

# INSTRUCTION MANUAL

**KENWOOD**

HF/ 50 MHz ALL MODE TRANSCEIVER

**TS-480HX**

**TS-480SAT**

**KENWOOD CORPORATION**

© B62-1735-00 (K, E)  
09 08 07 06 05 04 03 02 01 00

## NOTICE TO THE USER

One or more of the following statements may be applicable for this equipment.

### **FCC WARNING**

*This equipment generates or uses radio frequency energy. Changes or modifications to this equipment may cause harmful interference unless the modifications are expressly approved in the instruction manual. The user could lose the authority to operate this equipment if an unauthorized change or modification is made.*

### **INFORMATION TO THE DIGITAL DEVICE USER REQUIRED BY THE FCC**

*This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.*

*This equipment generates, uses and can generate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that the interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:*

- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment to an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer for technical assistance.*

## EUROPEAN CUSTOMERS

Amateur radio regulations vary from country to country. Confirm your local amateur radio regulations and requirements before operating the transceiver.

Depending on the size and type of vehicle, the maximum transmission output power for the mobile operation will vary. The maximum transmission output power is usually specified by the car manufacturer to avoid interference with other electric devices used in the car. Consult your car manufacturer and amateur radio equipment dealer for the requirements and installation.

# THANK YOU

## THANK YOU

Thank you for choosing this **KENWOOD** TS-480SAT/ HX transceiver. It has been developed by a team of engineers determined to continue the tradition of excellence and innovation in **KENWOOD** transceivers.

This transceiver features a Digital Signal Processing (DSP) unit to process AF signals. By taking maximum advantage of DSP technology, the TS-480SAT/ HX transceiver gives you enhanced interference reduction capabilities and improves the quality of audio. You will notice the differences when you fight QRM and QRN. As you learn how to use this transceiver, you will also find that **KENWOOD** is pursuing "user friendliness". For example, each time you change the Menu No. in Menu mode, you will see scrolling messages on the display that tell you what you are selecting.

Though user friendly, this transceiver is technically sophisticated and some features may be new to you. Consider this manual to be a personal tutorial from the designers. Allow the manual to guide you through the learning process now, then act as a reference in the coming years.

## FEATURES

- All mode operation from HF to 50 MHz amateur radio band with DSP functions
- Separate Remote Control panel for mobile operation
- Digital Signal Processing (DSP) unit
- Adjustable DSP filter frequencies
- A built-in Antenna Tuner for the HF/ 50 MHz band (TS-480SAT)
- 200 watts output power (TS-480HX)

## SUPPLIED ACCESSORIES

After carefully unpacking the transceiver, identify the items listed in the table below. We recommend you keep the box and packing materials in case you need to repack the transceiver in the future.

Accessory	Part Number	Quantity			
		TS-480SAT		TS-480HX	
		K	E	K	E
Microphone	T91-0638-XX	1	1	1	1
DC power cable	E30-3489-XX	1	1	2	2
mini DIN plug (6-pin male)	E57-0404-XX	1	1	1	1
mini DIN plug (8-pin male)	E57-0405-XX	1	1	1	1
Modular cable (RJ-11 4 m)	E30-3488-XX	1	1	1	1
Modular cable (RJ-11 20 cm)	E30-3500-XX	–	1	–	1
Fuse (25 A)	F05-2531-XX	1	1	2	2
Fuse (4 A)	F06-4027-XX	1	1	1	1
Screw Set for brackets (A)	N99-2035-XX	1	1	1	1
L-bracket	J29-0706-XX	2	2	2	2
Panel holder	J29-0663-XX	1	2	1	2
Panel bracket (mobile)	J29-0707-XX	1	1	1	1
Panel bracket (base)	J09-0409-XX	1	1	1	1
Line filter with a retaining band	L79-1408-XX	–	1	–	2
Line filter for Panel	L79-1417-XX	1	1	1	1
Portable bracket	J29-0705-XX	–	1	–	1
Carrying handle	K01-0420-XX	–	1	–	1
Screw set for Portable bracket (B)	N99-2041-XX	–	1	–	1
Instruction Manual	B62-1735-XX	E	1	1	1
	B62-1750-XX	F	–	1	–
	B62-1752-XX	S	–	1	–
	B62-1736-XX	G	–	1	–
	B62-1751-XX	I	–	1	–
	B62-1753-XX	D	–	1	–
Schematic/ Block Diagrams	B52-0619-XX B52-0620-XX	1	–	1	–
Warranty card	–	1	1	1	1

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## THANK YOU

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### MODELS COVERED BY THIS MANUAL

The models listed below are covered by this manual.

**TS-480SAT** : HF/ 50 MHz All mode Transceiver with Automatic Antenna Tuner (100 watts output)

**TS-480HX** : HF/ 50 MHz All mode Transceiver (200 watts output)

### MARKET CODES

**K-type** : The Americas

**E-type** : Europe/ General

The market code is shown on the carton box.

Refer to the specifications {page 92} for information on the available operating frequencies.

### WRITING CONVENTIONS FOLLOWED

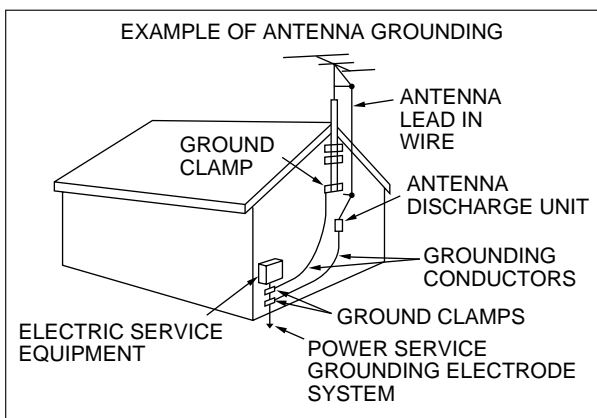
The writing conventions described below have been followed to simplify instructions and avoid unnecessary repetition.

Instruction	What to Do
Press <b>[KEY]</b> .	Press and release <b>KEY</b> .
Press <b>[KEY1]</b> , <b>[KEY2]</b> .	Press <b>KEY1</b> momentarily, release <b>KEY1</b> , then press <b>KEY2</b> .
Press <b>[KEY]</b> (1 s).	Press and hold <b>KEY</b> down for a second and then release <b>KEY</b> .
Press <b>[KEY1]+[KEY2]</b> .	Press and hold <b>KEY1</b> down, then press <b>KEY2</b> . If there are more than two keys, press and hold down each key in turn until the final key has been pressed.
Press <b>[KEY]+[ ⏻ ]</b> .	With the transceiver OFF, press and hold <b>KEY</b> , then switch ON the transceiver power by pressing <b>[ ⏻ ]</b> (POWER).

# PRECAUTIONS

Please observe the following precautions to prevent fire, personal injury, and transceiver damage:

- Connect the transceiver only to a power source described in this manual or as marked on the transceiver itself.
- Route all power cables safely. Ensure the power cables can neither be stepped upon nor pinched by items placed near or against the cables. Pay particular attention to locations near AC receptacles, AC outlet strips, and points of entry to the transceiver.
- Take care not to drop objects or spill liquid into the transceiver through enclosure openings. Metal objects, such as hairpins or needles, inserted into the transceiver may contact voltages resulting in serious electrical shocks. Never permit children to insert any objects into the transceiver.
- Do not attempt to defeat methods used for grounding and electrical polarization in the transceiver, particularly involving the power input cable.
- Adequately ground all outdoor antennas for this transceiver using approved methods. Grounding helps protect against voltage surges caused by lightning. It also reduces the chance of a build-up of static charge.



- Minimum recommended distance for an outdoor antenna from power lines is one and one-half times the vertical height of the associated antenna support structure. This distance allows adequate clearance from the power lines if the support structure fails for any reason.
- Locate the transceiver so as not to interfere with its ventilation. Do not place books or other equipment on the transceiver that may impede the free movement of air. Allow a minimum of 10 cm (4 inches) between the rear of the transceiver and the wall or operating desk shelf.
- Do not use the transceiver near water or sources of moisture. For example, avoid use near a bathtub, sink, swimming pool, or in a damp basement or attic.
- The presence of an unusual odor or smoke is often a sign of trouble. Immediately turn the power OFF and remove the power cable. Contact a **KENWOOD** service station or your dealer for advice.

- Locate the transceiver away from heat sources such as a radiator, stove, amplifier or other devices that produce substantial amounts of heat.
- Do not use volatile solvents such as alcohol, paint thinner, gasoline or benzene to clean the cabinet of the transceiver. Use a clean cloth with warm water or a mild detergent.
- Disconnect the input power cable from the power source when the transceiver is not used for long periods of time.
- Remove the transceiver's enclosure only to do accessory installations described in this manual or accessory manuals. Follow provided instructions carefully, to avoid electrical shocks. If unfamiliar with this type of work, seek assistance from an experienced individual, or have a professional technician do the task.
- Enlist the services of qualified personnel in the following cases:
  - a) The power supply or plug is damaged.
  - b) Objects have fallen or liquid has spilled into the transceiver.
  - c) The transceiver has been exposed to rain.
  - d) The transceiver is operating abnormally or performance has seriously degraded.
  - e) The transceiver has been dropped or the enclosure damaged.
- Do not attempt to perform any kind of configuration or menu setup configuration while driving your car.
- Do not wear headphones while driving.
- Install the transceiver in a safe and convenient position inside of your vehicle so as not to subject yourself to danger while driving. Consult your car dealer for the transceiver installation to ensure safety.
- HF/ 50 MHz mobile antennas are larger and heavier than VHF/ UHF antennas. Therefore, use a strong and rigid mount to safety and securely install the HF/ 50 MHz mobile antenna.

# INSTALLATION

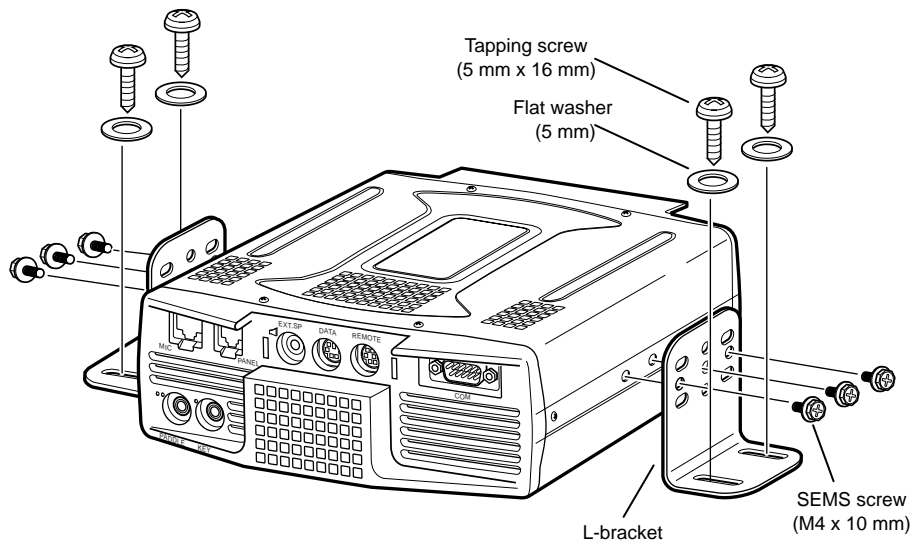
## MOBILE INSTALLATION

When you use this transceiver for mobile operation, do not attempt to perform any kind of configuration or menu setup configuration while driving your car; it is simply too dangerous. Stop the car and then perform transceiver configuration. In addition, do not wear headphones while driving.

You should install the transceiver in a safe and convenient position inside your vehicle so as not to subject yourself to danger while driving. For example, install the transceiver under the dash in front of the passenger seat so that knees or legs will not strike the transceiver if you brake suddenly. Additionally, do not install the transceiver and its accessories on to the air bag lids. We recommend you consult your car dealer for the transceiver installation to ensure safety.

## INSTALLATION EXAMPLE

- 1 Attach the 2 L-brackets using the 6 supplied SEMS screws (M4 x 10 mm) as shown below.
- 2 Position the transceiver in the mounting bracket and tighten the 4 supplied tapping screws (5 mm x 16 mm) to fix the transceiver in place.

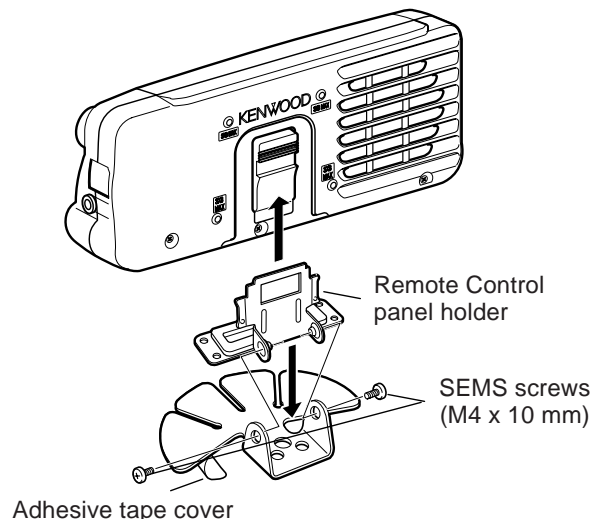


### CAUTION

*Do not install the TX/RX unit in non-ventilated areas. Air must flow through the TX/RX unit to keep the unit cooled.*

## REMOTE CONTROL PANEL INSTALLATION

- 1 Assemble the Remote Control panel holder with the fan-shaped base with 2 supplied SEMS screws.
- 2 Peel off the adhesive tape cover from the bottom of the base.
- 3 Afix the panel to the vehicle with 2 tapping screws.



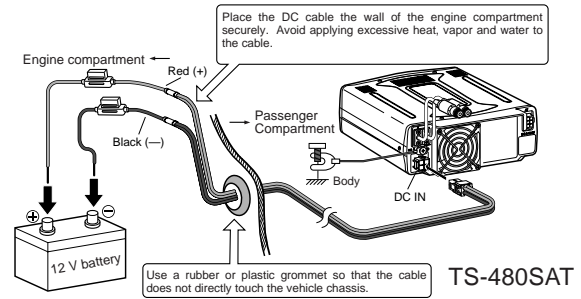
# 1 INSTALLATION

## DC POWER CABLE CONNECTION

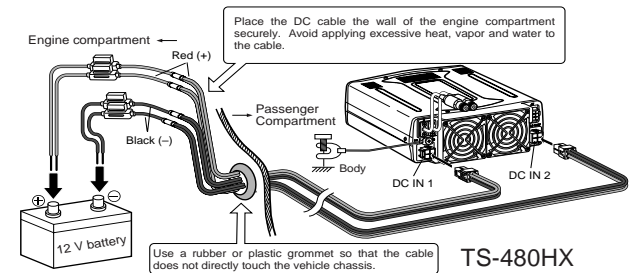
Connect the DC power cable directly to the vehicle's battery terminals using the shortest route. Do not use the cigarette lighter socket! The current rating of the cigarette lighter socket is too small to operate the transceiver. Ensure to use a 12 V vehicle battery which has sufficient current capacity. If the current is insufficient, the display may darken during transmission or the transceiver may work intermittently. If you use the transceiver for a long period when the vehicle battery has not been fully charged or when the engine has been stopped, the battery may become discharged in a short time and will not have sufficient reserves to start the engine. Avoid using the transceiver under these conditions. Keep in mind that the TS-480SAT transceiver draws a peak current of approximately 20.5 A and the TS-480HX transceiver draws a peak current of approximately 41 A during transmission.

### Note:

- ◆ Do not use two separate batteries to connect each DC cables from the transceiver (TS-480HX). The DC voltage difference between DC IN 1 and DC IN 2 connectors at the transceiver must be within DC 1.0 V to operate the transceiver.
- ◆ Do not use two different type of the cables. Using different length and/ or different gauged cable could result in a voltage difference between DC IN 1 and DC IN 2 connectors at the transceiver.



TS-480SAT



TS-480HX

## ANTENNA CONNECTION

In general, HF/ 50 MHz mobile antennas are larger and heavier than VHF/ UHF antennas. Therefore, use a strong and rigid mount to safely and securely install the HF/ 50 MHz mobile antenna.

A bumper mount is recommended for stable mounting. However, most recent models of vehicles have plastic bumpers. For such vehicles, ground the antenna mount to the body chassis with a large wire. Antenna installation is critical for successful mobile operation. For further information, refer to The Radio Amateur's Handbook, Radio Handbook, or other published texts.

## GROUND CONNECTION

The ground, which is the other half of the antenna system, is very important when using a mobile whip type antenna. Connect the feed line ground for the antenna securely to the vehicle's chassis, and be certain to bond (electrically connect) the vehicle's body to chassis. The sheet metal will provide the primary ground plane, so be sure to establish a good RF connection from the feed line to both the chassis and the body. For comprehensive information on mobile antennas installations and optimization, refer to the ARRL Handbook or similar publications.

## IGNITION NOISE

This transceiver has been equipped with a Noise Blanker and Digital Noise Limiter to filter ignition noises out. However, some cars may generate excessive ignition noise. If there is excessive noise, use suppressor spark plugs (with resistors), and/ or DC line filters to reduce the electric noises. The ARRL Handbook, or similar references, has a wealth of information regarding this topic.

### Note:

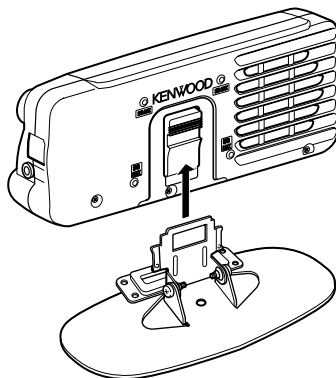
- ◆ After installation and wiring are completed, confirm that all work has been done correctly, then connect the DC power cable plug(s) to the transceiver.
- ◆ If the fuse blows, disconnect the DC power cable plug(s) from the transceiver immediately, then check all the DC power cables to find the reasons of the short circuit. The DC cable may be damaged, short circuited, pinched, or squashed. After resolving the problem, replace the fuse with one of the same type and rating.
- ◆ Do not remove the fuse holder for any reason.

## FIXED STATION INSTALLATION

When you use the transceiver at a fixed location, the transceiver requires 13.8 V DC power supply (The TS-480HX requires 2 DC power supplies).

### FRONT PANEL INSTALLATION

- 1 Attach the oval-shaped base to the front panel mounting bracket using two SEMS screws (3 mm x 5 mm) as shown below.
- 2 Slide the Remote Control panel along the mounting bracket rails until secure.



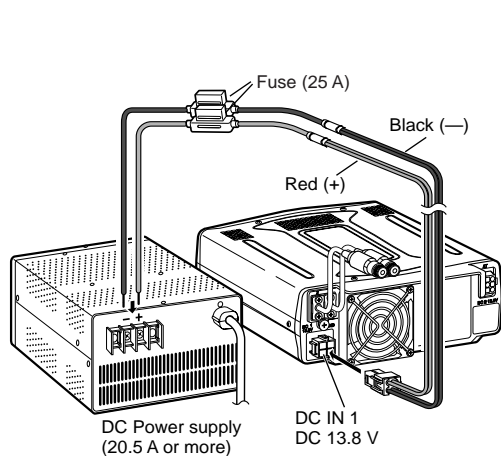
## DC POWER SUPPLY CONNECTION

In order to use this transceiver, you need a separate 13.8 V DC power supply (two 13.8 V DC power supplies are required to transmit for the TS-480HX) that must be purchased separately. Do not directly connect the transceiver to an AC outlet. Use the supplied DC power cables to connect the transceiver to a regulated power supply. Do not substitute a cable with smaller gauge wires. The current capacity of each power supply must be 20.5 A peak or more.

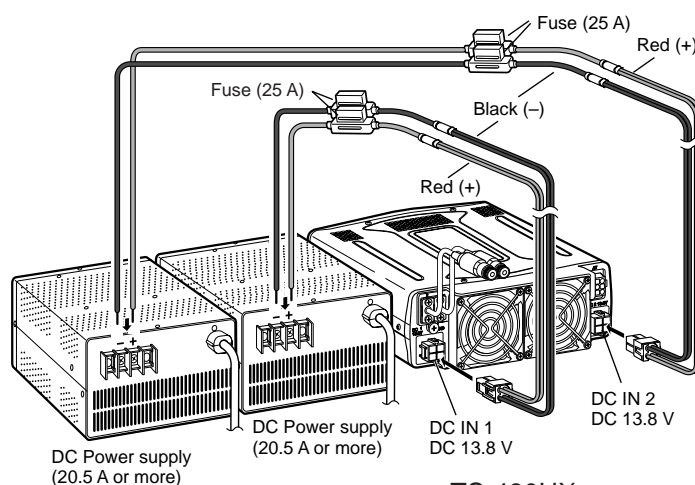
- 1 Connect the DC power cable(s) to the regulated DC power supply (two 13.8 V DC power supplies are used for the TS-480HX); the red lead to the positive terminal and the black lead to the negative terminal.
- 2 Connect the DC power cable to the transceiver's DC power connector.
  - Press the connectors firmly until the locking tab clicks.

#### Note:

- ◆ Before connecting the DC power supply to the transceiver, be sure to switch OFF the DC power supply and the transceiver.
- ◆ Do not plug the DC power supply into an AC outlet until you make all connections.
- ◆ When two power supplies are used for the TS-480HX, the DC voltage difference at the transceiver DC IN connectors must be within 1.0 V DC.
- ◆ Do not use different types (length and gauge) of DC cables to avoid voltage differences (TS-480HX).



