

Operation and maintenance manual

PAN-42 Sensor installation guide

Version 3.9 May 2025



**Panoramic
Power**

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FCC compliance statement

This device has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in residential installations. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio and television reception.

However, there is no guarantee that interference will not occur in a particular installation. If this device does cause such interference, which can be verified by turning the device off and on, the user is encouraged to eliminate the interference by one or more of the following measures:

- Re-orient or re-locate the receiving antenna.
- Increase the distance between the device and the receiver.
- Connect the device to an outlet on a circuit different from the one that supplies power to the receiver.
- Consult the dealer or an experienced radio/TV technician.

Warning: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference that may be received or that may cause undesired operation.

Manufacturer information

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IC compliance statement

This device complies with Innovation, Science and Economic Development Canada license-exempt RSS standard(s). Operation is subject to two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference that may be received or that may cause undesired operation.

A distance of at least 10 cm between the equipment and all persons should be maintained during the operation of the equipment.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

1. *l'appareil ne doit pas produire de brouillage, et*
2. *l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.*

Une distance d'au moins 10 cm entre l'équipement et toutes les personnes devraient être maintenues pendant le fonctionnement de l'équipement.



Product end of use handling (WEEE) - Waste of Electrical and Electronic Equipment

Panoramic Power is committed to protect the global environment and helping our customers with recycle responsibilities. Disposal of electrical and electronic products must be done according with the local and national regulations. You can return your product to a local collection point.

For information about your disposal or collection points, call your distributor or vendor, or contact <https://www.powerradar.energy/support>.

Safety Precautions – Panoramic Power Sensor Installation

The installation of this product (the ‘sensor’) must be undertaken by an electrically qualified and competent person to prevent danger, injuries or a fatality due to the significant risks associated with work on or near live electrical conductors. An electrical safe system of work (SSoW)/electrical safe work condition must be followed to prevent any potential incident, which shall include a suitable and sufficient risk assessment. The risk assessment shall cover the work on or near the specific electrical equipment and shall be carried out by someone with comprehensive knowledge and experience of this type of work and the means of controlling the risks.



The electrical supply to the distribution panel where the install is taking place must be isolated (shut off following appropriate Lockout/Tagout procedures/guidelines) before and during the installation of the sensor(s).



Where it is determined acceptable, and in compliance with all applicable and current International, Federal, State, and local laws, rules, or regulations (e.g. NFPA 70E) and any other Authorities Having Jurisdiction, for the installation to be performed on an energized conductor (live wire), then for reasons of safety and inadvertent shock hazard suitable additional controls must be detailed within the SSoW. This shall include, but not be limited to; the use of suitably (International Electrotechnical Commission - IEC) verified insulated tools, equipment, protective clothing including electrically insulated gauntlets and Arc Flash resistant.



On aged electrical installations, consideration must be given when removing barriers/covers from electrical enclosures to the potential for exposed electrical parts (i.e. no insulating material) within the distribution equipment or any deterioration of insulation on single insulated conductors within, where intrusive interaction is needed to fit the sensor.



The sensor must be installed only on an insulated conductor and shall not be installed near or touching any other non-insulated exposed electrical conductor as proximity to un-insulated electrical conductors could result in an electrical short circuit (Arc Flash) incident occurring.



The sensor shall be compatible with the physical size and maximum electrical load current of the conductor and in accordance with the installation specification guidance which shall be comprehensively adhered to; this includes such information as sensor orientation in relation to the electrical load, installed in non-hazardous areas (e.g. explosive dust, vapor or gas atmospheres) and within the sensor's standard operating temperature of between 0 - 50°C.



Installation is possible both on external entry/exit conductors before the terminal strip and both ends of the circuit breaker. The most accessible location within the electrical enclosure should be chosen for installation of the sensor in order to minimize the risk of danger and injury. The sensor should be installed so that the arrow points in the direction of the load, panoramic power does not take any responsibility for the incorrect fitting of the device.

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Overview



The PAN-42 wireless power sensor provides high-accuracy real-time power and power quality measurements for mains power monitoring, sub-metering and metering of large loads.

Designed for demanding electrical applications, supporting industry accuracy standards, PAN-42 enables the metering of power, voltage, current, power factor and power quality measurement data.

Information is sent wirelessly, through Panoramic Power's Bridge unit, to Panoramic Power's advanced cloud-based analytics platform. The data is then used to provide customers with actionable analytics and real-time dashboards and alerts.

