

Product Review Column from *QST* Magazine

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QST Compares: 2-Meter Hand-Held Transceivers

(Alinco DJ-162TD; Alinco DJ-F1T; ICOM IC-P2AT; ICOM IC-2SRA; Kenwood TH-28A; Kenwood TH-255A; Realistic HTX-202; Standard C168A; Yaesu FT-411E; Yaesu FT-415)

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QST Compares: 2-Meter Hand-Held FM Transceivers

By James W. "Rus" Healy, NJ2L

Deciding what to review for this month's column was *easy*! Almost every licensed ham in North America owns a 2-meter H-T. And most of those who don't own one *want* to. Even most of those who *do* own one (or more) want a *new* one! No matter what your budget, this month's comparison offers something for you.

In preparing to do this review, we found that the major companies serving this market offer no less than *ten* different 2-meter H-Ts to US hams. Two each are made by Alinco, ICOM, Kenwood and Yaesu; Standard and Radio Shack make the other two. But for you, especially if you're a new ham with no previous experience with hand-held transceivers, choosing the right one can be difficult. You have to wade through a lot of ad hype and ask a lot of people a lot of questions before you can make a sound decision. What's available? How do you separate the wheat from the chaff? Which radio is best for your needs?

Our goal for this month's column is to help you make a buying decision. We'll provide you with a single source of test data and operational comparisons, and show you what's available. You may have to do more research to reach a final decision, but the task should be much easier.

We harnessed the strengths of six ARRL HQ staffers to provide feedback after operating each radio covered in this review. The staffers included *QST* Features Editor Brian Battles, WS1O; Outgoing QSL Service Manager Joe Carcia, NJ1Q; Field Services Deputy Manager Luck Hurder, KY1T; Associate Technical Editor Joel Kleinman, N1BKE; *Repeater Directory* editor Jay Mabey, NU0X; and Field Services Manager Rick Palm, K1CE. The reviewers took two-week-long turns with each radio, operating them at home, portable and mobile. They endured thousands of miles of commuting, vacationing, and driving and flying to hamfests. Most of the reviewers and radios survived unscathed.

Here's a rundown of what the reviewers found, condensed

from 180 pages of comments that they generated during the 12-week review period. The tables list the usual specifications, performance data, and feature and option comparisons.

ALINCO DJ-162TD

The least expensive rig in this comparison, the DJ-162TD is also the larger of Alinco's two 2-meter offerings. The reviewers lauded the DJ-162TD's scanning features, more memories than the other low-priced competitors, comfortable size and good Function key placement (above the PTT button). They found it fairly easy to use once programmed, and liked the fact that frequencies can be entered by keypad in either VFO or memory mode.

The manual looks good, but its programming instructions aren't easy to understand. This 30-page booklet appears to be a rather poor translation from another language. Like most of the manuals for these radios, the DJ-162TD's documentation omits packet-radio connection information. And, also like the other manuals, this one fails to tell you that the radio's receiver covers 130 to 174 MHz. Alinco, and most other manufacturers that provide this feature, miss the chance to sell you this valuable feature by not covering it in their manuals.

The DJ-162TD is fairly rugged. The team found that its unlit keypad, weak contrast between the key labels and background, and top-mounted display-window glare interfere

with usage. The display, lit from only one side, is difficult to read in the dark.

In general, the DJ-162TD is a "read the book first" radio that offers transmitted and received audio and programming ease consistent with its low price. That, plus considerations like its volume- and squelch-knob placement (very close to the antenna); its use of the same awkward battery-retention scheme as the DJ-560T dual-bandster (reviewed in June '91 *QST*); trebly transmitter audio; and wide separation of the external mike and speaker jacks (awkward for packet and impossible for a speaker/mike), are evidence of this radio's less refined, low-budget design.

The DJ-162TD should serve well for those with very occasional 2-meter FM portable needs, but more serious users probably won't need to spend much time comparing it to its competition. On the other hand, no other synthesized 2-meter hand-held with 20 or more memories comes anywhere near the DJ-162TD's price.

ALINCO DJ-F1T

The fancier and better-equipped of the two Alinco 2-meter hand-held offerings, the DJ-F1T gained reviewer praise for its size and comfortable shape, loud, clear receiver output, well-placed buttons and knobs, and better fit and finish. Frequency selection is particularly easy, and the radio's die-cast case is quite rugged. One right-handed reviewer found it a bit easier to operate this radio left-handed.

Among its strong features are AM aircraft-band reception (something it shares with only the Standard C168 and ICOM IC-2SRA), and a 10-memory DTMF dialer for phone-patch use. The DJ-F1T's 54-page manual is very good, and includes a handy pocket guide. It omits packet-radio hookup documentation, however. Exactly opposite the DJ-162TD, the DJ-F1T manual mentions extended receiver coverage—but you have to cut a wire inside the radio to make this work, and there's no mention of *that* in the manual. The same goes for AM aircraft-band reception.

