Product Review & Short Takes Columns from *QST* Magazine

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Product Reviews

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Ten-Tec Jupiter HF Transceiver

Reviewed by Joe Bottiglieri, AA1GW
Assistant Technical Editor

The evolutionary path that has led up to Ten-Tec's latest HF transceiver—the Jupiter—has followed an interesting course.

Ten-Tec laid the groundwork for the Jupiter in 1998. Drawing on experience garnered from developing DSP-based receivers for their commercial and government markets, they set out to create a low priced radio for their short-wave customers. This became the RX-320: a compact "black box" receiver that connects to a computer and is entirely operated through software (see "Product Review," *QST*, Mar 1999).

Their Pegasus—debuted at Dayton Hamvention '99—was a logical extension: add a transmitter to the RX-320 and market it as an amateur HF transceiver. Paul Danzer, N1II, shared his impressions of this computer-controlled transceiver in our February 2000 column.

The flexibility that's made possible by using software to control these radios is perhaps one of their most notable attributes. Since their releases, Ten-Tec has turned out several updated versions of their respective GUI (*graphical user interface*) software packages. These updates can be downloaded from Ten-Tec's Web site free of charge.

Computer-connectivity also allows Pegasus owners to download and install updates to the "firmware"—the algorithms used within the radio's internal processor—opening the door to even more significant post-purchase enhancements.

The cost savings that were realized by eliminating expensive display and control components allowed Ten-Tec to set the price of the Pegasus in what most consider the affordable range. Apparently, however, a significant number of Ten-Tec's customers and prospective customers have expressed a strong desire to fork over a few additional bucks for a standalone front-paneled version of the Pegasus.

Hail Jupiter!

Borrowing heavily from the earlier design work—and the parts bin in several instances—of its older stable mate, Ten-Tec engineers got down to business. They built up logic and keypad boards that would take over the assignments that the connected computer handles in the Pegasus system. They wrapped up the pieces in an all new enclosure and topped it off with a fairly stylish injection-molded front panel. The result? The Model 538, aka Jupiter.

The Jupiter is a "conventional" 100 W transceiver with general coverage receive from 0.1 to 30 MHz and transceive capabilities on the 160 through 10-meter amateur bands. The SSB, CW, RTTY (AFSK), AM and FM modes are included and there are 128 memories, dual VFOs, RIT *and* XIT, adjustable AGC, a built-in CW keyer, true QSK and a spectrum scope feature. The heart of the system—an Analog Devices AD2181 Digital Signal Processor—also delivers 34 DSP receive filter bandwidths, 18 transmit filter bandwidths, passband tuning, automatic notch and noise reduction, an adjustable noise blanker and a speech processor. A built-in automatic antenna tuner is not available, but Ten-Tec has recently added the LDG Electronics line of external automatic tuners to their product offering.

The dimensions of the Jupiter seem to have been intentionally tailored with convenient desktop operation as a primary objective. While it certainly isn't too large to take along on Field Day, it's unlikely that we'll be seeing it in many mobile installations. A peek under the covers reveals a cavernous interior populated by just a handful of PC boards. It appears as if this radio could have easily been compressed down to a fraction of its size.

Bottom Line

Ten-Tec skillfully grafts a front panel onto their Pegasus computer-controlled transceiver. The result—the Jupiter—is a standalone radio that still manages to retain much of the flexibility of its PC dependent sibling.

The front panel controls include 26 buttons and a rocker-type **POWER** switch. Only seven of these buttons perform more than one operation. The design team did a commendable job of providing direct front panel access to those functions that are used most often, and clearly labeling and carefully positioning all of the controls. The result is a transceiver that's easy and intuitive to operate. Settings that are varied less often, referred to as "set and forget" parameters in the *Operating Manual*, are adjusted via a single menu.

There are five rotary controls: the large main tuning knob, the filter **BANDWIDTH** knob, the **PBT** (passband tuning) knob, the **RIT/XIT** knob and the **MULTI** knob. The **MULTI** knob—true to its label—is used to vary several different settings. The control's active assignment is indicated in reverse video (light color text on a small dark background field) in the lower left corner of the display window. The relative level of the particular setting is represented on a linear scale along the bottom of the screen. The equivalent numeric value—displayed as a percentage—is shown to the far right. The **MULTI** knob is used to control the volume, the RF gain, the mike gain, the all-mode squelch, the RF power output level, the

