# Product Review

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# Yaesu FT-747GX MF/HF Transceiver

*Reviewed by David Newkirk, AK7M*

The FT-747GX is Yaesu's entry in the field of what I call "tune and talk" ham gear—*communications* equipment in which secondary features (read: *frills*) and rarely used controls *don't* hide the basic radio performance necessary to communicate effectively from Point A to Point B. Does the FT-747GX succeed in its mission? Yes, and then some.


### FT-747GX Features

The FT-747GX receives from 100 kHz to 29.999975 MHz, has two "VFOs" (actually tunable memories) and 20 lithium-cell-backed memories, and transmits LSB, USB, CW, AM and (optionally) FM at 100 W PEP on all Amateur Radio bands within this range. The FM unit was not tested for this review.

The FT-747GX comes with three IF filters as standard; narrow and wide IF bandwidths are available in the CW and AM modes. The '747's IF filters are applied as follows: SSB, CW wide, AM narrow: 2.2 kHz at −6 dB and 5 kHz at −60 dB; CW narrow: 0.5 kHz at −6 dB and 1.8 kHz at −60 dB; AM wide: 6 kHz at −6 dB and 14 kHz at −50 dB. The '747 does not have an "RF gain" control,[1] IF-shift control, speech processor or provisions for connecting a transverter. Only push-to-talk (PTT) transmit-receive (TR) switching is available during SSB, AM and FM operation; "semi-break-in"[2] and MOX TR switching is available for CW.

The review FT-747GX came with an operating manual, a fused dc power cord, two 20-A fuses and an MH-1B8 hand scanning microphone. I powered the transceiver with a Yaesu FP-757HD power supply.

*Construction*

The FT-747GX is amazingly lightweight for its size. As soon as I discovered this, I took off the '747's cover to see what was inside. Most of the '747's electronics are contained on three circuit boards. One board—the Main Unit—is parallel with the rig's bottom cover and does the '747's small-signal amplification, conversion, filtering and detection chores. (Several small daughterboards, including noise blanker and crystal-filter units, are mounted on the Main Unit.) Another board—the Local Unit—contains the '747's signal-generation (LO, BFO and so on) and PLL circuitry; this is mounted along one side of the Main Unit. The third major circuit board, the Display Unit, is mounted on the back of the '747GX's front panel; it contains the FT-747GX's microprocessor, display, display driver and audio-power-amplifier circuitry. Most of the '747GX's front-panel controls are mounted on this board.

[1]Notes appear on p 52.

The FT-747GX's RF-power-amplifier circuitry is contained in a die-cast aluminum module. If you've already ogled an FT-747GX and wondered where its heat-sink fins are, they're *inside* this module! The RF-power-amplifier module includes a squirrel-cage fan that pulls air into the left side of the '747GX, blows the air past (through) the heat-sink fins and out the louvered back end of the module. The fan, which comes on in response to heat-sink heating, is moderately loud.

The FT-747GX's three-piece cabinet is, I think, something new to MF/HF ham radio gear: It's made entirely of metalized *plastic,* and is held together by two black-anodized aluminum extrusions that slide into place along the transceiver's sides.

What continues to amaze me about the FT-747GX is that about one third of its volume is air! Yaesu has packed a lot of radio performance into the FT-747GX's few circuit boards and RF power "brick."

*Controls and Connectors*

So intuitive is the FT-747GX's control system that I can combine a tour of the '747's controls and connectors with discussion of the rig's functions.

*Front Panel*

*Meter.* The FT-747GX's illuminated front-panel meter serves as a relative signal-strength (S) meter in receive, and a relative power-output meter in transmit. The S scale is calibrated from 1 to 9 (white) to about ⅔ scale; above this level, signal strength is indicated in decibels over S9 (red). The white PO scale is calibrated from linear units from 0 to 10.

Below this, the '747's push on, push off

**Table 1**

**FT-747GX Tuning-Step Size v Mode**

| *Mode* | *FAST On* | *FAST Off* |
|---|---|---|
| SSB/CW | 2.5 kHz | 25 Hz |
| AM | 10 kHz | 1 kHz |
| FM† | 12.5 kHz | 5 kHz |

† with optional FM board.

POWER switch makes and breaks the rig's dc supply connection.

The FT-747GX's eight-pin MIC jack includes connections for microphone audio, chassis common, and push-to-talk (PTT) TR switching, and microphone-mounted UP, DWN and FST tuning/memory-scan-control buttons.

