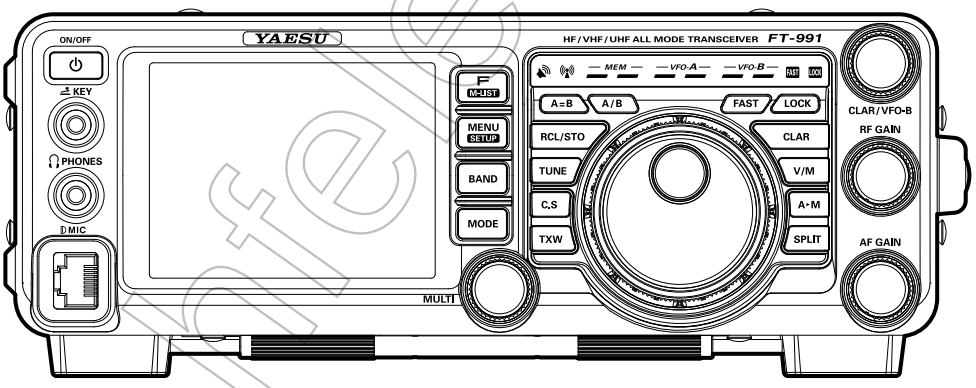
YAESU
The radio

HF/VHF/UHF All Mode Transceiver

FT-991

Operating Manual



YAESU MUSEN CO., LTD.
Tennozu Parkside Building
2-5-8 Higashi-Shinagawa, Shinagawa-ku, Tokyo 140-0002 Japan

YAESU USA
6125 Phyllis Drive, Cypress, CA 90630, U.S.A.

YAESU UK
Unit 12, Sun Valley Business Park, Winnall Close
Winchester, Hampshire, SO23 0LB, U.K.

TABLE OF CONTENTS

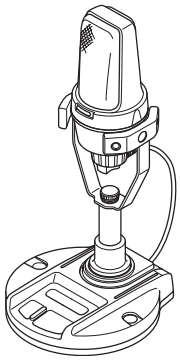
TABLE OF CONTENTS

SUPPLIED ACCESSORIES

Hand Microphone (**MH-31**A8J)	1 pc	A07890001
DC Power Cord	1 pc	T9025225
Spare Fuse (25A)	1 pc	Q0000074
Operating Manual	1 pc	
Warranty Card	1 pc	

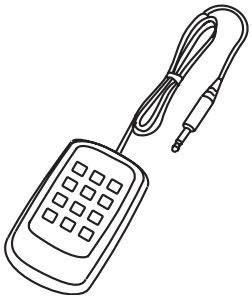
AVAILABLE OPTIONS

MD-200A8X	Ultra-High-Fidelity Desktop Microphone
MD-100A8X	Desktop Microphone
YH-77STA	Lightweight Stereo Headphone
FH-2	Remote Control Keypad
VL-1000/VP-1000	Linear Amplifier/AC Power Supply
FC-40	External Automatic Antenna Tuner
FP-1030A	External Power Supply (13.8 VDC 25 A)
CT-118	**VL-1000** Linear Amplifier Connection Cable
CT-39A	Packet Interface Cable
CT Cable (MDIN10P - Bare Wire 2m)	Linear Amplifier Connection Cable (P/N T9207451)

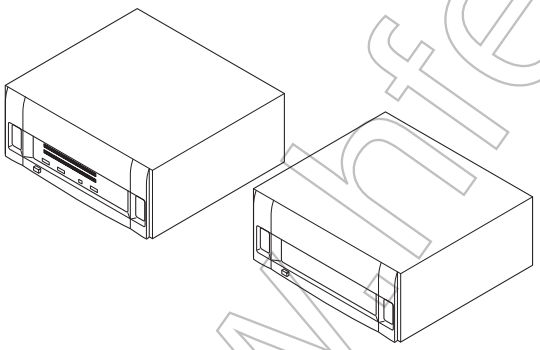


MD-200A8X

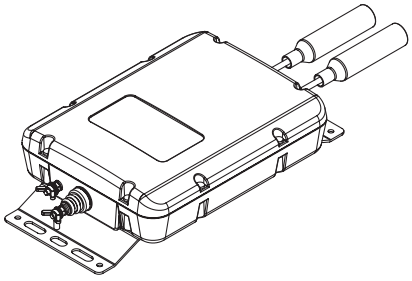
YH-77STA



FH-2



VL-1000/VP-1000

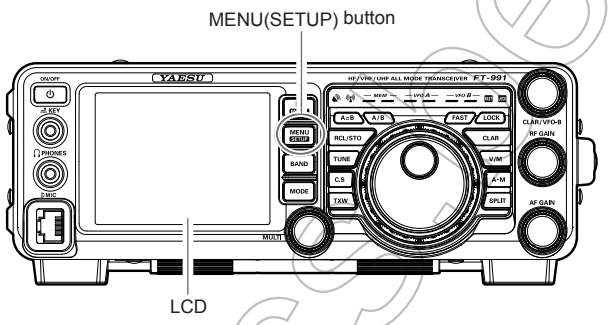


FC-40

ADJUSTING THE CLOCK

Use the following procedure to adjust the clock shown at the top right of the LCD display.

1. Press and hold the **MENU(SETUP)** button.
2. Touch [**TIME/DATE**] on the LCD.
3. Enter the present time with the number keys on the LCD, then touch [**ENT**].
4. Touch [**DATE**] on the LCD to switch the screen.
5. Enter month, day, and year with the number keys on the LCD, then touch [**ENT**].
6. Touch [**BACK**] on the LCD to return to the setup mode display.
7. Press the **MENU(SETUP)** button to return to the radio operation display.

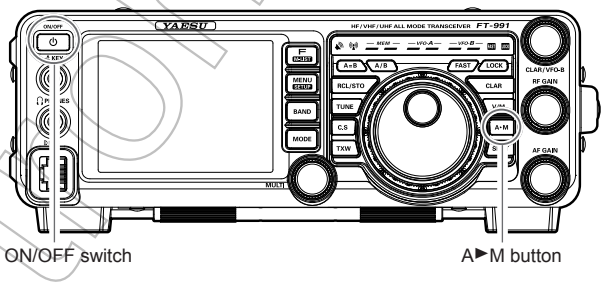


RESETTING THE MICROPROCESSOR

RESETTING MEMORIES (ONLY)

Use this procedure to reset (clear) the previously stored Memory channels, without affecting any configuration changes you may have made to the Menu settings.

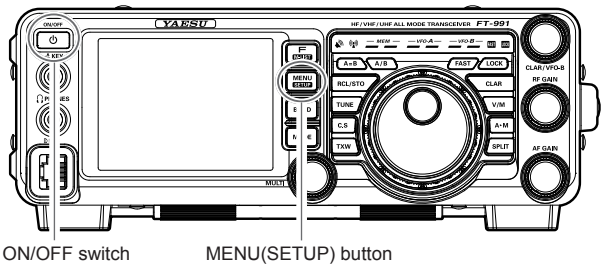
1. Press the front panel **ON/OFF** switch to turn the transceiver off.
2. While holding the **A►M** button in, press and hold in the front panel **ON/OFF** switch to turn the transceiver on. Once the transceiver comes on, you may release the buttons.



MENU RESETTING

Use this procedure to restore the Menu settings to their factory defaults, without affecting the memories you have programmed.

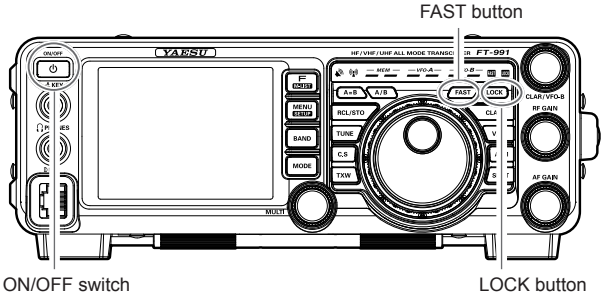
1. Press the front panel **ON/OFF** switch to turn the transceiver off.
2. While holding the **MENU(SETUP)** button in, press and hold in the front panel **ON/OFF** switch to turn the transceiver on. Once the transceiver comes on, you may release the buttons.



FULL RESET

Use this procedure to restore all Menu and Memory settings to their original factory defaults. All Memories will be cleared by this procedure.

1. Press the front panel **ON/OFF** switch to turn the transceiver off.
2. While holding the **FAST** and **LOCK** buttons in, press and hold in the front panel **ON/OFF** switch to turn the transceiver on. Once the transceiver comes on, you may release the buttons.



ANTENNA CONSIDERATIONS

The **FT-991** is designed for use with any antenna system providing a 50 Ohm resistive impedance at the desired operating frequency. While minor excursions from the 50-Ohm specification are of no consequence, if the Standing Wave Ratio (SWR) present at the Antenna jack is greater than 3:1, the transceiver's Automatic Antenna Tuner may not be able to reduce the impedance mismatch to an acceptable value.

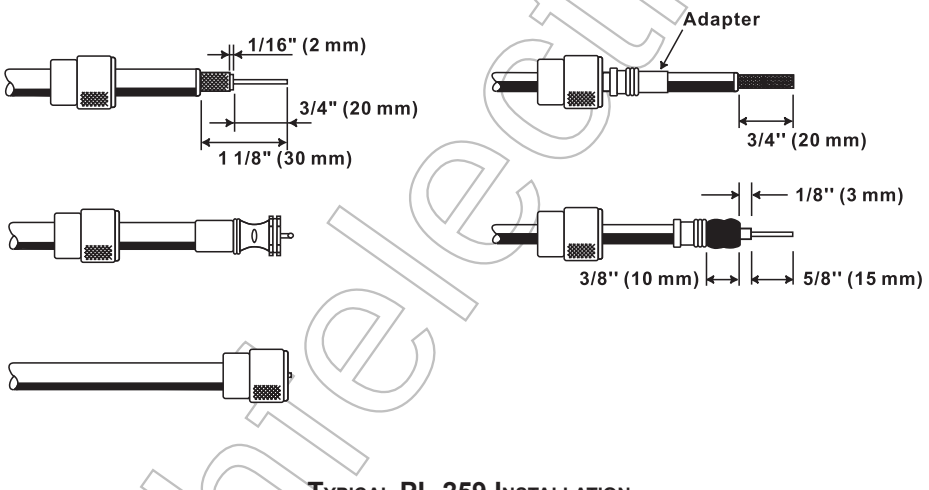
Every effort should be made to ensure that the impedance of the antenna system be as close as possible to the specified 50-Ohm value. Note that the "G5RV" type antenna does not provide a 50-Ohm impedance on all HF Amateur bands. An external wide-range antenna coupler must be used with this antenna type.

Any antenna to be used with the **FT-991** must be fed from the transceiver with 50 Ohm coaxial cable. Therefore, when using a "balanced" antenna such as a dipole, remember that a balun or other matching/balancing device must be used to ensure proper antenna performance.

The same precautions apply to any additional (receive-only) antennas connected to the antenna jacks. If your receive-only antennas do not have impedance near 50 Ohms at the operating frequency, you may need to install an external antenna tuner to obtain optimum performance.

ABOUT COAXIAL CABLE

Use high-quality 50-Ohm coaxial cable for the lead-in to your **FT-991** transceiver. All efforts at providing an efficient antenna system will be wasted if poor quality, lossy coaxial cable is used. This transceiver utilizes standard "M" ("PL-259") type connectors.



TYPICAL PL-259 INSTALLATION

GROUNDING

The **FT-991** transceiver, like any other HF communications apparatus, requires an effective ground system for maximum electrical safety and best communications effectiveness. A good ground system can contribute to station efficiency in a number of ways:

- ❒ It can minimize the possibility of electrical shock to the operator.
- ❒ It can minimize RF currents flowing on the shield of the coaxial cable and the chassis of the transceiver. such currents may lead to radiation, which can cause interference to home entertainment devices or laboratory test equipment.
- ❒ It can minimize the possibility of erratic transceiver/accessory operation caused by RF feedback and/or improper current flow through logic devices.

An effective earth ground system may take several forms. for a more complete discussion, see an appropriate RF engineering text. The information below is intended only as a guideline.

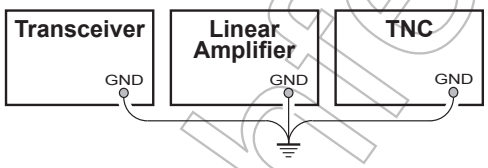
Typically, the ground connection consists of one or more copper-clad steel rods, driven into the ground. If multiple ground rods are used, they should be positioned in a "V" configuration and bonded together at the base of the "V" which is nearest the station location. Use a heavy, braided cable (such as the discarded shield from type RG-213 coaxial cable) and strong cable clamps to secure the braided cable(s) to the ground rods. Be sure to weatherproof the connections to ensure many years of reliable service. Use the same type of heavy, braided cable for the connections to the station ground bus (described below).

Inside the station, a common ground bus consisting of a copper pipe of at least 25 mm diameter should be used. An alternative station ground bus may consist of a wide copper plate (single-sided circuit board material is ideal) secured to the bottom of the operating desk. Grounding connections from individual transceivers, power supplies, and data communications devices (TNCs, etc.) should be made directly to the ground bus using a heavy, braided cable.

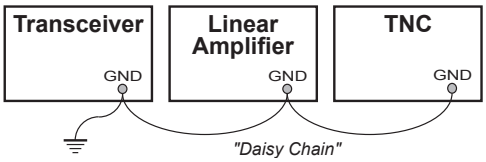
Do not "Daisy-Chain" ground connections from one electrical device to another and thence to the ground bus. This method may nullify any attempt at effective radio frequency grounding. See the drawing below for examples of proper grounding techniques.

Inspect the ground system - inside the station as well as outside - on a regular basis to ensure continued performance and safety.

Besides following the above guidelines carefully, note that household or industrial gas lines must never be used in an attempt to establish an electrical ground. Cold water pipes may, in some instances, help in the grounding effort, but gas lines represent a significant explosion hazard, and must never be used.



PROPER GROUND CONNECTION

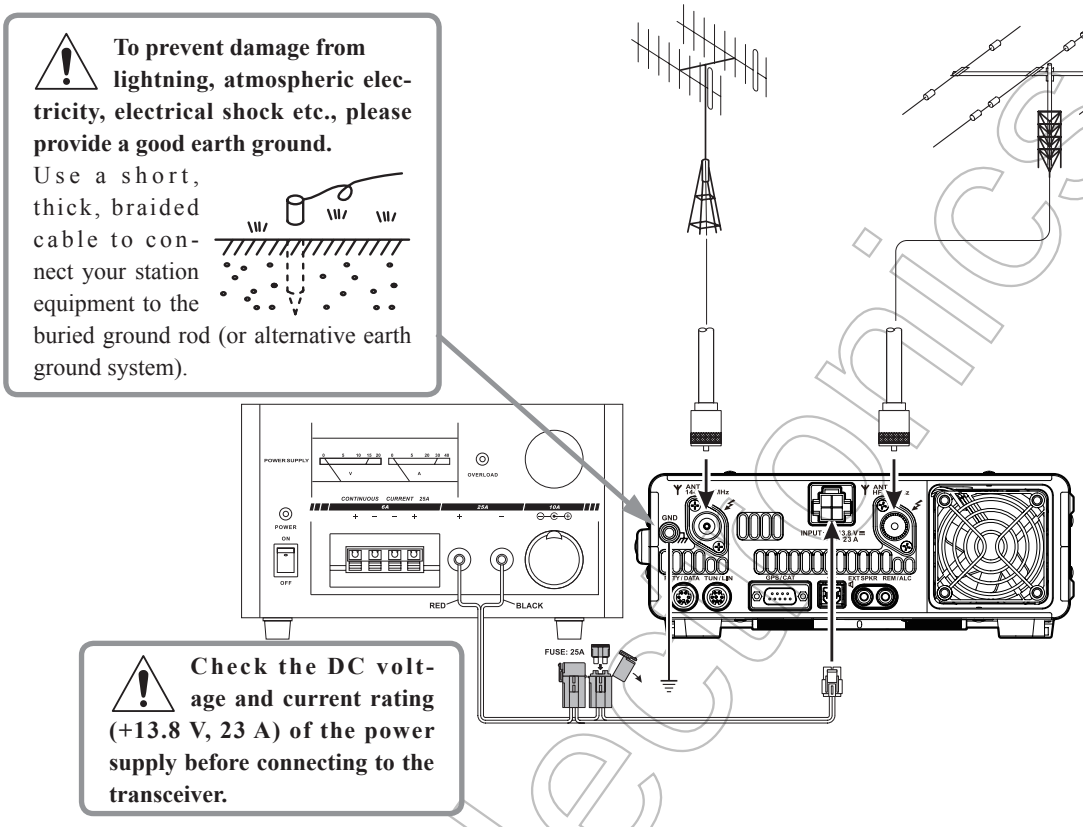


IMPROPER GROUND CONNECTION

CONNECTION OF ANTENNA AND POWER CABLES

Please follow the outline in the illustration regarding the proper connection of antenna coaxial cables, as well as the DC power cable. The DC power connector for the **FT-991** must only be connected to a DC source providing 13.8 Volts DC (±10 %), and capable of at least 23 Amperes of current. Always observe proper polarity when making DC connection:

The RED DC power lead connects to the Positive (+) DC terminal.
The BLACK DC power lead connects to the Negative (–) DC terminal.



We recommend the use of the **FP-1030A** (USA market only) AC Power Supply. Other models of power supplies may be used with the **FT-991**, but the 13.8 VDC input voltage, 23 Ampere current capability, and DC cable polarity guidelines described above must be strictly followed.

Note that other manufacturers may use the same type of DC power connections as does your **FT-991** transceiver, however, the wiring configuration may be different from that specified for your transceiver. Serious damage can be caused if improper DC connections are made; consult with a qualified service technician when in doubt.

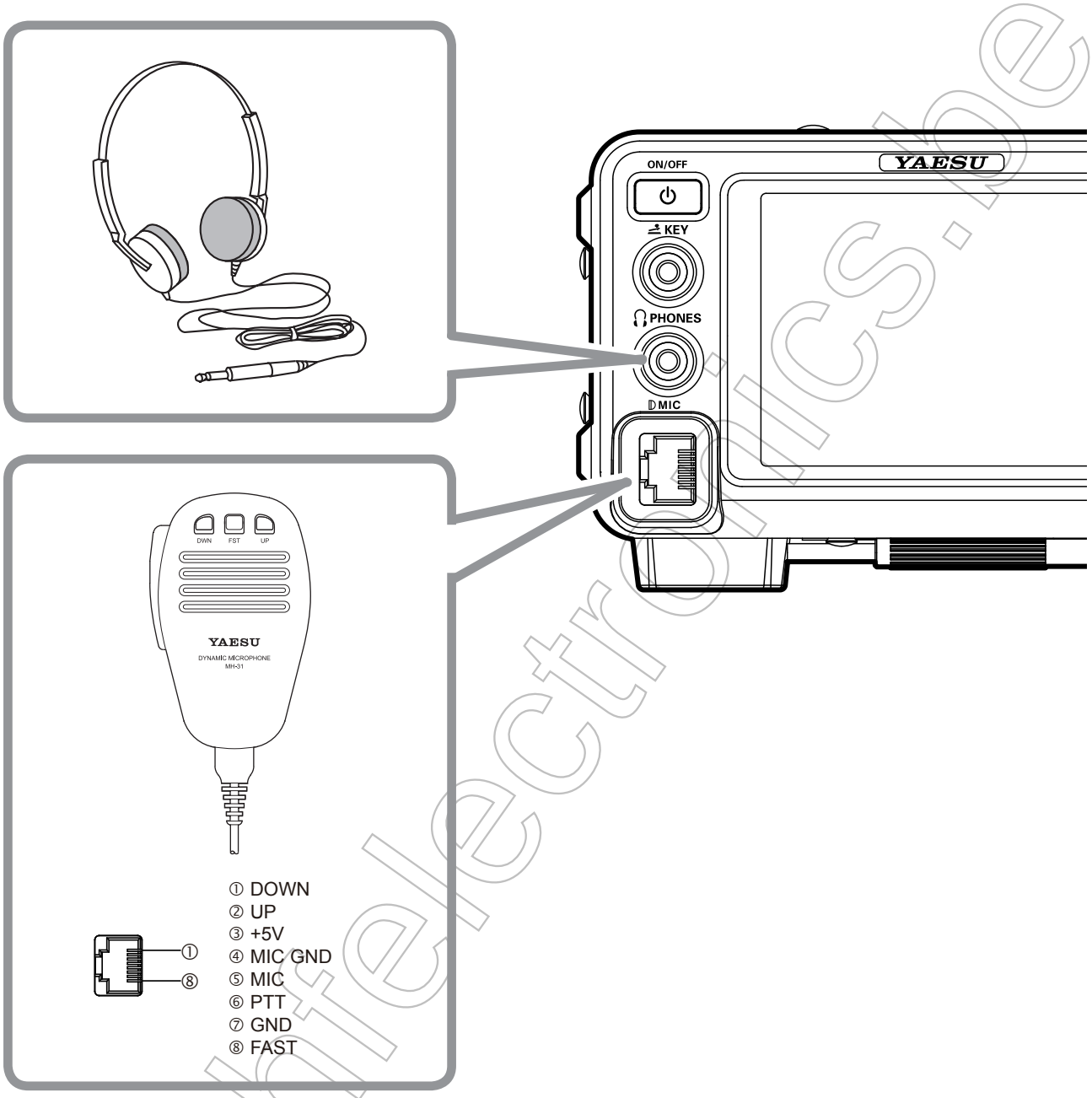
The 100 V RF voltage (@100 W/50-ohm) is applied to the TX RF section of the transceiver while transmitting. Do not touch the TX RF section absolutely while transmitting.

Permanent damage can result when improper supply voltage, or reverse-polarity voltage, is applied to the **FT-991**. The Limited Warranty on this transceiver does not cover damage caused by application of AC voltage, reverse polarity DC, or DC voltage outside the specified range of 13.8 V ±10 %. When replacing fuses, be certain to use a fuse of the proper rating. The **FT-991** requires a 25 A blade fuse.

ADVICE:

- ❒ Do not position the **FT-991** in a location with direct exposure to sunshine.
- ❒ Do not position the **FT-991** in a location exposed to dust and/or high humidity.
- ❒ Ensure adequate ventilation around the **FT-991**, to prevent heat build-up and possible reduction of performance due to high heat.
- ❒ Do not install the **FT-991** on an unstable desk or table. Do not place in a location where objects may fall onto it from above.
- ❒ To minimize the possibility of interference to home entertainment devices, take all precautionary steps including separation of TV/FM antennas from Amateur transmitting antennas to the greatest extent possible, and keep transmitting coaxial cables separated from cables connected to home entertainment devices.
- ❒ Ensure that the DC power cord is not subject to undue stress or bending, which could damage the cable or cause it to be accidentally unplugged from the rear panel **DC IN** jack.
- ❒ Be certain to install your transmitting antenna(s) so they cannot possibly come in contact with TV/FM radio or other antennas, or with power or telephone lines.

CONNECTION OF MICROPHONE AND HEADPHONE

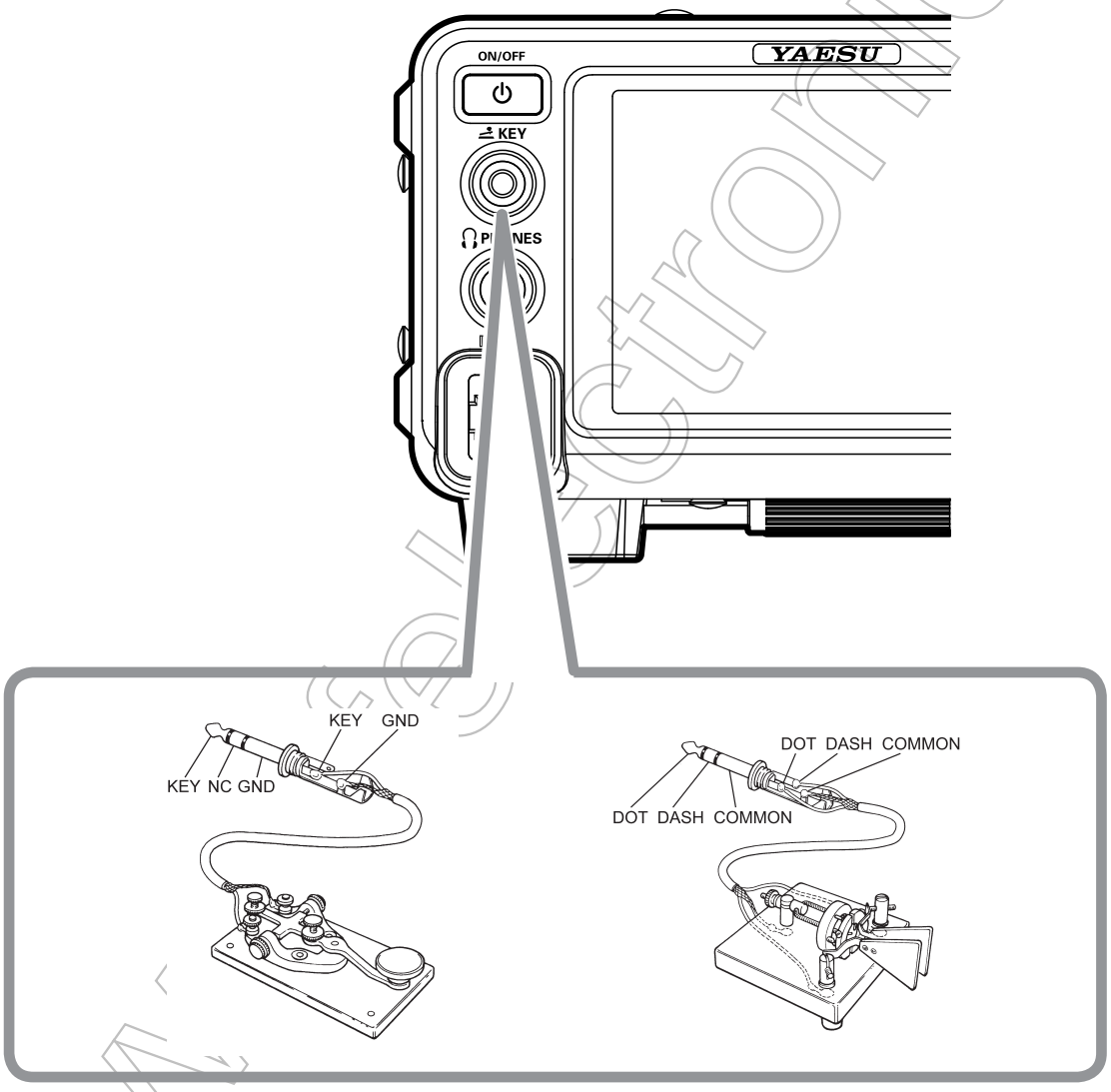


KEY, KEYER, AND COMPUTER-DRIVEN KEYING INTERCONNECTIONS

The **FT-991** includes many features for the CW operator. These functions will be detailed in the "Operation" section later. Besides the built-in Electronic Keyer, two key jacks are provided, one on the front and one on the rear panel, for convenient connection to keying devices.

The Menu selections allow you to configure the front panel **KEY** jack according to the device you wish to connect. For example, you may connect your keyer paddle to the front panel **KEY** jack, and use Menu item "018 F KEYER TYPE" for paddle input.

The **KEY** jack on the **FT-991** utilize "Positive" keying voltage. Key-up voltage is approximately +3.3V DC, and key-down current is approximately 4 mA. When connecting a key or other device to the **KEY** jack, use ***only*** a 3-contact ("stereo") 1/4" phone plug; a 2-contact plug will place a short between the ring and (grounded) shaft of the plug, resulting in a constant "key-down" condition in some circumstances.

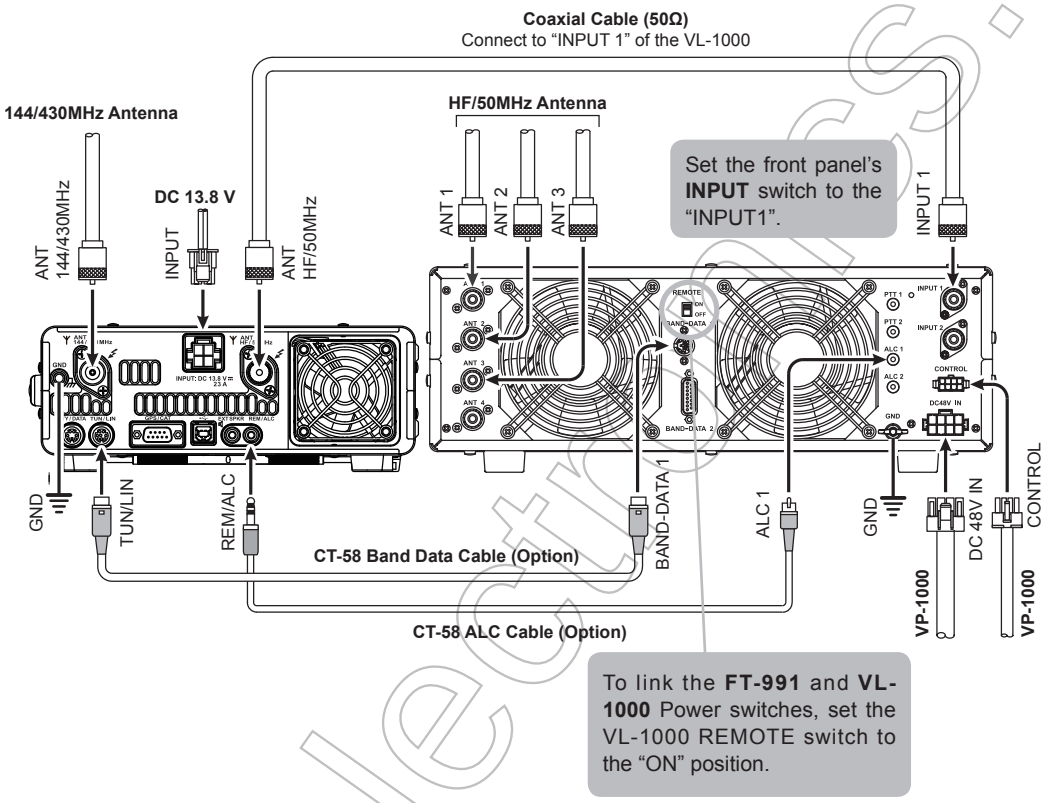


VL-1000 LINEAR AMPLIFIER INTERCONNECTIONS

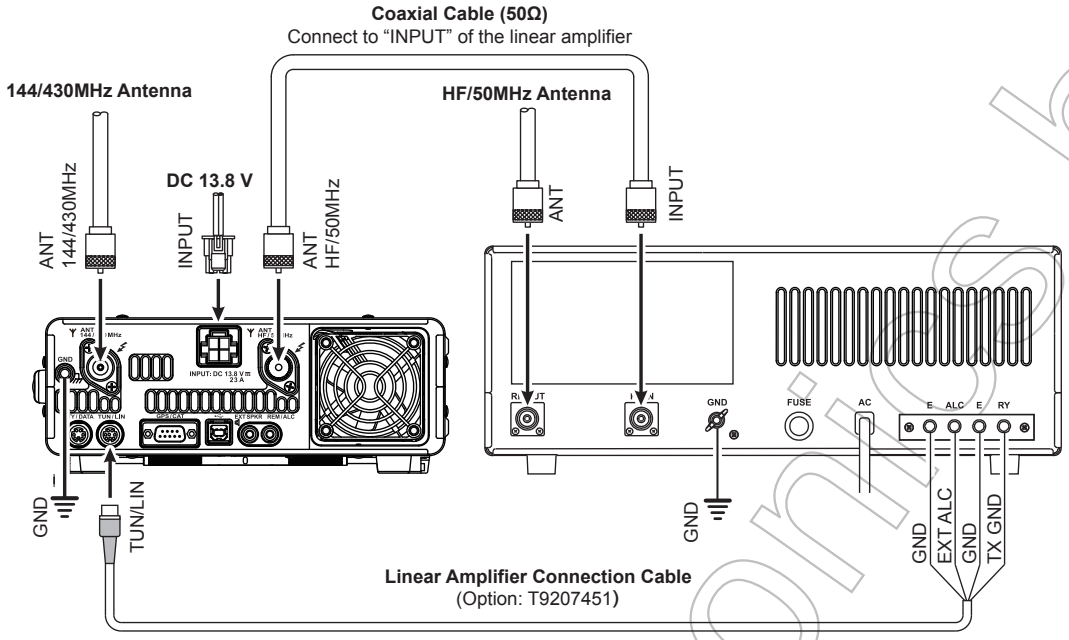
Be sure that both the **FT-991** and **VL-1000** are turned off, and then follow the installation recommendations contained in the illustration.

