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Application Note *AN0805*

Using WattsOn® in Single Phase Installations

Associated Product: WattsOn

Summary

The WattsOn® Power Transducer may be used in single, split, three and multi-phase installations. Because the WattsOn measures and accumulates all of its parameters on a per-phase basis, a single WattsOn unit may be used on multiple single-phase circuits, provided that the circuits share the same neutral.

In situations where only one phase is to be measured, depending on the wiring configuration, there may be a few different options.

The WattsOn and associated wiring must be installed in accordance with all National and Local Electrical building and safety codes.

The WattsOn can easily measure single and split phase installations, but some precautions may need to be taken depending on the installation. It is important to understand that the WattsOn measures all voltages relative to its "N" terminal.

Care should be taken to ensure that the "N" terminal is correctly wired to the system neutral, rather than the "HOT". This is specifically important in mA and mV (ie: non 5A) input versions of the meter. The reason for this is that the CT terminals are also referenced to the "N" terminal, and wiring a "HOT" conductor to the "N" terminal will effectively cause the CTs leads to be on the same potential. This method is valid from a metering perspective, but safety precautions should be observed (as discussed further in this application note).

Scenario #1: Single Phase system, 2-Wire (Hot & Neutral)

In this situation, there is one hot wire, and one neutral. The hot wire should be wired to "V1", and the neutral wire should be wired to "N". One CT should be connected between the I11 and I12 terminals. As an added (optional) step, the V2 and V3 terminals may be jumpered to "N", and the I21/I22 terminals jumpered together, along with the I31/I32 terminals jumpered together. Refer to Figure 1

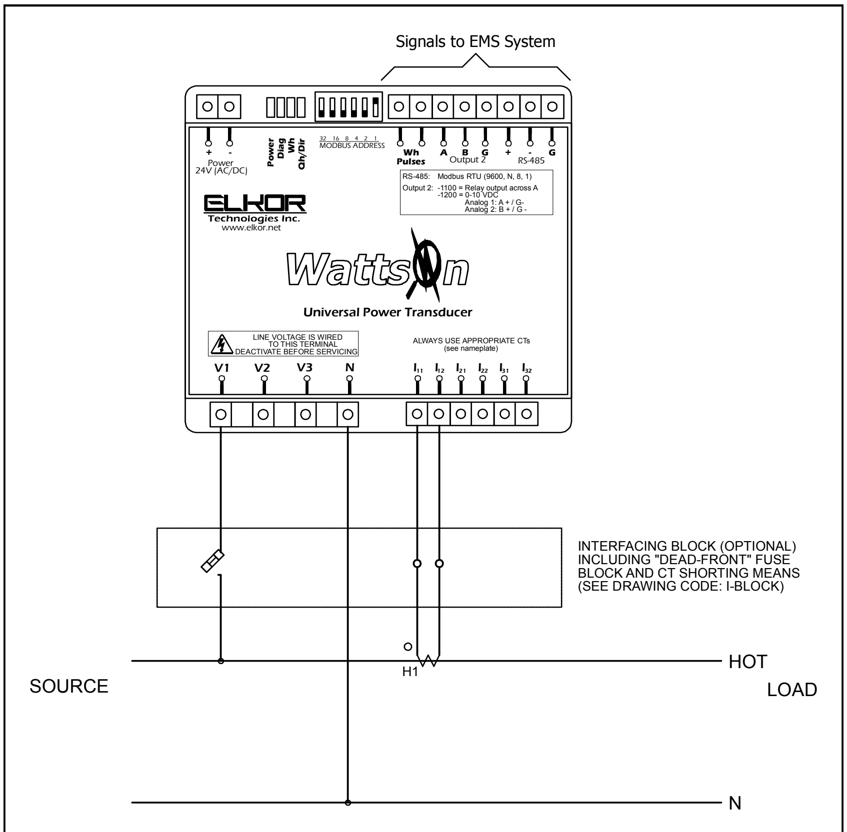

Figure 1

In this wiring scenario, the readings will be valid in the individual phase registers, as well as the total energy/ power registers. In this case the "average voltage" and "average current" registers will be incorrect (because they take the sum of THREE phases and divide by three), however they should simply be ignored.

Line-to-Line voltages (Vab, Vbc, Vac) should be ignored. These values are calculated by the WattsOn assuming a three-phase system (120° phase shift between phases). These values should simply be ignored.