The FT-747GX's PHONES jack allows connection of stereo or monaural headsets via a ¼-inch-diameter plug.

Amazingly, there's a tiny *front-panel speaker* between the FT-747GX's PHONES jack and tuning knob. (The FP-757HD power supply contains a larger front-panel speaker that's easily connectable to the '747 by means of the speaker plug at the end of the FP-757's power cable.)

*Tuning knob.* At just under 1-7/8 inches in diameter, the FT-747GX's lightweight, rubber-sided tuning control is easy to grip. The knob action is *detented;* that is, it rotates through a series of gentle hesitations, each of which is accompanied by a soft click—somewhat like a detented rotary switch, but requiring much less torque. I'm about as curmudgeonish as equipment reviewers come, and I can't find fault with the FT-747GX's detented tuning feel. It's not *bad,* it's just *different.* (I'd like Yaesu to add a finger hole to the

**Table 2**

**Yaesu FT-747GX Transceiver, Serial No. 8D040384**

| *Manufacturer's Claimed Specifications* | *Measured in the ARRL Lab* |
|---|---|
| Frequency coverage: Receiver, 100 kHz to 29.999 MHz; transmitter, 1.5-1.9999, 3.5-3.9999, 7.0-7.4999, 10.0-10.4999, 14.0-14.4999, 18.0-18.4999, 21.0-21.4999, 24.5-24.9999, 28.0-29.9999 MHz. | Receiver, 100 kHz to 29.999975 MHz; transmitter, as specified plus an additional 75 Hz at the upper end of each range. |
| Modes of operation: LSB, USB, CW, AM, FM† | As specified. |
| Frequency display: Not specified. | 6-digit, amber-backlit LCD. |
| Frequency resolution: Not specified. | Display, 100 Hz. Actual tuning resolution varies with mode and tuning speed as shown in Table 1. |
| Power requirement: 13.5 V dc ±10%, 19 A at 100 W output | At 13.5 V dc and 14.2 MHz, 17 A for 95.6 W output and 1.09 A during receive at full audio output. |
| *Transmitter* | *Transmitter Dynamic Testing* |
| Transmitter output power: SSB, CW and FM†: 100 W PEP/DC; AM: 25 W, carrier. | CW: 90.0 to 97.9 W PEP, depending on band; SSB, 98.4 to 105.8 W PEP depending on band; AM: as specified; FM not tested. |
| Spurious signal and harmonic suppression: Harmonic: better than 50 dB; non-harmonic: better than 40 dB. | See Fig 1. |
| Third-order intermodulation-distortion products: Better than −25 dB at 100 W PEP output. | See Fig 2. |
| CW-keying waveform: Not specified. | See Fig 3. |
| Transmit-receive turnaround time (PTT release to 90% audio output with an S9 signal): Not specified. | 19 ms. |
| *Receiver* | *Receiver Dynamic Testing* |
| Receiver sensitivity: SSB and CW: (CW bandwidth not specified) for a 10-dB (S+N)/N ratio, 0.5 μV from 0.5-1.5 MHz (0.1-0.5 MHz not specified) and 0.25 μV above 1.5 MHz. | Minimum discernible signal (noise floor) with "CW narrow" filter<br>1.0 MHz: −136 dBm<br>3.5 MHz: −136 dBm<br>14 MHz: −136 dBm |
| AM: (bandwidth not specified) for a 10-dB (S+N)/N ratio, 2 μV from 0.5-1.5 MHz (0.1-0.5 MHz not specified) and 1.0 μV above 1.5 MHz. | "AM wide" filter, with test signal 30% modulated with a 1 kHz tone;<br>1.0 MHz: −120.5 dBm (0.21 μV)<br>3.5 MHz: −118.5 dBm (0.30 μV)<br>14 MHz: −119.5 dBm (0.24 μV) |
| FM†: 0.7 μV for 12 dB SINAD above 28 MHz. | FM not tested. |
| Receiver dynamic range: Not specified. | Blocking dynamic range††:<br>3.5 MHz: 109.5 dB<br>14 MHz: 120 dB<br>Two-tone, third-order intermodulation distortion dynamic range††:<br>3.5 MHz: 90.0 dB; 14 MHz: 92.0 dB<br>Third-order input intercept:<br>3.5 MHz: −1 dBm; 14 MHz: +2 dBm |
| S-meter sensitivity (μV for S-9 reading): Not specified. | 34 μV at 1 MHz, 32 μV at 14 MHz, 35 μV at 28 MHz. |
| Squelch sensitivity: SSB/CW/AM: 4.0 μV from 0.5-1.5 MHz, 2.0 μV above 1.5 MHz; FM†: 0.32 μV. | At 14.2 MHz: Min, 1.7 μV; max, 2800 μV; FM not tested. |
| Receiver audio output: More than 1.5 W at 10% total harmonic distortion (THD) into an 8-Ω load. | 1.76 W into 8 Ω at 10% THD. |
| Color: Gray. | |
| Size (height, width, depth): 3.7 × 9.4 × 9.4 inches. | |
| Weight: 7.25 lb. | |