Offsetting some of the radio's high points are a few details such as its rather weak battery-attachment method (it's held in place by a very



Table 1
2-Meter Hand-Held Transceiver Features

	<i>Alinco</i>		<i>ICOM</i>		<i>Kenwood</i>		<i>Realistic</i>	<i>Standard</i>	<i>Yaesu</i>	
	<i>DJ-162TD</i>	<i>DJ-F1T</i>	<i>IC-P2AT</i>	<i>IC-2SRA</i>	<i>TH-28A</i>	<i>TH-225A</i>	<i>HTX-202</i>	<i>C168A</i>	<i>FT-411E</i>	<i>FT-415</i>
Receiver coverage (MHz)	130-174	130-174*	138-174	138-174, 25-950	136-174, 438-450	141-163	144-148	100-175.6	130-174	130-174
Memory channels (total)	20	41	103	93†	41‡	10	16	40‡	49	41
Band, memory and programmed scan modes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Selected memory-channel lockout	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Standard battery capacity (V/mAh)	7.2/700	7.2/700	7.2/400	7.2/1000	7.2/700	12/500	7.2/**	7.2/700	7.2/600	7.2/600
Automatic battery saving mode(s)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Automatic power-off	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes
Automatic repeater-offset selection	No	No	No	No	Yes	No	No	No	Yes	Yes
Voice-operated transmission (VOX)	No	No	No	No	Yes	No	No	No	No	Yes
Simultaneous dual-frequency receive	No	No	No	Yes	No	No	No	No	No	No
Dual frequency displays	N/A	N/A	N/A	Yes	N/A	N/A	N/A	N/A	N/A	N/A
Supply-voltage range	7.2-13.8	7.2-13.8	6-16	6-16	7.2-16	7.2-16	7.2-13.8	6-16	5.5-15	5.5-16
Dimensions (H/W/D) with standard battery	4.3/2.1/1.5"	4.3/2.1/1.5"	4.1/1.9/1.5"	6.7/2.1/1.4"	4.5/2/1.5"	6.8/2.6/1.5"	4.6/2.6/1.9"	4.7/1.9/1.2"	5.7/2.3/1.3"	5.7/2.2/1.3"
Weight (pounds) with standard battery	0.77	0.83	0.62	1.1	0.73	1.2	1.2	0.64	0.8	0.95
Suggested retail price	\$229.95	\$289.95	\$421	\$600	\$389.95	\$399.95	\$259.95	\$489	\$355	\$409

*Requires modification. Can also be modified for AM reception from 108 to 143 MHz.

†Ham band, 32; second receiver, 61.

‡Expandable.

**Not specified.

Table 2
2-Meter Hand-Held Transceiver Options

	<i>Alinco DJ-162TD</i>	<i>Alinco DJ-F1T</i>	<i>ICOM IC-P2AT</i>	<i>ICOM IC-2SRA</i>	<i>Kenwood TH-28A</i>	<i>Kenwood TH-225A</i>	<i>Realistic HTX-202</i>	<i>Standard C168A</i>	<i>Yaesu FT-411E</i>	<i>Yaesu FT-415</i>
Flexible antenna	Std	Std	Std	Std	Std	Std	Std	Std	Std	Std
Belt clip	Std	Std	Std	Std	Std	Std	Std	Std	Std	Std
Wrist strap	Std	Std	Std	Std	Std	Std	Std	Std	Std	Std
Battery pack and charger	Opt	Std	Std	Std	Std	Std	Std	Std	Std	Std
High-capacity battery packs	Opt	Opt	Opt	Std	Opt	Opt	Std	Opt	Opt	Opt
Alkaline-cell case	Std	Opt	Opt	Opt	Opt	Opt	Std	Opt	Opt	Opt
Drop-in charger*	Opt	Std	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Opt
Protective case(s)	N/A	Opt	Opt	Opt	Opt	Opt	N/A	Opt	Std	Std
Mobile bracket	N/A	N/A	Opt	Opt	Opt	Opt	N/A	Opt	Opt	Opt
Mobile power/charging cable(s)	Opt	Opt	Opt	Opt	Opt	Opt	N/A	Opt	Opt	Opt
Speaker/microphone(s)	N/A	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Opt
Earpiece/microphone	N/A	Opt	Opt	Opt	Opt	Opt	N/A	Opt	Opt	Opt
Headset	N/A	Opt	Opt	Opt	Opt	Opt	N/A	Opt	Opt	Opt
Memory expansion modules	N/A	N/A	N/A	N/A	Opt	N/A	N/A	Opt	N/A	N/A

*For use with some optional battery packs.

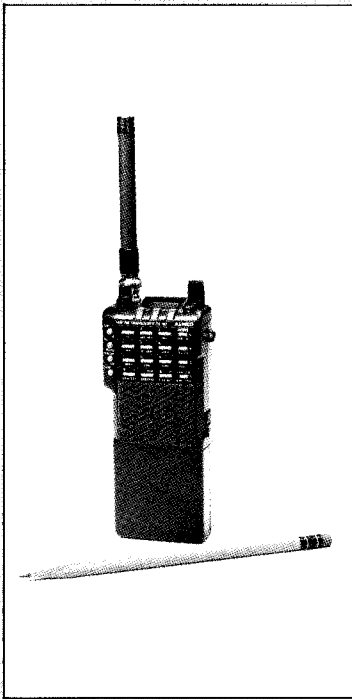
shallow lip on the battery that fits into a groove in the radio, and the release lever requires excellent dexterity to operate). The LCD display is lit from only one side, which makes it somewhat hard to read in darkness.

The DJ-F1T is more rugged, better-looking, smaller and better polished than DJ-162TD. A higher-end radio that holds its own with the other major players, the under-\$300 DJ-F1T prompted this quote, which sums up the reviewer sentiment about the Alinco rigs we review here: "Alinco has really gotten its act together."

ICOM IC-P2AT

The feature-packed ICOM mini hand-held family, of which the IC-P2AT is the 2-meter member, is incredibly flexible by the standards of H-Ts from a couple of years ago.

For your hard-earned dollars, the IC-P2AT gives you a highly polished, rugged package with a big, high-contrast LCD; relatively easy programming; big, comfortably spaced buttons for a transceiver of its size; variable display contrast; 103 memories; a time-of-day clock; four power levels; fairly standard 138- to 174-MHz receiver coverage; and 16 DTMF memories. It also includes features that most of the reviewers



Alinco DJ-162TD, Serial Number 1205

Manufacturer's Claimed Specifications

Frequency coverage: 144-148 MHz.