TS-480SAT



TS-480HX



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## 1 INSTALLATION

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### ANTENNA CONNECTION

An antenna system consists of an antenna, feed line, and ground. The transceiver can give excellent results if the antenna system and its installation are given careful attention. Use a properly adjusted 50  $\Omega$  antenna of good quality, a high-quality 50  $\Omega$  coaxial cable, and first-quality connectors. All connections must be clean and tight.

After making the connections, match the impedance of the coaxial cable and antenna so that the SWR is 1.5:1 or less. High SWR will cause the transmit output to drop and may lead to radio frequency interference to consumer products such as stereo receivers and televisions. You may even interfere with your own transceiver. Reports that your signal is distorted could indicate that your antenna system is not efficiently radiating the transceiver's power.

Connect your primary HF/ 50 MHz antenna feed line to ANT 1 on the rear of the transceiver. If you are using two HF/ 50 MHz antennas, connect the secondary antenna to ANT 2. Refer to page 16 for the location of the antenna connectors.

**Note:**

- ◆ *Transmitting without connecting an antenna or other matched load may damage the transceiver. Always connect the antenna to the transceiver before transmitting.*
- ◆ *All fixed stations should be equipped with a lightning arrester to reduce the risk of fire, electric shock, and transceiver damage.*
- ◆ *The transceiver's protection circuit will activate when the SWR is greater than 2.5:1; however, do not rely on protection to compensate for a poorly functioning antenna system.*

### GROUND CONNECTION

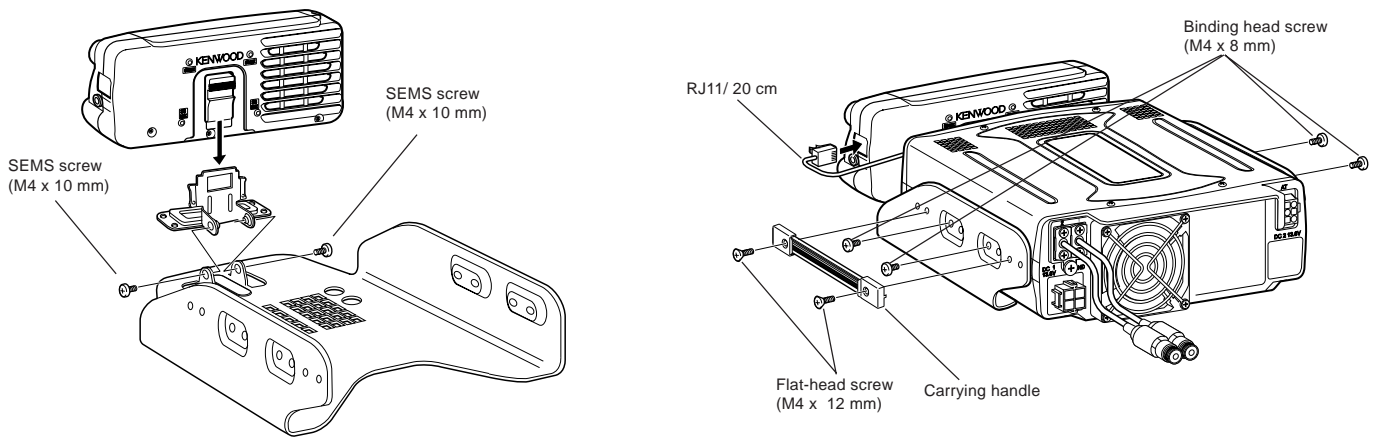
At the minimum, a good DC ground is required to prevent such dangers as electric shock. For superior communications results, a good RF ground is required against which the antenna system can operate. Both of these conditions can be met by providing a good earth ground for your station. Bury one or more ground rods or a large copper plate under the ground, then connect this to the transceiver GND terminal. Use heavy gauge wire or a copper strap, cut as short as possible, for this connection. Do not use a gas pipe, an electrical conduit, or a plastic water pipe as a ground.

### LIGHTNING PROTECTION

Even in areas where lightning storms are less common, there are usually a limited number of storms each year. Consider carefully how to protect your equipment and home from lightning. The installation of a lightning arrester is a start, but there is more that you can do. For example, terminate your antenna system transmission lines at an entry panel that you install outside your home. Ground this entry panel to a good outside ground, then connect the appropriate feed lines between the entry panel and your transceiver. When a lightning storm occurs, disconnecting the feed lines from your transceiver will ensure additional protection.

## PORTABLE BRACKET (E-TYPE ONLY)

Using the supplied Portable Bracket, you can carry the Remote Control panel and TX/ RX unit together. Two TX/ RX unit positions are available. If you do not use the **EXT.SP**, **REMOTE** or **DATA** terminals, place the transceiver in front position. If you use the **EXT.SP**, **REMOTE** or **DATA** terminals, place the TX/ RX unit to the back position. You can also attach the handle as shown if necessary. Use the supplied short cable (RJ11/ 20 cm) to connect the Remote Control panel and the TX/ RX unit.

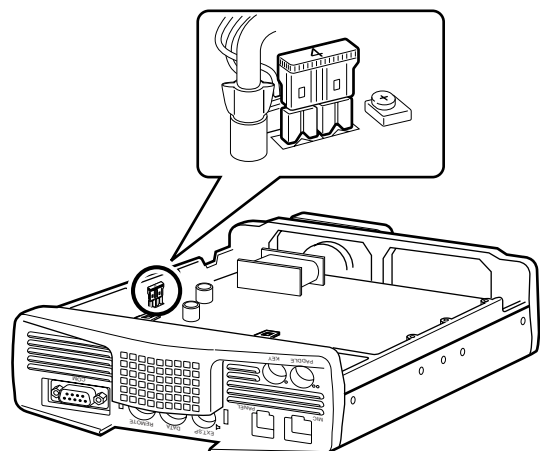
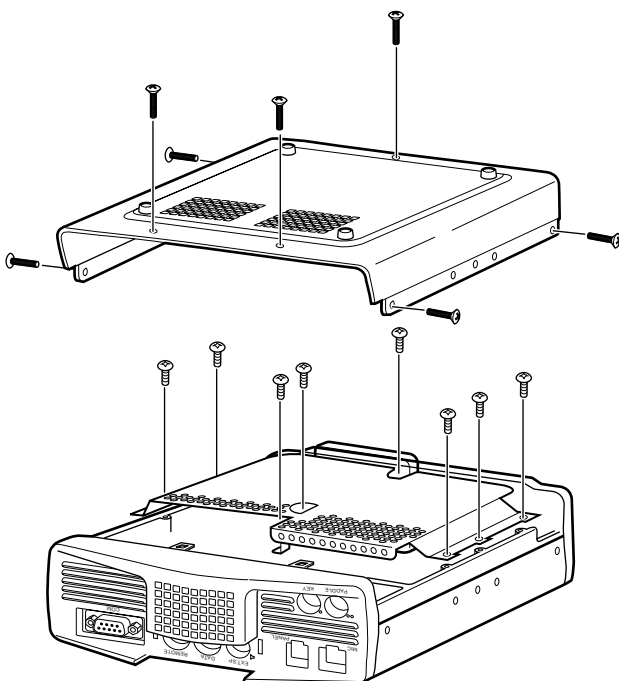


## FUSES

The following fuses are used in the TS-480SAT/ HX transceiver. If a fuse blows, determine the cause then correct the problem. Only after the problem has been resolved, replace the blown fuse with a new one with the specified ratings. If newly installed fuses continue to blow, disconnect the power plug and contact a **KENWOOD** service center or your dealer for assistance.

- 1 Remove 7 screws at the bottom of the TX/ RX unit.
- 2 Remove 8 screws inside of the TX/ RX unit.
- 3 Lift the shield cover.
- 4 Replace 4 A fuse.

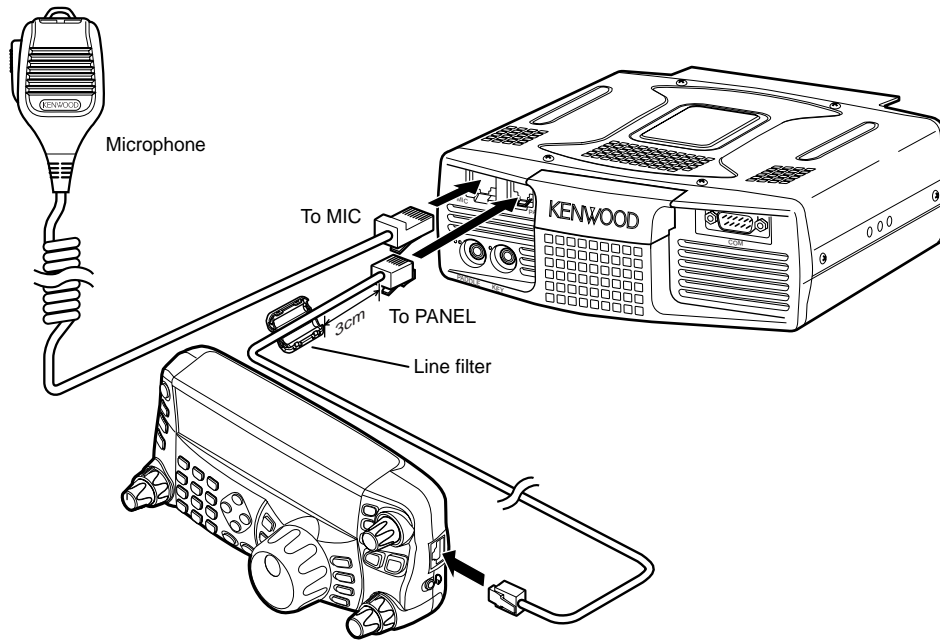
Fuse Location	Fuse Current Rating
TS-480SAT/ HX (TX/ RX unit)	4 A (For an external antenna tuner)
Supplied DC power cable	25 A



# 1 INSTALLATION

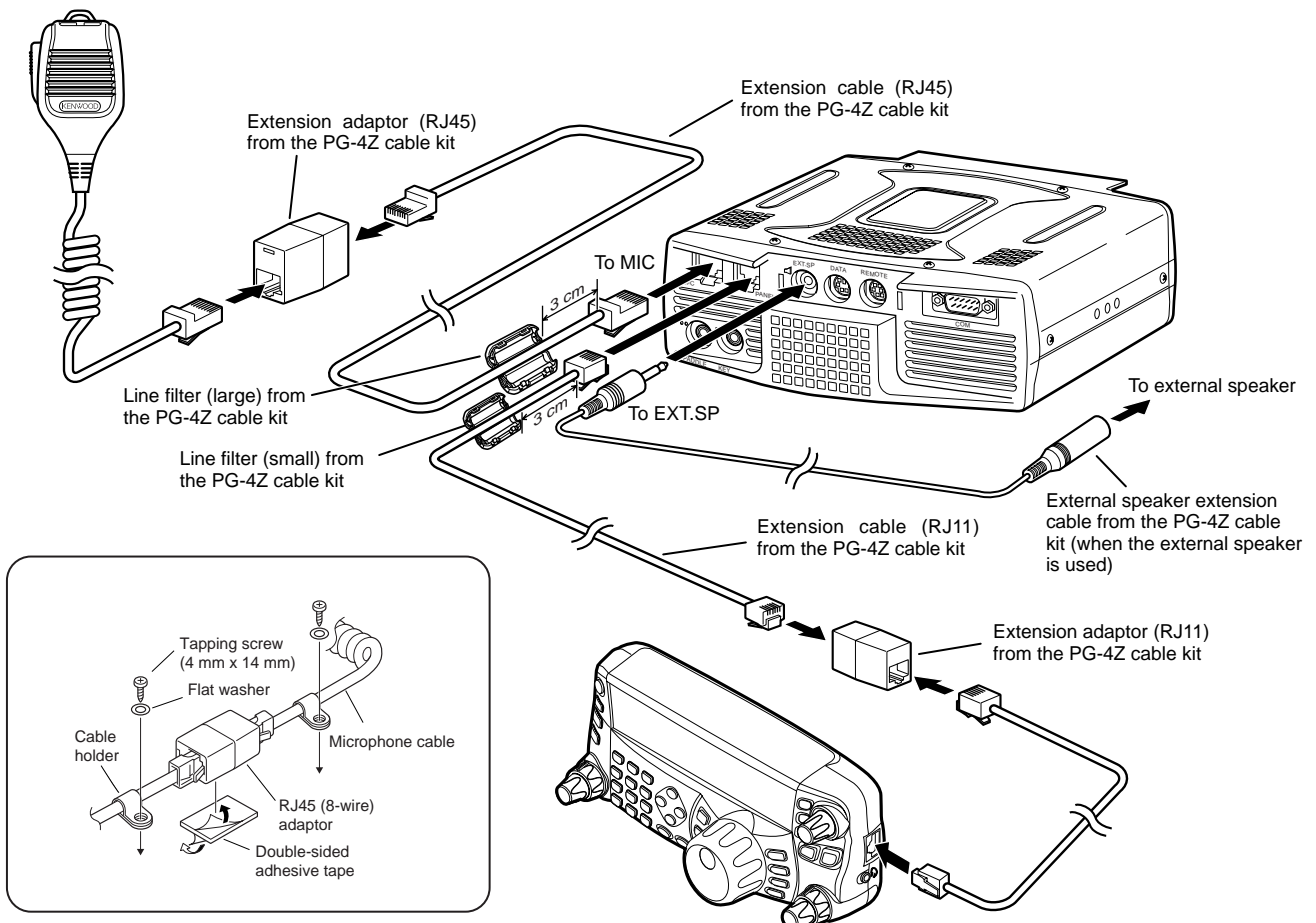
## PANEL AND MICROPHONE CONNECTION

Plug the microphone plug to the MIC jack (8-wire/ RJ45), then connect the Remote Control panel to the TX/ RX unit with the supplied cable (2 m/ 6-wire/ RJ11).



## PANEL AND MICROPHONE CONNECTION USING PG-4Z (OPTION)

Use the cables and connectors to connect the Remote Control panel and TX/ RX unit with the PG-4Z cable kit as shown below.



## ACCESSORY CONNECTIONS

### TX/ RX UNIT

#### ■ Microphone (MIC)

Connect a microphone having an impedance between 250 and 600  $\Omega$ . As for the supplied microphone, fully insert the modular connector into the **MIC** jack until the locking tab clicks. You can still utilize 8-pin metal type plug microphones, such as MC-43S, MC-47, MC-52DM, MC-60A, MC-80, MC-85, and MC-90 with the optional MJ-88 adaptor (optional) if necessary. However, do not use the MC-44, MC-44DM, MC-45, MC-45E, MC-45DM, MC-45DME, or MC-53DM condenser-type microphones.

#### ■ External Speaker (EXT.SP)

On the front panel of the TX/ RX unit, there is an external speaker jack. If an external speaker is connected to **EXP.SP** jack, the built-in speaker on the back of the remote control panel will mute. Use only external speakers with an impedance of 4 to 8  $\Omega$  (8  $\Omega$  nominal). The jacks accept only 3.5 mm (1/8") diameter, 2-conductor (mono) plugs.

- The “ $\blacktriangle$ ” projection indicates the external speaker jack.

**Note:** Do not connect headphones to this jack. The high audio output of this jack could damage your hearing.

#### ■ Keys for CW (PADDLE and KEY)

For CW operation using the internal electronic keyer, connect a keyer paddle to the **PADDLE** jack. For CW operation without using the internal electronic keyer, connect a straight key, semi-automatic key (bug), electronic keyer, or the CW keying output from a Multi-mode Communications Processor (MCP) to the **KEY** jack. The **PADDLE** and **KEY** jacks mate with a 3.5 mm (1/8") 3-conductor plug and a 3.5 mm (1/8") 2-conductor plug respectively. External electronic keyers or MCPs must have a positive keying output to be compatible with this transceiver. Use a shielded cable between the key and the transceiver.

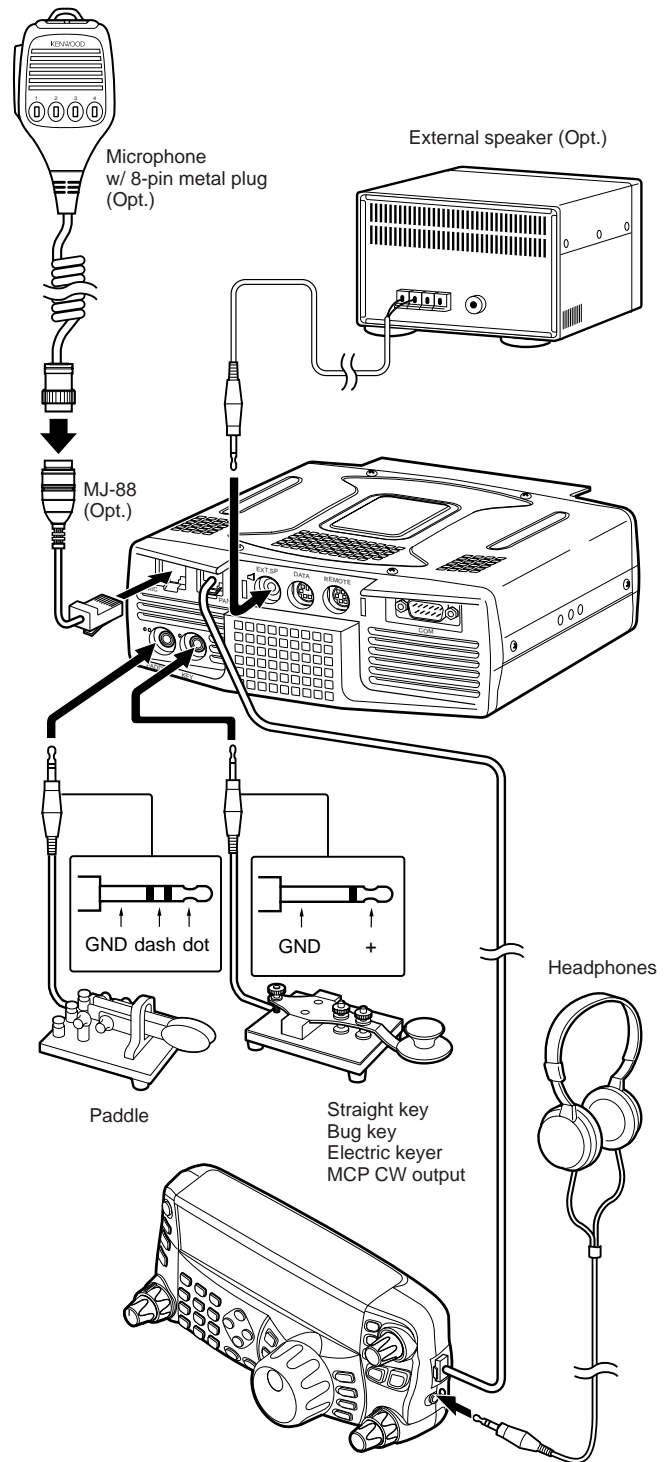
- The “ $\bullet$ ” projection indicates the key jack and the “ $\bullet\bullet$ ” projection indicates the paddle jack.

**Note:** Due to the functionality of the internal electronic keyer, you may find it unnecessary to connect both a paddle and another type of keyer unless you want to use a PC-based keyer for CW. Refer to the “ELECTRONIC KEYER” section (page 39) to become familiar with the internal keyer.

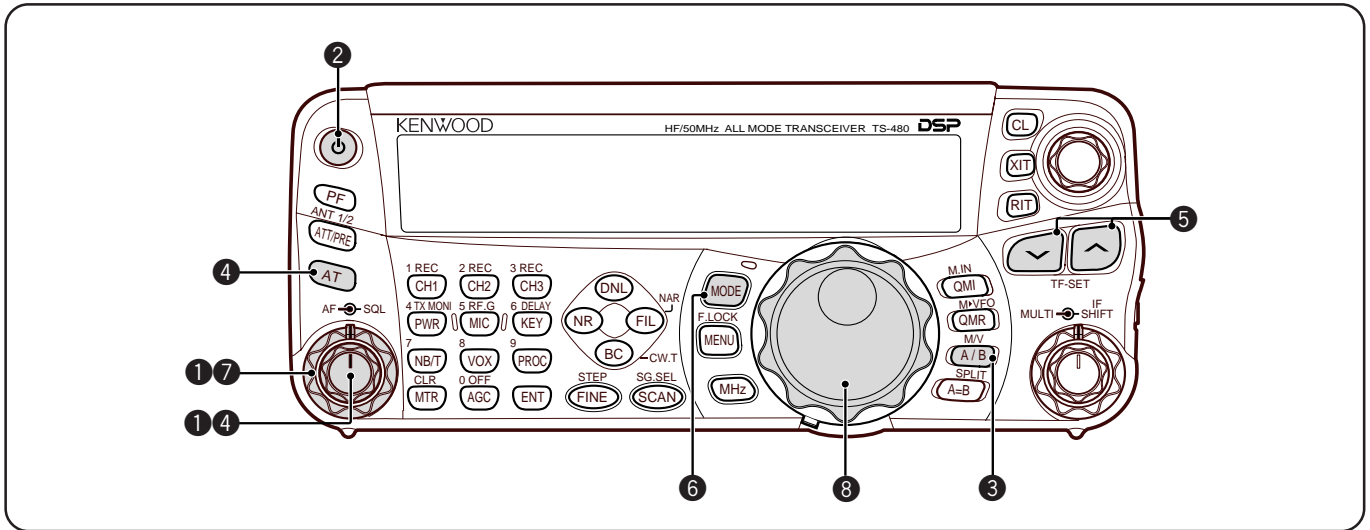
### REMOTE CONTROL PANEL

#### ■ Headphones (PHONES)

Connect monaural or stereo headphones having a 4 to 32  $\Omega$  impedance. This jack accepts a 3.5 mm (1/8") diameter, 2-conductor (mono) or 3-conductor (stereo) plug. After connecting the headphones, you will hear no sound from the internal (or optional external) speaker.



