

FRG-8800 OPERATING MANUAL

YAESU MUSEN CO., LTD.

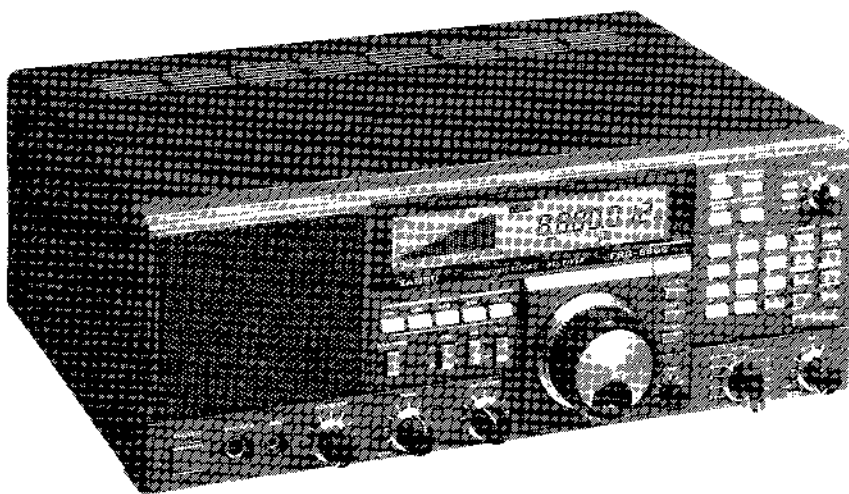
C.P.O. BOX 1500
TOKYO JAPAN

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ALL MODE COMMUNICATIONS RECEIVER

FRG-8800



GENERAL DESCRIPTION

The FRG-8800 is an all-mode dual-conversion general coverage shortwave superheterodyne receiver incorporating the latest up-conversion design techniques and the superb stability of PLL frequency synthesis with the most recent developments in microprocessor control, resulting in functionality and operating convenience never before available - even in much more costly equipment, for serious shortwave listening and professional monitoring.

Featuring a large liquid crystal display with 100Hz frequency resolution and including a unique S/SINPO "bar graph" type indicator, the FRG-8800 also incorporates a 21-button keypad for digital frequency entry and programming of the 12 internal memories and multi-function scanner. AM, SSB, CW and FM modes are pushbutton selectable with both wide and narrow bandwidths (exc. SSB), and all mode data is stored in the memories along with frequency. The front end circuitry utilizes an FET RF amplifier and double-balanced diode ring mixer, for excellent weak signal performance on today's crowded bands.

Selectable AGC rates, noise blanking widths and tuning rates are provided to ensure comfortable listening and easy operation even under adverse band conditions. Reception of CW signals is enhanced by an active audio peak filter in the CW narrow mode. Two 24-hour clocks with an automatic timer are provided for selectable display of local and universal time, and automatic power switching of the receiver and auxiliary recording equipment at preprogrammed time and frequency. All-mode squelch, tone and attenuator controls are also provided.

At the heart of the FRG-8800 is an 8-bit cpu controlling all of the tuning, mode selection, scanning, memory and clock functions. Three scanning modes are available through the keypad and two scan-stop modes are selectable by an internal switch, by which either all or only selected memories can be scanned, or all frequencies between two memories (at selectable rates and steps).

The Yaesu CAT System provides a direct link to the cpu in the FRG-8800, allowing operators with personal computers to add other functions as desired, such as unlimited additional memories, automatic tuning, customized scanning systems and even voting reception, using most any personal computer and a Yaesu FIF CAT Interface Unit.

The FRV-8800 VHF converter, which mounts inside the FRG-8800, is available as an option to add the range of 118 to 173.999 MHz to the receiver. The FRV-7700 Converters, FRA-7700 Active Antenna, FRT-7700 Antenna Tuner and FF-5 Lowpass Filter originally designed for the FRG-7700 are of course fully compatible with the FRG-8800.

Please read this manually carefully in order to gain a clear understanding of the functions of each control and button, in order to get optimum performance from the many convenient features of the FRG-8800. If you would like to try out each control while reading the sections that describe them, please read the "Installation" section first, before connecting power to the receiver.

SPECIFICATIONS

Frequency range:

150 kHz (or 2 MHz) to 29.999 MHz (or 25.999MHz), (according to government regulations)

Modes of reception:

AM, SSB (LSB and USB), CW, FM narrow (FM wide optional)

Sensitivity:

see Chart below

Selectivity:

	(kHz)	@-6dB	@-50dB
AM wide		6	15
AM narrow		2.7	8
SSB/CW		2.7	8
FM narrow		12.5	30(@-40dB)

Frequency stability:

less than 300Hz drift during the first 30 minutes after turn on after 1 minute warmup. Less than 50Hz drift every 30 minutes thereafter.

Antenna impedance:

50 or 500 ohms below 30MHz, 50 ohms for VHF (w/ converter)

Audio output:

at least 1.4W @8 ohms (for <10% THD)

External audio output:

4 to 16 ohms (External speaker and/or headphones), also 50-kilohms (RECORD jack) and 600-ohms (LINE OUT)

Power requirements:

100/120/220/240 VAC, 50/60Hz; 4.5 VDC for memory backup

Power consumption:

AC 35VA in operation, but with no signal input; AC 5VA in clock/timer standby (power switch off).

Dimensions:

334W x 118H x 225D (mm)

Weight:

6.1 kg (without options)

Specifications are for worst case except where stated otherwise, but may be subject to change without notice.

Sensitivity (uV @50 ohms)	AM (10dB S+N/N)	SSB & CW (20dB S+N/N)	FM-N (20dB S+N/N)
150kHz - 30MHz	30	3	-
1.6 - 29.999MHz (Squelch sens.-->>)	4 (2)	0.4 (2)	1 (0.5)
118 - 173.999MHz* (Squelch sens.-->>)	10 (4)	1 (4)	2 (1)

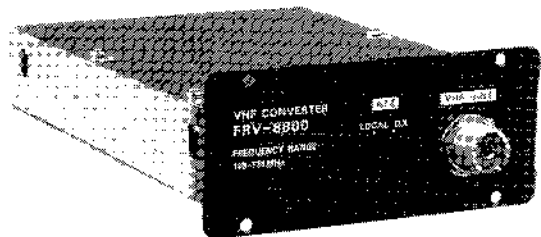
* with optional FRV-8800 converter

SUPPLIED ACCESSORIES

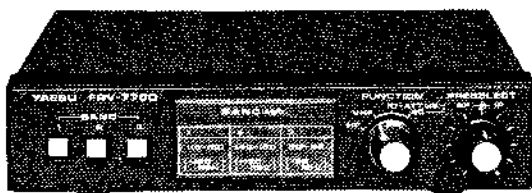
AC Power Cord
Spare AC Fuse (0.5A or 1A)
Long Cabinet Feed w/pads

OPTIONS

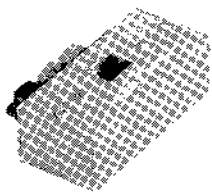
FRV-8800 Internal VHF Converter
FRV-7700 External VHF Converter
FRT-7700 Antenna Tuner
FRA-7700 Active Antenna
FF-5 Lowpass Filter
YH-77 Headphones



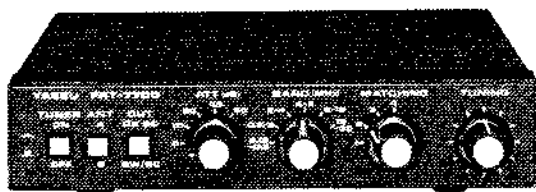
FRV-8800



FRV-7700



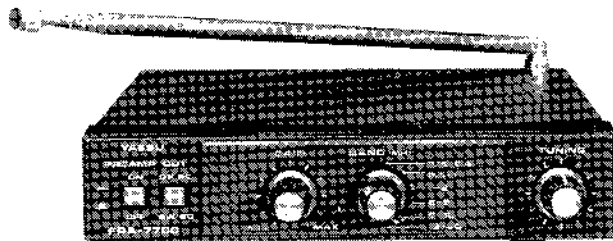
FF-5



FRT-7700

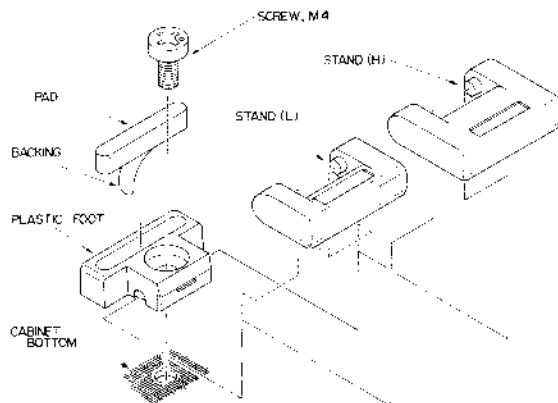


YH-77



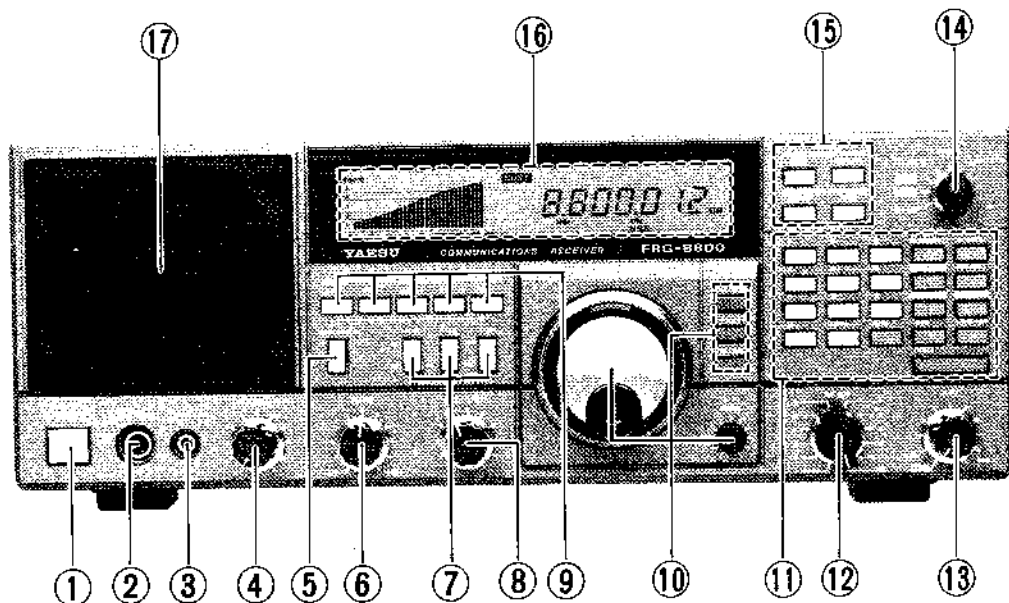
FRA-7700

On the bottom of the receiver, the special front feet allow selection of two different viewing angles. In addition, a pair of extra long extenders are provided in the accessory package, as well as rubber slip-stop inserts. The standard extenders can be replaced by the long ones, by removing the screws affixing the feet, and exchanging the extenders. The low viewing angle will remain the same. The slip-stop inserts are intended for installation only when necessary to prevent slippage, such as when the receiver is located on top of a slanted, smooth surface. Of course, when the extenders are lowered, the slip-stop inserts are not needed.



FRONT PANEL CONTROLS

Before connecting power to the receiver, please read the "Installation" section of this manual, beginning on page 10.



(1) POWER

This switch turns the main receiver circuits on and off. However, the clock and memory backup functions stay on and are not affected. Power may also be switched on and off automatically at preprogrammed times, in which case the POWER switch will remain off even though the receiver is on.

(2) PHONES

Standard monaural or stereo headphones with either a 2- or 3-contact plug may be connected to this jack. Either arrangement will reproduce the (monaural) audio in both ears. Inserting a plug into this jack disables the internal speaker, or external speaker if connected. Impedance of the headphones should be 4 to 16 ohms for best results.

(3) REC

This jack provides a constant level (40-100mV @50 kilohms) audio output, which is unaffected by the AF GAIN and TONE controls: for tape recording or data decoding purposes where a constant audio level is required.

(4) SQUELCH

This control adjusts the sensitivity of the all mode squelch system, which disables the receiver audio unless a signal is received that is stronger than the level selected by this control. Usually, when you want to hear all signals (strong and weak), this control should be set fully counterclockwise. However, if waiting for a strong station to come on the frequency, this control can be rotated clockwise just to the point where the received noise disappears. "BUSY" appears at the top center of the display when the squelch is "open" (audio enabled).

(5) NAR/WIDE

This momentary pushbutton toggles the narrow and wide filters on and off in the AM and CW modes (and FM if the optional FM-wide Unit is installed). Narrow filter selection is indicated by "NARROW" at the bottom center of the display, and a beep will sound whenever the selection is changed. The best fidelity AM and easiest tuning of CW are provided by the wide selection, while the narrow selection is most useful for suppressing interference from other stations on nearby frequencies. In the FM mode this is not the case, as described in the "Operation" section of this manual. The NAR/WIDE button is disabled in the LSB and USB modes.

(6) TONE

This control adjusts the treble and bass response of the audio amplifier in the receiver, to allow most comfortable listening. Normally it is set to about the center (12 o'clock) position, with clockwise rotation decreasing the bass response, and counterclockwise vice versa.

(7) Two Position Push Switches

AGC

This pushbutton selects slow or fast decay of the Automatic Gain Control circuit, which compensates for fading on shortwave signals. The depressed (FAST) position is useful when tuning for weak AM, SSB and CW stations, and for usual reception of weak CW signals. The undepressed (SLOW) position usually provides most comfortable listening in the AM and SSB (USB and LSB) modes. AGC is disabled in the FM mode.

NB

This is the on/off switch for the noise blanker, which reduces or eliminates interference cause by man-made impulse-type noise. Another NB switch on the rear panel selects the width of the blanker when the front panel switch is depressed, as described later. Normally, when such impulse noise is not present, this switch should be kept in the undepressed (off) position.

DIM

This switch selects the brightness of the display pilot lamps. When depressed, the lamps are dimmed to allow easier viewing in the dark.

(8) AF GAIN

This is the volume control for the receiver. It should be adjusted for a comfortable volume only when the SQUELCH control is set counterclockwise, so that a signal or noise can be heard. Adjusting this control does not affect the audio level at the REcording jack, described above.

(9) MODE Keys (AM, LSB, USB, CW, FM)

These five keys select the receiving mode. A beep sounds whenever one is pressed, and the display shows the currently selected mode just below the frequency digits. The use of each mode is described in the "Operation" section.