Receiver

Sensitivity: 0.18 μ V (–122 dBm) for 12 dB SINAD.

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

Adjacent-channel rejection: –60 dB at 15 kHz.

Squelch sensitivity: Less than 0.18 μ V (–122 dBm).

Receiver audio output: More than 250 mW at 10% THD.

Transmitter

Power output: 0.2 W/2 W.*

Spurious signal and harmonic suppression: Better than 60 dB.

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

*With standard battery.

Measured in the ARRL Lab

Transmit, 144-148 MHz; receive, 130-174 MHz.

Receiver Dynamic Testing

–122 dBm.

20 kHz offset, 73 dB.

20 kHz offset 52 dB.

At 146 MHz, –115.5 to –131 dBm.

300 mW into 8 Ω at 10% THD.*

Transmitter Dynamic Testing

0.3 W/2.4 W.*

As specified. The DJ-162TD meets FCC spectral-purity requirements for equipment in its power-output class and frequency range.

Squelch on, 180 ms; squelch off, 125 ms

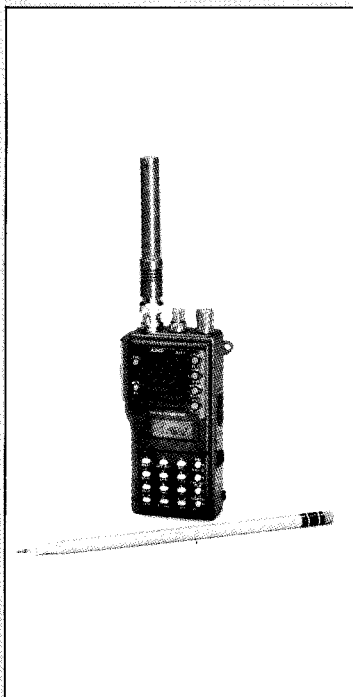
considered excessive, such as paging; code-squelch and tone-squelch operation; AI mode (described shortly); and several timer functions, including an on/off timer like those sported by so many coffee makers.

“Auto Information” (AI) mode, an ICOM creation not seen on earlier trans-

ceivers, lets you assign commonly used functions to the rig's front-panel AI button for quick recall. You can allow the radio to choose this for you based on the functions you select while operating, or you can semi-permanently assign it one function at a time. For all its gee-whiz appeal, this

function earned little reviewer support; it seems to be a frill for which the team found little use.

The radio's excellent 84-page manual easily lets you find just about anything you're looking for—except for details on packet-radio TNC connections! The



Alinco DJ-F1T, Serial Number 4890

Manufacturer's Claimed Specifications

Frequency coverage: Receive, 138-174 MHz; transmit 144-148 MHz.

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: 0.1 W/1 W/2 W.*

Spurious signal and harmonic suppression: Better than 60 dB.

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

*With standard battery.

Measured in the ARRL Lab

Receive, 130-174 MHz (FM), 108-143 MHz (AM); transmit, as specified.

Receiver Dynamic Testing

–123 dBm.

20 kHz offset, 62 dB.

20 kHz offset, 58 dB.

At 146 MHz, –118.5 to –131 dBm.

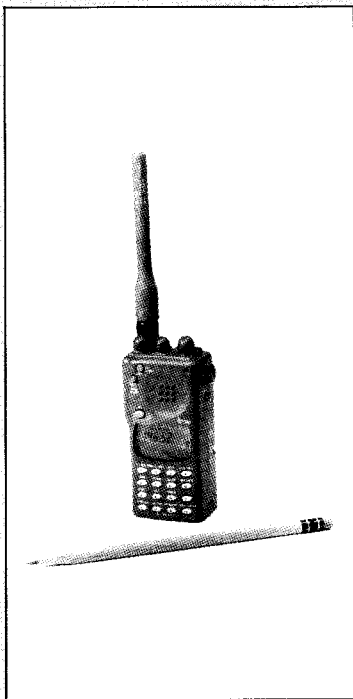
281 mW into 8 Ω at 10% THD.*

Transmitter Dynamic Testing

0.16 W/0.91 W/3.33 W.*

As specified. The DJ-F1T meets FCC spectral-purity requirements for equipment in its power-output class and frequency range.

Squelch on, 170 ms; squelch off, 165 ms.



ICOM IC-P2AT, Serial Number 3225

Manufacturer's Claimed Specifications

Frequency coverage: Receive, 138-174 MHz; transmit, 140-150 MHz.

Receiver

Sensitivity: Better than $0.16 \mu\text{V}$ (-123 dBm) for 12 dB SINAD.

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

Adjacent-channel rejection: 60 dB at 30 kHz.

Squelch sensitivity: Less than $0.1 \mu\text{V}$ (-127 dBm).

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

Transmitter

Power output: 0.5 W/1.5 W/ 3.5 W/5 W with 13.8-V supply.

Spurious signal and harmonic suppression: Better than 60 dB.

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

*With standard battery.

Measured in the ARRL Lab

As specified.

Receiver Dynamic Testing

-124 dBm .

20 kHz offset, 65 dB.

20 kHz offset, 70 dB.

At 146 MHz, -119.5 to -128 dBm .

281 mW into 8Ω at 10% THD.*

Transmitter Dynamic Testing

0.49 W/1.5 W/2.3 W/2.3 W.*

As specified. The IC-P2AT meets FCC spectral-purity requirements for equipment in its power-output class and frequency range.

Squelch on, 120 ms; squelch off, 120 ms.

manual's operating examples, however, are excellent, as are its diagrams.

