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QST Compares: 2-Meter FM Mobile Transceivers
(Alinco DR-130; Azden PCS-7000H; ICOM IC-281H; Kenwood TM-241A; Kenwood TM-251A; Standard C1208DA; Yaesu FT-2200; Yaesu FT-2500M)

Gap Challenger DX-VIII Vertical Antenna

Conducted by Mark Wilson, AA2Z
Editor, *QST*

QST Compares: 2-Meter FM Mobile Transceivers

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Two-meter FM transceivers are legion these days, and for a very good reason. With the influx of Technician licensees, FM is more popular than ever. Thanks to the vast repeater network that we enjoy in the US, it's possible to travel almost anywhere and still be within range of at least one system. Small wonder that 2 meters is the most active amateur band.

If you journey within the range of a powerful, sensitive repeater, there's no reason not to get double duty from your hand-held transceiver (H-T) by using it in your automobile. But if you attach a mobile antenna, external power source and so on, your H-T isn't nearly as handy as it used to be. And when you're on the fringe of a repeater's coverage, you need extra power that the H-T can't deliver on its own.

These are the factors that make mobile transceivers so attractive. With a mobile rig tucked under (or in) your dashboard, you have the ultimate in operating convenience. Today's mobile radios also offer considerable output power—the radios reviewed here all offer as much as 50 W. (This is overkill in some situations, so this crop of transceivers thoughtfully includes one or two lower-power choices.) Remove the transceiver, attach a dc power supply and the mobile radio quickly becomes a full-feature base rig for your home or wherever.

All of the rigs tested for this review include DTMF (*TouchTone*) encoders for autopatch dialing, repeater control and so on. Some radios took this a step further and offered DTMF *autodialers*. Autodialing is a terrific convenience when you're on the road. Press one or two buttons on the microphone keypad and the desired telephone number is transmitted automatically. Many radios also offer DTMF *decoders*. Selective calling or paging is their chief purpose.

With the proliferation of repeater systems, crowding is becoming a serious problem in some areas. When propagation is favorable, the users of one repeater will trip other systems each time they transmit. One way to solve this problem is to require that every transmission include a subaudible CTCSS tone at a specific frequency. The CTCSS tone frequencies are too low for human ears to detect, but special decoders in the repeater receivers are programmed to recognize them. If the tone frequency is correct, the repeater retransmits the voice audio. Otherwise, the repeater remains silent.

With this in mind, it's no surprise that we found CTCSS encoders in each transceiver. Some rigs also include CTCSS *decoders*, or make them available as options. With a CTCSS decoder installed, you have the ability to monitor transmissions selectively—just like the repeaters.

All radios reviewed here are approximately the same size. They differ, however, in the ways the manufacturers use the available space. This is where the concept of *ergonomics* (the degree of convenience each radio affords) comes into play. Depending on the design, some radios are easier to use than others. In most cases, the manufacturers transferred some—and in one case, all—of the controls to the microphone. There are advantages and disadvantages to this approach, as you'll see.

Nearly all mobile transceivers work as 1200-bit/s packet radios, usually through connections to the mike and external speaker jacks. This is nothing new. But in recent months several manufacturers have offered something new: rigs that will support *9600*-bit/s packet. Many such rigs also offer dedicated jacks for packet TNCs (terminal node controllers). If a transceiver is going to function well as a 9600-bit/s packet rig, however, it must be able to transmit and receive high-speed data without introducing unacceptable distortion. Distortion manifests itself in *bit errors* that effectively slow otherwise rapid throughput, or make it impossible to communicate at all. Just how well do these "9600-ready" radios work? The ARRL Lab has been conducting a series of tests, and we'll present our findings in an upcoming issue.

Six ARRL HQ staff members participated in this review: Brian Battles, WS1O, Features Editor; Pete Budnik, KB1HY, Educational Assistant; Mike Tracy, KC1SX, Technical Information Services Coordinator; Glen Swanson, KB1GW, Assistant to the VEC Manager; Jay Mabey, NUØX, Assistant Field Services Manager; and me. This review is based on our comments and ARRL Lab testing.

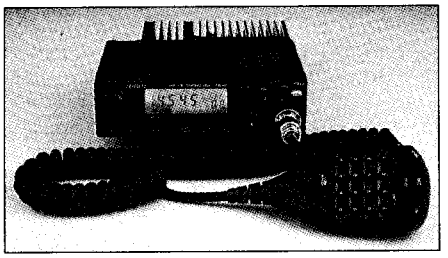
2-Meter FM Mobile Transceiver Features

	Alinco DR-130	*Azden PCS-7000H*	*ICOM IC-281H*	*Kenwood TM-241A*	*Kenwood TM-251A*	*Standard C1208DA*	*Yaesu FT-2200*	*Yaesu FT-2500M*
Expanded 2-meter reception	S	S	M	S	S	S	S	S
70-cm reception	X	X	S	X	S	S	X	X
Aviation band reception	X*	S	M	S	S	S	S	X
Memory channels	20	21	60	20	41	100	50	31
Band, memory and programmed-scan	S	S	S	S	S	S	S	S
Power-output selections	2	2	3	3	3	3	3	3
Automatic repeater offset	S	X	S	S	S	X	S	S
DTMF decoder	X	X	S	O	S	S	S	O
DTMF autodialer	X	X	S	X	S	S	S	S
CTCSS encoder	S	S	S	S	S	S	S	S
CTCSS decoder	O	O	O	O	O	S	O	O
Display dimmer	X	X	S	S	S	S	S	S
9600 bit/s packet capability	X	X	S	X	S	S	X	M
Dedicated TNC jack	X	X	S	X	S	S	X	M
Manufacturer's suggested retail price	$399	$335	$488	$459.95	$529.95	$529	$479	$449
Typical selling price as of 11/94**	$309	$335	$389	$335	$399	$430	$370	$350

Key
S = Standard X = Not available
O = Optional M = With modification

*The Alinco DR-130 receives to 131 MHz, which includes a portion of the aviation band. However, reception is FM only. Aircraft use AM.
**The typical selling price was determined by calling several dealers who advertise in *QST* and taking the average price. It does not include rebates, coupons or specials which manufacturers sometimes offer.

ALINCO DR-130T



The Alinco DR-130T is not a feature-packed radio compared to some of the other radios in this review—but that's one of its virtues, according to our reviewers. The radio concentrates instead on those features that are used most often, rather than confusing the operator with myriad options. As a result, the DR-130T is extraordinarily easy to operate and commands the lowest typical "street price" in this group.

