



## Product Review and Short Takes from QST Magazine

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### Product Reviews:

Yaesu FT-60R Dual-band Handheld Transceiver

International Radio Roofing Filters for Yaesu FT-1000MP Series Transceivers

West Mountain Radio PWRgate and Computerized Battery Analyzer

### Short Takes:

Heil Classic and Heritage Microphones

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## PRODUCT REVIEW

# Yaesu FT-60R Dual-band Handheld Transceiver

Reviewed by Dan Henderson, N1ND  
Contest Branch Manager

Ready to replace the old handheld transceiver with one of the dual-band models? If so you'll want to check out the latest offering from Vertex Standard, the Yaesu FT-60R. This lightweight (13 ounce) transceiver packs good "bang for the buck" with many extra features that will appeal to most Amateur Radio operators.

The Yaesu FT-60R claims a 5 W punch on the 144 and 430 MHz amateur bands, though the model tested at ARRL fell a bit short on 430 MHz. (The ARRL Lab measurement was 4.3 W on that band measured both on batteries and with an external dc supply. Yaesu indicates that this just requires a simple dealer adjustment and is not typical.) With three nominal power levels (5, 2 and 0.5 W) the amateur providing communications for a public service event or emergency response should be able to use this radio for a normal operating shift and be able to get the message through.

I find the smaller readouts on some radios a bit hard to read. I was pleasantly surprised that the FT-60R provided a clear and concise display on the radio, and an easy to read and follow operating manual. This made programming relatively simple. As with so many of today's products, the wide array of programmable options included with the radio requires you to refer to the manual for general set-up. This manual was very user friendly, with simple step-by-step instructions for each process.

### Making it Play

Since the whole purpose of a radio is to use it, I am a firm believer in being able to get on the air with the product as easily as possible. The FT-60R did not disappoint in this area. The ON/OFF/VOLUME knob is the smaller of the two knobs on top of the radio. Once a charged battery back is attached to the rig and an antenna is attached, you simply turn the knob clockwise and you are set to receive.

The larger knob on the top allows you to adjust the frequency up and down. The squelch adjustment is a ring knob at the bottom of the larger knob. I found this to be preferable to several comparable radios that have the squelch adjustment as a digital control, making it necessary to program in the squelch level.

Now that the radio is on, there are several ways to select a frequency. For the beginner, you may simply use the keypad on the front panel and punch in the desired frequency. If your choice is a common repeater output frequency, say 145.45 MHz simply key in 145450 and the FT-60R will automatically select the appropriate repeater offset for the frequency selected. The same is true for standard repeater splits on the 430 MHz band. Don't fret—the FT-60R will also automatically set itself to simplex when a standard simplex frequency is selected. Once the frequency is selected (and unless there is tone access required for your selected repeater), you are ready to get on the air.

After the initial set-up you will quickly learn that the F/W key, which is key D—the very last key on the keypad, will allow access to the secondary functions for the rest of the keypad. Once the secondary function is selected, the large knob on the top (used to change the frequency in its primary mode) allows you to select the desired variable for the selected secondary function. Remembering this combination makes programming the secondary functions easy.

For example, if you wish to operate the radio on a 146.91 MHz repeater that uses a 91.5 Hz CTCSS tone—first key in the frequency. The radio will go to that frequency and show the standard offset (–600 kHz). Now, to set the access tone,

### Bottom Line

This new dual-band handheld transceiver offers a lot in a rugged, compact, easy to use package.



press the F/W key, then press the 1 button (indicating that you are selecting the continuous tone-controlled squelch system (CTCSS) or digitally coded squelch (DCS) function). The main display will change to show which type is currently in memory or OFF, as the case may be. Simply turn the large knob on top until the display shows TONE, then press the F/W button again, and you will have turned on the CTCSS function. Now to choose the proper CTCSS tone, press the F/W button again, then press the 2 button. You can then turn the selection knob on top until you find the proper CTCSS tone. A final push of the F/W button once the display reads 91.5 and the FT-60R will be ready to transmit the CTCSS tone of 91.5 when transmitting on the frequency selected. It sounds more complicated than it is, but with the well written operating manual as your guide you will quickly be able to use the wide variety of features provided.

Once you begin using any handheld transceiver the variety of extra features—the *bells and whistles*—distinguish one model from its competition. The FT-60R offers an attractive package of extras that will appeal to a wide range of interests. I especially enjoyed the broad coverage receiver capability of the radio. It is capable of receiving the 108-137 MHz aircraft band, both in AM and FM. It then continues its coverage to 137 to 520 MHz, and 700 to 999.990 MHz, FM only, less the cellular frequencies.

