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QST Compares: Dual-band Hand-Held Transceivers
(ADI AT-600; Kenwood TH-G71A; Standard C510A; Yaesu VX-1R)

MFJ-1026 Deluxe Noise Canceling Signal Enhancer

Edited by **Rick Lindquist, N1RL**• *Senior Assistant Technical Editor*

QST Compares: Dual-band Hand-Held Transceivers

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QST *Managing Editor*

The market for hand-held FM transceivers is one of the most competitive in the ham industry. As a result of this competitive pressure, we've seen a bewildering flurry of change during just the last few years. Manufacturers are adding more features while still searching for ways to make them comprehensible to average users. Some H-Ts are exploring the less-is-more strategy while others seem to be auditioning for roles in the new sci-fi thriller, *The Incredible Shrinking Radio*.

The winner, of course, is *you*. Thanks to market forces in action we're blessed with hand-helds that were unimaginable 10 years ago. We're getting a lot more for our dollars, too. Not long ago, a dual-band H-T was considered a luxury. Now they're well within the price range of the average ham. Best of all, modern H-Ts have become multipurpose devices with uses beyond chatting on 2-meter or 70-cm repeaters.

We last looked at dual-band H-Ts in "Product Review" for July 1997, when we compared the Alinco DJ-G5TH, the ICOM IC-T7A, the ICOM IC-W32A, the Standard C508A, and the Yaesu FT-50R. All of these H-Ts still were available from retailers as we went to press. But this is a dynamic market segment, and some of our current crop of four new models already were about to hit the street as we were wrapping up our earlier review (and we have word of even more surprises on the way—stay tuned!) This time, we'll look at the ADI AT-600, the Standard C510A, the Yaesu VX-1R, and the Kenwood TH-G71A dual-band H-Ts. After careful testing and evaluation by the ARRL Laboratory, the radios were turned over to our *QST* review team for several weeks of "road testing." In addition to myself, our review team consisted of Rick Lindquist, N1RL, Joe Bottiglieri, AA1GW, and Dan Miller, K3UFG.

We found that programming all of these units was relatively simple. Manufacturers have made this process so intui-

Table 1: Dual-Band Hand-Held Transceiver Features

	ADI AT-600	*Kenwood TH-G71A*	*Standard C510A*	*Yaesu VX-1R*
Extended VHF/UHF reception	Y	Y	Y	Y
Aviation band reception (AM)	Y	Y	Y	Y
Regular memory channels	200[1]	200	200	194
Memory naming (characters)	Y (6)	Y (6)	N	Y (6)
Memory cloning	Y	N	N	Y
PC programmable	Y[2]	Y[2]	N	Y[2]
Programmed scanning	Y	Y	Y	Y
Power-output choices	H / M / L	H / L / EL	H / L	H / L
Low-battery indicator	Y	Y	N	Y
Lighted buttons	Y	Y	Y	Y
Automatic repeater offset	Y	Y	Y	Y
Crossband split	Y	Y	Y	Y
Full duplex	Y	N	N	N
Paging (code or tone squelch)	Y	Y	Y	Y
Dual watch	Y	Y	Y	Y
DTMF autodialer (memories)	Y (10)	Y (10)	Y (10)	Y (8)
CTCSS tone scan	Y	Y	Y	Y
Antenna connector type	BNC	SMA	SMA	SMA
Suggested retail price	$390	$430	$359	$349
Typical selling price (as of 2/98)[3]	$267	$365	$303	$277

Key
Y = Standard
O = Optional
N = None or not available

[1]120 if using memory-naming feature.

[2]Using optional software.

[3]Typical selling prices represent an average of prices quoted by three retailers and do not include rebates, coupons, or other sales incentives.

tive that it has become a routine operation for H-T users nowadays. Some review team members managed to program several memory channels without referring to the book.

Not all H-Ts sound the same on the air. We paid special attention to transmit audio quality on these units and conducted on-the-air tests on simplex to judge how each sounded on the other end of the radio circuit when listening on a typical mobile transceiver. We listened for such qualities as "natural-sounding" audio; low, mid-range, and high-end response; sibilance (over-emphasis of "s" sounds, especially when close-talked); and audio "punch."

In other cases, such a direct head-to-head comparison was impossible, because—as you'll soon see—these H-Ts are tailored to meet the needs of specific user types. Still, we found these radios had much in common, as well as some interesting differences.

ADI AT-600

The ADI AT-600 is styled along the lines of what we might call a "traditional" dual-band H-T. We were pleased to see separate volume and squelch controls for VHF and UHF, plus a separate **CH** (VFO tuning) control. The **VOL** and **SQL** controls are concentric, but adjusting either one is never a problem. In fact, we quickly learned how to use the sides of our thumbs to rotate the **SQL** "ring." With a little practice, it's a snap. We found that entering frequency changes via the keypad was preferable to twisting the little **CH** knob.

We found that the AT-600 had a very rugged, solid feel. The AT-600 handles well in either palm—maybe favoring lefties just a bit.

The *User's Manual* was quite adequate, but the *Get on the Air Quickly* sheet was *very* helpful. It has all the information you need to get up and running without flipping pages (everyone's in a hurry these days). We were able to find and execute most basic functions without cracking the manual, so it was kind of like *Cliff's Notes*.

The dot-matrix display on the AT-600 is one of the best we've seen in a while. The letters and numerals are very easy to read at any angle. They are thick and seem to almost glow with a slightly bluish hue. You can display the "main" and "sub" bands simultaneously, or individually. Better yet, you can monitor both bands simultaneously (hence the dual **VOL** and **SQL** controls). However, you can only transmit from the "main" band (VHF or UHF, depending on which you select).

