

West Mountain Radio PWRgate and Computerized Battery Analyzer

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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 week-end 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 controller⁴ to recharge the battery after sum-

⁴*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/.

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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 4×5×1⁵/₈ 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.⁵ 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 2³/₄×3¹/₂×3 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

⁵J. 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.

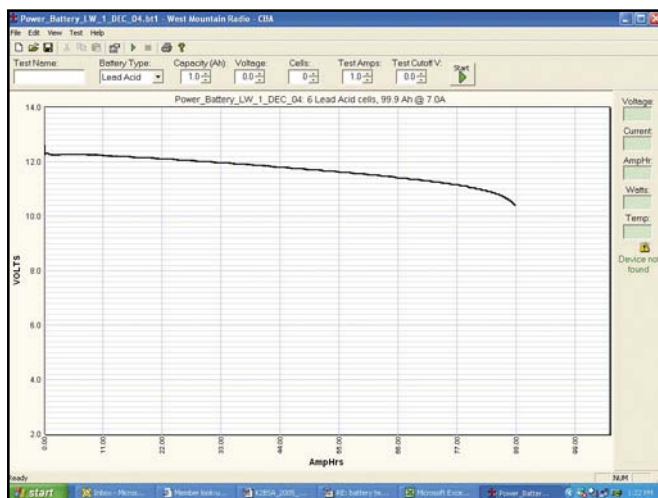


Figure 6—The results of testing my pulled 100 Ah gel cell. I set this test to draw 7 A from the battery. Notice that the test stopped when the battery voltage dropped to 10.4 V. This battery appears to have a capacity of about 88 Ah, rather than the rated 100 Ah.

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

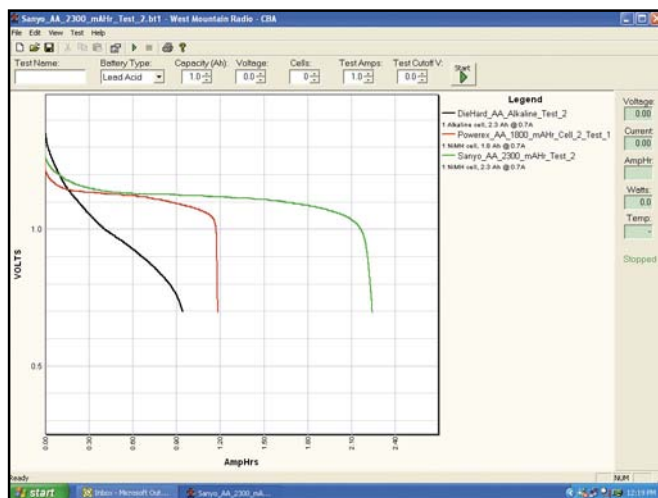


Figure 7—The results from three battery tests overlaid on top of each other. The test compares a Sears DieHard alkaline AA cell with two different NiMH AA cells.

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, 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. 