



HF SSB TRANSCEIVER

Model TS-180S



INSTRUCTION MANUAL

NOTE

This manual covers equipment without the DF-180 memory unit. If your TS-180S has the memory unit, refer to the separate DF-180 manual for its operation. For equipment without the memory unit, the following switches cannot be used.

DSP/M1, (The Differential Display can be used.), M, M', M'', M. SHIFT (DOWN, UP).

AFTER UNPACKING

- **SHIPPING CONTAINER:** Save the boxes and packing in the event your unit needs to be transported for remote operation, maintenance or service.

- The following explicit definitions apply in this manual:

NOTE = If disregarded, inconvenience only may occur. There is no risk of equipment damage or personal injury.

CAUTION = Equipment damage may occur, but not personal injury.

Please read this instruction manual carefully BEFORE placing your transceiver in service.

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SPECIFICATIONS

GENERAL

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 29.70 MHz
	WWV	10.0 MHz (receive only)
AUX 2 BANDS	A:	2.0 to 15.0 MHz each 500 kHz band
	B:	18.0 to 18.5 MHz
	C:	25.0 to 25.5 MHz

Proviso: Following frequencies cannot be used.

- * IF frequency (8.830 MHz and its adjacent frequency)
- * VFO frequency (6.6 MHz ~ 6.1 MHz and its adjacent frequency)
- * IF frequency, VFO frequency harmonic and I/N frequencies.
N: an integral number

Mode	SSB (A3J), CW (A1), FSK (F1)
Voltage Requirements	11.0 V DC to 16.0 V DC (13.8 V DC nominal)
Power Consumption	
(at 13.8 VDC VSWR less than 1.5:1)	

	TS-180 (without D.F.C)	TS-180S (with D.F.C)
Receive	1.2 A	1.6 A
Transmit	19.6 A	20 A

Semiconductor Complement

	TS-180 (without D.F.C)	TS-180S (with D.F.C)
Transistors	145	179
FETS	21	26
ICS	33	53
Diodes	213	250
MPU	1	2

Dimensions (Projections not included)	325 (12-13/16") wide × 133 (5-1/4") high × 287 (11-5/16") deep
Weight	

TS-180 (without D.F.C)	TS-180S (with D.F.C)
11.0 kg (24.2 lbs)	11.5 kg (25.3 lbs)

TRANSMITTER SECTION

Input Power

	160 to 15 meters band	10 meters band
SSB	200 Watts PEP	160 Watts PEP
CW	160 Watts PEP	140 Watts DC
FSK	100 Watts DC	100 Watts DC

Antenna Impedance	50 Ohms
Carrier Suppression	Carrier better than 40 dB down from the output signal
Unwanted Sideband Suppression	Unwanted sideband is better than 50 dB down from the output signal
Harmonic Radiation	Better than 40 dB down from output signal (out of Amateur Band)
Spurious Radiation	Better than 50 dB down from output signal (in Amateur Band)
Microphone Impedance	500Ω to 50 kΩ
AF Response of Transmitter	400 to 2600 Hz

RECEIVER SECTION

Receiver Sensitivity	0.25μV S + N/N 10 dB or more
Image Rejection	Image frequency better than 60 dB down from the output signal
IF Rejection	IF frequency is 80 dB or more down from output signal
Frequency Stability	Within ± 1 kHz during the first hour after 1 minute of warmup Within 100 Hz during any 30 minute period after warmup
Receiver Selectivity	SSB, CW WIDE 2.4 kHz (-6 dB) 4.2 kHz (-60 dB) CW NAR, FSK (With optional filter YK-88C) 0.5 kHz (-6 dB) 1.5 kHz (-60 dB)
Audio Output	More than 2 watts (with less than 10% distortion) into a 4 ohm load.
AF Output Impedance	4 to 16 ohms (speaker or headphones)

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

SECTION 1 FEATURES

1. DFC (Digital Frequency Control), with four tunable memories.

- Memories are usable in transmit and/or receive modes. Split-frequency operation is possible with the TS-180S VFO and any one of the memories, with the TS-180S VFO and optional VFO-180 external VFO, and with a DFC memory and VFO-180.
- Memories can store frequencies from the TS-180S VFO, FIX CH, and VFO-180. Also, frequencies can be transferred between memories.
- Memory-shift paddle switches allow any of the memory frequencies to be tuned in 20-Hz steps up or down, slow or fast, with recall of the original stored frequency.

2. High-performance solid-state final stage.

- No dipping or loading. Just dial up the frequency, peak the drive, and operate.
- High power...200 W PEP/160 W DC input on 160~15 meters, and 160 W PEP/140 W DC on 10 meters.
- Highly reliable, with large heat sink.
- Final transistors (two SRF1714s, each with $P_c = 250$ W) are manufactured by Motorola to Kenwood's specifications.
- Double protection circuits. If the SWR is more than 3:1, transmit power is automatically reduced. Also, if the case temperature of the transmitter output transformer rises abnormally, transmit power is reduced.

3. Covers 160~10 meters, with provisions for WARC allocations.

- Transceives on 160, 80/75, 40, 20, 15, and all of 10 meters.
- Receives WWV on 10 MHz
- Adaptable, by installing additional parts, to three new bands, if they should be made available at the World Administrative Radio Conference. AUX 1 and AUX 2 as well as the WWV positions are provided on the BAND switch for this purpose.
- The TS-180S VFO covers more than 50 kHz above and below each band, for MARS and other applications, and will thus accommodate shifts and expansion of existing bands that might be made at WARC.

4. Built-in microprocessor-controlled large digital display.

- Shows actual operating frequency.
- Digital display of memory and of frequency difference. With the DSP/M switch turned on when the DSP/DIFF switch is depressed, the frequency

that was displayed is memorized and shown at the left side of the digital display, and the difference between the memorized frequency and the new frequency is shown at the right side, continuously changing as the main tuning is changed.

- Blinking decimal points indicate "out of band".
- Monoscale analog dial also provided.

5. Improved dynamic range, with optimum cross-modulation rejection.

- RF AGC, using a PIN diode between the antenna input and RF amplifier. Attenuating is accomplished by the mixer's AGC output, due to superior characteristics of forward bias current versus high-frequency resistance. Thus, the RF-amplifier bias voltage is set automatically for optimum cross-modulation rejection.
- RF attenuator, with fixed AGC voltage for about 20 dB of attenuation.

6. Single-conversion system with highly advanced PLL circuit.

- Uses only one crystal.
- Improved stability and spurious characteristics.

7. Easy-to-use MODE switch.

- Automatic selection of upper and lower sideband by the BAND switch. SSB NORMAL and REVERSE positions on MODE switch.
- CW NARROW and WIDE positions, allowing narrowband operation on CW with the optional YK-88C filter — a low-pass audio filter is inserted in the CW positions.
- FSK position for RTTY operation, providing a 170-Hz frequency shift.

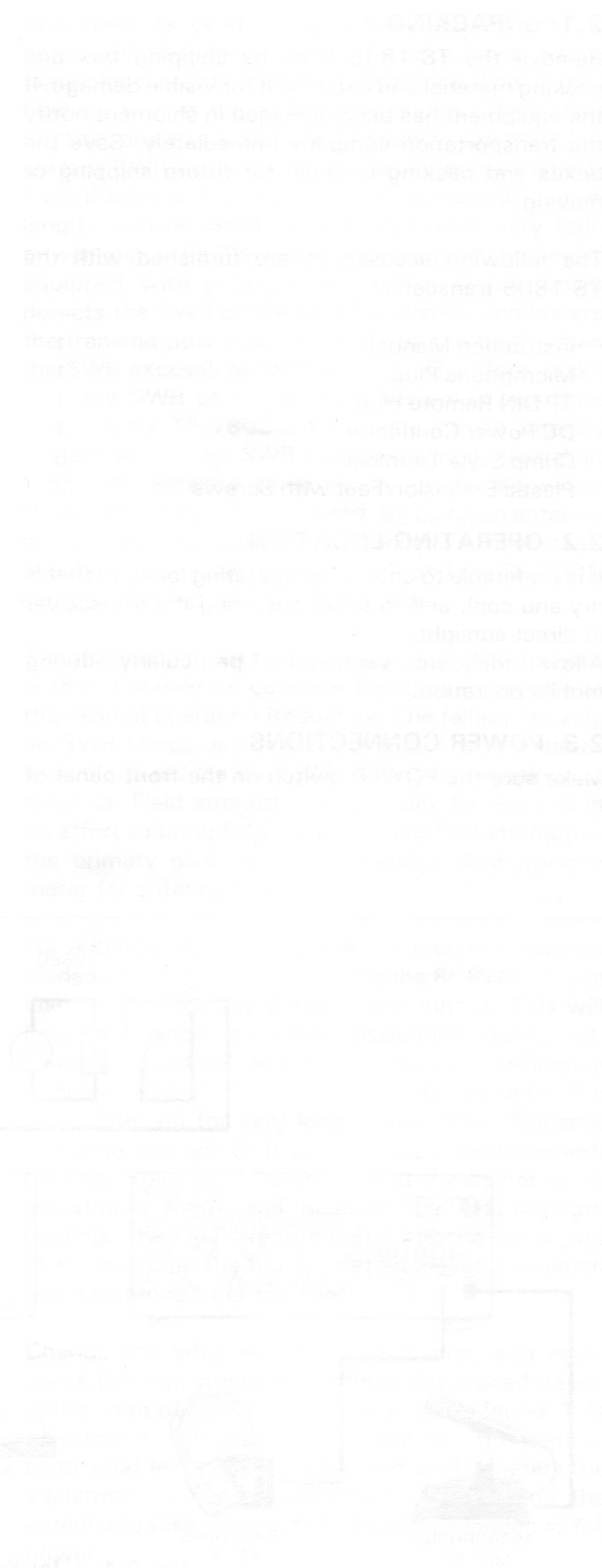
8. RF speech processor.

- Increases average audio level and average transmit power by maintaining constant IF amplifier output independent of the microphone output.
- Selectable SLOW and FAST time constants. SLOW (long) time constant provides more natural audio, whereas FAST (short) increases talk power.

9. Dual SSB IF crystal filter system

- Second filter (YK-88S) is optional. IF circuits are common for both transmission and reception.
- Improves signal-to-noise ratio and increases selectivity.
- Provides excellent audio compression when transmitting, while preventing sideband expansion (splatter).

10. Tunable noise blanker (adjusts noise-sampling frequency.)
11. Dual RIT (receiver incremental tuning). Operates on VFO and FIX/MEMORY positions, with separate concentric controls.
12. Variable-pitch CW sidetone (internal adjustment).
13. IF SHIFT moves passband away from interfering signals.
14. Fixed channel (for net and similar applications), when crystal is added. (User supplied).
15. Built-in VOX circuit.
 - Automatic transmission by voice. VOX GAIN and DELAY controls on front panel.
 - Semiautomatic keying on CW. Time constant automatically 1/2 shorter than on SSB.
16. Variety of rear-panel provisions:
 - IF OUT 1, IF OUT 2...for observing waveforms
 - XVTR terminal.....for transverters
 - ACSY terminal.....for linear amplifier and other optional accessories
 - EXT VFO terminal...for external VFO
 - RF ANT.....for a separate receive antenna
 - KEY terminal.....for CW key
 - RTTY terminal.....for radioteletype FSK operation
 - SP terminal.....for external speaker
 - ANTI VOX control...for antitrip of transmit from receiver audio during VOX operation
17. Full line of matching accessories.
 - PS-30 base-station power supply.
 - SP-180 external speaker with selectable audio-filters.
 - VFO-180 remote VFO
 - AT-180 antenna tuner/SWR and power meter/antenna switch
 - DF-180 Digital Frequency Control (if TS-180S is purchased without DFC)
 - YK-88C CW filter
 - YK-88S SSB filter



SECTION 2 INSTALLATION

2.1 UNPACKING

Remove the TS-180S from its shipping box and packing material and examine it for visible damage. If the equipment has been damaged in shipment notify the transportation company immediately. Save the boxes and packing material for future shipping or moving.

The following accessories are furnished with the TS-180S transceiver:

Instruction Manual	1
Microphone Plug	1
7P DIN Remote Plug	1
DC Power Connector	1
Crimp Style Terminal	6
Plastic Extension Feet with Screws	2

2.2 OPERATING LOCATION

It is preferable to choose an operating location that is dry and cool, and to avoid operating the transceiver in direct sunlight. Allow adequate ventilation, particularly during mobile operation.

2.3 POWER CONNECTIONS

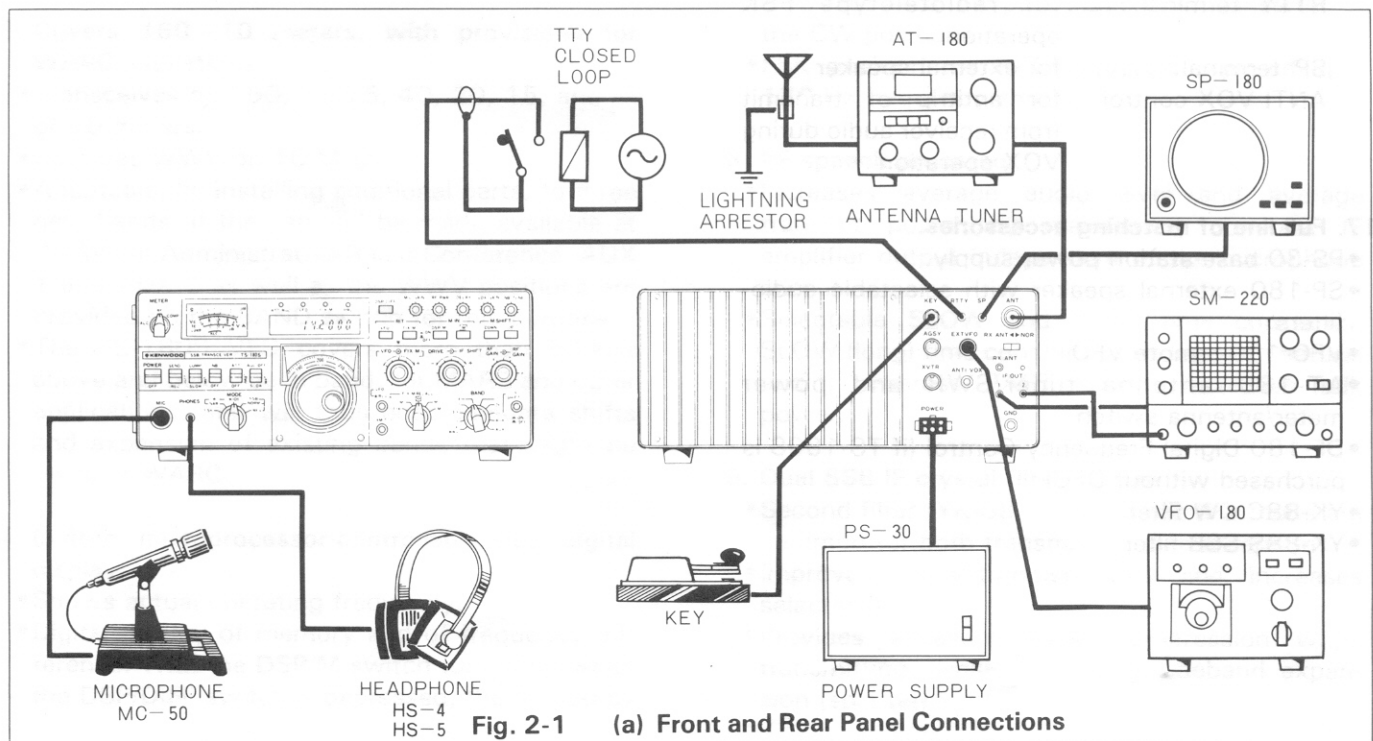
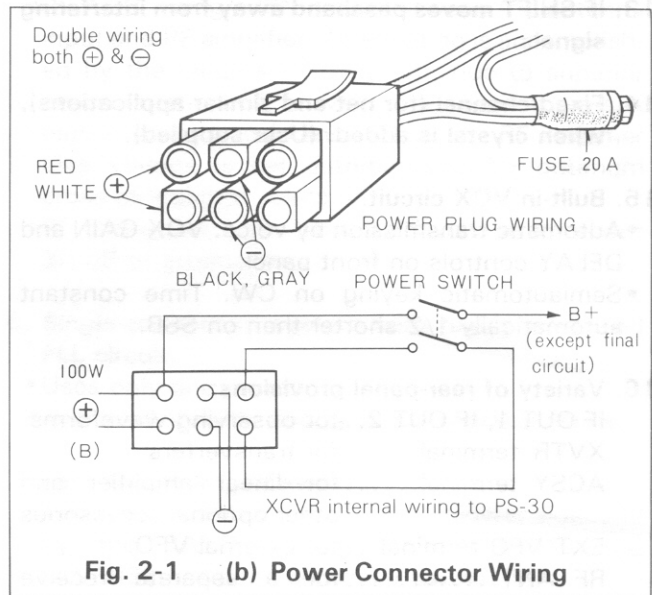
Make sure the POWER switch on the front panel of

the TS-180S is turned OFF, and the stand-by switch is in the REC position. Connect the POWER cord to an appropriate external power source such as the PS-30 or an automobile battery.

The rear panel power connector has a polarized mating receptacle.

See Figure 2-1 (b) for proper connections.

CAUTION: Be sure to wire the power connector exactly as shown to avoid damage to the transceiver. It is recommended that # 12 stranded wire be used



to wire the power connector directly to the vehicle battery, and that a fuse or circuit breaker rated at 20 amperes be installed in the positive supply line close to the battery.

2.4 ANTENNA

Fixed Station — Any of the common antenna systems designed for use on the high-frequency Amateur bands may be used with the TS-180S. The transmission line should be coaxial cable, and the antenna system should show a standing wave ratio of less than 1.5: 1 when using 50 ohm coaxial transmission line. If open wire or balanced transmission line is used, a suitable antenna tuner is recommended between the transceiver and the feed line. Construction and operating methods for such tuners are described in detail in the *ARRL Antenna Handbook*, and similar publications. For operation on the 75 and 40 meter bands, a simple dipole antenna, cut to resonance in the most used portion of the band, will perform satisfactorily. For operation in the 10, 15, and 20 meter bands, your stations efficiency will be greatly enhanced if a rotary beam antenna is used. Remember that even the most powerful transceiver is useless without a good antenna system.

If the antenna system SWR is too high, the result may be damage to the final transistors or deterioration of transmit signal quality. Make sure that the antenna system SWR is less than 1.5:1. If it cannot be reduced to less than 1.5:1, use of an antenna tuner (AT-180) is recommended.

Mobile Station — Mobile antenna installations are critical, since any mobile antenna for use on the high-frequency bands represents a number of compromises. Many Amateurs lose the efficiency of their antenna through improper tuning. Remember the following points when using the TS-180S with a mobile antenna.

The "Q" of the antenna loading coil should be as high as possible. There are several commercial models available which use high "Q" coils.

The loading coil must be capable of handling the power of the transceiver without overheating. In the CW mode the power output of the transceiver will exceed 100 watts.

The SWR bridge is a useful instrument, but unfortunately it is quite often misunderstood, and over-rated in importance. Basically, the SWR bridge will indicate how closely the antenna load impedance matches the transmission line. With long transmis-

sion lines, as used in many fixed-station installations, it is desirable to keep the impedance match fairly close in order to limit power loss. This is particularly true at the higher frequencies. The longer the line, and the higher the frequency, the more important SWR becomes. However, in mobile installations the transmission line seldom exceeds 20 feet in length, and an SWR of even 4:1 adds very little power loss. The TS-180S final stage is, however, equipped with a built-in protection circuit which detects the SWR of the antenna system and lowers the transmit power output to about one-tenth when the SWR exceeds more than 3 :1. Therefore, make sure the SWR of the antenna system is less than 1.5:1. If the TS-180S is to operate into an antenna system where the SWR cannot be made less than 1.5:1, an antenna tuner (such as the Kenwood Model AT-180) should be used. By using an antenna tuner, matching between the transceiver final stage and the antenna can be optimized, and the TS-180S can be operated safely at full power.

The really important factor with your mobile antenna is that it should be carefully tuned to resonance at the desired operating frequency. The fallacy in using an SWR bridge lies in the fact that it is sometimes possible to reduce the SWR reading by detuning the antenna. Field strength may actually be reduced in an effort to bring SWR down. Since field strength is the primary goal, we recommend a field-strength meter for antenna tuning.

For antenna adjustments, the transceiver should be loaded at minimum power, using the RF PWR control instead of operating at full power output. This will limit final-stage transistor dissipation during adjustments, and will also help to reduce interference to fellow operators. In any case, do not leave the transmitter on for very long at one time. Transmit just long enough to tune, and get a field-strength reading. Start with the antenna at the center of its adjustment range and observe the field-strength reading. The field-strength meter may be set on top of the dash, on the hood, or at an elevated location some distance from the car.

Change the whip length one-half inch, and again check the field strength. Continue this procedure until the point of maximum field strength is found. This adjustment will be most critical on 75 meters, somewhat less critical on 40, and on 10 meters the adjustment will be quite broad. After tuning the antenna to resonance, the finals can be loaded to full power.

2.5 MICROPHONE

Attach the microphone connector to a suitable microphone, as shown in Figure 2-2. Be sure the microphone PTT switch is separate from the microphone circuit, as shown in Figure 2-3. It should be noted that a microphone with a 3P plug using a common ground terminal should not be used.

The microphone input is designed for 500 to 50 kohm microphones. The choice of microphone is important for good speech quality, and should be given serious consideration. The crystal lattice filter in the transceiver provides all the restriction necessary on audio response, and further restriction in the microphone is not required. It is more important to have a microphone with a smooth, flat response throughout the speech range.

Follow the microphone manufacturer's instructions for connecting the microphone cable to the plug. With many microphones, the push-to-talk button must be pressed to make microphone audio available. For VOX operation, this unwanted feature may be eliminated, if desired, by opening the microphone case and permanently connecting the contacts which control the microphone audio.

2.6 KEY

If CW operation is desired, connect a key to the KEY jack. Use shielded cable, and a standard (mono or 2P) phone plug.

2.7 EXTERNAL SPEAKER AND HEADPHONES

Receive audio output from the TS-180S is 1.5 watts at 4 to 16 ohms. The TS-180S has a built-in speaker. An external speaker may be connected to the SPEAKER jack on the rear panel. The speaker may be an 8-ohm permanent-magnet type, 4 inches or larger. The internal speaker is disconnected when an external speaker is used. Headphones should also be 4 to 16 ohms impedance. When the headphones are connected to the front-panel PHONES jack, the speaker is disabled.

2.9 GROUND

To prevent electric shock, and reduce the possibility of TVI and BCI, connect the transceiver to a good earth ground through as short and heavy a lead as possible.

2.8 RTTY (FSK)

For RTTY operation, connect a teletypewriter to the RTTY KEY jack on the rear panel of the transceiver.

Since this jack is connected to a low-voltage switching circuit, a relay should be inserted in the teletypewriter closed loop for keying operation.

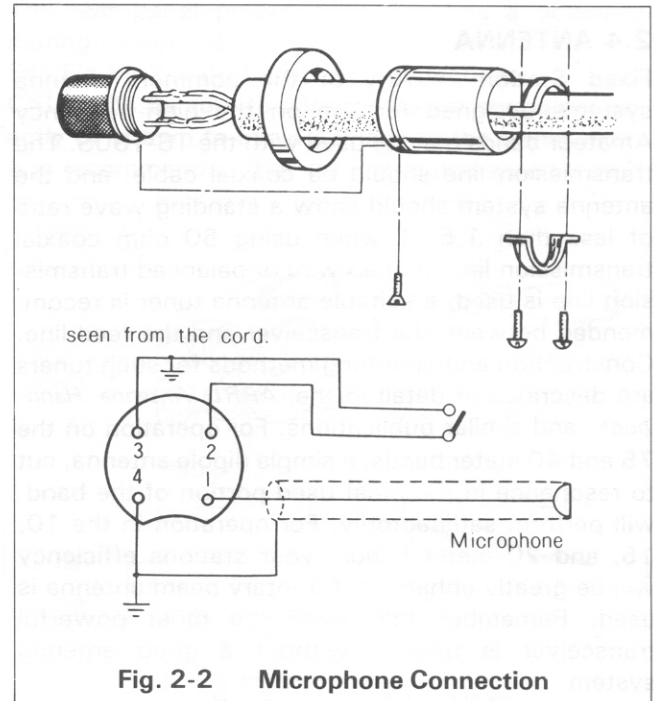


Fig. 2-2 Microphone Connection

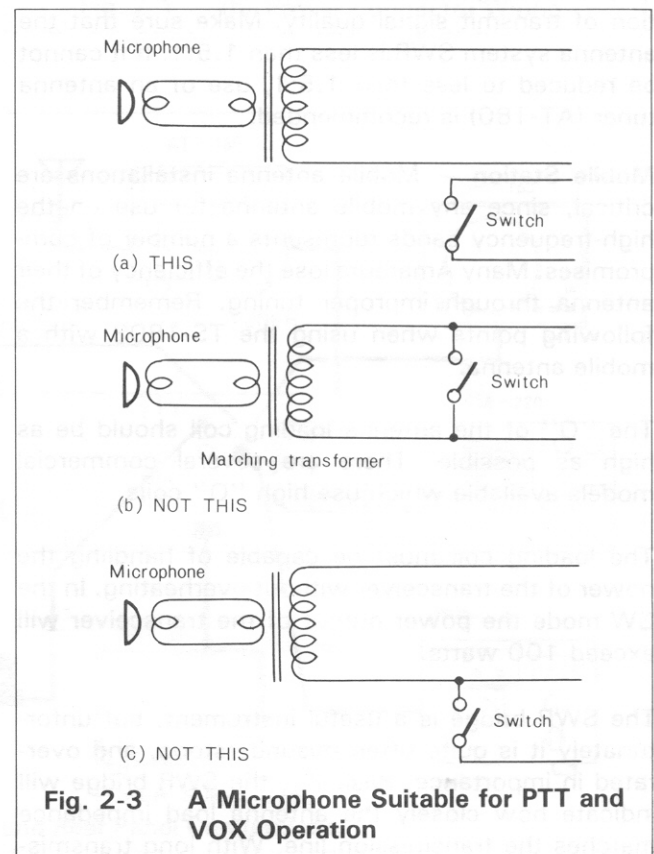


Fig. 2-3 A Microphone Suitable for PTT and VOX Operation

SECTION 3 CONTROLS AND THEIR FUNCTION

3.1 FRONT PANEL CONTROLS

1 METER

The meter monitors six different functions, depending on METER switch position. In receive the meter is automatically an S-meter, and shows received signal strength on a scale of 0 to 40 dB over S9. In transmit, meter function depends on the switch position, as described below.

2 METER SWITCH

This determines the transmit meter function:

- ALC:** (Automatic Level Control) - This position monitors internal ALC voltage, or the ALC voltage feedback from a linear amplifier operated with the TS-180S. For SSB operation the ALC reading for voice peaks should be within the ALC range. Reducing the RF Power control INCREASES the ALC reading. (This functions similarly to the RF Gain control.)
- IC:** (Collector Current) - This monitors the final transistor collector current. The meter scale is calibrated from 0 to 20A.
Note: Final transistor IC collector current should be read on the 0 — 20 A scale.
- RF:** (Output Power) - This monitors the relative output power. (No separate scale is provided for this position.)
- COMP:** This indicates speech processor compression level. Always operate within the 15-dB range, for both Fast and Slow Compression. (30 dB range with optional 2nd SSB filter installed.)
- VC:** This monitors the power-supply voltage. The meter scale is calibrated from 0 to 20 VDC.

3 RGC/ATT INDICATOR (RF AGC/ATTENUATOR)

This LED (light emitting diode) is illuminated when the RF ATT switch is turned ON, or when the RF AGC circuit is operating. (Operation is automatic, and only when needed.)

4 VFO INDICATOR

This LED illuminates when the internal VFO controls the transceiver's operation. The indicator is not lighted during MEMORY, FIX channel, or remote VFO operation.