Joe Bottiglieri, AA1GW ♦ Assistant Technical Editor

Table 1
Ten-Tec Jupiter (Model 538), serial number 12C10820

Manufacturer's Claimed Specifications	*Measured in the ARRL Lab*
Frequency coverage: Receive, 0.1-30 MHz; transmit, 1.8-2, 3.5-4, 7-7.3, 10.1-10.15, 14-14.35, 18.068-18.168, 21-21.45, 24.89-24.99, 28-29.7 MHz.	Receive and transmit, as specified.[1]
Power requirement: Receive, 1.5 A; transmit, 20 A; 12-14 V dc.	Receive, 1.2 A; transmit, 17 A. Tested at 13.8 V.
Modes of operation: SSB, CW, FM, AFSK, AM	As specified.
Receiver	***Receiver Dynamic Testing***
SSB/CW sensitivity, 3 kHz bandwidth, 10 dB S/N: 0.35 μV.	Noise floor (MDS), 525 Hz bandwidth: 1.0 MHz –121 dBm 3.5 MHz –127 dBm 14 MHz –135 dBm
AM sensitivity: Not specified.	10 dB (S+N)/N, 1-kHz tone, 30% modulation: 1.0 MHz 7.1 μV 3.8 MHz 2.2 μV
FM sensitivity: Not specified.	For 12 dB SINAD: 29 MHz 0.73 μV
Blocking dynamic range: Not specified.	Blocking dynamic range, 525 Hz filter: 3.5 MHz 113 dB 14 MHz 123 dB*
Two-tone, third-order IMD dynamic range: Not specified.	Two-tone, third-order IMD dynamic range, 525 Hz filter: 3.5 MHz 87 dB 14 MHz 85 dB*
Third-order intercept: +10 dBm.	3.5 MHz +11 dBm 14 MHz +7.3 dBm
Second-order intercept: Not specified.	+53.6 dBm.
FM adjacent channel rejection: Not specified.	20 kHz channel spacing: 29 MHz, 72 dB.
FM two-tone, third-order IMD dynamic range: Not specified.	20 kHz channel spacing: 29 MHz, 72 dB.
S-meter sensitivity: 50 μV at S9.	S9 signal at 14.2 MHz: 26 μV.
Squelch sensitivity: Not specified.	At threshold: SSB, 14 MHz, 0.14 μV; FM, 29 MHz, 0.36 μV.
Receiver audio output: 1.0 W into 4 Ω, THD not specified.	0.7 W at 4% THD into 4 Ω.[2]
IF/audio response: Not specified.	Range at –6 dB points, (bandwidth): CW-N (525 Hz bandwidth): 363-1000 Hz (636 Hz); CW-W: 286-2857 Hz (2571 Hz); USB-W: 200-2667 Hz (2467 Hz); LSB-W: 250-2667 Hz (2417 Hz); AM: 49-2985 Hz (2936 Hz).
Spurious and image rejection: 60 dB.	First IF rejection, 84 dB; image rejection, 82 dB.
Transmitter	***Transmitter Dynamic Testing***
Power output: SSB, CW, FM, 5-100 W; AM, 25 W (AM low power level not specified).	SSB, CW, FM, 1.3-105 W: AM 0-25 W.
Spurious-signal and harmonic suppression: ≥40 dB	46 dB. Meets FCC requirements for spectral purity.
SSB carrier suppression: ≥50 dB.	As specified. 60 dB.
Undesired sideband suppression: ≥60 dB, 1.5 kHz tone.	As specified. 65 dB.
Third-order intermodulation distortion (IMD) products: 25 dB below two tone.	See Figure 1.
CW keyer speed range: Not specified.	1 to 59 WPM.
CW keying characteristics: Not specified.	See Figure 3.
Transmit-receive turn-around time (PTT release to 50% audio output): <20 ms.	S9 signal, 20 ms.
Receive-transmit turn-around time (tx delay): Not specified.	SSB, 20 ms; FM, 9 ms. Unit is suitable for use on AMTOR.
Composite transmitted noise: Not specified.	See Figure 2.

Size (HWD): 5.12×12.75×14.35 inches; weight, 9 pounds.

Note: Unless otherwise noted, all dynamic range measurements are taken at the ARRL Lab standard spacing of 20 kHz.
*Measurement was noise-limited at the value indicated.
Third-order intercept points were determined using S5 reference.
[1]Transmit range extends a few kHz beyond the edges of each band (example 1797-2009 kHz for 160 meters). Receive sensitivity reduced below 1 MHz.
[2]Maximum volume.

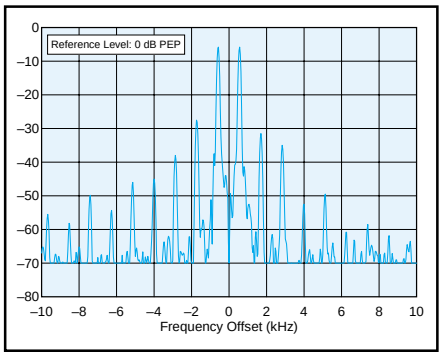

Figure 1—Worst-case spectral display of the Jupiter transmitter during two-tone intermodulation distortion testing. The worst-case third-order product is approximately 29 dB below PEP output, and the worst-case fifth-order product is down approximately 36 dB. The transceiver was being operated at 100 W PEP at 24.950 MHz.

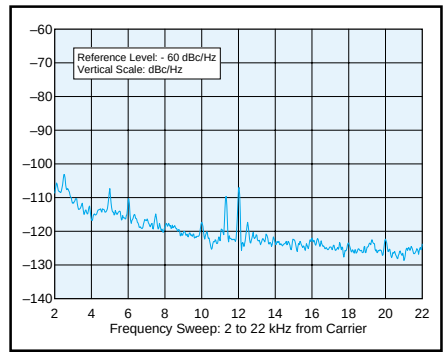

Figure 2—Worst-case spectral display of the Jupiter transmitter output during composite-noise testing. Power output is 100 W at 14.020 MHz. The carrier, off the left edge of the plot, is not shown. This plot shows composite transmitted noise 2 to 22 kHz from the carrier.