Workflow

Sensor installation consists of the following steps:

1. Map the circuits.
2. Physically attach the sensors and the CTs to the wires.
3. Monitors the proper functioning of the sensors.

This manual covers steps 1 and 2 of the workflow. For step 3, visit our [Knowledge Base Center](#) to learn how.

⚠ Safety precautions

Read the instructions in this manual before installing, and take note of the following precautions:

- Ensure that all incoming AC power and other power sources are turned **off** before performing any work or connecting the PAN-42. Failure to do so may result in serious or even fatal injury and/or equipment damage.
- Under no circumstances should PAN-42 be connected to a power source if it is damaged.
- To prevent potential fire or shock hazard, do not expose PAN-42 to rain or moisture.
- Ensure that the external current transformers are shorted (by using the recommended shorting switches) before disconnecting PAN-42 from its current inputs.

The sensor and CTs should be installed and removed only by a qualified electrician. Read this manual thoroughly before connecting the device to the current-carrying circuits.

During operation of the device, hazardous voltages are present on input terminals. Failure to observe precautions can result in serious or even fatal injury, or damage to equipment.

Mechanical installation

There are several mounting options for PAN-42:

- On a 35-mm DIN rail (see the drawing below)
- By using screws, using the slots on the back of the device
- With plastic tie-wraps, using the hooks on the back of the device

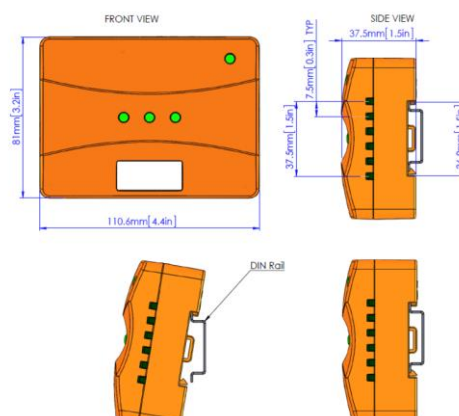


Figure 1. Hardware measurements

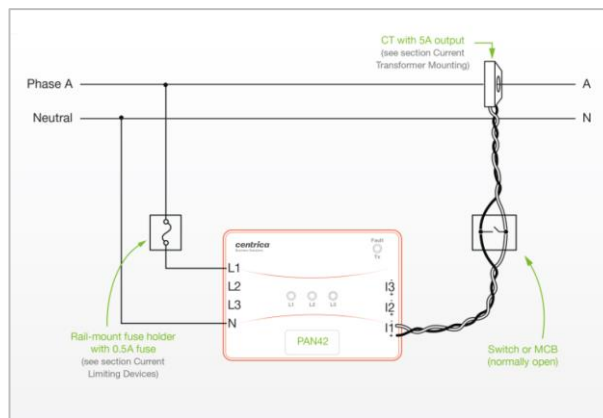
⚠ Electrical connections

PAN-42 supports the following phase configurations:

1. Single-phase – 120VAC (US) or 230VAC (EU) phase-neutral

Supported voltage range: 110-277 VAC phase-neutral

In this configuration, the single voltage line (phase and neutral) should be connected to L1 & N, and a single CT should be connected to I1.

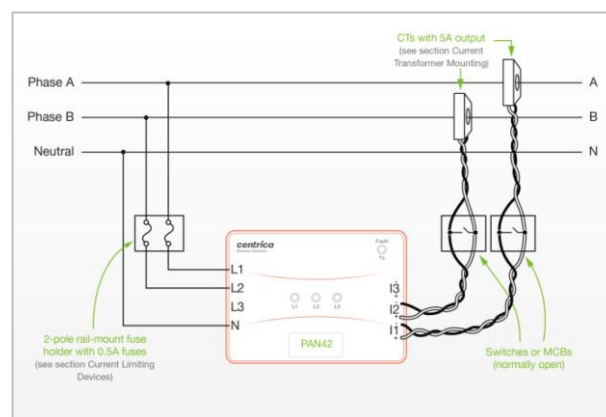


Single-phase configuration

2. Dual-phase – 240VAC (US) phase-phase

Supported voltage range: 220-554VAC phase-phase

In this configuration, the two voltage lines (phase A, phase B, and neutral) should be connected to L1, L2 & N, and two CTs should be connected to I1 & I2.

