

EPQ DataNode® Series

User's Guide

WARNING

Death, serious injury, or fire hazard could result from improper connection of this instrument. Read and understand this manual before connecting this instrument. Follow all installation and operating instructions while using this instrument.

Connection of this instrument must be performed in compliance with the National Electrical Code (ANSI/NFPA 70-2002) of USA and any additional safety requirements applicable to your installation.

Installation, operation, and maintenance of this instrument must be performed by qualified personnel only. The National Electrical Code defines a qualified person as “one who has the skills and knowledge related to the construction and operation of the electrical equipment and installations, and who has received safety training on the hazards involved.”

Qualified personnel who work on or near exposed energized electrical conductors must follow applicable safety related work practices and procedures including appropriate personal protective equipment in compliance with the Standard for Electrical Safety Requirements for Employee Workplaces (ANSI/NFPA 70E-2000) of USA and any additional workplace safety requirements applicable to your installation.

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5,574,654, 5,933,092, 5,862,391,
5,764,155, 5,696,501, 5,768,148

ADVERTENCIA

Una conexión incorrecta de este instrumento puede producir la muerte, lesiones graves y riesgo de incendio. Lea y entienda este manual antes de conectar. Observe todas las instrucciones de instalación y operación durante el uso de este instrumento.

La conexión de este instrumento debe ser hecha de acuerdo con las normas del Código Eléctrico Nacional (ANSI/NFPA 70-2002) de EE. UU., además de cualquier otra norma de seguridad correspondiente a su establecimiento.

La instalación, operación y mantenimiento de este instrumento debe ser realizada por personal calificado solamente. El Código Eléctrico Nacional define a una persona calificada como “una que esté familiarizada con la construcción y operación del equipo y con los riesgos involucrados.”

AVERTISSEMENT

Si l'instrument est mal connecté, la mort, des blessures graves, ou un danger d'incendie peuvent s'en suivre. Lisez attentivement ce manuel avant de connecter l'instrument. Lorsque vous utilisez l'instrument, suivez toutes les instructions d'installation et de service.

Cet instrument doit être connecté conformément au National Electrical Code (ANSI/NFPA 70-2002) des Etats-Unis et à toutes les exigences de sécurité applicables à votre installation.

Cet instrument doit être installé, utilisé et entretenu uniquement par un personnel qualifié. Selon le National Electrical Code, une personne est qualifiée si “elle connaît bien la construction et l'utilisation de l'équipement, ainsi que les dangers que cela implique.”

WARNUNG

Der falsche Anschluss dieses Gerätes kann Tod, schwere Verletzungen oder Feuer verursachen. Bevor Sie dieses Instrument anschliessen, müssen Sie die Anleitung lesen und verstanden haben. Bei der Verwendung dieses Instruments müssen alle Installation- und Betriebsanweisungen beachtet werden.

Der Anschluss dieses Instruments muss in Übereinstimmung mit den nationalen Bestimmungen für Elektrizität (ANSI/NFPA 70-2002) der Vereinigten Staaten, sowie allen weiteren, in Ihrem Fall anwendbaren Sicherheitsbestimmungen, vorgenommen werden.

Installation, Betrieb und Wartung dieses Instruments dürfen nur von Fachpersonal durchgeführt werden. In dem nationalen Bestimmungen für Elektrizität wird ein Fachmann als eine Person bezeichnet, welche “mit der Bauweise und dem Betrieb des Gerätes sowie den dazugehörigen Gefahren vertraut ist.”

Safety Summary

Definitions

WARNING statements inform the user that certain conditions or practices could result in loss of life or physical harm.

CAUTION statements identify conditions or practices that could harm the EPQ DataNode, its data, other equipment, or property.

NOTE statements call attention to specific information.

Symbols

The following International Electrotechnical Commission (IEC) symbols are marked on the top and rear panel in the immediate vicinity of the referenced terminal or device:



Caution, refer to accompanying documents (this manual).



Alternating current (ac) operation of the terminal or device.



Direct current (DC) operation of the terminal or device.



Protective conductor terminal.



Safety Summary

Definiciones

Las ADVERTENCIAS informan al usuario de ciertas condiciones o prácticas que podrían producir lesiones mortales o daño físico.

Las PRECAUCIONES identifican condiciones o prácticas que podrían dañar la EPQ DataNode, sus datos, otros equipos o propiedad.

Las NOTAS llaman la atención hacia la información específica.

Símbolos

Los siguientes símbolos de la Comisión Internacional Electrotécnica (IEC) aparecen marcados en el panel superior y el posterior inmediatos al terminal o dispositivo en referencia:



Precaución, consulte los documentos adjuntos (este manual).



Operación de corriente alterna (ca) del terminal o dispositivo.



Operación de corriente continua (CC) del terminal o dispositivo.



Terminal de protección del conductor.

Safety Summary

Définitions

Les messages d'AVERTISSEMENT préviennent l'utilisateur que certaines conditions ou pratiques pourraient entraîner la mort ou des lésions corporelles.

Les messages de MISE EN GARDE signalent des conditions ou pratiques susceptibles d'endommager "EPQ DataNode", ses données, d'autres équipements ou biens matériels.

Les messages NOTA attirent l'attention sur certains renseignements spécifiques.

Symboles

Les symboles suivants de la Commission électrotechnique internationale (CEI) figurent sur le panneau arrière supérieur situé à proximité du terminal ou de l'unité cité:



Mise en garde, consultez les documents d'accompagnement (ce manual).



Fonctionnement du terminal ou du dispositif sur le courant alternatif (c.a.).



Fonctionnement du terminal ou de l'unité courant continu (CC).



Borne conductrice de protection.

Definitionen

WARNUNGEN informieren den Benutzer darüber, daß bestimmte Bedingungen oder Vorgehensweisen körperliche oder tödliche Verletzungen zur Folge haben können.

VORSICHTSHINWEISE kennzeichnen Bedingungen oder Vorgehensweisen, die zu einer Beschädigung von EPQ DataNode, seiner Daten oder anderer Geräte bzw. von Eigentum führen können.

HINWEISE machen auf bestimmte Informationen aufmerksam.

Symbole

Die folgenden Symbole der Internationalen Elektrotechnischen Kommission (International Electrotechnical Commission; IEC) befinden sich auf der Abdeck- und Seitenplatte unmittelbar am betreffenden Terminal oder Gerät.



Vorsichtshinweis, siehe Begleitdokumente (dieses Handbuch).



Wechselstrombetrieb des Terminals bzw. Geräts.



Gleichstrombetrieb im Terminal oder Gerät.



Terminal-Schutzleiter.

Safety Summary

Safety Precautions

The following safety precautions must be followed whenever any type of connection is being made to the instrument.

- Connect the green safety (earth) ground first, before making any other connections.
- When connecting to electric circuits or pulse initiating equipment, open their related breakers. **DO NOT** install any connection of the instrument on live power lines.
- Connections must be made to the instrument first, then connect to the circuit to be monitored.
- Wear proper Personal Protective Equipment, including safety glasses and insulated gloves when making connections to power circuits.
- Hands, shoes and floor must be dry when making any connection to a power line.
- Make sure the unit is turned OFF before connecting probes to the rear panel.
- Before each use, inspect all cables for breaks or cracks in the insulation. Replace immediately if defective.

Medidas de seguridad

Las medidas de seguridad siguientes deberán observarse cuando se realice cualquier tipo de conexión al instrumento.

- Antes de hacer cualquier conexión, deberá enchufarse el conector de seguridad verde a tierra.
- Cuando se haga conexiones a circuitos eléctricos o a equipo de activación por pulso, deberá abrirse sus respectivas cajas de seguridad. **NO** deberá hacerse ninguna conexión del instrumento en líneas eléctricas bajo tensión.
- Las conexiones deberán hacerse primero al instrumento y, luego, al circuito a ser monitorizado.
- Al hacer conexiones a circuitos eléctricos, deberá utilizar anteojos y guantes protectores.
- Sus manos, zapatos y el piso deberán estar secos en todo momento en que se haga una conexión a un cable eléctrico.
- Verifique que la unidad esté DESACTIVADA antes de conectar sondas en el panel posterior.
- Previo a cada uso, deberá verificarse que los cables no estén rotos y que el material aislante no tenga rajaduras. Reemplace de inmediato cualquier parte defectuosa.

Mesures de Sécurité

Les mesures de sécurité suivantes doivent être prises chaque fois qu'un type de connexion quelconque est effectué sur l'instrument.

- Connecter d'abord la prise de terre de sécurité verte (terre) avant d'effectuer toute autre connexion.
- Ouvrir les disjoncteurs correspondants lors d'une connexion à des circuits électriques ou à des équipements de génération d'impulsions. **NE PAS** effectuer de connexion d'instrument sur des lignes électriques sous tension.
- Une fois toutes les connexions de l'instrument effectuées, connecter au circuit à contrôler.
- Porter des lunettes de protection et des gants isolants pour effectuer des connexions aux circuits électriques.
- S'assurer que les mains, les chaussures et le sol soient secs lors de connexions à une ligne électrique.
- S'assurer que l'unité est ÉTEINTE avant de connecter les sondes au panneau arrière.
- Inspecter tous les câbles, avant chaque utilisation, pour s'assurer que les isolants ne sont pas coupés ou fendus. Remplacer immédiatement tous les équipements défectueux.

Sicherheitsvorkehrungen

Die folgenden Sicherheitsvorkehrungen sind immer dann zu befolgen, wenn eine Verbindung zum Instrument hergestellt wird.

- Schließen Sie zuerst die grüne Sicherheits-/Erdleitung an, bevor Sie eine andere Verbindung herstellen.
- Öffnen Sie beim Anschluß an elektrische Stromkreise oder Impulsauslösungseinrichtungen die entsprechenden Unterbrecher. Es dürfen **KEINE** Anschlüsse an das Instrument unter stromführenden Spannungsleitungen montiert werden.
- Die Verbindungen müssen zuerst am Instrument und danach an der zu überwachenden Schaltung hergestellt werden.
- Tragen Sie Schutzbrillen und Isolierhandschuhe, wenn Sie Anschlüsse an den Stromkreisen vornehmen.
- Hände, Schuhe und Fußboden müssen trocken sein, wenn Sie Anschlüsse an den Stromkreisen durchführen.
- Stellen Sie sicher, daß das Gerät AUSgeschaltet ist, bevor Sie an der rückwärtigen Konsole Meßfühler anschließen.
- Prüfen Sie vor jedem Gebrauch alle Kabel auf Bruchstellen und Risse in der Isolierung. Wechseln Sie schadhafte Kabel sofort aus.

FCC Statement

This device has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his/her own expense.

Warranty

Dranetz-BMI warrants that the EPQ DataNode will be free from defects in workmanship and materials for a period of one year from the date of purchase. Dranetz-BMI will, without charge, replace or repair, at its option, any warranted product returned to the Dranetz-BMI factory service department.

Dranetz-BMI shall not be held liable for any consequential damages, including without limitation, damages resulting from loss of use, or damages resulting from the use or misuse of this product. Some states do not allow limitations of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

This warranty gives you specific rights and you may also have rights which vary from state to state.

Exclusions: *This warranty does not apply in the event of misuse or abuse of the product or as a result of unauthorized repairs or alterations.*

Need Help?

How to Contact Dranetz-BMI

Regardless of your location, Dranetz-BMI sales and product support are within easy reach through an established network of representatives and distributors worldwide.

For Sales, Technical Support, or the name of a Dranetz-BMI Sales Representative in your area, call:

1-800-372-6832 or 732-287-3680

Fax: 732-248-1834

Web site: www.dranetz-bmi.com

Welcome to the EPQ DataNode Series

Congratulations on your purchase of the EPQ DataNode Series.

The EPQ DataNodes serve as power quality and energy data and information gathering devices, connected to the InfoNode via Ethernet. By logging into the InfoNode from any PC having Internet access (or access to the network in which the system operates) or via modem, users can obtain extensive monitoring data, information and answers from all the connected DataNodes. The user interface is a conventional Internet browser, with access restricted only to those users with the correct password. No additional software is required on the user's PC.

More DataNodes can be added at any time, increasing the size and capabilities of the monitoring network. The individual capabilities and features of each different type of DataNode are covered in their own separate user's guides.

Please read this and all user's guides carefully to obtain the greatest value from your power monitoring equipment and to avoid damage and injury that can occur from misuse and improper connection.

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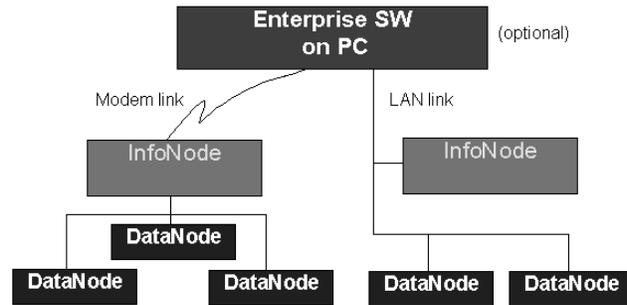
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The EPQ DataNode Series



The EPQ DataNode Series

DataNode Description

The Signature System consists of one or more DataNodes (the data acquisition modules) connected to an InfoNode (the data storage, analysis module and web server). See Chapter 5, *Specifications* for a detailed description of the DataNode hardware.

The InfoNode provides the user interface through a self-contained web server. See the *Series 5500 InfoNode User's Guide* (P/N UG-INODE5500) for additional information and instructions.

The following two items are included with the EPQ DataNode Series as standard accessories:

- Power cord* P/N 900744 (USA only)
P/N 115369-G1 (Euro only)
P/N 115368-G2 (UK only)
- User's Guide* P/N UG-DNODE5500

A variety of optional equipment is available. See Chapter 4, *Optional Equipment* for details.

Measurement Capabilities

The Enhanced Power Quality (EPQ) family of DataNodes is available in various model types: Model 5530, Model 5520, Model 5513 and Model 5510.

The EPQ DataNode models are designed with comprehensive and PQ-optimized data acquisition capabilities for power quality related disturbances or events. The trigger and capture mechanisms include RMS variations, peak transients, waveshapes, steady-state parameter limits, sensitivity changes, harmonics and more. From microsecond transients on voltage and current to cold load pick-up after a sustained interruption, the EPQ DataNode will provide the data and information needed to help determine the cause and severity of the event. In addition, the EPQ DataNodes can be set up to collect and trend and trigger on values from a list of hundreds of parameters, including power and energy related parameters. See Chapter 5, *Specifications*, for theory of operation and detailed hardware description.

EPQ DataNodes are available in a wide variety of functions and configurations. The chart next page details the similarities and differences between the various EPQ DataNode model types.

EPQ DataNode Series Overview

EPQ DataNode® Comparison Chart

	EPQ 5513	EPQ 5520	EPQ 5530
<i>Single, Split, Delta, Wye</i>		■	
<i>Circuit Connections</i>	5513: Plug-in	5520: Screw Terminal	5530: Remote Pods V, Screw Term I, Feed Through
Power Quality			
<i>Cycle-by-Cycle V & I Analysis</i>		■	
<i>Sag/Swell</i>		■	
<i>Current RMS Triggers</i>		■	
<i>Medium Freq Transients V&I</i>		■	
<i>High Freq. Transients V&I</i>		□	
<i>Neutral to Ground</i>		■	
<i>Waveshape Trigger</i>		■	
<i>IEEE 1159 Classification</i>		■	
Power/Energy			
<i>V, I, W, VA</i>		■	
<i>VAR, Power Factor (True & Displacement)</i>		■	
<i>Frequency</i>		■	
<i>Demand (KW, KVA)</i>		■	
<i>Consumption (Kwh)</i>		■	
<i>Revenue Accuracy (ANSI C12.1)</i>		□	
Harmonics			
<i>Total Harmonic Distortion</i>		■	
<i>Interharmonics</i>		■	
<i>Spectrum Analysis</i>		■	
Specialized Measurements			
<i>Cross Triggering</i>		■	
<i>Programmable Pre/Post</i>		■	
Answer Modules®		□	
Alarm Notification			
<i>E-mail, Pager, Contact Closure</i>		■	
Software			
<i>Web Browser Interface</i>		■	
<i>Enterprise – NodeLink®, NodeCenter™</i>		□	
Communications Base			
<i>Ethernet 10BaseT/AUI</i>		■	
<i>UCA-2/MMS</i>		■	
<i>Modem (via InfoNode®)</i>		□	
<i>RS232/485 (Diagnostics)</i>		■	
<i>GPS (via InfoNode)</i>		□	
<i>Modbus</i>		□	
Agency Approvals			
<i>CE Certification (IEC-1010)</i>		■	
<i>UL Certification</i>		■	

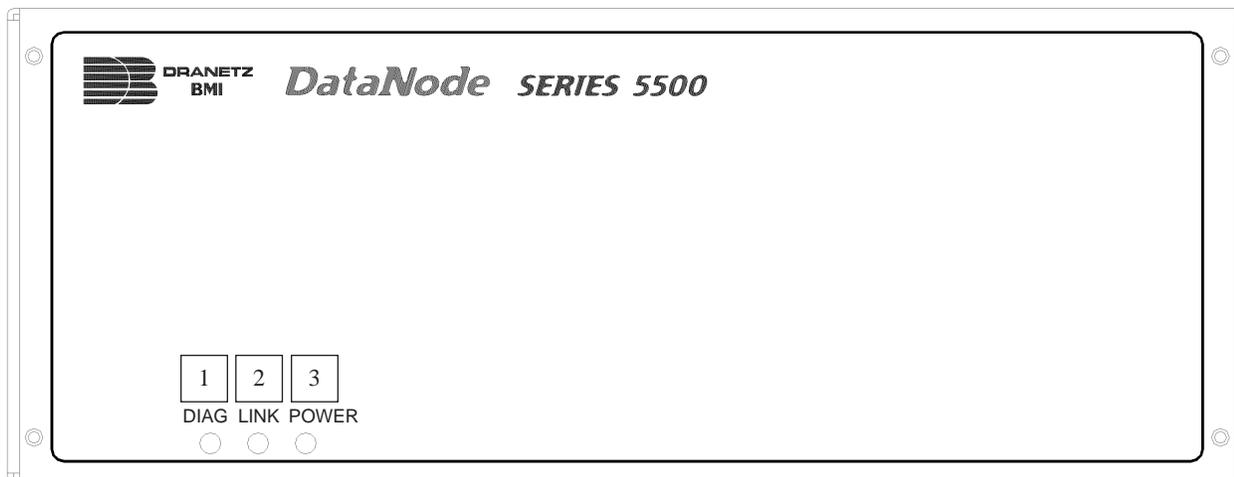
■ Standard Feature

□ Optional Feature

EPQ DataNode Series Overview

1

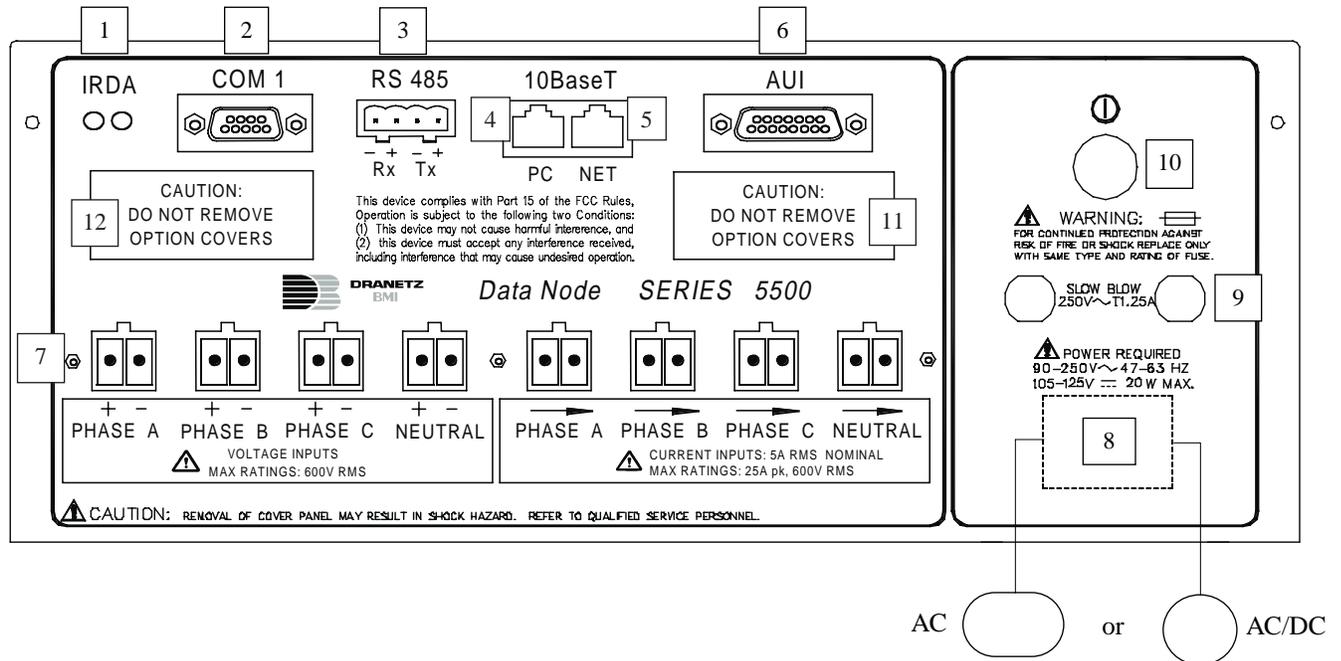
EPQ DataNode Series Front Panel (for DataNode 5520 and DataNode 5510/5530)



- 1 **DIAG** - Indicator lamp will be on during start-up and periodic healthcheck diagnostics.
- 2 **LINK** - Indicator lamp will flash when the unit is responding to network requests.
(Except when connected via AUI port.)
- 3 **POWER** - Indicator lamp will flash in a heartbeat fashion when the unit is operating normally.
NOTE: All three lamps will flash simultaneously when the unit is in Administrator mode.

EPQ DataNode Series Overview

EPQ DataNode 5520 Rear Panel



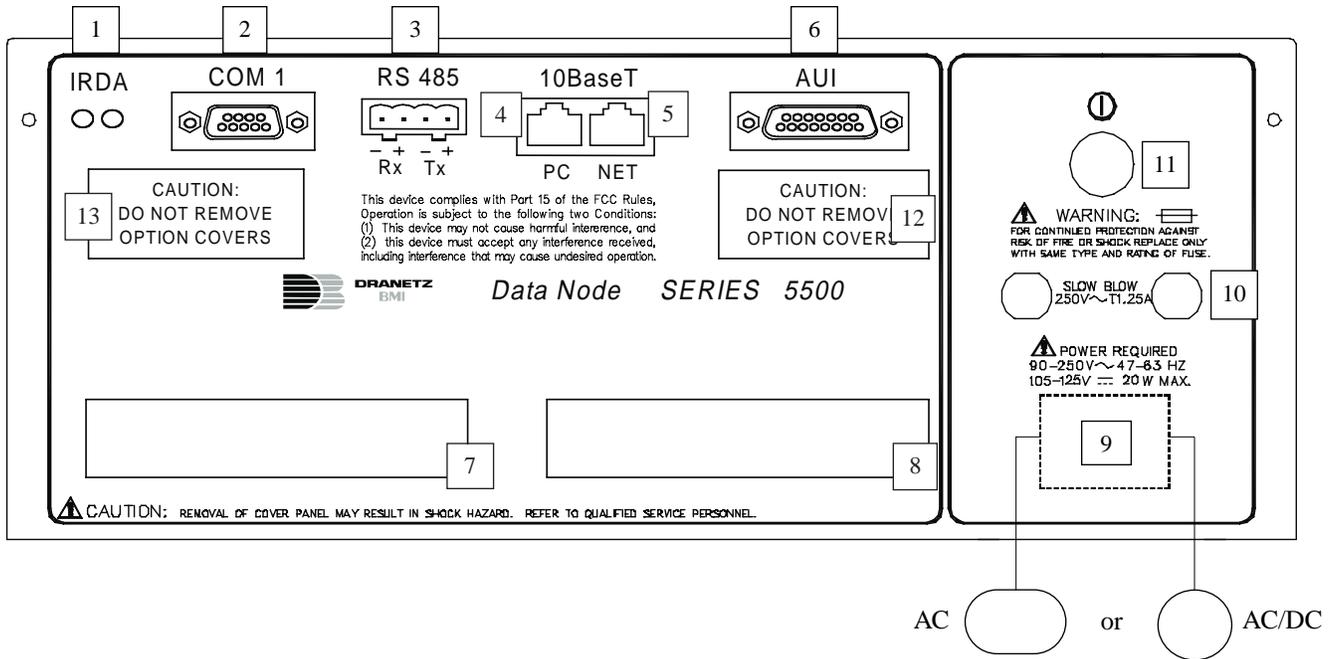
- 1 **IRDA** - Not activated at this time.
- 2 **COM 1- RS232** used for administrative setup of the DataNode for IP addressing, etc.
- 3 **RS485** - Not activated at this time.
- 4 **10BaseT PC (RJ-45)** - Allows connection via Ethernet cable to a PC (built-in “twist”).
- 5 **10BaseT NET (RJ-45)** - Allows connection via Ethernet cable to a network.
- 6 **AUI** - Auxiliary Universal Interface. Enables use of standard AUI adapters for use with fiber optic or other network types.
- 7 **Voltage/Current Channels** - Phases A, B, C and Neutral input connectors.
- 8 **Line power**
AC only power version - 90-250V ac, 47-63 Hz.
AC/DC power version - 90-250V ac, 47-63 Hz. and 105-125V dc, 20W max.
- 9 **Fuses** - Slow blow, 250V ac, 1.25A.
- 10 **Power switch** - Press to turn unit power on or off. Power indicator lamp on front panel flashes when unit is on.
- 11 **Digital Inputs (optional)** - 48V dc maximum. Not activated at this time.
- 12 **Relay Contacts (optional)** - 120V ac, 1A max. 30V dc, 1A max. Not activated at this time.

NOTE: See pages 2-2 to 2-11 for more information on DataNode 5520 Voltage and Current Connectors.