†Requires installation of optional FM board.

††Blocking dynamic range and third-order IMD dynamic range measurements were made at the ARRL Lab standard signal spacing of 20 kHz.

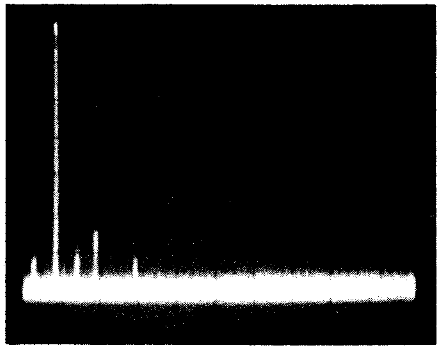


Fig 1—Worst-case spectral display of the Yaesu FT-747GX. Horizontal divisions are each 10 MHz; vertical divisions are each 10 dB. Output power is approximately 100 W at 10.15 MHz. All harmonics and spurious emissions are at least 54 dB below peak fundamental output. The FT-747GX complies with current FCC specifications for spectral purity.

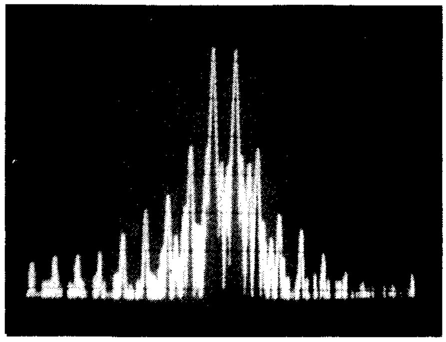


Fig 2—Spectral display of the Yaesu FT-747GX during two-tone intermodulation distortion (IMD) testing. Third-order products are approximately 32 dB below PEP output, and fifth-order products are approximately 45 dB down. Vertical divisions are each 10 dB; horizontal divisions are each 2 kHz. The transceiver was being operated at 100 W PEP output on 14.2 MHz.

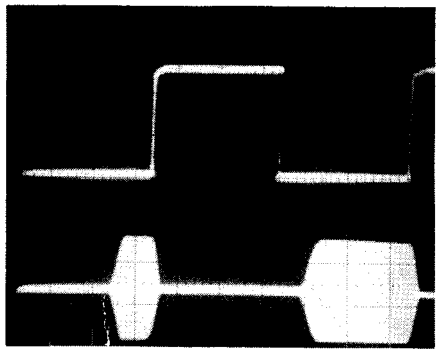


Fig 3—CW-keying waveform for the Yaesu FT-747GX in the semi-break-in mode. The lower trace is the RF envelope; the upper trace is the actual key closure. Each horizontal division is 10 ms. Note the shortening of the first dot after key closure.

'747's tuning knob, though.)

*Display.* The FT-747GX's amber-backlit liquid-crystal display (LCD) is easy to read and presents the current operating frequency to the nearest 100 Hz. (In transmit, the frequency displayed is the carrier frequency; in receive, the frequency displayed is the carrier frequency for incoming signals centered in the '747's IFs.) In addition to frequency, the FT-747GX's LCD displays the number of the current memory channel and includes BAND, SCAN, SPLIT, VFO A, VFO B, CLARifier, BUSY (receiver unsquelched), dial LOCK, FAST tuning, MR (memory recall), LSB, USB, CW, AM, FM, NARrow filter and PRIority channel annunciators.

CLARifier. Pressing this button turns the FT-747GX's tuning knob into a ±9.975-kHz receiver-incremental-tuning (RIT) control that does not change the transceiver's transmitting frequency. The frequency display registers the effect of clarifier tuning as appropriate. Notes: (1) the clarifier tunes in 25-Hz steps regardless of the FT-747's operating mode; (2) during VFO A/B operation, the '747's clarifier circuit "remembers" the clarifier offset after CLAR has been turned off *only if the tuning knob is not touched;* and (3) the clarifier functions during memory recall operation; switching memories with the clarifier turned off does not clear the clarifier offset.

