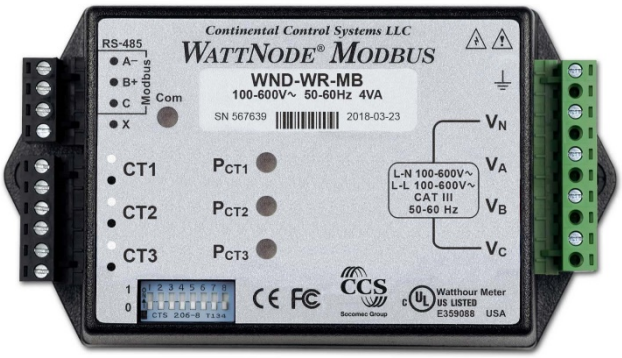


The WattNode® Wide-Range Modbus Meter measures bi-directional energy, power, voltage, current, etc. It communicates using Modbus® RTU over RS-485. The WattNode Wide-Range provides revenue-grade system accuracy when used with the CCS Accu-CT® family of revenue grade (C0.6 or better) current transformers.

Features

- One model can measure 100 to 600 Vac, single-phase or three-phase, wye or delta services
- Modbus registers can reverse CT polarity and change the assignment of CTs to voltage phases to correct wiring errors
- ANSI C12.20 class 0.5 and ANSI C12.1 accuracy
- Works with any 0.333 Vac current transformers and milliamp output CTs
- Line powered from 100 to 600 Vac
- Powered from line-to-neutral or line-to-line from any of: **V_N** to **V_A**, **V_N** to **V_B**, or **V_A** to **V_B**
- Includes support for external potential transformers

Links

- **Installation Guide:** https://ctlsys.com/m/WND-WR-MB-Install-Guide.pdf
- **Reference Manual:** https://ctlsys.com/m/WND-WR-MB-Ref-Manual.pdf
- **Product Web Page:** https://ctlsys.com/p/wnd-wr-mb/

1 Models

Table 1: Models

Model	Communication	UL Listed
WND-WR-MB	Modbus/RTU	Yes

To get a certificate of calibration for the meter, separately order **WN-CAL-CERT**.

1.1 DIP Switches

The WND-WR-MB includes an eight-position DIP switch with the following switch functions. See the Installation Guide or Reference Manual for more details.

1) Modbus address bit 1: down (0) = 0, up (1) = 1
2) Modbus address bit 2: down (0) = 0, up (1) = 2
3) Modbus address bit 3: down (0) = 0, up (1) = 4
4) Modbus address bit 4: down (0) = 0, up (1) = 8
5) Modbus address bit 5: down (0) = 0, up (1) = 16
6) Modbus address bit 6: down (0) = 0, up (1) = 32
7) RS-485 termination resistor: down (0) = no termination, up (1) = 120Ω termination
8) Modbus baud rate: down (0) = 9,600 baud, up (1) = 19,200 baud

1.2 Options

1.2.1 Communications Options

The communications options may be used to configure the Modbus address, baud rate, and other communications parameters.

Note: The DIP switches are normally used to configure the Modbus address and baud rate, so these options should only be used for special circumstances such as baud rates that cannot be specified with the DIP switches. If you order a meter with an address option or a baud rate option, then the DIP switch will no longer function to set the address or the baud rate.

Defaults: no parity, eight data bits, one stop bit

- **Option AD=xxx** – Set the Modbus slave address to **xxx**. This will prevent the DIP switch positions that set the address from functioning.
- **1.2K** - Set the baud rate to 1,200. This and the following baud rate options will prevent the DIP switch position that set the baud rate from functioning.
- **2.4K** - Set the baud rate to 2,400.
- **4.8K** - Set the baud rate to 4,800.
- **9.6K** - Set the baud rate to 9,600.
- **19K** - Set the baud rate to 19,200.
- **38K** - Set the baud rate to 38,400.
- **57K** - Set the baud rate to 57,600.
- **76K** - Set the baud rate to 76,800.
- **115K** - Set the baud rate to 115,200.
- **BAUD=xxx** - Set the baud rate to xxx, where xxx may be 1200, 2400, 4800, 9600, 19200, 38400, 57600, 76800, or 115200. The abbreviated baud rate options, such as 9.6K, are preferred.
- **EP** - Enable even parity (the default is no parity)
- **8N2** - Select two stop bits. The default is one stop bit.
- **T1** - Install a fixed (non-switchable) 120Ω termination resistor and 1.2kΩ bias resistors (A- to Common and B+ to 3.3 Vdc). By default, the meter does not provide biasing. Selecting this option will remove the DIP switch position 7 switchable termination.