(10) Main Tuning Knob and Controls

This knob is used for changing the receiver frequency. Clockwise rotation increases the frequency at the rate selected by the FAST and SLOW buttons to the right of this knob (125 or 6.25 kHz/turn, respectively). The main tuning knob is disabled when the D.LOCK button is pressed (or when receiving on a memory). Pressing any one of the D.LOCK, FAST or SLOW buttons disengages both of the other two buttons.

The FINE control allows very fine tuning of a signal once it has been tuned with the main knob, such as to "zero beat", or to set the precise frequency during SSB, CW narrow or ECSS reception. Frequency offset by the FINE control is not indicated on the display, so it should be returned to the center (12 o'clock) position when retuning the main knob.

(11) Keypad

These 21 keys provide control over the frequency, memory and scanning functions, as well as the clock/timer functions. The white keys are for numeric input and the orange and blue keys are used to enter the keyed digits into the memory or operating frequency register. The grey keys select and deselect the memory and scanning functions, as denoted above each key and described in the "Operation" section.

(12) M CH (Memory CHannel) Selector

This rotary switch selects the memory channel (1 - 12) for operation in the memory recall mode.

(13) ATT (ATTenuator)

This control adjust the gain of the first IF amplifier. Clockwise rotation increases the attenuation, decreasing the gain and sensitivity of the receiver so that when strong signals are present they do not overload the later stages. Normally, for maximum sensitivity, this control should be set fully counterclockwise in the OFF position.

(14) Display Selector

This knob selects the kind of data to be displayed on the LCD. The SLEEP function displays the number of minutes for which the count-down "sleep" timer is set, at the end of which the receiver will automatically turn off. The OFF and ON positions display the times at which the timer has been set to switch the receiver on and off. CLOCK 1 and CLOCK 2 display the two times that have been programmed; generally local time on one and universal time (UTC, or GMT) on the other. FREQ, of course, displays the receiving frequency and other operating data. All except the FREQ function are active whether or not the POWER switch is on.

(15) TIMER and SET Switches

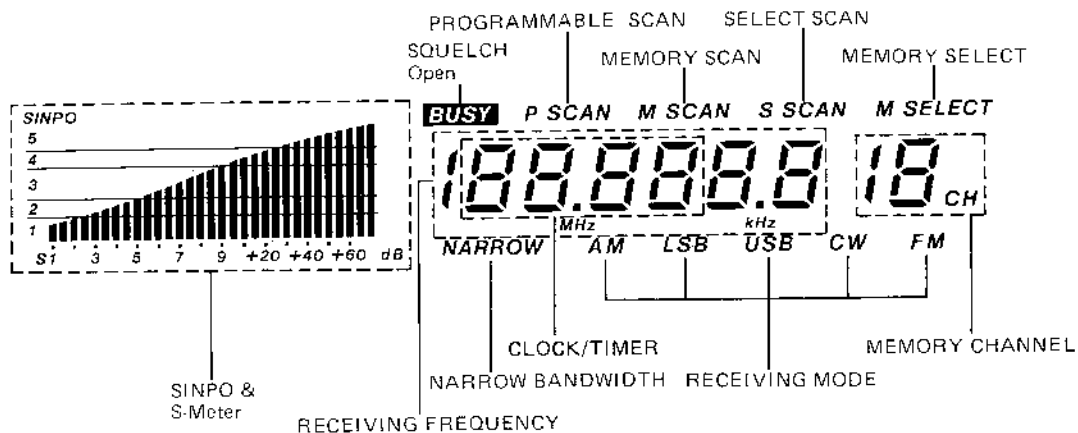
The two-position TIMER ON switch activates the timer when pressed. When in the un-depressed position, timer settings are preserved in memory, but will not affect the receiver. The CLEAR button clears the timer settings if they have been previously set. The HOUR and TIME buttons are used in conjunction with the white numeric keys on the keypad to set the clocks and timer settings. Note that all of the timer functions affect both the receiver power and the auxiliary power supplied by the REMOTE jacks on the rear panel.

(16) LCD (Display)

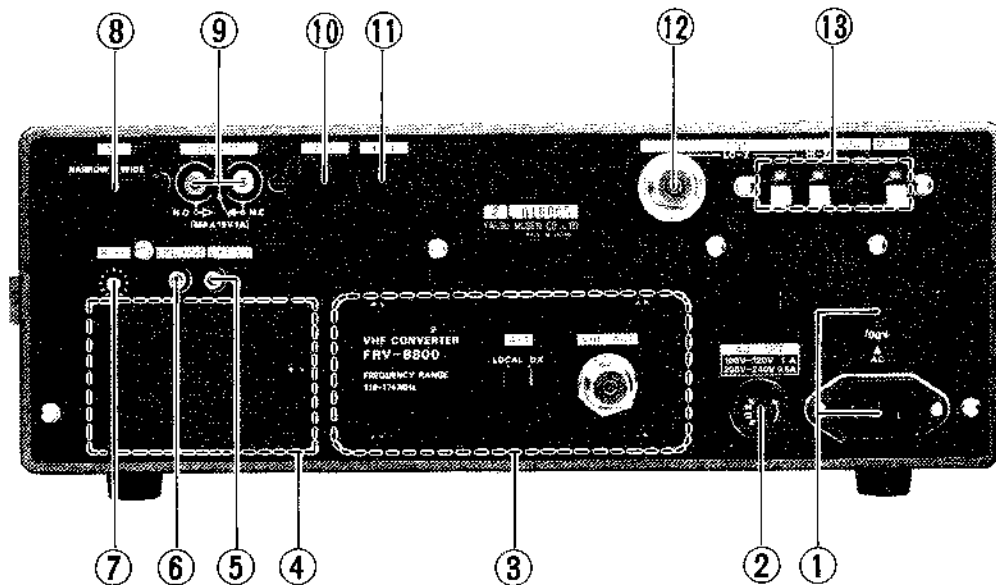
The left side of the Liquid Crystal Display indicates relative received signal strength on a bar graph type S-meter (horizontal scale) and SINPO meter (vertical scale). The right side shows either the clock-timer times or receiving frequency, modes and associated functions.

(17) Loudspeaker

Behind the grill is the built-in speaker.



REAR PANEL CONNECTORS AND CONTROLS



(1) AC Selector and Connector

This connector is for the female end of the AC Power cable supplied with the receiver. If the male plug at the other end of the cable does not match your wall socket do not connect the receiver, but contact your Yaesu dealer to obtain the correct cable. The AC Selector just above the connector allows selection of the AC voltage on which the receiver is to operate. Normally this is preset at the factory for the correct voltage for the country to which the receiver is shipped, but be absolutely certain that the correct voltage is displayed in the small window before connecting AC power, and use a screwdriver to reset this selector and replace the fuse if necessary.

(2) AC FUSE Holder

This fuse holder contains the fuse of the correct rating for the AC voltage selected by the AC Selector described above. The label above the holder shows the proper fuse ratings for the different voltages. Make sure that the fuse installed is of the correct rating for the selected AC voltage: 1A for 100 to 120VAC, or 0.5A for 200 to 240VAC.

(3) VHF Converter (Optional Accessory)

When the optional FRV-8800 VHF converter is installed, the coaxial feedline for the VHF antenna should be connected to the **VHF ANT** jack using a type-M male coaxial plug. An **ATT** (Attenuator) slide switch is also provided for reducing VHF sensitivity when receiving strong local VHF signals (the "LOCAL" position. For weak VHF signals, this switch should be set to the "DX" position. The FRV-8800 is available from your local Yaesu dealer.

(4) Access Subpanel

This is the access door to the memory/-clock backup battery holder. To open the door, gently pry the center pin of the black nylon button out about 3mm (1/8-inch), and then pull the door open. The holder requires three "AA" size penlight batteries (not supplied), which will serve to keep the clocks running and preserve the memories when no power is supplied to the receiver. Always remove the batteries if the receiver is to be stored without use for more than three weeks.

(5) EXT SP (External Speaker)

This two-contact mini phone jack is for connection of an external loudspeaker, with an impedance of 4 to 16 ohms. When a plug is inserted into this jack the internal speaker is disabled.

(6) LINE OUT

This two-contact mini phone jack provides low-level audio output (0dBm at 600 ohms), which is unaffected by the AF GAIN and TONE controls. This output may be connected to an external audio device that has an input impedance of 600 ohms, such as a teletype demodulator or line amplifier. This connection is not the same as the REC jack on the front panel, which has a higher impedance.

(7) BEEP (Level Adjustment)

This recessed control can be used to adjust the volume of the beep tone that sounds when certain buttons are pressed on the front panel, since its volume is independent of the AF GAIN control. Use a small screwdriver, and rotate the control clockwise to increase volume, or vice-versa, while pressing the MR button repeatedly.

(8) NB NARROW WIDE Slide Switch

This switch selects the blanking pulse width of the noise blanker, when it is activated by the front panel NB (on/off) switch. The NARROW position is for spike-type quick impulse noise, such as from electrical switching machinery; the WIDE position is for longer pulse noise, such as from the "woodpecker" over-the-horizon HF radar system.

(9) REMOTE Jacks

These two "RCA" phono jacks are provided for automatic control of a remote device such as a small tape recorder, to switch it on along with the receiver via the timer function, when the receiver is set to record a program in the absence of the operator. The center contact of the N.O. (Normally Open) jack is not connected to the outer contact when the timer is off, while the center contact of the N.C. (Normally Closed) jack is connected. When the receiver is switched on by the timer (not the POWER switch) the N.O. jack becomes closed (shorted), and the N.C. jack becomes open. Note that the center contacts of the two jacks are (always) connected together.

(10) ACC (Accessory) Jack

This five pin DIN jack provides power, AGC and muting interconnections for Yaesu accessories, including the FRA-7700 Active

Antenna and FRV-7700 series of VHF converters. The 11V DC contact of this connector provides a maximum current of 50mA.

(11) CAT Jack

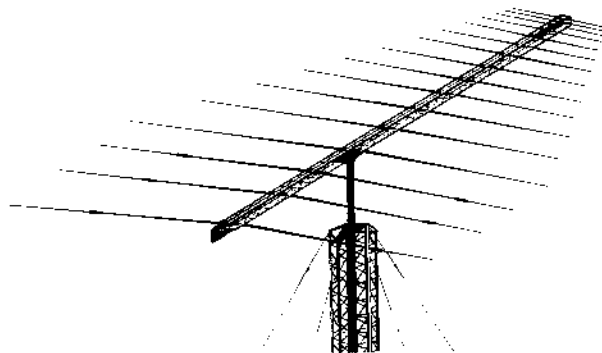
This 6-pin DIN jack accepts digital control signals from an external personal computer via the appropriate (optional) Yaesu FIF-series CAT Interface Unit, allowing computer control of the FRG-8800.

(12) ANT LO-Z Coaxial Jack

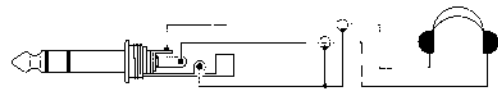
This type-M female connector is provided for connecting an antenna via a low impedance (50-ohm) coaxial feedline cable, with the mating plug. Use this connection for a resonant or tuned, 50-ohm "unbalanced" HF antenna, as described in the "Installation" section.

(13) ANT, GND & MUTE Push Terminals

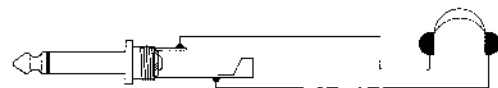
The two adjacent terminals with red levers are antenna connectors for wire antennas. The LO-Z terminal is for a tuned 50-ohm HF antenna, and the HI-Z terminal is for a single-wire non-resonant HF/MW/LW antenna, or a 600-ohm "balanced" feed antenna (with the adjacent GND terminal used for the other side of the feedline). The LO-Z terminal is connected in parallel with the center contact of the LO-Z coaxial jack. The MUTE terminal allows the receiver to be temporarily disabled (by connecting the MUTE terminal to the adjacent GND terminal), for use when the FRG-8800 is used together with a transmitter, as described in the following "Installation" section.



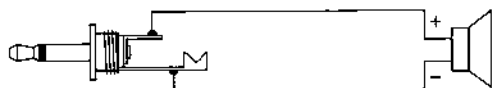
PLUG CONNECTIONS



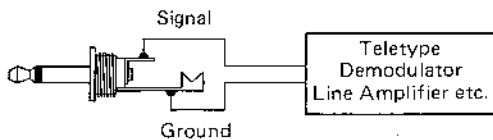
Stereo Headphone Plug



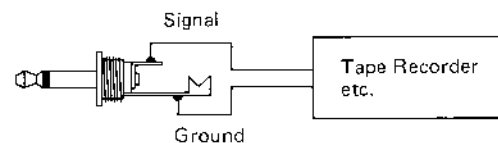
Monaural Headphone Plug



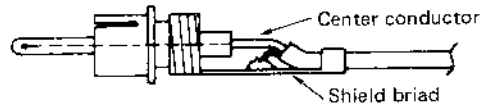
External Speaker Plug



LINE OUT Plug

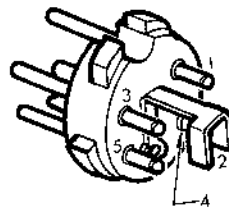


RECORDER Plug



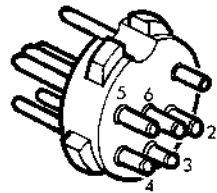
Signal or Control
to center pin, ground
outer contact.

RCA Plug



- PIN 1: GND
- 2: AGC
- 3: N.C
- 4: 11V DC
- 5: BLOCKING BIAS

ACC Plug



- PIN 1: GND
- 2: N.C
- 3: SI (Serial In)
- 4: N.C
- 5: S-Meter
- 6: BUSY

CAT Plug

INSTALLATION

Proper performance of the FRG-8800 depends on correct installation. Please take time to study this section carefully before connecting the receiver to the power source. While the setup procedure for the FRG-8800 is simple, permanent damage to the receiver can occur if improper voltage is applied or if external connections are improperly made.

Initial Inspection

After carefully removing the FRG-8800 from the carton, inspect it for any signs of physical damage. Rotate the knobs and push the buttons, checking each for normal freedom of action. If damage is suspected write down your observations and notify the shipping company (if the set was shipped to you), or your dealer immediately. Save the carton and packing material for possible use later.

Physical Location of the Receiver

The FRG-8800 should be located in a place that allows unobstructed ventilation around the cabinet: particularly the top and bottom. Do not place the receiver on top of another heat-generating device, and keep the top cover clear of papers, etc., so that air can pass freely out of the vents near the back of the set. There are three other factors to consider in setting up the FRG-8800 location: the distance to the antenna feedpoint, to the grounding point, and the proximity of RF noise generating devices such as electric motors and computer equipment. Unfortunately, each of these require some trade-offs. If the receiver is to be installed for optimum VHF reception it is more important that it be located near the antenna, while for optimum reception below 30 MHz (and especially for computer-controlled reception), it is often more important that the receiver be close to ground. Unless a computer is well shielded for RF noise (a rare case), the feedline to the antenna must be shielded and carefully grounded to avoid noise pickup by the antenna from the computer.