5 FIX/M INDICATOR

This LED illuminates when the FIX or memory circuit is ON.

6 PRO INDICATOR

This LED lights when either protection circuit is ON.

7 RIT INDICATOR

These LEDs illuminate when the RIT circuit (VFO or MEMORY) is ON, showing that transmit and receive frequencies may be different.

8 ANALOG DIAL SCALE

The mono-scale permits direct analog frequency readout over the 0 to 500 kHz range, graduated at 1-kHz intervals. Operating frequency equals the dial (in kHz) plus the BAND switch frequency (in MHz) An additional 50 kHz both above and below the 500 kHz range is also covered.

9 DIAL CALIBRATE KNOB

Use this knob to calibrate the dial scale reading. It should not be used for tuning.

10 MAIN TUNING KNOB

This controls the VFO, selecting the transceiver's operating frequency. The indented knob is convenient for quick tuning.

11 STAND-BY SWITCH

This three-position lever switch selects:

- REC:** The transceiver is receiving unless the microphone PTT switch is keyed to transmit.
- VOX:** In this position, the VOX circuit is turned on for Voice Operated Transmit in SSB, or semi-automatic break-in operation in CW.
- SEND:** The TS-180S is locked into the transmit mode in this switch position.

12 COMP SWITCH

This switch is used to select speech processor time constants; SLOW or FAST.

13 NB SWITCH

With the lever switch UP, the noise-blanker circuit is turned ON, reducing pulse-type noise.

14 RGC/ATT SWITCH (RF AGC/ATTENUATOR)

With the switch set to ATT, a 20-dB attenuator is inserted in the antenna circuit, protecting the RF amplifier and mixer from input overload on strong signals. The RF AGC function is a valuable and unique feature of the TS-180S. It prevents front-end overload (a problem contingent to many transceivers). When the RF AGC is activated by an adjacent-channel signal, the S-meter reading for the

SECTION 3 CONTROLS AND THEIR FUNCTION

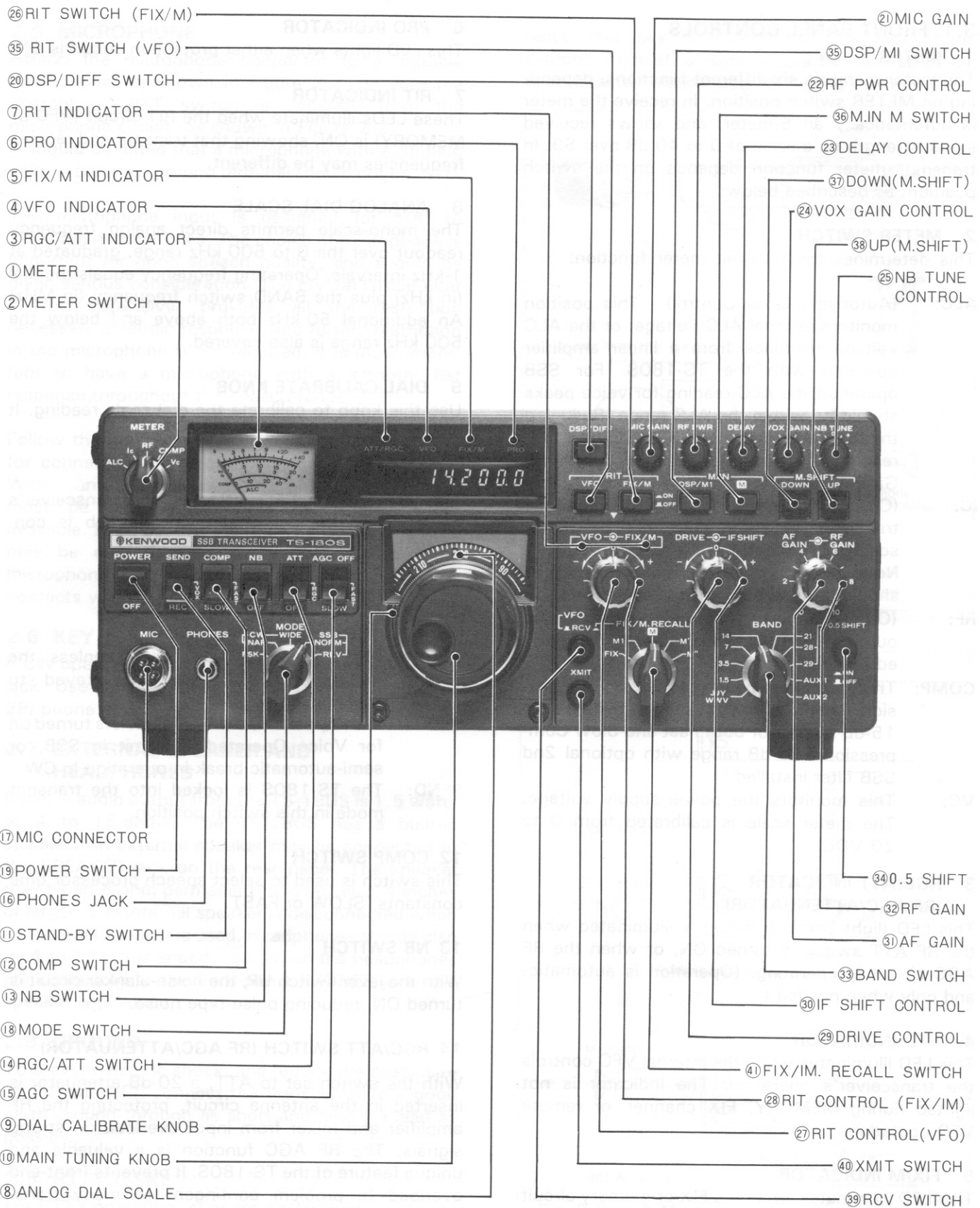


Fig. 3-1 Front Panel View

in-channel signal will be reduced.

15 AGC SWITCH

This controls the AGC (Automatic Gain Control) circuit:

- OFF:** AGC disabled (no AGC).
- FAST:** Normally used for CW operation.
- SLOW:** Normally used for SSB operation.

16 PHONES JACK

The headphones jack allows use of a 4 to 16 ohm headphone through a 1/4" phone plug. When phones are used the speaker is disconnected.

17 MIC CONNECTOR

The four pin connector allows use of a PTT microphone. Figure 2-2 shows plug wiring.

18 MODE SWITCH

The MODE switch selects type of emission.

- CW:** Used for CW operation. A high-cut filter is inserted in the receiver audio circuit to reduce unwanted noise.
NAR — (NARROW) optional CW filter YK-88C selected.
WIDE — SSB filter selected for WIDE receive bandwidth.

SSB NORM:

Used for SSB operation. The 14, 21 and 28 MHz bands are automatically switched to USB, and the 3.5 and 7 MHz bands to LSB

SSB REV:

For reversed mode SSB operation.

- FSK:** For narrow-shift RTTY operation with a teletypewriter.

19 POWER SWITCH

Controls power ON and OFF to the TS-180S.

20 DSP/DIFF SWITCH

Depress this momentary (non-locking) switch for the DISPLAY/MEMORY function.

21 MIC GAIN

This adjusts MIC amplifier gain during SSB operation. Adjust to prevent meter deflection beyond the 15-dB indication on the COMP scale.

22 RF PWR CONTROL

This controls transmit power continuously between approximately 10 W and full output.

Note: This control functions in ALL modes.

23 DELAY CONTROL

The DELAY control adjusts the hold time for VOX or break-in CW operation. Adjust for individual preference.

24 VOX GAIN CONTROL

This controls sensitivity of the VOX (Voice Operated Transmit) circuit.

25 NB TUNE CONTROL

This controls tuning of the NB circuit input within the receiver IF bandpass from the Mixer output.

26 RIT SWITCHES (VFO AND FIX/M)

These push switches activate the RIT (Receiver Incremental Tuning) circuit. The RIT indicators illuminate when the appropriate RIT is ON. By adjusting the RIT controls, the VFO receive frequency can be varied ± 2 kHz, and the fixed-channel and Memory frequency by ± 1.5 kHz, without changing the transmit frequency.

27, 28 RIT CONTROLS

VFO (inner), FIX/M (outer)

These are used to change receive frequency when the RIT is ON. The center (0) position equals no shift.

29 DRIVE CONTROL

The DRIVE Tuning control resonates the receiver's antenna and mixer coils, and is tuned for maximum sensitivity (maximum S-meter deflection). In transmit the DRIVE control is adjusted for a maximum RF reading. When correctly tuned for transmission it will also be correctly tuned for reception.

30 IF SHIFT CONTROL

During reception, the center frequency of the IF crystal filter can be shifted ± 1.7 kHz facilitating adjustment of tone quality, or eliminating interference from nearby frequencies. For normal operation, set to the center detent position (click stop).

31 AF GAIN

This adjusts receiver audio level. Volume increases clockwise.

32 RF GAIN

This adjusts receiver RF amplifier gain. Turn fully clockwise for maximum gain and a correct S-meter reading.

33 BAND SWITCH

This continuous rotary switch selects all circuits to place the transceiver on the desired band.

34 0.5 SHIFT

For 28 and 29-MHz operation, this selects a 0.5-MHz (500-kHz) shift for 28.5 and 29.5-MHz coverage.

35 DSP/M1 SWITCH

This momentary switch will display the memory if the DSP/DIFF button is depressed.

Notes.

1. The M1 memory is available only to the TS-180S with DFC.
2. The following switches (36 through 41) are operative only for the TS-180S with DFC.

36 M. IN M SWITCH

This locking switch is used to memorize frequencies in the M, M' and/or M'' position of the FIX/M RECALL switch.

When a frequency is memorized, (when the **M** switch is depressed) a short tone sounds to indicate data entry.

37 DOWN (M. SHIFT)

This switch is used to change a memory frequency downward. When used along with the UP switch, fast-forwarding downward is available.

38 UP (M. SHIFT)

This switch is used to change a memory frequency upward. When used along with the DOWN switch, fast-forwarding downward is available.

39 RCV SWITCH

This switch should be turned ON when receiving on a memory or FIX channel frequency.

40 XMIT SWITCH

This switch should be turned ON when transmitting on a memory or FIX channel or frequency.

41 FIX/M. RECALL SWITCH

This switch is used when recalling a memory or FIX channel. The appropriate RCV or XMIT switch should also be used to receive or transmit.

3.2 REAR PANEL CONTROLS AND CONNECTORS

1 POWER-SUPPLY CONNECTOR

This six-pin connector supplies DC POWER to the transceiver.

2 XVERTER

This DIN connector is used to interface a VHF transverter. (See Fig. 5-4.)

PIN	FUNCTION	PIN	FUNCTION
1	Ground	5	Transverter in
2	Relay Voltage (+ on transmit)	6	Transverter ALC input
3	Ground	7	Transverter out
4	+ 13.8V (Relay control)	8	HF ANT output

3 ACSY CONNECTOR (FOR OPTIONAL EXTERNAL ACCESSORIES)

The ACSY connector is used to interconnect a linear amplifier or other accessory item. (See Fig. 5-3)

PIN	FUNCTION	PIN	FUNCTION
1	REC. out	5	Normally closed relay contact
2	Relay common terminal	6	ALC-feedback ALC threshold level approx. -6 V
3	STBY control	7	Ground
4	Normally opened relay contact		

4 CW KEY JACK

Using shielded line, connect a key to this 1/4" phone jack for CW operation. Key-opened terminal voltage is approximately +4.5 V.

5 RTTY KEY JACK

For FSK operation use a 1/8 inch plug and an isolation relay connected to the teletypewriter switching circuit.

6 SPEAKER JACK

Receiver audio output can be connected through this jack to an external 4 to 16 ohm speaker. The internal speaker is disconnected when an external speaker is connected.

7 ANTENNA CONNECTOR

This SO-239 coax connector should be attached to a suitable 50Ω antenna for transmitting and receiving.

8 EXTERNAL VFO CONNECTOR

This DIN connector is used to interface the KENWOOD VFO-180 external VFO. The interconnecting cable is provided with the VFO-180.

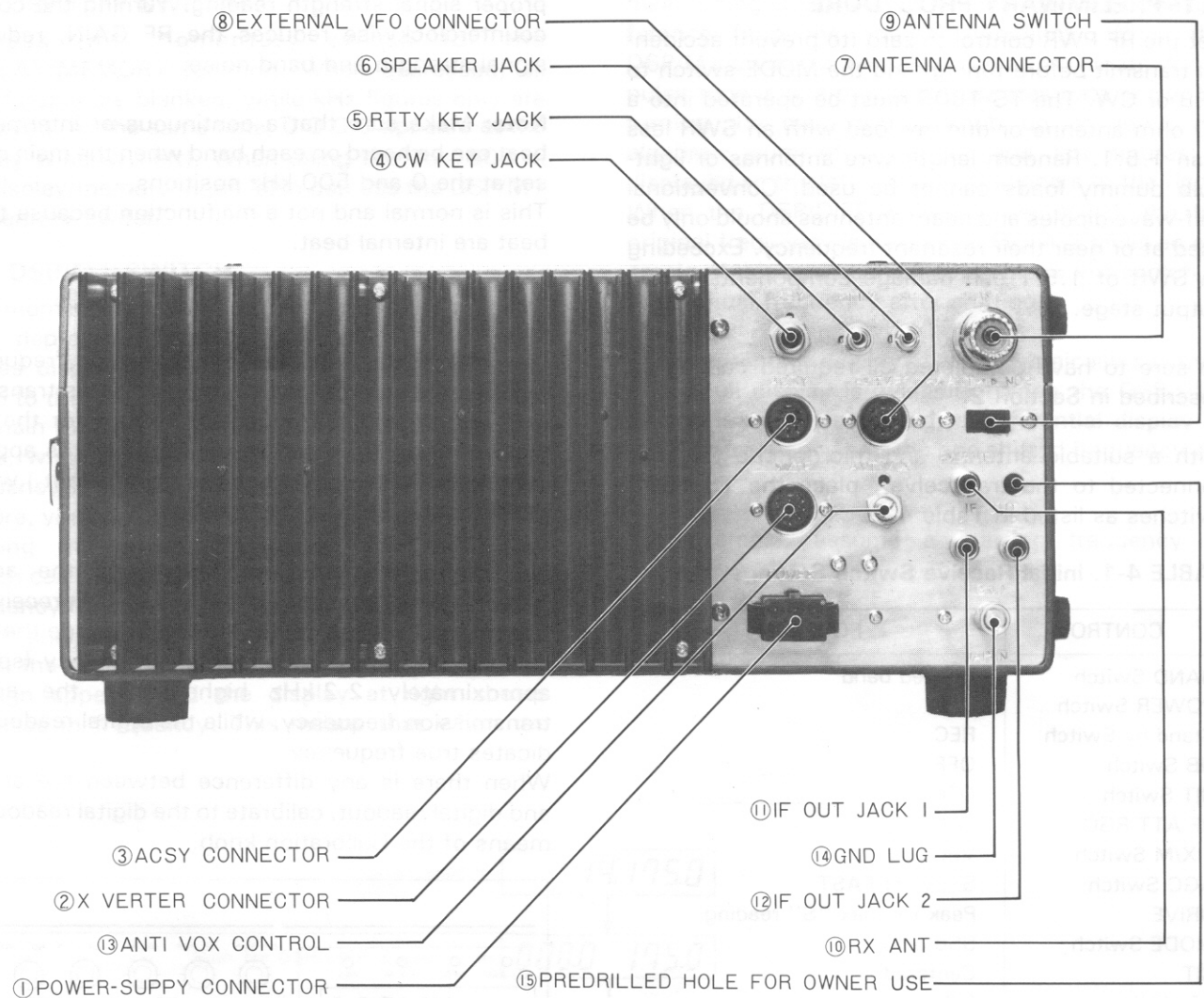


Fig. 3-2 Rear-Panel View

PIN	FUNCTION	PIN	FUNCTION
1	VFO signal	5	VFO control
2	Relay voltage (+ on transmit)	6	No connection
3	+ 8V	7	Ground
4	No connection	8	+ 14V

9 ANTENNA SWITCH

This switch remains in the NOR position when using a single antenna for receiving and transmitting. Place the switch in the RX ANT position when separate receive and transmit antennas are used.

10 RX ANT

Use this RCA phono jack to connect a receiving antenna when separate transmit and receive antennas are used.

11,12 IF OUT JACK 1, 2

IF OUT 1: A Buffered Mixer output for pan display use. This is a wide-band, low-level IF signal.

IF OUT 2: A high-level, narrow-band IF output, taken before the RX Produce Detector, for scope display of received signal waveform.

13 ANTI VOX CONTROL (ON THE REAR PANEL)

Adjust the control to prevent speaker output from tripping the VOX.

14 GND (GROUND) LUG

To prevent electric shock, as well as RFI and BCI, connect the transceiver to a good earth ground.

15 PREDRILLED HOLE

For owner installed switch or input/output connector.

SECTION 4 OPERATION

4.1 PRELIMINARY PROCEDURE

Set the RF PWR control to zero (to prevent accidental transmit before tuning) and the MODE switch to SSB or CW. The TS-180S must be operated into a 50 ohm antenna or dummy load with an SWR less than 1.5:1. Random length wire antennas or light-bulb dummy loads cannot be used. Conventional half-wave dipoles and beam antennas should only be used at or near their resonant frequency. Exceeding an SWR of 1.5:1 can damage components in the output stage.

Be sure to have completed all required cabling as described in Section 2.

With a suitable antenna and microphone (or key) connected to the transceiver, place the TS-180S switches as listed in Table 4-1.

TABLE 4-1. Initial Receive Switch Settings

CONTROL	POSITION
BAND Switch	Desired band
POWER Switch	OFF
Stand-by Switch	REC
NB Switch	OFF
RIT Switch	OFF
RF ATT/RGC	OFF
FIX/M Switch	VFO
AGC Switch	SLOW or FAST
DRIVE	Peak for max "S" reading
MODE Switch	SSB or CW
RIT	Centered
AF GAIN	fully counterclockwise
IF SHIFT	Centered
RF gain	fully clockwise

The remaining controls do not affect reception and may be in any position.

4.2 RECEIVER TUNING

Turn the POWER switch on. The meter, dial scale, and VFO indicator will light indicating the transceiver is operating. The transceiver is full solid-state allowing immediate reception. Advance the AF GAIN control clockwise until some receiver noise is heard in the speaker. Adjust the main tuning until a signal is heard. Tune for the clearest possible reception, and then adjust the DRIVE control for maximum deflection of the S-meter.

The RF GAIN control varies the AGC feedback voltage which effects the S-meter reading. With the RF GAIN control fully clockwise, the S-meter gives a

proper signal strength reading. Turning the control counterclockwise reduces the RF GAIN, reducing signal strength and band noise.

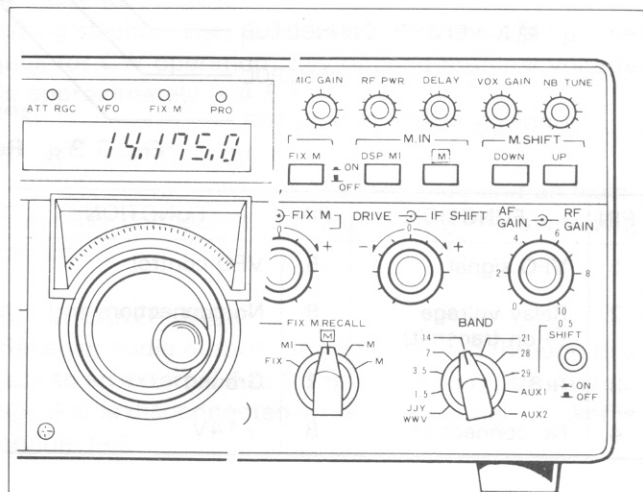
Note: Make sure that a continuous or intermittent beat can be heard on each band when the main dial is set at the 0 and 500 kHz positions. This is normal and not a malfunction because these beat are internal beat.

4.3 READING THE OPERATING FREQUENCY

The dial scale indicates exact carrier frequency regardless of mode, and directly indicates transmission and reception frequencies except for the CW receive mode (in which actual frequency is approximately 800 Hz higher than the dial readout,) which indicates the BFO frequency.

The digital frequency readout gives the actual transmission frequency. In the CW MODE, receive to transmit shift is indicated. In the FSK mode the tuning dial indicates a transmission frequency (space) approximately 2.2 kHz higher than the actual transmission frequency, while the digital readout indicates true frequency.

When there is any difference between the analog and digital readout, calibrate to the digital readout by means of the Calibration knob.



Dial Reading 175kHz
 The operating frequency of the transceiver is the sum of the band frequency and dial reading frequency.
 Example: Band switch 14MHz
 Operating Frequency: 14,000 + 175 = 14,175kHz

Fig. 4-1 Reading the Operating Frequency

4.4 DSP/DIFF SWITCH

Depress this momentary switch for the DISPLAY/MEMORY function. When depressed, all MHz figures are blanked, while kHz figures only are displayed. At the same time, 0 0 0 0 appears at the display window (left). When using the TS-180S in the display/memory mode, also depress the DSP/M1 momentary switch.

4.5 DSP/M1 SWITCH

This momentary switch is used to display memory after depressing the DSP/DIFF button. The kHz figures displayed at the right side of the window move to the left, and 0 0 appears at the right. When the main tuning is turned clockwise, the left display holds, while the right display figures rise. The first frequency is now memorized at the left. With this feature, you can change frequency up or down while keeping the original frequency displayed. This switch can also be used to memorize or hold the first frequency for later return. You can read how far from the original frequency you have shifted up or down. When the main tuning is turned counter-clockwise a - sign appears and the display at right shows decrease in frequency. This means that when the

main tuning is adjusted you can always read the difference from the original frequency. When the DSP/M1 switch is depressed an approximate 3 kHz pulse tone is heard, which indicates data entry. By turning the main tuning knob up or down, an algebraic sum of the right and left figures is displayed to the left, while 0 0 appears to the right. When the DSP/DIFF switch is depressed, the full original frequency is displayed. Fig. 4-2 gives an example of this operation. Also, depress this switch to read actual frequency after shifting.

The frequencies displayed are algebraically summed and a full display is available. When the DSP/DIFF switch is again depressed, a differential display of the first frequency and the one shifted frequency appears.

For example, assume a starting frequency of 14.175.0 MHz.

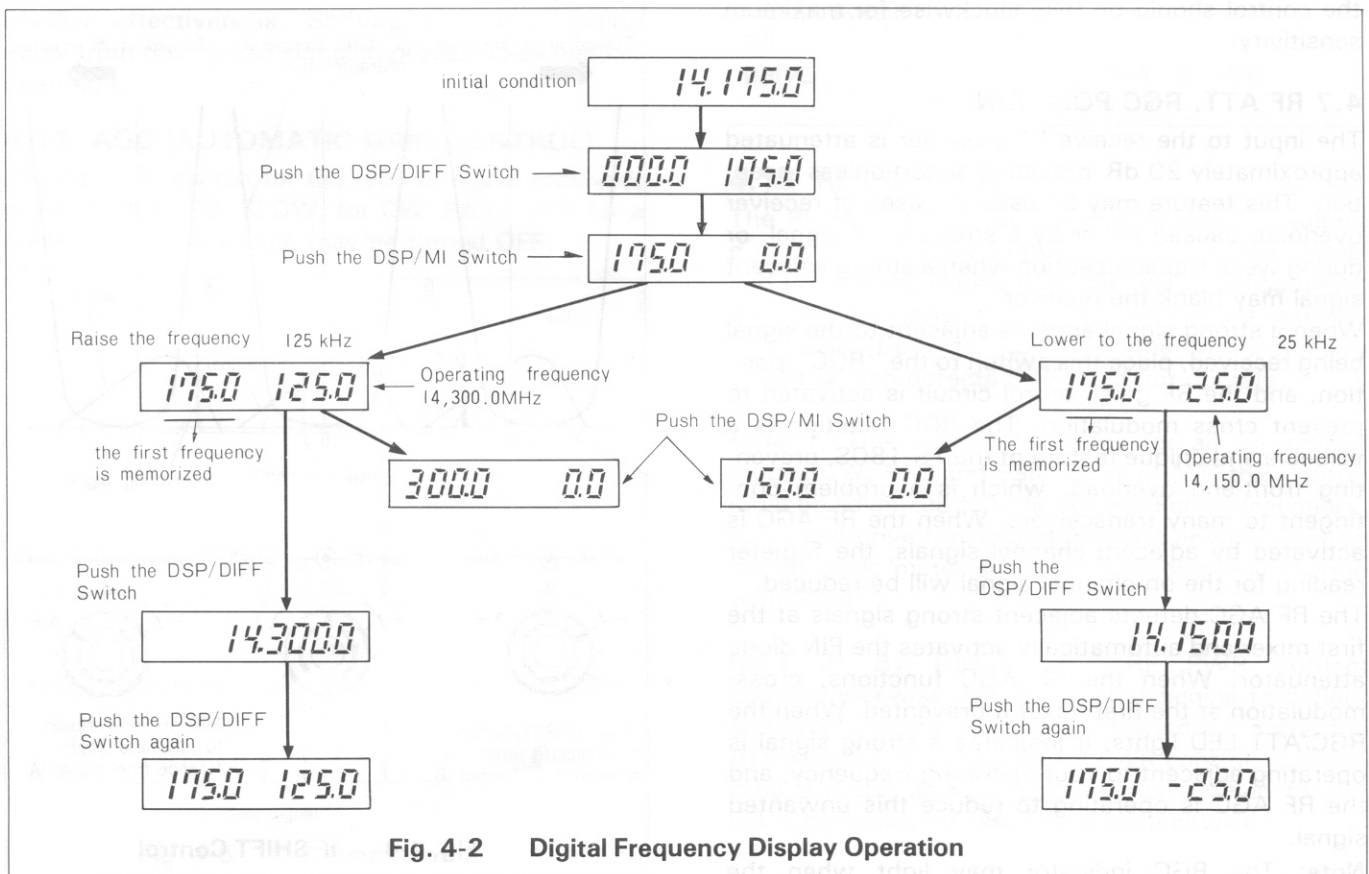
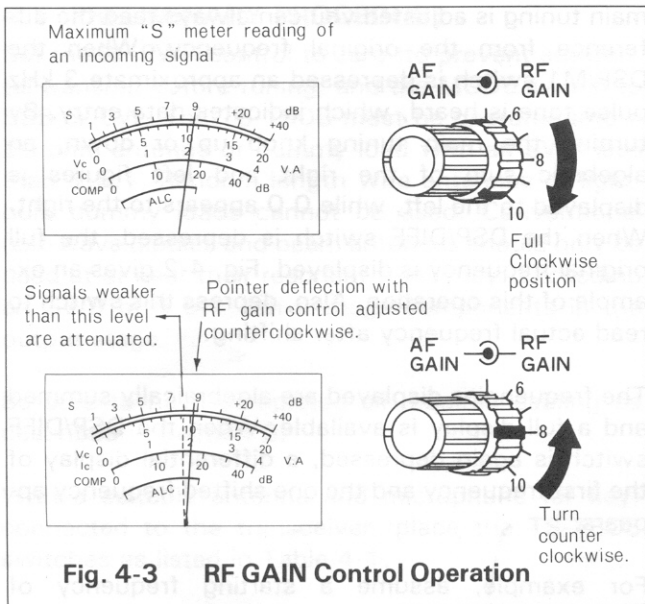


Fig. 4-2 Digital Frequency Display Operation



4.6 RF GAIN

RF GAIN is controlled by changing the AGC circuit voltage. Adjust the RF GAIN control so the S-meter does not deflect excessively. This minimizes noise during reception and still allows the S-meter to indicate correct signal strength. For normal operation, the control should be fully clockwise for maximum sensitivity.

4.7 RF ATT. RGC POSITION

The input to the receive RF amplifier is attenuated approximately 20 dB, providing distortionless reception. This feature may be used in cases of receiver overload, caused either by a strong local signal, or during weak signal reception when a strong adjacent signal may blank the receiver.