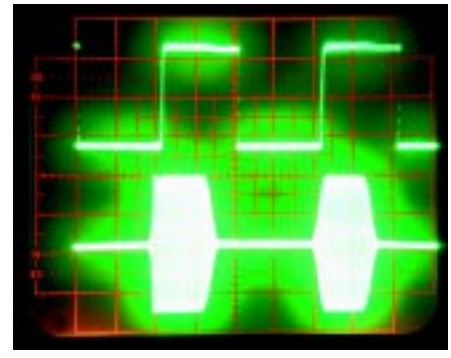

Figure 3—CW keying waveform for the Jupiter showing the first two dits in full-break-in (QSK) mode using external keying. Equivalent keying speed is 60 WPM. The upper trace is the actual key closure; the lower trace is the RF envelope. Horizontal divisions are 10 ms. The transceiver was being operated at 100 W output at 14.020 MHz.

CW keying speed, the transmit audio monitor volume and the CW sidetone volume. Just press the corresponding button first—**AF**, **RF**, **MIC**, for example—and then use the **MULTI** knob to adjust the setting to the desired value. When in the menu mode, this same knob is used to change the setting of the selected item.

The Jupiter's display is a 240×128-pixel dot-matrix LCD that measures about $4^{1}/_{2}\times2^{3}/_{4}$ inches. It's best viewed from head on, as extreme viewing angles and bright room lighting can make it difficult to read. The illumination level is fixed, but the contrast is adjustable.

A row of icons that show the state of the automatic notch filter, the DSP noise reduction, the squelch, the transmit audio monitor, the 20-dB attenuator, the VOX and the tune features are located along the upper edge of the screen. Enabled features appear in reverse video. The frequency of the main VFO is displayed just below. The digits are $^{5}/_{8}$-inch tall and in a stylized font. Just to the left—along the edge of the screen—is a column of icons that indicates the AGC setting (slow, medium or fast), transceive or split operation (**RXTX** when transceiving on the main VFO or **RX** alone when working split) the mode and the digital receive filter bandwidth (adjustable in steps from 300 to 8000 Hz). The selected tuning step size is shown near the right edge of the window.

Below the main VFO information is a smaller set of characters that show the frequency and mode of the sub VFO. When the radio is set up for split operation a **TX** icon appears to the left. An S meter is located to the right. On receive, the meter shows the relative signal strength graphically, and also displays the value numerically (ie **S9 + 20**). The same meter depicts the relative RF output power (or the SWR if desired) when transmitting, and this is also accompanied by a numeric value (**P 100** for power out or **1.6:1** for SWR for example).

A spectrum scope takes up a large portion of the lower half of the screen. Activate the *Sweep* feature and the receiver will rapidly scan through any of eight preset ranges from 240 Hz to 2.4 MHz and generate a plot of the signal strength vs frequency. Once the process is complete, a dotted-line cursor representing the current operating frequency appears at the center of the screen. You can then tune up and down through the spectrum snapshot and locate active or available frequencies. An *Autosweep* feature can be enabled that will automatically sweep a new range of frequencies should you tune off the edge of either end of the displayed plot.

The headphone, key and mike jacks are mounted along the left side of the front panel. The headphone and key jacks are $^{1}/_{4}$-inch. The key jack will accept a straight key, bug or paddles, and menu selections allow adjustment of the CW weighting, the QSK delay, the sidetone pitch and the sidetone volume. CW message memories are not included. The mike jack is a standard 4-pin style and provides a 9 V dc pin for powering electrets or amplified mike elements. The Jupiter does not come with a microphone, hand-held and desk models are sold separately. VOX operation is not possible when using the Ten-Tec hand mike, as the mike element is switched out of circuit when its PTT button is released.

'Round Back

The transceiver comes complete with a 6-foot dc power cord, an extra 2-pin Molex dc power connector, a male phono connector, a spare 25 A automotive-style fuse, a $^{1}/_{4}$-inch stereo plug and a 4-pin mike plug.

Ten-Tec also supplies a 6-foot ribbon cable with a 5-pin DIN connector on one end and four color-coded female phono jacks on the other. The DIN connector mates with the transceiver's rear-panel **ACC 1** socket. The phono jacks then serve as connection points for fixed-level audio out, line-level audio in and PTT (the fourth connector is a spare). This prefabricated cable simplifies wiring the Jupiter to a multimode TNC or computer sound card for digital modes such as PSK31, RTTY or SSTV.

A rear-panel 8-pin DIN **REMOTE** jack allows connection of Ten-Tec's optional 302J Remote Encoder/Keypad. This small desktop accessory—originally designed for use with the computer-controlled Pegasus—includes a main tuning knob, a keypad for directly punching in frequencies and three additional menu-definable function buttons.

There are six phono jacks mounted on the rear panel, including a pair of 13.5 V dc output jacks, an **EXT T/R** jack for controlling non-QSK amplifiers (+24 V dc/200 mA maximum), **TX EN**able and **TX OUT** jacks for sequencing QSK-equipped amplifiers and a **SPARE** jack. There's also a $^{1}/_{4}$-inch **EXT**ernal **SPEAKER** jack and a female DB-9 **SERIAL INTERFACE** connector.

Shared Talents

The Jupiter is capable of operating in a *Pegasus Emulation Mode*. Simply connect an appropriate cable between the **SERIAL INTERFACE** jack and a computer's COM port and fire up and configure Pegasus control software, and the PC will take over command. While in this mode, the radio's front panel controls are disabled and a message in the LCD display reads "**PEGASUS EMULATION MODE**." For

a detailed description of what it's like to operate the Jupiter in this configuration, have a look at the aforementioned Pegasus review. Memories and other settings that are programmed in through the front panel of the Jupiter cannot be copied or transferred to the Pegasus control software, or vice versa.