NOTE:

- ❒ Refer to the **VL-1000** Operating Manual for details regarding amplifier operation.
- ❒ Do not attempt to connect or disconnect coaxial cables when your hands are wet.



INTERFACING TO OTHER LINEAR AMPLIFIERS

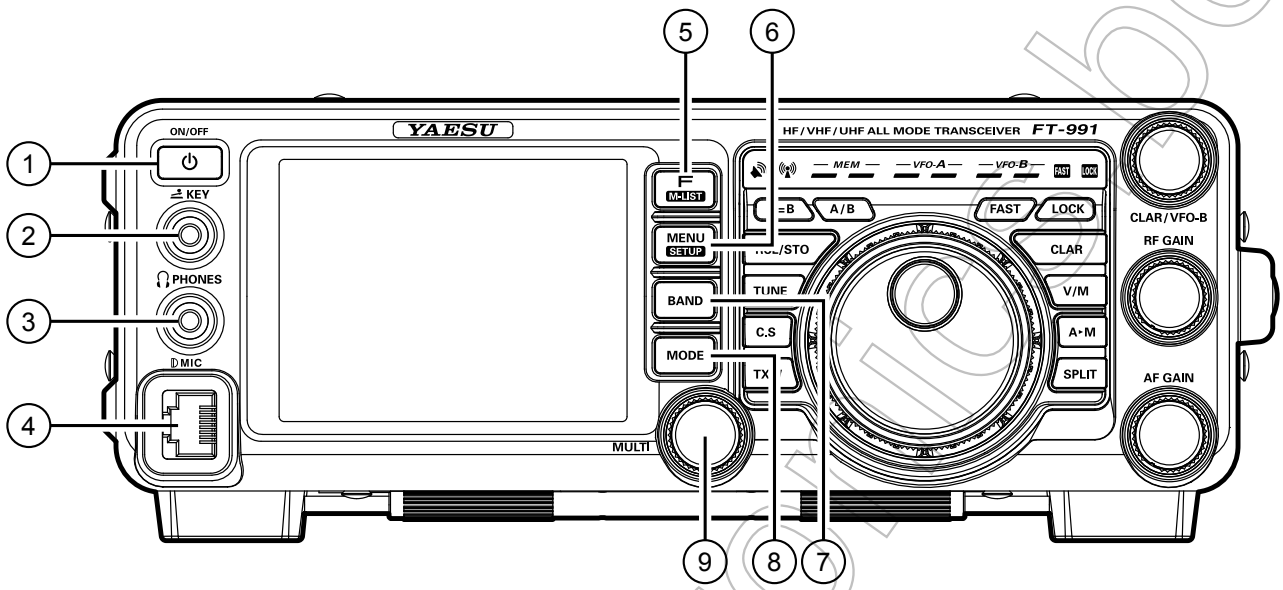


NOTE

- The TX GND OUT pin (pin 2) of the **TUN/LIN** jack is a transistor "open collector" circuit. It is capable of handling positive relay coil voltages up to +60VDC at 200 mA or +30 VDC at 1 A. If you plan to use multiple linear amplifiers for different bands, you must provide external band switching of the "Linear Tx" relay control line from the "TX GND OUT" line at the **TUN/LIN** jack.
- The specified range for ALC voltage to be used with the **FT-991** is 0 to -4 Volts DC.
- Amplifier systems utilizing different ALC voltages will not work correctly with the **FT-991**, and their ALC lines must not be connected if this is the case.

IMPORTANT NOTE!

- Do not exceed the maximum voltage or current ratings for the "TX GND OUT" pin (pin 2) of the **TUN/LIN** jack. This line is not compatible with negative DC voltages, or AC voltages of any magnitude.
- Most amplifier control relay systems require only low DC voltage/current switching capability (typically, +12V DC at 25 ~ 75 mA), and the switching transistor in the **FT-991** will easily accommodate such amplifiers.



① **ON/OFF** Switch

Press and hold in this switch for one second to turn the transceiver on. Similarly, press and hold in this switch for one second to turn the transceiver off.

② **KEY** Jack

This 1/4-inch, 3-contact jack accepts a CW key or keyer paddles (for the built-in electronic keyer), or output from an external electronic keyer. Pinout is shown on page ##. Key up voltage is +3.3 V DC, and key down current is 4 mA. This jack may be configured for keyer, "Bug", "straight key", or computer keying interface operation via Menu item "011 F CW KEYER" (see page ##).

NOTE:

You cannot use a 2-contact plug in this jack (to do so produces a constant "key down" condition).

③ **PHONES** Jack

A 1/4-inch, 3-contact jack accepts either monaural or stereo headphones with 2- or 3-contact plugs. When a plug is inserted, the loudspeaker is disabled.

NOTE:

When wearing headphones, we recommend that you turn the AF Gain levels down to their lowest settings before turning power on, to minimize the impact on your hearing caused by audio "pops" during switch-on.

④ **MIC** Jack

This 8-pin jack accepts input from a microphone utilizing a traditional YAESU HF transceiver pinout.

⑤ F(M-LIST) Button

F

This button is used to display function list. The following functions can be accessed from the function list:

NAR/WIDE, NB, AGC, ATT, IPO, NOTCH, CONT, DNR, DNF, SHIFT, WIDTH, MOX, VOX, MONI, MIC-EQ, PROC, BK-IN, SPEED, SQL

M-LIST

Pressing and holding this button will show the memory channel list. .....

⑥ MENU(SETUP) Button

MENU

This button is used to access the Menu system. The various transceiver characteristics may be configured.

SETUP

Pressing and holding this button will .....

⑦ BAND Button

These keys allow one-touch selection of the desired Amateur band (1.8 ~ 50 MHz).

The keys may also be used for direct entry of a desired operating frequency during VFO operation.

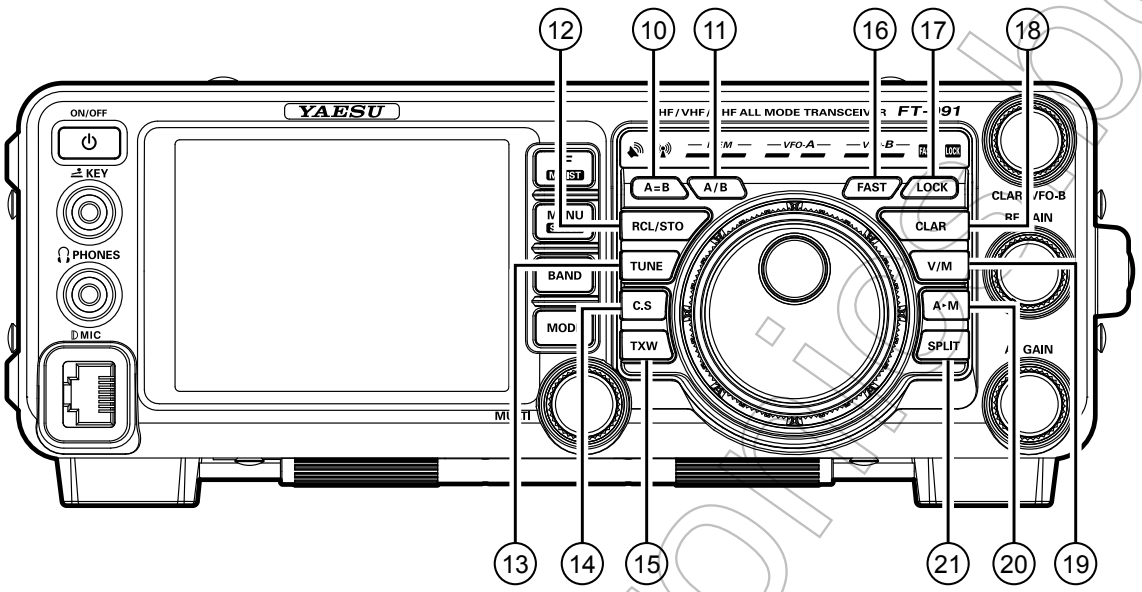
⑧ MODE Button

This button selects the operating mode. The selections available are:

LSB, USB, AM, CW (LSB), CW (USB), FM, RTTY (LSB), RTTY (USB), C4FM, DATA (LSB), DATA (USB), DATA (FM)

⑨ MULTI Knob

This knob allows you to select the Menu items and settings.



⑩ **A=B** Button

Press this button momentarily to transfer the frequency or memory channel data, from VFO-A to VFO-B, overwriting any previous contents in VFO-B. Use this key to set both VFO-A and VFO-B to the same frequency and mode.

⑪ **A/B** Button

Pressing this button momentarily, exchanges the frequency or memory channel data, of VFO-A and VFO-B.

⑫ **RCL/STO** Button

RCL (Recall)

Pressing this button, recalls one of up to five Quick Memory Bank memories for operation.

STO (Store)

Pressing this button copies the contents (frequency, mode, bandwidth, FM repeater offset, and CTCSS settings) of VFO-A, into consecutive QMB Memories.

⑬ **TUNE** Button

This is the on/off switch for the **FT-991**'s Automatic Antenna Tuner.

Pressing this button momentarily places the antenna tuner in line between the transmitter final amplifier and the antenna jack (The "**TUNER**" icon will appear in the display). Reception is not affected.

Pressing and holding in this button for two seconds, while receiving in an amateur band, activates the transmitter for a few seconds while the automatic antenna tuner rematches the antenna system impedance for minimum SWR. The resulting setting is automatically stored in one of the antenna tuner's 100 memories for instant automatic recall later when the receiver is tuned near the same frequency.

Pressing this button momentarily, while the Tuner is engaged, will take the Automatic Antenna tuner out of the transmit line.

NOTE:

When the Automatic Antenna Tuner is tuning itself, a signal is being transmitted. Therefore, be certain that an antenna or dummy load is connected to the selected antenna jack before pressing and holding in the **TUNE** button to start antenna tuning.

⑭ C.S Button

Press this button momentarily to directly recall a favorite Menu Selection.

To program a Menu selection to the **C.S** button, press the **MENU(SETUP)** button to enter the Menu. Select the Menu item you want to set as the short cut. Press the **C.S** button, then press the **MENU(SETUP)** button; this will lock in the selected Menu item as the short cut.

⑮ TXW (TX Watch) Button

Pressing and holding this button lets you monitor the transmit frequency when split frequency operation is engaged. Release the button to return to normal split frequency operation.

⑯ FAST Button

Pressing this button will change the tuning of the Main Tuning Dial knob (VFO-A) to a higher step rate.

When this function is activated, the "**FAST**" indicator in the LED indicators area illuminates.

⑰ LOCK Button

This button toggles locking on/off for the Main Tuning Dial knob (VFO-A). With "Lock" on, the Main Tuning Dial knob can still be turned, but the frequency will not change, and the "**LOCK**" indicator in the LED indicators area illuminates.

⑱ CLAR Button

RX

Pressing this button activates the RX Clarifier. This will allow you to temporarily adjust the receive frequency up to ±9.999 kHz with the **CLAR/VFO-B** knob. Press this button once more to return the receiver to the original frequency; the Clarifier offset will be remembered, in case you want to use it again. To cancel the Clarifier offset, press the [**CLEAR**] button.

Pressing this switch during Split operation will change the tuning rate of the **CLAR/VFO-B** knob (VFO-B) to 100 Hz/step.

When this function is activated, the "**FAST**" indicator in the LED indicators area illuminates.

TX

Pressing this button activates the TX Clarifier, to allow offsetting the transmit frequency temporarily. Press this button once more to return the transmitter to the original frequency; the Clarifier offset will be remembered, though, in case you want to use it again. To cancel the Clarifier offset, press the [**CLEAR**] button.

⑲ V/M Button

This button toggles frequency control between VFO-A and the memory system. In memory mode, "**MEM**" (Memory Channel) will be shown in the display to indicate the current selection. Pressing the **V/M** button displays the original memory frequency, and the "**MEM**" will be displayed. Pressing it once more returns frequency operation to VFO-A, and the icon will no longer be displayed.

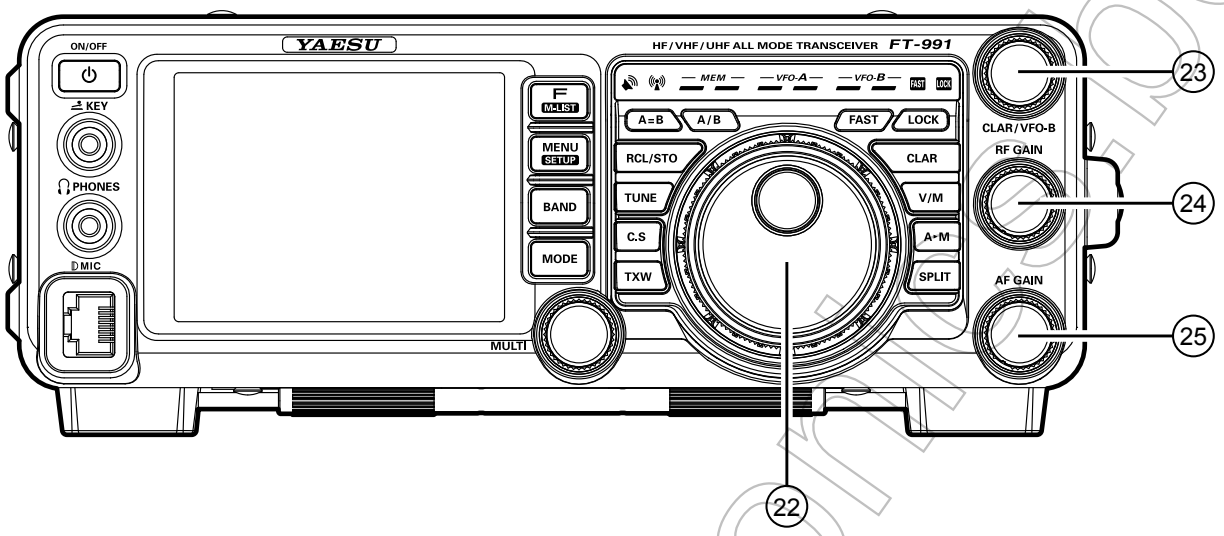
⑳ A►M Button

Pressing this button momentarily, displays the contents of the currently-selected memory channel for 10 seconds.

Pressing and holding in this key for one second (until the double beep) copies the current operating data into the currently selected memory channel, overwriting any previous data stored there.

㉑ SPLIT Button

Press this button to operate split frequency between VFO-A (used for reception) and VFO-B (used for transmission). If you press and hold in the **SPLIT** button for one second, the "Quick Split" feature will be engaged. VFO-B transmit will automatically be set to a frequency 5 kHz higher than the VFO-A receive frequency, with the same operating mode. The transceiver will operate in the Split mode.



㉒ Main Tuning Dial Knob

This large knob adjusts the operating frequency of VFO-A. Clockwise rotation of this knob increases the frequency. Default tuning increments are 10 Hz (CW, SSB), 50 Hz (RTTY/DATA), 100 Hz (AM/FM). When the **FAST** button is pressed, the tuning steps increases. The available steps are:

Operating Mode	1 Step	1 Dial Rotation
LSB/USB/CW	10 Hz (100 Hz)	10 kHz (100 kHz)
AM/FM	100 Hz (1 kHz)	100 kHz (1 MHz)
RTTY/DATA	5 Hz (100 Hz)	5 kHz (100 kHz)

Numbers in parentheses indicate steps when the **FAST** button is On.

㉓ **CLAR/VFO-B** Knob

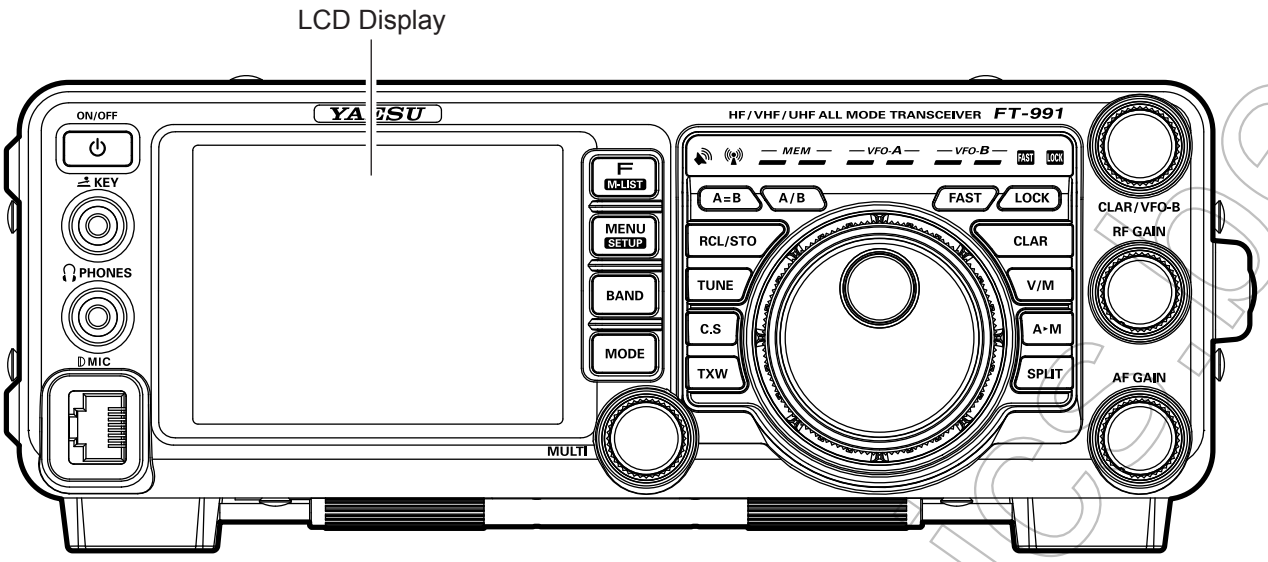
During the VFO-A operation, this knob tunes the Clarifier offset frequency up to ±9.999 kHz.
During Split operation, this knob adjusts the operating frequency of VFO-B.

㉔ **RF GAIN** Knob

The **RF GAIN** knob is the receiver RF gain control, which adjusts the gain of the receiver RF and IF amplifier stages. This control is normally left in the fully clockwise position.

㉕ **AF GAIN** Knob

The **AF GAIN** knob sets the receiver audio volume level. Typically, you will operate with this control set between the 9 o'clock and 10 o'clock positions.



① Mode Indicator
Displays the current operating mode.

② VFO-A Frequency Display
Shows the main band (VFO-A) frequency.

③ Tuning Offset Indicator
This indicates the relative offset of the CW-TUNE, μ-TUNE, Clarifier, etc.

④ Configuration Indicator
TUNER
This indicator appears when the internal Automatic Antenna Tuner is activated.

VOX
This indicator appears when the automatic voice-actuated transmitter switches in the SSB, AM, and FM modes.

PROC
This indicator appears whenever the DSP Speech Processor is activated.

MIC EQ
This indicator appears whenever the Three-Band Parametric Microphone Equalizer is activated via the Menu.

NAR
This indicator appears whenever the receiver's narrow IF DSP filter is engaged.

REC
This indicator appears while the optional Voice Memory Unit is recording your voice message, or the Contest Keyer is recording your CW keying.

PLAY
This indicator appears while the optional Voice Memory Unit is playing back the recorded voice message, or the recorded Contest CW keying.

[+]/[-]
During FM repeater operation, a negative frequency shift will be indicated by "[-]" while a positive frequency shift will be indicated by "[+]".

DNR
This indicator appears whenever the Digital Noise Reduction feature is activated.

DNF
This indicator appears whenever the Digital Notch Filter is activated.

⑤ VFO-B Frequency Display

Shows the sub band (VFO-B) frequency during Split operation.

⑥ S/PO Meter

On reception, this indicates the received signal strength from S-0 to S-9+60dB.

On transmission, this indicates the RF Power Output, from 0 to 150 Watts.

ADVICE:

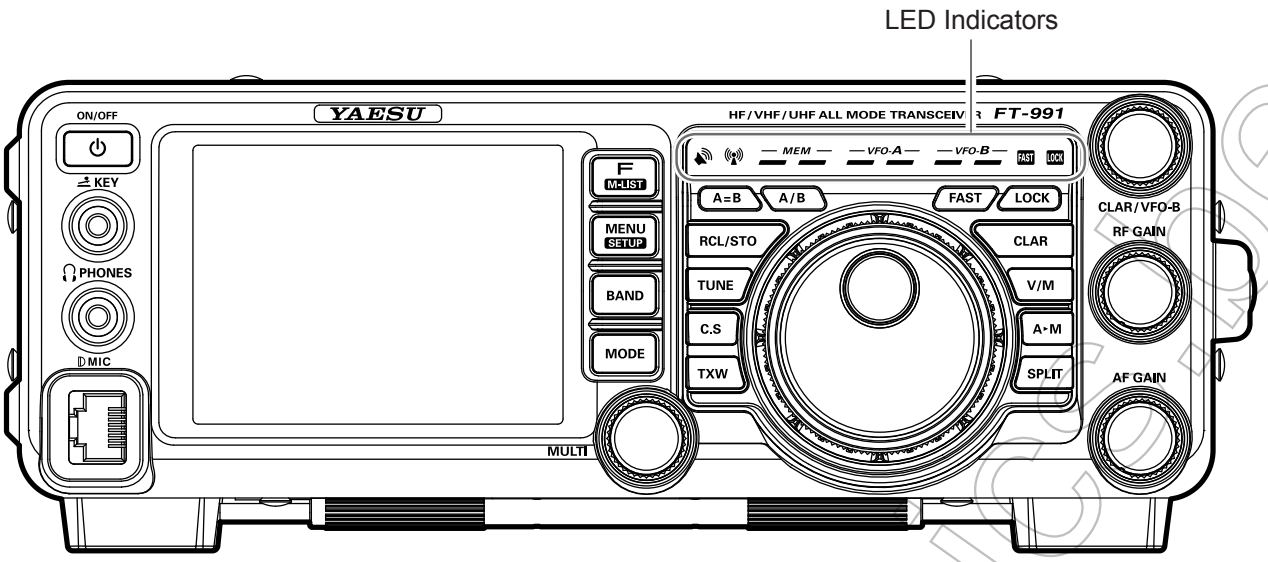
❒ The S/PO meters can be set to the Peak-hold function (BAR type only) via the menu item "008 BAR MTR PEAK HOLD".

⑦ Scope Display

⑧ Function Keys

⑨ Clock

Indicates the current time.



⑪ RX Indicator

This indicator illuminates when the squelch opens.

⑫ TX Indicator

This indicator illuminates during transmission.

⑬ Memory Mode RX/TX Indicators

Green (Left):

This indicator illuminates when the receiver is active on the memory channel.

Red (Right):

This indicator illuminates when the transmitter is active on the memory channel.

⑭ Main Band RX/TX Indicators

Green (Left):

This indicator illuminates when the receiver is active on the main band (VFO-A).

Red (Right):

This indicator illuminates when the transmitter is active on the main band (VFO-A).

⑮ Sub Band RX/TX Indicators

Green (Left):

This indicator illuminates when the receiver is active on the main band (VFO-B).

Red (Right):

This indicator illuminates when the transmitter is active on the main band (VFO-B).

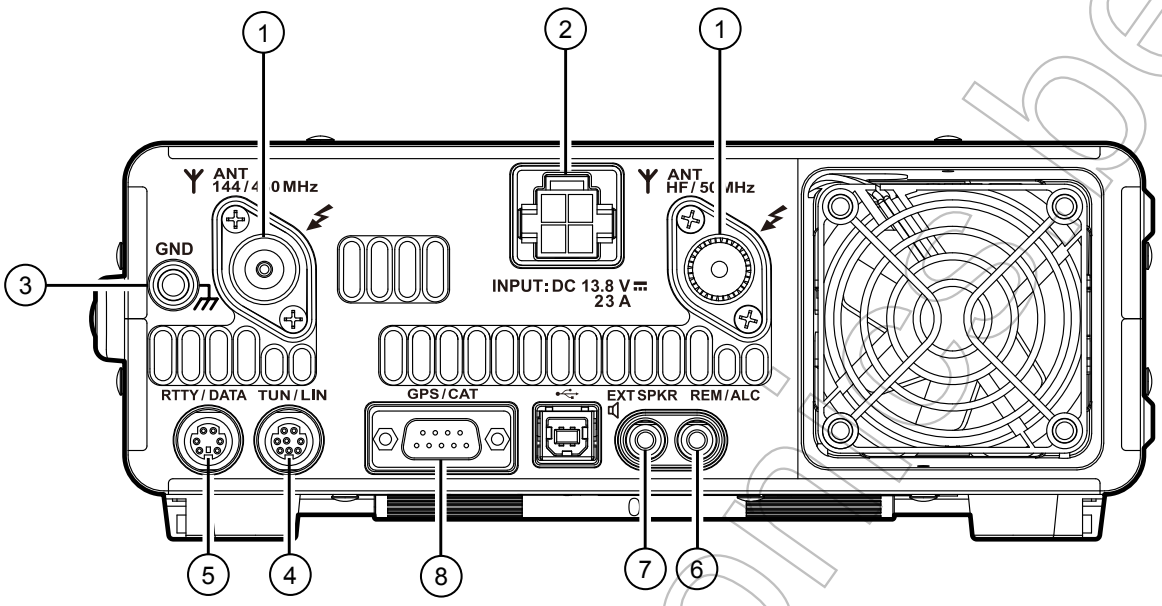
⑯ FAST/LOCK Indicators

FAST:

This indicator appears when the Main Tuning Dial knob tuning rate is set to “fast”.

LOCK:

This indicator appears when the Main Tuning Dial knob is locked.



① ANT Jack

Connect your main antenna(s) here, using type-M (PL-259) connectors and coaxial feed lines. The internal antenna tuner affects only the antenna(s) connected here, and only during transmission.

⚠ Warning!

The 100V RF voltage (@100 W/50 Ω) is applied to the TX RF section of the transceiver while transmitting. Do not touch the TX RF section while transmitting.

② DC IN Jack

This is the DC power supply connection for the transceiver. Use the supplied DC cable to connect directly to a DC power supply, which must be capable of supplying at least 23 A @13.8 VDC.

③ GND

Use this terminal to connect the transceiver to a good earth ground, for safety and optimum performance. Use a large diameter, short braided cable for making ground connections, and please refer to page ## for other notes about proper grounding.

To prevent damage from lightning, atmospheric electricity, electrical shock, etc., be certain to provide a good earth ground.

④ TUN/LIN Jack

TUN (Tuner)

This 8-pin output jack is used for connection to the **FC-40** External Automatic Antenna Tuner.

LIN (Linear)

This 8-pin output jack provides band selection data, which may be used for control of optional accessories such as the **VL-1000** Solid-state Linear Amplifier.

⑤ RTTY/DATA Jack

This 6-pin input/output jack accepts AFSK input from a Terminal Node Controller (TNC) or an optional interface unit; it also provides fixed level (100-mV @600 Ohms) receiver audio output, and FSK keying line.

⑥ REM/ALC Jack

REM (Remote)

By plugging the optional **FH-2** Remote Control Keypad into this gold-plated jack, direct access to the **FT-991** CPU is provided for control functions such as contest memory keying, plus frequency and function control.

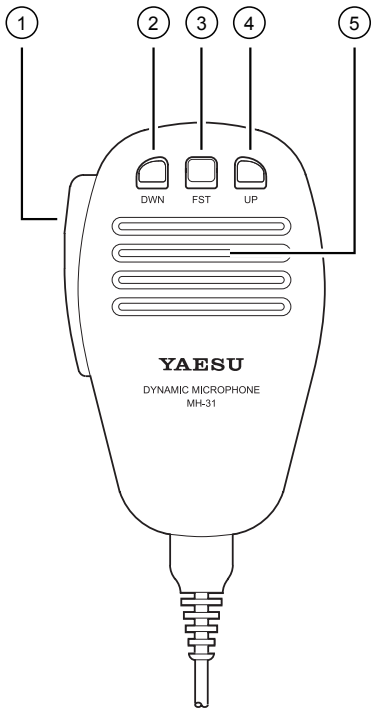
ALC ( )

⑦ EXT SPKR Jack

This 3.5-mm, 2-contact, gold-plated jack provides variable audio output for an external loudspeaker. The audio output impedance at this jack is 4 - 8 Ohms, and the level varies according to the setting of the front panel **AF GAIN** knob. Inserting a plug into this jack disables the internal loudspeaker.

⑧ GPS/CAT Jack

This 9-pin serial DB-9 jack allows external computer control of the **FT-991**. Connect a serial cable here and to the RS-232C COM port on your personal computer (no external interface is required).



① **PTT** Switch
Press and hold the **PTT** (Push To Talk) switch to start transmission.

② **DWN** Button
Press the **DWN** (Down) button to scan the frequency downward.