When a strong signal appears adjacent to the signal being received, place this switch to the "RGC" position, and the RF gain control circuit is activated to prevent cross modulation. The RGC function is a valuable and unique feature of the TS-180S, preventing front-end overload, which is a problem contingent to many transceivers. When the RF AGC is activated by adjacent-channel signals, the S-meter reading for the on-channel signal will be reduced. The RF AGC detects adjacent strong signals at the first mixer and automatically activates the PIN diode attenuator. When the RF AGC functions, cross-modulation at the first mixer is prevented. When the RGC/ATT LED lights, it indicates a strong signal is operating adjacent to your operating frequency, and the RF AGC is operating to reduce this unwanted signal.

Note: The RGC indicator may light when the

transceiver switches from transmit to receive. This is normal and not a malfunction.

4.8 RIT

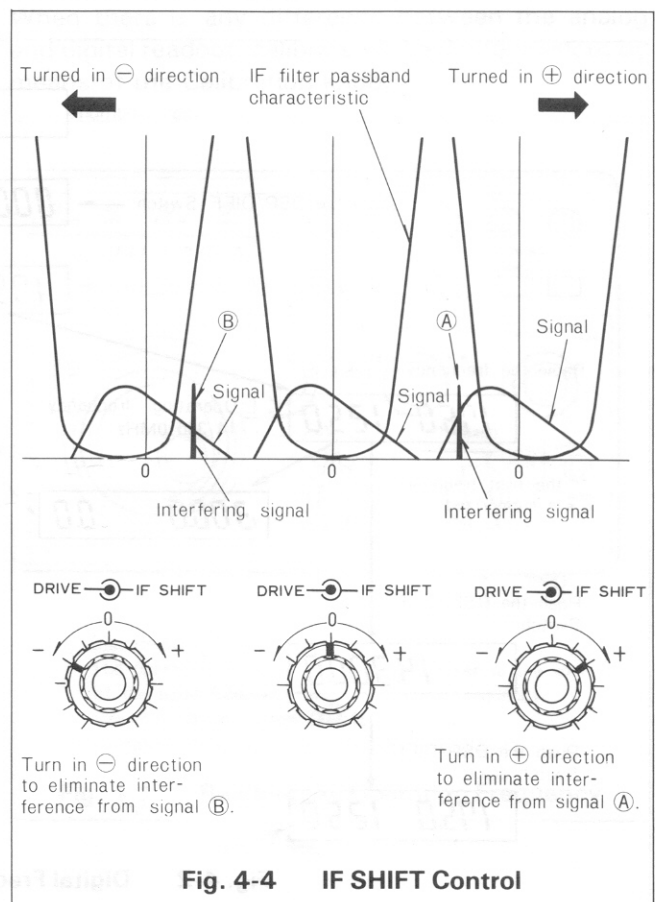
Using the RIT control, the VFO and FIX/M receive frequency can be shifted approximately ± 2 kHz, or the fixed channel frequency by about ± 1.5 kHz, without changing the transmit frequency. The RIT switches activate both the LED indicators and the RIT controls.

4.9 IF SHIFT

By using the IF SHIFT during reception, the crystal-filter passband frequency can be shifted approximately ± 1.7 kHz. This is achieved by use of a PLL (Phase-Locked Loop) in the L.O. (local oscillator) circuit. This is a major feature of the TS-180S and can be used in the following cases:

1. Adjustment of tone quality and interference rejection during SSB Reception.

When the transceiver is on 20 meters and above, Normal SSB mode, turn the IF SHIFT in the "+" direction and the lower frequencies are attenuated. Turning the knob in the "-" direction



tion cuts the higher frequencies. (These procedures are reversed for Normal SSB operation below 20 meters.) Adjust the control to your listening preference. The IF SHIFT is also effective in eliminating interference from adjacent receive signals.

2. Adjustment of tone quality during CW operation.

For detailed descriptions, refer to Section 4.15 "CW operation".

3. FSK (RTTY) operation at 170-Hz shift.

For detailed description, refer to Section 4.17 "RTTY operation".

4.10 NOISE BLANKER

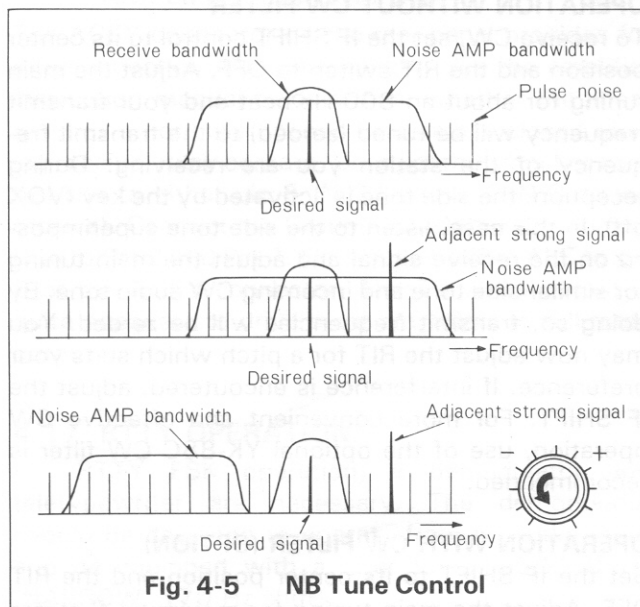
The TS-180S has a sophisticated built-in noise blanker designed to reduce ignition type pulse noise, and is particularly useful during mobile operation.

NB TUNE

The NB TUNE control is provided to change the input tuning of the NB circuit within the IF bandpass. It changes up to plus or minus 50 kHz, and selects and amplifies noise signals adjacent to the receive frequency. If a strong signal exists adjacent to the signal received, the AGC circuit will reduce both IF signal and noise components. This reduces Noise Blanker effectiveness. Shifting the input tuning away from this strong signal improves noise blanker operation.

4.11 AGC (AUTOMATIC GAIN CONTROL)

Set the AGC switch for the type of signal received; generally for SSB, SLOW, for CW, FAST, and for a weak signal, the switch may be turned OFF.



4.12 TRANSMIT OPERATION

Connect the TS-180S to a 50 ohm dummy load or antenna system with an SWR of less than 1.5:1 BEFORE making any transmitter adjustments.

CAUTION: The TS-180S is designed for use with antenna systems having a nominal impedance of 50 ohms. It is very important that the wide-band final amplifier is operated efficiently. Antenna system SWR should be made less than 1.5:1. For impedance matching between the antenna system and the transceiver, we recommend use of the optional AT-180 Antenna Tuner.

Refer to Table 4-2 for initial transmit switch settings. Adjust the main tuning for the desired operating frequency.

Table 4-2. Initial Transmit Switch Settings

(Controls not listed should be set per Table 4-1.)

CONTROL	POSITION
BAND Switch	Desired band
Power Switch	ON
Stand-by Switch	REC
MODE Switch	SSB NORM or CW WIDE
METER Switch	RF or Ic
RIT	OFF
DRIVE	Peak for MAX "S" (RX) or RF or Ic (TX)

4.13 RF PWR CONTROL

The RF PWR control is provided to adjust transmit power continuously between approximately 10 W and full output. During antenna system adjustment, etc., reduce power by turning this control counterclockwise. If power is kept low, the final protection circuit (which detects SWR) will not operate.

Note 1: This control functions for all transmitter modes CW, SSB and FSK. To read ALC this control must be advanced fully clockwise. For normal operation, read drive tuning and transmit power on either the RF or Ic meter scale. ALC reading will change with SWR.

Note 2: By turning the RF PWR control counterclockwise, the ALC meter begins to deflect and finally reaches full scale. This indicates that the ALC level is varied by the RF PWR control. (The S meter also deflects full scale when the RF GAIN control is adjusted counterclockwise.)

4.14 SSB OPERATION

Adjust the TS-180S as described in Section 4.12 and 4.13. Connect a microphone to the MIC connector. Key the transmitter and speak into the microphone in a normal tone of voice. Adjust the MIC control until voice peaks are just within the 15 dB COMP range on the meter scale. With the METER switched to the ALC position, readings should be within the ALC zone, or the transmitter will be driven to distortion.

PTT OPERATION

By using a microphone equipped with a PTT switch, the transceiver is ready for PTT operation. To key, depress the PTT switch. The STANDBY switch is left in the REC position.

MIC GAIN CONTROL

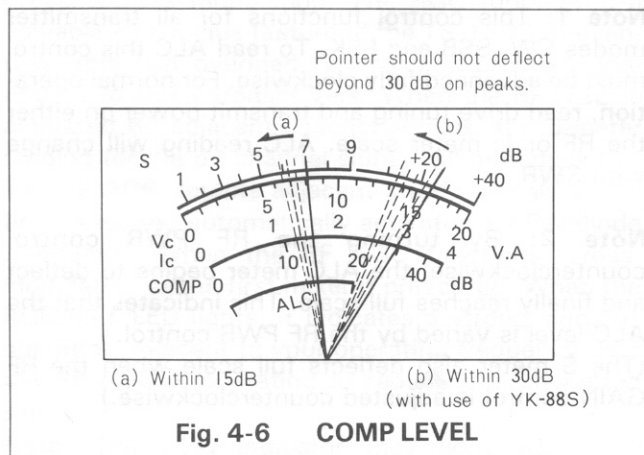
This control adjusts the microphone input level. Set the meter switch to COMP and key the transceiver. Speak into the microphone and adjust the MIC GAIN for 15 dB indication on peaks. This limit applies to both FAST or SLOW compression. The TS-180S will accept either a low or high impedance microphone (500 Ω to 50 k Ω).

ALC Meter reading

The all-transistor Final has an ALC circuit which protects the transistors and maintains uniform transmitter output.

When the meter reading is within the ALC zone, SSB output is distortion-free.

- * ALC level is preadjusted in the IF unit. The transmit IF output is maintained constant by the compression amplifiers in the IF stage. Therefore, ALC level remains constant even when the MIC GAIN is adjusted through the level at which the COMP circuit begins to operate.
- * Use the ALC meter position to check Drive level.
- * Use the COMP meter position to check MIC input level.



VOX (Voice Operated Transmit) OPERATION

Adjust the transceiver as described in paragraph 4.14. Place the STANDBY switch in VOX and, while speaking into the microphone, increase the VOX GAIN until the VOX just operates. For VOX operation it is desirable to close-talk the microphone to prevent background noises from tripping the TS-180S into transmit mode. Check that voice peaks are still within the 15 dB COMP range on the meter. If necessary, readjust the MIC GAIN.

If the VOX circuit is activated by speaker noise, adjust the ANTI-VOX control (on the rear panel). Increase the control as necessary for proper VOX operation. Excessive ANTI-VOX will inhibit VOX operation.

Do not use more VOX or ANTI-VOX gain than necessary. If the VOX circuit transfers between words, or holds too long, adjust the hold time constant by the DELAY control.

Note: In VOX operation, time constants change automatically for CW and SSB modes. The hold time is short for CW operation, and a little longer in SSB mode.

4.15 CW OPERATION

Adjust the TS-180S as described in Section 4.12 and 4.13. Connect a key to the rear panel CW KEY jack, and place the MODE switch to CW (WIDE or NAR). Place the standby switch to SEND for transmitting.

CW sidetone is monitored through the transceiver's speaker.

OPERATION WITHOUT CW FILTER

To receive CW, set the IF SHIFT control to its center position and the RIT switch to OFF. Adjust the main tuning for about an 800-Hz beat and your transmit frequency will be tuned (zeroed) to the transmit frequency of the station you are receiving. During reception, the side tone is activated by the key (VOX off). In this case, listen to the side tone superimposed on the receive signal and adjust the main tuning for similar side tone and incoming CW audio tone. By doing so, transmit frequencies will be zeroed. You may now adjust the RIT for a pitch which suits your preference. If interference is encountered, adjust the IF SHIFT. For more convenient and effective CW operation, use of the optional YK-88C CW filter is recommended.

OPERATION WITH CW FILTER (OPTION)

Set the IF SHIFT to its center position and the RIT OFF. Adjust the main tuning for maximum S-meter

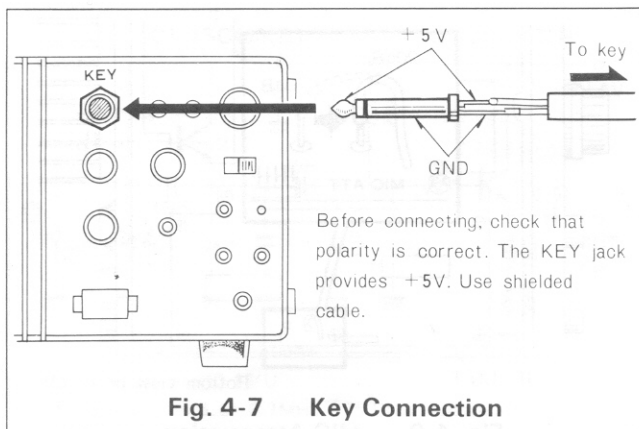


Fig. 4-7 Key Connection

deflection. Receive signal pitch will be about 800 Hz, indicating correct tuning.

KEY CONNECTION (Fig. 4-7)

Your key should be connected as illustrated in Fig. 4-7. When using an electronic keyer, make sure that polarity is correct. Use shielded line from the key to transceiver.

SEMI-BREAK-IN OPERATION

The TS-180S has a built-in side-tone oscillator to permit semi-break-in operation, besides the normal CW operation. During semi-break-in operation, the transceiver is set in transmit mode when the key is depressed, and returns to receive mode when the key is released. For semi-break-in operation, place the STANDBY switch to VOX. Adjust the DELAY control for your preference.

4.16 OPERATION WITH A LINEAR AMPLIFIER (See Fig. 5-3)

The ACSY connector on the rear panel provides for interconnection with an amplifier. See the amplifier instruction manual to determine whether the linear requires a normally opened or normally closed (during receive) relay contact. Connect the amplifier control line to either pin 5 (N.C.) or pin 4 (N.O. during receive). Connect the Ground (Shield) of the Control Line to Pin 2 and Pin 7. Connect amplifier ALC to pin 6 of the ACSY connector. The TS-180S output is quite adequate to drive most amplifiers to full rated output.

4.17 RTTY OPERATION

For RTTY FSK operation, a demodulator and teletypewriter are necessary. The demodulator should be designed to operate from an audio input and be equipped with a filter for 2125/2295 Hz (NARROW, 170 Hz shift).

To key the FSK circuit, insert a relay coil into the teletypewriter closed loop circuit and connect the relay contacts to the RTTY KEY jack on the rear panel. Fig. 4-8 shows the relationship between transmit and receive frequencies. Setting the MODE switch to FSK automatically decreases final stage input power permitting extended operation. For AFSK or SSTV operation, signal may be input through the MIC Jack. Set MIC GAIN or RF PWR for approximately 50% Duty (1/2 Power). Read either on the RF or IC meter position.

4.18 SPEECH PROCESSOR

The TS-180S Speech Processor uses the receive IF amplifier as a compression amplifier during transmit. A separate AGC circuit is provided in the transmit mode. The processor is always ON during transmission. By changing time constants, natural feeling is maintained when in SLOW by using a reasonably long time constant, while the average power is increased in FAST by employing a short time constant (SLOW or FAST) without making gain adjustment. Normally, this should be done at about the 10 dB compression level for both SLOW and FAST ranges, but within 15 dB at the maximum. Higher levels may cause distortion.

If the optional 2nd SSB filter (YK-88S) is installed, favorable operation can be enjoyed up to 30 dB maximum compression in FAST, without expansion of side bands.

COMP Meter reading.

Compression level is adjustable with the MIC GAIN control.

- * When the optional 2nd SSB filter YK-88S is not used, compression level should be adjusted within 15 dB
- * When the YK-88S Dual Filter is used, compression level may be adjusted up to 30 dB.

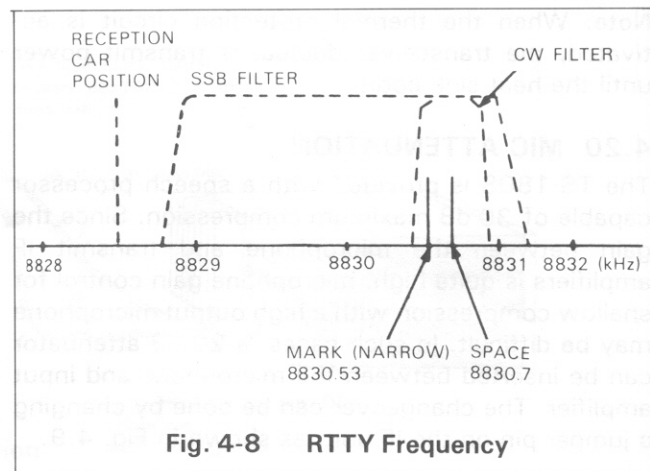


Fig. 4-8 RTTY Frequency

- * If compression level is in excess of these limits, deterioration of transmit sound quality due to compression distortion will result.
- * When SLOW COMP is selected, the meter returns slowly. This is normal and is not a malfunction.

4.19 PROTECTION CIRCUITS

The TS-180S has an all solid-state final stage. To protect the final transistors, two protection circuits are provided.

1) SWR Detection

As the antenna system SWR rises, reflected power increases, making the load on the final transistors excessive. When SWR exceeds 3:1 (at 14 MHz) this circuit decreases transmit power output.

Note: If the protection circuit operates, reduce the antenna SWR to at least less than 3:1 (PROTECTION STARTING POINT). If the antenna system is tuned at full power with an antenna tuner, the protection circuit may operate.

Before adjustment, turn the RF PWR control counterclockwise to reduce transmitter output. Adjust the antenna tuner for a 1:1 SWR. Then, resume normal operation.

2) Thermal Protection

The TS-180S is furnished with a heat sink large enough to dissipate final-stage heat. However, when final-stage temperature rises abnormally due to continuous transmission in CW, transmission with an incorrect load or over long sessions, this protection circuit detects the core temperature of the final-stage transformer and decreases transmit power output.

This circuit resets when the heat sink temperature returns to ambient level.

Note: When the thermal protection circuit is activated, the transceiver decreases transmit power until the heat sink cools.

4.20 MIC ATTENUATION

The TS-180S is provided with a speech processor capable of 30 dB maximum compression. Since the gain between the microphone and transmit IF amplifiers is quite high, microphone gain control for shallow compression with a high output microphone may be difficult. In such cases, a 20 dB attenuator can be inserted between the microphone and input amplifier. The changeover can be done by changing a jumper pin on the IF unit, as shown in Fig. 4.9.

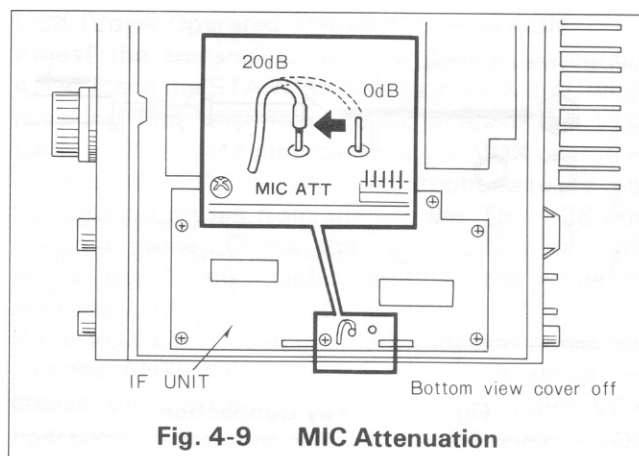


Fig. 4-9 MIC Attenuation

- Note 1.** If a high output microphone is used without attenuation, excessively high COMP will be indicated (more than 15 dB) even with the MIC Control at the 9 o'clock position. Use the attenuator to correct this condition.
2. The attenuator is factory preset at 0 dB.

4.21 FIXED CHANNEL OPERATION

A fixed channel is available for common use on all bands by installing a crystal in the socket on the Pre Mix unit (X50-1570-00). The crystal frequency can be computed by the following formula:

Crystal Frequency (MHz) = 6.6 MHz + X - Operating Frequency (MHz).

X = Band Switch frequency (1.5, 3.5, etc.)

Crystal specifications: See Fig. 4-10

Note: TRIO-KENWOOD does not supply crystals.

To use the fixed frequency oscillator, turn the FIX/M RECALL switch to the "FIX" position.

4.22 MOBILE OPERATION (Fig. 4-11)

The TS-180S, being DC operated, is ideal for mobile operation. Satisfactory mobile operation is achieved through proper power and antenna connection, and thoughtful transceiver installation and adjustment.

TS-180S INSTALLATION

Secure the TS-180S under the dash or on the floor using a mounting bracket. As an alternative, use strapping, making sure that the TS-180S will not slip out of place while driving.

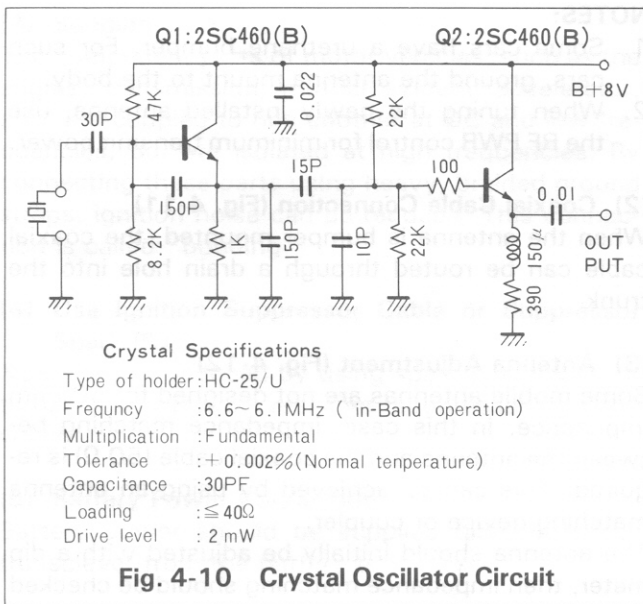


Fig. 4-10 Crystal Oscillator Circuit

Note:

1. Do not install near the heater outlet.
2. Allow sufficient space behind the TS-180S to ensure proper ventilation.

HOW TO HANDLE THE POWER CABLE

When connecting or disconnecting the power cable to or from the power connector, be sure that the power switch is always in the "OFF" position. Observe polarity of the cable. The TS-180S operates on 13.8 VDC, negative ground. Battery polarity must be correct. The power cord is color coded:

CAUTION:

Observe battery polarity.

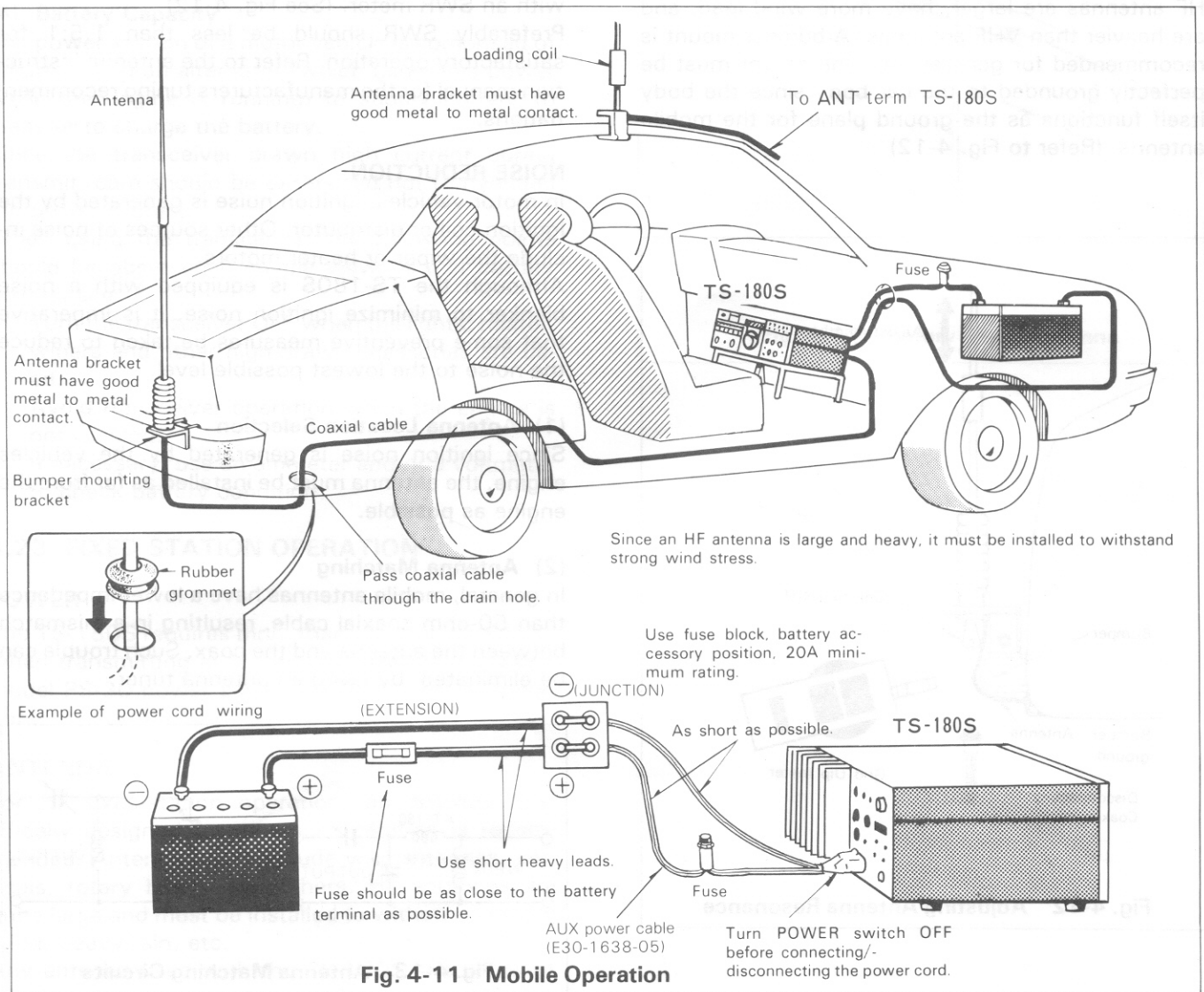


Fig. 4-11 Mobile Operation

POWER CABLE

Red or White + (plus)
Black or Gray - (minus)

First, determine that the cars power system (the battery and generator or alternator) will handle the increased load of the TS-180S.

Connect the power cable to the battery terminals, with consideration to current requirements and noise prevention. The maximum current drawn by the TS-180S reaches to between 18 and 20 A when transmitting. Therefore, the cable should be as short as possible. Route battery and antenna leads away from all high voltage secondary circuits to prevent ignition noise interference.

MOBILE ANTENNA

(1) Antenna Installation

HF antennas are larger, have more wind load, and are heavier than VHF antennas. A bumper mount is recommended for general use. The mount must be perfectly grounded to the car body since the body itself functions as the ground plane for the mobile antenna. (Refer to Fig. 4-12)

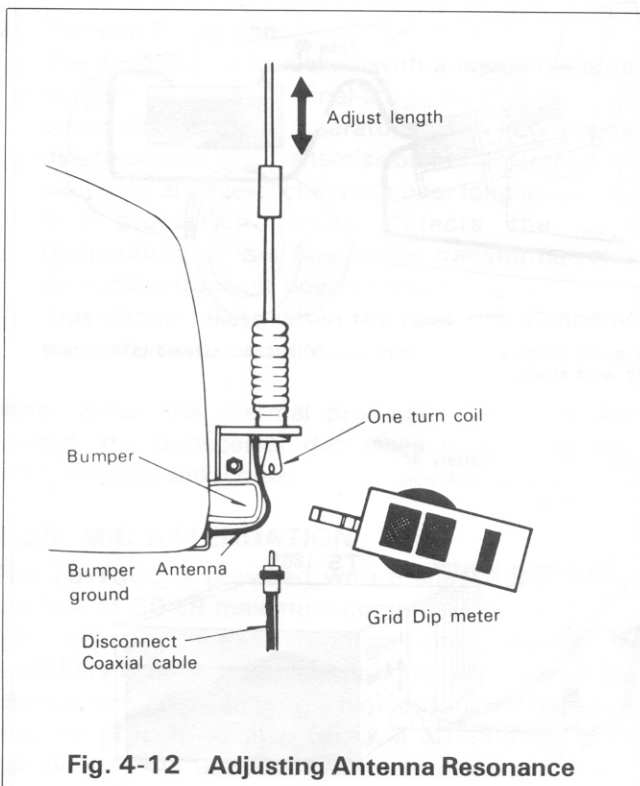


Fig. 4-12 Adjusting Antenna Resonance

NOTES:

1. Some cars have a urethane bumper. For such cars, ground the antenna mount to the body.
2. When tuning the newly installed antenna, use the RF PWR control for minimum transmit power.