1.2.2 Meter Element Configuration Options

These are used to configure the ***ConnectionType*** or ***MeterConfig*** registers. By default, with none of these options specified, the WND-WR-MB meter elements will function like the WNC series of meters.

Only one of the following two options may be specified for a particular meter.

- **CTR=x** - Set the ***ConnnectionType*** register to x (the default is 1). See the reference guide for more information.

Connec-tion Type	Name	Meter Element Mapping	CT Positions	Service Types	Notes	Meter Config1	Meter Config2	Meter Config3
0	Custom	Custom	Varies	Any	May not be used with the CTR=x option	-	-	-
1	**Wye**	**CT1-V_{AN} CT2-V_{BN} CT3-V_{CN}**	CT1 Phase A CT2 Phase B CT3 Phase C	**3-phase 4-wire wye**	**May also be used for delta and four-wire delta services**	**10**	**20**	**30**
2	Delta	CT1-V_{AC} CT2-V_{BC}	CT1 Phase A CT2 Phase B CT3 not used	3-phase 3-wire delta	CT3 is not used. Works for grounded delta with any phase grounded.	90	50	0
3	Branch circuits	CT1-V_{AN} CT2-V_{AN} CT3-V_{AN}	CT1 Phase A CT2 Phase A CT3 Phase A	1-phase, 2-wire with neutral	Use for monitoring 1-3 neutral connected branch circuits	10	10	10
4	House and Inverter	CT1-V_{AN} CT2-V_{BN} CT3-V_{AB}	CT1 Phase A CT2 Phase B CT3 Phase A	See notes	1-phase, 3-wire with neutral for CT1 and CT2; 1-phase, 2-wire without neutral for CT3	10	20	40
5	Line to Line	CT1-V_{AB}	CT1 Phase A CT2 not used CT3 not used	1-phase, 2-wire (no neutral)	CT2 and CT3 are not used	40	0	0

- **MCR=xx/yy/zz** - Set ***MeterConfig1*** to xx, ***MeterConfig2*** to yy, and ***MeterConfig3*** to zz. See the reference guide for more information

  The mapping from current transformer inputs to line voltage inputs is controlled with the MeterConfig registers. There are one meter element and one configuration register for each current transformer. For each meter element (CT), you can select the line voltage to be associated with that CT from the following list:

  - 0 = Disable meter element
  - 10 = V_{AN} (also called V_A), mount CT around phase A conductor
  - 20 = V_{BN} (also called V_B), mount CT around phase B conductor

- 30 = V_{CN} (also called V_C), mount CT around phase C conductor
- 40 = V_{AB}, mount CT around phase A conductor
- 50 = V_{BC}, mount CT around phase B conductor
- 60 = V_{CA}, mount CT around phase C conductor
- 70 = V_{BA} (equal to -V_{AB}), mount CT around phase B conductor
- 80 = V_{CB} (equal to -V_{BC}), mount CT around phase C conductor
- 90 = V_{AC} (equal to -V_{CA}), mount CT around phase A conductor

The default settings for the MeterConfig registers follow. These match the behavior of the older WNB and WNC meters:

- ***MeterConfig1*** = 10
- ***MeterConfig2*** = 20
- ***MeterConfig3*** = 30

1.2.3 Current Transformer Options

Either of the following CT= options are recommended for easier installation.