The DR-130T offers selectable 5 or 50-W output power levels. Some reviewers reported that the rig became quite warm during operation at 50 W. With sufficient air circulation around the radio, however, this should not pose a problem in normal use.

Twenty memory channels are provided in the DR-130T. While this number should be enough for most hams, you can expand the total to 100 with an optional module. All memory channels can store odd offsets, as well as CTCSS information for the standard encoder. A programmable time-out timer is also a standard feature.

Several reviewers commented on the easy-to-read LCD display. You can toggle the display between showing the frequency and channel number, or just the channel number only. The display offers essential information in either mode. It doesn't overwhelm you with extraneous data.

Alinco specifies the receive range as 136 to 174 MHz. The ARRL Lab discovered that the receive range actually extends down to 131 MHz.

The only complaints about the DR-130T concerned the manual. Most judged it to be too skimpy. Explanations were often abbreviated, if they were available at all. The most glaring example comes into play when you want to use the DR-130T on packet. You must connect your TNC to the microphone jack and speaker jack. The manual, however, lacks a wiring diagram for the connector.

Alinco DR-130T, serial no. T010019

Manufacturer's Specifications	*Measured in ARRL Lab*
Frequency coverage: Receive, 136-174 MHz; transmit, 144-148 MHz.	Receive, 131-174 MHz; transmit, 144-148 MHz.
Power requirements: At 13.8 V dc: 0.8 A max (receive); 10.5 A max (transmit).	At 13.8 V dc: 0.5 A max (receive); 8.8 A max (transmit).
Size (height, width, depth): 1.6×5.6×6.2 inches; weight, 2.5 lb.	
Receiver	*Receiver Dynamic Testing*
Sensitivity: Better than –16 dBμV (0.16 μV) for 12 dB SINAD.	0.14 μV for 12 dB SINAD.
Two-tone, third-order IMD dynamic range: Not specified.	20 kHz offset from 146 MHz, 69 dB; 10 MHz offset from 146 MHz, 86 dB.
Adjacent-channel rejection: Not specified.	20 kHz offset from 146 MHz, 68 dB.
IF rejection: Not specified.	1st IF (17.2 MHz): 95 dB; 2nd IF (455 kHz): >130 dB.
Image rejection: Not specified.	1st IF: 61 dB; 2nd IF: 84 dB.
Squelch sensitivity: Not specified.	0.08 μV at threshold.
Audio output: 2.5 W at 10% distortion.	3 W at 10% THD into 8 Ω.
Transmitter	*Transmitter Dynamic Testing*
Power output: High, 50 W; low, 5 W.	High, 49.1 W; low, 4.3 W.
Spurious signal and harmonic suppression: –60 dB or better.	As specified. The DR-130T meets FCC requirements for spectral purity for transmitters in its power class and frequency range.
Transmit-receive turnaround time (PTT release to 50% of full audio output): Not specified.	Squelch on, 145 ms; squelch off, 140 ms.

AZDEN PCS-7000H

The "H" in PCS-7000H is a reference to its output power—50 W on the high setting, 10 W on low. With its ample heat sink, the PCS-7000H ran cool, even during long-winded conversations at the 50-W level. The Azden is the only radio in this group to offer a two-year warranty.

This radio receives as well as it transmits. In fact, the receive coverage extends from 118 to 174 MHz. AM is selected automatically when you tune through the 118 to 136 MHz aviation band. One reviewer commented that the PCS-7000H seemed exceptionally sensitive on aviation frequencies.

There are two memory banks (labeled **A** and **B**). Each bank holds 10 memory channels. You can store any frequency combi-

Azden PCS-7000H, serial no. A835005

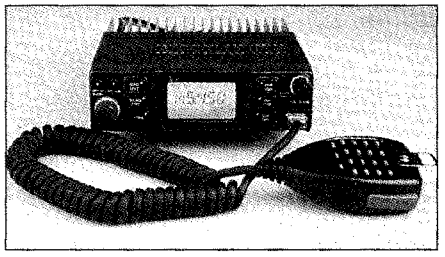
Manufacturer's Specifications	*Measured in ARRL Lab*
Frequency coverage: Receive, 118-174 MHz; transmit, 144-148 MHz.	As specified.
Power requirements: At 13.8 V dc: 0.6 A max (receive); 10 A max (transmit).	At 13.8 V dc: 0.6 A max (receive); 7 A max (transmit).
Size (height, width, depth): 2×5.5×7.25 inches; weight, 3 lb.	
Receiver	*Receiver Dynamic Testing*
Sensitivity: Better than 0.19 μV for 12 dB SINAD; AM: <1 μV for 10 dB S/N.	FM: 0.18 μV for 12 dB SINAD; AM: 0.50 μV for 10 dB S+N/N.
Two-tone, third-order IMD dynamic range: Not specified.	20 kHz offset from 146 MHz, 66 dB; 10 MHz offset from 146 MHz, 92 dB.
Adjacent-channel rejection: Not specified.	20 kHz offset from 146 MHz, 74 dB.
IF rejection: Not specified.	1st IF (16.9 MHz): 108 dB; 2nd IF (455 kHz): >130 dB.
Image rejection: Not specified.	1st IF: 81 dB; 2nd IF: >130 dB.
Squelch sensitivity: <0.12 μV.	0.06 μV at theshold.
Audio output: 2 W at 10% distortion.	2.9 W at 10% THD into 8 Ω.
Transmitter	*Transmitter Dynamic Testing*
Power output: High, 50 W; low, 10 W.	High, 57.8 W; low, 9.8 W.
Spurious signal and harmonic suppression: better than –60 dB.	As specified. The PCS-7000H meets FCC requirements for spectral purity for transmitters in its power class and frequency range.
Transmit-receive turnaround time (PTT release to 50% of full audio output): Not specified.	Squelch on or off, 300 ms.

nation in these memories, along with CTCSS tone information. (The CTCSS encoder is standard in the PCS-7000H. An optional CTCSS *decoder* is available.) In addition, there is a single "temporary memory" channel that functions like a scratch-pad memory to store information on the fly.

The scanning functions are flexible. For example, you can choose dual-memory scanning or programmable band scanning. The PCS-7000H monitors a programmable priority channel every four seconds. If a signal is heard there, you're alerted with a beep. (The radio does not switch to the priority channel automatically.)

