Murata Power Solutions

DMS APPLICATION NOTE 23

3-Wire, 240V Single-Phase Power Measurements

Introduction

We are often asked if one ACM20 power meter can be used to measure the total current and total real power (watts) in a 3-wire, single phase, 240V AC mains supply with a neutral conductor and two 120V hot legs. The answer to this question is a conditional "yes," and instructions and limitations—along with important safety precautions—pertaining to this type of configuration are provided in this application note.

This type of 3-wire single-phase system typically supplies power to either 120V loads or 240V loads, or any combination of the two. A wiring diagram showing connections for a typical installation is shown in figure 1 below. The supply wire colors in the diagram (red, black, and white) were chosen for reference only and can vary depending on the installation. Also, while the diagram illustrates a 240V mains supply, it's applicable to most 3-wire, single phase, AC mains in the range of 170Vac to 264Vac (47-63Hz). Detailed instructions for the wiring diagram are provided below.

Please note, the wiring configurations described in this application note involve hazardous—and potentially lethal—voltages and currents. Therefore, all associated work must only be performed by technically qualified personnel, while observing and adhering to all applicable regulatory codes and product data sheets, and with all AC power sources de-energized (OFF).

Detailed Instructions

1. Using a suitable measuring instrument, confirm that the 240Vac power source is de-energized (OFF) prior to making any connections to the ACM20 and all associated loads. To measure the total current and total real power in this type of system, connect the ACM20's rear TB1-A terminal to the neutral conductor and its TB1-B terminal to the 120V hot leg labeled L1 in the diagram. For proper current transformer (CT) phasing, the 120V leg L1 connected to TB1-B must first be routed through the ACM20's built-in CT, with its white polarity dot facing down, and then to the loads it is feeding, following the orientation shown in the diagram. It is extremely important to make sure the CT wiring orientation for both 120V legs is correct.
2. The other 120V leg (L2 in diagram) must be wired such that it first passes through the CT from top to bottom and then to the loads it's feeding, i.e., in a direction opposite to leg L1. This is to ensure proper CT phasing, which in turn will ensure that the two leg currents will be added correctly, and not subtracted. If the phasing of leg L1 with respect to TB1, or L1 to L2 legs is incorrect, the WATTS and AMPS readings will have very large errors, regardless of how much current is flowing in either leg. If the watts and Amps readings appear to be much lower than anticipated, turn the AC power source off and carefully check for correct CT phasing.