The Jupiter, just like the Pegasus, will accept firmware (internal software) updates. During the course of this review period, Ten-Tec made several revisions available on their Web site. Updates have included fixes for bugs that cropped up in earlier releases, but have also improved the accuracy of the S meter, extended the low frequency response of the mike audio and added a noise blanker, a speech processor and AM transmit capabilities. The current version is 1.09—there's no telling what new talents the Jupiter might develop through future revisions!

Updating the firmware is easy. All of the necessary files are contained in a small *EXE* file (version 1.09 is only 372 kB). It took under two minutes to download (using a 56k modem). The *EXE* file installed the firmware installation program and three text files onto my PC. The text files contained step by step instructions for performing the update and setting up and using the new features. The actual update process took about 25 seconds; a radio microprocessor reset is the final step. It sure was neat to see a few new features appear on the menu!

More Than Just an Operator's Manual

Ten-Tec did a particularly nice job with the Jupiter's *Operator's Manual*. It contains around 100 pages of mostly $8^{1}/_{2} \times$ 11-inch sheets, but it also includes several larger foldout pages with complete (and legible) schematics of the various PC boards. The actual operating instructions for the radio only fill about 20 pages, but the extensive additional information that's provided elevates this manual close to the level of a full-blown factory service manual. All of the material is well organized and thoroughly indexed and the programming instructions are clear and easy to follow.

On the Air

The Jupiter is a joy to operate. All of the rotary controls have a smooth action, and key presses are confirmed with a pleasant mechanical "click."

Overall, CW operation was pretty impressive. The built-in keyer works great and it's easy to adjust the speed on the fly. For those of you who haven't experienced Ten-Tec QSK, let's just say that it would be impossible to overstate the smoothness of its action. There's virtually no perceptible delay (at the shortest delay setting) and no clacking relays sounding along with the T/R switchover. I logged universally favorable reports on the CW transmit signal, but I did see a few messages on an e-mail reflector concerning a "raspy" sound to the note. I set up a second receiver and listened to the signal myself, and compared it to those of a couple of other rigs I own. The signal does indeed have a slightly different sound—not unlike that of CW signals *received* through DSP filters. I don't consider it particularly objectionable, but it *is* different. It's along the same lines as the difference between the sound of a digital and an analog telephone call. It sounds somewhat, well, digital.

SSB operation with the Jupiter is a unique experience. When the bands weren't very crowded, I found myself opening the receive filter bandwidths far wider than the 2.8 kHz or so that I'm limited to on my other equipment. This typically significantly improved the audio fidelity of the stations that I was listening to. When conditions were crowded, I'd crank the filter into more conventional 2.85 kHz and narrower setting to fight QRM.

The DSP (which works at the third IF) did a respectable filtering job with SSB and CW signals in most cases, but strong nearby signals can make it tough to copy weak ones. The passband tuning helps considerably if the interference is only on one side, though, and the automatic notch filter does an excellent job on carriers. The data in Table 1 points to receiver performance that's about on par with other mid-priced transceivers, and my on-the-air experience confirms this.

The SSB transmit signal consistently received nice audio reports. I experimented a little with local stations using the extreme transmit filter bandwidth settings, but got reports that more neighbor-friendly settings of 2.85 kHz sounded about the same. A fuller-range microphone element (and wider receive filters on their end) would probably help. The audio heard through the transmit audio monitor does not change when the bandwidth is varied.

Some Humble Opinions

There are a couple of controls on the Jupiter that I found myself constantly fiddling with, and I can't help but think that it may be worth it for Ten-Tec to consider revising them in future firmware updates. Let me preface this by saying that we all operate our radios differently, and what I might find to be an annoyance may not be perceived as such by others.

The first is the tuning action. The tuning steps can be set to seven different sizes from 1 Hz to 100 kHz for each step of the main tuning knob's rotary encoder. One revolution of the knob contains 120 "steps." Therefore, when the 1 Hz size is selected, it takes 25 turns of the knob to tune a measly 3 kHz. That's an awful lot of cranking—even when hunting signals in a busy CW sub-band! When you switch to the larger step sizes (as with all radios that use variable step arrangements) received signals—as you tune through them—take on the sound of a musical scale. When you encounter an interesting signal, you'll probably need to switch back to the 1 Hz setting for fine tuning. If you're the type of operator (like I am) that does quite a lot of tuning around and listening, you'll find yourself constantly playing around with the step setting. It would be more convenient if the *speed* of tuning was variable—not just the step size—especially if it could be made to be mode-specific (slow for CW and moderately fast for phone).

The second is the receive filter bandwidth setting. As is the case with all Ten-Tec radios, the available filter bandwidths are independent of mode—and this is a *good* thing. As you move from one mode to another, however (CW to SSB for example), you'll need to manually crank the filter bandwidth up to the wider setting. Switch back—SSB to CW—and you'll probably want to crank it back down. It would be nice if the radio would automatically recall the last filter setting used in a particular mode and revert to that setting. The filter bandwidth and the operating mode *are* retained in the memories, though, and the memories are tunable. This provides a suitable work-around: program several "starting" frequencies on the SSB, CW and the digital portions of each band—with the appropriate mode and bandwidth—in the memories, and then use the memory channels, in lieu of the **BAND** button or tuning knob, for hopping around. (Unfortunately, the tuning step size is not retained in the memories.)

Remember: The firmware used in this radio is updatable. If you've got suggestions of your own, be sure to share them with the friendly folks at Ten-Tec. You may just see your refinements turn up in a future revision!

