

120/240 AC Digital Meter Panel

PN 8410

Panel Specifications

Material:	0.125" 5052-H32 Aluminum Alloy	
Primary Finish:	Chemical Treatment per Mil Spec C-5541C	
Final Panel Finish:	Graphite color 2 part textured Polyurethane	
	Inches	Millimeters
Overall Dimensions:	5-1/4 x 3-3/4	133.40 x 95.30
Mounting Centers:	4-7/16 x 2-15/16	112.70 x 74.60
Standards:	This panel, when properly installed, complies with all applicable <i>Standards and Recommended Practices</i> of the American Boat and Yacht Council as well as United States Coast Guard 33 CFR Sub Part 1.	

Panel Features

- Perfect solution for monitoring 120/240V AC systems
- Monitor Line 1 or Line 2 to Neutral and Line 1 to Line 2 Voltages
- Monitor 120V and 240V currents
- Intended for use with 8247 AC Digital Multimeter (Not included)
- Includes two additional current transformers PN 8256

Blue Sea Systems Inc.
425 Sequoia Drive
Bellingham, WA 98226 USA

Phone (360) 738-8230
Fax (360) 734-4195
E-mail conduct@blueseas.com
www.blueseas.com

⚠ WARNING ⚠

- ☑ It is not possible within the scope of these instructions to fully acquaint the installer with all the knowledge of electrical systems that may be necessary to correctly install this product. If the installer is not knowledgeable in electrical systems we strongly recommend that an electrical professional be retained to make the installation.
- ☑ Do not use this meter panel for systems using two 120V shore cords and individual load groups in the panel. It is potentially hazardous to connect the two shore neutrals together on the boat if certain faults occur in the marina wiring. This panel only has a single neutral reference connection.
- ☑ If either the panel front or back is to be exposed to water it must be protected with a waterproof shield.
- ☑ The panels must not be installed in explosive environments such as gasoline engine rooms or battery compartments as the circuit breakers are not ignition proof.
- ☑ The vessel's shore power cord must be disconnected from shoreside power before installing this electrical panel.
- ☑ If an inverter is installed on the vessel its power leads must be disconnected at the battery before the panel installation. Be aware that many inverters have a "sleep mode" in which their voltage potential may not be detectable with measuring equipment.
- ☑ If an AC Generator is installed aboard it must be stopped and rendered inoperable before the panel is installed.
- ☑ Verify that no other AC source is connected to the vessel's wiring before the panel is installed.

Guarantee

Any Blue Sea Systems product with which a customer is not satisfied may be returned for a refund or replacement at any time.

Introduction

The 120/240V AC Digital Meter Panel (PN 8410) is a kit that allows a single Blue Sea Systems PN 8247 AC Digital Multimeter to completely monitor a 120/240V AC 60Hz, single phase, three wire system. The assembly is installed in a standard sized 4-7/16" x 2-15/16" Blue Sea Systems panel. The 8247 AC Digital Meter (not included) is panel mounted in a precut hole. The kit also includes the two additional Current Transformers (PN 8256) that are shown in the installation drawing.

Understanding Current Flow in 120/240V AC Single Phase Systems

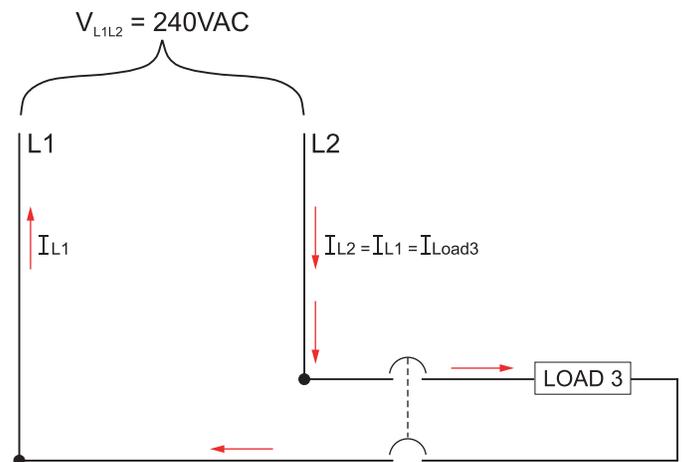
Before beginning installation please read this section to understand exactly how the system must be wired. The easiest way is to understand it one step at a time. We begin by thinking about DC systems.

