

DC Digital Meters

Single-Function Meters



8235 DC Digital Voltmeter
8236 DC Digital Ammeter

Multi-Function Meters



8248 DC Digital Multimeter with Alarm
8251 DC Digital Voltmeter with Alarm

Voltmeter Panel

8051 DC Digital Voltmeter Panel

Specifications

General:
Display Character Size 9/16"
Power Supply Voltage 8-50V DC
Maximum Power Consumption 1.00W*
Minimum Power Consumption 0.60W*
(Sleep mode PN 8248 and PN 8251 Only)

Voltage Measurement:
Range 0-60V DC
Resolution 0.01V DC
Accuracy (% of Reading) ± 0.5%**

Current Measurement:
Shunt 500A-50mV
Range ± 500A DC
Resolution (-100 to -500) 1A DC
Resolution (-99.9 to +500) 0.1A DC
Accuracy (% of Reading) ± 0.5%**

Physical:
Splashproof front
Dimensions Height 2.431" (61.75mm)
Width 2.896" (73.56mm)
Depth 3.400" (86.36mm)

* Variable with voltage, display intensity, segments illuminated, and sleep mode
** ± 1 least digit of resolution

Caution:
Positive voltage applied to terminals #4 and #5 will cause damage not covered by warranty.

Theory of Operation

The 8200 Series meters incorporate microprocessor control and advanced electronics specifically designed for power monitoring to provide accurate metering with a variety of adjustable user features. DC meters have the provision for separate power and voltage sensing. Using separate voltage sensing is recommended to minimize the voltage drop caused by the current consumption of the meter itself. This is particularly necessary if the meter is located more than a few feet from the battery or source being measured.

Models that have the ability to measure DC current come with a precision shunt. The shunt must be installed in the negative line to avoid damage to the meter. The shunt is a precise resistance that is temperature stable. It has a full current rating of 500 Amps and when 500 Amps flows it generates a voltage of 50 mV (0.050 V). Thus, 10 Amps generates 1.0 mV, 1 Amp generates 0.1 mV, and 0.1 Amp generates only 0.01 mV. This is a very small signal and you must be sure that all connections are secure and well made. It is also necessary to use twisted pair wire to minimize susceptibility to electrical system noise.

Use

A full discussion of the subject of battery management is beyond the scope of these instructions. However, the following will alert meter users to some of the issues requiring further study.

Battery management is the key to a healthy electrical system. There are several ways to measure the state of charge in a battery or battery bank. The three most common methods are:

1. Open Circuit Voltage
2. Electrolyte Specific Gravity
3. Net Amp-Hours

Voltage is an effective method of determining charge condition when properly used with an understanding of the battery charge and discharge process. The table below shows the state of charge for different type batteries. Please note the difference between a full and a discharged battery is about 1 volt.

Open Circuit Voltage vs. State-of-Charge

12 Volt Battery Open Circuit Voltage

State of Charge	Wet Cell	Gel Cell	AGM
100%	12.7-12.6	12.95-12.85	12.90-12.80
75%	12.40	12.65	12.60
50%	12.20	12.35	12.30
25%	12.00	12.00	12.00
0%	11.80	11.80	11.80

Note: Divide values in half for 6-volt batteries.

Voltage is an indicator of state-of-charge only when a battery's open circuit voltage is measured. Open circuit voltage is obtained when a battery is neither being charged nor discharged and the voltage is allowed to be stabilized. There is disagreement about the length of time the battery is required to rest before a usable open circuit voltage is obtained. However, the user will observe that in the first 10 to 20 minutes of rest the voltage will settle to a figure close to its completely rested open circuit voltage, which is generally considered to be obtained after 24 hours. Gel batteries can take up to 48 hours. With experience, the user will learn the time required for reliable readings on any particular system.

For maximum life a battery should be discharged no more than 50%. Once a battery is about 80% of full charge, its acceptance rate decreases rapidly and it can take a long time to bring the charge to 100%. For this reason, the practical operating range becomes the 50 - 80% of charge area.

A particularly good treatment of battery management is presented in Nigel Calder's book, *Boatowner's Mechanical and Electrical Manual (Third Edition, McGraw Hill)*.

