WattNode for LonWorks - Option PT

Overview

Option PT improves support for potential transformers (PTs), making it easier to use WattNode® for LONWORKS® meters with medium voltage services. Specifically, Option PT adds a configuration property ***UCPTptRatio*** which configures the ratio of the external PT, allowing the meter to automatically scale the voltage, power, and energy readings.

Continental Control Systems (CCS) offers Option PT for the WattNode for LonWorks, Plus and Logger models. Option PT is not available with Option B or Option BI.

Equipment

CCS supplies the WattNode meter rated up to 600 Vac and current transformers rated for use on circuits up to 600 Vac. CCS does not supply potential transformers, fuses, or CTs rated for use on medium voltage circuits, so you will need to find other suppliers for these components.

Current Transformers

Continental Control Systems does not sell CTs rated for use over 600 Vac, so in many cases, meters used with Option PT will use medium voltage ratio CTs with a 5 amp output, such as a 500:5 CT rated for 5 kV (or higher). The output of this will then need to be monitored with one of our CTs that can convert the 5 amp signal to a 0.333 Vac signal:

- CTM-0360-005 - split-core CT
- ACT-0750-005 - Accu-CT™ split-core CT (available late 2011)
- CTT-0300-005 - solid-core (toroid) CT

When you use two CTs together like this (a ratio CT combined with a voltage output CT), you should use the primary current **of the ratio CT** as the ***nciCtAmps*** value in the WattNode meter. For example, if the medium voltage CT is a 500:5 ratio, enter 500 as the ***nciCtAmps***.

It may be difficult to determine the correct polarity (which direction is the source) when wiring a 0.333 Vac CT onto a 5 amp output ratio CT. If you get this reversed, the indicated power will be negative. This can be corrected by swapping the white and black CT wires where they connect to the WattNode meter screw terminal.

Potential Transformer Circuits

This section describes the most common service types and PT circuits encountered. It provides recommended wiring diagrams and information on the measurements. In most cases, PTs are used with medium voltage circuits ranging from 2400 Vac to 35,000 Vac, so this will show medium voltage examples. The same circuits may also be used for lower voltage PTs.

Three-Wire Delta Service

Many medium voltage services are three-wire delta services without a neutral conductor. These use one of the following grounding schemes:

- **Floating:** In many cases, delta wound transformers are left ungrounded. This has the advantage of allowing a single-phase fault to ground without disrupting service.
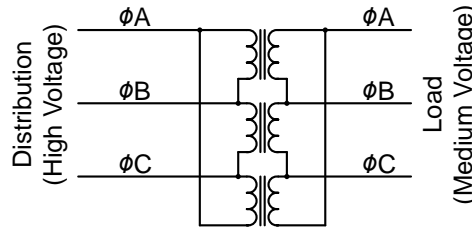
- **Corner Ground:** One corner, typically phase B, is grounded.
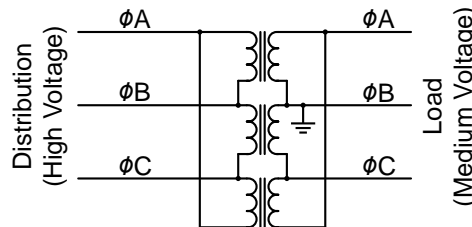
Figure 1: Utility Transformer: Delta-to-Delta With Corner Ground

- **Center Ground:** In this configuration, one winding is center-tapped and the center point tied to ground.
- **Other:** Other possibilities are possible (though uncommon) and include resistive grounding and inductive grounding.

All of the above grounding configurations (including floating) can be monitored as shown in **Figure 2**. This can use two or three element PTs. The third PT element is redundant (unnecessary) for this configuration and is shown in gray in the figure. As a result of grounding the phase B output of the PT, the WattNode meter will only report voltage, current, power, and energy for two phases: phase A and phase C.

Blondel's theorem explains that the sum results (***nvoPowerSum*** and ***nvoEnergySum***) are accurate with this configuration. However, the reported power, reactive power, and power factor for the two individual phases may appear imbalanced, even if the actual load is balanced, so in this configuration, only the power and energy sums are meaningful.

Because CCS does not offer a WattNode model that supports a delta circuit with 120 Vac line-to-line, you must wire the meter line-to-neutral. Therefore, we recommend using phase B as the reference and tying it to ground and neutral. This will result in zero readings for phase B from the meter.

