

Yaesu FT-767GX All-Mode HF Transceiver and FL-7000 Solid-State HF QSK Linear Amplifier

The current trend toward miniaturization and more features has created many amazing rigs. Yaesu's FT-767GX is one of the newest, and it may be the most versatile. The FT-767GX offers frequency coverage unobtainable before with a general-coverage receiver, transmitting capability on 160 m and all HF bands (including the WARC bands), and optional added coverage for 6 and 2 m, and 70 cm. When coupled with its mate, the FL-7000 HF linear amplifier, it provides efficient, easy operation with all amplifier control accomplished through the transceiver.

Transceiver Features

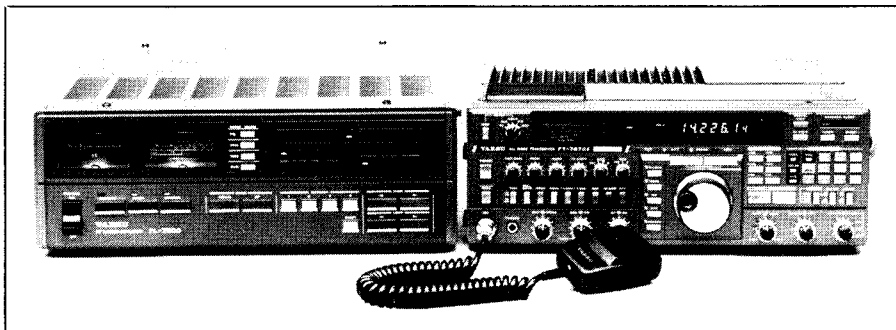
The FT-767GX is a solid-state, all-mode synthesized transceiver that incorporates an internal power supply, automatic antenna tuner and provisions for adding up to three internal transverter modules covering VHF and UHF bands. The rig provides 100 W output on 160 m and all HF bands in SSB, CW, FM and FSK modes. AM carrier output is 25 W, and the optional VHF/UHF modules provide outputs of 10 W.

Four microprocessors provide digital integration and control, together with features such as user-programmable independent tuning steps for each mode, an automatic calculating SWR meter, digital RF wattmeter, choice of VFO A/B and autospeed AGC (when tuning or scanning). Ten memories that store both frequency and mode, all-mode squelch, range/step programmable scanning, continuously variable noise-blanker threshold, IF shift and IF notch are also included.

For the CW operator, the FT-767GX operates full break-in (QSK) or semi break-in (VOX) and includes, as standard equipment, an iambic keyer with linear speed control, selectable sidetone and carrier offsets of 600, 700 and 800 Hz, three-speed AGC (plus OFF), a tunable audio peak filter and a 600-Hz crystal filter. All of these features are controlled from the front panel.

For VHF/UHF FM operation with the optional modules, an FM-discriminator center-tuning meter is provided. To facilitate repeater operation, a split-frequency and carrier-offset display function plus mode-dependent programmable tuning steps are very useful. An optional subaudible-tone squelch unit that is programmable from the front panel is also available.

The FT-767GX has a computer-aided tuning (CAT) system that allows external computer control of many of the transceiver's operations. With the FT-767GX operating under the CAT system, 21 commands can be used to control the VFOs and memories (data entry, selection and tuning) in addition to IF shift and CTCSS tone selection (if the optional tone squelch unit is installed). The FT-767GX also automatically controls its



matching amplifier, the FL-7000.

Transceiver Controls and Indicators

The front panel of the FT-767GX looks complex—and it is! There are 67 (the way I count 'em) separate controls located on the front panel, and some of these have multiple functions. Space limitations prohibit a description of all of these functions. The rear panel contains 25 jacks and switches, three controls and mounting space for the three VHF/UHF modules. All controls are within easy reach of the operator. It is not necessary to open the cabinet to adjust anything.

Before firing up the transceiver the first time, the BACKUP push-button switch on the rear panel must be in the out position to activate the lithium-battery VFO and memory data backup system. Although the FT-767GX operating system is in nonvolatile read-only memory (ROM), the information in its 10 memories is retained in random-access memory (RAM), which requires battery backup. Before the transceiver leaves the factory, the BACKUP switch is turned off. The operating manual states that because the backup system requires very little current, the battery will last for up to five years. The memories may be cleared by setting BACKUP to OFF. The OFF position is also useful in preserving the life of the backup cell if the transceiver is to be stored for a long period of time.

