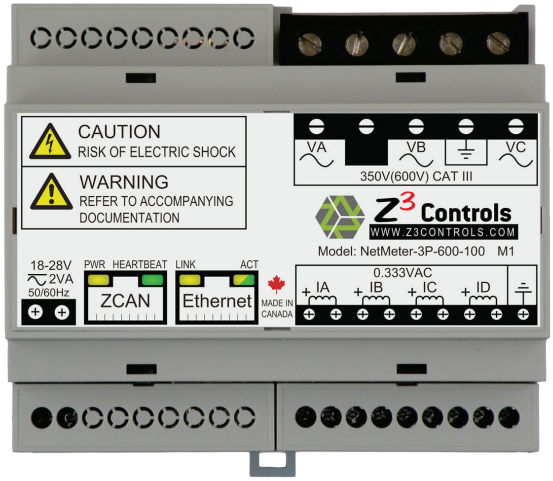
Online Support Portal:
help.z3controls.com



NetMeter-3P-600

3-Phase Commercial/Industrial Energy Meter/Monitor with Integrated Networking

Installation and Instruction Manual

1 Important Notice

During normal use, potentially lethal voltages are connected to the NetMeter system. Consequently, the NetMeter hardware module should only be serviced and installed by a qualified electrician.

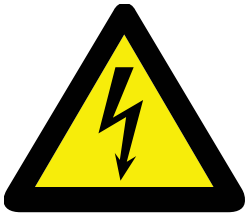
In no event will Z3 Controls be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment. The examples and diagrams in this manual are included solely for illustrative purposes.

Because of the many possible use scenarios and requirements associated with any particular installation, Z3 Controls cannot assume responsibility or liability for actual use based on the examples and diagrams.

Any specific application of the NetMeter system should be inspected and approved according to local standards and practices.

No patent liability is assumed by Z3 Controls with respect to use of information, circuits, equipment, or software described in this manual.

2 Safety Practices



SHOCK HAZARD

Only qualified personnel, following accepted safety procedures, should install, wire, and service the NetMeter unit and its associated components. Before beginning any work, disconnect all sources of power and verify that they are de-energized and locked out. Failure to follow these instructions may result in personal injury or death, property damage, or economic loss.

Never open a current transformer (CT) secondary circuit with primary current applied. All attached CTs must include a burden resistor on the secondary circuit. An open CT secondary with primary current applied produces a hazardous voltage, which can lead to personal injury, death, property damage, or economic loss.

WARNING

The NetMeter module contains sensitive electronic components that can be damaged by electrostatic discharge. The NetMeter module contains no user serviceable parts. Do not open the NetMeter case. Opening the NetMeter case voids the warranty.

ESD WARNING

Electrostatic discharge can damage the semiconductor components inside the NetMeter module. When handling the unit , follow these guidelines:

- Touch a grounded object to discharge bodily static potential before touching the NetMeter unit.
- Wear an approved wrist strap-grounding device.
- Do not open the module or attempt to service internal components.
- Use a static safe workstation, if available.
- Keep the module in its shipping container when not in use.

3 Overview

The Z3 controls NetMeter is a sophisticated and yet simple to use tool intended for monitoring and measuring energy use.

There are two main aspects of installing a NetMeter:

1. Physical installation of the hardware: this needs to be done by a qualified electrician.
2. Setting up network communication and configuring the NetMeter through the web interface: this requires some basic IT skills.

Initially, the NetMeter may be configured prior to performing the high-voltage electrical installation. This allows the user to establish network communication, configure the device, and become familiar with the NetMeter web based user interface prior to the hardware being installed inside a NEMA enclosure. If this is the preferred procedure, Section 8 is the place to start.

4 Preparing for Installation

Each NetMeter is typically shipped with the following items (items may vary, see invoice or packing slip):

- The NetMeter itself
- 1 – RJ45 plug specially wired for use in restoring network (LAN) defaults
- 1 – Ethernet Cable
- 1 – Installation Manual (this document)

In order to install the NetMeter, additional materials are or may be required. These include:

- An approved enclosure that can accommodate DIN rails to mount the NetMeter and other circuits. This may be part of a large panel or a smaller panel dedicated to the NetMeter.
- A power supply to power the NetMeter. Typically a 24V DIN mounted supply that may be dedicated to the NetMeter or be shared with other 24V loads. An example power supply is the DSP10-24 from TDK Lambda. The chosen power supply should meet regulatory requirements of your jurisdiction.
  See the NetMeter specifications (Section 12) for more details on the power supply requirements.

- CTs (current transformers) that are suitable for the project. See Section 6 for more information. Examples of suitable CTs:
    - 100A Split Core: SCT-0750-100 from Magnelab (www.magnelab.com)
    - 200A Split Core: SCT-0750-200 from Magnelab
    - 200A Split Core: SCT-1250-200 from Magnelab
    - 50A Solid Core: UCT-0500-050 from Magnelab
    - 100A Solid Core: UCT-0750-100 from Magnelab
- An Ethernet connection. For harsh environments the Bulgin IP68 rated Buccaneer series may be considered as a connector for use on the DIN enclosure.

5 Mounting Considerations

Mount the NetMeter module in a suitable protective DIN rail enclosure. The enclosure should protect against personal contact with energized circuits.

Select an enclosure that protects the module from atmospheric contaminants, such as oil, water, moisture, dust, corrosive vapors and other harmful airborne substances that may be present in the operating environment. The ambient temperature within the enclosure must remain within the specified limits. Select an enclosure that provides adequate clearance for ventilation and wiring for the NetMeter module and other equipment to be installed within the enclosure.

See Figure 16 on page 22 for dimensions of the NetMeter module.

When installed within a substation or switchgear lineup, it is recommended that the NetMeter module and its DIN enclosure be mounted within a low-voltage cubicle, isolated from high-voltage circuits.

6 Selecting Suitable CTs for the NetMeter

Current Transformers are common current measuring devices that consist of a magnetic core that encloses the primary current carrying wire, and a secondary winding at its output.

There are two main types of current transformer electrical configurations:

1. Voltage Output: produce an output voltage that is proportional to the input current.
2. Current Output: produce an output current that is proportional to the input current.

The NetMeter is designed to work with CTs that output a voltage between 0 and 0.333 volts RMS. For example, a 100A rated CT that produces a voltage of 0.333 VRMS when measuring 100 Amps RMS. Virtually any CT that produces a 0.333 VRMS output at maximum primary current can be used.

Current Output CTs can also be used with the NetMeter when a burden resistor is added in parallel with the transformers output coil. Calculating the required burden resistor is explained in Section 6.2.

6.1 Split Core vs. Solid Core CTs

There are two main mechanical configurations for current transformers:

1. Solid Core
2. Split Core

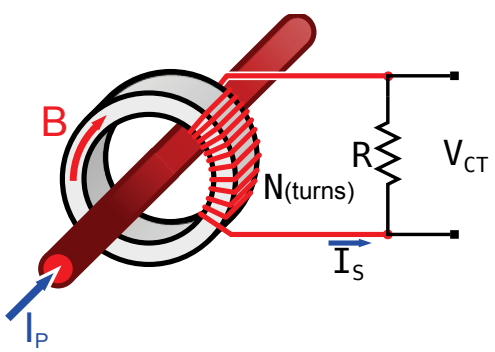
Solid core CTs can be used whenever it is possible to thread the primary current carrying wire directly through the CT core. Solid core CTs are typically lower cost compared to split core alternatives.

As the name implies, split core CTs allow the magnetic core to be opened up and placed around a primary wire. Consequently, it is not necessary to cut or disconnect the primary wire in order to physically attach the CT. As a result, split core CTs are easier to install in an existing panel. An example of a split core CT is shown in Figure 1 showing both the open (for installation) and closed (for electrical operation) conditions.

Figure 1: Example Split Core CT Open (left) and Closed (right)

6.2 How CTs Work

The fundamental operation of a current transformer is depicted in Figure 2



$$V_{CT} = \frac{I_P \times R}{N} \quad [1]$$

$$R = \frac{V_{CT} \times N}{I_P} \quad [2]$$

Figure 2: Diagram Showing Fundamental CT Operation

Where:

N = the turns ratio of the secondary winding (or the effective turns ratio after losses)

R = the value of the burden resistor in Ohms

V_{CT} = the voltage produced across the burden resistor in VRMS

I_P = the primary current of the CT

For CT's that do not have a built-in burden resistor, and external burden resistor must be used. The value of the burden resistor is calculated as above in Figure 2 equation [2].