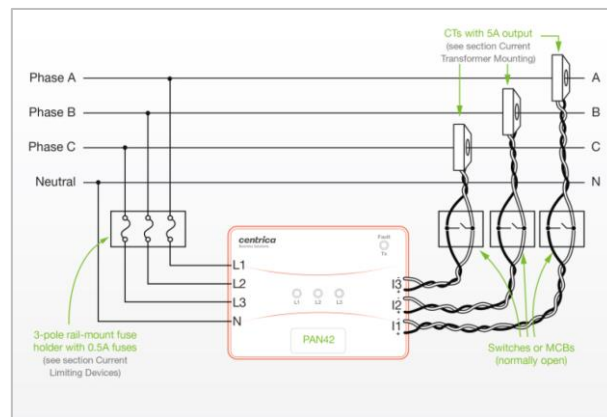


Dual-phase configuration

3. 3-phase 4-wire (wye) – 120/208VAC (US), 277/480VAC (US), or 230/380VAC (EU)

Supported voltage range: 110-277VAC phase-neutral / 190-480VAC phase-phase

In this configuration, all three voltage lines & neutral should be connected to L1, L2, L3 & N, and three CTs should be connected to I1, I2 & I3.

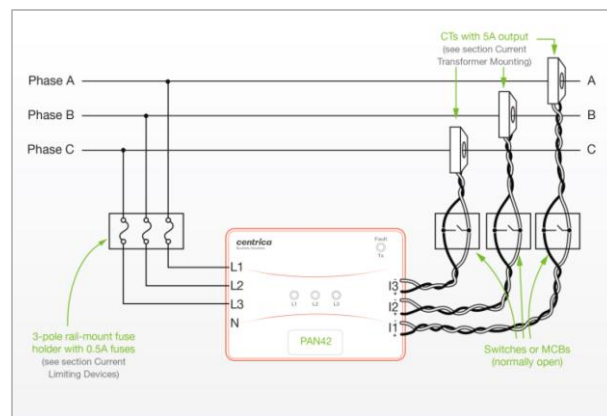


3-phase 4-wire (wye) configuration

4. 3-phase 3-wire (delta) – 120/208VAC (US), 277/480VAC (US), or 230/380VAC (EU)

Supported voltage range: 110-277VAC phase-neutral / 190-480VAC phase-phase

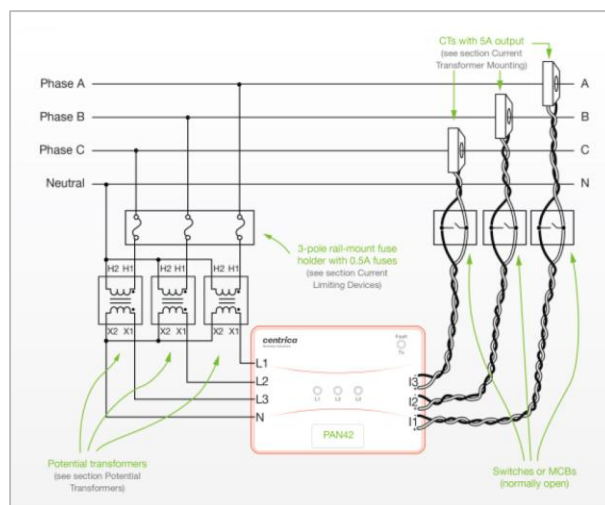
In this configuration, all three voltage lines should be connected to L1, L2 & L3 (N is left open), and three CTs should be connected to I1, I2 & I3.



3-phase 3-wire (delta) configuration

5. 3-phase 4-wire (wye) – 346/600VAC (Canada)

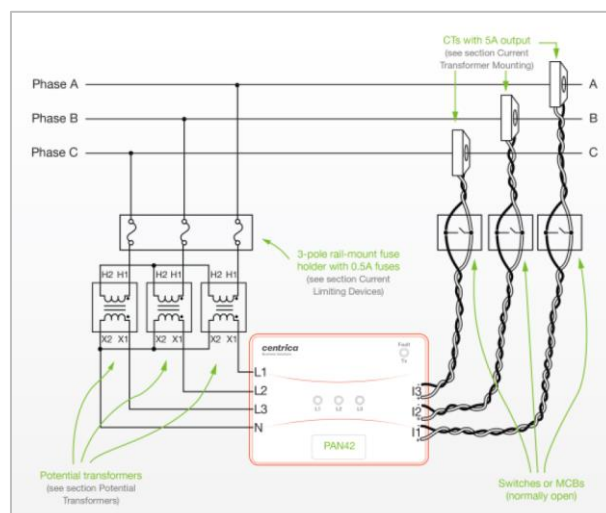
Since this voltage is beyond the rated voltage range of PAN-42, potential transformers must be used on each of the three voltage inputs. The PTs' primary windings should be connected between each phase and neutral, and the secondary windings should be connected to L1, L2, L3 & N. Three CTs should be connected to I1, I2 & I3.



