

Troubleshooting the TriMetric Battery Monitor

Although a meter will occasionally be defective or fail, most problems are due to improper installation, or misunderstanding of how the TriMetric is supposed to work. The following is based on actual field-service experience. If these instructions do not help, please [give us a call](#) for prompt service.

In summary, troubleshooting begins with verifying that the VOLTS reading is accurate, and then making sure the AMPS are being measured correctly. If both measurements are correct, any problem with the % FULL indicator usually are caused by incorrect programmed parameters. Check that parameters P1 (absorb voltage), P2 (absorb current), P3 (battery capacity), P20 (overcharge percentage target), and P12 (automatic reset) are set correctly.

Please click on the problem you are experiencing:

[Some or all display digits fail to light up](#)

[VOLTS not measured correctly](#)

[Display won't switch between VOLTS and AMPS when SELECT is pushed](#)

[AMPS not measured correctly](#)

[Battery % FULL reading seems wrong](#)

[The battery is charging, but the CHARGING lamp doesn't turn on](#)

[The reset button does not seem to be working](#)

Some or all display digits fail to light up

All digits are blank

Parts of digits turn on and others not, or some digits turn on and others not

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All digits are blank

The following steps may help solve the problem:

1. Push the SELECT button a few times to be sure the TriMetric is not in “dark” mode.
2. Check the fuse (shown in the wiring diagram of the TriMetric instruction manual) at the battery.
3. Check the wires from TriMetric to the battery, especially the G1 wire and the + wire, to see whether they are wired correctly.
4. If a hand multimeter is available, set it to measure volts and check that the battery voltage is present (at least 8V), measuring right at the TriMetric terminal block screws, from G1 to +. Make sure the polarity is correct, with the positive voltage on the + terminal. If necessary correct the wiring until fixed.
5. If you did not momentarily remove the fuse in step 2 above, momentarily remove and reconnect the + wire to the meter to reset the microcontroller. This can be done by momentarily removing and replacing the small fuse in the + wire that is shown in the wiring diagram in the TriMetric instruction manual.
6. [Click here](#) if the above steps did not help.

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Parts of digits turn on and others not, or some digits turn on and others not

Check if the display has the same problems in the VOLTS, AMPS and % FULL modes. If so, [click here](#).

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VOLTS not measured correctly

Display shows "888"

Voltage display is slightly off (by less than 1V)

Voltage display is stuck at some value other than zero

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Display shows "888"

This may be caused by lightning damage or polarity reversal during installation. [Click here.](#)

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Voltage display is slightly off (by less than 1V)

1. Use the select button to switch from VOLTS to AMPS. If the switch doesn't work, [click here](#).
2. Do a simple test to see that the amps read approximately correctly. With no charging sources on (turn off generators, solar, or other charging sources), turn a known load on and off. A 15W compact fluorescent light, for example, should cause the amps value to go more positive by a little more than one amp (for a 12V system), or about half an amp with a 24V system. If it doesn't change at all, [click here](#).
3. **If you have an accurate digital multimeter**, use it to measure the voltage at the TriMetric. Measure this voltage on top of the screw heads on the terminal block on the TriMetric circuit board, between the G2 terminal and the +M terminal. The terminals are identified by lettering on the green circuit board adjacent to the terminals; or consult the TriMetric instruction manual wiring diagram to identify the terminals. Check that the TriMetric agrees with the voltage measured by the digital multimeter.
 - a. **If the multimeter voltage doesn't agree with the TriMetric** by a small amount (less than 1V) and the amps reading is correct, it is possible that the TriMetric may have become uncalibrated. (This shouldn't happen on its own. Possibly someone accidentally readjusted it.) Either [return the TriMetric to the factory](#) to be calibrated for most accuracy, or if you are sure your multimeter is accurate, you can calibrate the TriMetric as follows: Connect the multimeter between the SIG and + terminals at the TriMetric terminal block—*not* at the battery. Then use a small screwdriver to adjust the screw on the square blue or gray potentiometer located on the TriMetric circuit board until the voltage reads correctly on the TriMetric display. With care, this should make the TriMetric accurate to within ± 0.1 volt or better.
 - b. **If the multimeter reading does agree with the TriMetric:** the TriMetric is measuring correctly and there probably is a wiring problem. Check the following possibilities that may be causing voltage inaccuracy:
 - i. It's easy to forget about the **voltage drop** possible between two seemingly identical measuring points. For example, if you compare the TriMetric voltage reading where the wires from the TriMetric are connected directly to the battery terminals with a voltage read with another meter a few feet away at the charge controller, the resistance between wires connecting the controller and battery can cause significant errors if charge current is flowing. Example: If the controller and the battery are 10 feet away connected by two #8 wires carrying 25 amps of charge current, there will be 0.3V drop—causing a 0.3V difference in reading—between the controller and the battery. If in addition there is a poor connection between these points, the error can be greater. Use an *accurate* digital meter to measure voltage between the Kelvin terminal at the shunt where the G1 and G2 wires are connected, and the exact point where the + wire to the TriMetric joins the battery. This reading should agree with the TriMetric.
 - ii. The wire connections between the TriMetric and the battery could have developed some resistance, especially the + wire. Check that the wires at the TriMetric are tight and well connected at both the TriMetric terminal block, and at the shunt and battery + end. Excess resistance, *especially in the + wire* could cause the voltage to read low at the TriMetric.
 - iii. **If the voltage is slightly low:** If the wire going from the + terminal at the TriMetric can introduce an error of 0.1 volt for each 3 Ohms of resistance. The following wire lengths

