor 2SC945(R)	
IC1,2	V30-0151-05	IC TD3490BP	
IC3	V30-0131-05	IC TD3472AP	
IC4	V30-0132-05	IC TD3400AP	
IC5	V30-0169-05	IC SN74H00N	
IC6	V30-0168-05	IC SN74176N	
IC7~11	V30-0151-05	IC TD3490BP	
IC12~16	V30-0167-05	IC TD3475AP	
IC17	V30-0165-05	IC TD3450AP	
IC18	V30-0166-05	IC TD3460AP	
IC19,20	V30-0165-05	IC TD3450AP	
IC21	V30-0166-05	IC TD3460AP	
IC22	V30-0165-05	IC TD3450AP	
IC23	V30-0132-05	IC TD3400AP	
IC24	V30-0151-05	IC TD3490BP	
IC25	V30-0164-05	IC TD3442AP	
IC26	V30-0163-05	IC TD3404AP	
COIL/MISCELLANEOUS			
L1	L40-4701-03	Ferri-inductor 17 μ H	
—	E40-0607-05	Mini-connector $\times$ 3	



▼ DISPLAY (X54-1170-00)

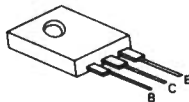


▼ 5V-AVR (X43-1220-00)

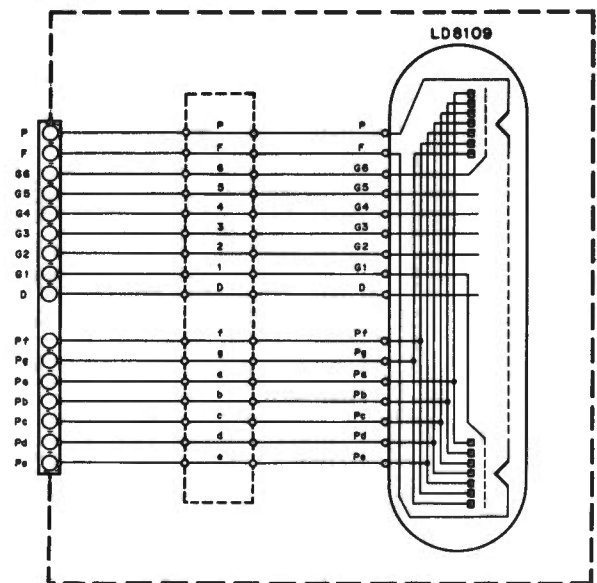


Q1: MC7805CP

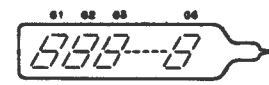
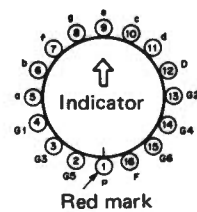
MC7805CP



