

Product Review Column from *QST* Magazine

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QST Compares: Dual-Band Hand-Held FM Transceivers

(Alinco DJ-560T; ICOM IC-32AT; Kenwood TH-77A; Standard C228A; Yaesu FT-470)

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QST Compares: Dual-Band Hand-Held FM Transceivers

By James W. ("Rus") Healy, NJ2L

What we've heard from you about our comparative wattmeter review in February *QST*, not surprisingly, shows that *QST* readers like the concept of comparative reviews and are hungry for more of them.

This installment of *QST Compares*: covers a very popular class—dual-band hand-held FM transceivers. We chose one popular full-size rig from each major manufacturer: Alinco's DJ-560T, ICOM's IC-32AT, Kenwood's TH-77A, Standard's C228A, and Yaesu's FT-470.¹ Four of these radios cover the 144- and 440-MHz bands; the new-to-the-US Standard C228A covers 144 and 220 MHz. It's included here because the 220-MHz band has at least as much of a following as the FM segment of the 420- to 450-MHz band in many parts of the US and Canada.

To best perform this review, five ARRL Headquarters staff members, each with different operating interests, volunteered (with some arm-twisting from the Product Review Editor) to be involved: *QST* Copy Editor Brian Battles, WA1YUA; Laboratory Supervisor Jon Bloom, KE3Z; Field Services Manager Rick Palm, K1CE; Deputy Field Services Manager Luck Hurder, KY1T; and Associate Technical Editor Joel Kleinman, N1BKE. Laboratory Engineer Mike Gruber, WA1SVF, performed the lab testing. The five staffers who participated in the field-operations segment of this review all tried the five radios for one week each, and then provided their impressions. The reviewers evaluated these radios as users most often operate them: Outdoors, in vehicles, day and night, usually with the supplied battery packs and antennas.

On many counts, the reviewers' observations about a given radio were consistent, but in others—mainly ease of programming, ease of use and other ergonomic considerations—they sometimes varied all over the board from "excellent" to "yecch!" This underscores the importance of choosing the right radio for your needs based on trying out all the models you're considering buying. The differences in features between radios may not be as important as the ways those features are implemented from rig to rig. With that in mind, here we go. We'll tackle the HTs in alphabetical order.

ALINCO DJ-560T

Alinco's DJ-560T is its first dual-band HT offered in the US Amateur Radio market. Its very wide UHF receiver coverage (400-520 MHz, well up into the UHF public-service allocations) and relatively low price make it attractive, but the radio also has drawbacks.

Automatic band-changing capability is one of the DJ-560T's slick features. In this mode, the radio watches activity on both bands, and when it finds a signal on one of the bands, it automatically gives you transmit capability on that band. (Usually, you have to manually switch bands, as only one can be active at a time for transmit.)

The reviewers like the radio's software; it has lots of functions, as Table 1 shows. Its automatic power shutoff—a feature the DJ-560T shares with its Kenwood, Standard and Yaesu counterparts—impressed the reviewers. The DJ-560T also has a large, easy-to-use keypad and knurled, well-spaced volume, squelch and tuning knobs. On the other hand, its dark-green keypad labels are hard to read (one reviewer even deemed them "useless") in low-light situations, especially because the keypad isn't illuminated. The liquid-crystal display's back-

lighting doesn't suitably light even the most significant part of the VHF-frequency display. The display is difficult to read when the radio is viewed at an oblique angle.

Alinco's battery-retention scheme is delicate and awkward; it's easy to drop the pack when removing it from the radio, and it doesn't seem very secure when attached. (Four tabs attached to the battery slip into slots in the rig's base.) The stock battery's capacity is adequate only for casual use: A full charge doesn't make it through a 10-minute high-power (2-watt) QSO, even though the stock pack has average capacity among those compared here. The other rigs (except the ICOM IC-32AT, which has higher output and a lower-capacity battery) fared better with their standard batteries.