3-phase 4-wire (wye) 346/600VAC configuration

6. 3-phase 3-wire (delta) – 346/600VAC (Canada)

Since this voltage is beyond the rated voltage range of PAN-42, potential transformers must be used on each of the three voltage inputs. The PTs' primary windings should be connected between each phase and a common connection point (virtual neutral), and the secondary windings should be connected to L1, L2, L3 & N. Three CTs should be connected to I1, I2 & I3.



3-phase 3-wire (delta) 346/600VAC configuration

Note: PAN-42 does not support a 3-phase high-leg delta configuration.

Important notes

1. Voltage lines **must** be connected through a current-limiting device. Current protection should be maximum 1A per phase. It is advised to use in-line rail-mount fuse holders. See the Current Limiting Devices section for recommended devices and specifications.
2. Ground wires should not be connected to any of PAN-42's voltage inputs, (including the Neutral input).
3. The gauge of the voltage input wires (between the current-limiting device and PAN-42) must be 0.8-4.0mm² (12-18 AWG).
4. Wrong polarity of the current transformers (CTs) will result in incorrect readings. See the 'Current transformer mounting' section for more details.
5. Never leave a CT's output open while primary current is flowing. If you need to disconnect the sensor from a CT, short its output (secondary winding) using its shorting switch, as shown in the connection diagrams above. The shorting switch is optional but not mandatory when using traditional split core CTs. For deployments that utilize Rope CTs (Rogowski coil) it is strictly **prohibited** to use a shorting switch.
6. When connecting to mains voltage >277VAC phase-neutral, or when installing in a noisy industrial environment, a potential transformer is required. See the 'Potential transformers' section for more details.



PAN-42 installed on a DIN rail

Mapping the site

Sensors are installed at the electrical panel of the mains and/or devices you wish to monitor. Per zone or panel, a Bridge must be installed within range to collect the sensor data. Visit our [Knowledge Base Center](#) to learn more about how to install Bridges and map sensors.

Current transformer mounting

Polarity

Current transformers (CTs) have polarity, and must be installed in the correct direction. This is important on both sides of the CTs:

1. The CTs must be placed on the load wires (primary side) so that current flows as shown by the arrow marked on the CT, or by the following common markings:
 - a. From the side marked 'P1' to the side marked 'P2'
 - b. From the side marked 'K' to the side marked 'L'
 - c. From the side marked 'H1' to the side marked 'H2'
2. The CTs' outputs (secondary side) must be connected to PAN-42's current input terminals as indicated by the following common markings:
 - a. Terminal or wire marked 'S1' to current terminal marked '+' on PAN-42, and 'S2' to '-'
 - b. Terminal or wire marked 'K' to current terminal marked '+' on PAN-42, and 'L' to '-'
 - c. Terminal or wire marked 'X1' to current terminal marked '+' on PAN-42, and 'X2' to '-'

Output shorting

As shown in the 'Electrical connections' section above, the CTs should be connected to PAN-42 through normally-open shorting switches or MCBs. Before mounting any CT on an active hot wire, its switch/MCB should be switched to the closed position, so that the CT's output is shorted. After the PAN-42 sensor's current input is connected, the switch can be moved to the open position.

Failure to short a CT's output when it is placed on an active hot wire can cause irreparable damage to the CT!

Connection wires to PAN-42

The CTs' secondary outputs are connected to the PAN-42 sensor's current input terminals. The wires used to connect the CTs to PAN-42 (through shorting switches) should have the following characteristics:

1. Gauge: 0.5-4.0mm² (12-20 AWG)
2. Maximum length: depends on gauge – voltage drop across the wires' total length must not exceed the CT's specification at 5A_{RMS} of current. The following list shows maximum lengths (per wire, total length between CT and PAN-42) for some common wire gauges:
 - a. 1 mm² – 1.5 m
 - b. 0.5 mm² – 75 cm
 - c. 16 AWG – 6 feet
 - d. 18 AWG – 4 feet
 - e. 20 AWG – 2.5 feet
3. Twist ratio: one twist per 5mm (2 inches)

Installing the sensor

This procedure must be carried out by a certified electrician.