EPQ DataNode Series Overview

1

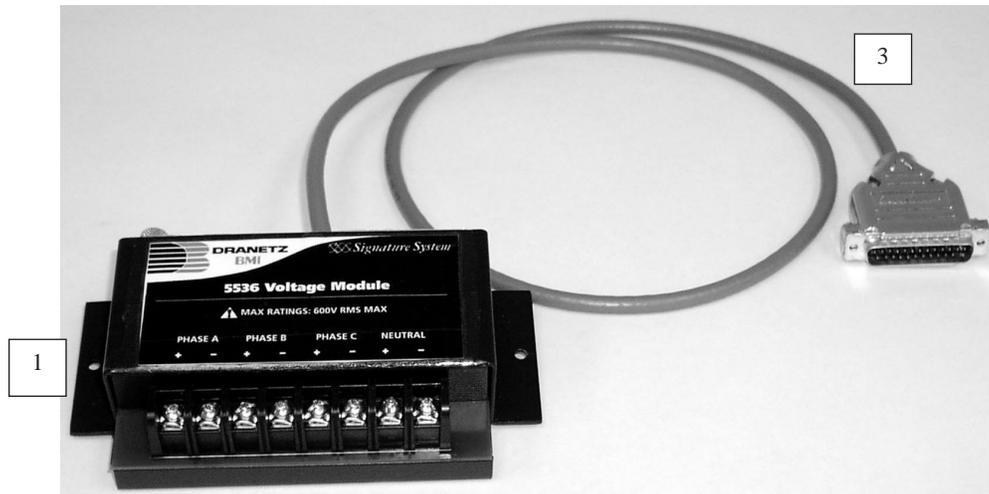
EPQ DataNode 5510/5530 Rear Panel



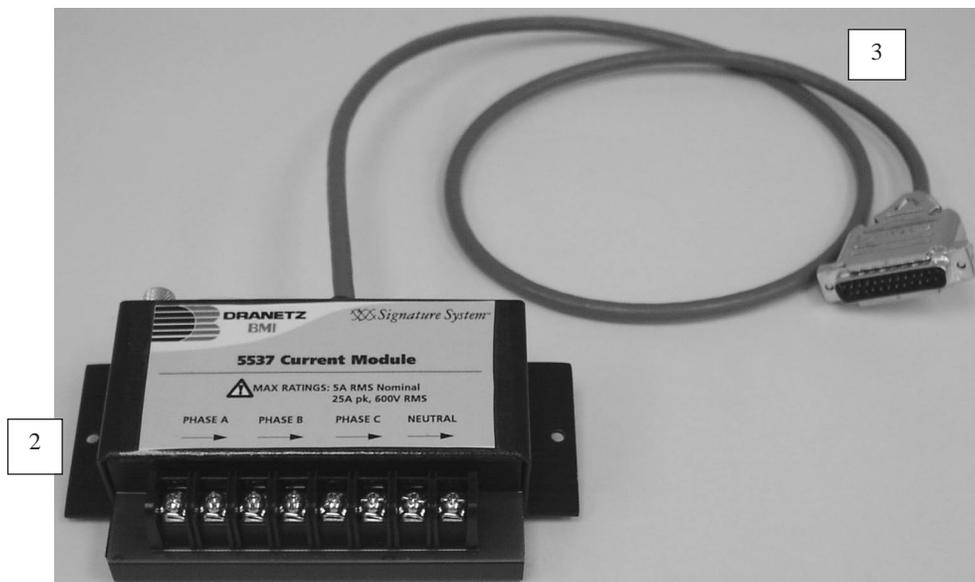
- 1 **IRDA** - Not activated at this time.
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- 4 **10BaseT PC (RJ-45)** - Allows connection via Ethernet cable to a PC (built-in “twist”).
- 5 **10BaseT NET (RJ-45)** - Allows connection via Ethernet cable to a network.
- 6 **AUI** - Auxiliary Universal Interface. Enables use of standard AUI adapters for use with fiber optic or other network types.
- 7 **Voltage Pod** - Allows connection to voltage pod via interface cable [for 5510, 5530].
- 8 **Current Pod** - Allows connection to current pod via interface cable [for 5510, 5530] or via optional CT adapter [BNCTO55, TRTO55].
- 9 **Line power**
AC only power version - 90-250V ac, 47-63 Hz.
AC/DC power version - 90-250V ac, 47-63 Hz. and 105-125V dc, 20W max.
- 10 **Fuses** - Slow blow, 250V ac, 1.25A.
- 11 **Power switch** - Press to turn unit power on or off. Power indicator lamp on front panel flashes when unit is on.
- 12 **Digital Inputs (optional)** - 48V dc maximum. Not activated at this time.
- 13 **Relay Contacts (optional)** - 120V ac, 1A max. 30V dc, 1A max. Not activated at this time.

EPQ DataNode Series Overview

DataNode 5510/5530 Voltage and Current Modules (new model)



(Actual Photo) Model 5536 Voltage Module (replacing old model 5531 voltage pod)



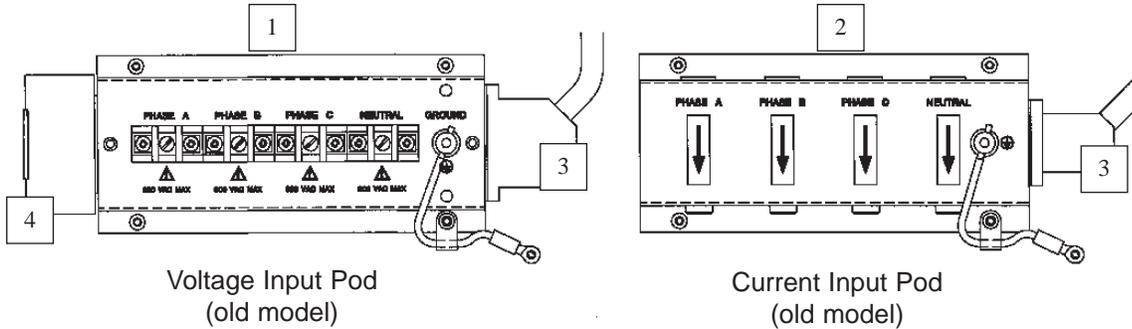
(Actual Photo) Model 5537 Current Module (replacing old model 5532 current pod)

There are two Input Pod types, Voltage and Current. The inputs are attenuated to low voltage signals that can be measured by the DataNode. All connections are safety terminated by the pod. Therefore, the DataNode can be safely removed.

- 1 **Voltage Module** - Accepts four 5 - 600 Vrms (AC or DC), ± 1000 Vpk phase A, B, C voltage, plus neutral and ground. Neutral to ground voltage range: 0.5 - 20 Vrms (AC or DC).
- 2 **Current Module** - Accepts four 0.01-5 A_{rms} and up to #12 AWG wires. Measurement range allows 25 A_{pk}.
- 3 **Data cables** - Enables connection of measurement pods to the DataNode. Cable length is 3' (0.9m).

EPQ DataNode Series Overview

DataNode 5510/5530 Voltage and Current Pods (old model)



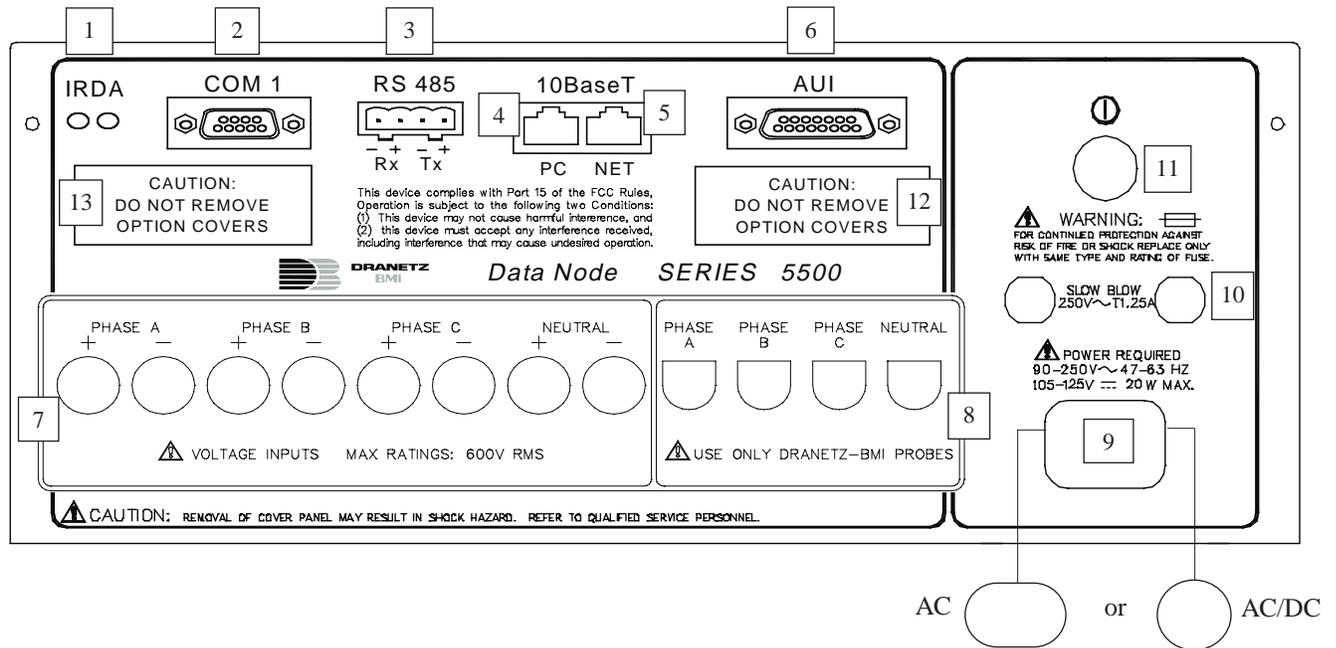
- 1 **Voltage Pod** - Accepts four 5 - 600 Vrms (AC or DC), ± 1000 Vpk phase A, B, C voltage, plus neutral and ground. Neutral to ground voltage range: 0.5 - 20 Vrms (AC or DC).
- 2 **Current Pod** - Accepts four 0.01-5 A_{rms} and up to #10 AWG wires. The current tube diameter is 0.215" (5.461mm). Measurement range allows 25 A_{pk} with 5532A Pod, 100 A_{pk} with 5533A Pod.
- 3 **Data cables** - Enables connection of measurement pods to the DataNode. Cable length is 3' (0.9m).
- 4 **Power type card (use with old model pods only)** - Display and set power measurement type: **Phase-to-Phase** or **Phase-to-Neutral**. The power type showing should be the power type in use. Front and back of card shown below.



NOTE: See pages 2-12 to 2-26 for more information on DataNode 5510/5530 Voltage and Current Input Pods.

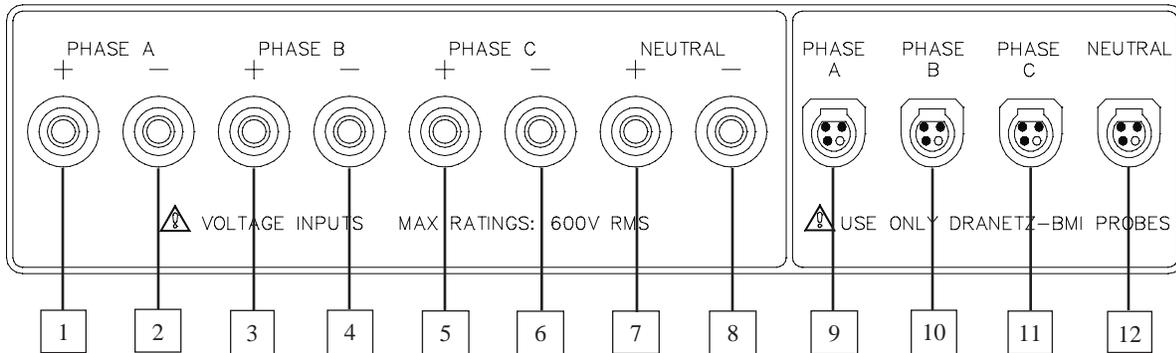
EPQ DataNode Series Overview

EPQ DataNode 5513 Rear Panel



- 1** **IRDA** - Not activated at this time.
- 2** **COM 1**- RS232 used for administrative setup of the DataNode for IP addressing, etc.
- 3** **RS485** - Not activated at this time.
- 4** **10BaseT PC (RJ-45)** - Allows connection via Ethernet cable to a PC (built-in “twist”).
- 5** **10BaseT NET (RJ-45)** - Allows connection via Ethernet cable to a network.
- 6** **AUI** - Auxiliary Universal Interface. Enables use of standard AUI adapters for use with fiber optic or other network types.
- 7** **Voltage Channels** - Phases A, B, C and Neutral voltage input connectors (see page 1-9).
- 8** **Current Channels** - Phases A, B, C and Neutral probe current input connectors (see page 1-9).
- 9** **Line power**
AC only power version - 90-250V ac, 47-63 Hz.
AC/DC power version - 90-250V ac, 47-63 Hz. and 105-125V dc, 20W max.
- 10** **Fuses** - Slow blow, 250V ac, 1.25A.
- 11** **Power switch** - Press to turn unit power on or off. Power indicator lamp on front panel flashes when unit is on.
- 12** **Digital Inputs (optional)** - 48V dc maximum. Not activated at this time.
- 13** **Relay Contacts (optional)** - 120V ac, 1A max. 30V dc, 1A max. Not activated at this time.

DataNode 5513 Voltage/Current Input Connectors

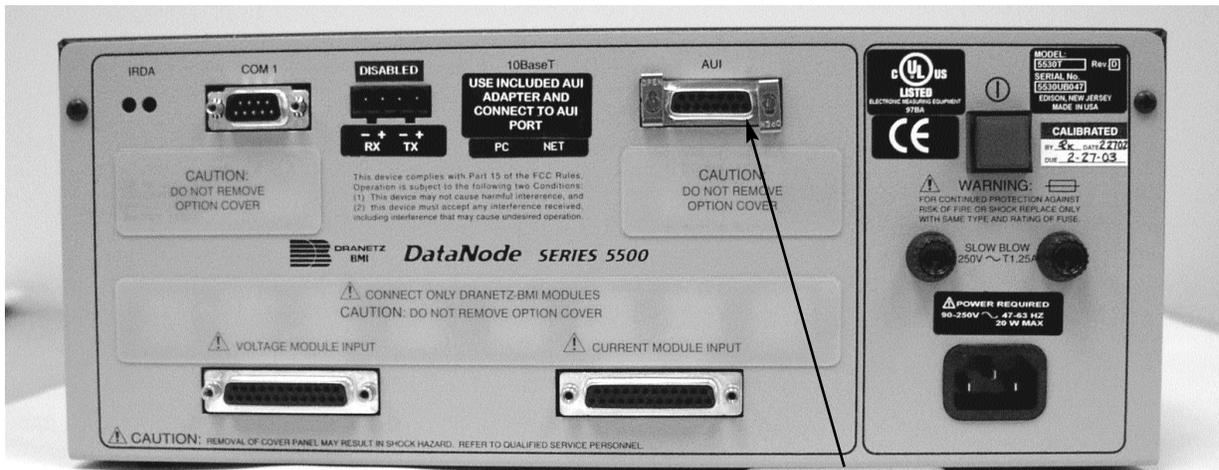


- 1 **CH A, +** Differential Voltage Input Connector; color red.
- 2 **CH A, -** Differential Voltage Input Connector; color white.
- 3 **CH B, +** Differential Voltage Input Connector; color yellow.
- 4 **CH B, -** Differential Voltage Input Connector; color white.
- 5 **CH C, +** Differential Voltage Input Connector; color blue.
- 6 **CH C, -** Differential Voltage Input Connector; color white.
- 7 **NEUTRAL, +** Differential Voltage Input Connector; color grey.
- 8 **NEUTRAL, -** Differential Voltage Input Connector; color white.
- 9 **CH A, PROBE**, Current Input Connector.
- 10 **CH B, PROBE**, Current Input Connector.
- 11 **CH C, PROBE**, Current Input Connector.
- 12 **NEUTRAL, PROBE**, Current Input Connector.

NOTE: See pages 2-27 to 2-36 for more information on DataNode 5513 Voltage and Current Connections.

EPQ DataNode Series Overview

EPQ DataNode Series 5500: Connecting the AUI Adapter

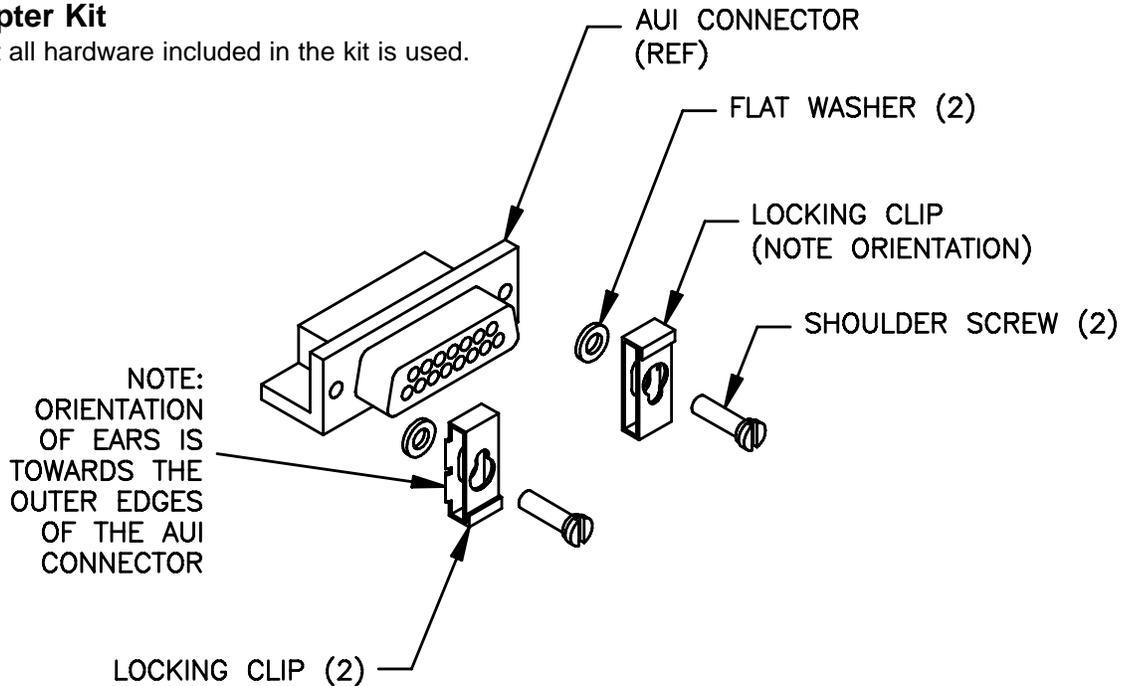


(Actual Photo) DataNode 5510/5530 rear panel with arrow pointing to the AUI Port where (photo upfront) AUI to 10BaseT Adapter connects. The AUI Adapter can be used with any EPQ DataNode model.

Reference part number for the AUI Adapter including the Slide Latch Clip Kit (shown below) is P/N AUI10BT.

AUI Adapter Kit

NOTE: Not all hardware included in the kit is used.



IMPORTANT: Dranetz-BMI recommends that you leave adequate working space for rear panel connections of the InfoNode/DataNode. This rear clearance space is necessary for proper installation of the AUI Adapter and/or other multi-pin connectors for the voltage and current pods.

Initial Setup and Configuration

NOTE: The following procedures are for first time setup and configuration of an EPQ DataNode. If the unit is already configured and connected to the network, proceed to Chapter 3, *Operation*.

The EPQ DataNode should be handled with care. After unpacking the unit, verify that all items ordered have been accounted for. Contact Dranetz-BMI Customer Service if any items are missing or damaged.

Position the DataNode on a dry, flat surface or mount with proper brackets or in an appropriate enclosure. Access to the power, measurement and communication connections is necessary.

Refer to the illustrations in Chapter 1 pages 1-4, 1-5 and 1-8 for location of the various connectors on the rear panel of the unit.

Getting Started

The IP (Internet Protocol) address of both the InfoNode and the EPQ DataNode must be configured before communication can take place. The following information is required:

- IP Address
- Gateway
- Subnet Mask

If you do not have the above information, contact your MIS or computer department.

1. Connect the RS232 serial port of a terminal or a PC running a terminal-emulator to the COM1 (RS232) port of the DataNode with a null modem 9 pin serial cable.

2. Set the serial port of the terminal to 9600 baud, 8 bit, 1 stop bit, no parity, no flow control.

3. Turn the DataNode ON.

4. A message "Press any key to stop auto-boot" will be displayed. Press any key.

5. Enter the user name and password as prompted: [admin] and [password] are the defaults.

6. The main menu selection has two choices:

1. Communication Parameter Setup
 2. Administrative Functions.
- Select [1].

7. On the next menu, choose [1] for Setting TCP/IP Parameters.

8. Enter the appropriate data for the following parameters. Press [Enter] to leave unchanged.

DataNode IP Address

The factory set IP address is 192.168.0.xx where "xx" is the last two digits of the DataNode serial number.

NOTE 1: A "default IP" selection is available through the serial communication port interface. If selected, this will set the DataNode IP address to 192.168.0.16.

NOTE 2: To avoid communication conflicts between InfoNodes and DataNodes, each unit must have its own unique IP address to operate properly.

Subnet Mask

Typically 255.255.255.0

Gateway

Enter 0.0.0.0 if none

Download IP Address

The address of the DataNode to receive updated firmware. Usually the InfoNode ID.

Time Sync

Usually set to InfoNode IP

9. When finished, press [Enter] to save, then [ESC] to go back to main menu.

Updating Firmware

NOTE: There are two sets of firmware to download, the ACP and the IOP. The ACP is comprised of the host CPU and DSP. The IOP handles communications with the InfoNode.

1. If new firmware is needed in the DataNode, refer to Step 6 in the *Getting Started* section above. Select [2] Administrative Functions, then proceed as follows.

2. From the menu, select [2] to Set ACP download flag, then press [Enter] to return to menu.

3. Be sure that the DataNode is connected to the network where the updates are to be extracted from before going further.

4. Select [1] to download new firmware. This is an automatic process that will take about five minutes, then automatically restart the DataNode.

DataNode 5520: Connecting the Voltage/Current Connectors

WARNING!

To avoid the risk of electric shock or burns, always connect the safety (or earth) ground before making any other connections.

WARNING!

To reduce the risk of fire, electrical shock, or physical injury it is strongly recommended to fuse the voltage measurement inputs. Fuses must be located as close to the load as possible to maximize protection.

WARNING!

For continued protection against risk of fire or shock hazard replace only with same type and rating of recommended fuse. Use only fast blow type fuse which is rated 600 V. Recommended fuse type is Littelfuse, part number KLKD.300 rated 600 V AC/DC, 0.3A fast blow.

WARNING!

Do not replace fuse again if failure is repeated. Repeated failure indicates a defective condition that will not clear with replacement of the fuse. Refer condition to a qualified technician.

Safety Precautions:

The following safety precautions must be followed whenever any type of connection is being made to the instrument.

Connect the green safety (earth) ground first before making any other connections.

When connecting to electric circuits or pulse initiating equipment, open their related breakers. DO NOT install any connection of the instrument on live power lines.

Connections must be made to the instrument first, then connect to the circuit to be monitored.

Wear proper Personal Protective Equipment, including safety glasses and insulated gloves when making connections to power circuits.

Hands, shoes and floor must be dry when making any connection to a power line.

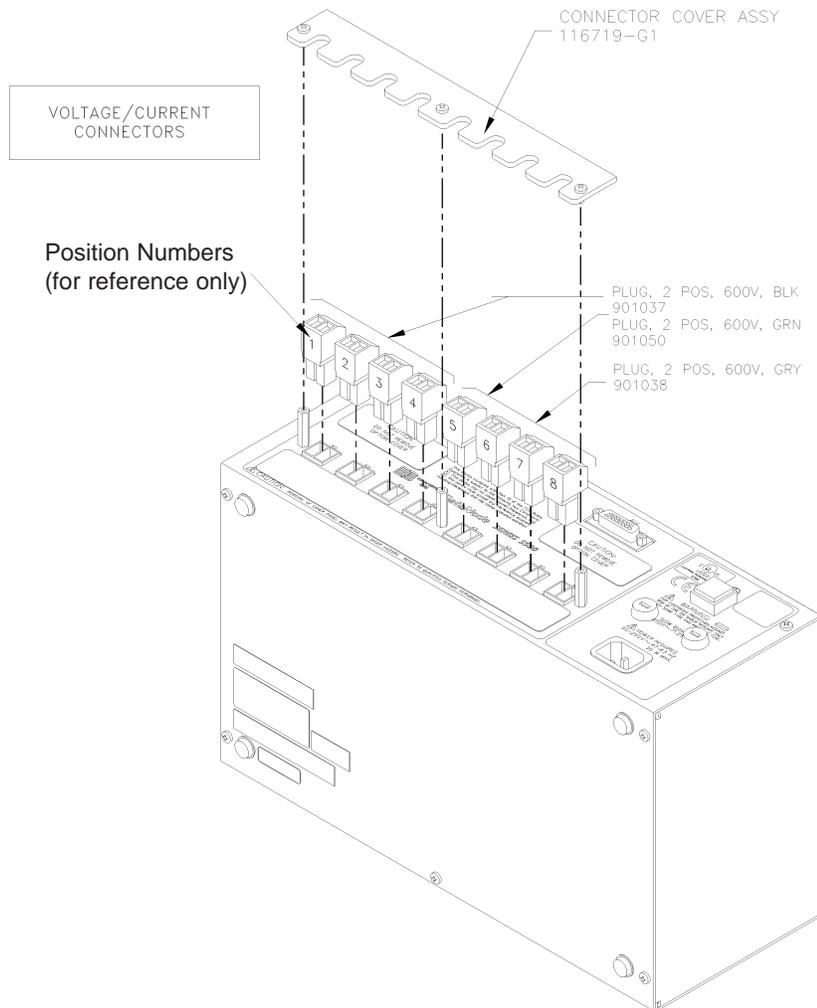
Make sure the unit is turned OFF before connecting probes to the rear panel.

Before each use, inspect all cables for breaks or cracks in the insulation. Replace immediately if defective.