Like the other very small radios, the IC-P2AT's tiny speaker yields tiny sound. An external speaker is almost a must in a mobile environment. The radio's stock BP-111 battery, which fits inside the radio, supplies only 400 mAh of energy, which

doesn't last long if you transmit much, and wouldn't hold up to extended monitoring if it weren't for the rig's battery-saving modes. And, although the battery can be charged separately with an optional drop-in charger, you can't separate the battery from the radio to charge it with the stock charger (the charger plugs into the radio,

not the battery). So, you can't simply change batteries when one dies and immediately start charging the depleted one. This is true of the IC-2SRA and Kenwood TH-28A as well.

It took the reviewers a while to learn all the radio's features, which curiously don't include automatic repeater-offset selection.



ICOM IC-2SRA, Serial Number 3389

Manufacturer's Claimed Specifications

Frequency coverage: Receive, 25-950 MHz; transmit, 140-150 MHz.

Receiver

Modes: AM, FM, wideband FM.

Sensitivity: FM (144-148 MHz), $0.16 \mu\text{V}$ (-123 dBm) for 12 dB SINAD; AM (25-950 MHz), $1.8 \mu\text{V}$ (-102 dBm) for 10 dB S+N/N; wideband FM (25-950 MHz), $1.8 \mu\text{V}$ (-102 dBm) for 12 dB SINAD.

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

Adjacent-channel rejection: 60 dB at 30 kHz.

Squelch sensitivity: Less than $0.18 \mu\text{V}$ (-122 dBm).

Receiver audio output: 180 mW at 10% THD into 8Ω .

Transmitter

Power output: 0.5 W/1.5 W/ 3.5 W/5 W with 13.8-V supply.

Spurious signal and harmonic suppression: Better than 60 dB.

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

*With standard battery.

†138-174 MHz receiver.

Measured in the ARRL Lab

As specified.

Receiver Dynamic Testing

As specified.

FM (146 MHz), -124 dBm ; AM (120 MHz), -106 dBm ; WFM (108 MHz), -110 dBm .

20 kHz offset from 146 MHz, 65 dB.†

20 kHz offset from 146 MHz, 67 dB.†

At 146 MHz, -121 to -130 dBm .

195 mW into 8Ω at 10% THD.*

Transmitter Dynamic Testing

0.4 W/1.25 W/2.11 W/2.11 W.*

As specified. The IC-2SRA meets FCC spectral-purity requirements for equipment in its power-output class and frequency range.

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

Some of its unique features, like its time-of-day clock and great frequency display, however, drew glowing praise. As a group, the team deemed the little ICOM a good, feature-packed radio.

ICOM IC-2SRA

"Wow! A 2-meter hand-held with a 25-to 950-MHz second receiver!" This is a typical initial reaction to the IC-2SRA. The IC-2SRA covers 138-174 MHz in the ham-band receive section, plus 25-950 MHz continuous in AM, FM and wideband FM modes in its second receiver. The receivers use independent antennas and volume and squelch controls, and either or both can be active at any time. The IC-2SRA is the first such radio on the market, and it won high praise from the staff evaluators. Its sturdiness; ease of programming and use; high-capacity battery (20% more than the biggest of the others); and good transmitted and received audio contributed to a sense of quality and satisfaction that last well beyond the initial raving about the radio's features.

The radio's 60-page manual is excellent. It's well organized and thoroughly indexed, and the table of contents includes a key to ham-band and second-receiver functions. Even this manual, however, lacks packet-radio connection information.

Like all the others, this rig has a few drawbacks. Its top-mounted knobs are somewhat difficult to manipulate with the antennas attached. The tiny power on/off button, mounted on the front panel, is hard to actuate. The second-receiver antenna

connects to the radio via 1/8-inch phone plug, which became intermittent during the review period.

If the radio is capable of retransmitting audio received on the second receiver, it's not apparent. The radio mutes the second-receiver and displays "off" on the right side of the LCD when you're transmitting.

Like the IC-P2AT, the IC-2SRA is loaded with features. It includes the timer, code- and tone-squelch functions, paging and other seldom-used IC-P2AT features, as well as its flexible second receiver. For its \$600 list price, however, you might expect such details; whether you'll use them all is another matter. . . .

Is it worth the slightly larger size, weight and your extra dollars to have receiver coverage from 25 to 950 MHz in the same box as a 2-meter hand-held? That's a decision you'll have to make. But if you compare the cost of a basic 2-meter hand-held and a scanner with equivalent versatility to the IC-2SRA, the '2SRA is definitely a better deal.

KENWOOD TH-28A

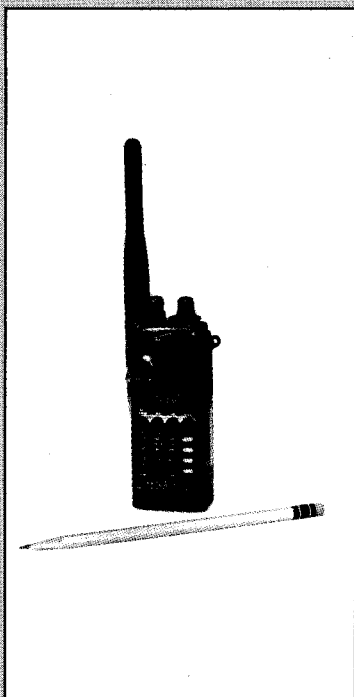
Kenwood took a more moderate approach to extended receiver coverage with the TH-28A than ICOM chose for the IC-2SRA. The TH-28A is a quasi-dual-bander, with transmitting coverage in the 2-meter ham band and receiver coverage of 136-174 and 438-450 MHz. Like the IC-2SRA, it's capable of cross-band operation.

It's a little ironic that the TH-28A's otherwise fine manual omits any mention

of the rig's 438- to 450-MHz receiver coverage—even in its (very brief) section on cross-band operation. It seems that Kenwood would tout this impressive feature in the manual. Among this manual's better features are its troubleshooting chart and quick-reference section. It also includes a packet-radio hookup diagram!