③ **FST** Button
Press the **FST** (Fast) button to increase the tuning rate by a factor of ten when scanning the frequency.

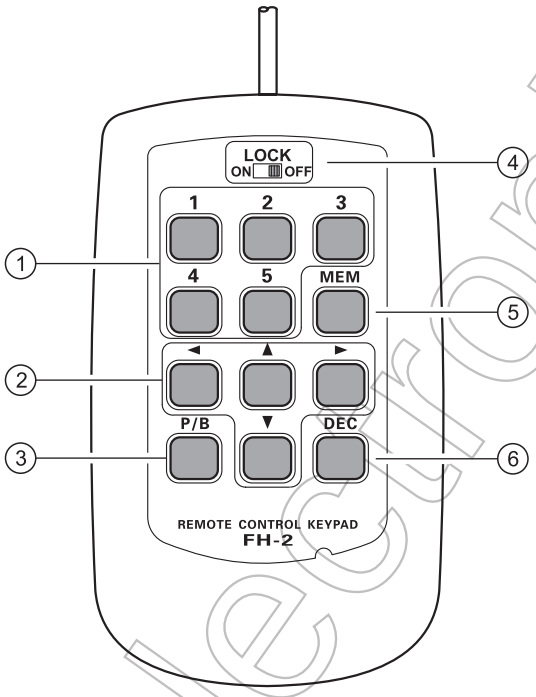
④ **UP** Button
Press the **UP** button to scan the frequency upward.

⑤ Microphone
Speak into here during transmission.

OPTIONAL FH-2 SWITCHES

The optional Remote Control Keypad **FH-2** can be used to control the optional DVS-6 Voice Memory capability for the SSB/AM/FM modes; the contest memory keyer for the CW mode; and the text memory for the RTTY/DATA modes. Some specific capabilities of the **FH-2** are:

- On SSB/AM/FM modes, five channels of storage and playback of voice memory (20 seconds each), using your own voice for recording (see page 71).
- On CW mode, the **FH-2** provides storage and recall of CW messages for repetitive CQ and contest automatic number transmissions (see page 85).
- On RTTY/DATA mode, the **FH-2** provides storage and recall of TEXT messages for repetitive CQ transmissions (see pages 104, 106).



① [1], [2], [3], [4], [5] Buttons

These buttons work as the Voice Memory and CW Message Memory Selection Key.

In the case of Voice Memory, up to 20 seconds of audio may be stored on each channel.

For CW Messages and CW Text Messages, up to 50 characters ("PARIS" specification) may be stored into each channel.

② [◀], [▶], [▲], [▼] Buttons

Usually, these buttons are used for tuning the VFO frequency. Press the [▲]/[▼] buttons to change the frequency in the same increments as the microphone [**UP**]/[**DWN**] switches. Press the [◀]/[▶] buttons to change the frequency by 100 kHz steps.

When programming the Contest Memory Keyer, these buttons are used to move the cursor and select the text characters.

③ [P/B] Button

This button can be used to insert a space into the position where the cursor is blinking.

④ [LOCK] Button

This button may be used to lock out the **FH-2** key buttons, to prevent accidental activation of **FH-2** operations.

⑤ [MEM] Button

Press this button to store either a Voice Memory, or a Contest Keyer Memory.

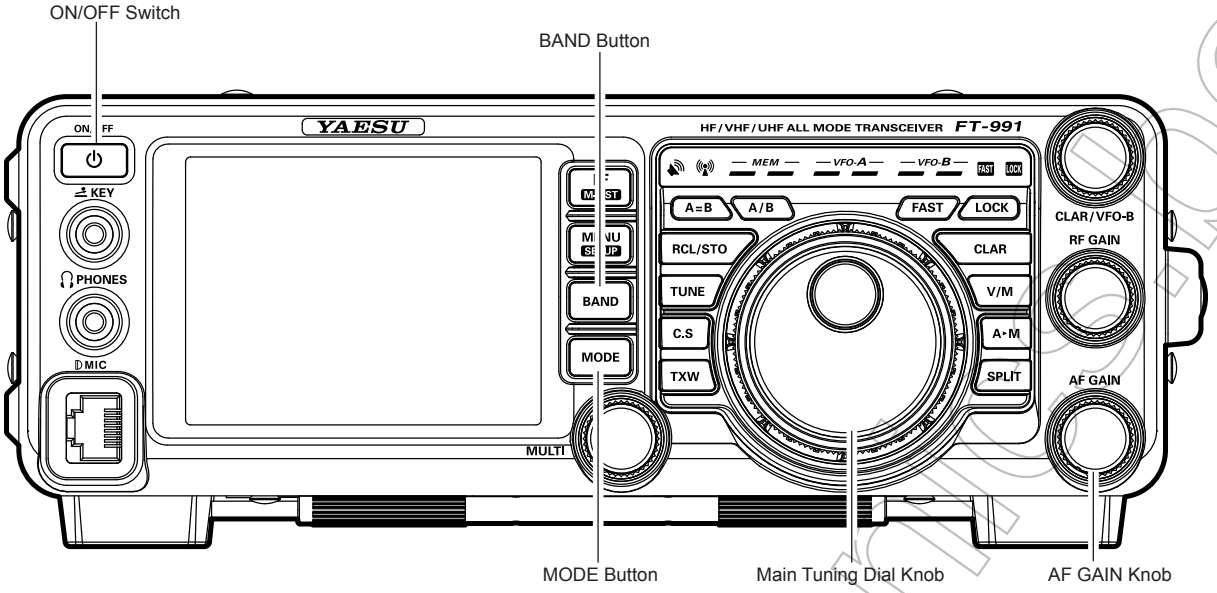
⑥ [DEC] Button

When utilizing the sequential contest number capability of the Contest Keyer, press this button to decrement (decrease) the current Contest Number by one digit (i.e. to back up from #198 to #197, etc.).

Before turning on the main power, please verify the following items once more.

- ❒ Have you made all ground connections securely? See page ## for details.
- ❒ Do you have your antenna(s) connected to the rear-panel Antenna jack(s)? See page ## for details.
- ❒ Is your microphone (and/or key or paddle) connected? See pages ##, ## for details.
- ❒ If using a linear amplifier, have all interconnections been successfully completed? See pages ##, ## for details.
- ❒ Please rotate the **AF GAIN** control to the fully counter-clockwise position, to avoid a loud blast of audio when the transceiver turns on. See page ## for details.

Here is the typical start-up procedure for normal operation:



1. Turn on the external DC power supply.
2. Press and hold in the front-panel **ON/OFF** switch until the transceiver turns on. After about five seconds, the transceiver is ready for full operation.
3. The transceiver will start up on 7.000.00 MHz LSB, (or the previously used operating frequency) and normal operation may begin.

   NOTE:

   To turn power off, press and hold in the front panel **ON/OFF** switch for one second.
4. Rotate the **AF GAIN** knob to set a comfortable audio level of the incoming signals or noise. Clockwise rotation of the **AF GAIN** knob increases the volume level.

   NOTE:

   When using headphones, start by rotating the **AF GAIN** knob counter-clockwise, then bring the volume level up after you put the headphones on. This will minimize the chance of damage to your hearing caused by an unexpectedly high audio level.
5. Press the **BAND** button to display the list of Amateur bands on the LCD, then touch a key corresponding to the band on which you wish to begin operation.

   ADVICE:

   - ❒ One-touch selection of each Amateur band between 1.8 and 50 MHz, 144 MHz, and 430 MHz is provided.
   - ❒ The **FT-991** utilizes a triple band-stack VFO selection technique, which permits storing up to three favorite frequencies and modes onto each VFO band register. For example, you may store one frequency each on 14 MHz CW, RTTY, and USB, then recall these frequencies by successive, momentary touches of the [**14**] on the screen displayed by pressing the **BAND** button. Each Amateur band key may similarly have up to three frequency/mode settings applied.

     When [**MHz**] is touched, the "**MHz**" notation will appear in the display, and then rotation of the **CLAR/VFO-B** knob will change the frequency in 1 MHz steps.
6. Press the **MODE** button to display the available selections.

   Touch the corresponding key to select the desired operating mode.

   ADVICE:

   - ❒ By convention in the Amateur bands, LSB is used on the 7 MHz and lower bands (with the exception of 60 meters), while USB is utilized on the 14 MHz and higher bands.
   - ❒ When changing modes from SSB to CW, you will observe a frequency shift on the display. This shift represents the BFO offset between the "zero beat" frequency and the audible CW pitch (tone) you can hear (the pitch is programmed via the Menu item "060 CW FREQ DISPLAY"), even though the actual tone that you hear is not changing.
   - ❒ When operating on the FM mode, repeatedly touch [**SQL**] (Squelch) on the screen displayed by pressing the **F(M-LIST)** button to point where the background noise is just silenced. This is the point of maximum sensitivity to weak signals. Excessive advancement of [**SQL**] will decrease the ability of the receiver to detect weak signals.

7. Rotate the Main Tuning Dial knob to tune around the band, and begin normal operation.

ADVICE:

❒ Clockwise rotation of the Main Tuning Dial knob increases the operating frequency, one "step" of the synthesizer at a time; similarly, counter-clockwise rotation of the Main Tuning Dial knob will decrease the frequency. Two settings, one "normal" and one "fast", are available for each operating mode. Pressing the **FAST** button engages the "Fast" tuning selection (see chart below).

MAIN TUNING DIAL KNOB TUNING RATE

OPERATING MODE	1 STEP	1 DIAL ROTATION
LSB/USB/CW/ RTTY/DATA	1 / 5 / 10 Hz (100 Hz)	1 / 5 / 10 kHz (100 kHz)
AM/FM	100 Hz (1 kHz)	100 kHz (1 MHz)

Numbers in parentheses indicate steps when the **FAST** button is On.

❒ If you want to effect rapid frequency change, there are several techniques available:

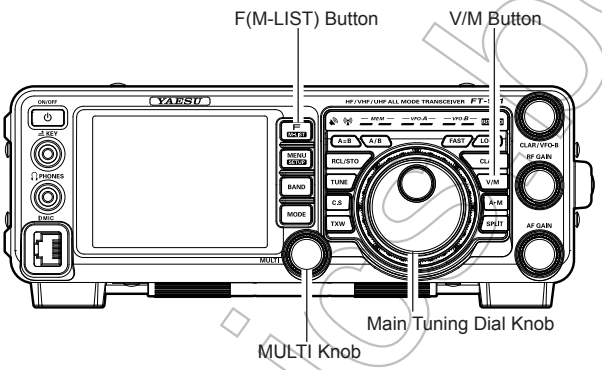
- Direct keyboard entry of the frequency.
- Use the microphone's **UP**/**DWN** scanning keys, if your microphone is so equipped.

OPERATION ON 60-METER (5 MHZ) BAND (U.S. VERSION ONLY)

The recently-released 60-meter band is covered, in the **FT-991**, by fixed memory channels. These channels are set to USB or CW, and they appear between the "last" PMS channel ("P9U") and the first "regular" memory channel (Channel 1):

1. Press the **V/M** button once to enter the "Memory" mode; the "**MEM**" icon will appear in the display.
2. Touch [**MCH**] on the screen displayed by pressing the **F(M-LIST)** button. The "**MCH**" notation and a memory channel number will appear on the display to signify that rotation of the **MULTI** knob will allow selection of the memory channel.
3. Memory channels ("501" through "510") are pre-programmed, at the factory, with the permitted frequencies in the 5 MHz band, and the USB or CW mode is automatically selected on these channels.
4. To exit from 60-meter operation and return to the VFO mode, just press the **V/M** button.

NOTE:
The frequencies and operating mode for 5 MHz band operation are fixed, and may not be changed.



CHANNEL NUMBER	FREQUENCY
501	5.332000 MHz
502	5.348000 MHz
503	5.358500 MHz
504	5.373000 MHz
505	5.405000 MHz
506	5.332000 MHz
507	5.348000 MHz
508	5.358500 MHz
509	5.373000 MHz
510	5.405000 MHz

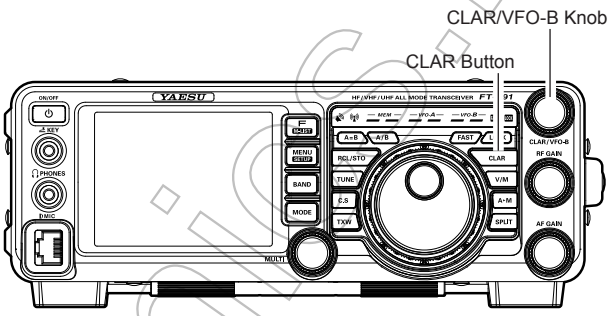
CLAR (CLARIFIER) OPERATION

The **CLAR** button and **CLAR/VFO-B** knob are used to offset the receive frequency, the transmit frequency, or both, from their settings on the VFO-A frequency. Four small numbers on the TFT Display show the current Clarifier offset. The Clarifier controls on the **FT-991** are designed to allow you to preset an offset (up to ±9.99 kHz) without actually retuning, and then to activate it via the Clarifier **CLAR** button. This feature is ideal for following a drifting station, or for setting the small frequency offsets sometimes utilized in DX "Split" work.

Here is the technique for utilizing the Clarifier:

1. Press the **CLAR** button. The "**RX**" notation will appear in the TFT Display, and the programmed offset will be applied to the receive frequency.
2. Rotation of the **CLAR/VFO-B** knob will allow you to modify your initial offset on the fly. Offsets of up to ±9.99 kHz may be set using the Clarifier.

To cancel Clarifier operation, press the **CLAR** button. The "**RX**" notation will disappear from the display.



ADVICE:

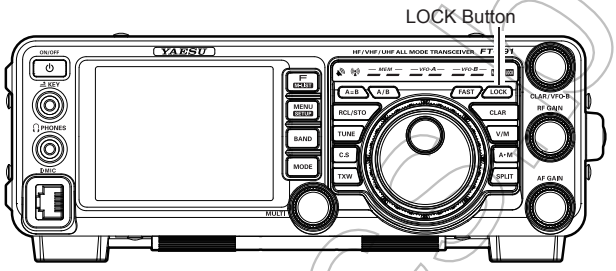
- Turning the Clarifier off merely cancels the application of the programmed offset from the receive and/or the transmit frequencies. To clear the Clarifier offset, and reset it to "zero," press and hold the **CLAR** button. The programmed offset is displayed in the small multi-channel window of the frequency display.
- The Clarifier operation (including the offset frequency) will be memorized independently on each VFO stack of VFO-A and VFO-B.

LOCK

You may lock the setting of the Main Tuning Dial knob (for VFO-A frequency tuning) and the **CLAR/VFO-B** knob (for VFO-B frequency tuning during Split operation), to prevent accidental frequency change.

Main Tuning Dial Knob Lock

To lock the Main Tuning Dial knob, press the **LOCK** button that is located to the right of the Main Tuning Dial knob. To unlock the Dial setting, and restore normal tuning, press the **LOCK** button once more.



ADVICE:

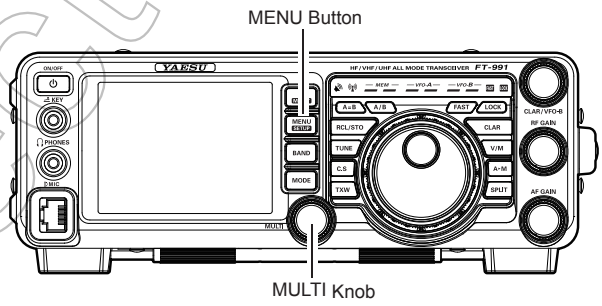
The lock feature will be memorized independently on the Main Tuning Dial knob and the **CLAR/VFO-B** knob.

DIMMER

The illumination level of the TFT display and LED indicators (above the Main Tuning Dial knob), may be adjusted via Menu items 009 and 010.

To adjust the illumination level:

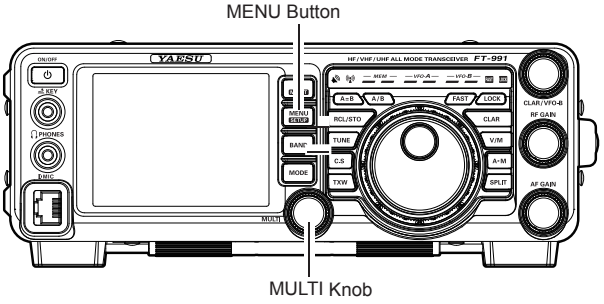
1. Press the **MENU** button to enter the Menu mode.
2. Rotate the **MULTI** knob to select Menu item "006 DIMMER LED" (for LED indicators) or "007 DIMMER TFT" (for TFT display).
3. Touch [**SELECT**] on the LCD then rotate the **MULTI** knob to select the desired illumination level.
4. Touch [**ENTER**] on the LCD, then touch [**BACK**] on the LCD or press the **MENU** button to save the new setting and exit to normal operation.



VFO COLOR

The background color of the VFO-A frequency in the TFT display may be selected via Menu item 007.

1. Press the **MENU** button to enter the Menu mode.
2. Rotate the **MULTI** knob to select Menu item "005 DISPLAY COLOR".
3. Touch [**SELECT**] on the LCD, then rotate the **MULTI** knob to select from the following colors: BLUE (default) / SKY BLUE / GREEN / PURPLE / RED / ORANGE / GRAY
4. Touch [**ENTER**] on the LCD, then touch [**BACK**] on the LCD or press the **MENU** button to save the new setting and exit to normal operation.



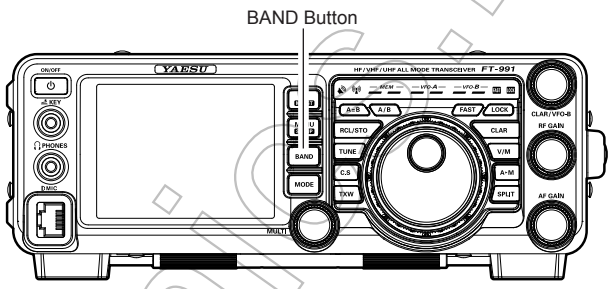
BAND STACK OPERATION

The **FT-991** utilizes a triple band-stack VFO selection technique, that permits you to store up to three favorite frequencies and modes onto each band's VFO register. For example, you may store one frequency each on 14 MHz CW, RTTY, and USB, then recall these VFOs by successive, momentary touches of [**14**] on the screen displayed by the **BAND** button. Each Amateur band key may similarly have up to three frequency/mode settings applied. Note that only the VFO-A system has the band stacks.

A typical setup, for the 14 MHz band, might be arranged like this:

1. Program 14.025 MHz, CW Mode, press the **BAND** button, then touch [**14**] on the LCD;
2. Program 14.080 MHz, RTTY Mode, press the **BAND** button, then touch [**14**] on the LCD;
3. Program 14.195 MHz, SSB Mode, press the **BAND** button, then touch [**14**] on the LCD.

With this configuration, successive momentary touches of [**14**] on the screen displayed by the **BAND** button will allow you to step sequentially through these three VFOs.

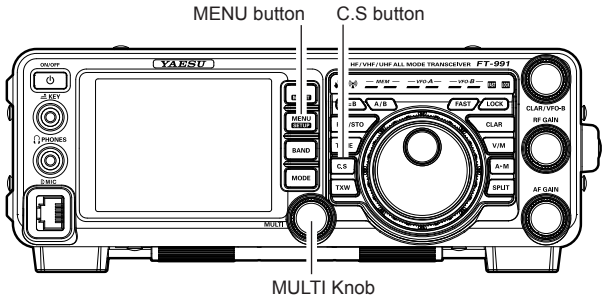


C.S (CUSTOM SWITCH)

The front panel **C.S** button may be programmed to directly access an often-used Menu Mode selection.

C.S Setup

1. Press the **MENU** button to engage the Menu mode; the Menu list will appear on the display.
2. Rotate the **MULTI** knob to select the Menu item you want to access with the front panel **C.S** button.
3. Press the **C.S** button to lock in your selection.
4. Press the **MENU** button or touch [**BACK**] on the LCD to save the new configuration and exit to normal operation.



Menu Selection Recall via C.S button

Press the **C.S** button.

The programmed Menu item will appear on the display. Press the **MENU** button or touch [**BACK**] on the LCD exit to normal operation.

SCOPE

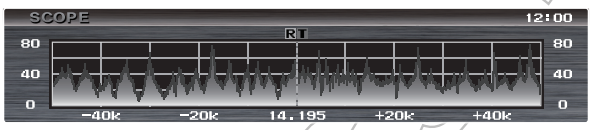
This function displays a convenient spectrum scope for monitoring the band conditions. Both strong and weak signals can be displayed in an easy-to-understand manner on the TFT screen. This multifunctional scope takes into consideration the operator's preference, by switching between the convenient CENTER mode where the VFO frequency is constantly in the center of the screen (for monitoring conditions on both sides of your operating frequency), and the FIX mode, where the frequency is fixed to the left side of the screen (for convenience in monitoring in the band).

Note: Since the **FT-991** has only one receiver the audio will be muted while the spectrum scope is scanning.

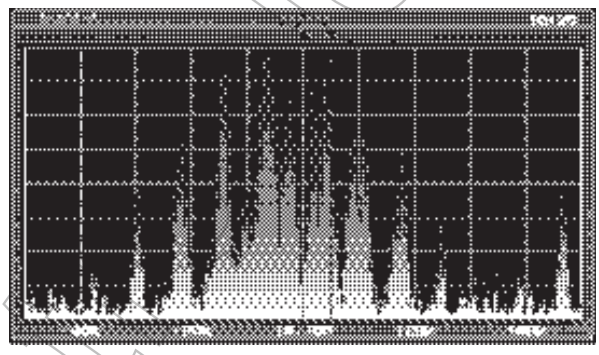
1. Press the [**SCOPE**] button momentarily to display the scope screen.
   Five different screens are shown on the TFT display by pressing the [**SCOPE**] button.

   ADVICE:

   ❒ During continuous sweeping, no audio will be heard.



Spectrum scope display



Full screen spectrum scope display

MORE FREQUENCY NAVIGATION TECHNIQUES

Keyboard Frequency Entry

The Operating frequency may be entered directly into the current VFO, using the keyboard screen displayed by pressing the front panel **BAND** button.

Example: Enter 14.250.00 MHz

1. Press the **BAND** button to begin the direct frequency entry process.
2. Touch [**ENT**] on the LCD. The first digit of the frequency (the leftmost digit) will blink.
3. Enter, in order, the digits of the operating frequency, touching the keys on the LCD
   The decimal point after the "MHz" portion of the frequency must be entered, but no decimal point is required after the "kHz" portion.
3. Touch [**ENT**] on the LCD once more to complete the operating frequency entry. A short "beep" will confirm that the entry was successful, and the new operating frequency will appear on the display.

ADVICE:

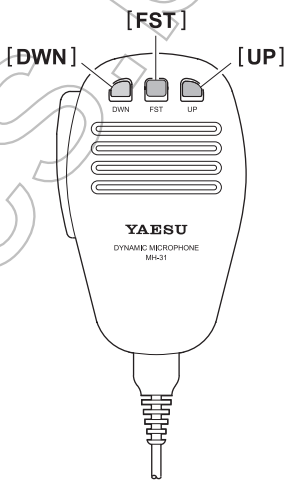
If you attempt to enter a frequency outside the operating range of 30 kHz ~ 56 MHz, the microprocessor will ignore the attempt, and you will be returned to the previous operating frequency. If this happens, please try again, taking care not to repeat the error in the frequency entry process.

Using the UP/DWN buttons of the supplied MH-31A8J Hand Microphone

The **UP**/**DWN** buttons on the supplied **MH-31A8J** Hand Microphone may also be used to manually scan the frequency upward or downward.

The microphone's **UP**/**DWN** buttons utilize the tuning steps of the Main Tuning Dial knob.

When the microphone **FST** button is pressed, the tuning rate increases by a factor of ten, in a manner similar to the transceiver front panel **FAST** button.



RECEIVER OPERATION (FRONT END BLOCK DIAGRAM)

The **FT-991** includes a wide range of special features to suppress the many types of interference that may be encountered on the HF bands. However, real world interference conditions are constantly changing, so optimum setting of the controls is somewhat of an art, requiring familiarity with the types of interference and the subtle effects of some of the controls. Therefore, the following information is provided as a general guideline for typical situations, and a starting point for your own experimentation.

The **FT-991** interference-fighting circuitry begins in its "RF" stages, and continues throughout the entire receiver section. **FT-991** allows configuration of the features described below.

CONTOUR Filter

The DSP Contour filter has the unique ability to provide either a null or a peak in tunable segments of the receiver passband. You may suppress interference and excessive frequency components on an incoming signal, or you may peak those tunable frequency segments. The level of the null or peak, and the bandwidth, over which it is applied, are adjustable via the Menu.

IF SHIFT

The passband center frequency of the IF DSP filter may be moved up or down by adjusting this control.

IF WIDTH

The width of the IF DSP filtering may be adjusted using this control.

IF NOTCH

The IF Notch filter is a high-Q notch filter that can eliminate, or significantly reduce an interfering carrier.

DNF (Digital Notch filter)

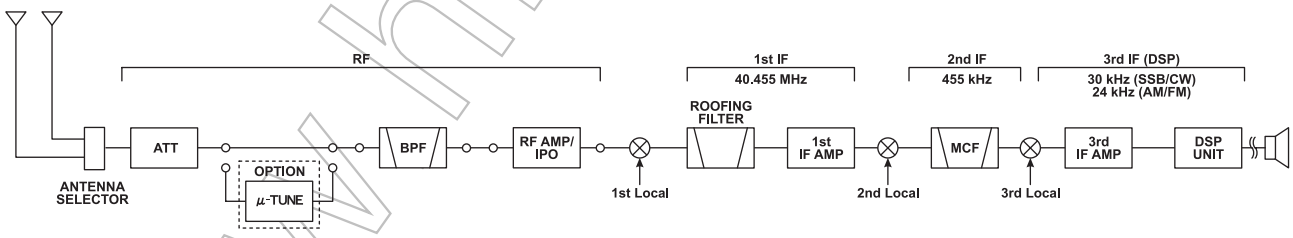
When multiple interfering carriers are encountered during reception, the Digital Notch Filter can significantly reduce the level of these signals.

DNR (Digital Noise Reduction)

The DSP's Digital Noise Reduction (DNR) feature utilizes 15 different mathematical algorithms to analyze and suppress different noise profiles encountered on the HF/50 MHz bands. Choose the selection that provides the best noise suppression, and allows the signal to rise up out of the noise.

AGC

The AGC system is highly adaptable to changing signal and fading characteristics, making reception possible under the most difficult conditions.

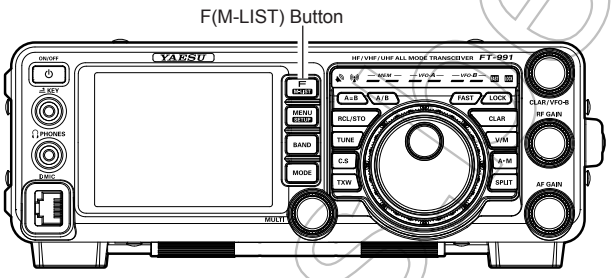


FRONT END BLOCK DIAGRAM

ATT (ATTENUATOR)

When extremely strong local signals or high noise degrades reception, you can use [**ATT**] displayed by pressing the **F(M-LIST)** button to insert 6, 12, or 18-dB of RF attenuation in front of the RF amplifier.

1. Press the **F(M-LIST)** button, then touch [**ATT**] on the LCD several times to set the desired attenuation level, per the chart below.
   OFF: Attenuator is Off
   -6dB: The incoming signal power is reduced by 6 dB (Signal voltage reduced by 1/2)
   -12dB: The incoming signal power is reduced by 12 dB (Signal voltage reduced to 1/4)
   -18dB: The incoming signal power is reduced by 18 dB (Signal voltage reduced to 1/8)
   The selected attenuation level will be indicated in the ATT column of the Key Function Display on the TFT display.
2. To restore full signal strength through the Attenuator circuit area, touch [**ATT**] on the LCD to restore the ATT display to the "OFF" position.

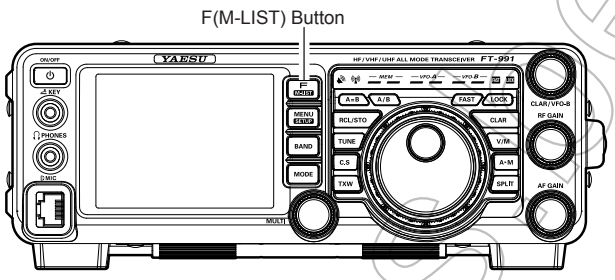


ADVICE:

- If background noise causes a high S-meter indication on clear frequencies, touch [**ATT**] on the LCD until the S-meter drops to about "S-1". This setting optimizes the trade-off between sensitivity, noise, and interference immunity. Also, once you have tuned in a station you want to work, you may want to reduce sensitivity further (add more attenuation) by touching [**ATT**] on the LCD to a higher setting. This reduces the strength of all signals (and noise) and can make reception more comfortable, important especially during long QSOs. When looking for weak signals on a quiet band, you will want maximum sensitivity, so the IPO should be disabled and [**ATT**] on the LCD should be set to "OFF." This situation is typical during quiet times on frequencies above 21 MHz, and when using a small or negative-gain receiving antenna on other bands.

IPO (INTERCEPT POINT OPTIMIZATION)

The IPO feature allows the operator to optimize the characteristics of the receiver front end, depending on the current noise level and the strength of incoming signals.



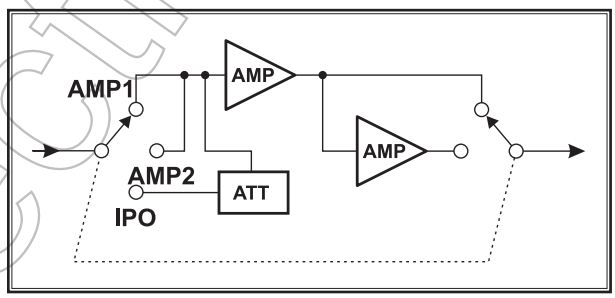
Touch [**IPO**] displayed by pressing the **F(M-LIST)** button repeatedly, to set the desired characteristic of the receiver front end, according to the chart below.

- **AMP1**: Amplifies the incoming signals, using a low distortion RF preamplifier (gain: approx. 10 dB).
- **AMP2**: Amplifies the incoming signals, using a 2-stage low-distortion RF preamplifier (total gain: approx. 20 dB).
- **IPO**: Bypasses the RF preamplifier, yielding direct feed to the first mixer.

The selected receiver RF preamplifier will be indicated in the IPO column of the Key Function Display on the TFT display.