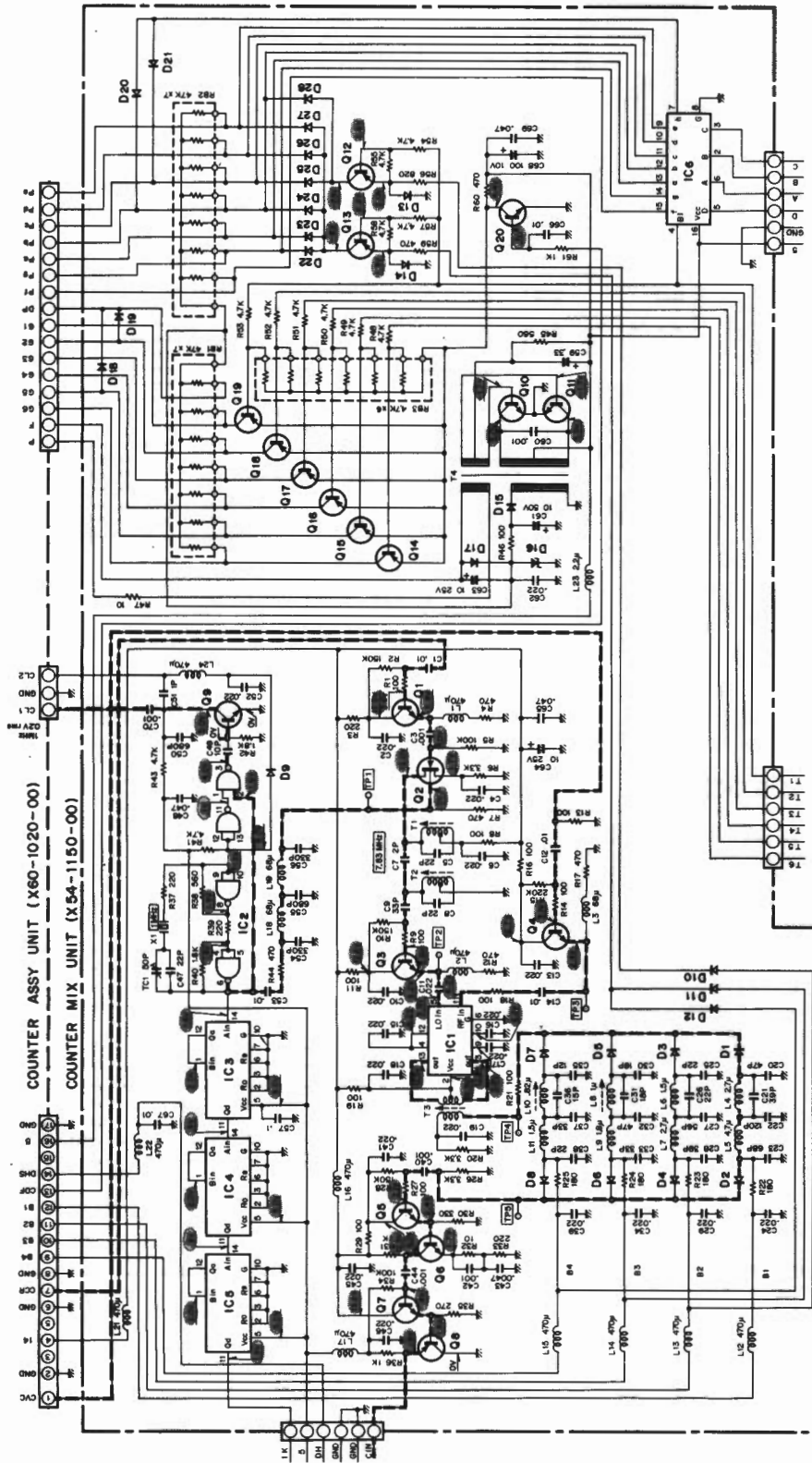
▼ DISPLAY (X54-1170-00)