In a DC circuit we assign a polarity to Voltage and a direction to current flow. By convention current flows out of the positive of the source through the load, where there is a voltage drop, and returns to the negative of the source. It is easy to visualize the current flowing out of a battery, through a light bulb, and back to the battery. There is a voltage rise across the battery and a drop across the light bulb. If we connect another light bulb, it too requires current. The total current will be sum of the current flowing in each bulb.

When we think about AC current flow it is easy to be confused by the fact that the current flow changes direction 60 times a second (or 50 in Europe). That is why we call it alternating current. Fortunately, if we use RMS Voltage and Current, we normally use exactly the same laws and rules for AC and DC. We simply assign a current flow direction, voltage rises and drops, and as long as we stay consistent everything works just like DC. The major exception is when calculating power for non-resistive we must take into account power factor, which is beyond the scope of these instructions.

Current Flow in a 240V Load

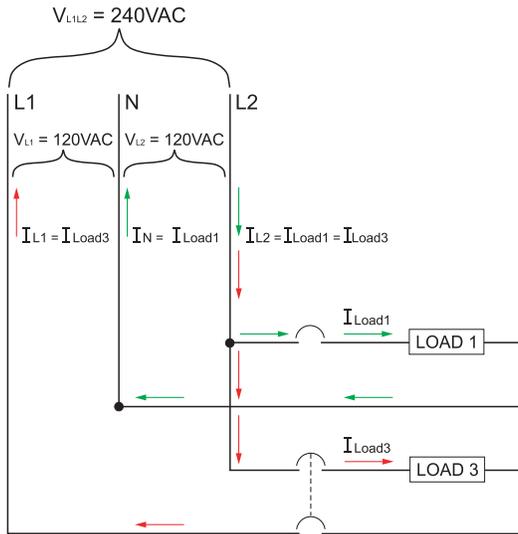
First consider the current flow in a 240V load, in this example Load 3, and assume it is purely resistive. The red arrows indicate the direction we are assigning to the current flow from the AC source, which might be shore power or a generator. We could have reversed the current flow assignment but once a direction is assigned we cannot change it. We have intentionally not shown the neutral.



Adding a 120V Load

Now let's add the Neutral and a 120V load that is connected between L2 and Neutral. The current flow for this load is shown with green arrows. The current flows through the load and returns back to the source (shore power or a generator) via the neutral. We see that the current in L2 is now equal to the current flowing in the 240V Load 3 plus the 120V Load1. We also see that the current flow in Line 1 is unchanged.

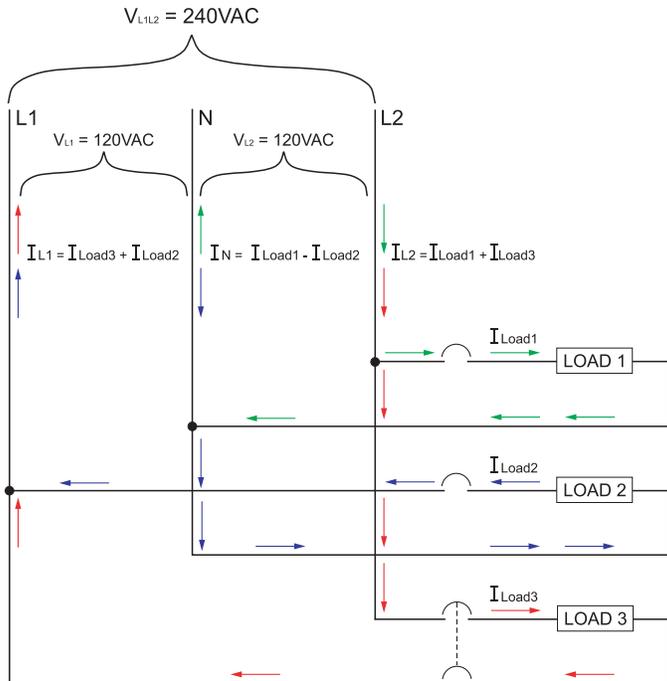
Adding a 120V Load (continued)



Current Flows in a 120/240 Single Phase Three Wire System

Finally, in this diagram we add another 120V load, Load 2 connected to L1 and Neutral. Since we have already assigned a direction to the current flow in L1 we must use the same current flow direction to supply Load 2. We see that the current flow in L1 is equal to the sum of the current flow for Load 3 and Load 2. Just like the current in L2 was the sum of the currents supplying Load 1 and Load 3.