1. Make sure the CT outputs are shorted (see the 'Current transformer mounting' section above)
2. Mount the CT(s) on the hot wire(s):
 - a. If the CT is split-core: Open the CT, and close it around the hot wire.
 - b. If the CT is solid-core: disconnect one of the ends of the hot wire from the panel, insert it through the CT, and then reconnect it to the panel.
 - c. In both cases, make sure the CT is placed on the wire so that the direction of current flow on the wire is correct (see the 'Current transformer mounting' section above).
3. Connect the CT(s) from one to three phases A, B, C to the PAN-42 sensor's current input terminals marked 'I1', 'I2', 'I3', respectively, making sure polarity is correct, and wire gauge and length are appropriate (see the 'Current transformer mounting' section above).
4. Connect the voltage inputs:
 - a. Connect one to three phases A, B, C to the PAN-42 sensor's voltage input terminals marked 'L1', 'L2', 'L3', respectively. If there is a

neutral wire, connect it to the 'N' terminal. Refer to the Electrical Connections section above for more details about connecting different phase configurations.

- b. Make sure each phase is connected through a current limiting device (see the 'Current limiting devices' section for details).
- c. If the phase voltages are higher than the rated input of PAN-42, such as 346/600V systems in Canada, connect the phases through potential transformers, as shown in the 'Electrical connections' section (see also the 'Potential transformers' section for more details). In this case, make sure that you **measure** the input and output voltage of each potential transformer, and record the input to output voltage ratio for use in the deployment process (the potential transformer's rated ratio is often not completely accurate, and so **the voltages must be measured**).
- d. Make sure that you use the same phase for the current and voltage inputs; that is, L1 and I1 are for the same phase, L2 goes with I2, and L3 goes with I3.

Note: In order for the PAN-42 sensor to turn on, the neutral wire and at least one voltage phase, or at least two voltage phases, must be connected.

5. After connecting the current and voltage inputs, make sure that the phase indication LED for each phase connected is steady green, and that the Tx LED flashes green every 10 seconds.
6. For each phase, the LED indications are as follows:

Connection	LED visual indication
Both voltage ¹ and current ² are connected	Steady green
Only voltage ¹ is connected	Flashing green
Current ² connection is reversed	Flashing orange
Only current ² is connected	Flashing red
No voltage ¹ or current ² is connected	Off

¹ Voltage > 90V_{RMS}

² Current > 0.05A_{RMS} (1% of full-scale)

7. Finalize the PAN-42 sensor's and the CTs' position in the panel, maintaining a reasonable distance between the CTs and PAN-42.

⚠ Important notes

Do not mount the CT on the hot wire before you have already connected its outputs to the PAN-42 sensor, or to the shorting switch, making sure the switch is in its closed state!

If a PAN-42 sensor needs to be replaced, put the suggested shorting switches in their closed states **before** PAN-42 is disconnected!

Do not leave the CT mounted/installed on a hot wire without being short circuited.

Resetting the internal energy counter

PAN-42 holds an internal, nonvolatile energy counter that keeps the accumulated energy (kWh) readings. It is recommended to reset the counter when installing a new PAN-42 unit.

To reset the counter, insert a pin into the hole on the back side of PAN-42, press and hold the pin for 5-8 seconds. When the resetting is complete, the three phase-indication LEDs will flash once in red.



Registering the installed sensor

Visit our [Knowledge Base Center](#) to read our articles about mapping the sensors to the devices configured to the site.

Monitoring sensor activity

Visit our [Knowledge Base Center](#) to learn more about the sensor summary window that helps monitor sensor activity.

⚠ Uninstalling a sensor

Put the in-line fuse holders on the phase lines in their open position, thereby disconnecting the voltage inputs from the PAN-42 sensor. Put the CT shorting switches in their closed position. Then disconnect the current and voltage inputs from the PAN-42 sensor and remove it from the electrical panel.

Current limiting devices

For each voltage phase connected to the PAN-42 sensor, a current-limiting device must be connected in series. Modular rail-mount fuse holders are recommended.

For installations with more than one phase, one multiple-phase fuse holder should be used, so that all phases are disconnected at once when the fuse holder is put in the open position.

The neutral wire should **not** be connected through a current-limiting device.

The following are recommended fuse holders:

- Littelfuse LPSC series (LPSC0001Z for 1 phase, LPSC0002Z for 2 phases, LPSC0003Z for 3 phases)
- Cooper Bussman CHCC series (CHCC1DU for 1 phase, CHCC2DU for 2 phases, CHCC3DU for 3 phases)
- Fuses used should not exceed 1A rating.
- The following are recommended fuses (0.5A):
- Littelfuse KLKR.500
- Edison HCLR0.5

Potential transformers

When connecting the PAN-42 sensor to a panel with phase-neutral voltages over 277VAC (such as 346/600VAC systems in Canada), it is necessary to use potential transformers (PTs) at the voltage inputs (see the ‘Electrical connections’ section above for connection diagrams).