Scenario #2: Split Phase system, 3-Wire (2-Hot & Neutral)

This is the most common wiring configuration for residential and small commercial installations. This is essentially a single phase 240V system, with a centertap (neutral). In this case, the WattsOn should be wired with one HOT (L1) to "V1", the other HOT (L2) to "V2" and the neutral to "N". Two CTs must be used for proper accuracy, such that both the 120V and 240V loads may be properly monitored. Refer to Figure 2

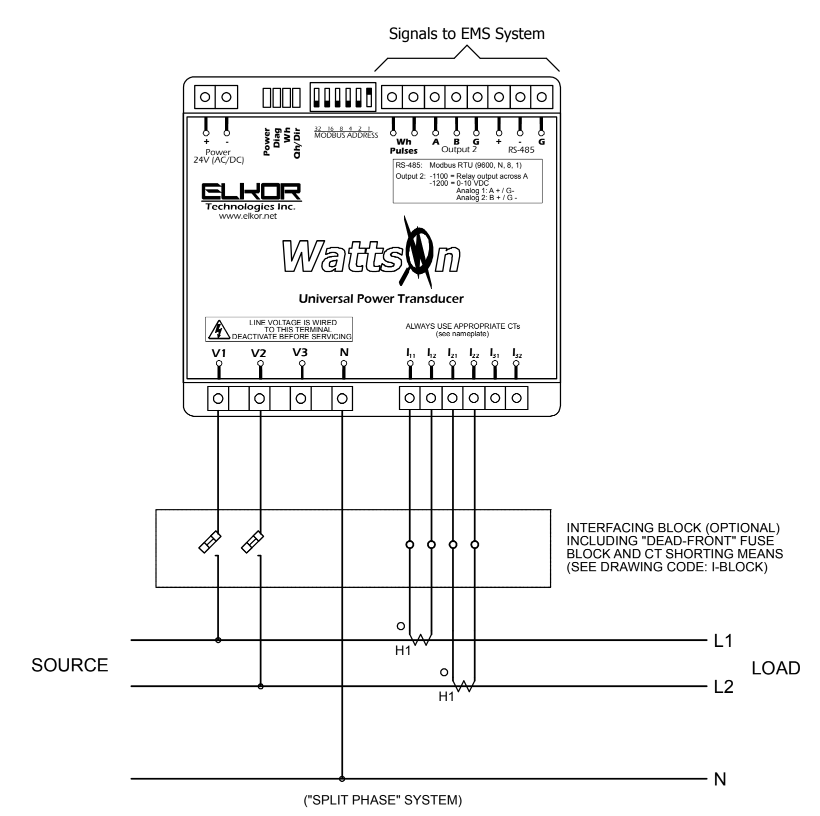

Figure 2

In this wiring scenario, the readings will be valid in the phase A and phase B registers, as well as the total energy/power registers. Phase C registers will read 0. The "Average voltage" and "Average current" registers will be incorrect (because they take the sum of THREE phases and divide by three), and they should simply be ignored. However, it is possible to change the way that the average registers are computed, to display a sum (A+B+C) rather than average ((A+B+C)/3). Please refer to the WattsOn manual regarding the Configuration Word bits.

Line-to-Line voltages (Vab, Vbc, Vac) should be ignored. These values are calculated by the WattsOn assuming a three-phase system (120° phase shift between phases). These values should simply be ignored.

Scenario #2: Split Phase system, 2-Wire (2-Hot)

This wiring configuration does not typically exist on its own, but rather as a part of a solar or wind inverter system. That is, the installation is typically a "split" phase (or three-phase) wiring type, but the inverter does not have a neutral, and supplies power to the two "HOT" legs of the system.

This type of system presents some challenges, and there are a few options to monitor this system type, each having their own advantages and disadvantages. The options are discussed below:

Option 1: Wire the system with a Neutral

Although the inverter itself does not have a neutral, it is feeding a system that does. Therefore, the best method, if at all possible is to wire the system using two CTs, and the two "HOT" lines from the inverter, as per Figure 3.

This is the preferred wiring method whenever possible. It yields the best accuracy, and presents no issues with safety.