(from TriMetric to battery) represent resistance of 3 Ohms. Longer distances will result in greater error.

(1) 120 feet of #24 wire

(2) 190 feet of #22 wire

(3) 470 feet of #18 wire

(4) 750 feet of #16 wire

This error can be avoided by using a larger wire, or instead can be eliminated with two smaller wires by running both from the battery + terminal to the TriMetric. In this case you should remove the jumper that is usually connected from the + and +M terminals on the TriMetric terminal block, and run one of the two wires to + and the other wire to +M. See the appropriate section of the TriMetric instruction manual under “For unusual cases...”

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AMPS not measured correctly

Check that the TriMetric reads 0 in AMPS mode when there is no current. Turn all loads in the system off, and make sure any inverter is switched to “off”—not even search mode. Be sure that no charging is taking place, either because the solar array is dark or disconnected, and no other charging source is operating. If you are using the 500A/50mV shunt, you should read 0.0 or 0.1. (It is also possible that an inverter, even if “off,” can still be drawing a small amount of current—usually less than 1A.) If you are using the 100A/100mV shunt, even if no other current is being drawn it should read from -0.02 to -0.04 because the TriMetric is reading the small amount of current that it uses. This value should be very steady, with at most a fluctuation of ± 1 in the least significant digit. If the TriMetric does not show the expected value, [click here](#).

Afterward, the following possible fault may persist. Click on the corresponding link for troubleshooting help.

[The amps reading drift regardless of loads, possibly at a large value](#)

[The amps reading is always zero regardless of current](#)

[The TriMetric ignores the current to a particular load, or from a particular charging source](#)

[The amps reading is positive under load and negative when charging](#)

[The TriMetric seems to be measuring all energy sources and all loads, but inaccurately](#)

[None of the above helped, but I have an accurate multimeter on hand](#)

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The TriMetric does not show 0A for zero current

If there are residual amps showing, perform these steps:

1. Make sure both the G2 and G1 wires each connect directly to the Kelvin terminal on the shunt as shown in the TriMetric instructions wiring diagram, and that you do not have G2 and G1 sharing a common wire for even one inch with only one wire actually connecting to the Kelvin terminal.
2. Check that the SIG , G1 and G2 wires are properly and tightly connected from meter to shunt.
3. Check that there is no short between the G1 and G2 wires in their travels from meter to shunt, or similarly no short between the G1 and Sig wires, and that the G1 and G2 wires meet only right at the shunt's Kelvin terminal.
4. If the amps number doesn't change, or doesn't seem to be responsive to loads or charging sources when they are turned on or off (i.e, the amps value does not go more positive when a charging source is turned on, or more negative when a load is turned on), proceed to next step.

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The amps reading drift regardless of loads, possibly at a large value

This is usually caused by an open G2 or Sig wire going from the TriMetric to the shunt connection at the battery. Check the connections carefully at both ends. Also wires could have been severed or damaged. You can also use a multimeter to measure the resistance (Ohms) from the G2 to Sig terminals (with wires connected to them that go to the shunt). This resistance should be less than a few ohms if the connection to the shunt is intact. A high resistance here would indicate defective wiring to the shunt.