- **CT=xxx** - Pre-assign xxx as the global ***CtAmps*** value for the current transformers.
- **CT=xxx/yyy/zzz** - Pre-assign xxx to ***CtAmps1***, yyy to ***CtAmps2***, and zzz to ***CtAmps3***. This is used if non-matching CTs are connected to different inputs.

The following options are only for use with non-standard current transformers (CTs), such as milliamp output CTs, CTs with a full-scale output voltage other than 0.33333 Vac, or CTs that need some other adjustment.

- **MA** - Specify that the meter is designed for 40mA output CTs. Equivalent to "Opt R=10,V=0.4".
- **R=xxx** or **R=xxx/yyy/zzz** - Specify the addition of burden resistance for all three CT inputs or individually for each CT input. This means a burden resistor is installed in the meter to allow use of a milliamp output CT. If this option is not specified, then there are no burden resistors installed in the meter and the meter must be used with 0.333 Vac CTs (internally burdened millivolt output CTs). The **xxx**, **yyy**, and **zzz** values are the ohms of the burden resistors. Contact the factory for supported values.
- **V=xxx** or **V=xxx/yyy/zzz** - Specify the full-scale CT output voltage for all three CT inputs or individually for each CT input. If this option is not specified, then 0.33333 Vac is the default value. The **xxx**, **yyy**, and **zzz** values are in units of volts. This supports values from 0.1 to 0.5 Vac. Values below 0.25 Vac may affect the accuracy for low-current signals.
- **PA=xxx** or **PA=xxx/yyy/zzz** - CT phase adjustment in millidegrees. The first form uses **xxx** as the adjustment for all three CTs. This option determines the values that are written to the ***PhaseAdjust1***, ***PhaseAdjust2***, and ***PhaseAdjust3*** configuration registers. Use negative values to compensate for a phase lead in the CT.
- **L** - Factory lock the CT amps rating, CT directions, CT gain adjust, CT phase adjust, PT ratio, and the creep limit configuration registers. The ***CT=xxx*** option must be used with this because it will not be possible to set the CT amps in the field. This option is recommended only if required due to security concerns.

2 Specifications

2.1 Accuracy

The following accuracy specifications do not include errors caused by the current transformer accuracy or phase angle errors. “Rated current” is the current that generates a CT output voltage of 0.33333 Vac or equivalent milliamp output.

Unless otherwise noted, all accuracy specifications assume the following conditions:

- **Line voltage:** 100 to 690 Vac
- **Power factor (PF):** 1.0
- **Frequency:** 48 - 62 Hz
- **Ambient Temperature:** 23°C ± 5°C
- **CT Current:** 1% - 100% of rated current

Parameter	Test Conditions	Typ	Max	Unit
EnergySum, Energy1, 2, 3[1] (active energy)	elapsed time[2] >= 30 s	±0.2	±0.5	%
EnergySum, Energy1, 2, 3; PF 0.5 to 0.9	elapsed time[2] >= 30 s	±0.4	±0.8	%
PowerSum, Power1, 2, 3 (active power)	averaging >= 1 s	±0.3	±0.5	%
PowerSum, Power1, 2, 3; PF 0.5 to 0.9	averaging >= 1 s	±0.5	±1.0	%
VoltAN, BN, CN, VoltAB, BC, CA (RMS voltage)	averaging >= 1 s	±0.3	±0.5	%

Parameter	Test Conditions	Typ	Max	Unit
EnergySum, Energy1, 2, 3[1] (active energy)	elapsed time[2] >= 30 s	±0.2	±0.5	%
Current1, 2, 3 (RMS current)	averaging >= 1 s	±0.25	±0.5	%
Freq (frequency)	averaging >= 1 s	±50 ±3	±150 ±9	ppm mHz
PowerFactor1, 2, 3	averaging >= 1 s, PF > 0.5	±0.5	±1.0	%
EnergyReacSum, EnergyReac1, 2, 3 (reactive energy)	elapsed time[2] >= 30 s, PF < 0.9	±0.6	±1.5	%
PowerReacSum, PowerReac1, 2, 3 (reactive power)	averaging >= 1 s, PF < 0.9	±0.6	±1.5	%
EnergyAppSum, EnergyApp1, 2, 3 (apparent energy)	elapsed time[2] >= 30 s	±0.3	±0.5	%
PowerAppSum, PowerApp1, 2, 3 (apparent power)	averaging >= 1 s	±0.3	±0.5	%

[1] Note: when parameters are written like Energy1, 2, 3, this means Energy1, Energy2, and Energy3.