### Memories to Burn

Your desired receiving frequencies can readily be programmed into the large

**Table 1****Yaesu FT-60R, Serial Number 4K050350**

<b>Manufacturer's Specifications</b>	<b>Measured in the ARRL Lab</b>
Frequency coverage: Receive, 108-137 MHz (AM), 137-520 MHz (AM/FM), 700-999 MHz (cell blocked); transmit, 144-148, 430-450 MHz.	Receive and transmit, as specified.
Power requirements: 6.0-16.0 V dc <sup>1</sup> ; receive, 0.13 A; transmit, 1.6 A max, high power.	Receive, 0.17 A (max volume, no signal); Transmit, 1.7 A. Tested at 7.2 V.
<b>Receiver</b>	<b>Receiver Dynamic Testing</b>
Sensitivity: AM, 10 dB S/N, 108-137; 0.8 $\mu$ V; FM, 12 dB SINAD, 140-150 MHz, 0.2 $\mu$ V; 174-300 MHz, 400-470 MHz, 800-900 MHz, 0.5 $\mu$ V; 900-999 MHz, 0.8 $\mu$ V.	AM, 10 dB S+N/N, 120 MHz, 0.56 $\mu$ V; FM, 12 dB SINAD, 144 MHz, 0.13 $\mu$ V; 222 MHz, 0.16 $\mu$ V; 430 MHz, 0.16 $\mu$ V; 902 MHz; 0.5 $\mu$ V.
Two-tone, third-order IMD dynamic range: Not specified.	20 kHz offset from 146 MHz, 67 dB;* 10 MHz offset from 146 MHz, 85 dB; 20 kHz offset from 222 MHz, 65 dB;* 20 kHz offset from 440 MHz, 58 dB;* 10 MHz offset from 440 MHz, 83 dB; 20 kHz offset from 902 MHz, 55 dB.*
Two-tone, second-order IMD dynamic range: Not specified.	80 dB.
Adjacent-channel rejection: Not specified.	20 kHz offset from 146 MHz, 67 dB; 20 kHz offset from 222 MHz, 65 dB; 20 kHz offset from 440 MHz, 58 dB; 20 kHz offset from 902 MHz, 55 dB.
Spurious response: Not specified.	IF rejection, 146 MHz, 92 dB; 222 MHz, 115 dB; 440 MHz, 142 dB; 902 MHz, 128 dB. Image rejection, 146 MHz, 79 dB; 222 MHz, 68 dB; 440 MHz, 68 dB; 902 MHz, 4 dB.
Squelch sensitivity: Not specified.	At threshold, 146 MHz, 0.06 $\mu$ V; 440 MHz, 0.11 $\mu$ V.
Audio output: 400 mW at 10% THD into 8 $\Omega$ (7.2 V dc).	720 mW at 10% THD into 8 $\Omega$ (battery); 810 mW at 10% THD into 8 $\Omega$ (dc <sup>1</sup> ).
<b>Transmitter</b>	<b>Transmitter Dynamic Testing</b>
Power output: 5.0 W high, 2.0 W mid, 0.5 W low.	146 MHz, 5.1 / 2.0 / 0.5 W; 440 MHz, 4.3 / 1.6 / 0.4 W.
Spurious signal and harmonic suppression: 60 dB for high and mid, 40 dB for low.	VHF, 62 dB; UHF, 72 dB. Meets FCC requirements.
Transmit-receive turnaround time (PTT release to 50% of full audio output): Not specified.	Squelch on, S9 signal, VHF, 180 ms; UHF, 170 ms.
Receive-transmit turnaround time ("tx delay"): Not specified.	VHF, 80 ms; UHF, 77 ms.
Size (height, width, depth): 4.3"x2.3"x1.2", weight: 13.1 ounces.	
Note: Unless otherwise noted, all dynamic range measurements are taken at the ARRL Lab standard spacing of 20 kHz.	
*Measurement was noise limited at the value indicated.	
<sup>1</sup> External dc: battery is 7.2 V.	



Figure 1—Although it is thicker than some low-power units, the FT-60R is still easy to handle.

if during your travels you use two repeaters on the same frequency pair, but with different CTCSS codes, with alphanumeric labels you don't have to guess which is which. The FT-60R includes a wide range of scanning functions that make this expanded memory useful, including priority channel alert and weather alert scanning.

### Additional Features

Many amateurs today want to be available on the radio when friends call, but don't wish to be disturbed by communications not intended for their station. By using an enhanced paging and code squelch system (EPCS), the FT-60R can be utilized as a pager. Simply put, you can set your receiver to only open when a specific CTCSS tone is received on the frequency being monitored. This allows friends to "give you a call" by activating your radio. The FT-60R automatically disables the EPCS after it has received the incoming page, which lets you know someone tried to contact you if you were away from the radio at the time.

The FT-60R includes two interesting emergency features. One allows you to press a single button for several seconds to activate an emergency alert on the primary UHF channel. Someone needs to be monitoring the channel at another location. This feature could be useful for families of licensed amateurs to know to get help quickly. Second is an emergency automatic ID system that allows you to locate someone with an FT-60R who might be down or incapacitated, trapped in a disaster, or lost in a search-and-rescue situation. Both have the potential to be very useful in specific situations.

The FT-60R is also equipped to take advantage of a repeater system or home base that is tied into the Vertex Standard

available channel memory. And you won't have to worry about available memory for storage, as the FT-60R has more than enough memory channels to handle your selections. You begin with up to five "home" channels that allow you to store and quickly recall a primary frequency on each band. In addition there are memory slots for the 10 weather broadcast channels and up to 50 sets of programmable memory channels

for scanning. Top the count with 1000 (yes, one thousand) standard memory channels, and there should be more than enough for any application.