For convenience, Z3 Controls provides an online tool for calculating burden resistor values at http://www.z3controls.com/ct-helper/

7 System Connection

The input/output connectors of the NetMeter are depicted in Figure 3. The connectors are:

- Voltage Connector (VA/VB/VC/GND)
    - GND is a Ground connection
    - Each of the voltage terminals VA/VB/VC is connected to a voltage to be monitored.
    - For 3 phase systems all three voltage inputs are used.
    - For split phase systems, VA and VB are used and VC not connected.
    - For single phase systems, only VA is used. Alternately, up to 3 separate single phase loads can be monitored. In this case, VB and VC would also be connecter to the source voltage. (see Figure 7)
- Current Input Connector (IA/IB/IC/GND)
    - Connect each of the current input pairs to current transformers
- Supply Voltage
    - A low voltage power supply (12-24V) provides the power required to operate the NetMeter
- Ethernet Connector
    - This is a standard 10/100 Mb RJ45 Ethernet port that should be connected to an Ethernet switch/router using standard (CAT5/CAT5e) network cable.
- ZCAN Connector
    - Provides expansion capabilities for the NetMeter to communicate with other Z3 products

It is recommended that all wires connected to screw terminals on the NetMeter be terminated and using ferrules and according to local electrical codes.

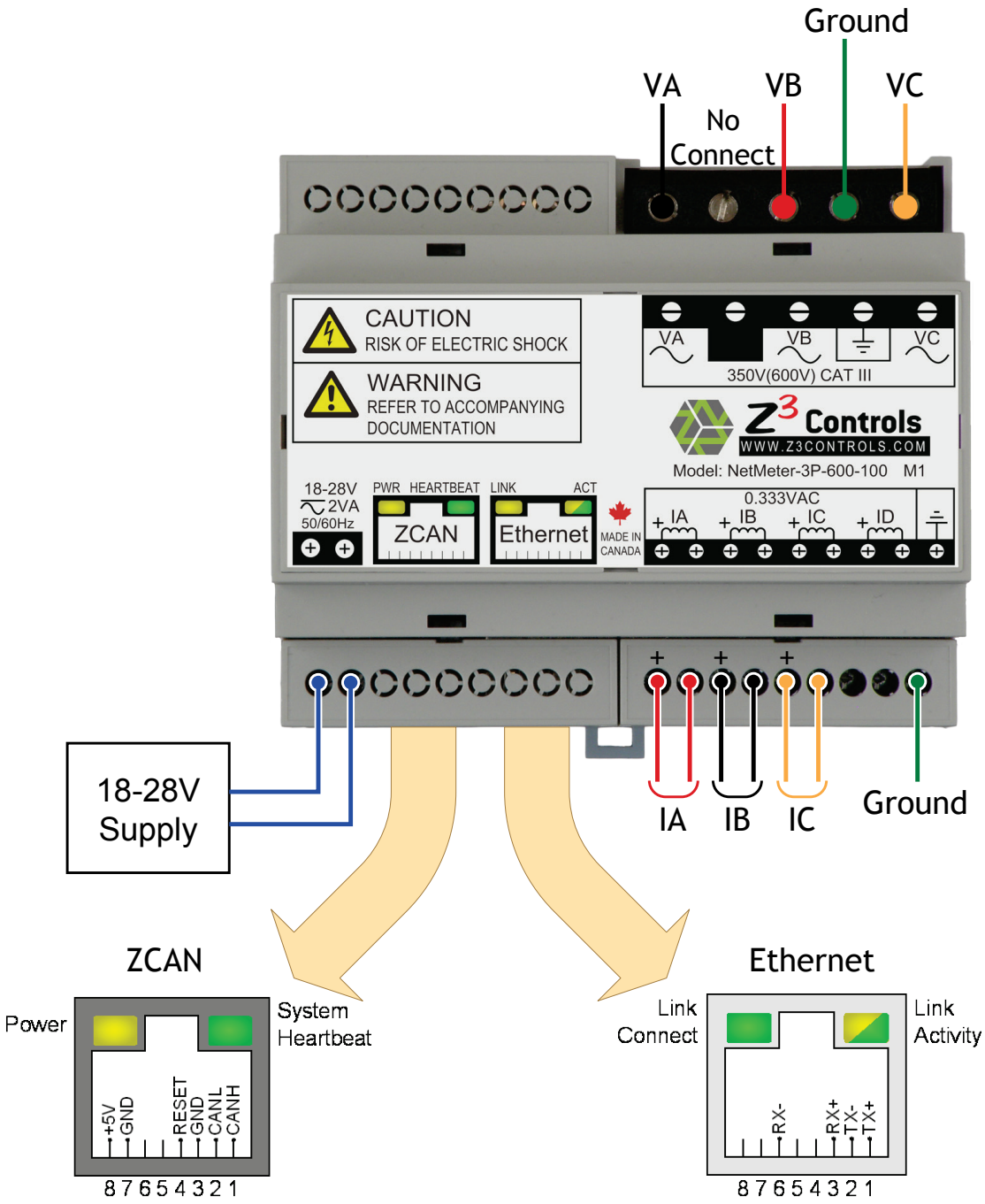


Figure 3: NetMeter Connector Diagram

7.1 3-Phase Systems

Figure 4 shows a typical net meter connection in a three phase system. It is important to ensure that each voltage input is matched to the corresponding CT input (VA with IA, VB with IB, and VC with IC). If current and voltage inputs are mismatched, the net meter will fail to register the correct power/energy measurement.

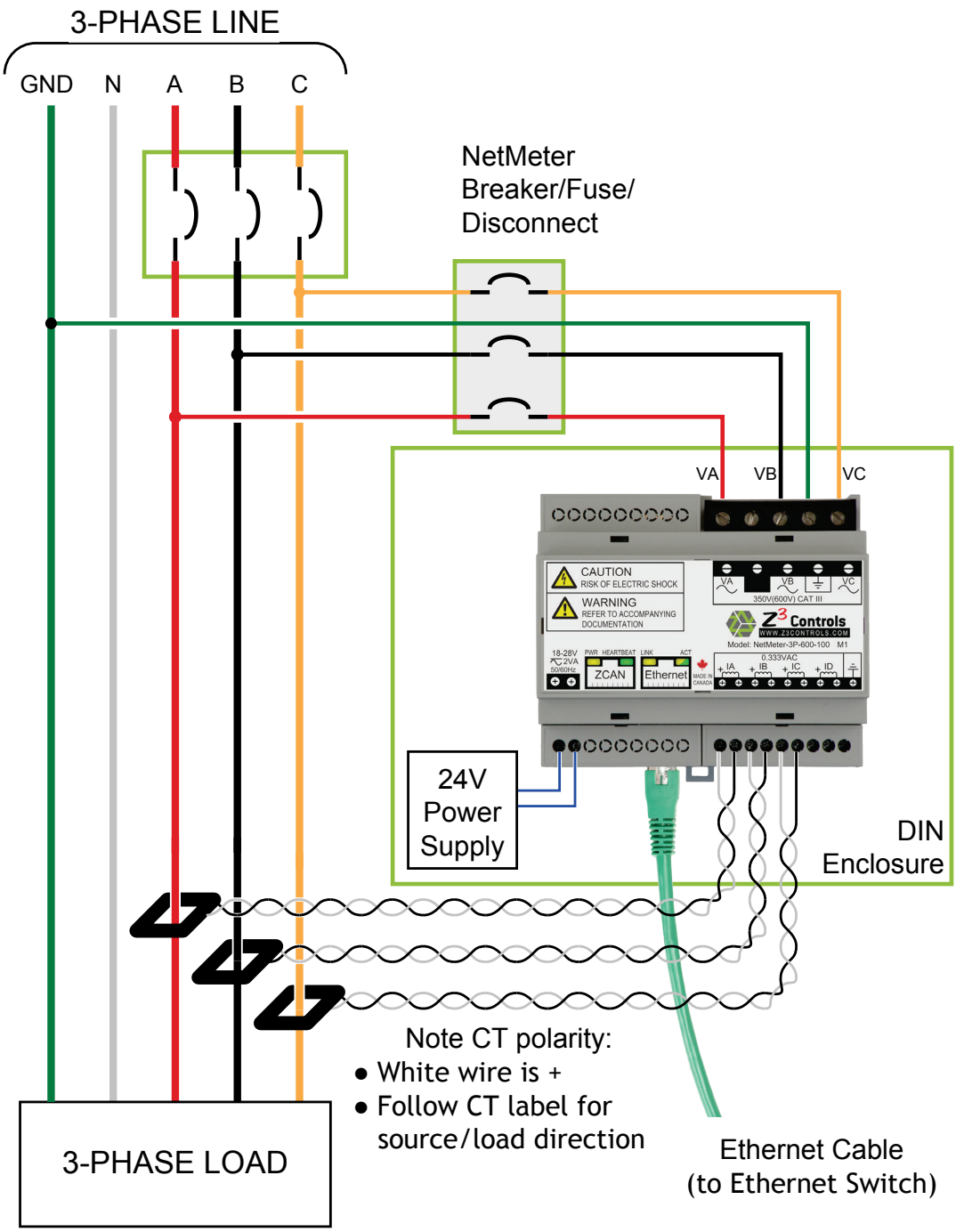


Figure 4: Typical NetMeter 3-Phase System Level Connection Diagram

7.2 Split-Phase Systems

Figure 5 shows a typical net meter connection in a split phase system. It is important to ensure that each voltage input is matched to the corresponding CT input (VA with IA, VB with IB). If current and voltage inputs are mismatched, the net meter will fail to register the correct power/energy measurement.