DataNode 5520: Connecting the Voltage/Current Connectors

Connection Guidelines:

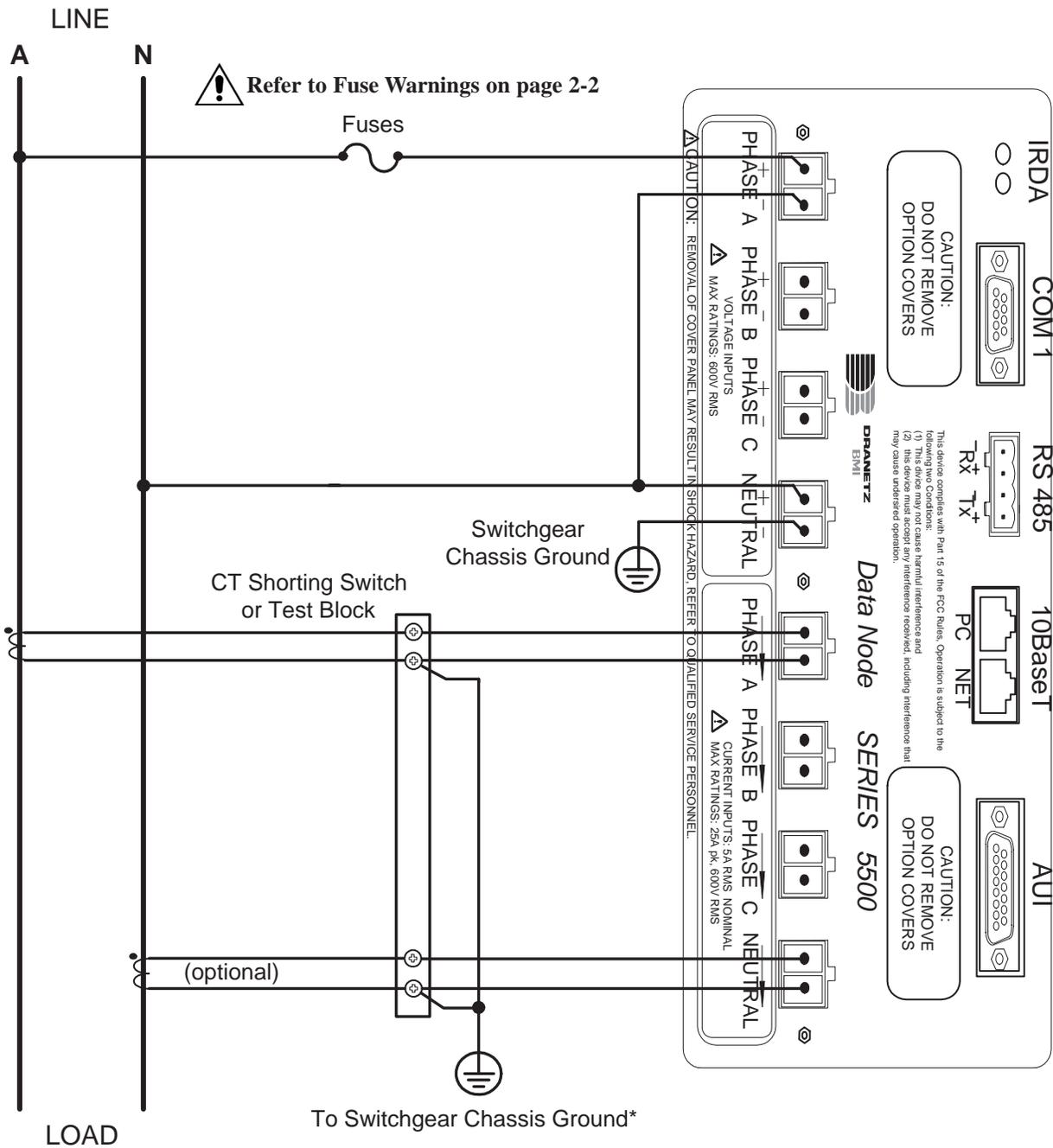
1. Refer to the figure below to connect the Voltage/Current Plugs with the DataNode.
2. Route power wires in a safe manner in accordance with good practice and local codes.
3. Make sure all circuits are de-energized before making connections.
4. Refer to the appropriate connection diagram on pages 2-4 to 2-11 for wiring configurations.
5. Connect monitored voltages to the appropriate Voltage Input connections. Refer to the appropriate wiring diagram on pages 2-4 to 2-11. Attach phases A, B, C and Neutral to the instrument if applicable. (5 - 600 V_{RMS} up to #10 AWG wire)
6. Connect A, B, C and Neutral (if applicable) CT secondaries to the current input connection. The 5520 is designed to connect to CTs with 5 Amp nominal secondaries. (.01 - 5 A_{RMS} up to #10 AWG wire)
7. Turn DataNode ON by pushing the power switch. Proceed to Chapter 3, *Operation*.



Preparation for Use

DataNode 5520: Connecting Power

Connection Type: SINGLE PHASE

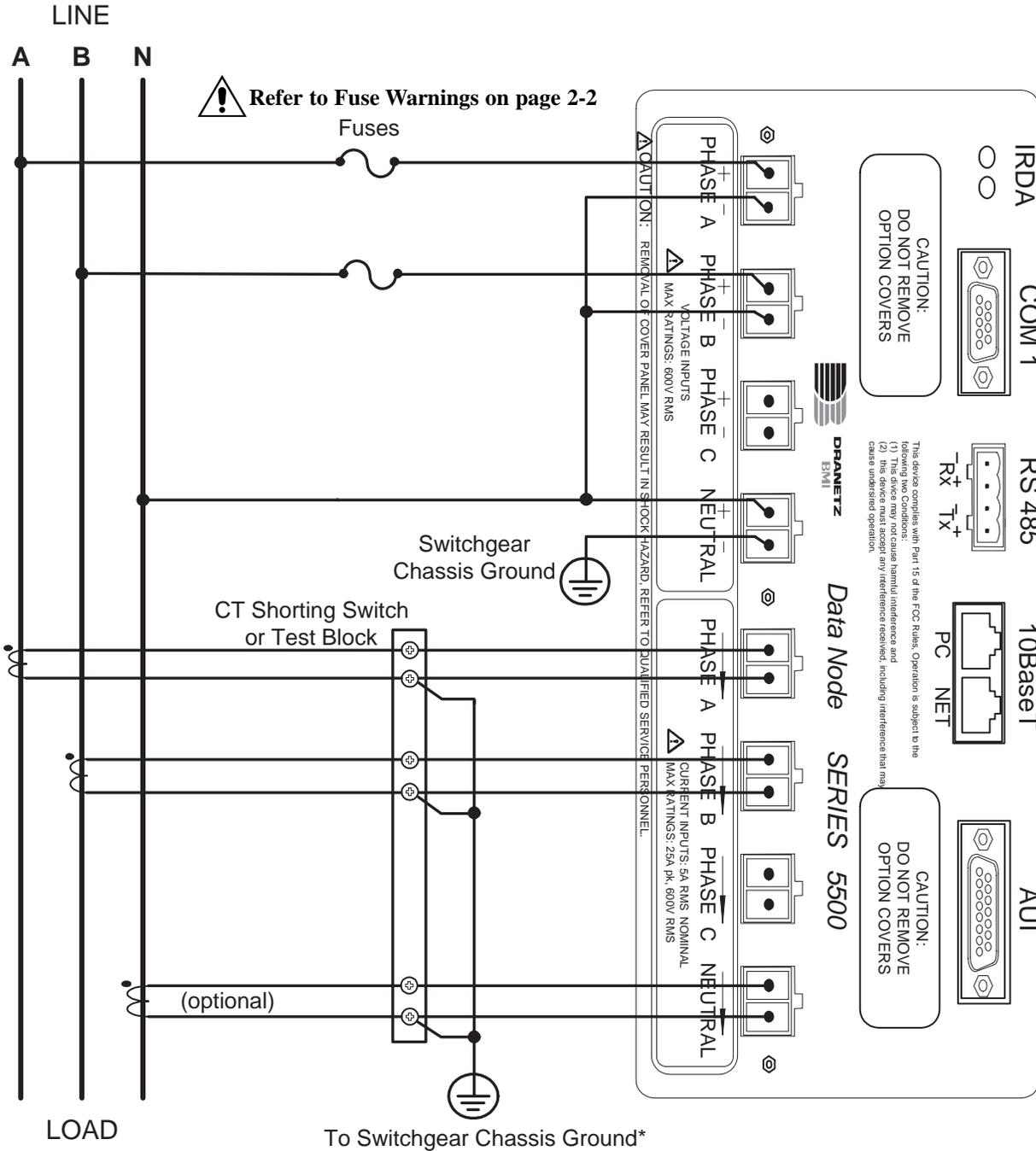


Connections must be performed in compliance with all safety requirements applicable to your installation.

***NOTE:** Connections of CT leg to ground is recommended, but not required for proper operation.

DataNode 5520: Connecting Power

Connection Type: **SPLIT PHASE**



Connections must be performed in compliance with all safety requirements applicable to your installation.

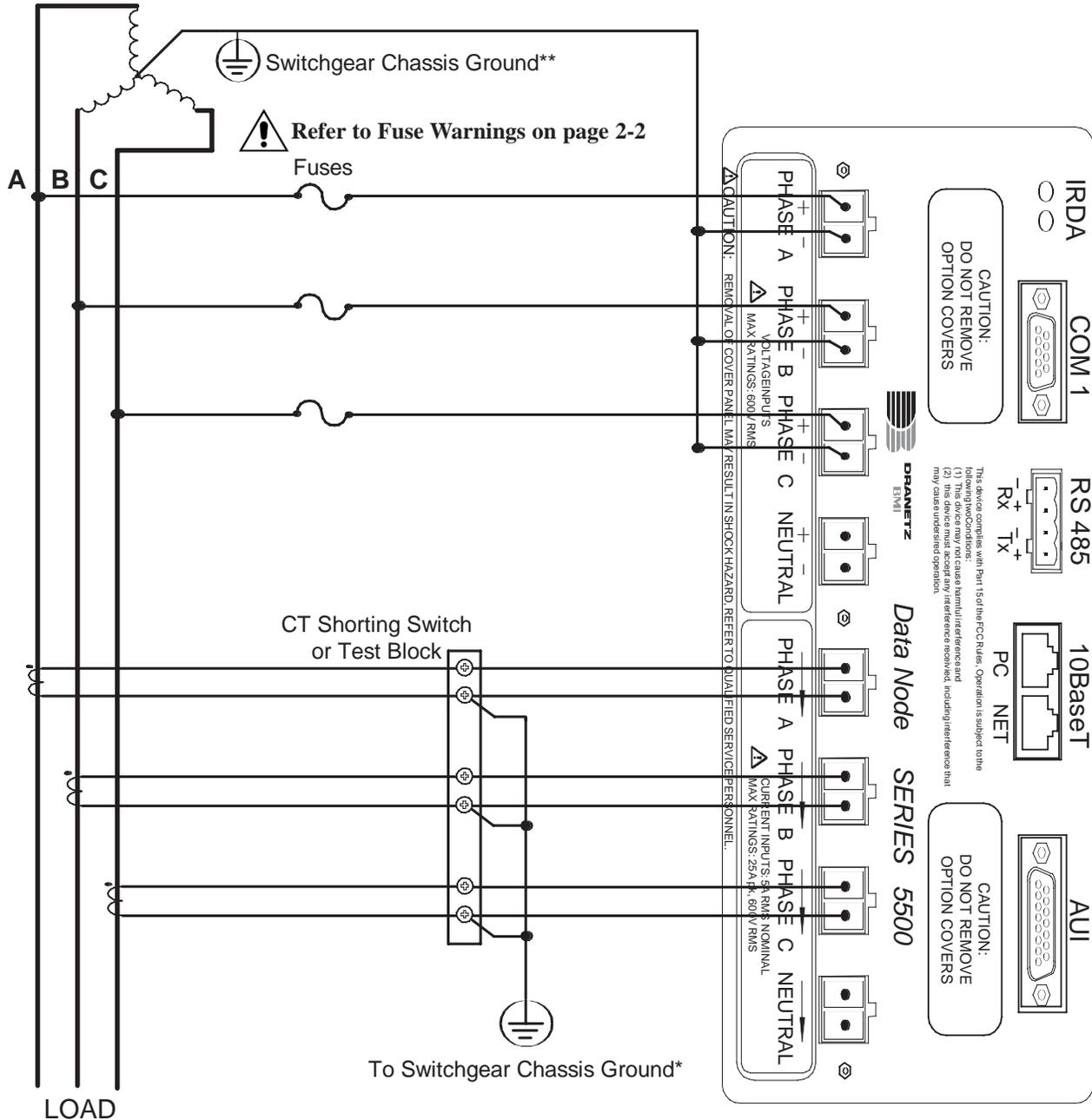
***NOTE:** Connections of CT leg to ground is recommended, but not required for proper operation.

Preparation for Use

DataNode 5520: Connecting Power

Connection Type: 3 WIRE GROUNDED WYE, 3 ELEMENT DIRECT

Setup Mode: Wye



! Connections must be performed in compliance with all safety requirements applicable to your installation.

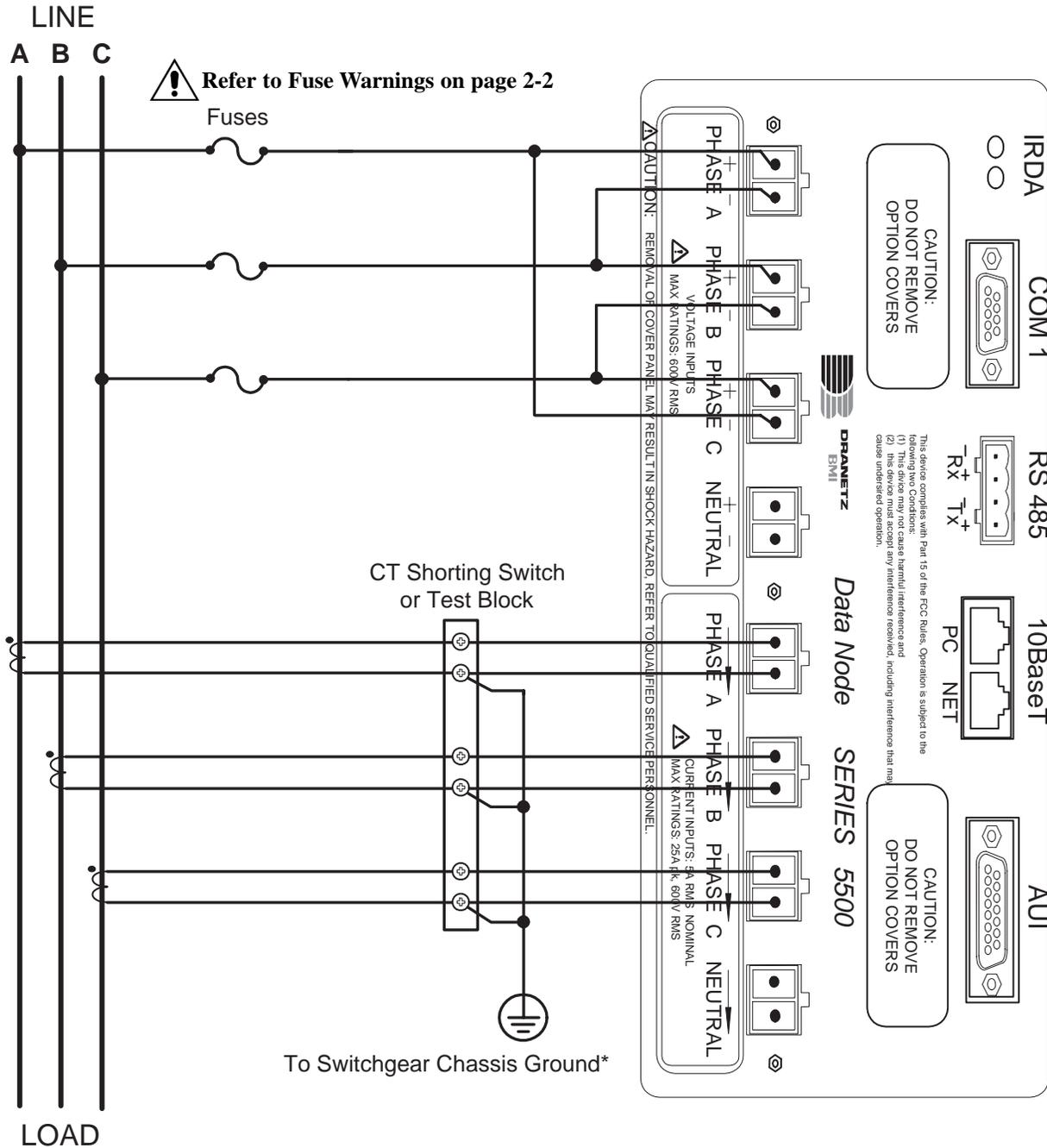
***NOTE:** Connections of CT leg to ground is recommended, but not required for proper operation.

****NOTE:** Connections are the same for 3 Wire Ungrounded Wye, 3 Element Direct.

DataNode 5520: Connecting Power

Connection Type: 3 WIRE DELTA, 3 ELEMENT DIRECT

Setup Mode: Delta



Connections must be performed in compliance with all safety requirements applicable to your installation.

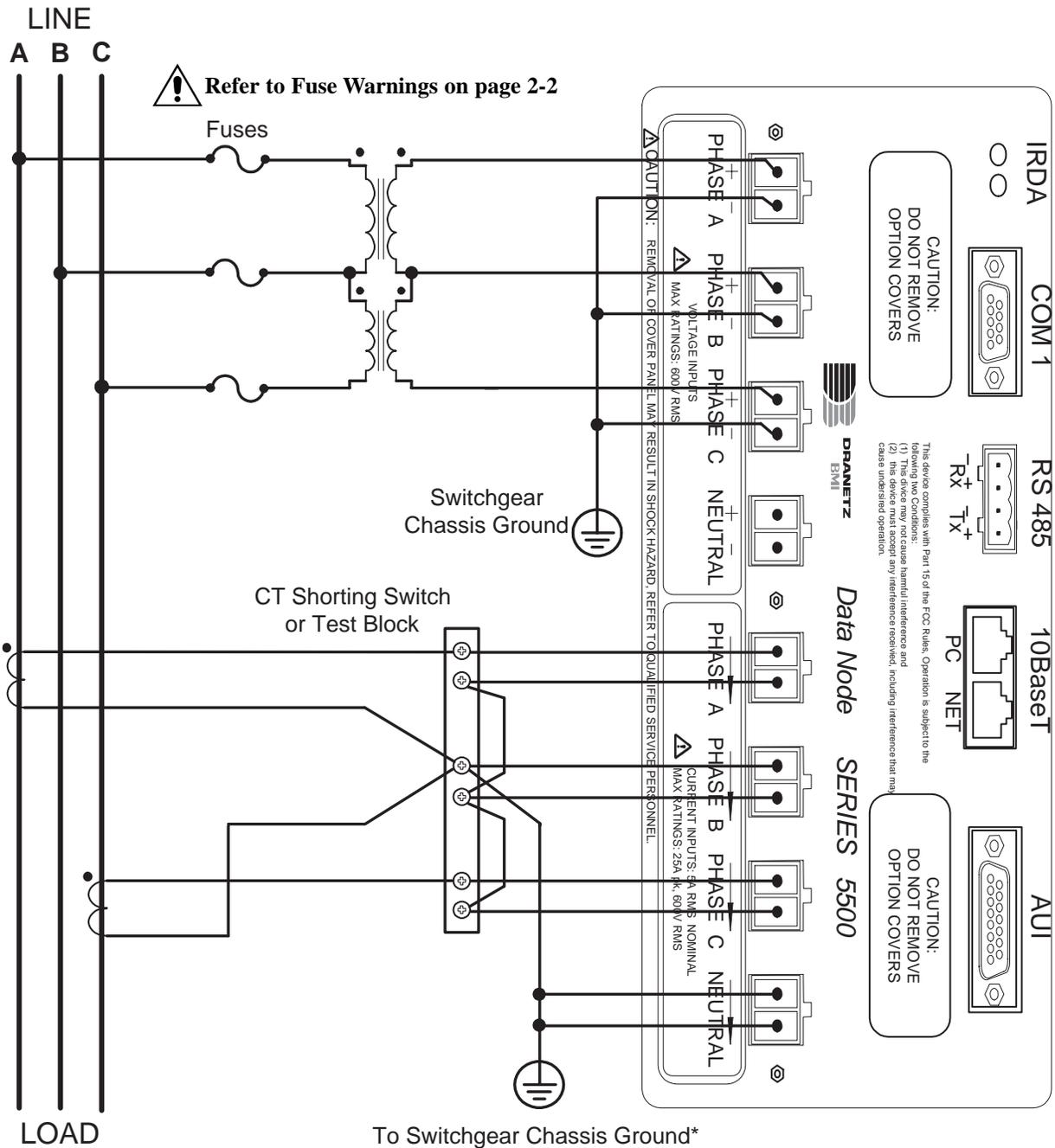
***NOTE:** Connections of CT leg to ground is recommended, but not required for proper operation.

Preparation for Use

DataNode 5520: Connecting Power

Connection Type: 3 WIRE DELTA, 2 ELEMENT, 2 PT, 2 CT

Setup Mode: Delta



Connections must be performed in compliance with all safety requirements applicable to your installation.

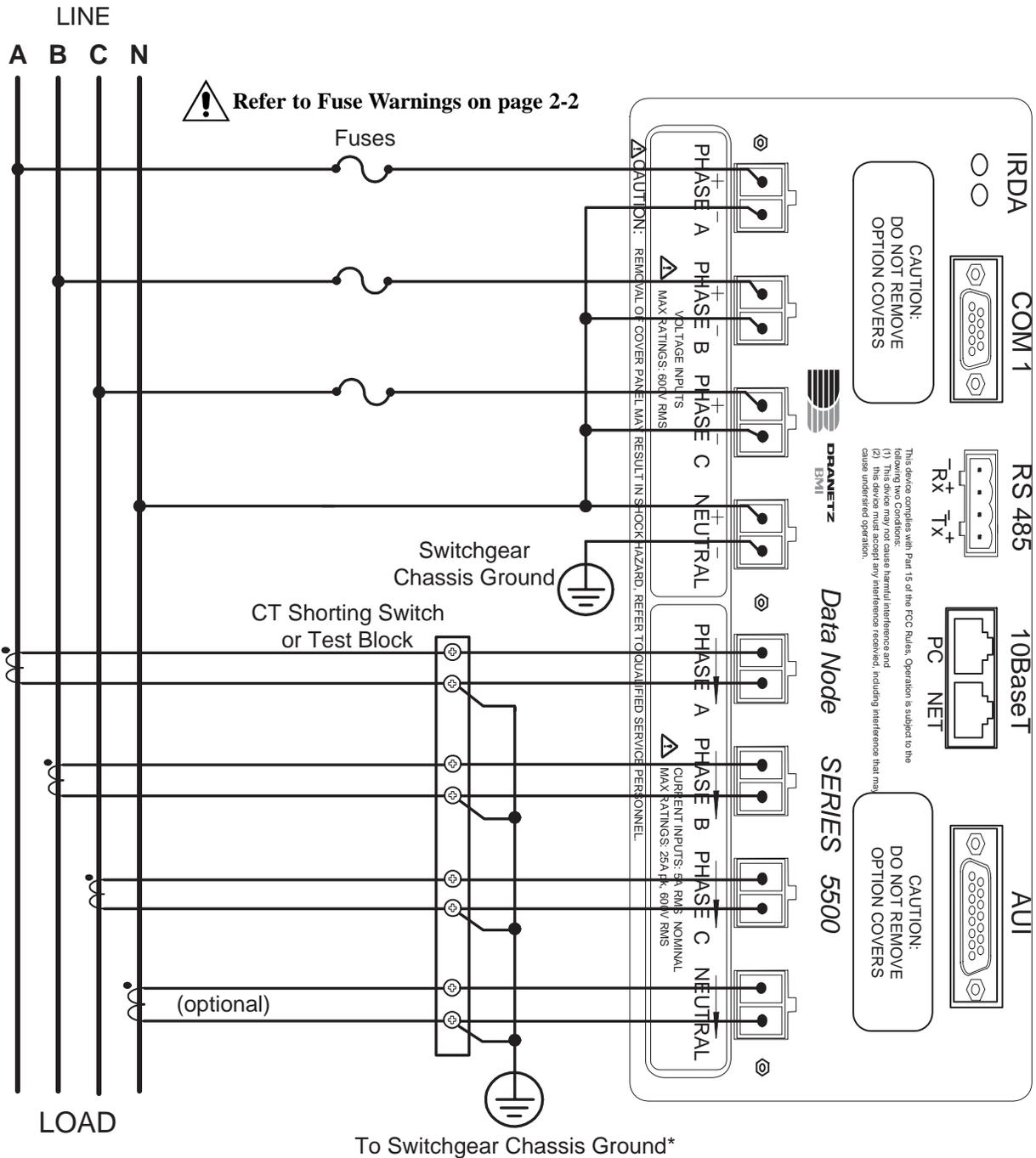
***NOTE:** Connections of CT leg to ground is recommended, but not required for proper operation.