Installation Overview

1) Physical: The meter should be located in a visible position with easy access for operation of the pushbuttons. The display has adjustable brightness for various lighting conditions, but for best visibility do not place the meter in full daylight. The location should also be dry and protected. The face is splash proof and its circuit boards are coated for corrosion resistance, but it is not intended for use in very wet environments or for installation outside without additional protection. Additionally, the wiring should be located in safe and dry raceways with appropriate strain relief.

2) Safety: Installation requires the ability to make high current capacity connections, as well as connections directly to the battery positive terminal. These connections must be made carefully and fused as indicated in wiring diagram. When working on the battery be sure to wear safety glasses, turn off all charging sources, and be careful not to create sparks which might ignite battery gases. The scope of this document does not include instruction in the basic electrical skills necessary to install the meter. If you do not have the necessary basic skills you should employ a qualified electrician.

Installing Shunt

Models that have the ability to measure DC current are supplied with a precision shunt. The shunt must be installed in the negative line of the circuit whose current you wish to measure. For marine and RV applications this will normally be in the negative line of the battery that supplies the domestic systems. The current must flow through the shunt to be measured. For example, if you connect the negative return wire of a load or source directly to the battery its current will not be measured.

To attain the most accurate reading the shunt must be located adjacent to the battery, avoiding long battery cables. Break the circuit at this point and install the shunt by connecting the ends of the wire under each of the two large bolts at the top of the shunt. It makes no difference which wire is attached to which bolt. The small screws are for the meter sense leads and should have no current-carrying connections made to them as this will affect measurement accuracy.

Use this simple example: *Disconnect everything from the battery negative and connect it to one side of the shunt; this is now referred to as the Load side of the shunt. Run a single cable capable of carrying the maximum combined current of all loads between the other side of the shunt and the battery negative; we will call this the Battery side of the shunt. This cable must be as big, or bigger than the largest cable connected to the Load side of the shunt.*

CAUTION

The shunt must be installed in the negative line to avoid damage to the meter. Positive voltage applied to terminals #4 and #5 will cause damage not covered by warranty.

All Models: Startup Sequence



Upon power up the meter goes through a self test sequence which lights all the function LEDs, then all segments of the display.

All Models: Using * Button for Dimming

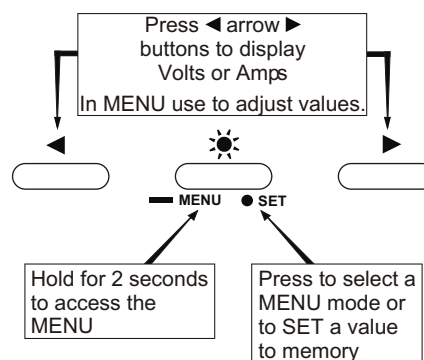


Pressing the * button causes the display to dim. There are three levels of brightness. Models with a single button also have a fourth sleep mode in which the display is off with the exception of a single decimal point. Models with three buttons have an automatic sleep mode, which is accessed through the menu as described in the manual.

Three Button Models

The ◀ arrow ▶ buttons have two functions. Normally they change the display between Volts and Amps. When in the MENU mode they are used to navigate through the functions or adjust the values.

The center * button has three functions. Normally it is used to dim the display. Holding the button for 2 seconds will access the MENU and while in the MENU mode, pressing it is used to SET or store the displayed value to memory.



Sleep Mode - SLP



The Sleep mode is a simple power-saving feature. If there are no button presses for 10 minutes the display goes to sleep and only a single decimal point is lit. Pressing any button causes the meter to exit the sleep mode and revert to the last displayed function.

To access the Sleep mode, hold the * button for two seconds. Use the ◀ arrow ▶ buttons to scroll until SLP is in the display. Press * to select the Sleep mode. Use the ◀ arrow ▶ buttons to select ON or OFF. (Default OFF) Press the * button to save the selection to memory. Two short beeps will let you know you have successfully set the function and the meter will revert to the last displayed function.

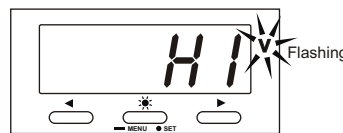
Scan Mode - SCAN



The Scan mode will automatically scroll the display between Volts and Amps displaying each for about 3 seconds. If the ◀ arrow ▶ buttons are pressed the Scan mode is temporarily suspended and the buttons may be used to manually scroll through the measured parameters. If no button is pressed for 10 minutes the Scan mode is resumed.