ADVICE:

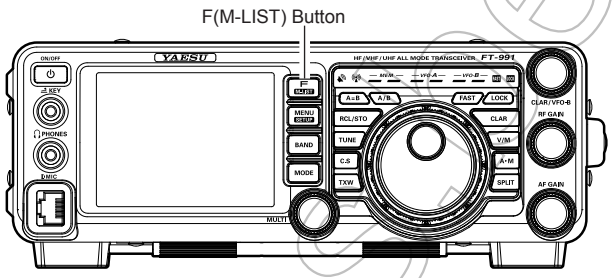
- On the 10 MHz and lower bands, it generally is not necessary to use any preamplifier at all; selecting the "IPO" position as described above will increase the strong-signal-handling capability of the receiver, and generally will result in more pleasant reception due to reduced noise. If you can hear band noise with the preamplifiers disengaged, then a preamplifier is generally not needed.



IF NOISE BLANKER (NB) OPERATION

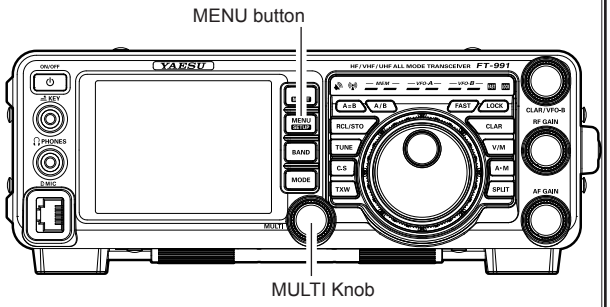
The **FT-991** includes an effective IF Noise Blanker, which can significantly reduce noise caused by automotive ignition systems.

1. Touch [**NB**] displayed by pressing the **F(M-LIST)** button briefly to reduce ***short duration pulse noise*** such as from switching transients, automobile ignitions and power lines. The "**NB ON**" will appear in the display to confirm that the Narrow-NB is operating.
2. Touch [**NB**] on the LCD again to reduce ***longer-duration man-made pulse noise***. The "**NBW ON**" will appear in the display to confirm that the Wide-NB is operating.
3. If desired, you may adjust the Noise Blanker level via Menu item "024 NB LEVEL" to the point where the offending noise is best reduced or eliminated. See box below for details.
4. To end Noise Blanker operation, touch [**NB**] on the LCD once more. The "**NB OFF**" will appear in the display, confirming that the Noise Blanker is no longer in operation.



Adjusting the Noise Blanker Level

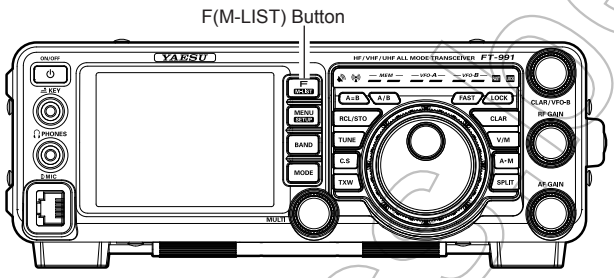
1. Press the **MENU** button to engage the Menu mode.
2. Rotate the **MULTI** knob to select Menu item "024 NB LEVEL".
3. Touch [**SELECT**] on the LCD
4. Rotate the **MULTI** knob to the point where the offending noise is best reduced or eliminated.
5. Touch [**ENTER**] on the LCD, then press the **MENU** button or touch [**BACK**] on the LCD to lock in the new setting and exit to normal operation.



CONTOUR CONTROL OPERATION

The Contour filter system provides a gentle perturbation of the IF filter passband. The Contour is set to either suppress, or boost specific frequency components, and thus enhances the sound and readability of a received signal.

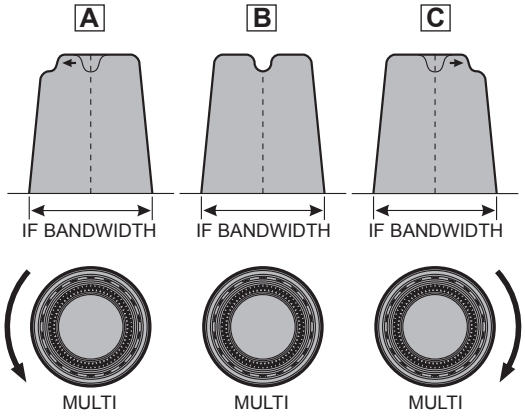
1. Touch [**CONT**] displayed by pressing the **F(M-LIST)** button to activate the Contour filter. The DSP graphic display will illuminate and the current "null" (or "peak") position of the Contour filter will appear in the CONTOUR indicator on the display.
2. Rotate the **MULTI** knob to achieve the most natural-sounding audio reproduction on the incoming signal.
   ADVICE:
   The display will show the Contour frequency whenever [**CONT**] on the LCD is touched.
3. To cancel Contour tuning, touch [**CONT**] on the LCD.
   ADVICE:
   Alternate touches of [**CONT**] on the LCD will switch the Contour filter between on and off.



ADVICE:

- ❒ The Contour filter level (either a null or a peak) may be adjusted using Menu item "112 CONTOUR LEVEL". The factory default setting is for a null of –15 (dB).
- ❒ The bandwidth over which the Contour filter effect is applied may be adjusted using Menu item "113 CONTOUR WIDTH". The factory default setting is 10. When the set value is increased, the bandwidth becomes wider.

Refer to Figure "**B**", this illustrates an "indentation" of the Contour filter in the center of the passband. The Contour filter places a low-Q "notch" in the passband, per the settings of Menu items "112 CONTOUR LEVEL" and "113 CONTOUR WIDTH" (referenced above). Counter-clockwise rotation (to the left) of the **MULTI** knob causes the notch to move toward a lower frequency within the passband, while clockwise rotation (to the right) causes the notch to move toward a higher frequency within the passband. By removing interference or unwanted frequency components of the incoming signal, it is possible to make the desired signal rise out of the background noise/interference, enhancing intelligibility.



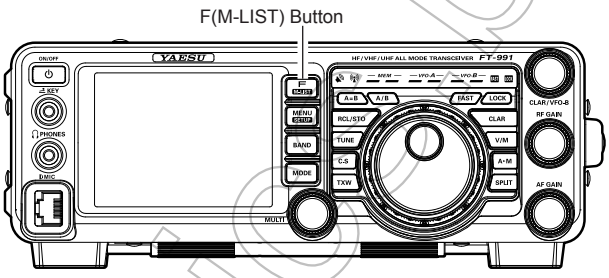
QUICK POINT:

By judicious use of the Contour filter, the "shoulder" of the passband response may be altered, or components may be removed from within the passband, allowing the desired signal to rise above the background noise and interference in a manner not obtainable with other filtering systems.

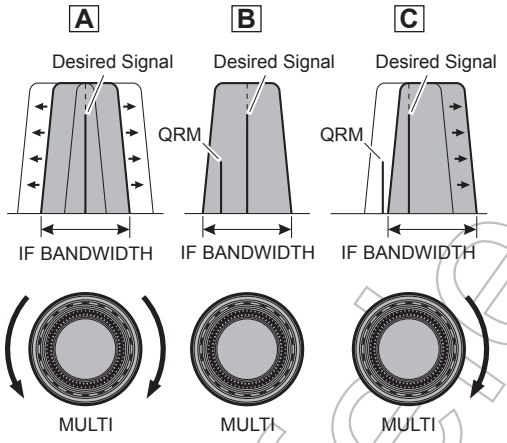
IF SHIFT OPERATION (SSB/CW/RTTY/PKT MODES)

IF SHIFT allows you to move the DSP filter passband higher or lower, without changing the pitch of the incoming signal, and thus reduces or eliminates interference. Because the carrier tuning frequency is not varied, there is no need to re-tune the operating frequency to eliminate the interference. The total passband tuning range for the IF SHIFT system is ±1 kHz.

1. Touch [**SHIFT**] displayed by pressing the **F(M-LIST)** button repeatedly to reduce the interference.
   ADVICE:
   The display will show the shift value of the IF SHIFT whenever [**SHIFT**] on the LCD is touched.



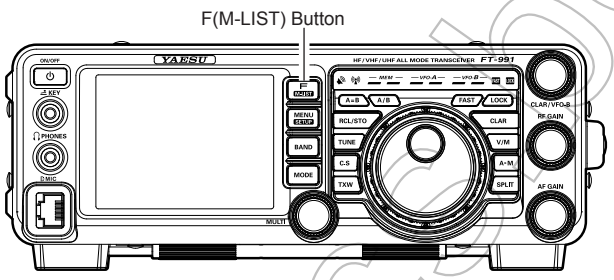
Referring to Figure "**A**", note the depiction of the IF DSP filter as the thick line, with **MULTI** knob in the 12 o'clock position. In Figure "**B**", an interfering signal has appeared inside the original passband. In Figure "**C**", you can see the effect of rotating the **MULTI** knob. The interference level is reduced by moving the filter passband so that the interference is outside of the passband.



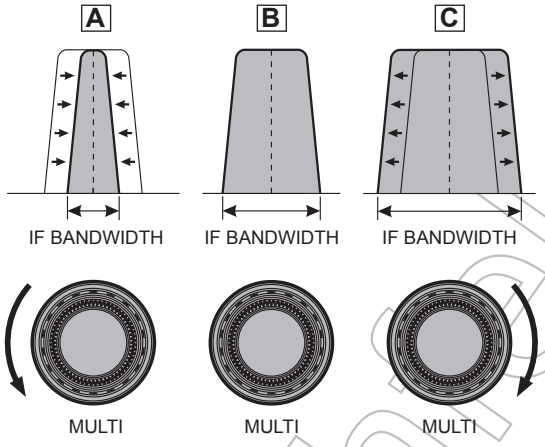
WIDTH (IF DSP BANDWIDTH) TUNING (SSB/CW/RTTY/DATA MODES)

The IF WIDTH tuning system allows you to vary the width of the DSP IF passband, to reduce or eliminate interference. Moreover, the bandwidth may actually be *expanded* from its default setting, should you wish to enhance incoming signal fidelity when interference on the band is low.

1. Touch [**WIDTH**] displayed by pressing the **F(M-LIST)** button repeatedly to reduce the interference.
   ADVICE:
   The frequency display will show the bandwidth of the IF passband whenever [**WIDTH**] is touched.



Referring to Figure "**B**", you can see the default bandwidth on the SSB mode.
By rotating the **MULTI** knob to the left, the bandwidth will narrow (see Figure "**A**", while rotation of the **MULTI** knob to the right, as depicted in Figure "**C**", will increase the bandwidth.

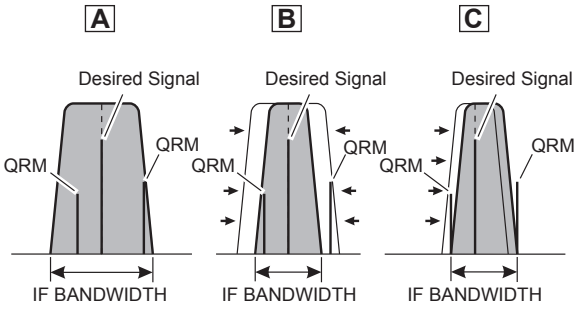


The default bandwidths, and total bandwidth adjustment range, will vary according to the operating mode:
SSB Mode: 1.8 kHz ~ 4.0 kHz (default: 2.4 kHz).
CW Mode: 500 Hz ~ 2.4 kHz (default: 2.4 kHz)
RTTY/DATA Modes: 500 Hz ~ 2.4 kHz (default: 500 Hz)

Using IF SHIFT and WIDTH Together

The IF SHIFT and Variable IF WIDTH features together form a very effective interference-fighting filtering system.

For example, in Figure "**A**", you can see how interference has appeared both on the high and low sides of the desired signal. Touch [**WIDTH**] on the LCD, the interference from one side can be eliminated (Figure "**B**"). Next, rotate the **MULTI** knob to re-position the passband (Figure "**C**"), the interference on the opposite side can be removed, without re-introducing the interference previously eliminated in Figure "**B**".



ADVICE:
For best interference reduction, the WIDTH and SHIFT features are the primary tools you should use, after narrowing the bandwidth (WIDTH) and/or adjusting the center of the passband (SHIFT). The Contour control may then yield additional signal-enhancement benefits on the net residual bandwidth. Even more, the IF NOTCH Filter (described later) may also be used, in conjunction with these filter systems, to significant advantage.

NARROW (NAR) ONE-TOUCH IF FILTER SELECTION

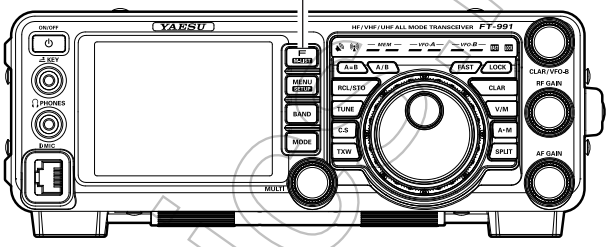
Touching [**NAR/WIDE**] displayed by pressing the **F(M-LIST)** button provides one-touch, mode-specific, selection of a narrow IF DSP filter setting that does not require resetting the bandwidth control to the WIDTH/SHIFT system.

Touching [**NAR/WIDE**] on the LCD once more returns the bandwidth control to the WIDTH/SHIFT system. The factory default bandwidths are:

OPERATING MODE	[NAR/WIDE] TOUCH KEY	
	"ON"	"OFF"
SSB	200 Hz ~ 1.8 kHz※ (1.5 kHz)	1.8 ~ 3.0 kHz※ (2.4 kHz)
CW	50 ~ 500 Hz※ (500 Hz)	500 Hz ~ 3.0 kHz※ (2.4 kHz)
RTTY/DATA	50 ~ 500 Hz※ (300 Hz)	500 Hz ~ 2.4 kHz※ (500 Hz)
AM	6 kHz	9 kHz
FM (28/50/144/430 MHz Bands)	9 kHz	16 kHz

※: Depends on the [**WIDTH**] setting
( ): Default Bandwidth

F(M-LIST) Button



ADVICE:

- When the narrow bandwidth is selected, the "**NAR**" icon will appear in the display.
- If [**NAR/WIDE**] on the LCD has been touched to engage the narrow filter, you may still adjust the narrow IF bandwidth with [**WIDTH**] on the LCD and the **MULTI** knob. The IF SHIFT is also operational.
- When you touch [**NAR/WIDE**] on the LCD in the FM mode, both transmit and receive bandwidths are narrowed.

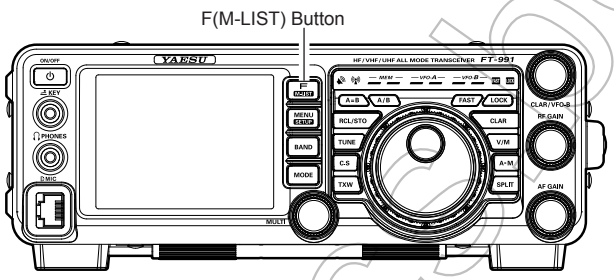
IF NOTCH FILTER OPERATION (SSB/CW/RTTY/DATA/AM MODES)

The IF NOTCH filter is a highly effective system that allows you to slice out an interfering beat note or other carrier signal from inside the receiver passband.

1. Press the **F(M-LIST)** button, then touch [**NOTCH**] on the LCD to activate the Notch filter. The DSP graphic display will illuminate and the current "null" position of the NOTCH filter will appear in the NOTCH indicator on the display. The **MULTI** knob functions as the Notch adjustment knob.
2. Rotate the **MULTI** knob to adjust the "null" position of the Notch filter.
3. To cancel the NOTCH filter, touch [**NOTCH**] on the LCD. The graphic disappears from the NOTCH indicator on the display, confirming that the NOTCH filter is no longer in operation.

ADVICE:

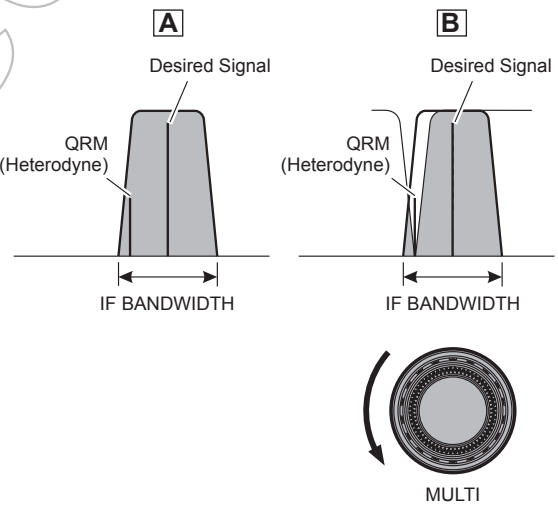
Alternate touches of [**NOTCH**], will switch the NOTCH filter between on and off.



ADVICE:

- The bandwidth of the NOTCH filter (either narrow or wide) may be adjusted using Menu item "114 IF NOTCH WIDTH". The factory default setting is "WIDE".

The performance of the IF NOTCH filter is illustrated in Figure "**A**", where the effect of rotation of the **MULTI** knob is depicted. In Figure "**B**" you can see the notching effect of the IF NOTCH filter as you rotate the **MULTI** knob to eliminate the interfering heterodyne.



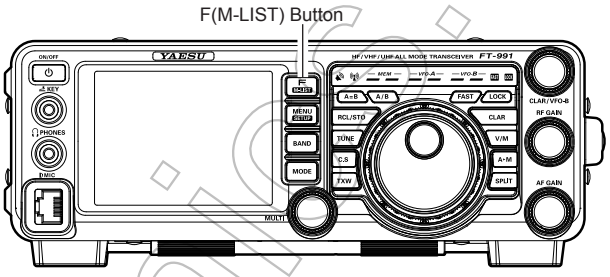
DIGITAL NOTCH FILTER (DNF) OPERATION

The Digital NOTCH Filter (DNF) is an effective beat-canceling filter that can null out a number of interfering beat notes inside the receiver passband. Because this is an Auto-Notch feature, there is no adjustment knob associated with this filter.

ADVICE:
If a very strong interfering carrier is encountered, we recommend you first use the IF NOTCH filter, as it is the most effective notching tool in the receiver section.

1. Press the **F(M-LIST)** button, then touch [**DNF**] on the LCD. The "**DNF**" will appear in the display.

To disable the Digital NOTCH Filter, just repeat the above procedure, touching [**DNF**] on the LCD to choose "OFF". The "**DNF**" will turn off, confirming that the Digital NOTCH Filter is not active.

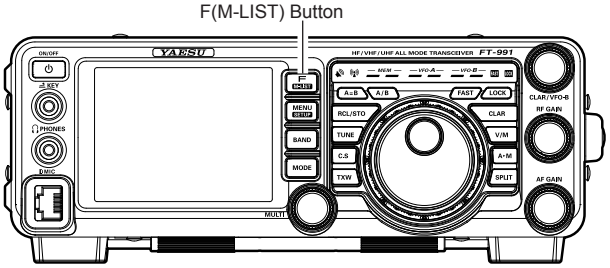


DIGITAL NOISE REDUCTION (DNR) OPERATION

The Digital Noise Reduction (DNR) system is designed to reduce the level of random noise found on the HF and 50 MHz bands, and it is especially effective during SSB operation. By setting the Menu item "110 DNR LEVEL", any of 15 different noise-reduction algorithms can be selected; each of these algorithms was created for dealing with a different noise profile. You will want to experiment with the DNR system to find the best setting corresponding to the noise currently being experienced.

1. Press the **F(M-LIST)** button, then touch [**DNR**] on the LCD. The "**DNR**" will appear in the display.

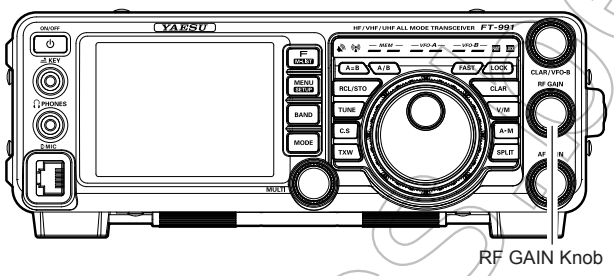
To disable the DNR system, just repeat the above procedure, touching [**DNR**] on the LCD to choose "OFF". The "**DNR**" will turn off, confirming that the DNR system is not active.



RF GAIN

The RF Gain control provides manual adjustment of the gain levels for the receiver RF and IF stages, to account for noise and signal strength conditions at the moment.

1. The **RF GAIN** knob should, initially, be rotated to the fully clockwise position. This is the point of maximum sensitivity.
2. Counter-clockwise rotation of the **RF GAIN** knob will gradually reduce the system gain.



ADVICE:

- As the **RF GAIN** knob is rotated counterclockwise to reduce the gain, the S-meter reading will rise. This indicates that the AGC voltage being applied to the receiver is increasing (this causes a *reduction* in receiver gain).
- Rotating the **RF GAIN** knob control to the fully counter-clockwise position will essentially disable the receiver, as the gain will be greatly reduced. In this case, the S-meter will appear to be "pegged" against the right edge of the analog S-meter scale.

QUICK POINT:

- Reception frequently can be optimized by rotating the **RF GAIN** knob slightly counter-clockwise to the point where the "stationary" meter indication is set just about the same as the incoming noise level. This will reduce the RF gain to find a level of improved signal to noise ratio.
- The RF Gain control, along with the IPO and the Attenuator features, all affect the system receiver gain in different ways. The IPO generally should be the first feature engaged when dealing with a high noise level, or a crowded, high-level signal environment. Also, the IPO generally should be the first feature engaged, if the frequency is low enough to allow the preamplifier to be bypassed. Thereafter, the RF Gain and Attenuator features may be employed to provide precise, delicate adjustment of the receiver gain to fully optimize performance.

AUDIO PEAK FILTER

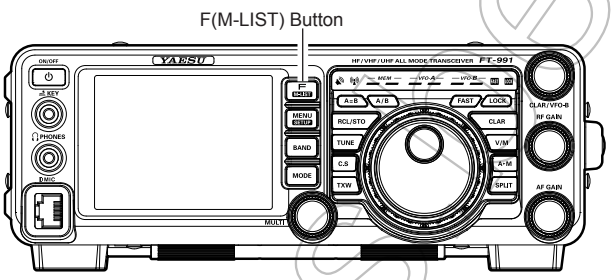
1. Press the **F(M-LIST)** button, then touch [**APF**] on the LCD. The "**APF**" indicator will appear in the DSP display.

   ADVICE:

   When APF is engaged, the peak position of the APF is depicted graphically in the NOTCH indicator on the display.
2. Touch [**AFP**] on the LCD again to disable the APF.

ADVICE:

The APF may only be activated while the transceiver is in CW mode.



AGC (AUTOMATIC GAIN CONTROL)

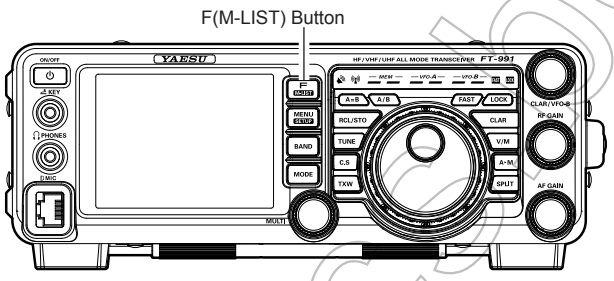
The AGC system is designed to help compensate for fading and other propagation effects. The AGC characteristics can be individually set for each operating mode. The basic objective of AGC is to maintain a constant audio output level once a certain minimum threshold of signal strength is achieved.

Press the **F(M-LIST)** button, then touch [**AGC**] on the LCD repeatedly to select the desired receiver-recovery time constant. You will observe the AGC status notation in the AGC column of the Key Function Display on the TFT display, denoting the AGC receiver-recovery time currently in use. For most operations, we recommend the "AUTO" mode. Additionally, you may disable the AGC by touching [**AGC**] on the LCD.

NOTE:

- ❒ The "AUTO" selection mode selects the optimum receiver-recovery time for the reception mode.
  In this case, the selected receiver-recovery time in the AGC column of the Key Function Display glows green (Normally glows blue).
- ❒ Touching [**AGC**] on the LCD allows selection of the desired receiver-recovery time constant. Normally, the "AUTO" selection is satisfactory for most situations, but in the event of operation on a crowded band where you wish to receive a weak signal, you may wish to change the setting to FAST. The AUTO mode selections are:

OPERATING MODE	AUTO AGC SELECTION
LSB/USB/AM	SLOW
CW/FM	FAST
RTTY/DATA	MID



ADVICE:

- ❒ If the AGC receiver-recovery time is set to "Off" by touching [**AGC**] on the LCD, the S-meter will no longer deflect. Additionally, you will likely encounter distortion on stronger signals, as the IF amplifiers and the following stages are probably being overloaded.

QUICK POINT:

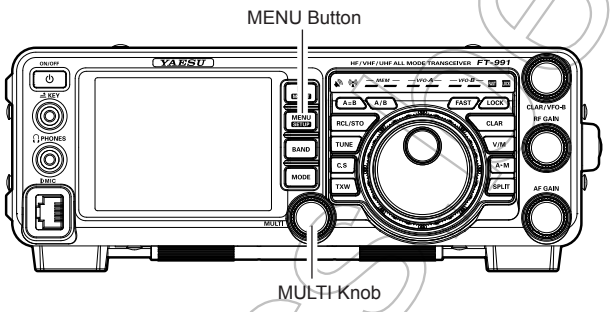
Several aspects of AGC performance may be configured via the Menu. However, because AGC can have such a profound impact on overall receiver performance, we generally do not recommend any changes to the AGC Menu selections until you are thoroughly familiar with the performance of the **FT-991**.

TERMINOLOGY:

Automatic Gain Control, or AGC, is a circuit that senses the received signal strength, and then limits the gain of the RF and IF stages to keep the output audio volume at a more-or-less constant level. AGC also protects the RF, IF, Audio, and DSP stages from overload, as it limits the signal strength that is allowed to flow, irrespective of the input signal level.

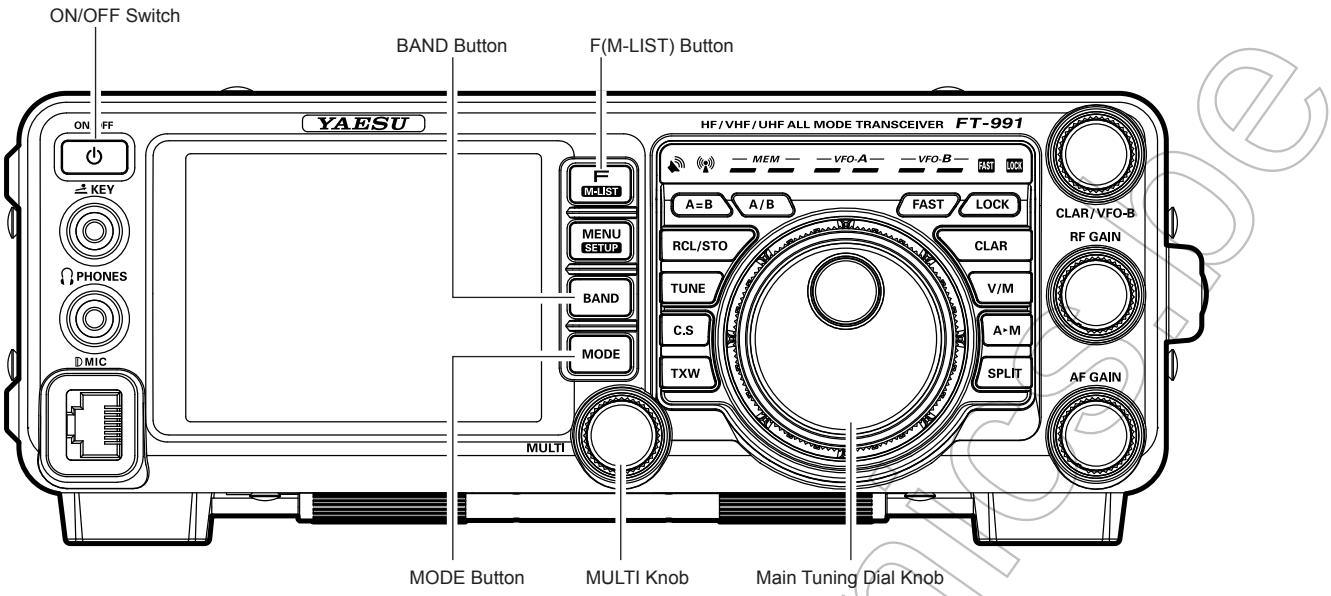
ADJUSTABLE RECEIVER AUDIO FILTER

The **FT-991** includes an adjustable receiver audio filter, that provides precise, independent control of the low; and upper audio ranges.



1. Press the **MENU** button to enter the Menu mode.
2. Rotate the **MULTI** knob to find Menu items "040" through "043" these parameters apply to the adjustment of the receiver audio filter in the AM mode, Menu items "050" through "053" apply to the adjustment of the RX audio filter in the CW mode, Menu items "067" through "070" apply to the adjustment of the RX audio filter in the DATA mode, Menu items "092" through "095" apply to the adjustment of the RX audio filter in the RTTY mode, and Menu items "102" through "105" apply to the adjustment of the RX audio filter in the SSB mode
3. Touch [**SELECT**] on the LCD.
4. Rotate the **MULTI** knob to adjust the receiver audio response as desired.
5. Touch [**ENTER**] on the LCD to save the new setting.
6. Press the **MENU** button or touch [**BACK**] on the LCD to exit to normal operation.

MODE	MENU ITEM	AVAILABLE VALUES
AM	040 AM LCUT FREQ	OFF/100(Hz) ~ 1000(Hz)
	041 AM LCUT SLOPE	6dB/oct / 18dB/oct
	042 AM HCUT FREQ	700(Hz) ~ 4000(Hz)/OFF
	043 AM HCUT SLOPE	6dB/oct / 18dB/oct
CW	050 CW LCUT FREQ	OFF/100(Hz) ~ 1000(Hz)
	051 CW LCUT SLOPE	6dB/oct / 18dB/oct
	052 CW HCUT FREQ	700(Hz) ~ 4000(Hz)/OFF
	053 CW HCUT SLOPE	6dB/oct / 18dB/oct
DATA	067 DATA LCUT FREQ	OFF/100(Hz) ~ 1000(Hz)
	068 DATA LCUT SLOPE	6dB/oct / 18dB/oct
	069 DATA HCUT FREQ	700(Hz) ~ 4000(Hz)/OFF
	070 DATA HCUT SLOPE	6dB/oct / 18dB/oct
RTTY	092 RTTY LCUT FREQ	OFF/100(Hz) ~ 1000(Hz)
	093 RTTY LCUT SLOPE	6dB/oct / 18dB/oct
	094 RTTY HCUT FREQ	700(Hz) ~ 4000(Hz)/OFF
	095 RTTY HCUT SLOPE	6dB/oct / 18dB/oct
SSB	102 SSB LCUT FREQ	OFF/100(Hz) ~ 1000(Hz)
	103 SSB LCUT SLOPE	6dB/oct / 18dB/oct
	104 SSB HCUT FREQ	700(Hz) ~ 4000(Hz)/OFF
	105 SSB HCUT SLOPE	6dB/oct / 18dB/oct



1. Press the **BAND** button to shown the band list, then touch a band key corresponding to the Amateur band on which you wish to operate.
2. Press the **MODE** button to show the mode list, then select the operating mode by touching the corresponding key.

