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Short Takes

None

ICOM IC-V8000 VHF FM Transceiver

Reviewed by Steve Ford, WB8IMY

ICOM has gone back to basics with the IC-V8000 transceiver. Gone are the elaborate menus, the multitude of buttons and the endless features—most of which you may never use. Instead, the V8000 puts the focus on simplicity, durability and power—*lots* of power.

Although it is designed as a 2-meter FM mobile, the V8000 does just as well on your desk (as long as you have a hefty dc power supply handy). The display is large and easy to read. You can vary not only the display brightness, but also the *color* (amber or green). VOLUME and SQUELCH controls are separate. The tuning knob is sizeable and the speaker is forward firing. There is enough audio power to overcome most mobile noise environments. In fact, one of our reviewers characterized it as "deafening."

The HM-133V microphone that's packed with the V8000 is particularly nice. Nearly all front-panel operations can also be controlled using the mike keypad—even the squelch level. The 25 buttons on the keypad are translucent and backlit. The key size and spacing is generous. The microphone cable connects to the radio via an RJ45 connector. The mike cable connects to the mike itself with an RJ45 connector as well, making it easy to replace the cord. Extension microphone cables—16.4 and 8.2 feet long—are available as optional accessories. There are so many functions on the microphone, you could probably store the radio out of sight and use the microphone as the remote "front panel."

At about 6 × 2 × 6 inches, the V8000 is relatively compact. But don't let the size fool you—this transceiver is built like a tank. The V8000 has quite a bit of heft at nearly 3 pounds. In fact, its die-cast single-piece chassis reminded me of several commercial marine radios on the market.

Features

Repeater input/output offset frequencies are programmable in all of the 207 memory channels, or you can use the "auto repeater" function to let the V8000 set them automatically. Subaudible tones for repeater access can be programmed and stored in the same manner. The V8000 can even scan for subaudible tones and write them to memory. The V8000 also offers DTMF "TouchTone" transmission for autopatch and control functions. DTMF decoding is available as an option.

Speaking of tones and decoding, the IC-V8000 makes good use of both audible and subaudible tone decoding for its various tone squelch, pocket beep and paging functions. You can set the V8000 for complex group-calling schemes where, for example, your V8000 will spring to life only when it receives your code or the code of your group. Not many hams will use these functions in normal day-to-day operation, but they are excellent for public service applications.

There is one feature in the V8000 that I wish was standard equipment in every FM transceiver. It's called "Repeater Lockout" and its function is straightforward. When it is active, Repeater Lockout will not allow you to transmit while there is a signal present. Even if you become impatient on the push-to-talk button, the V8000 will not let you interfere. Think of it as a courtesy enforcer. Of course, you have to have the initial courtesy to turn the function on in the first place!

I've already mentioned the ample memory channels. The well-written V8000 manual devotes a number of pages to describing how to program them. In truth, the process is much easier than it appears. It follows the procedures that have become standard in most modern FM radios. I was able to program the V8000 memories without referring to the manual, although I did have to glance at the pages when I tried to *transfer* the memory contents. Programming the memory channel names (up to 6 alphanumeric characters per channel) also required a little time with the book. If you travel with your V8000, you'll be pleased to learn that the memories can be stored in up to 10 different "banks" of about 20 slots each. You could have one bank of settings for your hometown, another for the city where your buddy lives, and so on.

Toggling between the frequency and name display is easy—just a long press of the MON/ANM button. And the choice of showing the frequency or channel name display is independent for each memory position.

The memory channels store power output settings, which is very handy. Repeaters that are within easy range can be programmed in with low output power settings. Memory channels for repeaters that are on the fringe can be set up with the higher levels.

You can clone memory programming from another V8000, or from a personal computer. The rear-panel external speaker jack functions as a data port in this application. To program from your PC, however, you need an optional ICOM

Bottom Line

ICOM's IC-V8000 packs a substantial RF punch in a no-nonsense package.