When the FT-767GX is first turned on, the meter and the blue fluorescent digital display light up, with the display indicating the default frequency of 7.000 MHz. In subsequent on/off cycles, the radio remembers the frequency to which it was tuned when turned off.

There are several means of changing the FT-767GX's operating frequency. VFO A or B can be used to change frequency in 1-kHz or 10-Hz steps. To toggle between VFO A and B, press the VFO A/B button. The tuning knob controls the selected VFO. The UP/DOWN switches (immediately above the tuning knob) can also be used to change the operating fre-

quency, as can the UP/DOWN buttons on the microphone. Normal and fast settings are possible for tuning steps/rates; the FAST button toggles between these choices. When FAST is used, the 10-Hz digit on the display is blanked. The FUNCTION keypad can also be used to enter frequencies.

The 15 FUNCTION keys have *dual* functions. Normally, the default functions labeled on the top of the key apply, but when the orange FUNC key is pressed, the alternate functions (reverse-lettered labels) are selected. For example, the H/G ENT switch toggles between Ham bands or General coverage in the default position. When General coverage is selected, a green LED, GEN, lights up beneath the frequency display. The alternate (ENT) function allows direct keypad frequency entry. After the last digit is entered, tuning shifts to the new frequency and the functions of all keys return to their default states.

The BAND/MCH keys, DOWN and UP, select the operating frequency band or memory channel according to the function selected by the keypad. In General coverage, BAND steps are 500 kHz; in Ham mode, steps are in 500-kHz band segments.

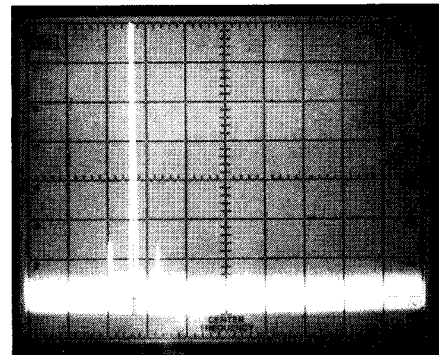
For split-frequency operation, press the SPLIT button; the active VFO frequency is displayed during receive and transmit. The display indicates SPLIT operation and which VFO is active.

The FT-767GX has 10 programmable memory channels (0 through 9) that store operating frequency and emission. Selection and manipulation of the memories and VFOs are accomplished through default keypad functions. First press the MCK key, then select the desired memory channel with the MCH UP or DOWN key. Press the VFO>M key to write the data to memory. Press the MCK key again to return the display to the VFO after you confirm that the desired data has been stored.

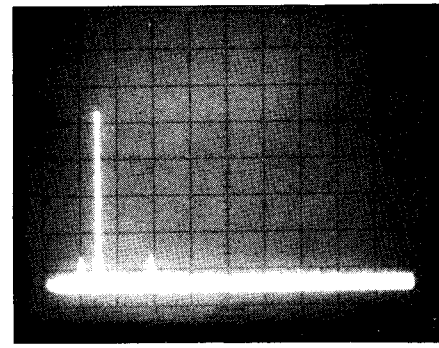
To recall a memorized frequency, press the MR key. The display shows the last channel accessed, along with its frequency. Press the MCH UP and DOWN keys to get to the desired memory channel. You may return to the last