A lighted keypad on the microphone allows you to control several PCS-7000H functions remotely, including priority channel switching and frequency selection (up or down). The radio received compliments for the fidelity of its transmitted audio. The receive audio was also quite good, with plenty of power to overcome noisy environments.

ICOM IC-281H



One of the hallmarks of the IC-281H is its ability to function as a 70-cm FM receiver as well as a 2-meter FM transceiver. As with similar rigs, you can enjoy full-duplex crossband operation. The only trick is finding someone who has simultaneous 70-cm transmit and 2-meter receive.

The bottom end of its 70-cm receive capability is specified as 440 MHz. That puts the satellite subband out of reach, which is unfortunate because the IC-281H supports 9600-bit/s packet with a dedicated TNC jack. It would have been interesting to use the IC-281H to work OSCARs 22, 23 or 25 on packet. (Or, for that matter, OSCAR 27 on FM voice.)

The good news is that the radio can be modified to extend the receive coverage to 430 MHz. A modification is also available to extend the 2-meter coverage to 118 MHz. According to one reviewer who actually performed the modification, it isn't for the faint of heart. You have to virtually disassemble the entire radio and then carefully unsolder a tiny surface-mount component. (Contact your dealer or ICOM for details.)

Our reviewers enjoyed the 10 "scratch pad" memories in the IC-281H. This function automatically stores your 10 previously transmitted frequencies (five simplex and five duplex). You also have 60 memory channels that you can allocate to 2 meters or 70 centimeters as you see fit.

ICOM IC-281H, serial no. 06396

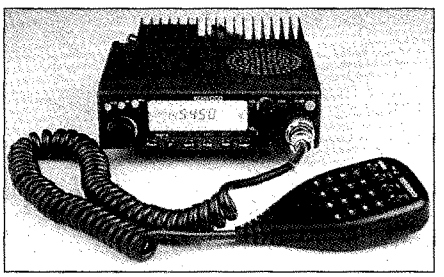
Manufacturer's Specifications	*Measured in ARRL Lab*
Frequency coverage: Receive, 144-148 MHz, 440-450 MHz; transmit, 144-148 MHz.	As specified. Can be modified for extended coverage; see text.
Power requirements: At 13.8 V dc: 1 A max (receive); 10.5 A max (transmit).	At 13.8 V dc: 0.7 A max (receive); 8.6 A max (transmit).
Size (height, width, depth): 1.6×5.5×6.7 inches; weight, 2.1 lb.	
Receiver	*Receiver Dynamic Testing*
Sensitivity: 146 MHz, better than 0.16 μV for 12 dB SINAD; 440 MHz, better than 0.2 μV for 12 dB SINAD.	146 MHz, 0.16 μV for 12 dB SINAD; 440 MHz, 0.2 μV for 12 dB SINAD.
Two-tone, third-order IMD dynamic range: Not specified.	20 kHz offset from 146 MHz, 66 dB; 10 MHz offset from 146 MHz, 86 dB; 20 kHz offset from 440 MHz, 60 dB.
Adjacent-channel rejection: More than 60 dB.	20 kHz offset from 146 MHz, 62 dB; 20 kHz offset from 440 MHz, 64 dB.
IF rejection: Not specified.	1st IF (30.85 MHz): 104 dB; 2nd IF (455 kHz): >130 dB.
Image rejection: Not specified.	1st IF: 70 dB; 2nd IF: >130 dB.
Squelch sensitivity: Not specified.	146 MHz, 0.06 μV at theshold; 440 MHz, 0.11 μV at threshold.
Audio output: 2.4 W at 10% distortion.	2.4 W at 10% THD into 8 Ω.
Transmitter	*Transmitter Dynamic Testing*
Power output: High, 50 W; medium, 10 W; low, 5 W.	High, 50.1 W; medium, 9.3 W; low, 4.6 W.
Spurious signal and harmonic suppression: Better than –60 dB.	As specified. The IC-281H meets FCC requirements for spectral purity for transmitters in its power class and frequency range.
Transmit-receive turnaround time (PTT release to 50% of full audio output): Not specified.	Squelch on or off, 180 ms.

Many of the IC-281H's functions can be controlled remotely through the microphone keypad. In addition, the rig includes an autodialer with can hold up to 14 telephone numbers—a real bonus for repeater autopatch operating.

Most reviewers found the IC-281H to be easy to program. In fact, several commented on the transceiver's one-push switch setup. This avoids fumbling with a multistep "function" switch when you're trying to activate (or deactivate) one of the radio's many features.

Everyone complimented the IC-281H on its styling and overall ease of use. Several mentioned the large display and the fact that the rig ran cool, even when operating at its full 50 W output. The only complaints concerned receive audio (some felt that it sounded hollow and tinny). Others disliked the modular telephone-type plug used for the microphone.

KENWOOD TM-241A



The TM-241A offers a number of essential features—and selectable output power (5, 10 or 50 W)—in a small package. This can be good or bad, depending on how the radio is designed. Fortunately, the TM-241A is relatively easy to operate despite liberal use of multifunction buttons. Several reviewers said that they were able to program some functions without consulting the manual. In addition, its large display is readable in all but the brightest light, and you can adjust the brightness levels in four steps to suit your needs.

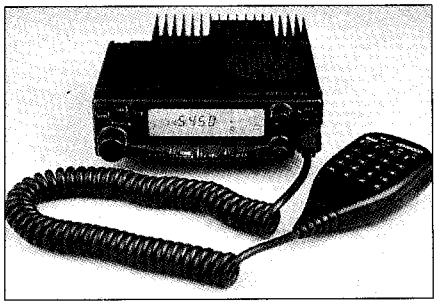
With the TM-241A's extended receive coverage (118 to 174 MHz), you can listen to much more than the amateur 2-meter band. The AM aircraft band is especially interesting to hear while you're driving around town. The Priority Alarm function (similar to Priority Scan on other radios) beeps when there is activity on the designated "watch" channel, rather than switching automatically.

The repeater offset is selected automatically, but you have the option of programming up to four "odd" splits in the TM-241A's memory. You can scan all 20 memory channels, or scan the entire receive range. In addition, there are selectable scan stops and memory channel lock-outs. A CTCSS encoder is standard, but a CTCSS *decoder* is optional.