## RECEPTION



Are you ready to give your TS-480SAT/ HX a quick try? Reading these two pages should get your voice on the air in your first QSO on the HF/ 50 MHz band shortly. The instructions below are intended only for a quick guide. If you encounter problems or there is something you don't understand, read the detailed explanations given later in this manual.

**Note:** This section explains only keys and controls required to briefly try the transceiver.

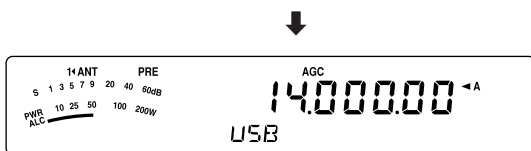
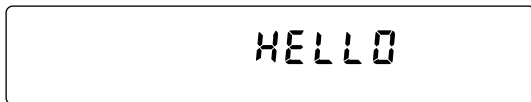
**1** Set the following as specified:

- **AF** control: Fully counterclockwise
- **SQL** control: Fully counterclockwise

Then, switch ON the DC power supply if you are using the DC power supply. If you are operating the transceiver with the car batteries, ensure that the DC power source(s) are available at the DC connector(s).

**2** Press and hold [  $\phi$  ] (POWER) briefly to turn ON the transceiver.

- Do not press the switch for more than approximately 2 seconds; the transceiver will be switched OFF.
- Upon power up, "HELLO" appears, followed by the selected frequency and other indicators.



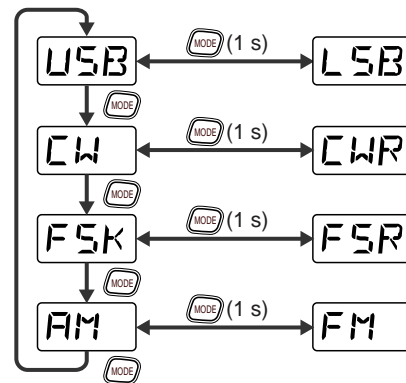
**3** Confirm that VFO A has been selected for communications; "◀A" should be visible on the display. If it has not, press [A/B / M/V] to select VFO A.

**4** Turn the **AF** control slowly clockwise until you hear a suitable level of background noise.

**5** Press [  $\nabla$  ] / [  $\blacktriangle$  ] to select a desired HF/ 50 MHz Amateur radio band.

**6** Press [MODE] to select the desired communication mode.

- There are 4 mode pairs: USB/ LSB, CW/ CWR (Reversed pitch), FSK/ FSR (Reverse shift) and AM/ FM. Press [MODE] (1 s) to toggle the mode within each pair: USB  $\leftrightarrow$  LSB, CW  $\leftrightarrow$  CWR, FSK  $\leftrightarrow$  FSR, or AM  $\leftrightarrow$  FM.
- To select the alternate mode on each operating mode, press and hold the key for 1 second. For example, if USB is selected, press [MODE] (1 s) to switch to LSB mode. The following diagram illustrates how to access each mode.



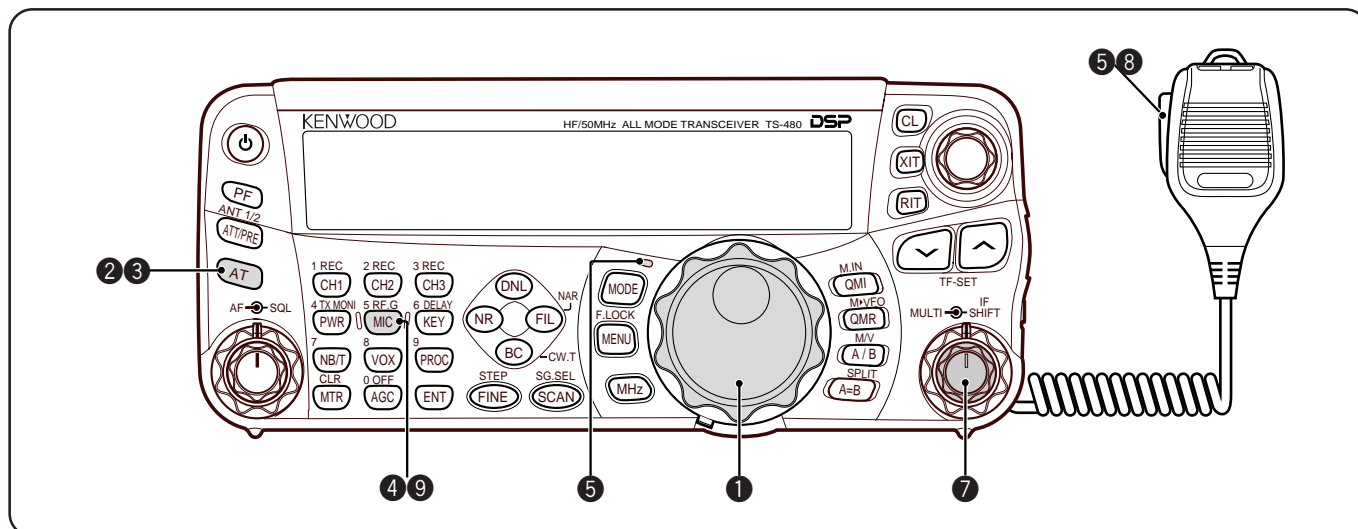
**7** If you have selected FM, turn the **SQL** control clockwise until the background noise is just eliminated; the green LED (above the [MODE] key) turns OFF.

- With LSB or USB selected, skip this step.

**8** Turn the **Tuning** control to tune in a station.

- If you do not hear any stations, you may have the wrong antenna connector selected. In this case, try selecting another antenna by pressing and hold [ATT/PRE/ ANT1/2] (1 s).

## TRANSMISSION



- 1 Turn the **Tuning** control to tune in a desired station or to select an unused frequency.
  - If you are operating the TS-480HX transceiver without the AT-300 antenna tuner, continue to step 4.
- 2 Press **[AT]** momentarily.
  - “R◀AT▶T” appears.
- 3 Press and hold **[AT]** to start tuning the antenna tuner (TS-480SAT or TS-480HX with the AT-300 antenna tuner).
  - “R◀AT▶T” starts blinking and the LED above the **[MODE]** key turns red.
  - Tuning should be completed in under 20 seconds, then a morse code “T” (a long single beep) sounds and “AT▶T” stops blinking.
  - If tuning is not completed within 20 seconds, error beeps sound. Press **[AT]** to stop the error beeps and quit tuning. Check your antenna system before continuing. If you do not press **[AT]**, tuning will continue for approximately 60 seconds.

**Note:** You will hear a lot of clicking sounds coming from the transceiver or external antenna tuner while the antenna tuner is trying to tune the antenna. This is simply the relay switches turning ON and OFF.

- 4 With LSB, USB, or AM selected, press **[MIC/ 5/ RF.G]** to adjust the Microphone Gain.
  - “MIC -- 50” appears.



- With FM selected, skip this step.
- 5 Press Mic **[PTT]**.
    - The LED lights red.
  - 6 Begin speaking into the microphone in your normal tone of voice.

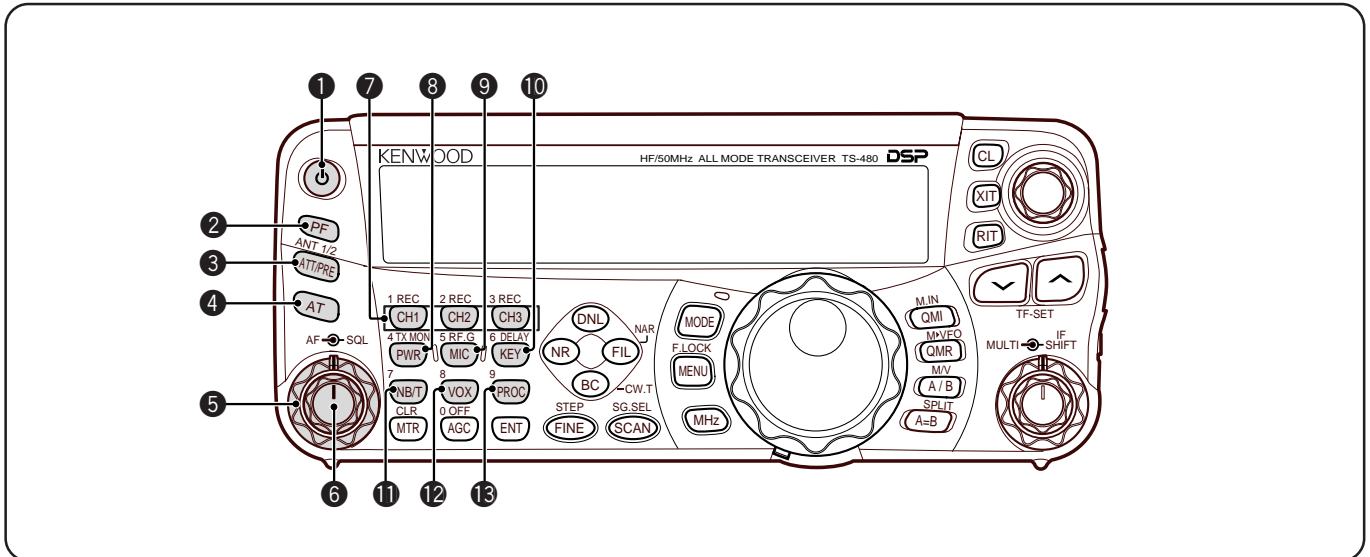
- 7 **LSB/ USB:** While speaking into the microphone, adjust the **MULTI** control so that the ALC meter reflects according to your voice level.  
**AM:** While speaking into the microphone, adjust the **MULTI** control so that the power meter slightly reflects to your voice level.  
**FM:** Skip this step.
- 8 When you finish speaking, release Mic **[PTT]** to return to receive mode.
- 9 Press **[MIC/ 5/ RF.G]** to finish adjusting the Microphone Gain.

**Note:** If desired, access Menu No. 44 (page 27) to adjust the Microphone Gain for FM mode.

This completes your introduction to the TS-480 transceiver, but there is a great deal more to know. “OPERATING BASICS” {page 18} and the following chapters explain all the functions of this transceiver, starting with the most basic, commonly-used functions.

# GETTING ACQUAINTED

## REMOTE CONTROL PANEL



### ❶ [ $\phi$ ] (POWER) switch

Press and hold briefly to switch the transceiver power ON. Press again to switch the power OFF {page 18}.

### ❷ PF key

You can assign a function to this Programmable Function key. The default function is VOICE1 {page 64}.

### ❸ ATT/PRE/ ANT 1/2 key

Press to cycle between receiver attenuator ON, pre-amplifier ON and OFF {pages 49, 61}. Press and hold for 1 second, then release it to select either ANT 1 or ANT 2 {page 60}.

### ❹ AT

Press to activate the internal antenna tuner {page 60} or an external antenna tuner. Press and hold to start tuning the automatic antenna tuner.

### ❺ SQL control

Used for muting (“squenching”) the speaker, the headphones and the AF output on DATA (8-pin mini DIN connector) when no receive signal is present on the transceiver {page 19}.

### ❻ AF control

Turn to adjust the audio volume on the transceiver {page 18}.

### ❼ CH1/ 1/ REC, CH2/ 1/ REC, CH3/ 3/ REC key

Press to play back the CW or voice messages (the VGS-1 is required) {page 40}. Press and hold to record the voice messages (the VGS-1 is required) {page 68} or CW messages that are associated with the internal electronic keyer {page 40}.

### ❽ PWR/ 4/ TX MONI key

Press to adjust the transmission output power. Press and hold to adjust the volume of the transmission signal monitor function {page 65}.

### ❾ MIC/ 5/ RF.G key

Press to adjust the microphone gain {page 27}. While the Speech Processor function is ON, press to adjust the Speech Processor output level {page 37}. Press and hold to adjust the receiver RF gain {page 18}.

### ❿ KEY/ 6/ DELAY key

Press to adjust the internal electronic keyer speed. Press and hold to adjust the VOX delay time {page 36} or break-in time (Full break-in/ Semi break-in time) for CW mode {page 39}.

### ⓫ NB/T/ 7 key

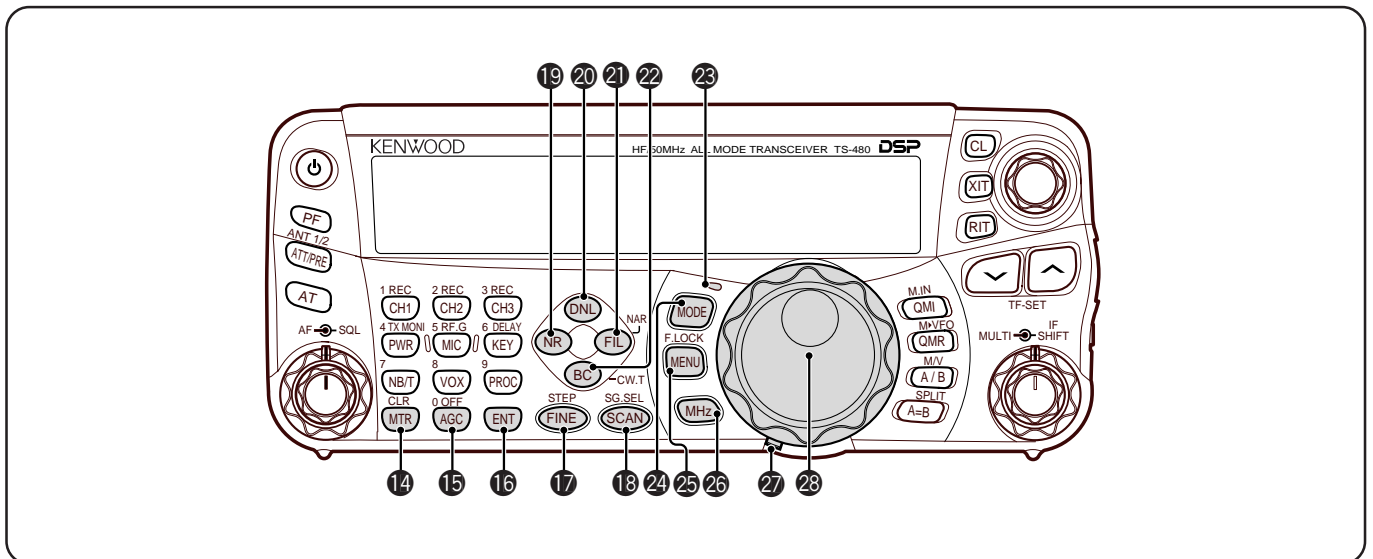
Press to switch the Noise Blanker ON or OFF. Press and hold to adjust the Noise Blanker level {page 47}. In FM mode, press to turn the Tone function ON or OFF {page 32}. Press and hold to select a sub-audible tone for the Tone function {page 32}.

### ⓬ VOX/ 8 key

In Voice Mode, press to turn the VOX (Voice-Operated Transmit) function ON or OFF {page 36}. In CW mode, press to turn the Break-in function ON or OFF {page 39}. Press and hold to adjust the microphone input gain for VOX operation. The VOX icon appears when the VOX (Voice)/ Break-in (CW) function is active.

### ⓭ PROC/ 9 key

Press to turn the Speech Processor ON or OFF {page 37}. Press and hold to adjust the Speech Processor input level. The PROC icon appears when the Speech Processor function is ON.



#### 14 MTR/ CLR key

Press to select the meter scales {page 20} or exit from, abort, or reset various functions. Press and hold to clear memory channels {page 54}.

#### 15 AGC/ 0/ OFF key

Press to toggle the fast or slow response time for the Automatic Gain Control (AGC). Press and hold to switch the AGC OFF {page 35}.

#### 16 ENT key

Press to enter your desired frequency using the keypad {page 34} or lock out memory channels from the scan list {page 54}.

#### 17 FINE/ STEP key

Press to activate the Fine tuning function to allow more precise tuning {page 35}. Press and hold to select the frequency step size for the **MULTI** control {page 34}.

#### 18 SCAN/ SG.SEL key

Press to start or stop the Scan function {page 56}. Press and hold to select a Scan group {page 59}.

#### 19 NR key

Press to select the DSP Noise Reduction function, NR1, NR2 or OFF {page 47}. When the Noise Reduction function is turned ON, press and hold key to change the parameter of the Noise Reduction function {page 47}.

#### 20 DNL key

Press to turn the DNL (Digital Noise Limiter) function ON or OFF. The "DNL" icon appears when it is ON. Press and hold the key to change the level of DNL function {page 47}.

#### 21 FIL/ NAR key

Press to configure the low-cut and high-cut filter frequency for the DSP filter (AF). Press and hold to select the narrow IF filter if available {page 45}.

#### 22 BC/ CW.T key

Press to select the DSP Beat Cancel function, BC1 (Beat Cancel 1), BC2 (Beat Cancel 2) or OFF {page 47}. In CW mode, press to start the Auto CW Tuning {page 29}.

#### 23 LED

Lights red when the transceiver is transmitting, lights green when the transceiver is receiving signals, and turns OFF when the transceiver mutes with the squelch function.

#### 24 MODE key

Press to change the operating mode pair. There are 4 pairs: USB/ LSB, CW/ CWR, FSK/ FSR, and AM/ FM. Press and hold for a second to toggle the mode within each pair: USB ↔ LSB, CW ↔ CWR, FSK ↔ FSR, or AM ↔ FM {page 19}.

#### 25 MENU/ F.LOCK key

Press to enter Menu Mode {page 22}. Press and hold to activate the Frequency Lock function {page 63}.

#### 26 MHz key

Press to turn the MHz Up/ Down function ON or OFF. The MHz digit increases or decreases when you turn the **MULTI** control. Press and hold to change the increment/ decrement step value {page 36}.

#### 27 Tuning control torque adjustment lever

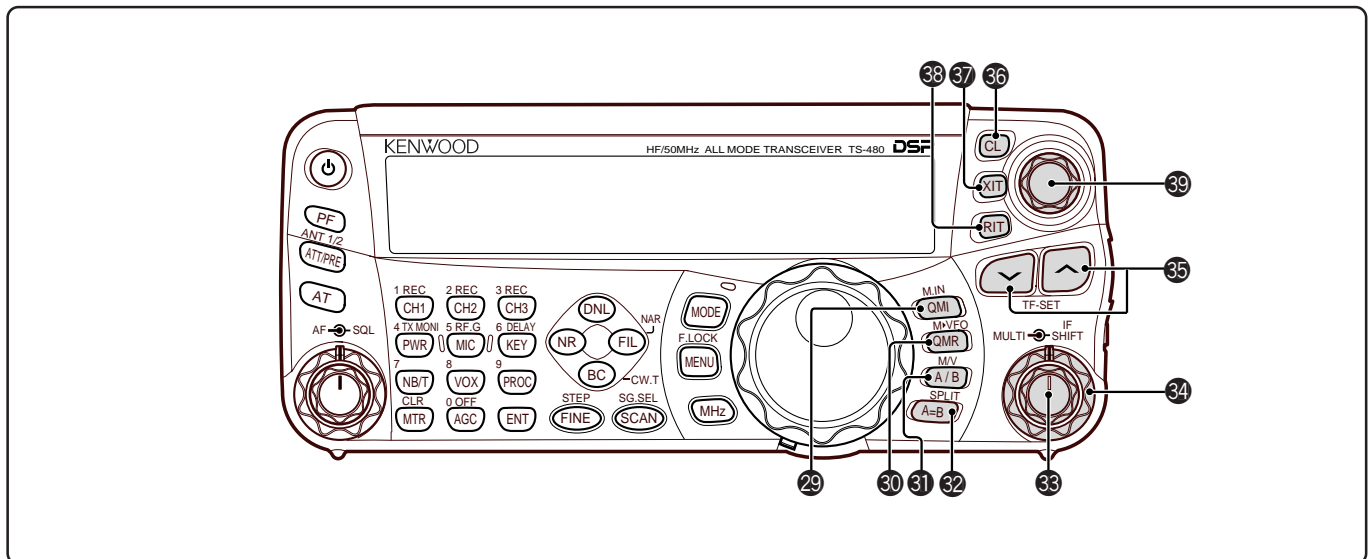
The lever behind the **Tuning** control adjusts the control torque level; turn clockwise for light torque or counterclockwise for heavy torque.

#### 28 Tuning control

Turn to select the desired frequency {page 34}. Use the convenient finger-tip cavity for continuous tuning.



### 3 GETTING ACQUAINTED



#### 29 QMI/ M.IN key

Press to store data to the Quick Memory. Press and hold to store the current operating frequencies and other data to the Memory channel.

#### 30 QMR/ M>VFO key

Press to recall data from the Quick Memory {page 55}. Press and hold to transfer the Memory Channel frequencies and other data to the VFO.

#### 31 A/B / M/V key

Press to select either VFO A or VFO B {page 50}. Press and hold to toggle between Memory and VFO Modes.

#### 32 A=B/ SPLIT key

Press to duplicate the data in the currently selected VFO to the other VFO {page 30}. Press and hold to enter split-frequency operation which allows you to use different transmission and reception frequencies {page 30}.