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The amps reading is always zero regardless of current

Check that the G2 and Sig wires to the shunt are not switched. Also check that the shunt is wired correctly (refer to the wiring diagram in the TriMetric instructions). You may also want to [jump to the procedure below](#), and check that a millivolt measurement across G2 and SIG is not zero. If it is not zero, [click here](#).

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The TriMetric ignores the current to a particular load, or from a particular charging source

For example, the TriMetric doesn't measure the current from the solar array, although it does measure loads connected to the inverter. This is almost always caused by a mis-wired shunt in the system. The TriMetric measures only electrical current (amps) that flow through the shunt. Make sure the missing current flows through the shunt to get to the battery. The only item that should be connected to the negative terminal of the battery system is one end (large bolt) of the shunt, as shown in the wiring diagram in the TriMetric manual. All other loads and charging sources must be connected to the other side (large bolt) of the shunt, as shown in the TriMetric instructions wiring diagram. Any vehicle chassis or similar grounding should also be connected to the other side of the shunt. For example, if solar panels or solar charge controller are connected directly to the negative terminal of the battery instead of the other side of the shunt (where the inverter is connected), then the current from the panels goes directly into the battery without going through the shunt, so the meter will not measure the charge current from this source. Rewire the shunt if necessary.

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The amps reading is positive under load and negative when charging

That would *not* be correct. Charging should show as a positive value of amps, and loads should show as a negative value. The connections to the Kelvin terminals on the shunt are reversed, so that Sig wires need to be reversed with the G2 wires. This is usually easiest to accomplish by switching the wires at the TriMetric terminal block. Check the TriMetric wiring diagram in the TriMetric instruction manual.

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The TriMetric seems to be measuring all energy sources and all loads, but inaccurately

1. Make sure that there is no wire, or bus bar, or any other connection that shorts from one side of the shunt to the other, i.e. from one of the large bolts on the shunt to the other. If any other wire connects from the large bolt on one side of the shunt to the other large bolt, then the shunt is being bypassed, and the meter will display current that is too low. A ground or chassis connection, if used, should be connected not directly to the minus side of the battery, but rather to the other side of the shunt (minus load).
2. **If the current reading is off by a factor of 10**
 - a. Make sure that the meter is correctly programmed for the shunt you have. (See section C2. “Shunt type and charge efficiency factor”, in the TriMetric TM-2020 instructions.)
 - b. Conversely, you may have programmed the shunt you desired but somehow installed the wrong type of shunt. Shunt amps and millivolts are usually stamped somewhere on the shunt. Check that the shunt is either a 500A/50mV type or a 100A/100mV type, and that it corresponds to what is programmed in the TriMetric.

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None of the above helped, but I have an accurate multimeter on hand

With a sensitive multimeter, e.g. with a 200mV (millivolt) scale that can resolve 0.1mV or less, turn on a steady load (or charging source) that will cause at least 10 amps to flow to or from the battery. Using the millivolts scale, use the digital meter to read the voltage between G2 and Sig at the TriMetric terminals. If the TriMetric is set for the “H” shunt, then each millivolt on the multimeter should register as 10 amps on the TriMetric. For example, 1.5 millivolts should show as 15 amps on the TriMetric. If the TriMetric is set for the “L” shunt, then each millivolt should register as 1 amp on the meter. If the multimeter and the TriMetric agree, then there must be a shunt or wiring error. If you read much less than 1 millivolt with a load (or source) that is known to be over 10 amps, then there must be a wiring error between the TriMetric and the shunt, or an error in wiring the shunt in the system. Either the current is not flowing through the shunt, or the wires from the TriMetric to the shunt are not connected correctly to the shunt Kelvin terminals. If the TriMetric disagrees with a known good multimeter, [click here](#).

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Battery % FULL reading seems wrong