Pressing D LOCK disallows adjustment of the FT-747GX's operating frequency by means of the tuning knob.

>MODE<, a "rocker button," selects the FT-747GX's operating mode. Pressing the < or > end of the button "moves" the mode choice left or right through the LCD's mode annunciators. Depending on the setting of an internal switch (switch S01 on the FT-747GX's Main Unit circuit board), the < MODE > button also selects the FT-747GX's automatic-gain-control (AGC) decay rate: slow in SSB and AM, and fast in CW and FM. Moving S01 from its factory setting sets the '747's AGC decay to slow in all modes.

NAR selects the appropriate "narrow" IF filter during CW and AM reception. The LCD's NAR annunciator darkens when the NAR button is pressed and when FM operating is selected (just in case an FT-747GX user might think that the '747 can do other than *narrowband* FM, I guess!).

VFO MR, another rocker button, actually switches between *three* states: VFO A, VFO B and memory-recall operation. Pressing the VFO end of the switch toggles between VFOs A and B, and allows the microphone UP, DWN and FST buttons to be used for frequency slewing. Pressing the MR end of the switch selects the current memory channel, turns the tuning knob into a memory-channel-select switch and allows the microphone UP, DWN and FST buttons to control memory selection and scanning.

*Memories*—the concept, not a control. The FT-747GX's 20 memories, each of which stores frequency, mode and IF-bandwidth choice in CW and AM, are tunable ±9.975 kHz by means of the clarifier function. The '747's operating mode can be altered by means of the < MODE > button; frequency and mode shifts made during memory-recall operation cannot be written into the memory channel involved, however. The '747's memories can be written to only from VFOs A and B (or via computer control). All but memories 18 and 19 are capable of storing frequency splits (see next item).

SPLIT. Pressing this button displays the LCD SPLIT annunciator, activates split-frequency operation (that is, transmission on one VFO and reception on the other) and selects the current VFO as the receive VFO. The FT-747GX's split-frequency feature can operate between any two frequencies covered by the '747GX as long as the transmit frequency falls in one of the rig's "transmit bands" (see Table 2).

VFO > M. Pressing this button during reception on VFO A or B (1) writes the current frequency and mode (and split, if selected, when the current memory channel is not 18 or 19) into the current memory channel during VFO A or VFO B operation; or (2) toggles scanning lockout of the current memory channel during memory recall operation.

M > VFO. Pressing this button during reception on VFO A or B, or during memory-recall reception, transfers the contents of the current memory channel to the current VFO (or to both VFOs, if the recalled memory channel contains a frequency split).

PRI-M. Pressing this button during VFO operation darkens the LCD SPLIT annunciator and causes the FT-747GX to check the current memory channel for activity every 4 seconds or so. For this to work properly, the '747's SQL (squelch) control must be advanced just enough to mute the receiver during reception on the memory channel.

FAST toggles the FT-747GX between fast and slow tuning and band-change rates (that is, between larger and smaller tuning and band-change steps). The tuning rate selected depends on the FT-747GX's operating mode as shown in Table 1. The step sizes shown in Table 1 equate to tuning rate as follows: 25 Hz = 1.25 kHz/rev of the tuning knob; 2.5 kHz = 125 kHz/rev; 1 kHz = 50 kHz/rev; 10 kHz = 500 kHz/rev. That works out to one step for each of the 50 clicks made by the tuning knob through one rotation. Because the review FT-747GX did not contain the optional FM unit, I can only surmise that this step-per-click rate holds for FM tuning with the '747; if this relationship holds, 12.5 kHz = 625 kHz/rev and 5 kHz = 250 kHz/rev. The band-change rate is 500 kHz/click with FAST off and 5 MHz/click with FAST on.

BAND. Pressing this button turns the FT-747's tuning knob and mike keys (DWN, FST, UP) into band switches, causes the LCD BAND annunciator to flash and starts a timer that senses tuning knob and mike-key activity. Band-change input from the tuning knob and mike keys changes the '747's frequency display, but the '747 doesn't actually move to the selected frequency until BAND is pressed a second time. This is where the timer comes in: The band-change function times out without effect if band-change input is absent for more than about 4 seconds.