The TH-28A is tiny and easy to carry. It features a pleasant display and comfortable case contours. Its tons of built-in features include eight scan modes, paging, tone squelch, a time-of-day clock and timer functions. The radio comes with 41 memories—and you can add 200 more for about \$24 by installing a tiny memory-expansion module. An optional hand mike allows control of the radio's most-used functions. On the frilly side, this transceiver allows sending six-character messages (to compatible radios), and has a 10-character message memory. Like the IC-P2AT, the TH-28A is fairly easy to program and use, but its multiplicity of features can be a liability at times.

The display lamp fully illuminates the LCD, but the keypad is unlit. The gray-blue and red keypad labels are sometimes hard to read because they contrast poorly with the radio's dark gray front panel. The one resounding reviewer complaint about this radio is that its receiver audio is weak with the standard battery. Here again, an external speaker works wonders. The reviewers also found the radio's power on/off button, mounted in a recess above the display, awkward to operate, and that the battery sometimes falls out when you're attaching



Kenwood TH-28A, Serial Number 31104063

Manufacturer's Claimed Specifications

Frequency coverage: 144-148 MHz.

Receiver

Sensitivity: Better than 0.16 μ V (–123 dBm) for 12 dB SINAD.

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

Adjacent-channel rejection: 40 dB at 28 kHz.

Squelch sensitivity: Better than 0.1 μ V (–107 dBm).

Receiver audio output: More than 200 mW into 8 Ω .

Transmitter

Power output: 0.02 W/0.5 W/2 W.*

Spurious signal and harmonic suppression: Better than 60 dB.

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

*With standard battery.

Measured in the ARRL Lab

Receive, 136-174 and 438-450 MHz; transmit, as specified.

Receiver Dynamic Testing

146 MHz, –125 dBm; 440 MHz, –119 dBm.

20 kHz offset from 146 MHz, 64 dB.

20 kHz offset from 146 MHz, 63 dB.

At 146 MHz, –121 to –130.5 dBm.

340 mW into 8 Ω at 10% THD.*

Transmitter Dynamic Testing

0.015 W/0.66 W/2.16 W.*

As specified. The TH-28A meets FCC spectral-purity requirements for equipment in its power-output class and frequency range.

Squelch on, 54 ms; squelch off, 54 ms.



Kenwood TH-225A, Serial Number 31100086

Manufacturer's Claimed Specifications

Frequency coverage: 144-148 MHz.

Receiver

Sensitivity: Better than 0.2 μ V (–121 dBm) for 12 dB SINAD.

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

Adjacent-channel rejection: 40 dB at 24 kHz.

Squelch sensitivity: Better than 0.1 μ V (–127 dBm).

Receiver audio output: More than 500 mW into 8 Ω at 10% distortion.

Transmitter

Power output: 0.5 W/5 W.*

Spurious signal and harmonic suppression: Better than 60 dB.

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

*With standard battery.

Measured in the ARRL Lab

Receive, 141-163 MHz; transmit, as specified.

Receiver Dynamic Testing

–125.5 dBm.

20 kHz offset, 67.5 dB.

20 kHz offset, 60.5 dB.

At 146 MHz, –123 to –131 dBm.

578 mW into 8 Ω at 10% THD.*

Transmitter Dynamic Testing

0.54 W/6.17 W.*

As specified. The TH-225A meets FCC spectral-purity requirements for equipment in its power-output class and frequency range.

Squelch on, 210 ms; squelch off, 210 ms.

the radio to a belt or pocket because battery release is located just under the belt clip. Dropping a \$55 battery three feet onto concrete definitely limits its life expectancy!

In the war of the features, Kenwood has a definite contender with the slick, loaded TH-28A. The radio is rugged and refined, and comfortable to hold and use, but its many features may overwhelm users with more pedestrian H-T needs.

KENWOOD TH-225A

Slightly larger than the TH-28A, Kenwood's TH-225A is one of the most rugged and easiest to program radios reviewed here. And its good keypad layout makes it easy to manipulate—even for large-handed and -fingered operators. Unlike many of its competitors, the TH-225A produces receiver audio loud and clear enough for use even in noisy mobile environs. Its manual is clear and complete, except that it doesn't mention the radio's extended receiver coverage.

Like the TH-28A, the '225A's keypad is difficult to read in low-light conditions. Its two power levels are rather widely disparate—the reviewers wished for something between 500 mW and the rig's charge-chugging 6-W high-power setting. It generates more power with its standard battery than any other H-T in this comparison, but has only 10 memories; odd, considering that this radio's list price is \$10 *higher* than the TH-28A's!

The reviewers were split on the TH-225A's lack of a tuning knob—something included on all the others in this

comparison. All frequency and memory selection is done via the keypad. Some favored this approach, and others prefer having the capability to dial around and select memories with a knob. The TH-225A is chunky, but is otherwise a fine, well-balanced, straightforward radio with good basic performance. Its only major limitation—its relatively few memory channels—may alone send many hand-held-transceiver shoppers looking elsewhere.

REALISTIC HTX-202

The runaway leader in in-band receiver performance, the HTX-202, Radio Shack's first-ever 2-meter hand-held transceiver, does the company proud. This rig has taken a lot of pounding on the air and in other ham forums for its lack of receiver coverage outside the 2-meter ham band—something that every competing radio provides—but the benefit is a direct payoff in adjacent-channel selectivity and two-tone, third-order IMD dynamic range. No other hand-held in this group exceeds 70 dB in both categories. What does this mean to you? The HTX-202 is practically immune to the interference problems so common in urban areas thick with VHF radio traffic. Where many radios choke on strong public-service signals and adjacent-channel FM activity, the HTX-202 fares very well. Only the ICOMs come close to its strong-signal performance.