   ADVICE:

   By convention, LSB is used in the 7 MHz and lower Amateur bands for SSB communication, and USB is used on the 14 MHz and higher bands (the 10 MHz band is used for CW and data modes only).
3. Rotate the Main Tuning Dial knob to adjust the operating frequency. Alternately, you may use the **UP**/**DWN** scanning buttons on the **MH-31A8J** Hand Microphone to sweep up or down the current band.
4. Press the microphone **PTT** (Push To Talk) switch to begin transmission; speak into the microphone in a normal voice level.

   ADVICE:

   - ❒ The "  " indicator will light up in the LED indicators area, confirming that transmission is in progress.
   - ❒ When transmitting in the AM mode, set a maximum (carrier) power output of 25 Watts via [**PROC**] displayed by pressing the **F(M-LIST)** button.
5. Adjust the microphone amplifier gain to match the microphone and your voice level: Touch [**METER**] on the LCD repeatedly to select the "ALC".
   Press and hold the **PTT** switch, and speak into the microphone in a normal voice level.
   In the SSB mode, touch [**MIC GAIN**] and then adjust **MULTI** knob so that the ALC meter stays within the ALC zone of the meter (up to half scale deflection) on voice peaks.
   In the AM mode, touch [**MIC GAIN**] and then adjust **MULTI** knob so that the ALC meter does not deflect at voice peaks.
6. Release the **PTT** switch at the end of your transmission. The transceiver will return to the receive mode.

ADVICE:

- ALC meter deflection may be caused by excessive drive power, but also by reflected power detected in the antenna system. If the impedance presented to the transceiver is other than 50 Ohms, ALC meter action may be observed that is not related to the proper setting of [**MIC GAIN**] on the LCD. Therefore, we recommend that you make [**MIC GAIN**] adjustments into a dummy load or antenna system presenting impedance very close to 50 Ohms.
- When performing "on air" tests (such as the setup of microphone gain), be sure to check the frequency before transmitting, to avoid interference to others who may already be using the frequency.
- Four techniques for exercising Transmit/Receive control are provided on the **FT-991**. You may choose the technique(s) that best suit your operating needs:
  - Pressing the microphone **PTT** switch will engage the transmitter.
  - The rear panel **PTT** jack may be connected to a foot switch or other manual switching device in order to engage the transmitter.
  - Touching [**MOX**] displayed by pressing the **F(M-LIST)** button will lock the transmitter on. Touch [**MOX**] on the LCD again to return to receive.
  - The VOX (Voice Operated Xmit) circuit will engage the transmitter automatically when you speak into the microphone. For details of VOX operation refer to page ##.

USING THE AUTOMATIC ANTENNA TUNER

The Automatic Antenna Tuner (hereinafter referred to as the "ATU") built into each **FT-991** is designed to ensure a 50-Ohm load for the final amplifier stage of the transmitter. We recommend that the ATU be used whenever you operate on the **FT-991**.

ADVICE:

- ❒ Because the ATU of the **FT-991** is located inside the station, it only adjusts the impedance presented to the transceiver at the station end of your coaxial cable feedline. It does not "tune" the SWR at the antenna feed point itself. When designing and building your antenna system, we recommend that every effort be made to ensure a low SWR at the antenna feed point.
- ❒ The ATU of the **FT-991** includes 100 memories for tuning data. Eleven of these memories are allocated, one per Amateur band, so that each band has at least one setting preset for use on that band. The remaining 89 memories are reserved for the 89 most-recent tuning points, for quick frequency change without the need to retune the ATU.
- ❒ The ATU in the **FT-991** is designed to match impedances within the range of 16.5 Ohms to 150 Ohms, corresponding to an SWR of 3:1 or less on the 160 through 6 meter amateur bands. Accordingly, simple non-resonant whip antennas, along with random-length wires and the "G5RV" antenna (on most bands) may not be within the impedance matching range of the ATU.

ATU OPERATION

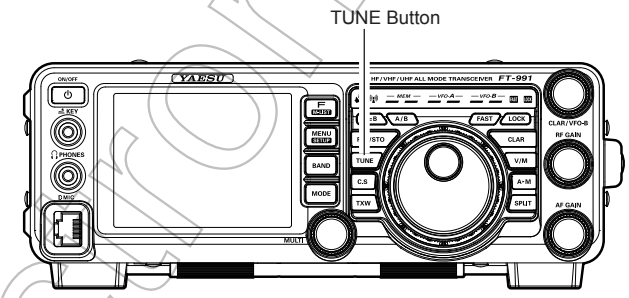
1. Use the Main Tuning Dial knob to set the radio to the desired operating frequency within the Amateur band.
2. Press the **TUNE** button momentarily to place the ATU in the transmit line (no adjustment/tuning will occur yet). The "**TUNER**" icon will appear in the display.

   QUICK POINT:

   The momentary press of the **TUNE** button will turn the tuner on, and the microprocessor will automatically select the tuning point closest to the current operating frequency.
3. Press and hold in the **TUNE** button for one second to begin automatic tuning. The transmitter will be engaged, and the "**TUNER**" icon will blink while tuning is in progress. When the optimum tuning point has been reached, the radio will return to receive, and the "**TUNER**" icon will again glow steadily (instead of blinking).
4. To disconnect the ATU from the transmit line, press the **TUNE** button momentarily. The "**TUNER**" icon will turn off, confirming that the ATU has been turned off. In the "Off" mode, the transceiver will be directly connected to the coaxial cable connected to your antenna, and will respond to whatever impedance is present at the station end of the coax.

ADVICE:

The ATU circuit is located between the final amplifier and the rear-panel antenna jack; reception is not affected by the ATU.



QUICK POINTS:

As shipped from the factory, only one ATU alignment point is saved on each Amateur band. This was memorized during the final alignment and performance verification stages on the production line.

NOTE:

Please check the operating frequency before beginning the tuning process, to be sure you are not interfering with others who may already be using the frequency.

TERMINOLOGY:

Antenna Tuner Memories: The microprocessor of the ATU makes a note of the selected tuning capacitors and inductors, and stores the data for each 10 kHz window in which tuning has occurred. This eliminates the need to re-tune every time you return to a frequency on which you have already completed the tuning process.

ABOUT ATU OPERATION

Figure 1 depicts a situation where normal tuning via the ATU has been successfully completed, and the tuning data has been stored in the ATU memory. The antenna system as seen by the transmitter is shown.

In Figure 2, the operator has changed frequency, and the "**HI-SWR**" icon has appeared. The operator presses and holds in the **TUNE** button for two seconds to begin impedance matching using the ATU.

If a high SWR condition exists (above 3:1), corrective action must be taken in the antenna system to bring the impedance closer to 50 Ohms. The ATU will refuse to memorize settings on frequencies where the SWR exceeds 3:1. A High SWR may indicate a mechanical failure in the feed system, and can lead to the generation of spurious signals causing TVI, etc.

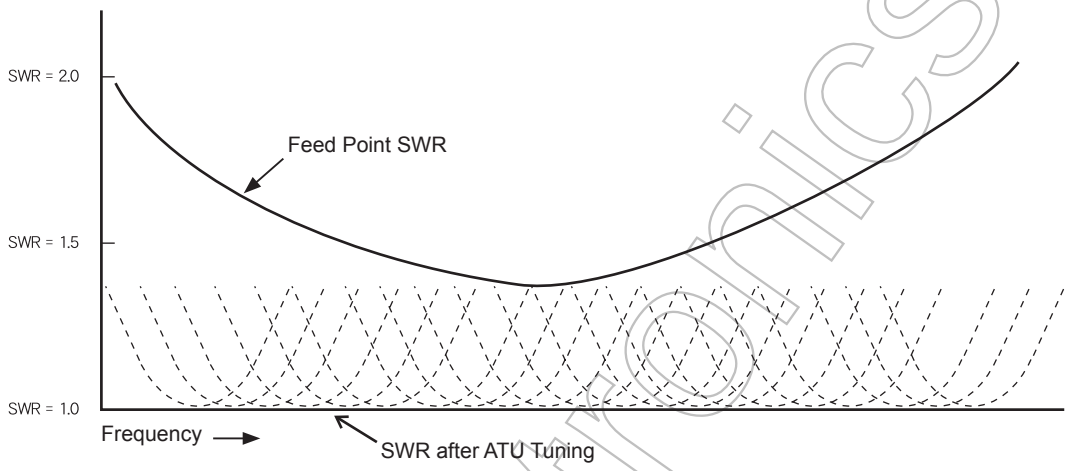


FIGURE 1

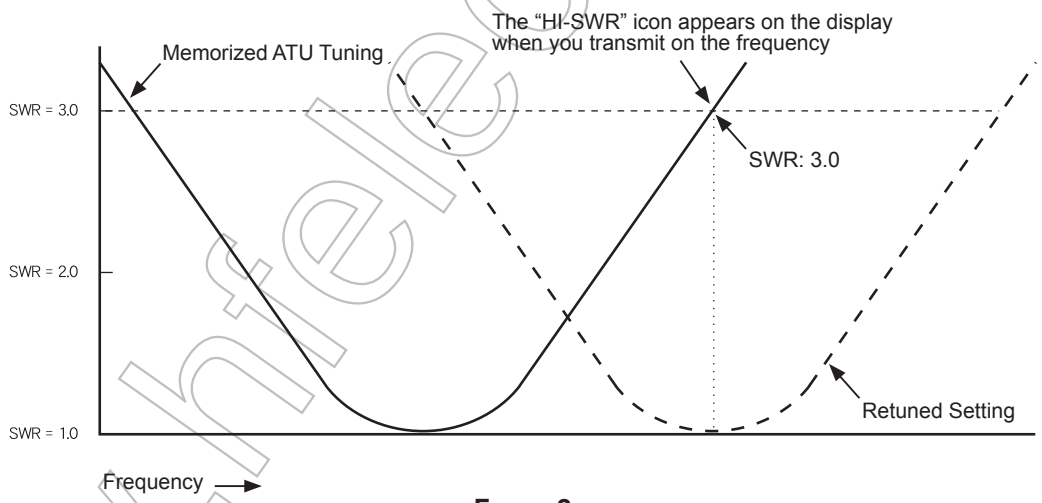


FIGURE 2

About ATU Memories

SWR (After tuning) Less than 1.5:1
The tuner settings are stored in the ATU memory.

SWR (After tuning) Greater than 1.5:1
Tuning data will not be retained in memory. If you return to the same frequency, the tuning process must be repeated.

SWR (After tuning) Greater than 3:1
The "**HI-SWR**" icon will light up, and the tuner settings, if achieved, will not be memorized. Please investigate the high SWR condition and resolve the problem before attempting further operation using this antenna.

PARAMETRIC MICROPHONE EQUALIZER (SSB/AM/FM MODE)

The **FT-991** includes a unique Three-Band Parametric Microphone Equalizer that provides precise, independent control over the low, mid and treble ranges in your voice waveform. You may utilize one group of settings when the speech processor is off and an alternate group of settings when the speech processor is on. The speech processor feature is described in the next chapter.

QUICK POINT:

The Parametric Equalizer is a unique technique for adjusting the signal quality. The three audio ranges may be adjusted so precisely, it is possible to craft an audio response that provides a natural and pleasant sound that you may not have ever experienced before. Alternately, the effective "talk power" can be significantly enhanced.

The aspects of configuration that you may adjust on the Parametric Equalizer are:

Center Frequency: The center frequency of each of the three bands may be adjusted.
Gain: The amount of enhancement (or suppression) within each band may be adjusted.
Q: The bandwidth over which the equalization is applied may be adjusted.

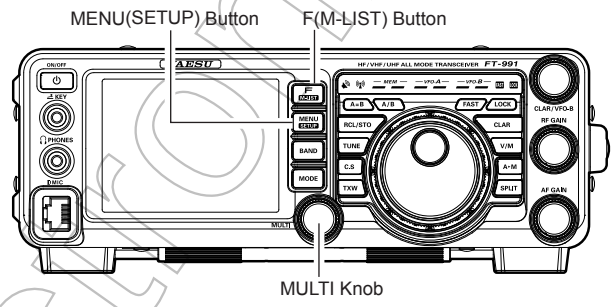
Setup of the Parametric Microphone Equalizer

1. Connect the microphone to the **MIC** jack.
2. Set the RF output power to minimum value.

   ADVICE:

   - ❒ We recommend that you connect a dummy load to one of the Antenna jacks, and monitor your signal on a separate receiver, to prevent interference to other users.
   - ❒ You will have the best chance of hearing the effects of adjustments if you wear headphones (connected to the monitor receiver) while listening to your transmitted signal.
3. To adjust the Parametric Microphone Equalizer while the speech processor is disabled, press the **F(M-LIST)** button, then touch [**MIC-EQ**] to select "ON".

   To adjust the Parametric Microphone Equalizer with the speech processor engaged, press the **F(M-LIST)** button, then touch [**PROC**] to select "ON".
4. Touch [**MONI**], if you want to listen on the **FT-991** internal monitor.
5. Press the **MENU(SETUP)** button. The Menu list will appear in the display.
6. Rotate the **MULT** knob to find the "EQ" Menu area, containing Menu items "119" through "127"; these parameters apply to the adjustment of the Parametric Microphone Equalizer when the speech processor is disabled. Menu items "128" through "136" apply to the adjustment of the Parametric Microphone Equalizer when the speech processor is engaged.



7. Touch [**SELECT**] on the LCD, then rotate the **MULT** knob to perform adjustments to a particular Menu item.
8. Press and hold the **PTT** switch, and speak into the microphone while listening to the effect of the changes you are making. Because the overall effect on the sound will change with each adjustment, you should make several passes through each adjustment area, to be sure that you are achieving the optimum settings.
9. When you have completed all adjustments, touch [**ENTER**] on the LCD to save the new settings.
10. Press the **MENU(SETUP)** button or touch [**BACK**] on the LCD to exit to normal operation. If you only touch [**BACK**] momentarily to exit, none of the changes you performed will be stored.

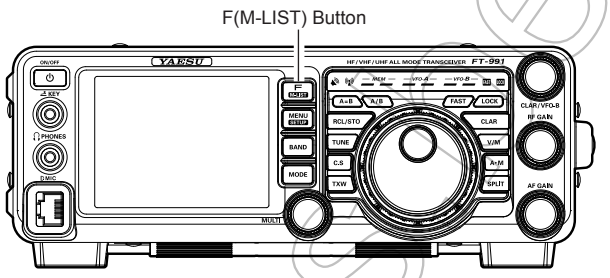
ADVICE:

To roll off excessive bass response in a wide-range studio microphone, try putting a 10 dB null at 100 Hz with a bandwidth of "1" or "2", do about a 3 dB null centered on 800 Hz with a bandwidth of "3," and then put an 8 dB peak centered on 2100 Hz with a bandwidth of "1." These are starting recommendations; each microphone and user's voice will be different, often requiring different settings.

PARAMETRIC MICROPHONE EQUALIZER (SSB/AM/FM MODE)

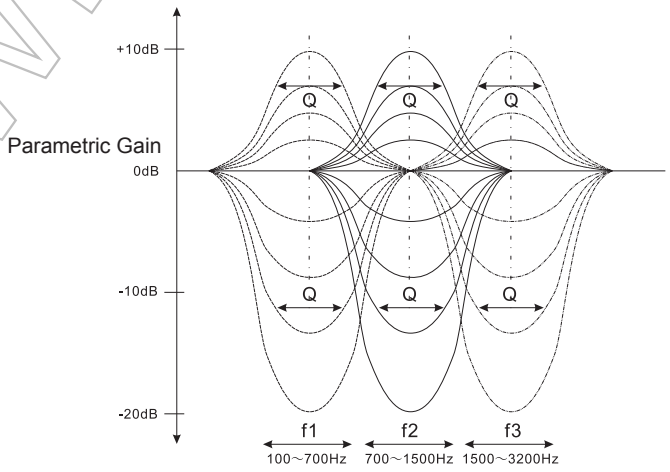
Activating the Parametric Microphone Equalizer

1. Adjust [**MIC GAIN**] on the LCD, as described on page ##.
2. Press the **F(M-LIST)** button, then touch [**MIC-EQ**] on the LCD to select "ON". If you use the Parametric Microphone Equalizer with the speech processor engaged, press the **F(M-LIST)** button, then touch [**PROC**] on the LCD to select "ON".
   The "**MIC EQ**" (and "**PROC**") will appear in the display, confirming that the Parametric Microphone Equalizer is engaged.
3. Press the **PTT** switch on the microphone, and speak into the microphone in a normal voice level.
4. To switch the Parametric Microphone Equalizer off, touch [**MIC-EQ**] on the LCD again until the "**MIC EQ**" icon disappears.



3-STAGE PARAMETRIC EQUALIZER ADJUSTMENTS (SPEECH PROCESSOR: "OFF")		
Center Frequency	"119 PRMTRC EQ1 FREQ"	"100" (Hz) ~ "700" (Hz) / "OFF"
	"122 PRMTRC EQ2 FREQ"	"700" (Hz) ~ "1500" (Hz) / "OFF"
	"125 PRMTRC EQ3 FREQ"	"1500" (Hz) ~ "3200" (Hz) / "OFF"
Parametric Gain	"120 PRMTRC EQ1 LEVEL"	(Low) "–20" (dB) ~ "+10" (dB)
	"123 PRMTRC EQ2 LEVEL"	(Mid) "–20" (dB) ~ "+10" (dB)
	"126 PRMTRC EQ3 LEVEL"	(High) "–20" (dB) ~ "+10" (dB)
Q (Bandwidth)	"121 PRMTRC EQ1 BWTH"	(Low) "1" ~ "10"
	"124 PRMTRC EQ2 BWTH"	(Mid) "1" ~ "10"
	"127 PRMTRC EQ3 BWTH"	(High) "1" ~ "10"

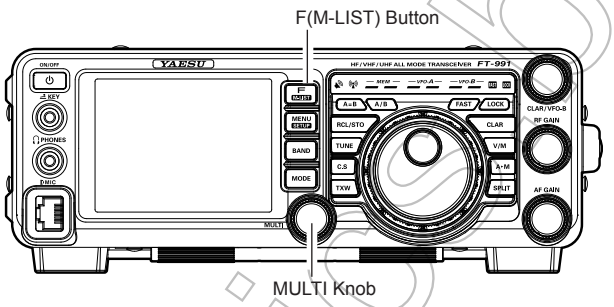
3-STAGE PARAMETRIC EQUALIZER ADJUSTMENTS (SPEECH PROCESSOR: "ON")		
Center Frequency	"128 P-PRMTRC EQ1 FREQ"	"100" (Hz) ~ "700" (Hz) / "OFF"
	"131 P-PRMTRC EQ2 FREQ"	"700" (Hz) ~ "1500" (Hz) / "OFF"
	"134 P-PRMTRC EQ3 FREQ"	"1500" (Hz) ~ "3200" (Hz) / "OFF"
Parametric Gain	"129 P-PRMTRC EQ1 LEVEL"	(Low) "–20" (dB) ~ "+10" (dB)
	"132 P-PRMTRC EQ2 LEVEL"	(Mid) "–20" (dB) ~ "+10" (dB)
	"135 P-PRMTRC EQ3 LEVEL"	(High) "–20" (dB) ~ "+10" (dB)
Q (Bandwidth)	"130 P-PRMTRC EQ1 BWTH"	(Low) "1" ~ "10"
	"133 P-PRMTRC EQ2 BWTH"	(Mid) "1" ~ "10"
	"136 P-PRMTRC EQ3 BWTH"	(High) "1" ~ "10"



USING THE SPEECH PROCESSOR (SSB MODE)

The **FT-991** Speech Processor is designed to increase "talk power" by increasing the average power output (via a sophisticated compression technique) and adjusting the audio quality to the menu settings ("128 P-PRMTRC EQ1 FREQ", "131 P-PRMTRC EQ2 FREQ", "134 P-PRMTRC EQ3 FREQ"). The result is improved intelligibility when conditions are difficult.

1. Adjust [**MIC GAIN**] on the LCD, as described on page ##.
2. Touch [**METER**] on the LCD to select "COMP" (Compression) meter.
3. Press the **F(M-LIST)** button, then touch [**PROC**] on the LCD to select "ON".
   The "**PROC**" will appear in the display, confirming that the Speech Processor is engaged.
4. Press the **PTT** switch on the microphone, and speak into the microphone in a normal voice level.
5. Adjust the **MULT** knob to set the compression level within the 5 dB to 10 dB range.
6. To switch the Speech Processor off, touch [**PROC**] on the LCD once more. The "**PROC**" will turn off, confirming that the Speech processor is turned off.



ADVICE:

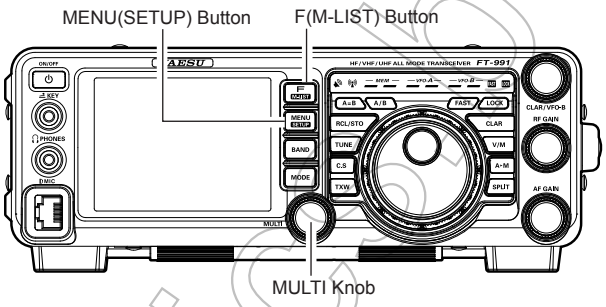
- You may adjust the Parametric Microphone Equalizer when the speech processor is engaged, using Menu Items "128" through "136". See page ## for details.

ADJUSTING THE SSB TRANSMITTED BANDWIDTH (SSB MODE)

For transmission on SSB, a default bandwidth of 2.4 kHz is provided. This bandwidth provides reasonable fidelity along with good talk power, and is typical of the bandwidth used for decades for SSB transmission. The bandwidth may be varied by the operator, to provide different levels of fidelity or talk power, according to your preferences.

Here are the steps to adjust the SSB transmit bandwidth:

1. Press the **MENU(SETUP)** button to engage the Menu.
2. Rotate the **MULTI** knob to select Menu item "110 SSB TX BPF".
3. Touch [**SELECT**] on the LCD, then rotate the **MULTI** knob to select the desired bandwidth. The available selections are: 100-3000 Hz, 100-2900 Hz, 200-2800 Hz, 300-2700 Hz, and 400-2600 Hz. The default is 300-2700 Hz. A wider bandwidth will provide greater fidelity. A narrow bandwidth will compress the available transmitter power into less spectrum, resulting in more "talk power" for DX pile-ups.
4. Touch [**ENTER**] on the LCD to save the new setting.
5. Press the **MENU(SETUP)** button or touch [**BACK**] on the LCD to exit to normal operation.



ADVICE:

The Transmit Monitor function is a very helpful way to confirm the effect that changing the bandwidth will have on fidelity. With [**MONI**] displayed by pressing the **F(M-LIST)** button, you will be able to hear the difference in sound quality as you make changes.

QUICK POINTS:

The higher fidelity associated with wide bandwidth will be particularly enjoyable on the low bands during local rag-chew QSOs.

VOICE MEMORY (SSB/AM/FM MODES: REQUIRES OPTIONAL DVS-6 AND FH-2)

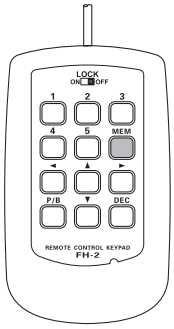
You may utilize the Voice Memory capability of the **FT-991** for repetitive messages. The Voice Memory system includes five memories capable of storing up to 20 seconds of voice audio each. The maximum that any memory can hold is 20 seconds.

Voice Memory Operation from the FH-2 Remote Control Keypad

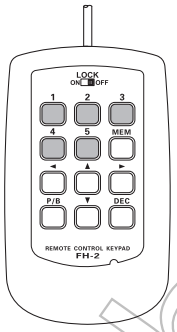
You may also utilize the Voice Memory capability of the **FT-991** from the optional **FH-2** Remote Control Keypad, which plugs into the rear panel's **REM/ALC** jack.

Recording Your Own Voice in Memory

1. Select the LSB, USB, AM, or FM mode using the front panel **MODE** button.
2. Adjust [**MIC GAIN**] on the LCD, as described on page ##.
3. Press the [**MEM**] key on the **FH-2**. A blinking "**REC**" icon will appear in the display.



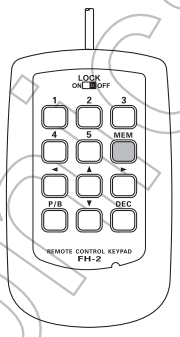
4. Press any of the **FH-2**'s keys numbered [**1**] through [**5**] to select that memory storage register.



ADVICE:

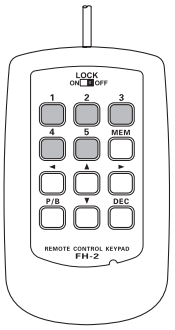
If you do not press the **PTT** key (see next step) within five seconds, the memory storage process will be cancelled.

5. Press the microphone's **PTT** switch momentarily. The "**REC**" icon will glow steadily and recording will begin.
6. Speak into the microphone in a normal voice level to record the message (such as "CQ DX, CQ DX, this is W 6 Delta X-Ray Charlie, W 6 Delta X-Ray Charlie, Over"). Remember that the time limit for recording any message is 20 seconds.
7. Press the **FH-2** [**MEM**] key to terminate the message storage process.



Checking Your Recording

1. Be sure that [**MOX**] and [**BK-IN**] on the LCD displayed by pressing the **F(M-LIST)** button are "Off".
2. Press the **FH-2** [**1**] ~ [**5**] key (whichever one you just recorded in). The "**PLAY**" icon will appear in the display and you will hear the contents of the Voice Memory you just recorded.



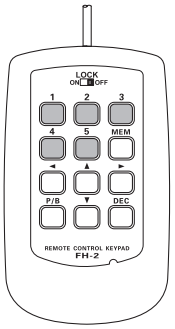
ADVICE:

You may adjust the playback level of the recording via Menu item "009 RX OUT LEVEL".

VOICE MEMORY (SSB/AM/FM MODES: REQUIRES OPTIONAL DVS-6 AND FH-2)

Transmitting the Recorded Message

1. Select the LSB, USB, AM, or FM mode using the front panel **MODE** button.
2. Press the front panel **F(M-LIST)** button, then touch [**BK-IN**] on the LCD.
3. Press the **FH-2** [**1**] ~ [**5**] key (whichever one you just recorded in). A "**PLAY**" icon will appear in the display and the message will be transmitted.



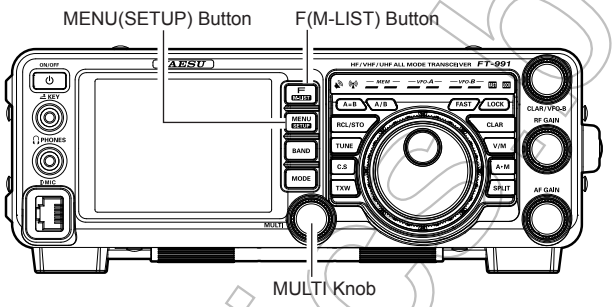
ADVICE:

You may adjust the transmit (audio) level of the recording via Menu item "010 TX OUT LEVEL".

VOX (SSB/AM/FM MODES: AUTOMATIC TX/RX SWITCHING USING VOICE CONTROL)

Instead of using the microphone **PTT** switch or [**MOX**] displayed by pressing the **F(M-LIST)** button to activate the transmitter, the VOX (Voice Operated TX/RX Control) system provides hands-free, automatic activation of the transmitter, based on voice input into the microphone.

1. Press the **F(M-LIST)** button, then touch [**VOX**] on the LCD to select "ON". The "**VOX**" will appear in the display.
2. Without pressing the **PTT** switch, speak into the microphone in a normal voice level. When you start speaking, the transmitter should be activated automatically. When you finish speaking, the transceiver should return to the receive mode (after a short delay).
3. To cancel VOX and return to **PTT** operation, touch [**VOX**] on the LCD once more. The "**VOX**" will turn off, signifying that the VOX circuitry has been turned off.



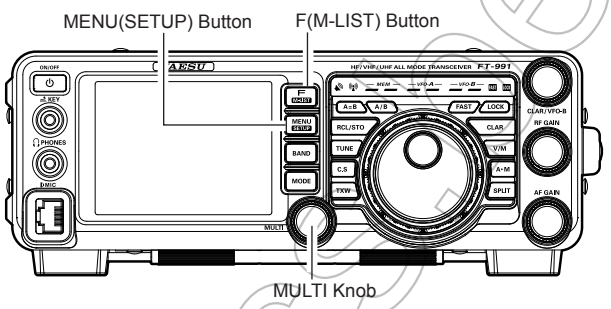
ADVICE:

- The VOX Gain may be adjusted to prevent accidental transmitter activation in a noisy environment. To adjust the VOX Gain:
  1) Activate the VOX circuitry, if necessary.
  2) Press the **MENU(SETUP)** button to engage the Menu mode.
  3) Rotate the **MULTI** knob to select Menu item "143 VOX GAIN", then touch [**SELECT**] on the LCD.
  4) While speaking into the microphone, rotate the **MULTI** knob to the point where the transmitter is quickly activated by your voice, without background noise causing the transmitter to activate.
  5) When you satisfied with the setting, touch [**ENTER**] on the LCD to save the new setting.
  6) Press the **MENU(SETUP)** button or touch [**BACK**] on the LCD to exit to normal operation.
- The "Hang-Time" of the VOX system (the transmit/receive delay after the cessation of speech) may also be adjusted via the Menu mode. The default delay is 500 msec. To set a different delay time:
  1) Activate the VOX circuitry, if necessary.
  2) Press the **MENU(SETUP)** button to engage the Menu mode.
  3) Rotate the **MULTI** knob to select Menu item "144 VOX DELAY", then touch [**SELECT**] on the LCD.
  4) Rotate the **MULTI** knob while saying a brief syllable like "Ah" and listening to the hang time for the desired delay.
  5) When you satisfied with the setting, touch [**ENTER**] on the LCD to save the new setting.
  6) Press the **MENU(SETUP)** button or touch [**BACK**] on the LCD to exit to normal operation.
- The Anti-Trip setting adjusts the level of negative receiver audio feedback to the microphone, to prevent receiver audio from activating the transmitter (via the microphone). This setting can also be adjusted via Menu item "145 ANTI VOX GAIN".
- VOX operation may be engaged on either Voice modes (SSB/AM/FM) or on AFSK-based Data modes. Use Menu item "142 VOX SELECT" (the selections are "MIC" and "DATA").