1. In order to check that the current from the solar panel and all loads is being monitored by the TriMetric, [follow this link](#).
2. If the AMPS display has the wrong polarity (negative when charging), [click here](#).
3. The other common problem is that one or more of the following TriMetric settings are incorrect: “charged voltage,” “charged amps,” “shunt type,” “efficiency factor,” “preferences,” and “battery capacity.” Refer to the TriMetric instruction manual on page 13 for information on how to access and change data in these program modes. Programmed settings are described below for troubleshooting purposes:
 - a. “Charged voltage” and “Charged amps”: As batteries are being charged by their charging sources (i.e. the inverter charger system and the solar or other charge controllers), their voltage gradually rises until it reaches the “bulk voltage” settings of the charger systems. Once this voltage is reached, the chargers should remain at this voltage while the current (“amps”) gradually declines as the battery becomes more charged. When the voltage is at this “bulk” voltage, and the charging current (amps) has declined sufficiently, this indicates that the battery is fully charged. The “charged voltage” and “charged amps” programmed into the TriMetric allow the TriMetric to determine when this has occurred. When the battery voltage rises *above* the “charged voltage” and simultaneously the charging amps are *less* than the “charged amps” (for at least 20 seconds), the TriMetric will consider the batteries to be “fully charged.” When this occurs, the battery percentage-full is ordinarily reset to 100%. First, generally you should check that all your charging systems are using the same, or nearly the same “bulk charge voltage.” These adjustments are usually made on your charger (or charger/inverter) and solar charge controller. If not adjusted to about the same “bulk” charge voltage they should be adjusted correctly according to the battery manufacturer. For the most commonly used “liquid electrolyte” lead-acid batteries, this voltage is about 14.5 for 12V battery systems, and 29.0 volts for 24V systems. Other battery types may have different voltage requirements. Then the TriMetric “charged voltage” setting should be set a little lower than this: usually about 14.3 or 28.6 volts for 12 or 24V systems respectively. Next enter a value for the “charged amps.” Determine the total system battery capacity in amp-hours of your battery system (see section C4 of TriMetric instructions for how to determine this), and divide by a number about 50 to get a value of “charged amps.” You can use a higher or lower number than 50 (25 to 100) depending on how charged you wish the batteries to be before the TriMetric resets the meter to “Full.” By dividing by a number higher than 50 you will be demanding a higher standard before the batteries are considered charged, and if you divide by a lower number you will lower the bar for what is considered charged.
 - b. Next check the “shunt type” and “efficiency factor.” The most common setting is H94. The “H” is used for the most commonly used shunt: 500A/50mV. However, if you are using the less common 100A/100mV shunt it should be set to about L94. The meaning of these is explained in the TriMetric instructions, sections D6 and C2. Higher numbers for the “efficiency factor” will give more optimistic (i.e. generally higher) values of battery % FULL.
 - c. Check the “preferences.” This should be set to P00 or P01 to allow the TriMetric to automatically reset itself in the manner described above in (a.). P01 also makes the battery % FULL to display charge in 1% increments instead of 5% increments. The benefit of this is that you can watch the % FULL readings gradually go up and down, instead of jumping only at 5% increments. The drawback is that it is implying an accuracy of measurement that is somewhat greater than is realistic. If preferences are set to P02 or P04, the meter will *not* reset when the “charged criteria” described above in (a.) are reached; therefore, it is better to leave preferences on P00 or P01 for the battery % FULL reading to display properly. This also makes the “amp-hours from full” to reset to zero when discharging commences, just after the batteries have been fully charged sufficiently for the amp hours to become positive.
 - d. Check the “battery capacity” setting: As amp-hours are removed from the battery, the TriMetric causes the battery % FULL to decrease in proportion. This setting determines the rate at which the battery % FULL goes up and down as it is being charged and discharged. When the “amp hours from full” (as a negative value) is equal to the value programmed here (in amp hours), the TriMetric will show 0% or LO. It is usually a good idea to enter a value here which is 50% to 75% of the amp hours specified by

the battery manufacturer. This should make the battery % FULL numbers go to 0 before the battery actually is flat out of power, and thus gives you a more conservative (lower) estimate of how full your batteries are. Also, many renewable energy systems don't get the batteries really fully charged, so the actual usable storage capacity is often less than the optimistic number claimed by the battery manufacturer. Also note that when you enter the "battery capacity" value in the program mode, the flashing decimal point means "multiply the number by 1000". Therefore "1.02" with flashing decimal point represents 1020 amp hours.

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The reset button does not seem to be working

To reset the TriMetric, push *and hold* the reset down until the display flashes three times. This requirement insures that you don't accidentally reset something you didn't intend to. If nothing happens at all in the display when you push it down, the RESET button could be stuck. Sometimes pushing it down a few times will get it unstuck, and it should continue to work properly. If not, [click here](#).

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Your meter is probably defective. Please call [Bogart Engineering](#) to arrange for repair.

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How to obtain customer service

Please contact your dealer, or contact Bogart Engineering, Inc. at 19020 Two Bar Road, Boulder Creek, CA 95006, (831) 338-0616. Contact us or the dealer before returning any item.

www.bogartengineering.com

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