Aside from its tuning knob, the FT-747GX has four rotary controls; these are arranged in two concentric pairs. The pairs comprise AF gain and SQL, and MIC and DRIVE. MIC adjusts the microphone-input level during SSB and AM operation. (The '747's mike gain is fixed during FM operation.) DRIVE adjusts the carrier level during CW, AM and FM transmission and is nonfunctional during SSB operation. As measured in the ARRL lab, DRIVE reduces the FT-747GX's output from maximum down to about 50 mW.

ATT, NB and MOX are push-on, push-off latching buttons. ATT selects or deselects a 20-dB RF attenuator during receive; a green LED lights behind a window in the ATT button when the attenuator is in use. NB turns the '747's noise blanker on and off. MOX (manually operated switch) puts the FT-747GX into the transmit mode; a red ON AIR LED behind the '747's dial escutcheon (between the meter and LCD) lights when the transceiver is switched into transmit.

### *Rear Panel*

The FT-747GX's rear-panel connectors and controls include:

CAT. This 6-pin DIN jack allows computer control of the FT-747GX by means of Yaesu's CAT (Computer Aided Transceiver) control system. The CAT connector lines carry serial data in and serial data out; PTT and AGC signals; and a ground connection. One pin is unused.

CAR ADJ. Despite their accessibility, these three BFO/carrier-oscillator frequency controls (CW, USB, LSB), are not intended for routine adjustment by FT-747GX owners.

+13.5V. According to the '747's *Operating Manual,* this phono jack sources 13.5 V dc at 200 mA "for powering accessories."

EXT SP, a 1/8-inch phone jack, allows connection of a 4- to 16-Ω speaker.

KEY, a ¼-inch phone jack, allows connection of a key or keyer. The open-circuit voltage of the FT-747GX's keying circuit is 13, negative ground; 0.7 to 1 mA flows in the keying line when the circuit is closed.

AF OUT, a phono jack, sources fixed-level FT-747GX receiver audio at 50 mV, peak, at an output impedance of 10 kΩ. This jack is suitable for connection to a digital-communications processor, tape recorder, phone patch, audio equalizer or external audio amplifier.

EXT ALC, a phono jack, accepts automatic-level-control (ALC) voltage (0 to −5, positive ground) from an external power amplifier.

PTT, a phono jack, affords access to the '747's PTT line.

BAND DATA, an 8-pin DIN jack, sources band-data and control signals for Yaesu's FC-757AT and FC-1000 antenna tuners, and the FL-7000 amplifier. Pin 6 of this jack provides access to a transistor capable of switching 150 V dc at 1.5 A, negative ground, for control of an external power amplifier. Amplifiers with switching requirements outside this voltage/current range can be controlled via Yaesu's optional FRB-757 relay box.

DC 13.5V, a chassis-mount, four-prong TRW/Cinch/Jones-style plug, is the FT-747GX's power-input connector. Judging by the speed with which they tarnish, the pins are silver-plated.

GND, a binding post with a knurled, captive nut, allows the FT-747GX to be grounded by a means independent of power-supply and antenna grounds.

ANT, a single-hole-mount SO-239 connector, serves as the '747's RF input/output connector. Check this connector for tightness from time to time if you connect and disconnect antennas often; the ANT jack on the review '747 loosened after a few weeks of multioperator use and had to be retightened several times during the review period.

**Internal Adjustments**

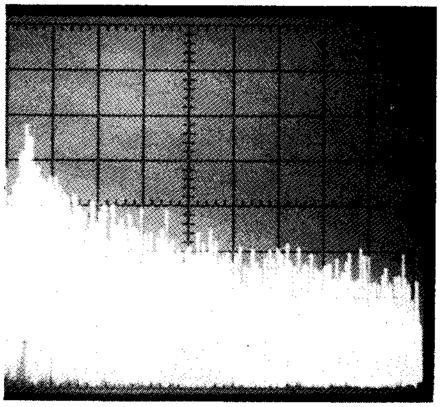
Aside from its AGC switch, the FT-747GX has four internal controls. These are: (1) VR1013, which adjusts the hold-in time of the FT-747GX's keyed TR switching for CW operation (set VR1013 for minimum delay if you want the '747 to return receive instantly on release of the MOX button); (2) S02, which enables inhibition of FT-747GX transmission by an external device via the '747's BAND DATA jack; (3) the sidetone level control (VR08), which is accessible through a hole in the '747's bottom cover; and (4) the memory backup switch (S19, also accessible through a hole in the '747's bottom cover), which disconnects the FT-747GX's lithium memory-backup cell to clear all memories or "if you plan to store the transceiver for a long time without power connected."