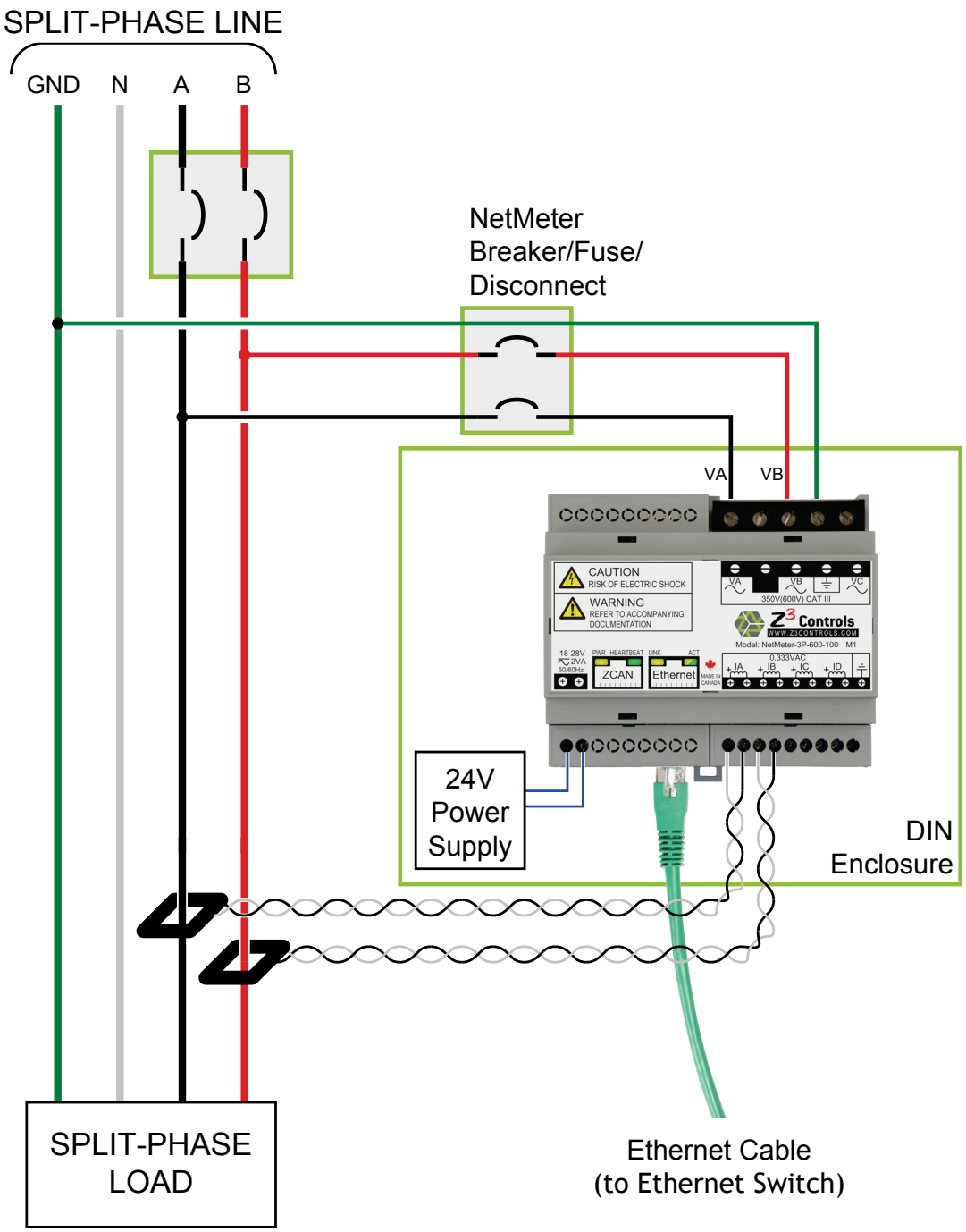


Figure 5: Typical NetMeter Split-Phase System Level Connection Diagram

7.3 Single-Phase Systems

Single Phase system connection with a single load is shown in Figure 6 with the option of monitoring up to 3 loads as depicted in Figure 7.

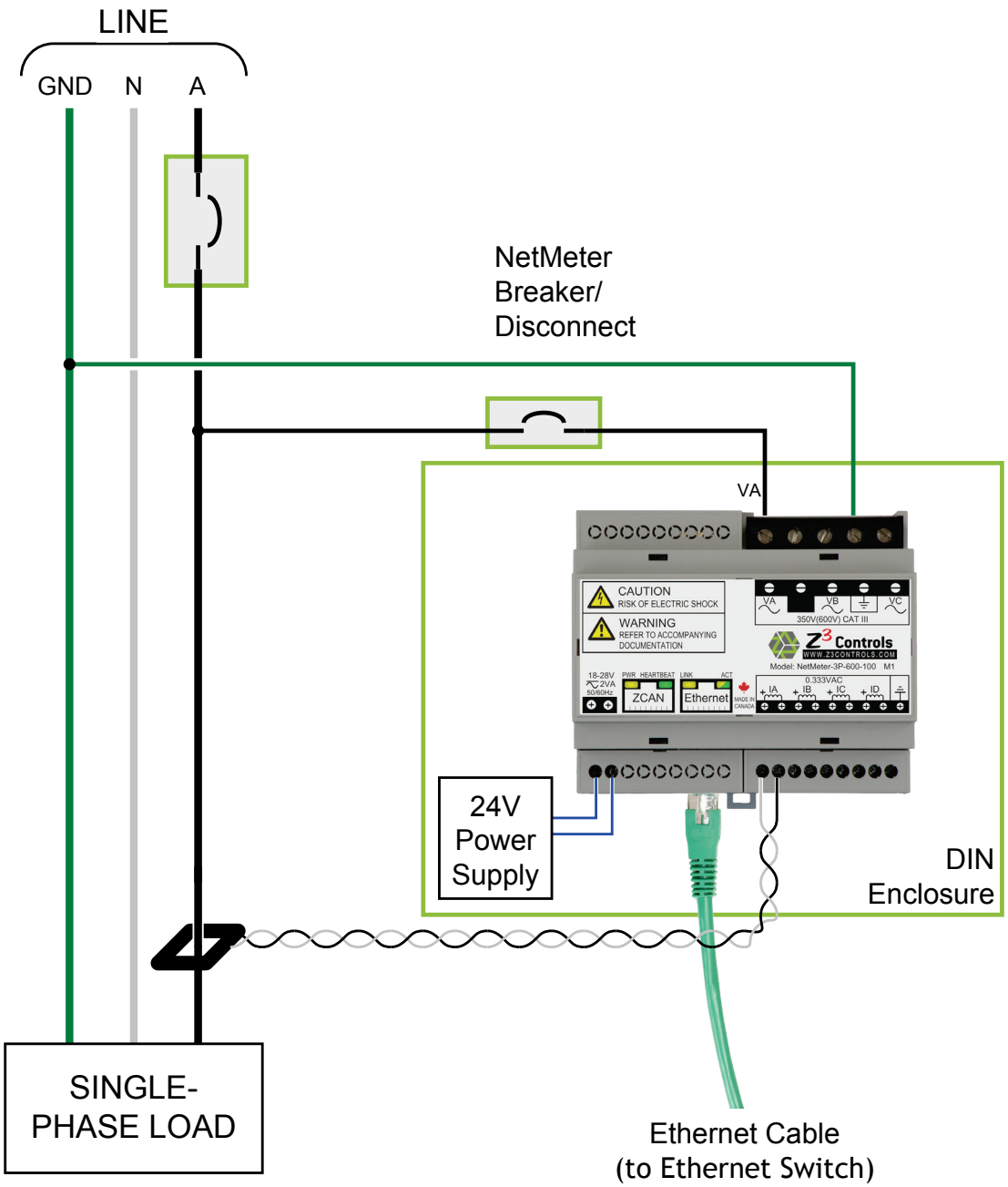


Figure 6: NetMeter Single-Phase System Level Connection Diagram (Single Load)