Experimentation in several different locations with different ground connections may be necessary to determine the best overall placement of the receiver.

AC Voltage Selection

The FRG-8800 includes a power transformer designed for operation from 100, 120, 220 or 240 volts. Before shipping from the factory, each receiver is set for the voltage used in the area to which it is to be sent. However, there are sometimes several voltages available in one area. It is extremely important that the FRG-8800 be set for the correct AC voltage before connecting the power cord.

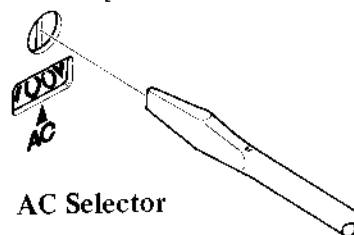
Therefore, before connecting the power cord to the receiver, make sure that the selected voltage indicated in the small window above the AC jack on the rear panel matches your local supply voltage. Also, before connecting the power cord, check that the fuse installed in the rear panel **AC FUSE** holder is of the proper rating: 1A for 100/120V, or 0.5A for 220/240V. Never remove the fuse when the power cord is connected.

CAUTION

The above precautions regarding power connections and fuses must be observed: damage caused by failure to do so can not be covered by the warranty.

If it is necessary to reset the receiver power supply for a different line voltage, proceed as follows;

- (1) With the power cord disconnected from the receiver, insert a small screwdriver into the hole above the AC voltage window on the rear panel and rotate the selector so that the voltage shown in the window matches your line voltage. If in doubt as to the correct voltage, contact your local Yaesu dealer.
- (2) If the selected voltage is changed from 100/120 to 220/240 volts or vice versa, remove the fuse from the **AC FUSE** holder, and replace it with one of the same physical size but different rating: use a 1A fuse for 100/120 volt operation, and a 0.5A fuse for 220/240 volt operation. Your dealer will have the correct fuse for your area.
- (3) Make sure that the power cord that is supplied with the receiver includes the correct AC wall plug for the local wall sockets. If the plug is wrong, contact your Yaesu dealer. Do not replace a 2-pin plug with a 3-pin plug unless all three wires are properly connected in the cord. Some countries require a 2-wire cord which must not be used where 3-pin plugs are required: this can result in dangerous high voltage on the case of the receiver.
- (4) Connect the power cord first to the wall outlet, and then to the **AC** jack on the rear panel of the receiver.

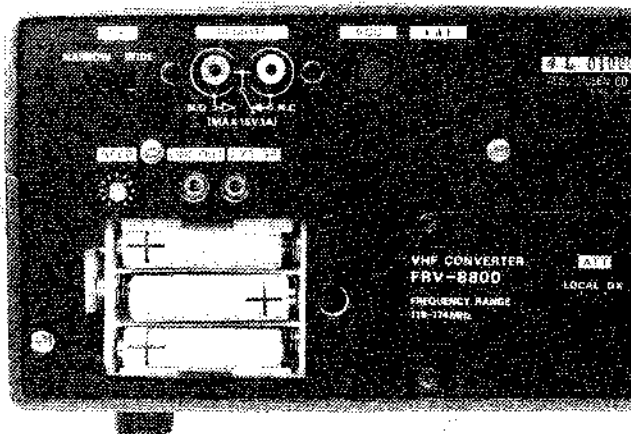


Backup Battery Installation

The FRG-8800 includes a memory/clock back-up system that will preserve the memories and clock times even when the power supply is interrupted. Three AA-size penlight cells (not supplied) should be installed in the compartment on the rear panel. To open the compartment door, gently pry the center pin up about 3mm (1/8-inch) to release the lock, and then pull the door open. Be sure that the batteries are installed in the right directions, as shown below.

Normally, when an external power source is connected, all backup will be provided by the main supply, in which case the batteries will last about one year, after which they must be replaced. However, if the external supply is interrupted or disconnected often, the life of the backup batteries will be much shorter.

If the receiver is to be disconnected from all external power for more than a few days, remove the backup batteries from their compartment.



IMPORTANT NOTE

There are two situations that can cause the microprocessor in the FRG-8800 to "lock up", or malfunction: if the POWER switch is left on (depressed) when connecting or removing the AC or optional DC power connector, or when static electricity is discharged from your finger to the receiver in dry weather. Neither of these are likely to cause permanent damage, but may require that the microprocessor be reset to restore normal operation.

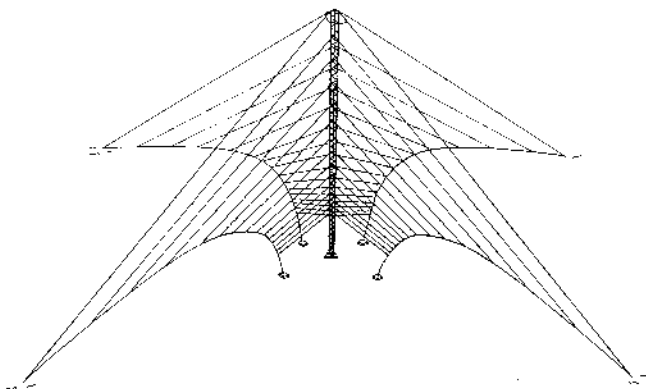
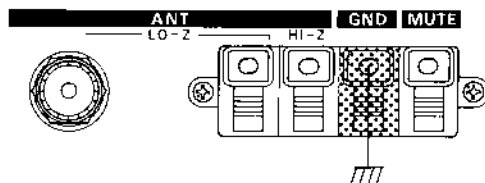
If abnormal operation of the controls occurs, reset the microprocessor as follows (note that any data stored in the memories must be sacrificed);

Set the POWER switch off (undeepressed position), and remove the power cord(s). Open the battery compartment cover on the rear panel, and remove one backup battery.

Wait at least one minute, and then reconnect the power cord(s) and switch the receiver on, confirming that it behaves properly (the memories will be cleared to 10 MHz). Replace the backup battery.

Earth Ground Connection

For best performance and safety, the FRG-8800 should be connected to a good earth ground. This is especially important when using a single-wire or vertical HF, MW or LW antenna. The grounding lead should be a heavy-gauge braided wire or cable, as short as possible, connected to the GND terminal on the rear panel. Ask your Yaesu dealer or consult a radio handbook if you need information on the best way of obtaining a good connection to ground in your area.



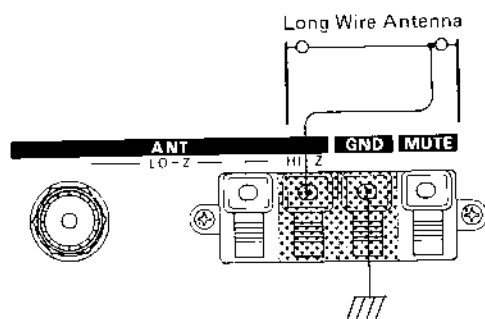
Antenna Installation and Connection

The FRG-8800 is designed to operate only with an antenna connected to the rear panel connectors. This is intentional, as it allows the operator to take full advantage of the gain and directivity characteristics of large antenna systems, which would not be possible with an internal "loopstick" or telescoping whip antenna, such as are used on portable radios. However, if portability is required or if there is no space for an external antenna, the FRG-8800 can be used with the **FRA-7700** Active Antenna (see page 16), which includes a 1.2-meter telescoping whip and high gain preamplifier for frequencies below 30 MHz. In most cases, however, a proper outdoor antenna cut or tuned for the receiving frequency will outperform any whip or preamplifier.

The type and installation of the antenna are critical to proper performance of the FRG-8800. While some strong signals can be received with just about any piece of wire connected to the proper terminal, reception of long distance (DX) or low power stations will require additional effort and care in choosing or constructing and installing the antenna. As there is not enough space here to cover many of the details of antenna systems for LW, MW, HF and VHF reception, please refer to a shortwave antenna handbook if this subject is new to you. A few basic antennas are described below, in order to get started initially.

(1) Antennas for Low and Medium Frequency Reception (below 2 MHz)

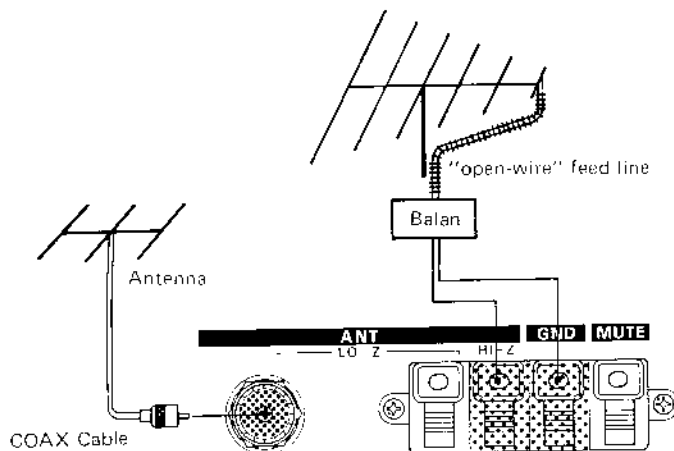
Fair all-round reception can be had if a single long random-length wire is connected to the **HI-Z** terminal on the rear panel. The wire should be supported as high above ground as possible by insulators at the ends, and should be located as far as possible from any other objects. Insulated wire is generally preferable, mainly because it is less susceptible to corrosion. The longer the wire, the stronger will be the signals in these bands. A good earth ground connection, as described above, can be essential to good performance with a random wire antenna.



If there are any strong broadcasting stations located nearby, a random wire antenna is likely to pick up so much energy from those stations that the receiver can be overloaded, particularly if the antenna is very long. This can result in objectionable distorted signals appearing on the wrong frequencies (where the station is not transmitting). The **ATT** control on the FRG-8800 is provided to reduce the overall sensitivity of the receiver and thus reduce susceptibility to such overloading, but this also reduces the strength of desired signals. In situations where this is unacceptable, we recommend the **FRT-7700** Antenna Tuner be connected between the receiver and the antenna, allowing precise impedance matching at the receiving frequency while suppressing signals at other frequencies. The **FRT-7700** also allows a random wire antenna to provide fair to good performance at all frequencies between 150 kHz and 30 MHz. See page 16 for connection details.

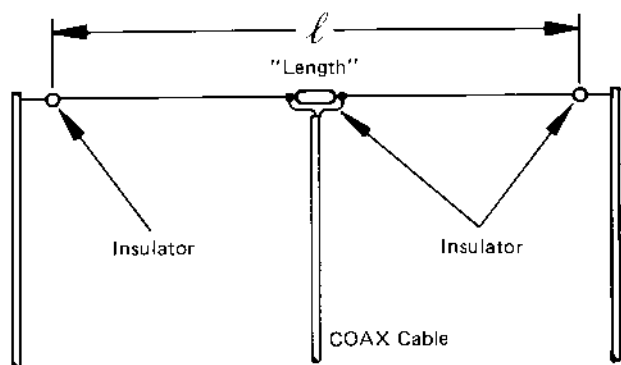
(2) Antennas for Shortwave (HF)

Optimum performance on frequencies between 2 and 30 MHz will generally be obtained through use of a tuned or self-resonant antenna with an impedance of 50-ohms at the receiving frequency. However, such antennas (e.g. the "quad" and "yagi") are generally only optimal at one, or at most several narrow bands or frequencies; giving only fair to poor performance otherwise. Exceptions to this are the directive log-periodic array, and omnidirectional "conical", which are generally large and expensive, but provide excellent long-range performance consistently over a wide range of frequencies. For correct operation all such antennas must be connected to the receiver by either a coaxial cable (to the **LO-Z** 50-ohm coaxial jack), or a high impedance "open-wire" feedline to the **HI-Z** and adjacent **GND** terminals, depending on the feedpoint impedance of the antenna (which must be matched by the feedline and receiver connections).



Fair to good performance on a specific band can be achieved with a simple resonant wire dipole antenna, consisting of two equal-length wires cut for the center of the desired band. Such a dipole can be easily constructed from available materials, or from a kit available through your dealer. If you wish to make such a dipole for optimum performance at a certain frequency, the following formulas can be used to obtain the correct overall length (add a little extra to allow for attaching at the ends).

Length (meters) = $142.5 / \text{frequency (MHz)}$, or
 Length (feet) = $468 / \text{frequency (MHz)}$



Dipole Antenna

The two legs of the dipole must be insulated from their supports at each end, and from one another in the center. Reception of long distance stations requires that horizontal antennas be as high above ground as possible (with a height of a little over twice the length of the antenna calculated above considered about optimum). Connection should be made using 50- or 75-ohm coaxial cable, with the center conductor connected to one leg and the shield to the other. The other end of the cable connects to the LO-Z coaxial jack on the receiver. If the antenna is installed vertically, it need not be so high (the optimum center feedpoint is about the same as the length of the above formulas), but in this (vertical) case the earth ground is more critical.

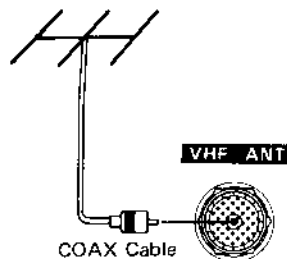
Of course any of the above HF antennas can be used with varying success on frequencies outside of their optimum range, in which case the FRT-7700 Antenna Tuner mentioned earlier can provide considerable improvement in performance. Also, good low frequency reception can sometimes be achieved with an HF antenna if the two feedline conductors are connected together to the HI-Z terminal on the receiver, or the RED terminal on the FRT-7700, but this can also introduce overloading or objectionable noise.

Note: For proper shortwave reception, two antennas should not be connected to the FRG-8800 at the same time. While this may not affect, and may even improve LW and MW performance, it can cause overloading on the higher frequencies. If you wish to use a long wire antenna for the low bands and a separate dipole antenna for a higher band, disconnect the long wire antenna when receiving on the higher frequencies. This is not necessary when the FRT-7700 is used, since an antenna selector is included in the Tuner.

Caution: Do not install an antenna near electric power lines, where there could be any chance of the antenna coming into contact with the high tension lines.