Table 1
Yaesu FT-767GX HF Transceiver, Serial No. 6J030740

<i>Manufacturer's Claimed Specifications</i>	<i>Measured in ARRL Lab</i>
Frequency coverage: Receiver coverage—100 kHz to 29.99999 MHz; transmitter coverage—1.5-1.99999, 3.5-3.99999, 7.0-7.49999, 10.0-10.49999, 14.0-14.49999, 18.0-18.49999, 21.0-21.49999, 24.5-24.9999, 28.0-29.99999 MHz.	As specified.
Modes of operation: USB/LSB (J3E), CW (A1A), AFSK (J2B, F1B), AM (A3E), FM (F3E).	As specified.
Frequency display: 8-digit, blue fluorescent LEDs.	As specified.
Frequency stability: Better than ± 3 ppm (-10 to $+50^\circ\text{C}$) after 15-min warmup.	Not measured.
<i>Transmitter</i>	<i>Transmitter Dynamic Testing</i>
Power output: HF (all modes except AM), 100 W; HF (AM carrier), 25 W; VHF/UHF (all modes except AM), 10 W; VHF/UHF (AM carrier), 2.5 W.	As specified.
Spurious signal and harmonic suppression: HF, better than 50 dB below peak output, VHF/UHF, better than 60 dB.	See Fig 1.
Third-order intermodulation distortion: Better than 35 dB below peak output.	See Fig 2.
CW keying waveform: Not specified.	See Figs 3 and 4.
<i>Receiver</i>	<i>Receiver Dynamic Testing</i>
Receiver sensitivity: See Table 2.	Minimum discernible signal (Noise floor), (dBm): Preamp on Preamp off 20 m, -131 20 m, -116 80 m, -136 80 m, -116
Receiver dynamic range: Not specified.	<i>HF Measurements</i> Blocking dynamic range (dB): Noise limited, measured at 100 kHz. Preamp on Preamp off 20 m, 117 20 m, 120 80 m, 115 80 m, 119
	Two-tone, 3rd-order intermodulation distortion dynamic range (dB): Preamp on Preamp off 20 m, 92 20 m, 86 80 m, 85 80 m, 86
	Third-order input intercept (dB): Preamp off, 20 m +13 dBm
	<i>VHF Measurements (2-m module)</i> Minimum discernible signal (dBm) -139
	Blocking dynamic range (dB) 112
	Two-tone IMD dynamic range (dB) 71
	Receiver quieting (μV for 12 dB signal + noise + distortion/ signal + distortion): 0.26
Receiver recovery time: Not specified	Rise time 2.4 ms, fall time 2.4 ms, on delay 22 ms, off delay, 14 ms.
	Not measured.
Squelch sensitivity: See Table 2.	3.2 W.
Receiver audio output into 4 Ω with 10% total harmonic distortion: 1.5 W	
Color: Brown	
Size (height, width, depth): 5 \times 14-1/2 \times 11-5/8 in.	
Weight: 35 lb (with options).	



(A)



(B)

Fig 1—Worst-case spectral display of the FT-767GX operating on the 20-m band (A). Vertical divisions are each 10 dB; horizontal divisions are each 10 MHz. Output power is approximately 104 W at a frequency of 14.011 MHz. All spurious emissions are at least 56 dB below peak fundamental output. The two taller pips on each side of the fundamental are mixing products, but are below the maximum level allowable under FCC regulations. At B, the FT-767GX is operating on the 2-m band with an output power of 14 W. The fundamental has been reduced approximately 26 dB by means of notch cavities to reduce spectrum analyzer overload. All spurious emissions are at least 65 dB below peak fundamental output. The FT-767GX complies with current FCC specifications for spectral purity on all bands.

again to return to the VFO. If you don't want to keep the VFO data, but want to save the memory data, press the M>VFO key to copy the stored data to the VFO. This leaves the data in memory intact. If you want to save the VFO data, but not that in memory, press the VFO/M key to swap the memory and VFO data.

For memory-channel scanning, set the squelch control to the point where background noise is silenced, press the MR key, then press SCAN to start scanning. Scanning speed is controlled by the FAST key.

Another variation in the FT-767GX's frequency-control scheme is the CLARifier, another name for receiver incremental tuning (RIT). In the default mode, CLAR fixes the transmit frequency, allowing the tuning knob and buttons to control only the receive frequency. As a CLAR offset is set, it is stored in a memory unrelated to memory channels 0-9. This is not erased when the clarifier is

selected VFO by pressing VFO A/B once. Changing the data stored in a memory channel requires shifting the data to a VFO, altering it, and remembering it. Two means

are available to accomplish this. First, select the target VFO (A or B). Press the MCK key and select the channel to be changed with the MCH UP or DOWN keys, and then press MCK

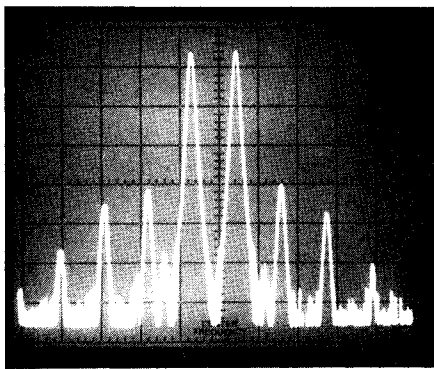


Fig 2—Spectral display of the FT-767GX output during transmitter two-tone intermodulation distortion (IMD) testing. The transmitter is being operated at 115-W output power on the 20-m band. Third-order products are 40 dB below PEP, and fifth-order products are 45 dB down. Vertical divisions are each 10 dB; horizontal divisions are each 1 kHz.

turned off; only the AC key can erase the clarifier memory.