The current flow in the Neutral deserves a special look. Since the currents “flow” in opposite directions we subtract to get the net current flowing in the Neutral. If Load 1 and Load 2 are exactly the same size the Neutral current will be Zero. In fact when the loads are assigned electricians try to balance the load on Line 1 and Line 2 so that the neither leg is overloaded, the result of this is that the Neutral current should be about zero in a well-designed system.

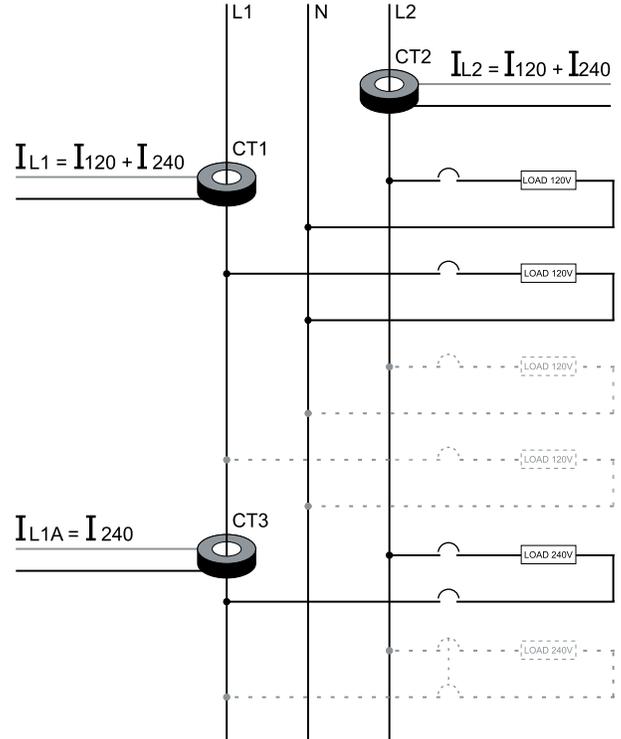


Based on the previous diagram we see that if we want to measure all of the relevant currents in a 120/240V AC system we need to place our current sensing Current Transformers (CT) in the appropriate positions.

To see the current associated with 240V loads alone, we must arrange the distribution panel loads and buses exactly as shown. The current measured by CT1 and CT2 measures the current flow total in L1 and L2. This is the sum of the currents of the 120V loads on that line and the current to the 240V loads. The current measured by CT3 is only that associated with 240V AC loads.

Current Flows in a 120/240 Single Phase Three Wire System (continued)

This approach requires that the 240V loads on the system be “down stream” from the 120V loads. In other words, all of the 120V loads are connected to the bus ahead of the 240V loads. If the bus arrangement cannot be setup in this manner it may only be possible to monitor Line 1 and Line 2 current.



Complete Instrumentation For 120/240V Systems

To fully instrument such a system requires measuring three voltages and three currents:

- 1) Line 1 to Neutral voltage
- 2) Line 2 to Neutral voltage
- 3) Line 1 to Line 2 voltage
- 4) Line 1 total current
- 5) Line 2 total current
- 6) Current flow in only the 240V loads