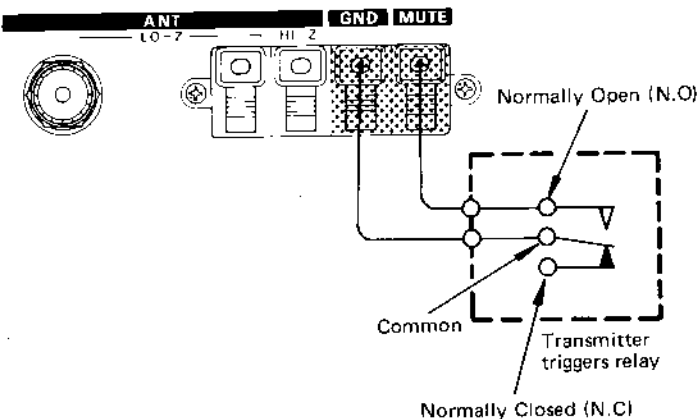
(3) Antennas for VHF Reception

When either the optional FRV-8800 VHF Converter is installed, or an FRV-7700 VHF Converter is used with the FRG-8800, a separate antenna is required to be connected to the VHF ANT jack for VHF reception. Only 50-ohm coaxial cable should be used for the connection, and it should be as short as possible while still allowing the antenna to be mounted high above surrounding objects. For general VHF scanning and monitoring a vertical ground plane antenna is usually preferred, since it does not need to be rotated to cover all directions. However, in some locations a high gain unidirectional (vertical) yagi antenna is best, if most VHF activity is in one direction from the receiving station, or if a rotator is available and the extra gain required. Like HF antennas, the best VHF performance will usually be obtained at some sacrifice of frequency coverage (bandwidth). Contact your local dealer for advice on the best VHF antenna for your location.



MUTE Terminal Connection

The MUTE terminal on the rear panel allows the receiver to be silenced during transmission when the FRG-8800 is used for two-way communication in conjunction with a transmitter (not available from Yaesu). However, the antenna must also be switched so that it is not connected to the receiver during transmission, either via an external T/R switch or relay. Shorting the MUTE terminal to the receiver chassis ground silences the receiver.



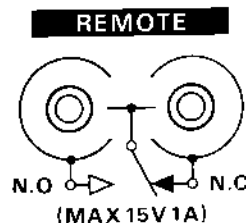
Note that the receiver audio is available at high impedance (50-kilohms) from the REC jack on the front panel, as well as at standard "line" impedance from the LINE OUT jack on the rear panel. Generally the REC jack should be used for direct connection to the high-impedance (HI-Z) audio input to a tape recorder, along with the remote control connection(s) mentioned above. Shielded cable should be used for all interconnections, to minimize noise pickup that might otherwise interfere with reception.

The LINE OUT connector provides audio output at the standard (telephone and studio system) level of 0dBm at 600 ohms. This jack may be connected to the studio mixer for retransmission of received signals (refer to local regulations on retransmission, as this is illegal with certain signals in most countries).

Note that the AF GAIN and TONE controls do not affect the audio at the REC or LINE OUT jacks.

REMOTE and LINE OUT Connections

The two REMOTE jacks on the rear panel are connected to a relay in the FRG-8800. The center jack contacts connect together to the (common) moving relay contact, and the outer jack contacts connect independently: the RED jack to the "N.O." (Normally Open) relay contact, and the YELLOW jack to the "N.C." (Normally Closed) relay contact. The relay is controlled by the clock timer, allowing automatic control of a tape recorder or other device simply by the proper setting of the FRG-8800 timer. Thus, for example, if the "remote control" jack on a tape recorder is connected to the yellow N.C. jack on the FRG-8800, the recorder will be switched on and off along with the receiver at the preprogrammed time, allowing program recording in your absence. This example assumes that the remote control jack on the tape recorder switches the recorder ON when the jack is shorted, and OFF when open-circuited. The other (RED) jack is provided for the opposite situation. Remember that the center contacts of the two REMOTE jacks are always connected together.



TIMER FUNCTION	N.O Terminal	N.C Terminal	FRG-8800
ON TIMER	 OPEN → CLOSE	 CLOSE → OPEN	ON at the programmed time
OFF TIMER	 CLOSE → OPEN	 OPEN → CLOSE	OFF at the programmed time
SLEEP TIMER	 OPEN → CLOSE	 CLOSE → OPEN	OFF after the programmed period of time*
When the timer is activated			* Up to 59 minutes

Personal Computer Interconnection

The CAT System allows external control of the power, mode and frequency functions of the FRG-8800 via a variety of brands of personal computer (not available from Yaesu). "CAT" stands for "Computer-Aided Transceiver", since this system was originally developed for amateur radio transceivers.

Interconnection between the computer and receiver requires a digital interface unit, to convert parallel 8-bit ASCII data from the computer into 4800 bits/sec serial data at the correct voltage level required by the FRG-8800. Yaesu offers the FIF-series CAT Interface Units for this purpose. Some of these Units are for installation in particular brands of computers, but the FIF-232C Unit is designed for use with any computer that is equipped with an EIA standard RS-232C serial output port capable of 4800 bits/sec operation. Except for the FIF-232C, all of the Yaesu CAT Interface Units also include an analog-to-digital converter to allow the computer to measure the relative strength of received signals, for interactive operation between the computer and receiver.

The FIF interface units include a DIN plug for connection to the CAT jack on the rear of the FRG-8800, and some means of easy connection to (or installation within) the computer. The FIF-232C also requires connection to the AC line.

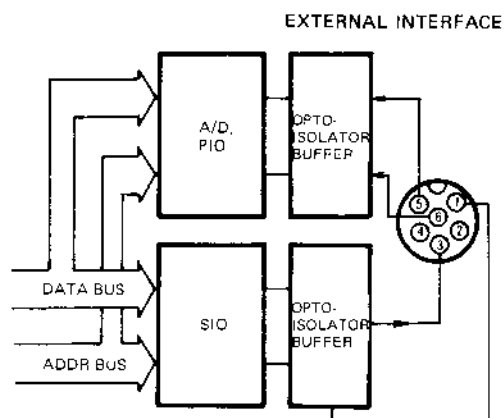
Additional details are provided in the "Operation" section of this manual, and in the manual supplied with each FIF Interface Unit.

Note: While the FRG-8800 was designed to be well shielded against RF interference from computer noise, personal computers are generally not designed to limit the amount of RF noise that they produce,

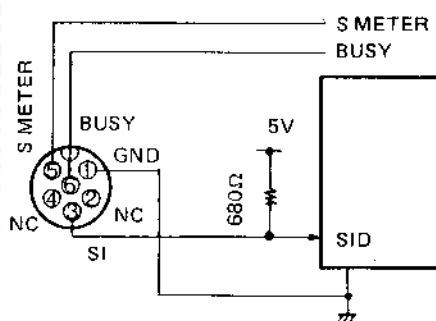
except within very broad limitations: some computers may produce enough noise to interfere with reception, particularly on lower frequencies. Some computer manufacturers and suppliers offer modifications and outboard noise filters to suppress RF noise, but Yaesu cannot accept responsibility for interference that may be caused by your computer. However, if such interference is encountered, it can often be minimized or eliminated by the following steps (first tune in the noise on the receiver, and switch the computer off and on to make sure that it is from your computer):

- (1) Locate the HF antenna as far as practicable from the receiver and computer, and use only the best coaxial cable feedline available, with proper connection to the coaxial LO-Z jack on the receiver, and impedance matching at the antenna. This usually calls for a self-resonant antenna, as described above. For LW and MW reception it may be necessary to turn the computer off.
- (2) Pay special attention to the earth ground connection to the receiver. In most cases it may be necessary to not connect the earth or receiver chassis ground to the computer chassis. A specially filtered signal ground line for the CAT System is provided in the CAT Interface cable. However, there is no fixed rule for grounding to minimize noise, so some experimentation may be necessary.
- (3) Use only good quality shielded cable for all external connections to the receiver, and to the computer. Noise can easily be picked up by a device such as an external speaker cable or tape recorder, and passed to the receiver. Disconnecting one accessory at a time from the receiver may help to isolate the culprit.

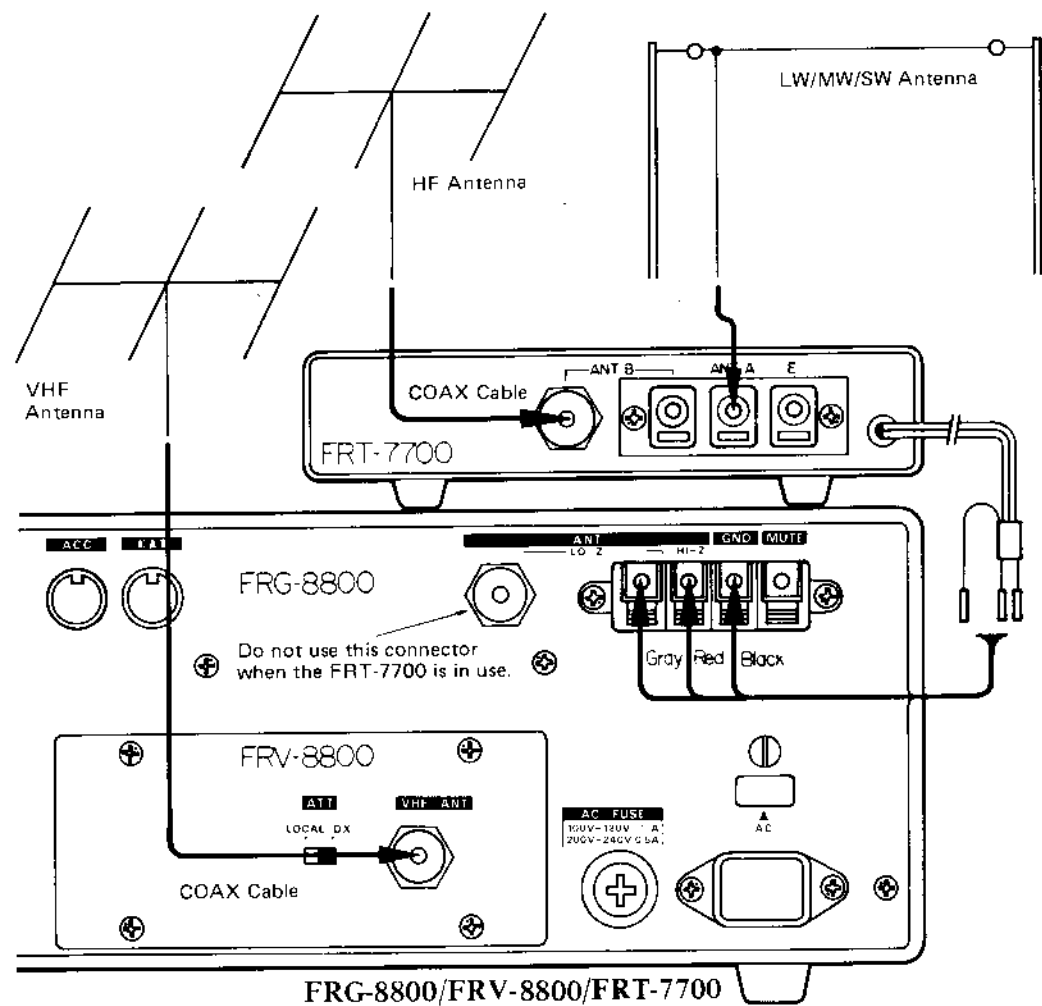
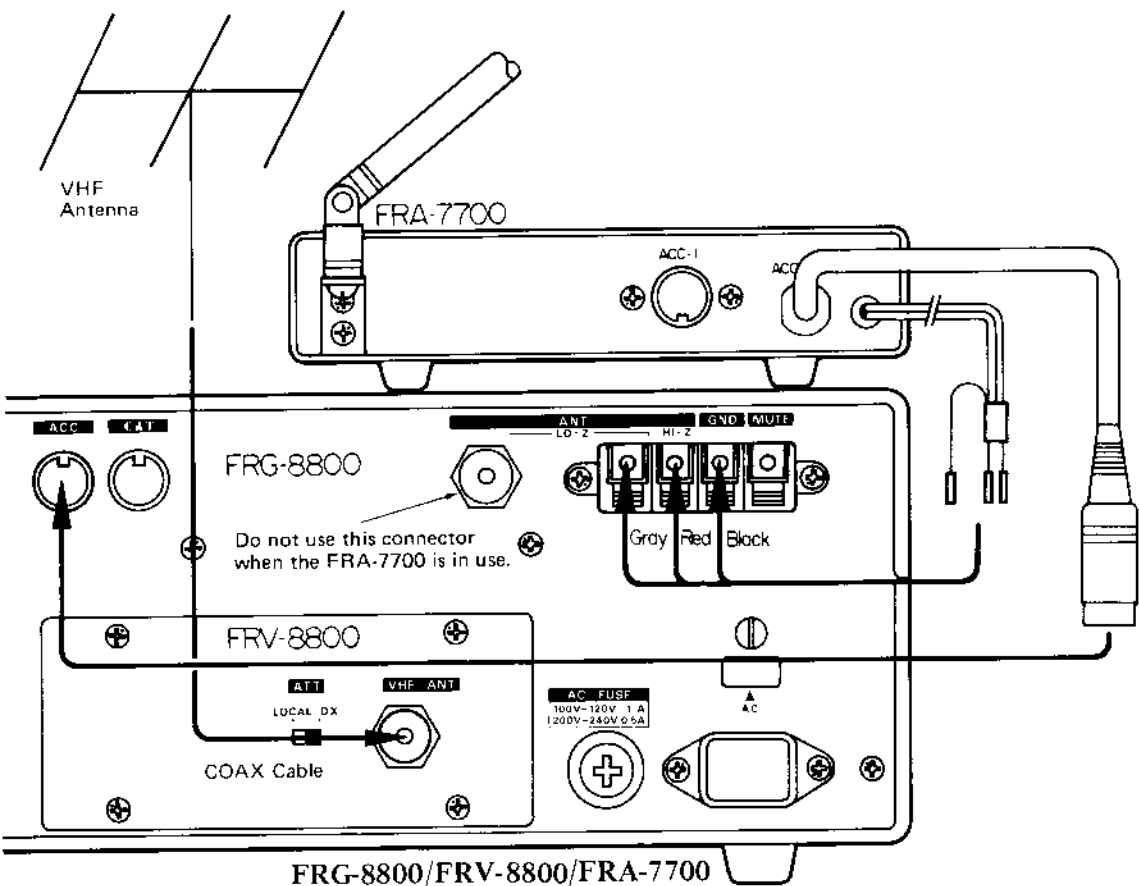
EXT CNTL PINOUT