#### 33 MULTI control

In VFO Mode, rotate to step the operating frequency up or down {page 34}. In Memory Channel Mode, rotate to select a Memory Channel {page 51}. Also, used for selecting Menu numbers when accessing the Menu Mode {page 52} and as a selector to choose settings for various functions activated by Remote Control panel keys.

#### 34 IF SHIFT control

Rotate to shift the center frequency of the IF passband either lower or higher, to remove interference {page 45}.

#### 35 $\vee/\wedge$ key

Normally, press to step through all the Amateur radio bands consecutively {page 19}. Also used to make selections from the Menu {page 22} and to check the Start and End frequencies of the Scan function {page 53}. When both the split-frequency and the frequency lock function are activated, press and hold to perform the TF-SET function {page 30}.

#### 36 CL key

Press to clear the RIT/ XIT frequency to zero {pages 35, 37}.

#### 37 XIT key

Press to turn the XIT (Transmit Incremental Tuning) function ON or OFF {page 37}. When the XIT function is ON, the XIT icon appears.

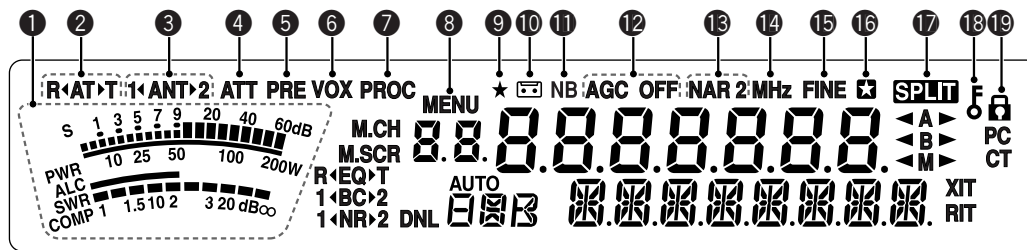
#### 38 RIT key

Press to turn the RIT (Receive Incremental Tuning) function ON or OFF {page 35}. When the RIT function is ON, the RIT icon appears.

#### 39 RIT/ XIT control

When the RIT/ XIT function is ON, turn to adjust the offset frequency. The RIT/ XIT offset frequency appears on the sub-display {pages 35, 37}.

## LCD DISPLAY

**1 METER**

While receiving, serves as an S-meter to measure and display the received signal strength. While transmitting, serves as a power meter plus an ALC meter, an SWR meter, or a Speech Processor compression meter. The Peak Hold function holds each reading for approximately half a second.

**2 R<ANT>T**

Appears while the internal antenna tuner {page 60} or an external antenna tuner is in-line for the operation.

**3 1<ANT>2**

Either “1<ANT>” or “<ANT>2” appears, depending on which antenna connector is selected for the operation {page 60}.

**4 ATT**

Appears when the receiver’s attenuator (approx. 12 dB) is ON {pages 49, 61}.

**5 PRE**

Appears when the receiver pre-amplifier (approx. 6 dB) is ON {page 49}.

**6 VOX**

Appears when the VOX (Voice Operated Transmission) function is ON or the Break-in function is ON for the CW mode {pages 36, 39}.

**7 PROC**

Appears when the Speech Processor function is ON {page 37}.

**8 MENU**

Appears when configuring the parameters in the Menu Mode {page 22}.

**9 ★**

Reserved for the future updates.

**10**

Appears while the Constant Recording function is ON {page 70}.

**11 NB**

Appears when the Noise Blanker is ON {page 47}.

**12 AGC OFF**

“AGC - F” (fast) or “AGC” (slow) appears when the AGC (Automatic Gain Control) function is ON. “AGC OFF” appears when the AGC is OFF {page 35}.

**13 NAR 2**

“NAR” appears when the narrow IF filter is selected for the operating mode. If two optional IF filters are installed and the transceiver selects the secondary IF filter, “NAR 2” appears {page 45}.

**14 MHz**

Appears when the MHz Up/ Down mode using the **MULTI** control is ON {page 34}. It also appears when the Quick Menu function is ON {page 22}.

**15 FINE**

Appears when the Fine function is ON {page 35}.

**16 ★**

Appears when the selected Menu No. is in the Quick Menu list. It also appears when you specify the slow down frequency points {page 57}.

**17 SPLIT**

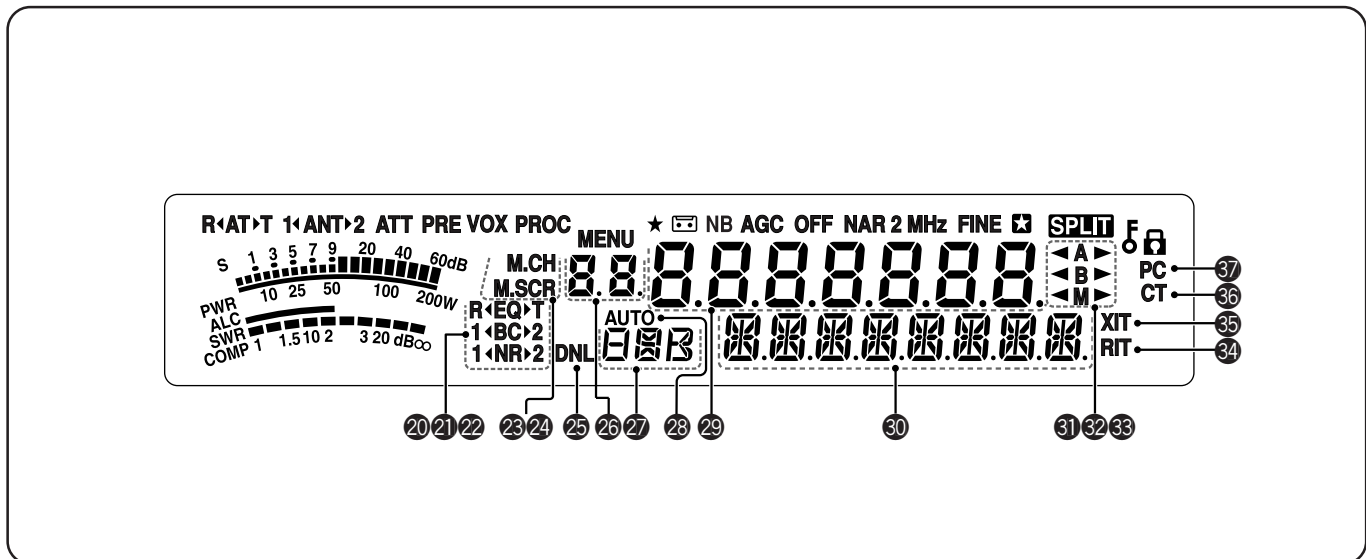
Appears when the split-frequency operation is ON {page 30}.

**18**

Appears when the **Tuning** control Lock function is ON {page 63}.

**19**

Appears when the Frequency Lock function is ON {page 63}.



20 R<EQ>T

“R<EQ>” appears when the RX Equalizer function is ON {page 64}. “EQ>T” appears when the TX Equalizer function is ON {page 38}.

21 1<BC>2

“1<BC>” or “BC>2” appears, as you select the DSP Beat Cancel 1 or Beat Cancel 2 {page 47}.

22 1<NR>2

“1<NR>” or “NR>2” appears, depending on whether DSP Noise Reduction 1 (Line Enhanced method) or Noise Reduction 2 (SPAC method) is selected {page 47}.

23 M.CH

Appears in Memory Recall Mode {page 51}.

24 M.SCR

Appears in Memory Scroll Mode {page 52}.

25 DNL

Appears when the Digital Noise Limiter function is ON {page 47}.

26 8.8

Shows the Memory Channel number for the transceiver. In Menu Mode, it displays the Menu No. In Quick Memory Mode, it shows the Quick Memory number location (the Quick Memory number ranges from “0\_” to “9\_”) {page 55}.

27 日

Displays a communication mode {page 19}.

28 AUTO

Appears when Auto Mode function is ON {page 61}.

29 8.888888

The transceiver operating frequency display. In Menu Mode, it displays the parameters.

30 日

In the normal operating mode, it displays the transceiver status and Menu item descriptions when necessary. While the RIT, XIT or SPLIT function is turned ON, it is used to display the frequency information for these functions {pages 35, 37}.

31 <A>

“<A>” or “A>” appears while VFO A is selected {page 30}. “A” appears while Menu A is being accessed in the Menu Mode {page 22}.

32 <B>

“<B>” or “B>” appears while VFO B is selected {page 30}. “B” appears while Menu B is being accessed in the Menu Mode {page 22}.

33 <M>

“<M>” or “M>” appears while a simplex memory channel is selected {page 50}.

34 RIT

Appears when Receive Incremental Tuning function is ON {page 35}.

35 XIT

Appears when Transmit Incremental Tuning function is ON {page 37}.

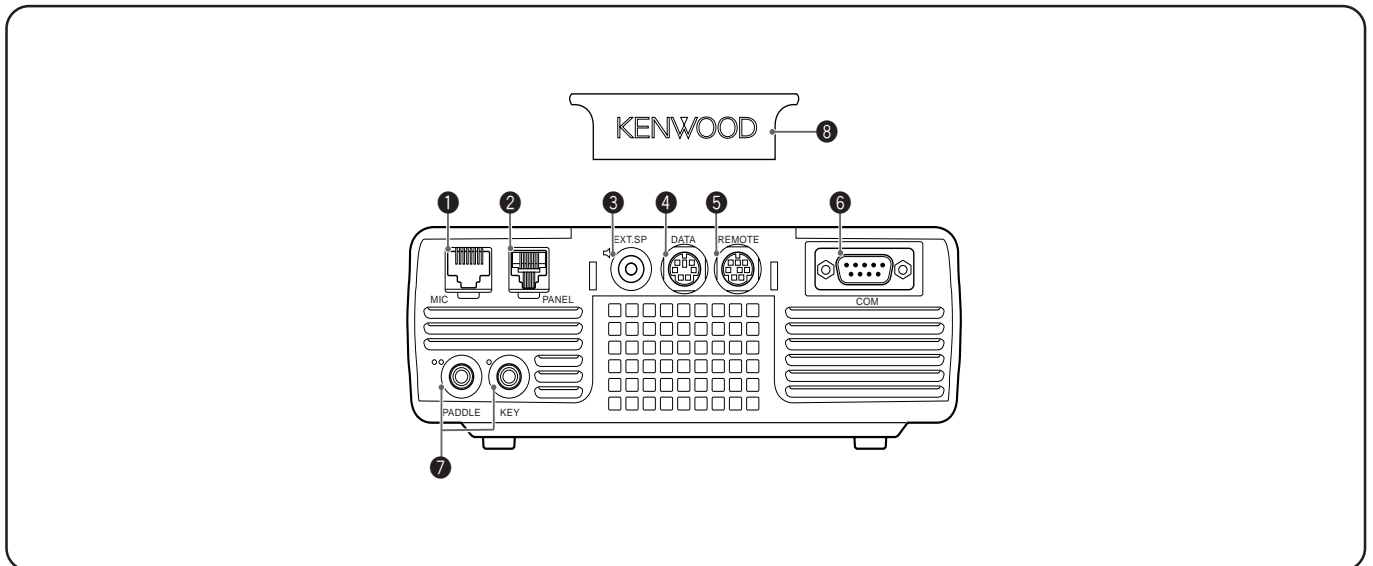
36 CT

“T” appears when the Tone function is ON {page 32}. “CT” appears when the CTCSS (Continuous Tone Coded Squelch System) is ON {page 33}.

37 PC

Appears when the transceiver is being controlled by a PC {page 67}.

## TX/ RX UNIT

**1 MIC** connector

Connect a cable from the supplied microphone to this connector {page 6}.

**2 PANEL** connector

Connect a cable from the Remote Control panel to this connector {page 6}.

**3 EXT.SP** jack

Mate with a 3.5 mm (1/8"), 2-conductor (mono) plug for connecting an external speaker {page 7}.

**4 DATA** connector

Mates with a 6-pin male DIN connector for connecting various accessory equipment, such as an external TNC/ MCP or a RTTY terminal {pages 80, 81}.

**5 REMOTE** connector

Mates with a 6-pin male mini DIN connector for connecting an HF/ 50 MHz linear amplifier {page 80}.

**6 COM** connector

Mates with a DB-9 female connector for connecting a computer via one of its serial communication (COM) ports {page 79}. Also used with the Quick Data Transfer function {page 79} and DX Packet Cluster Tune function {page 82}.

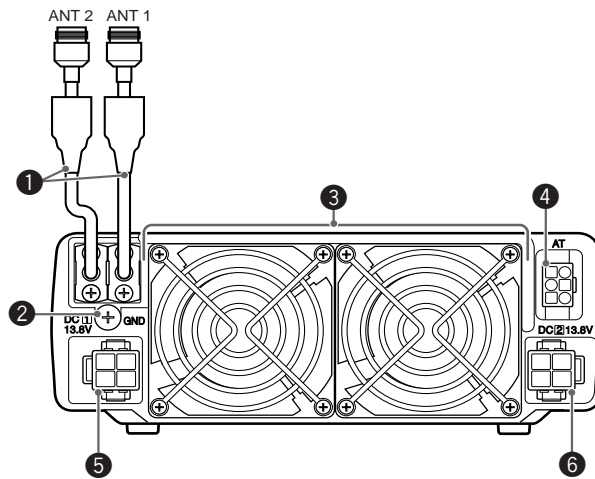
**7 PADDLE** and **KEY** jacks

The PADDLE jack mates with a 6.3 mm (1/4") 3-conductor plug for connecting a keyer paddle to the internal electronic keyer. The KEY jack mates with a 3.5 mm (1/8") 2-conductor plug for connecting an external key for CW operation. Refer to "Keys for CW (PANEL and KEY)" {page 7} before using these jacks.

**8 Plastic cover**

If the **EXT.SP** jack, **DATA** connector and **REMOTE** connector are not used, attach this cover to protect the connectors from dust.

### 3 GETTING ACQUAINTED



#### ❶ ANT 1 and ANT 2 connectors

Connect your primary HF/ 50 MHz antenna to ANT 1. If you are using 2 antennas for the HF/ 50 MHz band, connect the secondary antenna to the ANT 2 connector.

#### ❷ GND post

Connect a heavy gauge wire or copper strap between the ground post and the nearest earth ground or vehicle body {pages 2, 4}.

#### ❸ Cooling Fans

The TS-480SAT is equipped with 1 cooling fan. The TS-480HX is equipped with 2 cooling fans. Air flows in from these fans.

#### ❹ AT connector

Mates with the connector from the cable supplied with the AT-300 external antenna tuner. Refer to the instruction manual supplied with the tuner for more information.

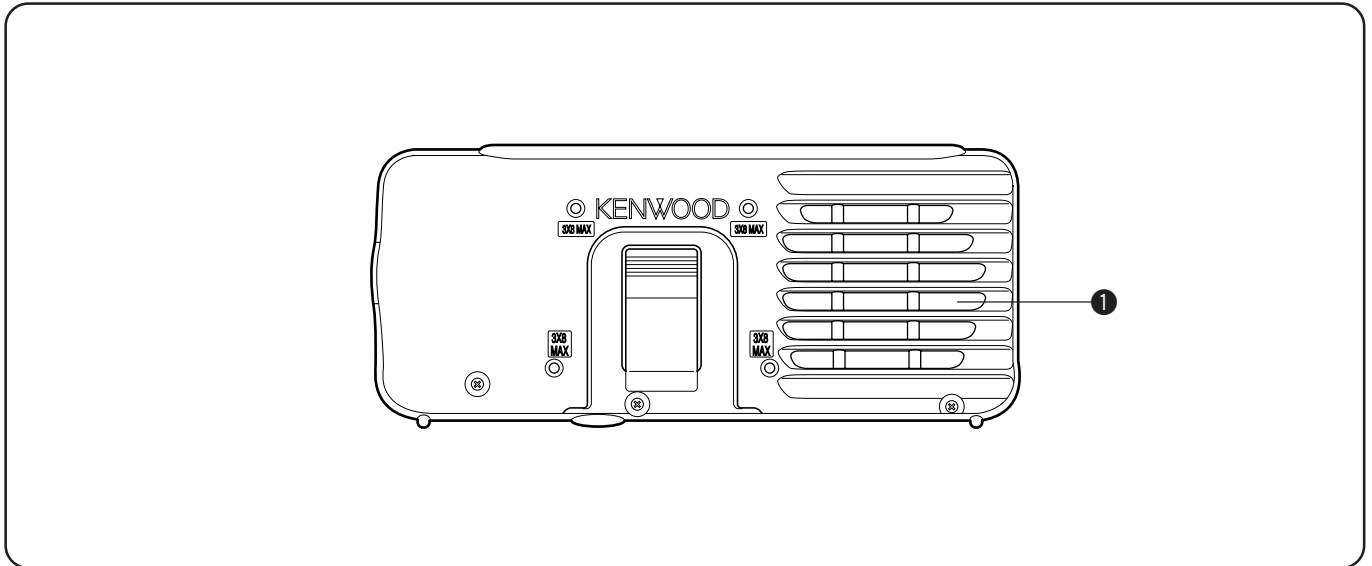
#### ❺ DC 1 13.8 V DC power input connector

Connect a primary 13.8 V DC power source to this connector {pages 2, 3}. Use the DC cable supplied with the transceiver.

#### ❻ DC 2 13.8 V DC power input connector (TS-480HX only)

You must connect a secondary 13.8 V DC power source to this connector in order to transmit {pages 2, 3}. Use the cable supplied with the transceiver. If no DC power source is available on this connector, you cannot transmit at any output

power. However, you can still receive {page 18}.

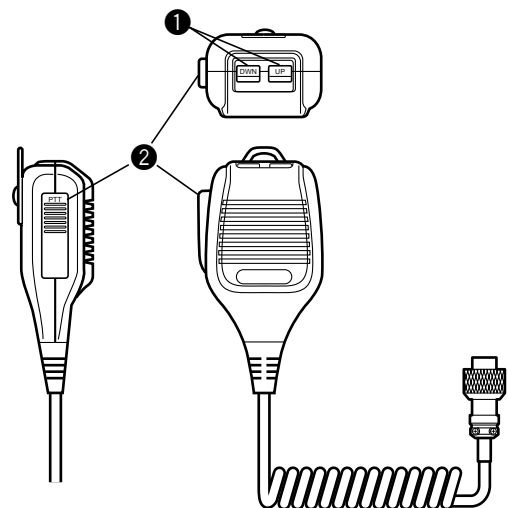


## REMOTE CONTROL PANEL (REAR)

- ① Speaker  
When the headphones are connected, the

speaker mutes.

## MICROPHONE



### ① UP/ DWN keys


Use these keys to step the VFO frequency, Memory Channels, or Menu selections up and down. Press and hold these keys to continuously change the settings.

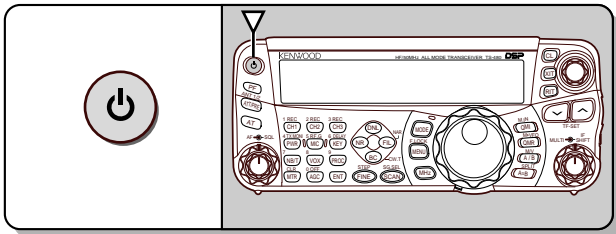
### ② PTT (Push-to-Talk) switch


The transceiver is placed in Transmission Mode when this non-locking switch is held down. Releasing the switch returns the transceiver to Reception Mode.

# OPERATING BASICS

## SWITCHING POWER ON/ OFF

- 1 Switch the DC power supply(s) ON if you are using a DC power supply(s).
- 2 Press and hold [  ] (POWER) briefly to switch the transceiver ON.

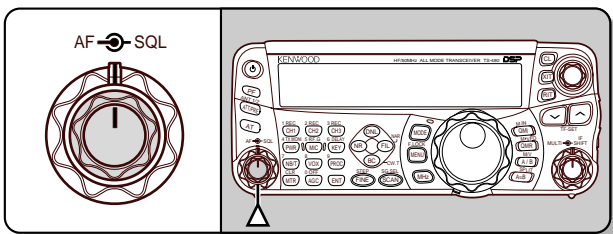


- Do not press the switch for more than approximately 2 seconds; the transceiver will be switched OFF.
  - **TS-480HX only:** If “RX ONLY” appears on the sub-display upon power up, confirm that two DC cable connectors are securely connected to the DC-1 and DC-2 connectors. When this warning message appears, you can receive signals as usual but you cannot transmit even if you decrease the output power. “TWIN PWR” appears when two DC power cables are connected to the DC-1 and DC-2 connectors.
  - Upon power up, “HELLO” appears on the main display, followed by the selected frequency and other indicators.
- 3 To switch the transceiver OFF, press [  ] (POWER) again.
  - 4 Switch the DC power supply(s) OFF.
    - You may skip step 3. After switching the transceiver ON, you can switch it OFF or ON using only the power switch of the DC power supply(s). The transceiver remembers the information of the POWER switch position when the DC power source is switched OFF.

## ADJUSTING VOLUME

### AF (AUDIO FREQUENCY) GAIN

Turn the **AF** control clockwise to increase the audio level and counterclockwise to decrease the level.

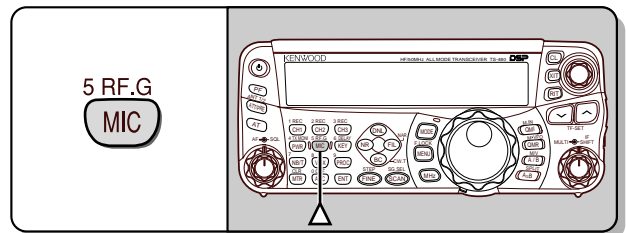


**Note:** The position of the **AF** control does not affect the volume of beeps caused by pressing keys nor the CW TX sidetone. The audio level for Digital mode operation is also independent of the **AF** control setting.