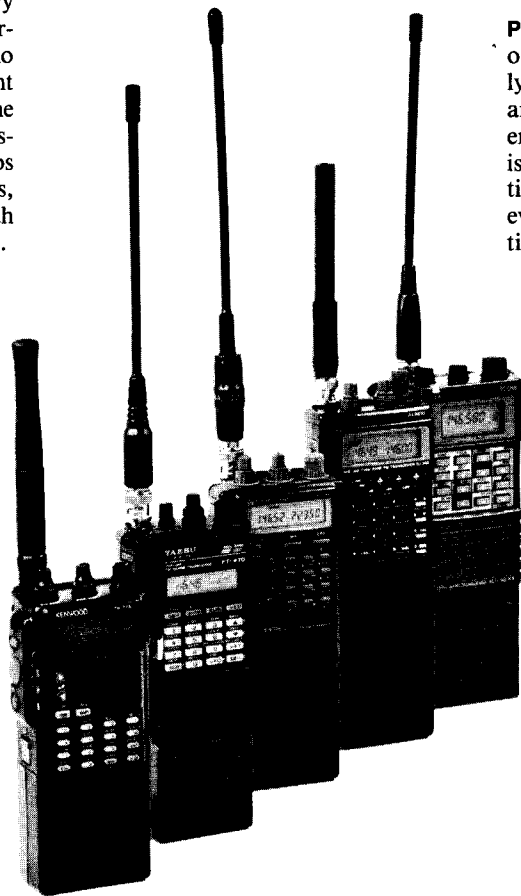
Transmitted and received audio drew "muddy," "muffled," "tinny" and "inadequate" assessments from the evaluators. The DJ-560's 1¼-inch speaker is surely part of the reason for this.

In terms of programming ease, the reviewers were again divided: Three deemed the radio reasonably easy to program and use, but two complained that some of its features are nonintuitive and even "a pain." One described the '560 as "not user-friendly."

DJ-560T users didn't like the nub on its PTT button (it's easy for your finger to slip off, unkeying the radio), the rig's relatively uncomfortable presence in your hand, and the "howling screech" that the radio emits after PTT release when the battery is low. The stock antenna had trouble getting signals in and out where others didn't, even though the DJ-560T's receiver sensitivity is on par with the rest of the radios.

The DJ-560's manual is somewhat anemic. In fact, our radio came without a manual—we had to call Alinco to get one. (By their own admission, they had shipped an unknown quantity without documentation.) We promptly received a photocopy that's somewhat hard to decipher but fairly clearly written. In the step-by-step operating instructions, the manual's small graphics make it challenging to figure out the radio's workings, though; in the descriptive sections, the manual shows miniature key labels instead of referring to them by name. No information is included on connecting a packet-radio TNC to the DJ-560T.

In general, the DJ-560T has good control software (features) but less impressive hardware. As-is,



¹B. Hale, "Yaesu FT-470 Dual-Band Hand-Held VHF/UHF Transceiver," *Product Review*, Sep 1990 *QST*, pp 32-35.



Alinco DJ-560T, Serial no. 0000866

Manufacturer's Claimed Specifications

Frequency coverage: Receiver, 130-174 MHz, 400-520 MHz; transmitter, 144-148 MHz, 440-450 MHz.

Receiver

Receiver sensitivity: Better than 0.18 μ V (-122 dBm) for 12 dB SINAD.

Two-tone third-order IMD dynamic range: Not specified.

Adjacent-channel rejection: Not specified.

Squelch sensitivity: Not specified.

Receiver audio output: Not specified.

Transmitter

Power output with standard battery: 2 W.

Spurious signal and harmonic suppression: Better than 60 dB.

Transmit-receive turnaround (PTT release to 90% of full audio output): Not specified.

Measured in the ARRL Lab

As specified.

Receiver Dynamic Testing

146 MHz, -122 dBm; 430 MHz, -118 dBm.

20-kHz offset from 146 MHz, 53 dB; 20-kHz offset from 440 MHz, 72 dB.

20-kHz offset from 146 MHz, 57 dB; 20-kHz offset from 440 MHz, 55 dB.

146 MHz, -129 to -121 dBm.

260 mW into 8 Ω at 10% THD with standard battery.

Transmitter Dynamic Testing

146 MHz, 2.4 W; 440 MHz, 2 W.

As specified. The DJ-560T meets FCC requirements for spectral purity for transmitters in its power-output class and frequency range.