To access the Scan mode, hold the * button for two seconds. Use the ◀ arrow ▶ buttons to scroll until SCAN is in the display. Press * to select the Scan mode. Use the ◀ arrow ▶ buttons to select ON or OFF. (Default OFF) Press the * button to save the selection to memory. Two short beeps will let you know you have successfully set the function and the meter will revert to the last displayed function.

High Voltage Alarm - HI



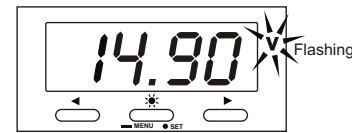
Set the meter to display voltage using the ◀ arrow ▶ buttons. The V function LED will be on. Hold the * button for two seconds to access the MENU. Use the ◀ arrow ▶ buttons to scroll until HI is in the display. Press * to select the High Voltage Alarm.



Use the ◀ arrow ▶ buttons to select ON or OFF (Default OFF). Press the * button to save the selection to memory and continue.



The present setting will appear in the display (Default 14.80). If the set point is acceptable, press the * button or wait for 15 seconds and the meter will revert to normal operation. Otherwise use the ◀ arrow ▶ buttons to select the desired value. For example, press and hold the right ▶ button to scroll up to 14.90.



Press the * button when the desired set point is displayed and the new value will be saved to memory. Two short beeps will let you know you have successfully set the new value and the meter will revert to normal operation.

Low Voltage Alarm - LO

Setting the LO alarm is exactly like setting the HI alarm. First select the V function, then hold down the * button for 2 seconds to enter the menu. Use the ◀ arrow ▶ to scroll until LO appears in the display.



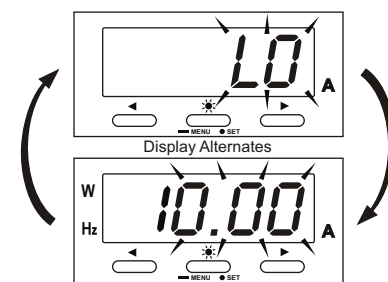
Press * to continue, ON or OFF will appear. Press ◀ arrow ▶ until ON is displayed.



Press * button to continue. The present setting will be displayed. (Default 10.80) Use ◀ arrow ▶ to select the LO alarm value, press * to store to memory.



Acknowledging an Alarm



If an alarm occurs, the audible alarm will sound and the display will alternate between the type of alarm and the measured value.