A Work in Progress

The Jupiter is one harbinger of a change that we're seeing both in ham radio and consumer electronics. The ability for the end user to easily update firmware opens the door to the possibility of near endless evolution throughout a product's serviceable life.

Manufacturer: Ten-Tec, 1185 Dolly Parton Pkwy, Sevierville, TN 37862; 865-453-7172; fax 865-428-4483; **sales@tentec.com**; **www.tentec.com**. Price: Jupiter (Model 538), $1189; hand-held microphone (Model 701), $28; desk microphone (Model 705), $89.95; Remote Encoder/Keypad, (Model 302J), $139.

Yaesu VR-5000 Communications Receiver

Reviewed by Rick Lindquist, N1RL
ARRL Senior News Editor

A ham friend spotted the VR-5000 sitting on a table next to my amateur station. "Hey! New transceiver?" he asked. "No," I said. "It's Yaesu's new dc-to-daylight receiver-scanner."

My friend seemed a little disappointed, and that's a common reaction among those who believe that anything in a box with a dial, buttons and a frequency display must also be capable of transmitting to have real value.

While it's true that many of us amateurs live to transmit there are occasions when *just listening* can be as much or even more fun.

The Yaesu VR-5000 communications receiver gives you access to a lot of wide-open listening spaces. It also includes some dandy features you probably don't have on any of your amateur transceivers.

A Quick Overview

What's in the little black box? Well, it's a general-coverage, multimode receiver that can help you get acquainted with the radio frequency real estate between 100 kHz and 2600 MHz (cellular excluded). This includes nearly all of the major Amateur Radio allocations as well as some potential bands we haven't yet acquired title to but might, such as 136 kHz and 5 MHz. The VR-5000 also can give you entrée to UHF bands your H-T or VHF-UHF mobile likely do not cover. For example, AO-40 (as of press time) was transmitting telemetry only on its 2.4 GHz beacon. Unfortunately for scanner fans, the VR-5000 lacks trunk-tracking capability, a desirable feature found in scanners within the same general price range.

Available modes for the main receiver include FM (narrow and wide), AM (narrow and wide), LSB/USB, and CW. The sub-receiver operates either in AM or FM.

Other goodies include 2000 regular memories, 50 band-edge memories, and five preset channels. With that many memories, you should not have a problem storing all of your favorite short-wave and public safety frequencies. Additionally, the 50 programmable search ranges allow setting up many discrete spectrum segments for searching. The five preset memories are great for quickly getting to those most special frequencies—the local repeaters, for example, or possibly the Amateur Radio on the International Space Station—or ARISS—2-meter downlinks. There's a sub-receiver that lets you make excursions from the main dial setting up to 20 MHz away.

Connectors on the rear apron let you hook up a coaxial fed antenna (there's an SO-239) or an unbalanced high-impedance antenna. Also on the back of the radio are a **MUTE** jack, a switch to select the antenna jack, A or B, an external speaker jack, a record jack (constant 8 mV) that provides output unaffected by the volume or tone controls; a +8 V jack for accessories, an IF output jack (10.7 MHz), and a nine-pin *Computer Aided Transceiver*, or CAT, serial (RS-232C) computer control jack.

The serial jack suggests the option of greater external control than is actually possible. PC control of the VR-5000 is limited to the main VFO frequency, receive mode and channel step.

One neat feature is called *Programmable Memory Recall*. PMR lets you set up the radio to monitor activity on up to 50 memory channels at the same time. Why would you want to do that? Glad you asked. Yaesu suggests that this capability could come in handy if you wanted to monitor traffic levels on several repeater sites. The PMR Board on the display gives a graphical representation of channel occupancy at a given time.

Another is the *Band Scope*. This lets you view activity on either side of your current operating frequency. Move the channel marker to a signal you spot, and you're there.

For prospective short-wave listeners (SWLs), Yaesu has thoughtfully programmed a block of popular international broadcast outlets, such as *Radio Nederland*, *Radio Australia* and *Deutsche Welle*. This is a great help to new hams who often cut their radio teeth as SWLs.

Bottom Line

The VR-5000 Communications Receiver opens the door to endless exploration in a nearly boundless range of radio spectrum—but don't forget to bring along the manual!

Using It

We amateurs tend to expect receivers to be uncomplicated devices that are simple to use. After all, there's no transmitter in the box—how hard could it be, right? Well, not so fast there, VOX breath! We determined that while the VR-5000 is pretty easy to hook up and get squawking, making it do what we wanted takes a bit more TLC.

Our resident scanner buff tried putting the *Operating Manual* aside to see how easy it would be to play with the features and how much he could figure out on his own. "While I was able to operate in the VFO mode, it was not long before I had to hit the book," he reported.

In short, the VR-5000 is not always very intuitive to use, and on occasion it could get downright frustrating when you'd unintentionally back yourself into some nook or cranny by pushing a wrong button. There are a keypad and a lot of buttons, most of them with at least two discrete functions and not all obvious by their labels. On the other hand, some buttons that seemed to be obvious—weren't! Pushing the **BANK** key is supposed to select the desired memory bank. On all occasions, pushing this button took us to a setup menu that let the user modify the current memory bank or create a new one altogether.