Operating Features

Receiver

The FT-767GX is equipped with several operating aids. The IF shift and width controls, squelch and variable noise blanker allow you to eliminate interference of different types and durations.

The following functions are controlled by the group of five push buttons located to the left of the tuning dial: D LOCK (red LED indicator) disables the tuning knob to prevent inadvertent frequency changes; MUTE (yellow LED) disables the receiver audio, keeping the receiver in standby; NB (green LED) activates the noise blanker; APF (green LED) activates the audio filter for CW reception; and NOTCH (green LED) activates the IF notch filter.

An RF preamplifier (RF AMP) may be activated for increased sensitivity below 30 MHz, but this increases the chances of overload. In addition, a 20-dB attenuator may be switched in between the antenna and the receiver front end for extra immunity to overload on the HF bands. The ATT indicator LED below the display window lights when this feature is activated.

Transmitter

The FT-767GX transmitter has more standard operating features than most of the new rigs. In addition to VOX and a speech processor, it also includes an automatic antenna tuner and an iambic keyer.

The antenna tuner can match the antenna to the transmitter on all bands below 30 MHz, including 160 meters. Once a particular antenna has been matched on a band, the settings are stored in memory. If you select another band and then return to the previous band, the antenna tuner returns to the proper settings automatically. All antenna-tuner controls are in the upper-right corner of the front panel. The indicator window shows "READY" (in green) when the tuner has returned to previous settings or found an acceptable match. When the tuner is activated, a yellow "WAIT" appears. If the

tuner fails to find an acceptable match (SWR below 3:1), a red "WARN" appears. The antenna tuner memories are set for a 50-ohm load on all bands. Once you have set the tuner for your particular antenna and operating frequencies, you will rarely have to reset it.

Meter

With the FT-767GX in receive, the meter displays either relative received signal strength, in S units, or discriminator tuning. In the FM mode, with the DISC button pressed, the meter shows discriminator center tuning instead of signal strength. The discriminator meter indication is at center scale when no signal is received or when an FM signal is precisely tuned in. When an FM signal is not properly tuned, the meter will deflect to the right or left of center depending on whether the signal is above or below the frequency tuned.

In transmit, the 5-position meter switch selects relative transmitter power output (PO), final transistor current (ICC), automatic level control (ALC) or speech processor compression level (COMP). The fifth position, VCC, can be used to read power supply voltage at the final transistors at any time.

Filters

In addition to the usual CW and SSB filters, the FT-767GX is equipped with an audio peaking filter, IF shift and IF notch. The audio filter provides a narrow audio bandwidth for CW reception. It is activated by pressing a front-panel switch (APF), and adjustments are made using a knob on the bottom-right side of the front panel. When APF is activated, the indicator light next to the APF switch glows green.

In SSB, CW, AM and FSK modes, the location of the IF passband relative to the received carrier frequency can be adjusted with the SHIFT control. If there is interference on the desired signal, SHIFT can move the passband window farther away from the interference. The tone characteristics of the received signal will also vary—this is useful in AM to supplement the TONE control.

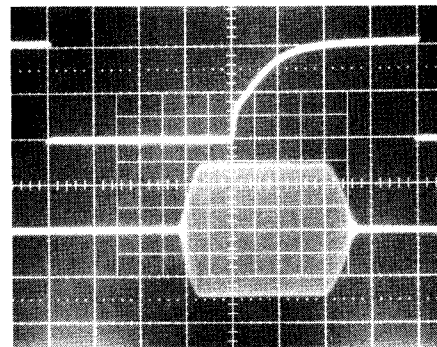
The IF notch filter provides a means of suppressing interfering heterodynes in SSB, CW, AM and FSK modes. NOTCH should be activated only after the SHIFT control has been adjusted for minimum adjacent-channel interference.