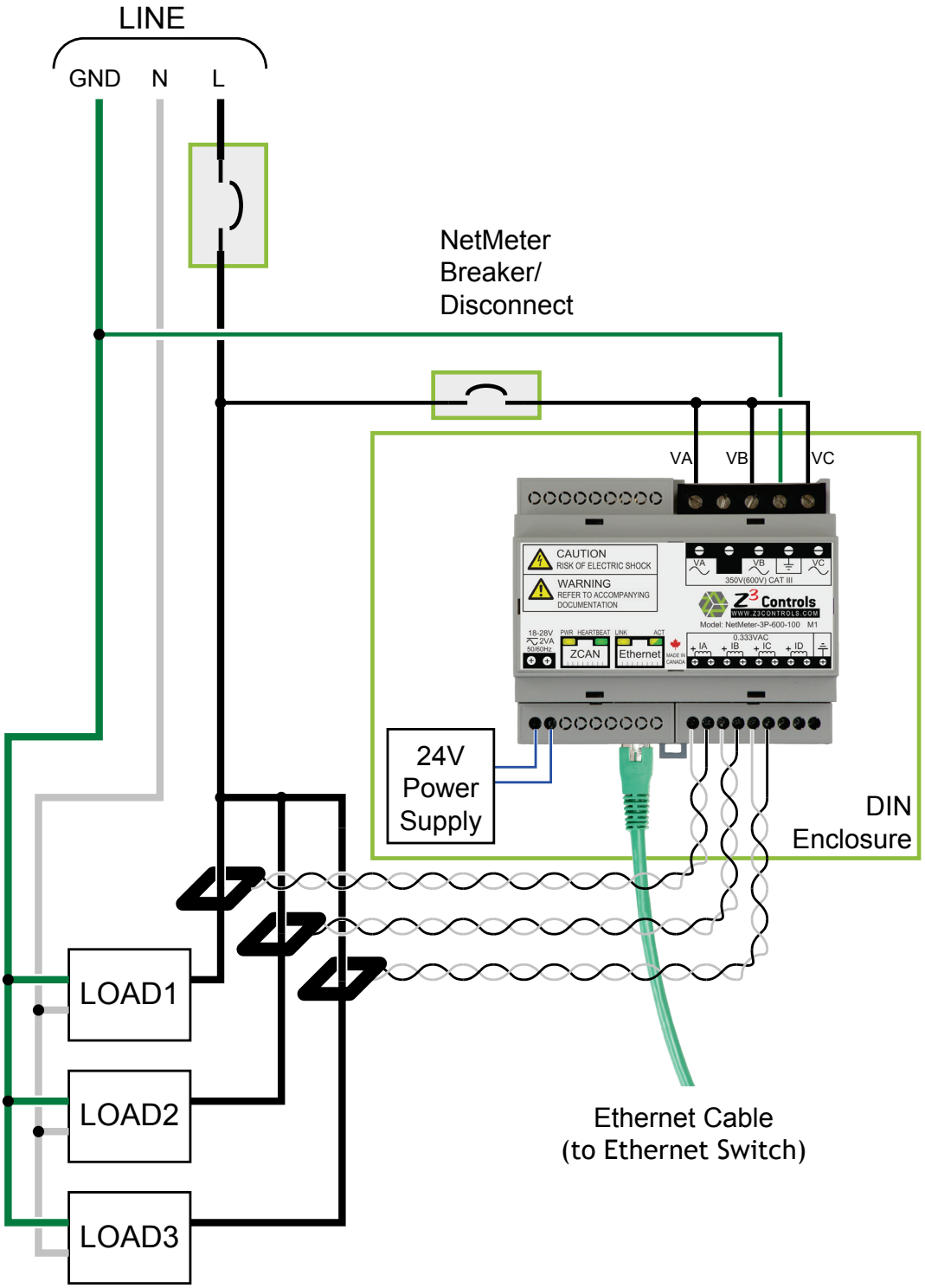


Figure 7: NetMeter Single-Phase System Level Connection Diagram (3 Loads)

7.4 3 Phase 3 Wire with Open Delta PT

Open delta potential transformers can be used to monitor high voltage 3 Phase 3 Wire services (>600V). This configuration is the ANSI Form 5S/13S[1] and the connection for this configuration is depicted in Figure 8.

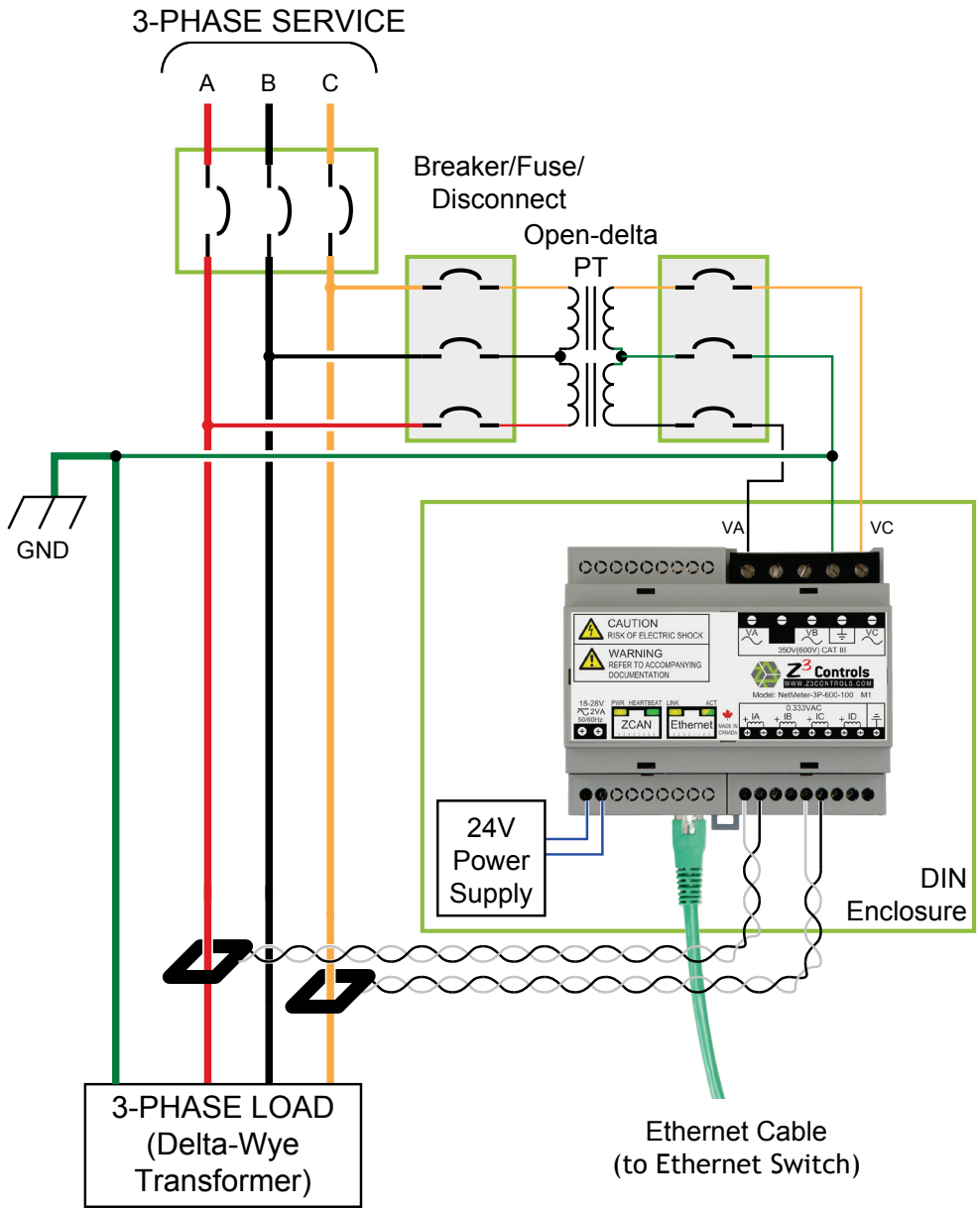


Figure 8: NetMeter 3-Phase Open Delta Connection Diagram

The NetMeter sensor configuration should be set to ANSI Form 5S/13S to use this mode of operation (may require a firmware update for older NetMeters). In this mode, Phase B becomes referenced to ground on the output of the PT and the CT for Phase B is thus not required. It is assumed that there is no current flow back through ground.

[1] As defined by the National Electrical Manufacturers Association (NEMA) in ANSI C12.20

8 Network Setup

It is recommended that the NetMeter unit be configured prior to the installation of the device into a panel containing lethal voltages. This may be done by simply connecting a small 12 or 24 Volt power supply to the NetMeter and also connecting the NetMeter to an Ethernet network or small WiFi router. An example setup is depicted in Figure 9.

Figure 9: NetMeter Setup Used to Perform Initial Configuration

In order to test out network connectivity as in Figure 9, the following items are required in addition to the NetMeter:

- Power supply (such as the EPS240025-P5P available at www.digikey.com) or other wall-mount supply in the 12-24V range
- Ethernet Cable
- WiFi router (alternately a wired router if the laptop is connected using an Ethernet cable)
- Laptop computer with a current version of Internet Explorer (V9 or above), FireFox, Chrome, Safari, Opera or other W3C compliant browser[2]

[2] To check browser compatibility, visit http://www.z3controls.com/browserchk.html

Step 1: First, establish communication between the computer and the WiFi router (see manual for the WiFi router). Make sure the router is configured to provide DHCP services on the local area network.

Step 2: Next, connect the NetMeter to one of the LAN ports on the router and power-up the NetMeter from the power adapter. The green "hearbeat" LED on the netmeter should start to blink and the other green "Link Connect" LED should turn on to indicate that the network connection is established.