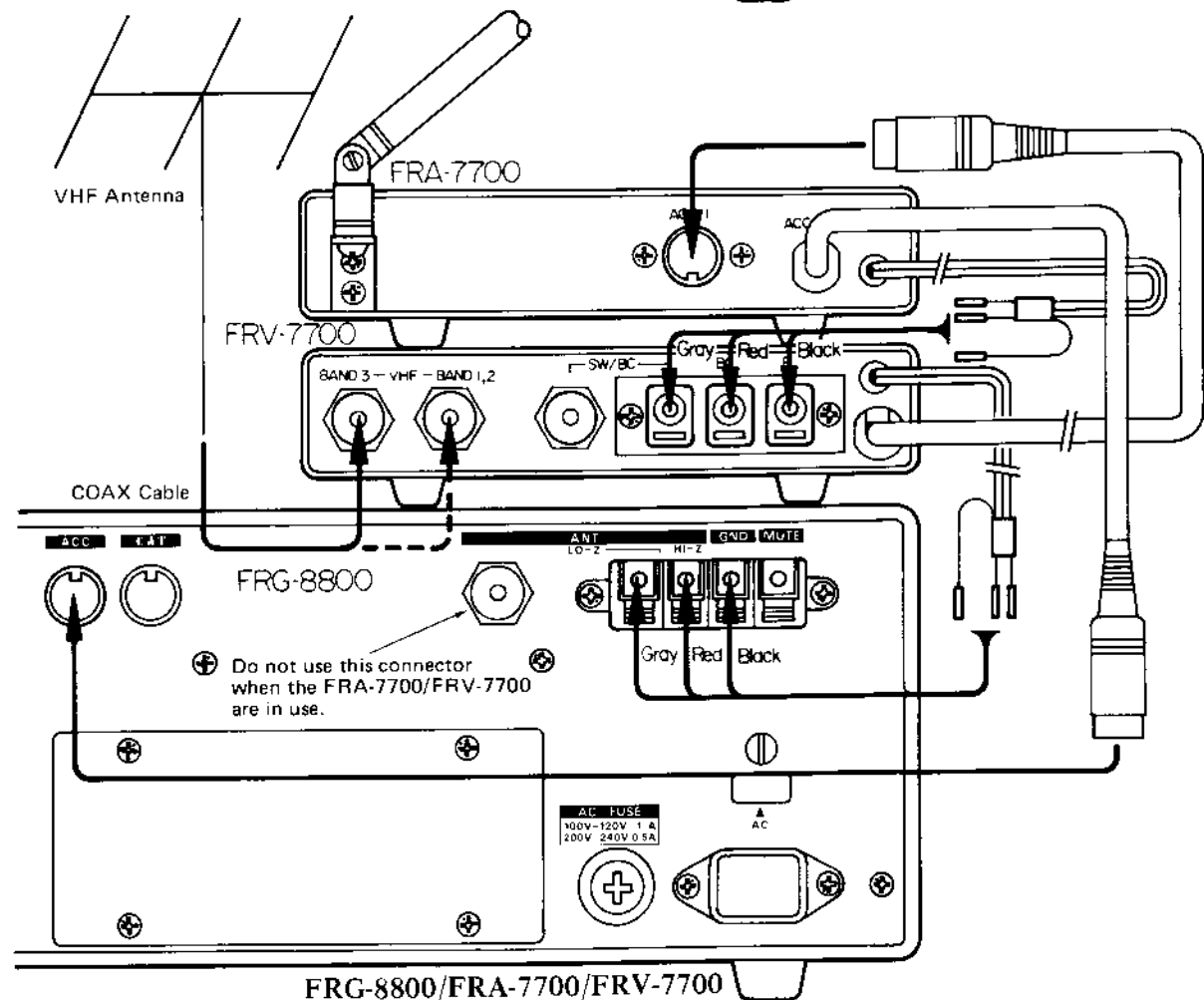
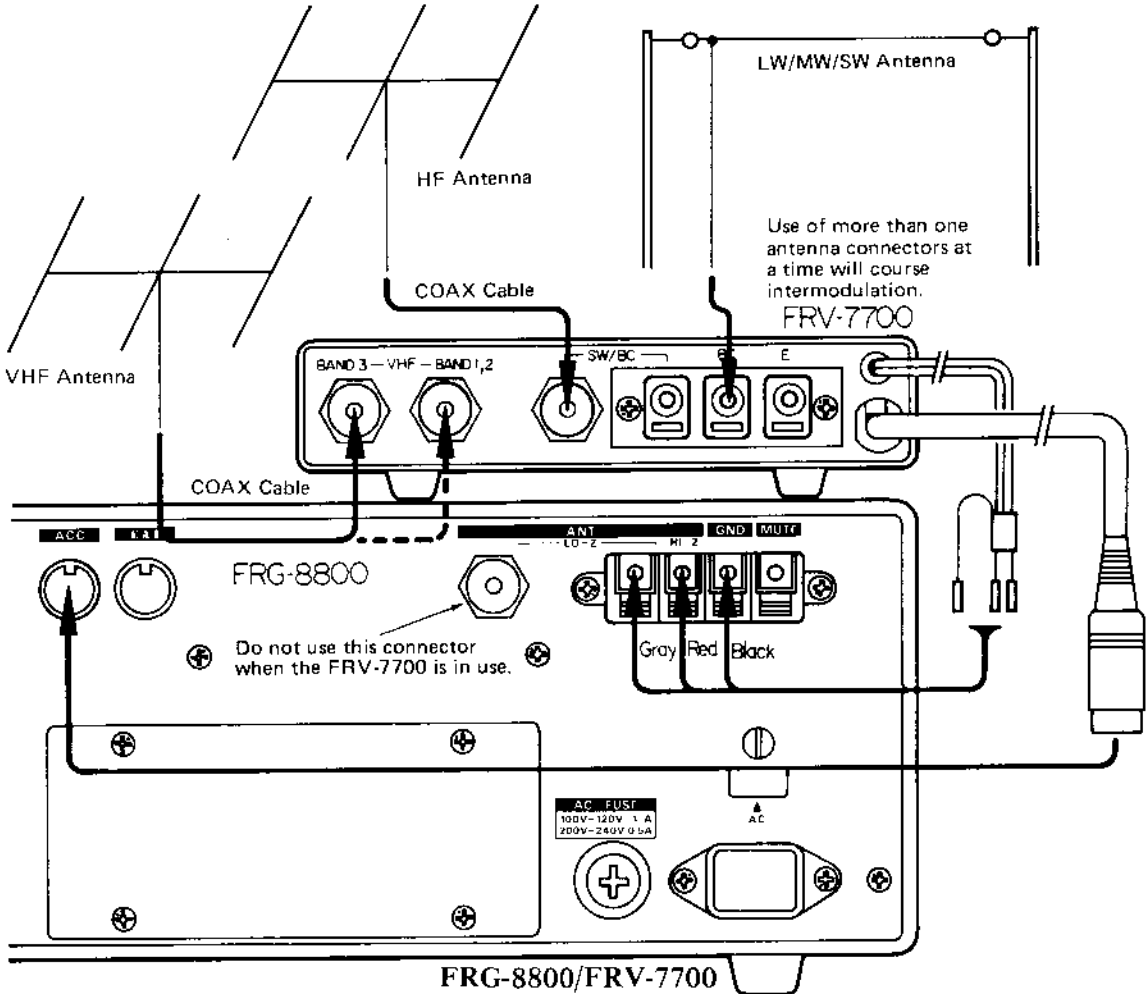


FRG-8800



ANTENNA & ACCESSORY CONNECTIONS





Basic operation of the FRG-8800 is quite simple. However, some of the advanced digital functions can be confusing at first if the operator is not familiar with the operation intended by the designers. Please read this section carefully while trying out each step on the receiver, after making sure that the power, antenna and ground connections have been made correctly, as described in the preceding section.

Preliminary Setup

If the receiver has been used previously by someone else, you may wish to clear all of the memories and reset the clocks and cpu, as the following procedures will assume that the receiver memories are clear. To do this, with the POWER switch off, remove the external power connection(s) from the rear panel, open the backup battery access door, and remove one of the backup batteries for a few seconds. Then replace the backup battery, access door and power connector(s).

Set the controls and switches as follows;

POWER switch	out (OFF)
SQUELCH control	counterclockwise
AF GAIN control	counterclockwise
AGC, NB, and DIM keys	all out
FAST button	in (selected)
FINE control	12 o'clock
ATT control	counterclockwise
CLOCK/FREQ selector	to FREQ
TIMER ON button	out (OFF)

Now press the POWER button to turn on the receiver. The display should take on a soft green glow, and the default receiving frequency "10.000.0" (10 MHz) appear, along with "BUSY" above and to the left of the frequency, and "AM" below it. If nothing happened, check your power connections. If some other data is displayed, the memories and cpu were not cleared.

Advance the AF GAIN control clockwise for comfortable volume in the speaker (or headphones, if connected). The "BUSY" indication shows that the squelch is now open. Rotate the SQUELCH control clockwise to check that the indication disappears when the squelch closes, and then return the SQUELCH control counterclockwise for now.

The default mode is AM wide, indicated by "AM" below the frequency display. Press the NAR/WIDE button once to select AM narrow momentarily ("NARROW" will appear at the bottom center of the display, and the audio should be noticeably narrower), and then press NAR/WIDE again to return to AM wide.

Frequency Selection

The FRG-8800 provides a convenient combination of keypad and knob tuning techniques, to allow very fast, accurate frequency selection. To select any frequency in the range of the FRG-8800, proceed as follows;

- (1) First use the numeric keypad to select the MHz digits of the desired frequency. For example, if you wish to tune to 21.550 MHz (from 10.000 MHz), the first step is to press 2, 1, and then the orange MHz key on the keypad. Note that before the MHz key is pressed the digits just keyed in will appear in the 10 and 1 kHz digit locations on the display, shifting to the MHz locations only when the MHz key is pressed*. Also note that the operating frequency does not change until the MHz key is pressed.

If you accidentally press the wrong key when entering the digits of a new frequency, just press 0 three times and re-enter the desired digits before pressing MHz. If digits are pressed inadvertently (when you do not wish to change frequency), it will be necessary to move the main knob slightly to clear the keyed digits and return to the original frequency display (do not press MHz).

- (2) After pressing the MHz key and confirming that the display now shows the desired MHz digits, press the numeric keys for the kHz digits desired (including zeros), and then press the blue kHz key after confirming that the correct digits are shown on the frequency display. The actual receiving frequency will change only when the kHz key is pressed. Errors can be corrected in the same manner as above. Continuing the above example for selecting 21.550 MHz, press 5, 5 and 0, followed by kHz.
- (3) The main dial can then be used for tuning around the immediate vicinity or band just selected. The FAST selection provides for coarse tuning over a wide range, and is usually sufficient for all AM wide and FM reception. Press SLOW for more precise tuning (especially for AM narrow, SSB and CW modes). Of course the main tuning knob can be used for tuning over any part of the receiver range, but when changing frequency by more than 1 MHz or so it is easier to use the keypad, once a little experience is gained.

Note: After keying in any numerics on the keypad either the orange **MHz** or blue **kHz** key must be pressed, or the main tuning knob moved. Otherwise the receiving frequency will be different than that displayed.

* if the desired frequency is below 1 MHz, key in the kHz digits first as described in part (2), and then "0" and **MHz**. Otherwise the MHz zero entry will be refused if the resulting frequency would be below 150 kHz. Refusal of keyed data is indicated by a longer than normal beep, and cancellation of the keyed data.

AM Broadcast Reception

Most commercial broadcasting stations below 30 MHz use AM (Amplitude Modulation). Use the above tuning methods to locate an AM station, either on the standard MW (AM) broadcast band, or any of the shortwave broadcast bands. For example, if your local AM station is at 810 kHz, press **8**, **1** and **0** on the keypad, followed by the blue **kHz** key, and then **0** on the keypad, followed by the orange **MHz** key. Now you can adjust the main tuning dial slightly while watching the S-meter indication to ensure that the signal is tuned for peak signal strength.

Adjust the **TONE** control to select the audio tone that is most comfortable for you. Note that in the case of weak signal reception when the background noise level is high, the **TONE** control can be used to suppress much of the noise by setting it more counterclockwise (towards the "LOW" position) than usual.

The **SQUELCH** control is of limited usefulness for AM reception, except when waiting for a station to come on the air, on an otherwise clear frequency. This is not uncommon for shortwave broadcast stations. To make use of this, though, you must know the frequency of the station and have the receiver tuned there in advance. If the narrow (AM) mode is selected, the likelihood of nearby stations and noise opening the squelch will be lessened. After selecting the mode, rotate the **SQUELCH** control to the point where the background noise is just silenced, and the **BUSY** indication disappears from the display. Note that any signal strong enough will open the squelch, whether or not it is the intended station. This tendency can be reduced if, once the desired station comes on, you rotate the **SQUELCH** control further clockwise to the point just before the squelch closes, and note this for use later with that station and frequency.

When the desired station comes on the air and opens the squelch, press the **NAR/WIDE** button to select AM wide.

Fading and Noise Rejection

Signals from stations more than about 50 km distant may be subject to extreme fluctuation (called "fading" or "QSB"), due to variations in the reflecting layers of the ionosphere. See the section on Shortwave Propagation. The actual change in signal strength is often a factor of 100 to 1000 times or more (between the weakest and strongest moments). The AGC circuit in the FRG-8800 is designed to counteract this fading, by increasing and decreasing the receiver gain as the signal fades and peaks. This action can be seen by fluctuations of the S-meter indication, which is actually a display of the AGC voltage. However, in some circumstances the speed of the AGC circuit can be either too fast, or not fast enough, to follow the fading, in which case some fluctuation or even distortion may occur in the audio.

In most cases, when receiving voice signals in the AM or SSB modes, the best quality reception will result when the **AGC** button is set to the slow (undeepressed) position. However, this can be a nuisance when tuning for weak signals, since any strong signals tuned through will desensitize the receiver for a few seconds, possibly causing weak stations to be passed over. To avoid this problem, advanced shortwave listeners and DXers always set the AGC to the fast position (depress the **AGC** button) when tuning, and the switch to slow when a station is found (unless interference or impulse noise is present).

The noise blanker in the FRG-8800 is designed to effectively blank the two common types of impulse noise that are found on the shortwave bands. These are the short duration man-made "spikes" emitted by poorly shielded automobile ignition systems and some electric motors, and the "woodpecker" over-the-horizon radar (heard in some parts of the world). The first type of noise has a very short pulse duration, and thus requires a short blanking pulse, selected in the FRG-8800 by setting the rear panel **NB** switch to the **NARROW** position. The "woodpecker" has a much longer pulse duration, but a constant pulse rate, requiring that the rear panel **NB** switch be set to the **WIDE** position.

When noise is heard on the receiver, just press the **NB** button on the front panel. The noise blanker will the sense any noise pulses that are stronger than the received signal, and shut the receiver (IF stages) off for a brief instant. Unfortunately, when the noise is being blanked the signal will be too, which may be noticed as a slight distortion in the audio output, especially if the rear panel **NB** switch is set to **WIDE**. For this reason the **NB** switch should be kept in the **OFF** (undeepressed) position except when impulse noise is present on the receiving frequency.

One final word on noise blanking: it is not always possible to blank every type of noise that appears on the shortwave bands. For example, semi-random noise such as from electrical storms will only be partially blanked, and generally not enough to warrant use of the noise blanker. Also, since the "woodpecker" is a system designed to reflect very strong pulses from far off objects so as to produce an echo, the returning echo will lag behind the outgoing signal at all points along the path. Thus while the noise blanker (set for WIDE pulses) will blank the outgoing signal, some situations where the echo is long-delayed will result in some of the echo getting past the blanker (this usually sounds like a softer thumping in comparison to the sharp outgoing pulse). In this case the noise will be reduced, but not eliminated. In such cases where the noise blanker cannot remove all of the noise, it is often best to depress the **AGC** button to the **FAST** position if the remaining noise is stronger than the received signal.