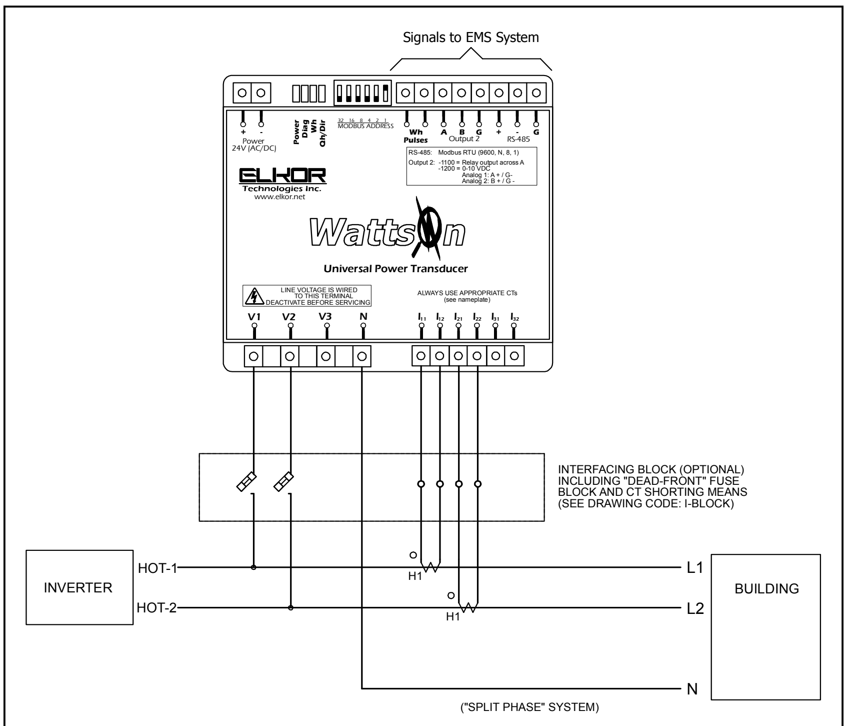

Figure 3

In this wiring scenario, the readings will be valid in the phase A and phase B registers, as well as the total energy/power registers. Phase C registers will read 0. In this case the "average voltage" and "average current" registers will be incorrect (because they take the sum of THREE phases and divide by three), and they should simply be ignored. However, it is possible to change the way that the average registers are computed, to display a sum (A+B+C) rather than average ((A+B+C)/3). Please refer to the WattsOn manual regarding the Configuration Word bits.

Line-to-Line voltages (Vab, Vbc, Vac) should be ignored. These values are calculated by the WattsOn assuming a three-phase system (120° phase shift between phases). These values should simply be ignored.

Option 2: Wire the system without a Neutral

Although option 1 is recommended whenever possible, in situations where access to the building neutral is impossible, the WattsOn may be wired using the two hot legs of the inverter only. In this case, one Hot from the inverter would be wired to "V1" and the other Hot would be wired to "N". Only one CT will be used in this case as per Figure 4.

If using a 5A meter (ie: meter designed for use with 5A CTs), this type of wiring method poses no additional concerns, because the 5A meter has internal hardware that completely isolates the CT input terminals from the voltage terminals.

HOWEVER, in the case of mA and mV input models, the CT input terminals are tied to the same potential as the "N" terminal (in this case, one of the HOT leads from the inverter), and may create a potentially unsafe condition.

The meter will produce accurate readings, however, extra care must be taken from a safety perspective. These precautions should be followed regardless of the system and model being worked on, but are especially critical in this case:

1. The CTs, and CT terminals must not be serviced with live input voltage to the meter. That is, the voltage leads coming into V1 and N must be completely disconnected before ANY of the CT wires are installed, or removed from the Ixx terminals.

2. The CT leads should be marked as hot for added safety.

3. The CTs and meter should be contained in the same cabinet, to avoid any potential confusion regarding the CT leads outside the cabinet.