Steve Ford, WB8IMY ◻ QST Editor

Table 1
ICOM IC-V8000, serial number 01825

Manufacturer's Claimed Specifications	*Measured in the ARRL Lab*
Frequency coverage: Receive, 136-174 MHz; transmit, 144-148 MHz.	Receive and transmit, as specified.
Power requirement: Receive, 1.0 A (maximum audio); transmit, 15 A (high power).	Receive, 0.8 A; transmit, 12 A. Tested at 13.8 V.
Modes of operation: FM.	As specified.
Receiver	***Receiver Dynamic Range***
FM sensitivity: 12 dB SINAD, 0.15 µV typical.	For 12 dB SINAD, 0.15 µV.
Weather band sensitivity,12-dB SINAD (tested at 162.400 MHz): Not specified.	0.14 µV.
FM adjacent channel rejection: Not specified.	20-kHz channel spacing: 74 dB.
FM two-tone, third-order IMD dynamic range: Not specified.	20-kHz channel spacing: 74 dB.* 10-MHz channel spacing: 87 dB.
FM two-tone, second-order IMD dynamic range: Not specified.	93 dB.
S-meter sensitivity: Not specified.	S9 indication: 1.8 µV.
Squelch sensitivity: 0.08 µV typical.	At threshold: 0.09 µV.
Receiver audio output: 2.0 W at 10% THD into 8 Ω.	2.4 W at 10% THD into 8 Ω.
Spurious and image rejection: 75 dB typical.	First IF rejection, 99 dB; image rejection, 93 dB.
Transmitter	***Transmitter Dynamic Testing***
Power output (H/M/ML/L): 75/25/10/5 W (approximately).	69 / 26 / 9.3 / 5.0 W.
Spurious-signal and harmonic suppression: ≥60 dB	64 dB. Meets FCC requirements for spectral purity.
Transmit-receive turnaround time (PTT release to 50% audio output): Not specified.	S9 signal, 168 ms.
Receive-transmit turnaround time (tx delay): Not specified.	130 ms.

Size (HWD): 2.0×5.9×5.9 inches; weight, 2.4 pounds.

*Note: Unless otherwise noted, all dynamic range measurements are taken at the ARRL Lab standard spacing of 20 kHz.

interface and software.

When it comes to scanning, the V8000 features the typical full scan (band edge to band edge), programmed scan and memory scan. You can opt to skip channels during a memory scan and adjust the scan-resume conditions for all three scan types. The V8000 receiver covers 136 to 174 MHz, so you can eavesdrop on more than just amateur activity.

Weather Alert

One of the most interesting features of the IC-V8000 is the "weather channel operation." When this feature is switched on, the V8000 will quickly scan through the NOAA Weather Radio channels every five seconds. The V8000 scans through 10 channels:

US—162.550, 162.400, 162.475, 162.425, 162.450, 162.500, 162.525 MHz

Canada—161.650, 161.775, 163.275 MHz

If it detects a weather alert tone, the V8000 gets your attention by sounding an alarm and flashing a display message. This is ideal for hams involved in SKYWARN and other severe-weather support activities.

You can test the weather channel alarm by switching on your V8000 each Wednesday between 10 AM and noon local time when the NOAA Weather Radio stations run their tests.

Power

As I stated at the beginning of this review, the V8000 offers more power than you are likely to need. The output is variable from 5 W to 75 W. We found the 5-W setting to be adequate most of the time, but when the going became rough, the 75-W punch made the difference. This is particularly true when you are operating at the fringe of a repeater coverage area, or when operating simplex.

We were pleasantly surprised at how cool the V8000 was when running high power. Even after a couple of hours of net operation, the case remained cool to the touch. That's thanks in large part to the sizeable fan on the rear panel. Our reviewers described the fan noise as "moderate." Fan operation is adjustable as part of the V8000 programming.

ICOM rates the 75 W output level as "approximate." The ARRL Lab measured 69 W with our V8000. In random tests ICOM reported output between 71 and 74 W. It's important to note that you must use a heavy dc power cord, preferably the one supplied by ICOM. This transceiver draws almost 15 A in high-power transmit, so an inadequate power cord may create resistive loss, resulting in lower voltage and lower output. However, it is highly unlikely that you or anyone else will notice a performance difference based on the lack of a few watts of RF.

Manufacturer: ICOM America, 2380 116th Ave NE, Bellevue, WA 98004; 425-454-8155, fax 425-454-1509; **amateur@icomamerica.com**; **www.icomamerica.com**. Manufacturer's suggested list price: $306.65. Typical current street price: $250. List prices of selected optional accessories: CS-V8000 *Windows 95/98/ME* programming software (on CD ROM), $35; OPC-478 cable for computer to transceiver programming, $45; OPC-474 cable for transceiver to transceiver cloning, $18; OPC-440 microphone extension cable (16.4 feet), $85; UT-108 DTMF decoder unit, $35.