Note, the PT primaries are monitoring the medium voltage **line-to-line** voltages, so select the PT ratio based on the line-to-line voltages.
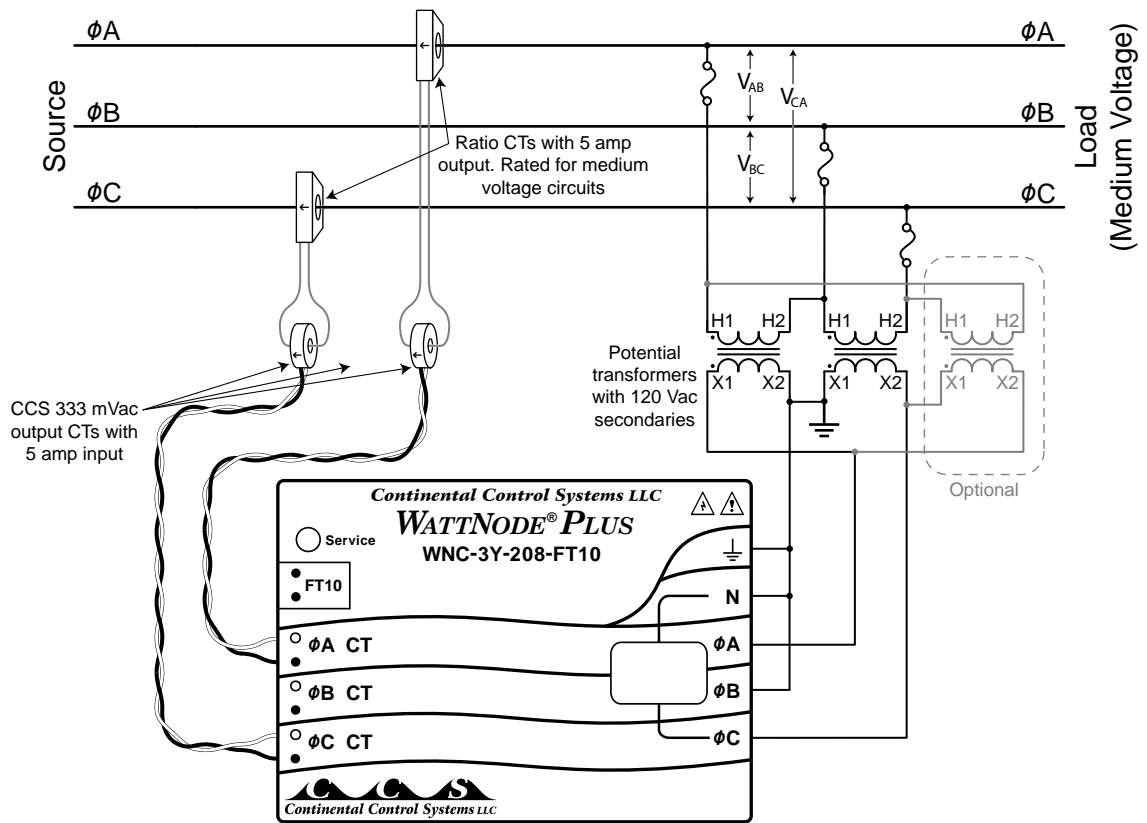
Figure 2: Monitoring a Delta Circuit

Four-Wire Wye Service

This is a medium voltage wye service with a neutral conductor. The utility transformer may be a delta-wye (shown below) or a wye-wye transformer.
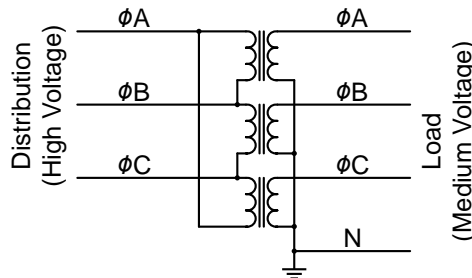

Figure 3: Utility Transformer: Delta-to-Wye

Four-wire wye service is monitored with the three-element PT configuration shown in **Figure 4** below. The meter will provide per-phase voltage, current, power, and energy readings that correspond to the medium voltage quantities.