(2) Coaxial Cable Connection (Fig. 4-11)

When the antenna is bumper mounted, the coaxial cable can be routed through a drain hole into the trunk.

(3) Antenna Adjustment (Fig. 4-12)

Some mobile antennas are not designed for 50-ohm impedance. In this case, impedance matching between the antenna and the coaxial cable (50 Ω) is required. This can be achieved by using an antenna matching device or coupler.

The antenna should initially be adjusted with a dip meter, then impedance matching should be checked with an SWR meter. (See Fig. 4-12)

Preferably SWR should be less than 1.5:1 for satisfactory operation. Refer to the antenna instruction manual for the manufacturers tuning recommendations.

NOISE REDUCTION

In motor vehicles, ignition noise is generated by the ignition coil or distributor. Other sources of noise include the wiper or heater motors.

Although the TS-180S is equipped with a noise blanker to minimize ignition noise, it is imperative that some preventive measures be taken to reduce the noise to the lowest possible level.

(1) Antenna Location Selection

Since ignition noise is generated by the vehicles engine, the antenna must be installed as far from the engine as possible.

(2) Antenna Matching

In general, mobile antennas have a lower impedance than 50-ohm coaxial cable, resulting in a mismatch between the antenna and the coax. Such trouble can be eliminated by using an antenna tuner.

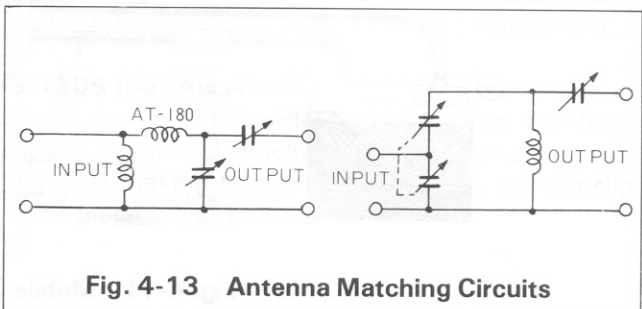


Fig. 4-13 Antenna Matching Circuits

(3) Bonding

The component parts of motor vehicles, such as the engine, transmission, muffler system, accelerator, etc., are coupled to one another at DC and low frequencies, but are isolated at high frequencies. By connecting these parts using heavy, braided ground straps, ignition noise can be reduced. This connection is called "bonding".

(4) Use Ignition Suppressor Cable or Suppressor Spark Plugs

Noise can be reduced by using spark plugs with internal resistors, or resistive suppressor ignition cable.

(5) Battery Power Connection.

Battery power should be supplied directly to the transceiver from the battery terminals.

(6) Battery Capacity

The power system of a motor vehicle is comprised of a battery and an alternator (which generates power while the engine is running) to supply current to loads or to charge the battery.

Since the transceiver drawn high current during transmit, care should be excersised not to overload the power system.

When using the transceiver, the following points should be observed from the viewpoint of battery maintenance:

- Turn the transceiver OFF when the lights, heater, wipers and other high-draw accessories are used.

- Avoid transceiver operation when the engine is not running.

- If necessary, use an ammeter and/or a voltmeter to check battery condition.

4.23 FIXED STATION OPERATION

POWER

The TS-180S requires more than 20 A at 13.8 VDC when transmitting at full power. Use the Kenwood model PS-30 power supply for fixed station operation.

ANTENNA

For HF fixed-station operation, an antenna specifically designed for amateur operation is recommended. Antenna types include wire antennas, verticals, rotary beam, and others. HF antennas are quite large and must be installed to withstand strong wind, heavy rain, etc.

Any antenna used with the TS-180S should be of 50 ohm impedance and should be connected using

an appropriate coaxial cable such as RG-8/U.

Impedance matching is important. Impedance mismatching will result in a high SWR and power loss, or can cause unwanted harmonic radiation and interference (TVI, BCI). The impedance match can be checked with an SWR meter. Generally satisfactory operation is assured when the VSWR (Voltage Standing Wave Ratio) is less than 1.5:1.

For impedance matching between the antenna system and transceiver, use of the AT-180 Antenna Tuner (option) is recommended. A rotary beam antenna is very effective for DX operation in the 14, 21 and 28 MHz bands. (Fig. 4-14)

Note: Protect your Equipment — Use a LIGHTNING ARRESTOR.

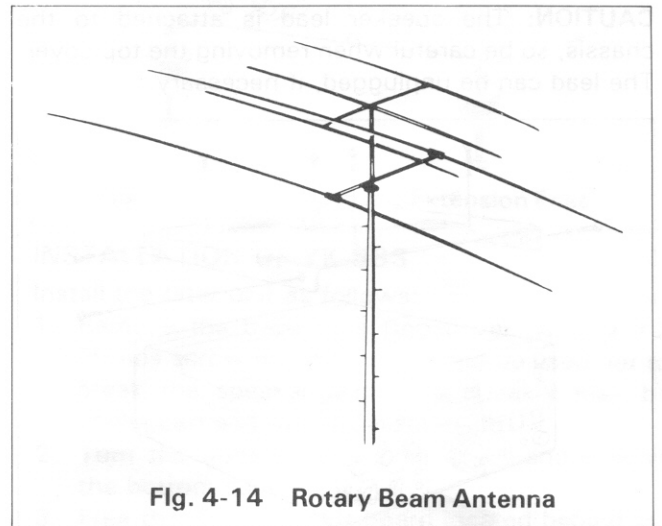


Fig. 4-14 Rotary Beam Antenna

SECTION 5 ADDITIONAL INFORMATION

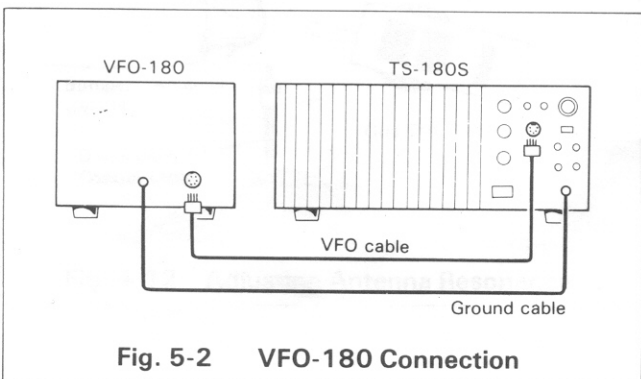
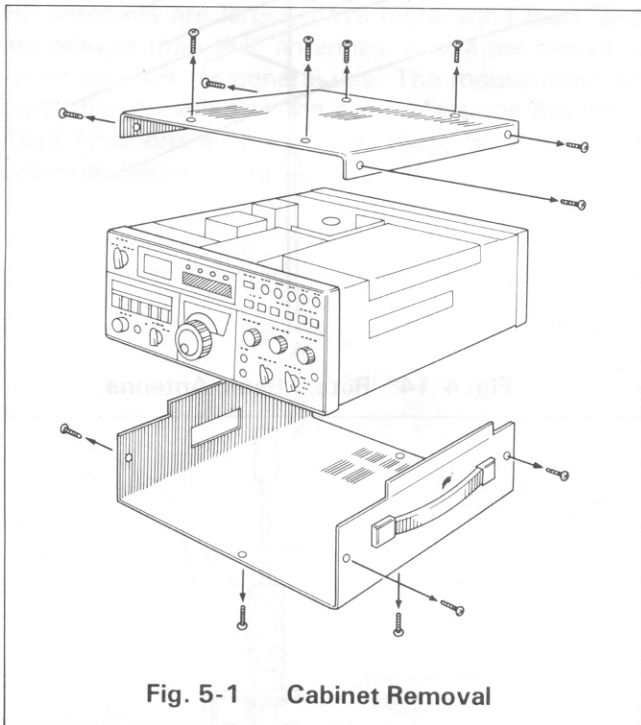
5.1 GENERAL

Your TS-180S has been factory aligned and tested to specification before shipment. Under normal circumstances the transceiver will operate in accordance with these operating instructions. All adjustable trimmers and coils in your transceiver were preset at the factory and should only be readjusted by a qualified technician with proper test equipment. Attempting service or alignment without factory authorization can void the transceivers warranty.

REMOVING THE CABINET (See Fig. 5-1)

Figure 5-1 illustrates cabinet removal. Remove the eight top-cover and five bottom-cover screws and lift away the panels.

CAUTION: The speaker lead is attached to the chassis, so be careful when removing the top cover. The lead can be unplugged, if necessary.



5.2 ACCESSORIES

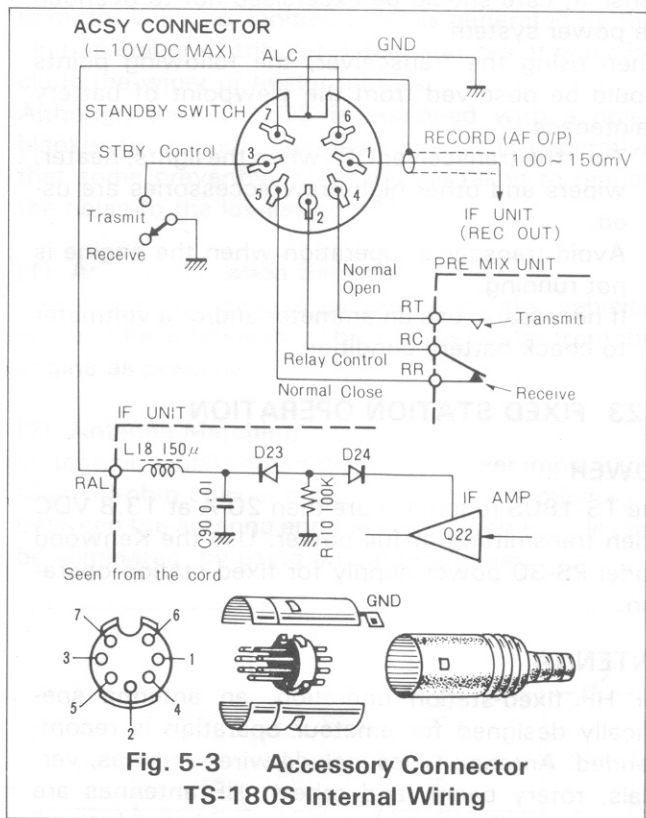
VFO-180 CONNECTION (Fig. 5-2)

Connect the VFO-180 as shown in Fig. 5-2. Addition of this accessory item will make your station more enjoyable to operate. All cables are supplied with the VFO-180. Through the function switch of the VFO-180, you can operate as if you are using a separate transmitter and receiver. Transmit frequency can be preset (spotted) by simply pressing the T-F switch without using the FUNCTION switch. The VFO is placed in transmit mode during reception.

ACCESSORY CONNECTIONS

Fig. 5-3 shows the ACSY connector. This DIN plug can be used for attaching a linear amplifier or other external accessories to the transceiver. Always use shielded line for all functions.

Function	Pins
ALC	6, GND * (-10VDC max.)
Relay Control * 100V 0.3A	2 and 5 or 4 * Bridge 2 to GND if Required.
EXT. P.T.T.	3, GND
RECORD O/P	1.7



EXTENSION FEET

The TS-180S is provided with two extension feet which can be used to elevate the front panel. In

some operating positions the tilt makes it easier to read the dial and meter. Fig. 5-5 shows how to install the feet.

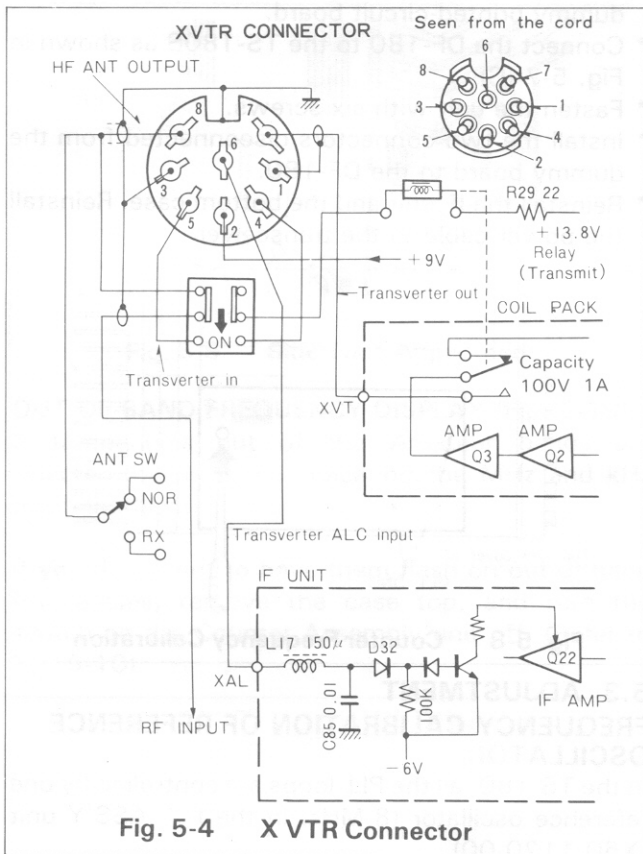


Fig. 5-4 X VTR Connector

INSTALLING THE CW FILTER YK-88C (Fig. 5-6)

Install the filter unit as follows:

1. Disconnect power BEFORE proceeding.
2. Remove the top and bottom cover.
3. Remove 6 screws holding the IF unit (X48-1240-00) located behind the Mode switch.
4. Swing the IF unit upright as shown in Fig. 5-7 (A).

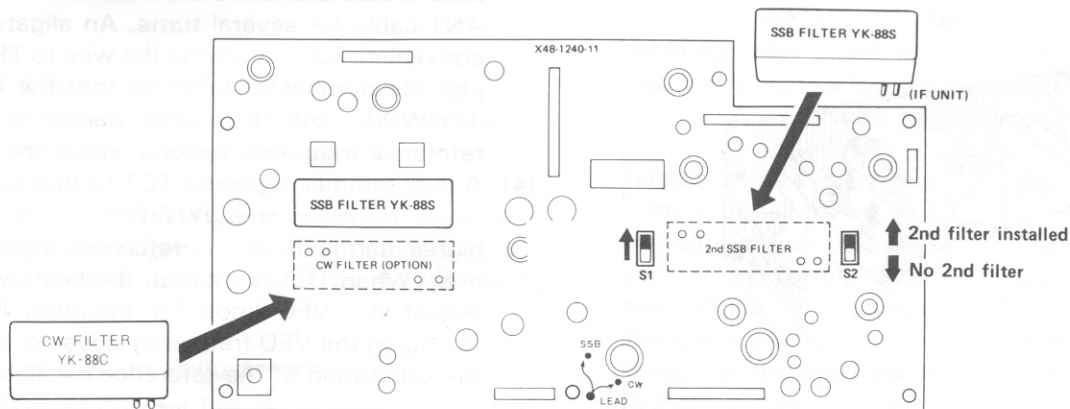


Fig. 5-6 Installing the Optional CW and/or SSB Filters

5. Clear any solder from the filter mounting holes with your soldering pencil.
6. Install the filter on the IF unit circuit board. (There is NO POLARITY. The filter can be installed either way.) Move any wires away from the filter space. Solder the four pins and two TABS from the rear using a low-power soldering pencil (25 W). Soldering should be finished as quickly as possible.
7. Reposition the Jumper from the SSB to CW terminal.

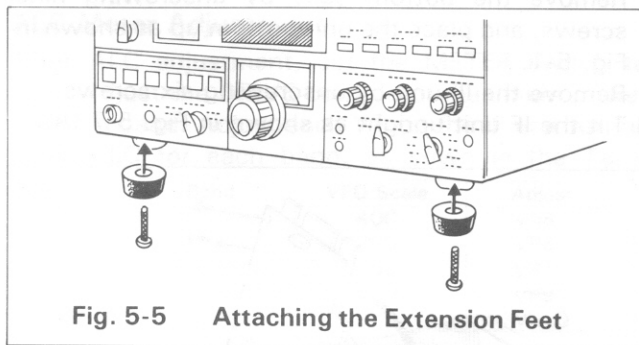


Fig. 5-5 Attaching the Extension Feet

INSTALLATION OF YK-88S

Install the filter unit as follows:

1. Remove the transceiver top cover using a #2 Phillips screw-driver. Care should be used not to break the speaker lead. The speaker may be unplugged and the cover set aside.
2. Turn the transceiver upside down and remove the bottom cover.
3. Free the IF unit circuit board located behind the Mode Switch by Six Screws. Swing the unit to the front and upright.
4. Insert the filter in the space marked 2nd SSB FILTER. Solder the 4 pins and 2 tabs from the rear using a low wattage soldering pencil (25 W or less). Soldering should be finished as quickly as possible.

5. Change the position of the preset switches as shown in Fig. 5-6.

NOTE: When the preset switches are in lower side position, the transceiver is in original condition.

6. Reconnect the speaker, then replace the bottom and top covers.

Filter installation is now complete.

INSTALLATION OF THE DF-180

- * Disconnect the power cable BEFORE proceeding.
- * Remove the bottom case by unscrewing nine screws, and place the unit bottom up as shown in Fig. 5-1.
- * Remove the IF unit by unscrewing six screws.
- * Tilt the IF unit upright as shown in Fig. 5-7 (A).

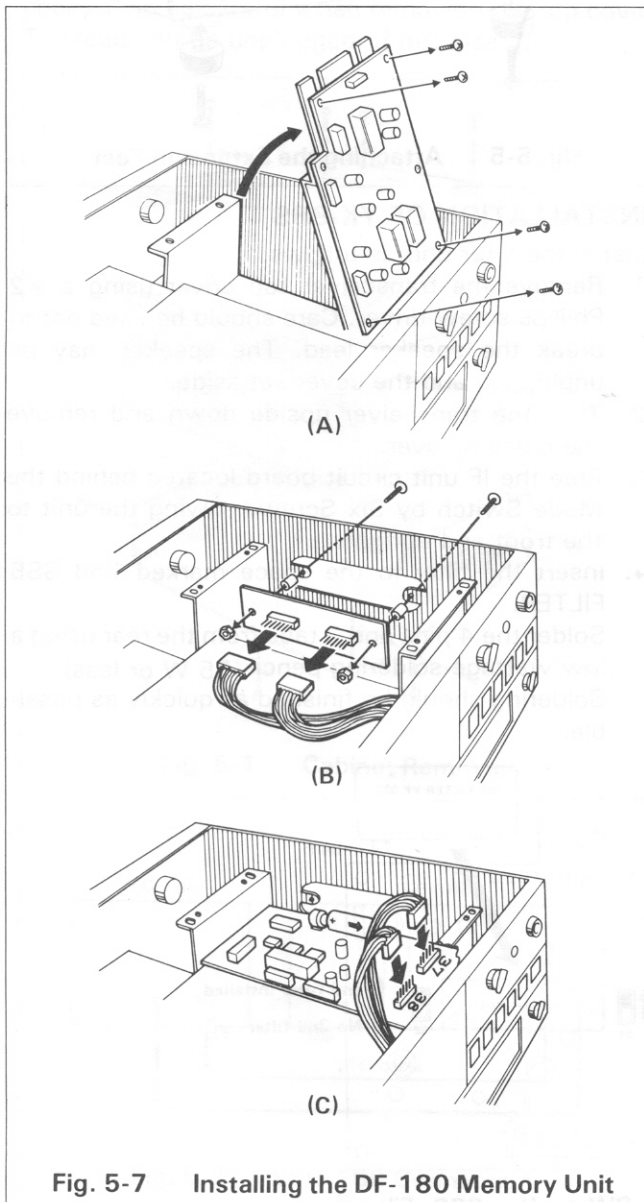


Fig. 5-7 Installing the DF-180 Memory Unit

- * Remove the dummy printed-circuit board shown in Fig. 5-7 (B) by removing two screws and two nuts and remove the two connectors attached to the dummy printed-circuit board.
- * Connect the DF-180 to the TS-180S as shown in Fig. 5-7 (C)
- * Fasten the unit with six screws.
- * Install the two connectors disconnected from the dummy board to the DF-180.
- * Reinstall the IF unit and the bottom case. Reinstall the power cable to the transceiver.

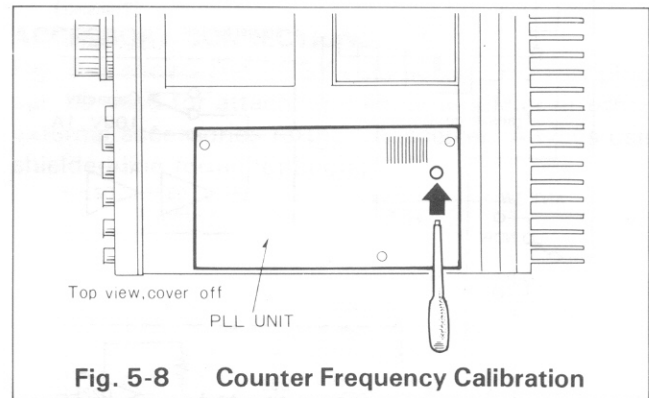


Fig. 5-8 Counter Frequency Calibration

5.3 ADJUSTMENT

FREQUENCY CALIBRATION OF REFERENCE OSCILLATOR

In the TS-180, all the PLL loops are controlled by one reference oscillator (8 MHz) in the PLL ASS'Y unit (X60-1120-00).

This reference oscillator has been adjusted exactly in the factory. However, if the frequency varies for some reason (e.g. changes with the passage of time), calibrate the frequency in the following manner.

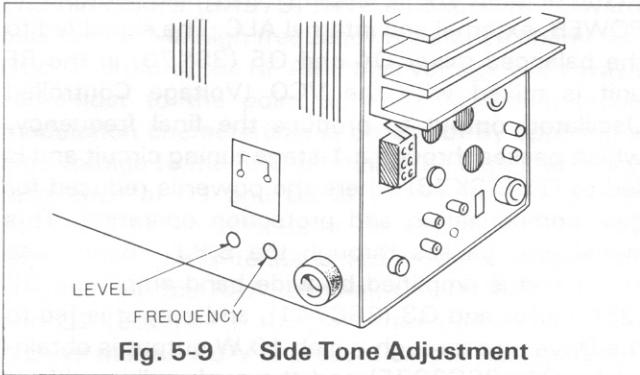
(Calibration utilizing JJY/WWV)

- (1) Remove the cover of the PLL ASS'Y unit.
- (2) Tune to JJY/WWV.
- (3) Connect a covered wire to TP10 of the PLL ASS'Y unit and wind the other end round the ANT cable for several turns. An alligator clip is convenient for connecting the wire to TP10. Adjust the number of turns so that the levels of JJY/WWV and a higher harmonic of the reference frequency become about the same.
- (4) Adjust trimmer capacitor TC1 so that the double beats between the JY/WWV signal and the higher harmonic of the reference signal disappear. When TC1 is rotated, the beats will vary. Adjust the VFO knob for optimum listening. Changing the VFO frequency does not influence the calibration of the reference oscillator.

SIDE TONE FREQUENCY ADJUSTMENT

In the TS-180S, Side Tone frequency as well as

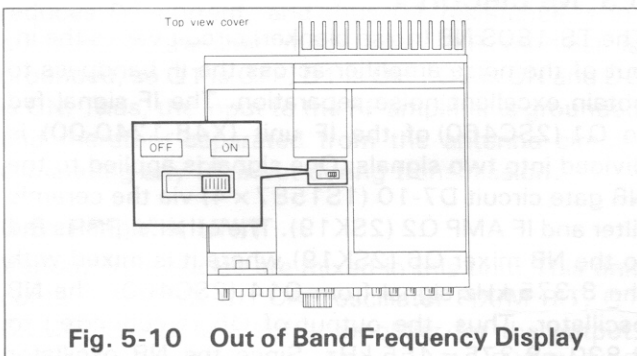
volume is adjustable. Adjustments are located on the IF unit (X48-1240-00), and can be accessed through the bottom cover. (See Fig. 5-9)



OUT-OF-BAND FREQUENCY DISPLAY (Fig. 5-10)

If frequencies out of the Amateur bands are selected, the decimals indicating the MHz and kHz positions flash.

If you desire not to have them flash on out-of-band frequencies, remove the case top, and turn the switch on the Counter Assembly unit off. (Refer to Fig. 5-10)



Adjustment of AVR Voltage (AVR unit X43-1340-00)

Adjust VR1 for 8V between the TR-2 terminal and chassis.

S Meter adjustment (IF Unit)

Disconnect the antenna with the transceiver in receive mode. The S meter zero-point adjustment is first.

Adjust VR2 so that meter pointer just indicates zero. If a standard signal generator (SSG) is available, adjust VR3 for S-9 at 14.175 MHz, 40 dB signal (50 μ V).

ALC Meter 0-Point Adjustment

With a 100 W dummy load in circuit, turn the RF PWR control fully clockwise, the MODE switch to

SSB MIC gain minimum, SSB mode and place the STBY switch to SEND. Set the METER switch to the ALC position and adjust VR4 in the IF unit for zero.

ALC Adjustment

Connect a power meter to the antenna terminal. Turn the RF PWR control fully clockwise and place the MODE switch to CW. Tune to 14.200 MHz, and set the STBY switch to SEND. Adjust the DRIVE control for maximum power.

Adjust VR3 (ALC) on the Filter unit to obtain 100 W.

ALC Meter Adjustment

After ALC adjustment, set the METER switch to ALC. Adjust the DRIVE control for maximum power for each band. Adjust each VR on the IF unit for full scale ALC for each band, as shown in the Table below.

Band	VFO Scale	Adjust
1.5 MHz	400	VR8
3.5 MHz	250	VR6
7.0 MHz	250	VR13
14.0 MHz	250	VR9
21.0 MHz	250	VR10

RF Meter Adjustment

Tune to 14.200 MHz and peak the Drive control for maximum ALC. Set the METER switch to the RF position and adjust VR2 (RF) on the Filter unit so the meter indicates 15 A on the IC scale.

5.4 ORDERING SPARE PARTS

When ordering replacement or spare parts for your equipment, be sure to specify the following information:

Model and serial number of the equipment. Schematic number of the part. Printed circuit board number on which the part is located. Part number and name, if known, and Quantity desired.

Note: A full Service Manual is available as a separate publication.

5.5 SERVICE

Should it ever become necessary to return the equipment for repair, pack in its original boxes and packing, and include a full description of the problems involved. Also include your telephone number. You need not return accessory items unless directly related to the service problem. Tag all returned items with your call for easy I.D.

Please mention the model and serial number of your radio in any correspondence, whether phone or written. For future reference, record this information in the space provided on the back cover of this manual.

Note: When claiming warranty service, please include a photocopy of the bill of sale, or other proof of purchase showing the date of sale.

SECTION 6 CIRCUIT DESCRIPTION

6.1 Receiver

The receiver is of the single conversion type using an 8.83 MHz IF circuit.

The NB (noise blanker) circuit is of the double conversion type. The signal from the ANT or RX ANT is applied through the PIN diode (BA379 × 2) RF ATT circuit in the RF unit to the antenna coil in the Coil Pack unit.

The signal is stepped up by the antenna coil, amplified by the RF AMP Q3 (3SK73) in the RF unit, and is fed to the balanced mixer circuit Q7 and Q8 (2SK125 × 2) via the buffer amplifier Q6 (2SK125), to obtain an 8.83 MHz IF signal. This IF signal is fed to the IF unit (X48-1240-00) where it is divided into two signals. One signal is amplified by Q3 (2SA1015), detected by D1 and D2 (1N60), and is amplified by Q4 (2SC945). Then, it is fed to the RF unit and amplified by Q4 (2SC945) to control the RF ATT circuit.