[2] Note: This indicates that energy accuracy should be evaluated over a period of 30 seconds or longer.

All models

- Meet the ANSI C12.1-2008 and ANSI C12.20-2010 class 0.5 accuracy requirements, excluding errors caused by attached current transformers.
- Meet the ANSI C12.1-2014 standard for revenue metering with CTs with class 0.6 or better current transformers.
- Meet the ANSI C12.20-2015 class 0.5 standard for revenue metering with class 0.2 and class 0.3 current transformers.
- Certified by MET Labs, Inc. to meet ANSI C12.1-2014 and C12.20-2015 Class 0.5 from 120 to 480 Vac, when used with current transformer models TCL-B-100 Opt C0.3, ACTL-0750-200 Opt C0.6, or ACTL-1250-400 Opt C0.3.

2.2 Measurement

- **Update Rate:** Approximately 0.1 second, adjusted to an integer number of AC line cycles. All measurements are performed at this rate. All measurement registers except the energy registers can update as fast as every 0.1 seconds depending on the configuration of the ***Averaging*** register. The energy registers are updated from the internal values every 1.0 second.
- **Start-Up Time:** ≤ 1 second after the supply voltage is applied.
- **Default CT Phase Angle Correction:** 0.0 degrees.
- **Creep Limit:** 0.04% (1/2500th) of full-scale.

2.3 Modbus Communication

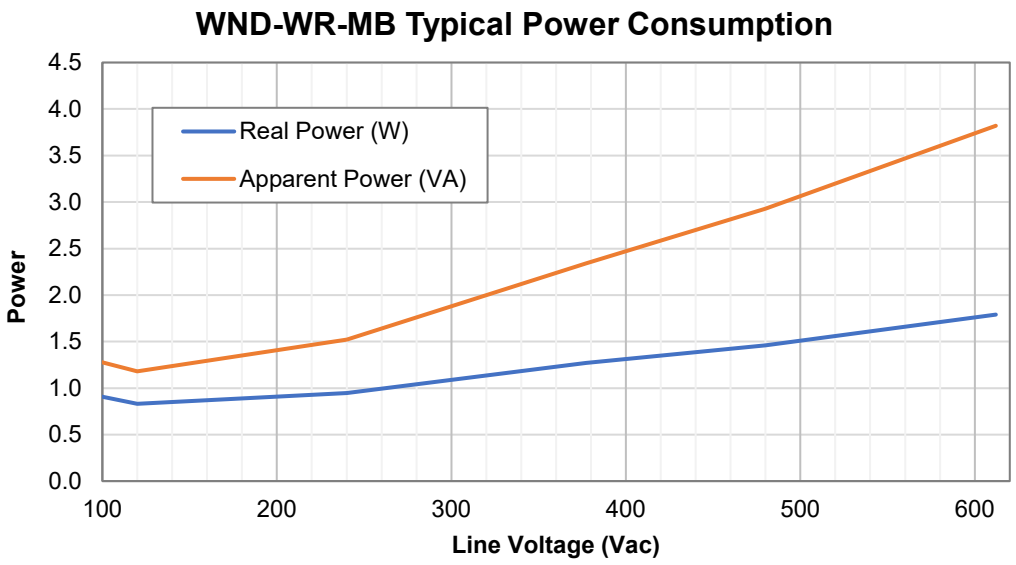
- **Protocol:** Modbus RTU (binary)
- **Baud Rates:** 1200, 2400, 4800, 9600, 19200, 38400, 57600, 76800, and 115200
- **Duplex:** Half (two-wire plus common)
- **Parity:**
  - **Standard:** N81 (no parity, eight data bits, one stop bit)
  - **Optional:** E81 (even parity, eight data bits, one stop bit)
  - **Optional:** N82 (no parity, eight data bits, two stop bits)
- **Modbus Buffer:** 256 bytes
- **Communication Response Time:** 5 - 25 milliseconds (may be longer immediately after a Modbus write command, while values are saved to non-volatile memory).