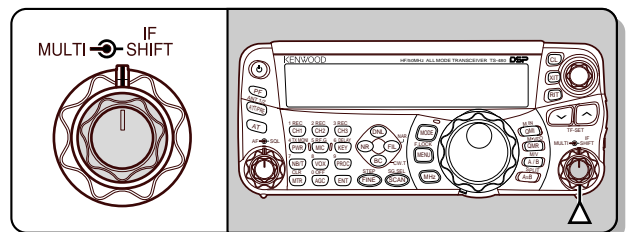
## RF (RADIO FREQUENCY) GAIN

The **RF GAIN** is normally configured to the maximum level regardless of the operating modes. The transceiver has been configured to the maximum level at the factory. However, you may decrease the RF GAIN slightly when you have trouble hearing the desired signal because of excessive atmospheric noise or interference from other stations. First, take note of the peak S-meter reading of the desired signal.

- 1 Press [ **MIC/ RF.G** ] (1 s).



- The current RF GAIN level appears on the sub-display (0: minimum ~ 100: maximum).
- 2 Turn the **MULTI** control counterclockwise until the S-meter reads the peak value that you noted.



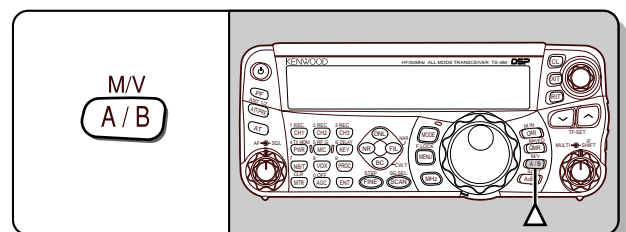
- Signals that are weaker than this level will be attenuated and reception of the station will become easier.

Depending on the type and gain of your antenna, and the condition of the band, adjust the RF GAIN. When using FM Mode, always adjust the RF GAIN to the maximum level.

## SELECTING VFO A OR VFO B

2 VFOs are available for controlling the frequency on the transceiver. Each VFO (VFO A and VFO B) works independently so that a different frequency and mode can be selected. For example, when SPLIT operation is activated, VFO A is used for reception and VFO B is used for transmission. The opposite combination is also possible.

Press [ **A/B / M/V** ] to toggle between VFO A and B.

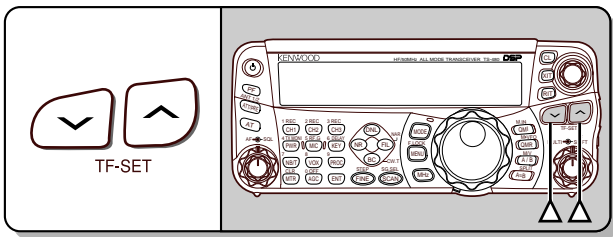


- “◀A” or “◀B” appears to indicate which VFO is selected.

## SELECTING A BAND

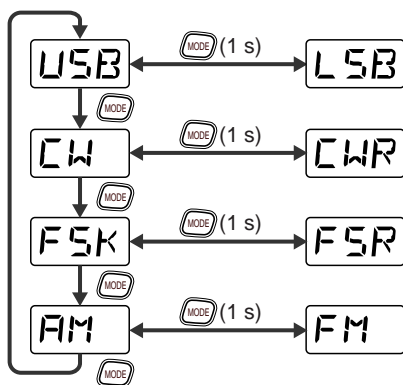
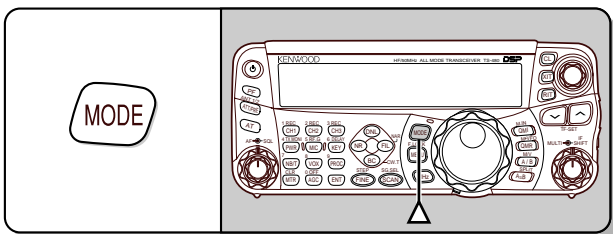
Press [V]/ [^] to select your desired band.

- Holding down either key changes the bands continuously.



## SELECTING A MODE

Press [MODE] to cycle through the 4 mode pairs: USB/ LSB, CW/ CWR, FSK/ FSR, and AM/ FM. Each time you press [MODE], the mode display cycles USB or LSB, CW or CWR, FSK or FSR, FM or AM. To select the other mode on each pair, press [MODE] (1 s). For example, to select “LSB” while “USB” is visible, press [MODE] (1 s). “USB” changes to “LSB”. Press [MODE] (1 s) again to go back to “LSB” from “USB”. The following illustration describes how to access each mode with the [MODE] key.

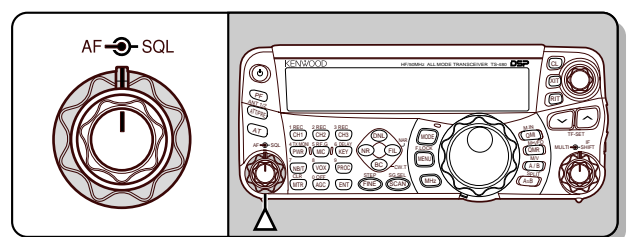


Access Menu No. 2 then press [^] to select “on” to turn the Auto Mode selection ON. When it is ON, “AUTO” appears. As a default setting, if you change the frequency above or below 9.5 MHz, the transceiver automatically switches modes; LSB for frequencies under 9.5 MHz and USB for frequencies equal to or over 9.5 MHz. You can further add the frequency table data to change the mode automatically {page 61}.

## ADJUSTING SQUELCH

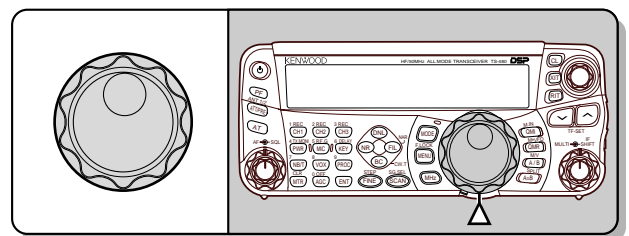
The purpose of the Squelch is to mute the speaker when no signals are present. With the squelch level correctly set, you will hear sound only while actually receiving signals. The higher the selected squelch level, the stronger the signals must be to receive. The appropriate squelch level depends on the ambient RF noise conditions.

Turn the **SQL** control when there are no signals present to select the squelch level at which the background noise is just eliminated; the green LED will turn off. Many ham operators prefer leaving the **SQL** control fully counterclockwise unless operating on a full-carrier mode such as FM. The squelch level for the main transceiver is preset at the factory to approximately the 9 o'clock position for FM and 11 o'clock for SSB and AM.

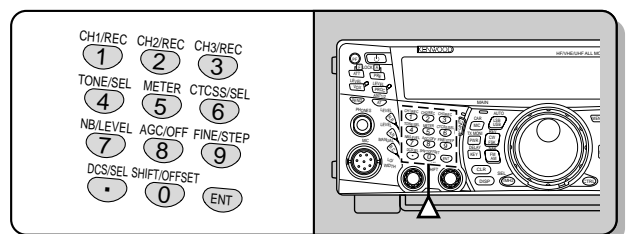


## SELECTING A FREQUENCY

Turn the **Tuning** control clockwise or press Mic [UP] to increase the frequency. Turn the **Tuning** control counterclockwise or press Mic [DWN] to decrease the frequency.



You may prefer directly entering a frequency using the numeric keypad if the desired frequency is far from the current frequency. Press [ENT], then press the numeric keys as necessary. For details, refer to “Direct Frequency Entry” {page 34}.



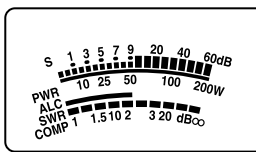
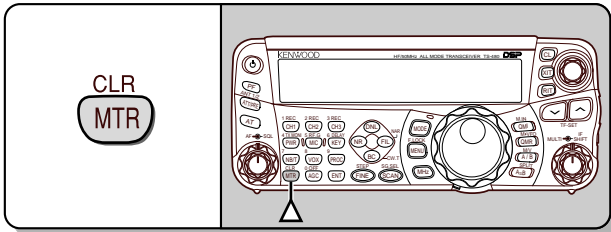
This transceiver provides many other methods for quickly selecting a frequency. For further information, refer to “SELECTING YOUR FREQUENCY” {page 34}.



## 4 OPERATING BASICS

### FRONT PANEL METER

The multi-function meter measures the parameters in the table below. The S-meter scale appears when the transceiver is in reception mode, and the PWR meter appears when it is in transmission mode. Each time you press **[MTR/ CLR]**, it cycles between the ALC, SWR, and COMP meters. Peak readings for the S-meter, ALC, SWR, COMP, and PWR functions are held momentarily.



Multi-function meter

Meter	What Is Measured?
S	Strength of received signals
PWR	Transmission output power
ALC	Automatic level control status
SWR	Antenna system standing wave ratio
COMP	Speech compression level when using the Speech Processor {page 37}

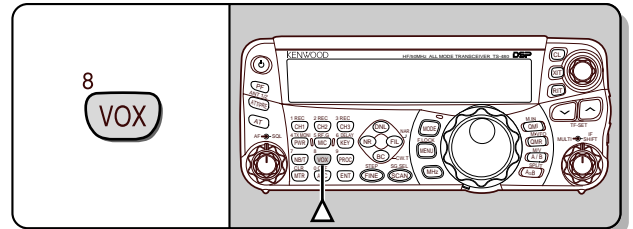
#### Note:

- ◆ The COMP meter functions only when the Speech Processor is ON for SSB, FM, or AM mode.
- ◆ Peak Hold readings cannot be deactivated.

### TRANSMITTING

For voice communications, press and hold Mic **[PTT]**, then speak into the microphone in your normal tone of voice. When you finish speaking, release Mic **[PTT]** to receive.

To transmit CW, press **[VOX/ 8]** to switch the Break-in function ON. "VOX" appears. Close the key or keyer paddle. Connect a key or keyer paddle {pages 7, 15}, then select CW using **[MODE]** {page 19}.



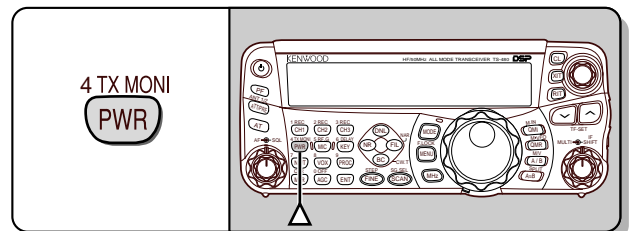
For a detailed explanation on transmitting, refer to "BASIC COMMUNICATIONS", beginning on page 27.

### SELECTING TRANSMISSION POWER

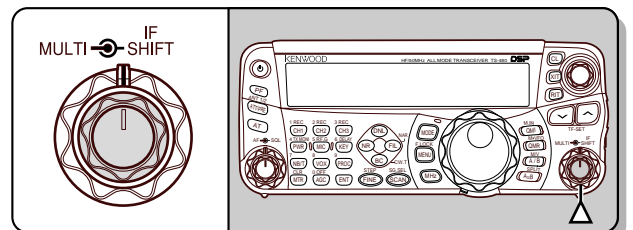
It is wise to select a lower transmission power if communication is still reliable. This lowers the risk of interfering with others on the band. When operating from battery power, selecting a lower transmission power allows you more operating time before recharging is necessary. This transceiver allows you to change the transmission power even while transmitting.

1 Press **[PWR/ 4/ TX MONI]**.

- The current transmission power appears.



2 Turn the **MULTI** control counterclockwise to reduce the power or clockwise to increase the power.



- The selectable range differs, depending on the transceiver model, the current band, and the mode.

3 Press **[PWR/ 4/ TX MONI]** to complete the setting.

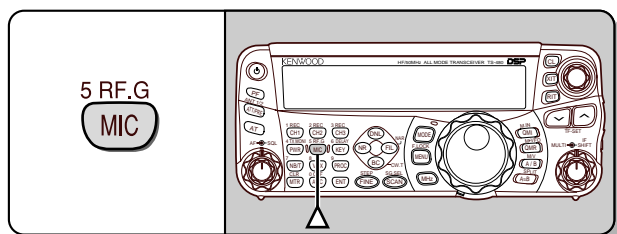
**Note:** You may access Menu No. 21, and select "on" to change the step size from 5 W to 1 W {page 65}.

## MICROPHONE GAIN

The microphone gain must be adjusted when SSB or AM mode is selected without using the speech processor {pages 27, 28}.

### 1 Press [MIC/ 5/ RF.G].

- The current microphone gain level appears. The range is from 0 to 100 with a default of 50.



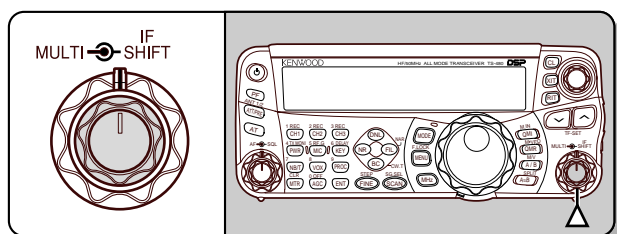
### 2 Press and hold Mic [PTT].

- The LED on the panel lights red.

### 3 SSB: While speaking into the microphone, adjust the **MULTI** control so that the ALC meter reflects your voice level but does not exceed the ALC limit.

AM: While speaking into the microphone, adjust the **MULTI** control so that the power meter slightly reflects your voice level.

FM: Access Menu No. 44 and select "1" (Low), "2" (Medium), or "3" (High) for the microphone gain, if necessary {page 27}.



### 4 Release Mic [PTT] to return to receive.

- The LED lights green or turns off, depending on the **SQL** control setting.

**Note:** When using the optional MC-90 microphone with the MJ-88 in FM mode, select "3" (High) for the microphone gain. The microphone sensitivity is low in FM mode. This may cause insufficient modulation. For other microphones, select either "1" (Low) or "2" (Medium).

# MENU SETUP

## WHAT IS A MENU?

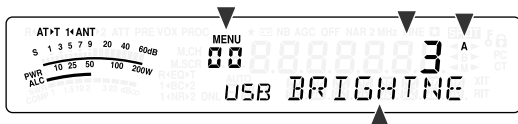
Many functions on this transceiver are selected or configured via a software-controlled Menu, rather than through the physical controls of the transceiver. Once familiar with the Menu system, you will appreciate the versatility it offers. You can customize the various timings, settings, and programming functions on this transceiver to meet your needs without using many controls and switches.

## MENU A/ MENU B

This transceiver has 2 menus: Menu A and Menu B. These menus contain identical functions and can be configured independently. The transceiver, therefore, allows you to switch between 2 different environments quickly and easily. For example, you can configure Menu A for DXing and contesting while Menu B is for relaxed local ragchewing. By switching from Menu A to Menu B, you can instantly change the Menu configuration and key assignment to suit your current operating style. Or, 2 operators may share a single transceiver by dedicating one Menu to each operator. Both operators can always enjoy their own configuration.

## MENU ACCESS

- 1 Press **[MENU/ F.LOCK]**.
  - The Menu No. and setting appear on the display, and the explanation of the menu appears on the sub-display.



- 2 Press **[A/B / M/V]** to select Menu A or Menu B.
  - "A" or "B" appears, indicating which Menu is selected.
- 3 Turn the **MULTI** control to select the desired Menu No.
  - Each time you change the Menu No., a different scrolling message appears on the sub-display, describing the Menu No.
- 4 Press **[v]/ [^]**, or Mic **[UP]/ [DWN]** to select a parameter.



- 5 Press **[MENU/ F.LOCK]** to exit Menu mode.

## QUICK MENU

Because the number of functions this transceiver provides is extraordinary, there are numerous items in each Menu. If you find accessing desired Menu Nos. to be too time consuming, use the Quick Menu to create your own customized, abbreviated Menu. You can then add those Menu Nos. which you frequently use, to the Quick Menu. Copying Menu Nos. to the Quick Menu has no effect on the Menu.

## PROGRAMMING THE QUICK MENU

- 1 Press **[MENU/ F.LOCK]**.
- 2 Turn the **MULTI** control to select the desired Menu No.
- 3 Press **[QMI/ M.IN]**.
  - An inverted star, "☉" appears, indicating that the Menu item has been added to the Quick Menu.
- 4 Press **[MENU/ F.LOCK]** to exit Menu mode.



- To remove the item from the Quick Menu, press **[QMI/ M.IN]** again. "☉" disappears.
- 4 Press **[MENU/ F.LOCK]** to exit Menu mode.

## USING THE QUICK MENU

- 1 Press **[MENU/ F.LOCK]**.
- 2 Press **[MHz]**.
  - "MHz" appears.
- 3 Turn the **MULTI** control to select the desired Quick Menu No.
- 4 Press **[v]/ [^]**, or Mic **[UP]/ [DWN]** to change the current setting for the selected Menu No.
  - When the Menu is registered to the Quick Menu list, "☉" appears.
- 5 Press **[MENU/ F.LOCK]** to exit Quick Menu mode.

**Note:** If the Quick Menu has not been programmed, turning the **MULTI** control in step 2 causes "CHECK" to be output in Morse code.

## MENU CONFIGURATION

Group	Menu No.	Function	Selections	Default	Ref. Page
Operator Interface	00	Display brightness OFF, 1: minimum, 4: maximum	oFF/ 1 to 4	3	63
	01	Key illumination	oFF/ on	on	63
Tuning Control	02	Auto mode operation	oFF/ on	oFF	61
	03	Tuning control change per revolution	250/ 500/ 1000	500	35
	04	Tuning with <b>MULTI</b> control in FM mode	oFF/ on	oFF	34
	05	Rounds off VFO frequencies changed by using the <b>MULTI</b> control	oFF/ on	on	34
	06	9 kHz frequency step size for the <b>MULTI</b> control in AM mode on the AM broadcast band	oFF/ on	See Reference Page	34
Memory Channel	07	Tunable (ON) or fixed (OFF) memory channel frequencies	oFF/ on	oFF	52
Scan Operation	08	Program scan partially slowed	oFF/ on	on	57
	09	Slow down frequency range for the Program scan	100/ 200/ 300/ 400/ 500 Hz	300	57
	10	Program scan hold	oFF/ on	oFF	57
	11	Scan resume method	to (Time-Operated)/ co (Carrier-Operated)	to	58
Monitor Sound	12	Beep output level OFF, 1: minimum, 9: maximum	oFF/ 1 to 9	4	62
	13	TX sidetone volume OFF, 1: minimum, 9: maximum	oFF/ 1 to 9	5	29
	14	VGS-1 playback volume OFF, 1: minimum, 9: maximum	oFF/ 1 to 9	4	69
	15	VGS-1 announcement volume OFF, 1: minimum, 7: maximum	oFF/ 1 to 7	4	69
	16	VGS-1 announcement speed 0: slow, 4: fast	0 to 4	1	69
IF Filter	17	Use CW IF filter for SSB reception	oFF/ on	oFF	45
DSP Equalizer	18	DSP RX equalizer oFF: Flat Hb1: High boost 1 Hb2: High boost 2 FP: Formant pass bb1 Bass boost 1 bb2: Bass boost 2 c: Conventional U: Flat (Reserved for ARCP software)	oFF/ Hb1/ Hb2/ FP/ bb1/ bb2/ c/ U	oFF	64

## 5 MENU SETUP

Group	Menu No.	Function	Selections	Default	Ref. Page
DSP Equalizer	19	DSP TX equalizer oFF: Flat Hb1: High boost 1 Hb2: Hight boost 2 FP: Formant pass bb1: Bass boost 1 bb2: Bass boost 2 c: Conventional U: Flat (Reserved for ARCP software)	oFF/ Hb1/ Hb2/ FP/ bb1/ bb2/ c/ U	oFF	38
TX Filter	20	DSP TX filter bandwidth for SSB or AM	2.0/ 2.4 kHz	2.4	38
TX Power	21	Fine transmission power tuning	oFF/ on	oFF	65
TOT	22	Time-out timer	oFF/ 3/ 5/ 10/ 20/ 30 minutes	oFF	65
Transverter	23	Transverter frequency display	oFF/ on	oFF	65
	24	Output power adjustment for Transverter	oFF/ on	on	65
Antenna Tuner	25	TX hold when AT completes the tuning	oFF/ on	oFF	60
	26	In-line AT while receiving	oFF/ on	oFF	60
	27	Control method for the external AT	At1/ At2	At1	61
Linear Amplifier	28	Linear amplifier control delay for HF band	oFF/ 1/ 2/ 3	oFF	63
	29	Linear amplifier control delay for 50 MHz band	oFF/ 1/ 2/ 3	oFF	63
Message Playback	30	Constant recording	oFF/ on	oFF	69
	31	Repeat the playback	oFF/ on	oFF	69
	32	Interval time for repeating the playback	0 to 60 seconds (in steps of 1 second)	10	69
CW	33	Keying priority over playback	oFF/ on	oFF	41
	34	CW RX pitch/ TX sidetone frequency	400 to 1000 Hz (in steps of 50 Hz)	800	29
	35	CW keying dot, dash weight ratio	Auto/ 2.5 to 4.0 (in steps of 0.1 )	Auto	39
	36	Reverse CW keying auto weight ratio	oFF/ on	oFF	39
	37	Bug key mode	oFF/ on	oFF	40
	38	Swap dot and dash paddle	oFF/ on	oFF	41
	39	Auto CW TX in SSB mode	oFF/ on	oFF	41
	40	Frequency correction for changing SSB to CW	oFF/ on	oFF	41
FSK	41	FSK shift	170/ 200/ 425/ 850 Hz	170	80
	42	FSK keying polarity	oFF (Normal)/ on (Reverse)	oFF	42, 80
	43	FSK tone frequency	1275/ 2125 Hz	2125	42, 80
FM	44	Mic gain for FM	1 (Low)/ 2 (Medium)/ 3 (High)	1	27