MONITOR (SSB/AM/FM MODES)

You may listen to the quality of your transmitted signal using the Monitor feature.

1. Press the **F(M-LIST)** button, then touch [**MONI**] on the LCD. The "**MONI**" will appear on the TFT display.
2. During transmission, rotate the **MULTI** knob to adjust the audio level in the Headphones or speaker. Clockwise rotation of this knob will increase the volume level.
3. To switch the Monitor off again, touch [**MONI**] on the LCD once more. Confirming that the Monitor is now disengaged.



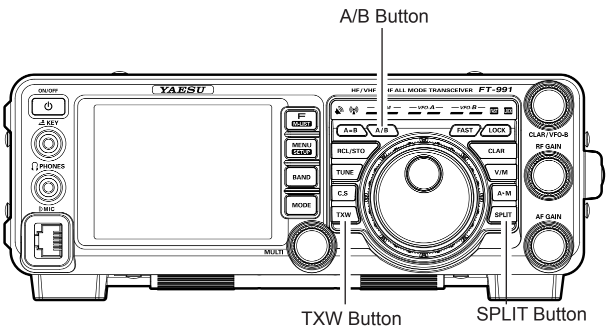
ADVICE:

- Because the Monitor feature samples the transmitter IF signal, it can be very useful for checking the adjustment of the Speech Processor or Parametric Equalizer on SSB, and for checking the general signal quality on AM and FM.

SPLIT-FREQUENCY OPERATION

A powerful capability of the **FT-991** is its flexibility in Split Frequency operation using the VFO-A and VFO-B frequency registers. This makes the **FT-991** especially useful for high-level DX-peditions. The Split operation capability is very advanced and easy to use.

1. Rotate the Main Tuning Dial knob to set the desired RX frequency.
2. Press the **A/B** button, then rotate the Main Tuning Dial knob to set the desired split TX frequency.
3. Press the **A/B** button, then press the **SPLIT** button. The VFO-B frequency will appear in the TFT display and the LED indicators will look like as below:
   VFO-A RX Indicator: "ON" (LED glows Green)
   VFO-A TX Indicator: "OFF" (LED Off)
   VFO-B RX Indicator: "OFF" (LED Off)
   VFO-B TX Indicator: "ON" (LED glows Red)



During Split operation, the VFO-A register will be used for reception, while the VFO-B register will be used for transmission. If you press the **SPLIT** button once more, Split operation will be cancelled.

ADVICE:

- ❒ During Split operation, pressing the **A/ B** button will reverse the contents of the VFO-A and VFO-B. Press the **A/B** button once more to return to the original frequency alignment.
- ❒ During Split operation you may listen to the TX frequency temporarily while pressing the **TXW** button located on the bottom left of the Main Tuning Dial knob.
  While pressing the **TXW** button during split operations, the frequency on the transmission side can be changed.
- ❒ It is possible to set different operating modes (for example, LSB and USB) on the two VFOs used during Split operation.
- ❒ During Split operation it is also possible to set VFO-A and VFO-B to different Amateur bands if you use a multi band antenna.

Quick Split Operation

The Quick Split feature allows you to set a one-touch offset of +5 kHz to be applied to your radio's VFO-B (transmit) frequency, compared to the VFO-A frequency.

1. Start with regular transceiver operation on the VFO-A.
   VFO-A RX Indicator: "ON" (LED glows Green)
   VFO-A TX Indicator: "ON" (LED glows Red)
   VFO-B RX Indicator: "OFF" (LED Off)
   VFO-B TX Indicator: "OFF" (LED Off)
2. Press and hold in the **SPLIT** button for one second to engage the Quick Split feature, and apply a frequency 5 kHz above the VFO-A frequency to the VFO-B frequency register.
   The VFO configuration will then be:
   VFO-A RX Indicator: "ON" (LED glows Green)
   VFO-A TX Indicator: "OFF" (LED Off)
   VFO-B RX Indicator: "OFF" (LED Off)
   VFO-B TX Indicator: "ON" (LED glows Red)
3. Press and hold in the **SPLIT** switch for one second to increment the Sub (VFO-B) frequency another +5 kHz.

QUICK POINTS:

- ❒ The operating mode applied to the VFO-B register will be the same as that in use on the VFO-A register.
- ❒ The offset of VFO-B from VFO-A is programmed via the Menu and is set to +5 kHz at the factory. However, other offsets may be selected using the following procedure:

1. Press the **MENU(SETUP)** button to engage the Menu mode.
2. Rotate the **MULTI** knob to select Menu item "034 QUICK SPLIT FREQ".
3. Touch [**SELECT**] on the LCD, then rotate the **MULT** knob to select the desired offset. The available selections are –20kHz ~ +20kHz (factory default: +5 kHz).
4. Touch [**ENTER**] button to save the new setting.
5. Press the **MENU(SETUP)** button or touch [**BACK**] on the LCD to exit to normal operation.

The powerful CW operating capabilities of the **FT-991** permit operation using an electronic keyer paddle, a "straight key", or a computer-based keying device.

SETUP FOR STRAIGHT KEY (AND STRAIGHT KEY EMULATION) OPERATION

Before starting, connect your key line(s) to the front panel **KEY** jack. Be sure [**BK-IN**] displayed by pressing the **F(M-LIST)** button is turned off for now.

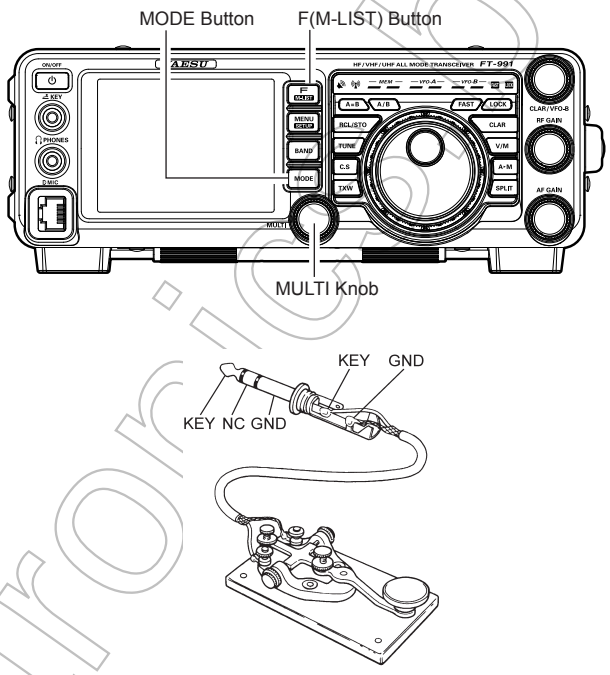
1. Press the **MODE** button, then touch [**CW-USB**] on the LCD. The "**USB CW**" icon will appear in the display. The "**MONI**" icon will appear in the TFT display; and the CW monitor is activated.

   ADVICE:

   If you press and hold the **MODE** button, you will engage the "CW Reverse" mode, whereby the "opposite" sideband injection is used, compared to the "normal" sideband. The "**LSB CW**" icon will appear in the display if you select CW Reverse.
2. Rotate the Main Tuning Dial knob to select the desired operating frequency.
3. Press the **F(M-LIST)** button, then touch [**BK-IN**] on the LCD to engage automatic activation of the transmitter when you close the CW key. The "**BK-IN**" icon will appear in the TFT display.

   ADVICE:

   - ❒ When you close your CW key, the transmitter will automatically be activated, and the CW carrier will be transmitted. When you release the key, transmission will cease, and after a brief delay, receive will be restored. The delay time is user-programmable per the discussion on page ##.
   - ❒ As shipped from the factory, the **FT-991** TX/RX system for CW is configured for "Semi-break-in" operation. However, using Menu item "057 CW BK-IN", you may change this setup for full break-in (QSK) operation, whereby the switching is quick enough to hear incoming signals in the spaces between the dots and dashes of your transmission. This may prove very useful during contest and traffic handling operations.
4. Operation using your CW key may now proceed.



- ❒ If you set [**BK-IN**] displayed by pressing the **F(M-LIST)** button to Off, you may practice sending CW with the sidetone only, without having the signal go out over the air.
- ❒ If you reduce power via [**PROC**] displayed by pressing the **F(M-LIST)** button, the ALC meter reading will increase; this is normal and does not indicate any problem whatsoever (because increased ALC voltage is being used to lower the power).

TERMINOLOGY:

Semi-break-in

This is a pseudo-"VOX" mode used on CW, whereby the closure of the CW key will engage the transmitter, and release of the key will allow the receiver to recover after a short delay. No signals will be heard during the spaces between dots and dashes (unless the sending speed is extremely slow).

Full break-in

Full break-in (also known as "Full QSK") involves very fast switching between transmit and receive, incoming signals may be heard between the dots and dashes as you send them. This allows you to hear a station that suddenly starts transmitting on your frequency, while you are in the midst of a transmission.

USING THE BUILT-IN ELECTRONIC KEYER

Connect the cable from your keyer paddle to the front panel **KEY** jack.

1. Press the **MODE** button, then touch [**CW-USB**] on the LCD. The "**USB CW**" icon will appear in the display. The "**MONI**" icon will appear in the TFT display; and the CW monitor is activated.

   ADVICE:

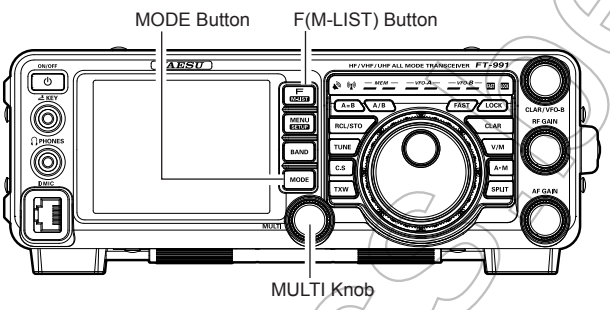
   If you press the "CW" mode, you will engage the "CW Reverse" mode, whereby the "opposite" sideband injection is used, compared to the "normal" sideband. The "**LSB CW**" icon will appear in the display if you select CW Reverse.
2. Rotate the Main Tuning Dial knob to select the desired operating frequency.
3. Press the **F(M-LIST)** button, then touch [**KEYER**] on the LCD to select "ON". The "**KEYER**" will appear in the display, confirming that the built-in Electronic Keyer is now active.
4. Touch [**SPEED**] on the LCD repeatedly to set the desired sending speed (4 ~ 60 WPM).

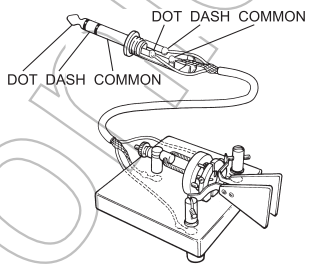
   ADVICE:

   - ❒ The display will show the keying speed for 3 seconds whenever [**SPEED**] on the LCD is touched.
   - ❒ When you press either the "Dot" or "Dash" side of your paddle, the CW keying tone will automatically be generated.
5. Touch [**BK-IN**] on the LCD to engage automatic activation of the transmitter when you press either the "Dot" or "Dash" side of your paddle. The "**BK-IN**" icon will appear in the TFT display.
6. CW operation utilizing your paddle may now commence.

   ADVICE:

   When you utilize your keyer paddle, the transmitter will automatically be activated, and the CW characters (or a string of dots and dashes) will be transmitted. When you release the keyer paddle contacts, transmission will cease, and reception will be restored after a brief delay. The delay time is user-programmable, per the discussion on page ##.





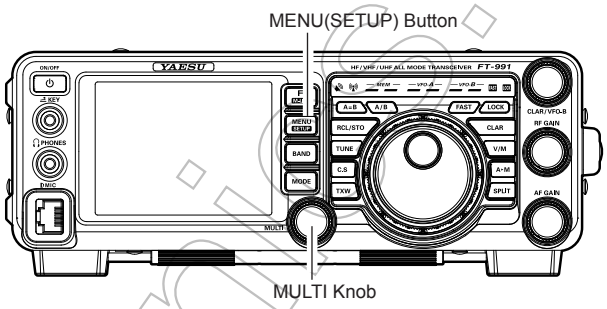
- ❒ If you set [**BK-IN**] displayed by pressing the **F(M-LIST)** button to Off, you may practice sending CW with the sidetone only, without having the signal go out over the air.
- ❒ If you reduce power via [**PROC**] displayed by pressing the **F(M-LIST)** button, the ALC meter reading will increase; this is normal and does not indicate any problem whatsoever (because increased ALC voltage is being used to lower the power).

USING THE BUILT-IN ELECTRONIC KEYER

Full Break-in (QSK) Operation

As shipped from the factory, the **FT-991** TX/RX system for CW is configured for "Semi-break-in" operation. However, this setup may be changed to full break-in (QSK) operation using Menu item "057 CW BK-IN". With full break-in QSK, the TX/RX switching is quick enough to hear incoming signals in the spaces between the dots and dashes of your transmission.

1. Press the **MENU(SETUP)** button to engage the Menu.
2. Rotate the **MULTI** knob to select Menu item "057 CW BK-IN".
3. Press the [**SELECT**] button, then rotate the **MULTI** knob to set this Menu item to "FULL".
4. When your adjustments are complete, touch [**ENTER**] on the LCD to save the new setting.
5. Press the **MENU(SETUP)** button or touch [**BACK**] on the LCD to exit to normal operation.

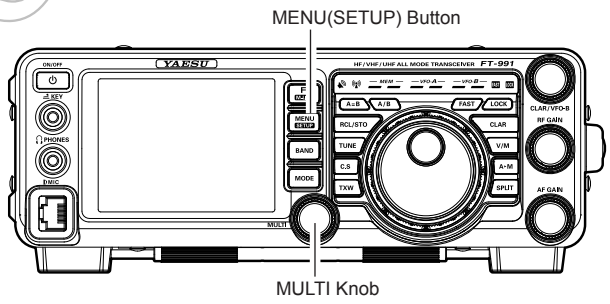


A number of interesting and useful features are available during Electronic Keyer operation.

Setting the Keyer Weight (Dot/Dash) Ratio

This Menu item may be used to adjust the dot/dash ratio for the built-in Electronic Keyer. The default weighting is 3:1 (a dash is three times longer than a dot).

1. Press the **MENU(SETUP)** button to engage the Menu.
2. Rotate the **MULTI** knob to select Menu item "013 CW WEIGHT".
3. Press the [**SELECT**] button, then rotate the **MULTI** knob to set the weight to the desired value. The available adjustment range is a Dot/Dash ratio of 2.5 ~ 4.5 (default value: 3.0).
4. When your adjustments are complete, touch [**ENTER**] on the LCD to save the new setting.
5. Press the **MENU(SETUP)** button or touch [**BACK**] on the LCD to exit to normal operation.

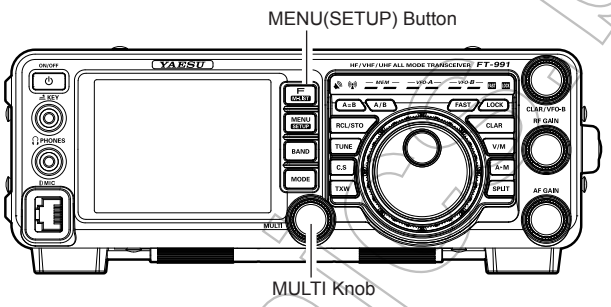


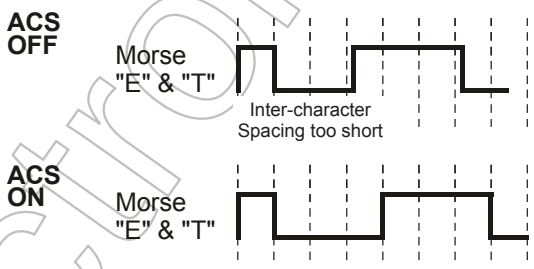
USING THE BUILT-IN ELECTRONIC KEYER

Selecting the Keyer Operating Mode

The configuration of the Electronic Keyer may be customized independently for the front panel **KEY** jack of the **FT-991**. This permits utilization of Automatic Character Spacing (ACS), if desired. This permits the use of an electronic keyer via the front jack and a straight key or computer-driven keying line via the rear panel jack.

1. Press the **MENU(SETUP)** button to engage the Menu.
2. Rotate the **MULTI** knob to select Menu item "011 KEYER TYPE".
3. Press the [**SELECT**] button, then rotate the **MULTI** knob to set the keyer to the desired mode. The available selections are:
   - OFF: The built-in Electronic Keyer is turned off ("straight key" mode).
   - BUG: Dots will be generated automatically by the keyer, but dashes must be sent manually.
   - ELEKEY: Both dots and dashes will be generated automatically when using a paddle.
   - ACS: Same as "ELEKEY" except that the spacing between characters is precisely set by the keyer to be the same length as a dash (three dots in length)
4. When your adjustments are complete, touch [**ENTER**] on the LCD to save the new setting.
5. Press the **MENU(SETUP)** button or touch [**BACK**] on the LCD to exit to normal operation.





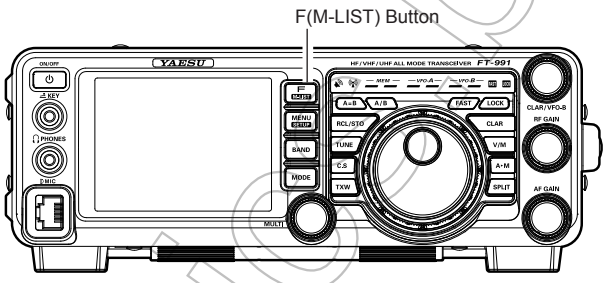
CW SPOTTING (ZERO-BEATING)

"Spotting" (zeroing in on another CW station) is a handy technique to ensure you and the other station are precisely on the same frequency.

The Tuning Offset Indicator in the display may also be moved so you can adjust your receiver frequency to center the incoming station on the pitch corresponding to that of your transmitted signal.

Using the Auto Zeroing System

(Only when the optional FFT unit is installed)
Press the **F(M-LIST)** button, then touch [**ZIN**] on the LCD to adjust the receiving frequency to the zero-in automatically while receiving the CW signal.



Using the SPOT System

Press the **F(M-LIST)** button, then touch [**SPOT**] on the LCD. Touch [**MONI**] on the LCD, the Spot tone will be heard through your speaker. This tone corresponds to the pitch of your transmitted signal. If you adjust the receiver frequency until the pitch of the received CW signal matches that of the Spot tone, your transmitted signal will be precisely matched to that of the other station.
Touch [**SPOT**] on the LCD again to turn the Spot tone off.

ADVICE:

- In a tough DX pile-up, you may actually want to use the SPOT system to find a "gap" in the spread of calling stations, instead of zeroing in precisely on the last station being worked by the DX station. From the DX side, if a dozen or more operators (also using Yaesu's SPOT system) all call precisely on the same frequency, their dots and dashes merge into a single, long tone that the DX station cannot decipher. In such situations, calling slightly higher or lower in frequency may get your call through.

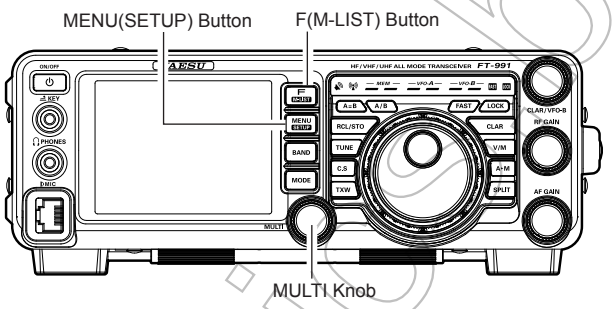
QUICK POINTS:

- The displayed frequency on CW normally reflects the "zero beat" frequency of your offset carrier. That is, if you were to listen on USB on 14.100.00 MHz to a signal with a 700 Hz offset, the "zero beat" frequency of that CW carrier would be 14.100.70 MHz; the latter frequency is what the **FT-991** displays, by default. However, you can change the display to be identical to what you would see on SSB by using Menu item "060 CW FREQ DISPLAY" and setting it to "DIRECT FREQ" instead of the default "PITCH OFFSET" setting.

CW DELAY TIME SETTING

During semi-break-in (not QSK) operation, the hang time of the transmitter, after you have finished sending, may be adjusted to a comfortable value consistent with your sending speed. This is the functional equivalent of the "VOX Delay" adjustment used on voice modes, and the delay may be varied anywhere between 30 msec and 3 seconds via Menu item "064 CW BK-IN DELAY".

1. Press the **F(M-LIST)** button, then touch [**BK-IN**] on the LCD to enable CW transmission (Menu item "057 CW BK-IN" must be set to "SEMI").
2. Press the **MENU(SETUP)** button to enter the Menu mode.
3. Rotate the **MULTI** knob to select Menu item "058 CW BK-IN DELAY", then touch [**SELECT**] on the LCD.
4. Start sending and rotate the **MULTI** knob to adjust the hang time, as you prefer for comfortable operation.
5. When your adjustments are complete, touch [**ENTER**] on the LCD to save the new setting.
6. Press the **MENU(SETUP)** button or touch [**BACK**] on the LCD to exit to normal operation.



CONTEST MEMORY KEYER (USING THE OPTIONAL FH-2 REMOTE CONTROL KEYPAD)

You may also utilize the CW message capability of the **FT-991** from the optional **FH-2** Remote Control Keypad, which plugs into the rear panel **REM/ALC** jack.

Message Memory

Five memory channels capable of retaining 50 characters each are provided (using the PARIS standard for characters and word length).

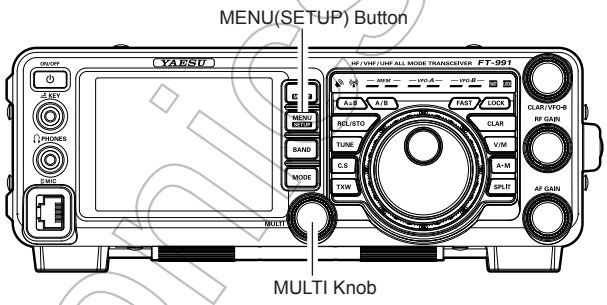
Example: CQ CQ CQ DE W6DXC K (19 characters)

−·−· −−·− −·−· −−·− −·−· −−·− −·· · ·−− −···· −·· −··− −·−· −·−

(C) (Q) (C) (Q) (C) (Q) (D) (E) (W) (6) (D) (X) (C) (K)

STORING A MESSAGE INTO MEMORY

1. Press the **MENU(SETUP)** button to enter the Menu mode.
2. Rotate the **MULTI** knob to select the CW Memory Register into which you wish to store the message; for now, we are just setting the message entry technique to (Keyer entry).
   017 CW MEMORY 1
   018 CW MEMORY 2
   019 CW MEMORY 3
   020 CW MEMORY 4
   021 CW MEMORY 5
3. Touch [**SELECT**] on the LCD, then rotate the **MULTI** knob to set the selected CW Memory Register to "MESSAGE". If you want to use your keyer paddle for message entry on all memories, set all five Menu items (#017 ~ 021) to "MESSAGE".
4. Touch [**ENTER**] on the LCD to save the new setting.
5. Press the **MENU(SETUP)** button or touch [**BACK**] on the LCD to exit to normal operation.



TERMINOLOGY:

PARIS Word Length: By convention among CW and Amateur operators (utilized by ARRL and others), the length of one "word" of CW is defined as the length of the Morse Code characters spelling the word "PARIS". This character (dot/dash/space) length is used for the specific definition of code speed in "words per minute".

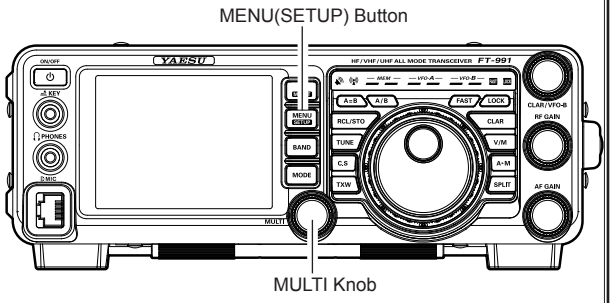
Contest Number Programming

Use this process if you are starting a contest, or if you somehow get out of sync with the proper number in the middle of a contest.

1. Press the **MENU(SETUP)** button to enter the Menu mode.
2. Rotate the **MULTI** knob to select Menu item "016 CONTEST NUMBER". The current contest number appears on the TFT display.
3. Touch [**SELECT**] on the LCD, then rotate the **MULTI** knob to set the Contest Number to the desired value.

   ADVICE:

   Touch [**BACK**] on the LCD to cancel the setting.
4. Touch [**ENTER**] on the LCD to save the new setting.

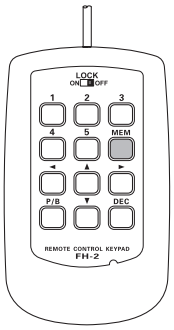


5. Press the **MENU(SETUP)** button or touch [**BACK**] on the LCD to exit to normal operation.

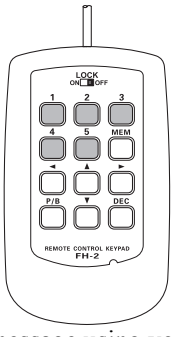
CONTEST MEMORY KEYER (USING THE OPTIONAL FH-2 REMOTE CONTROL KEYPAD)

MESSAGE MEMORY PROGRAMMING (USING YOUR PADDLE)

1. Set the operating mode to CW.
2. Set [**BK-IN**] on the LCD to "Off".
3. Turn the internal Electronic Keyer "On".
4. Press the [**MEM**] key on the **FH-2**. A blinking "**REC**" icon will appear in the display.



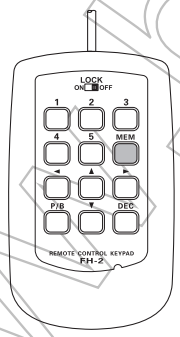
5. Press any of the **FH-2** keys numbered [**1**] through [**5**] to begin the memory storage process, and the "**REC**" icon will glow steadily.



6. Send the desired message using your keyer paddle.

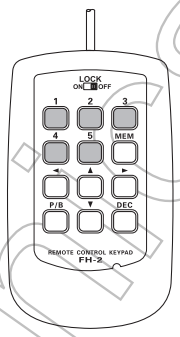
   ADVICE:

   If you do not start keying within ten seconds, the memory storage process will be cancelled.
7. Press the [**MEM**] key on the **FH-2** once more at the end of your message. Up to 50 characters may be stored in each of the five memories.



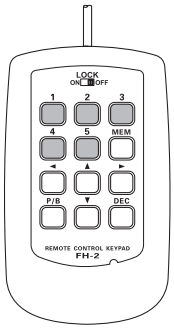
CHECKING THE CW MEMORY CONTENTS

1. Be sure that Break-in is still turned "Off" by [**BK-IN**] on the LCD.
2. Touch [**MONI**] on the LCD to enable the CW monitor.
3. Press the **FH-2** [**1**] ~ [**5**] key, whichever memory you just recorded in. You will hear the results in the sidetone monitor, but no RF energy will be transmitted.



ON-THE-AIR CW MESSAGE PLAYBACK

1. Touch [**BK-IN**] on the LCD to enable transmission. Either Full- or Semi-break-in will be engaged, depending on the setting of Menu item "057 CW BK-IN".
2. Press the **FH-2** [**1**] ~ [**5**] key, depending on which CW Memory Register message you wish to transmit. The programmed message will be transmitted on the air.



NOTE:

If you subsequently decide to use the "Text Memory" technique for memory storage, please note that a message stored using keyer paddle input will not be transferred over when you select "Text Memory technique" on a particular memory register (the Menu Mode Setting is set to "TEXT").

CONTEST MEMORY KEYER (USING THE OPTIONAL FH-2 REMOTE CONTROL KEYPAD)

TEXT Memory

The five channels of CW message memory (up to 50 characters each) may also be programmed using a text-entry technique. This technique is somewhat slower than when you send the message directly from your keyer paddle, but accuracy of character spacing is ensured. Be sure to enter the character "}" at the end of texts.

Example 1: CQ CQ CQ DE W6DXC K} (20 characters)

The sequential Contest Number ("Count up") feature is another powerful feature of the CW Memory Keyer.

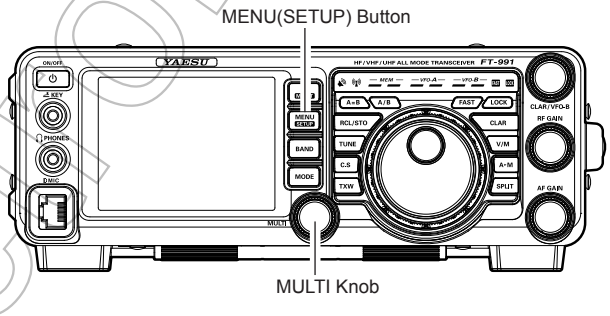
Example 2: 599 10 200 # K} (15 characters)

TEXT MEMORY STORAGE

1. Press and hold in the **MENU(SETUP)** button for one second to enter the Menu mode.
2. Rotate the **MULTI** knob to select the CW Memory Register into which you wish to store the message; we are now setting the message entry technique to (Text entry).
   017 CW MEMORY 1
   018 CW MEMORY 2
   019 CW MEMORY 3
   020 CW MEMORY 4
   021 CW MEMORY 5

   ADVICE:

   The following texts are programmed to the MEMORY 4 and MEMORY 5 in factory default.
   MEMORY 4: DE FT-991 K}
   MEMORY 5: R 5NN K}
3. Touch [**SELECT**] on the LCD, then rotate the **MULTI** knob to set the selected CW Memory Register to "TEXT". If you want to use text message entry on all memories, set all five Menu items (#017 ~ 021) to "TEXT".
4. Touch [**ENTER**] on the LCD to save the new setting.
5. Press the **MENU(SETUP)** button or touch [**BACK**] on the LCD to exit to normal operation.

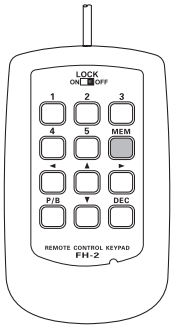


TEXT	CW CODE	TEXT	CW CODE	TEXT	CW CODE	TEXT	CW CODE	TEXT	CW CODE	TEXT	CW CODE
!	SN	&	AS	+	AR	:	OS	?	IMI	^	—
”	AF	´	WG	,	MIM	;	KR	@	@	_	IQ
#	—	(	KN	-	DU	<	—	[	—	}	—
$	SX	)	KK	.	AAA	=	BT	¥(＼)	AL		
%	KA	*	—	/	DN	>	—	}	—		

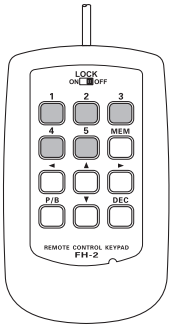
CONTEST MEMORY KEYER (USING THE OPTIONAL FH-2 REMOTE CONTROL KEYPAD)

TEXT MESSAGE PROGRAMMING

1. Press the **MODE** button to set the operating mode to CW.
2. Be sure that Break-in is "Off" with [**BK-IN**] on the LCD, if necessary.
3. Press the **FH-2** [**MEM**] key. A blinking "**REC**" icon will appear in the display.