Reviewers were unanimous in their praise of the TM-241A's overall performance. The only slight negative was the

receive audio which some called "tinny." Others complimented the radio on its "human engineering." The multifunction microphone is especially well suited to mobile operating. Its durability was also impressive. A recent development is that the TM-241A is MIL-SPEC (military specification) rated, which means it conforms to the endurance requirements set by the US military. (Only TM-241As with serial numbers above 5080000 carry the MIL-SPEC rating.)

KENWOOD TM-251A



This transceiver is loaded to the gills with features—perhaps too many features, in the opinions of some reviewers. There are 41 memory channels (expandable to 200), selectable frequency stepping, an auto-power-off function, 10 DTMF memories (each memory slot can hold up to 15 digits), three RF power levels (50, 10 and 5 W), and much more. It took several days of use before most of the reviewers could say that they had mastered the radio. The trick was figuring out which multiple functions were performed by which buttons. The dual menu system was a great help in this regard.

Among the more unusual features is the built-in digital recording system. It will record an incoming audio message up to 16 seconds in length. The recorder would come in handy in many situations—especially when someone pages you and you aren't close enough to the radio to catch their call sign.

While the TM-251A is a 2-meter transceiver, it also receives on 70-cm. Not only can you monitor activity on local 440 MHz repeaters, you can set up a full-duplex crossband link using the split-memory channels. If you know a ham who has a 70-cm transceiver with 2-meter receive (such as the Kenwood TM-451A), he or she could transmit on 440 MHz while listening on 2 meters. You would do exactly the opposite. As a result, you could communicate telephone-style without having to take turns talking.

The TM-251A can monitor down to 300 MHz. This opens the possibility of using the radio with 9600-bit/s packet satellites such as OSCARs 22, 23 and 25. These satellites transmit between 435 and 437 MHz while listening on 2 meters.

The TM-251A provides a 6-pin mini DIN jack to connect to your packet TNC.

Kenwood TM-241A, serial no. 51103055

Manufacturer's Specifications	*Measured in ARRL Lab*
Frequency coverage: Receive and transmit, 144-148 MHz.	Receive, 118.0-174.0 MHz (118-136 MHz AM); transmit, 144-148 MHz.
Power requirements: At 13.8 V dc: 0.6 A max (receive); 11 A max (transmit).	At 13.8 V dc: 0.8 A max (receive); 9.5 A max (transmit).

Size (height, width, depth): 1.6×5.5×6.3 inches; weight, 2.7 lb.

Receiver	*Receiver Dynamic Testing*
Sensitivity: Better than 0.16 μV for 12 dB SINAD; AM: Not specified.	FM: 0.16 μV for 12 dB SINAD; AM, 0.81 μV for 10 dB S+N/N at 120 MHz.
Two-tone, third-order IMD dynamic range: Not specified.	20 kHz offset from 146 MHz, 70 dB; 10 MHz offset from 146 MHz, 96 dB.
Adjacent-channel rejection: Not specified.	20 kHz offset from 146 MHz, 67 dB.
IF rejection: Not specified.	1st IF (30.825 MHz): 96 dB; 2nd IF (455 kHz): >130 dB.
Image rejection: Not specified.	1st IF: 123 dB; 2nd IF: >130 dB.
Squelch sensitivity: Less than 0.1 μV.	0.04 μV at threshold.
Audio output: >2 W at 5% distortion.	2.8 W at 5% THD into 8 Ω.
Transmitter	*Transmitter Dynamic Testing*
Power output: High, 50 W; medium, ≈10 W; low, ≈5 W.	High, 54.7 W; medium, 12.6 W; low, 6 W.
Spurious signal and harmonic suppression: Better than –60 dB.	As specified. The TM-241A meets FCC requirements for spectral purity for transmitters in its power class and frequency range.
Transmit-receive turnaround time (PTT release to 50% of full audio output): Not specified.	Squelch on, 190 ms; squelch off, 200 ms.

Kenwood TM-251A, serial no. 50700343

Manufacturer's Specifications	*Measured in ARRL Lab*
Frequency coverage: Receive, 118-174 MHz, 300-470 MHz; transmit, 144-148 MHz.	Receive, 118-174 MHz and 300-470 MHz; transmit, 144-148 MHz.
Power requirements: At 13.8 V dc: 0.6 A max (receive); 11 A max (transmit).	At 13.8 V dc: 0.6 A max (receive); 9.1 A max (transmit).

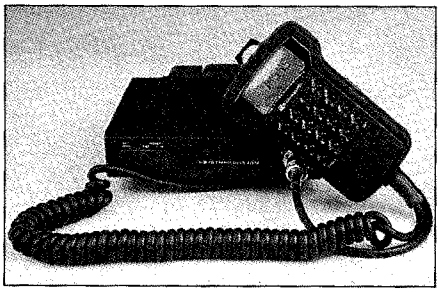
Size (height, width, depth): 1.6×5.6×6.4 inches; weight, 2.2 lb.

Receiver	*Receiver Dynamic Testing*
Sensitivity: Better than 0.16 μV for 12 dB SINAD.	146 MHz, 0.13 μV for 12 dB SINAD; 440 MHz, 0.12 μV for 12 dB SINAD.
Two-tone, third-order IMD dynamic range: Not specified.	20 kHz offset from 146 MHz, 65 dB; 10 MHz offset from 146 MHz, 78 dB; 20 kHz offset from 440 MHz, 68 dB.
Adjacent-channel rejection: Not specified.	20 kHz offset from 146 MHz, 72 dB; 20 kHz offset from 440 MHz, 69 dB.
IF rejection: Not specified.	1st IF (45.05 MHz): 101 dB; 2nd IF (455 kHz): >130 dB.
Image rejection: Not specified.	1st IF: 129 dB; 2nd IF: 72 dB.
Squelch sensitivity: 0.1 μV or less.	146 MHz, 0.06 μV at threshold; 440 MHz, 0.04 μV at threshold.
Audio output: >2.0 W at 5% distortion.	2.4 W at 5% THD into 8 Ω.
Transmitter	*Transmitter Dynamic Testing*
Power output: High, 50 W; medium, ≈10 W; low, ≈5 W.	High, 56.5 W; medium, 12.2 W; low, 4.2 W.
Spurious signal and harmonic suppression: Better than –60 dB.	As specified. The TM-251A meets FCC requirements for spectral purity for transmitters in its power class and frequency range.
Transmit-receive turnaround time (PTT release to 50% of full audio output): Not specified.	Simplex: squelch on, 96 ms; squelch off, 76 ms. Duplex: squelch on, 105 ms; squelch off, 97 ms.