Squelch on, approx 190 ms; squelch off, approx 135 ms.

this inexpensive radio is fine for most applications, and it's the only HT that offers such wide VHF and UHF receiver coverage. One staff critic liked this radio a lot, but another said it was his least favorite. This underscores the differing needs and desires of HT users, but it's nonetheless clear that better transmitted and received audio, improved battery-usage efficiency and more effective lighting of the

display and controls would greatly boost this radio's value.

ICOM IC-32AT

The IC-32AT, ICOM's only full-size 144/440-MHz HT, has some features unique to the radios covered in this review. For instance, it can deliver more than 5 W of RF output with its standard battery

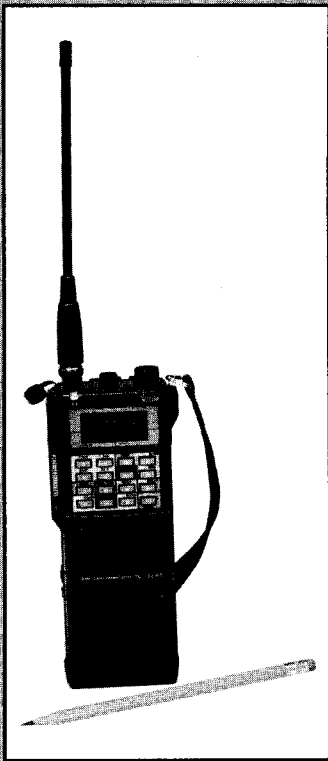
pack—fully twice that of some of the others. It also has the largest, easiest-to-read frequency display of the rigs compared here. In addition, the IC-32AT is compatible with the huge variety of ICOM (and aftermarket) IC-2-series accessories.

A relatively large radio, the IC-32AT is the most rugged rig we tested. WA1YUA put it succinctly: "It's heavy enough to use as a weapon in the close quarters of a

Table 1
Dual-Band Hand-Held Transceiver Features

	Alinco DJ-560T	ICOM IC-32AT	Kenwood TH-77A	Standard C228A	Yaesu FT-470
Dual frequency displays	Yes	No	Yes	Yes	Yes
Simultaneous dual-band receive	Yes	No	Yes	Yes	Yes
Automatic band switching	Yes	No	Yes	No	No
Expanded receiver coverage (VHF/UHF*)	Yes/Yes	Yes/No	Yes/No	Yes/Yes	Yes/No
Cross-band full-duplex operation	Yes	Yes	Yes	Yes	Yes
Memory channels (total)	42	20	42	20	42
Band, memory and programmed scan modes	Yes	Yes	Yes	Yes	Yes
Selected memory-channel lockout	Yes	Yes	Yes	Yes	Yes
Separate audio outputs	No	No	Yes	Yes	No
Standard battery capacity (V/mAh)	7.2/700	13.2/275	7.2/600	7.2/700	7.2/600
High power output (W) with standard battery (VHF/UHF*)	2/2	5.5/5	2/1.5	2.8/2.5	2.3/2.3
High/low power output selection (VHF/UHF*)	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes
Automatic battery-saving mode(s)	Yes	Yes	Yes	Yes	Yes
Automatic power-off	Yes	No	Yes	Yes	Yes
Automatic repeater-offset selection (VHF/UHF*)	No/No	No/No	Yes/No	No/No	Yes/Yes
Supply-voltage range	7.2-12	7.2-13.8	6.3-16	6-16	5.5-15
Dimensions (H/W/D, with standard battery)	6.7/2.2/1.2"	7.1/2.6/1.4"	5.7/2.3/1.2"	6.3/2.6/1.4"	6.5/2.2/1.3"
Weight (lb, with standard battery)	1	1.3	0.9	1.1	0.9
Suggested retail price	\$399.95	\$629.95	\$599.95	\$689.95	\$478.95

*220 MHz is actually a VHF band, but is referred to here as UHF for simplicity.



ICOM IC-32AT, Serial no. 07608

Manufacturer's Claimed Specifications

Frequency coverage: Receiver, 138-174 MHz, 440-450 MHz; transmitter, 144-148 MHz, 440-450 MHz.

Receiver

Receiver sensitivity: Better than 0.25 μ V (-119 dBm) for 12 dB SINAD.