In this configuration, the PT primaries and secondaries are both wired in wye configurations. If either side of the PT were wired in a delta, it would cause a 30° voltage phase shift and incorrect readings.

Note, the PT primaries monitor the medium voltage **line-to-neutral** voltages, **not** the line-to-line voltages. So be careful to select the correct PT ratio. For example, if the medium voltage circuit is 4160/2400Y (2400 Vac line-to-neutral) you would need a 20:1 PT ratio to step the voltage down to 120 Vac.
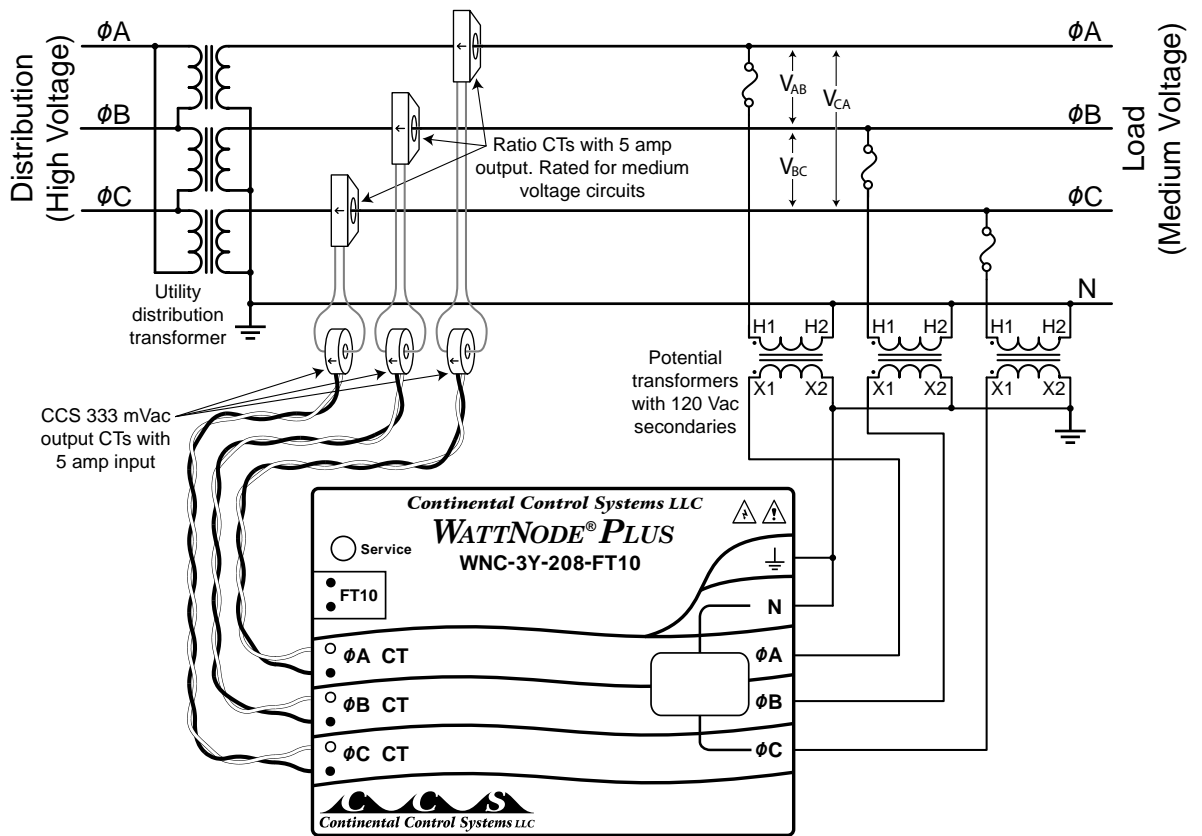
Figure 4: Monitoring a Four-Wire Wye Circuit With Neutral

Three-Wire Wye Service (No Neutral)

This is the same as the four-wire wye service except no neutral wire is brought out to the load. V_A to ground, V_B to ground, and V_C to ground are all nearly equal. The ground potential is the same as neutral if neutral were used.
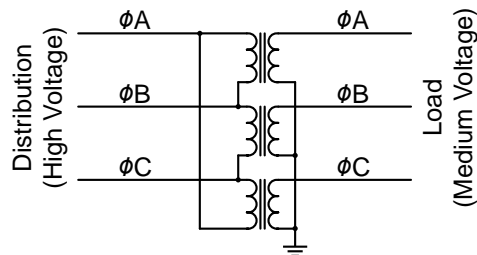

Figure 5: Utility Transformer: Delta-to-Wye Without Neutral

Three-wire wye service can be monitored with two different PT configurations.