The other signal is applied to the ceramic filter (CF1) via buffer amplifier Q1 (2SC460). The signal from Q1 is also fed to the NB MIX circuit Q6. The signal from CF1 is amplified by Q2 (2SK19) and is fed to the crystal filter (XF1 for SSB; XF2 [option] for CW) through the Noise Blanker gate D7-10 (1S1587 × 4). The signal from the crystal filter is amplified by Q15, 16 and 17 (3SK73 × 3) and is fed to the buffer amplifier Q28 (2SC460) via the (optional) SSB filter. This signal is then detected by the product detector D43 and 44 (1N60 × 4) to produce an audio signal. Audio passes through the active LPF Q29 (2SC1000), and is fed to the AF VOX unit. This signal is applied to the power amplifier Q1 to drive the speaker.

6.2 Transmitter

The microphone signal is applied to the MIC preamplifier Q32 (2SC1000), the MIC gain control, and the MIC amplifier Q33 (TA7140P). Microphone input impedance may be 500 ohms to 50 k ohms. If the microphone output level is too high, the 20 dB attenuator can be inserted by moving the jumper on the IF unit. The MIC amplifier (Q33) output is fed to the balanced modulator D60-64 (1N60 × 4) where it is switched by the carrier signal from the buffer amplifier Q34 (2SC460) to produce a DSB signal. This DSB signal is applied through buffer amplifier Q35 (2SK19) to the crystal filter and is converted to an SSB signal. Amplified by the 3-stage IF amplifier Q15-17 (3SK73), it is fed to the optional 2nd SSB crystal filter. Q15-Q17 also function as the processor Compression amplifiers, operating continuously during SSB transmission. Processor control is accomplished by switching the transmit ALC circuit time constant for the Compression amplifiers

to SLOW or FAST. The signal from the Compression circuit is fed to the optional SSB crystal filter, amplified by IF amplifier Q22 (3SK73), and applied to the RF unit. The IF amplifier Q22 also controls RF POWER, external and internal ALC. The signal fed to the balanced mixer Q4 and Q5 (3SK73) in the RF unit is mixed with the VCO (Voltage Controlled Oscillator) output to produce the final frequency, which passes through a 1-stage tuning circuit and is fed to Q1 (3SK73) where the power is reduced for gain compensation and protection operation. This signal also passes through the B.P.F. (Band Pass Filter) and is amplified by wide band amplifiers Q2 (2SC1595) and Q3 (2SC741), and output is fed to the Drive unit through which 10 W output is obtained by Q1 (2SC2075) and the push-pull amplifiers Q2 and Q3 (2SC2509 × 2). This output drives the FINAL unit where it is amplified to 100 W output by Q1 and Q2 (SRF1714 × 2). The 100 W output is fed to the antenna through the LPF (Low Pass Filter) and the antenna relay. In the LPF unit, the antenna SWR is detected and the rectified error voltage is fed back to Q1 in the Coil Pack unit to reduce the drive for Output protection. The LPF unit also detects ALC.

6.3 NB CIRCUIT

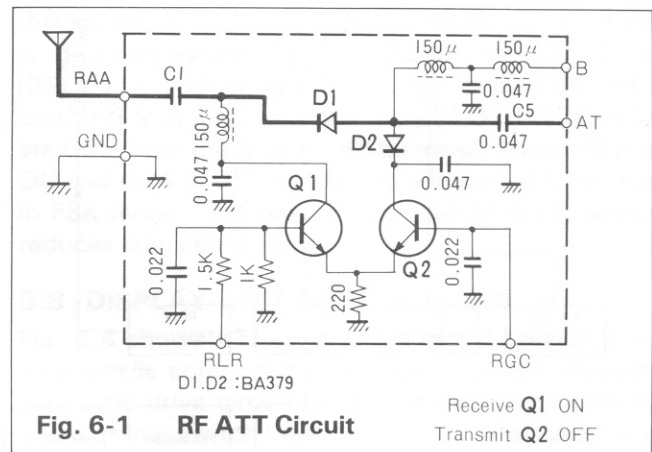
The TS-180S NB (noise blanker) circuit varies the input of the noise amplifier across the IF bandpass to obtain excellent noise separation. The IF signal fed to Q1 (2SC460) of the IF unit (X48-1240-00) is divided into two signals. One signal is applied to the NB gate circuit D7-10 (1S1587 × 4) via the ceramic filter and IF AMP Q2 (2SK19). The other signal is fed to the NB mixer Q6 (2SK19) where it is mixed with the 8,375 kHz signal from Q14 (2SC460), the NB oscillator. Thus, the output of Q6 is converted to $8,830 - 8,375 = 455$ kHz. Since the NB oscillator can be varied by ± 75 kHz with the NB TUNE control, the output of Q6 is adjustable from 530 to 380 kHz. This output is amplified by Q7-9 (2SC460) and detected by D3 and D4 (1N60). The detected output is DC amplified by Q10 (2SC945), Q11 (2SA1015) and Q12 (2SC945), and fed to the NB gate circuit D7-10. In this circuit the input signal is switched OFF according to pulse noise duration. The switching period is generally several microseconds and does not affect the signal when demodulated. The total circuit has a signal subcircuit and a noise amplifier circuit; the signal path is adjusted for noise timing because of the difference in the circuits (phase lag). This signal-to-noise timing is obtained by the ceramic filter inserted in the signal circuit.

6.4 RF ATT CIRCUIT

The TS-180S RF ATT circuit, (shown in Fig. 6.1), uses two pin-diodes to attenuate the input signal. The pin-diodes (BA379) have an excellent forward bias current vs. high frequency resistance characteristic. Therefore, the RF AMP bias voltage will always self-adjust to the point at which optimum cross modulation characteristic is obtained. By applying a bias voltage to the RGC terminal, the high frequency resistance of D1 and D2 is varied and the circuit functions as an attenuator. In Fig. 6.1 the input signal from the antenna is fed to the coil pack RF amplifier via the RAA terminal, C1, D1 and C5. Q1 and Q2 (2SC1815) form a differential amplifier. In receive mode, +8 V is present on the RLR terminal, so Q1 turns ON. Thus D1, connected to the collector of Q1, is forward biased. When the ATT switch is turned ON or RF AGC voltage is detected due to a high input signal, DC voltage is applied to the RGC terminal and, hence, Q2 is energized and a current flows to D2. This reduces the resistance of D2 which in terms of high frequency, reduces the resistance between the signal circuit and ground, and thus the input signal is attenuated. Differential amplifier Q1 current is also reduced which, in turn, reduces D1 current, and thus D1 resistance is increased. In transmit mode, the RLR terminal is grounded, so Q1 is OFF, D1 is OFF, Q2 is ON and D2 is ON. Thus, the input to the RF amplifier is grounded and therefore separated from the antenna circuit, eliminating any RF input during transmission.

6.5 PRE MIX UNIT

Various frequencies are mixed in this unit. This unit contains the FIX CH CAR oscillator FIX/M RIT, Q1 (2SC460). Q2 is a buffer amplifier for the output, and Q3 is a buffer amplifier to feed the FIX CH/VFO output to the memory unit. The VFO, external VFO and memory inputs are each fed to the diode switch D4, D3, D2 and D1, and to the low pass filter (DC to 8 MHz) where the harmonic component is removed. The input without harmonic component is fed to the buffer amplifier Q4 (2SC460). This output is mixed with the FIX/M RIT output (46.6 MHz) oscillator by the DBM (double balanced modulator) Q7 (SN76514N), through buffer amplifier Q6 (2SC460). This converted output is 40.0–40.5 MHz, which is fed through buffer amplifier Q8 and Q9 (2SC460 × 2) to the COUNTER ASSY unit. This signal is also mixed with the CARRIER oscillator output Q13, 14 and 15 (2SC460) by the DBM Q11 (SN76514N). This output is 48.83–49.33 MHz, and is fed to the PLL unit via buffer amplifier Q12 (2SC460).



6.6 SPEECH PROCESSOR

The TS-180S speech processor uses the receiver IF amplifiers as a compression amplifier during transmission (see IF unit X48-1240-00). The signal from the SSB filter (XF1) is amplified by the IF AMP Q15, 16 and 17 (3SK73). The output of Q17 passes through buffer amplifier Q19 (2SC460) and is rectified by D17 and 18 (1N60) to detect signal peaks. This rectified output is amplified by Q21 and is fed back as an AGC voltage to Q15, 16 and 17 to maintain a constant signal amplitude. Compression is always ON. The transmit AGC circuit has both SLOW and FAST time constants. In SLOW mode, R115 (47 ohm) and C94 (10 μ F) are connected to the RFB terminal through the CM1 terminal to form a SLOW time constant circuit along with R114 (2.2 M ohm). In FAST mode, the CM1 terminal is shorted to the CM2 terminal to form a FAST time constant circuit with R114 (2.2 M ohm), C93 (0.022 μ F), C55, C58 and C61 (0.0022 μ F). Selection of the AGC circuit time constant between transmission and reception is made by relay RL1-2. In receive mode, the gain of Q16 and 17 would be too great for transmission. This gain is reduced by changing the source resistance of Q16 and 17 during transmission. In receive mode, Q18 is ON by +8 V present on its base, holding the source resistance of Q16 and 17 to 330 ohms (R66 and R70). In transmit mode, Q18 is OFF because its base voltage is 0 V, so the source resistance of Q16 and 17 is 470 ohms (R74) and circuit gain is reduced.

6.7 IF DUAL FILTER

The IF amplifier has a crystal filter XF1 at its input. If the option 2nd SSB filter (YK-88S) XF3 is added to the output of the IF amplifier, the following 3 effects will occur. (The IF amplifier now has two SSB filters, hence the name IF Dual Filter.)

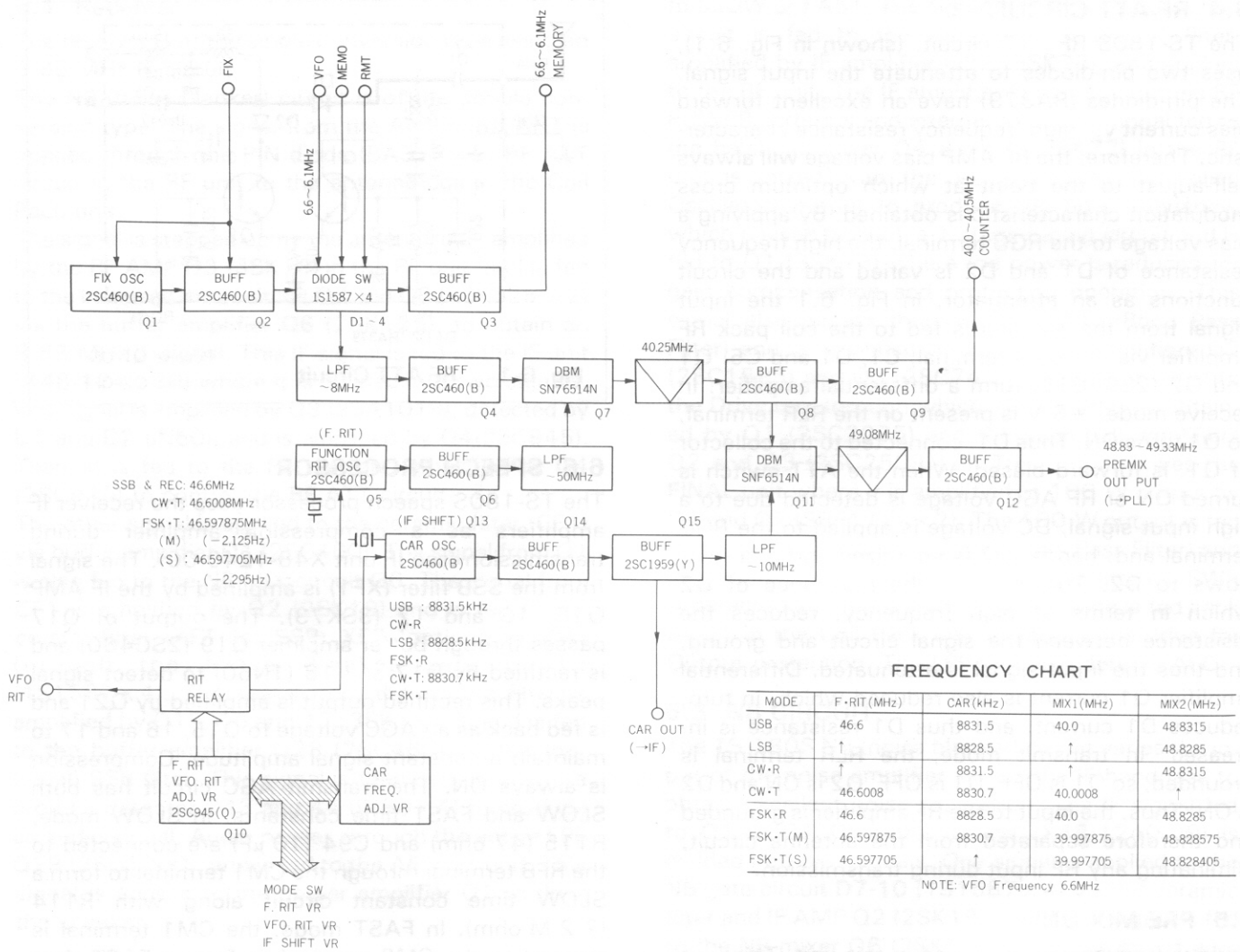


Fig. 6-2 PRE MIX Circuit

- (1) Better S/N ratio.
- (2) Improvement in single signal selectivity.
- (3) Improvement in compression effect during transmission.

(1) Better S/N ratio

External noise or noise from the RF AMP and MIX stages will be limited by the crystal filter at the IF amplifier input. However, noise generated in the IF amplifier cannot be limited, though there is a filter effect in the AF amplifier. By installing an additional crystal filter at the IF amplifier output S/N ratio will improve, for the following reasons. As an example, if the AF bandwidth is 200 Hz to 3 kHz and the carrier frequency is 8831.5 kHz (USB), noise, generated from the IF amplifier, appears at the AF output in two groups; 8831.7-8834.5 kHz and 8831.3-8828.5 kHz. When the IF bandwidth is limited by inserting a

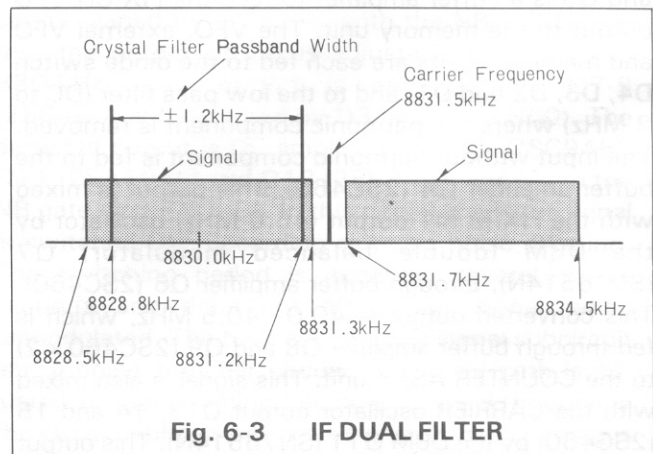


Fig. 6-3 IF DUAL FILTER

2nd crystal filter (YK-88S) with a bandwidth of 8830.0 kHz \pm 1.2 kHz between the IF amplifier output and the detector input, the noise bandwidth at the detector input becomes 8831.2–8828.8 kHz, so the 8831.2–8828.8 kHz range only becomes AF output after shaping by the AF amplifier bandwidth characteristic. **See fig 6.3.**

Thus the noise energy developed in the IF amplifier is reduced by about 3 dB at the AF output. It should be noted that the S/N sensitivity and noise figure of the TS-180S is determined not only by noise in the IF stage, but also are influenced greatly by the RF stage preceding the IF. For this reason, the improvement of S/N by 3 dB cannot be obtained in practice. The IF stage noise level is increased when IF SHIFT control is excessive. Again, use of the dual filter is very effective in minimizing the noise. With a crystal filter having an AF bandpass characteristic used at the IF stage output, the high frequency cutoff characteristic becomes sharp, improving the S/N ratio even when the IF SHIFT control is centered.

(2)Improvement in single signal selectivity.

The crystal filter XF1 at the IF input is in the AGC loop. So, when the received frequency is compressed while receiving an external signal, the crystal filter bandwidth characteristic is compressed by the AGC, and single signal selectivity as seen from the receiver output is deteriorated. By using a dual filter, the excellent bandwidth characteristic of the filter appears as the receiver bandwidth characteristic regardless of input signal level because the filter at the IF output is outside the AGC loop, eliminating the alternate sideband image.

(3)Improvement in compression effect during transmission.

The TS-180S RF speech compressor is designed to minimize splatter due to compression operation and amplifier distortion. Side band expansion can practically be disregarded. The side bands are expanded if the compression exceeds 30 dB, the full dynamic range of the balanced modulator circuit, at a fast time constant. By using Dual filters, the speech processor signal passes through the 2nd filter, and bandwidth is limited even during side band expansion, providing enhanced compression effect.

Switching of Transmit Output in FSK.

The TS-180S is designed to reduce transmitter output to 50 W in the FSK mode. The transmit output is detected and rectified as ALC voltage by R17 and R18 in the LPF unit (X51-1180-00). This voltage is applied through the ALC terminal on the IF unit (X48-1240-00) to ALC amplifier Q25 (2SC945) after voltage division by R103 (10 kohm) and R104

(56 kohm). The ALC voltage divided by the resistors is accomplished by transistor switch Q24 (2SC945). With the MODE switch in the FSK position, +8 V is applied to the base of Q23 (2SC945) via D52 from the IF unit FSB terminal. Thus, Q23 is ON and Q24 is OFF, producing a larger ALC voltage in FSK mode. This reduces the gain of Q22, which reduces transmit output.

6.8 DISPLAY UNIT (X54-1430-00)

Fig. 6.4 shows a block diagram of the Display unit. This unit is composed of a counter circuit, fluorescent tube drive circuit, pulse tone oscillator circuit, and external switch interface circuit, all of which are controlled by the micro processor Q20.

6.9 COUNTER CIRCUIT

The CTR signal (40.0–40.5 MHz) from the Premix unit (X50-1570-00) is amplified by Q1-3 (2SC460) and is waveform shaped by Q10. This signal is counted by Q11–14 (counter). The 4-digit (100 Hz to 100 kHz) data (4 bits \times 4) is divided to 4 bit \times 2 by the data selector Q15 and Q16 and is inputted to 26–29 (R4–7) and 34–37 (R12–15) of the microprocessor Q20. The data selector is controlled by the output from pin 25 (R3) of Q20. Input is stored in RAM in the microprocessor. Input is made when the GATE signal (pin-4 [IRQ] of Q20) falls.

Display circuit

Four digit data (100 Hz–100 kHz) stored in the microprocessor RAM is selected by the input data B0–B3 (38–41 [K0–K3] terminals). This is produced for each band by the MHz order preset matrix unit in the PLL assy (X60-1120-00).

The preset frequency is converted by the processor for driving the 7-segment display, which is connected to the indicating tube drive circuit through pins 13–20 (O0–O7). At the same time, individual digit drive signals are outputted from pins 9–12 (P0–P3), and are converted to DECIMAL by the binary-decimal converter Q23 (RCD) to drive the indicating tube.

Display changeover operation

When the DSP/DIF switch is depressed, the input of the gate circuit Q17 1/5 is changed from H to L and its output is changed from L to H. This is fed to pin 31 (R9) of the microprocessor through a flip-flop (latch) circuit. When this signal falls, the microprocessor produces a signal to drive the differential indicator.

NX174S-1

Display memory operation

When the DSP/M1 switch is depressed, the gate cir

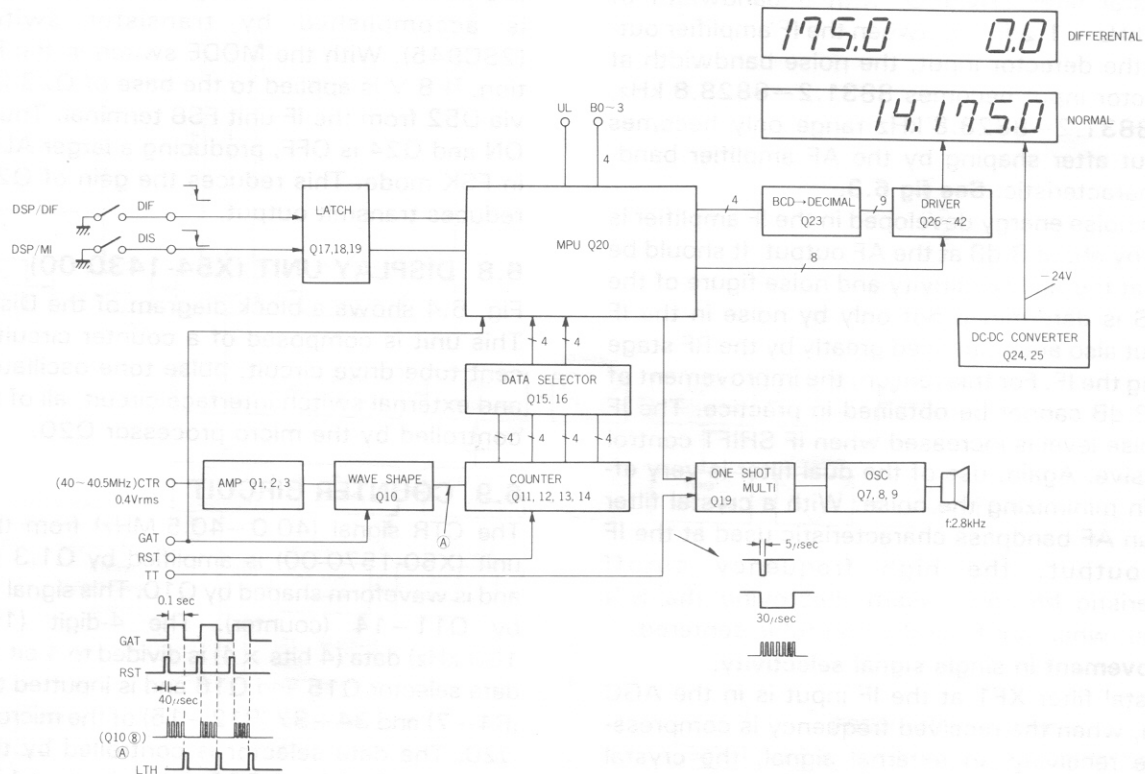


Fig. 6-4 DISPLAY Unit

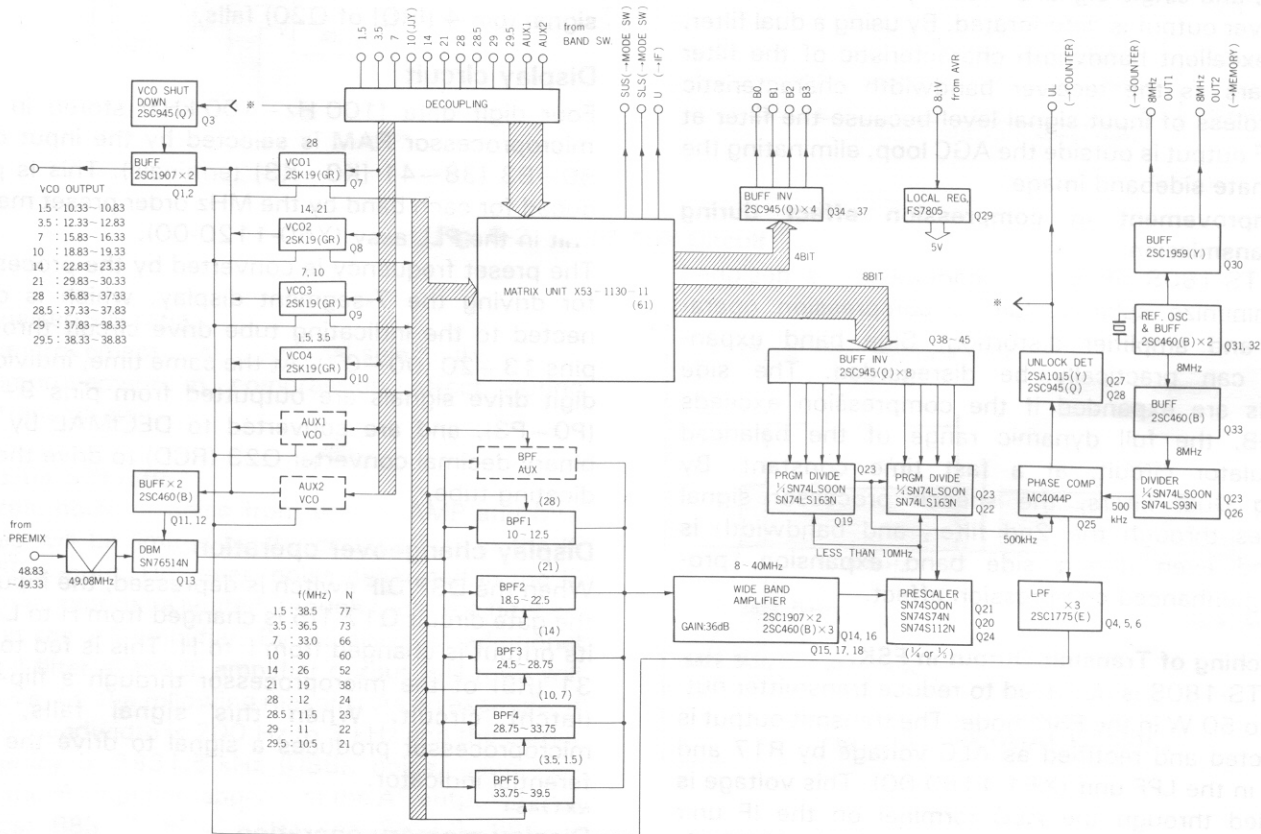


Fig. 6-5 PLL Circuit

cuit Q17 2/5 input is changed from H to L and the output is changed from L to H just as DSP/DIF switch operation. The DSP/M1 is applied to pin 30 (R8) of the microprocessor Q20 through latch Q18. When this signal falls, the frequency being displayed is stored. At this time, a pulse is outputted from pin 23 (R1) of Q20 to drive the pulse tone oscillator circuit. Pulse time is 30 m sec and frequency is 2.8 kHz. The time is determined by C8 and R16, and the frequency by C9 and R18.

6.10 PLL CIRCUIT

The TS-180S is a single conversion transceiver. The RF signal from the antenna is applied to the RX mixer where it is converted to 8.830 MHz (1st IF) by the VCO signal from the PLL unit. The VCO produces frequencies corresponding to each band as shown in Fig. 6-5.

The PLL is controlled by the band switch. In the 14 MHz band, the VCO frequency is 22.83–23.33 MHz and the frequency division ratio is 1/52. The 48.83 MHz signal from the PREMIX unit is mixed with the VCO frequency in the DBM (Double Balanced Mixer) to produce a 26.00 MHz output which is fed to the frequency dividing circuit through BPF3 (24.5–28.75 MHz) and WIDE BAND amplifier Q14–18. In the frequency dividing circuit the

signal is converted to 500 kHz by a frequency division ratio of 1/52.

The signal is then compared with the 500 kHz reference (1/16 of 8 MHz) from the standard oscillator. This output returns to the VCO through the LPF (Q4–6) to form a PLL loop. The 8 MHz standard oscillator output is also used by the Counter assy unit and Memory unit.

6.11 DFC OPERATION (See Fig. 6-6) (TS-180S with DFC only)

The frequency controlling signal (VFO, external VFO, FIX, or MEMORY) from Q3 in the PRE MIX unit is fed through the MRO terminal to the Control unit (X53-1100-00), where the input signal (6.699.8–6.000.02 MHz) is amplified by Q3 (2SC945), Q4 (2SA1015-Y) and Q15 (SN74L-SOON), and is then fed to the decimal counter Q22 (TC5032P). The 5-digit 10 Hz–100 kHz data is converted to a 4-bit signal and is applied to the data selector Q21 (TC4019BP) together with the BCD data (4 bit). Data selector control is by output 25 (R3) of the microprocessor Q23. The BCD (4 bit) output is applied to pins 38–41 (K0–K3) of Q23 and is stored in the RAM (Random Access Memory). This function is accomplished by the GATE signal at the pin 4 (IRQ) of Q23.