Two-tone third-order IMD dynamic range: Not specified.

Adjacent-channel rejection: Not specified.

Squelch sensitivity: Less than 0.158 μ V (-123 dBm).

Receiver audio output: >400 mW into 8 Ω at 10% distortion.

Transmitter

Power output with standard battery: 144 MHz, 5.5 W; 440 MHz, 5 W.

Spurious signal and harmonic suppression: Better than 60 dB.

Transmit-receive turnaround (PTT release to 90% of full audio output): Not specified.

Measured in the ARRL Lab

As specified.

Receiver Dynamic Testing

146 MHz, -123 dBm; 430 MHz, -120 dBm.

20-kHz offset from 146 MHz, 59 dB; 20-kHz offset from 440 MHz, 59 dB.

20-kHz offset from 146 MHz, 62 dB; 20-kHz offset from 440 MHz, 61 dB.

146 MHz, -128 to -120 dBm.

551 mW into 8 Ω at 10% THD with standard battery.

Transmitter Dynamic Testing

146 MHz, 5.7 W; 440 MHz, 4.7 W.

As specified. The IC-32AT meets FCC requirements for spectral purity for transmitters in its power-output class and frequency range.

Squelch on, approx 100 ms; squelch off, approx 100 ms.

crowded flea market!" (I don't know about *that*, but it certainly gets the point across!) ICOM's hallmark transmitted and received audio are also IC-32AT strong points; the radio's size allows a large speaker (by HT standards), and all its users got good transmitted-audio reports. The knobs atop the rig are well spaced and feel solid.

Especially in its high-power-output mode, the IC-32AT drains the charge from the stock battery relatively quickly. ICOM rates the stock BP-70 for only 2 hours of VHF use (and a scant 1.5 hours on UHF), assuming 1 minute of transmit, 1 minute of receive and 8 minutes of standby. To their frustration, the reviewers found that this rating is accurate; one user barely made it through a 20-minute QSO on a full charge. A look at the table of specifications shows why this is so: The BP-70 is rated at 13.2 V and 275 mAh, whereas the batteries supplied with the other radios are 7.2 V/600-700 mAh units that store between 20 and 40% more energy than the stock ICOM battery.

With the exception of its simple direct frequency entry, the IC-32AT is initially somewhat difficult to program; it has lots of functions, but lacks intuitive programming sequences and keypad labels. Once you've learned to program the radio, though, it's easy to use. The IC-32AT's single-frequency display leaves no doubt about what band you're on.

The ICOM documentation left mixed

impressions with the reviewers. They agreed that it's complete and has clear step-by-step instructions, but they feel that it's written for those who are already familiar with ICOM's programmable HTs. This may confuse first-time users.

Once again, the evaluators were divided when it came time to suggest changes or improvements for the IC-32AT. Some felt that a dual-frequency display and simultaneous dual-receive capability should be included, and others preferred the simplicity of the current design. Also, evaluators would like a better keypad layout, buttons that allow 1-MHz frequency changes, an illuminated keypad and automatic repeater-offset selection. This radio is nice for home-station use because of its relatively high power output and solid construction (it won't be dragged off a tabletop by a speaker/mike, for instance). One reviewer liked the IC-32AT better than any other rig he tested, but most preferred others, as you'll see.

Of the HTs reviewed, the IC-32AT is most like two separate radios in one box. Its basic performance is good, but its engineers didn't integrate the two bands to the degree they have been in the other reviewed radios. With its new IC-W2A, which has simultaneous dual-receive capability and is much smaller than the IC-32AT, ICOM appears to have addressed many of the rough edges found by the IC-32AT reviewers, but only a closer look

in a future review will tell for sure.

KENWOOD TH-77A

The smallest and lightest radio reviewed here, the Kenwood TH-77A, like the ICOM IC-32AT and Alinco DJ-560T, drew considerably varying commentary from the reviewers. They liked the radio's display and some of its nice touches, but weren't fond of its programming. As a side effect of its small enclosure, this radio has the smallest buttons and controls of all the rigs in this comparison, and it's therefore difficult for some users to manipulate. Its display lighting is effective and stays on for a few seconds after you press the tiny LAMP button below the PTT switch. Other buttons are mounted on the left side of the radio, including the very small, recessed POWER button, which some evaluators had trouble locating and actuating.