These channels have the capability to store not only the frequencies, but also the various CTCSS or DCS codes, unique offset, or other information desired to utilize them. The inclusion of alphanumeric labeling for the channels makes for easier operation and recall. For example,

Wide-Coverage Internet Repeater Enhanced System (WIRES). Also new to me with this radio was its automatic range transponder system (ARTS), a system that allows you and another ARTS-equipped station to determine if you are within range for radio communications. Again, I could see this feature being useful for groups on an outdoor outing and the like, but it is one of the bells and whistles that I would probably not be inclined to utilize. The FT-60R has all the required pieces to allow repeater autopatch use, something that we have come to expect.

One interesting feature that some may be inclined to use is the ability to use a password system to secure your radio. You may set up a four digit (numbers and letters are available) password that would be required to activate your radio. For those with curious children around

the house who want to get on the radio just like their parent, this would be a good feature to stop unauthorized transmissions.

The FT-60R offers two user-definable keys on the front panel. By following the detailed instructions in the manual, a user is capable of adding certain features (such as specific memory recall) to the basic operation of the radio simply at the press of a button.

One last available feature, which I did not have the ability to test (optional software and a cable is required), was programming software. This option allows you to use your PC to set up the



**Figure 2—The supplied antenna is much larger than the radio.**

memory channels then import the data file to the radio, eliminating the need to punch in the options manually for each channel. This timesaver could be a real plus considering the number of memory locations provided.

### And the Verdict Is...

Overall, I found the FT-60R durable and straightforward to operate. It performed well in on-the-air testing. Comments from other operators praised its transmit audio quality. I found that it offered a wide range of features for a moderately priced radio—this is one that I would consider adding to my shack, even though I might not need all the features it offers.

*Manufacturer:* Vertex Standard, 10900 Walker St, Cypress, CA 90630; tel 714-827-7600; [www.vxstdusa.com](http://www.vxstdusa.com). Price: FT-60R, \$199.99; ADMS1J, programming software, \$38.99; CT27, cloning cable, \$11.99.

## International Radio Roofing Filters for Yaesu FT-1000MP Series Transceivers

Joel R. Hallas, W1ZR  
Assistant Technical Editor

It is not an exaggeration to say that today's top ranked Amateur Radio transceivers have receivers that are far better in most respects than those of earlier generations. Fortunately for us (perhaps unfortunately for manufacturers) every advance in technology results in the raising of the bar for some parameter or other. In the very early days, there was a quest to be the most sensitive. The sensitivity goal was followed by a desire for optimum selectivity. Then came image rejection, linear and consistent tuning rate, reduction in front-end overload and on and on it went. Each advance seemed to highlight the next parameter that needed attention.

Today a remaining Achilles' heel of our highly refined receivers seems to be *near-in third order intermodulation distortion* (3OIMD). All mixers have products beyond the usual signal frequency  $\pm$  the local oscillator. Generally other products are reduced significantly, but if the signals are very strong the undesired products can be heard. A particularly troublesome response is from the combination of signals at one frequency and

twice another frequency, referred to as the third order ( $K \times f_1 \times f_2^2$ ) response. The 3OIMD response of your receiver can generate an interfering signal(s) right on top of the one you are listening to from two (or more) signals outside your listening passband.

This parameter has been discussed a number of times in the past in *QST* and elsewhere.<sup>1</sup> This phenomenon manifests itself while you are trying to copy a weak signal on frequency  $f_1$ , and there are strong signals at  $f_1$  plus a small increment and another at  $f_1$  plus twice the same increment.<sup>2</sup>

This effect can be verified by switch-

<sup>1</sup>D. Potter, W2GZD (now W4RPI), "Intermodulation Reviewed," *QST*, May 1983, pp 17-18.

ing in your attenuator, or turning off your receiver preamp. The 3OIMD response will be reduced three times as fast as the desired signal and often the 3OIMD signal(s) will disappear. Unfortunately, by reducing the receiver gain, you are also reducing the desired weak signal. Even though it is not reduced by as much as is the 3OIMD response, it may become difficult copy.

Fortunately, many casual operators don't notice this effect since there usually aren't as many really strong signals all over the band much of the time. The real problem shows up during contests when signals may be every 0.5 kHz (for CW) or every 2 kHz (for SSB contests) over the whole band. During DX pile-ups, the same situation may occur. The signals tend to be clustered more tightly, but the often weak DX station will request calls up 2 or 5 kHz, setting the stage for 3OIMD just when you're trying to figure out which station he's calling.

It's worth noting that while we test in the Lab with two signals for each mea-

<sup>2</sup>For example, if you are trying to listen at 14,020 kHz and there are strong signals at 14,023 and 14,026 kHz.

### Bottom Line

A transceiver popular with the contest and DX communities can be brought up to date at reasonable cost using InRad roofing filters.