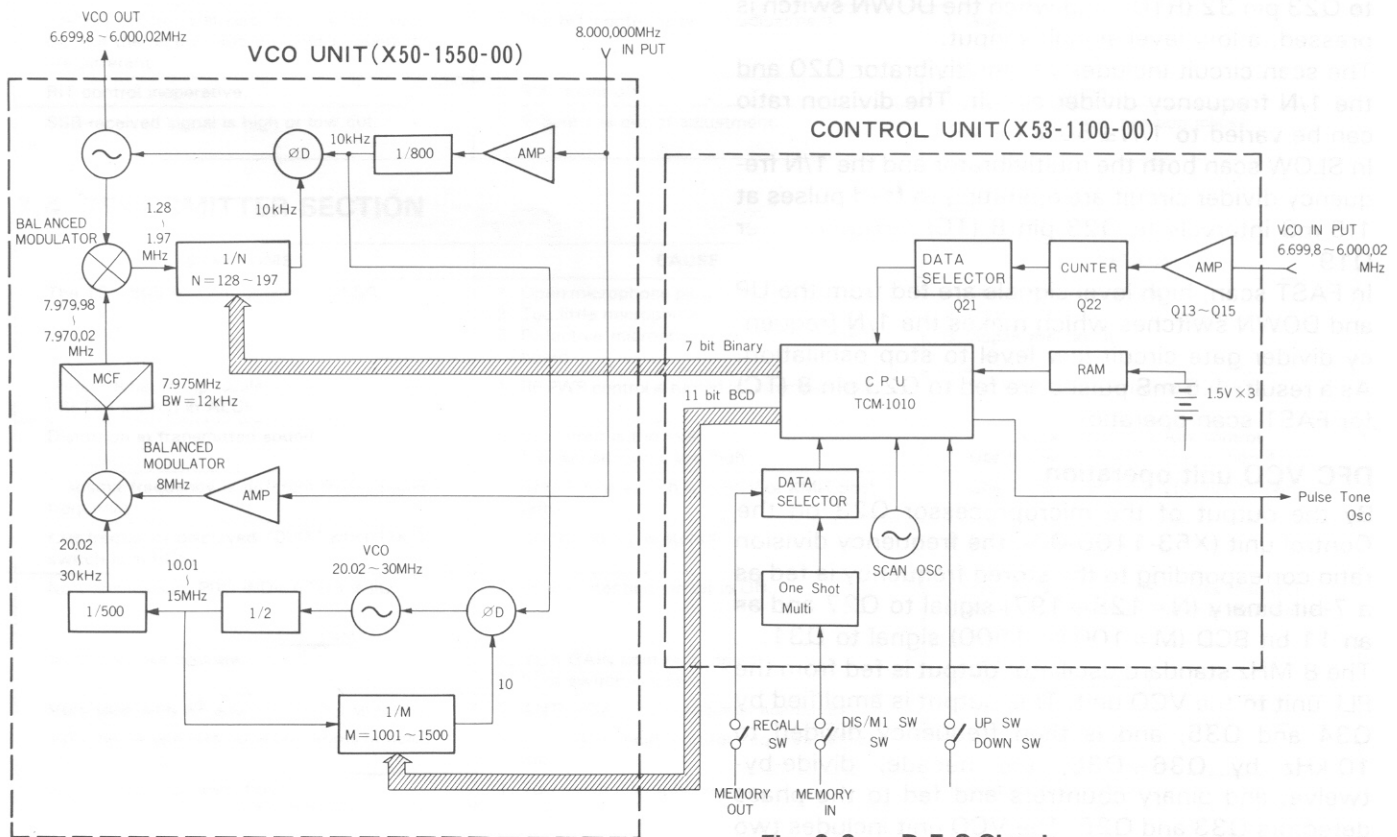


Fig. 6-6 D.F.C. Circuit

Memory in operation

By pressing the M.IN switch "M" or DSP/M1 switch, the RS flip-flop is activated by Q17 (TC7400BP) and its output is fed to the data selector Q18 (TC4019BP). The output of Q17 is also fed to pin 4 (IRQ) of Q23. Thus, the VFO frequency is stored in Q23's RAM.

When the frequency is stored, a signal is outputted from Q23 pin 38 (R11), which is then fed to the Display unit to activate the one-shot multivibrator which operates the tone oscillator circuit.

Memory out operation

The output logical level from Q8 and Q9 is established by pressing the M. RECALL switch to ON. The output is fed to the data selector Q18 and is further fed as a read command to Q23, 30 and 31 pins (R8, 9). The data stored in RAM is read out as a 7-bit binary signal and an 11-bit BCD signal. This output controls the frequency division ratio of the two frequency divider circuits in the VCO unit, which is fed back to the PRE MIX circuit through the VCO OUT.

UP/DOWN and scan operation

In the UP/DOWN operation, the signal is inputted from the RS flip-flop circuit Q19. That is, when the UP switch is pressed, a high level signal is inputted to Q23 pin 32 (R10), and when the DOWN switch is pressed, a low level signal is input.

The scan circuit includes the multivibrator Q20 and the 1/N frequency divider circuit. The division ratio can be varied to $1/N \pm 50\%$ by VR1.

In SLOW scan both the multivibrator and the 1/N frequency divider circuit are operating to feed pulses at 1.5 mS intervals to Q23 pin 8 (TC) through buffer Q19.

In FAST scan, high level signals are fed from the UP and DOWN switches which makes the 1/N frequency divider gate circuit low level to stop oscillation. As a result, 1.5 mS pulses are fed to Q23 pin 8 (TC) for FAST scan operation.

DFC VCO unit operation

By the output of the microprocessor Q23 on the Control unit (X53-1100-00), the frequency division ratio corresponding to the stored frequency is fed as a 7-bit binary ($N = 128 - 197$) signal to Q27 and as an 11-bit BCD ($M = 1001 - 1500$) signal to Q31.

The 8 MHz standard oscillator output is fed from the PLL unit to the VCO unit. This output is amplified by Q34 and Q35, and is then frequency divided to 10 kHz by Q36-Q38, the decade, divide-by-twelve, and binary counters and fed to the phase detectors Q33 and Q26. The VCO unit includes two separate PLL loops, Q33 and Q26.

The output of Q33 is applied to the VCO, Q19. This output (20.02-30.0 MHz) is frequency divided to 1/2 by Q28; one is fed to Q31 and the other is further divided to 1/500 by Q29.

In Q31 the 10.01-15.0 MHz output is divided to 1/M ($M = 1001 - 1500$) by the 11-bit BCD from the Control unit microprocessor to produce a 10 kHz output, which is fed to Q33 and compared with the standard oscillator output by Q33 the phase detector.

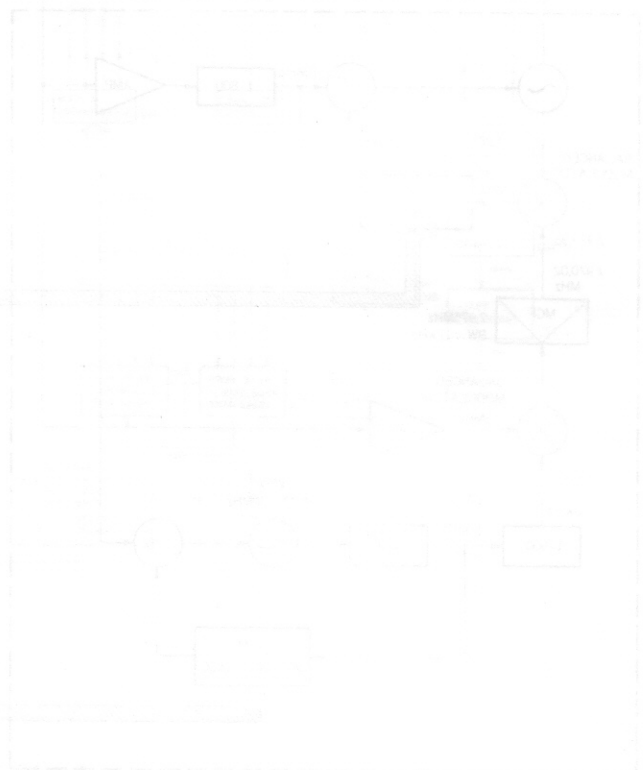
Since the output is divided to 1/500 by Q29, the output frequency becomes 20.02-30 kHz. That is, the change in one step of the frequency division command from the microprocessor is 20 Hz at the output of Q29.

The output of Q29 is mixed with the 8 MHz standard oscillator output by the balanced modulator D7-D10.

The output then becomes 7.979,98-7.970,02 MHz which is fed to Q11 through MCF filters XF2 and XF1. Q11 is in the Q26 PLL loop.

The output of VCO Q6 is 6.699,8-6.000,02 MHz, so the output of Q11 is 1.28-1.97 MHz.

This output is divided to 1/N ($N = 128 - 197$) by the 7-bit binary output of the microprocessor Q23 of the the control unit and is compared with the standard oscillator output by Q26.



SECTION 7 TROUBLESHOOTING

7.1 GENERAL INFORMATION

The problems described in this table are failures caused in general by improper operation or connection of the transceiver, not by defective components.

There is a separate service manual for repair of the TS-180S.

7.2 TRANSMITTER AND RECEIVER CIRCUITS

SYMPTOMS	CAUSE	REMEDY
Pilot lights do not light and there is no receiver noise when the POWER switch is turned on.	<ol style="list-style-type: none"> 1. Bad power cable or connections. 2. Blown power supply fuse. 3. Wrong polarity connection for DC operation. 	<ol style="list-style-type: none"> 1. Check cables and connections. 2. Replace the fuse. 3. Check for a negative ground power connection.
Frequency difference between transmit and receive. FMing on sideband operation.	<ol style="list-style-type: none"> 1. 8 VDC supply not adjusted. 2. Short circuit in 8 volt power supply or line. 3. Improper battery voltage in mobile or portable operation. 	<ol style="list-style-type: none"> 1. See Section 5.3. 2. Check the 8 volt supply. 3. Check battery or alternator voltage.
The relays operate with the stand-by switch in the REC position.	<ol style="list-style-type: none"> 1. Improper microphone connection. 	<ol style="list-style-type: none"> 1. Rewire the microphone connector.

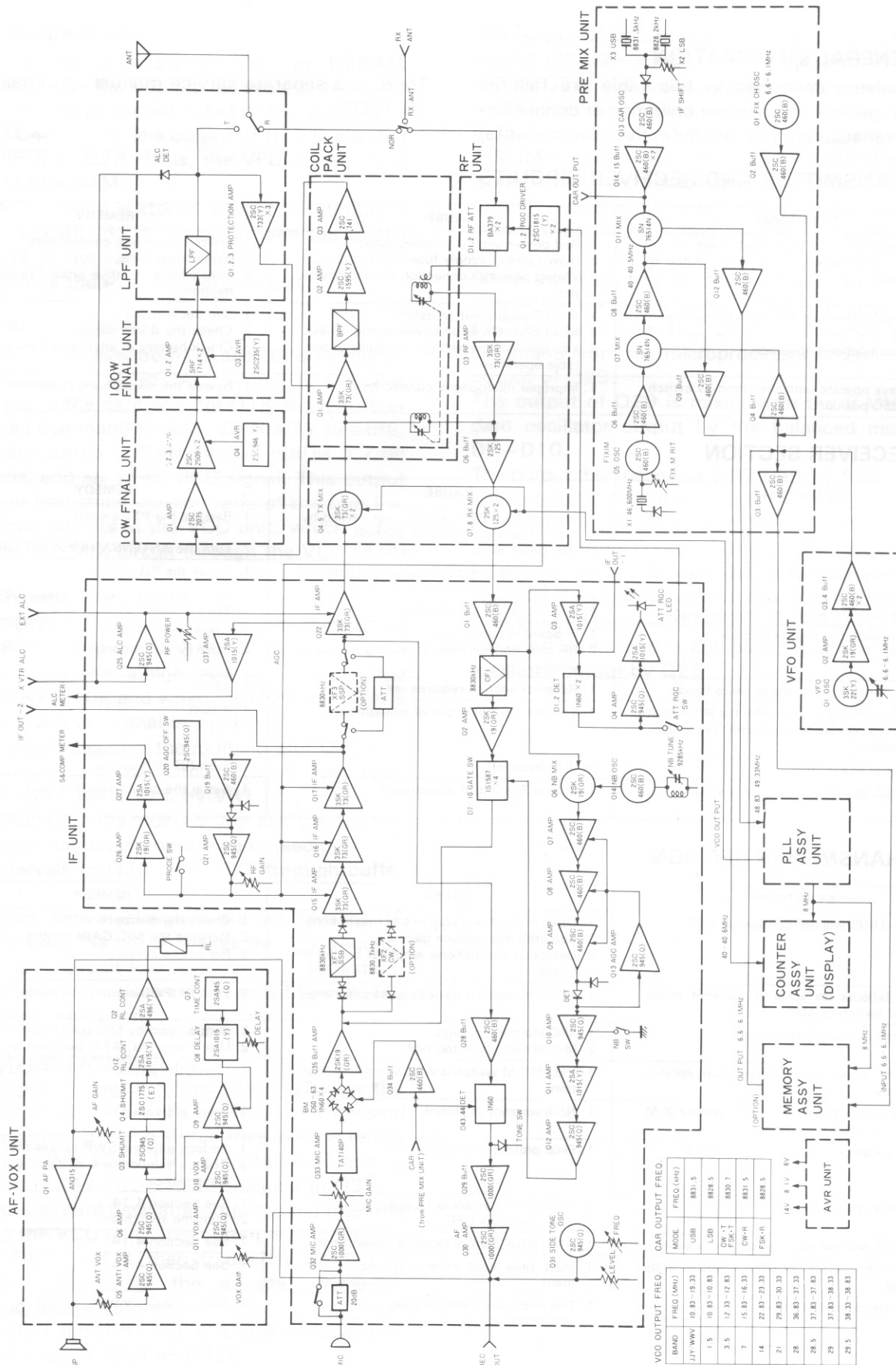
7.3 RECEIVER SECTION

SYMPTOMS	CAUSE	REMEDY
An antenna is connected but no signals are heard.	<ol style="list-style-type: none"> 1. Microphone PTT switch (or stand-by switch) is in the transmit position. 2. ANTENNA switch is in the RX ANT. 	<ol style="list-style-type: none"> 1. Release the PTT switch. 2. Turn the ANTENNA switch to NOR.
One or more bands are operating but some are not.	<ol style="list-style-type: none"> 1. The PLL unit is not operating on the defective band. 	<ol style="list-style-type: none"> 1. Repair the PLL unit.
S-meter deflects without a received signal.	<ol style="list-style-type: none"> 1. IF board is out of adjustment. 	<ol style="list-style-type: none"> 1. See Section 5.3.
S-meter reads too high or too low.	<ol style="list-style-type: none"> 1. IF board is out of adjustment. 2. RF gain control closed causing low sensitivity. 	<ol style="list-style-type: none"> 1. See Section 5.3. 2. Open RF GAIN control.
Lack of sensitivity on one or more bands.	<ol style="list-style-type: none"> 1. Receiver section requires realignment. 	<ol style="list-style-type: none"> 1. Align.
The RIT control is at zero with the RIT circuit on, but the receive and transmit frequencies are different.	<ol style="list-style-type: none"> 1. The RIT control is out of adjustment. 	<ol style="list-style-type: none"> 1. Adjust.
RIT control inoperative.	<ol style="list-style-type: none"> 1. RIT circuit off. 	<ol style="list-style-type: none"> 1. Push RIT button.
SSB received signal is high or low cut.	<ol style="list-style-type: none"> 1. IF SHIFT is out of adjustment. 	<ol style="list-style-type: none"> 1. Set in the center position (click).

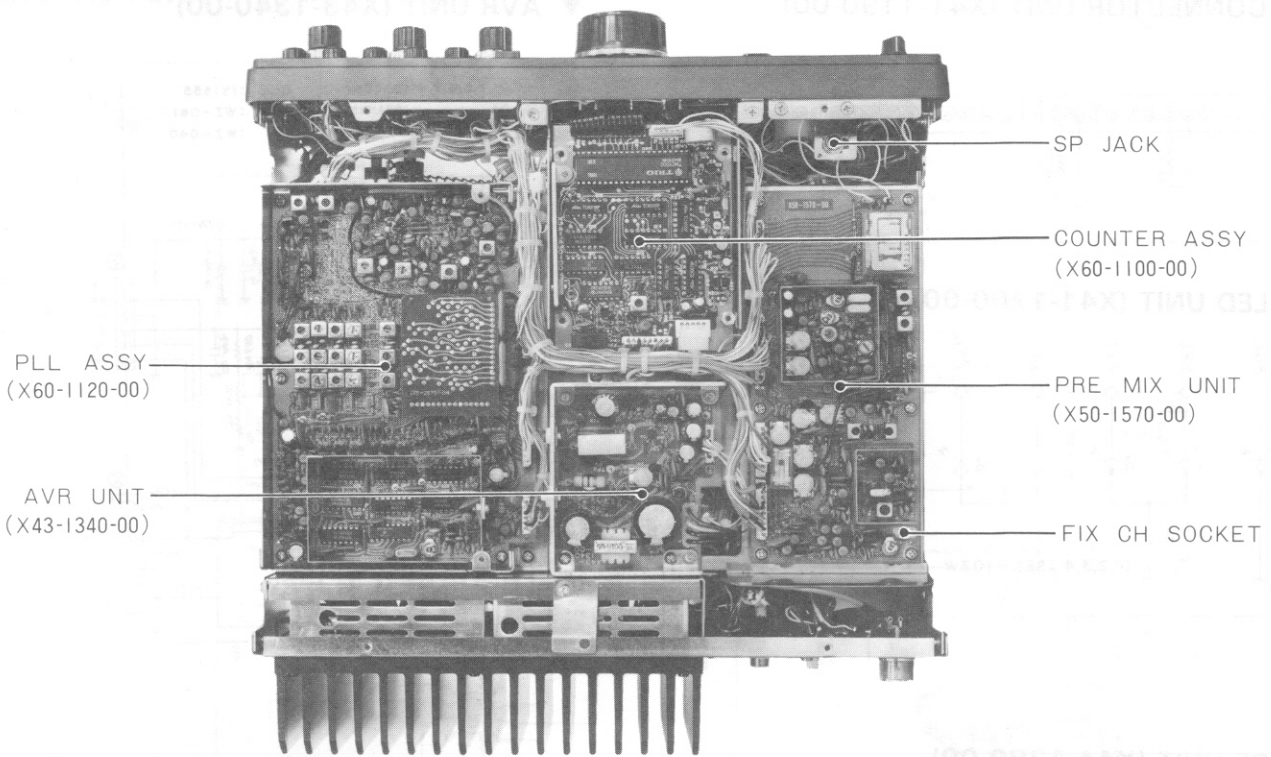
7.4 TRANSMITTER SECTION

SYMPTOMS	CAUSE	REMEDY
The TS-180S will not operate on SSB.	<ol style="list-style-type: none"> 1. Open microphone plug or bad microphone. 2. Too little microphone gain. 3. Defective microphone amplifier on the IF board. 	<ol style="list-style-type: none"> 1. Check the microphone. 2. Increase the MIC GAIN control. 3. Repair the circuit.
Meter deflects up scale in transmit mode (METER switch in ALC).	<ol style="list-style-type: none"> 1. RF PWR control is turned counterclockwise. 	<ol style="list-style-type: none"> 1. Turn RF PWR control clockwise.
Distortion in transmitted sound.	<ol style="list-style-type: none"> 1. MIC input is too high. 2. MIC sensitivity is too high. 	<ol style="list-style-type: none"> 1. Reduce gain by MIC GAIN control. 2. Use IF unit MIC ATT. See section 4.20.
Transmit frequency is different from receive frequency.	<ol style="list-style-type: none"> 1. VFO/FIX/M switch is in RCV or XMIT position. 	<ol style="list-style-type: none"> 1. Check the position of VFO/FIX/M switch.
KHz frequency displayed "000" when FIX/M switch is in RCV.	<ol style="list-style-type: none"> 1. No frequency is stored. 	<ol style="list-style-type: none"> 1. Store a frequency.
No transmission. PRO INDICATOR is lit.	<ol style="list-style-type: none"> 1. Final protection circuit is ON. 	<ol style="list-style-type: none"> 1. Reduce antenna SWR to less than 3:1. 2. Reduce temperature of final unit before transmission.
VOX does not operate.	<ol style="list-style-type: none"> 1. VOX GAIN control is closed. 2. VOX switch is OFF. 	<ol style="list-style-type: none"> 1. See Section 4.14. 2. Turn the switch on.
VOX trips with AF sound from the speaker.	<ol style="list-style-type: none"> 1. ANTI VOX control requires adjustment. 	<ol style="list-style-type: none"> 1. See Section 4.14.
VOX circuit releases between words or holds too long.	<ol style="list-style-type: none"> 1. VOX time hold control requires adjustment. 	<ol style="list-style-type: none"> 1. See Section 4.14.
Signal reports of distortion.	<ol style="list-style-type: none"> 1. Too much microphone gain. 	<ol style="list-style-type: none"> 1. Reduce MIC control.

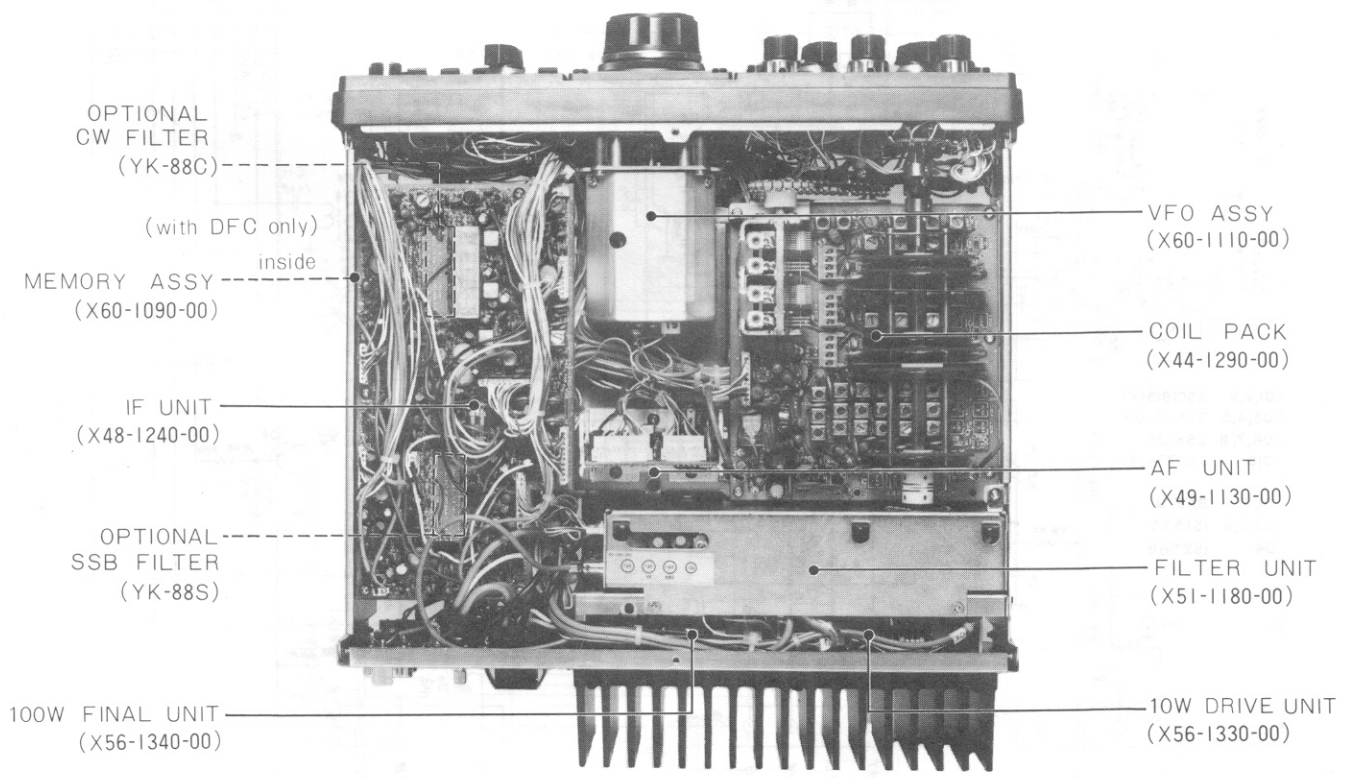
TS-180S BLOCK DIAGRAM



TOP AND BOTTOM VIEW OF THE TS-180S



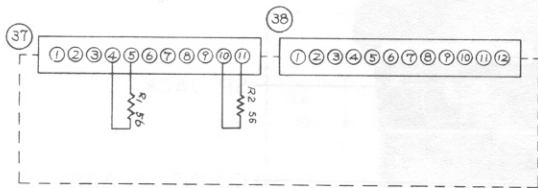
Top View



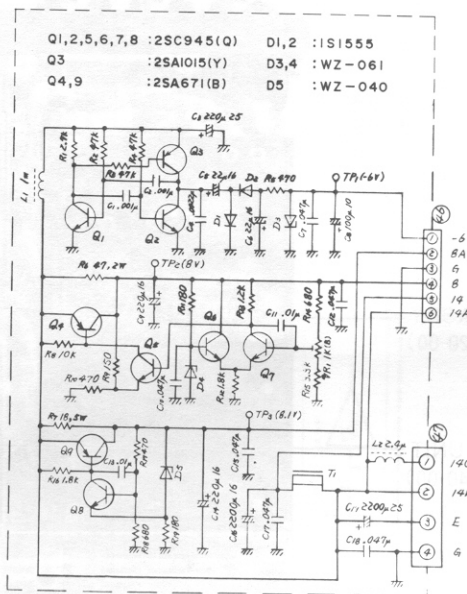
Bottom View

SCHEMATIC DIAGRAM

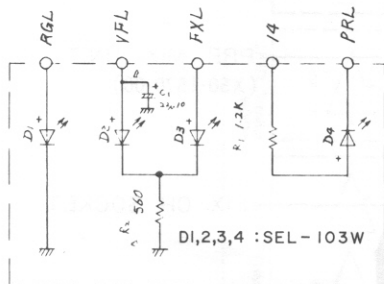
▼ CONNECTOR UNIT (X41-1190-00)