Users rated the TH-77A's audio output reasonable, but tinny and distorted in high-noise environments. Transmitted-audio reports were consistently good. Battery life was on par with that of the other similarly equipped radios, and the rig is solidly made.

Surprisingly, the evaluation team was almost evenly divided on the TH-77A's programming ease. One deemed it "easy" to program, and another said it was "a pain in the neck." Here again, we see how much variation exists in people's conceptions of



Kenwood TH-77A, Serial no. 20900880

Manufacturer's Claimed Specifications

Frequency coverage: Receive, 136-174 MHz, 438-450 MHz; transmit, 144-148 MHz, 438-450 MHz.

Receiver

Receiver sensitivity: Better than 0.18 μ V (-122 dBm) for 12 dB SINAD.

Two-tone third-order IMD dynamic range: Not specified.

Adjacent-channel rejection: Not specified.

Squelch sensitivity: Less than 0.1 μ V (-127 dBm).

Receiver audio output: >200 mW into 8 Ω at 10% distortion.

Transmitter

Power output with standard battery: 144 MHz, 2 W; 440 MHz, 1.5 W.

Spurious signal and harmonic suppression: Better than 60 dB.

Transmit-receive turnaround (PTT release to 90% of full audio output): Not specified.

Measured in the ARRL Lab
As specified.

Receiver Dynamic Testing

146 MHz, -123 dBm; 430 MHz, -121 dBm.
20-kHz offset from 146 MHz, 60 dB;
20-kHz offset from 440 MHz, 65 dB.
20-kHz offset from 146 MHz, 67 dB;
20-kHz offset from 440 MHz, 56 dB.
146 MHz, -135 to -124 dBm.
211 mW into 8 Ω at 10% THD with standard battery.

Transmitter Dynamic Testing

146 MHz, 2.9 W; 440 MHz, 1.8 W.

As specified. The TH-77A meets FCC requirements for spectral purity for transmitters in its power-output class and frequency range.

Squelch on, approx 100 ms; squelch off, approx 100 ms.

what's easy and what's difficult. All the reviewers lamented that the TH-77A's keypad frequency entry is time-consuming, in part because it's hard to tell what band you're entering the frequency on. Most of the reviewers also reflected that, even though the keypad has a good feel and is effectively backlit, the radio is somewhat difficult to operate once programmed because the radio has so many functions and the keypad buttons are very small. WA1YUA observed that the TH-77A requires "the attention of a neurosurgeon to fiddle with the controls (forget mobilizing!). It's just too inconvenient to be fun to use."

The TH-77A instruction manual,

although complete, suffers from weak translation from the Japanese and contains several typos. The manual's elusive instructions on direct frequency entry doubtless contribute to the relative difficulty of performing those operations.

On the nifty side, the TH-77A comes with a removable plastic cover that protects the keypad (a flexible window allows you to operate the Function key while the cover is in place). The multifunction LCD has dual S meters and icons for at least a dozen functions (including a battery-charge indicator), making it easy to determine how the rig is operating. The TH-77A also features automatic repeater-offset selection in the 144-MHz band, and has two energy-conser-

vation modes (battery saver and timed automatic shutoff). Like the Alinco DJ-560T, the TH-77A features automatic band changing, too.

In short, the TH-77A is a feature-packed, smoothly finished radio (in typical Kenwood fashion), but it almost tries to do *too* much for a package of its size. A larger enclosure and display, or a slightly less ambitious set of features, would bring this rig closer to the top of the five reviewers' lists.

STANDARD C228A

The C228A is Standard's first US-market Amateur Radio VHF HT marketed under

Table 2
Dual-Band Hand-Held Transceiver Accessories

Std = standard, Opt = optional, N/A = not available.