Step 3: The default host name of the NetMeter is NETMETER. Open the web browser on the laptop and enter the following address:

HTTP://netmeter/

Once connected, the NetMeter should show an initial screen that indicates that the device requires setup. The screen will look similar to that of Figure 10

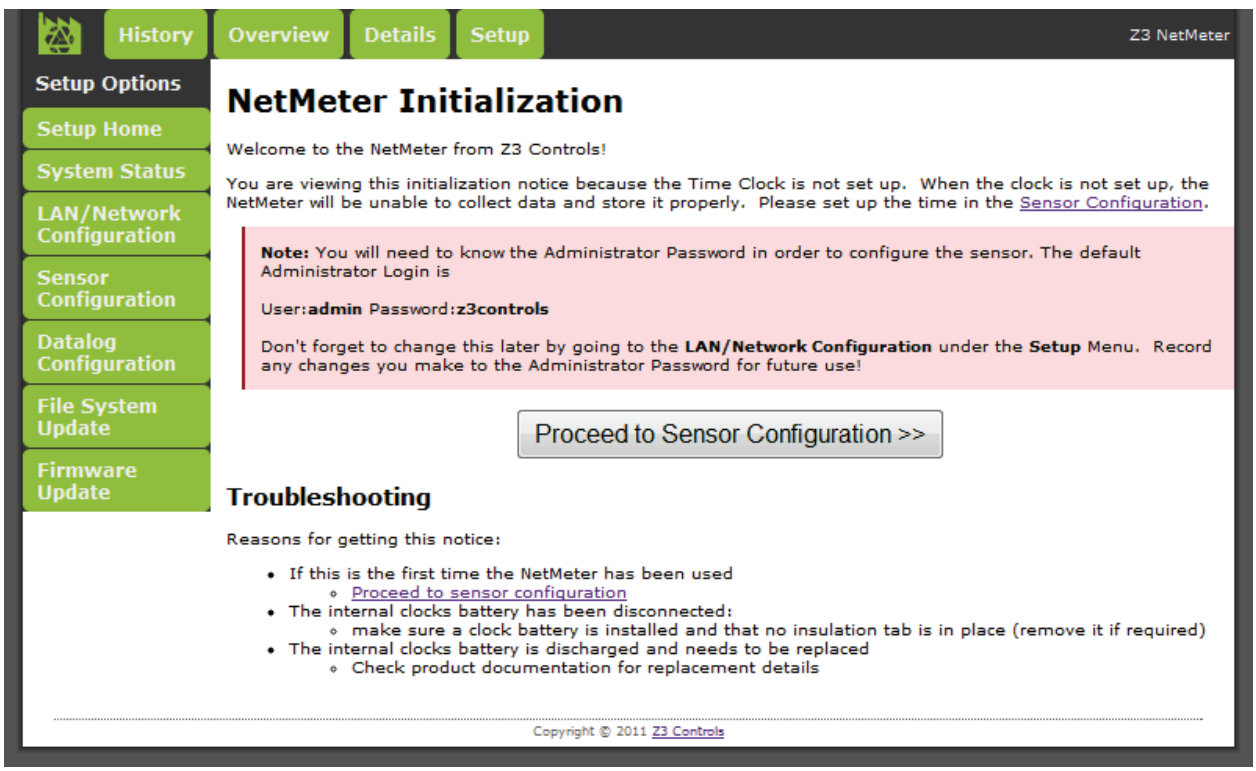
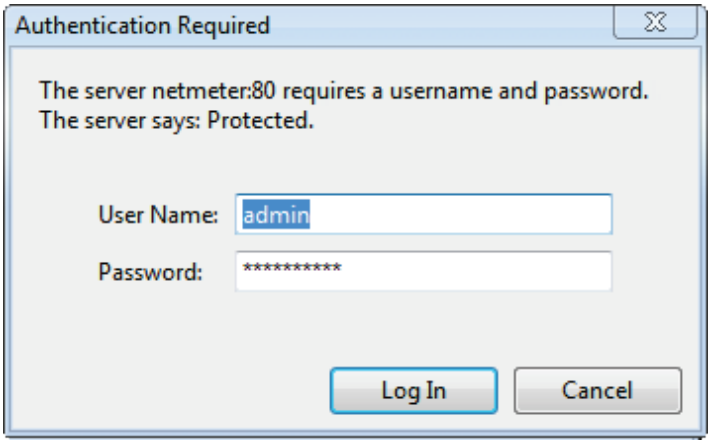


Figure 10: Initialization Webpage Displayed by the NetMeter upon First Use

Step 4: Press "Proceed to Sensor Configuration" and then enter the default login:

User Name: admin

Password: z3controls



This will cause the Sensor Setup page to be displayed:

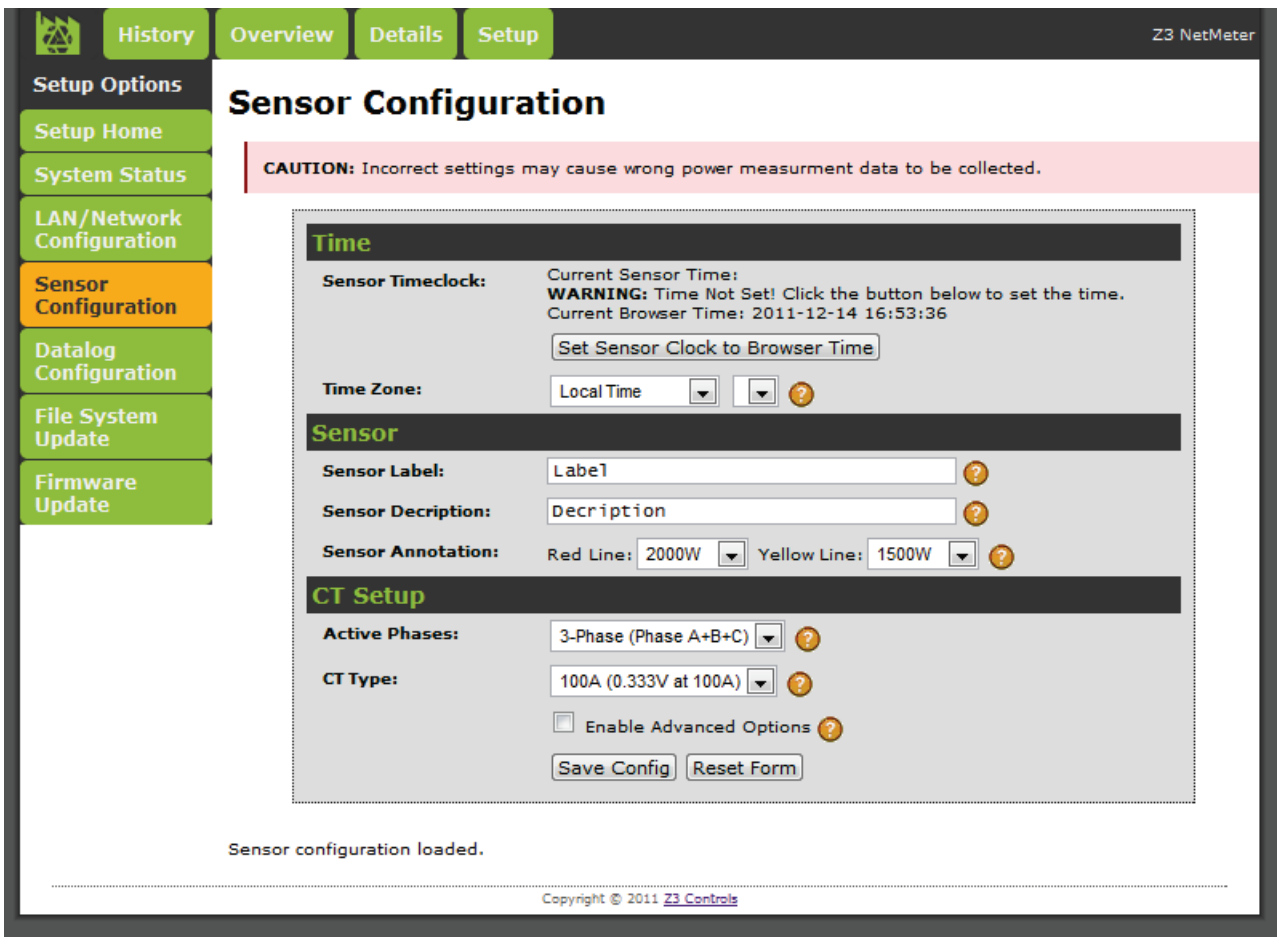
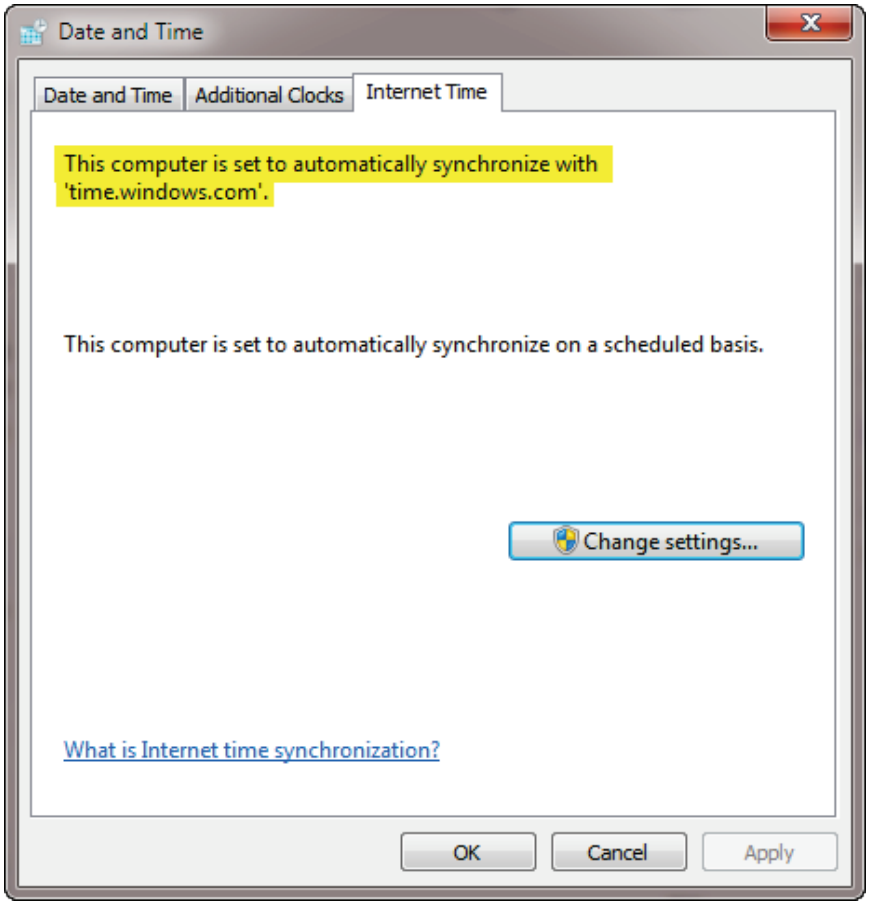