## Table 2 Comparison of Two FT-1000MP Series Transceivers With and Without International Radio Roofing Filter Modification

### Yaesu Mark V FT-1000MP, serial number 0K120017

Data taken on 20 meters with pre-amp off

Parameter	Unmodified	Modified
Noise Floor	-123 dBm	-130 dBm
Audio/IF Bandwidth	600 Hz	470 Hz
Blocking Dynamic Range, 20 kHz	130 dB	146 dB*
5 kHz	105 dB	130 dB*
2 kHz	102 dB	105 dB
1 kHz	104 dB <sup>1</sup>	106 dB <sup>1</sup>
IMD Dynamic Range, 20 kHz	88 dB	93 dB
5 kHz	76 dB	89 dB*
2 kHz	69 dB	79 dB*
1 kHz	68 dB	69 dB*

\*Measurement was noise limited at the value indicated.

<sup>1</sup>Some filter blow-by was noted on this measurement.

### Yaesu FT-1000MP, serial number 7J21036

Data taken on 20 meters with pre-amp off

Parameter	Unmodified	Modified
Noise Floor	-123 dBm	-126 dBm
Audio/IF Bandwidth	600 Hz	470 Hz
Blocking Dynamic Range, 20 kHz	138 dB	141 dB
5 kHz	111 dB	128 dB
2 kHz	106 dB	108 dB
1 kHz	102 dB*	103 dB
IMD Dynamic Range, 20 kHz	94 dB	100 dB
5 kHz	76 dB	90 dB*
2 kHz	69 dB	71 dB
1 kHz	68 dB*	68 dB*

\*Measurement was noise limited at the value indicated.

surement point (5 and 10 kHz, for the 5 kHz spacing, for example), in real life we get a spurious signal from every such pair. Thus we will get a 3OIMD response from 5 and 10 kHz off frequency signals, but also from 3.3 and 6.6 kHz and -4 and -8 kHz and 2 and 4 and 8 kHz, etc. This is why we usually don't just hear 3OIMD as a single signal—it just sounds like junk.

### So What Can We Do About 3OIMD?

The key to fighting 3OIMD is to keep the interfering signals out of the stage that

is generating the problem response. The optimum way to do this is to filter right at the antenna. This can be effective, but is really only feasible if you only operate on a single or small number of frequencies. The most frequently used approach these days is to design an RF stage (if needed at all) and first mixer that can handle the large signals with minimum distortion, and follow immediately with a *roofing filter*. The roofing filter need only be as wide as the widest bandwidth of signals you wish to process further downstream in the receiver—but

that's the rub. Many receivers are designed to do everything—CW, SSB, AM and FM and thus settle on a roofing filter that is 15 to 20 kHz wide. The problem is that if you're a contester you end up with all those signals  $\pm 7.5$  to 10 kHz away. In addition, the filter skirts may not be steep, so you may get signals even further removed. Note that IMD from signals spaced at 20 and 40 kHz (the 20 kHz IMD data in *QST* Product Reviews<sup>3</sup>) comes out looking good with this filter, but not so for signals at 5 and 10 kHz (the recently added 5 kHz IMD reports).

The best of the newest transceivers solve this problem by having selectable roofing filters to allow an optimum choice for each mode. The Ten-Tec Orion is notable in having optional roofing filters as tight as 0.25 kHz bandwidth. The ICOM IC-7800 has two (15 kHz and 6 kHz) and the soon to be released Yaesu FTDX-9000 promises three (15, 6 and 3 kHz). Single conversion receivers, such as the Elecraft K2, can set both the roofing and selectivity with a single filter following the mixer.

The Ten-Tec Orion (main receiver) and Elecraft K2 are ham band only designs and thus have their first IF and roofing filters in the HF region. The ICOM and Yaesu transceivers include general coverage receivers with an upconverting architecture to a first IF in the VHF region. Narrow bandwidth steep skirted crystal filters in the HF region are much easier to make than those for the VHF region and only recently have filters as tight as those by International Radio been available.

Note that the roofing filters are generally wider than the selectivity setting filter (except for single conversion designs such as the K2). Thus, neither of the in-

<sup>3</sup>M. Tracy, "QST Product Reviews—In Depth, In English," *QST*, Aug 2004, pp 32-36.

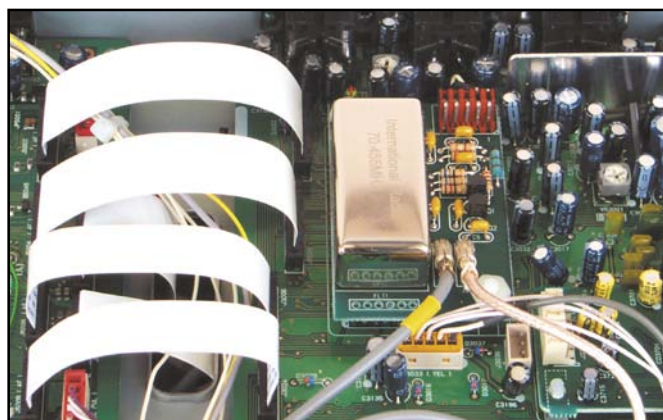


Figure 3—The International Radio roofing filter.