AGC

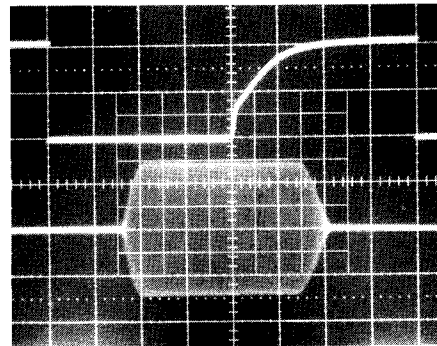
The FT-767's microprocessor automatically selects fast AGC when the tuning knob is rotated quickly. This feature helps in detecting weak signals while tuning. With the tuning parked on a desired frequency, you can select the AGC decay rate for most comfortable reception through the four-position AGC selector switch (OFF, Fast, Medium and slow). The M (medium) position is a good option when you are trying to work weak signals in noisy band conditions.

VHF and UHF Modules

There are four VHF/UHF band modules available for the FT-767GX: one for 6 m, one for 2 m, and two for 70 cm (430-440 MHz or 440-450 MHz). There are mounting locations for only three modules on the rear panel, and the modules must be installed in predetermined positions. Only the 70-cm modules are interchangeable. Thus, a fully



(A)



(B)

Fig 3—CW keying waveforms for the FT-767GX transceiver operating in the VOX and MOX modes. Horizontal divisions are each 5 ms. At A, the transceiver is operating in the VOX mode with QSK. At B, the transceiver is operating in the MOX mode. Although the waveforms are comparable, in the VOX mode with QSK the delay between initial key closure and RF output is approximately 7.5 ms longer.

loaded FT-767GX can cover 6 and 2 m, and only one of the 70-cm ranges.

Installation of the modules is simple and requires only a screwdriver. The review unit was equipped with the 2-m module. Installation is almost effortless: The entire process takes less than 10 minutes.

The Manual

Lately, it seems that operating manuals, in general, satisfactorily describe a radio's features, but fall short in areas where detailed explanations are required. The FT-767GX manual is no exception. It lacks sufficient detailed instructions for the FT-767GX's frequency and memory schemes, and the complexity of these can be mind-boggling. The descriptions covering front- and rear-panel controls, jacks and switches are adequate, however. The 2-m module operating instructions covered installation, and included block diagrams and a schematic.

Observations

Operating a new rig should be a pleasant experience. For the most part, that's how it went with me and the FT-767GX. I qualified for my Golden Jubilee DXCC in about six weeks of casual weekend operation on both CW and SSB. The radio performs well, and I received many unsolicited compliments

Table 2
FT-767GX Sensitivity Chart

	100 to 200 kHz	200 to 500 kHz	0.5 to 1.5 MHz	1.5 to 29.9 MHz	2m
10-dB signal + noise/noise (μ V)					
SSB/CW/FSK	2.5	1.0	4.0	0.25	0.25
AM	25.0	4.0	20.0	1.0	1.0
12-dB SINAD (μ V)	—	—	—	0.5	0.32
Squelch sensitivity					
SSB/CW/FSK/AM	20.0	10.0	20.0	2.0	2.0
FM	—	—	—	0.32	0.32

Table 3
Yaesu FL-7000 Solid-State HF QSK Linear Amplifier, Serial No. 6N050017

<i>Manufacturer's Claimed Specifications</i>	<i>Measured in ARRL Lab</i>
Frequency coverage (MHz): 1.8-2.0, 3.5-4.0, 7.0-7.5, 10.0-10.5, 14.0-14.5, 18.0-18.5, 21.0-21.5, 24.5-25.0 and 28.0-30.0 (28.0-30.0 not in US version).	As specified, except no coverage on 12 m.
Collector input power: (SSB) 1200 W PEP; (CW/FSK) 1200 W dc.	Power output: 500 W or more on all bands.
Spurious signal and harmonic suppression: Better than 50 dB.	See Figs 5 and 6.
Third-order intermodulation distortion (IMD): Less than 25 dB.	As specified.
Turnaround time: Not specified.	14 ms.
Antenna impedance matching range: 1.8-2.0 MHz, 25 to 100 ohms; other amateur bands, 16-150 ohms.	Not measured.
Color: Brown.	
Size: (height, width, depth) 5-1/8 x 15-1/2 x 15-3/4 in.	
Weight: 66 lb.	

about clean CW keying and SSB audio quality. I noticed one FT-767GX shortcoming: The receiver selectivity seems noticeably worse when the noise blanker is used, making operation on crowded bands somewhat more of a challenge.