**FT-747GX Performance**

Looking over what I've written so far, I realize that using the FT-747GX is easier done than said! In my opinion, most FT-747GX users will be able to figure out how to use all of the on-board features within half an hour. (If you stoop to opening the FT-747GX *Operating Manual*—which I suggest you do because [1] the manufacturer recommends it and [2] the manual is well-written and accomplishes its mission pleasantly—you'll be up and running that much faster.) Table 2 shows the results of ARRL lab tests on the review FT-747GX.

*CW operation* is straightforward with the FT-747GX: Tune in the station you want to work and press your key! The DRIVE control allows smooth control of the '747GX's output power in this mode; it's easy to set the transceiver's output to the QRP (5 W or less) level by this means, for instance. The FT-747GX's AGC system, though simple, works admirably for CW in its slow *and* fast decay modes: AGC-attack popping does not occur, even on very strong signals. This is important in the absence of an RF-gain control. My most memorable FT-747GX CW QSO: Working VK9 on 30 meters with my indoor (apartment) antenna!

*SSB performance.* To test the '747GX in this mode, I used the transceiver to put W1AW on the air in the 10-meter Novice/Technician SSB segment. After surviving to QSL the *eighty*-odd contacts that ensued—if you've ever heard me work voice, you know why I say *surviving*—I can say that the FT-747GX works well on phone. The rig's AGC works as well on SSB as it does on CW. Every ham I asked for an audio-quality report told me that the '747GX's transmit audio sounds fine. Some rigs "FM" on SSB voice peaks when used in situations where the dc supply voltage drops below the manufacturer-specified range; I heard no trace of FMing in the FT-747GX down to 11 V, the lowest supply voltage I tried.



(A)

(B)

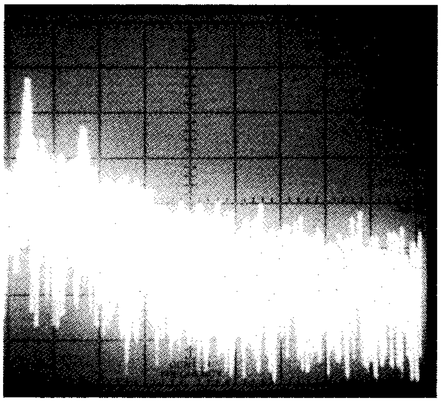


Fig 4—Spectral displays of the Yaesu FT-747GX transmitter output during composite-transmitted-noise testing. Power output: 100 W at 14 MHz (at A) and 100 W at 3.5 MHz (at B). Each vertical division is 10 dB; each horizontal division is 2 kHz. The scale on the spectrum analyzer on which these photos were taken is calibrated such that the log reference level (the top horizontal line on the scale in the photos) represents −60 dBc/Hz, and the baseline is −140 dBc/Hz. Composite noise levels between −60 and −140 dBc/Hz may be read directly from the photographs. The carrier, which would be off the left edge of the photographs, is not shown. The photographs show noise at frequencies 2 to 20 kHz offset from the carrier.

**Rough Edges**

Yaesu's options for powering the FT-747GX, the heavy-duty FP-757GX (price class, $270) and the light-duty FP-700 (price class, $220) are expensive, considering what they provide for their cost. Careful shopping may net you lower-cost alternatives to the Yaesu supplies.

As Fig 3 shows, the FT-747GX's keyed TR switch truncates the first Morse-code element sent. This didn't bother me because my inability to tolerate *any* form of delayed-hold-in, keyed TR switching had me reaching for the '747GX's MOX button every time! For hams who prefer to use delayed-hold-in, keyed TR switching instead of MOX, though, the FT-747GX's "short first dot" may be an annoyance.

The FT-747GX's sidetone cannot be heard without putting the rig into transmit. The FT-747GX *Operating Manual* declares that

> To practice sending CW, just set the DRIVE control fully counterclockwise. Now, closing the key will generate the sidetone but no signal will be transmitted.