	Alinco DJ-560T	ICOM IC-32AT	Kenwood TH-77A	Standard C228A	Yaesu FT-470
Flexible antenna	Std	Std	Std	Std	Std
Belt clip	Std	Std	Std	Std	Std
Wrist strap	Std	Std	Std	Std	Std
Battery pack and charger	Std	Std	Std	Std	Std
Drop-in battery charger	N/A	Opt	Opt	Opt	Opt
Protective case(s)	Opt	Opt	Opt	Opt	Std
Mobile bracket	N/A	N/A	Opt	Opt	Opt
Mobile power/charging cable(s)	Opt	Opt	Opt	N/A	Opt
Speaker/microphone(s)	Opt	Opt	Opt	Opt	Opt
Earpiece/microphone	Opt	N/A	N/A	N/A	Opt
Headset	Opt	Opt	Opt	Opt	N/A
High-capacity battery packs	Opt	Opt	Opt	Opt	Opt
Alkaline-cell case(s)	N/A	Opt	Opt	N/A	Opt



Standard C228A, Serial no. OXU 010062

Manufacturer's Claimed Specifications

Frequency coverage: Receiver, 130-175 MHz, 200-245 MHz; transmitter, 144-148 MHz, 220-225 MHz.

Receiver

Receiver sensitivity: Better than 0.158 μ V (-123 dBm) for 12 dB SINAD.

Two-tone third-order IMD dynamic range: Not specified.

Adjacent-channel rejection: Not specified.

Squelch sensitivity: 0.1 μ V (-127 dBm).

Receiver audio output: 200 mW into 8 Ω at 10% distortion

Transmitter

Power output with standard battery: 144 MHz, 2.8 W; 220 MHz, 2.5 W.

Spurious signal and harmonic suppression: Better than 60 dB.

Transmit-receive turnaround (PTT release to 90% of full audio output): Not specified.

Measured in the ARRL Lab

As specified.

Receiver Dynamic Testing

146 MHz, -123 dBm;

220 MHz, -123 dBm.

20-kHz offset from 146 MHz, 69 dB;

20-kHz offset from 220 MHz, 69 dB.

20-kHz offset from 146 MHz, 62 dB;

20-kHz offset from 220 MHz, 61 dB.

146 MHz, -128 to -119 dBm.

245 mW into 8 Ω THD at 10% with standard battery.

Transmitter Dynamic Testing

146 MHz, 2.1 W; 223 MHz, 1.8 W.

As specified. The C228A meets FCC requirements for spectral purity for transmitters in its power-output class and frequency range.

Squelch on, approx 40 ms; squelch off, approx 30 ms.

its own name. (Heath carried Standard products under the Heath label until they recently left the Amateur Radio business.) The reviewers found the C228A rugged and ergonomically pleasant, with an easily readable, effectively backlit liquid-crystal display. Its controls are logically laid out and labeled, making for easy programming and use. Especially popular were its easy band-changing via its **144** and **220** buttons, comfortable physical size and shape, and separate audio outputs for each band. Its tuning ease (via keypad, the tuning knob atop the radio, and in 100-kHz or 10-MHz steps) also drew praise.

The C228A produces adequately loud and decent-fidelity received audio with its supplied battery pack. The rig also brought consistently good transmitted-audio reports. The C228A's automatic-power-shutoff feature hints at the C228A's power-efficient design: The '228 uses its battery capacity maximally, faring better (in one particularly demanding reviewer's experience) than any of the other radios—even though its stock battery has only average capacity among the rigs covered here.

The C228A's stock antenna is thin, and flexible enough that it doesn't jab you in the ribs like the stubby antennas supplied with some radios. The antenna and radio work well together, too, getting signals in and out of places where some others had trouble.

The evaluation team rated the C228A's

instruction manual a notch above average, deeming it reasonably complete, well-illustrated, clearly written and easy to navigate. The manual's step-by-step instructions are a big help. The documentation lacks information on connecting a TNC to the radio, however.

In addition to wishing for a little more transmitter output and an easy way to cancel direct-frequency-entry operations, the reviewers' few complaints include the placement of the C228A's concentric 144-MHz **VOLUME** and **SQUELCH** controls (too close to the antenna jack). Also, the keypad's small and closely spaced keys make it hard for large-fingered users to manage them easily. That this was the rig's most-mentioned deficiency tells you that the C228A doesn't give you much to complain about!