Other points in its favor include its ruggedness; super-easy programming and operation; loud, low-distortion receiver

audio; and clear, well-illuminated display. It's the only radio in the group that comes with both an alkaline battery case and a NiCd battery pack. Its instruction manual is also excellent. The manual includes clear instructions, a concise introduction to Amateur Radio, packet-radio connection information, and warnings about operating the rig without a license—something quite appropriate for a radio that's so inexpensive and readily available.

The HTX-202's unlit keypad can be hard to read in the dark, and this is *not* a compact radio. It's in the same size class as the TH-225A, and ICOM's older IC-2GAT and IC-32AT. But therein lies an advantage: Though Radio Shack's accessory offerings are few, the HTX-202 is compatible with ICOM's large line of IC-2AT-series accessories.

For budget-conscious operators who value solid receiver performance and the ability to buy locally, and who don't consider the HTX-202's lack of extended receiver coverage a major liability, this radio offers solid value and good basic performance.

STANDARD C168A

Except for the ICOM IC-2SRA's second receiver, the C168 features the widest VHF receiver coverage—100-175.6 MHz—of any radio tested here. Only it and the '2SRA receive AM out of the box (although the Alinco DJ-F1T can be relatively easily modified to do so as well). The reviewers found the C168 to be the perfect size for most hands, and liked its easy-to-read LCD



Realistic HTX-202, Serial Number 10008654

Manufacturer's Claimed Specifications

Frequency coverage: 144-148 MHz.

Receiver

Sensitivity: Better than $0.2 \mu\text{V}$ (-121 dBm) for 12 dB SINAD.

Two-tone, third-order IMD dynamic range: 70 dB.

Adjacent-channel rejection: 70 dB at 25 kHz.

Squelch sensitivity: Better than $0.1 \mu\text{V}$ (-127 dBm).

Receiver audio output: 300 mW at 10% THD into 8Ω .*

Transmitter

Power output: 1 W/2.5 W.*

Spurious signal and harmonic suppression: Better than 70 dB.

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

*With standard battery.

Measured in the ARRL Lab

As specified.

Receiver Dynamic Testing

-122.5 dBm .

20 kHz offset, 70.5 dB.

20 kHz offset, 72.5 dB.

At 146 MHz, -107.5 to -135 dBm .

340 mW into 8Ω at 10% THD.

Transmitter Dynamic Testing

1.09 W/2.16 W.*

As specified. The HTX-202 meets FCC spectral-purity requirements for equipment in its power-output class and frequency range.

Squelch on, 175 ms; squelch off, 180 ms.

with good main-display night lighting and low-battery indicator. It's solidly made—except for the protruding Function button above PTT button; the F button on the review radio was somehow torn loose during the review period. The controls feel good and control layout is great. The C168

drew some of the best transmitted-audio reports of all of these radios (as did the two Yaesus). Clone mode, a feature that lets you transfer the memory contents from one C168 to another without connecting them by wire, is interesting—but none of us could think of a practical use for it.

Like the TH-28A and IC-P2AT, the reviewers found that the rig's many features complicate its programming and operation. They also complained of its low receiver audio output and that its keypad and sections of the LCD are difficult to read in the dark.



Standard C168A, Serial Number U020295

Manufacturer's Claimed Specifications

Frequency coverage: 144-148 MHz.

Receiver

Sensitivity: Better than $0.158 \mu\text{V}$ (-123 dBm) (SINAD not specified).

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

Adjacent-channel rejection: Not specified.

Squelch sensitivity: $0.1 \mu\text{V}$ (-127 dBm).

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

Transmitter

Power output: 0.35 W/2.5 W/2.8 W.*

Spurious signal and harmonic suppression: Better than 60 dB.

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

*With standard battery.

Measured in the ARRL Lab

Receive, 100-175.6 MHz; transmit, as specified.

Receiver Dynamic Testing

FM, -123 dBm at 146 MHz; AM, -128 dBm at 120 MHz.

20 kHz offset, 74 dB.

20 kHz offset, 57 dB.

At 146 MHz, -118 to -129 dBm .

245 mW into 8Ω at 10% THD.*

Transmitter Dynamic Testing

0.4 W/2.51 W/2.76 W.*

As specified. The FT-2400H meets FCC spectral-purity requirements for equipment in its power-output class and frequency range.

Squelch on, 160 ms; squelch off, 160 ms.



Yaesu FT-411E, Serial Number 1L511524

Manufacturer's Claimed Specifications

Frequency coverage: 144-148 MHz.

Receiver

Sensitivity: Better than 0.158 μ V (–123 dBm) for 12 dB SINAD.

Two-tone, third-order IMD dynamic range: >65 dB (spacing not specified).

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

Squelch sensitivity: Not specified.

Receiver audio output: 500 mW into 8 Ω at 5% THD with 12-V supply.

Transmitter

Power output: 2.5 W.*

Spurious signal and harmonic suppression: Better than 60 dB.

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

*With standard battery.

Measured in the ARRL Lab

Receive, 130-174 MHz;
transmit, 140-150 MHz.

Receiver Dynamic Testing

–121.5 dBm.

20 kHz offset, 43.5 dB.

20 kHz offset, 63 dB.

At 146 MHz, –118 to –128 dBm.

320 mW into 8 Ω at 5% THD.*

Transmitter Dynamic Testing

0.77 W/2.38 W.*

As specified. The FT-411E meets FCC spectral-purity requirements for equipment in its power-output class and frequency range.

Squelch on, 95 ms; squelch off, 70 ms.

The C168A's manual is generally excellent. It doesn't mention how to set the 5-kHz digit, however, or the receiver's extended coverage. It also doesn't show you how to connect a packet-radio TNC to the transceiver.