Group	Menu No.	Function	Selections	Default	Ref. Page
Data Comm.	45	Filter bandwidth for Data communications	oFF/ on	oFF	80, 81
	46	AF input level for Data communications (0: minimum ~ 9: maximum)	0 to 9	4	80, 81
	47	AF output level for Data communications (0: minimum ~ 9: maximum)	0 to 9	4	80, 81
PF keys	48	Remote Control panel PF key	00 to 93 and 99	61 (VOICE1)	64
	49	Microphone PF1 key	00 to 93 and 99	75 (A/B)	64
	50	Microphone PF2 key	00 to 93 and 99	74 (SPLIT)	64
	51	Microphone PF3 key	00 to 93 and 99	76 (M/V)	64
	52	Microphone PF4 key	00 to 93 and 99	63 (RX MONI)	64
Quick Data Transfer	53	Split frequency transfer in master/ slave operation	oFF/ on	oFF	79
	54	Permit to write the transferred Split frequencies to the target VFOs	oFF/ on	oFF	79
TX Inhibit	55	TX inhibit	oFF/ on	oFF	38
COM port	56	COM port communication speed	4800/ 9600/ 19200/ 38400/ 57600/ 115200 bps	9600	67
Crossband Repeater	57	DTS polarity	oFF/ on	oFF	70, 82
Busy Lockout	58	Busy lockout (TX)	oFF/ on	oFF	38
APO	59	APO (Auto Power Off) function	oFF/ 60/ 120/ 180 minutes	oFF	60
VOX Source	60	Transmit with the audio input on the DATA terminal	oFF/ on	oFF	36

## 5 MENU SETUP

### ALPHABETICAL FUNCTION LIST

Function	Menu No.
9 kHz frequency step size for the <b>MULTI</b> control in AM mode on the AM broadcast band	06
AF input level for Data communications	46
AF output level for Data communications	47
APO (Auto Power Off) function	59
Auto CW TX in SSB mode	39
Auto mode operation	02
Beep output level	12
Bug key mode	37
Busy lockout (TX)	58
COM port communication speed	56
Constant recording	30
Control method for the external AT	27
CW keying dot, dash weight ratio	35
CW RX pitch/ TX sidetone frequency	34
Display brightness	00
DSP RX equalizer	18
DSP TX equalizer	19
DSP TX filter bandwidth for SSB or AM	20
DTS polarity	57
Filter bandwidth for Data communications	45
Fine transmission power tuning	21
Frequency correction for changing SSB to CW	40
Remote Control panel PF key	48
FSK keying polarity	42
FSK shift	41
FSK tone frequency	43
In-line AT while receiving	26
Interval time for repeating the playback	32
Key illumination	01
Keying priority over playback	33
Linear amplifier control delay for HF band	28
Linear amplifier control delay for 50 MHz band	29
Mic gain for FM	44
Microphone PF1 key	49
Microphone PF2 key	50
Microphone PF3 key	51
Microphone PF4 key	52
Output power adjustment for Transverter	24
Permit to write the transferred Split frequencies to the target VFOs	54
Program scan hold	10
Program scan partially slowed	08

Function	Menu No.
Reverse CW keying auto weight ratio	36
Repeat the playback	31
Round off VFO frequencies changed by using the <b>MULTI</b> control	05
Scan resume method	11
Slow down frequency range for the Program scan	09
Split frequency transfer in master/ slave operation	53
Swap dot and dash paddle	38
Time-out timer	22
Transmits with the audio input on the DATA terminal	60
Transverter frequency display	23
Tunable (ON) or fixed (OFF) memory channel frequencies	07
Tuning control change per revolution	03
Tuning with <b>MULTI</b> control in FM mode	04
TX hold when AT completes the tuning	25
TX inhibit	55
TX sidetone volume	13
Use CW IF filter for SSB reception	17
VGS-1 announcement speed	16
VGS-1 announcement volume	15
VGS-1 message playback volume	14

## SSB TRANSMISSION

SSB is the most commonly-used mode on the HF Amateur radio bands. Compared with other voice modes, SSB requires only a narrow bandwidth for communications. SSB also allows long distance communications with minimum transmission power.

If necessary, refer to “OPERATING BASICS”, beginning on page 18, for details on how to receive.

- 1 Select an operating frequency.
- 2 Press **[MODE]** until “USB” or “LSB” appears on the operating mode display.
  - If the desired sideband (“USB” or “LSB”) does not appear, select the other sideband first. Then, press **[MODE]** (1 s). The mode indicator changes to your desired sideband.
  - “USB” represents the upper sideband and “LSB” represents the lower sideband. Normally, USB is used for the communications for 10 MHz and above. While LSB is used for the frequencies below 10 MHz.



- 3 Press **[MIC/ 5/ RF.G]** to adjust the Microphone gain.
  - The current gain level appears on the sub-display.



- 4 Press and hold Mic **[PTT]**.
  - The LED above the **[MODE]** key lights red.
  - Refer to “VOX” {page 36} for information on automatic TX/ RX switching.
- 5 Speak into the microphone and turn the **MULTI** control so that the ALC meter reflects your voice level but does not exceed the ALC limit.
  - Speak in your normal tone and level of voice. Speaking too close to the microphone or too loudly may increase distortion and reduce intelligibility at the receiving end.
  - You may want to use the Speech Processor. Refer to “SPEECH PROCESSOR” {page 37} for details.
- 6 Release Mic **[PTT]** to return to Reception mode.
  - The LED lights green or turns off, depending on the **SQL** control position.
- 7 Press **[MIC/ 5/ RF.G]** to exit the Microphone gain adjustment.

Refer to “COMMUNICATING AIDS”, beginning on page 34, for information on additional useful operation functions.

## FM TRANSMISSION

FM is a common mode for communicating on VHF or UHF frequencies. As for HF and the 6 m band, 29 MHz and 51-54 MHz bands are commonly used for FM operation. You can also utilize 10 m/ 6 m band repeaters to reach your friends when they are outside or skipped over from your coverage. Although FM requires a wider bandwidth when compared to SSB or AM mode, it has the finest audio quality among these modes. When combined with the full-quieting aspect of FM signals, which suppress background noise on the frequency, FM can be the best method for maintaining casual communications with your local friends.

If necessary, refer to “OPERATING BASICS”, beginning on page 18, for details on how to receive.

- 1 Select an operating frequency.
- 2 Press **[MODE]** until “FM” appears.
  - If “FM” does not appear, select “AM”, then press **[MODE]** (1 s). The mode indicator changes to “FM”.



- 3 Press and hold Mic **[PTT]**.
  - The LED lights red.
  - Refer to “VOX” for information on automatic TX/ RX switching {page 36}.
- 4 Speak into the microphone in your normal tone and level of voice.
  - Speaking too close to the microphone or too loudly may increase distortion and reduce intelligibility at the receiving end.
  - You can switch the Microphone gain for FM between 1 (Low), 2 (Medium), and 3 (High) by using Menu No. 44. 1 (Low) is usually appropriate; however, select 3 (High) if other stations report that your modulation is weak.
- 5 Release Mic **[PTT]** to return to Reception mode.
  - The LED lights green or turns off, depending on the **SQL** control position.

Refer to “COMMUNICATING AIDS”, beginning on page 34, for additional information on useful operation functions.

**Note:** Microphone gain adjustment for SSB or AM has no effect in FM mode. In FM mode, you must select 1 (Low), 2 (Medium), or 3 (High) in Menu No. 44.



## AM TRANSMISSION

Each mode used on the HF Amateur bands has its own advantages. Although long distance DX contacts may be less common while using AM, the superior audio quality characteristic of AM operation is one reason why some hams prefer this mode.

When looking for others operating on AM, check the following frequencies first:

3885 kHz, 7290 kHz, 14286 kHz, 21390 kHz, and 29000 ~ 29200 kHz

If necessary, refer to “OPERATING BASICS”, beginning on page 18, for details on how to receive.

- 1 Select an operating frequency.
- 2 Press **[MODE]** until “AM” appears.
  - If “AM” does not appear, select “FM” first, then press **[MODE]** (1 s). The mode indicator changes to “AM”.



- 3 Press **[MIC/ 5/ RF.G]** to enter the Microphone gain adjustment mode.
  - The current gain level appears on the sub-display.
- 4 Press and hold Mic **[PTT]**.
  - The LED lights red.
  - Refer to VOX function for information on automatic TX/ RX switching {page 36}.
- 5 Speak into the microphone and adjust the **MULTI** control so that the power meter slightly reflects your voice level.
  - Speak in your normal tone and level of voice. Speaking too close to the microphone or too loudly may increase distortion and reduce intelligibility at the receiving end.
  - You may want to use the Speech Processor. Refer to “SPEECH PROCESSOR” {page 37} for details.
- 6 Release Mic **[PTT]** to return to Reception mode.
  - The LED lights green or turns off, depending on the **SQL** control position.
- 7 Press **[MIC/ 5/ RF.G]** to exit the Microphone gain adjustment mode.

Refer to “COMMUNICATING AIDS”, beginning on page 34, for information on additional useful operation functions.

**Note:** While transmitting, press **[MIC/ 5/ RF.G]** and then turn the **MULTI** control so that the ALC meter just begins to indicate. Press **[MIC/ 5/ RF.G]** again to complete the adjustment.

## NARROW BANDWIDTH FOR FM

Select wide band or narrow band TX deviation depending on whether the other station is using wide band or narrow band RX deviation. The table below shows the RX IF filter bandwidth and TX deviation combination for each operating mode. The bandwidth selection is crucial to avoid audio distortion or insufficient intelligibility that the other station will encounter.

Mode	RX IF Filter	TX Deviation
FM	Narrow	Wide
FM + NAR	Narrow	Narrow

- 1 Press **[MODE]** until “FM” appears.
  - If “FM” does not appear, select “AM” first, then press **[MODE]** (1 s). The mode indicator changes to “FM”.
- 2 Press **[FIL/ NAR]** (1 s) to toggle the selection between wide and narrow TX deviation.
  - “NAR” appears when the narrow TX deviation is selected.



## NARROW BANDWIDTH FOR AM

When receiving AM, you can further decrease the bandwidth to eliminate interference. However, the transmission deviation of AM is not affected by this selection.

- 1 Press **[MODE]** until “AM” appears.
  - If “AM” does not appear, select “FM” first, then press **[MODE]** (1 s). The mode indicator changes to “AM”.
- 2 Press **[FIL/ NAR]** (1 s) to toggle the selection between Normal and Narrow.
  - “NAR” appears when the narrow bandwidth is selected for the AM reception.

## CW TRANSMISSION

CW operators know that this mode is very reliable when communicating under worst conditions. It may be true that newer digital modes rival CW as being equally as useful in poor conditions. These modes, however, do not have the long history of service nor the simplicity that CW provides.

This transceiver has a built-in electronic keyer that supports a variety of functions. For details on using these functions, refer to “ELECTRONIC KEYS” {page 39}.

If necessary, refer to “OPERATING BASICS”, beginning on page 18, for details on how to receive.

- 1 Select the operating frequency.
- 2 Press **[MODE]** until “CW” or “CWR” appears.



- To precisely tune in another station, use Auto Zero-beat. Refer to “AUTO ZERO-BEAT” {below}.
- 3 Press **[VOX/ 8]** to activate the CW break-in function.
    - “VOX” appears.
    - Refer to “CW BREAK-IN” for further information on automatic TX/ RX switching {page 39}.
  - 4 Begin sending the message.
    - As you transmit, you should hear a sidetone that lets you monitor your own transmission.
    - The LED lights red as you send the message.
  - 5 Stop sending the message to return to Reception mode.
    - The LED lights green or turns off, depending on the **SQL** control setting.

## AUTO ZERO-BEAT

Use Auto Zero-beat before transmitting to tune in a CW station. Auto Zero-beat automatically and exactly matches your transmit frequency with the station you are receiving. Neglecting to do this will reduce your chances of being heard by the other station.

- 1 Tune to the CW signal using the **Tuning** control.
- 2 Press **[BC/ CW.T]** (1 s) to start Auto Zero-beat while CW is selected for the operating mode.
  - “CW TUNE” appears.



- Your reception frequency automatically changes so that the pitch (tone) of the received signal exactly matches the TX sidetone/ RX pitch frequency that you have selected. Refer to “TX SIDETONE/ RX PITCH FREQUENCY” {below}.
  - When matching is completed, “CW TUNE” disappears.
  - If matching is unsuccessful, the previous frequency is restored.
- 3 To quit Auto Zero-beat, press **[CLR/ MTR]** or press **[BC/ CW.T]** again.

### Note:

- ◆ You cannot start Auto Zero-beat if you have selected 1.0 kHz or wider for the DSP filter bandwidth {page 46}.
- ◆ When using Auto Zero-beat, the matching error is within  $\pm 50$  Hz in most cases.
- ◆ Auto Zero-beat may fail if the keying speed of the target station is too slow or some interference is present.
- ◆ When the RIT function is ON, only RIT frequencies change to make the Auto Zero-beat adjustment.

## TX SIDETONE/ RX PITCH FREQUENCY

As you send CW, you will hear tones from the transceiver speaker. These are called TX (transmission) sidetones. Listening to these tones, you can monitor what you are transmitting. You may also use the tones to ensure that your key contacts are closing, the keyer is functioning, or to practice sending without actually putting a signal on the air.

RX (reception) pitch refers to the frequency of CW that you hear after tuning in a CW station.

On this transceiver, the frequency of the sidetone and RX pitch are equal and selectable. Access Menu No. 34 to select the frequency that is most comfortable for you. The selectable range is from 400 Hz to 1000 Hz in steps of 50 Hz (default is 800 Hz).

To change the volume of the TX sidetone, access Menu No. 13. The selections range from 1 to 9 and OFF (default is 5).

**Note:** The position of the **AF** control does not affect the volume of the TX sidetone.

## SPLIT-FREQUENCY OPERATION

Usually you can communicate with other stations using a single frequency for receiving and transmitting. In this case, you select only one frequency on either VFO A or VFO B. However, there are cases where you must select one frequency for receiving and a different frequency for transmitting. This requires the use of 2 VFOs. This is referred to as “split-frequency operation”. One typical case which requires this type of operation is when you use an FM repeater {page 31}. Another typical case is when you call a rare DX station.

When a rare or desirable DX station is heard, that operator may immediately get many simultaneous responses. Often, such a station is lost under the noise and confusion of many calling stations. If you find that you are suddenly being called by many operators, it is your responsibility to control the situation. You may announce that you will be “listening up 5 (kHz, from your present transmission frequency)”, or “listening down between 5 and 10 (kHz)”.

- 1 Press **[A/B / M/V]** to select VFO A or VFO B to reception frequency.
  - “◀A” or “◀B” appears to show which VFO is selected.
- 2 Select an operating frequency.
  - The frequency selected at this point will be used for transmission.
  - To copy the selected VFO frequency to the other VFO, press **[A=B/ SPLIT]**.
- 3 Press **[A/B / M/V]** to select the other VFO.
- 4 Select an operating frequency.
  - The frequency selected on this VFO will be used for reception.
- 5 Press **[A=B/ SPLIT] (1 s)**.
  - “**SPLIT**” appears.



- Each time you press **[A/B / M/V]**, the reception and the transmission frequency are swapped.
- 6 To quit split-frequency operation, press **[A=B/ SPLIT] (1 s)** again.
    - “**SPLIT**” disappears.

## TF-SET (TRANSMISSION FREQUENCY SET)

TF-SET allows you to temporarily switch your transmission frequency and reception frequency. Canceling this function immediately restores the original transmission and reception frequencies. By activating TF-SET, you can listen on your transmission frequency, and change it while listening. This allows you to check whether or not the newly selected transmission frequency is free of interference.

- 1 Configure split-frequency operation as explained in the previous section.
- 2 Press **[MENU/ F.LOCK] (1 s)** to lock the **Tuning** control.
  - “**Ⓕ**” appears.



- 3 Press and hold either **[V]** or **[^]** while the “**Ⓕ**” icon is visible. While holding down **[V]** or **[^]**, turn the **Tuning** control or press Mic **[UP]/ [DWN]** to change the transmission frequency.



- The transceiver receives on the frequency as you change, but the frequency shown on the sub-display (the original reception frequency) stays unchanged.
- 4 Release **[V]** or **[^]**.
    - You are now receiving again on your original reception frequency.

Successfully contacting a DX station in a pileup often depends on making a well-timed call on a clear frequency. That is, it is important to select a relatively clear transmission frequency and to transmit at the exact instant when the DX station is listening but the majority of the groups aren't transmitting. Switch your reception and transmission frequencies by using the TF-SET function and listen to your transmission frequency. You will soon learn the rhythm of the DX station and the pileup. The more proficient you become at using this function, the more DX stations you will contact.

### Note:

- ◆ *TF-SET is disabled while transmitting.*
- ◆ *An RIT offset frequency is not added; however, an XIT offset frequency is added to the transmission frequency.*

## FM REPEATER OPERATION

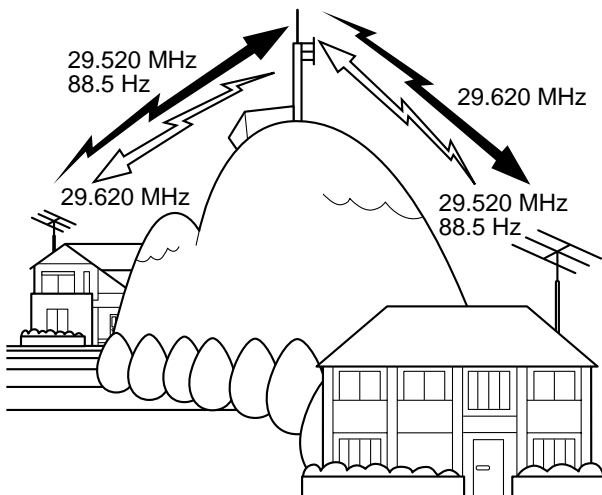
Most Amateur radio voice repeaters use a separate reception and transmission frequency. The transmission frequency may be higher or lower than the reception frequency. In addition, some repeaters may require the transceiver to transmit a subtone before the repeater can be used.

Compared to simplex communication, you can usually transmit over much greater distances by using a repeater. Repeaters are typically located on a mountain top or other elevated location. Often they operate at higher ERP (Effective Radiated Power) than a typical station. This combination of elevation and high ERP allows communications over considerable distances.

HF/ 6 m band repeaters operate usually in the 29 MHz FM sub-band and 51-54 MHz band. This special service combines the advantages of FM operation, good fidelity with noise and interference immunity, with the excitement of HF DX (long distance) communications. Even on a quiet day, 10 meter FM provides reliable around-town communications with the potential for sudden DX from across the country or around the world.

### Note:

- ◆ When programming 2 separate frequencies using 2 VFOs, be sure to select FM mode on both VFOs.
- ◆ When operating through a repeater, over deviation caused by speaking too loudly into the microphone can cause your signal to "talk-off" (break up) through the repeater.



- 1 Press **[A/B / M/V]** to select VFO A or VFO B.
  - “◀A” or “◀B” appears to show which VFO is selected.
- 2 Turn the **Tuning** control or **MULTI** control to select the reception frequency.
- 3 Press **[MODE]** to select FM mode {page 19}.
- 4 Press **[A=B/ SPLIT]** to duplicate the frequencies and other data to the other VFO.
- 5 Turn the **Tuning** control or **MULTI** control to select the transmission frequency.
  - The frequency selected on this VFO will be used for transmission.
- 6 Press **[NB/T/ 7]** to turn the Tone function ON if the repeater requires a subtone.
  - “T” appears.
  - Refer to “SELECTING SUBTONE FREQUENCY” for more details on the subtone {page 32}.



- To quit the Subtone function, press **[NB/T/ 7]** twice.
- 7 Press **[A=B/ SPLIT]** (1 s).
    - “SPLIT” appears.
  - 8 Press **[A/B / M/V]** to go back to the original reception frequency.
  - 9 Press Mic **[PTT]** to transmit.
    - The VFO changes to the other VFO to transmit.
    - Each time you press **[A/B / M/V]**, the reception and the transmission frequency are swapped.
  - 10 Press **[A=B/ SPLIT]** (1 s) to quit split-frequency operation.
    - “SPLIT” disappears.

The data that you select in steps 1 to 8 can be stored in memory. Refer to “Split-Frequency Channels” {page 51}.

### Note:

- ◆ When operating through a repeater, over deviation caused by speaking too loudly into the microphone can cause your signal to “talk-off” (break up) through the repeater.
- ◆ To check the subtone frequency stored in a memory channel, recall the desired memory channel, and press **[NB/T/ 7]** (1 s).

## 7 ENHANCED COMMUNICATIONS

### TRANSMITTING A TONE

In general, FM repeaters require the transceiver to transmit a sub-audible tone to prevent other repeaters on the same frequency from locking each other up. The required tone frequency differs among repeaters. Repeaters also differ in their requirements for either continuous or burst tones. For the appropriate selections for your accessible repeaters, consult your local repeater reference.