Interference from Other Stations

While not so common in the MW band, interference from stations on adjacent frequencies often disturbs reception on the shortwave bands. When this is encountered in the AM mode the **NAR/WIDE** switch can be pressed to select the narrower IF filter. However, with the narrower AM bandwidth fidelity will also be reduced, which can often be remedied somewhat by using the main tuning knob (set for the **SLOW** tuning rate) to intentionally detune the station slightly to one side or the other.

An alternative method which can offer better results is **ECSS** (Exalted Carrier Single Sideband) reception of AM signals. This is generally preferred for weak signal reception, when fidelity is unimportant. Not many receivers have the stability or tuning capabilities that are required for use of this mode, but the FRG-8800 makes it easy, once some experience has been gained, because the very high speed digital S-meter makes precise zero-beating simple. The receiver should be allowed at least 30 minutes to warm up before using **ECSS**.

(1) To receive an AM signal using **ECSS**, first tune in the station in the AM (wide) mode, and press the **NAR/WIDE** button to change to AM narrow. Then retune for peak signal indication on the S-meter, with the **SLOW** tuning rate selected for the main tuning knob. It is a good idea to practice this on some strong stations while getting the feel for the technique.

(2) Now press either the **LSB** or **USB** button; most broadcasters use both sidebands, so the choice will depend on which sideband is most free from interference. If there is interference from a station lower in frequency than the desired one, use **LSB**; and vice versa for **USB**. Some shortwave broadcasters are now making experimental transmissions with the carrier and only one sideband, so for these stations only one sideband can be used, which must be determined by testing both unless you have been informed.

(3) Once the **LSB** or **USB** mode has been selected the carrier heterodyne will be heard. Now turn the **FINE** control slowly to lower the pitch of the heterodyne until it can no longer be heard. The audio will become intelligible, but the **FINE** control will still require some additional adjustment to obtain precise zero-beat, so that music and voices sound normal. This can be done by ear, but the S-meter can provide more accurate tuning. Set the **AGC** to fast (depressed), and watch the signal indication while carefully adjusting the **FINE** control. As the receiver is tuned closer to zero-beat the signal indication will fluctuate regularly, at a slower and slower rate. Tune for the point where the fluctuation stops (this is where practice pays off). Then set the **AGC** button back to the slow (undeepressed) position. Slight re-zeroing may be necessary from time to time to correct for drift, so if the music or voices begin to sound odd, set the **AGC** to fast, retune the **FINE** control, and return the **AGC** to slow.

Once you are comfortable with the technique on strong stations, try it on weak ones, comparing with normal AM detection to see the difference. **ECSS** can also be used when tuning around the shortwave broadcast bands, as the carrier heterodyne is helpful in located stations, but for strong stations in the clear AM wide generally gives better fidelity and is easier to use. Remember to return the **FINE** control to center before changing to another mode, or the displayed frequency will be offset.

Another type of interference from other stations is caused by very strong stations overloading the mixer stages in the receiver. The FRG-8800 has a special FET RF amplifier and diode ring mixer to minimize this effect, but it can still occur if an extremely strong signal reaches the antenna, such as from a nearby transmitter. In this case the interference usually can not be easily tuned out without losing the desired signal. The **ATT**enuator control on the FRG-8800 provides a means to remedy the problem if the desired signal is fairly strong. Just rotate the **ATT** control clockwise after tuning in the desired signal, until the interference drops to an acceptable level, or ceases. Note that the S-meter indication will be decreased. When the attenuator is used, remember to switch it back off (fully counterclockwise) when tuning to a new station, or sensitivity will remain low.

If weak signal reception is disturbed by this type of interference, the situation can usually be improved by using an antenna tuning unit, such as the **FRT-7700**, which provides some additional filtering of signals far away (in frequency) from the receiving frequency. This reduces the level of the overloading signal without affecting weak signals to which the receiver is tuned. The same result can be obtained by using a self-resonant antenna cut specifically for a selected frequency (but only when receiving that frequency).

Single Sideband Reception

Single sideband is the most common voice mode on HF for two-way communications, such as amateur radio, land and marine mobile and base, and military communications. SSB is now also being used experimentally by shortwave broadcasters. USB (Upper SideBand) is used most commonly on frequencies above 10 MHz, and LSB (Lower SideBand) below that, although many exceptions may be found. Begin by selecting the mode based on the above rule of thumb, and if you cannot tune the signal, try the other sideband.

The **SLOW** tuning rate for the main knob will be necessary to tune in SSB signals accurately, and the **FINE** control may also be useful if the station seems to drift (this is not uncommon for older SSB transmitters). If you use the **FINE** control remember to return it to center before retuning the main knob, or the displayed frequency will be slightly off. Also, as mentioned before, tuning for weak signals is much easier if the **AGC** is set to fast when tuning, and then to slow when monitoring a station (unless it is very weak, or close to a strong station).

Interference from nearby SSB stations can sometimes be reduced by the **ATT** control, but there is no narrow/wide selection for this mode, since the receiver bandwidth is already optimized to match that of the transmitted signals. The noise blanker will be found very effective in the SSB modes, since the signals do not include a carrier that must be overcome by the noise before it can be blanked. The **TONE** control is also useful in these modes, especially to reduce atmospheric noise hiss.

CW (Radiotelegraph) Reception

CW (Continuous Wave radiotelegraphy) is popular mainly in the amateur bands, perhaps because of its unique quality of being readable even when other modes (at the same power level) would be too weak or interfered with to be copied. One of the reasons for this is the very narrow bandwidth of CW signals, which can be used to special advantage in the FRG-8800 when the CW narrow mode is selected.

To tune CW signals (found commonly at the low ends of the amateur bands), set the **AGC** to fast, press the CW mode button but not the **NAR/WIDE** button just yet. When near the desired frequency range, press the **SLOW** tuning rate selector, and tune slowly for a signal, so that the pitch is about 800Hz (between G and G# notes). Then press the **NAR/WIDE** button to select CW narrow, and very carefully adjust the **FINE** tuning until the audio level is peaked.

Return the **FINE** control to center and return to CW wide to facilitate tuning to another station.

FM Reception

The FRG-8800 comes equipped with the narrow (± 5 kHz deviation) FM mode as standard. This mode is most commonly used for two-way FM communication on the VHF bands, which can be received by the FRG-8800 when the optional FRV-8800 VHF Converter is installed, or with one of the optional (outboard) FRV-7700 Converters. Some FM is also used by radio amateurs on frequencies between 29 and 29.7 MHz (HF). Note that this narrow FM differs from that used by FM broadcasters on some VHF frequencies, which has a much wider (± 50 kHz) deviation. This FM wide mode is available as an option for the FRG-8800, but can only be used in those areas where the FM broadcast band is between 118 and 174 MHz.

Tuning FM communications is very easy; just set the tuning rate selector to **FAST**, and tune the main tuning knob for the best fidelity audio. The AGC and noise blanker are not used for FM reception. Instead, the **SQUELCH** control should be set while on a clear frequency just to the point where the noise is silenced and **BUSY** disappears from the display. Then when a signal appears (or is tuned in), the squelch will open.

Memory Operation

The FRG-8800 allows you to store up to 12 frequencies for quick recall at a later time. The mode and wide/narrow at the time of memorizing are also stored. The process of memory storage simply transfers the data from the "VFO" (Variable Frequency Oscillator) to the memory channel in the internal computer selected by the **M CH** selector. Previously, all operation described was in the VFO. To transfer the mode and frequency to a memory channel, just set the **M CH** selector to the desired channel number, and press the **VFO** \rightarrow **M** button at the lower right corner of the keypad. A beep will sound, indicating that the data has been transferred into the memory channel. Always be sure that the **FINE** control is centered before storing a new frequency.

To recall a stored memory channel, set the **M CH** selector appropriately, and press the **MR** (Memory Recall) key just to the right of the blue key. A beep will again sound, and the display will show the stored data, plus the memory channel number to the right of the frequency. Reception will now be on the memory channel.

Pressing the **MR** button as above activates the memory mode, indicated by the presence of the channel number on the display. In this state the **MODE** buttons, tuning controls and the **VFO** \rightarrow **M** key are deactivated. However, rotating the **M CH** selector will now cause the display (and reception) to reflect the contents of each memory channel (10 MHz AM wide is the default, if nothing has been stored previously). To return to the VFO at any time, just press the large **VFO** button at the bottom of the keypad. The VFO mode and frequency will remain unchanged from what was set when the memory mode was entered. However, you can transfer memory channel data into the VFO while in the memory mode, by pressing the \rightarrow **VFO** key at the upper right corner of the keypad before pressing the **VFO** key. Use this key if you want to change only the mode or frequency of a memory; by transferring it into the VFO, making the desired change, and then restoring it (if desired) with the **VFO** \rightarrow **M** button. The presence (memory mode) or absence (VFO) of a memory channel on the display shows which state is currently selected.

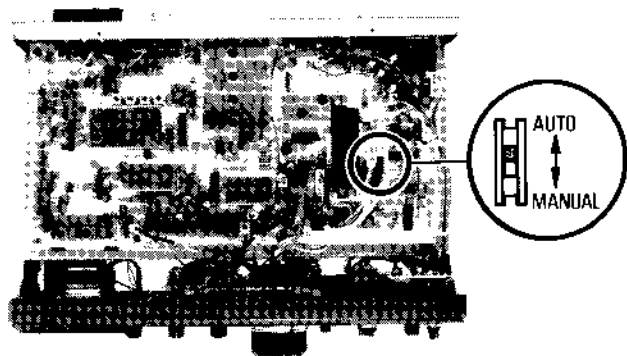
Scanning

Three types of scanning are provided in the FRG-8800: **M SCAN** (Memory Scan), which scans all of the memory channels; **S SCAN** (Selective Scan), which scans only preselected memory channels; and **P SCAN** (Programmable Band Scan), which scans all frequencies between any two (adjacent) memory channels.

There are two possible scan halt modes, **AUTO** and **MANUAL**, applicable to all three types of scanning. In the **AUTO** stop mode, the stopping point of the scanner (in all modes) is the level at which the squelch opens, so the setting of the **SQUELCH** control is critical: before activating the scanner, set the squelch so that it is just closed (silenced) when no signal (only noise) is being received. While scanning the **SQUELCH** control can be re-adjusted for the desired halt threshold level. The **AUTO** mode is preferable for VHF scanning (with the optional FRV-8800 or FRV-7700 VHF Converters).

In the **MANUAL** scan halt mode, the scanner can be stopped at any time by pressing the **PAUSE** button at the right side of the keypad. In this mode the setting of the squelch is irrelevant, and thus the scanner can be used most easily for multi-mode memory scanning, and on frequencies below 30 MHz.

Selection of the scan halt mode is made by the **AUTO/MANUAL** miniature switch inside the top cover, just to the right of the cpu. This switch is normally set to the **AUTO** position at the factory prior to shipping.



Regardless of the setting of the scan halt mode switch, scanning can always be stopped and resumed manually by the **PAUSE** key.

Any scanning mode may be activated from either VFO or memory operation.

(1) Memory Scanning

Scanning of all of the memory channels is activated by pressing **M SCAN**. The scanner will check each memory channel sequentially for about 1/2-second before moving to the next channel, and each time the scanner moves from channel 12 to channel 1 a beep will sound, giving an audible indication that the scanner is active.

(2) Selective Memory Scanning

This mode allows scanning of only preselected memory channels. To select a channel to be scanned, first recall the channel (**MR**, followed by selection with the **M CH** selector), and then press the **M SELECT** key to the right of the **9** key on the keypad. "**M SELECT**" will appear above the channel number on the display, to indicate that this channel will now be included in selective scanning. Once the desired channels have been preselected in the above manner, press the **S SCAN** key at the right side of the keypad. Any channels that have not been selected will be skipped over.

(3) Programmable Band Scanning

This mode allows scanning of any preselected range of frequencies within the tuning limits of the receiver, at two selectable step rates (selected by the **FAST** and **SLOW** selector buttons to the right of the main tuning knob). First store in any two adjacent memory channels the desired scanning limits: if you prefer to start scanning upwards in frequency, put the lower limit in the lowest numbered channel, or vice versa if you want to start scanning downwards. Then press the **P SCAN** key just to the right of the **6** key on the keypad, to activate the scanner. When the scanner reaches the frequency stored in the higher numbered channel (or that in memory channel 1 if the **M CH** selector is set for memory channel 12), the direction of scan will reverse, and return in the opposite direction to the starting frequency in the lower numbered channel. You can change the scanning rate at any time by pressing the **FAST** or **SLOW** tuning rate buttons. Note that the operating mode (**AM/SSB/CW/FM**) used in scanning will always be that of the lowest numbered channel. If the mode of the next higher channel is different, it will not affect the scanner, which will still reverse when it reaches the stored frequency.

If you halt the scanner on a frequency you want to store in memory, press the **► VFO** key to move it first into the VFO, and then set the **M CH** selector to the desired channel, and press **VFO ►M**.

Digital Clock Operation

The dual time digital clock in the FRG-8800 is designed especially for the shortwave radio operator, and is built in to the microprocessor. Either of two time zones can be displayed by setting the clock/timer function selector at the upper right corner of the front panel to **CLOCK 1** or **CLOCK 2**, in which case the time will be displayed whether or not the receiver **POWER** switch is on, as long as the receiver is connected to external power. If the external power source fails, the clock will continue to run on the internal backup batteries, but the time will not be displayed until external power is restored.

Clock time is displayed in 24-hour format, since that is generally used for international broadcasting, and is accurate to within ± 10 seconds per month. A blinking decimal is displayed between the hour and minute digits. Time setting is performed while the receiver is on, using the (**SET**) **HOUR** and **TIME** buttons, and the numeric keys on the keypad. We recommend setting **CLOCK 1** for universal time (UTC, or GMT), since that is used by the international broadcasting stations, and **CLOCK 2** to your local time (in 24-hour format). This should make later use of the automatic power timer straightforward.

Before setting the time, with the clock/timer function selector set to the **FREQ** position, tune in a standard time station, such as WWV at 5, 10 or 15 MHz. To set the clocks, move the clock/timer function selector to **CLOCK 1**. (Note that the receiver will remain active, but that all of the mode and frequency controls are disabled when the function selector is set to any position other than **FREQ**). On the display, the frequency will be replaced with "**0.00**" (default), plus the time in hours and minutes since the cpu was last reset. The decimal point in the time display will blink at one-second intervals while the clock is active.