Figure 11: NetMeter Sensor Configuration Page

Step 5: Set the Timeclock. Before proceeding with this, make sure that your computers timeclock setting is correct and accurate. For best results, ensure that your computer is configured for automatic Internet time synchronization. In Windows 7 this is accomplished through the "Change date and time settings" link in the time panel. Make sure that it shows "This computer is set to automatically synchronize with…":



If the computer's time is set correctly, then press the button "Set Sensor Clock to Browser Time" as shown in Figure 11. [3]

Step 6: Sensor Configuration:

- Enter an appropriate label and description for the NetMeter.
- Set the Red/Yellow line: this is used for annotating colour onto power charts. Red/Yellow is meant to indicate power levels that are considered higher than the desired range.
- CT Setup: select one of the preset CTs or enter custom values.
- Save the new configuration

Step 7: Network Configuration: the way that the NetMeter communicates on the local area network is configured through the Lan/Network Configuration as shown in Figure 12.

[3] Note that the NetMeter internally stores time based on universal timecode (UTC). When accessing the NetMeter through the web interface, the NetMeter internal time is converted and displayed as local time according to your browser's time zone settings.

- Host Name: If only a single NetMeter is present on a network then the default value of NETMETER may be used. However, if more than one NetMeter will be used on a network then each one should have a unique IP address.
- Enable DHCP: When enabled, the NetMeter will obtain it's IP address automatically from a DHCP server. When unchecked, the IP configuration will be set manually. The use of this option requires the user to have some working knowledge of the network set up with the NetMeter will be used.
- The admin password can also be changed on the LAN/Network Configuration page.

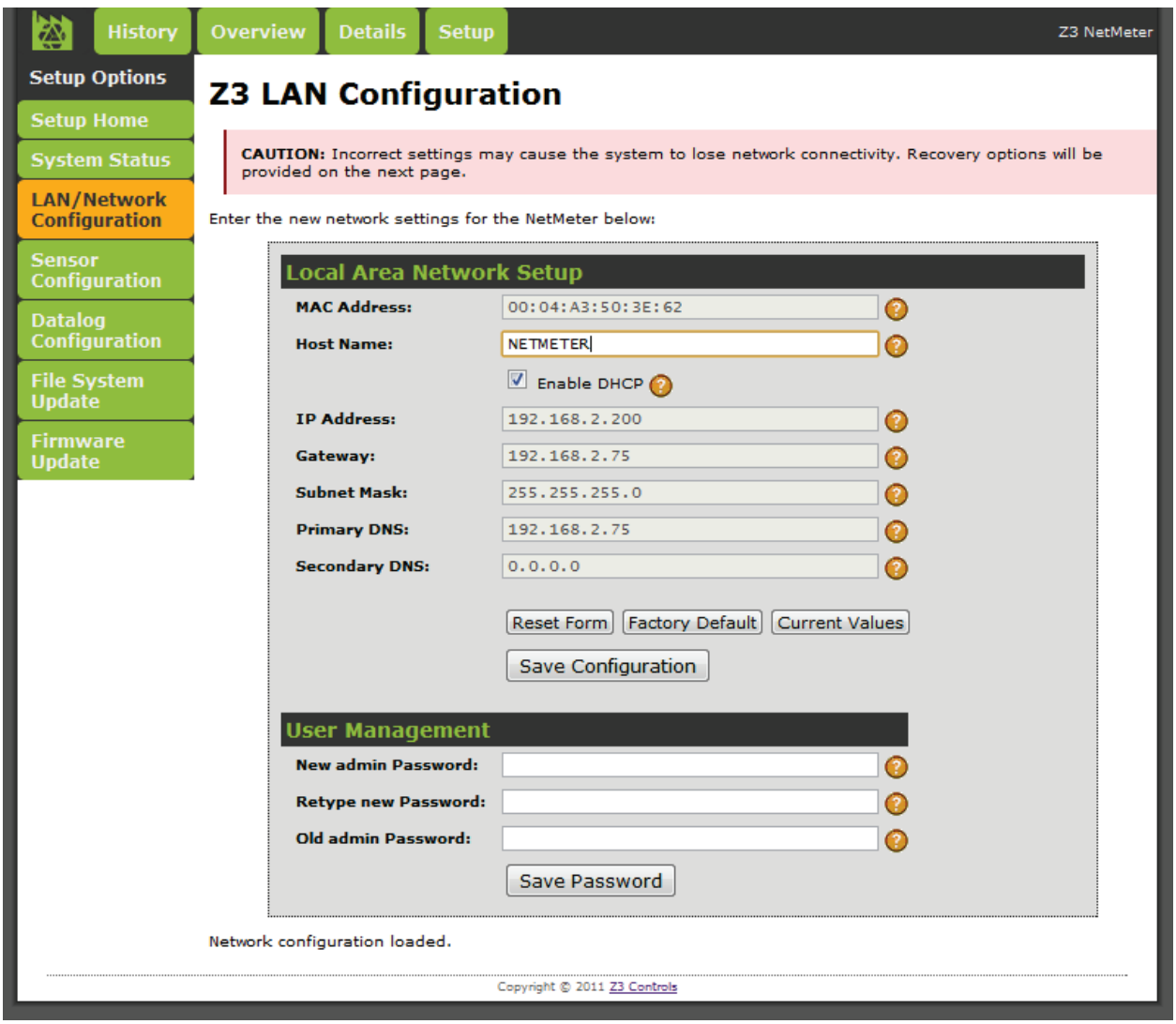


Figure 12: LAN/Network Configuration Page

IMPORTANT NOTE: make sure that you document all changes that you make to network settings.

Step 8: Reset the NetMeter in order for the NetMeter to apply the new values. This can be done by power cycling the unit.

8.1 Network Default Recovery

If network parameters are incorrectly set up, then communication with the NetMeter may fail. It is possible to temporarily restore the default values of the network configuration.

> WARNING: before proceeding with network default recovery, disconnect all sources of power and verify that they are de-energized and locked out. Failure to follow these instructions may result in personal injury or death, property damage, or economic loss.

The following steps are used to temporarily restore the default network configuration:

1. Power off the NetMeter and disconnect all lethal voltages
2. With the power off, momentarily ground the RESET pin on the ZCAN connector. This is done by connecting pin 3 to pin 4 of the ZCAN connector. Z3 Controls provides a special RJ45 plug for this purpose (called a "Reset Plug").
3. Remove the connection between ZCAN pin 3 and pin 4 (unplug the Reset Plug)
4. Safely power on the NetMeter and connect using the factory default network parameters.
5. Enter new (correct) information into the LAN/Network Configuration Page
6. Reset or Power cycle the NetMeter to invoke the revised network parameters

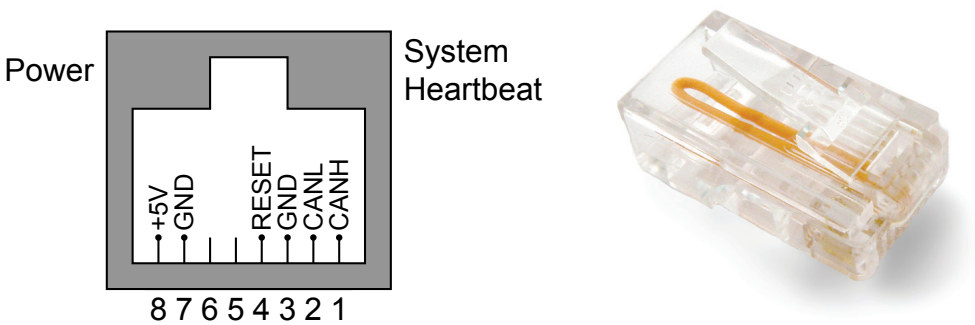


Figure 13: ZCAN Connector Pinout (left) and the Reset Plug (right)

8.2 Using the NetMeter

This manual only describes the steps required for basic NetMeter setup. For information on using the NetMeter, consult the online help at: help.z3controls.com where you will find the most up-to-date information.