Beyond 2 meters and 70 cm, the AT-600 offers extended receive coverage in several bands, beginning at 100 MHz. The rig includes an AM detector for aeronautical reception. You can set the radio via the menu to automatically go into AM mode in the aircraft band. At the opposite end of its extended coverage, the AT-600 tops out at 985 MHz (cellular bands excluded).

If you don't want to take advantage of the memory naming feature, the AT-600 offers 200 memory slots (100 for each band). If you use memory naming, you still have 120 memories to label for future reference. The AT-600 lets you apply six-character names to up to 55 memories. In either configuration (this is menu-settable), it's likely more memories than you'll ever want or need.

With the standard 7.2 V battery, the AT-600 is rated at 2 W on VHF and 1.8 W on UHF (ours actually delivered more than 3 W on 2 meters and more than 2 W on 70 cm on a full charge); for another $25 or so on the street, you can get the optional high-power (HP) package with a taller battery that can deliver 5 W output on VHF or UHF.

Since our manual specified 450 mW of audio output, we expected more sound. Reviewers complained that they'd like to have more. "Seems a bit low for a radio this size," is how one user put it. Some noted distortion at high-volume settings. Our ears weren't fooling us. In the ARRL Lab, we measured

ADI AT-600, serial number 7440000477

Manufacturer's Specifications	***Measured in the ARRL Lab***
Frequency coverage: Receive and transmit, 144-148 MHz, 438-450 MHz.	Receive, 100-173 MHz, 350-470 MHz, 900-985 MHz; transmit, 144-148 MHz, 430-450 MHz.
Power requirements: 6-16 V dc. Receive, 85 mA (dual mode);transmit, (max, high power), 1.5 A with 13.8 V dc.	Receive, 70 mA; transmit, (max, high power), 1.7A.
Size (HWD): 7.6×2.4×1.7; weight, 13.3 oz.	
Receiver	*Receiver Dynamic Testing*
FM sensitivity, 12 dB SINAD: VHF, 0.16 μV; UHF, 0.18 μV.	For 12 dB SINAD: VHF, 0.13 μV; UHF, 0.35 μV (see text).
AM sensitivity: Not specified.	120 MHz, 0.2 μV.
Two-tone, third-order dynamic range: Not specified.	20 kHz offset from 146 MHz, 64 dB*; 10 MHz offset from 146 MHz, 82 dB; 20 kHz offset from 440 MHz, 53 dB*; 10 MHz offset from 440 MHz, 68 dB.
Adjacent channel rejection: Not specified.	20 kHz offset from 146 MHz, 64 dB; 20 kHz offset from 440 MHz, 53 dB
First IF and image rejection: Not specified.	IF rejection, VHF, 127 dB; UHF, 103 dB; image rejection, VHF, 80 dB; UHF, 44 dB.
Squelch sensitivity: 0.15 μV.	At threshold, 0.06 μV.
S-meter sensitivity: Not specified.	S9=2.5 μV.
Audio output: 250 mW at 10% THD into 8 Ω.	228 mW at 10% THD into 8 Ω (see text).
Transmitter	*Transmitter Dynamic Testing*
Power output (H/M/L): with BA072R167, 7.2 V VHF, 2 W / 2 W / 0.35 W; UHF, 1.8 W / 1.8 W / 0.35 W; battery pack, with external supply, VHF, 5 W / 2 W / 0.35 W; UHF, 5 W / 1.8 W / 0.35 W.	VHF, 3.3 W / 2.9 W / 0.4 W; UHF, 2.1 W / 2 W / 0.3 W with BA072R167, 7.2 V battery pack; VHF, 5.6 W / 2.6 W / 0.3 W; UHF, 4.9 W / 2.3 W / 0.3 W at 13.8 V dc (external supply).
Spurious signal and harmonic suppression: 60 dB.	VHF, 67 dB; UHF, 70 dB. Meets FCC requirements for spectral purity.
Transmit-receive turn-around time (PTT release to 50% of full audio output): Not specified.	Squelch off, S9 signal, VHF, 130 ms; UHF, 95 ms.
Receive-transmit turn-around time ("tx delay"): Not specified.	VHF, 28 ms; UHF, 29 ms.

*Measurement was noise-limited at the value indicated.

less than half the specified power. ADI says the specification should have read 250 mW. Our unit didn't even make that, however (see table).

Also, our AT-600 seemed pretty deaf on UHF, and our Lab measurements confirmed this (see table). Our radio apparently was defective. We checked out another unit from a local retailer's and a third supplied by ADI, and both handily met the posted receive sensitivity spec on UHF.

The AT-600 edged out the other units in this group with the best two-tone, third-order dynamic range—64 dB. All were in the same ballpark, however. It also had the best FM sensitivity and adjacent channel rejection numbers on VHF.

We judged the AT-600 to have the most pleasant and natural-sounding transmit audio of this current crop. It was not especially "punchy" audio, but it was very clean at both normal and close-talking range, with no sibilance or popping. "Communication quality *plus*" is how one reviewer rated it.

We found a few nits to pick with the AT-600. During our transmit audio tests, we noted a very faint whine in the background of undetermined origin. Also, the **PTT** button is combined on the same pad with the **FUNCTION** button. We often found ourselves pressing **FUNCTION** when we wanted **PTT**, and vice versa. Some reviewers reported that the **PTT** button itself was difficult to press, requiring more force than we've encountered on other radios. Also, reviewers weren't keen on the metal belt clip and predicted it likely would eventually be bent under repeated use.

Overall, we found the AT-600 to be a solid performer in the conventional, full-featured H-T mold.