Figure 4—The roofing filter installed in a Mark V FT-1000MP.

terfering signals may be audible at all, until the second one shows up and the 3OIMD signal appears *within* the listening bandwidth.

## Enter International Radio

International Radio (InRad) has been providing high quality selectivity setting filters for years, and has now responded to the need for roofing filters as well. They have designed a (almost) plug and play roofing filter for the Yaesu FT-1000MP series transceivers with a bandwidth of 4 kHz instead of the stock 12 kHz unit. The InRad filter has steeper skirts as well. Note that this bandwidth will start to improve intermod problems resulting from signals farther apart than a 1 kHz spacing (+2 in Table 2), and that is what we observed. Note that the downside is that this receiver will be sharp (barely communications quality) for AM reception and useless for FM. Fortunately, the MP series radios have a second receiver that can be used for these modes. Most serious contesters and DXers will be happy to make that trade.

## Hooking it Up and Checking it Out

ARRL Lab Engineer Michael Tracy, KC1SX, has installed and tested a roofing filter in two versions of the FT-1000MP series so far—a Mark V FT-1000MP and an early FT-1000MP. The first of these versions require that two small wires be soldered to existing pads on a PC board to provide pins for attachment. Other versions have the pins already in place and the filter can drop in. The filter module includes an amplifier to compensate for the filter insertion loss. Figure 3 shows a close-up of the filter board, while Figure 4 shows how it fits under the chassis (top, center) of the Mark V.

Before and after lab testing for both

radios is shown in Table 2 and the improvement is notable. Note that the filter also improves a related parameter—*blocking dynamic range*. BDR is a measure of how much stronger than the noise floor an off-frequency signal needs to be to reduce the gain of the receiver by 1 dB. Generally, this is less of a problem than 3OIMD, but can still be troublesome since it only requires a single out of band signal. A strong CW signal that you can't hear can result in the receiver gain going up and down, for example. While this is not great, it's usually not as bad as having a 3OIMD signal right on top of the one you're trying to copy.

## How The Roofing Filter Sounds (or *Doesn't* Sound) on the Air

Tom Frenaye, K1KI

Director, ARRL New England Division

During the K1KI multioperator-single transmitter effort in the October CQWW SSB Contest, we used one FT-1000MP without and one Mark V FT-1000MP with the International Radio roofing filter. They were used on several bands during the weekend. For the single operator November ARRL Sweepstakes CW contest an FT-1000MP with the roofing filter was used as the main radio, and one without the roofing filter was used as a second radio.

In trying to figure out what could be said about the radio's performance with the roofing filter, what stands out is what *doesn't* happen. In the past when there were very loud signals (S9+20 dB or so) on the band, we'd often hear extra IMD products on our frequency, even if the loud signals were 10 to 20 kHz away. With the roofing filter installed, we just don't hear them at all, unless they are very close in frequency. Listening to other stations on CW or SSB is less stressful without the extra noises!

When looking for a clear spot on 40 meter SSB, the radio with the roofing filter is able to find more "holes" between the S9+40 dB international broadcast stations, and able to copy other stations that would not have been heard in the past.

After the first Ten-Tec Orions hit the bands in late 2003, there were several times when good friends with new Orions seemed to start up too close to our frequency. It turned out they couldn't even hear us. It became clear that the performance of that radio was superior to the FT-1000MPs used here. With the International Radio roofing filter, the situation seems to be back to even again in the never-ending goal to keep up with the competition!

We have no clear answer for why the results differ between the two radios tested. It should be clear that the better the original filter is, the less improvement there will be. It is also possible that the radio with the least improvement (an earlier version) was generating some level of 3OIMD response in the mixer ahead of the filter. In any case, the filters resulted in notable improvement in both cases. The sidebar relates to the radio with the least difference.

*Manufacturer:* International Radio, 13620 Tyee Rd, Umpqua, OR 97486; tel 541-459-5623; fax 541-459-5632; [www.qth.com/inrad/](http://www.qth.com/inrad/). Price: \$165.

# West Mountain Radio PWRgate and Computerized Battery Analyzer

Reviewed by Larry Wolfgang, WR1B  
Senior Assistant Technical Editor

A friend recently gave me a 12 V, 100 ampere hour (Ah) gelled electrolyte battery that had been pulled from service in a bank of emergency power backup batteries. The commercial communications service my friend works for replaces the entire bank of batteries if one of the batteries drops below about 80% capacity. My

main reason for having the battery is to have a power source to run some radio equipment so I can demonstrate ham radio when I go camping with Boy Scout groups.

I needed a convenient way to keep the battery charged and ready to go for weekend campouts. I contemplated various additional pieces of equipment that I might need to safely keep the battery charged and also be able to connect my

station equipment to exercise the battery occasionally. I have used a small portable solar panel and a Micro M + charge controller<sup>4</sup> to recharge the battery after sum-

<sup>4</sup>The ARRL Handbook for Radio Communication, 2005 edition, pp 17.41-17.44. Available from the ARRL Bookstore for \$39.95 plus shipping. Order number 9280. Telephone toll-free in the US 888-277-5289, or 860-594-0355; [www.arrl.org/shop/](http://www.arrl.org/shop/).



merit time Scout operations—not good for winter months.