QST Compares HF/VHF Wattmeters

By Steve Ford, WB8IMY

One of the most important pieces of test gear you'll ever own is your wattmeter. With a wattmeter you can measure the output of your transceiver and adjust it accordingly. A wattmeter can alert you to a problem with your antenna system by displaying the forward and reflected power at a particular point. With the forward and reflected power values, you (or the meter) can calculate the Standing Wave Ratio (SWR). You can even use a wattmeter to calculate feed line loss—just compare the power at the input of the feed line to the power at the output.

Many modern radios and antenna tuners include wattmeters, but these are tied to the equipment in which they are installed. In contrast, a stand-alone wattmeter can be used anywhere. This is convenient when you're trying to troubleshoot a problem—especially when you need to take a measurement at the feedpoint of an antenna, or in a mobile station.

Wattmeters differ in several ways. Some models display forward power, reflected power and SWR simultaneously. Some display only forward and reflected power, leaving it up to you to "ask" for the SWR by flipping a switch or twisting a calibration knob. Other wattmeters display *only* forward or reflected power—you have to jot down the measurements and calculate the SWR yourself.

Many wattmeters claim to be *peak reading*. That is, they can display power levels that are present at extremely brief periods of time. A good example is an SSB signal that can have a relatively low *average* power, but include numerous bursts of higher peak power that exist for only fractions of a second.

There are two types of peak-reading meters: *active* and *passive*. The active wattmeters sample peak power levels electronically and then amplify and display the results. These meters require an external dc power source. Passive models use unamplified meter-damping circuits for peak-power readings. As you might guess, active wattmeters provide the most accurate peak-power readings. In most instances you'll be concerned with *average* power readings, and passive meters often do an adequate job in this department.

The ARRL Laboratory tested the meters at 2, 14, 28, 50 and, for those meters with extended coverage, 144 MHz. Power accuracy tests were conducted at 5, 100 and 1000 W (for those meters rated at 1 kW) in key-down CW (100% duty cycle), 50% duty cycle CW (60 WPM keying), two-tone SSB (700 and 1900 Hz) and standard voice SSB. SWR accuracy testing was performed with resistive loads that created 1:1 and 2:1 SWRs.

The wattmeters chosen for this review are *not* laboratory-grade meters. Although we measured them against calibrated ARRL Lab equipment, it isn't fair to expect the same level of performance. If you require extreme accuracy, you have to pay for it, often to the tune of hundreds or even thousands of dollars. But for most Amateur Radio applications you can tolerate *reasonable* accuracy; you don't need to split hairs at tiny fractions of watts.

DIAMOND SX-200

The Diamond SX-200 uses vertically stacked scales and a single meter movement to measure power and SWR. The display is lighted, but you have to supply an external 12-V power source (Diamond includes the power cable, though). To operate the SX-200 you have to use the front-panel switches to jump between forward power, reflected power and SWR functions as necessary. The SX-200 is a passive peak-reading meter with a switch to select either average or peak-power modes. To measure SWR, you must first calibrate the SX-200 in the calibrate mode using the front-panel CALIBRATE control, then switch to the SWR mode. The SX-200 specifies a frequency range of 1.8 to 200 MHz and power scales of 5, 20 and 200 W. The minimum power required to obtain an SWR reading is 1 W. Primarily a desktop meter, the SX-200 measures 6 × 2 × 4 inches and weighs 2 pounds, making it one of the heftier meters of the bunch.

The SWR accuracy of the SX-200 was quite good in our Lab tests, but the forward power accuracy could have been better. From a user standpoint, we found the need to frequently change switch settings a little cumbersome. The meter is ruggedly built, however, with a sleek, attractive appearance.

Manufacturer: Diamond Antenna, 435 South Pacific St, San Marcos, CA 92069; tel 760-744-0900; **www.rfparts.com/diamond/**. $99.95.