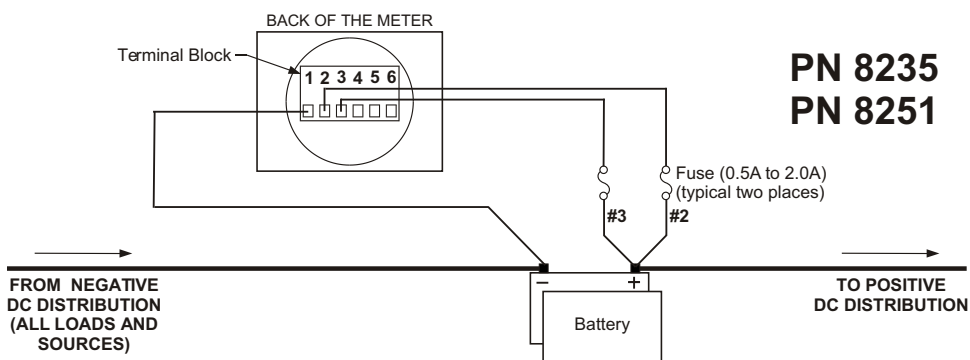
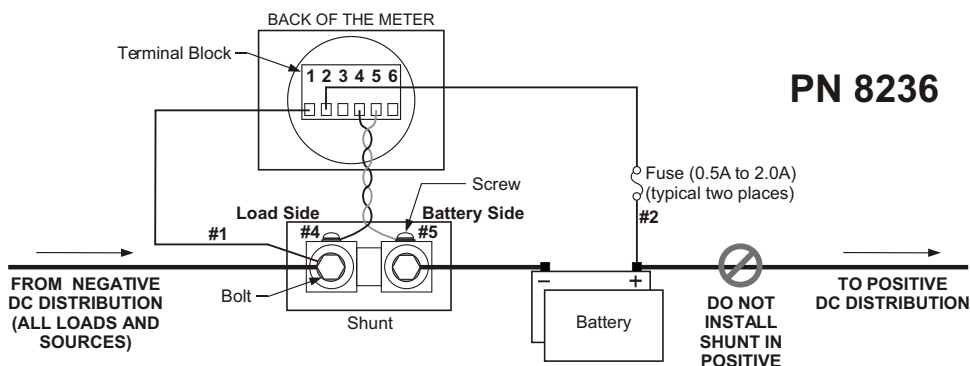
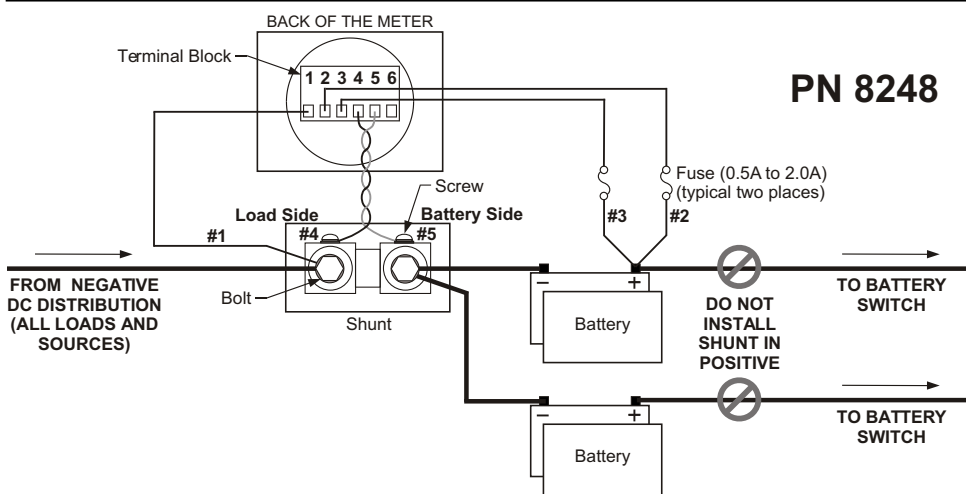
Silence by pressing the * button. Display will alternate between the alarm condition and the value. Every 5 minutes the alarm will give four beeps and display the alarmed parameter. This will continue until the alarm condition is cleared, or the alarm function is turned off, or the set point changed.

If in Sleep an alarm will "wake up" the meter and it will function as above. After 10 minutes of no acknowledgement it will re-enter the Sleep mode. Every 5 minutes it will give four audible beeps and display the alarmed condition and measured value for 30 seconds before returning to Sleep mode.

Displaying the Code Revision

For customer service convenience, all models are able to display the revision of software installed in the meter. To see the software revision for meters with a single button, press and hold the center (*) button. To see the revision on meters with three buttons, press and hold the two ◀ arrow ▶ buttons. In either case, the power-up test will be performed and the software revision will be displayed.

Wiring Diagram



Wire by Wire Instructions

NOTE:

Use 16 AWG for all meter wiring.

All models require connections to terminals #1 and #2.

Terminal #3 used for models PN 8235, PN 8248, and PN 8251.

Terminals #4 and #5 used for PN 8236 and PN 8248 only.

Wire to terminal #1 (Negative)---Supplies the DC negative return from the meter. Make the connection as close as possible to the DC negative battery terminal to attain the most accurate meter reading. If installing a current sensing meter, connect to the Load Side of the shunt. The connection to the shunt must be made under the large bolt, not the small sense screws.

Wire to terminal #2 (Power 8-50V DC Positive)---Supplies power for meter operation. It may be a different source than the voltage being measured provided the negatives are common. For example, the meter can be powered from a 12V system and measure the voltage of a 24V battery, if the negatives of the two batteries are connected together. This wire must be fused as close to the source as possible (any fuse between 0.5A and 2.0A is acceptable.)

Wire to terminal #3 (Voltage Sensing 0-60V DC Positive)---This wire supplies the voltage to be measured. Separate voltage sensing is recommended if the source is more than a few feet from the meter. This helps reduce errors due to voltage drop in the wires to the meter. Make the connection as close as possible to the DC positive battery terminal to attain the most accurate meter reading. This wire must be protected by a fuse (any size between 0.5A and 2.0A). If the meter is close to the measured source, then terminals #2 and #3 may be jumped together and a single wire may be used for power and voltage sensing.