LD8109

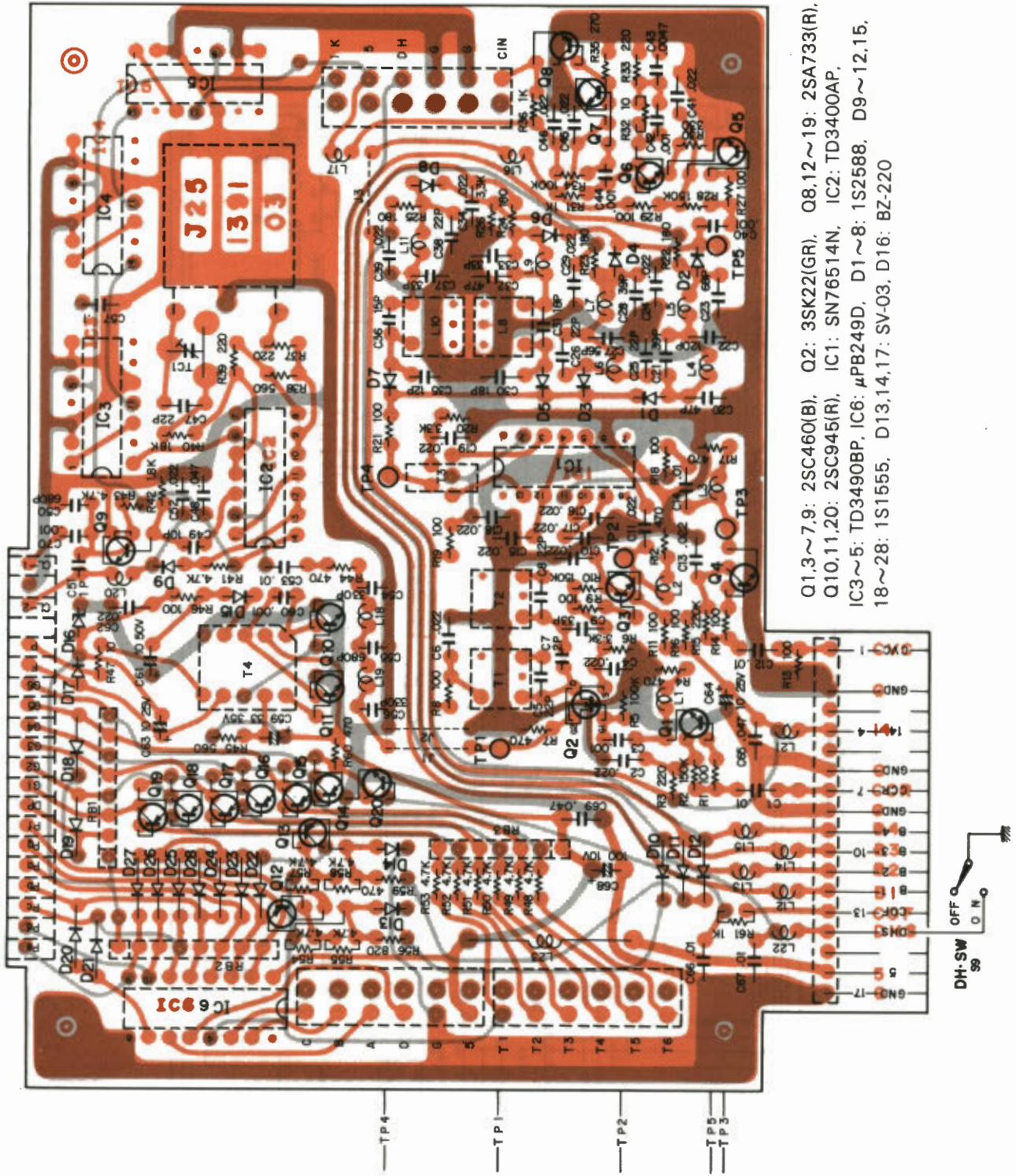


▼ COUNTER MIX (X54-1150-00)

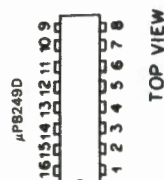
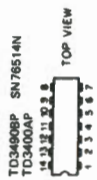


IC1: SN76514N, IC2: TD3400AP, IC3~5: TD3490BP, IC6: μ PB249D, Q1,3~7,9: 2SC460(B), Q2: 3SK22(GR), Q8,12~19: 2SA733(R), Q10,11,20: 2SC945(P, D1~8: 1S2588, D9~12,15,18~26: 1S1555, D13,14,17: SV-03, D16: BZ-220