DIAMOND SX-200
Frequency Range: 1.8-200 MHz
Power Range(s): 5/20/200 W
PEP Measurement: Passive†

Actual Forward Power (Average/Peak)

Frequency (MHz)	*2*	*14*	*28*	*50*	*144*
5 W CW*	6.0/6.0	6.0/6.0	5.8/5.8	5.2/5.2	4.5/4.5
5 W 50%	–/4.7	–/4.7	–/4.8	–/4.3	–/3.5
100 W CW	130/130	125/125	125/125	120/120	100/100
100 W 50%	–/130	–/120	–/125	–/100	–/90
100 W Two-Tone	–/100	–/90	–/100	–/95	–/85
100 W Voice	–/110	–/90	–/90	–/80	–/80
SWR Accuracy					
1:1 SWR	1:1	1:1	1.1:1	1.1:1	1.1:1
2:1 SWR	2:1	2:1	2:1	1.9:1	2:1
Insertion Loss	–	<0.1 dB	–	<0.1 dB	<0.1 dB

Notes
†For PEP monitoring, "Active" indicates that a circuit requiring external power is used. "Passive" indicates a circuit that requires only RF.
*Used 20-W scale for 5-W tests.

DIAMOND SX-20C

The SX-20C is a compact meter ($3^{5}/_{16} \times 3^{5}/_{16} \times 3^{3}/_{4}$ inches) designed to be as "hands off" as possible. The SX-20C is intended for mobile use, but it works just as well in the shack or just about anywhere else. This passive meter uses two meter movements that sweep across each other (the so-called "cross needle meter" design). When you apply RF, the SX-20C displays forward and reflected power simultaneously. Beneath the arcing forward and reflected power scales there is an SWR nomograph. Just watch where the needles cross and that's your SWR. The SX-20C has two power settings that are selected with a front-panel pushbutton: 30 and 300 W (average reading only). The minimum power necessary for a reading is 5 W. The SX-20C is rated for operation over three frequency ranges: 3.5-30 MHz, 50-54 MHz and 130-150 MHz.

The SX-20C seems not to be as ruggedly built as the Diamond SX-200. In performance, however, the SX-20C turned in impressive results with good forward power and SWR accuracy.

Manufacturer: Diamond Antenna, 435 South Pacific St, San Marcos, CA 92069; tel 760-744-0900; **www.rfparts.com/diamond/**. $89.95.

PALSTAR WM150

The WM150 is the only active peak-reading wattmeter in the group. The WM150 is also one of the few meters in this review to boast the ability to measure up to 3 kW. The WM150 display uses the cross-needle approach that allows forward power, reflected power and SWR to be measured at the same time. There are two pushbutton-selectable power ranges: 300 W and 3 kW. Another pushbutton selects average or peak power displays. The frequency range of the WM150 is 1.8 to 150 MHz.

The WM150 is a durable instrument housed in a $4^{1}/_{2} \times 3^{1}/_{4} \times 3^{1}/_{4}$-inch aluminum case. The display is illuminated and, unlike many wattmeters in this price range, the WM150 package includes a 12-V dc "wall wart" supply to power the lamp and the active circuits.

The WM150 provided reasonably accurate forward measurements on HF, but seemed to suffer on VHF. The same was true for SWR accuracy. Although the

DIAMOND SX-20C
Frequency Range: 3.5-150 MHz
Power Range(s): 30/300 W
PEP Measurement: None

Actual Forward Power (Average only)

Frequency (MHz)	*2*	*14*	*28*	*50*	*144*
5 W CW	–	4.9	5.0	4.8	4.8
100 W CW	–	100	100	97	98
SWR Accuracy					
1:1 SWR	–	1:1	1:1	1.1:1	1.1:1
2:1 SWR	–	2.2:1	2:1	2:1	2:1
Insertion Loss	–	<0.1 dB	–	<0.1 dB	<0.1 dB

PALSTAR WM150

Frequency Range: 1.8-150 MHz
Power Range(s): 300/3000 W
PEP Measurement: Active†

Actual Forward Power (Average/Peak)

Frequency (MHz)	*2*	*14*	*28*	*50*	*144*
5 W CW	8/–	7/–	7/–	6/–	110/90*
100 W CW	103/105	103/102	102/101	103/102	110/90
100 W 50%	–/102	–/102	–/102	–/102	–/70
100 W Two-Tone	–/100	–/102	–/100	–/100	–/90
100 W Voice	–/100	–/98	–/100	–/100	–/90
1 kW CW	900/1250	950/1260	900/1250	–/–‡	–/–‡
1 kW 50%	–/1250	–/1250	–/1250	–/–	–/–
1 kW Two-Tone	–/1250	–/1250	–/1250	–/–	–/–
1 kW Voice	–/1250	–/1250	–/1250	–/–	–/–
SWR Accuracy					
1:1 SWR	1:1	1:1	1:1	1.2:1	2.5:1
2:1 SWR	2:1	2:1	1.7:1	1.4:1	–
Insertion Loss	–	<0.1 dB	–	<0.1 dB	<0.1 dB

Notes
*Input SWR at 100 W on 144 MHz was 1.7:1 (2.5:1 indicated on meter), possibly affecting accuracy.
**Peak detector circuit in this unit requires more than 5 W for proper operation.
†For PEP monitoring, "Active" indicates that a circuit requiring external power is used. "Passive" indicates a circuit that requires only RF.
‡Amplifiers for 6 meters or 2 meters were not available at the time of testing.