Preparation for Use

DataNode 5520: Connecting Power

Connection Type: 4 WIRE WYE, 3 ELEMENT DIRECT

Setup Mode: Wye



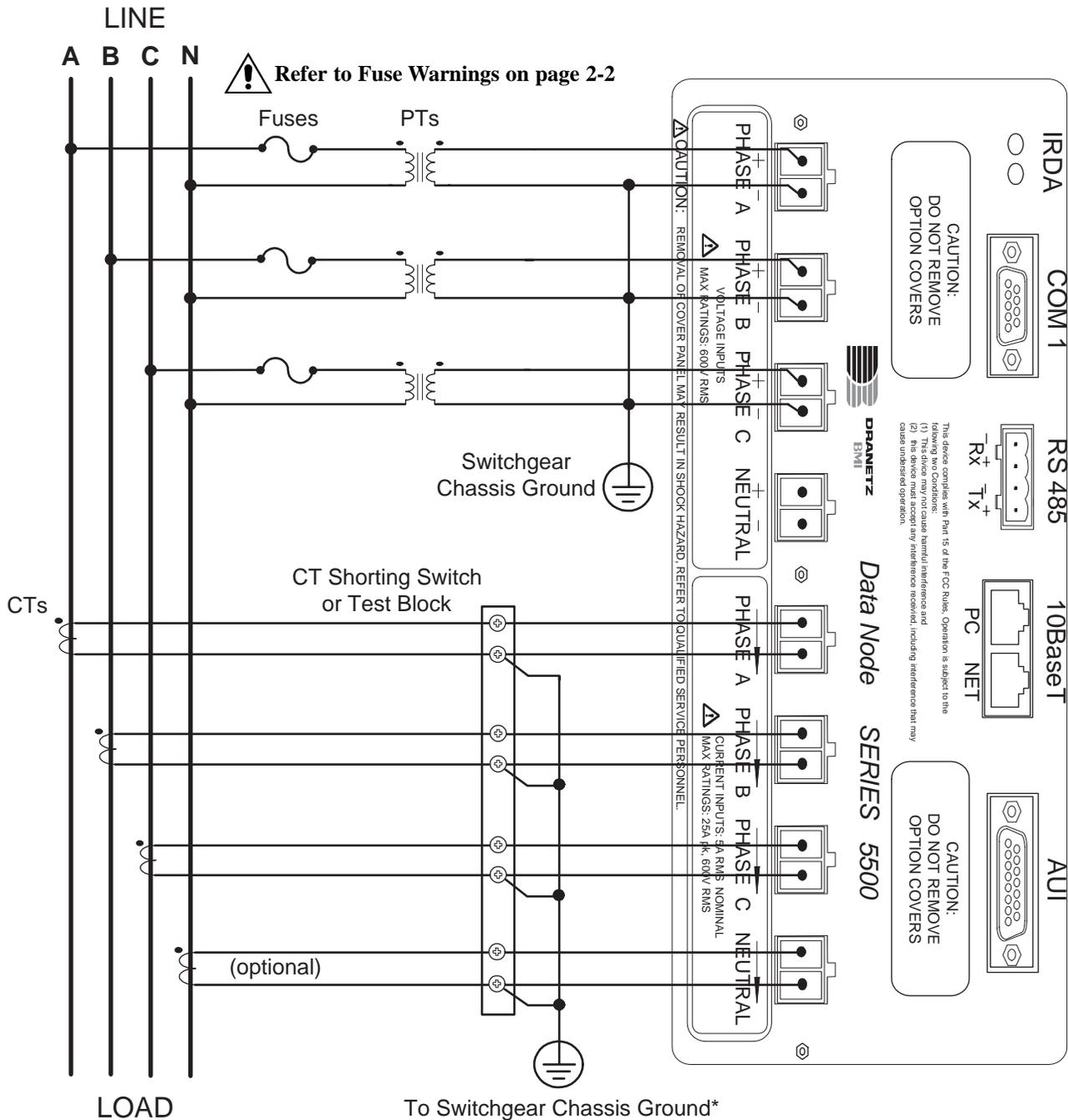
Connections must be performed in compliance with all safety requirements applicable to your installation.

*NOTE: Connections of CT leg to ground is recommended, but not required for proper operation.

DataNode 5520: Connecting Power

Connection Type: 4 WIRE WYE, 3 ELEMENT, 3 PT

Setup Mode: Wye



Connections must be performed in compliance with all safety requirements applicable to your installation.

*NOTE: Connections of CT leg to ground is recommended, but not required for proper operation.

DataNode 5510/5530: Connecting the Voltage and Current Input Pods

WARNING!

To avoid the risk of electric shock or burns, always connect the safety (or earth) ground before making any other connections.

WARNING!

To reduce the risk of fire, electrical shock, or physical injury it is strongly recommended to fuse the voltage measurement inputs. Fuses must be located as close to the load as possible to maximize protection.

WARNING!

For continued protection against risk of fire or shock hazard replace only with same type and rating of recommended fuse. Use only fast blow type fuse which is rated 600 V. Recommended fuse type is Littelfuse, part number KLKD.300 rated 600 V AC/DC, 0.3 A fast blow.

WARNING!

Do not replace fuse again if failure is repeated. Repeated failure indicates a defective condition that will not clear with replacement of the fuse. Refer condition to a qualified technician.

Safety Precautions:

The following safety precautions must be followed whenever any type of connection is being made to the instrument.

Connect the green safety (earth) ground first before making any other connections.

When connecting to electric circuits or pulse initiating equipment, open their related breakers. DO NOT install any connection of the instrument on live power lines.

Connections must be made to the instrument first, then connect to the circuit to be monitored.

Wear proper Personal Protective Equipment, including safety glasses and insulated gloves when making connections to power circuits.

Hands, shoes and floor must be dry when making any connection to a power line.

Make sure the unit is turned OFF before connecting probes to the rear panel.

Before each use, inspect all cables for breaks or cracks in the insulation. Replace immediately if defective.

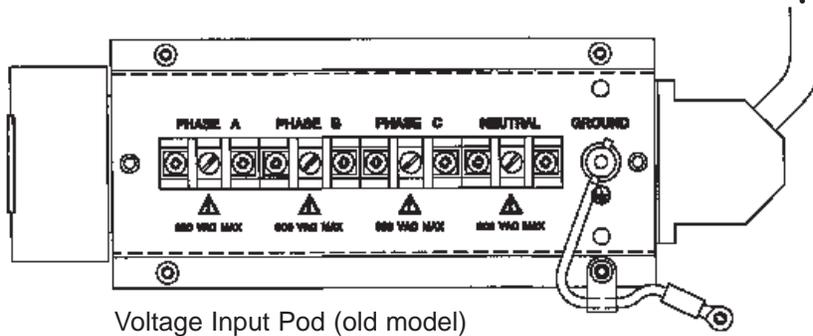
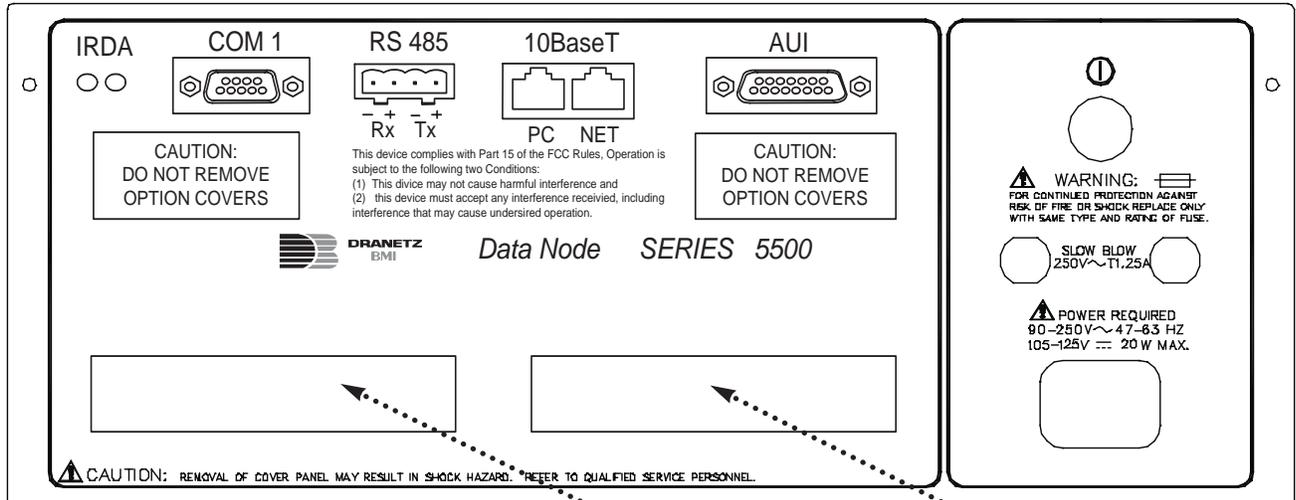
DataNode 5510/5530: Connecting the Voltage and Current Input Pods

Connection Guidelines:

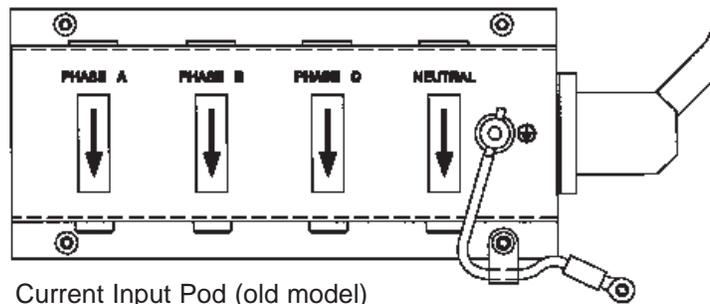
1. Refer to the figures on pages 2-14 to 2-17 to mount the Voltage/Current Pods to the 5510/5530 DataNode.
2. Make sure all circuits are de-energized before making connections.
3. Connect the Data Cables.
Plug the Measurement Pod data cables into the appropriate DataNode connectors. *See appropriate figure on pages 2-14 to 2-17.*
4. Refer to the appropriate connection diagram on pages 2-18 to 2-26 for wiring configurations.
5. Insert the Power Type Card (when using old model voltage/current pods) with the desired power type visible from the front, Phase-to-Phase or Phase-to-Neutral. Use Phase-to-Phase when measuring Delta power systems. Use Phase-to-Neutral when measuring Single-phase, Split phase, and Wye systems.
6. Remove the terminal protective cover(s) from the front of the Voltage Input Pod(s). Unsnap from the edge.
7. Route the power wires in a safe manner, in accordance with good practice and local codes.
8. Connect the ground wire first, before making any other connections.
9. Connect power source to the Voltage and Current Input pods. Attach phase A, B, and C voltage connections plus neutral, if applicable, to the screw terminals on the Voltage Input Pod(s). (5-600 V_{rms}, up to #12 AWG wire)
10. Replace the terminal protective cover(s) on the front of the Voltage Input Pod(s).
11. Pass the CT secondary conductors (0.01-5 A_{rms} and up to #12 AWG wire) through current tubes located on the face of the Input Pod. The arrows on the Input Pod point from source to load.
12. Turn DataNode ON by pushing the power switch. Proceed to Chapter 3, *Operation*.

Preparation for Use

Connecting the Input Pods (old model) to DataNode 5510/5530



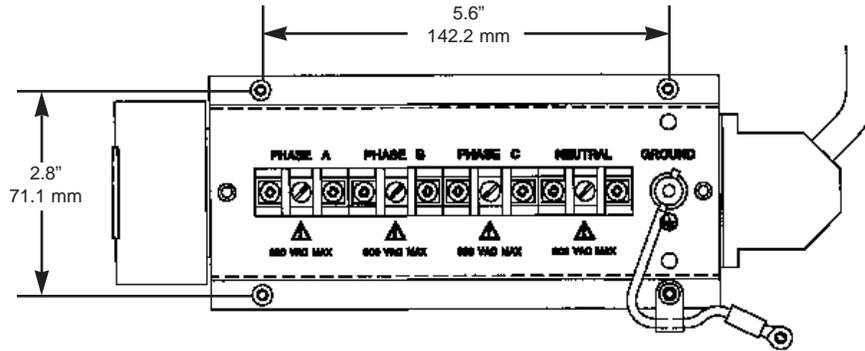
Voltage Input Pod (old model)



Current Input Pod (old model)

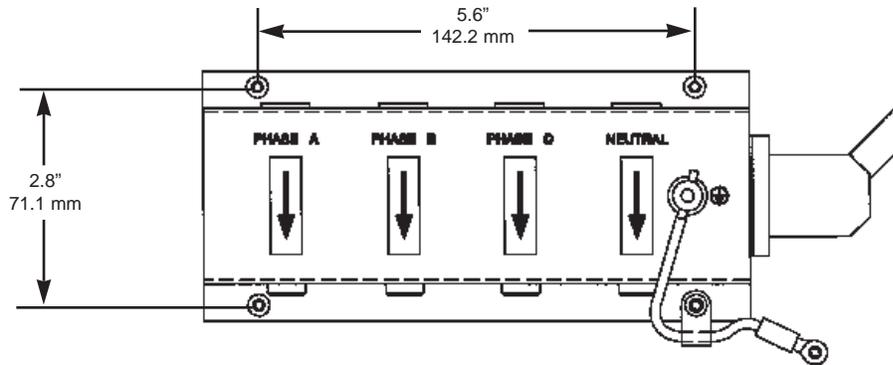
DataNode 5510/5530: Mounting Dimensions for Voltage and Current Input Pods (old model)

Voltage Input Pod



Pod depth is approximately 2.5" (63.5 mm).

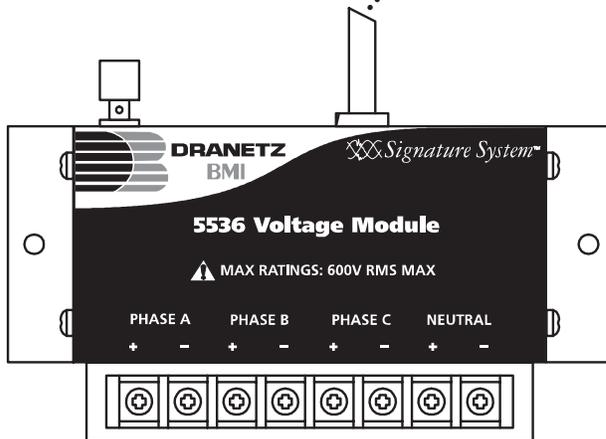
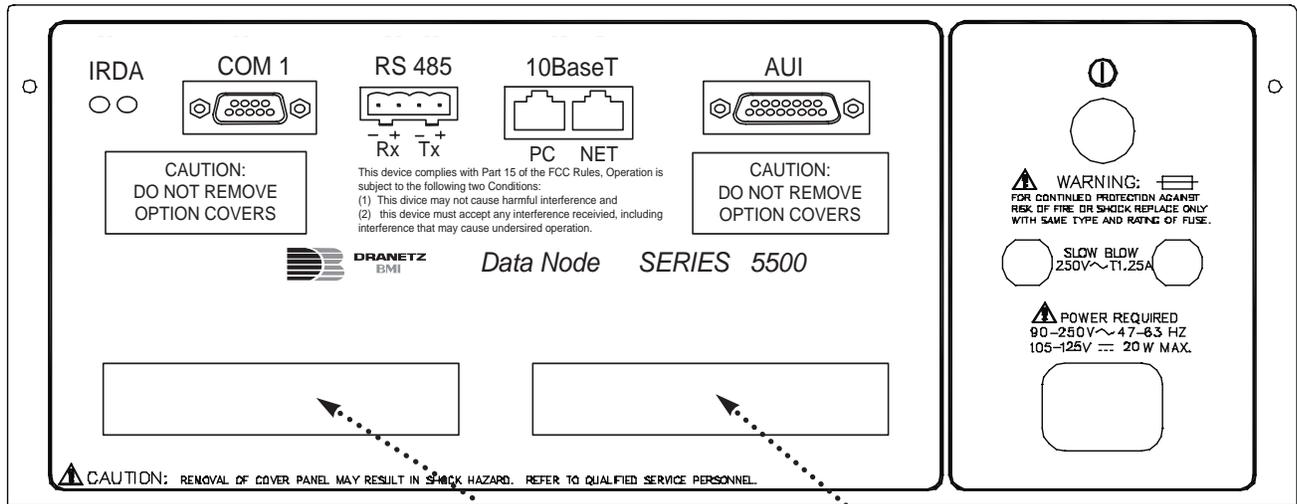
Current Input Pod



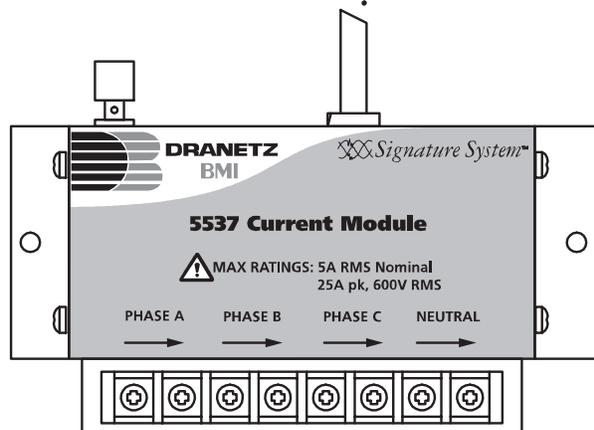
Pod depth is approximately 2.5" (63.5 mm).

Preparation for Use

Connecting the Input Pods (new model) to DataNode 5510/5530



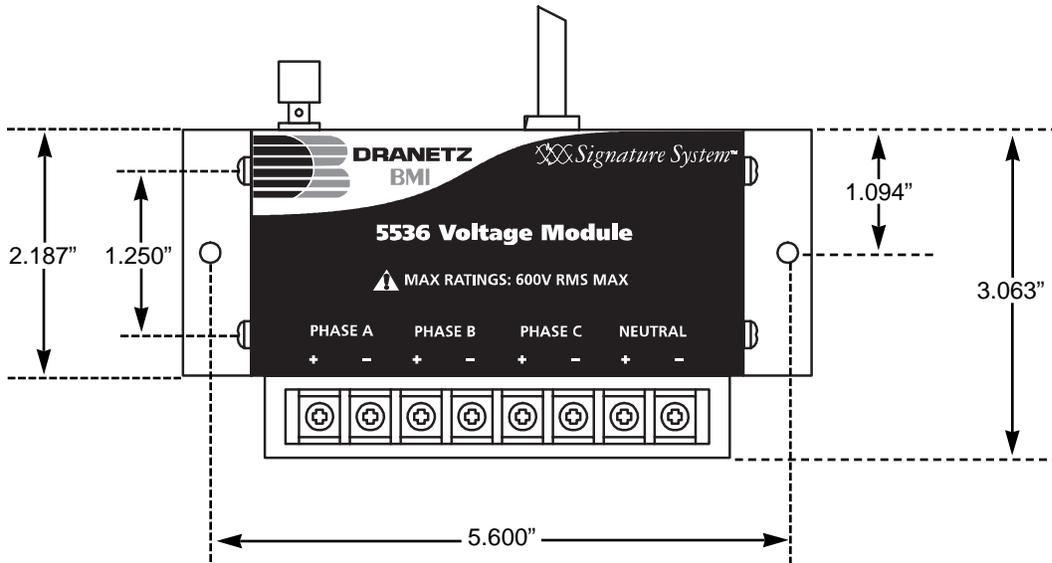
Voltage Input Pod (new model)



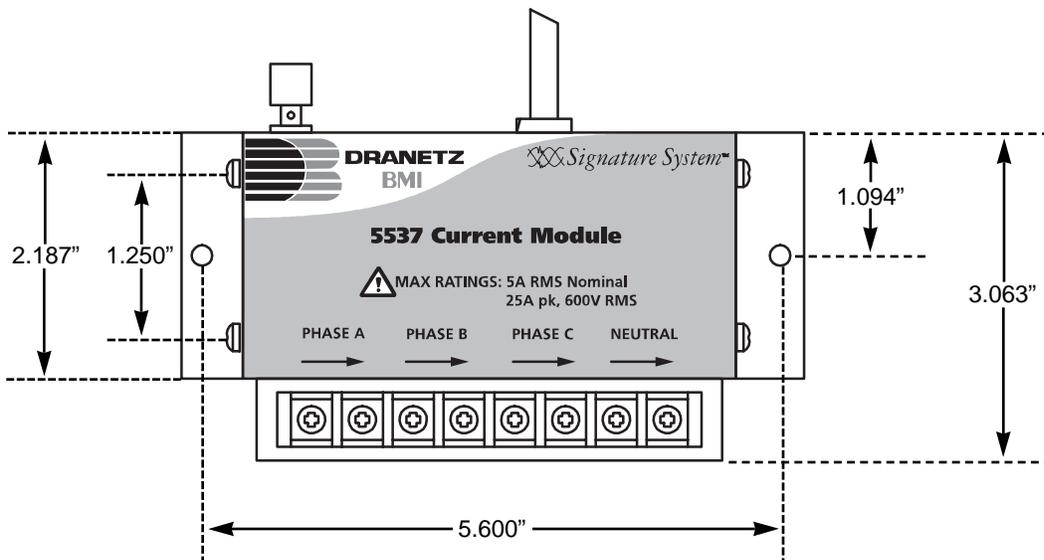
Current Input Pod (new model)

DataNode 5510/5530: Mounting Dimensions for Voltage and Current Input Pods (new model)

Voltage Input Pod

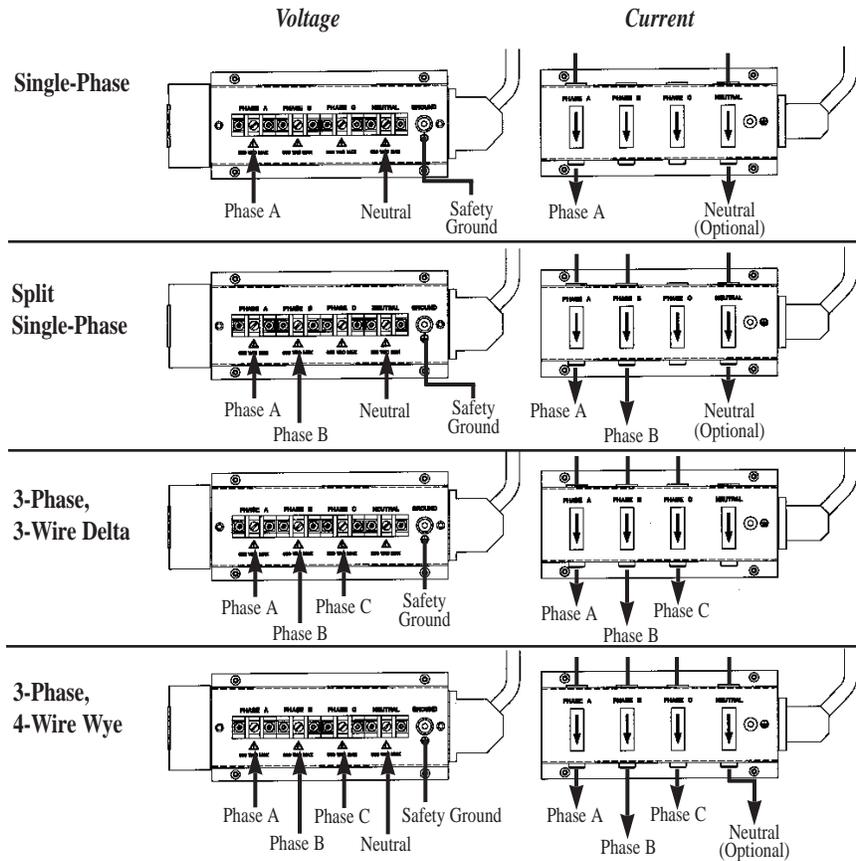


Current Input Pod



Preparation for Use

DataNode 5510/5530: Connecting Power to the Input Pods (Old model Voltage and Current Pods shown)



WARNING!

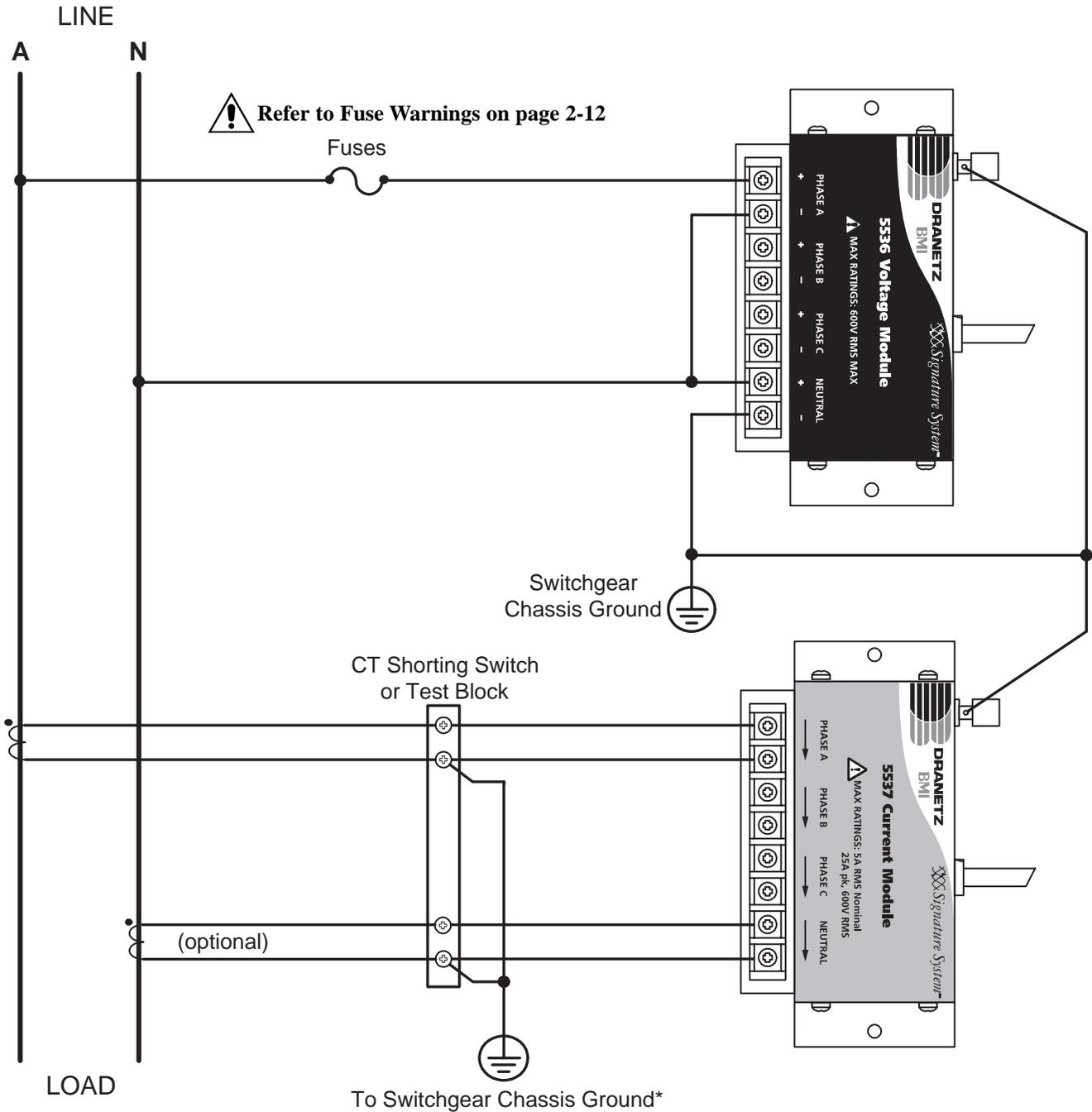
Use only insulated wire for any connections to the voltage or current measurement inputs. **DO NOT** use uninsulated wire.