Kenwood offers a prewired cable, the PG-5A, for $14.95. If you manage to locate a mini DIN plug to roll your own, you'll find that wiring it is a chore, not only because of its size, but also because the instructions in the TM-251A manual are rather vague.

The only noteworthy criticisms concerned the ergonomics of the TM-251A. The remote-control microphone (including keypad frequency entry) was difficult to use without frequent reference to the manual. Other reviewers commented on what appeared to be excessive side-to-side movement of the **VOLUME** and **SQUELCH** controls.

STANDARD C1208DA



The Standard C1208DA transceiver takes a novel approach to the problem of rig security. The radio is housed in a compact enclosure that fits easily beneath a car seat, out of sight and out of the attention of would-be thieves. All the functions of the C1208DA are controlled *from the microphone*. When you leave your vehicle, it's a simple matter to unplug the mike and drop it in your pocket.

Operating the C1208DA from the microphone takes some getting used to. Because every function of the rig is accessed from the mike, it is a very busy microphone indeed. Hams with large fingers may find it difficult to navigate the tiny buttons on the keypad. Some reviewers complained that the PTT (push-to-talk) operation was awkward. Almost everyone agreed that the display was difficult to read in sunlight unless you held the microphone at an exact angle. Others felt that the audio was insufficient and somewhat tinny.

On the positive side, you get 100 memories to store frequencies, repeater offsets, CTCSS tones and so on. Six scanning modes (including priority and CTCSS scanning) add to the C1208DA's versatility. As part of the DTMF function, there are 10 autodialer memories capable of holding telephone numbers of up to 15 digits.

Of all the radios tested for this review, the C1208DA had the widest receive range. The manual specifies receive coverage from 144 to 148 MHz and from 420 to 450 MHz. The ARRL Lab, however, measured receive coverage from 100 to 200 MHz, 250 to 520 MHz and 800 to 1000 MHz! (823.99 to 849.00 MHz and 868.99 to 894.00 MHz are blocked out.) You can tune in steps from 5 to 100 kHz.

Crossband operation is possible with the C1208DA. One reviewer used the transceiver to work the OSCAR 27 satellite (2 meters up, 70 cm down) on FM voice. With the C1208DA's 9600-bit/s packet ability, it would also be possible to work OSCARs 22, 23, and 25.

Standard C1208DA, serial no. 44U020091

Manufacturer's Specifications	*Measured in ARRL Lab*
Frequency coverage: Receive, 144-148 MHz, 420-450 MHz; transmit, 144-148.	Receive, 100-200 MHz, 250-520 MHz, 800-1000 MHz (823.99-849 and 868.99-894 MHz blocked out); transmit, 144-148 MHz.
Power requirements: At 13.8 V dc: 0.5 A max (receive); 11 A max (transmit).	At 13.8 V dc: 0.6 A max (receive); 10.1 A max (transmit).
Size (height, width, depth): 1.2×5.6×5.9 inches; weight, 1.6 lb.	
Receiver	*Receiver Dynamic Testing*
Sensitivity: Better than 0.2 μV for 12 dB SINAD.	146 MHz, 0.24 μV for 12 dB SINAD; 440 MHz, 0.19 μV for 12 dB SINAD; 910 MHz, 0.27 μV for 12 dB SINAD.
Two-tone, third-order IMD dynamic range: Not specified.	20 kHz offset from 146 MHz, 71 dB; 10 MHz offset from 146 MHz, 90 dB; 20 kHz offset from 440 MHz, 73 dB.
Adjacent-channel rejection: Not specified.	20 kHz offset from 146 MHz, 64 dB; 20 kHz offset from 440 MHz, 57 dB.
IF rejection: Not specified.	1st IF (23.05 MHz): 80 dB; 2nd IF (455 kHz): >130 dB.
Image rejection: Not specified.	1st IF: 86 dB; 2nd IF: >130 dB.
Squelch sensitivity: 0.141 μV.	146 MHz, 0.14 μV at threshold; 440 MHz, 0.08 μV at threshold.
Audio output: 3.0 W at 10% distortion.	As specified.
Transmitter	*Transmitter Dynamic Testing*
Power output: High, 50 W; medium, 10 W; low, 3 W.	High, 52.9 W; medium, 9 W; low, 3 W.
Spurious signal and harmonic suppression: Better than –60 dB.	As specified. The C1208DA meets FCC requirements for spectral purity for transmitters in its power class and frequency range.
Transmit-receive turnaround time (PTT release to 50% of full audio output): Not specified.	Simplex: squelch on or off, 140 ms; duplex: squelch on or off, 175 ms.

YAESU FT-2200

The FT-2200 transceiver provides a nice selection of features, including DTMF paging and CTCSS encoding. Maximum RF power output is a hefty 50 W, yet the rig is designed to fit in relatively small spaces.

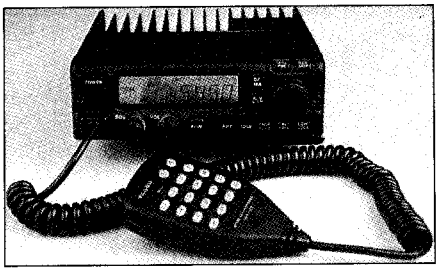
The reviewers found the FT-2200 easy to use, helped in large part by the detailed, well-written manual. The only criticism concerned the multifunction key which you must press and hold for a specified amount of time, depending on what you want to do. If you hold the button too long, you skip over the operation you want to access. This would be especially maddening in a mobile environment.

The FT-2200 offers 50 memory channels. This is more than enough for most hams. Several reviewers were impressed by how easy it was to store odd offsets (or even completely different transmit/receive frequencies) on the fly. It's as simple as executing a "memory save" for your receive frequency, then tuning to your transmit frequency and closing the mike button while toggling "memory save" again.

Receive coverage extends from 110 to 180 MHz, including automatic AM selection when you tune through the aircraft band. In addition to 1-MHz step tuning, you can even select 10-MHz step tuning. This makes is easy to cruise through the complete receive range in short order.

The FT-2200 is usable as a packet transceiver, but the rig does not offer a separate TNC jack. You must wire the TNC to the radio through the microphone jack. The FT-2200 does not support 9600-bit/s packet.