It can take many keystrokes on the VR-5000 to reach a desired state or to program a block of channels. Going strictly by the book, it takes a dozen steps to set the handy on-screen world clock (with accompanying map graphic) that gives time reference to 66 different areas of the world. We found that it was easy to mess up on the steps, and that programming

Table 2
Yaesu VR-5000, serial number 0K030164

Manufacturer's Claimed Specifications	*Measured in the ARRL Lab*
Frequency coverage: 0.01-824; 849-870; 894-2600 MHz.	As specified.
Modes of operation: FM, WFM, AM, AM-N, WAM, USB, LSB, CW.	As specified.
Power requirements: 0.7 A (maximum volume), 13.5 V dc ±15%.	0.76 A (maximum volume, no signal), tested at 13.8 V dc.
Size (HWD): 2.8×7.1×8 inches; weight, 4.2 pounds.	
CW/SSB sensitivity (10 dB S/N): 0.2-0.5 MHz, 4.8 μV; 0.5-1.8 MHz, 1.0 μV; 1.8-4 MHz, 0.6 μV; 4-30 MHz, 0.3 μV; 30-2000 MHz, 0.3 μV; 2000-2600 MHz, 1.8 μV.	Noise floor (MDS): 1.0 MHz, –118 dBm; 3.5 MHz, –124 dBm; 14 MHz, –128 dBm; 50 MHz, –133 dBm; 144 MHz, –133dBm; 222 MHz, –125 dBm; 432 MHz, –133 dBm; 902 MHz, –128 dBm; 1240 MHz, –122 dBm; 2400 MHz, –128 dBm.
AM sensitivity (10 dB S/N): 0.2-0.5 MHz, 10.8 μV; 0.5-1.8 MHz, 4.0 μV; 1.8-4 MHz, 2.5 μV;4-30 MHz, 1.1 μV; 30-2000 MHz, 1.2 μV; 2000-2600 MHz, 1.8 μV.	AM narrow, test signal modulated 30% with a 1-kHz tone, 10 dB (S+N)/N: 1.0 MHz, 3.2 μV; 3.8 MHz, 1.2 μV; 53 MHz, 0.55 μV; 120 MHz, 0.53 MHz; 146 MHz, 0.7 μV; 440 MHz, 0.71 μV.
FM narrow sensitivity (12 dB SINAD): 28-30 MHz, 0.35 μV; 30-2000 MHz, 0.45 μV; 2000-2600 MHz, 0.8 μV.	FM narrow, 12 dB SINAD: 29 MHz, 0.33 μV; 52 MHz, 0.21 μV; 146 MHz, 0.24 μV; 222 MHz, 0.58 μV; 440 MHz, 0.23 μV; 906 MHz, 0.41 μV; 1296 MHz, 0.69 μV; 2400 MHz, 0.49 μV.
FM wide sensitivity (12 dB SINAD): 30-2000 MHz, 1.5 μV.	100 MHz, 1.8 μV.
Blocking dynamic range: Not specified.	CW mode: 3.8 MHz, 70 dB; 14 MHz, 70 dB; 50 MHz, 72 dB; 144 MHz, 69 dB; 222 MHz, 68 dB; 432 MHz, 76 dB; 902 MHz, 69 dB; 1240 MHz, 81 dB.
Two-tone, third-order IMD dynamic range: Not specified.	CW mode dynamic range and third-order intercept point *Frequency (MHz)* / *Dynamic Range (dB)* / *Intercept point[1] (dBm)* 3.8 / 61 / –32 14 / 63* / –35 50 / 63* / –38 144 / 62* / –40 432 / 65* / –36 902 / 60* / –38 1240 / 71* / –17
Second-order intercept point: Not specified.	+11 dBm.
FM adjacent channel rejection: Not specified.	20 kHz channel spacing: 29 MHz, 49 dB; 52 MHz, 48 dB; 146 MHz, 47 dB; 440 MHz, 47 dB; 906 MHz, 39 dB; 1296 MHz, 50 dB.
FM two-tone, third-order IMD dynamic range: Not specified.	20 kHz channel spacing: 29 MHz, 49 dB*; 52 MHz, 49 dB*; 146 MHz, 46 dB*; 440 MHz, 48 dB*; 906 MHz, 40 dB*; 1296 MHz, 51 dB*; 10 MHz channel spacing: 52 MHz, 72 dB; 146 MHz, 68 dB; 440 MHz, 65 dB.
Squelch sensitivity (threshold): Not specified.	At threshold: SSB, 14 MHz, 1.9 μV; FM, 29 MHz, 1.5 μV; 52 MHz, 1.0 μV; 146 MHz, 1.1 μV; 440 MHz, 1.1 μV; 906 MHz, 1.8 μV; 1296 MHz, 1.8 μV.
Audio output: 1.0 W into 8 Ω (THD not specified).	1.0 W into 8Ω (maximum output)[2]
IF/audio response: Not specified.	Range at –6 dB points, (bandwidth): CW: 174-2222 Hz (2048 Hz); USB: 174-2222 Hz (2048 Hz); LSB: 174-2222 Hz (2048 Hz); AM: 140-1326 Hz (1186 Hz).
Spurious and Image rejection: Not specified.	IF: HF, 40 dB; VHF, 39 dB; UHF, 13 dB; Image: HF, 86 dB; VHF, 87 dB; UHF, 81 dB.

Except as noted, all dynamic range measurements were taken using the ARRL Lab standard spacing of 20 kHz.

[1]Third-order intercept points were determined using noise floor reference.
[2]THD at max output was 50% with signal at maximum indication on S-meter (5 bars). Minimum THD was about 15%.

some features took a few tries to get right.