● **Two-Element PT:** See **Figure 2: Monitoring a Delta Circuit.**

● **Three-Element PT (Wye Output):** This is the preferred PT configuration, because the meter will provide per-phase voltage, current, power, and energy readings for all three phases.

In this configuration, the PT primaries and secondaries are both wired in wye configurations. If one side of the PT were wired in a delta, it would cause a 30° voltage phase shift and incorrect readings.
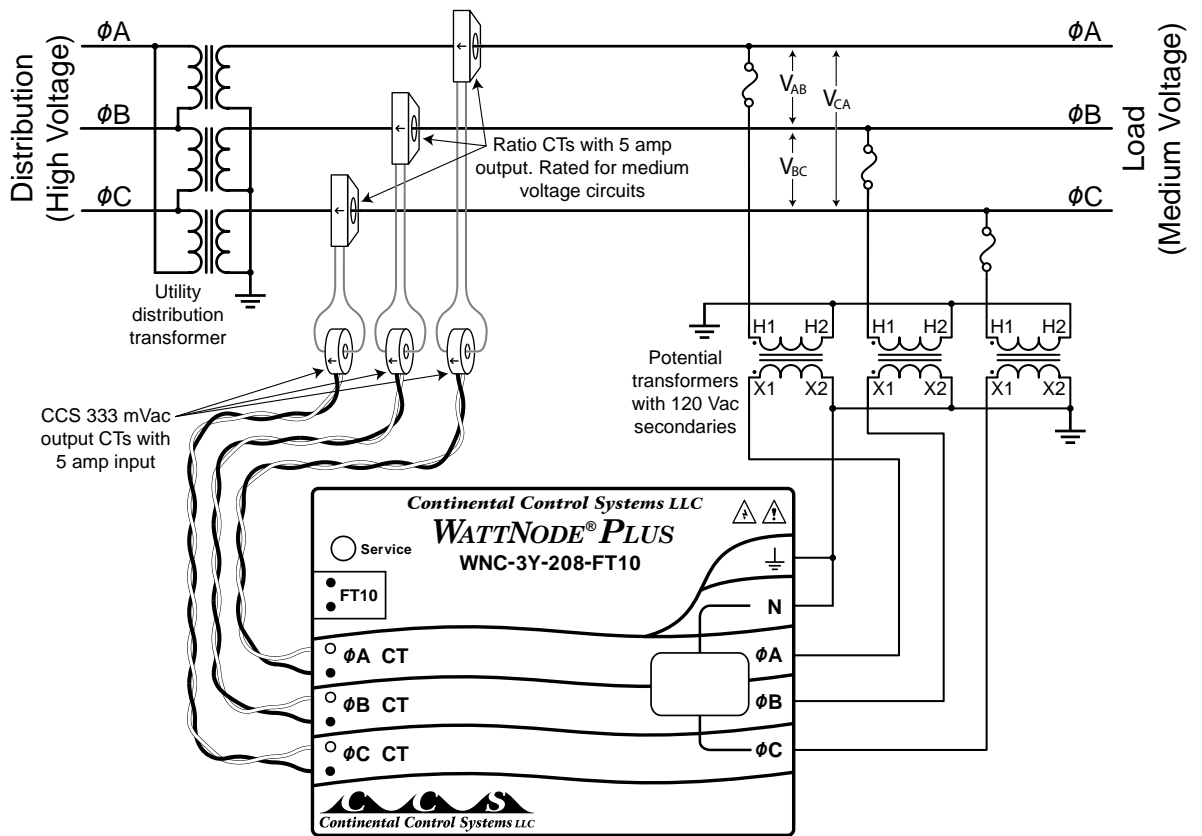
Figure 6: Monitoring a Three-Wire Wye Circuit without Neutral

Note, the PT primaries are monitoring the medium voltage **line-to-ground** voltages, **not** the line-to-line voltages. So be sure to select the correct PT ratio. For example, if the medium voltage circuit is a delta with 4160 Vac line-to-line, then the line-to-ground voltages will be 2400 Vac and you would need a 20:1 PT ratio to step down to 120 Vac.