The only 144/220 HT currently available, the Standard C228A is a nice, if expensive, package. It should be popular among Novices looking forward to upgrading to Technician, new licensees entering ham radio at the Technician Class level, and others who want these two bands in one hand-held box. Extended receiver coverage in both the 100- and 200-MHz ranges is the icing on the cake.

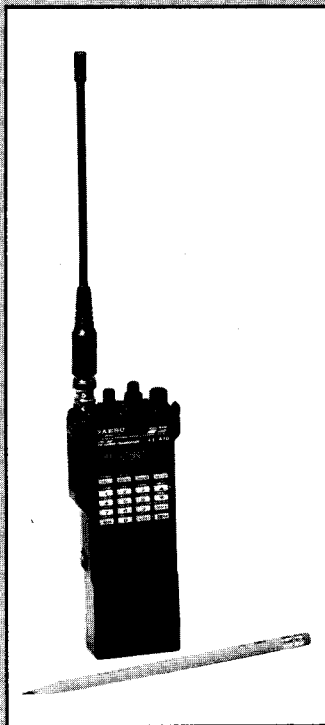
YAESU FT-470

The FT-470 has established itself well in the dual-band HT marketplace over the last

couple of years and continues to enjoy good sales. Reasons for this are many, as the team of reviewers discovered. For instance, this reasonably rugged radio is easier to use than most of its competition. Its useful liquid-crystal display is well illuminated, and so is its keypad. The reviewers also complimented the FT-470's physical size and shape—a significant response, because comfort is high on everyone's list of important HT characteristics. One way Yaesu takes maximum advantage of top-panel space without crowding controls together is by using a single squelch control and concentric volume/balance controls to determine the audio-output level and the relative levels of VHF and UHF receiver audio.

The rig's receiver produces adequately loud and clear audio output with acceptable fidelity. Its transmit audio sounds good, too. A charge of the FT-470's stock battery pack lasts for several hours of listening and scanning, and also holds up well during QSOs. And the radio's battery-saving modes help conserve the charge.

Some reviewers needed a little longer than others to learn how to program the FT-470, but the instruction manual made learning the rig easy. The manual's high quality and clear writing (with the exception of some typographical errors) assist newcomers with lucid explanations of the radio's features and programming. The manual includes a section called "Getting



Yaesu FT-470, Serial no. 0L280845

Manufacturer's Claimed Specifications

Frequency coverage: Receiver, 130-180 MHz, 430-450 MHz; transmitter, 144-148 MHz, 430-450 MHz.

Receiver

Receiver sensitivity: Better than 0.158 μ V (-123 dBm) for 12 dB SINAD.

Two-tone third-order IMD dynamic range: Better than 65 dB (offset not specified).

Adjacent-channel rejection: Better than 60 dB (offset not specified).

Squelch sensitivity: Not specified.

Receiver audio output: 500 mW into 8 Ω at 5% distortion.

Transmitter

Power output with standard battery: 2.3 W.

Spurious signal and harmonic suppression: Better than 60 dB.

Transmit-receive turnaround (PTT release to 90% of full audio output): Not specified.

*Refer to Sep 1990 QST Product Review for more information.

Measured in the ARRL Lab

As specified.

Receiver Dynamic Testing

146 MHz, -124 dBm; 430 MHz, -124 dBm.

20-kHz offset from 146 MHz, 53 dB; 20-kHz offset from 440 MHz, 58 dB.

20-kHz offset from 146 MHz, 65 dB; 20-kHz offset from 440 MHz, 62 dB.

146 MHz, -135 to -121 dBm.

195 mW into 8 Ω at 5% THD with standard battery.*

Transmitter Dynamic Testing

146 MHz, 2.4 W; 440 MHz, 1.9 W.

As specified. The FT-470 meets FCC requirements for spectral purity for transmitters in its power-output class and frequency range.

Squelch on, approx 250 ms; squelch off, approx 150 ms.

the Most from Your Batteries," which is a particularly nice touch. A handy quick-reference card and a schematic of the radio round out the documentation. You'll have to garner TNC-interfacing information from the schematics.