Press the **SET TIME** button to clear the clock, and enter the time setting mode. The blinking decimal will disappear, and only three zeros remain. Now note what the next minute mark will be from the standard time station, and key in the hour digits, with a leading zero if before 10 o'clock. Next key in the first minute digit, and wait to press the last digit until the standard time station announces the next minute. At the instant the last (fourth) digit key is pressed, a beep will sound, the clock will start, and the blinking decimal reappear.

EXAMPLE: set the clock to 20:30 (8:30 PM)
One minute or so before 20:30, press **SET TIME**, and then **2**, **0** and **3** on the keypad. Wait until the time standard chimes the 30 minute mark, and at that instant press **0**. The clock will beep and start and the blinking decimal appear.

Don't forget that four digits must always be pressed to set the time - even if they are all zeros, and that the clock will start immediately when the fourth digit is pressed.

Setting different hour digits in **CLOCK 2** is easy once **CLOCK 1** has been set. Just move the function selector to **CLOCK 2**, and again press the **SET TIME** button. Now the only the hour digits will be reset to zero, while the minute digits remain unchanged (from those set in **CLOCK 1**). The blinking decimal will again disappear, indicating that the clock is in the set mode. Now determine your local time in 24-hour format (just add 12 hours if after 12 noon), and press the appropriate two numeric keys. At the instant the second key is pressed, a beep will sound and the blinking decimal reappear, indicating that **CLOCK 2** is now set.

If it becomes necessary to reset the clocks exactly to the second, this can be done most easily at the hour mark. First tune in the standard time station just before the hour, and then set the function selector to **CLOCK 1**. At the precise hour mark, just press the **SET HOUR** button. A beep will sound, and the minute digits will be reset to "00" (seconds will also be reset to zero, but not displayed). Note that if the minute digits prior to resetting were less than 30, the hour digit(s) will remain unchanged, but if 30 or greater, the hour digit(s) will increment by one. This function affects both **CLOCK 1** and **CLOCK 2**, so it is not necessary to recalibrate each independently.

Automatic Timer Operation

The timer system in the FRG-8800 microprocessor allows automatic power on/off switching at preprogrammed times (relative to the time in **CLOCK 1**), as well as count-down to switch-off of up to 59 minutes (the "SLEEP" timer). These functions can be used in conjunction with the **REMOTE** jacks on the rear panel and the **REC** jack on the front, to record programs while the operator is absent, or just as an "alarm clock" or reminder of certain times or programs.

To program the timer to switch the receiver on at a certain time, set the clock/timer function selector to the **ON** position, and press the **SET TIME** button. Then key in the desired turn-on time using the numeric keypad (this is the time that **CLOCK 1** will show when the receiver should come on: not **CLOCK 2**). As in clock setting, all four digits (two hour digits and two minute digits) must be keyed in, using 24-hour format, even if all zeros. Pressing the fourth digit will cause a beep to sound, and the (non-blinking) decimal to appear, indicating that the **ON** timer is now set. Note that the decimal between hours and minutes in the timer display differs from that of clock time display, in that the timer decimal does not blink.

After setting, the timer will become active when the **TIMER ON** button is depressed. The receiver **POWER** switch can then be turned off, and the receiver will turn on automatically at the time set in the **ON** timer.

Of course the timer may also be programmed to switch off at a certain time, in the same manner as the **ON** timer was programmed, but with the function selector set to **OFF**. Again, all timer settings are relative to **CLOCK 1** only.

The default timer setting for both the **ON** and **OFF** timers is "0.00" (midnight). Once reprogrammed, the new settings will remain until again reset, and can be used daily, weekly, etc. To disable the timer on those days when it is not needed, set the **TIMER ON** button to the undepressed position. If you forget to do this, or if you want to turn off the automatic timer function before the time set in the **OFF** timer, just press **TIMER CLEAR**. This will not erase the stored settings, but it will return power control to the **POWER** switch for this period only.

Again, If the radio will not turn off by the **POWER** switch, press the **TIMER CLEAR** button at the upper right. Remember, the radio will turn on every day at the programmed time if the **TIMER ON** switch is depressed, so set it to the undepressed position if you don't want the timer activated.

The **SLEEP** timer allows setting the receiver to automatically switch itself off, 1 to 59 minutes after the **SLEEP** timer is set. This function is useful if the operator is going to sleep, or if it is necessary to leave the receiver unattended after starting to record a program. To set this timer, move the clock/timer function selector to **SLEEP** ("00" will be displayed), and press the **SET TIME** button (the receiver **POWER** switch may be either on or off). Then enter the number of minutes the receiver is to remain on using the numeric keypad, from 01 to 59. Note that two digits must be pressed: after the second key is pressed a beep will sound, and the timer will be active. However, the receiver **POWER** switch must be turned off (undeepressed), or the radio will not turn off at the end of the programmed time. The display will show the number of (whole) minutes of operation remaining. To cancel the remaining **SLEEP** time, press the **TIMER CLEAR** button.

The clock/timer function selector may be moved without disturbing any of the timer settings.

Propagation of Radio Waves

While the subject of radio signal propagation is quite complex and only partially understood, following are a few general guidelines to help you choose the optimum listening frequency at various times from your location. Additional information is available from some shortwave broadcasters, as well as in various shortwave listener's handbooks.

Shortwave broadcasters commonly transmit hundreds of thousands of watts (or more) from very large, directional antenna systems. But even with all of this power, the capability of their signals to reach listeners more than about 100 km away depends on reflection of the signal from the ionosphere (a group of high-altitude atmospheric layers) back down to the earth's surface (see diagram). Without such reflections the signals would simply pass out into space, with only those close to the transmitter having any reception.

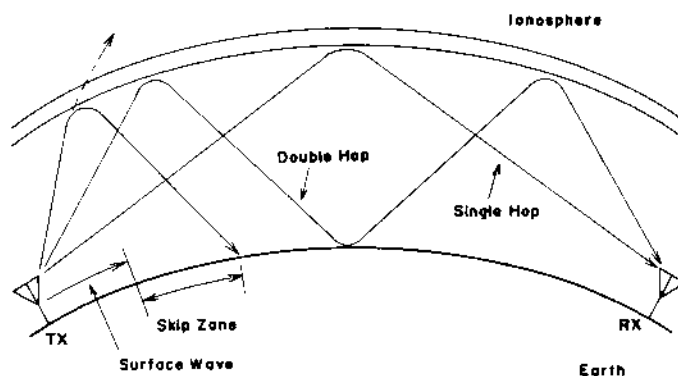
In fact, this is just what happens with signals above 30 MHz most of the time, which is why VHF signals usually can only be received from up to about 100 km (except for high-flying aircraft).

The reflecting properties of the ionosphere are in a constant state of change, and depend on the frequency, time of day and season, geographical latitude, temperature, and even (most importantly!) the activity on the surface of the sun. All of these factors cause the optimum frequency for reflection of a signal over a particular distance to vary. Thus, for example, to listen to stations at a distance of more than several thousand kilometers over a period of several hours, it may be necessary to change your receiving frequency several times, to take into account the changing propagation conditions.

Shortwave broadcasters try to take these propagation variations into account when arranging their schedules, so that signals will be beamed to your area only at those times when reflections are expected to provide the right propagation at the scheduled frequency. This is why most shortwave broadcasters change their frequencies almost hourly, as well as seasonally.

Another factor that affects the choice of optimum frequency is the absorption of the signal by the lower layers of the atmosphere. Signals are absorbed more at lower frequencies than higher, and more during the daylight hours than at night.

In general, daytime conditions for long distance propagation will be best at about 12-14 MHz and higher, while at night long distance signals will be heard at the lower frequencies. Also, during the winter the lower frequencies will have stronger signals and less noise than in the summer, but the higher frequencies should be better in the summer. Unfortunately, these general guidelines have many exceptions and special conditions. For example, when the solar "sunspot cycle" is



FRV-8800 VHF CONVERTER

The FRV-8800 can be installed in the FRG-8800 to add the VHF range of 118 to 173.999 MHz to the receiver, for all modes. Actual VHF frequency is displayed in seven digits, including the hundreds of MHz, in otherwise the same format as the standard frequencies of the FRG-8800.

Installation:

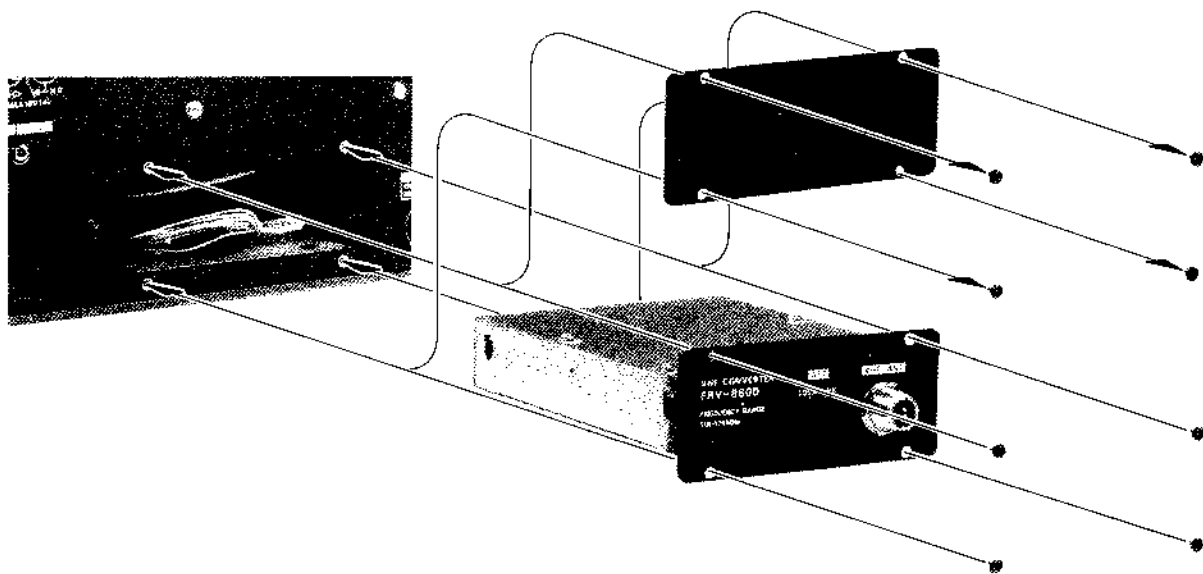
1. Switch the front panel POWER switch off, and disconnect the power cable(s) from the rear panel. Open the backup battery access door, and remove one cell.
2. Remove the four screws from the rectangular dummy subpanel in the center of the rear panel, and remove the subpanel.
3. Locate white plastic connector P52, which is not connected, but should be temporarily taped to the chassis just inside of the access space. Pick the connector off of its temporary mount and remove the tape before securing it in the mating socket on the FRV-8800.
4. Carefully slide the FRV-8800 into the space, keeping the Converter aligned with the guiding tabs on the bottom chassis (slide it straight in). Then replace the four mounting screws.
5. Replace the power cable first, and switch on the front panel POWER switch before reinstalling the backup battery. Check for proper operation of the Converter, just by keying a frequency at each end of the VHF band into the VFO, and check tuning with the main knob (don't look for signals yet). Then replace the backup battery, and door.

Operation

While a small whip antenna is supplied with the FRV-8800, which may be used for testing on strong local signals, this is not recommended for serious VHF listening, which requires an external, resonant antenna mounted high and in the clear, with good quality 50-ohm coaxial feedline to the VHF ANT jack on the converter. See the "Installation" section of the manual for more information, and contact your local Yaesu dealer for advice on the best antenna for use in your area.

The VHF bands that are covered by the FRV-8800 are the International Aeronautical Band between 118 and 137 MHz, on which stations generally use the AM mode; the "2-meter" Amateur Band between 144 and 146 or 148 MHz, on which stations use CW and SSB on the lower portion, and FM (narrow) on the upper portion; the VHF Maritime Band between 154 and 162 MHz (FM narrow), and the VHF Land Mobile band between 162 and 174 MHz (FM narrow). Within and between these bands, in some locations, police, military, and satellite transmissions can also be heard.

Then only additional control used for operation of the FRV-8800 is the ATTenuator slide switch on the rear panel of the converter, which should normally be set to the DX position unless listening to a very strong signal that overloads the converter (causing distortion that cannot be remedied by the front panel ATT control).

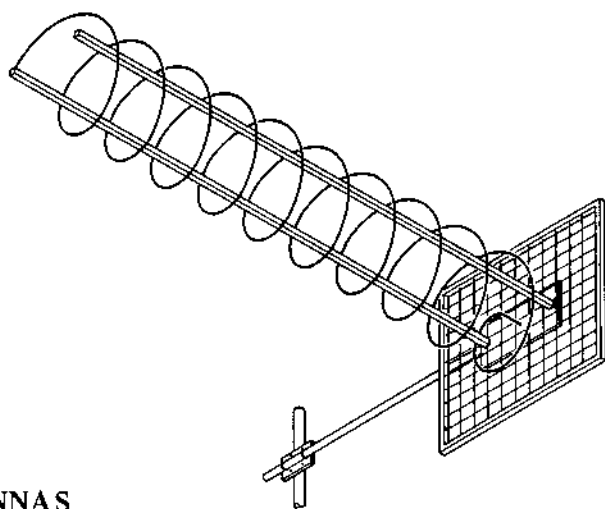
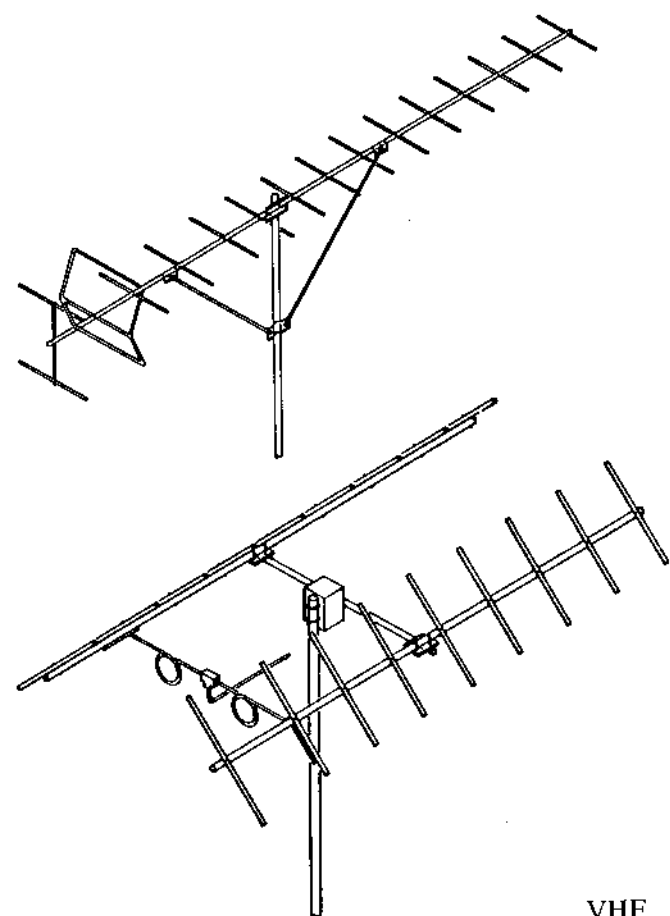
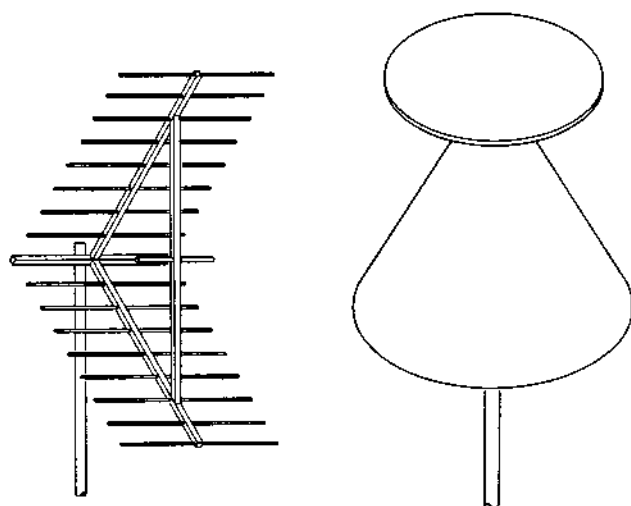
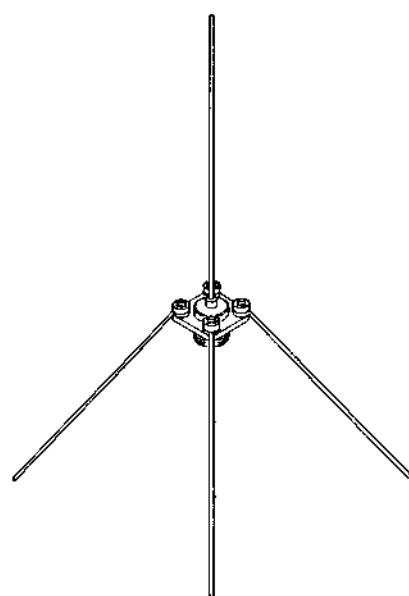