Manufacturer: Premier Communications, 20277 Valley Blvd, No J, Walnut, CA 91789; tel 909-869-5711; fax 909-869-5710; e-mail **premier@adi-radio.com**; **http://www.adi-radio.com/**. Manufacturer's suggested retail price, AT-600, $390; AT-600HP, $410.

KENWOOD TH-G71A

Modern H-Ts are complicated enough. Squeeze in two bands and a bucketload of features and you have a very complicated radio indeed! In the new TH-G71A, Kenwood has opted to concentrate on the most popular features alone. In doing so, they've created a dual-band H-T that is strong on performance while being quite easy to use.

The TH-G71A offers a total of 200 memories, memory naming, and a versatile group of scanning options. An automatic power-off function and battery saver mode are present as well, but the Kenwood engineers seemed to draw the line at this level of complexity. Instead, they addressed the problems of ease of use and performance. That's where the TH-G71A excels.

With the supplied 9.6 V battery, you get a maximum of 5 W of power on VHF and UHF with the TH-G71A. Even running high power, no one complained that the radio got too hot while transmitting for extended periods. Kenwood says the unit has a "huge" heat sink. It can run up to 6 W on VHF and 5.5 W on UHF with external power.

A low-power version TH-G71AK2, with a commensurately slimmer battery, is the option—around $30 less on the street. (There's an optional AA cell battery case available too.) Unlike most H-Ts, the TH-G71A includes a long "high performance" rubber duck antenna. This antenna is super flexible and won't jab you in the abdomen if you clip the H-T to your belt. Reviewers liked the molded plastic belt clip, too.

Extended receive coverage (including the aviation band—see table) is standard in the TH-G71A. But, there's not quite as much extended coverage as competing models offer, and this might limit the marketplace appeal of this otherwise superb H-T. Kenwood advises, however, that it will supply information on a strictly do-it-yourself, no-warranty extended receive

Kenwood TH-G71A, serial number 90600838

Manufacturer's Specifications	*Measured in the ARRL Lab*
Frequency coverage: Receive and transmit, 144-148 MHz, 438-450 MHz.	Receive, 136-174 MHz, 400-470 MHz, 118-136 MHz (AM); transmit, 144-148 MHz, 430-450 MHz.
Power requirements: 6-16 V dc. Receive, 70 mA; transmit, (max, high power), 2.1 A with 13.8 V dc.	Receive, 50 mA; transmit (max, high power), 1.7A.
Size (HWD); 4.4×2.1×1.5 in; weight 11.6 oz.	
Receiver	***Receiver Dynamic Testing***
FM sensitivity, 12 dB SINAD: 0.18 μV.	For 12 dB SINAD: VHF, 0.16 μV, UHF, 0.16 μV.
AM sensitivity: Not specified.	120 MHz, 0.19 μV.
Two-tone, third-order dynamic range: Not specified.	20 kHz offset from 146 MHz, 62 dB*; 10 MHz offset from 146 MHz, 83 dB; 20 kHz offset from 440 MHz, 58 dB*; 10 MHz offset from 440 MHz, 72 dB.
Adjacent channel rejection: Not specified.	20 kHz offset from 146 MHz, 61 dB; 20 kHz offset from 440 MHz, 58 dB
First IF and image rejection: Not specified.	IF rejection, VHF, 89 dB; UHF, 141 dB; image rejection, VHF, 125 dB; UHF, 88 dB.
Squelch sensitivity: 0.1 μV.	At threshold, VHF, 0.11 μV; UHF, 0.18 μV.
S-meter sensitivity: Not specified.	S9=1.3 μV.
Audio output: 500 mW at 10% THD into 8 Ω.	690 mW at 10% THD into 8 Ω.
Transmitter	***Transmitter Dynamic Testing***
Power output (H/M/L): with PB-39, 9.6 V battery pack, VHF, 5 W / 0.5 W / 0.05 W; UHF, 5 W / 2.2 W / 0.05 W; with external supply, VHF, 6 W / 0.5 W / 0.05 W; UHF, 5.5 W / 0.5 W / 0.05 W.	VHF, 5.2 W / 0.8 W / 0.08 W; UHF, 4.1 W / 0.4 W / 0.09 W with PB-39, 9.6 V battery pack; VHF, 5.8 W / 0.8 W / 0.1 W; UHF, 5.2 W / 0.5 W / 0.1 W at 13.8 V dc (external supply).
Spurious signal and harmonic suppression: 60 dB.	VHF, 70 dB; UHF, 63 dB. Meets FCC requirements for spectral purity.
Transmit-receive turn-around time (PTT release to 50% of full audio output): Not specified.	Squelch off, S9 signal, VHF, 10 ms; UHF, 25 ms.
Receive-transmit turn-around time ("tx delay"): Not specified.	VHF, 84 ms; UHF, 77 ms.

*Measurement was noise-limited at the value indicated.

modification for the TH-G71A. With modification, the unit also is capable of receiving 320 to 400 MHz and between 800 and 950 MHz (cellular excluded).

By the way, the unit automatically defaults to AM on its 118 MHz band, although you can manually select either AM or FM reception.

The radio has a very durable feel. In fact, it's quite a handful. The TH-G71A meets MilSpec 810E for water and shock resistance. The ample battery pack attaches to the back of the rig in clamshell fashion, rather than on the bottom like most traditional H-Ts. The tuning control is concentric with the **VOLUME** control, but both seem to operate without too much mechanical interference. (The squelch is set through the menu mode—a growing trend among H-T designs.)

The TH-G71A sports a relatively large speaker for an H-T. Everyone agreed that the receive audio was outstandingly rich and full—the best of the group. On transmit audio tests, we judged the TH-G71A to have great communication quality audio that was fairly natural and neither favors nor rolls off excessively at the top or bottom ends. We detected no undue sibilance, even when close-talked. At normal speaking distances, transmit audio was not remarkably "punchy;" it's just fine. Close-talking gives you a bit of a boost without distortion.