On the unfavorable side, the FT-470's keypad keys are too closely spaced for comfortable operation by hams with large fingers, and its keypad/display lighting stays on only while the LAMP button is held, making nighttime programming a two-handed job. During memory scanning, one reviewer had trouble telling whether received signals were on VHF or UHF because both bands drive a single signal-strength bar on the display.

Special features noted by the evaluators include the FT-470's musical keypad (potentially quite useful for vision-impaired operators). (If the tones annoy you, you can shut them off with a couple of keypresses.) The rig's separate keypad and PTT "locks" were also popular, as was its low-battery display icon and programmable battery saver. Other impressive features include the radio's scanning modes (detailed in the September 1990 QST review), the choice of carrier- or time-operated scan hold, and automatic repeater-offset selection.

The reviewers wished that the FT-470 had separate audio outputs for each band, better keypad spacing and an indicator to show when the battery is charging.

The FT-470 embodies solid performance enhanced by lots of nice touches (including its standard vinyl protective case), and has relatively few drawbacks. The rig's easy programming, good ergonomic design and comfortable size make it the clear reviewer favorite among the 144/440-MHz models this month. Considering that only the Alinco DJ-560T costs less among the five radios compared here, the FT-470 is also a true bargain in the dual-band HT market.

Caveats

We tested these radios only in their standard configurations. We did not test optional battery packs and other nonstandard accessories. With the exception of mobile antennas, all reviewer comments pertain to operation with the rigs' standard flexible antennas. Because some aspects of HT operation vary with the power source and antenna used, consider using optional battery packs and antennas. For instance, battery-pack charges don't last long, so a second pack is a must. The optional high-capacity units available for each of these rigs are just about mandatory for anyone but the most casual users.

As you evaluate our comments and test results pertaining to receiver-audio-output levels, keep in mind that many of these transceivers (except, perhaps, the IC-32AT) produce considerably more distortion-free receiver audio when used with higher-

voltage battery packs or run from an automotive power supply. (The table in September 1990 QST's FT-470 review reflects this.) Also, an external speaker works wonders for these and other hand-held radios; a speaker crammed into a 2½-inch-wide box that's already bursting with electronics simply can't compete with even a modest external speaker.

Conclusions

All of these radios performed without trouble during testing and review. That's a testament to modern manufacturing practices and quality control, especially considering what we put them through!

As stated earlier, the reviewers generally came to no clear consensus in the areas of programming and operating ease. But there were exceptions. The Standard C228A was noncontroversial. Everyone loved it. Yaesu's FT-470 was similarly popular, drawing fire from only one reviewer for the size of its keypad keys—a common complaint with the other radios.

What says even more about the five radios tested is that the reviewers came to use the Standard C228A and Yaesu FT-470 as references when quantifying the performance of the other rigs. All of the radios sport a wide array of features, but how the features are implemented heavily in-

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Product Review

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fluenced the reviewers' opinions. The evaluation team agreed that Alinco's DJ-560T, the least-expensive rig reviewed here, doesn't have some of the features and polish of its higher-priced competition. That said, the DJ-560T isn't a bad radio; but to add that polish would drive its price up considerably.

Kenwood's TH-77A and ICOM's IC-32AT fall squarely in the middle of the opinion polls, faring about equally, but for

different reasons. The IC-32AT is a rock-solid powerhouse that lacks some of the slick band-to-band integration that the others embody; the Kenwood TH-77A is loaded with features, but is uncomfortably small and complicated to operate.

Only the Kenwood TH-77A documentation includes information on connecting packet-radio TNCs (terminal-node controllers). Considering how widespread packet-radio operation has become, the lack of this information in VHF/UHF-radio documentation is surprising, although many packet operators don't use HTs for packet.

Still, manufacturers should recognize that if you can only afford (or only *want*) one FM transceiver, a dual-band HT is a

good choice. These radios give you portability, flexibility in operation and power-supply requirements, reasonable power output, and a second band for much less than the price of another rig. TNC interconnection information therefore really ought to be included.

Even though these radios all have similar missions, they're not comparable in some areas. As with any other major radio purchase you're considering—and let's face it, several hundred dollars or more constitutes a major Amateur Radio purchase for most of us—order the instruction manuals from the manufacturers and make an effort to get hands-on experience with the radios you're considering *before* deciding which one is right for you. 