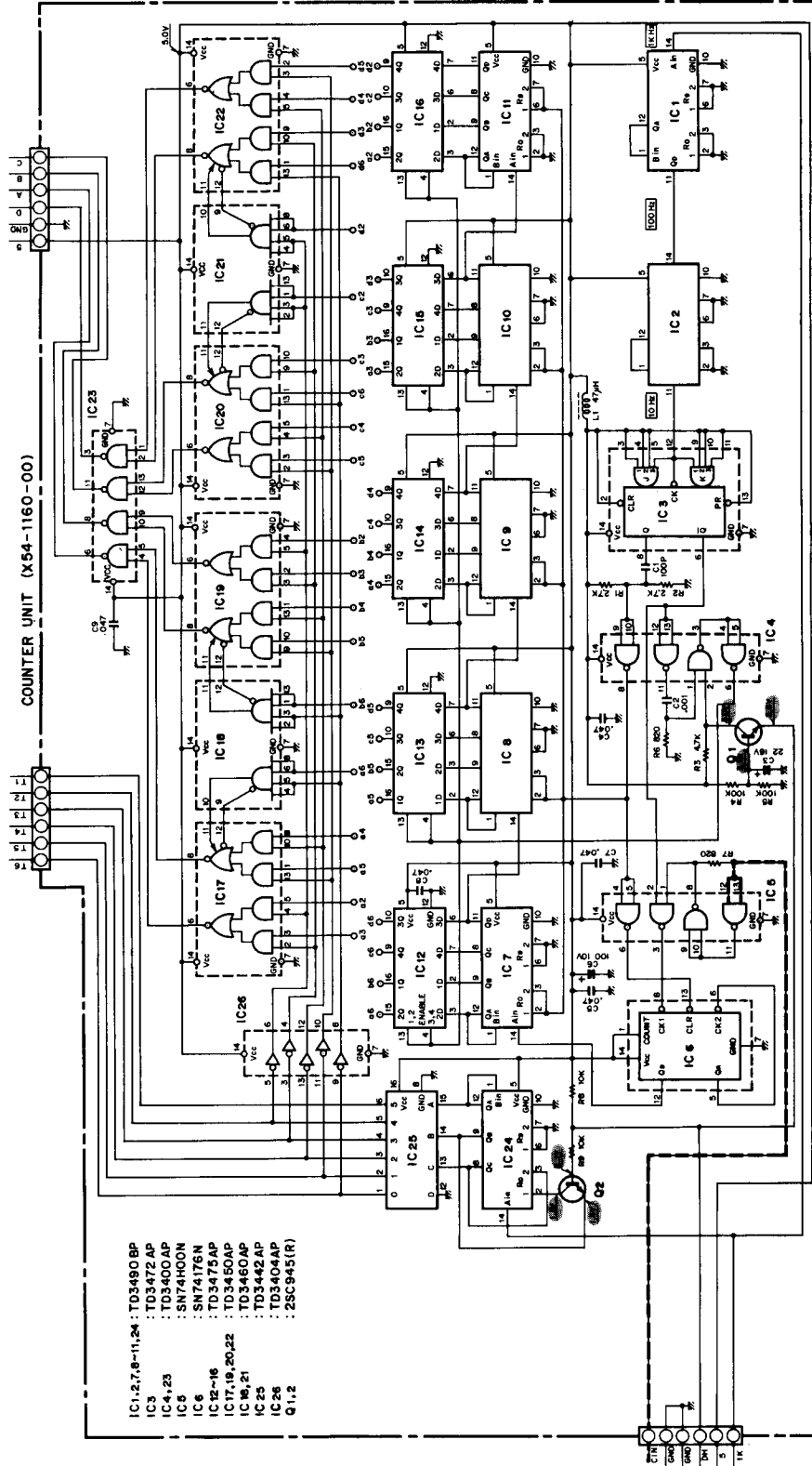
▼ COUNTER MIX (X54-1150-00)



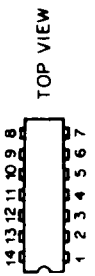
Q1,3~7,9: 2SC460(B), Q2: 3SK22(GR), Q8,12~19: 2SA733(R),
Q10,11,20: 2SC945(R), IC1: SN76514N, IC2: TD3400AP,
IC3~5: TD3490BP, IC6: μPB249D, D1~8: 1S2588, D9~12,15,
18~28: 1S1555, D13,14,17: SV-03, D16: BZ-220



▼ COUNTER (X54-1160-00)