YAESU FT-2500M



The first thing you notice about the FT-2500M is its ruggedness. Every reviewer commented favorably on this aspect of the FT-2500M. It's a radio designed to withstand considerable abuse. The FT-2500M is MIL-SPEC rated (the first radio in this group to carry that spec).

The front panel is designed for operation in a busy environment. Only essential controls are visible. The functions you'll use less often are concealed behind a drop-down panel. Programming can be complicated, but the manual outlines the procedures in detail. In fact, the manual won unanimous praise for its straightforward explanations and reader-friendly style.

Noteable features include 31 memory channels, automatic power off function, a time-out timer and manual or automatic backlighting adjustment. (The large, easy to read display and backlighted microphone keypad won several compliments.) A CTCSS encoder is standard in the FT-2500M, but a CTCSS decoder is optional.

The FT-2500M works well for 1200 bit/s packet, although you must wire the TNC to the transceiver through the microphone jack. This is complicated by the fact that the FT-2500M uses a modular telephone-type microphone plug. These plugs are notoriously difficult to wire. Even so, you can buy an adapter cord that makes wiring somewhat easier. The transceiver can operate 9600-bit/s packet, but an internal modification is necessary. A modification kit is offered by Yaesu, but the work should only be attempted by hams who have experience with surface-mount components.

Conclusions

When you have so many radios to choose from, making a purchase decision isn't easy. This is complicated by the fact that *all* the transceivers we received were good performers. In the end, it comes down to which rigs have particular advantages that are important to you.

If cost is your primary concern, you'll want to take a close look at the Alinco DR-130T. It offers good basic performance and has the essential features. If you enjoy listening to aviation communication, you should know that many reviewers commented favorably on the Azden PCS-7000H and the Yaesu FT-2200. Both models appeared to be very sensitive in the aviation band.

Yaesu FT-2200, serial no. 4E131080

Manufacturer's Specifications	*Measured in ARRL Lab*
Frequency coverage: Receive, 140-174 MHz; transmit, 144-148 MHz.	Receive, 140-174 MHz FM, 110-140 MHz AM; transmit, 140-150 MHz.
Power requirements: At 13.8 V dc: 0.7 A max (receive); 10 A max (transmit).	At 13.8 V dc: 0.5 A max (receive); 8.3 A max (transmit).
Size (height, width, depth): 1.6×5.6×6.4 inches; weight, 2.8 lb.	
Receiver	*Receiver Dynamic Testing*
Sensitivity: FM, better than 0.21 μV for 12 dB SINAD; AM, not specified.	FM: 0.16 μV for 12 dB SINAD; AM: 0.48 μV for 10 dB S+N/N at 120 MHz.
Two-tone, third-order IMD dynamic range: Not specified.	20 kHz offset from 146 MHz, 73 dB; 10 MHz offset from 146 MHz, 87 dB.
Adjacent-channel rejection: Not specified.	20 kHz offset from 146 MHz, 70 dB.
IF rejection: Not specified.	1st IF (17.7 MHz): 111 dB; 2nd IF (455 kHz): >130 dB.
Image rejection: >65 dB.	1st IF: 98 dB; 2nd IF: 93 dB.
Squelch sensitivity: Not specified.	146 MHz, 0.08 μV at threshold.
Audio output: 1.5 W at 5% distortion	2.3 W at 5% THD into 8 Ω.
Transmitter	*Transmitter Dynamic Testing*
Power output: High, 50 W; medium, 25 W; low, 5 W.	High, 47.4 W; medium, 21.4 W; low, 4.1 W.
Spurious signal and harmonic suppression: Better than –60 dB.	As specified. The FT-2200 meets FCC requirements for spectral purity for transmitters in its power class and frequency range.
Transmit-receive turnaround time (PTT release to 50% of full audio output): Not specified.	Squelch on, 62 ms; squelch off, 56 ms.

Yaesu FT-2500M, serial no. 46041324

Manufacturer's Specifications	*Measured in ARRL Lab*
Frequency coverage: Receive, 140-174 MHz; transmit, 144-148 MHz.	As specified.
Power requirements: At 13.8 V dc: 0.6 A max (receive); 12 A max (transmit).	At 13.8 V dc: 0.8 A max (receive); 10.3 A max (transmit).
Size (height, width, depth): 2×6.4×7.2 inches; weight, 3.3 lb.	
Receiver	*Receiver Dynamic Testing*
Sensitivity: Better than 0.2 μV for 12 dB SINAD.	146 MHz, 0.21 μV for 12 dB SINAD.
Two-tone, third-order IMD dynamic range: Not specified.	20 kHz offset from 146 MHz, 69 dB; 10 MHz offset from 146 MHz, 103 dB.
Adjacent-channel rejection: Not specified.	20 kHz offset from 146 MHz, 78 dB.
IF rejection: >70 dB.	1st IF (21.4 MHz): 102 dB; 2nd IF (455 kHz): >130 dB.
Image rejection: >70 dB.	1st IF: 96 dB; 2nd IF: 88 dB.
Squelch sensitivity: Not specified.	146 MHz, 0.12 μV at threshold.
Audio output: 3.5 W at 10% distortion.	4.1 W at 10% THD into 4 Ω.
Transmitter	*Transmitter Dynamic Testing*
Power output: High, 50 W; medium, 25 W; low, 5 W.	High, 47.8 W; medium, 22.2 W; low, 4 W.
Spurious signal and harmonic suppression: Better than –60 dB.	As specified. The FT-2500M meets FCC requirements for spectral purity for transmitters in its power class and frequency range.
Transmit-receive turnaround time (PTT release to 50% of full audio output): Not specified.	Squelch on, 64 ms; squelch off, 52 ms.

Security is a concern for many amateurs these days. The Standard C1208DA, with its "hideaway" design, takes the top spot as the radio least likely to be stolen. The rig stays out of sight and the microphone—the *only* part that's visible—detaches easily. The C1208DA is at the high end of the price scale, but it's loaded with features that are optional—or simply not available—in lower-priced radios.

We tested each radio for its ability to perform under conditions of extreme

temperature, according to their own specifications (as low as –4°F to as high as 140°F). We also tested each transceiver for low-voltage operation (down to 11.5 V dc). We're pleased to say that every rig passed muster. For sheer ruggedness, however, check out the Kenwood TM-241A and the Yaesu FT-2500M. As we said, transceivers carry military MIL-SPEC ratings.