The button and keypad layout are clear and easy to understand. We were pleased to see the power adjustment in the form of a button labeled **LOW**. By pressing this button you can quickly step through the various power output options. This would be very handy in situations where you need to bump your output up or down immediately without fumbling through a menu system.

The display visibility was judged easy to read—with good character size. The icons that indicate various modes or functions were on the small side—typical of similar sized H-Ts. Display backlighting is good, too. The only real display-related complaint was that the display washes out when viewed from below.

By the way, the TH-G71A includes an outstanding manual—arguably the best one among the H-Ts in this review. The instructions are simple without being silly, and the graphics are extremely well done. The manual also provides some nice detail—the remote microphone wiring diagram, for example. Kenwood now packs a laminated *Quick Reference Guide* with the TH-G71A. These also are available from Kenwood dealers.

Also noteworthy: The TH-G71A had the best wideband (10 MHz) dynamic range on both VHF and UHF of the H-Ts in this review group plus the best adjacent channel rejection on UHF.

Overall, this is a great-sounding H-T that incorporates a lot of nice features without going overboard.

Manufacturer: Kenwood Communications Corp, 2201 E Dominguez St, Box 22745, Long beach, CA 90801-5745; tel 310-639-5300; fax 310-631-3913; **http://www.kenwood.net**. Manufacturer's suggested retail price, TH-G71A, $430; TH-G71AK2 (low-power model), $410.

STANDARD C510A

Although not quite as tiny as the Yaesu VX-1R, the Standard C510A is a close second. Its stylish, compact design fits just about anywhere—or in any pocket. The C510A is solidly constructed, right down to the buttons. Unlike the rubbery buttons you're accustomed to seeing on other H-Ts, these are tough, clear plastic with labels deeply inset. They seem to almost float on the C510A's front panel.

Like some of the other H-Ts in this review, the C510A avoids the curse of cramming in dozens of features that most operators will never use. Instead, the focus is on simplicity. Still, there are plenty of goodies in the C510A, including 200 memories and auto repeater mode.

As one of our users put it, "The C510A made me a believer in alkalines!" This H-T is designed primarily for use with alkaline batteries. In fact, if you want a NiCd battery

Standard C-510A, serial number 73U120119

Manufacturer's Specifications	*Measured in the ARRL Lab*
Frequency coverage: Receive and transmit, 144-148 MHz, 438-450 MHz.	Receive, 100-192 MHz, 333-490 MHz, 700-955 MHz (cell blocked); transmit, 144-148 MHz, 438-450 MHz.
Power requirements: 3.3-8.4 V dc. Receive, 33 mA; transmit, (max, high power), 0.95 A.	Receive, 26 mA; transmit (max, high power), 1.0 A.
Size (HWD); 4.2×2.3×1.1 in; weight 7.4 oz.	
Receiver	*Receiver Dynamic Testing*
FM sensitivity, 12 dB SINAD: VHF, 0.2 μV; UHF, 0.22 μV.	For 12 dB SINAD: VHF, 0.14 μV; UHF, 0.19 μV.
AM sensitivity: Not specified.	120 MHz, 0.18 μV.
Two-tone, third-order dynamic range: Not specified.	20 kHz offset from 146 MHz, 58 dB; 10 MHz offset from 146 MHz, 69 dB; 20 kHz offset from 440 MHz, 57 dB*; 10 MHz offset from 440 MHz, 67 dB.
Adjacent channel rejection: Not specified.	20 kHz offset from 146 MHz, 61 dB; 20 kHz offset from 440 MHz, 57 dB.
First IF and image rejection: Not specified.	IF rejection, VHF, 119 dB; UHF, 121 dB; image rejection, VHF, 67 dB; UHF, 79 dB.
Squelch sensitivity: 0.2 μV.	At threshold, VHF, 0.22 μV; UHF, 0.32 μV.
S-meter sensitivity: Not specified.	S9=2.8 μV.
Audio output: 100 mW at 10% THD into 8 Ω.	195 mW at 10% THD into 8 Ω.
Transmitter	*Transmitter Dynamic Testing*
Power output (H/L): with 3 AA alkalines, VHF and UHF, 1 W / 0.3 W; with external supply, Not specified.	VHF, 1.2 W / 0.3 W; UHF, 0.7 W / 0.2 W with 3 AA alkalines; VHF, 1.2 W / 0.3 W; UHF, 0.7 W / 0.2 W at 4.5 V dc (external supply).
Spurious signal and harmonic suppression: 60 dB.	VHF and UHF, 70 dB. Meets FCC requirements for spectral purity.
Transmit-receive turn-around time (PTT release to 50% of full audio output): Not specified.	Squelch off, S9 signal, VHF, 80 ms; UHF, 90 ms.
Receive-transmit turn-around time ("tx delay"): Not specified.	VHF, 76 ms; UHF, 72 ms.

*Measurement was noise-limited at the value indicated.

pack you have to buy it as an option. However, we achieved outstanding performance and long operability with alkalines. Powering the C510A with an alkaline battery pack, you can coax a full 1 W from the unit; switching to a NiCd pack will drop you down to 0.7 W (not that a 300 mW deficit will make much difference in the real world). The low-power setting ratchets the C510A down to 300 mW output. When used within the coverage area of a sensitive repeater, the 300 mW output proved to be entirely adequate on either 2 meters or 70 cm.

If H-T power is not enough, however, the C510A can become the first component—essentially a hand-held control head—in a much higher-power mobile station. The optional CPB510DA power booster provides 50 W on VHF and 35 W on UHF, plus more receive audio, and additional receiving passband filters.