—but *the second statement in the second sentence of this excerpt is not true.* Turning the FT-747GX's DRIVE control fully counterclockwise reduces the '747's RF output to minimum, *but the rig still puts out a signal*—about 50 mW of RF, depending on the band. Because of this, *don't assume you can't be heard when you set your FT-747GX's drive to minimum;* QRP enthusiasts work the world at the 50-mW level all the time. If you want to adjust your keyer or practice sending code with the FT-747GX's sidetone *without* transmitting, tune to a frequency outside the transmitter ranges listed in Table 2. When you set the '747 to such a "no-transmit" frequency and press MOX, the '747 emits two audio error beeps and displays .Err.—and allows you to listen to the sidetone without transmitting anything. To simplify this operation, write a no-transmit frequency to one of the '747's memory channels and return to it when you want to adjust your keyer or practice sending.

The FT-747GX's receive-audio chain cuts high audio frequencies to a considerable degree. On CW, such a response is fine; the test FT-747GX exhibits a "CW narrow" audio bandwidth of 490 Hz at −6 dB—a passband width on par with that of the rig's 500-Hz CW filter. SSB is a different story: The overall SSB receive bandwidth of the test FT-747GX is only *1246 Hz* at −6 dB—with a 2.2-kHz-wide IF filter in line! On AM, the FT-747GX's receive audio is just plain muddy: The rig's overall AM-receive frequency response was measured in the ARRL Lab as 100 to 1200 Hz at −6 dB with the 6-kHz AM filter selected. Result: Tuning off to one side of a broadcast signal even in "AM wide" doesn't noticeably improve recovery of audio highs. On the test FT-747GX, AM signals are most intelligible when received as LSB or USB.

Good news, though: Chip Margelli, K7JA, Vice President of Marketing for Yaesu USA, reports that the high end of the FT-747GX's receive-audio response can be moved to over 2100 Hz at −6 dB by removing just one capacitor, and that Yaesu will be making a change in the production of new '747s to in-

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clude this fix. Modified as Chip suggests, the review FT-747GX produces crisp, communications-quality receive audio. Yaesu has released a technical bulletin giving instructions for removing the culprit capacitor; you can obtain a copy of this bulletin by writing to Yaesu.

The selectivity improvement afforded by the FT-747GX's narrow CW filter is offset somewhat by distortion somewhere in the rig's receive-audio chain. Because of this, it's sometimes easier for me to copy weak CW signals in the '747's "CW wide" mode than in "CW narrow."

### Overall Impression

I like the FT-747GX. I don't miss the absence of RF-gain-control and IF-shift functions, and I had no trouble getting used to the rig's detented tuning and tuning-speed options. Its controls are well thought-out and easy to use, and its compactness amazes me. As an added attraction, the FT-747GX works well as a general-coverage LF, MF and HF receiver. If you need solid tune-and-talk communication on a budget, consider adding an FT-747GX to your station.

Price class: FT-747GX, $700; FP-757GX compact power supply, $220; FP-757HD heavy duty power supply/speaker, $270; MD-1B8 desk microphone, $110; FM-747 FM unit, $45. Manufacturer: Yaesu USA, 17210 Edwards Rd, Cerritos, CA 90701, tel 213-404-2700.

### Notes

[1]I put quotes around *RF gain* because the RF-gain controls in most current transceivers actually adjust *IF* gain. The receive RF amplifiers (if present) in most current MF/HF transceivers are fixed-gain (often switch-selectable) preamplifiers.

[2]In other words, a keyed TR relay with adjustable hold-in time.

### MORE TO COME ON THE MFJ-1278

The MFJ-1278 Multi-Mode Data Controller reviewed in July was from an early production run. There have been several changes to both the unit's hardware and firmware. In order to present an accurate picture of the capabilities and performance of currently available units, a review of a current MFJ-1278 will appear soon in *QST*.

### SOLICITATION FOR PRODUCT REVIEW EQUIPMENT BIDS

[In order to present the most objective reviews, ARRL purchases equipment off the shelf from Amateur Radio dealers. ARRL receives no remuneration for items presented in the Product Review or New Products columns.—*Ed.*]

The following ARRL-purchased Product Review equipment is for sale to the highest bidder. Prices quoted are minimum acceptable bids and reflect a discount from the purchase price.

Sealed bids must be submitted by mail and be postmarked on or before August 27, 1989. Bids postmarked after the closing date will not be considered. Bids will be opened seven days after the closing postmark date. In the case of equal high bids, the high bid bearing the earliest postmark will be declared the successful bidder.

Please clearly identify the item you wish to bid on, using the manufacturer's name, model number, or other identification number if specified. Each item requires a separate bid and envelope. Shipping charges will be paid by the successful bidder, FOB Newington. The successful bidder will be advised by mail of the successful bid. No other notifications will be made, and no information will be given by telephone to anyone regarding final price or identity of the successful bidder.