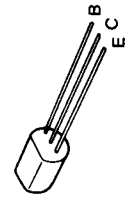


TD3400AP TD3460AP
TD3490BP TD3404AP
TD3472AP SN74HOON
TD3450AP SN74176N



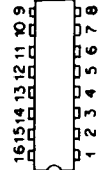
TOP VIEW

2SC945

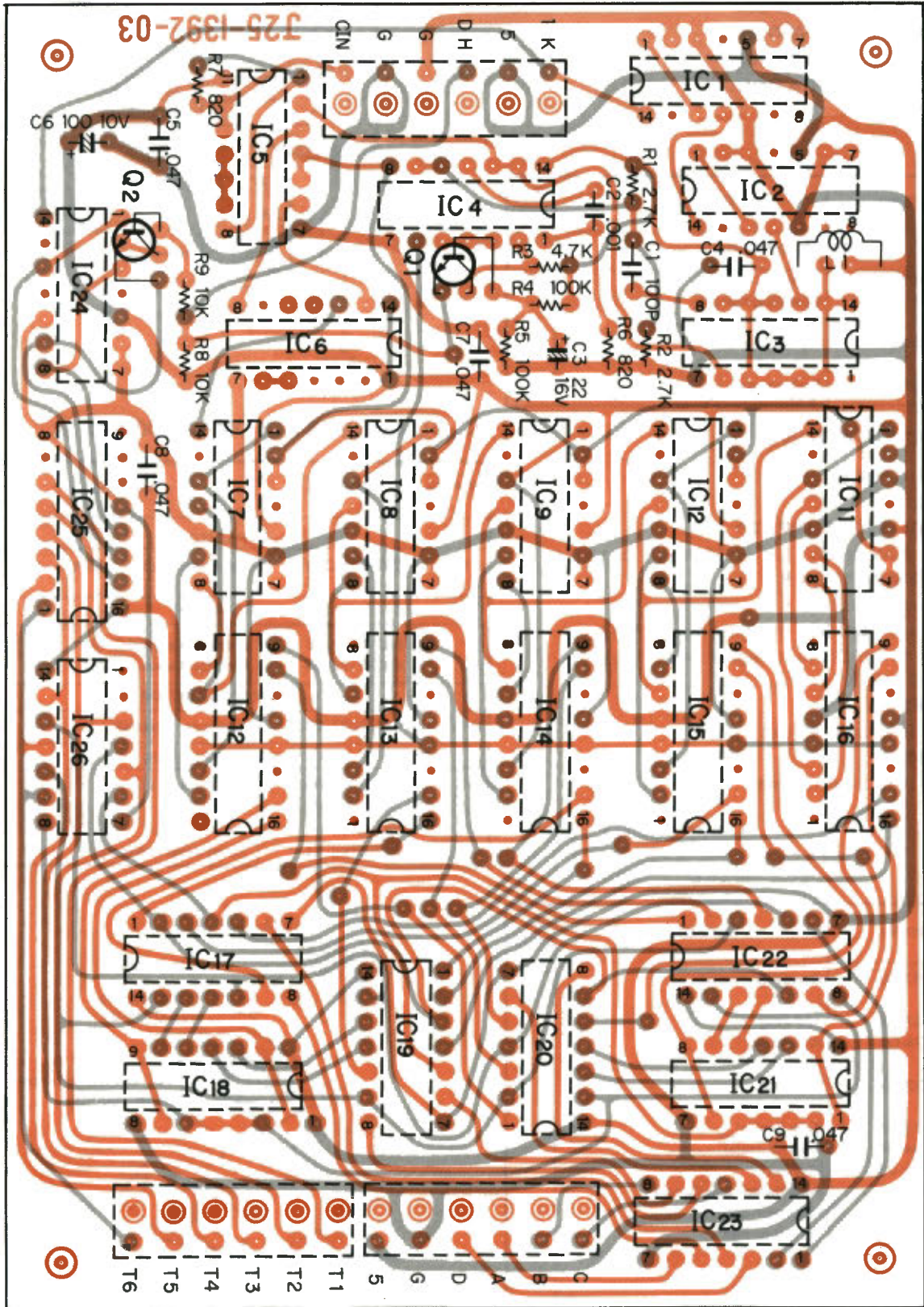


TOP VIEW

TD3475AP
TD3442AP



▼ COUNTER (X54-1160-00)