PTs must be chosen so that their output (secondary) voltage is always within PAN-42’s input voltage range (110-277VAC phase-neutral). It is recommended to use PTs with high voltage accuracy and minimal phase shift, in order to minimize the effect on PAN-42 measurement accuracy.

For Canadian 346/600VAC systems, it is recommended to use PTs with 346VAC inputs and 120VAC outputs, such as the following models:

- Instrument Transformers (ITI/GE) model 3VT468-346 (3-phase)
- Hammond Manufacturing model VT56A (1-phase)
- For noisy industrial environments, where voltage spikes are common: Hammond Power Solutions model PH50MGJ (1-phase) – connect to 380V input, 120V output (see connection diagrams starting on p.8)

Note: The above PTs are recommended for use with the PAN-42 sensor, but they are not considered a part of the PAN-42 product, and Panoramic Power does not take responsibility for their certification status or suitability to the installation site.

Sensor specifications

3-phase 4-wire (wye, 3-phase 3-wire (delta, dual-phase 3-wire, single-phase 3-wire, or single-phase 2-wire configurations)

Voltage input range: 110-277VAC (phase-neutral)

Voltage configurations supported: [120/208VAC], [240/416VAC], or [277/480VAC]; [346/600VAC] is supported through external potential transformer

Frequency: 48-62 Hz

CT current input: standard 0-5 A_{RMS}

Current measurement range: depends on CT ratio

Minimum power for phase measurement (at device input): 0.25 W

Outputs

- Active Energy (kWh) – accumulated, per phase
- True RMS Voltage/Current – per phase
- Active/Reactive Power – per phase
- Power Factor – per phase
- Frequency

Accuracy (for Voltage, Current and Active Energy)	According to ANSI C12.1 (Class 1)* *Assuming CT of class 0.2 or better
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Transmission frequency	434 MHz (EU) 915 MHz (US)
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Transmission power (ERP)	0 dBm (max)
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Transmission interval	10 seconds
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Certification	USA and Canada Safety: UL 61010-1, UL 61010-2-030, CAN/CSA-C22.2 No. 61010-1 EMC: FCC Part 15 subpart B, ICES-003 Radio: FCC Part 15 subpart C, RSS-210, RSS-Gen Europe Safety: EN 61010-1, EN 61010-2-030 (CE) EMC: EN ETSI 301 489-1, 301 489-3, 613 326-1 Radio: EN ETSI 300 220-1, 300 220-2 CB Certification IEC 61010-1, IEC 61010-2-030 by Intertek Testing Services
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Dimensions	110.3 × 81 × 37.2 mm / 4.34 × 3.19 × 1.46 inch
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Weight	200 g
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Mounting options	Wall mount, or DIN rail top hat EN50022 - 35x7.5
Flammability rating of external enclosure	UL94 V-0
Operating temperature	-25 – 55° C (-13– 131° F)
Operating humidity range	5% - 90% non-condensing
Display	3 LEDs for phase indications and additional LED for transmission or fault indication

Certified CTs

General notes

- Solid-core or split-core CTs can be used.
- CT's accuracy class should be 0.5% or better.
- CTs with included burden resistors cannot be used.
- Flexible/rope CTs cannot be used, unless a 5A output conversion system is used (such as Dent Instruments' RoCoil TCA-5 system).

The following is a list of CTs that were already tested and approved by Panoramic Power.

Dixsen CTs

- 600A split (model DBP-58, P/N 765751)
- 600A solid rectangular (model MES-62, P/N 764812)
- 1000A split (model DBP-58)
- 1000A solid rectangular (model MES-60, P/N 764761)

Veris CTs

- 600A solid round (BL601)
- 1000A solid round (BL102)

Magnetlab CTs

- 600A split (ICT-2000-600)
- 600A solid rectangular (CCT-1200-600)
- 1000A split (ICT-2000-1000)

Maintenance and Servicing

Maintenance is not required. For any issues, please reach out to your Support Provider who can submit a support ticket on your behalf at:

<https://www.powerradar.energy/support>

Support

More support can be obtained at by submitting a support ticket at:

<https://www.powerradar.energy/support> .