While looking through a recent issue of *QST*, I noticed an ad for the West Mountain Radio PWRgate PG40. The PWRgate can handle up to 40 A continuously, either from a power supply or battery. That makes it a perfect match for my 40 A switching supply, and will handle the current requirements of my Elecraft K2/100 HF rig, KAT100 antenna tuner and a VHF FM transceiver and other station accessories.

The PWRgate PG40 looks like a small heat sink with three sets of Anderson Powerpole connectors on top. The Powerpole connectors follow what has become the common standard for ARES and other emergency operators. The compact PG40 package is about 4×5×1<sup>5</sup>/<sub>8</sub> inches (H×W×D), and has mounting holes on each end. Connect your 13.8 V dc supply to the PS input and your 12 V battery to the BAT input. Then connect your rig or dc distribution panel to the OUT connector and you are ready to operate.

When the ac supply is on, your station power supply powers your equipment. If the ac supply goes off for any reason, the PWRgate instantly routes the battery voltage to the output connector. My radios didn't even blink when I tested the operation by pulling the PS connector out of the PG40. With my K2 display set to read applied voltage and current I could see the supply change instantly from 13.8 to 12.0 and back again when I unplugged and reconnected the ac supply to the PG40. With a PG40 connecting my ac supply and back-up battery, I may not even know the commercial power went off until it gets dark.

### What's Inside?

The PWRgate uses two 80 A Schottky diodes wired to isolate the battery and power supply from each other. The input with the higher voltage automatically connects to the output. The Schottky diodes have a forward voltage drop of about 0.4 V that should be considered during

your dc wiring design.<sup>5</sup> The PWRgate also uses a diode and resistor to provide up to 1 A of charge current to the battery when the ac supply is operating. When the ac power comes back on, the PG40 will switch back to your power supply and your battery will start to recharge at up to a 1 A rate.

It will take a while to recharge my 100 Ah battery if it is completely discharged. After a relatively brief operating period on the battery, though, the PG40 will top up the battery and keep it fully charged and ready for the next emergency or weekend campout.

### How Do You Know That Battery is Taking a Full Charge?

As any battery ages it will tend to lose some of its ability to take a charge and return the energy as useable current. This is where the West Mountain Radio Computerized Battery Analyzer (CBA) becomes valuable. The CBA looks like a large heat sink and top-mounted fan attached to a small plastic tray. It measures about 2<sup>3</sup>/<sub>4</sub>×3<sup>1</sup>/<sub>2</sub>×3 inches (H×W×D). See Figure 5.

An 8051 microcontroller measures current, temperature and voltage, in three automatically switched ranges to 10 bit resolution. The microcontroller operates a pulswidth modulated power MOSFET load for the battery under test. A plug-and-play USB interface to your computer allows software control of the load current, temperature sensed cut-off (with the optional temperature probe) and also allows the computer to collect data about the battery discharge characteristics.

The user interface to the CBA is via *Windows* software that installs from a CD included with the package. You will need

<sup>5</sup>J. Hallas, "Emergency Power at W1ZR," *QST*, Dec 2003, pp 41-44.

a PC running *Windows* 98SE or higher with a Pentium 233 or faster processor, at least an 800×600 display and an available USB port.

The warnings about heat build-up when charging and discharging the batteries point to the value of the optional temperature probe. This optional device plugs into the side of the CBA. When connected, the software will display the temperature. You can set an automatic test cut-off temperature, so if your battery becomes too hot the test will stop. The default temperature is 140°F, but you can change that in the software.

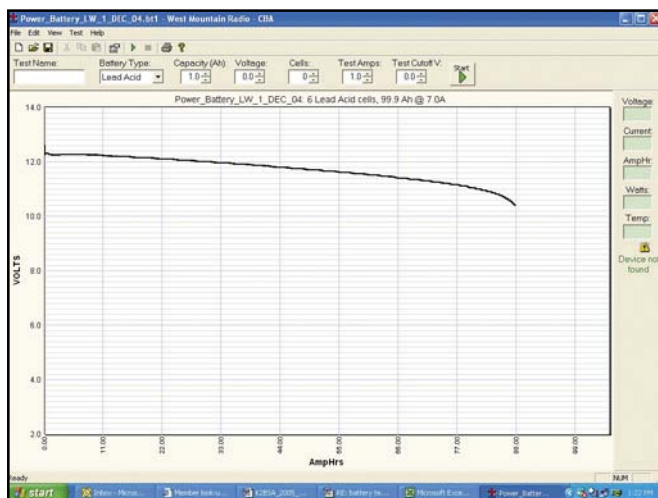
### Setting Up a Test

Before you are ready to start a battery test, take a few minutes to read the safety information file on the CD, as well as the CBA owner's manual and the battery information and FAQ files. Then double click on the software icon and a test window will open. Type a descriptive name into the TEST NAME box. Next you will have to select the battery type from a dropdown list that includes most battery types. Enter the battery capacity for the battery you are testing. When you connect the battery to the CBA it will measure the battery voltage and take a guess at the nominal battery voltage and the number of cells in the pack. The software usually defaults to a test current equal to the capacity of the battery. The software also sets a default test ending voltage; in the case of the 12 V gel cell, the default is 11.4 V.