Shortwave listening was a renewed and enjoyable experience with the FT-767GX.

Most shortwave broadcast stations are spaced 5 kHz apart, and the PROGRAM and mic UP/DOWN keys are useful in finding these stations.

The FT-767GX is a good radio for the operator with limited room for equipment, and for operators who move between several equipment locations. This rig offers coverage

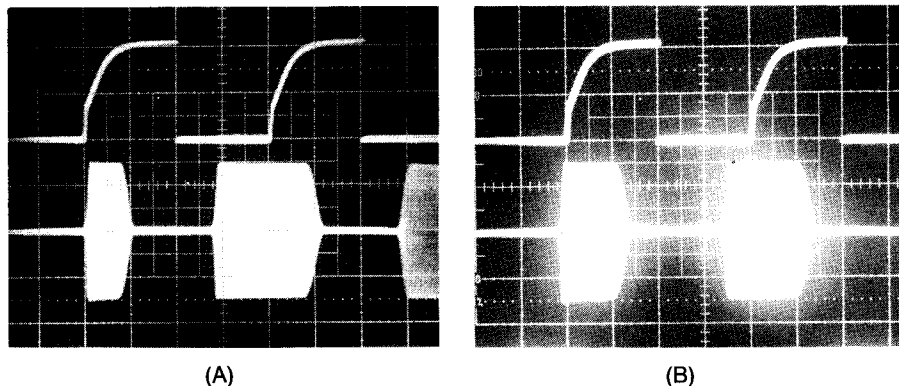


Fig 4—Keying waveforms for the FT-767GX operating in VOX and QSK modes. At A, the transmitter is operating in the VOX (non-QSK) mode. Each horizontal division is 5 ms. The top trace is the input key closure; the bottom trace is the RF output. There is shortening of the first dot in this mode. At B, the transceiver is operating in the full-break-in (QSK) mode. In this mode, shortening of the first dot is less evident.

of nearly all amateur bands in one compact package. With the features it packs, it will surely not be obsolete for a long time.

LINEAR AMPLIFIER FEATURES

The FL-7000 is a microprocessor-controlled solid-state linear amplifier with a built-in power supply and automatic antenna tuner. It provides at least 500-W RF output power on 160 m and all HF Amateur Radio bands (excluding 10- and 12-m bands in the US version). The FL-7000's TR turnaround time allows it to be used for QSK CW, HF packet radio and even AMTOR when driven by the proper exciter.

The '7000 requires 70 W drive for full power output. Four final transistors, each capable of 300-W collector dissipation, are combined into a fully SWR-protected push-pull, parallel "no tune" amplifier. These transistors are powered by a 47-V, 25-A supply that is cooled by a fan mounted in the bottom of the cabinet. Input ac power can be supplied at 100/110/117/200/220/234 V, 50 to 60 Hz, selectable through transformer taps. The review unit was wired for 117-V operation.

When the FL-7000 is used with Yaesu transceivers equipped with digital band data output (FT-767GX, FT-757GX and FT-980), band changing is completely automatic and controlled from the transceiver. As each band is selected, antenna choice and tuner settings are recalled from the transceiver memories.

The sensing circuitry in the FL-7000's antenna tuner turns off the amplifier and rematches the antenna whenever the SWR exceeds 2:1. During this process, the power amplifier shuts down until the antenna has been properly matched. If the SWR cannot be brought below 1.2:1, the protective circuitry causes the amplifier to be bypassed, and the red WARNING indicator lights. When the FL-7000 is used with the optional FAS-1-4R remote antenna relay unit, up to four different antennas can be connected to the