Q1,2: 2SC945(R), IC1,2,7~11,24: TD3490BP, IC3: TD3472AP, IC4,23: TD3400AP, IC5: SN74H00N, IC6: SN74176N
 IC12~16: TD3475AP, IC17,19,20,22: TD3450AP, IC18,21: TD3460AP, IC25: TD3442AP, IC26: TD-3404AP

YG-88C/DS-1

YG-88C SPECIFICATIONS

CENTER FREQUENCY:

8830.7 kHz

PASS BAND WIDTH:

Better than ± 250 Hz (-6 dB)

ATTENUATION BAND WIDTH:

Less than ± 900 Hz (-60 dB)

GUARANTEED ATTENUATION:

Better than 80 dB

YG-88C

Ref. No.	Parts No.	Description	Re- marks
MISCELLANEOUS			
—	B42-0664-04	Label	
—	B50-1556-00	Operating manual	
—	L71-0024-05	Crystal filter	
—	H01-0585-05	Packing case	

DS-1 SPECIFICATIONS

SEMICONDUCTORS

2N4049 (2)

RATED FINAL STAGE INPUT *

More than 90W at CW (1.8 ~ 28 MHz), DC13.8V

POWER CONSUMPTION *

15A (CW transmission)

0.6A (heater switch OFF in signal receive mode)

5A (heater switch ON in no-signal receive mode)

Note: AT DC13.8V

POWER SUPPLY

DC12-16V (standard: 13.8V)

DIMENSIONS

80 (W) × 51 (H) × 94 (D) mm

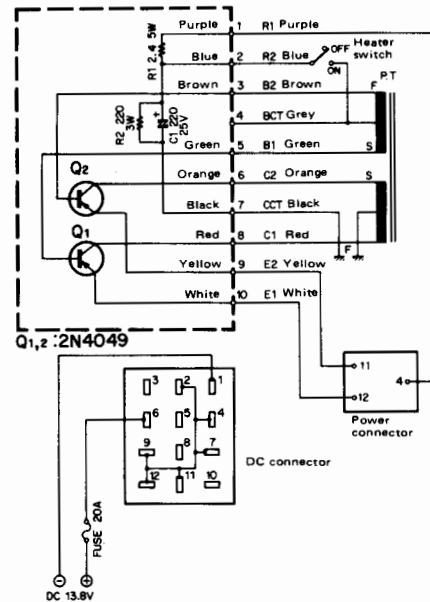
WEIGHT

300g

*TS-820 is used.

DS-1

Ref. No.	Parts No.	Description	Re- marks
—	B50-1567-00	Operating manual	
—	E08-1207-05	12P Plug	
—	E33-0074-00	Wire kit	
—	F05-2032-05	Fuse 20A	
—	H01-1617-03	Case (Inside)	
—	H03-0544-04	Case (Outside)	
—	H10-1001-03	Cushion	
—	H25-0029-04	Polyethylene bag (Small)	
—	H25-0103-04	Protection bag	
—	H25-0105-04	Protection bag	
—	J13-0037-05	Fuse holder	
—	J41-0024-15	Cord bushing	
—	J61-0014-05	Free up bolt	
—	X46-1000-00	DC-DC converter	



DC-DC CONVERTER (X46-1000-00)

Ref. No.	Parts No.	Description	Re- marks
CAPACITOR			
C1	CE02W1E221	Electrolytic 220 μ F 25WV	
RESISTOR			
R1	R92-0121-05	Resistor (Cement) 2.4 Ω 5W	
R2	R92-0120-05	Resistor (Cement) 220 Ω 2W	
SEMICONDUCTOR			
Q1,2	V11-0292-05	Transistor 2N4049	
MISCELLANEOUS			
—	E20-0513-05	5P terminal × 2	
—	F01-0170-14	Heat sink (A)	
—	F01-0171-04	Heat sink (B)	
—	F11-0195-14	Cover (Heat radiating)	