The display is small, and the lens is rounded, but it's readable from most angles. The only complaint about this arrangement was that the display lens catches a lot of glare when lighted from above (ie, from overhead lighting or even out in the sun). This also applies to the little plastic buttons, which are rounded. Another illumination problem: our users found that while the lamp adequately illuminates the keypad number keys, it does not provide sufficient backlighting for the various function buttons surrounding the keypad.

The **VOLUME** control is side mounted, so it is easily adjustable with the thumb or index finger, although it might get in your way when you're stuffing this H-T into a pocket. Considering the small speaker size, receive audio on the C510A was fairly clean. We noted some distortion at the highest volume setting. There's not a great deal of audio, but one user had no trouble hearing other stations while using it inside his noisy vehicle.

Transmit audio tests indicated the audio had good "punch" at typical and close speaking distances and sounded fairly natural. We noted a little sibilance and raspiness, especially when the unit was close-talked, but no popping. The audio retains some low end response without being muddy. The desired "communication value" midrange response was excellent.

The tuning control is prominently placed on the top. Squelch settings are controlled through the menu and include an RF-activated squelch (a squelch that activates according to actual S meter readings).

The C510A offers extended receive coverage in different bands between 100 and 999 MHz (cellular blocked). The AM detector can be set to switch in automatically when you enter the aviation band. With this much spectrum to cover, it helps to have a good scanning system. Fortunately, the C510A delivers with a number of available scanning modes.

While you can't simultaneously listen to two bands, the C510A does permit crossband split operation. The instructions in the *Owner's Manual* are less than clear on this, but you can put frequencies on different bands into one memory channel or the call channel and, for example, transmit via your higher power mobile (FCC rules require you to identify your mobile as a repeater).

Other helpful features include an automatic power-off mode, a battery-saver function, an adjustable time-out timer and a DTMF autodialer.

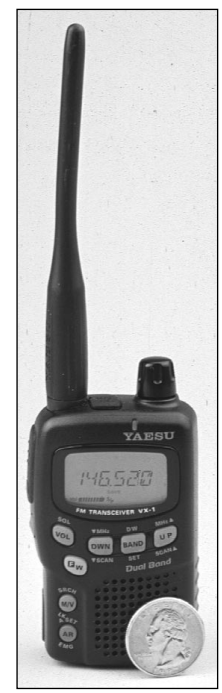
We worried a bit about the battery cover on the back of the radio. The little clasp is not overly secure and under more vigorous use, this can open up allowing the cover to come off.

Overall, a very compact H-T that covers lots of spectrum and has the right mix of features for its size.

Manufacturer: Standard Amateur Radio Products, Box 48480, Niles, IL 60714; tel 773-763-0081; fax 773-763-3377; **http://www.stdradio.com**. Manufacturer's suggested retail price, $359.

Yaesu VX-1, serial number 71032574

Manufacturer's Specifications	*Measured in the ARRL Lab*
Frequency coverage: Receive, 0.5-1.7 MHz, 76-999 MHz, (cell blocked); transmit, 144-148 MHz, 430-450 MHz.	As specified.
Power requirements: 3.2-7 V dc. Receive, 150 mA; transmit, (max, high power), 0.4 A with 3.6 V dc.	As specified.
Size (HWD); 3.2×1.9×1.0 in; weight 4.4 oz.	
Receiver	*Receiver Dynamic Testing*
FM sensitivity, 12 dB SINAD: 76-108 MHz, 1.6 μV; 144-148 MHz, 0.16 μV; 170-222 MHz, 15.8 μV; 300-420 MHz, 0.5 μV 430-450 MHz, 0.18 μV; 470-800 MHz, 15.8 μV (except 540- 600 MHz); 800-999 MHz, 5 μV.	For 12 dB SINAD: 76-108 MHz, 1.7 μV; 144-148 MHz, 0.18 μV; 170-222 MHz, 2.2 μV; 340-420 MHz, 0.5 μV; 430-450 MHz, 0.18 μV; 470-800 MHz, 3.2 μV; 800-999 MHz, 4.5 μV.
AM sensitivity, 10 dB S/N: 0.5-1.7 MHz, 5 μV; 108-137 MHz, 0.5 μV.	10 dB (S+N)/N: 1.0 MHz, 2.2 μV; 120 MHz, 0.3 μV.
Two-tone, third-order dynamic range: Not specified.	20 kHz offset from 146 MHz, 62 dB; 10 MHz offset rom 146 MHz, 72 dB; 20 kHz offset from 440 MHz, 49 dB*; 10 MHz offset from 440 MHz, 68 dB.
Adjacent channel rejection: Not specified.	20 kHz offset from 146 MHz, 62 dB; 20 kHz offset from 440 MHz, 47 dB
First IF and image rejection: Not specified.	IF rejection, VHF, 75 dB; UHF, 138 dB; image rejection, VHF, 70 dB; UHF, 50 dB.
Squelch sensitivity: Not specified.	At threshold, VHF, 0.11 μV; UHF, 0.13 μV.
S-meter sensitivity: Not specified.	S9=3.5 μV.
Audio output: 50 mW at 10% THD into 8 Ω.	61 mW at 10% THD into 8 Ω.
Transmitter	*Transmitter Dynamic Testing*
Power output: with FNB-52LI, 3.6 V battery pack, VHF and UHF, 0.5 W; with external supply, VHF and UHF, 1 W (low power not specified).	VHF, 0.46 W / 0.07 W; UHF, 0.47 W / 0.06 W with FNB-52LI, 3.6 V battery pack; VHF, 1.0 W / 0.12 W; UHF, 1.0 W / 0.14 W at 6 V dc (external supply).
Spurious signal and harmonic suppression: 50 dB.	VHF, 65 dB; UHF, 68 dB. Meets FCC requirements for spectral purity.
Transmit-receive turn-around time (PTT release to 50% of full audio output): Not specified.	Squelch off, S9 signal, VHF, 90 ms; UHF, 190 ms.
Receive-transmit turn-around time ("tx delay"): Not specified.	VHF, 20 ms; UHF, 25 ms.