Note that the low background noise levels on VHF calls for use of the SQUELCH control, except when listening to SSB and CW. AM and FM VHF tuning is usually done using the scanning functions, for which the scan stop switch should be set to the AUTO position. The main tuning knob is then used only when necessary to "zero-in" on a signal when the scanner has stopped.

The noise blanker (NB) control should rarely, if ever, be required on VHF, and if so the rear panel NB switch should be set to narrow. Normally the front panel NB switch should be off.

If your local area has an FM broadcasting station between 118 and 174 MHz, contact your Yaesu dealer to obtain the FM Wide (demodulator) Unit. Otherwise, FM wide is not required.

Except for transmissions from airplanes and satellites, VHF range is generally limited to about 30% beyond the horizon (over flat terrain), since VHF signals are usually not subject to the reflections from the ionosphere like the lower frequencies. However, certain conditions occasionally develop in the lower atmospheric layers which permit VHF signals to propagate 1,000 km or more. Listen for such conditions around mid-June and mid-December, which can be recognized by unusually high background noise and crowding on the bands.



VHF ANTENNAS

Remote Computer Control—the CAT System

The CAT (Computer-Aided Transceiver) System was originally developed for external control of Amateur Transceivers by external personal computers. The simplified but powerful version of this system in the FRG-8800 offers vast potential for expanding the present functions of the receiver, and adding new functions as may be desired for specialized reception techniques that are not possible with the receiver alone.

Physically, the CAT System is a serial data input port to the microprocessor in the FRG-8800, which accepts commands from an external computer via pin 3 of the CAT jack on the rear panel (pin 1 is ground). This control data must be sent in groups of five bytes, "TTL" level (0V="MARK" and +5V="SPACE"), with eight data bits, two stop bits and no parity, at 4800 bits/sec. Within the groups of five bytes, each byte must be sent within 300ms of the last. Since most computers are not equipped with an output port that provides this format, Yaesu offers the FIF-series CAT Interface Units (see page 15), the appropriate one of which should be installed between the computer and the receiver.

The CAT jack on the FRG-8800 also provides a sample of the AGC (S-meter) voltage at pin 5, and of the squelch (BUSY=0V) status at pin 6. The AGC voltage can be converted into a digital pulse and used to inform the computer of the received signal level, either via the analog-to-digital converter in certain of the FIF-Units, or by an external A-to-D converter, either outboard, or in the computer. The squelch status can be passed to the computer via a TTL-level digital input port. While neither of these connections is necessary for external control, they do provide a means by which the operating condition of the receiver can be fed back to the computer, allowing interactive ("intelligent") control by the external computer.

External Control Programming

There are just four types of commands used to control the FRG-8800: External Control on/off, Frequency Set, Power on/off and Mode Set. While this makes programming very simple, the tremendous flexibility that these offer when wisely applied in a creative program should be borne in mind. The CAT Command Chart shows the format of these commands. Note that the bytes are actually sent from left to right, chronologically on the serial data line, so that the Instruction byte is always sent last.

For clarity, all bytes (8-bit values) are depicted in their hexadecimal (base 16) forms, with this indicated by an "H" appended to the two digits.

(A) External Control On/Off

The Instruction byte (byte 5) for this command is zero, and it has two types: one is necessary to initialize external control at the start of a session (byte 4 = 0), and the other to terminate external control at the end of a session (byte 4 = 80H, = 128 decimal). Bytes 1 - 3 may be any number (their value is irrelevant, but they must be sent). While external control is activated, the mode buttons, tuning controls and keypad are all disabled, until the External Control Off command is sent, at which time the receiver will return to the last frequency and mode used, in the VFO mode. This command can be accepted by the FRG-8800 regardless of whether the receiver is switched on or off.

(B) Frequency Set

This command has an Instruction byte (5) of the value 1, and has just one function: to change the receiving frequency to that encoded in bytes 1 - 4 of the command. The encoded byte values appear "backward" from the frequency display, with the smallest frequency increments (least significant digits) in byte 1, sent first, and the largest increment (hundred's and ten's of MHz digits) in byte 4. While appearing awkward to humans, this format allows the microprocessor to handle the data efficiently.

Byte 1 has a special coding, in which the two hexadecimal digits (nibbles) of the byte are treated separately, in different ways. The left-hand digit is simply equivalent to the 100Hz digit (0 - 9) of the frequency. However, the right-hand digit is a coded representation of the number of 25Hz steps to be appended to the frequency, with this digit equal to 1 for no 25Hz steps, 2 for one 25Hz step, 4 for two 25Hz steps (50Hz), or 8 for three 25Hz steps (75Hz). Note that these are the only acceptable values for the right-hand hex nibble: 1, 2, 4 or 8. So, for example, if byte 1 is 58H (hexadecimal), this represents 500 plus 75, or 575Hz.

Bytes 2, 3 and 4 are encoded more simply, with the total byte value (both digits) simply the hex number with the same two digits as the corresponding two decimal digits of the frequency. Byte 2 represents the ten's and one's decimal digits of the frequency, byte 3 the one's of MHz and hundred's of kHz, and byte 4 the hundred's and ten's of MHz. Note that the decimally converted hex value of each byte is not the same as the encoded value. For example, if byte 4 is 12H (hexadecimal), this represents a frequency of 120MHz, while the decimal conversion of 12H is actually $1 \times 16 + 2 \times 1$, or 18 decimal. Make sure this point is clear before attempting to write a program.

Example: To convert 14.25400 MHz into the proper byte code for sending to the receiver.

- (1) Since the 100's and 25's of Hz are both zero, byte 1 is 01H (note that 00H is invalid for byte 1; since 1 in the right-hand digit is the correct code for zero Hz).
- (2) The 10's and 1's of kHz digits are 5 and 4, respectively, so byte 2 is just 54H (which is actually $5 \times 16 + 4$, or 84 decimal: don't forget the encoding).
- (3) The 1's of MHz and 100's of kHz digits are 4 and 2, so byte 3 is 42H.
- (4) The 100's of MHz is zero, and the 10's of MHz is 1, so byte 4 is 01H. If you are setting a frequency below 10 MHz, don't forget to make this byte zero.

Recall that since byte 1 is sent first, the command to send to set the FRG-8800 to 14.25400 MHz is, from left to right in the order of sending;

01H 54H 42H 01H 01H

Notice that the alphabetic digits of base 16 numbers, A through F, are never used in frequency commands. Also, since the values of bytes 1 through 3 are only relevant to the frequency set command, they can be left unchanged (as "dummy" values) when using other commands. This can be used to advantage in programming.

(C) Power On/Off Command

This command has two types, with a common Instruction byte (5) of 80H (128 decimal). The first type is sent when the receiver power is off, to turn it on. This ON command requires that byte 4 have the value FEH (254 decimal). The second type is sent to switch the receiver off, and it requires that byte 4 have the value FFH (255 decimal). The values of bytes 1 - 3 don't matter, but again, they must still be sent. If the wrong command is sent (for example, if the OFF command is sent when the FRG-8800 is already off), nothing happens (so it's okay to do this).

(D) Mode Set Command

This command has eight types, one for each mode. Byte 5 is always 80H (128 decimal), just like the Power on/off commands, so be careful. Byte 4 must be 00H for AM wide, 08H (8 decimal) for AM narrow, 01H (1 decimal) for LSB, 02H (2 decimal) for USB, 03H (3 decimal) for CW wide, 0BH (11 decimal) for CW narrow, 04H (4 decimal) for FM wide, or 0CH (12 decimal) for FM narrow. Of course, if you send 04H for FM wide without the optional FM wide Unit installed, nothing happens. Again, the value of bytes 1 - 3 don't matter, but they must still be sent.

CAT SYSTEM COMMAND CHART

Command byte no. →	Byte Data					Function
	Parameter	Field	*Inst			
	1	2	3	4	5	
Ext Cntl ON	X**	X	X	00H	00H	Activate CAT
" " OFF	X	X	X	80H	00H	Deactivate CAT
Frequency set	NNH	NNH	NNH	NNH	01H	see *** below
Power ON	X	X	X	FEH	80H	Receiver ON
" OFF	X	X	X	FFH	80H	Receiver OFF
Mode Set: AM-W	X	X	X	00H	80H	AM wide mode
AM-N	X	X	X	08H	80H	AM narrow mode
LSB	X	X	X	01H	80H	Lower sideband
USB	X	X	X	02H	80H	Upper sideband
CW-W	X	X	X	03H	80H	CW wide mode
CW-N	X	X	X	0BH	80H	CW narrow mode
FM-W	X	X	X	04H	80H	FM wide option
FM-N	X	X	X	0CH	80H	FM narrow

* Instruction Byte - sent last, determines nature of command

** "X" signifies "dummy" byte: value inimportant, but must be sent to fill command to 5-byte format.

*** "NNH" values are hexadecimal codes for frequency data, explained in the text.

CAT control programs can be written in most any computer language, as long as the time between sending bytes does not exceed the 300ms limit. In most cases the BASIC language will suffice. While it is not possible to give enough examples to cover all of the different dialects of BASIC, following are a few possible ways using general BASIC statements to send commands to the FRG-8800. They will need to be modified for different brands of personal computers.

The first example illustrates use of the BASIC "OUT" command for single byte "port poking". This technique requires that the hardware interface include a port address decoder and parallel-to-serial converter that has been preset for 4800 bits/sec.

```
REM PTADDR = PORT ADDRESS OF SERIAL OUT

OUT(PTADDR),1:OUT(PTADDR),&H54:
  OUT(PTADDR),&H42: OUT(PTADDR),1:
  OUT(PTADDR),1
```

Note that "&H" in the above example signifies for that BASIC that the following digits are a hexadecimal byte. In computers that do not have a hex number handling capability, the hex code must first be translated into decimal, in which case &H54 would be replaced with 84 (decimal), and &H42 with 66 (decimal). In either case the result of the command would be the same: to set the FRG-8800 to 14.254 MHz.

Another way to send the same command, when using a computer that is equipped with an RS-232C serial port and the FIF-232C CAT Interface Unit, is shown below (this is for the Radio Shack Model 100, NEC PC-8201 or Olivetti M-10 portable computers)

```
OPEN "COM:7N82NN" FOR OUTPUT AS #1
PRINT#1, CHR$(1); CHR$(84); CHR$(66);
  CHR$(1); CHR$(1);
```

The result would be the same as in the previous example: set the FRG-8800 to 14.254 MHz. However, in this case the decimal equivalents of the properly selected hex digits have been substituted in the arguments. Note that this conversion is only necessary if the computer cannot accept hex arguments in the CHR\$ command. If the conversion is necessary, make an array with the subscripts equal to the hex bytes and the contents equal to the associated decimal byte.

Again note that the above command cannot be sent by itself: the External Control On and Power On commands would have to be sent first.

If the FRG-8800 is actively scanning frequencies via the internal scanner when the External Control ON command is sent, it will be ignored. Scanning must be halted before external control can start. The only other rule to remember should be obvious - the External Control ON command must be sent before anything else (even if the receiver power switch is off), and the Power ON command must then be sent if the receiver is not already on. However, don't forget to send the External Control OFF command when you want to use the manual controls on the front panel. When this is sent to return control to the front panel, the operating mode and frequency will return to whatever was last used (before external control started) in the VFO*. Also, if the Timer is set, the power on/off times programmed in the timer will be undisturbed when external control is released.

Using only the main CAT serial input command line you should have no trouble with simple programs, such as increasing the number of memories to hundreds, or thousands using tape or disk storage, and referencing the frequencies to station callsigns, times of transmission, seasons propagation conditions and etc., according to the type of operation you prefer. If the personal computer includes a real time clock, you can increase the automatic timer functions, adding multiple timers with individual frequencies or station callsigns. Logging and QSL functions can be linked directly to the receiver.

When the S-meter and squelch status lines in the CAT system are also used in programming, the external computer has some indication from the FRG-8800 of the results of commands it has issued: especially, whether or not a signal is present on the frequency, and how strong it is. This information can be used for programming just about any type of automatic scanning system. For example, since many shortwave broadcasters use several bands simultaneously, a program can be written to test each (pre-entered) frequency for signal strength at regular intervals, and to select and change the receiving frequency whenever propagation conditions cause the optimum frequency to change.

* There is an exception to this which can be quite useful: if the last frequency set command from the external computer is sent twice, it will appear on the VFO when external control is released, because the first of the two last commands will be pushed onto a stack in the internal microprocessor, and then popped off when external control is released.

PROGRAMMING