Do not use the circuit in **Figure 6** if the medium voltage service does not come from a distribution transformer with a wye secondary, because the PT primary voltages may be indeterminate or mismatched.

Configuring the PT Ratio

Potential transformers convert medium (or high) utility voltages down to a lower voltage that is compatible with the WattNode meters. PTs are described by the step-down ratio as shown in the following table of common ratios.

PT Primary Voltage	PT Secondary Voltage (Line-to-Neutral)	Ratio = *UCPTptRatio*
2400	120	2400:120 = 20
4200	120	4200:120 = 35
4800	120	4800:120 = 40
7200	120	7200:120 = 60
8400	120	8400:120 = 70
12000	120	12000:120 = 100
14400	120	14400:120 = 120

Table 1: Common PT Ratios

The ***UCPTptRatio*** values are just the primary voltage divided by the secondary voltage. For example, 4200 / 120 = 35.

In rare cases, it is also possible to use a reverse PT to step up a lower voltage like 12 Vac to 120 Vac to enable a WattNode meter to monitor 12 or 24 Vac power consumption. This would result in PT ratios like 0.1 (12 Vac to 120 Vac) or 0.2 (24 Vac to 120 Vac).

In the United States and Canada, most PTs have a secondary voltage of 120 Vac, so we have assumed that for this supplement. If your PT has a different secondary voltage, you will need to make sure the WattNode meter's voltage rating matches the secondary voltage. The following table shows some possible PT secondary voltages and the associated WattNode models you would use.

PT Secondary Voltage (Line-to-Line)	PT Secondary Voltage (Line-to-Neutral)	WattNode Model
120	69	Not supported
208	120	WNC-3Y-208-FT10
230	132	WNC-3Y-208-FT10
400	230	WNC-3Y-400-FT10

Table 2: PT Secondary Voltages and WattNode Models

Note: Because CCS does not offer a model with a power supply that can operate from 120 Vac line-to-line or 69 Vac line-to-neutral, it may be necessary to tie one PT output voltage to neutral and ground as shown in **Figure 2**.

Once you have determined the correct PT ratio, program this into ***UCPTptRatio*** using LonMaker®, the WattNode LNS® Plug-In, or another LonWorks tool. ***UCPTptRatio*** is limited to the range 0.05 to 300. If you try to configure a value less than 0.05 or greater than 300, the meter will revert to a PT ratio of 1.0 (effectively no PT).

If you know the PT ratio at the time you are ordering the meter, you may specify the ratio as part of the option to have the ratio pre-programmed by the factory. For example, for a 4200:120 ratio PT, you would order the following:

WNC-3Y-208-FT10 Opt PT=35

The value following the "**PT=**" must be the ratio as a single number. Do not specify the primary voltage or two numbers separated by a colon.

If you do not know the PT ratio when you are ordering the meter, then add "**Opt PT**" to the model. The meter will ship with the PT ratio set to 1.0 and will need to be field configured.

Installation and Configuration

This section describes the files you will need to install first, followed by basic instructions on installing the WattNode meter.

The following webpage provides links to all the files you will need.

http://www.ccontrolsys.com/w/WattNode_LonWorks_Option_PT

WattNode LNS Plug-In

If you are using the WattNode LNS Plug-In, you will need to upgrade to the latest version for Option PT compatibility (version 1.11 or later). If you install the plug-in, it will automatically update your resource files and install the new XIF files.

- http://www.ccontrolsys.com/w/LNS_Plug-in

Resource Files

If you are not installing the new plug-in, you will need to manually install the latest LON-MARK® resource files (version 1.05) to add support for the new LonWorks configuration property ***UCPTptRatio***. See the following links

- **Resource Files Webpage:** http://www.ccontrolsys.com/w/LonWorks_Resource_Files
- **Resource Files Download:** CControlsys-Resource-Files-V1.05.zip
- **Resource Files Installation Instructions:** AN-118

External Interface (XIF) Files

The Option PT models have updated XIF files. If you are not installing the new plug-in, then see the following webpage for links to download the XIF files:

- http://www.ccontrolsys.com/w/WattNode_LonWorks_Option_PT

WattNode Meter

WattNode meters with Option PT are installed like regular models, but they do have a new program ID and XIF (external interface) file, so you cannot treat them as identical to the regular models.

