

Computed Current Measurement - CompCurrent

Overview

The WND Series WattNode® Modbus® meters can compute a current—typically neutral—using the other measured currents. The computed current feature calculates the imbalance of the CT inputs and reports the RMS current value of the imbalance. In a well-balanced three-phase wye service or split-phase service, the current flow through the neutral wire is near zero. Imbalance or harmonics can increase the neutral current, in some cases, exceeding the rated limits for the wiring. Using this computed neutral current, an external controller can safely disable the service to prevent damage.

Additionally, the computed current feature can compute the current flow for one phase of a three-phase delta service where only two CTs are used, or one leg of a two wire service where only one CT is used.

Details

The computed current feature was introduced in firmware version 34 for all WattNode Modbus meter models: WND-WR-MB, WND-M1-MB, WND-xx-xxx-MB, and RWND-xx-xxx-MB, where xx-xxx is the voltage model.

In order to use the computed current feature, the following conditions must be met:

- The **CtAmps1**, **CtAmps2**, and **CtAmps3** registers must all be set to the same value. The **CtAmps** register (1603) reports a zero value when the **CtAmps1**, **CtAmps2**, and **CtAmps3** registers (1604, 1605, and 1606) are not equivalent, and the **CompCurrent** register will also report a zero value in this situation.
- For the circuit being monitored, you must install CTs on N-1 conductor, where N is the number of distinct conductors, not including ground (this assumes no ground current). For example:
 - For a three-phase wye service, there are four conductors (N, L1, L2, L3), so you must have CTs on three of these (generally L1, L2, and L3) in order to compute the current on neutral (N).
 - For a three-phase delta service, there are three conductors (L1, L2, L3), so you must have CTs on two of these to compute the current on the third.
 - For a three-wire 120/240 split-phase service, there are three conductors (N, L1, L2), so you must have CTs on two of these to compute the current on neutral (N).
- When using the computed current feature, you can only measure a single circuit because the meter will base the computed current on all active CTs. There is no way to select particular CTs to use for the computed current.
- We recommend setting the **MeterConfig** register to zero for any meter elements / CTs that are not being used. This ensures the meter will not pick up noise on unused CT inputs which might affect the computed current. This only applies to cases where only one or two CTs are being used.

The computed current feature includes the following updates and details:

- Add the **CompCurrent** register (1199, 1200) to the floating-point register set. This reports the floating-point computed RMS current value. It is always positive.

- Add the **CompCurrentInt** register (1380) to the integer register set. This reports the 16-bit integer computed RMS current value. It is unsigned and always positive. The integer current registers are scaled so that a reported value of 20,000 corresponds to the rated amps. For example, if the rated amps of the CTs are 100 and **CompCurrentInt** reports a value of 6,000, then the measured current is $100 \times (6000/20000) = 30$ amps.
- The **CtDirections** register (1607) works as usual to optionally invert the polarity of one or more current inputs. Changing the **CtDirections** will affect the computed current. If the direction (polarity) of a CT is incorrectly reversed (CT backwards, white/black wires swapped, **CtDirections** set incorrectly), the computed current value will be meaningless.
- The **MeterConfig1**, **MeterConfig2**, and **MeterConfig3** registers (1624, 1625, and 1626) are used to control the power and energy calculations for the meter elements and CT inputs 1, 2, and 3, respectively. Disabling a CT input with a value of zero removes that current input from the **CompCurrent** computation.
- When the **Current1**, **Current2**, and **Current3** registers (1163, 1164, and 1165) are all below the threshold value for the **CreepLimit** register (1618)—0.04% of rated current by default—the **CompCurrent** register will report zero.
- Averaging is applied to the **CompCurrent** value based on the **Averaging** register (1608).

Notes

Accuracy

While the computed current feature may be used in place of an additional CT device to estimate the current flow in an unmeasured phase or neutral wire of a circuit, the accuracy of this computation is limited by a combination of factors, particularly measurement noise, and will be less accurate than the directly measured currents.

Specifically, testing shows that the typical additional error is approximately:

$$Err_{typ} = \frac{0.15\%}{\%FS}$$

Where $\%FS$ is the percentage of full-scale (or rated) amps. For example, if **CtAmps** = 200 and **CompCurrent** is reporting 20 A, that is 10% of full-scale, so the error would be $0.15\%/10\% = 1.5\%$.

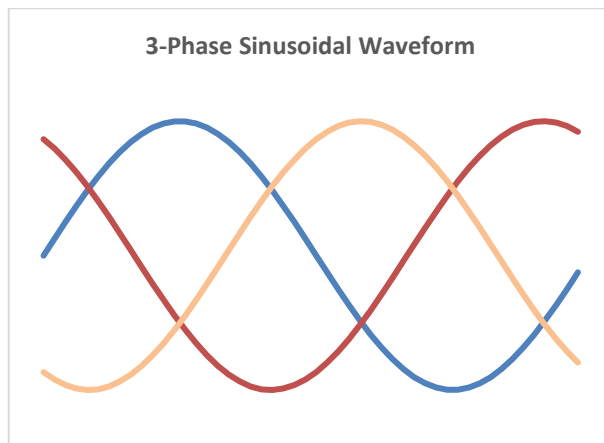
Power Measurement

The computed current cannot be used for power or energy measurements.

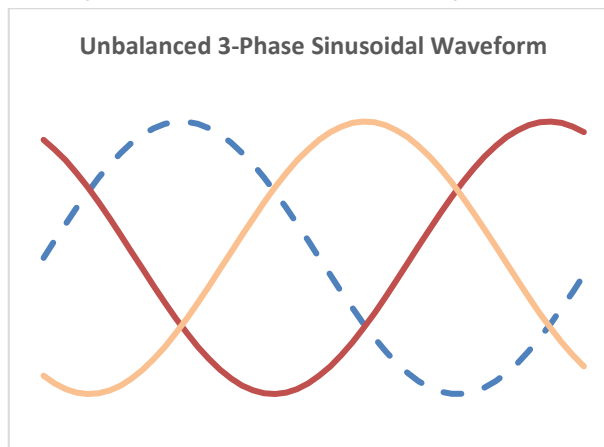
Theory of Operation

Electrical current is conserved. Unless there is leakage current (what GFCIs try to detect), the moment-by-moment sum of the currents in all the conductors for a circuit will always add to zero. The meter uses this to compute the current in the conductor that is not being monitored with a CT. This works only if all conductors but one (not counting ground) are monitored with CTs.

In a perfect three-phase wye alternating current service, the current flow in each of the phases is alternating positive or negative, and the sum of these flows is zero. The moment-by-moment calculation of current flows in a real-world circuit rarely yields exactly zero, and a neutral wire current offsets the imbalance.



If the current flow in one of the phases were disrupted, the imbalance in the circuit will result in current flowing through a neutral wire or possibly to ground. The amount of current flowing would then be the same magnitude as the current flow in the uninterrupted phases.



Similarly, current flows in a split-phase service sum to zero, and any imbalance in the current flows may be calculated to estimate the remaining current.

Additional Information

See the full manual for your model for information not in this supplement.

Contact technical support for any further questions.