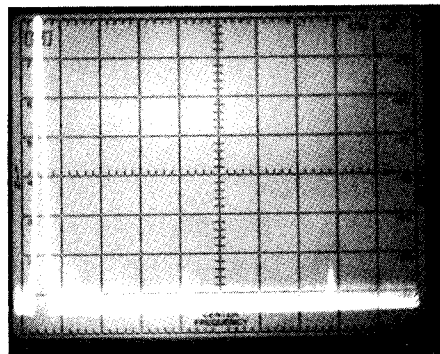
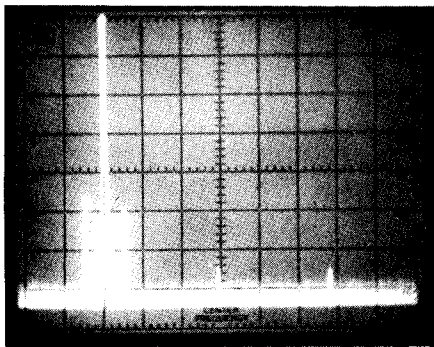
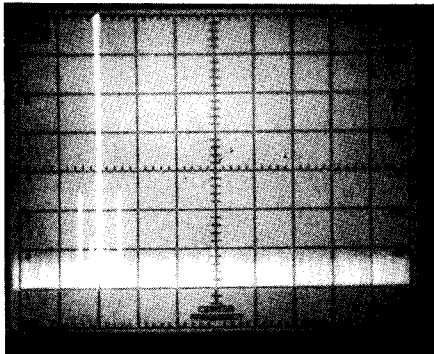


Fig 5—Best-case spectral display of the FL-7000 operating on the 40-m band. Vertical divisions are each 10 dB; horizontal divisions are each 10 MHz. Output power is approximately 525 W at a frequency of 7.020 MHz. All spurious emissions are at least 65 dB below peak fundamental output. The FL-7000 complies with current FCC specifications for spectral purity.



(A)



(B)

Fig 6—Spectral display of the FL-7000 operating on the 20-m band. At A, the input to the FL-7000 during testing. The exciter was a Kenwood TS-440S transceiver. Vertical divisions are each 10 dB; horizontal divisions are each 10 MHz. At B, the output of the FL-7000. Output power is approximately 580 W at a frequency of 14.2 MHz. All spurious emissions are at least 45 dB below peak fundamental output, and the FL-7000 output shows some attenuation of the upper close-in spurious response of the TS-440S transceiver.

amplifier and automatically selected by the FL-7000's microprocessor.

Front Panel

The front panel controls and indicators comprise 19 switches, 2 meters and 17 LED indicators. One of two large, illuminated meters provides continuous monitoring of amplifier collector current. The other meter provides selectable monitoring of relative power output, supply voltage, SWR or ALC through a four-position switch. Eight LEDs indicate amplifier, tuner and protective systems status, including fan activity and speed (high/low). (The FL-7000 has dual two-speed fans for cooling the amplifier and power supply; these are controlled by independent thermal sensors. If one of the monitored parameters exceeds safe limits, a PROTECT LED indicator lights while the microprocessor takes defensive action.)

The POWER ON/OFF switch controls input ac power to the amplifier. If the switch is turned OFF while the power supply and amplifier transistors are hot, the PS TEMP, FAN 1, FAN 2 indicators and fans will remain on until the components have cooled.

When the two-position OPERATE switch is pressed, the amplifier is operational, and the green indicator glows when the exciter acti-

vates the amplifier. When the OPERATE switch is set to OFF, the amplifier is bypassed. This switch function can be overridden by the microprocessor if it senses a problem. The two-position TUNER switch controls switching of the antenna tuner. With the TUNER set to ON, the antenna tuner is connected between the amplifier and the antenna. The tuner is bypassed when TUNER is set to OFF.

When pressed, the MANUAL switch allows manual control of band switching through the BAND DOWN/UP push buttons. This feature can be used if the exciter is not equipped with the Yaesu band-control feature. When this feature is not activated (MANUAL not pressed), the band is automatically selected by the transceiver (Yaesu FT-767GX, FT-757GX or FT-980, only). The active band is indicated by one of nine green LEDs.

The four ANTENNA selector switches are used to manually select one of up to four antennas if the optional FAS-1-4R antenna relay unit is used. If the optional unit is not used, these buttons and indicators have no function and the antenna selection will default to antenna 1.