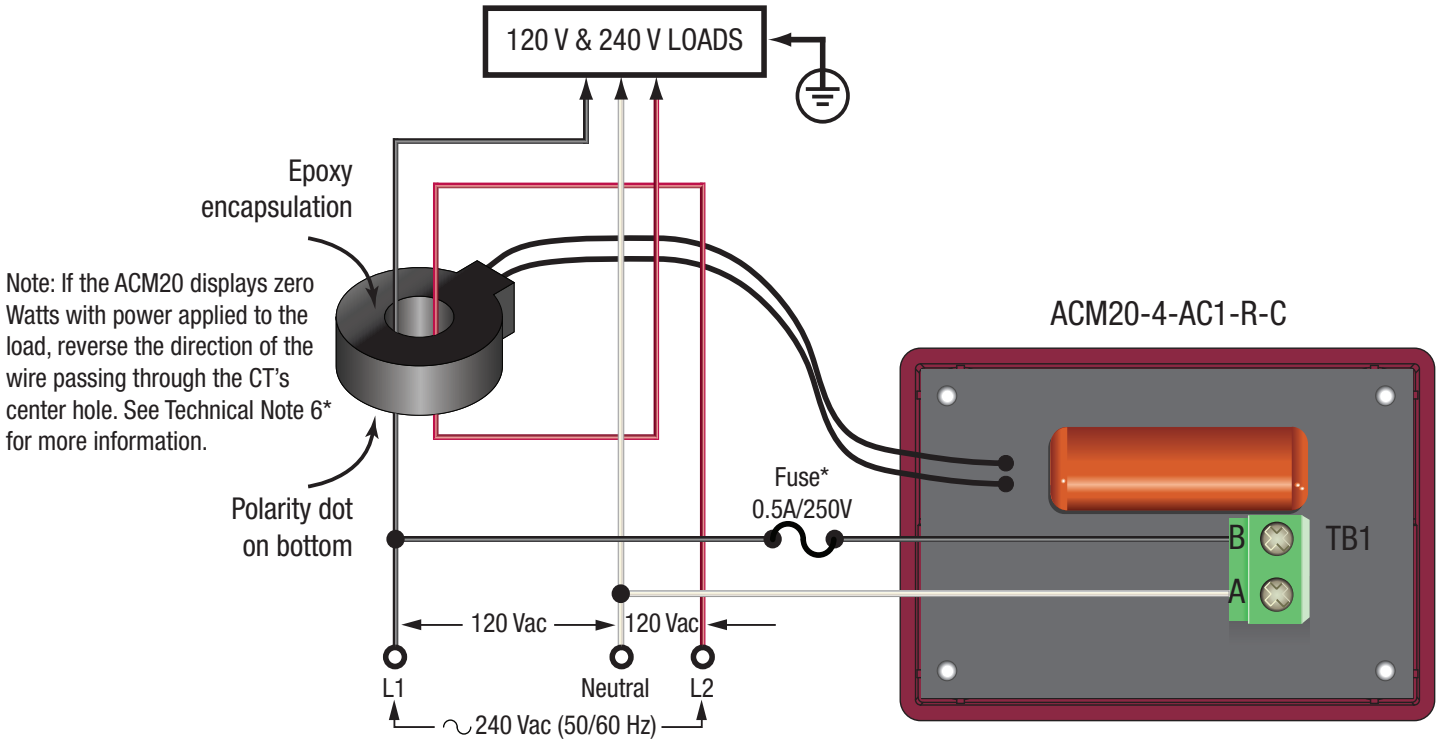

Figure 1. Wiring diagram for 3-wire 120V/240V single-phase systems with neutral wire, monitoring total current and total power

***Click here to view the ACM20 data sheet for more information.**

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Precautions and limitations applicable to 3-wire, single-phase wiring configurations:

1. The ACM20's VOLTS reading will always be that of leg L1 (120Vac), and not the full 240Vac supply. The voltage of leg L1 is used for all power and power factor calculations. Therefore, any voltage imbalances between legs L1 and L2 will introduce WATTS reading errors, with the magnitude of these errors being proportional to the voltage imbalance. In most applications, voltage imbalance errors are usually relatively low. However, imbalance errors are in addition to those specified in the ACM20 data sheet's "Performance/Functional Specifications" section.
2. Due to the unique nature of this wiring configuration, Murata Power Solutions cannot guarantee that the ACM20 will meet all of its standard published specifications. **IMPORTANT: the sum of the currents flowing through the ACM20's built-in CT cannot exceed the ratings for that particular model's input range.** For example, when using the 100A model in this configuration, the sum of the currents in legs L1 and L2 cannot exceed 100 Amps.
3. The 100 Amp model (ACM20-4-AC1-R-C) should be used for this configuration because of its higher current rating and ability to display power in Kilowatts. This particular model is rated for 100A, but has an overcurrent capability of 150A.
4. Fusing the ACM20's TB1 input lines is always required; complete fusing specifications and instructions are included in the ACM20 product data sheet. For reference, a link to the ACM20 data sheet is provided here: **http://www.murata-ps.com/data/meters/acm20.pdf**.
5. The products described in this application note are subject to Murata Power Solutions' "Operating Requirements" and the "Life and Safety Critical Applications Sales Policy" described at **http://www.murata-ps.com/requirements**.
6. Any mechanical or electrical modifications to the ACM20 (adding CT lead extensions, use of substitute hardware or components, etc.), or failure to adhere to the data sheet's specifications and instructions, will void its warranty and safety-agency certification status.

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