After completing the tone settings, pressing and holding Mic **[PTT]** causes the transceiver to transmit the selected tone. If you have selected a 1750 Hz tone, the transceiver sends a 500 ms tone burst each time transmission starts.

**Note:** If you store tone settings in a memory channel, you need not reprogram each time. Refer to "MEMORY FEATURES" (page 50).

#### ■ Activating the Tone Function

- 1 Confirm that FM mode has been selected on the VFO(s) (page 19).
  - When using 2 VFOs, you must select FM mode on both VFOs.
- 2 Press **[NB/T/ 7]**.
  - "T" appears.



**Note:** You cannot use the Tone function with the CTCSS function.

#### ■ Selecting a Tone Frequency

- 1 While "T" appears (Tone function is ON), press **[NB/T/ 7]** (1 s).
  - The current tone frequency appears. The default is 88.5 Hz.



- 2 Turn the **MULTI** control to select the desired tone frequency.
  - The available tone frequencies are listed in the following table.
- 3 Press **[MTR/ CLR]** to complete the setting.

No.	Freq. (Hz)	No.	Freq. (Hz)	No.	Freq. (Hz)	No.	Freq. (Hz)
00	67.0	11	97.4	22	141.3	33	206.5
01	69.3	12	100.0	23	146.2	34	210.7
02	71.9	13	103.5	24	151.4	35	218.1
03	74.4	14	107.2	25	156.7	36	225.7
04	77.0	15	110.9	26	162.2	37	229.1
05	79.7	16	114.8	27	167.9	38	233.6
06	82.5	17	118.8	28	173.8	39	241.8
07	85.4	18	123.0	29	179.9	40	250.3
08	88.5	19	127.3	30	186.2	41	254.1
09	91.5	20	131.8	31	192.8	42	1750
10	94.8	21	136.5	32	203.5		

#### **Note:**

- ◆ You can select a tone frequency independent of a CTCSS frequency.
- ◆ When 1750 Hz is selected, the transceiver sends a 500 ms tone burst each time transmission starts. You cannot transmit 1750 Hz tone manually.

### TONE FREQ. ID SCAN

This function scans through all tone frequencies to identify the incoming tone frequency on a received signal. You may find this useful when you do not know the tone frequency that the repeater uses.

- 1 While the Tone function is ON ("T" is visible), press **[NB/T/ 7]** (1 s).
  - The current tone frequency appears.
- 2 Press **[SCAN/ SG.SEL]** to activate the Tone frequency ID scan.
  - "T" blinks and every tone frequency is scanned. When the tone frequency is identified, the transceiver stops scanning and the identified frequency is displayed.



- Press **[SCAN/ SG.SEL]** to stop scanning while the tone frequency ID scan is active.
- Press **[SCAN/ SG.SEL]** again to resume scanning.

**Note:** Received signals are audible while scanning is in progress.

## FM CTCSS OPERATION

You may sometimes want to hear calls only from specific persons. When using FM mode, the Continuous Tone Coded Squelch System (CTCSS) allows you to ignore (not hear) unwanted calls from other persons who are using the same frequency. A CTCSS tone is sub-audible and is selectable from among the 42 tone frequencies. Select the same CTCSS tone as the other stations in your group. You will not hear calls from stations other than those using the same CTCSS tone.

**Note:** *CTCSS does not cause your conversation to be private. It only relieves you from listening to unwanted conversations.*

- Press **[A/B / M/V]** to select VFO A or VFO B.
  - “◀A” or “◀B” appears to show which VFO is selected.
- Select the 29 MHz band or the 51-54 MHz band using **[v]** or **[^]**.
- Select the desired frequency with the **Tuning** control or **MULTI** control.
- Press **[MODE]** to select FM mode {page 19}.
- Turn the **SQL** control to adjust the squelch.
- Press **[NB/T/ 7]** until “CT” appears.



- While “CT” is visible, press **[NB/T/ 7]** (1 s).
  - The current CTCSS frequency appears. The default CTCSS frequency is 88.5 Hz.



- Turn the **MULTI** control to select the appropriate CTCSS frequency.
  - The selectable CTCSS frequencies are listed in the following table.
- Press **[MTR/ CLR]** to complete the setting.

No.	Freq. (Hz)	No.	Freq. (Hz)	No.	Freq. (Hz)	No.	Freq. (Hz)
00	67.0	11	97.4	22	141.3	33	206.5
01	69.3	12	100.0	23	146.2	34	210.7
02	71.9	13	103.5	24	151.4	35	218.1
03	74.4	14	107.2	25	156.7	36	225.7
04	77.0	15	110.9	26	162.2	37	229.1
05	79.7	16	114.8	27	167.9	38	233.6
06	82.5	17	118.8	28	173.8	39	241.8
07	85.4	18	123.0	29	179.9	40	250.3
08	88.5	19	127.3	30	186.2	41	254.1
09	91.5	20	131.8	31	192.8		
10	94.8	21	136.5	32	203.5		

You will hear calls only when the selected tone is received. To answer the call, press and hold Mic **[PTT]**, then speak into the microphone.

Skip steps **7** and **8** if you have already programmed the appropriate CTCSS frequency.

**Note:**

- ◆ *When using split-frequency operation, select FM mode on both VFOs to use CTCSS.*
- ◆ *You can select a CTCSS frequency independent of a tone frequency.*
- ◆ *You cannot use the CTCSS function with the Tone function.*

## CTCSS FREQUENCY ID SCAN

This function scans through all CTCSS frequencies to identify the incoming CTCSS frequency on a received signal. You may find this useful when you cannot recall the CTCSS frequency that the other persons in your group are using.

- While the CTCSS function is ON, press **[NB/T/ 7]** (1 s).
  - The current CTCSS frequency appears.
- Press **[SCAN/ SG.SEL]** to activate the CTCSS frequency ID scan.
  - “CT” blinks and every CTCSS frequency is scanned. When the CTCSS frequency is identified, the transceiver stops scanning and the identified frequency is displayed.



- ◆ Press **[SCAN/ SG.SEL]** again to resume scanning.
- ◆ Press **[SCAN/ SG.SEL]** to stop scanning while the CTCSS frequency ID scan is active.

**Note:** *Received signals are audible while scanning is in progress.*

## RECEPTION

### SELECTING YOUR FREQUENCY

In addition to turning the **Tuning** control or pressing Mic **[UP]/ [DOWN]**, there are several other ways to select your frequency. This section describes additional methods of frequency selection that may save you time and effort.

#### ■ Direct Frequency Entry

When the desired frequency is far removed from the current frequency, directly entering a frequency from the numeric keypad is usually the fastest method.

##### 1 Press **[ENT]**.

- “- - - - -” appears.



##### 2 Press the numeric keys (**[0]** to **[9]**) to enter your desired frequency.

- Pressing **[ENT]** at any time fills the remaining digits (the digits you did not enter) with 0 and completes the entry. To select 1.85 MHz for example, press **[ENT]**, **[0]**, **[1]**, **[8]**, **[5]**, then press **[ENT]** to complete the input (6 key strokes).
- Pressing **[MTR/ CLR]** before pressing **[ENT]** cancels the entry and restores the current VFO frequency.

#### Note:

- ◆ You can enter a frequency in the range of 30.00 kHz to 59.999.99 MHz. Refer to the specifications for the available frequency range.
- ◆ Attempting to enter a frequency that is outside the selectable frequency range causes an alarm to sound. The entered frequency is rejected.
- ◆ When the entered frequency does not meet the current VFO frequency step size requirement, the nearest available frequency is automatically selected after the entered frequency is changed.
- ◆ When the 10 Hz digit (last displayed digit) is entered, the digit 0 is automatically entered for the 1 Hz digit, and frequency entry is completed. The 1 Hz digit is not displayed.
- ◆ When an entered frequency is accepted, RIT or XIT will be switched OFF, but the RIT or XIT offset frequency is not cleared.

#### ■ Using the MHz key

Pressing **[v]/ [^]** on the Remote Control panel changes Amateur bands. You can also use the **MULTI** control to change the operating frequency in steps of 1 MHz.

##### 1 Press **[MHz]**.

- “MHz” appears.



##### 2 Turn the **MULTI** control.

- Clockwise increases the frequency and counter-clockwise decreases the frequency.

##### 3 Press **[MHz]** again to exit.

- “MHz” disappears.

If you prefer to change the frequency in steps of 100 kHz or 500 kHz rather than 1 MHz, press **[MHz]** (1 s), then turn the **MULTI** control to select 100 kHz, 500 kHz, or 1 MHz.

**Note:** Even if 100 kHz or 500 kHz is assigned for the **[MHz]** key, “MHz” appears on the display.

#### ■ Quick QSY

To move up or down the frequency quickly, use the **MULTI** control. Turning this control changes the operating frequency in steps of 5 kHz for SSB/ CW/ AM/ FSK and 10 kHz for FM.

- If you want to change the default frequency step size, press **[FINE/ STEP]** (1 s). Turn the **MULTI** control to select 5 kHz, 6.25 kHz, 10 kHz, 12.5 kHz, 15 kHz, 20 kHz, 25 kHz, 30 kHz, 50 kHz or 100 kHz for FM/ AM, and 500 Hz, 1 kHz, 2.5 kHz, 5 kHz, or 10 kHz for the other modes. The default step size is 5 kHz for SSB/ CW/ FSK/ AM and 10 kHz for FM.
- When changing the operating frequency by using the **MULTI** control, frequencies are rounded such that new frequencies are multiples of the frequency step size. To disable this function, access Menu No. 05 and select “off” (default is “on”).
- Within the AM broadcast band, the step size automatically defaults to the frequency step value in Menu No. 06. This step size can be switched between 9 kHz (all E-types: “on”) and 5 kHz (K-type: “off”) via Menu No. 06.

**Note:** The programmed frequency step size for the **MULTI** control is stored independently for the HF and 50 MHz bands. You can also set a different frequency step size for SSB/ CW/ FSK, AM and FM modes.

#### ■ Configuring the Tuning Control as MULTI control (FM)

In FM mode, you can configure the **Tuning** control to change the frequency as same as the **MULTI** control. Access Menu No. 04 and select “on” (default is “off”). O yu turn the **Tuning** control, the frequency changes as same as turning the **MULTI** control.

## ■ Fine Tuning

The default frequency step size when turning the **Tuning** control to change the frequency is 10 Hz for SSB, CW, and FSK modes, and 100 Hz for FM and AM modes. However, you can change the frequency step size to 1 Hz for SSB, CW, and FSK modes, and 10 Hz for FM and AM modes.

### 1 Press [FINE/ STEP].

- “FINE” appears.



- 2 Turn the **Tuning** control to select the exact frequency.
- 3 To quit the function, press [FINE/ STEP] again.
  - “FINE” disappears.

## ■ Tuning control adjustment rate

The default **Tuning** control adjustment rate is “500”. This represents the number of pulses the **Tuning** control generates in a complete revolution. Each pulse changes the tuning frequency based on the current frequency step size (the frequency step size for the **Tuning** control is 10 Hz for SSB/ CW/ FSK mode and 100 Hz for AM/ FM mode). For example, in SSB mode the frequency step size is 10 Hz, so the frequency would change by 5,000 Hz in a complete revolution of the **Tuning** control. The adjustment rate of the **Tuning** control can be lowered to “250” pulses per revolution or increased to “1000” pulses per revolution.

- 1 Press [MENU/ F.LOCK].
- 2 Turn the **MULTI** control to select Menu No. 4.
- 3 Press [V]/ [^] to select “250”, “500” (default), or “1000”.
- 4 Press [MENU/ F.LOCK] to store the setting and exit Menu mode.

## ■ Equalizing VFO Frequencies (A=B)

This function allows you to copy the frequency and modulation mode of the active VFO to the inactive VFO.

- 1 Select the frequency and mode on VFO A or VFO B.
- 2 Press [A=B/ SPLIT].
  - The frequency and mode selected in step 1 are duplicated to the inactive VFO.
- 3 Press [A/B / M/V] to confirm that the frequency was copied.

## RIT (RECEIVE INCREMENTAL TUNING)

RIT provides the ability to change your reception frequency by  $\pm 9.99$  kHz in steps of 10 Hz without changing your transmission frequency. If the Fine Tuning ([FINE/ STEP]) function is ON, the step size

becomes 1 Hz. RIT works equally well with all modulation modes and while using VFO or Memory Recall mode.

### 1 Press [RIT].

- “RIT” and the RIT offset appear.



- 2 If required, press [CL] to reset the RIT offset to 0.
- 3 Turn the **RIT/ XIT** control to change your reception frequency.
- 4 To turn RIT OFF, press [RIT].
  - The reception frequency is returned to the frequency that was selected prior to step 1.

**Note:** When storing the frequency in a Memory channel with the RIT function ON, the RIT offset frequency is added or subtracted to/ from the VFO frequency. The calculated data is then stored in the Memory channel.

## AGC (AUTOMATIC GAIN CONTROL)

When using a mode other than FM, AGC selects the time constant for the Automatic Gain Control circuit.

Selecting a slow time constant will cause the receiver gain and S-meter readings to react slowly to large input changes. A fast time constant causes the receiver gain and the S-meter to react quickly to changes in the input signal. A fast AGC setting is particularly useful in the following situations:

- Tuning rapidly
- Receiving weak signals
- Receiving high-speed CW

For your convenience, the following default AGC time constant has already been programmed.

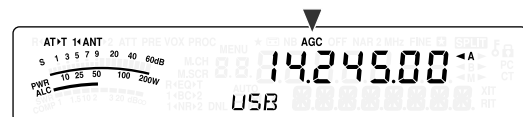
SSB: Slow (“AGC”) CW: Fast (“AGC - F”)

FSK: Fast (“AGC - F”) AM: Slow (“AGC”)

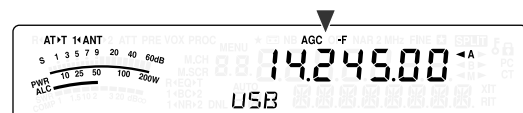
To change the default time constant:

### 1 Press [AGC/ 0/ OFF].

- The AGC time constant icon appears on the display (“AGC”: Slow, “AGC - F”: Fast).



- Each time you press [AGC/ 0/ OFF], the AGC time constant alternates fast and slow.



- 2 If you want to turn the AGC OFF, press [AGC/ 0/ OFF] (1 s).
  - “AGC OFF” appears on the display.

**Note:** You cannot adjust the AGC time constant in FM mode.



### TRANSMISSION

#### VOX (VOICE-OPERATED TRANSMIT)

VOX eliminates the necessity of manually switching to the transmission mode each time you want to transmit. The transceiver automatically switches to transmission mode when the VOX circuitry senses that you have begun speaking into the microphone.

When using VOX, develop the habit of pausing between thoughts to allow the transceiver to drop back to reception mode briefly. You will then hear if anybody wants to interrupt, plus you will have a short period to gather your thoughts before speaking again. Your listeners will appreciate your consideration as well as respect your more articulate conversation.

VOX can be switched ON and OFF independently for CW and the other modes, excluding FSK.

Press **[VOX/ 8]** to toggle between VOX ON and OFF.

- “VOX” appears when the VOX function is ON.



#### Microphone Input Level

To enjoy the VOX function, take the time to properly adjust the gain of the VOX circuit. This level controls the capability of the VOX circuit to detect the presence or absence of your voice. In CW mode, this level cannot be adjusted.

- 1 Select USB, LSB, FM, or AM mode.
- 2 Press **[VOX/ 8]** to switch the VOX function ON.
  - “VOX” appears.



- 3 Press **[VOX/ 8]** (1 s).
  - The current VOX gain appears on the sub-display.



- 4 While speaking into the microphone using your normal tone of voice, adjust the setting (default is 4) using the **MULTI** control until the transceiver reliably switches to transmission mode each time you speak.
  - The selectable gain range is from 0 to 9.
  - The setting should not allow background noise to switch the transceiver to transmit mode.

**Note:** The VOX gain level can be adjusted even if VOX is switched OFF or while you are transmitting.

#### Delay Time

If the transceiver returns to reception mode too quickly after you stop speaking, your final word may not be transmitted. To avoid this, select an appropriate delay time that allows all of your words to be transmitted without an overly long delay after you stop speaking.

- 1 Select USB, LSB, FM, or AM mode.
- 2 Press **[VOX/ 8]** to switch the VOX function ON.
  - “VOX” appears.
- 3 Press **[KEY/ DELAY]** (1 s).
  - The current setting appears on the sub-display. The default is 50 (1500 ms).



- 4 While speaking into the microphone using your normal tone of voice, turn the **MULTI** control such that the transceiver switches to reception mode after you have stopped talking.
  - The selectable range is from 5 to 100 (150 ms to 3000 ms) in steps of 5, or OFF.
- 5 Press **[MTR/ CLR]** to store the parameter and exit the setting mode.

#### Anti-VOX adjustment

The TS-480 transceiver has a DSP IC to improve and customize incoming/ outgoing audio signals. When VOX function is turned ON, the DSP IC adjusts the Anti-VOX level automatically, comparing the reception sound level and microphone input level. So, you never have to worry about adjusting the anti-VOX level.

#### VOX Source

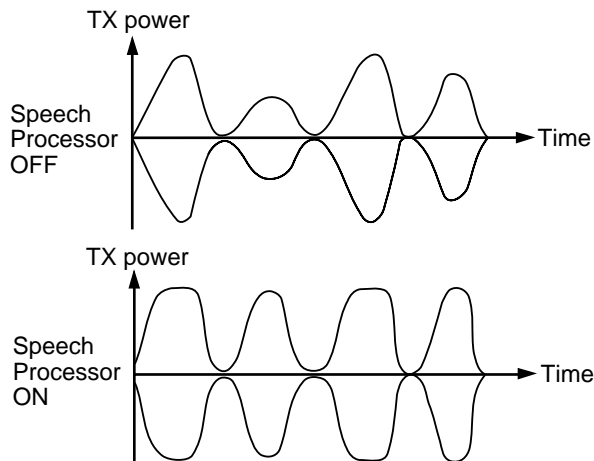
Although microphone is normally used to perform the VOX transmission, you can also utilize AF input of the **DATA** connector (pin 1) on the TX/ RX unit {page 81}. When the transceiver detects the audio signal on the pin 1 of **DATA** connector, the transceiver automatically transmits.

- 1 Select USB, LSB, FM, or AM mode.
- 2 Press **[VOX/ 8]** to switch the VOX function ON.
  - “VOX” appears.
- 3 Press **[MENU/ F.LOCK]** and turn **MULTI** control to select Menu No. 60.
- 4 Press **[^]** to switch the VOX with DATA input function ON.
- 5 Turn **MULTI** control to select Menu No. 46.
- 6 While sending AF signal to pin 1 of DATA connector, adjust the value (default is 4) using **[^]**/ **[v]** until the transceiver reliably switches to transmit mode each time you send AF signal to pin 1 of DATA connector.

**Note:** VOX function does not work even if you speak into the microphone. However, you can transmit with the Mic **[PTT]**.

## SPEECH PROCESSOR

The Speech Processor levels out large fluctuations in your voice while you speak. When using SSB, FM, or AM mode, this leveling action effectively raises the average TX power, resulting in a more understandable signal. The amount of voice compression is fully adjustable. You will notice that using the Speech Processor makes it easier to be heard by distant stations.



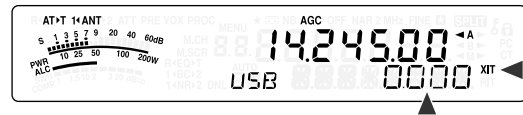
- 1 Select USB, LSB, FM, or AM mode.
- 2 Press **[PROC/ 9]** to turn the Speech Processor ON.
  - “PROC” appears.
- 3 Press **[PROC/ 9] (1 s)** to enter the Speech Processor input level adjustment mode.
- 4 As you speak into the microphone, turn the **MULTI** control so that the compression meter indicates that the compression level is around 10 dB while you speak.
  - Using higher compression will not improve your signal clarity or apparent signal strength. Excessively compressed signals are more difficult to understand due to distortion and are less pleasant to hear than signals with less compression.
- 5 Press **[PROC/ 9] (1 s)** to exit the Speech Processor input level adjustment mode.
- 6 Press **[MIC/ 5/ RF.G]** to enter the Speech Processor output level adjustment mode.
  - As you speak into the microphone, turn the **MULTI** control so that the ALC meter reflects according to your voice level but does not exceed the ALC limit. Press **[MIC/ 5/ RF.G]** to exit when you finish the adjustment mode.

## XIT (TRANSMIT INCREMENTAL TUNING)

Similar to RIT, XIT provides the ability to change your transmission frequency by  $\pm 9.99$  kHz in steps of 10 Hz without changing your reception frequency. If the Fine Tuning function is ON, the frequency step size becomes 1 Hz.

- 1 Press **[XIT]**.

- “XIT” and the XIT offset appear.



- 2 If required, press **[CL]** to reset the XIT offset to 0.
- 3 Turn the **RIT/ XIT** control to change your transmit frequency.



- 4 To turn XIT OFF, press **[XIT]**.

- “XIT” and offset frequency display disappear. The transmission frequency is returned to the frequency that was selected prior to step 1.

### Note:

- ◆ If the Fine Tuning function is ON, you can adjust the frequency within  $\pm 9.99$  kHz.
- ◆ The frequency shift set by the XIT control is also used by the RIT function. Therefore, changing or clearing the XIT offset also affects the RIT offset.
- ◆ When the XIT frequency exceeds the limit of available transmission frequency, the transceiver automatically stops transmitting.