DAIWA CN-101L

Frequency Range: 1.8-150 MHz
Power Range(s): 15/150/1500 W
PEP Measurement: Passive†

Actual Forward Power (Average/Peak)*

Frequency (MHz)	*2*	*14*	*28*	*50*	*144*
5 W CW	4.6/4.6	5/5	5/5	4.2/4.2	4.8/4.8
5 W 50%	–/2.2	–/2.5	–/2.3	–/2.1	–/2.2
100 W CW	90/90	95/95	93/93	88/88	100/100
100 W 50%	–/63	–/68	–/65	–/62	–/70
100 W Two-Tone	–/55	–/52	–/60	–/55	–/70
100 W Voice	–/30	–/30	–/30	–/25	–/30
1 kW CW	1050/1050	1100/100	1050/1050	–/–‡	–/–‡
1 kW 50%	–/900	–/1070	–/900	–/–	–/–
1 kW Two-Tone	–/750	–/800	–/720	–/–	–/–
1 kW Voice	–/900	–/800	–/900	–/–	–/–
SWR Accuracy					
1:1 SWR	1:1	1:1	1:1	1:1	1:1
2:1 SWR	2.2:1	2.3:1	2.3:1	2.2:1	1.6:1
Insertion Loss	–	<0.1 dB	–	<0.1 dB	0.1 dB

Notes
*According to the CN-101L manual, "For monitoring PEP, a condensor is placed into detector circuit. This function can not hold peak envelope power."
†For PEP monitoring, "Active" indicates that a circuit requiring external power is used. "Passive" indicates a circuit that requires only RF.
‡Amplifiers for 6 meters or 2 meters were not available at the time of testing.

WM150 is specified to function at VHF, Palstar states that the meter is not specifically designed for accuracy above 50 MHz.

Manufacturer: Palstar Inc, 9676 N Looney Rd, PO Box 1136, Piqua, OH 45356; 937-773-6255; **www.palstarinc.com/**. $89.95.

DAIWA CN-101L

Daiwa Industry Company pioneered the cross-needle meter design more than 20 years ago, and it has been showing up in their wattmeters ever since. The CN-101L is a desktop meter with three switch selectable power levels: 15, 150 and 1500 W. The frequency range is 1.8 to 150 MHz. You can toggle between average and peak power (passive) readings.

The cross-needle meters provide simultaneously forward power, reflected power and SWR displays, which is extremely convenient. No calibration or other adjustments are necessary. The meter face is backlighted and a power cable is included.

The enclosure is quite attractive with a large, easy-to-read meter. The front panel switches, however, lacked a solid feel. We found the CN-101L to be accurate on average power, but unacceptably inaccurate when attempting to measure peak envelope power (PEP). The CN-101L isn't well designed for peak power measurement, and the manual says as much (see the note in the data table).

Manufacturer: Daiwa Industry Company, 60 9th Floor, TOC Building, 22-17-7 chome, Nishi-Gotanda Shinagawa-ku, Tokyo, Japan. Available from several US dealers. Typical street price $94.75.

DAIWA CN-410M

The CN-410M is a compact wattmeter that also features Daiwa's famous cross-needle design. Being able to read power and SWR at a glance is a boon to portable and mobile operators—and it is a pleasant experience in the shack as well. The CN-410M is designed for operation from 3.5 to 150 MHz at pushbutton-selectable 15- or 150-W power levels (peak or average). The CN-410M comes with a mobile mounting bracket. According to its specifications, the CN-410M can provide readings with as little as 3 W, but this aspect of its performance was not tested.

It is important to point out that the CN-410M has been discontinued. However, this meter is still quite popular at hamfest fleamarkets and on-line auctions.

The CN-410M held its own on HF, but we noticed that its accuracy declined at the high end of its range. Also, on 2 meters, the CN-410M presented an SWR of 2:1, a significant figure at this frequency.