We were dismayed to discover that the VR-5000 is not computer programmable, although it's possible to use a PC to *control* some functions, such as the main VFO frequency. Our scanner aficionado says that the ability to use software to set up the memories would be extremely helpful; the VR-5000's manual approach translates into a lot of button-pushing. "This is one radio you'd get programmed and not fool with too much," he predicted.

Our scanner guy appreciated that the VR-5000 did not greet him with one of those cutesy messages that often confront owners of newer ham transceivers—or cellular telephones—these days. "When I power up, I like to get to work," he said. "The display, with adjustable brightness and contrast, is easy to see."

Unfortunately, the manual does not always describe some of the symbols and icons that popped up. An annotated display graphic would be a helpful and useful addition to the manual, which earned a "fair" rating. A radio at this level of sophistication, complexity and multiple features should have a better-detailed and more clearly written manual and a quick-reference card to avoid dog-earing the manual's pages through repeated look-ups. This manual was just not up to Yaesu's typically excellent standards.

Keeping It Simple

Hams are used to twisting dials and maybe pushing a button or two or even entering a frequency on a keypad. That's the place to start with the VR-5000, then work your way up into the more complex stuff like creating, programming and labeling memory banks. The VR-5000 lets you apply alphanumeric names to memory banks and to individual channels alike, and this is one feature that's simple and fun to take advantage of.

Fortunately, there is a nice little rubber-covered, detented tuning knob to twirl. Entering a frequency on the keypad is very simple too. So is moving around using the manual controls. Pushing the **F** key and then turning the dial moves you in 1-MHz steps; pushing the **F** key and the **>** or **<** button shifts your frequency in 10 MHz increments up or down. You can change the tuning step at the push of a button too.

Out of the box, the VR-5000 automatically selects the receiving mode based on the frequency the main receiver is tuned to. You can shift modes manually and override this feature, however.

The main and sub-receiver audio gain controls are simple rotary pots like the ones you'd find on the typical amateur mobile transceiver. Sharing the shaft with the main volume knob is the outer **SQL** (squelch) control. The sub-receiver volume control, which does not quite kill the audio completely when turned fully counterclockwise, is backed by a **TONE** knob that alters the receiver's audio response on both channels. Another surprise was that there is no way to squelch the sub-receiver, which limits the flexibility of having a sub-receiver to start with. If you don't want to hear the sub-receiver, the manual advises you to simply turn down the volume control.

Greater Complexity

Trying to set up and program a memory bank with discrete channels sent me scrambling for the *Operating Manual*. It takes a bit of patience to get a handle on this receiver, and you'll want to keep the manual close at hand. But there's lots of memory to fill (remember, 2000 of them plus 100 memory banks), and there are lots of things you can do in terms of memory operation.

We already mentioned the ability to apply alphanumeric tags to memories and memory groups (banks). You can choose from among 74 characters that include numerals, upper and lower-case letters, and several special characters. The VR-5000 gives you the capability to search for these labels; you also can sort memories by using their alphanumeric tags.

Speaking of sorting, it's possible to sort memory channels by frequency, by receive mode or by channel number—and you can delete vacant memories automatically.

Memories can be protected from inadvertent erasure or deletion. It's also possible to mask certain memory channels that you don't need to recall—and unmask them later if it turns out you need them in the rotation again. There's a priority feature that lets you monitor a memory channel while checking a priority channel every five seconds for activity.

Yaesu has included *Smart Search* in the VR-5000, a feature that's proven handy in its Amateur Radio products, including the very popular FT-817 transceiver (see "Product Review," *QST*, Apr 2001). Smart Search can take some of the pain out of loading the VR-5000's many memories, although it can load a strong signal into more than one channel, so you might have some cleaning up to do once you've let it do its thing.

Scanning comes in several flavors, but our scanner buff didn't like that the VR-5000 does not let you scan only selected memory banks. In general, you can scan memory channels only, scan while in VFO mode, scan according to S meter level (on an arbitrary scale of 0 to 255) or scan just to find voice channels. It's possible in VFO scanning to set the radio up to scan only a portion of the VFO's range instead of the whole radio. Using the programmable memory scan (PMS) feature, you can set up the VR-5000 to scan between up to 50 separate upper and lower-limit pairs. It's possible to reverse the scan direction in midstream by simply turning the **DIAL** knob one click clockwise (to scan upward) or counter-clockwise (to scan downward). The scan resume mode can be set to hold when the scanner encounters a signal longer than two seconds; delay or hold until the signal disappears, then resume after two seconds or another user-settable interval, or pause for a user-settable interval then resume.

Special Features

The VR-5000 offers some interesting and useful sideshow features. We've mentioned some already. Others include putting the receiver to use as a comparative field strength meter with a bar graph representation of test and reference signals. The receiver also can be set up to display audio waveforms on the LCD screen.

It's possible to clone memory data from one VR-5000 to another. The *Operating Manual* also includes the CAT (*Computer Aided Transceiver*) computer-control protocols.

A Word on Performance

While our scanner friend was happy with the VR-5000's performance on HF and VHF using mostly modest antennas, I was a little disappointed in the receiver's performance on HF. It's important to bear in mind that that the VR-5000 was never intended to serve as a second receiver in an HF contest station. The ARRL Lab test results bore this out. The radio's dynamic range measurements at the standard 20-kHz spacing were well below the numbers we typically see even on low-end amateur transceivers, but is in line with the level of performance we've observed in some of the other LF to microwave receivers. Intercept numbers were well into the negative range. Apparently, even at this price range, there are some trade-offs to be made. When purchasing a receiver like this you pay for wide frequency coverage and programming, scanning and memory features, not strong-signal performance.