For hams who operate near commercial VHF transmitter sites (pagers, police dispatchers, etc), a rig's ability to reject out-of-band interference is critical. As you look over the ARRL Lab results, pay close attention to the 10-MHz offset IMD measurements. This will give you a good idea of the radio's susceptibility to interference from other services, such as transmitters operating from 152 to 158 MHz (a popular frequency range for commercial pagers). The higher the dB number, the better. Of all rigs tested for this review, the Yaesu FT-2500M exhibited superior 10-MHz offset IMD dynamic range.

Ease of use is in the eye of the beholder. Even so, most reviewers felt that the ICOM IC-281H and the Kenwood TM-241A caused the least amount of frustration. The IC-281H also drew accolades for its ample audio.

All of the radios in this group are worth your consideration. Which one you pick will depend largely on your operating habits and your budget.

Gap Challenger DX-VIII Vertical Antenna

Reviewed by Bill Kennamer, K5FUV
DXCC Manager

Moving always becomes a traumatic experience for me, when radio withdrawal often takes hold as does no other malady. After moving to Connecticut, it took over a year to locate a suitable antenna-planting location. Even then, it would be a while before the weather, time and other factors could coincide to allow the usual antenna farm to begin to grow. My plight was well known around the office, so one day a very large box turned up on my desk, along with the instructions to take it, try it, see what you think. Thus was I introduced to the Gap Challenger DX-VIII, a multiband vertical antenna for 80, 40, 20, 15, 12, 10, 6 and 2 meters.

Assembly

The Gap comes in a box about eight feet long, and weighs about 16 pounds. Most of the parts are pieces of aluminum tubing, and assembly is relatively easy. Although the manual says that assembly can be accomplished in about an hour, I spent an hour and a half putting it all together. The antenna comes with all parts and a nutdriver, which is the only tool needed to complete the job.

Assembly consists of merely screwing the different pieces of tubing together. Some alignment of stand-off insulators is necessary, but there is little else to be done. Assembly will go faster if you have the recommended area of 35 feet to work in. No conductive grease of any kind came with the antenna. My experiences have shown that joints can oxidize and become intermittent, so I took the time to put conductive grease at the section joints.

The manual is quite good, with nothing left to chance. Each assembly step is described fully, and drawings appear at the point where they are needed. All parts (and their sizes) are shown on one fold-out drawing for easy identification. You don't need to make any measurements, and all holes are predrilled—just align the holes and screw the pieces together.

I built much of the antenna in the basement and finished it outside, joining the upper and lower sections, and making the electrical connections to the tuning rods. The hardest part of the whole assembly was pulling the coax out of the bottom section of tubing and attaching a PL-259 to the end of the coax. Gap recommends attaching three 25-foot pieces of wire to the bottom of the vertical as a counterpoise, and I followed their recommendation. I then raised the antenna to a vertical position, inserted it into the base section (a supplied 3-foot piece of plastic pipe) and attached a coaxial feed line (Gap recommends at least 65 feet) to complete the assembly.

The DX-VIII easily met its SWR specifications on all bands. On 80 meters, the antenna resonated at 3850 kHz and measured 1.6:1 at 3950 and 1.4:1 at 3750. On the other bands, the SWR never exceeded 1.4:1. Gap specifies 130 kHz between 2:1 SWR points on 80 meters and SWR of 2:1 on the other bands.

Although the instructions say that the Gap will resonate close to the center frequency selected on 80 meters, what isn't said is how that frequency is selected. It's actually done at the time you order, and the antenna I received was tuned for phone. There doesn't appear to be any easy way to change the selected frequency of 80 meter operation.

On the Air

I used the Gap on the air for several months and had an opportunity to compare it to several other antennas. I did quite a bit of A-B testing with low dipoles (20 to 30 feet high) on 10, 15 and 20 meters. My old standby Electrospace HV-3 vertical with eight 30-foot-long on-ground radials provided a good comparison on 20, 40 and 80 meters. (The HV-3 is 31 feet long, tapers from 2 inches OD at the base to $\frac{5}{8}$ inch at the tip, and functions as a top-loaded short vertical on 80 meters, a full-size $\frac{1}{4}$ wave vertical on 40 meters and a $\frac{5}{8}$ wavelength vertical on 20 meters. It was manufactured in the early 1980s and is no longer available.) Finally, I borrowed a Cushcraft R7 multiband vertical and erected it several hundred feet away for comparison on 40 through 10 meters.

The following comparisons were made during a number of listening sessions with my Kenwood TS-850S transceiver and by asking other amateurs to listen critically while I switched among the available antennas. Here's what I found.

On 80 meters, signals on the DX-VIII were down by about two S-units compared to the Electrospace HV-3 vertical I use regularly. This did not vary with time of day or on different days.

On 40 meters, the Gap compared favorably to the HV-3. At no time could I notice any difference between the two. The Gap clearly outperformed the R7 on 40 meters by about one S-unit.

On 20 meters, signals on the HV-3 and the dipole at 30 feet were about one S-unit better than the Gap most of the time. Occasionally the Gap equaled the dipole, depending on time of day, when the lower radiation angles of the vertical gave it a boost, but it was never better. I found signals on the Gap to be virtually identical to the R7.

On 15 meters, the dipole was better than the Gap, usually by more than two S-units. Signals on the R7 again equaled the Gap. On 12 meters, the 10 meter dipole tuned by the TS-850's internal antenna tuner was at least two S-units better than the Gap, while the R7 was typically one S-unit better.

There weren't many signals on 10 meters during the review period, and the ones I did find were weak. I noticed a more substantial difference in signal strengths between the Gap and the other antennas on this band. Signals were noticeably weaker on the Gap than either a dipole at 30 feet or

the R7. One afternoon I ran across a New Zealand station that was workable on the dipole but inaudible on the Gap.

I didn't try the Gap on 6 meters. Although I wouldn't normally consider using a multiband HF vertical on 2 meters, I was able to make contacts there but didn't have another outdoor antenna for comparison. As an unexpected benefit, I was able to work stations on 30 meters with the aid of my transceiver's antenna tuner, even though the DX-VIII is not specified for use there. For me, 30 and 17-meter operation would be a desirable addition.