The terminal protective cover must be installed on each Voltage Input Pod before applying power. The cover prevents accidental contact with the terminals and reduces the risk of electric shock.

NOTE: The terminal protective cover on the front of the Voltage Input Pod is not shown in these drawings.

DataNode 5510/5530: Connecting Power to the Input Pods (New model Voltage and Current Pods shown)

Connection Type: **SINGLE PHASE**



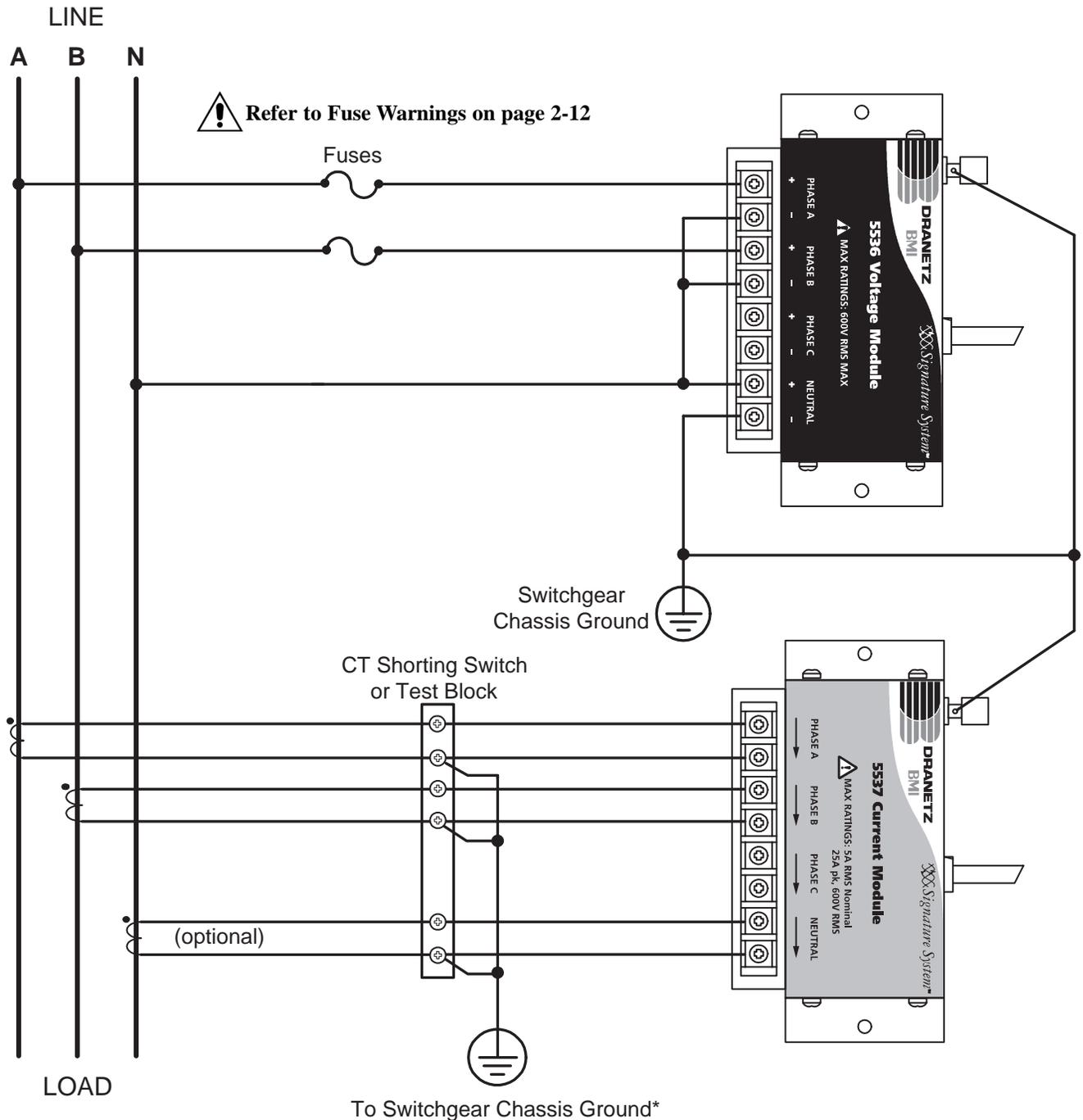
Connections must be performed in compliance with all safety requirements applicable to your installation.

***NOTE:** Connections of CT leg to ground is recommended, but not required for proper operation.

Preparation for Use

DataNode 5510/5530: Connecting Power to the Input Pods (New model Voltage and Current Pods shown)

Connection Type: **SPLIT PHASE**

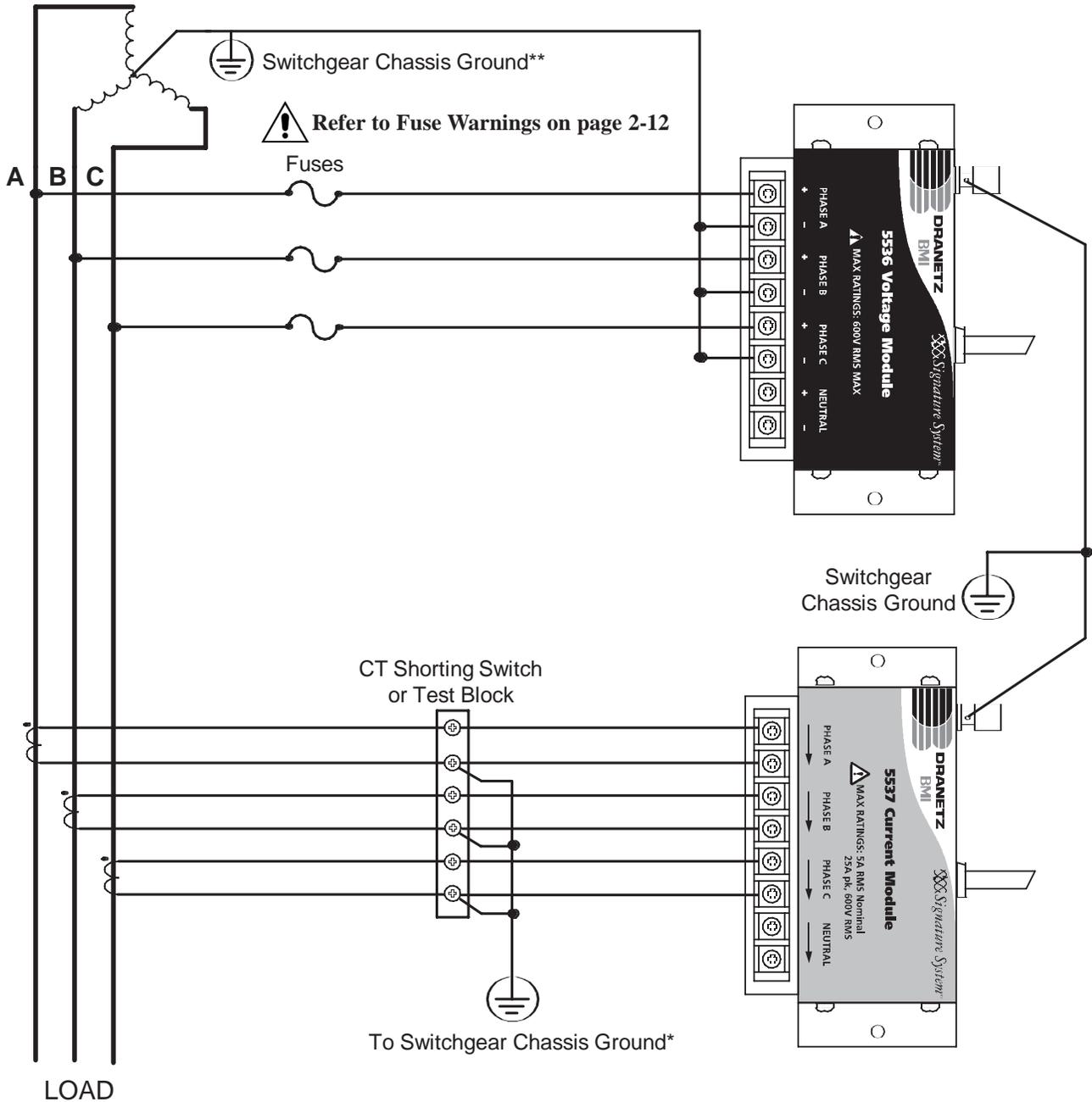


Connections must be performed in compliance with all safety requirements applicable to your installation.

***NOTE:** Connections of CT leg to ground is recommended, but not required for proper operation.

DataNode 5510/5530: Connecting Power to the Input Pods (New model Voltage and Current Pods shown)

Connection Type: 3 WIRE GROUNDED WYE, 3 ELEMENT DIRECT
Setup Mode: Wye



! Connections must be performed in compliance with all safety requirements applicable to your installation.

***NOTE:** Connections of CT leg to ground is recommended, but not required for proper operation.

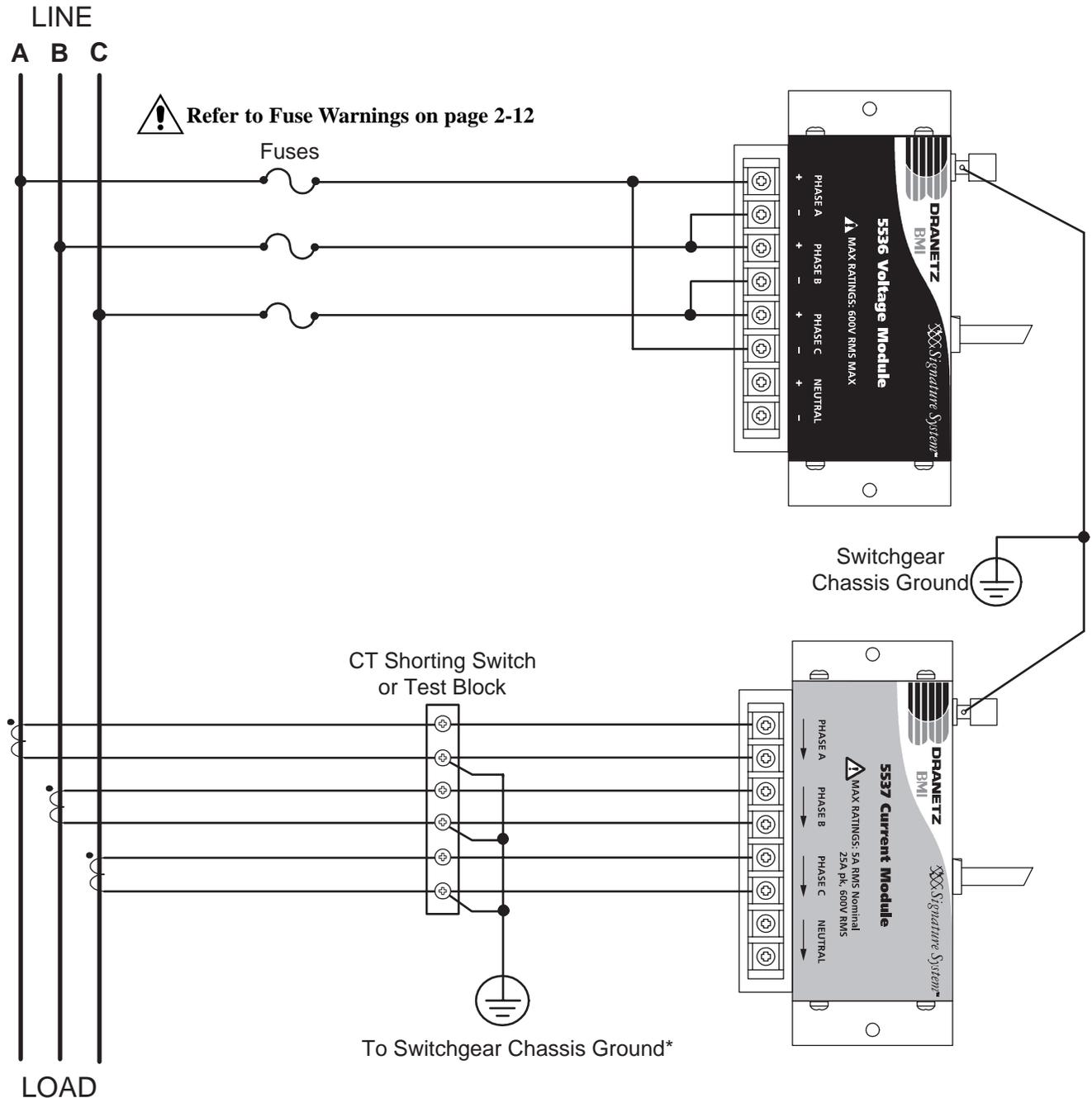
****NOTE:** Connections are the same for 3 Wire Ungrounded Wye, 3 Element Direct.

2

Preparation for Use

DataNode 5510/5530: Connecting Power to the Input Pods (New model Voltage and Current Pods shown)

Connection Type: 3 WIRE DELTA, 3 ELEMENT DIRECT
Setup Mode: Delta

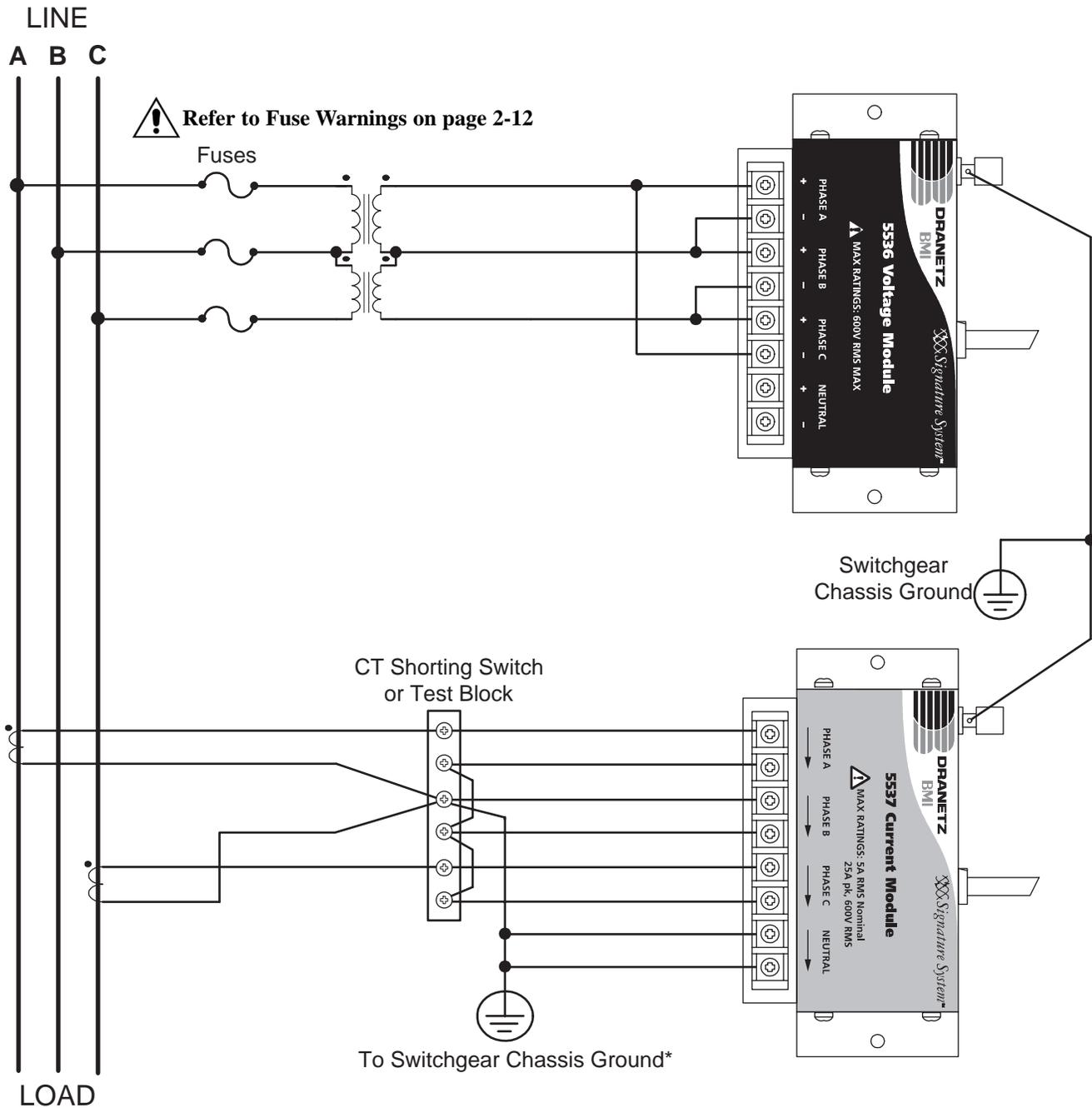


Connections must be performed in compliance with all safety requirements applicable to your installation.

***NOTE:** Connections of CT leg to ground is recommended, but not required for proper operation.

DataNode 5510/5530: Connecting Power to the Input Pods (New model Voltage and Current Pods shown)

Connection Type: 3 WIRE DELTA, 2 ELEMENT, 2 PT, 2 CT
Setup Mode: Delta



Connections must be performed in compliance with all safety requirements applicable to your installation.

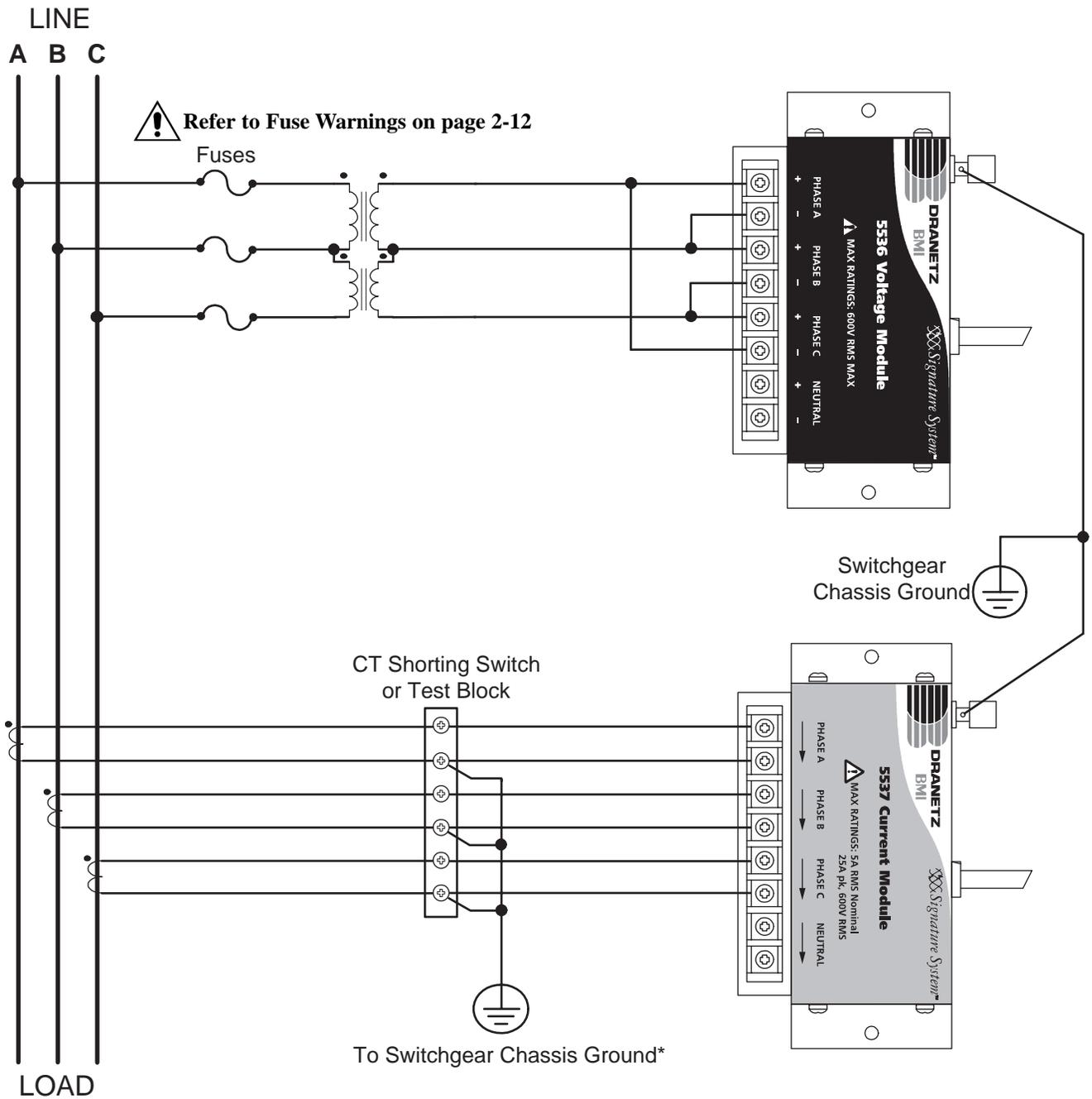
***NOTE:** Connections of CT leg to ground is recommended, but not required for proper operation.

2

Preparation for Use

DataNode 5510/5530: Connecting Power to the Input Pods (New model Voltage and Current Pods shown)

Connection Type: 3 WIRE DELTA, 2 1/2 ELEMENT, 2 PT, 3 CT
Setup Mode: Delta

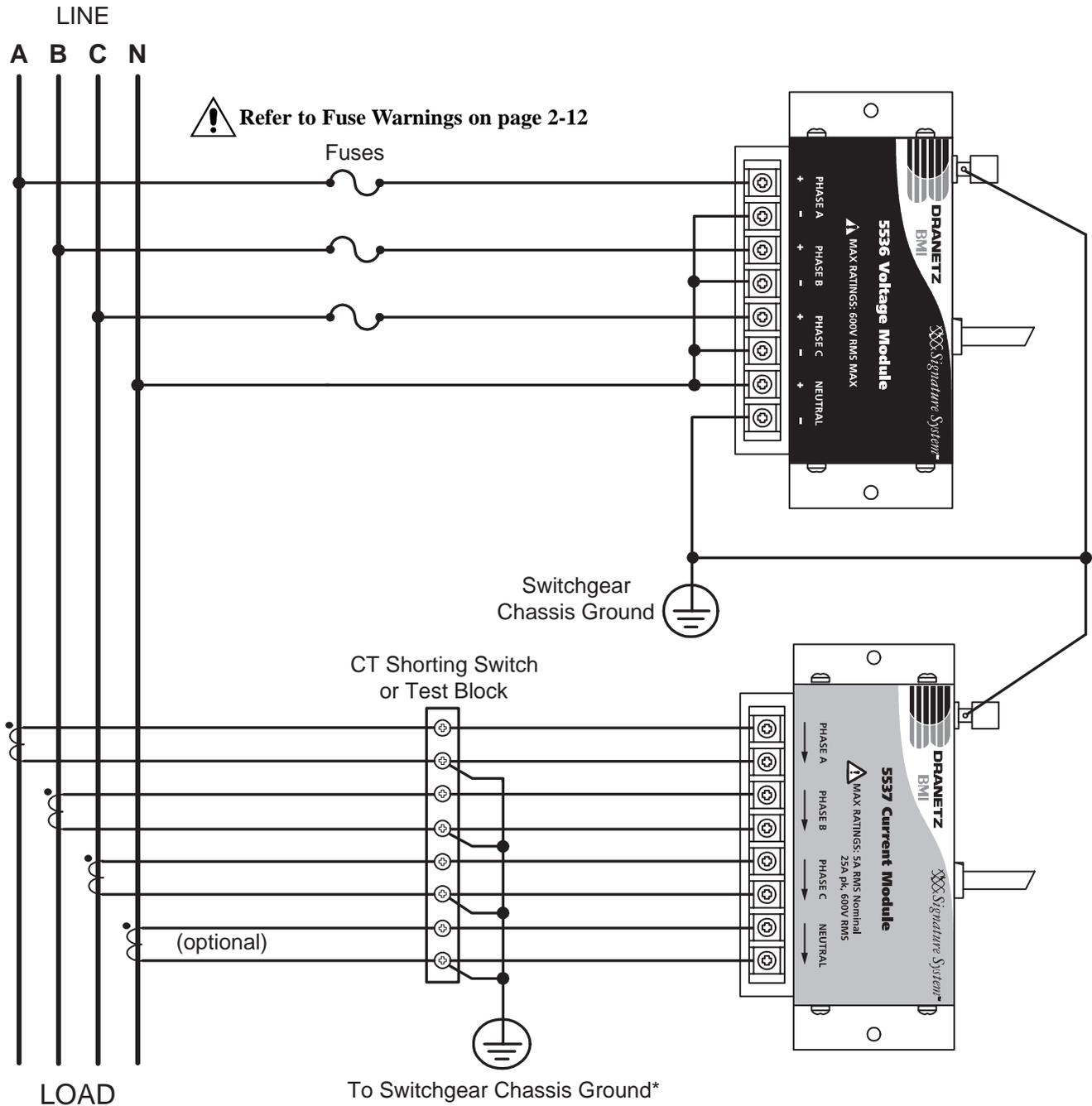


Connections must be performed in compliance with all safety requirements applicable to your installation.

***NOTE:** Connections of CT leg to ground is recommended, but not required for proper operation.

DataNode 5510/5530: Connecting Power to the Input Pods (New model Voltage and Current Pods shown)

Connection Type: 4 WIRE WYE, 3 ELEMENT DIRECT
Setup Mode: Wye



Connections must be performed in compliance with all safety requirements applicable to your installation.