After you have installed the meter, if the PT ratio was not factory programmed, configure it now using ***UCPTptRatio***. Also configure the ***nciCtAmps***. Verify that the voltages, currents, power and power factor values are reasonable.

Notes

Energy Rollover

The WattNode for LonWorks models have an internal energy rollover point of 100 GWh (100,000,000 kWh). When the energy reaches the rollover point, it rolls over to zero (like an odometer rolling around to zero). Generally it requires years to reach this rollover point, but with Option PT, rollovers could occur much more often.

For example, in an extreme case, with the maximum PT ratio of 300, 5000 amp current transformers, and a very high continuous load of 75% of maximum, the energy could reach 100 GWh in as little as 30 days.

A more realistic example might be a PT ratio of 60 (7200 Vac) and 2000 amp CTs, resulting in a rollover roughly once per year.

PT Burden

The WattNode meter will be powered from the PT secondaries, so you will need to select a PT with a high enough burden rating. WattNode for LonWorks models draw between 2 and 3 VA at a power factor (PF) between 0.7 and 0.8, and so require a potential transformer that is rated for that burden.

There are standard ANSI C57.13 letter codes for PTs rated to handle different burdens:

- **W:** 12.5 VA @ 0.10 PF. WattNode meters draw far less than 12.5 VA, but the meter power factor is much higher than 0.10, so the accuracy of the PT might be affected.
- **X:** 25 VA @ 0.70 PF. This can easily supply a WattNode meter.
- **M:** 35 VA @ 0.20 PF. WattNode meters draw far less than 35 VA, but the meter power factor is higher than 0.20, so the accuracy of the PT might be affected.
- **Y:** 75 VA @ 0.85 PF. This can easily supply a WattNode meter.
- **Z:** 200 VA @ 0.85 PF. This can easily supply a WattNode meter.

Detailed Changes

The Option PT meters are very similar to the regular Plus and Logger models, but with the following changes:

- Addition of the ***UCPTptRatio*** configuration property: The ratio is a floating point number that can range from 0.05 to 300.
- Updated calculations to include the ***UCPTptRatio:*** The following network variables are scaled by ***UCPTptRatio*** (current and power factor are not affected):
  - **Voltage:** nvoVoltsA, nvoVoltsB, nvoVoltsC
  - **Power:** nvoPowerSum, nvoPowerA, nvoPowerB, nvoPowerC
  - **Reactive Power:** nvoReacPwrSum, nvoReacPwrA, nvoReacPwrB, nvoReacPwrC
  - **Demand:** nvoDemand, nvoDemandPk
  - **Energy:** nvoEnergySum, nvoEnergySumNR, nvoEngyPosSum, nvoEngyPosSumNR, nvoEnergyA, nvoEnergyB, nvoEnergyC
  - **Reactive Energy:** nvoReacEngySum
- New program IDs: Because there is a new PT ratio configuration property, the program IDs have changed.
  - WattNode Plus: 9:00022:1500:0A:04:0C
  - WattNode Logger: 9:00022:1500:0A:04:0D
- Not LONMARK certified: The option PT models are identical to LONMARK approved models except for the addition of the ***UCPTptRatio*** configuration property.
- New LONMARK resource file version: 1.05. Updated to add ***UCPTptRatio***.
- Updated WattNode LNS Plug-In with support for Option PT.
- Firmware version updates:
  - WattNode Plus: 3.40
  - WattNode Logger: 3.70
- On Logger models, changing ***UCPTptRatio*** is considered a configuration change and will result in the "Configuration Change Flag" being set in the log for the time interval in which is was changed.

Upgrades

If you have a WattNode for LonWorks meter and would like to add potential transformer support, contact CCS to arrange an upgrade.

Additional Information

See the full manuals for information not in this supplement:

- **WattNode Plus for LonWorks - Installation and Operation Manual**
- **WattNode Logger for LonWorks - Installation and Operation Manual**

Also see the web article: **Using Potential Transformers**

- http://www.ccontrolsys.com/w/Using_Potential_Transformers