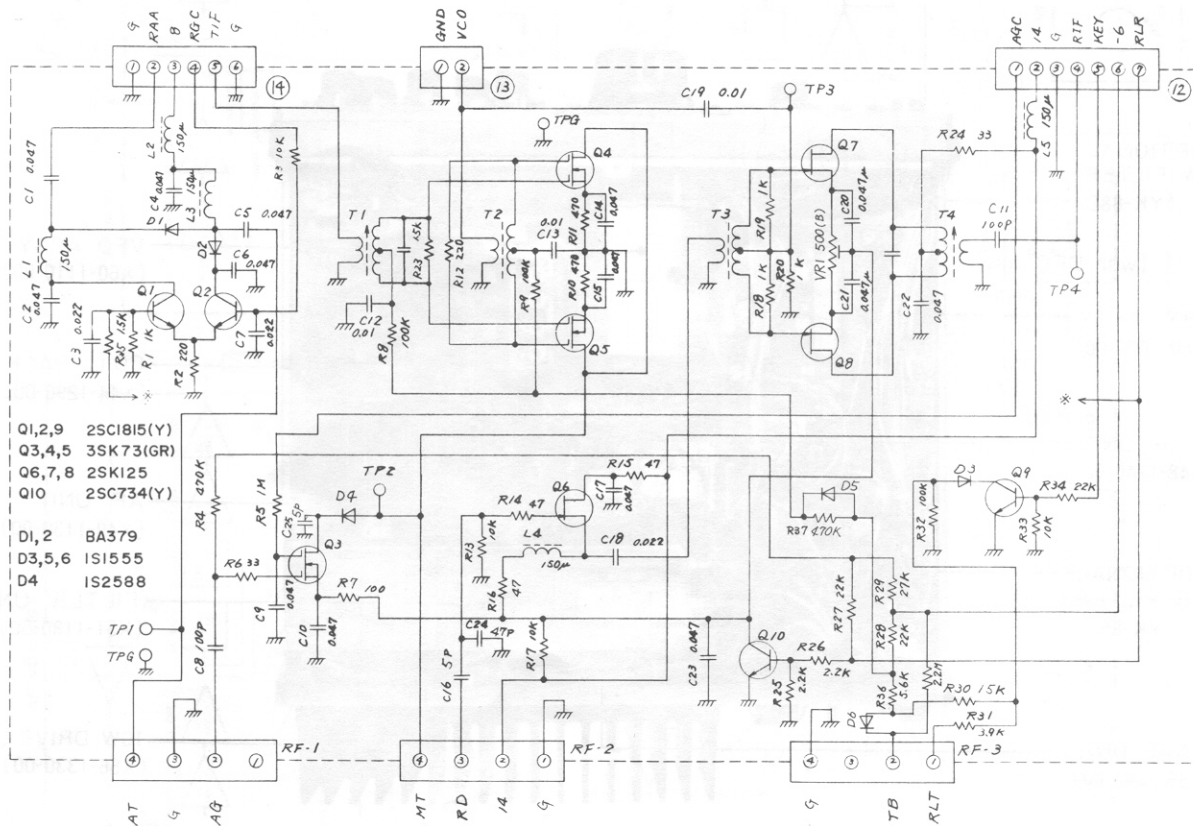
▼ AVR UNIT (X43-1340-00)



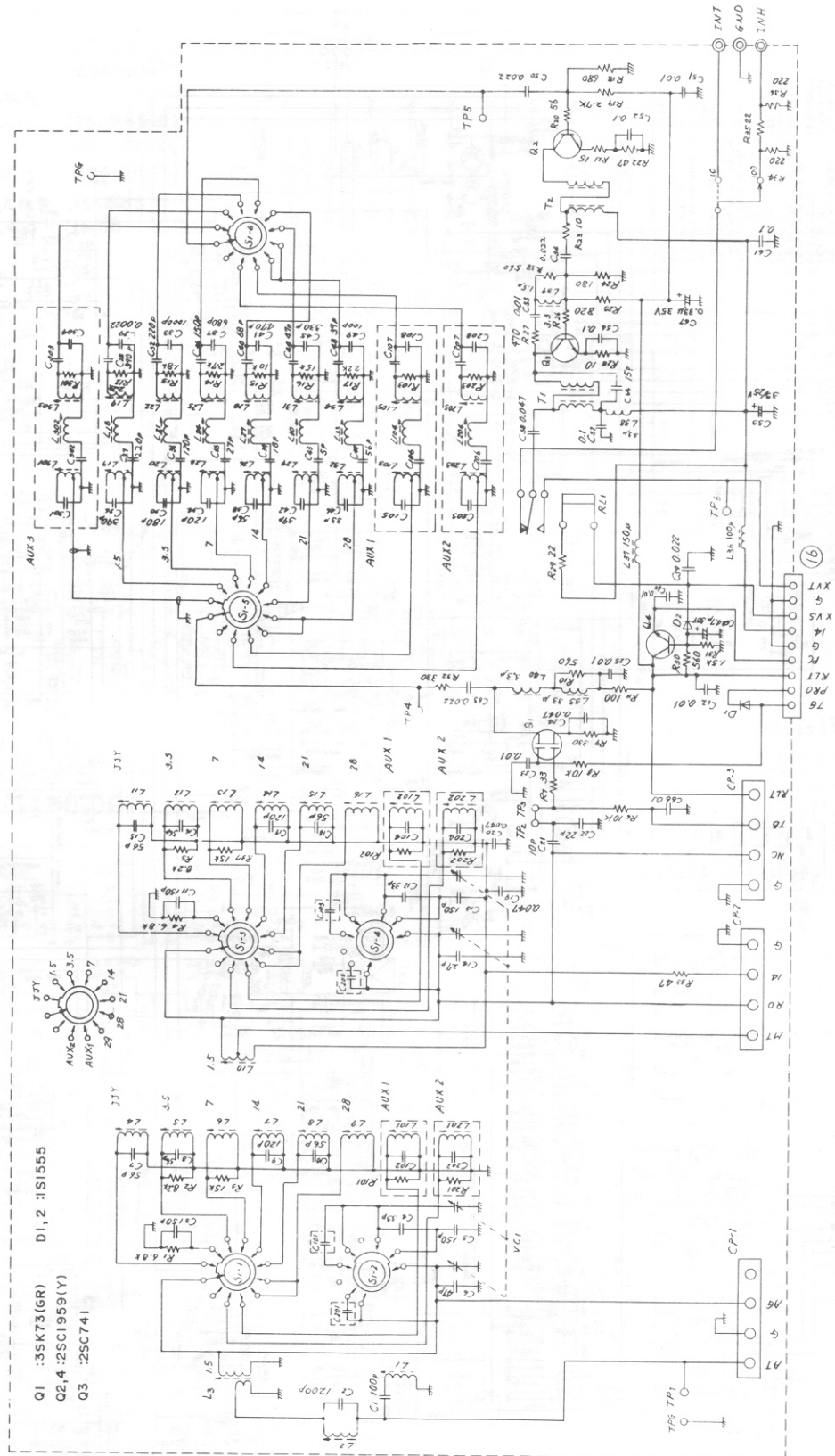
▼ LED UNIT (X41-1200-00)



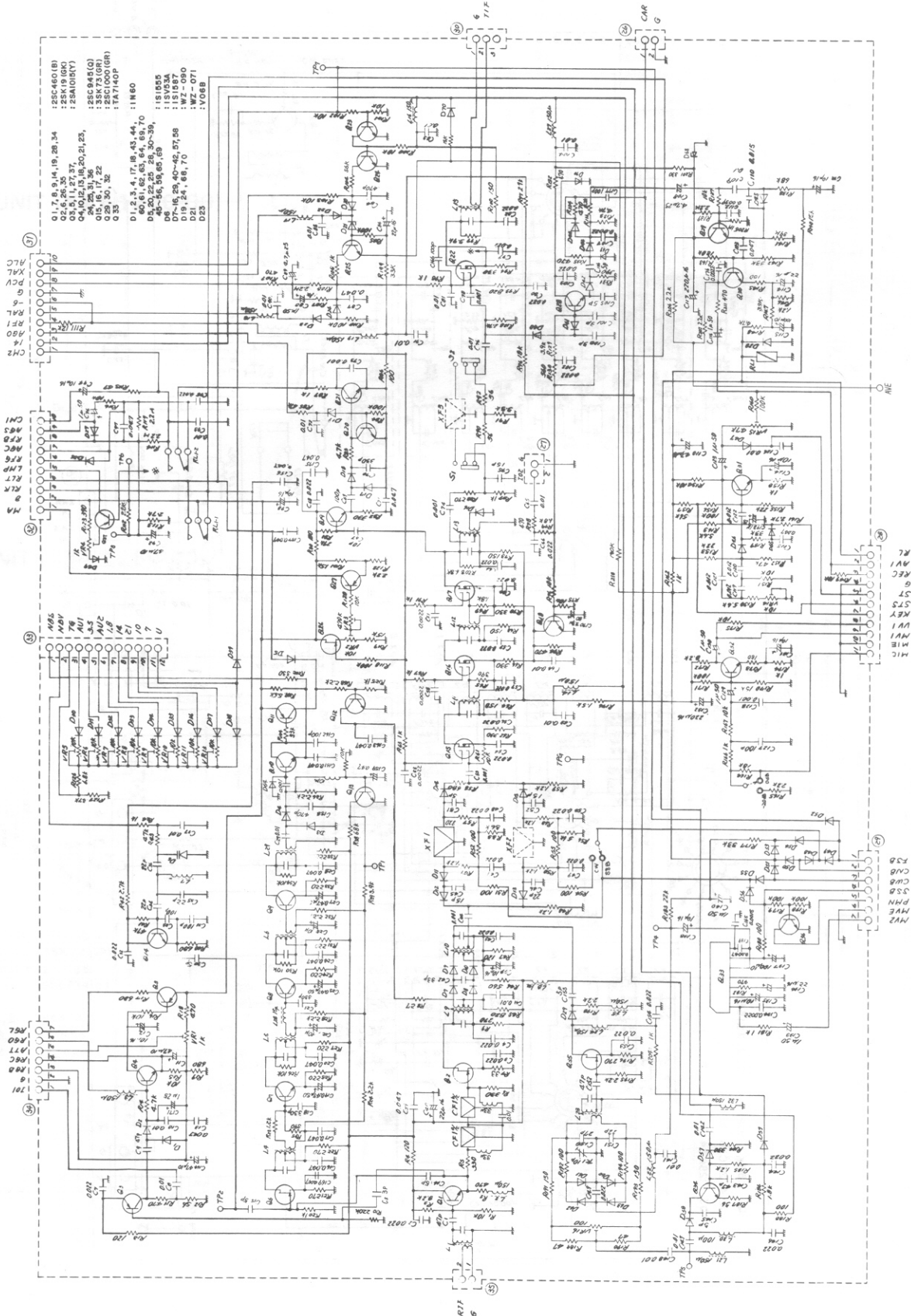
▼ RF UNIT (X44-1280-00)



▼ COILPACK UNIT (X44-1290-00)



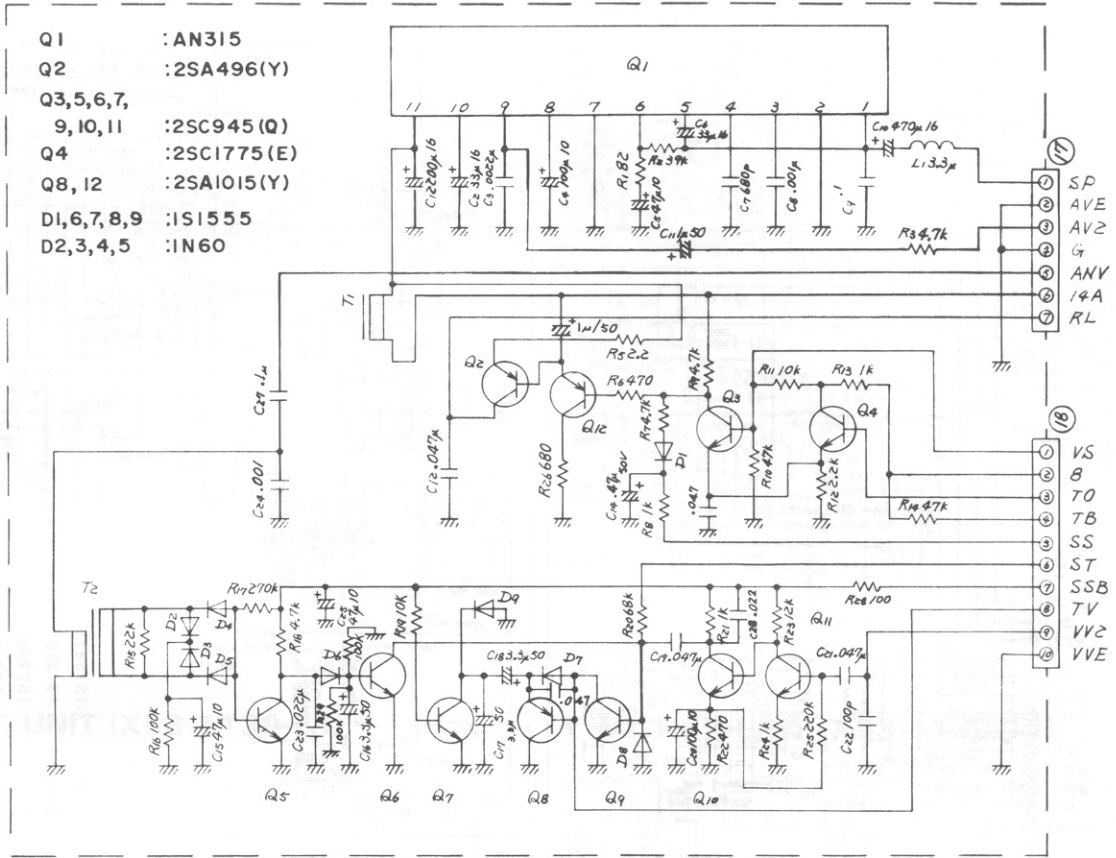
▼ IF UNIT (X48-1240-11)



TS-180S(K)

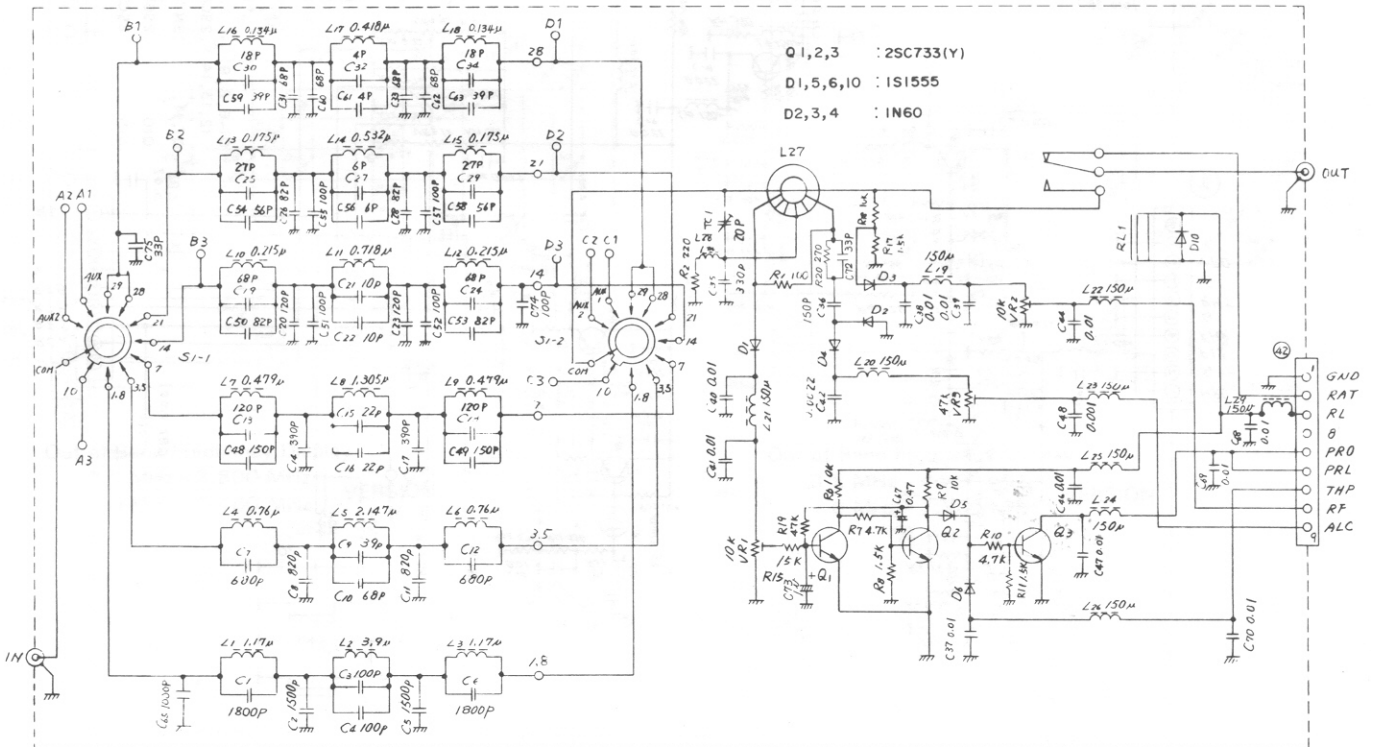
▼ AF VOX UNIT (X49-1130-00)

- Q1 : AN315
- Q2 : 2SA496(Y)
- Q3,5,6,7,9,10,11 : 2SC945(Q)
- Q4 : 2SC1775(E)
- Q8,12 : 2SA1015(Y)
- D1,6,7,8,9 : 1S1555
- D2,3,4,5 : 1N60

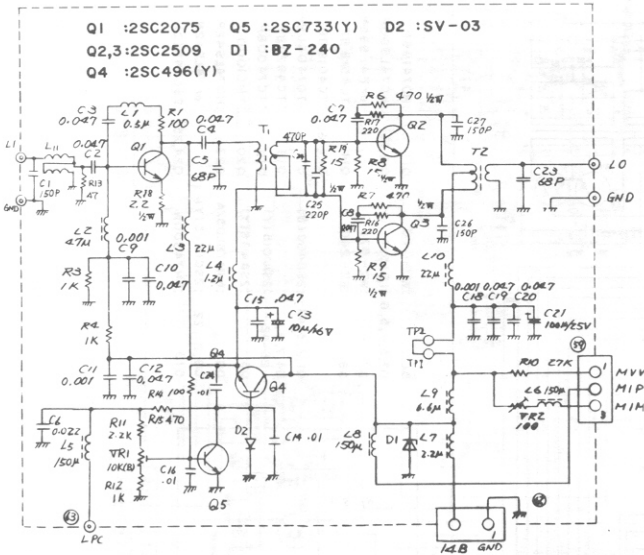


▼ LPF UNIT (X51-1180-00)

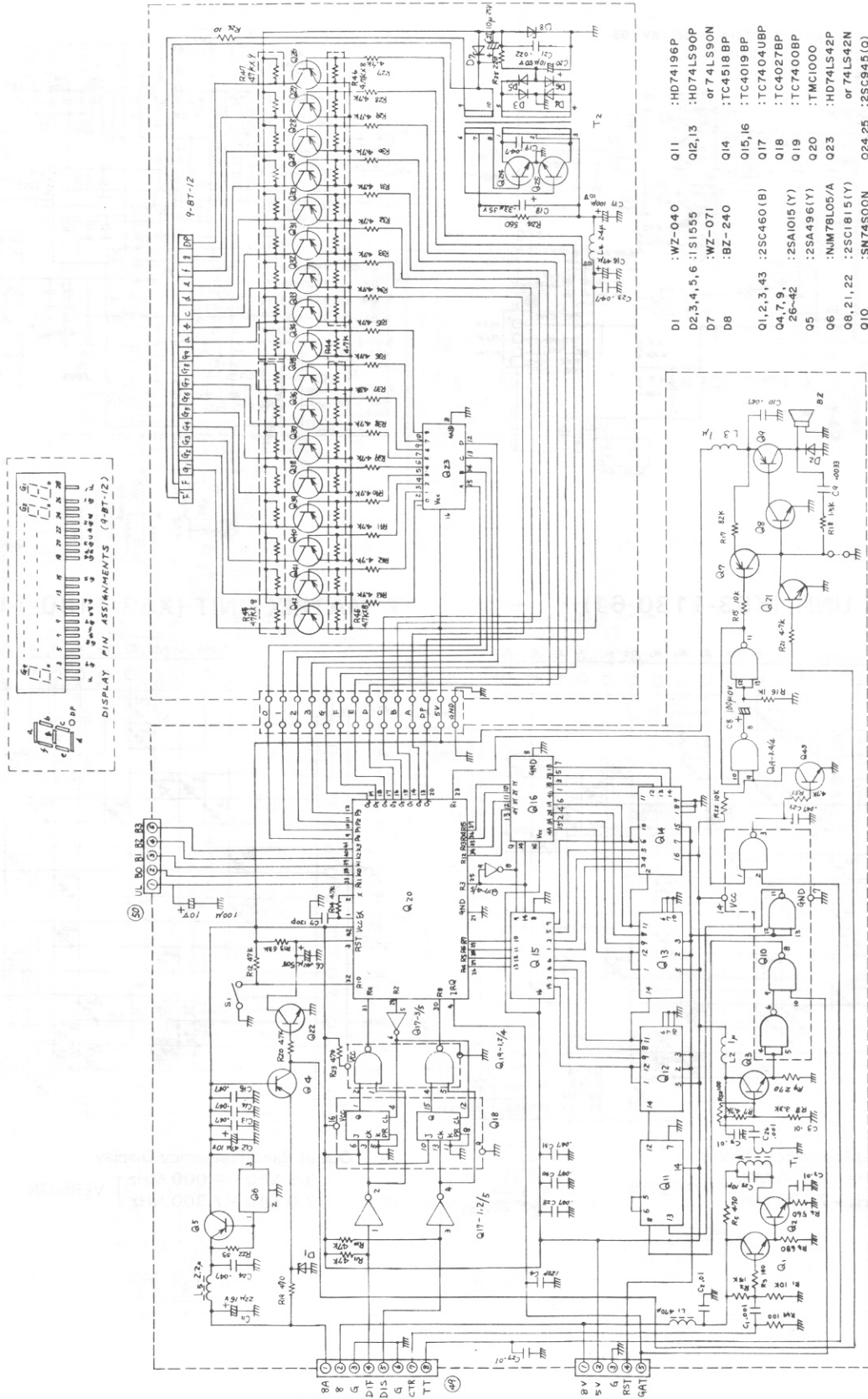
- Q1,2,3 : 2SC733(Y)
- D1,5,6,10 : 1S1555
- D2,3,4 : 1N60



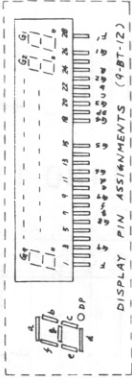
▼ 10 W DRIVE UNIT (X56-1330-01)



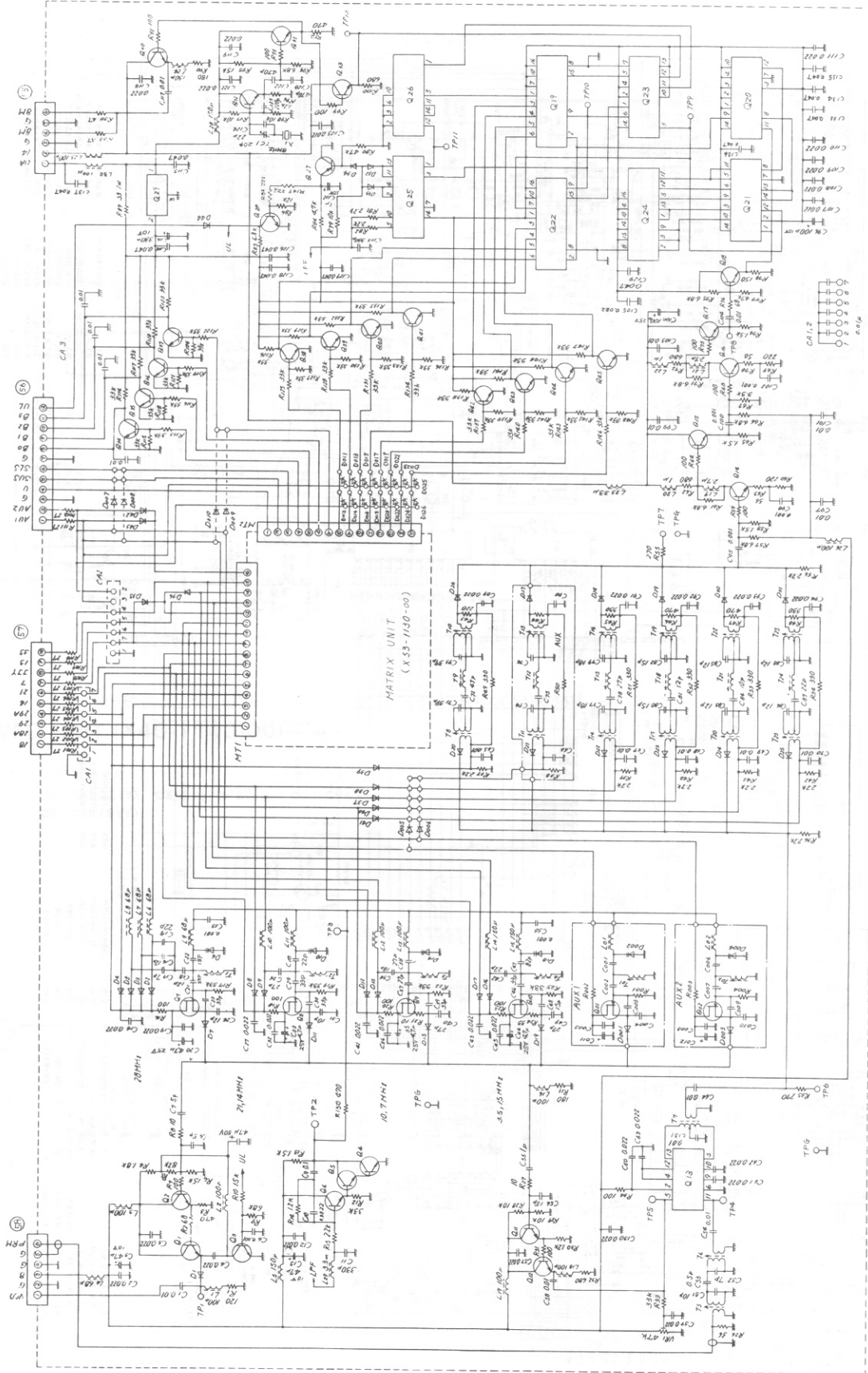
▼ DISPLAY UNIT (X60-1090-00)



- Q11 : HD74196P
- Q12,13 : HD74LS90P or 74LS90N
- Q14 : TC4518 BP
- Q15,16 : TC4019 BP
- Q17 : TC7404UBP
- Q18 : TC4027BP
- Q19 : TC7400BP
- Q20 : TMC1000
- Q23 : HD74LS42P or 74LS42N
- Q24,25 : 2SC945(Q)
- D1 : WZ-040
- D2,3,4,5,6 : S1555
- D7 : WZ-071
- D8 : BZ-240
- Q1,2,3,4,3 : 2SC460(B)
- Q4,7,9,26-42 : 2SA1015(Y)
- Q5 : 2SA496(Y)
- Q6 : NUM78L05/A
- Q8,21,22 : 2SC1815(Y)
- Q10 : SN74SOON



▼ PLL UNIT (X50-1560-00)