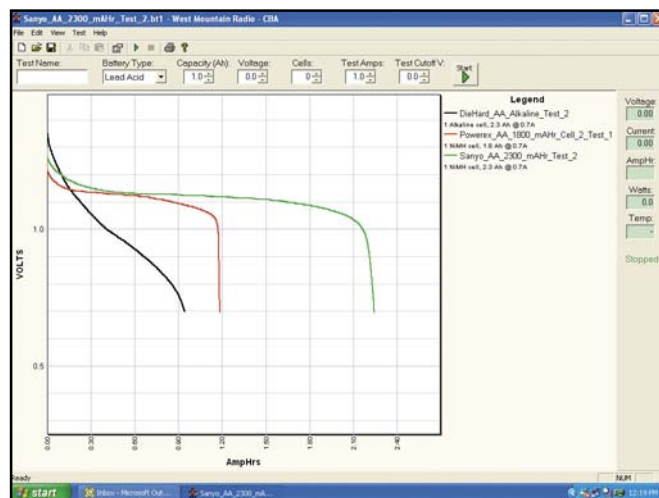
If you want to use these software defaults, simply click the START button. If you want to find out how long the battery will run *your* equipment, set the test end voltage to the lowest battery voltage at which your radio will still operate (taking into account all voltage drops between the battery and radio) and the current to correspond to the drain of your



Figure 5—The Computerized Battery Analyzer consists of a heat sink and small fan sitting on top of a plastic tray.



**Figure 6—The results of testing my pulled 100 Ah gel cell. I set this test to draw 7 A from the battery. Notice that the test stopped when the battery voltage dropped to 10.4 V. This battery appears to have a capacity of about 88 Ah, rather than the rated 100 Ah.**



**Figure 7—The results from three battery tests overlaid on top of each other. The test compares a Sears DieHard alkaline AA cell with two different NiMH AA cells.**

setup. The graph automatically adjusts the vertical voltage scale and the horizontal capacity scale to suit your test. The CBA continues to draw the specified current until the battery voltage drops to the end voltage.

The CBA can dissipate at least 100 W, higher for lower capacity battery packs. If you try to set a test current that will exceed the ratings, the software will prompt you to reduce the test current to a safe level.

I wanted to know how my 100 Ah gel cell would compare to that rated capacity, so I ran a test on the fully charged battery. See Figure 6. With a 7 A load it has a capacity of about 88 Ah, down to 10.4 V.

I also tested a 17.2 Ah 12 V gel cell that I have used to operate a 2 meter rig for many of my Scout demonstrations over the years. I recharged and tested this battery several times, but it only seems to have a capacity of about 1.2 Ah. I was convinced this battery was better than that, but after several tests I have concluded that it isn't providing as much operating time as it should. It may be well past time to replace that battery. I also tested another old gel cell that didn't seem to be holding a charge very well. Sure enough, the CBA indicates that battery is beyond any useful life.

To test some known good batteries I decided to set up test fixtures for a few other battery types.

A quick trip to RadioShack produced a single AA cell holder that I clipped to the Powerpole adapter cable to test some AA cells. I have been using some NiCd and NiMH cells for a variety of applications recently, and was curious as to how

they tested when compared to an alkaline cell [note that testing the capacity of a non-rechargeable battery is a destructive test, but useful on a sample of a battery type—*Ed.*]. Figure 7 shows a graph comparing three different AA cells.

### Other Software Features

The CBA software has a number of other very useful features. Obviously, you can save each test graph for later review. You can also overlay one test on top of another. Figure 7 shows three such graphs overlaid on each other. When you overlay a test graph, the software color codes each new graph, and also places a color-coded legend along the right side of the graph. If you have a color printer, you can print the image in color. If you only have a black printer, then the software will add symbols to the lines and legend to distinguish them from each other.

The software also has a *print labels* feature that helps you set up and print labels to apply to your batteries. If you have several similar packs, this is especially useful because it helps you keep track of the individual packs. Rather than always using the same one or two packs, you can easily rotate the several packs and use them uniformly. You can also keep track of which packs are older, so it is easier to decide when to test a pack that may be getting past its useful life. The label template is set up to use Avery 05160 or equivalent label sheets.

### How Often Should I Test My Batteries?

That is an important question. If a re-

chargeable battery is good for a certain number of charge/discharge cycles, then every time you test the battery you can subtract one from the remaining life of your battery. Obviously, over testing is not a good thing. West Mountain Radio suggests that you run a test for a new battery pack [especially good advice for NiCd batteries—*Ed.*]. That will give you a point of comparison as the pack ages. They also recommend that you retest the pack after it has been setting for some time, or after it has been used a great deal. I would probably err on the side of not testing often enough rather than over testing. West Mountain Radio says they do not recommend testing or cycling batteries if they are used regularly and seem to be working well. That makes sense to me.