*Measurement was noise-limited at the value indicated.

The OSCAR 27 Test

As a satellite enthusiast, I couldn't resist testing these H-Ts with the AMRAD-OSCAR 27 satellite. AO-27, as it is affectionately known, functions as an orbiting FM repeater. You transmit to the satellite on 145.850 MHz and receive on 436.800 MHz. (See "AO-27: An FM Repeater in the Sky" by Ray Soifer, W2RS, *QST*, Jan 1998, page 64, for the whole story.)

Of the H-Ts in our review group, only the ADI AT-600 is capable of crossband duplex (transmitting on one band while listening on another), so I wanted to see if I could use it to work through AO-27 using just the supplied "rubber ducky" antenna. For the remaining radios, I simply wanted to see if they could at least pick up the satellite's 500 mW 70-cm signal on their "duckies." For each test I selected a high-elevation pass that brought the bird at least 50° above my local horizon. Oddly enough, I often achieved best results when I held the radios and their antennas *horizontally*. The results were quite interesting.

• ***ADI AT-600*:** The AT-600 offers crossband duplex, but I never had a chance to test this function with AO-27 since I could barely hear the satellite with the antenna supplied. When the bird was at maximum elevation, I could copy a word or two, but nothing more. There is no point in doing a transmit test if you can't hear the satellite! Just before this review went to press, I conducted another AO-27 test with a new AT-600 and the improvement was dramatic. Obviously our original AT-600 had been defective.

• ***Kenwood TH-G71A*:** The TH-G71A includes an extra-long rubber ducky antenna, so I expected good performance. I wasn't disappointed. The TH-G71A copied AO-27 with excellent strength during the test pass.

• ***Standard C510A*:** Something about the design of the C510A and/or its antenna is a bit different. Unlike the other H-Ts, I heard the strongest signals from the satellite when I held the radio *vertically*. Copy was outstanding, lasting for several minutes.

• ***Yaesu VX-1R*:** Despite the VX-1R's very short antenna, I heard strong, full-quieting signals from AO-27 from horizon to horizon.

This was hardly a scientific comparison. Although I tested each radio at exactly the same location, there are bound to be many variables involved (antenna designs and atmospheric phenomena, for example).—*Steve Ford, WB8IMY*

YAESU VX-1R

The Yaesu VX-1R, the world's smallest dual-band H-T, generated quite a stir when it was introduced last year at the Dayton Hamvention. The VX-1R isn't a mini, it's a *micro*-mini—about the size of a small pager. The radio not only fits easily in any pocket, you might even lose it in a large one. As one reviewer exclaimed, "This radio beats it all for a fun toy."

With the supplied battery the VX-1R develops 500 mW of output. If you run it from an external 6-V supply, you can get a full 1 W. We found that if you were close to a sensitive repeater or remote receiver, 500 mW was sufficient when using the supplied "rubber ducky" antenna (more efficient after-market antennas—the Comet SMA503, for example—are available for this and other low-power units—*Ed*). The one-half watt is more than enough power for simplex use while hiking or enjoying other outdoor activities. The VX-1R can trans-ceive on 2 meters or 70 cm, and it can operate crossband split, but you cannot receive both bands simultaneously.

This is the first H-T we've looked at that uses a lithium ion battery, but we're certain to see others. The battery takes less than two hours to fully charge. The 500 mA capacity wall-cube charger is about twice as large as the transceiver itself, but it can be used to operate the transceiver as a dc power source, something many—if not most—H-Ts cannot do.

The LCD display is large and very easy to read. There are a minimal number of buttons and a single multipurpose knob. Controlling the volume is a two-step operation. You press the **VOL** button, then turn the knob clockwise or counterclockwise. It takes three steps to select the desired squelch setting, but these were mild inconveniences given this radio's manifold capabilities.

The VX-1R has astonishing receiver range—the most extensive among the present company of H-Ts. It covers 0.5 to 1.7 and 76 to 999 MHz in nine labeled bands. Yes, you can listen to AM broadcast stations with the VX-1R, although you must connect an external antenna (receiver sensitivity in this part of the spectrum is very respectable at slightly more than 2 μV). For some odd reason, the VX-1R cannot display the received frequency during AM broadcast reception. You're forced to tune in very relative terms by observing the signal-strength display, but 10 memories are set aside for the BC band. You can also enjoy FM broadcast (it does a surprisingly fine job on this band), aeronautical, public service, and just about everything in between.

Note that receiver sensitivity takes quite a dip in a couple of segments (see table). It's especially deaf around 290 MHz, where we measured sensitivity at a whopping 500 μV.

For such a tiny radio, it has an adequate display with a bold font that's easy to read. Yaesu also highlighted the **+** and **–** symbols for ease of visibility. At some angles, the display washes out, but, overall, the display was deemed quite acceptable for a radio of this size. Display and button backlighting were judged to be good too. The display lamp can be set to come on automatically whenever you press a button on the VX-1R.

One gripe: the power button can be hard to activate. Sometimes, you needed to apply your fingernail to the rubber button.

The four-connector mike-speaker jack requires using the CT-44 adapter (or similar) to connect conventional headphones or to use the unit on packet. The manual includes connection information, but without an adapter, you can't just plug in an earpiece, to, say, listen while you're waiting at the airport.