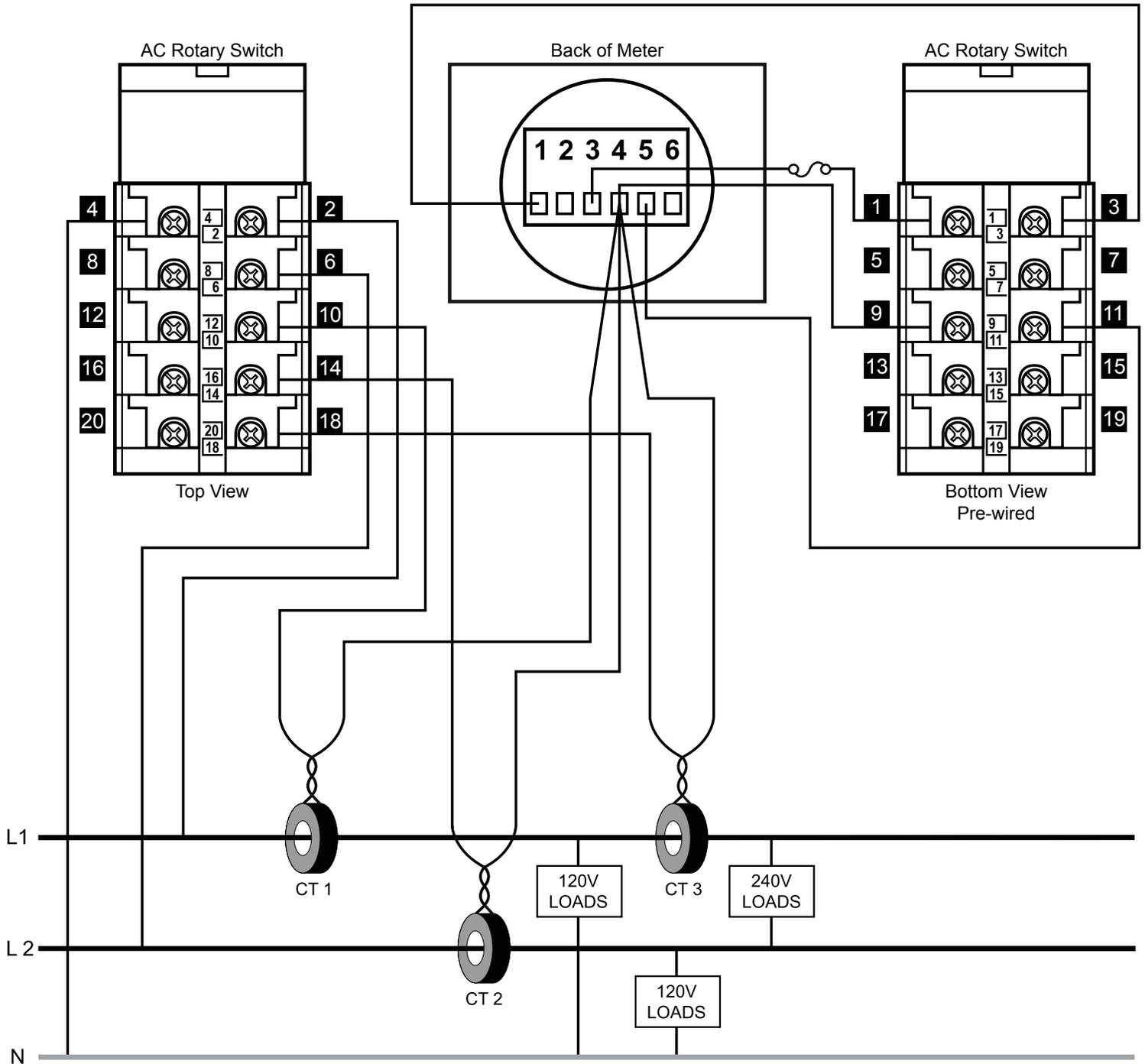
The 8410 Panel when connected as show and installed in a system with the bus arrangement shown allows the 8247 AC Digital Meter to fully monitor a 120/240V AC system.

It is critical that the loads be arranged as shown, otherwise the 120V and 240V load currents cannot be separated. Wired as shown, any current required can easily be calculated. For example: If Line 1 current was 10 Amps, Line 2 current was 20 Amps, and the 240V load current was 5 Amps, then the 120V loads on Line 1 total $10A - 5A = 5A$. Similarly, the 120V loads on Line 2 equal $20A - 5A = 15A$.

It is also possible to monitor the current flow to, or from, a particular load or source, by simply passing the circuit’s hot or neutral wire through its own CT.

AC Voltage

There is no separate voltage sensing for the AC meters, this means that to measure multiple voltages the power to the meter is switched from one source to another. The meter’s internal power supply can tolerate temporary transients but if the “off time” is too long the meter will go through its power up process. This does not damage the meter; it is simply a bit of an inconvenience. This should not normally occur with the 8410 Panel as the rotary switch minimizes “off time”.



Wiring Diagram
 8247 Digital Meter Wiring
 For 120/240 Volt AC

Notes

1. See installation manual for PN 8247 AC Digital Multimeter.
2. See Warnings! Disconnect all AC power originating on or off the vessel. This includes inverters, generators, shore power attachments and any other device capable of supplying AC power to the ship's circuits.
3. Select a mounting location which is protected from water on the panel front and back and is not in an area where flammable vapors from propane, gasoline or lead acid batteries accumulate. The circuit breakers used in marine electrical panels are not ignition protected and may ignite such vapors.

Caution

The wiring complexity is naturally increased by the addition of two more CT's and sensing two additional voltages. **Be careful not to accidentally switch the system voltage on to terminal 4 and 5, the current sensing inputs, as it will suffer serious damage.** If during startup and testing there is a question about the values being displayed bypass the switch and feed the input directly to the appropriate terminals on the meter. This way, correct operation of the meter can be verified as a separate issue from the correct wiring of the switched inputs. Additional information is also available at www.blueseas.com under the technical tab.