DAIWA CN-410M
Frequency Range: 3.5-150 MHz
Power Range(s): 15/150 W
PEP Measurement: None

Actual Forward Power (Average only)

Frequency (MHz)	*2*	*14*	*28*	*50*	*144*
5 W CW	–	5.2	5.0	4.3	4.6
100 W CW	–	110	105	90	*
SWR Accuracy					
1:1 SWR	–	1:1	1:1	1:1	1.2:1
2:1 SWR	–	2:1	2:1	2:1	2.7:1
Insertion Loss	–	<0.1 dB	–	0.1 dB	–

Note
*SWR on input was 2:1 at 100 W on 144 MHz, so test was not performed.

MFJ ENTERPRISES MFJ-860
Frequency Range: 1.8-54 MHz
Power Range(s): 30/300 W
PEP Measurement: None

Actual Forward Power (Average/Peak)

Frequency (MHz)	*2*	*14*	*28*	*50*
5 W CW	4.6	4.6	4.8	4.3
100 W CW	110	110	115	110
SWR Accuracy				
1:1 SWR	1:1	1:1	1:1	1.3:1
2:1 SWR	2:1	2:1	2:1	2.2:1
Insertion Loss	–	<0.1 dB	–	<0.1 dB

Manufacturer: Daiwa Industry Company, 60 9th Floor, TOC Building, 22-17-7 chome, Nishi-Gotanda Shinagawa-ku, Tokyo, Japan. Available from several US dealers. Typical street price $98.75.

VECTRONICS PM-30

The PM-30 is the second wattmeter in the group to include the ability to measure up to 3 kW output. With its large cross-needle display, the PM-30 can simultaneously measure forward power, reflected power and SWR. The power is selected by pushbutton in two ranges: 300 and 3000 W with average or peak power display (selectable). The frequency range is 1.8 to 60 MHz. The meter can be backlighted if you connect an external 12-V dc source. You can turn the backlighting on or off from the front panel.

VECTRONICS PM-30
Frequency Range: 1.8-60 MHz
Power Range(s): 300/3000 W
PEP Measurement: Passive†

Actual Forward Power (Average/Peak)

Frequency (MHz)	*2*	*14*	*28*	*50*
5 W CW	8/8	8/7	8/8	7/8
100 W CW	125/125	125/125	130/130	125/120
100 W 50%	–/120	–/120	–/125	–/115
100 W Two-Tone	–/92	–/90	–/100	–/100
100 W Voice	–/80	–/85	–/90	–/80
1 kW CW	1000/1000	920/900	920/900	–/–‡
1 kW 50%	–/900	–/900	–/900	–/–
1 kW Two-Tone	–/800	–/800	–/750	–/–
1 kW Voice	–/900	–/800	–/1000	–/–
SWR Accuracy				
1:1 SWR	1.2:1	1:1	1.1:1	1.3:1
2:1 SWR	1.7:1	1.7:1	1.5:1	1.5:1
Insertion Loss	–	<0.1 dB	–	<0.1 dB

Notes
†For PEP monitoring, "Active" indicates that a circuit requiring external power is used. "Passive" indicates a circuit that requires only RF.
‡Amplifiers for 6 meters or 2 meters were not available at the time of testing.

The PM-30's construction is sturdy and at 5 × 3½ × 5 inches it is the largest meter tested for this review. A Lexan face protects the meter movements.

The PM-30's forward power accuracy varied considerably according to the power level and frequency. SWR accuracy was fair.

Manufacturer: Vectronics, 300 Industrial Park Rd, Starkville, MS 39759; 800-363-2922; **www.vectronics.com/**. $79.95.

MFJ ENTERPRISES MFJ-860

The MFJ-860 is the least expensive wattmeter in this group. At about 4½ × 3½ × 2½ inches, it is also among the smallest. It sports the convenient cross-needle meters for instant SWR and power readings. In fact, the only switch on the meter is a pushbutton to select one of two power ranges: 30 and 300 W. The MFJ-860 is average-reading only. The frequency range is 1.8 to 60 MHz.

Despite the lower cost, the MFJ-864 was surprisingly accurate. Its insertion loss was also acceptable and well within specifications. The only criticism was related to the small size of the meter display itself. It can be difficult to read under some lighting conditions.

Manufacturer: MFJ Enterprises, PO Box 494, Starkville, MS 39759; 800-674-1800; **www.mfjenterprises.com/**. $44.95. QST