It's obvious that the VX-1R was intended for outdoor activities—public service and recreation in particular. For instance, if you press and hold the **A SET/EMG** button for two seconds, the VX-1R goes into its "emergency" mode. It switches to a UHF "home" frequency and begins transmitting an emergency tone. At the same time, it jumps to maximum audio volume and activates a screeching siren! This is a terrific feature for campers, hunters, search and rescue, and the like.

If you and a friend both own VX-1Rs (or similarly equipped Yaesu radios), you can take them on your next hiking trip. With the *Automatic Range Transpond System* (ARTS) activated, your VX-1Rs will "ping" each other at 15-second intervals. If they can hear each other, a beeper sounds (if enabled) and IN RNG ("in range") appears on the respective displays. But if you wander too far from each other, three beeps sound and the display indicates OUTRNG ("out of range"). This would be a good feature to use at busy hamfests, too.

With 194 conventional memories there's more than enough room to store just about every conceivable repeater pair and simplex frequency. Better yet, the VX-1R's *Smart Search* will scan and automatically store active channels in 31 dedicated memories. Plus, you can apply six-character memory names very easily. The VX-1R also includes versatile scanning modes, automatic power off, a transmit timer, and a battery-saving mode. Although the VX-1R lacks a DTMF keypad, Yaesu thought to include an autodialer to store and transmit strings of DTMF tones (that you set using the knob). So, you could program one memory to send the autopatch activation code and then another to send, say, your home telephone number.

OK, enough for features. Let's talk about performance. Size (and low power output) have their limitations under the current technology. While the VX-1R hears pretty well, the audio coming out of the tiny little speaker is tinny sounding, and available volume is pretty limited. To be sure, the audio is understandable, if not hi-fi, and that's the point after all. This is not a Bose.

Interestingly, we noted many of the same characteristics while evaluating transmit

audio on simplex. The audio on the other end of the QSO also was understandable most of the time, but it was tinny and not especially natural-sounding. Mid and high-range response predominated at the expense of low-end response and presence. Transmitted audio emphasized sibilants at normal and close-range, and it was slightly raspy sounding at times. We noticed little difference in audio quality when close-talking as opposed to typical speaking distances.

In customary Yaesu fashion, the VX-1R manual is thorough. It includes handy little user tips from a cutesy H-T-like hominoid called "R. F."

One feature we hadn't before seen on an H-T: the VX-1R lets you adjust the clock oscillator from the menu to shift birdies away from certain frequencies you might want to use.

Overall, the VX-1R offers quite a lot in its teeny package, and it works well. As one tester predicted after using the VX-1R, "Dick Tracy wrist radios are only a bit of battery technology away."

Manufacturer: Yaesu USA, 17210 Edwards Rd, Cerritos, CA 90703; tel 562-404-2700; fax 562-404-1210; **http://www.yaesu.com/**. Manufacturer's suggested retail price, $349.

MFJ-1026 Deluxe Noise Canceling Signal Enhancer

By Paul Danzer, N1II
Assistant Technical Advisor

In the 1950s, sophisticated television viewers in the New York City area had big-time TV reception with five local channels available plus a sixth channel from New Jersey. Late at night, this out-of-state channel featured a gentleman offering the *Veg-a-Matic*—"It cuts, it slices, it chops, it dices for the low price of $9.95 plus 50 cents for handling." Surprisingly, it did all this, and not badly.

The name of the MFJ-1026 reminds me of the *Veg-a-Matic*. It is *Deluxe*, and contains a number of features and capabilities you may not expect. Just as the Veg-a-Matic never replaced a $500 tungsten-steel chef's knife, this MFJ unit will not replace some other noise cancelers, including DSP-based units. But it works—and it works well—on some types of noise and interference. Finally, it can be configured as a *Signal Enhancer*, and the enhancement is not just due to interference reduction. All in all, this is a very interesting unit.

BOTTOM LINE

The MFJ-1026 is a useful and inexpensive station accessory that can enhance weak-signal reception for hams and SWLs and eliminate interfering signals or noise. Getting the most out of it takes some practice.

What is It?

1+1=2, and 1–1=0. It is that simple. Suppose there was a fixed, unvarying signal. No QSB, no amplitude changes and no phase changes. Take two identical receivers and two identical antennas, combine the receiver outputs with the plus sign and you hear twice the signal. Invert one output and you are now using the minus sign. The result, if both channels are identical, is zero—the signal nulls. You don't want to use two separate receivers? Just put a dual-channel preamp in front of your receiver. Make one channel adjustable so you can change the incoming signal phase by at least 180°, and make the channel gains variable. Use two independent antennas and you can now do the 1+1=2, and 1–1=0 trick. This is the essence of the MFJ-1026.

What's in the Box?

In a $7^1/_2 \times 2^1/_2 \times 6$-inch box, MFJ has packaged two preamplifiers, a phase control, T/R relay and control circuits. The unit is powered by 10 to 15 V dc and draws about 150 mA. The optional MFJ 1312 (12 VDC, 300 mA ac-to-dc adapter) wall cube can be used. A 2.1-mm coaxial connector (center pin positive) is supplied for the power connection.

The unit is installed between your antenna and your transceiver. Front panel controls pretty much tell the story. The **POWER ON/OFF** controls the DC supply line. The *Instruction Manual* does not say how much power you can run with the MFJ-1026 in line. It has a small relay included for switching from receive to transmit, so 100 W PEP or so is the likely limit. Built-in automatic RF sensing can be used to control the T/R relay, but MFJ suggests hard wiring to the T/R control line connection on the back panel whenever possible. A **T/R DELAY** control on the panel adjusts the relay's recovery time.