Please send your bids to Kathy McGrath, Product Bids, ARRL, 225 Main St, Newington, CT 06111.

Advanced Radio Devices model 230A MF/HF linear amplifier, s/n 0126 (see Product Review, May 1989 *QST*). Minimum bid: $4700.

Uniden® President™ HR2510 10-meter transceiver, s/n 83000616 (see Product Review, May 1989 *QST*). Minimum bid: $179.

Kantronics KAM® multimode communications processor, s/n 74146 (see Product Review, June 1989 *QST*). Minimum bid: $220.

### *QEX:* THE ARRL EXPERIMENTERS EXCHANGE AND AMSAT SATELLITE JOURNAL

The July issue of *QEX* includes:

- "Practical Spread-Spectrum: An Experimental Transmitted-Reference Data Modem," by Andre Kesteloot, N4ICK. A simple data link using the transmitted reference approach. Included is a brief description of circuitry (most elements have been described in previous articles).
- "NET98.EXE: A Japanese Version of the KA9Q Internet (TCP/IP) Package," by Masahiro Yamada, JK1NNT and Takayuki Kushida, JG1SLY. Modifications include the support of Kanji characters and support of the PC-9801 series personal computer.
- "Correspondence," describes an easy way to calculate distance and bearing between two locations using USGS maps.
- ">50" by Bill Olson, W3HQT gives an update of solid-state RF receiving devices.

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# Improving and Using R-X Noise Bridges

(continued from page 32)

$$Z_i(f+f_\lambda/4) = Z_0\left(\frac{Z_L\sinh(\gamma\ell) + Z_0\cosh(\gamma\ell)}{Z_0\sinh(\gamma\ell) + Z_L\cosh(\gamma\ell)}\right) \quad \text{(Eq 27)}$$

Eqs 26 and 27 can be manipulated so that the characteristic impedance can be found by

$$Z_0 = \sqrt{Z_i(f)\, Z_i(f+f_\lambda/4)} \quad \text{(Eq 28)}$$

The square root is complex, and may be calculated with a scientific calculator using the Eqs 29 through 33.

$$Z = R + jX = Z_i(f)Z_i(f + f_\lambda/4) \quad \text{(Eq 29)}$$

$$|Z| = \sqrt{R^2 + X^2} \quad \text{(Eq 30)}$$

$$R_0 = \sqrt{|Z|}\cos\left(½\tan^{-1}\left[\frac{X}{R}\right]\right) \quad \text{(Eq 31)}$$

$$X_0 = \sqrt{|Z|}\sin\left(½\tan^{-1}\left[\frac{X}{R}\right]\right) \quad \text{(Eq 32)}$$

$$Z_0 = R_0 + jX_0 \quad \text{(Eq 33)}$$

Transmission-line attenuation can be calculated after using this transmission-line impedance equation:

$$Z_i = Z_0\left(\frac{Z_L[\cos(\beta\ell) + j\alpha\ell\sin(\beta\ell)] + Z_0[\alpha\ell\cos(\beta\ell) + j\sin(\beta\ell)]}{Z_0[\cos(\beta\ell) + j\alpha\ell\sin(\beta\ell)] + Z_L[\alpha\ell\cos(\beta\ell) + j\sin(\beta\ell)]}\right) \quad \text{(Eq 34)}$$

This equation yields an error of less than 5%—as long as the transmission-line loss is less than 3 dB. If the transmission line is an odd multiple of a quarter wavelength (n = 1, 3, 5,...) and is terminated by an open circuit, or if the transmission line is an even multiple of a quarter wavelength (n = 2, 4, 6,...) and is terminated by a short circuit, the input impedance is given by

$$Z_i = \alpha\ell\, Z_0 \quad \text{(Eq 35)}$$

The attenuation of this transmission line can be found by

$$\alpha\ell = \frac{R_i}{R_0} \quad \text{(Eq 36)}$$

where $R_i$ and $R_0$ are the resistive parts of the input impedance and the characteristic impedance, respectively. The transmission-line attenuation increases with frequency. An estimate for this attenuation is given by

$$\alpha\ell(f) = \alpha\ell(f_\alpha)\left(\frac{f}{f_\alpha}\right)^\sigma \quad \text{(Eq 37)}$$

where

$0.5 < \sigma < 1$

This equation can be used to interpolate between unmeasured values of attenuation. For most coaxial cables, $\sigma = 0.5$ works well.