### Testing Accuracy

I used my digital multimeter (DMM) as an ammeter to verify that the actual load current was close to the indicated test current. Within the accuracy of my meter, I measured the same current as the CBA. I also used the DMM to monitor the battery voltage during a couple of tests. Again, within the measurement accuracy of my meter, the CBA software was reporting the same terminal voltage.

The manufacturer reports that by our publication date they will offer a CBA II with higher resolution at low current.

**Manufacturer:** West Mountain Radio, [www.westmountainradio.com](http://www.westmountainradio.com), 18 Sheehan Ave, Norwalk, CT 06854; tel 203-853-8080. Price: PWRgate PG40, \$69.95; Computerized Battery Analyzer, \$99.95; Temperature Probe for CBA, \$10.95.





## Heil Classic and Heritage Microphones

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### The Heil Classic

The Heil Classic is a replica of a 1930 RCA 74B broadcast microphone. A few of its more notable features include:

- Two mic elements easily selected by a miniature back-panel toggle switch. The elements are partially selectable at the time of purchase. More about this later.
- Switchable high and low impedance is set by a tiny bottom-panel slide switch. The Classic is therefore compatible with both vintage tube transmitters and modern solid-state transceivers.
- A PTT “Soft Touch” switch on the back panel.

Perhaps the Classic’s most prominent visual feature is its cast aluminum name flag. Complete the warranty card that comes in each box and Heil sends you the call letters of your choice. The letters are plastic with an adhesive backing.

Four possible elements come with Heil Classic microphones. One is standard issue for all mics. The customer selects the second element from one of the three remaining options:

**PRO LINE:** This is a broadcast element with a frequency response of 50 to 18,000 Hz. It is the standard element in all versions of the Heil Classic microphone.

**HC-4:** The “DX Dream Machine” is a dynamic element engineered for contest and DX operators. It has a specified 500 to 3800 Hz response with a 10 dB rise at 2000 Hz.

**HC-5:** The “Key Element” is a dynamic cartridge designed for general SSB communication. It has a specified frequency response of 350 to 4000 Hz with a 6 dB rise at 2000 Hz.

**Heil IC:** This is a “high performance electret element” specifically designed to provide the higher audio levels required for older ICOM radios. It’s specified at 35 to 10,000 Hz at -3 dB.

The Heil Classic microphone comes in three different versions as follows:

**Classic 5**—Includes the PRO LINE broadcast element and the HC-5. This is the version we obtained for this review.

**Classic 4**—Includes the PRO LINE broadcast element and the HC-4 element.

**Classic IC**—Includes the PRO LINE broadcast element and IC element. As mentioned previously, this is for older ICOMs only.

### The Heil Heritage

The Heil Heritage microphone is styled after the Shure 55. Right from the box, its sparkling heavy chrome finish was an attention grabber here at Headquarters.

The Heritage is a single element dynamic microphone. Its frequency response is specified to be smooth 40 to 18,000 Hz with a standard bal-

anced output of 600 Ω. The Heritage has a mute switch, but not a PTT switch. PTT is accomplished via an outboard switch connected to the Heil interface cable. The Heritage also has a 5/8-27 standard thread assembly that mates with all of Heil’s microphone stands and booms.

### On the Air


Both the Classic and Heritage mics were used on the air with a variety of operators, rigs and modes. In all cases we tried, the Heil mics received excellent audio reports. These mics were also the clear favorite in blind comparisons with the stock mic that came with my ICOM IC-746 transceiver and other radios.

### Final Thoughts

Although the Classic does have a PTT switch, I didn’t find it convenient for general use or long-winded transmissions. I’d suggest an additional hand or foot operated PTT switch, both of which are available from Heil. (Obviously, the Heritage requires an outboard PTT switch since it only has a mute switch.)

The Heil Heritage microphone.

There are a few caveats when selecting a mic or its associated hardware. The Classic, for example, comes with a base; the Heritage does not. If planning on a Heritage, you’ll probably want to buy the CB-1 base stand, especially if you don’t plan on a boom. (The base is surprisingly heavy and features a rubber non-skid bottom.) It’s also particularly important to get the correct cable for your radio and microphone. The Classic is a four-pin XLR connector while the Heritage is only a three-pin XLR. Classic and Heritage cables are therefore not interchangeable.

**Manufacturer:** Heil Sound Ltd, 5800 North Illinois, Fairview Heights, IL 62208; tel 618-257-3000; [www.heilsound.com](http://www.heilsound.com).  
**MSRP:** Heritage \$130; Classic (all versions) \$229. 



The Heil Classic microphone.

## New Products

### OHM’S LAW DESK AND WALL CLOCKS

◇ TechNote Time Watch Company has added Ohm’s Law desk and wall clocks to their line of Ohm’s Law wristwatches.

TechNote Time Watch Company now carries 12 different products for both ac and dc applications. For more information, see [www.technotetime.com](http://www.technotetime.com) or contact TechNote Time Watch Co, 5330 SE 28th Ln, Ocala, FL 34471; tel 352-694-2744 or [info@technotetime.com](mailto:info@technotetime.com).