In general, the reviewers felt that the C168A furthers Standard's highly refined, feature-packed heritage, and that it offers strong competition to its high-end competition: primarily the IC-P2AT, TH-28A and FT-415.

YAESU FT-411E

Like its lower-end competition, the FT-411E is reasonably inexpensive, with the fourth lowest list price of the radios reviewed here. And it doesn't skimp on features. It has 49 memories; tone squelch; paging; DTMF memories; wide receiver coverage; and comes with a leatherette case, like the FT-415. Like the C168A, the FT-411E has a clone mode, but requires a wired connection to a second FT-411E to take advantage of it.

The reviewers appreciated the FT-411E's comfortable size, good display and transmitter audio, comfortably under-complicated operation, and good keypad. Display and keypad illumination make nighttime use easy. Despite the radio's considerable features and flexibility, it's quite easy to program and use.

Like other small rigs, this one has rather meager receiver audio, and receiver sensitivity seems to be sub-par outside the ham band. This rig also has unusually poor third-order IMD dynamic range, but that

shouldn't be a major problem except in densely populated areas. (We confirmed the data in the FT-411E performance table with a second unit because it differed considerably from the other rigs compared here.)

The FT-411E manual is pretty good, but it's not one of Yaesu's wonderful newer manuals. It makes no mention of the rig's extended receiver coverage or packet-radio interconnections. The quick-reference card included with the radio is helpful, but its small print is difficult to read.

Overall, the team feels that the FT-411E has a good size, weight, feel and balance of features, with ease of use typical of Yaesu H-Ts. The one thing they longed for was more distortion-free receiver audio, but that doesn't offset this little radio's strengths.

YAESU FT-415

The FT-415 almost looks like a next-generation FT-411E. They sport many of the same features (DTMF memories, tone squelch, etc). Both radios are current models, however. The FT-415's looks, size, ruggedness and polish all drew praise, as did its easy programming and use, transmitter audio and illuminated LCD and keypad. The only major negative the evaluation team found is the radio's battery life, which is marginal at best during high-power transmission. But, the rig's low-battery indicator tips you off when you've depleted the battery's charge.

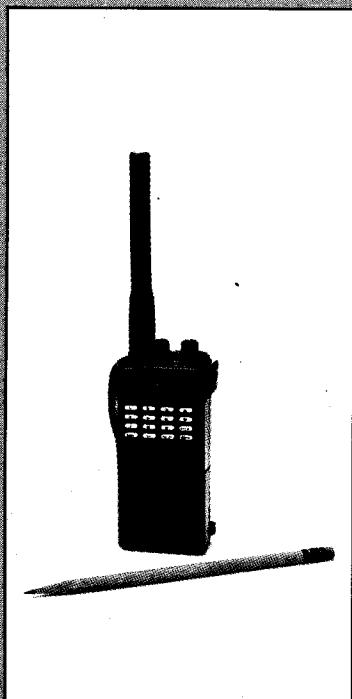
The rig's manual, like Yaesu's newer MF/HF rig manuals, is *superb*. It's well

organized, the instructions are clear, and photos, sidebars, and tables illustrate various programming operations and features. A five-page section covers techniques you can use to extend battery life, and the troubleshooting section is a nice touch. Even this manual doesn't list the receiver's frequency range or packet-radio connections, however. Its quick-reference card is good and easier to read than the FT-411E's.

The FT-415 includes all of the features the reviewer team wants most in a 2-meter hand-held transceiver. That, coupled with its size and feel, made it very popular among them. At a suggested retail price of \$409, it's also one of the best values in high-end 2-meter hand-helds.

The Reviewers' Wish List

Only the HTX-202 includes a battery-charging indicator. This feature, insignificant though it may seem, made most of the evaluators' wish lists. The reviewer team also found that several of these radios include features that they seldom or never used. Here's a novel idea: How about making these radios *software configurable*, or perhaps better yet, making software *upgradable* so that you can buy a radio with basic features and upgrade it later at a reasonable cost? The latter would give users the basic performance they need at a reasonable price, while still making the less commonly used functions available to those who want them. Two manufacturers (Kenwood, with the TH-28A, and Standard, with the C168A) already make user-installable memory upgrades, so the prece-



Yaesu FT-415, Serial Number 1L052508

Manufacturer's Claimed Specifications

Frequency coverage: 144-148 MHz.

Receiver

Sensitivity: Better than 0.158 μ V (–123 dBm) for 12 dB SINAD.

Two-tone, third-order IMD dynamic range: >65 dB (spacing not specified).

Adjacent-channel rejection: >60 dB (spacing not specified).

Squelch sensitivity: Not specified.

Receiver audio output: 500 mW into 8 Ω at 5% THD with 12-V supply.

Transmitter

Power output: 0.5 W/1.5 W/3 W/5 W with 12-V supply.

Spurious signal and harmonic suppression: Better than 60 dB.

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

*With standard battery.

Measured in the ARRL Lab

Receive, 130-174 MHz;
transmit, 140-150 MHz.

Receiver Dynamic Testing

–123.5 dBm.

20 kHz offset, 64.5 dB.

20 kHz offset, 68.5 dB.

At 146 MHz, –117 to –131 dBm.

281 mW into 8 Ω at 10% THD.*

Transmitter Dynamic Testing

0.67 W/1.74 W/2.2 W/2.2 W.*

As specified. The FT-415 meets FCC spectral-purity requirements for equipment in its power-output class and frequency range.

Squelch on, 160 ms; squelch off, 120 ms.

dent and feasibility are already established. This seems like the next logical step in microprocessor-controlled radio evolution. Who'll do it first?