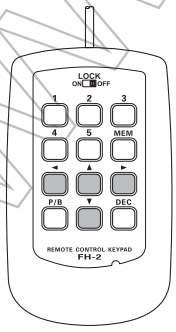
4. Press an **FH-2** [**1**] ~ [**5**] key to select the desired CW Memory Register into which you wish to program the text, the blinking "**REC**" icon will disappear.



5. Use the **FH-2** [◀] and [▶] keys to set the cursor position and use the **FH-2**'s [▲] and [▼] keys to choose the letter/number to be programmed in each slot of the memory. In the case of the second example on the previous page the "**#**" character designates the slot where the Contest Number will appear.

   ADVICE:

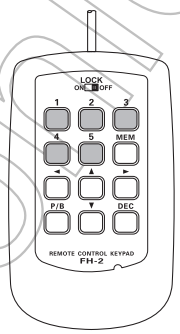
   You may also use the Main Tuning Dial knob and the **MULTI** knobs to program the message characters.



6. When the message is complete, add the "**}**" character at the end to signify the termination of the message.
7. Press and hold in the **FH-2** [**MEM**] key for one second to exit, once all characters (including "**}**") have been programmed.

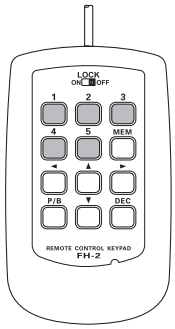
CHECKING THE CW MEMORY CONTENTS

1. Be sure that Break-in is still turned "Off" with [**BK-IN**] on the LCD.
2. Touch [**MONI**] on the LCD to enable the CW monitor.
3. Press an **FH-2** [**1**] ~ [**5**] key, whichever memory you just recorded in. You will hear the results in the sidetone, but no RF energy will be transmitted.



ON-THE-AIR CW MESSAGE PLAYBACK

1. Touch [**BK-IN**] on the LCD to enable transmission. Either Full-break-in or Semi-break-in will be engaged, depending on the setting of Menu item "063 CW BK-IN".
2. Press an **FH-2** [**1**] ~ [**5**] key, depending on which CW Memory Register message you wish to transmit. The programmed message will be transmitted on the air.



CONTEST MEMORY KEYER (USING THE OPTIONAL FH-2 REMOTE CONTROL KEYPAD)

NOTE:

If you subsequently decide to use the "Message Memory" technique for memory storage, please note that the contents of a message stored using text input will not be transferred over when you set entry to "Message Memory technique" on a particular memory register (the Menu Mode Setting is set to "MESSAGE").

Decrementing the Contest Number

Use this process if the current contest number gets slightly ahead of the actual number you want to send (in case of a duplicate QSO, for example).

Press the **FH-2** [**DEC**] key momentarily. The current Contest Number will be reduced by one. Press of the **FH-2** [**DEC**] key as many times as necessary to reach the desired number. If you go too far, use the "Contest Number Programming" technique described previously.

Transmitting in the Beacon Mode

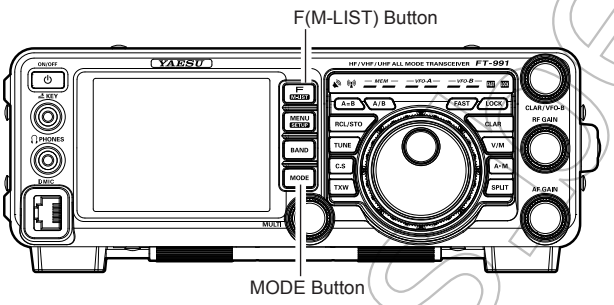
In "Beacon" mode, it is possible to repeatedly transmit any message programmed, either via paddle input, or via the "Text" input method. The time delay between message repeats may be set anywhere between 1 and 690 seconds (1 ~ 240 sec (1 sec/step) or 270 ~ 690 sec (30 sec/step)) via Menu item "014 BEACON TIME" If you do not wish the message to repeat in a "Beacon" mode, please set this Menu item to "OFF".

To transmit the message:

1. Touch [**BK-IN**] on the LCD to enable transmission. Either Full-break-in or Semi-break-in will be engaged, depending on the setting of Menu item "057 CW BK-IN".
2. Press an **FH-2** [**1**] ~ [**5**] key. Repetitive transmission of the Beacon message will begin.

BASIC OPERATION

1. Press the **MODE** button, then touch the corresponding key on the LCD to select the FM operating mode. The "**FM**" icon appears in the display.
2. Rotate the Main Tuning Dial knob to select the desired operating frequency. Pressing the microphone **UP** or **DWN** button will cause frequency change in 5 kHz steps.
3. Press the microphone **PTT** switch to transmit. Speak into the microphone in a normal voice level. Release the **PTT** switch to return to receive.
4. Adjustment of the microphone gain may be accomplished in two ways. At the factory, a default level has been programmed that should be satisfactory for most situations. However, using Menu item "077 FM MIC GAIN", you may set a different fixed value, or choose the "MCVR" option, which then lets you use [**MIC GAIN**] on the LCD to set the microphone gain in the FM mode.



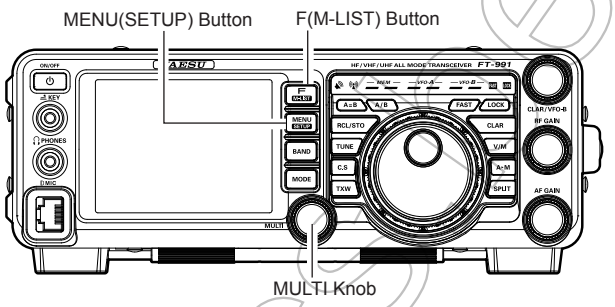
ADVICE:

- The Transmit Monitor is another helpful way to verify proper adjustment of the FM MIC Gain. With [**MONI**] displayed by pressing the **F(M-LIST)** button, you will be able to hear the differences in deviation as you make adjustments.
- FM is only used in the 28 MHz, 50 MHz, 144 MHz, and 430 MHz Amateur bands covered by the **FT-991**. Please do not use FM on any other bands.

REPEATER OPERATION

The **FT-991** may be utilized on 29 MHz, 50 MHz, 144 MHz, and 430 MHz repeaters.

1. Rotate the Main Tuning Dial knob to the output frequency (downlink) from the repeater.
2. If CTCSS Tone operation is desired/needed, press the **F(M-LIST)** button, then touch [**TONE**] on the LCD to engage the CTCSS mode.
3. Touch [**TONE**] on the LCD repeatedly to select the desired CTCSS mode. If you just need to send the uplink encoding tone, select "ENC." For encode/decode operation, choose "T.SQL" instead. The available choices are
   "OFF" → "ENC (Tone Encoder)"
   → "T.SQL (Tone Squelch)" → "OFF"
4. Rotate the **MULTI** knob to select the desired CTCSS Tone to be used. A total of 50 standard CTCSS tones are provided (see the CTCSS Tone Chart).
5. Press the **F(M-LIST)** button, then touch [**RPT**] on the LCD to select the desired repeater shift direction. The selections are:
   "SIMP" → "+" → "–" → "SIMP"
   where "SIMP" represents "Simplex" operation (not used on a repeater).
6. Press and hold the microphone **PTT** switch to begin transmission. You will observe that the frequency has shifted to correspond to the programming you set up in the previous steps, and a "t" notation will appear on the "10 Hz" frequency digit while transmitting. Speak into the microphone in a normal voice level. Release the **PTT** switch to return to the receive mode.



ADVICE:

- The conventional repeater shift used on 29 MHz is 100 kHz, while on the 50 MHz band the shift may vary between 500 kHz and 1.7 MHz (or more). To program the proper repeater shift, use Menu items "083 RPT SHIFT [28MHz]" (28 MHz), "084 RPT SHIFT [50MHz]" (50 MHz), "085 RPT SHIFT [144MHz]" (144 MHz), and "086 RPT SHIFT [430MHz]" (430 MHz) as appropriate.

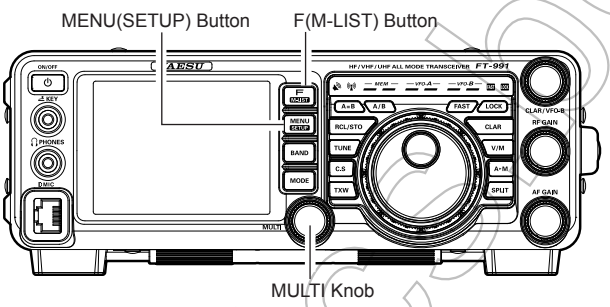
CTCSS TONE FREQUENCY (Hz)

67.0	69.3	71.9	74.4	77.0	79.7	82.5	85.4
88.5	91.5	94.8	97.4	100.0	103.5	107.2	110.9
114.8	118.8	123.0	127.3	131.8	136.5	141.3	146.2
151.4	156.7	159.8	162.2	165.5	167.9	171.3	173.8
177.3	179.9	183.5	186.2	189.9	192.8	196.6	199.5
203.5	206.5	210.7	218.1	225.7	229.1	233.6	241.8
250.3	251.4	–	–	–	–	–	–

TONE SQUELCH OPERATION

You may also use "Tone Squelch" whereby your receiver will be kept silent until an incoming signal modulated with a matching CTCSS tone is received. The receiver squelch will then open in response to the reception of the required tone.

1. Rotate the Main tuning Dial to the output frequency (downlink) from the repeater.
2. If CTCSS Tone operation is desired/needed, press the **F(M-LIST)** button, then touch [**TONE**] on the LCD to engage the CTCSS mode.
3. Touch [**TONE**] on the LCD repeatedly to choose "T.SQL" from the available choices of "OFF" → "ENC (Tone Encoder)" → "T.SQL (Tone Squelch)" → "OFF"
4. Rotate the **MULTI** knob to select the desired CTCSS Tone to be used. Fifty standard CTCSS tones are provided (see the CTCSS Tone Chart).
5. A "d" notation on the "1 Hz" frequency digit in the display will indicate that the Tone Decoder is engaged. A "t" notation on the "1 Hz" frequency digit while transmitting will indicate that the Tone Squelch is engaged.



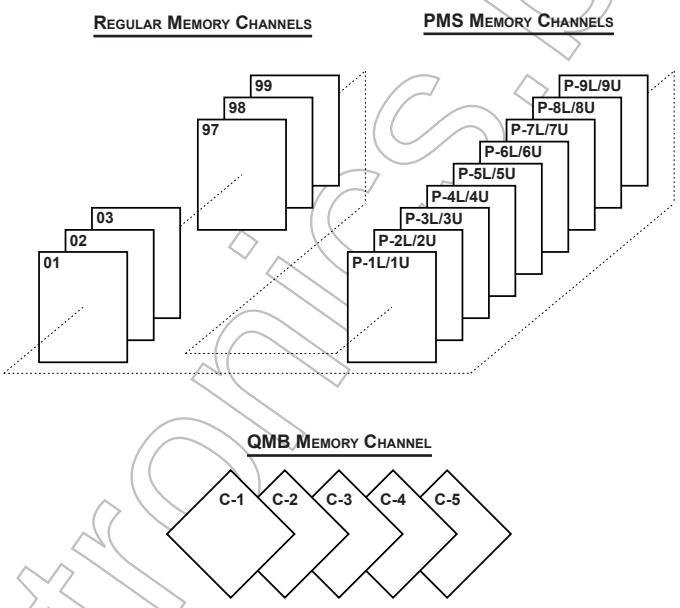
CONVENIENT MEMORY FUNCTIONS

The **FT-991** contains ninety-nine regular memories, labeled "01" through "99", nine special programmed limit memory pairs, labeled "P-1L/P-1U" through "P-9L/P-9U", and five QMB (Quick Memory Bank) memories, labeled "C-1" through "C-5". Each stores various settings, in addition to the VFO-A frequency and mode (See below). By default, the 99 regular memories are contained in one group; however, they can be arranged in up to six separate groups, if desired.

QUICK POINT:

The **FT-991** memory channels store the following data (not just the operating frequency):

- ❒ VFO-A Frequency
- ❒ VFO-A Mode
- ❒ Clarifier status and its Offset Frequency
- ❒ ANT status
- ❒ IPO status
- ❒ Roofing filter status and its Bandwidth
- ❒ Attenuator status
- ❒ Noise Blanker status
- ❒ IF SHIFT and WIDTH status
- ❒ CONTOUR status and its Peak Frequency
- ❒ DSP Noise Reduction (DNR) status and its Reduction algorithm selection.
- ❒ DSP Notch filter (NOTCH) status
- ❒ NAR bandwidth status
- ❒ DSP Auto Notch filter (DNF) status
- ❒ Repeater Shift Direction



QMB (QUICK MEMORY BANK)

The Quick Memory Bank consists of five memories (labeled "Q-1" through "Q-5") independent from the regular and PMS memories. These can quickly store operating parameters for later recall.

QMB Channel Storage

1. Tune to the desired frequency on the VFO-A.
2. Press the **RCL/STO** button. The "beep" will confirm that the VFO-A contents have been written to the currently available QMB memory.

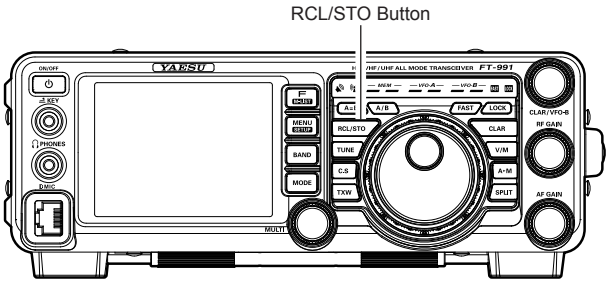
If you repeatedly press the **RCL/STO** button, the QMB memories will be written in the following order:

Q-2 → Q-3 → Q-4 → Q-5 → Q-1.

Once all five QMB memories have data on them, previous data (starting with channel Q-1) will be over-written on a first-in, first-out basis.

QMB Channel Recall

1. Press the **RCL/STO** button. The current QMB channel data will be shown on the frequency display area. The "**QMB**" icon will also appear and the Memory Mode indicators in the LED indicators area will illuminate.
2. Repeatedly pressing the **RCL/STO** button will toggle you through the QMB channels:
   Q-2 → Q-3 → Q-4 → Q-5 → Q-1.
3. Press the **V/M** button to return to the VFO or Memory mode.



ADVICE:

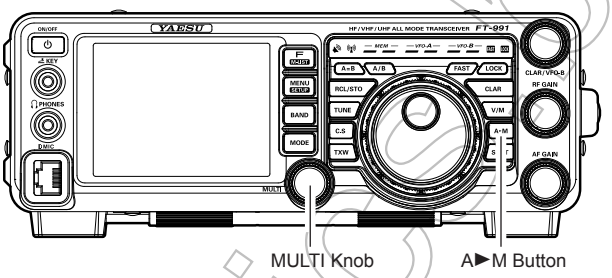
Rotating the Main Tuning Dial knob, or changing the operating mode, will place the transceiver in the "Memory Tune" mode, which is a temporary "pseudo-VFO" method of tuning off of a stored memory channel. If you do not over-write the contents of the current memory channel, the original contents will not be disturbed by the initiation of Memory Tune operation.

STANDARD MEMORY OPERATION

The Standard Memory of the **FT-991** allows storage and recall of up to 99 memories, each storing frequency, mode, and a wide variety of status information, detailed previously. Memories may be grouped into as many as six Memory Groups, and additionally you get nine pairs of band-limit (PMS) memories along with five QMB (Quick Memory Bank) memories.

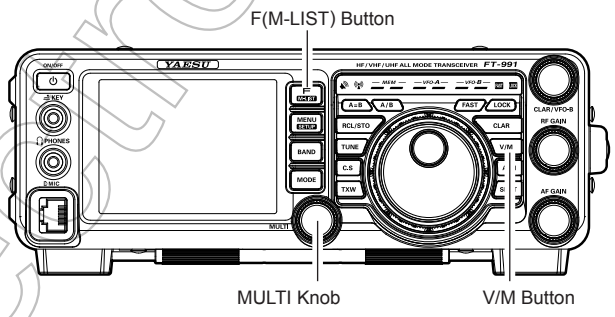
Memory Storage

1. Set VFO-A up with the frequency, mode, and status, the way you want to have it stored.
2. Press the **A►M** button momentarily; the current channel number will start blinking in the display and the "**MCK**" notation will appear.
3. Rotate the **MULTI** knob to select the memory channel that you wish to store the data on.
4. Press and hold in the **A►M** button for one second to store the frequency and other data into the selected memory channel. A double beep will confirm that you have held the **A►M** button in long enough.



Memory Channel Recall

1. Press the **V/M** button, if necessary, to enter the "Memory mode".
2. Press the **F(M-LIST)** button, then touch [**MCH**] on the LCD. A memory channel number and the "**MCH**" notation will appear in the display.
3. After touching [**MCH**] on the LCD, you may rotate the **MULTI** knob to select the desired memory channel.



ADVICE:

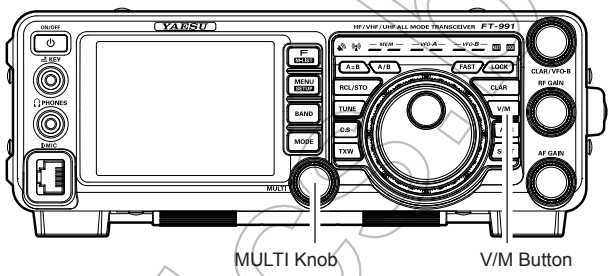
To work within a particular Memory Group, press the **F(M-LIST)** button, then touch [**GRP**] on the LCD. Rotate the **MULTI** knob to select the desired Memory Group, then touch [**ENTER**] on the LCD (the "**MCH**" notation will appear instead of the "**GRP**"); you may now choose the memory channel within the selected Memory Group.

STANDARD MEMORY OPERATION

Labeling Memories

You may wish to append an Alphanumeric "Tag" (label) to a memory or memories, to aid in recollection of the channel's use (such as a club name, etc.). To do this:

1. Press the **V/M** button, if necessary, to enter the "Memory Mode".
2. Press and hold in the **F(M-LIST)** button.
   The data stored in the currently selected memory channel will be displayed on the TFT.
3. Rotate the **MULTI** knob to recall the memory channel that you wish to append a label.
4. Touch [**TAG**] on the LCD.
   A blinking cursor will appear on the first digit.
5. Touch a key on the LCD to enter the letters, numbers, or symbols of the desired label.
6. Repeat step 5 to program the remaining letters, numbers, or symbols of the desired label. 18 characters may be used in the creation of a label.
   Use [⬅] and [➡] on the LCD to set the cursor position and [◀] on the LCD to erase a letter at the left of the cursor.
7. When you have completed the creation of the label, touch [**ENT**] on the LCD.
8. Press the **F(M-LIST)** button to save the new setting and return to normal operation.



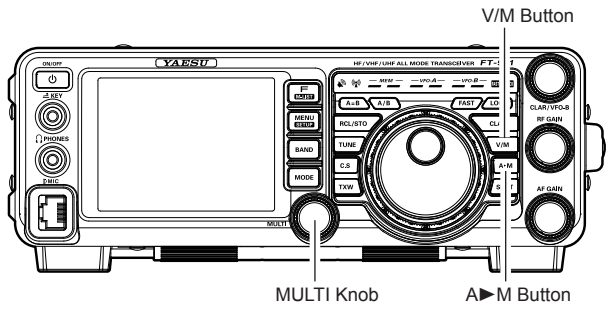
Checking a Memory Channel Status

Before programming a channel into memory, you can check the current contents of that channel without the danger of over-writing the channel accidentally.

1. Press the **A►M** button momentarily.
   The data stored in the currently selected memory channel will be displayed on the TFT. However, since you are only checking the contents of the memory channel, your radio will not have moved to the memory channel frequency.
2. Rotate the **MULTI** knob to select a different memory channel. To exit from the Memory Check mode, press the **A►M** button momentarily once more.

ADVICE:

- While the Memory Check function is engaged, the memory channel number will blink in the display.
- While operating in the VFO mode, using Memory Check, you may store the current VFO frequency into the selected memory by pressing and holding in the **A►M** button for one second (until the double beep). Conversely, if you wish to write the contents of the current memory into the VFO-A register, press the **V/M** button.



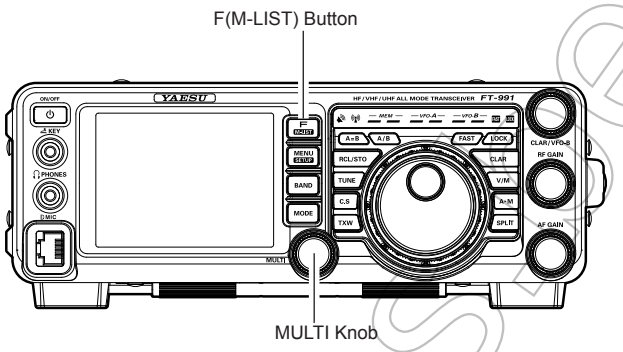
STANDARD MEMORY OPERATION

Erasing Memory Channel Data

1. Press and hold in the **F(M-LIST)** button.
2. Rotate the **MULTI** knob to select the memory channel that you would like to erase.
3. Touch [**ERASE**] on the LCD.

ADVICE:

- ❒ The **FT-991** can not erase the memory channels "01" (and "501" through "510": U.S. version).
- ❒ If you make a mistake and wish to restore the memory's contents, just repeat steps (1) through (3) above.



STANDARD MEMORY OPERATION

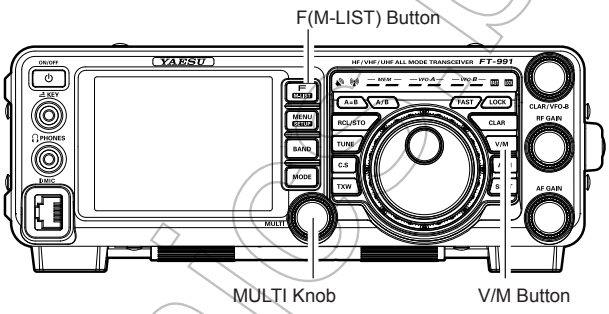
Memory Tune Operation

You may freely tune off from any memory channel in a "Memory Tune" mode, this is similar to VFO operation. So long as you do not over-write the contents of the current memory, Memory Tune operation will not alter the contents of the memory channel.

1. Press the **V/M** button to recall any memory channel.
2. Press the **F(M-LIST)** button, then touch [**MCH**] on the LCD.
3. Rotate the **MULTI** knob to select the memory channel.
4. Rotate the Main Tuning Dial knob; you will now observe that the memory channel frequency is changing.

   ADVICE:

   ❒ During Memory Tune operation, you may change operating modes, and engage the offset Clarifier, if desired.
5. Press the **V/M** button momentarily to return to the originally memorized frequency of the current memory channel. One more press of the **V/M** button will return to VFO operation.



NOTE:

Computer software programs utilizing the CAT system interface port may presume that the transceiver is operating in the VFO mode, for certain features like "band mapping" and/or frequency logging, because the "Memory Tune" mode so closely resembles the VFO mode. Be sure that you have the **FT-991** operating in a control mode compatible with your software's requirements. Use the VFO mode if you're not sure.

MEMORY GROUPS

Memory channels may be arranged into as many as six convenient groups, for easy identification and selection. For example, you might want to designate memory groups for AM BC stations, short-wave broadcast stations, contest frequencies, repeater frequencies and PMS limits, or any other groupings you like.

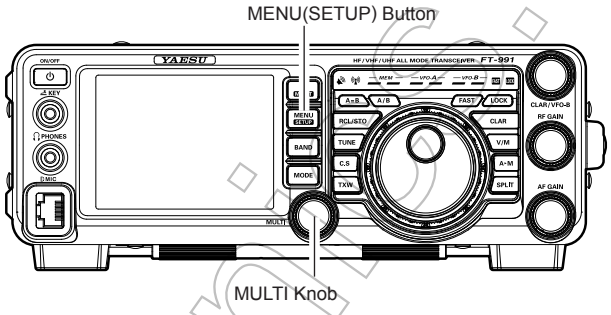
Each memory group is capable of holding up to 20 memory channels (except Memory Group 01: it is 19 memory channels, and the Group size is fixed). When a memory channel is grouped, the channel numbers change to correspond to the chart below:

Memory Group Assignment

1. Press the **MENU(SETUP)** button to enter the Menu mode.
2. Rotate the **MULTI** knob to select Menu item "033 MEM GROUP".
3. Touch [**SELECT**] on the LCD, then rotate the **MULTI** knob to set this Menu item to "ENABLE" (the default setting is "DISABLE").
4. Touch [**ENTER**] on the LCD to save the new setting.
5. Press the **MENU(SETUP)** button or [**BACK**] on the LCD to exit. Operation will now be restricted to the six Memory Groups.

To cancel Memory Group operation, repeat steps (1) through (4) above, choosing "DISABLE" in step (3).

ADVICE:
To avoid confusion, note that the PMS memory group and the PMS memories "P-1L" through "P-9U" will be so designated.



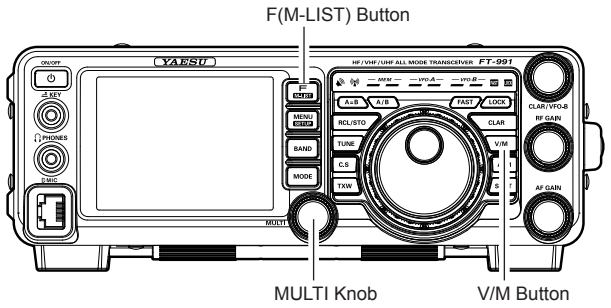
MEMORY CHANNEL NUMBER	
GROUP MEMORY "OFF"	GROUP MEMORY "ON"
01 ~ 19	1-01 ~ 1-19
20 ~ 39	2-01 ~ 2-20
40 ~ 59	3-01 ~ 3-20
60 ~ 79	4-01 ~ 4-20
80 ~ 99	5-01 ~ 5-20
P-1L/1U ~ P-9L/9U	P-1L/1U ~ P-9L/9U
5M-01 ~ 5M-10	US-1 ~ US-5

Choosing the Desired Memory Group

You may recall memories just within a particular Memory Group, if desired.

1. Press the **V/M** button, if necessary, to enter the "Memory" mode.
2. Press the **F(M-LIST)** button, then touch [**GRP**] on the LCD. The "**GRP**" icon will appear on the display.
3. Rotate the **MULTI** knob to select the desired Memory Group.
4. Press the **F(M-LIST)** button, then touch [**MCH**] on the LCD. The "**MCH**" icon will appear on the display.
5. Rotate the **MULTI** knob to select the desired Memory Channel within the Selected Memory Group.

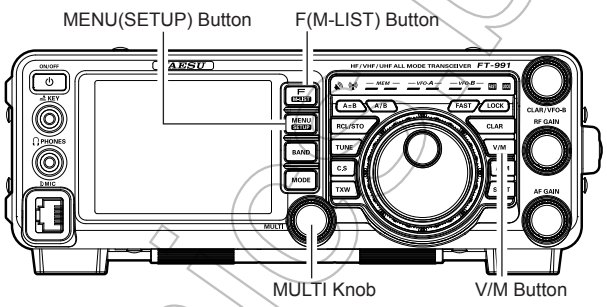
ADVICE:
If no channels have been assigned to a particular Memory Group, you will not have access to that Group.



Section 97.401(d) of the regulations governing amateur radio in the United States permit emergency amateur communications on the spot frequency of 5167.5 kHz by stations in (or within 92.6 km of) the state of Alaska. This frequency is only to be used when the immediate safety of human life and/or property are threatened, and is never to be used for routine communications.

The **FT-991** includes the capability for transmission and reception on 5167.5 kHz under such emergency conditions via the Menu system. To activate this feature:

1. Press the **MENU(SETUP)** button to enter the Menu mode.
2. Rotate the **MULTI** knob to select Menu item "149 EMERGENCY FREQ TX".
3. Touch [**SELECT**] on the LCD, then rotate the **MULTI** knob to select "ENABLE."
4. Touch [**ENTER**] on the LCD to save the new setting.
5. Press the **MENU(SETUP)** button or [**BACK**] on the LCD to exit to normal operation. Emergency communication on this spot frequency is now possible.
6. Press the **V/M** button, as necessary, to enter the Memory mode.
7. Press the **F(M-LIST)** button, then touch [**MCH**] on the LCD.
8. Rotate the **MULTI** knob to select the emergency channel ("EMERGENCY"), which is found between channels "510" and "01").



NOTE:

- The receive-mode CLARIFIER functions normally while using this frequency, but variation of the transmit frequency is not possible. The full specifications of the **FT-991** are not necessarily guaranteed on this frequency, but power output and receiver sensitivity should be fully satisfactory for the purpose of emergency communication.
- If you wish to disable operation capability on the Alaska Emergency Frequency, repeat the above procedures, but set the Menu item "149 EMERGENCY FREQ TX" to "DISABLE" in step 3.
- In an emergency, note that a half-wave dipole cut for this frequency should be approximately 45'3" on each leg (90'6" total length). Emergency operation on 5167.5 kHz is shared with the Alaska-Fixed Service. This transceiver is not authorized for operation, under the FCC Part 87, for aeronautical communications.

You may scan either the VFO or the memories of the **FT-991**, and the radio will halt scanning on any frequency with a signal strong enough to open the receiver squelch.

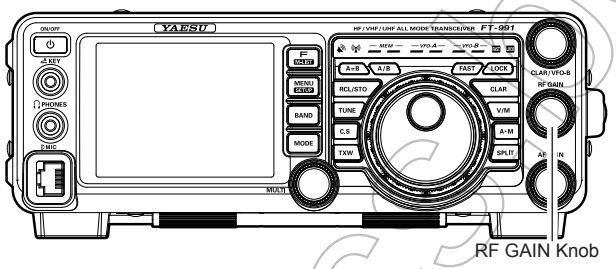
VFO SCANNING

1. Set the VFO-A to the frequency on which you would like to begin scanning.
2. Rotate the **RF GAIN** knob so that the background noise is just silenced.
3. Press and hold in the microphone **UP** or **DWN** button for one second to start scanning in the specified direction on the VFO frequency.
4. If the scanner halts on an incoming signal, the decimal point between the "MHz" and "kHz" digits of the frequency display will blink.

ADVICE:

- ❒ If the incoming signal disappears, scanning will resume in about five seconds.
- ❒ On the SSB/CW and SSB-based Data modes, the scanner will pause on a received signal, then will step across the signal very slowly, giving you time to stop the scan, if you like. In these modes on the VFO, the scanner does not stop, however.