The START switch is a momentary push-button that activates the antenna tuner system manually. Normally, as operating bands are changed, the tuner adjusts itself to the same antenna and matching impedances set at the last time the band was used. Press the START switch to retune if you're on a different part of the band, or if SWR is still a bit high after automatic tuning.

The TUNE and LOAD buttons allow manual adjustment of the matching network in the antenna tuner. These buttons are disabled when the tuning system is active or when the TUNER switch is off. In some cases, it is handy to be able to tweak the tuner settings.

Rear Panel Connectors and Controls

There are nine connectors and two switches located on the rear panel. These include a GROUND terminal post, SO-239 ANTENNA jack, remote terminal strip, SO-239 RF INPUT jack, a fuse holder, ALC jack and PTT jack. In addition, there are two accessory remote-control connections: ACC-1 is a 28-pin jack provided for use with the FT-980 transceiver; ACC-2 is an 8-pin Molex jack for the FT-757GX and FT-767GX transceivers. Rear-panel-mounted controls include an ATT/OFF slide switch to activate an input-power attenuator that is used if input power exceeds 100 W, and an ALC adjustment control.

Operation With The FT-767GX Transceiver

I've got to tell you about operating this amplifier with a matching transceiver! Ease of operating the system is almost unbelievable! Once you've completed all the proper interconnections between transceiver and amplifier, just turn on the power and you are truly set for "hands off" operation.

The first thing I noticed about the station was that at initial power-up, there was no fan noise. I thought for an instant that something was wrong with the amplifier, but such was not the case. Those fans are quiet!

The meters and status-indicating LEDs light up, and the amplifier is automatically set to the band you have selected on the transceiver. Simultaneously, the proper antenna is selected and the antenna tuner recalls its proper settings. Within seconds, you are ready to go on the air with a very respectable signal of about 600-W PEP output (as indicated by

the PO meter). If you want to change bands, simply select the new band on the transceiver, and the process starts all over again. It's that simple!

My only problem (if you can call it a problem) was getting used to not having to perform operator functions such as retuning the finals, checking the amplifier drive, and so on. With the FT-767GX/FL-7000 combo, about all I have to do is occasionally monitor the function and status-indicating LEDs.

The FL-7000 performs as if it is part of the exciter—which, in use, it really is! True, it is the second piece of equipment at the operating position, but all you have to do is turn it on. Because of its size, features and outstanding performance, the FL-7000 is a fine complement to the FT-767GX transceiver.

Manufacturer: Yaesu USA, 17210 Edwards Rd, Cerritos, CA 90701, tel 213-404-2700. Recommended list prices: FT-767GX transceiver, \$1895; FL-7000 linear amplifier, \$1895; 2-m module \$180. —Don "Mac" McGrath, KZ1A

New Books

ALL ABOUT VERTICAL ANTENNAS

By William I. Orr, W6SAI, and Stuart D. Cowan, W2LX. Published by Radio Publications, Inc, PO Box 247, Lake Bluff, IL 60044. First printing, 1986. Soft-cover edition, 8 × 5½ inches, 191 pages, \$10.95.

As an inveterate antenna experimenter, I was attracted to this new booklet by Orr and Cowan. I knew from reading previous works by these prolific amateurs that the text of the new book would be to the point and presented in plain language. I was correct in my assumption. *All About Vertical Antennas* is not laced with unwieldy equations or phrases that could confuse the radio newcomer. The text has been prepared using a computer and printed in letter-quality Gothic type. This makes the narrative easy to read, even if you have weak or tired eyes!

The book has the flavor of the old Frank Jones publications. I can think of no more appropriate word to describe it than "earthy." It has a down home character that makes for enjoyable reading.

There are eight chapters and countless easy-to-follow line drawings that deal with how verticals work, practical Marconi antennas and radio ground systems. The authors also treat the subjects of matching devices, ground-plane antennas and phased vertical arrays. Multiband vertical antennas are also included in the wide-ranging coverage. The final chapter, Antenna Roundup, contains a collection of ideas that should make your antenna work better.

The urban dweller should be particularly interested in this book because it describes antennas that go up, rather than out. Full-sized and shortened antennas are discussed in sufficient depth to permit any beginner to build and adjust them easily. I found no evidence of theoretical designs in the book; the practical antennas described by Orr and Cowan appear to be based on proven, established designs. I recommend this book for any amateur library.—Doug DeMaw, W1FB