One VR-5000 feature that's helpful in this regard is *RF Tune*, which lets you shift the RF passband to maximize sensitivity and minimize the impact of other nearby signals on what you're trying to hear. This is a sort of preselector, to use a term from an earlier era. I found using an antenna tuner ahead of the receiver was beneficial, too.

Random Thoughts

The world clock feature is very nice, but the VR-5000 lacks any kind of back-up battery for the clock, so you have to supply power to the radio at all times to preserve its time setting.

While we're on the subject of power: The radio operates on 13.8 V dc and comes complete with one of those "wall wart" supplies everyone loves to hate. A separate dc cord for hooking it up in your car or wiring to your existing station supply is also included.

The size and weight are easy to handle, so this is a receiver that could easily go mobile, although no bracket was supplied for mobile mounting.

There's plenty of audio from the little speaker, although it will distort pretty quickly at higher volume settings. An external speaker helps.

In general, while the VR-5000 offers many features, it might be a tad too busy for less experienced (or less adept) users who just want a decent receiver to play with. The multiplicity of keystrokes sometimes required to take advantage of certain functions tended to blunt the convenience of having those features in the first place.

Our thanks to Bill Moore, NC1L, and to Ed Hare, W1RFI, and Michael Tracy, KC1SX of the ARRL Lab staff for their assistance in preparing this review.

Manufacturer: Yaesu USA, 17210 Edwards Rd, Cerritos, CA 90703; 562-404-2700; fax 562-404-1210; **www.yaesu.com**. Manufacturer's suggested list price: $1099; Typical current street price: $890. List prices of selected accessories: DSP-1 Digital Signal Processing Unit: $119.95; DVS-4 Digital Voice Recorder: $47. QST

SHORT TAKES

HEIL SOUND HS-706 HEADSET

Problem: You want to haul your ICOM IC-706 transceiver along for Field Day—or perhaps use it on a low-budget DXpedition, for a special event, or even while mobile—and you really need the convenience of hands-free SSB operation.

Solution: The Heil Sound HS-706 headset!

This lightweight yet rugged (and attractive) headset not only provides hands-free convenience but audio that's a few steps ahead of what you'll ever get out of the hand-held stock mike that comes with the radio. Using it is simplicity itself.

The HS-706 is specifically designed for use with the popular IC-706 radios—from the "classic" to the IC-706MkIIG—and Heil Sound does not recommend its use on other radios. Heil Sound says the HS-706 was developed to address what it calls ICOM's "history of very low gain" when using a dynamic microphone.

Hooking the HS-706 up to your IC-706 is plug-and-play. It comes equipped with a modular RJ-11 plug on the end of its five-foot cable that fits the IC-706 mike jacks on the radio's faceplate or rear apron. That's it!

Well, of course, you've also got to slip the HS-706 on your head, and when you do, you'll notice that it's pretty darn comfortable. The pad for the single headphone—you can swing the mike boomset 180º so you can listen with either ear (I happen to be left-eared)—reminded me of that "fine Corinthian leather" Ricardo Montalban used to talk about in those automobile ads. The headband expands to accommodate (we'd assume) any reasonable head size. A foam-rubber piece on the opposite end of the headband helps keep the whole business in place.

The built-in headphone seems to have excellent audio response and was able to handle fairly high audio-level settings without exhibiting any distortion. Since the HS-706 plugs into the mike jack on the IC-706 and takes its receive audio from that jack, the radio's internal or external speaker is not defeated and continues to operate. A blank plug or a set of headphones inserted into the front-panel phone jack can disable the speaker if desired.

Inserted in the cord about two feet from the headset is a PTT button with a handy clip that allows the user to snap it onto a shirt or belt.

The mike element itself, covered by a foam-rubber windscreen, sits at the end of a flexible boom that's approximately six inches long. Heil mike elements are the gold standard for many SSB contesters and DXers. Heil Sound says the HS-706 boasts a "new high-gain FET" (electret) microphone that produces "extremely articulate audio that will make your IC-706 come alive!" Advertising hype aside, the HS-706 does indeed make for excellent-sounding audio; it's perceptibly cleaner, more natural-sounding, and punchier, but not remarkably so. Some stations we worked could not tell much difference between the stock mike and the Heil, although recordings made by another station show the audio from the hand mike to be a bit flat-sounding when compared to that from the HS-706.

Heil Sound advises tweaking the radio's settings to optimize it for the HS-706. This is advisable. For my voice, the best arrangement seemed to include some compression and shifting the carrier frequency by up to the maximum 200 Hz above the filter's center frequency. Your mileage may vary.

But that's really only half the story. The convenience of the HS-706 really has to be considered a big part of its overall value. I found the best part of using it with VOX enabled on the IC-706 was that I could concentrate on keeping the log, tuning the radio, or possibly driving the car (this might draw unwanted attention from other drivers, and use of a headset device like this even might be illegal in some jurisdictions). One drawback: When you're using the HS-706 headset, you don't have the **UP/DOWN** buttons right in your hand as you do with the stock microphone.

In sum, I'd have to say that the HS-706 certainly was a joy to use. It could even cause an old CW-hound like me to get on SSB more often!

Manufacturer: Heil Sound Ltd, 5800 North Illinois, Fairview Heights, IL 62208; 618-257-3000; **info@heilsound.com**; **www.heilsound.com**. Price: HS-706 headset, $59. QST

Rick Lindquist, N1RL ♦ QST Senior News Editor