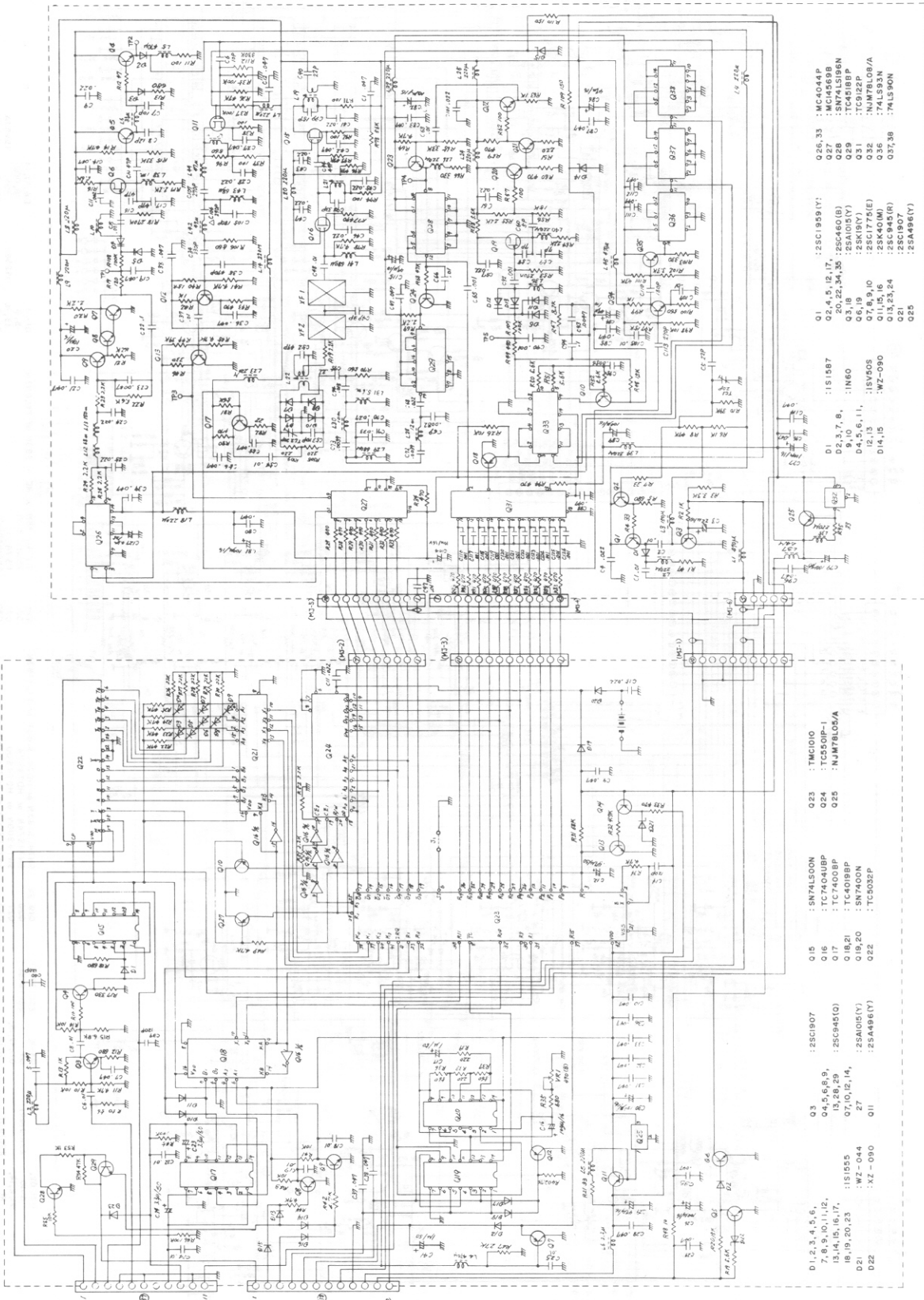


- Q4-6 : 25C1775(E)
- Q4-6 : 25K191(BL)
- Q1-12,15,17,18,31-33 : 25C945(Q)
- Q13 : 25C945(Q)
- Q19,22 : SN74LS163N or HD74LS163P or 74LS163N
- Q20 : SN74S00N or HD74S74
- Q21 : SN74S00N or HD74LS00P or 74LS00N
- Q23 : SN74S112N or HD74S112
- Q24 : SN74S112N or HD74S112
- Q25 : MC4044P
- Q26 : SN74LS93N or HD74LS93P or 74LS93N
- Q27 : 26A1015(Y)
- Q28 : 25C989(Y)
- Q30 : 25C989(Y)
- DI-3 : 25C989(Y)
- D1-3 : 25C989(Y)
- D4 : 25C989(Y)
- D5,16 : 25C989(Y)
- D6,10,14,18,002 : 25C989(Y)
- 004 : 25C989(Y)
- D20,31 : 25C989(Y)
- 12,15,17,19 : 25C989(Y)
- 001,003 : 25C989(Y)
- 005-026 : 25C989(Y)

▼ CONTROL UNIT (X53-1100-00)

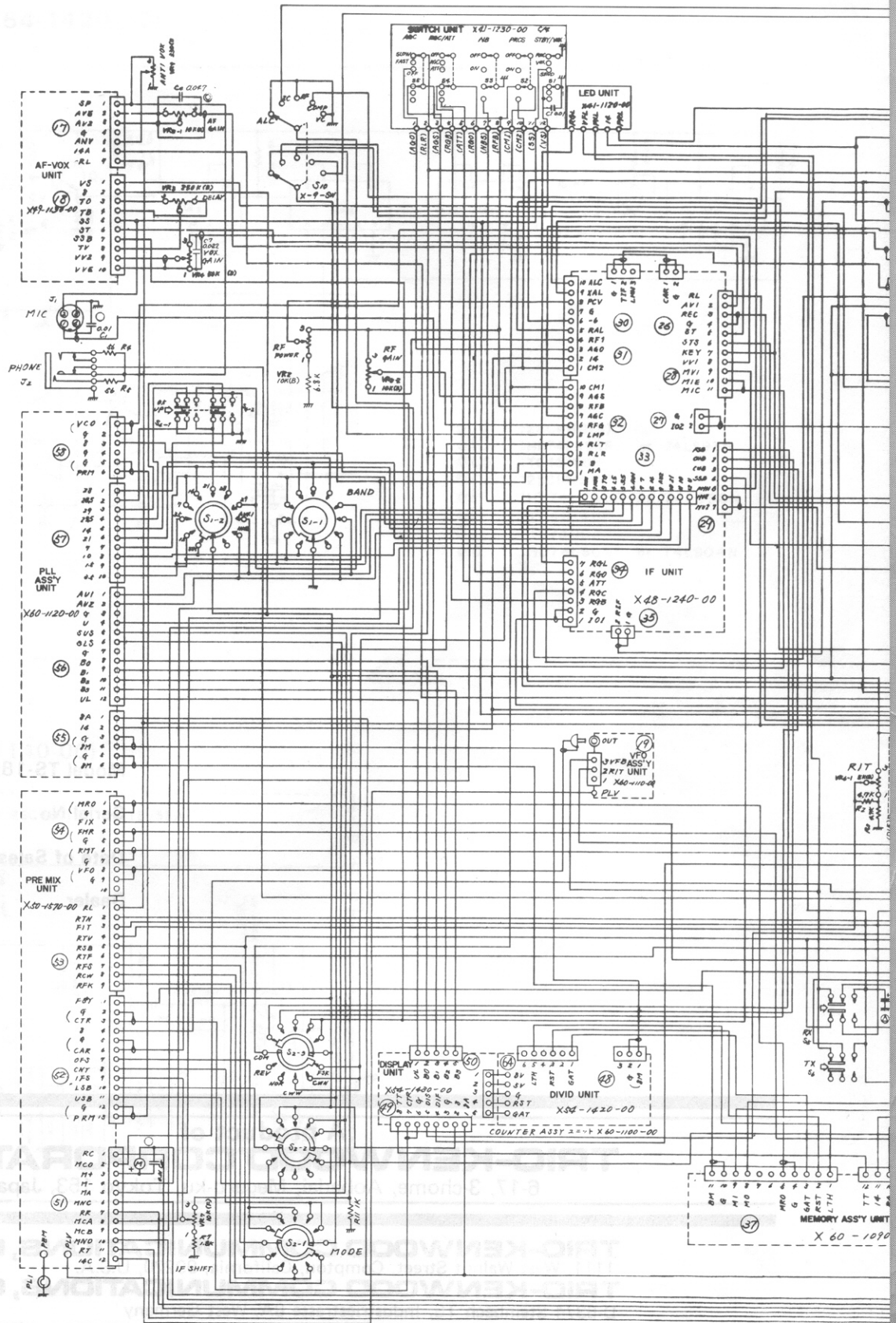
▼ VCO UNIT (X50-1550-00)

▼ MEMORY ASS'Y (X60-1090-00)

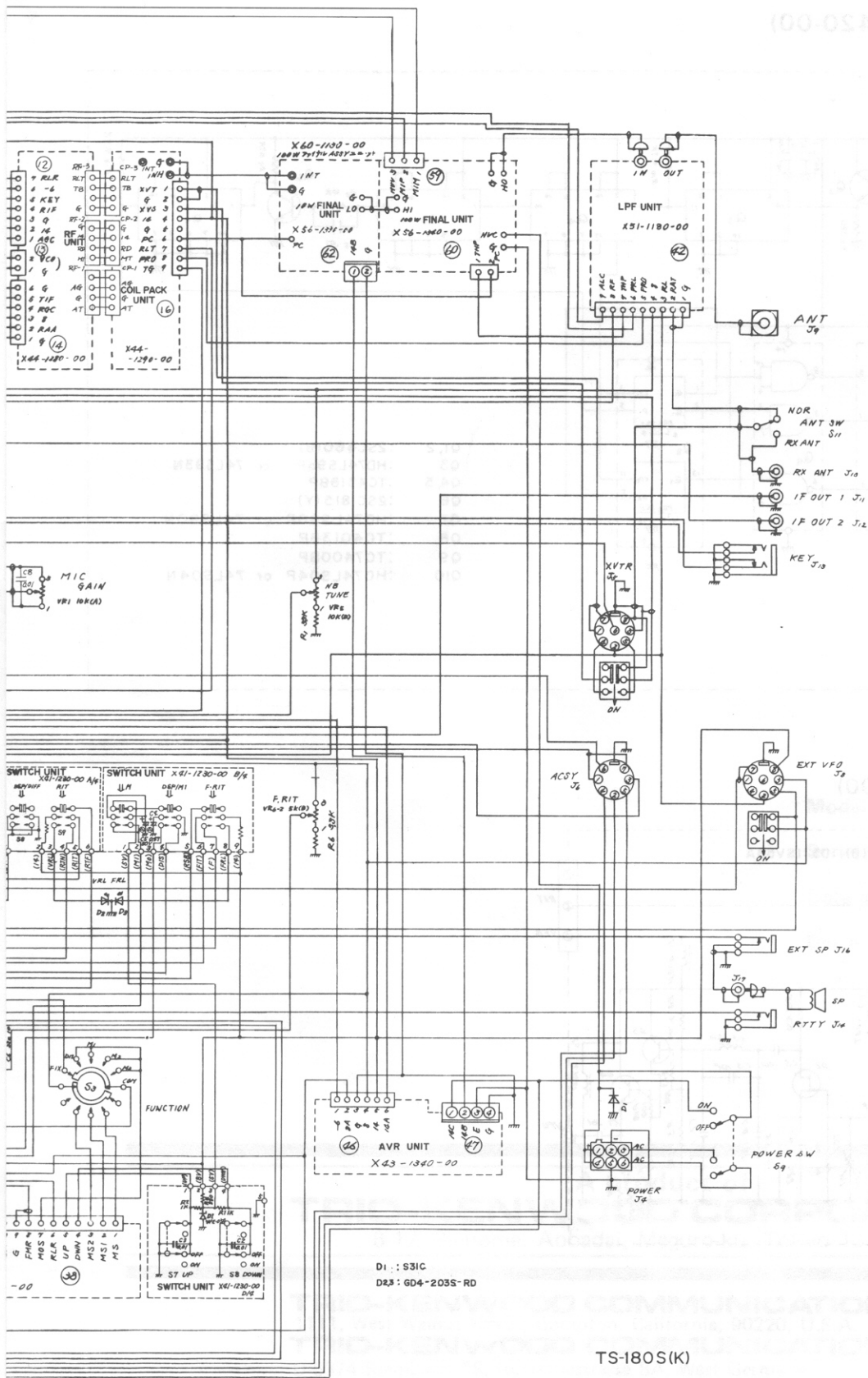


- | | | | | | | | | | |
|--|-------------|--|-------------|-----------|------------|-------------|-------------|-----------|-------------|
| D1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 | : 1S1555 | : 2SC1907 | Q3 | : 2SC1907 | Q15 | : SN74LS00N | Q23 | : TMC1010 | |
| D22 | : 2K-090 | Q4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 | : 2SC945(G) | Q24 | : TC7404BP | Q16 | : TC501P-1 | Q25 | : N4M78L05A |
| D23 | : 2SA486(Y) | Q11 | : 2SA486(Y) | Q25 | : TC4098P | Q18, 21 | : TC501P-1 | | |
| D24 | : 2K-044 | Q12 | : 2SA486(Y) | | : SN7400N | Q19, 20 | : N4M78L05A | | |
| D25 | : 2K-090 | Q13 | : 2SA486(Y) | | : TC8032P | Q22 | | | |
| D26 | : 2K-090 | Q14 | : 2SA486(Y) | | | | | | |
| D27 | : 2K-090 | Q15 | : 2SA486(Y) | | | | | | |
| D28 | : 2K-090 | Q16 | : 2SA486(Y) | | | | | | |
| D29 | : 2K-090 | Q17 | : 2SA486(Y) | | | | | | |
| D30 | : 2K-090 | Q18 | : 2SA486(Y) | | | | | | |
| D31 | : 2K-090 | Q19 | : 2SA486(Y) | | | | | | |
| D32 | : 2K-090 | Q20 | : 2SA486(Y) | | | | | | |
| D33 | : 2K-090 | Q21 | : 2SA486(Y) | | | | | | |
| D34 | : 2K-090 | Q22 | : 2SA486(Y) | | | | | | |
| D35 | : 2K-090 | Q23 | : 2SA486(Y) | | | | | | |
| D36 | : 2K-090 | Q24 | : 2SA486(Y) | | | | | | |
| D37 | : 2K-090 | Q25 | : 2SA486(Y) | | | | | | |
| D38 | : 2K-090 | Q26 | : 2SA486(Y) | | | | | | |
| D39 | : 2K-090 | Q27 | : 2SA486(Y) | | | | | | |
| D40 | : 2K-090 | Q28 | : 2SA486(Y) | | | | | | |
| D41 | : 2K-090 | Q29 | : 2SA486(Y) | | | | | | |
| D42 | : 2K-090 | Q30 | : 2SA486(Y) | | | | | | |
| D43 | : 2K-090 | Q31 | : 2SA486(Y) | | | | | | |
| D44 | : 2K-090 | Q32 | : 2SA486(Y) | | | | | | |
| D45 | : 2K-090 | Q33 | : 2SA486(Y) | | | | | | |
| D46 | : 2K-090 | Q34 | : 2SA486(Y) | | | | | | |
| D47 | : 2K-090 | Q35 | : 2SA486(Y) | | | | | | |
| D48 | : 2K-090 | Q36 | : 2SA486(Y) | | | | | | |
| D49 | : 2K-090 | Q37 | : 2SA486(Y) | | | | | | |
| D50 | : 2K-090 | Q38 | : 2SA486(Y) | | | | | | |
| D51 | : 2K-090 | Q39 | : 2SA486(Y) | | | | | | |
| D52 | : 2K-090 | Q40 | : 2SA486(Y) | | | | | | |
| D53 | : 2K-090 | Q41 | : 2SA486(Y) | | | | | | |
| D54 | : 2K-090 | Q42 | : 2SA486(Y) | | | | | | |
| D55 | : 2K-090 | Q43 | : 2SA486(Y) | | | | | | |
| D56 | : 2K-090 | Q44 | : 2SA486(Y) | | | | | | |
| D57 | : 2K-090 | Q45 | : 2SA486(Y) | | | | | | |
| D58 | : 2K-090 | Q46 | : 2SA486(Y) | | | | | | |
| D59 | : 2K-090 | Q47 | : 2SA486(Y) | | | | | | |
| D60 | : 2K-090 | Q48 | : 2SA486(Y) | | | | | | |
| D61 | : 2K-090 | Q49 | : 2SA486(Y) | | | | | | |
| D62 | : 2K-090 | Q50 | : 2SA486(Y) | | | | | | |
| D63 | : 2K-090 | Q51 | : 2SA486(Y) | | | | | | |
| D64 | : 2K-090 | Q52 | : 2SA486(Y) | | | | | | |
| D65 | : 2K-090 | Q53 | : 2SA486(Y) | | | | | | |
| D66 | : 2K-090 | Q54 | : 2SA486(Y) | | | | | | |
| D67 | : 2K-090 | Q55 | : 2SA486(Y) | | | | | | |
| D68 | : 2K-090 | Q56 | : 2SA486(Y) | | | | | | |
| D69 | : 2K-090 | Q57 | : 2SA486(Y) | | | | | | |
| D70 | : 2K-090 | Q58 | : 2SA486(Y) | | | | | | |
| D71 | : 2K-090 | Q59 | : 2SA486(Y) | | | | | | |
| D72 | : 2K-090 | Q60 | : 2SA486(Y) | | | | | | |
| D73 | : 2K-090 | Q61 | : 2SA486(Y) | | | | | | |
| D74 | : 2K-090 | Q62 | : 2SA486(Y) | | | | | | |
| D75 | : 2K-090 | Q63 | : 2SA486(Y) | | | | | | |
| D76 | : 2K-090 | Q64 | : 2SA486(Y) | | | | | | |
| D77 | : 2K-090 | Q65 | : 2SA486(Y) | | | | | | |
| D78 | : 2K-090 | Q66 | : 2SA486(Y) | | | | | | |
| D79 | : 2K-090 | Q67 | : 2SA486(Y) | | | | | | |
| D80 | : 2K-090 | Q68 | : 2SA486(Y) | | | | | | |
| D81 | : 2K-090 | Q69 | : 2SA486(Y) | | | | | | |
| D82 | : 2K-090 | Q70 | : 2SA486(Y) | | | | | | |
| D83 | : 2K-090 | Q71 | : 2SA486(Y) | | | | | | |
| D84 | : 2K-090 | Q72 | : 2SA486(Y) | | | | | | |
| D85 | : 2K-090 | Q73 | : 2SA486(Y) | | | | | | |
| D86 | : 2K-090 | Q74 | : 2SA486(Y) | | | | | | |
| D87 | : 2K-090 | Q75 | : 2SA486(Y) | | | | | | |
| D88 | : 2K-090 | Q76 | : 2SA486(Y) | | | | | | |
| D89 | : 2K-090 | Q77 | : 2SA486(Y) | | | | | | |
| D90 | : 2K-090 | Q78 | : 2SA486(Y) | | | | | | |
| D91 | : 2K-090 | Q79 | : 2SA486(Y) | | | | | | |
| D92 | : 2K-090 | Q80 | : 2SA486(Y) | | | | | | |
| D93 | : 2K-090 | Q81 | : 2SA486(Y) | | | | | | |
| D94 | : 2K-090 | Q82 | : 2SA486(Y) | | | | | | |
| D95 | : 2K-090 | Q83 | : 2SA486(Y) | | | | | | |
| D96 | : 2K-090 | Q84 | : 2SA486(Y) | | | | | | |
| D97 | : 2K-090 | Q85 | : 2SA486(Y) | | | | | | |
| D98 | : 2K-090 | Q86 | : 2SA486(Y) | | | | | | |
| D99 | : 2K-090 | Q87 | : 2SA486(Y) | | | | | | |
| D100 | : 2K-090 | Q88 | : 2SA486(Y) | | | | | | |
| D101 | : 2K-090 | Q89 | : 2SA486(Y) | | | | | | |
| D102 | : 2K-090 | Q90 | : 2SA486(Y) | | | | | | |
| D103 | : 2K-090 | Q91 | : 2SA486(Y) | | | | | | |
| D104 | : 2K-090 | Q92 | : 2SA486(Y) | | | | | | |
| D105 | : 2K-090 | Q93 | : 2SA486(Y) | | | | | | |
| D106 | : 2K-090 | Q94 | : 2SA486(Y) | | | | | | |
| D107 | : 2K-090 | Q95 | : 2SA486(Y) | | | | | | |
| D108 | : 2K-090 | Q96 | : 2SA486(Y) | | | | | | |
| D109 | : 2K-090 | Q97 | : 2SA486(Y) | | | | | | |
| D110 | : 2K-090 | Q98 | : 2SA486(Y) | | | | | | |
| D111 | : 2K-090 | Q99 | : 2SA486(Y) | | | | | | |
| D112 | : 2K-090 | Q100 | : 2SA486(Y) | | | | | | |

TS-180S SCHEM



WIRING DIAGRAM

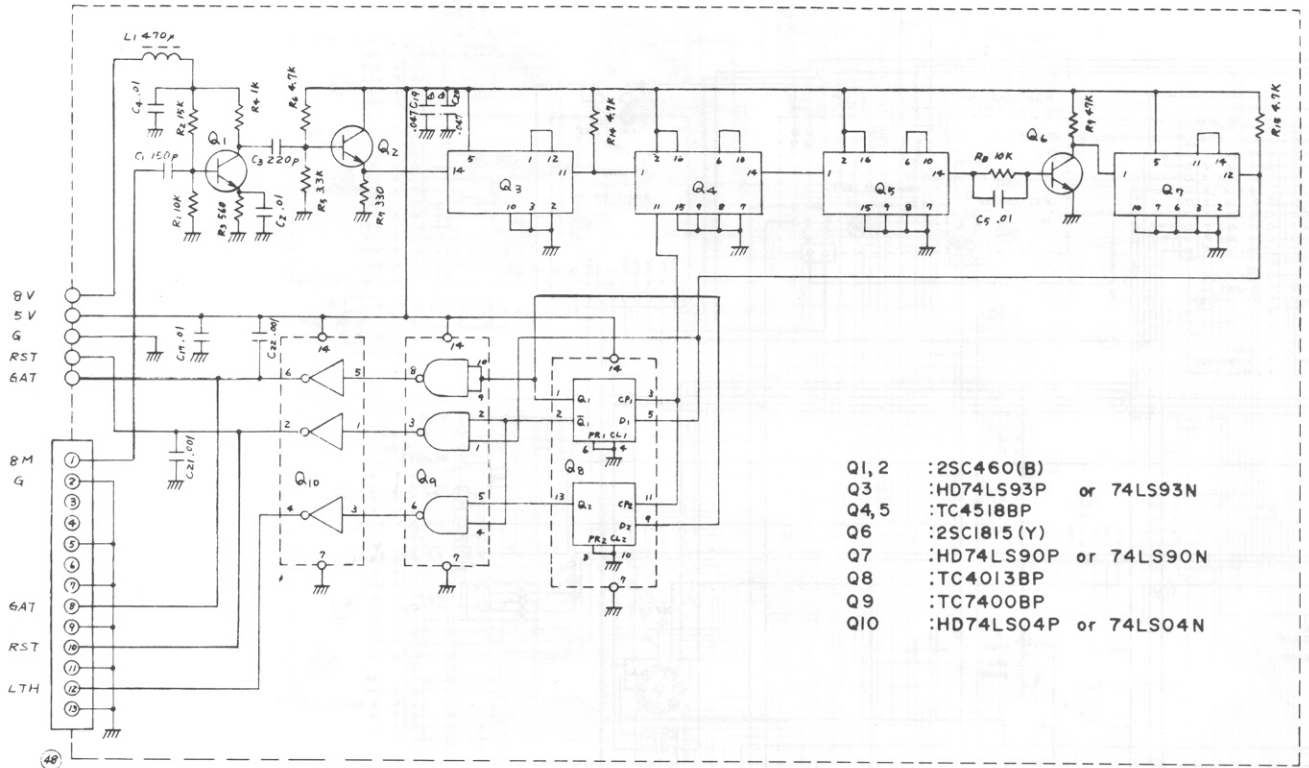


D1 : S31C
 D2 : GD4-203S-RD

TS-180S(K)

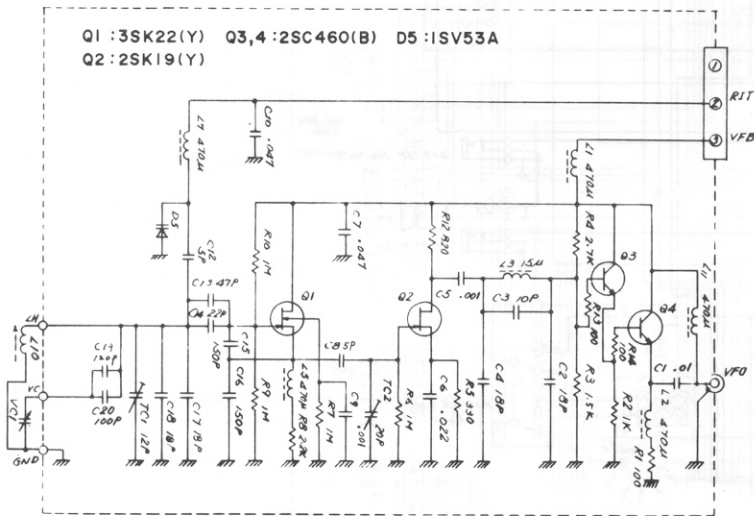
Circuits and specifications are subject to change for improvement.

▼ DIVIDE UNIT (X54-1420-00)

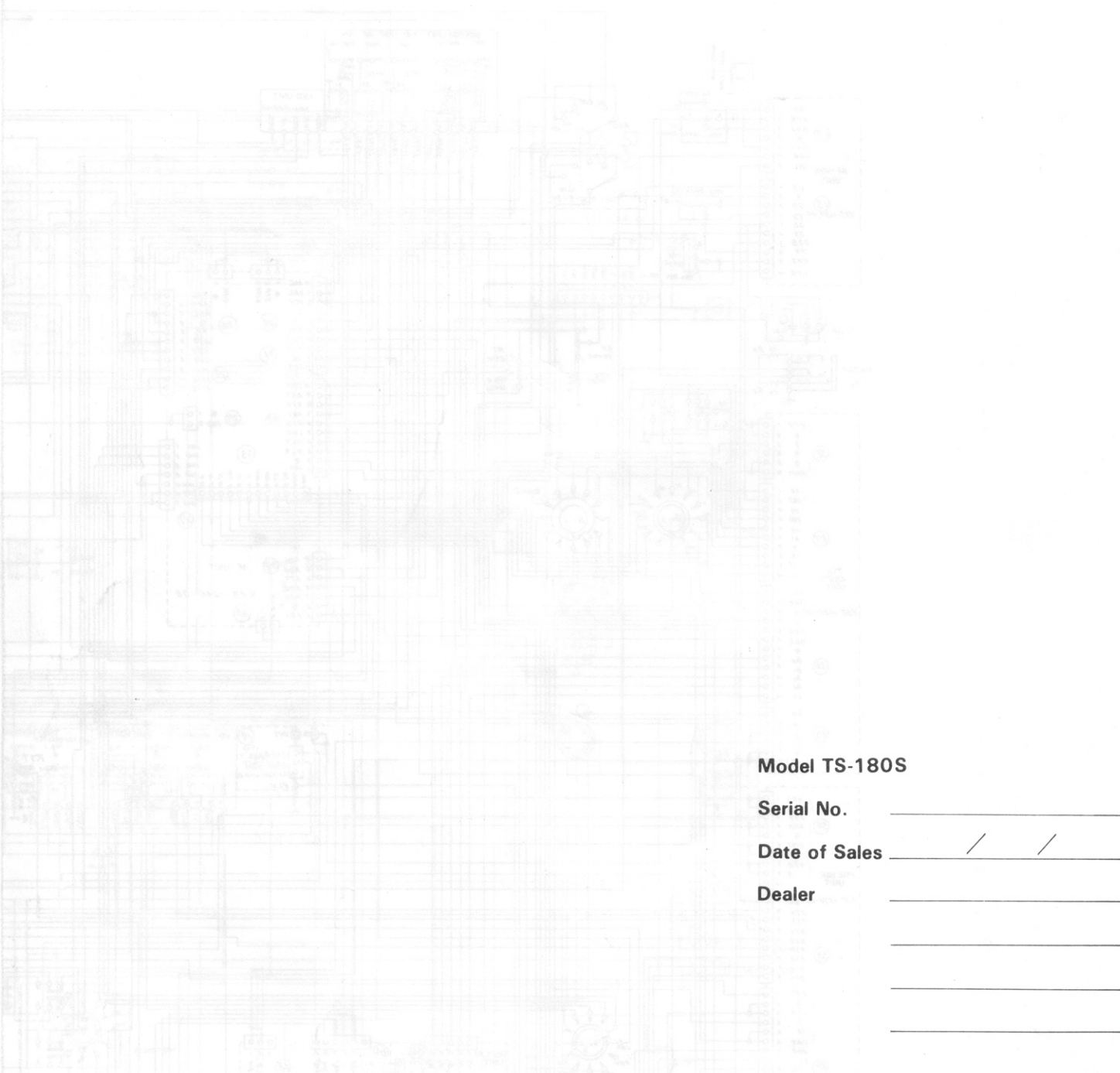


- Q1, 2 : 2SC460(B)
- Q3 : HD74LS93P or 74LS93N
- Q4, 5 : TC4518BP
- Q6 : 2SC1815(Y)
- Q7 : HD74LS90P or 74LS90N
- Q8 : TC4013BP
- Q9 : TC7400BP
- Q10 : HD74LS04P or 74LS04N

▼ VFO UNIT (X40-1140-00)



TS-180S SCHEM



Model TS-180S

Serial No. _____

Date of Sales _____ / _____ / _____

Dealer _____

A product of
TRIO-KENWOOD CORPORATION

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