4. As with all mA and mV CT installations, the CTs must NOT be grounded.

5. This method must not be used in systems whose line-to-neutral voltage exceeds 250VAC.

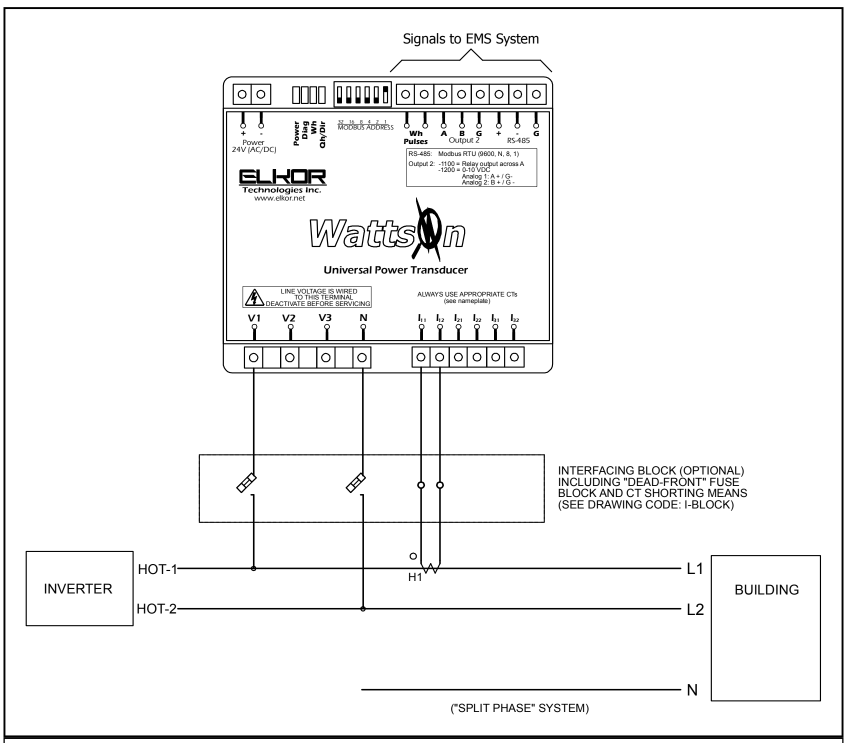

Figure 4

In this wiring scenario, the readings will be valid in the A phase register, as well as the total energy/power registers. The "Average Voltage" and "Average Current" registers will be incorrect (because they take the sum of THREE phases and divide by three), and they should simply be ignored.

Line-to-Line voltages (Vab, Vbc, Vac) should be ignored. These values are calculated by the WattsOn assuming a three-phase system (120° phase shift between phases). These values should simply be ignored.

Option 3: Wire the system without a neutral, use GROUND into the "N" terminal.

In most installations, the available GROUND will be at the same potential as the system Neutral. Therefore the WattsOn may be wired as per Figure 5.

In this case, the HOT leads from the inverter are wired to "V1" and "V2" respectively, and the "N" terminal is wired to ground. This method requires two CTs.

This method poses some issues from a metering perspective. If the GROUND of the meter and the GROUND of the building are at the same potential AND at the same potential as the building Neutral, this method will work.

However, if the grounds are at different potentials, it is possible that some metering error will be introduced. Depending on the physical location of the grounding points, the type of cabling used the distance from the ground-to-neutral bonding point, and the system load balance, it will determine the magnitude of the error.

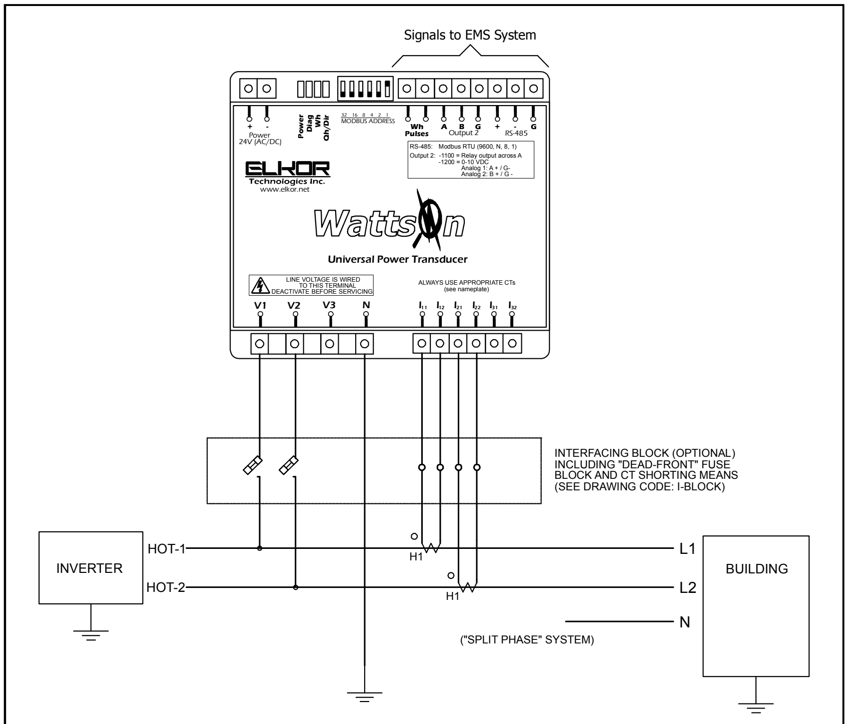

Figure 5

In this wiring scenario, the readings will be valid in the phase A and phase B registers, as well as the total energy/power registers. Phase C registers will read 0. In this case the "average voltage" and "average current" registers will be incorrect (because they take the sum of THREE phases and divide by three), and they should simply be ignored. However, it is possible to change the way that the average registers are computed, to display a sum (A+B+C) rather than average ((A+B+C)/3). Please refer to the WattsOn manual regarding the Configuration Word bits.

Line-to-Line voltages (Vab, Vbc, Vac) should be ignored. These values are calculated by the WattsOn assuming a three-phase system (120° phase shift between phases). These values should simply be ignored.