> Check the web site for the latest firmware updates.

9 Maintenance

9.1 Battery Replacement

The real-time clock inside the NetMeter uses a small CR2032 lithium battery for maintaining time during power outage. It may require replacement after about 5 or more years of use. The necessity for battery replacement can be determined by observing the Setup screen as in Figure 14. The flashing red battery icon (upper right corner) indicates that the battery should be replaced.

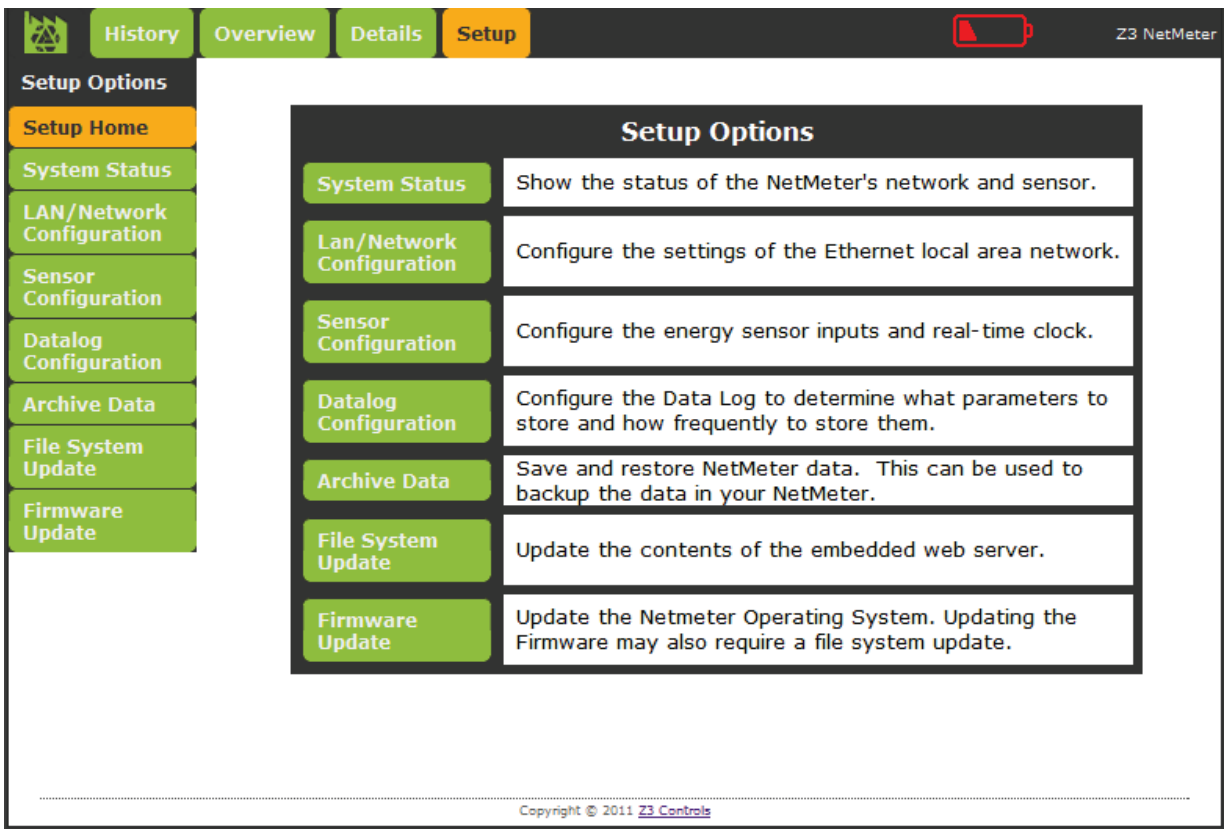


Figure 14: Setup Screen Showing Battery Replacement Indicator

Before battery replacement is attempted, always consult the online help about this topic as the procedure may change. This will help ensure that data is not lost.

WARNING

Before proceeding with battery replacement, disconnect all sources of power and verify that they are de-energized and locked out. Failure to follow these instructions may result in personal injury or death, property damage, or economic loss

After disconnecting all power sources to the NetMeter, the clock battery can be accessed through a snap-out cover as shown in Figure 15. Gently push on the NetMeter housing at ① (this will help release the cover) and carefully pry up on the battery access cover and remove it.

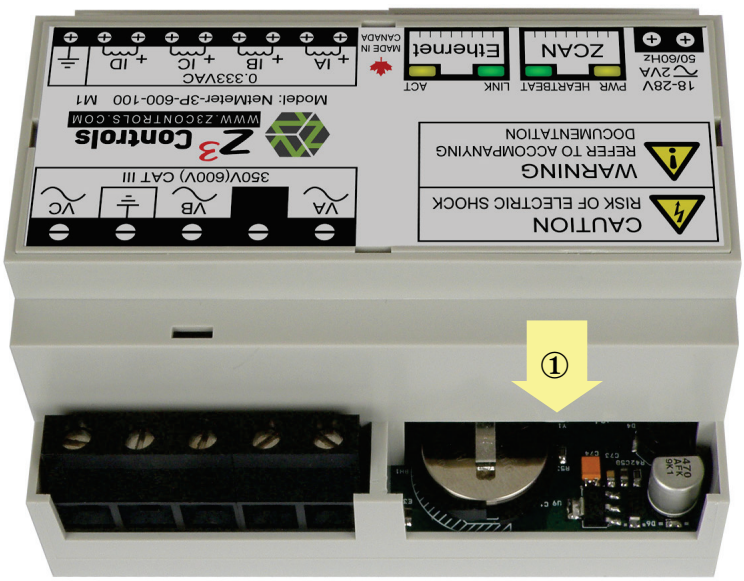


Figure 15: Battery Access Cover

Remove the battery by carefully prying it up by hand or using a small non-conductive flat tool.

Replace the battery with a similar CR2032 battery by carefully inserting it under the retention tab. The battery must be inserted with the Positive terminal up.

Once the battery has been replaced, carefully snap the battery access cover back into place. Then, safely restore the NetMeter to it's previous operational state.

9.2 General Maintenance and Cleaning

Aside from battery replacement as described above, the NetMeter requires no maintenance and cleaning. Proper installation will prevent any contaminants from coating the NetMeter.

A NetMeter which has an accumulation of contaminants, such as oil, water/moisture residue, dust of any kind, or corrosive substances should be safely taken out of service or replaced.

> Use no cleaning agent on the NetMeter.

10 Support

The Z3 Controls web site provides many useful resources including video tutorials, FAQs, and Online Help:

- Online Support Portal: help.z3controls.com

Technical support is also available by contacting Z3 controls at:

- Email: support@z3controls.com
- Phone: 1-877-454-4436
- Mailing address:

  4261-A14 Highway #7 East, Unit 290
  Markham, ON L3R 9W6
  Canada

11 Product Dimensions

The NetMeter module is designed to snap on to standard 35 mm top-hat DIN-rail (EN 50022) as specified in Figure 16.

Dimensions for the NetMeter module itself are given in Figure 17.