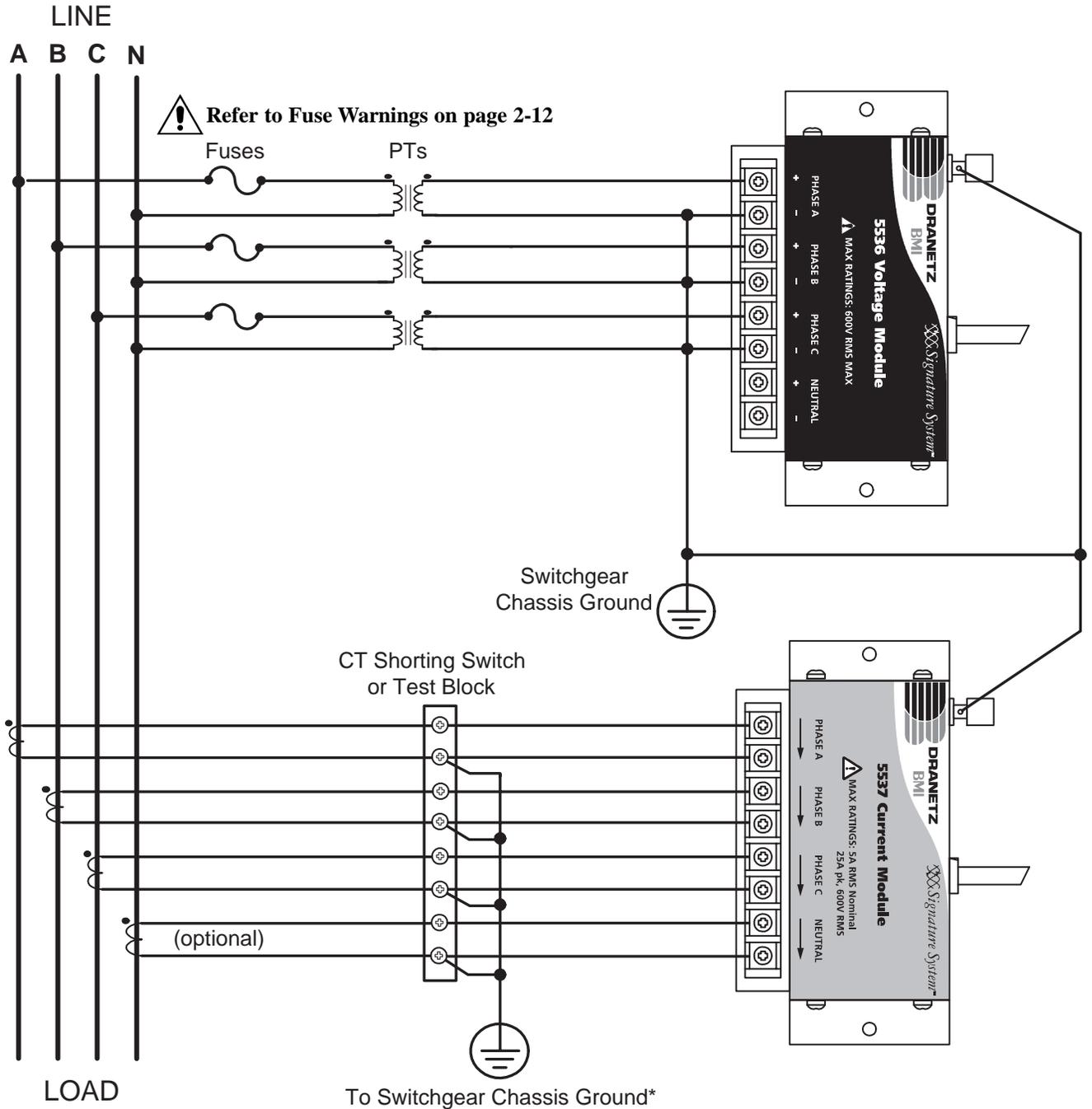
***NOTE:** Connections of CT leg to ground is recommended, but not required for proper operation.

2

Preparation for Use

DataNode 5510/5530: Connecting Power to the Input Pods (New model Voltage and Current Pods shown)

Connection Type: 4 WIRE WYE, 3 ELEMENT, 3 PT
Setup Mode: Wye



Connections must be performed in compliance with all safety requirements applicable to your installation.

*NOTE: Connections of CT leg to ground is recommended, but not required for proper operation.

DataNode 5513: Voltage Measurement Cables and Current Probe Connections

WARNING!

To avoid the risk of electric shock or burns, always connect the safety (or earth) ground before making any other connections.

WARNING!

To reduce the risk of fire, electrical shock, or physical injury it is strongly recommended to fuse the voltage measurement inputs. Fuses must be located as close to the load as possible to maximize protection.

WARNING!

For continued protection against risk of fire or shock hazard replace only with same type and rating of recommended fuse. Use only fast blow type fuse which is rated 600 V. Recommended fuse type is Littelfuse, part number KLKD.300 rated 600 V AC/DC, 0.3A fast blow.

WARNING!

Do not replace fuse again if failure is repeated. Repeated failure indicates a defective condition that will not clear with replacement of the fuse. Refer condition to a qualified technician.

Safety Precautions:

The following safety precautions must be followed whenever any type of connection is being made to the instrument.

Connect the green safety (earth) ground first before making any other connections.

When connecting to electric circuits or pulse initiating equipment, open their related breakers. DO NOT install any connection of the instrument on live power lines.

Connections must be made to the instrument first, then connect to the circuit to be monitored.

Wear proper Personal Protective Equipment, including safety glasses and insulated gloves when making connections to power circuits.

Hands, shoes and floor must be dry when making any connection to a power line.

Make sure the unit is turned OFF before connecting probes to the rear panel.

Before each use, inspect all cables for breaks or cracks in the insulation. Replace immediately if defective.

DataNode 5513: Connecting Voltage Measurement Cables

Connection Guidelines:

1. Refer to the figure on page 2-29 to connect the voltage measurement cables with the DataNode.
2. Route power wires in a safe manner in accordance with good practice and local codes.
3. Make sure all circuits are de-energized before making connections.
4. Connect the Voltage Measurement Cables. Refer to the measurement cable set figure for color coding of probes that connect to voltage input channel connectors A, B, C and Neutral. Measurement cables are available as optional accessories along with the optional fuse voltage adapter.
5. Each channel input has plus (+) and minus (-) differential inputs of 60 to 600 Vrms max.
6. Neutral has an additional low voltage range of 0.5 to 20 Vrms max. for low voltage measurements.

Measurement Cable Set

Description: Voltage measurement cables are provided as optional accessories and are stored in a cable pouch as part of the measurement cable set, P/N 116042-G1. Each cable set consists of a cable and alligator clip.

Voltage Rating: Direct connection of all voltage measurement cables are rated at 600 Vrms max. For measuring voltage greater than 600 Vrms, potential transformers (PTs) must be used.

Contents: The voltage measurement cables are shown on page 2-29 (positioned relative to their actual use). A cable set consists of eight, 6-foot channel measurement cable assemblies (probes), each with a detachable, alligator jaw, safety clip assembly (maximum jaw opening, 3/4 in (20 mm)). The safety clip assemblies are red (+) and black (-) for each of the four channels. One cable each of red (channel A), yellow (channel B), blue (channel C), and grey (channel D), and four each of white are provided.

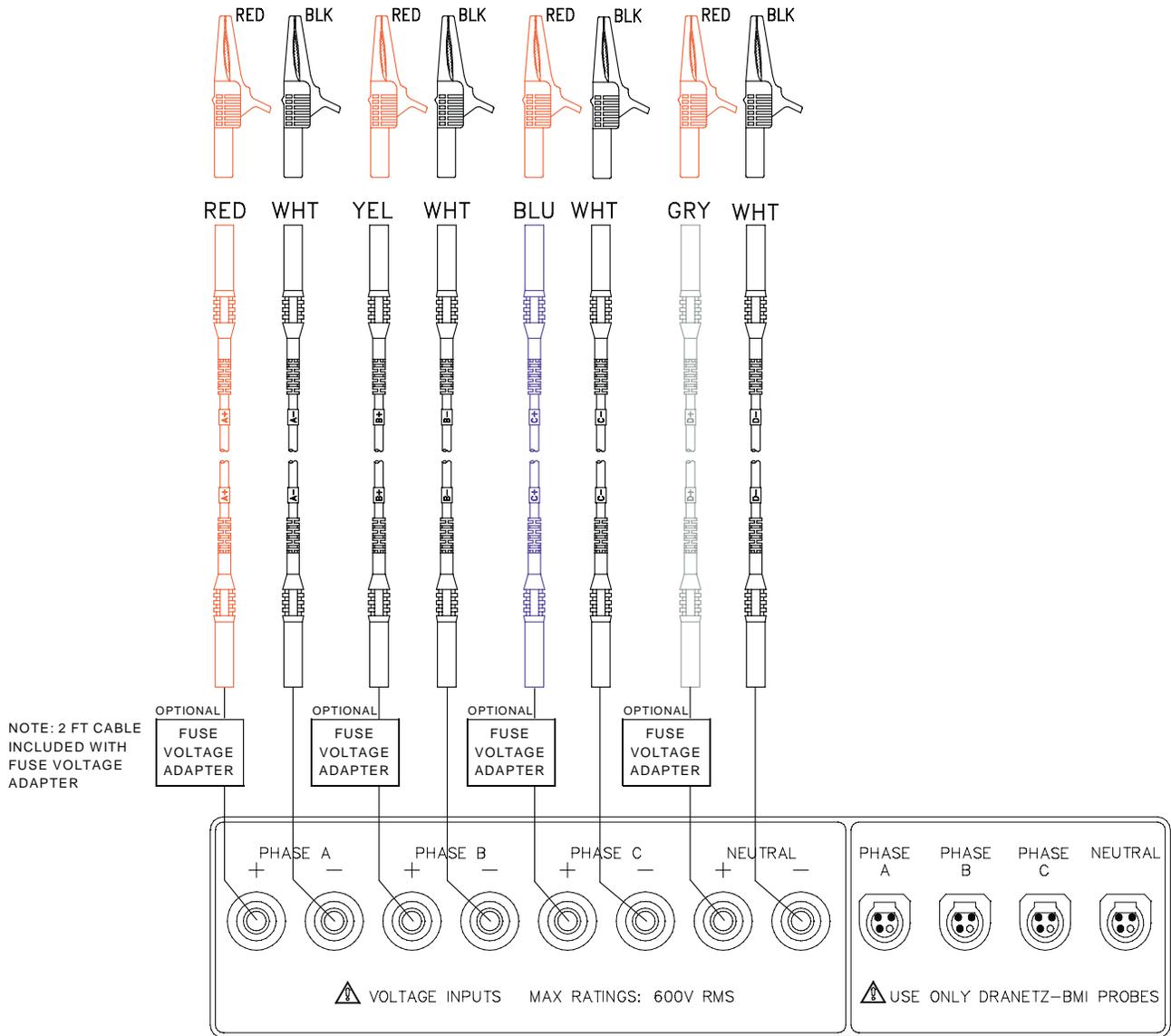
A pouch for storage of the cables and the AC adapter/battery charger is included in the contents of the measurement cable set, but is not shown in the figure.

Optional Fused Voltage Adapter

There are two optional fuse accessory kits available for use with the measurement cables. One kit (P/N FVA-1) contains one fused voltage adapter and one measurement connecting Red cable 50 cm in length. The other kit (P/N FVA-4) contains four voltage adapters and four measurement connecting cables 50 cm in length (one Red, one Yellow, one Blue, one Grey).

The single fuse voltage adapter kit is used for one single voltage measurement input. While the four fuse voltage adapter kit is used for a three phase and neutral voltage measurement inputs.

Connecting Measurement Cables with Optional Fuse to DataNode 5513 Voltage Connectors



See Chapter 4 Optional Accessories for the complete list of optional voltage and current probes. For more information on fused voltage adapter, refer to Dranetz-BMI Information Sheet titled Model FVA - Fuse Voltage Adapter, P/N 899107. Contact Dranetz-BMI Customer Service Department at 1-800-372-6832 or 732-287-3680 for more information on optional accessories.

2

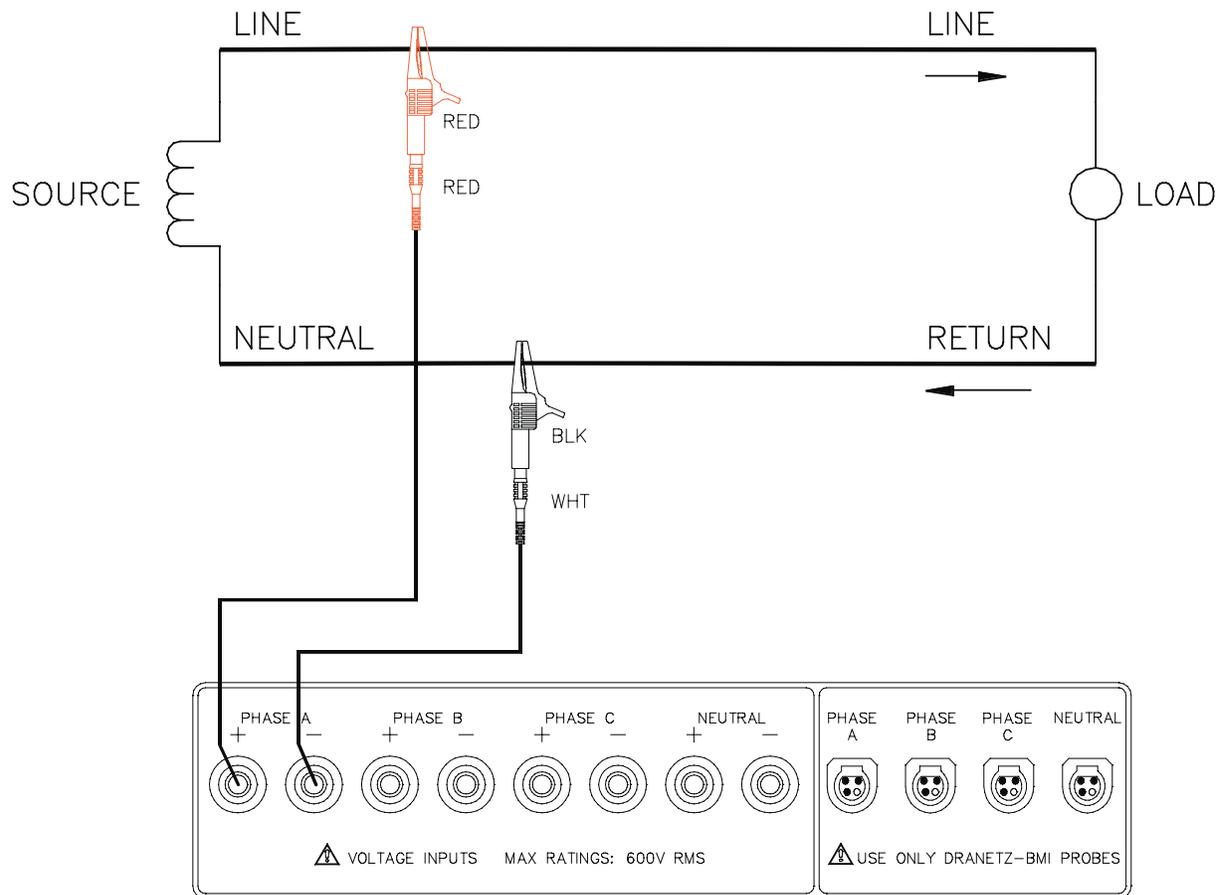
Preparation for Use

DataNode 5513 Sample Voltage Connections

Voltage probes are connected to the individual source or load line and are referenced to the return (common) line voltage probe connection for greater accuracy.

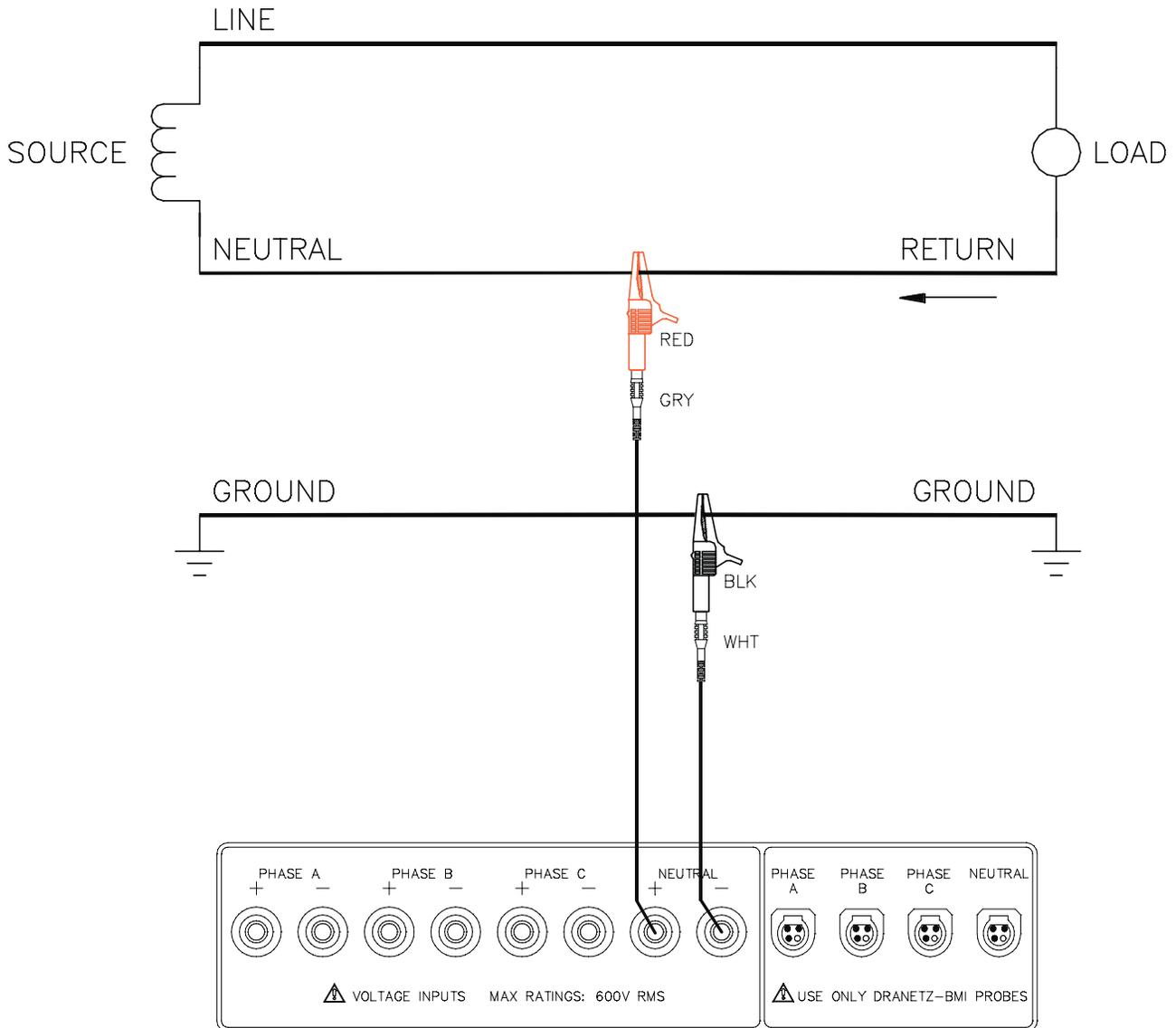
Example: Single phase voltage connection

The following figure shows a voltage connection to a single phase circuit for channel A.



Example: Neutral to ground voltage connection

The following figure shows a voltage connection using Neutral as a differential input for measuring neutral to ground voltage. Connections are identical for split phase and wye configurations. One probe connects the source neutral line to the Neutral+ input. Another probe connects the ground to the Neutral- input.



DataNode 5513: Connecting Current Probes

WARNING!

DO NOT USE non-insulated current probe cores around a non-insulated wire. Probes of this type are designed for use around insulated wires only. Use only completely insulated probe cores with no exposed conductive areas of the core around non-insulated wires.

ADVERTENCIA!

NO UTILIZAR transformadores de corriente sin material aislante al rededor de conductores sin material aislante. Los Transformadores de corriente de este tipo están diseñados para ser utilizados solamente con conductores con aislamiento eléctrico. Utilizar transformadores de corriente completamente aislados alrededor de conductores sin aislamiento.

AVERTISSEMENT!

N'EMPLOYEZ PAS les noyaux courants non-isolés de sonde autour d'un fil non-isolé. Des sondes de ce type sont conçues pour l'usage autour des fils isolés seulement. L'utilisation seulement a complètement isolé des noyaux de sonde sans des secteurs conducteurs exposés du noyau autour des fils non-isolés.

WARNUNG!

VERWENDEN Sie keine Stromzangen mit nicht isolierten Ferritkernen bei Messungen an nicht isolierten Leitungen. Stromzangen dieses Typs sind nur für Messungen an isolierten Leitern geeignet. Bitte verwenden Sie zur Messung an nicht isolierten Leitungen Stromzangen mit vollständig isoliertem Kernmaterial.

Safety Precautions:

The following safety precautions apply to current probe connections in addition to those safety precautions stated on page 2-27.

DO NOT attempt to measure current in any circuit in which the circuit to ground voltage exceeds the insulation rating of the current probe (600 Vrms max).

Make sure the jaws of the current probe are tightly closed. Keep mating surfaces clean and free from foreign matter.

DataNode 5513: Connecting Current Probes

Connection Guidelines:

1. Refer to the figure on page 2-35 to connect the current probes with the DataNode.
2. Route power wires in a safe manner in accordance with good practice and local codes.
3. Make sure all circuits are de-energized before making connections.
4. Connect the Current Probes.
Position the probe with the arrow on the handle pointing towards the load.

Probe positioning: An arrow marking on the handle is a guide to ensure that you position the probe with the arrow pointing towards the load when monitoring the line conductor. Correct position of the probe is necessary for correct power measurements, where in-phase voltage and current measurements are necessary. A positive watts reading indicates that the probe is pointing towards the load, and a negative reading indicates that the probe is pointing towards the source.

5. For greatest accuracy, use a probe that is rated at no more than twice the nominal value you expect to measure.

Current Probes Available for Use with DataNode 5513 Current Connectors

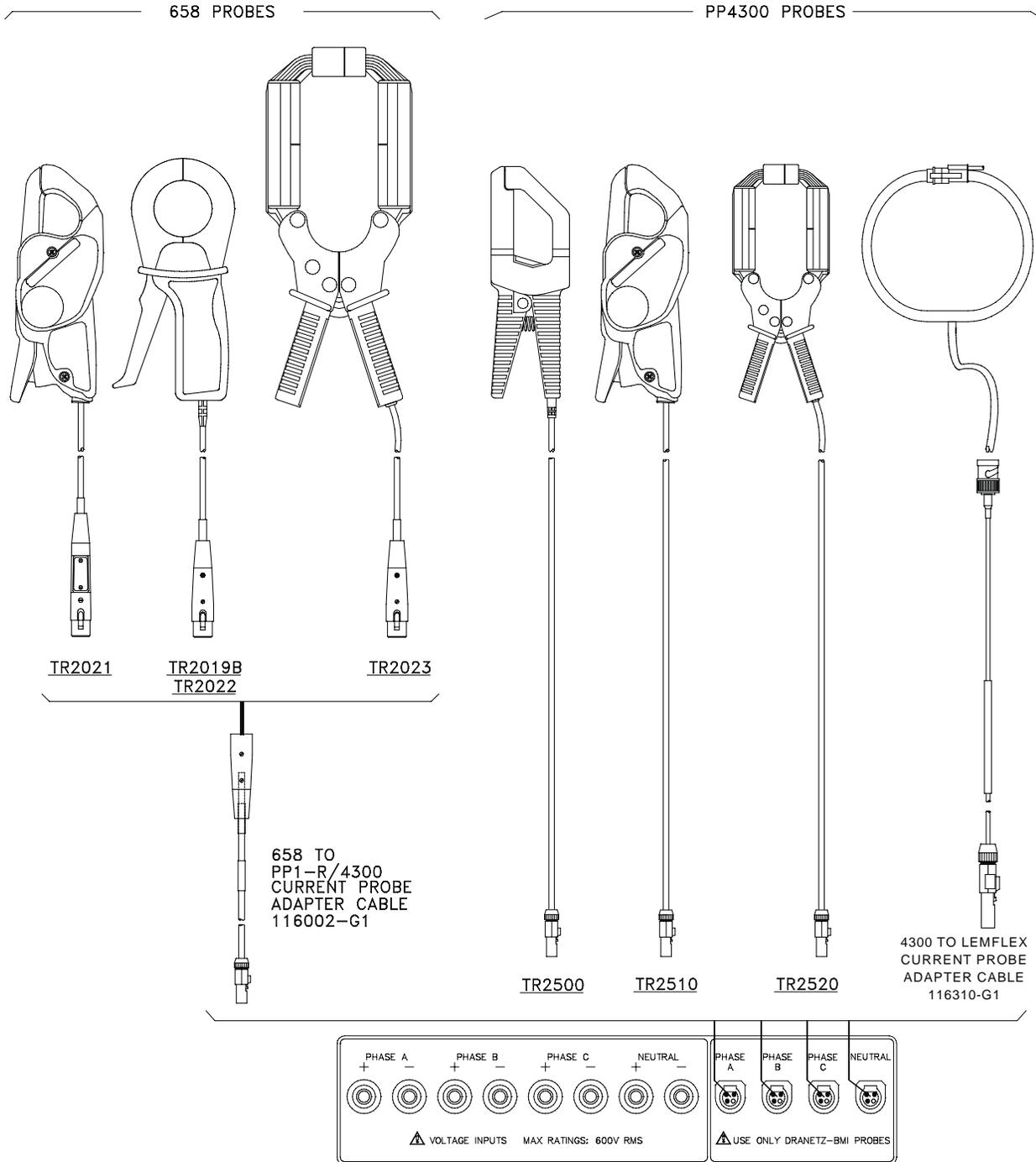
Several Dranetz-BMI current probes can be used with the DataNode 5513 current connectors: model TR2500, TR2500A, TR2510, TR2510A, TR2520, TR2520A, TR2019B, TR2021, TR2022, TR2023. The typical current probes are illustrated on page 2-35.

TR2500, TR2510, TR2520 (TR2500A, TR2510A, TR2520A): These models will measure rms currents from 10 to 500 A, 0.1 to 500 A, and 300 to 3000 A, respectively. They plug directly into any of the current inputs on the rear panel. These probes are not recommended for measuring medium or high frequency transients.

TR2021, TR2019B, TR2022, TR2023: These four probes are made for Dranetz-BMI Model 658 but can be used with DataNode 5513 current connectors by using an adapter cable (P/N CA-4300). These probes can measure rms currents in ranges of 1 to 30 A, 1 to 300 A, 10 to 1000 A, and 10 to 3000 A, respectively. These probes accurately measure medium and high frequency transients.

DRANFLEX4300: These current probes allow current measurements in the range of 5 to 3000 A full scale, or 10 to 6000 A full scale. DRANFLEX4300 probes are available in three sizes: 24" probe length - conductor(s) up to 8" diameter; 36" probe length - conductor(s) up to 11" diameter; 48" probe length - conductor(s) up to 17" diameter. DRANFLEX4300 probes are battery powered only and are supplied with a standard 9V alkaline battery.