5. To cancel scanning, press the **PTT** switch.



ADVICE:

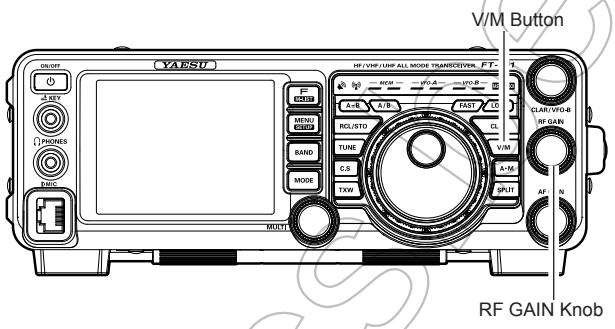
- ❒ If you press the microphone **PTT** switch during scanning, the scanner will halt at once. However, pressing the **PTT** switch during scanning will not cause transmission.
- ❒ You may select the manner in which the scanner resumes while it has paused on a signal, using Menu item "037 MIC SCAN RESUME". The default "TIME" (5 sec) setting will cause the scanner to resume scanning after five seconds; you may change it, however, to resume only after the carrier has dropped out.

MEMORY SCAN

1. Set the transceiver up in the "Memory" mode by pressing the **V/M** button, if necessary.
2. Rotate the **RF GAIN** knob so that the background noise is just silenced.
3. Press and hold in the microphone **UP** or **DWN** button for one second to start scanning in the specified direction.

   ADVICE:

   - ❒ If the scanner halts on an incoming signal, the decimal point between the "MHz" and "kHz" digits of the frequency display will blink.
   - ❒ If the incoming signal disappears, scanning will resume in about five seconds.
4. To cancel scanning, press the **PTT** witch.



ADVICE:

- ❒ During Memory Group operation, only the channels within the current Memory Group will be scanned.
- ❒ If the scan has paused on a signal, pressing the microphone **UP** or **DWN** button will cause scanning to resume instantly.
- ❒ If you press the microphone **PTT** switch during scanning, the scanner will halt at once. However, pressing the **PTT** switch during scanning will not cause transmission.
- ❒ You may select the manner in which the scanner resumes while it has paused on a signal, using Menu item "037 MIC SCAN RESUME". During memory scanning, the default "TIME" (5 sec) setting will cause the scanner to resume scanning after five seconds. However, you may change this setting to resume only after the carrier has dropped out, if you like.

QUICK POINT:

If you have no interest in scanning, and wish to prohibit the microphone **UP**/**DWN** buttons from initiating scanning, you may disable scanning control from the microphone using Menu item "036 MIC SCAN" (set it to "DISABLE").

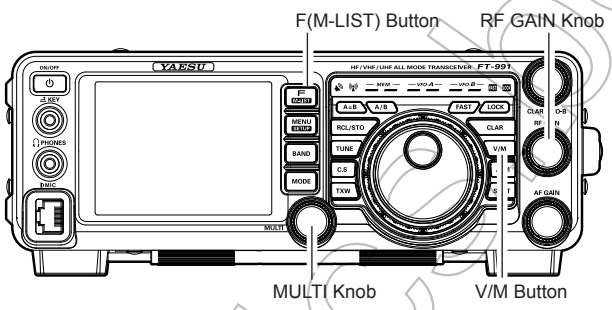
PMS (PROGRAMMABLE MEMORY SCANNING)

To limit scanning (and manual tuning) within a particular frequency range, you can use the Programmable Memory Scanning (PMS) feature, which utilizes nine special-purpose memory pairs ("P-1L/P-1U" through "P-9L/P-9U"). The PMS feature is especially useful in helping you to observe any operating sub-band limits, which apply to your Amateur license class.

1. Store the Lower and Upper tuning/scanning limit frequencies into the memory pair "P-1L" and "P-1U", respectively, or any other "L/U" pair of memories in the special PMS memory area. See page ## for details regarding memory storage.
2. Press the **V/M** button to enter the "Memory" mode.
3. Press the **F(M-LIST)** button, then touch [**MCH**] on the LCD. The LEDs indicating the Memory mode will illuminate.
4. Rotate the **MULTI** knob to select memory channel "P-1L" or "P-1U".
5. Rotate the **RF GAIN** knob so that the background noise is just silenced.
6. Turn the Main Tuning Dial knob slightly (to activate memory tuning). Tuning and scanning are now limited to the range within the P-1L/P-1U limits until you press the **V/M** button to return to memory channel or VFO operation.
7. Press and hold in the microphone **UP** or **DWN** button for one second to start scanning in the specified direction.

   ADVICE:

   - ❒ If the scanner halts on an incoming signal, the decimal point between the "MHz" and "kHz" digits of the frequency display will blink.
   - ❒ If the incoming signal disappears, scanning will resume in about five seconds.
   - ❒ On the SSB/CW and SSB-based Data modes, the scanner will pause on a received signal, then will step across the signal very slowly, giving you time to stop the scan, if you like. However, in these modes on the VFO, the scanner does not stop.
   - ❒ If the scan has paused on a signal, pressing the microphone **UP** or **DWN** button will cause scanning to resume instantly.
8. If you rotate the Main Tuning Dial knob in the opposite direction from the current scanning direction (in other words, you rotate the dial to the left when scanning toward a higher frequency), the direction of the scan will reverse.
9. If you press the microphone **PTT** switch during scanning, the scanner will halt at once. Pressing the **PTT** switch *during scanning* will not cause transmission.



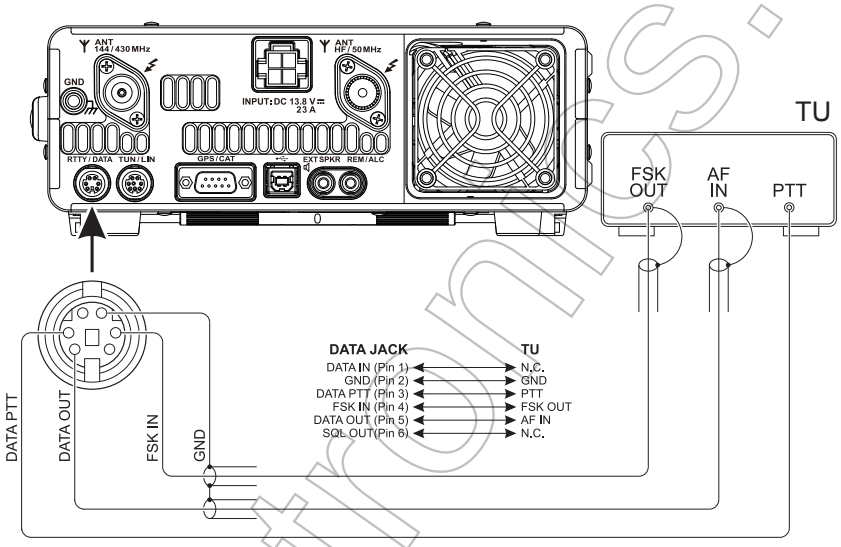
EXAMPLE OF CONNECTING RTTY COMMUNICATIONS DEVICE

Connect the RTTY communications TU (Terminal Unit) to the rear panel RTTY/PKT terminal. Be sure to read the instructions manual of the device to connect when connecting.

See page ## for details on the connections and settings to use the optional USB Interface Unit "**SCU-17**".

ADVICE:

You can adjust RTTY data output level using Menu item "099 RTTY OUT LEVEL".



EXAMPLE OF DATA COMMUNICATIONS DEVICE

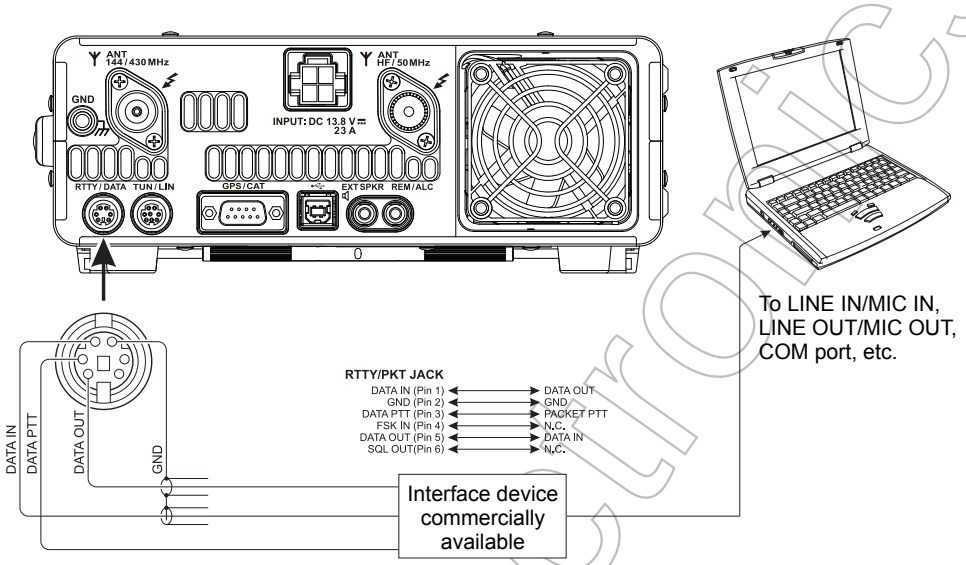
You can use commercial and free computer software for PSK data communications. See the illustration below for connection to your computer.

Be sure to read the instruction manual of the device to be connected to the radio and computer.

See page ## for details on the connections and settings to use the optional USB Interface Unit "**SCU-17**".

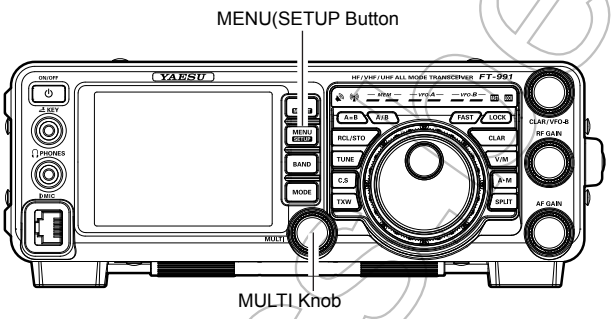
ADVICE:

- ❒ You can set the data output level for data communications (PSK31, SSTV, etc.) using Menu item "075 DATA OUT LEVEL".
- ❒ You can set VOX DELAY in VOX operation for data communications (PSK31, SSTV, etc.) using Menu item "147 DATA VOX DELAY". You can also set data input VOX gain using Menu item "146 DATA VOX GAIN".



The Menu system of the **FT-991** provides extensive customization capability, so you can set up your transceiver just the way you want to operate it. The Menu items are grouped by general utilization category, and are numbered from "001 AGC" to "149 E/D PSK".

Using the Menu



1. Press the **MENU(SETUP)** button to engage the Menu mode.
   The display will show the Menu Number, the Menu Group Name and the Menu Item.
2. Rotate the **MULTI** knob to select the Menu item you wish to modify.
3. Touch [**SELECT**] on the LCD, then rotate the **MULTI** knob to change the current setting of the selected Menu item.
   ADVICE:
   Touch [**BACK**] on the LCD to cancel the setting.
4. When you have finished making your adjustments, touch [**ENTER**] on the LCD to save the new setting, then press the **MENU(SETUP)** button or touch [**BACK**] on the LCD to exit to normal operation.

Group	No.	Menu Function	Available Settings	Default Value
AGC	001	FAST DELAY	20 ~ 4000 (20msec/step)	300msec
AGC	002	MID DELAY	20 ~ 4000 (20msec/step)	700msec
AGC	003	SLOW DELAY	20 ~ 4000 (20msec/step)	3000msec
DISPLAY	004	MY CALL TIME	OFF ~ 5sec	1sec
DISPLAY	005	DISPLAY COLOR	BLUE/GRAY/GREEN/ORANGE/PURPLE/RED/ SKY BLUE/	BLUE
DISPLAY	006	DIMMER LED	1/2	2
DISPLAY	007	DIMMER TFT	0 ~ 15	8
DISPLAY	008	BAR MTR PEAK HOLD	OFF/0.5/1.0/2.0 (sec)	OFF
DVS	009	RX OUT LEVEL	0 ~ 100	50
DVS	010	TX OUT LEVEL	0 ~ 100	50
KEYER	011	KEYER TYPE	OFF/BUG/ELEKEY-A/ELEKEY-B/ELEKEY-Y/ ACS	ELEKEY-B
KEYER	012	CW KEYER	NOR/REV	NOR
KEYER	013	CW WEIGHT	2.5 ~ 4.5	3.0
KEYER	014	BEACON TIME	OFF/1 ~ 240sec/270 ~ 690sec	OFF
KEYER	015	NUMBER STYLE	1290/AUNO/AUNT/A2NO/A2NT/12NO/12NT	1290
KEYER	016	CONTEST NUMBER	0 ~ 9999	1
KEYER	017	CW MEMORY 1	TEXT/MESSAGE	TEXT
KEYER	018	CW MEMORY 2	TEXT/MESSAGE	TEXT
KEYER	019	CW MEMORY 3	TEXT/MESSAGE	TEXT
KEYER	020	CW MEMORY 4	TEXT/MESSAGE	TEXT
KEYER	021	CW MEMORY 5	TEXT/MESSAGE	TEXT
GENERAL	022	NB WIDTH	1/3/10msec	3msec
GENERAL	023	NB REJECTION	10/30/50dB	30dB
GENERAL	024	NB LEVEL	0 ~ 100	50dB
GENERAL	025	BEEP LEVEL	0 ~ 100	50
GENERAL	026	TIME ZONE	-12:00 ~ 0:00 ~ +14:00	0:00
GENERAL	027	GPS/232C SELECT	GPS/RS232C	GPS
GENERAL	028	232C RATE	4800/9600/19200/38400 (bps)	4800bps
GENERAL	029	232C TOT	10/100/1000/3000 (msec)	10msec
GENERAL	030	CAT RATE	4800/9600/19200/38400 (bps)	4800bps
GENERAL	031	CAT TOT	10/100/1000/3000 (msec)	10msec
GENERAL	032	CAT RTS	ENABLE/DISABLE	ENABLE
GENERAL	033	MEM GROUP	ENABLE/DISABLE	DISABLE
GENERAL	034	QUICK SPLIT FREQ	-20 ~ +20kHz	5kHz
GENERAL	035	TX TOT	OFF/1 ~ 30 (min)	OFF
GENERAL	036	MIC SCAN	ENABLE/DISABLE	ENABLE
GENERAL	037	MIC SCAN RESUME	PAUSE/TIME	TIME
GENERAL	038	FREQ ADJ	-25 ~ 0 ~ 25	0
GENERAL	039	CLAR SELECT	RX/TX/TRX	
MODE-AM	040	AM LCUT FREQ	OFF/100Hz ~ 1000Hz (50Hz/step)	OFF
MODE-AM	041	AM LCUT SLOPE	6dB/oct / 18dB/oct	6dB/oct
MODE-AM	042	AM HCUT FREQ	700Hz ~ 4000Hz (50Hz/step) / OFF	OFF
MODE-AM	043	AM HCUT SLOPE	6dB/oct / 18dB/oct	6dB/oct
MODE-AM	044	AM MIC SEL	MIC/REAR	MIC
MODE-AM	045	AM MIC GAIN	MCVR/0 ~ 100	30
MODE-AM	046	AM OUT LEVEL	0 ~ 100	50
	047	REAR PTT SELECT	DAKY/RTS/DTR	DAKY
	048	REAR PORT SELECT	DATA/USB	DATA
	049	AM DATA GAIN	0 ~ 100	50
MODE-CW	050	CW LCUT FREQ	OFF/100Hz ~ 1000Hz(50Hz/step)	250Hz
MODE-CW	051	CW LCUT SLOPE	6dB/oct / 18dB/oct	18dB/oct

Group	No.	Menu Function	Available Settings	Default Value
MODE-CW	052	CW HCUT FREQ	700Hz ~ 4000Hz(50Hz/step)	1200Hz
MODE-CW	053	CW HCUT SLOPE	6dB/oct / 18dB/oct	18dB/oct
MODE-CW	054	CW OUT LEVEL	0 ~ 100	50
MODE-CW	055	CW AUTO MODE	OFF/50M/ON	OFF
MODE-CW	056	CW BFO	USB/LSB/AUTO	USB
MODE-CW	057	CW BK-IN	SEMI/FULL	SEMI
MODE-CW	058	CW BK-IN DELAY	30 ~ 3000 (msec)	200msec
MODE-CW	059	CW WAVE SHAPE	1/2/4/6 (msec)	4msec
MODE-CW	060	CW FREQ DISPLAY	DIRECT FREQ/PITCH OFFSE	PITCH OFFSE
MODE-CW	061	PC KEYING	OFF/DAKY/RTS/DTR	OFF
MODE-CW	062	QSK	15/20/25/30(msec)	15msec
MODE-DATA	063	DATA MODE	PSK/OTHERS	PSK
MODE-DATA	064	PSK TONE	1000/1500/2000(Hz)	1000Hz
MODE-DATA	065	OTHER DISP (SSB)	-3000 ~ 0 ~ +3000(10Hz/step)	0Hz
MODE-DATA	066	OTHER SHIFT (SSB)	-3000 ~ 0 ~ +3000(10Hz/step)	0Hz
MODE-DATA	067	DATA LCUT FREQ	OFF/100 ~ 1000(Hz)(50Hz/step)	300Hz
MODE-DATA	068	DATA LCUT SLOPE	6dB/oct / 18dB/oct	18dB/oct
MODE-DATA	069	DATA HCUT FREQ	700 ~ 4000(Hz)(50Hz/step)/OFF	3000Hz
MODE-DATA	070	DATA HCUT SLOPE	6dB/oct / 18dB/oc	18dB/oct
MODE-DATA	071	DATA IN SELECT	REAR/MIC	REAR
MODE-DATA	072	DATA MIC GAIN	0 ~ 100	50
MODE-DATA	073	REAR PTT SELECT	DAKY/RTS/DTR	DAKY
MODE-DATA	074	REAR PORT SELECT	DATA/USB	DATA
MODE-DATA	075	DATA OUT LEVEL	0 ~ 100	50
MODE-FM	076	FM MIC SEL	MIC/REAR	MIC
MODE-FM	077	FM MIC GAIN	MCVR/0 ~ 100	30
MODE-FM	078	FM OUT LEVEL	0 ~ 100	50
MODE-FM	079	REAR PTT SELECT	DAKY/RTS/DTR	DARY
MODE-FM	080	REAR PORT SELECT	DATA/USB	DATA
MODE-FM	081	FM PKT GAIN	0 ~ 100	50
MODE-FM	082	FM PKT MODE	1200/9600	1200
MODE-FM	083	RPT SHIFT 28MHz	0 ~ 1000kHz (10kHz/step)	100kHz
MODE-FM	084	RPT SHIFT 50MHz	0 ~ 4000kHz (10kHz/step)	1000kHz
MODE-FM	085	RPT SHIFT 144MHz	0 ~ 4000kHz (10kHz/step)	600kHz
MODE-FM	086	RPT SHIFT 430MHz	0 ~ 9990kHz (10kHz/step)	5000kHz
MODE-FM	087	ARS 144MHz	OFF/ON	ON
MODE-FM	088	ARS 430MHz	OFF/ON	ON
	089	DCS POLARITY	Tn-Rn/Tn-Riv/Tiv-Rn/Tin-Riv	Tn-Rn
	090	AMS TX MODE	AUTO/DN/VW/ANALOG	AUTO
	091	RADIO ID		*****
MODE-RTTY	092	RTTY LCUT FREQ	OFF/100Hz ~ 1000Hz (50Hz/step)	300Hz
MODE-RTTY	093	RTTY LCUT SLOPE	6dB/oct / 18dB/oct	18dB/oct
MODE-RTTY	094	RTTY HCUT FREQ	700Hz ~ 4000Hz (50Hz/step) / OFF	3000Hz
MODE-RTTY	095	RTTY HCUT SLOPE	6dB/oct / 18dB/oct	18dB/oct
MODE-RTTY	096	RTTY SHIFT PORT	SHIFT/DTR/RTS	SHIFT
MODE-RTTY	097	POLARITY-R	NOR/REV	NOR
MODE-RTTY	098	POLARITY-T	NOR/REV	NOR
MODE-RTTY	099	RTTY OUT LEVEL	0 ~ 100	50
MODE-RTTY	100	RTTY SHIFT	170/200/425/850 (Hz)	170Hz
MODE-RTTY	101	RTTY MARK FREQ	1275/2125 (Hz)	2125Hz
MODE-SSB	102	SSB LCUT FREQ	OFF/100Hz ~ 1000Hz (50Hz/step)	100Hz
MODE-SSB	103	SSB LCUT SLOPE	6dB/oct / 18dB/oct	6dB/oct
MODE-SSB	104	SSB HCUT FREQ	700Hz ~ 4000Hz (50Hz/step) / OFF	3000Hz

Group	No.	Menu Function	Available Settings	Default Value
MODE-SSB	105	SSB HCUT SLOPE	6dB/oct / 18dB/oct	6dB/oct
MODE-SSB	106	SSB MIC SELECT	MIC/REAR	MIC
MODE-SSB	107	SSB OUT LEVEL	0 ~ 100	50
	108	REAR PTT SELECT	DAKY	DAKY
	109	REAR PORT SELECT	DATA/USB	DATA
MODE-SSB	110	SSB TX BPF	100-3000/100-2900/200-2800/300-2700/400-2600	300-2700
RX-DSP	111	APF WIDTH	NARROW/MEDIUM/WIDE	MEDIUM
RX-DSP	112	CONTOUR LEVE	-40 ~ 0 ~ 20	-15
RX-DSP	113	CONTOUR WIDTH	1 ~ 11	10
RX-DSP	114	IF NOTCH WIDTH	NARROW/WIDE	WIDE
AF-SCOPE	115	DISPLAY MODE	SPECTRUM/WATER FALL	SPECTRUM
	116	START CYCLE	OFF/3/5/10 (sec)	OFF
	117	START DIAL SPEED	0.25kHz/0.5kHz/1kHz/2kHz/4kHz (sec)	1kHz/sec
	118	SPAN FREQ	50/100/200/500/1000 (kHz)	100kHz
TX AUDIO	119	PRMTRC EQ1 FREQ	OFF/100 ~ 700 (100/step)	OFF
TX AUDIO	120	PRMTRC EQ1 LEVEL	-20 ~ 0 ~ +10	5
TX AUDIO	121	PRMTRC EQ1 BWTH	1 ~ 10	10
TX AUDIO	122	PRMTRC EQ2 FREQ	OFF/700 ~ 1500 (100/step)	OFF
TX AUDIO	123	PRMTRC EQ2 LEVEL	-20 ~ 0 ~ +10	5
TX AUDIO	124	PRMTRC EQ2 BWTH	1 ~ 10	10
TX AUDIO	125	PRMTRC EQ3 FREQ	OFF/1500 ~ 3200 (100/step)	OFF
TX AUDIO	126	PRMTRC EQ3 LEVEL	-20 ~ 0 ~ +10	5
TX AUDIO	127	PRMTRC EQ3 BWTH	1 ~ 10	10
TX AUDIO	128	P-PRMTRC EQ1 FREQ	OFF/100 ~ 700 (100/step)	200
TX AUDIO	129	P-PRMTRC EQ1 LEVEL	-20 ~ 0 ~ 10	0
TX AUDIO	130	P-PRMTRC EQ1 BWTH	1 ~ 10	2
TX AUDIO	131	P-PRMTRC EQ2 FREQ	OFF/700 ~ 1500 (100/step)	800
TX AUDIO	132	P-PRMTRC EQ2 LEVEL	-20 ~ 0 ~ 10	0
TX AUDIO	133	P-PRMTRC EQ2 BWTH	1 ~ 10	1
TX AUDIO	134	P-PRMTRC EQ3 FREQ	OFF/1500 ~ 3200 (100/step)	2100
TX AUDIO	135	P-PRMTRC EQ3 LEVEL	-20 ~ 0 ~ 10	0
TX AUDIO	136	P-PRMTRC EQ3 BWTH	1 ~ 10	1
TX GNRL	137	HF TX MAX POWER	5 ~ 100	100
TX GNRL	138	50M TX MAX POWER	0 ~ 100	100
TX GNRL	139	144M TX MAX POWER	0 ~ 50	50
TX GNRL	140	430M TX MAX POWER	0 ~ 50	50
TX GNRL	141	TUNER SELECT	OFF/INTERNAL/EXTERNAL/ATAS/LAMP	INTERNAL
TX GNRL	142	VOX SELECT	MIC/DATA	MIC
TX GNRL	143	VOX GAIN	0 ~ 100	50
TX GNRL	144	VOX DELAY	30 ~ 3000 (msec)	500msec
TX GNRL	145	ANTI VOX GAIN	0 ~ 100	50
TX GNRL	146	DATA VOX GAIN	0 ~ 100	50
TX GNRL	147	DATA VOX DELAY	30 ~ 3000 (msec)	100msec
TX GNRL	148	ANTI DVOX GAIN	0 ~ 100	0
TX GNRL	149	EMERGENCY FREQ TX	DISABLE/ENABLE	DISABLE

General

Rx Frequency Range:	30 kHz - 55.999995 MHz 118 MHz - 163.999995 MHz 420 MHz - 469.999995 MHz
Tx Frequency Ranges:	1.8 MHz - 430 MHz (Amateur bands only)
Frequency Stability:	±0.5 ppm (after 1 minute @+14 °F to +140 °F [–10 °C to +60 °C])
Operating Temperature Range:	+14 °F to +122 °F (–10 °C to +50 °C)
Emission Modes:	A1A, A3E, J3E, F3E, F7W, F1B, F1D, F2D, G1B
Frequency Steps:	5/10 Hz (SSB, CW), 50/100 Hz (AM, FM)
Antenna Impedance:	50 Ohms, unbalanced 16.7 - 150 Ohms, unbalanced (1.8 MHz - 29.7 MHz) 25 - 100 Ohms, unbalanced (50 MHz - 54 MHz) (Tuner ON, 1.8 MHz - 50 MHz Amateur bands, TX only)
Power Consumption (Approx.):	Rx (no signal) 1.8 A Rx (signal present) 2.2 A Tx (HF/50 MHz, 100 W) 22 A, (144/430 MHz, 50 W) 15 A
Supply Voltage:	DC 13.8 V ± 15 % (Negative Ground)
Dimensions (WxHxD):	9.01” x 3.15” x 9.96” (229 x 80 x 253 mm)
Weight (Approx.):	9.46 lbs (4.3 kg)

Transmitter

Power Output:	HF/50 MHz: 5 - 100 watts (2.5 - 25 watts AM carrier) 144/430 MHz: 5 - 50 watts (2.5 - 12.5 watts AM carrier)
Modulation Types:	J3E: Balanced, A3E: Low-Level (Early Stage), F3E: Variable Reactance F7W: 4FSK (C4FM)
Maximum FM Deviation:	±5.0 kHz/±2.5 kHz
Harmonic Radiation:	Better than –50 dB (below 30 MHz) Better than –60 dB (above 30 MHz)
SSB Carrier Suppression:	At least 50 dB below peak output
Undesired Sideband Suppression:	At least 50 dB below peak output
Bandwidth:	3 kHz (LSB/USB), 500 Hz (CW), 6 kHz (AM), 16 kHz (FM)
Audio Response (SSB):	Not more than –6 dB from 300 to 2700 Hz
Microphone Impedance:	600 Ohms (200 to 10 kOhms)

Receiver

Circuit Type: SSB/CW/AM: Triple-conversion Superheterodyne
FM: Double-conversion Superheterodyne

Intermediate Frequencies: 69.450 MHz
9.000 MHz (SSB, CW, AM)
24 kHz (SSB, CW, AM)
450 kHz (FM)

Sensitivity: SSB/CW (10 dB S+N/N)
0.158 µV (1.8 - 30 MHz) (RF AMP 2 "ON")
0.125 µV (50 - 54 MHz) (RF AMP 2 "ON")
0.125 µV (144 - 146 MHz) (RF AMP 2 "ON")
0.125 µV (430 - 440 MHz) (RF AMP 2 "ON")
AM (10 dB S+N/N, 30 % modulation @400 Hz)
28 µV (0.1 - 1.8 MHz) (RF AMP 2 "ON")
2 µV (1.8 - 30 MHz) (RF AMP 2 "ON")
1 µV (50 - 54 MHz) (RF AMP 2 "ON")
FM (12 dB SINAD)
0.5 µV (1.8 - 30 MHz) (RF AMP 2 "ON")
0.25 µV (50 - 54 MHz) (RF AMP 2 "ON")
0.18 µV (144 - 146 MHz) (RF AMP 2 "ON")
0.18 µV (430 - 440 MHz) (RF AMP 2 "ON")
There is no specification for frequency ranges not listed.

Selectivity (WIDTH: Center):

Mode	–6 dB	–60 dB
SSB/CW (Width=2.4 kHz)	2.4 kHz or better	3.6 kHz or less
CW-N (Width =500 Hz)	0.5 kHz or better	750 Hz or less
AM	6 kHz or better	15 kHz or less
FM	12 kHz or better	30 kHz or less
FM-N	9 kHz or better	25 kHz or less

Image Rejection: 70 dB or better (1.8 MHz - 50 MHz Amateur bands)
60 dB or better (144/430 MHz Amateur band)

Maximum Audio Output: 2.5 W into 4 Ohms with 10% THD

Audio Output Impedance: 4 to 16 Ohms (8 Ohms: nominal)

Conducted Radiation: Less than 4000 uuW

Specifications are subject to change, in the interest of technical improvement, without notice or obligation, and are guaranteed only within the amateur bands.

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 radiate 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 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:

- ❒ Increase the separation between the equipment and receiver.
- ❒ Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- ❒ Consult the dealer or an experienced radio/TV technician for help.

1. Changes or modifications to this device not expressly approved by YAESU MUSEN could void the user's authorization to operate this device.
2. This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions; (1) this device may not cause harmful interference, and (2) this device must accept any interference including interference that may cause undesired operation.
3. The scanning receiver in this equipment is incapable of tuning, or readily being altered, by the User to operate within the frequency bands allocated to the Domestic public Cellular Telecommunications Service in Part 22.

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

DECLARATION BY MANUFACTURER

The scanner receiver is not a digital scanner and is incapable of being converted or modified into a digital scanner receiver by any user.

WARNING: MODIFICATION OF THIS DEVICE TO RECEIVE CELLULAR RADIOTELEPHONE SERVICE SIGNALS IS PROHIBITED UNDER FCC RULES AND FEDERAL LAW.

CAN ICES-3 (B) / NMB-3 (B)

YAESU
The radio

Printed in Japan