2.4 Electrical

2.4.1 Power Supply

- **Nominal Power Supply Voltage:** 100 to 600 Vac
- **Power Supply Input Terminals:** Vn, Va, Vb (the meter supply can operate line-to-neutral or line-to-line)
- **Power Supply Minimum Operating Voltage:** 85 Vac
- **Power Supply Absolute Maximum Voltage:** 690 Vac. Exceeding this limit can damage the WattNode and void the warranty.
- **Power Supply Typical Watts:** see graph below
- **Power Supply Typical Voltage-Amperes:** see graph below

- **Power Supply Typical Power Factor:** 0.6



2.4.2 General Electrical

- **Line Frequency:** 45 to 65 Hz
- **Nominal Line-to-Neutral Vac:** 90 to 347 Vac
- **Nominal Line-to-Line Vac:** 120 to 600 Vac
- **Over-Current Limit:** 200% of rated current. Exceeding 200% of rated current will not harm the meter, but the current and power will not be measured accurately.
- **Maximum Surge:** EN 61000-4-5: 2kV, ANSI C12.1 combination wave: 6kV, 1.2/50 µs – 8/20 µs
- **Measurement Category:** The line voltage measurement terminals on the meter are rated for CAT III, 600 Vac

  Measurement Category III is for measurements performed in the building installation. Examples are measurements on distribution boards, circuit-breakers, wiring, including cables, busbars, junction boxes, switches, socket-outlets in the fixed installation, and equipment for industrial use and some other equipment, for example, stationary motors with a permanent connection to the fixed installation.

2.4.3 Current Transformer Inputs:

- **Voltage Mode:**
  - **Nominal Input Voltage (At CT Rated Current):** 0.33333 Vac RMS
  - **Absolute Maximum Input Voltage:** 5.0 Vac RMS
  - **Input Impedance at 50-60 Hz:** 23 kΩ
- **Current Mode:**
  - **Nominal Input Current (At CT Rated Current):** 40 mA RMS
  - **Absolute Maximum Input Current:** 200 mA RMS
  - **Input Impedance at 50-60 Hz:** 10 Ω

2.4.4 EIA RS-485 Interface

- **RS-485 Output Isolation:** 4500 Vac RMS
- **Driver Output:**
  - **Voltage (Open Circuit):** ±6 Vdc maximum
  - **Voltage (54 Ω load):** ±1.5 Vdc minimum
  - **Current (54 Ω load):** ±60 mA typical
  - **Rise Time (54 Ω || 50 pF load):** 900 nS typical
- **Receiver:**
  - **Common-Mode Range:** -7 Vdc to +12 Vdc max
  - **Sensitivity:** ±200 mV
  - **Bus Load:** 1/8 unit load (up to 256 WattNode meters per subnet)
  - **Failsafe Modes:** bus open, shorted, and idle