Current Probes Available for Use with DataNode 5513 Current Connectors



NOTE: Current probes TR2500 can be used interchangeably with TR2500A, TR2510 with TR2510A, and TR2520 with TR2520A.

2

Preparation for Use

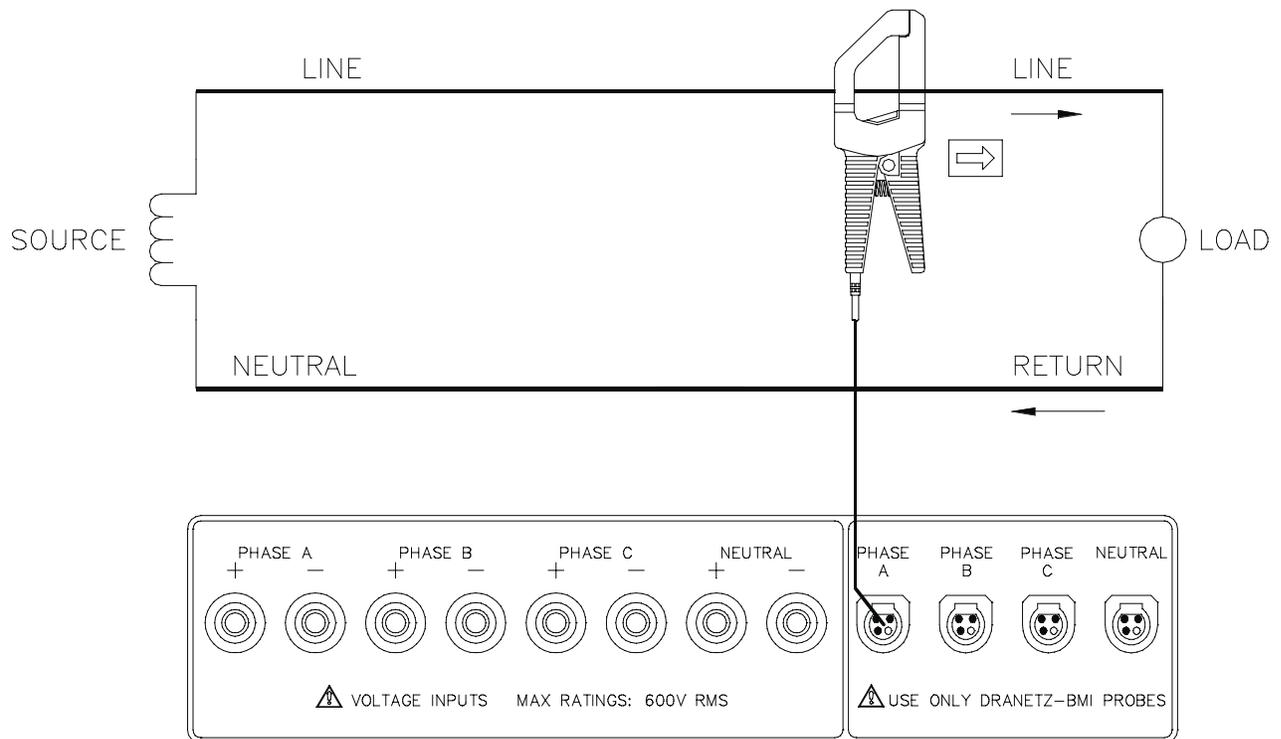
DataNode 5513 Sample Current Connection

Current probes are connected to each line and positioned to measure currents with reference to the voltage probe. Incorrectly positioned current probes may produce erroneous power measurement.

Example: Single phase current probe connection

The following figure shows how to connect a current probe to channel A for current monitoring of a single phase line.

The current probe may be connected to the return line if desired to measure the return current when checking for load current leakage, loop current relationships, etc. If measuring power, position the probe with the arrow pointing towards the load.



INTRODUCTION

The EPQ DataNodes have a large number of user-programmable features that can be set through the SETUP tab of the InfoNode. Under the DataNode setup tree, select the DataNode 5530/5520 folder, and then select the specific DataNode that you wish to program.

The setup of the EPQ DataNodes is similar to other DataNodes, with tabs across the bottom of the page to select the appropriate group of programmable features. You also should select the <SAVE SETUP> button on the bottom of the screen before switching from one tab to the next. Note also that the response time of the system may improve by doing the following: uncheck the ACTIVE box before making any changes, make all the changes, save the setup, then recheck the ACTIVE box after completing all changes.

Refer to the *General Guidelines in Setting Up DataNodes through the InfoNode Setup Page* found in Chapter 7 of the InfoNode Series 5500 User's Guide.

Where Programmed DataNode Settings Translate to Meaningful Data

The SETUP tab of the Signature System InfoNode is where the parameters and value settings for specific DataNodes sites are programmed. The programmed parameters are translated and displayed in meaningful data format under the VIEWS tab, REAL TIME tab and REPORTS tab. Refer to the InfoNode Series 5500 User's Guide for detailed discussions on the said menu tabs.

Standard and Hidden Tabs

Each DataNode site is designed with its own programmable tabs where various parameters and values are set. These programmable tabs are classified as Standard or Hidden tabs.

Standard programmable tabs are automatically available to users and need not be activated or enabled in order to display. Hidden programmable tabs are not automatically available and need to be activated or enabled for display.

This chapter lists the various tabs available in the EPQ DataNodes 5530/5520. It provides descriptions of each programmable tab, the more significant points highlighted with drawings and further explanations. An illustration of each tab is available in Appendix B. More detailed discussions on RMS Variation triggering, Transient event recording, Transducer installation, and Harmonic distortions are available in Appendix B as Additional Notes.

A Word of Caution

Dranetz-BMI has already set default values for the various parameters in each DataNode. The default values have been tested to result in optimal system performance. Users are advised not to change the default value settings unless their applications need advanced setups which make the default values inapplicable.

STANDARD TABS

GENERAL tab

The General tab allows for entering a name for the DataNode, along with a description about it (typically where it is located). It also provides status information, such as the serial number, firmware versions, last connection time, and system health. When adding new DataNodes, the ACTIVE box must be checked to enable it to become part of the system. Do not activate until the communication parameters are properly set up.

See Appendix B page B-1 for tab illustration. Refer to the InfoNode Series 5500 User's Guide on how to set the parameters found in General tab.

BASIC tab

The BASIC tab allows the user to select the wiring configuration {Single Phase, Wye, Delta, Split Single Phase} and rotation {Normal, Reverse}, base voltage, what type of units to display the data in {Volts, Per Unit, Percent}, and how often the periodic RMS and waveform snapshots are recorded {1-120 minutes}. For power demand values, the demand interval {1-120 minutes} and sub-demand interval (used for updating certain parameters within the demand interval and must be integer-divisor of demand interval) can be programmed. The eight properties with check boxes opposite them are known as the hidden tabs. The eight check boxes for the different parameters can be selected or deselected so those tabs will or will not be displayed.

See Appendix B page B-2 for tab illustration. Refer to the InfoNode Series 5500 User's Guide on how to set the parameters found in Basic tab.

RMS VARIATIONS tab

RMS variations are treated separately from all other parameters, as it is the primary means for recording many power quality phenomena. It is the most common type of disturbance and is identified as a specific type of event by IEEE and IEC. RMS values are updated at half-cycle rates, calculated over one cycle and compared against limits on a cycle by cycle basis. The high and low limits associated with sags (dips) and swells can be based on absolute values or a percentage of a fixed base value.

Select the appropriate line that describes the phase {Va, Vb, Vc, Vn, Ia, Ib, Ic, In} or phase-to-phase {Vab, Vbc, Vca} value that you wish to change. The high and low limits can be enabled and programmed individually for each phase and phase-to-phase value. For wye circuits,

L-N, N-G and L-L limits can be programmed. For delta circuits, only L-L voltages are applicable. To disable the value, uncheck the enable box.

If a high or low limit crossing is detected for longer than the programmed minimum number of cycles to begin an event, then an event is begun. The first cycle and channel which were out of limits are labeled as the trigger cycle and trigger channel, respectively.

The number of RMS and waveform cycles to be saved before (pre-) and after (post-) the start and the end of the event can be individually programmed. For waveforms, the maximum total cycles is 16 {# start cycles = 0 to 16, # end cycles = 0 to 16, not to exceed 16- # of start cycles}. For RMS recordings, the maximum of event start cycles is 240 {# pre-event start = 0 to 8, # post end start = 0 to 240, not to exceed 240 - # pre}. If the event lasts longer than 240 cycles, then the unit goes into a reduced sampling rate to conserve memory. The post-event end RMS cycles can be programmed to 0-16. For compliance with most standards, this should be set to 1.

If the voltage goes from out of limits to within limits (that is, below the hi_limit minus the hysteresis) and above the lo_limit plus the hysteresis) for at least the programmable minimum_required_event_end_cycles number of cycles, then the RMS event recording is terminated. The first cycle (of the last phase) which was back in limits is the fault recovery cycle.

Note, as per IEC and IEEE standards for multi-phase systems, the beginning of the voltage RMS event occurs when any phase voltage goes outside the limits, and ends when all of the phases are within limits for the end_event number of cycles specified. This is only true for voltage, not current.

In addition, RMS variations can have three stages of averaging or chart rates, which is particularly useful for long duration events to save memory in exchange for reduced resolution. This is accomplished by programming the number of cycles to be consolidated for the min/max/avg values {1-10000}, as well as for how long to use this rate {1-100000 seconds}. This mode begins if the RMS value remains out of limits for longer than the post-start event number of RMS cycles that were programmed.

The next pages 3-3 to 3-7 contain important details on RMS Variations. See Appendix B page B-3 for RMS Variations tab illustration and additional notes. Refer to the InfoNode Series 5500 User's Guide on how to set the parameters found in RMS Variations tab.

RMS Trigger Parameters

The following parameters are required to define how an RMS variation is triggered:

- Low Limit
- High Limit
- Cycles in range to end event (fixed at 1)

The programmable tab allows the user to enter the thresholds in absolute volts or in percentage of a specified nominal.

In order for the Monitor to trigger on RMS variation, any one of the measured quantities for which a trigger is enabled must go above the High Limit or below the Low Limit for a period of at least one RMS sample point (which are taken twice per cycle with a one cycle sliding integration window).

The disturbance end point is defined as the point when all channels for which triggers are enabled have come back within limits (plus a little internally calculated hysteresis) for a minimum duration of Cycles in range to end event. Until this criteria is met, any subsequent excursions beyond the threshold are considered part of the original disturbance. To minimize the number of triggers recorded for a sequence of closely spaced perturbations, hysteresis is employed in both voltage and time for the begin-event and end-event thresholds.

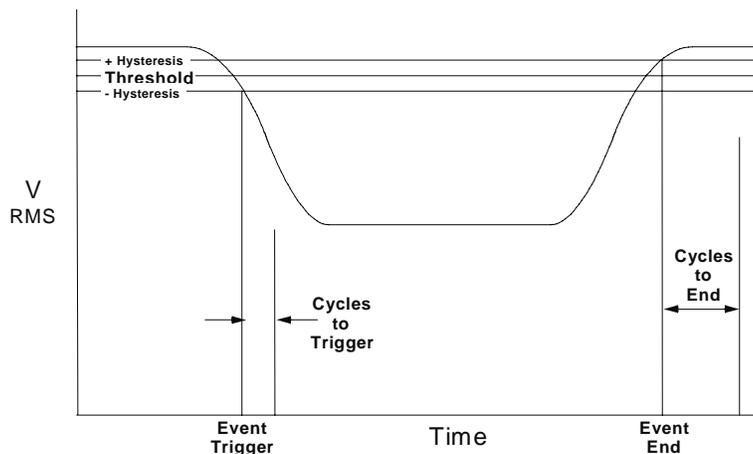


Figure 3.1 RMS Triggering on Low Voltage

How RMS Disturbances Are Recorded

Once an event has been triggered, the following information is needed to define how and what information is to be stored:

Pre-event start RMS samples (cycles) - the number of cycles of instantaneous (twice per cycle) RMS samples to record before event start (the trigger point). Maximum is 8 cycles.

Pre-event start waveform samples (cycles) - the number of cycles of instantaneous point-on-waveform data (128 points per cycle) to record before event start (the trigger point). Maximum is 7 cycles.

Post-event start RMS samples (cycles) - the number of cycles of instantaneous (twice per cycle) RMS samples to record after event start (the trigger point) before switching to min/max/average recording mode. Maximum is 512 cycles.

Post-event start waveform samples (cycles) - the number of cycles of instantaneous point-on-waveform data (128 points per cycle) to record after event start (the trigger point). Maximum is 15 cycles.

Pre-event end waveform samples (cycles) - the number of cycles of instantaneous point-on-waveform data (128 points per cycle) to record before event end point. Maximum is 8 cycles.

Post-event end waveform samples (cycles) - the number of cycles of instantaneous point-on-waveform data (128 points per cycle) to record after the event end point. Maximum is 15 cycles.

Post-event end RMS samples (cycles) - the number of cycles of instantaneous (twice per cycle) RMS samples to record after the event end point. Maximum is 15 cycles.

3 Operation

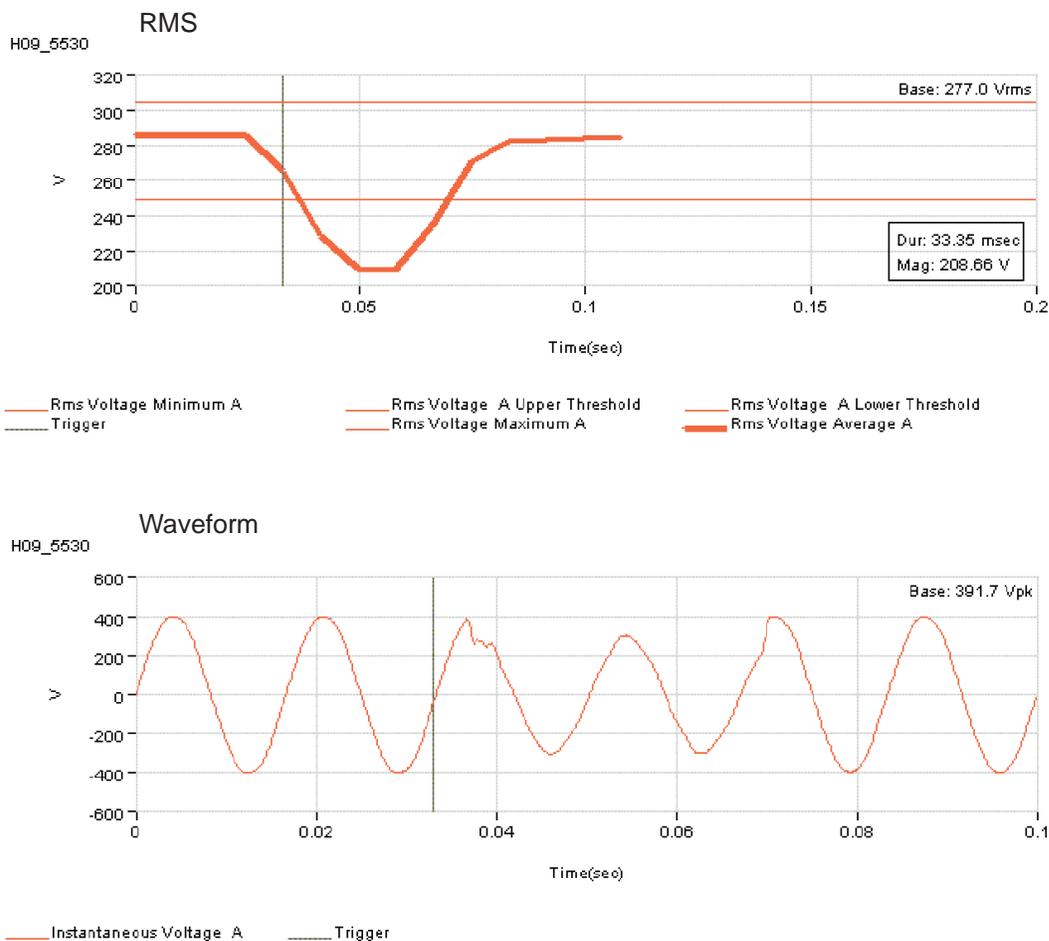
Number of rates to use - the number of reduced sampling rate ranges to be used to record longer RMS variations. Maximum is 3 cycles.

Reduced sampling rate #1, #2, and #3 - when one of these items is selected, the reduced sampling rate parameters can be set for that item. These are sometimes referred to as the three different "chart speeds".

Sample min/max/avg every N cycles - the number of cycles to average for the selected reduced sampling rate.

Number of seconds to use this rate - the number of seconds to record at the selected reduced sampling rate.

Short Duration Variations - Since memory capacity of the monitoring instrument makes it impractical to always record the waveform of an entire sag or swell point by point, a maximum of 22 cycles of the waveform before and after the trigger are digitized to help identify the cause of the excursion. Only RMS values are stored over the full duration of the event, if the event lasts longer than 22 cycles. Results of the variations display are shown below. The trigger point is indicated by the vertical line in the RMS plot and the waveform.



12-02-2001 16:28:14.18 Instantaneous Sag

Dranetz-BMI/Electrotek Concepts®

Figure 3.2 Short Duration RMS and Waveform Variation

Long Duration Variations - RMS values for overvoltages and undervoltages are computed twice per cycle. Initially, all values are stored, but if the event has not ended after a user-definable time period, the instrument switches to averaging several cycles of RMS data to further conserve memory. At this point, the RMS plot diverges from a single-valued line to a band of average, minimum and maximum values. During extremely long events, the instrument switches to successively longer averaging periods.

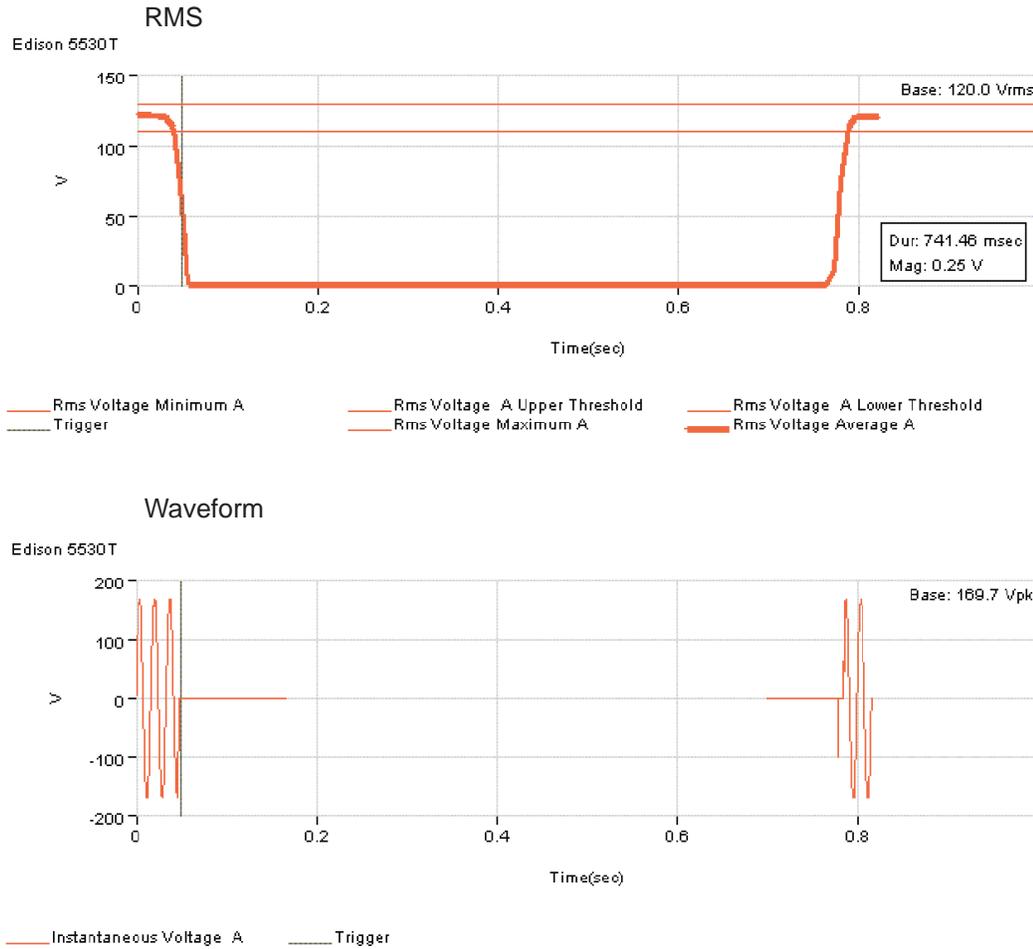


Figure 3.3 Long Duration RMS and Waveform Variation

3 Operation

RMS Sample Capture

When an RMS trigger is received, the monitor saves the RMS data twice per cycle. When sampling at this rate, the monitor is said to be in Instantaneous RMS mode. It will continue storing Instantaneous RMS data for the number of cycles after the trigger specified by Post-event start RMS samples (cycles) or until the disturbance ends - whichever occurs first. It will have saved the number of cycles before the trigger specified by Pre-event start RMS samples (cycles).

The following figure will help visualize the Instantaneous RMS and other regions for a long-duration RMS variation:

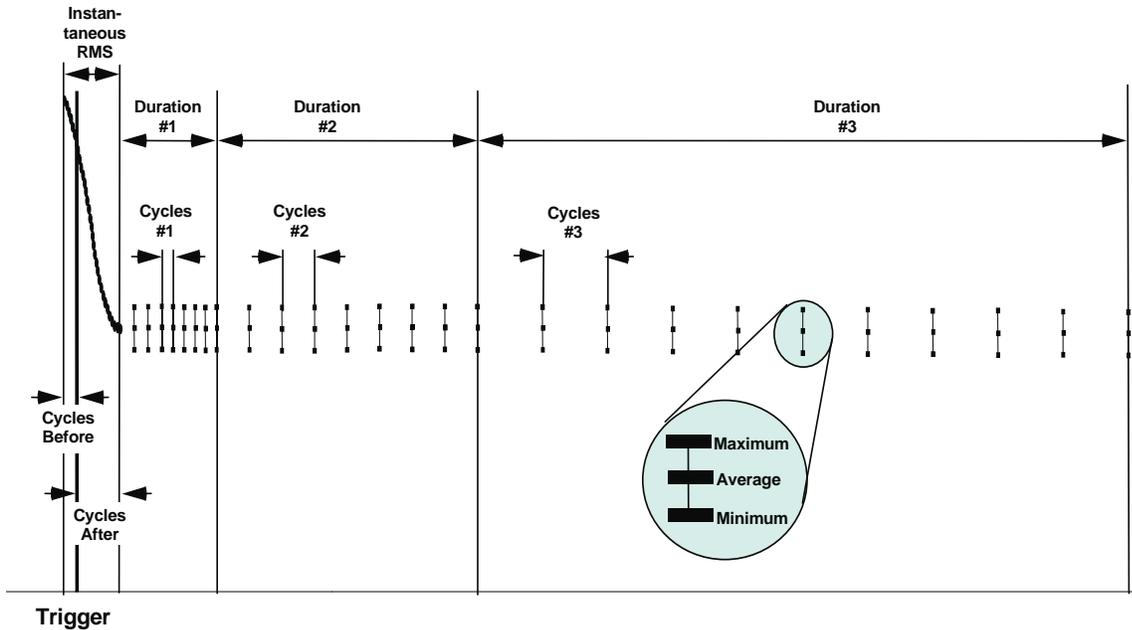


Figure 3.4 RMS Envelope Recording Detail

In this example, the voltage is still out of threshold when the number of cycles specified by the Post-event start RMS samples (cycles) has been recorded. If set to 240 (the maximum is 512), this value will capture 4 seconds of data at 60 Hz. However, the reduced sampling rates (specified in the intervals section of the property page) allows the monitor to measure longer intervals by averaging several consecutive samples.

The limit is 512 cycles of “instantaneous” RMS samples only, not the total number of RMS values in the overall RMS variation recording. Instantaneous means two RMS values per cycle for a total of 1024 RMS values using a 1 cycle wide RMS calculation window sliding by 1/2 cycle for up to 512 cycles (10.25 seconds at 50 Hz, 8.533 seconds at 60 Hz). There is no min or max values during the “instantaneous” RMS sampling period since the system is calculating and saving the data as fast as it is possible to calculate it - min, max, and average would all be the same value.

If the event lasts longer than the value set for instantaneous sampling (120 cycles by default), the recording enters chart mode where the RMS voltage is recorded at a lower rate using the min/max/avg technique, where the min and max are based on the twice per cycle calculation. The Signature System implements three chart speeds.

If the disturbance has not ended after the number of cycles specified by Post-event start RMS samples (cycles), the Monitor shifts to reduced sampling rate #1. It continues to compute the RMS value twice per cycle, but will store only the minimum, average, and maximum values computed over the number of cycles specified in the Sample min/max/avg every N cycles property field for reduced sampling rate #1. If the disturbance has not ended after the number of seconds specified in the Number of seconds to use this rate property field for reduced sampling rate #1, the instrument shifts to reduced sampling rate #2, and so on. Up to three reduced sampling rates can be specified.

RMS Waveform Capture

The waveform recording options allow customers to record waveforms for up to 7 cycles before (Pre-event start waveform samples), or up to 15 cycles after (post-event start waveform samples) the trigger where the total number of cycles captured at event start must be equal to or less than 16. Similarly, a waveform capture can be made that straddles the event end point for up to 7 cycles before (Pre-event end waveform samples), or up to 15 cycles after (post-event end waveform samples) the trigger where the total number of cycles captured at event end must be equal to or less than 16. If the event is short enough, the two waveform recordings are merged into a single larger one. Hence, if the maximum settings are used, disturbances of up to 22 cycles in duration can be recorded where waveform is captured for the entire event.

The following example illustrates a 1 second RMS variation with waveform capture at the beginning and end of the event. In this example, 2 cycles of waveform were requested for pre-event start and post-event end. Also, 7 cycles of waveform were requested for post-event start, and pre-event end. For RMS recording, 2 cycles of pre-event start were requested, up to 240 cycles of post-event start before chart mode (not used here since event was less than 4 seconds long) and 2 cycles of post-event end.