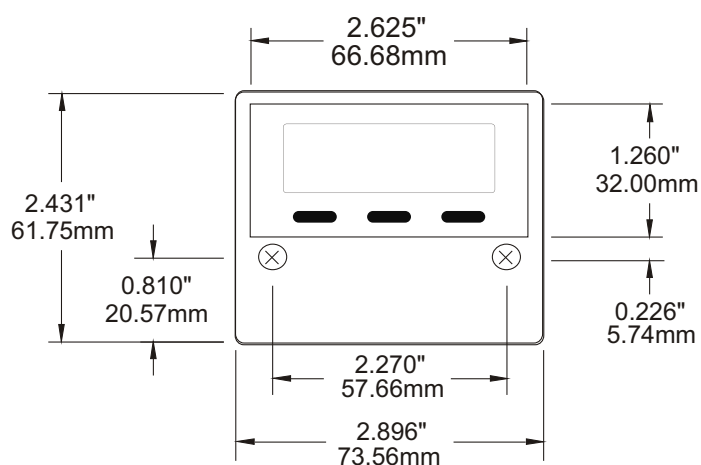
The wires to terminals #4 and #5 must be a twisted pair to avoid electrical system noise that will affect the accuracy of current measurement. These may be twisted by hand or by using an electric drill motor, or twisted pair wire may be purchased from most electrical supply companies.

Wire to terminal #4 (Current Shunt Load Side Sense)---For models that measure DC current, wires #4 and #5 provide the mV signal (generated by current flow in the shunt) to the meter for current measurement. Wire #4 must be connected under the small screw on the side of the shunt, which is connected to the negative Loads and Sources in the system. It must be a twisted pair with the wire going to terminal #5.

Wire to terminal #5 (Current Shunt Battery Side Sense)---Must be securely connected under the small screw on the side of the shunt, which is connected to the battery negative. It must be a twisted pair with the wire going to terminal #4.

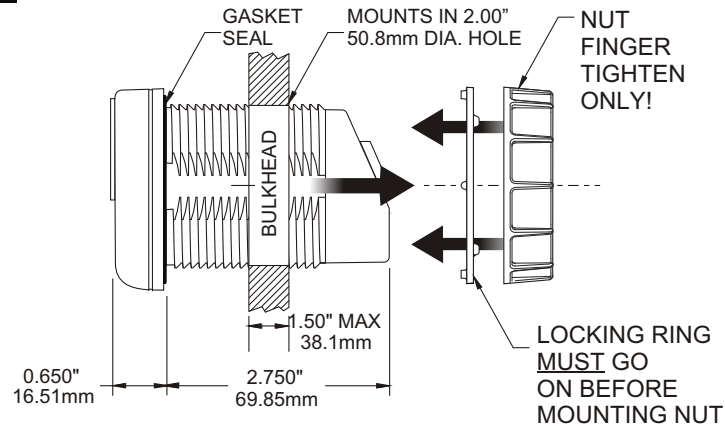
Terminal #6 is not used.