2.5 Regulatory

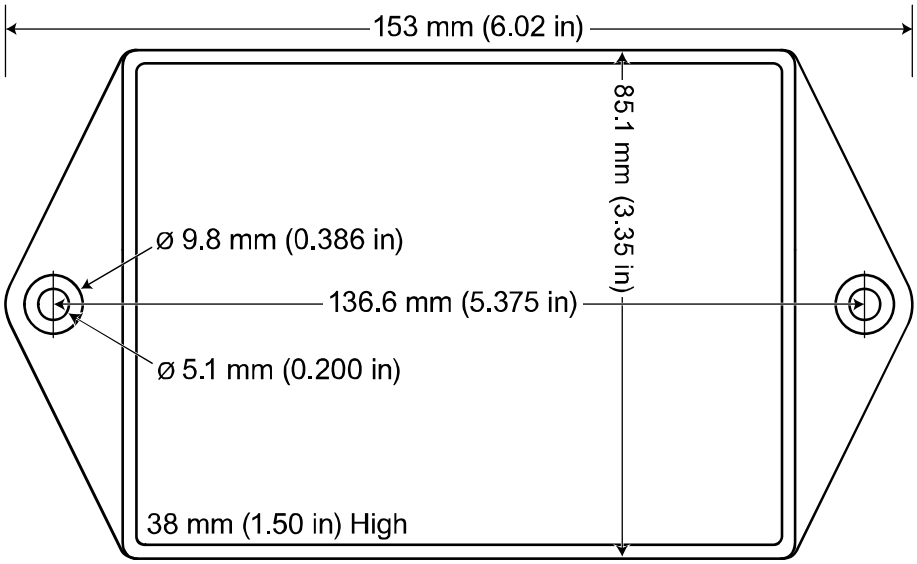
- **Safety:** meets European Parliament Directive 2014/35/EU: Low Voltage Directive
  - UL Listed (U.S. and Canada), file number E359088
  - UL / IEC 61010-1, 3rd Edition
  - CAN/CSA-C22.2 No. 61010-1-12, 3rd Edition
- **FCC:** Class B, FCC Part 15, radiated and conducted emissions
- **EMC:** meets European Parliament Directive 2014/30/EU: Electromagnetic Compatibility
  - **EMC Requirements:** EN 61326-1: 2013, industrial locations
  - **Radiated Emissions:** CISPR / EN 55011, Class B
  - **Conducted Emissions:** CISPR / EN 55011, Class B
  - **Electrostatic Discharge:** EN/IEC 61000-4-2: (B) Self-Recovering
  - **Radiated RF Immunity:** EN/IEC 61000-4-3: (A) No Degradation
  - **Electrical Fast Transient / Burst:** EN/IEC 61000-4-4: (A) No Degradation
  - **Surge Immunity:** EN/IEC 61000-4-5: (A) No Degradation
  - **Conducted RF Immunity:** EN/IEC 61000-4-6: (A) No Degradation
  - **Power Frequency H-field Immunity:** EN/IEC 61000-4-8: (A) No Degradation
  - **Voltage Dips, Interrupts:** EN/IEC 61000-4-11: (B) Self-Recovering
- **RoHS Compliant:** European Parliament Directive 2011/65/EU: Hazardous Substances

2.6 Environmental

- **Operating Temperature:** –40°C to +80°C (–40°F to 176°F)
- **Operating Humidity:** non-condensing, 5 to 90% relative humidity (RH) up to 40°C, decreasing linearly to 50% RH at 55°C.
- **Operating Altitude:** Up to 3000 m (9842 ft)
- **Pollution:** POLLUTION DEGREE 2 - Normally only non-conductive pollution; occasionally, a temporary conductivity caused by condensation must be expected
- **Degree of Protection:** IP40 (>1 mm solids, no protection from liquids)
- **Indoor Use:** Suitable for indoor use
- **Outdoor Use:** Suitable for outdoor use if mounted inside an electrical enclosure (Hammond Mfg., Type EJ Series or equivalent) rated NEMA 3R or 4 (IP 66)

2.7 Mechanical

2.7.1 Standard Enclosure



- **Enclosure:** High impact, ABS/PC plastic
  - **Flame Resistance Rating:** UL 94V-0, IEC FV-0
  - **Overall Size:** 6.02 in. × 3.35 in. × 1.50 in. (153 mm × 85.1 mm × 38.0 mm)

- **Weight:** 233 g (8.2 oz)

2.7.2 Connectors

- **Connectors:** Euroblock pluggable terminal blocks
  - **Green:** up to 12 AWG or 2.5 mm^2, 600 V, screw torque: 3.5 lbf·in (0.4 N·m)
  - **Black:** up to 12 AWG or 2.5 mm^2, 300 V, screw torque: 3.5 lbf·in (0.4 N·m)