Things to Consider

In June 1991 *QST*, Product Review compared five dual-band hand-helds.¹ I highly recommend reading or rereading that review. In it, I covered some issues you should keep in mind while you're making a buying decision. Here are the high points: We reviewed these radios using only batteries and other items supplied as standard equipment with the rigs. With the exception of mobile antennas, all reviewer comments are based on use with the rigs' flexible antennas. Although these radios can all operate acceptably over a wide supply-voltage range, they produce the best receiver audio and highest power output when operated from a 12-V battery or external 13.8-V supply. Using an external speaker also makes for big improvements in receiver-audio intelligibility.

Why are There Ten?

These rigs loosely form two classes of radios. If they didn't, you could legitimately question the wisdom of four major manufacturers making two 2-meter hand-held transceivers each! The lower-end, less expensive radios in this comparison are the Alinco DJ-162TD, Kenwood TH-225A,

Yaesu FT-411E and Realistic HTX-202. The Standard, as well as the Alinco DJ-F1T, Kenwood TH-28A, Yaesu FT-415 and both ICOMs fit into the higher-end category. (Yes, both ICOMs unquestionably fit into that slot: The IC-P2AT is very much in line in features, size and cost with the other upper-echelon radios; the IC-2SRA, with its wide-range receiver, is a different animal altogether, sporting high-end radio features *and* an extraordinary second receiver—with a heart-stopping price tag to match.)

The list prices don't tell the whole story, as you can see from the foregoing. The FT-411E's features, for instance, compete solidly with the higher-end radios, but its price is nearer the low end. The TH-225A is the opposite. So, which are the best values in each class, and which are not? We'll let you make that determination, fueled by these final thoughts:

For price alone, you can't beat the DJ-162TD. A bit primitive by modern standards, it works well enough and offers an unbeatable price. At less than \$300, the DJ-F1T hits the performance level above the '162 and represents a great value, especially if AM air-band reception and a small package are high on your want list.

For those who need only ham-band coverage and 16 memories, Radio Shack's \$260 HTX-202, the second-least-expensive radio reviewed here, is another super value. Its receiver performance, standard extras, and high transmitter power (6 W at 13.8 V) make it best suited for occasional portable or mobile use and the best of this bunch for home-station operation.

The middle of the price range includes the Yaesus, the Kenwoods, the ICOM IC-P2AT, and the Standard C168A. The Yaesus, by virtue of their low price and solid balance of features, make superb values. The TH-28A, C168A and IC-2PAT are feature-loaded radios separated mainly by their specific characteristics; there's no loser and no clear winner among them, and they all retail for about the same price. The TH-225A is bulky, expensive and lean on features for its cost.

At the high end, the IC-2SRA is in a class by itself. With its separate receiver *and* high-end single-band hand-held features, it satisfies needs that none of the other rigs in this review can.

As you should with any major Amateur Radio purchase, get hands-on experience and a good look at the documentation for each of the radios you're considering. None of these radios is likely to leave you unhappy if you follow the tips in this review, but you can surely make the best buying decision by learning all you can about how these radios look and feel *in person*.

SOLICITATION FOR PRODUCT REVIEW EQUIPMENT BIDS

[In order to present the most objective reviews, ARRL purchases equipment off the shelf from dealers. ARRL receives no remuneration from anyone involved with the sale or manufacture of items presented in the Product Review or New Products columns.—Ed.]

The ARRL-purchased Product Review equipment listed below is for sale to the

(continued on page 95)

¹J. Healy, "QST Compares: Dual-Band Hand-Held FM Transceivers," *QST*, June 1991, pp 36-41, 44. Copies of this review are available from the ARRL Technical Department Secretary for \$3 postpaid. Your local library may also receive and file *QST*; check there first.

rules published prior to June 1989 are obsolete. If you quote a rule from a pre-1989 version of Part 97, people won't know what you're referring to. That's why it's critical that all amateurs have a copy of Part 97 dated 1989 or later.

Q: What's the basis for Part 97? Where does its power come from and why do we need rules?

A: The basis for FCC regulations is found in international treaties, agreements and statutes that provide for the allocation of frequencies and place conditions on how the frequencies are used. The FCC's statutory authority comes from the US Communications Act of 1934. The Act provides for regulation of interstate commerce in communications by wire or radio. Under the Communications Act of 1934, the FCC is responsible for regulating all telecommunications except those of the federal government. Chapter 14 of the *FCC Rule Book* gives a comprehensive discussion of the FCC's role.

Three other acts of Congress affect FCC rule making to amend Part 97. The Administrative Procedures Act allows for public participation in the rule-making process. Under the Regulatory Flexibility Act, the FCC certifies that new rule changes won't have a significant impact on small businesses. The Paperwork Reduction Act makes sure that the information-collection burden placed on the public is minimal.

Q: Are there other "parts" to other FCC rules?

A: Yes, Part 97 is just a small part of the picture. The US Code of Federal Regulations, Title 47, consists of telecommunications rules. Title 47 is subdivided into "Parts" and contain rules for the many telecommunications services the FCC administers. You may purchase a specific rule Part for a particular service from the Superintendent of Documents, US Government Printing Office, Washington, DC 20402-9371; tel 202-783-3238).

Q: Amateur Radio has been around for a long time and I guess the regulations have too, right?

A: Amateur Radio has been around roughly since the turn of the century, but there weren't any rules in the earliest days. Before 1927, Amateur Radio's administrative agency was the Department of Commerce. Amateur Radio's affairs were handled by the Federal Radio Commission from 1927-34. The FCC was created in 1934. Amateur regulations were simple in 1934. In fact, they consisted of only one page of text! By the mid-1950s, the amateur regulations had grown to more than 10 pages. The amateur regulations could be found in Part 12 back then.

In 1963, Part 12 was changed to Part 97. This indicates the increasing complexity of telecommunications rules. The amateur regulations today are very different than they were in Amateur Radio's early days.

Part 97 is a living, breathing body of rules, able to change to meet changing needs.