Dimensions

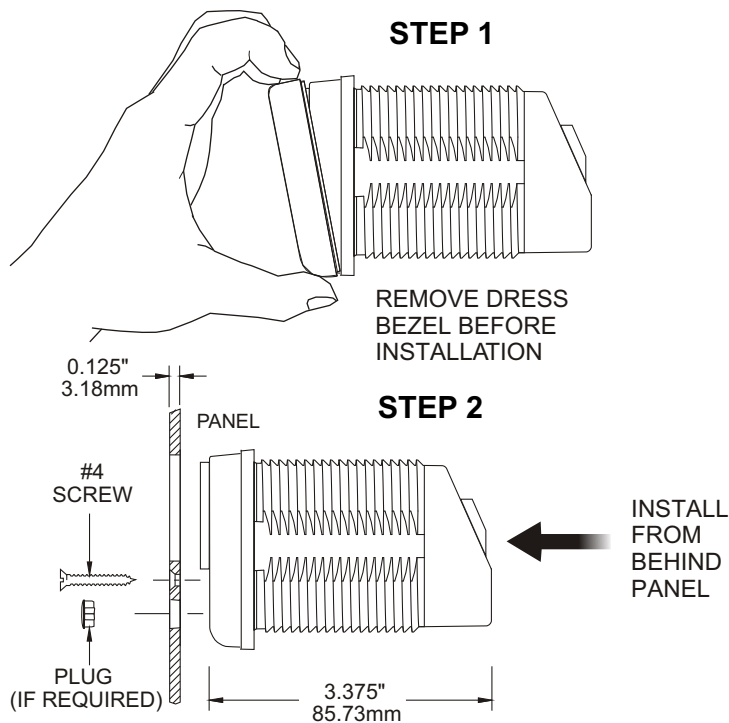


Mounting Methods

1 THROUGH HOLE MOUNT



2 PANEL MOUNT



DC Digital Voltmeter Panel PN 8051 Instructions

1. Use 16 AWG wire

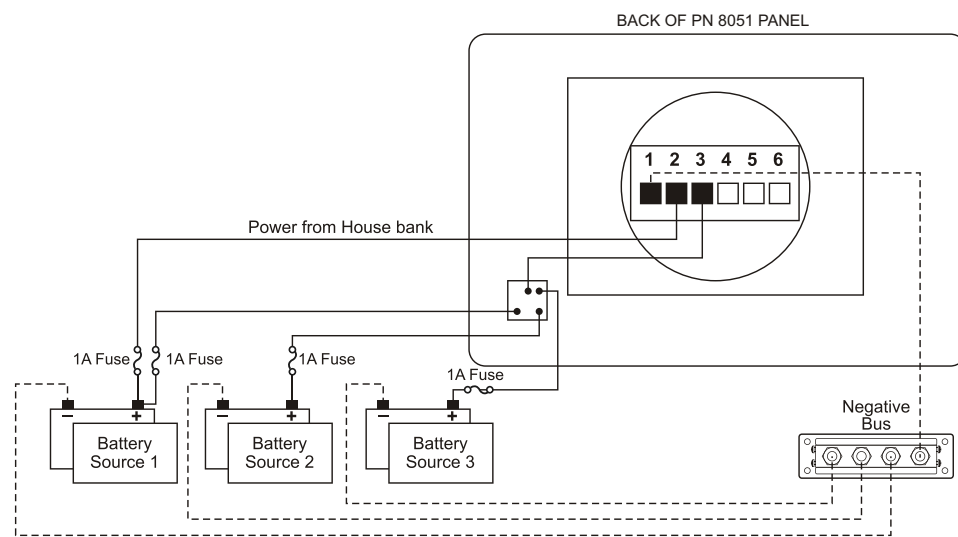
2. Fuse all positive connections

3. Connect to meter terminals

1. Negative Bus
2. Power 8-50V DC (House)
3. Voltage Sense (VMTR+)
4. Do not use
5. Do not use
6. Do not use

4. Connect to source 1, 2, and 3

5. See meter operation section of this manual



Warranty

ALL BLUE SEA SYSTEMS DIGITAL METERS ARE WARRANTED TO BE FREE FROM DEFECTS IN MATERIALS OR WORKMANSHIP FOR THREE YEARS FROM THE DATE OF FIRST PURCHASE.

"DATE OF FIRST PURCHASE" MEANS:

- (i) the date on which the product was purchased by the first retail customer.
- (ii) the date on which the first retail customer purchases a vessel on which the product was installed.

BLUE SEA SYSTEMS WILL (AT ITS SOLE DISCRETION) REPAIR OR REPLACE ANY PRODUCT WHICH IS:

- (i) proven to be defective in materials or workmanship.
- (ii) returned to Blue Sea Systems (or its agent) during the warranty period in accordance with this warranty.

Replacement products may be new or refurbished in as-new condition. Such repair or replacement will be the sole remedy by Blue Sea Systems under this warranty. Any repaired or replacement product will be warranted in accordance with this warranty, for the unexpired balance of the warranty period on the original product.

Warranty Registration

Blue Sea Systems is committed to exceptional customer service. Please allow us to serve you better by registering your product online at <http://blueseasystems.com/go/warranty-registration>. If you would prefer to register your product by fax, please call (360) 738-8230 or Toll Free in the USA and Canada (800) 222-7617 for a fax-ready Warranty Registration card.