The **FREQ** button sets operation for below 7 to 12 MHz or above 7 to 12 MHz. An operating test showed no real difference on the 7 MHz band with either switch setting. In the ARRL Lab, we determined that broadband noise could be nulled between approximately 2 MHz and 35 MHz.

The four controls you will use constantly are the **AUXILIARY ANTENNA GAIN, PHASE, PHASE NORMAL/INVERT** and **MAIN ANTENNA GAIN**. Some of these controls operate differently, depending on the setting of internal jumpers. The *Instruction Manual* is pretty clear on the topic of jumper settings.

MAIN ANTENNA GAIN is just that. It sets the receiver gain of the channel connected to the main antenna connector. The other three controls set the phase and gain of the auxiliary channel, with a 180° shift selected by **NORMAL/INVERT**. The **PHASE** control provides an additional shift capability of approximately 145°.

The auxiliary channel can be connected either to a back-panel connector or to the included short vertical whip. A small incandescent bulb inside the unit acts as a fuse of sorts to protect the auxiliary channel when you are transmitting through the main antenna.

What Does it Do?

Used properly, quite a bit! It will cancel noise and interfering signals. But—and it is a big but—the signal you want to cancel must be *unvarying*. As an example, power noise from a pole transformer will most likely be canceled and stay canceled, at least for reasonable periods of time. Ignition noise from a stationary car also will be canceled. If the car is moving, and therefore the amplitude and phase of the noise are changing, you will not be able to cancel the noise. We found in the ARRL Lab that a strong local signal or noise that's at some distance in frequency from the desired signal could be nulled up to around 60 dB.

Similarly, a carrier on a fairly stable path, such a ground wave, will probably stay constant enough for you to adjust the front panel controls and reduce it considerably. But if there is QSB—fading—and the amplitude and phase of the carrier changes, the null set by the front panel controls will no longer cancel the signal reliably.

While the unit's basic frequency range is in the MF/HF spectrum, we determined during ARRL Lab testing that the unit worked for noise suppression down into the Standard Broadcast band, but less effectively as we dropped in frequency.

There's another issue here that involves the usable frequency range. When I first tried to obtain a null on a strong carrier, I failed completely. The carrier was the local

Table 2
MFJ-1026 Noise-Canceling Signal Enhancer

Manufacturer's claimed specifications	*Tested in the ARRL Lab*
Frequency range: Not specified	Approximately 2 to 35 MHz (see text).
Power requirement: 150 ma at 10-15 V dc.	As specified.
Receive-Transmit Turn-Around: Not Specified.	0.6 ms (with 100W transmitter power).
Transmit-Receive Turn-Around: Not specified.	5 ms to 1.7 sec (adjustable via T/R **DELAY** control on front panel).
Noise reduction: Up to 60 dB.	As specified (typically at least 30 dB).
Signal Loss from Main Antenna: Not specified.	Adjustable (via **MAIN ANTENNA GAIN** control) from a 38 dB loss to a 1 dB gain.

broadcast station, and my first clue that something was wrong was when I could not follow the procedure in the *Instruction Manual*. The **MAIN ANTENNA GAIN** control had no effect. I theorized that the BC station's signal was so strong that it must have been getting into the box via a route other than the antenna port. In order for the null function to work properly, the unit must be able to hear the desired signal primarily on the **MAIN** antenna port and the interfering signal mostly on the **AUXILIARY** antenna port. Type and placement of the actual antennas can make or break your ability to eliminate the desired interference.

By the way, since the nulling has nothing to do with the type of signal you want to hear, the unit will work when you are in any mode—CW, SSB, AM, NBFM or whatever you normally run. But the interference must be from a stationary source and reasonably unvarying in phase and amplitude.

The null function is quite tricky to use—especially at first—but you will get better and better with practice. But don't expect to null a new signal as quickly as you can hit a button to change a receiver filter. It takes work and concentration. Local line noise disappeared in one test on the 15 MHz WWV signal which was much less readable with the unit off-line.

The unit also was able to "move" the null of a signal generated inside the shack so that the signal was stronger on one antenna or the other. The signal source (stationary and unvarying) was physically much closer to one of the antennas, however. This capability lets you steer the pattern away from an interfering signal, although for this to be useful, the desired signal would have to be in another direction from the interference.

This brings us to another capability of the unit that's really interesting. Set the phase so the two signals are additive, and you can now get an effective sort of *diversity* function (*true* diversity reception would require polling). QSB got you down? Try using one input from a dipole and the other from a vertical. I am not equipped with a HF vertical, but my long wire has a good vertical component. Several tests on 20 meters with a multiband Yagi on the main input and the long wire (untuned—just stuck into the auxiliary input) showed considerable improvement in many cases. Unfortunately, it often brought up the noise level and QRM. The unit does have some gain, and the FET preamplifier appeared to block at a high setting. With two *matched* antennas—as MFJ suggests—you might get some very interesting receiving effects. And it is certainly much cheaper than two complete receivers plus an external phasing and mixing unit!

And the Answer is...

To eliminate a persistent carrier or noise source, the MFJ-1026 is an approach worth considering. It also can be used to, in effect, set up a "steerable array" of two receiving antennas. The best part, from my operating test, was the diversity mode, where 1+1 was a very interesting 2 or more! MFJ also makes a somewhat less expensive unit, the MFJ-1025, which does not have a preamplifier and the built-in "active antenna."

Manufacturer: MFJ Enterprises Inc, Box 494, Mississippi State, MS 39762, tel 601-323-5869; orders 800-647-1800. Manufacturer's suggested retail price: MFJ-1026, $139.95; MFJ-1312B ac adapter, $12.95.

QST