### CUSTOMIZING TRANSMISSION SIGNAL CHARACTERISTICS

The quality of your transmission signal is important, regardless of which on-air activity you pursue. However, it is easy to be casual and overlook this fact since you don't listen to your own signal. The following sub-sections provide information that will help you tailor your transmission signal.

#### ■ TX Filter Bandwidth (SSB/ AM)

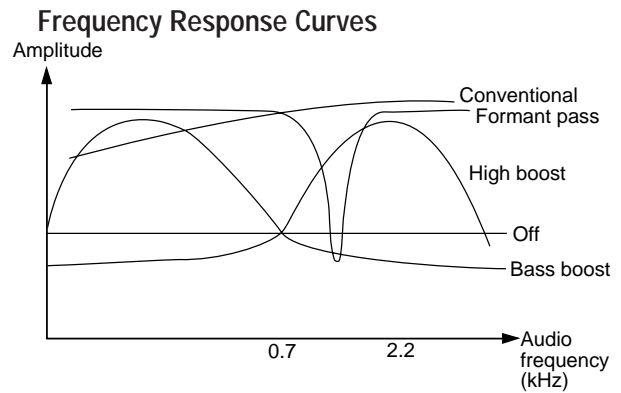
Use Menu No. 20 to select one of the following TX filter bandwidths: 2.0 kHz or 2.4 kHz (default).

Display	Bandwidth	Passband frequency
2.0	2.0 kHz	500 ~ 2500 Hz
2.4	2.4 kHz	300 ~ 2700 Hz

#### ■ TX Equalizer (SSB/ FM/ AM)

Use Menu No. 19 to change the transmission frequency characteristics of your signal. You can select from one of 6 different transmission profiles including the default flat response. Selecting any of the following items from the Menu causes "EQ▶" to appear on the display.

- **Off (oFF):**  
The default frequency response for SSB, FM, and AM.
- **High boost 1 (Hb1)/ High boost 2 (Hb2):**  
Emphasizes higher audio frequencies; effective for a bassy voice. High boost 2 does not reduce the low frequency as much as High boost 1.
- **Formant pass (FP):**  
Improves clarity by suppressing audio frequencies outside the normal voice frequency range.
- **Bass boost 1 (bb1)/ Bass boost 2 (bb2):**  
Emphasizes lower audio frequencies; effective for a voice with more high frequency components. Bass boost 2 emphasises more low frequency response.
- **Conventional (c):**  
Emphasizes by 3 dB frequencies at 600 Hz and higher.
- **User (U):**  
Reserved for the optional ARCP software. Off is programmed at the factory as a default.



#### TRANSMIT INHIBIT

Transmit Inhibit prevents the transceiver from being placed in transmission mode. No signal can be transmitted when this function is ON even if Mic [PTT] is pressed.

- **TX Inhibit OFF:** Transmission is allowed.
- **TX Inhibit ON:** Transmission is not allowed.

Switch the function ON or OFF via Menu No. 55. The default is OFF.

#### BUSY LOCKOUT

Busy Lockout prevents the transceiver from being placed in transmit mode. Transmission is not allowed if the current operating frequency is busy (in other words, the squelch is open).

- **Busy Lockout OFF:** Transmission is allowed.
- **Busy Lockout ON:** Transmission is not allowed.

Switch the function ON or OFF via Menu No. 58. The default is OFF.

#### CHANGING FREQUENCY WHILE TRANSMITTING

Moving your frequency while transmitting is usually an unwise practice due to the risk of interfering with other stations. However, if necessary, by using the **Tuning** control you can change the operating frequency while transmitting. You also can change the XIT offset frequency while in transmission mode.

While transmitting, if you select a frequency outside the transmission frequency range, the transceiver is automatically forced to return to the reception mode. If you selected transmission mode by pressing Mic [PTT], transmission will not resume until you select a frequency inside the transmission frequency range, at which time you must release and press Mic [PTT] again.

## CW BREAK-IN

Break-in allows you to transmit CW without manually switching between transmission and reception modes. Two types of Break-ins are available: Semi Break-in and Full Break-in.

### Semi Break-in:

When the key contacts open, the transceiver automatically waits for the passage of the time period that you have selected. The transceiver then returns to reception mode.

### Full Break-in:

As soon as the key contacts open, the transceiver returns to reception mode.

## USING SEMI BREAK-IN OR FULL BREAK-IN

- Press **[MODE]** until you select CW mode.
  - “CW” or “CWR” appears.
- Press **[VOX/ 8]**.
  - “VOX” appears.
- Press **[KEY/ 6/ DELAY]** (1 s).
  - The current setting (Full or delay time) appears. The default is FBK (Full Break-in).



- Turn the **MULTI** control to select FBK (Full Break-in) or a delay time for Semi Break-in.
  - Delay time ranges from 5 to 100 (50 ms to 1000 ms) in steps of 5.



- Begin sending.
  - The transceiver automatically switches to transmission mode.
  - When FBK (Full Break-in) is selected:** The transceiver immediately switches to reception mode when the key opens.
  - When a delay time is selected:** The transceiver switches to reception mode after the delay time that you have selected has passed.
- Press **[MTR/ CLR]** to exit.

**Note:** Full Break-in cannot be used with the TL-922/ 922A linear amplifier.

## ELECTRONIC KEYS

This transceiver has a built-in electronic keyer that can be used by connecting a keyer paddle to the transceiver's rear panel. Refer to “Keys for CW (PADDLE and KEY)” {page 7} for details regarding this connection. The built-in keyer supports lmbic (squeeze) operation.

## CHANGING KEYING SPEED

The keying speed of the electronic keyer is fully adjustable. Selecting the appropriate speed is important in order to send error-free CW that other operators can copy solidly. Selecting a speed that is beyond your keying ability will only result in mistakes. You will obtain the best results by selecting a speed that is close to the speed used by the other station.

- Press **[MODE]** until you select CW mode.
  - “CW” or “CWR” appears.
- Press **[KEY/ 6/ DELAY]**.
  - The current keying speed appears. The default is 20 (WPM).



- While keying the paddle and listening to the TX (transmission) sidetone, turn the **MULTI** control to select the appropriate speed.
  - The speeds range from 10 (WPM) to 60 (WPM), in steps of 1 (WPM). The larger the number, the faster the speed.
- Press **[KEY/ 6/ DELAY]** again to complete the setting.

**Note:** When using the semi-automatic “Bug” function, the selected speed applies only to the rate that dots are sent.

## AUTO WEIGHTING

The electronic keyer can automatically change the dot/ dash weighting. Weighting is the ratio of dash length to dot length. The weighting changes with your keying speed, thus making your keying easier for other operators to copy.

Access Menu No. 35 to select “auto” or “2.5” ~ “4.0” (in steps of 0.1) fix weight ratio. The default is “auto”. When the fix weight ratio is selected, the dot/ dash weight ratio is locked regardless of the keying speed.

### Reverse Keying Weight Ratio

Auto Weighting increases the weighting as you increase your keying speed. However, the electronic keyer also can decrease the weighting as you increase your keying speed.

To switch this function ON, access Menu No. 36, and select “on”. The default is OFF.

Reverse Keying Weight	Keying Speed (WPM)		
	10 ~ 25	26 ~ 45	46 ~ 60
OFF	1:2.8	1:3.0	1:3.2
ON	1:3.2	1:3.0	1:2.8

## 8 COMMUNICATING AIDS

### BUG KEY FUNCTION

The built-in electronic keyer also can be used as a semi-automatic key. Semi-automatic keys are also known as “Bugs”. When this function is ON, dots are generated in the normal manner by the electronic keyer. Dashes, however, are manually generated by the operator by holding the keyer paddle closed for the appropriate length of time.

To switch this function ON, access Menu No. 37 and select “on”. The default is OFF.

**Note:** When the Bug Key function is ON, CW Message Memory (see below) cannot be used.

### CW MESSAGE MEMORY

This transceiver has 3 memory channels for storing CW messages. Each memory channel can store approximately 50 characters (equivalent of 250 dots). These memory channels are ideal for storing contest exchanges that you want to send repeatedly. Stored messages can be played back to check message content or for transmitting.

The electronic keyer has a function that allows you to interrupt playback and manually inject your own keying. To switch this function ON, access Menu No. 33 and select “on”. The default is OFF.

The electronic keyer can also repeatedly play back the message that you stored. To switch this function ON, access Menu No. 31 and select “on”. The default is OFF.

For repetitive message playback, you can change the interval between each series of messages. Use Menu No. 32 and select the time in the range of 0 to 60 seconds in steps of 1 second {page 39}.

#### **Note:**

- ◆ This function cannot be used when the Bug Key function is ON.
- ◆ Operating the keyer paddle with Menu No. 33 OFF cancels message playback. Even if message playback does not stop because of your keying start timing, you can cancel playback by pressing [MTR/ CLR].

### ■ Storing CW Messages

- 1 Press [MODE] until you select CW mode.
  - “CW” or “CWR” appears.
- 2 If VOX is ON, press [VOX/ 8].
  - “VOX” disappears {page 39}.
- 3 Press [CH1/ 1/ REC] (1 s), [CH2/ 2/ REC] (1 s) or [CH3/ 3/ REC] (1 s) to select a memory channel to be recorded.



- If the Constant Recording is ON (Menu No. 30), you cannot store a message to CH3 {page 70}.
- 4 Begin sending using the keyer paddle.
    - The message you send is stored in memory.



- 5 To complete the message storage, press [MTR/ CLR] to stop.
  - When the memory becomes full, recording automatically stops.

**Note:** If you do not operate the keyer paddle after starting to record a message, a pause is stored in the channel.

### ■ Checking CW Messages without Transmitting

- 1 Press [MODE] until you select CW mode.
  - “CW” or “CWR” appears.
- 2 If VOX is ON, press [VOX/ 8] to switch it OFF.
- 3 Press [CH1/ 1/ REC], [CH2/ 2/ REC] or [CH3/ 3/ REC] to select the channel to be played back.
  - The message is played back.
  - To play back the messages stored in the other channels in sequence, press the corresponding channel keys during playback. Up to 3 channels can be queued at the same time.



- While playing back the messages, you can also adjust the keyer speed by pressing [KEY/ 6/ DELAY] and turning the MULTI control.
- To interrupt playback, press [MTR/ CLR].

### ■ Transmitting CW Messages

Messages can be transmitted using Semi Break-in/ Full Break-in or manual TX/ RX switching.

- 1 Press [MODE] until “CW” or “CWR” appears.
- 2 To use Semi Break-in/ Full Break-in, press [VOX/ 8].
  - “VOX” appears.
- 3 Press [CH1/ 1/ REC], [CH2/ 2/ REC] or [CH3/ 3/ REC] to select the channel to be played back.
  - The message is played back and transmitted automatically.
  - To transmit the messages stored in the other channels in sequence, press the corresponding channel keys during playback. Up to 3 channels can be queued at the same time.
  - While playing back the messages, you can also adjust the keyer speed by pressing [KEY/ 6/ DELAY] and turning the MULTI control.
  - To interrupt transmission, press [MTR/ CLR].

### ■ Changing the Inter-message Interval Time

For the message playback repeat, access Menu No. 31 and select “on”. You can also change the interval playback time of the message. Access Menu No. 32 and select the time in the range of 0 to 60 seconds in steps of 1 second.

*Note: Menu Nos. 31 and 32 settings are shared with the voice communication modes when the optional VGS-1 is installed.*

### ■ Changing the Sidetone Volume

Turning the **AF** control does not change the CW sidetone playback volume. To change the CW sidetone volume, access Menu No. 13 and select “oFF”, or “1” to “9”.

### ■ Insert Keying

If you operate a CW keyer manually while playing back a recorded CW message, the transceiver stops playing back the message. However, during contests or regular QSOs, you may sometimes want to insert a different number or message at a certain point in the recorded message.

In this case, first record the CW message as usual {page 40}, without the number or message you want to insert. Then, access Menu No. 33 and select “on”.

Now if you operate a CW keyer while you play back a recorded message, the transceiver pauses the playback of the recorded message, instead of stopping it. When you finish sending the number or message with the keyer, the transceiver resumes playback of the message.

## FREQUENCY CORRECTION FOR CW

If you operate both SSB and CW modes, you would sometimes use SSB mode (USB or LSB) just to watch and listen to CW signals. It is fine just to monitor those CW signals but you have experienced that changing the mode from SSB to CW results in losing the target CW signal. This is because the frequency on the display always shows the true carrier frequency for all modes. If you want the transceiver to shift the reception frequency to trace the receiving CW signal when changing the mode from SSB (USB or LSB) to CW, switch this function ON. The transceiver shifts the reception frequency when changing the mode from SSB to CW, so you can still hear the target signal and instantly transmit the signal in CW without adjusting the frequency.

- 1 Press **[MENU/ F.LOCK]**, then turn the **MULTI** control to access Menu No. 40.
- 2 Press **[^]** to select “on”.
- 3 Press **[MENU/ F.LOCK]** to store the settings and exit the Menu mode.

## AUTO CW TX IN SSB MODE

If you operate both SSB and CW modes, you can configure the transceiver to change the operating mode from SSB (USB or LSB) to CW and then transmit in CW mode automatically when you operate the CW keyers.

- 1 Press **[MENU/ F.LOCK]**, then turn the **MULTI** control to access Menu No. 39.
- 2 Press **[^]** to select “on”.
- 3 Press **[MENU/ F.LOCK]** to store the settings and exit the Menu mode.

*Note: You must switch the CW break-in function ON to change the mode and transmit in CW mode {page 39}.*

## MIC UP/ DWN KEY PADDLE MODE

This function allows you to send CW message without using an optional paddle {page 7}. Mic **[UP]** key can be used as dot paddle and Mic **[DWN]** key can be used as a dash paddle.

To activate Mic UP/ DWN key Paddle Mode:

- 1 Turn the transceiver OFF.
- 2 Press Mic **[UP]** or Mic **[DWN] + [ϕ]** (POWER).
  - Press and hold Mic **[UP]** to send dots or Mic **[DWN]** to send dashes in CW mode.

To exit Mic UP/ DWN key Paddle Mode, perform step 1 and 2 again.

## CW REVERSE (RECEPTION)

This function pivots the BFO from the default position (USB) to another position (LSB) in CW mode. It is sometimes effective to remove the interfering signals from the IF passband by pivoting the BFO.

- 1 Press **[MODE]** until “CW” appears.
- 2 Press **[MODE] (1 s)**.
  - “CW” changes to “CWR”.
- 3 To recover the default BFO position, press **[MODE] (1 s)** again.
  - “CWR” changes to “CW”.

## RADIO TELETYPE (RTTY)

RTTY is the data communications mode with the longest history. It was originally designed for use with mechanical teletypewriters which were often used before personal computers became common. Now you can easily start operating RTTY with a personal computer and MCP. Unlike Packet, each time you type a letter, it is transmitted over the air. What you typed is transmitted and displayed on the computer screen of the recipient.

RTTY operation uses frequency shift keying (FSK) and the 5-bit Baudot code or the 7-bit ASCII code to transmit information.

For the cable connections, refer to "RTTY OPERATION" {page 80}.

For further information, consult reference books about Amateur Radio.

- 1 Access Menu No. 41 and select an FSK shift.
  - FSK shift is the difference in frequencies between a mark and a space.
  - The 170 Hz shift (default) is normally used on the Amateur bands for the RTTY.
- 2 Access Menu No. 42 and select a key-down polarity.
  - Select "oFF" (default) to transmit a mark when keying down or "on" to transmit a space.
- 3 Access Menu No. 43 and select high tone (2125 Hz) or low tone (1275 Hz) for mark.
  - High tone (default) is commonly used nowadays.
- 4 Select an operating frequency.
- 5 Press **[MODE]** to select FSK mode {page 19}.
  - If necessary, use Menu No. 47 to configure the appropriate audio level from your MCP. The **AF** control cannot be used to adjust the audio level from your MCP.



- 6 Some stations may be operating in Reverse shift. In this case, press **[MODE]** (1 s) to reverse the shift (the upper sideband is used).
  - "FSR" appears.



- Traditionally, the lower sideband is used for FSK operation. Press **[MODE]** (1 s) again to return to the lower sideband. "FSK" appears.
- 7 Follow the instructions provided with your MCP and enter a command from your computer to transmit.
    - The LED changes from green (RX) to red (TX).

- 8 Begin sending data from your computer.
  - Press **[PWR/ 4/ TX MONI]** (1 s) to monitor your signals. Press **[PWR/ 4/ TX MONI]** (1 s) again to quit this function.
- 9 When finished transmitting, enter a command from your computer to return to reception mode.
  - The LED changes from red (TX) to green (RX).

The following frequencies (measured in kHz) commonly used for RTTY operation:

U.S.A./ Canada	ARU Region 1 (Europe/ Africa)
1800 ~ 1840	1838 ~ 1842
3605 ~ 3645 (DX: 3590)	3580 ~ 3620
7080 ~ 7100 (DX: 7040)	7035 ~ 7045
10140 ~ 10150	10140 ~ 10150
14070 ~ 14099.5	14080 ~ 14099.5
18100 ~ 18110	18101 ~ 18109
21070 ~ 21100	21080 ~ 21120
24920 ~ 24930	22920 ~ 24929
28070 ~ 28150	28050 ~ 28150

## AMTOR/ PacTOR/ CLOVER/ G-TOR/ PSK31

Besides RTTY, digital modes which have been used among hams include AMTOR, PacTOR, CLOVER, G-TOR, and PSK31. For details, consult reference books about the digital mode communications of amateur radio.

AMTOR (AMateur Teleprinting Over Radio) has brought amateur HF digital communication into the computer age. It is the first error-free HF digital mode by which data bursts (not steady stream of data) are transmitted.

PacTOR (Packet Teleprinting On Radio) has combined the best features of both AMTOR and Packet to improve the efficiency of HF digital communications. Like Packet and AMTOR, PacTOR sends error-free data using a handshaking method.

Of all the Amateur Radio HF digital modes, CLOVER offers the best overall performance using a complicated modulation technique, automatic power adjustment and other advanced features. It may allow communications to be maintained under the worst conditions.

G-TOR (Golay-coded Teleprinting Over Radio) is a relatively new Amateur Radio digital mode currently in use. G-TOR was developed specifically to handle the adverse conditions of communicating across the solar system with spacecraft during their missions.

PSK31 was developed by an RTTY enthusiast, G3PLX, in the United Kingdom. The operating technique is very similar to the conventional Baudot-RTTY, although more sensitive fine-tuning is required, as a PSK31 signal requires a tuning accuracy of a few Hertz. A special feature of PSK31 is that it allows the entire ASCII character set, including the back space character.

Your MCP should handle some or all of the above modes. For available modes on your MCP, consult the instruction manual for the MCP. For the cable connections, refer to "MCP AND TNC" {page 81}.

On most HF bands, audio frequency shift keying (AFSK) is used for the above modes. This method of modulation uses audio tones, therefore either LSB or USB mode should be selected. Traditionally, LSB is used, similar to RTTY, with the exception of AMTOR which is normally operated in USB.

AMTOR activity can be found on or near 14075 kHz and 3637.5 kHz. These are also good starting places when searching for PacTOR, CLOVER, G-TOR, or PSK31 stations.

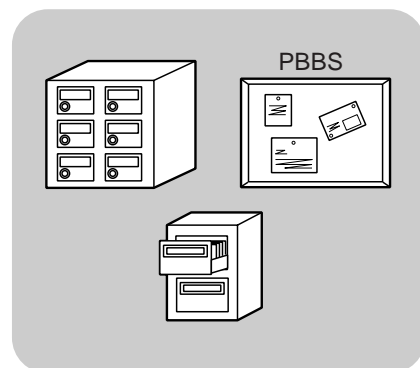
The TS-480 transceiver has special DSP filters for these digital modes. Refer to page 48 for details.

**Note:** When using SSB mode for digital operation, use a fast AGC setting and switch your Speech Processor OFF.

## PACKET RADIO

Packet is a unit of data transmitted as a whole from one computer to another, on a network. Packets can be transmitted on radio waves as well as on communications lines. Besides a transceiver and a computer, all you need is a terminal node controller (TNC) or Multimode Communications Processor (MCP). One of the tasks of TNCs and MCPs is to convert data packets to audio tones, and vice versa. Connecting a TNC to this transceiver allows you to use many packet applications.

A variety of packet applications developed by hams include packet bulletin board systems (PBBSs). PBBSs are created and maintained by volunteers called System Operators (SysOp). You may access one of your local PBBSs to send e-mail, download files, or obtain various useful information. Thousands of PBBSs, which have formed a worldwide network, relay e-mail to their intended destinations around the world.



When you access a local PBBS for the first time, you often need to register as a new user. After you are successfully registered, it will then be available as your home PBBS. E-mail addressed to you will be held under a directory, called a mailbox, on your home PBBS.

For further information, consult reference books which should be available at any store that handles Amateur Radio equipment. Web pages relating to Packet will also be helpful. On Internet search engines, use "Packet Radio" as key words to find those Web pages.

### Note:

- ◆ Unlike a TNC, a Multimode Communications Processor (MCP) serves as a communications interface in several digital modes such as Packet, RTTY, and AMTOR. You can cause it to switch among the modes by sending a single command from your computer.
- ◆ If there is an amateur radio club in your area, consider becoming a member. You can often learn more in an hour from experienced hobbyists, than in a month of independent research. Ask on the local repeaters or contact your national amateur radio organization (the ARRL in the U.S.A.) for information on local amateur radio clubs. You'll be glad you did.