Conclusions

The Gap Challenger DX-VIII is ruggedly built, although the construction style does produce some wind loading higher up on the antenna. The manufacturer recommends guying the antenna, and I think this is a good idea. Assembly is easy, with no need to measure, and little chance of misidentifing parts.

While I found some differences between the performance of the Gap and the others I used for comparison, those differences are not substantial. I was especially impressed by the Gap's performance on 40 meters. After a couple of years of operating from New England, I've come to expect the performance of vertical antennas in general to be inferior to horizontal antennas because the poor soil characteristics contribute to far-field losses. (You can read more about this on page 2-36 of the 17th edition *ARRL Antenna Book*.) If you live in other areas of the country with better soil, you may find that vertical antennas work better for you.

The Gap covers eight bands with one feed line and requires little space to install. Sometimes there is a tendency to discount convenience, ease of assembly and other factors when making comparisons, and yet these items should be part of the comparison. For example, none of the other antennas I used cover all the bands that the Gap covers. My normal antenna complement requires four feed lines (one for each of the three dipoles and one for the HV-3), plus support points necessary for four antennas, and space for separation from each other. The Gap offers a much simpler approach. By and large I found that any station workable on my usual antennas was workable on the Gap—with the possible exception of 10 meters.

After 34 years of ham radio, this is my first experience with a multiband antenna of this type. We don't all need or want monoband antennas, or even a field of dipoles. This antenna will do the job and, I think, represents a good value for the price.

Manufacturer: GAP Antenna Products, 6010 Bldg B, N Old Dixie Highway, Vero Beach, FL 32967; tel 407-778-3728. Manufacturer's suggested retail price: $259.

How Does it Work?

That's a real good question. Just how does the DX-VIII achieve a match on the various bands? Several antenna experts referred me to a review of an earlier (but similar) Gap antenna, the DX-VI, by Peter Hart, G3SJX, in the December 1991 issue of *Radio Communication*. Here's a summary of what Peter had to say:

The tubing is split about halfway up to give a 16-foot top section electrically insulated from the lower section, which is grounded at the bottom. The 50 Ω coax feed passes through a hole at the base and then up inside the lower section. The outer conductor of the coax is connected to the top of the lower section and the inner conductor passes through a series stub to the bottom of the upper section. Hence the feed is connected across the gap (which gives rise to the name of the company). The feeder and the stub are formed from a single length of 1/4 inch diameter thick-braided coax with the braiding suitably cut at the gap feed point. The stub is electrically 1/4 wavelength long on 3.5 MHz and is terminated at the far end in a capacitor. The value of the capacitor on the [*Radio Communication*] review antenna was measured as 2440 pF. The stub is contained within the upper section by "zig-zagging" inside the tubing.

The other notable feature of the antenna is that there are tuning rods protruding both upward and downward from the gap. These are spaced away from the antenna elements on insulated supports and are connected in antiphase to the adjacent antenna element section. On the low frequency bands, these tuning rods act as capacity loading. On the higher frequency bands, the length of the tuning rods becomes significant in terms of wavelength and these must be considered as transmission lines with the main antenna element. The lower two tuning rods each comprise transmission lines with higher impedance sections connecting to lower impedance sections. The result is three shunt stubs across the gap, which gives a multi-resonance and matches the antenna across different bands. However, the situation is probably more complex than this, and the tuning rods almost certainly radiate on the higher bands, particularly where they are a resonant length.

The precise details of how the antenna functions on all the bands is not clear to me. However some general observations can be made:

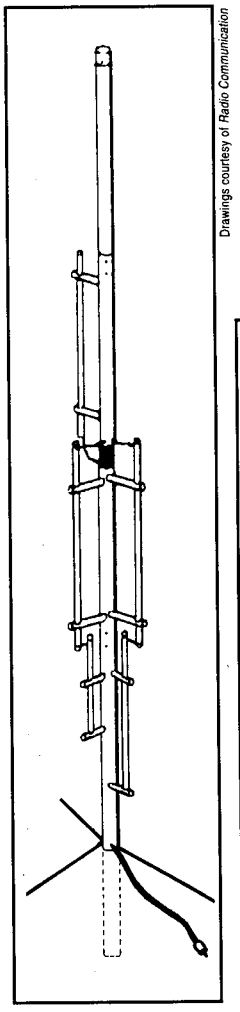
On 3.5 MHz, the antenna is less than λ/8 long and the series stub is λ/4 long. The 2440 pF capacitor across the end of the stub is transformed to an inductive reactance in series with the upper antenna section. This is equivalent to a series loading coil at this point and brings the antenna into resonance together with the additional shunt capacity provided by the tuning rods.

On 7 MHz, the antenna is a little under λ/4 long and the series stub is λ/2 long. The capacitor across the stub is quite a low impedance and this is transformed to an equal low impedance in series with the top section. The capacity of the tuning rods resonates the antenna.

On 14, 21 and 28 MHz, the stub is a multiple of λ/2 in length and the capacitor can be regarded as a short circuit. Hence the stub is a short circuit at the feed and the feeder is effectively connected across the gap. On 14 MHz the antenna is a center-fed λ/2; 3/8λ on 21 MHz; and a full wavelength on 28 MHz. The tuning rods provide a stub matching system on these bands but also contribute to the radiation. On 24 MHz, the stub presents a fairly high impedance, which matches to the relatively high feed impedance of the antenna in conjunction with the tuning rods.

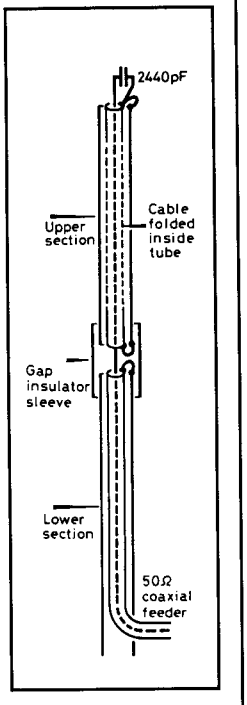
I will not hazard a guess at how the antenna matches or radiates on 50 or 144 MHz!

[For a technical analysis of vertical antennas of this class, see "A Vertical Monopole with Elevated Feed—A Full-Length Radiator," by Jack Belrose, VE2CV, in this month's Technical Correspondence column (pages 78 and 79).—*Ed.*]



Drawings courtesy of *Radio Communication*

Challenger DX-VI physical layout.



Arrangement of the coax.