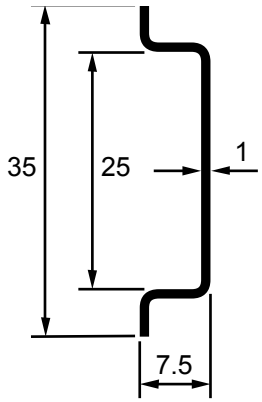
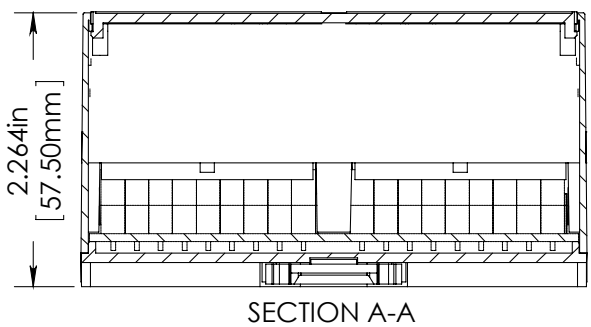


Figure 16: DIN Rail Cross Section Dimensions (Units in mm)



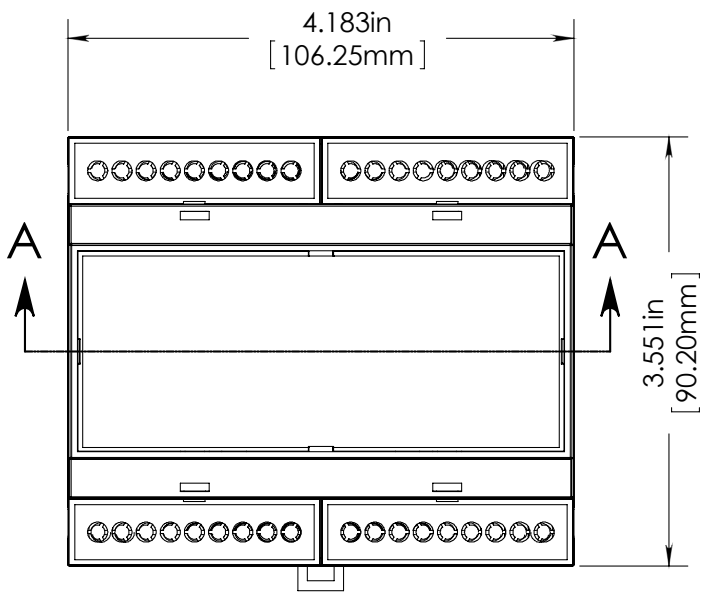


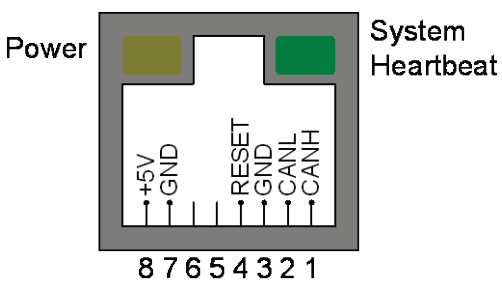
Figure 17: NetMeter Chassis Dimensions

12 Product Specifications

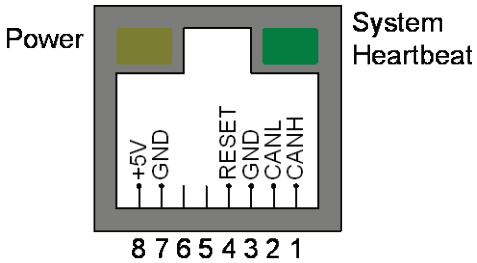
Measurement Range and Accuracy

Parameter		Value
Voltage Sense Inputs (VA, VB, VC)	Maximum Input Voltage	380V(600V) CAT III 380VAC measured between any voltage input (VA/VB/VC) and ground. 600VAC measured between any voltage input (VA/VB/VC) and any other voltage input (VA/VB/VC).
	Input Voltage Accuracy	±1% for inputs above 30VAC
	Input Impedance	>1.8MΩ
	AC Input Frequency	40-80 Hz
	Input Frequency Accuracy	±0.2%
	Wire Gauge	18-10 AWG
	Torque	0.5-0.6 Nm
Current Sense Inputs (IA, IB, IC, ID)[4]	Maximum Input Voltage	0.35VAC 0.5VDC
	Input Voltage Accuracy	±1% for inputs above 0.03VAC
	Input Impedance	>100KΩ
	Wire Gauge	26-12 AWG
	Torque	0.5-0.6 Nm
Supply Voltage	Minimum Supply Voltage	18VDC/AC

[4] The current sensor inputs are a voltage input that is designed to measure the output of the current transformer that includes a burden resistor.

Parameter		Value
	Maximum Supply Voltage	28VAC/DC
	Wire Gauge	26-14 AWG[5]
	Torque	0.5→0.6 Nm
Physical	Dimensions	See Figure 17
	Weight	~175g
Environmental	Operating Temperature	-20→60 ºC
	Storage Temperature	-40→80 ºC
	Humidity	5-95%, noncondensing
Ethernet Network	Data Rate	10/100 Mb/s (fast Ethernet), compatible with 10Mb/100Mb/1Gb switches and routers.
	Connector	RJ45 with shield and G/Y LEDs 
	Galvonic isolation	1000V
ZCAN Network	Data Rate	1Mb/s CAN2.0b

[5] Will accommodate wire gauge plus ferrule.

Parameter		Value
	Connector	RJ45 with Y/G LEDs 
Non-volatile Energy Data Storage	1 Min Resolution	Over 2 years
	1 Hour Resolution	~14 years[6]
Non-volatile Datalog Storage	Selectable capture rate	Up to 128,000 data values
Electrical Parameter Measurements	Instantaneous Measurements	RMS Voltage for each phase: V_A, V_B, V_C RMS Current for each phase: I_A, I_B, I_C Active Power for each phase: P_A, P_B, P_C Active Power total: $P_{(A+B+C)}$ Volt-Amperes per phase: VA_A VA_B VA_C Volt-Amperes total: $VA_{(A+B+C)}$ Volt-Amperes Reactive per phase: VAR_A, VAR_B VAR_C Volt-Amperes Reactive total: $VAR_{(A+B+C)}$ Phase Angle: Φ_A, Φ_B, Φ_C Power Factor each phase: PF_A, PF_B, PF_C Power Factor total: $PF_{(A+B+C)}$ Line Period phase A: T_A
	Cumulative Measurements, Wide Bandwidth	Active Energy per phase: WHR_A, WHR_B, WHR_C Active Energy total: $WHR_{(A+B+C)}$ Reactive Energy per phase: $VARHR_A$, $VARHR_B$, $VARHR_C$ Reactive Energy total: $VARHR_{(A+B+C)}$ Apparent Energy per phase: $VAHR_A$, $VAHR_B$, $VAHR_C$ Apparent Energy $VAHR_{(A+B+C)}$

[6] The storage capacity is reduced if the unit undergoes a high rate of power cycling as power off/on events consume memory.

Parameter		Value
	Cumulative Measurements, Fundamental Frequency	Active Energy per phase: $FWHR_A$, $FWHR_B$, $FWHR_C$ Active Energy total: $FWHR_{(A+B+C)}$ Reactive Energy per phase: $FVARHR_A$, $FVARHR_B$, $FVARHR_C$ Reactive Energy total: $VARHR_{(A+B+C)}$
Firmware	Operating system	Can be field upgraded
	TCP Protocols	HTTP server/client, DHCP client, NetBIOS, ICMP server, SSL, SMTP client
	User Interface	Standard Web browser interface with pages for realtime power, historical power with day-over-day comparison, network and sensor setup. Web content can be field upgraded.
Standards		IEEE 802.3-2008, IEC 61010-01 RFC 675, RFC 793, RFC 2131, RFC 5321, RFC 3986
Compliance		Units containing the QPS[7] label have been tested according to SPE-1000.

[7] QPS is accredited in the U.S. by OSHA and in Canada by the SCC, as an Nationally Recognized Testing Laboratory (NRTL) and a Certification Body respectively. A product bearing the QPS Certification Mark is a legal statement that such a product has been tested by QPS to the applicable U.S. and/or Canadian safety standards, and found to be in compliance. In addition, the Mark indicates that the manufacturer's production site has been determined to conform to specific quality system requirements and subject to periodic inspections to verify continued conformance of the product and the system. Thousands of clients in North America and around the world use the QPS Mark on their products to demonstrate compliance with the regulations.

In the USA, electrical safety regulations pertaining to product approval include: workplace safety laws of the OSHA, installation requirements specified in NFPA 70, the NEC, and the laws of individual municipalities. OSHA's Regulations referenced in Part 1910 of the CFR (29 CFR Part 1910) are United Sates law and stipulate that all equipment must be approved by a NRTL. Similarly, as per Article 110.2 and 110.3 of the NEC, all electrical equipment must either be "approved" by the Authority Having Jurisdiction (AHJ) or "Listed", or "Labeled" by an NRTL.

In Canada: Product safety is under the Jurisdiction of Provincial Governments. Provincial Regulations stipulate that "no person may manufacture, install, offer for sale, or otherwise dispose of electrical equipment unless the equipment in question displays a label or mark of a certification organization that is accredited by the Standards Council of Canada (SCC)…"

13 Warranty

Z3 Controls warrants equipment manufactured by it to be free from defects in materials and workmanship for twenty-four (24) months from date of invoice from Z3 Controls or its authorized sales channel. If within the applicable warranty period purchaser discovers such item was not as warranted and promptly notifies Z3 Controls in writing, Z3 Controls shall repair or replace the items or refund the purchase price, at Z3 Controls option.

These warranties shall not apply (a) to equipment not manufactured by Z3 Controls, (b) to equipment which shall have been repaired or altered by others than Z3 Controls, (c) to equipment which shall have been subjected to negligence, accident, or damage by circumstances beyond the control of Z3 Controls, or to improper operation, maintenance or storage, or to other than normal use or service.

With respect to equipment sold but not manufactured by Z3 Controls, the warranty obligations of Z3 Controls shall in all respects conform and be limited to the warranty actually extended to Z3 Controls by its supplier. The foregoing warranties do not cover reimbursement for labour, transportation, removal, installation, or other expenses which may be incurred in connection with repair or replacement.

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