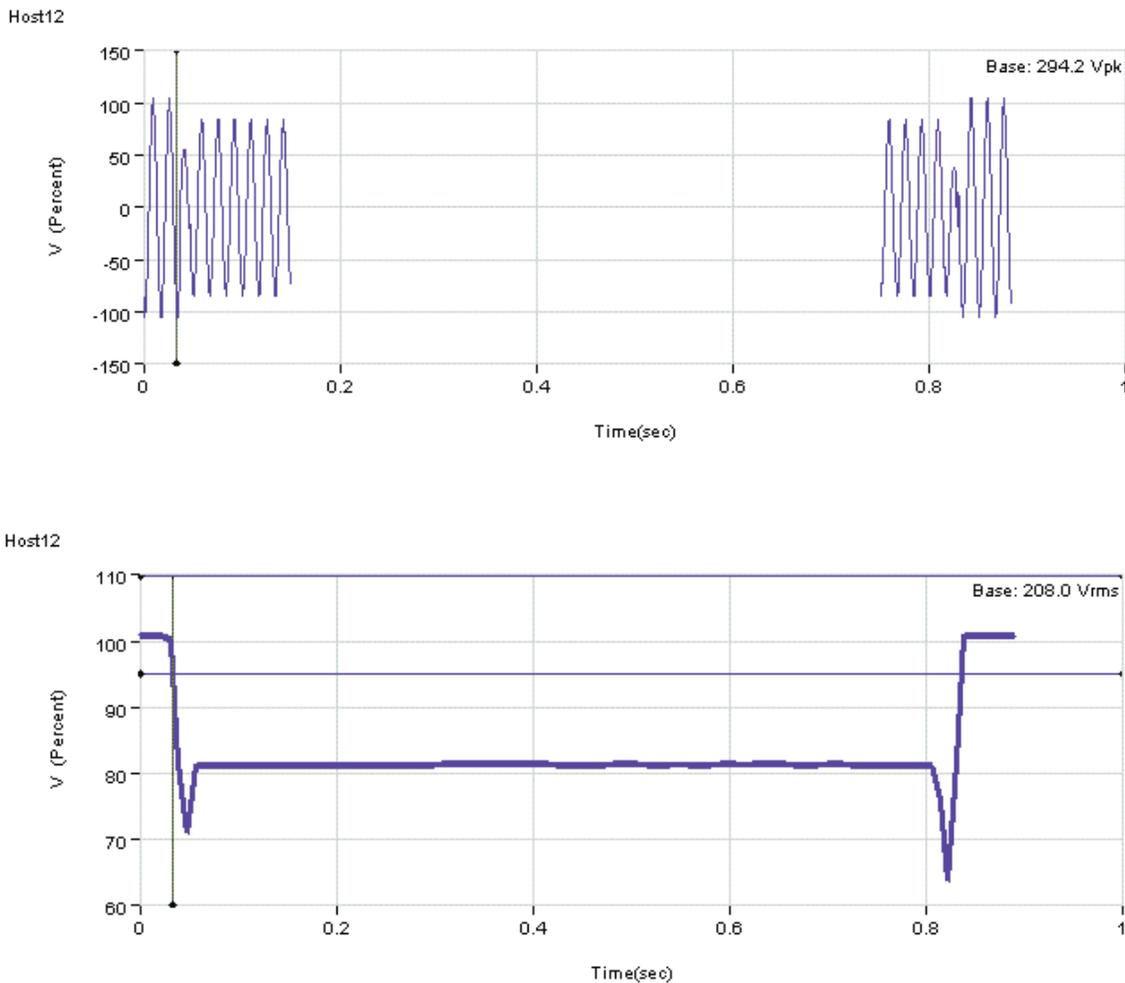


Figure 3.5 Example of RMS Variation Recording with Waveform Capture

TRANSIENTS tab

Voltage disturbances which are shorter in duration than sags and swells are classified as transients and include two basic classes: (1) impulsive transients, often attributable to lightning and load switching, and (2) oscillatory transients, usually caused by capacitor bank switching. Utility capacitor banks are often switched into service early in the morning in anticipation of a higher power demand period. Transients with a high magnitude and fast rise times can lead to insulation breakdown in motors, transformers, capacitors, and switchgear.

Pages 3-8 to 3-9 contain important details on Transients. See Appendix B page B-5 for Transients tab illustration and additional notes. Refer to the InfoNode Series 5500 User's Guide on how to set the parameters found in Transients tab.

Transient Detection

Transients can be captured using three trigger mechanisms: the high frequency positive/negative peak detectors, crest factor peak (instantaneous), and/or the waveshape variation. The high frequency peak detected transient uses special circuitry to detect and capture impulsive transients as small as 1/2 microsecond in duration. These transients are the positive and/or negative value above or below the low frequency waveshape. The crest factor or instantaneous peak is the absolute peak sample value within one cycle. The Instantaneous peak triggers on the absolute peak value of the entire waveform. The high frequency peak detector and instantaneous peak transients are triggerable for voltage and current. The waveshape trigger values include the magnitude and duration of the difference between the present and previous cycle's waveshapes. Waveshape changes are only triggerable for voltage transients.

The following information is required to set up the triggering mechanism:

Waveshape Threshold Magnitude or Tolerance
 Waveshape Threshold Duration or Window
 Peak or Instantaneous trigger magnitude
 Hi freq negative/positive peak detectors magnitude (early versions of DataNode have this value set the same as the Instantaneous peak)

Detecting Impulses

In each of the 128 "time slices" of the waveform, there are 3 sample points taken. These are a Low Frequency sample and a pair of High Frequency Peak samples. The Low Frequency point is used for the calculation of RMS and harmonics. The pair of Peak samples represents the output of a set of analog peak detectors that capture the instantaneous (in the order of a microsecond) high and low values. These peak detectors are reset 128 times per cycle, and are used for the HF Transient measurements. Thus there are 128 Low Frequency samples plus 128 Peak sample pairs per cycle, for a total of 384 samples per cycle.

A high-frequency transient event is recorded if the deviation between the highest and lowest values of the HF Transient exceeds the user-specified threshold.

Note that the DataNode measures hi and low peaks in the interval between low frequency samples (130 μ sec at 60 Hz). Thus, although a single 1 μ sec HF Transient can be detected, its time can only be determined to within 130 μ sec. This applies to each of the 128 intervals in the waveform.

The impulse detection circuit records positive and negative peak magnitude and volt-seconds for transients of 1 - 200 μ sec in duration. The 130 μ sec (at 60 Hz) or the 156 μ sec (at 50 Hz) limit was selected to prevent low frequency transients (< 5 kHz) from triggering impulse captures, which are captured by RMS measuring circuitry.

The transient triggers cause up to 8 pre-trigger cycles of the waveform, recorded immediately to be saved in memory. More than one cycle of triggered disturbance can be recorded. If another disturbance occurs on the cycle immediately following the initial one, the recording is extended up to a max of 10. After that, the threshold is increased by 50%. When there are no more transient triggers, the post-trigger cycles are saved and the event ends. This method permits capturing long transients like transformer energization.

As shown in Figure 3.6 next page, the impulse will either add to or subtract from the fundamental frequency voltage, increasing or reducing the apparent peak voltage magnitude. To insure consistent detection of an impulse of a given magnitude, regardless of where it occurs on the fundamental sinusoid, the delta between the Hi Peak and Low Peak detectors for each of the 128 intervals is measured before the voltage signal is compared with the threshold level.

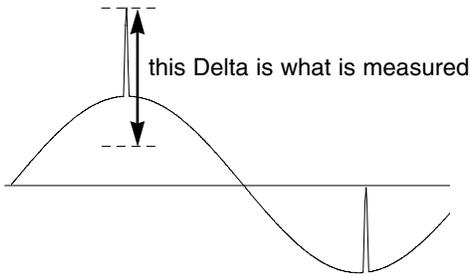


Figure 3.6 Addition of Impulsive Transient to the Fundamental Frequency Waveform

Detecting Oscillatory Transients

These types of disturbances are captured as waveshape faults. The waveshape fault triggering algorithm essentially compares the samples for each cycle to the corresponding samples from the previous cycle. If the samples differ by more than Threshold tolerance for a length of time exceeding Window percent of the power frequency cycle, a waveshape fault is registered. This algorithm is very sensitive to small deviations and allows triggering on waveform deviations that might not cause peak detection-based algorithms to trigger. The actual algorithm is more involved than this, but this is the basic idea. A trigger occurs when one or more voltage channels meets the triggering criteria.

Figure 3.7 below illustrates the "floating window" algorithm used for waveshape fault detection. This window can be visualized as sliding along the waveform, precisely one cycle behind the previous sample point, v_i . The height of the window defines a maximum allowable voltage deviation in magnitude. The width or duration corresponds to a number of sample points, N . For each sample v_i , when compared to $v_{i-1\text{cycle}}$ where the deviation in magnitude is outside the maximum allowable deviation, a counter is incremented. For each sample v_i that is within

the maximum allowable deviation, the counter, if greater than 0, is decremented. If the count reaches N , a trigger occurs.

Once an event is detected, instantaneous waveform information is recorded for all instrument channels. The following information is required to specify how much information is recorded:

- Before (Pre-trigger) Cycles
- After (Post-trigger) Cycles

The Before and After items allow a variable number of cycles before and after the disturbance to be recorded. Setting these values to 0 causes one cycle of data to be recorded for each event - the cycle in which the transient was detected. Typical values for these settings are 1 and 2 cycles respectively, with a maximum of 7 and 15 respectively.

Note that RMS Variation events will often result in a transient event being triggered and recorded as well. Since the RMS Variation sub-system typically records more waveform information than the transient sub-system, the recorded transient record is not saved.

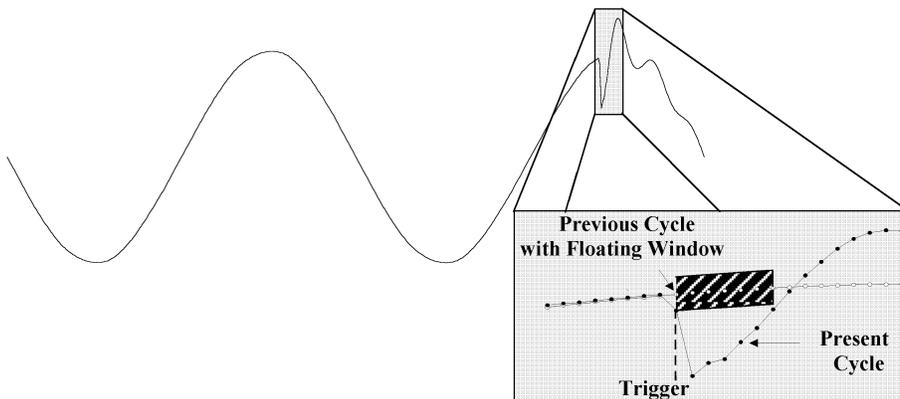


Figure 3.7 Waveshape Fault Detection

TRANSDUCERS tab

Values to account for any voltage or current transformers can be entered for each input channel. The primary and secondary values are entered. For example, if the primary voltage is 2400 volts and the secondary voltage is 120 volts, then those values should be entered, which gives an effective 20:1 reduction in voltage. When the input voltage applied to the measuring inputs of DataNode is 120V, the displayed value will be 2400 volts.

See Appendix B page B-10 for Transducer tab illustration and notes concerning Transducer installation. Refer to the InfoNode Series 5500 User's Guide on how to set the parameters found in Transducers tab.

ADVANCED tab

Parameters under this tab allow the administrator or user to set up functions of communications, information access and download between the InfoNode and DataNode systems.

See Appendix B page B-12 for Advanced tab illustration. Refer to the InfoNode Series 5500 User's Guide on how to set the parameters found in Advanced tab.

ACCUMULATOR RESETS tab

In connection with electric utility billing practices, the DataNode uses the Accumulator Resets tab as interface to reset demand and energy accumulation readings. This tab further extends to two hidden tabs where applicable value limit settings are defined - the Demand tab and the Advanced Metering tab.

See Appendix B page B-13 for Accumulator Resets tab illustration. Refer to the InfoNode Series 5500 User's Guide on how to set the parameters found in Accumulator Resets tab.

HIDDEN TABS

METERING tab

RMS voltage and current variations have their own tab relative to traditional power quality events, such as sags and swells (see RMS Variations). In addition, the RMS voltage and current phase and total values calculated over 1 cycle, updated over 1 second intervals and averaged over the programmed periodic interval are compared against the programmed limits. The minimum and maximum values over the periodic interval are updated

and stored at the end of the interval for trending.

For wye circuits, L-N, N-G and L-L limits can be programmed. For delta circuits, only L-L values are applicable. Other selectable parameters calculated at same rate with min/avg/max values over the periodic interval include: True Phase Power, Total Power, Reactive Phase Power, Total Reactive Power, Apparent Phase Power, Total Apparent Power, Power Factor, Average PF, Angle between Phase Fundamental Voltage and Current, and Frequency. Definitions of these terms can be found on Appendix C, *Glossary*.

Limits: When you select the parameter you wish to change, first check the "enable" periodic sampling box. Then if it is not already enabled, check the "limit enable" box followed by the value for that limit. Repeat this for all parameters of interest. Each parameter has five limits: High-High, High, Low, Low-Low, Deadband. The High-High must be greater than High, Low-Low less than Low, etc. Deadband or sensitivity is used to record incremental changes in the parameter besides when limits are crossed. Hysteresis on these limits is fixed and not programmable by the user.

NOTE: These limits are the absolute or actual values to trigger on, not a percent of fixed base as can be used in RMS Variation limits. This applies to all parameters including voltage, which may be in % of nominal for RMS variations.

See Appendix B page B-14 for Metering tab illustration. Refer to the InfoNode Series 5500 User's Guide for details on and how to set the parameters found in Metering tab.

REVENUE tab

Each individual phase, three phase total energy and integrated reactive power values can be enabled, along with High-High, High, Low, Low-Low limits, and Deadband. They are programmed in a similar manner to limits under Metering tab, as are those parameters on the following tabs.

See Appendix B page B-15 for Revenue tab illustration. Refer to the InfoNode Series 5500 User's Guide for details on and how to set the parameters found in Revenue tab.

DEMAND tab

Each individual phase and three phase total real power demand, reactive demand, apparent power demand, average PF and peak real power values can be enabled, along with High-High, High, Low, Low-Low, and Deadband

limits. Demand values are computed as the average value over the demand interval, which can be programmed as a different value than the periodic readings.

See Appendix B page B-16 for Demand tab illustration. Refer to the InfoNode Series 5500 User's Guide for details on and how to set the parameters found in Demand tab.

ADVANCED ENERGY tab

The Advanced Energy tab is an extension of the Accumulator Resets tab featuring energy value entries to which limits can be set. Highlight the phase value parameter you wish to change, then check the enable box, then check the threshold enable box, and then enter the value for that threshold. Repeat this for all parameters of interest.

See Appendix B page B-17 for Advanced Energy tab illustration. Refer to the InfoNode Series 5500 User's Guide for details on and how to set the parameters found in Advanced Energy tab.

ADVANCED METERING tab

Numerous total apparent power and power factor parameters, calculated on using arithmetic and vector sums of the individual phases can be enabled, along with High-high, High, Low, Low-Low, and Deadband limits. Parameters include: Total Arithmetic VA, Total Vector VA, Total Fundamental Arithmetic VA, Total Fundamental Vector VA, True PF, Worst PF, Total Arithmetic True PF, Total Vector PF, Displacement PF, Worst Displacement PF, Average Displacement PF, Total Arithmetic Displacement PF, Total Vector PF, Residual Current, and Net Current. Definitions of these terms can be found on Appendix C, *Glossary*.

See Appendix B page B-18 for Advanced Metering tab illustration. Refer to the InfoNode Series 5500 User's Guide for details on the Advanced Metering tab.

IMBALANCE tab

The voltage and current imbalance for each phase from the average value for all three phases can be trended and limits set. The positive, negative and zero sequence components for voltage and current as well as phase value deviation from average can be trended, along with setting High-High, High, Low, and Low-Low limits, as well as Deadband.

See Appendix B page B-19 for Imbalance tab illustration. Refer to the InfoNode Series 5500 User's Guide for details on the Imbalance tab.

HARMONICS tab

Waveform Distortion

Waveform distortion is a steady-state deviation from an ideal power frequency sinusoid, and is characterized by the spectral content of the waveform. There are five categories of waveform distortion:

- Harmonic
- Interharmonic
- DC Offset
- Notching
- Noise

Summary values such as THD (fundamental or RMS normalized), TID, TIF, harmonic and interharmonics RMS, Crest factor, TDD, kfactor, TDF, as well as total and signed harmonic power can be trended and limits programmed.

See Appendix B page B-20 for Harmonics tab illustration and additional notes. Refer to the InfoNode Series 5500 User's Guide for details on and how to set the parameters found in Harmonics tab.

ADVANCED HARMONICS tab

The voltage and current harmonics for each phase and neutral channel can be trended under the Advanced Harmonics tab. Resulting individual harmonic distortion values and graphs are displayed in the Views tab of the InfoNode system.

The user can specify individual harmonic numbers, a range of harmonic numbers, and/or odd or even harmonic ranges. Each harmonic selected for trending and limit crossings is treated as a separate parameter in the list of 200 total trendable parameters.

See Appendix B page B-22 for Advanced Harmonics tab illustration. Refer to the InfoNode Series 5500 User's Guide for details on the Advanced Harmonics tab.

3 Operation

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Software Options

The following optional features are available to enhance the function and performance of the EPQ DataNode Series. See the EPQ DataNode Comparison Chart on page 1-2 for the complete list of standard and optional features available in various EPQ DataNode models.

Specifications are subject to change without notice. Contact Dranetz-BMI Customer Service for the latest information on options and accessories.

Power Quality (optional on 5510; standard on 5513, 5520 & 5530)

- Cycle-by-Cycle V & I Analysis
- Current RMS Triggers
- Freq. Transients V & I
- Waveshape Trigger

Power Energy

- Revenue Accuracy (ANSI C12.1) (optional on 5510, 5513, 5520, 5530)

Harmonics (optional on 5510; standard on 5513, 5520 & 5530)

- Total Harmonic Distortion
- Interharmonics
- Spectrum Analysis

Answer Modules (optional on 5510, 5513, 5520, 5530)

- Capacitor Switching
- Sag Directivity
- Radial Line Fault
- VAR Verifier
- UPS Verification

Software

- Enterprise - NodeLink, NodeCenter (optional on 5510, 5513, 5520, 5530)

External Hardware

Standard Accessories Description and Part Numbers: for EPQ 5510, 5513, 5520, 5530 (except when noted)

- *Power Cord, Shielded, 125V 10A: USSTDCORD (US)
- *Power Cord, Shielded, 230Vac: EUROSTDCORD (Euro)
- *Power Cord, Shielded, 230Vac: UKSTDCORD (UK)
- AUI-to-10BaseT Adapter: AUI10BT
- Cable, CAT 5 UTP Patch: 10BTSTD
- Series 5500 DataNode User's Guide: UG-DNODE5500
- Cable Set: 116042-G1 (standard on 5513 only)
- Voltage Cable Accessory Pack: VCP-4300 (standard on 5513 only)

**User specified, one standard only.*

Optional Accessories Description and Part Numbers: for EPQ 5510, 5513, 5520, 5530 (except when noted)

- AUI-to-Fiber Optic Adapter: AUIFIBER
- 3.2 ft. Fiber Optic Extension Cable: FBR3
- 100 ft. Fiber Optic Extension Cable: FBR100
- 300 ft. Fiber Optic Extension Cable: FBR300
- DB25-F/DB9-F to DB25-F/DB9-F Pin Null RS-232 6 ft. Cable: RS232NUL
- 10BaseT Null, RJ-45, 6 ft. Cable: 10BTNUL
- Mounting Brackets (Long): 550BRKTL
- Mounting Brackets (Short): 550BRKTS
- 19" Rack Mounting Panel: 55RACK
- DC Power Option, DataNode: EPQDCPOWER
- AC Power Cord, 115 V: USACCORD
- AC Power Cord, 230 V: EUROACCORD
- AC Power Cord, 230 V: UKACCORD
- PCB, Analog, with Transient Peak Detector: 5511TRAN
- Small NEMA4 Enclosure, DataNode: NEMA4DATA

The following are additional optional accessories for 5510/553x Series

- Current Interface Cable, 8010 Input Module to DataNode: 8010PODCABLE
- Cable, BNC to DB25: BNCTO55
- Cable, TR Probe to DB25: TRT055
- Dual Unit Mounting Enclosure, InfoNode, DataNode: 55DUAL
- Module Set, 5536/5537: 116689-G1
- External Current Interface: 5533APOD
- External Voltage Module, 5536: 5536VPOD
- External Current Module, 5537: 5537APOD
- External Voltage Module, 5531: 5531VPOD
- External Current Module, 5532: 5532APOD

The following are additional optional accessories for 5513

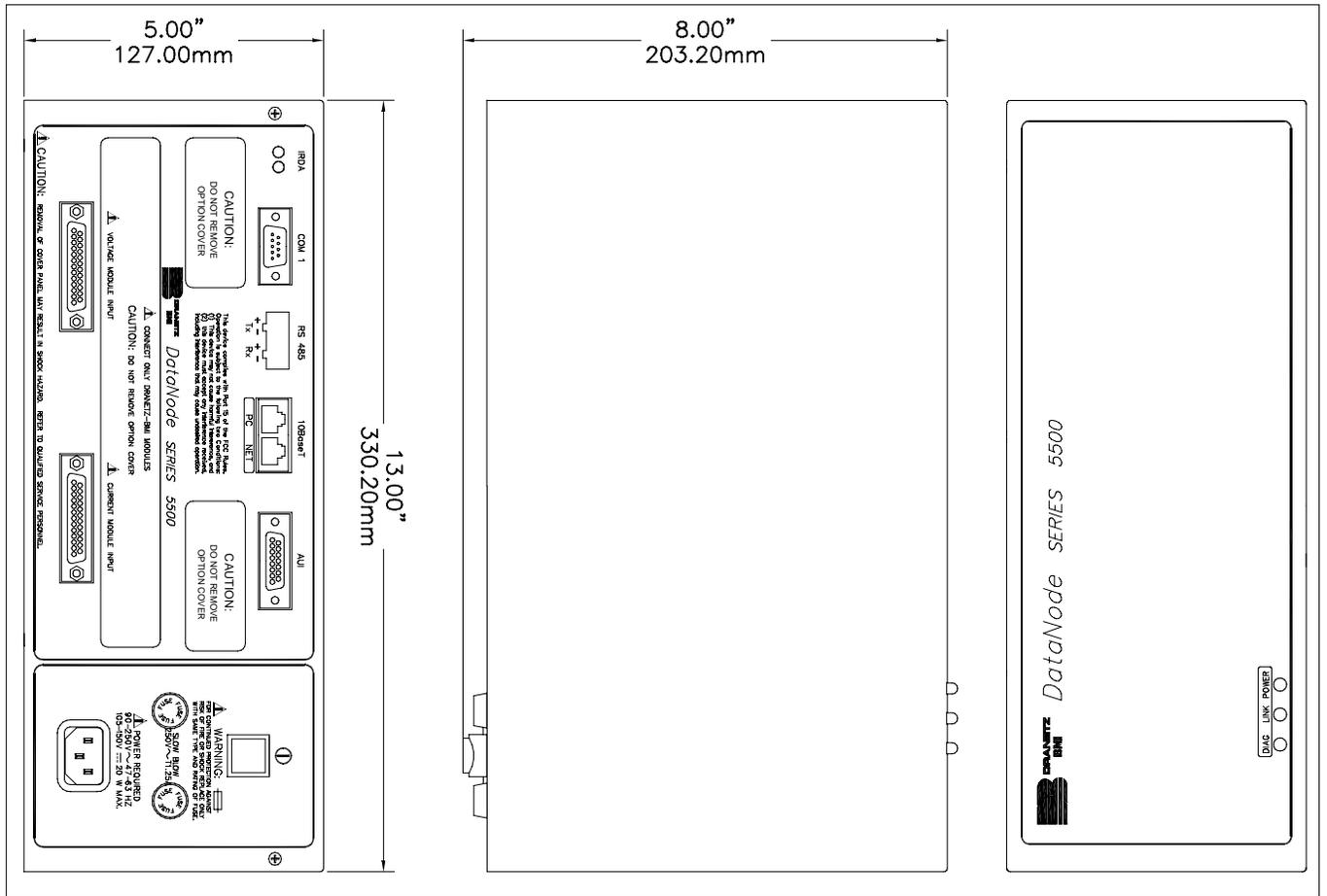
Current Probes

•Current Probe, 10 to 500 A RMS:	TR-2500
•Current Probe, 10 to 500 A:	TR-2500A
•Current Probe, 0.1 to 10 A RMS:	TR-2510
•Current Probe, 1 to 10 A:	TR-2510A
•Current Probe, 300 to 3000 A:	TR-2520
•Current Probe, 10 to 3000 A:	TR-2520A
•Current Probe, 1 to 30 A RMS:	TR-2021
•Current Probe, 1 to 300 A RMS:	TR-2019B
•Current probe, 10 to 1000 A RMS:	TR-2022
•Current probe, 10 to 3000 A RMS:	TR-2023
•Adapter Cable, 4300 to LEMFLEX:	CA4300LEM
•LEMFLEX Current Probe, 300/3000A, AC:	LEMFLEX3K
•DRANFLEX Current Probe, 300A/3000A, 24”:	DRANFLEX4300-3K24
•DRANFLEX Current Probe, 300A/3000A, 36”:	DRANFLEX4300-3K36
•DRANFLEX Current Probe, 300A/3000A, 48”:	DRANFLEX4300-3K48
•DRANFLEX Current Probe, 600A/6000A, 24”:	DRANFLEX4300-6K24
•DRANFLEX Current Probe, 600A/6000A, 36”:	DRANFLEX4300-6K36
•DRANFLEX Current Probe, 600A/6000A, 48”:	DRANFLEX4300-6K48
•AC/DC Current Probe, 150A, Without AC:	PR150/SP1
•AC/DC Current Probe, 150A, Battery:	PR150/SP2
•AC/DC Current Probe, 1500A, Without AC:	PR1500/SP7
•AC/DC Current Probe, 1500A, Battery:	PR1500/SP8
• Probe Power Adapter:	DF-PPA

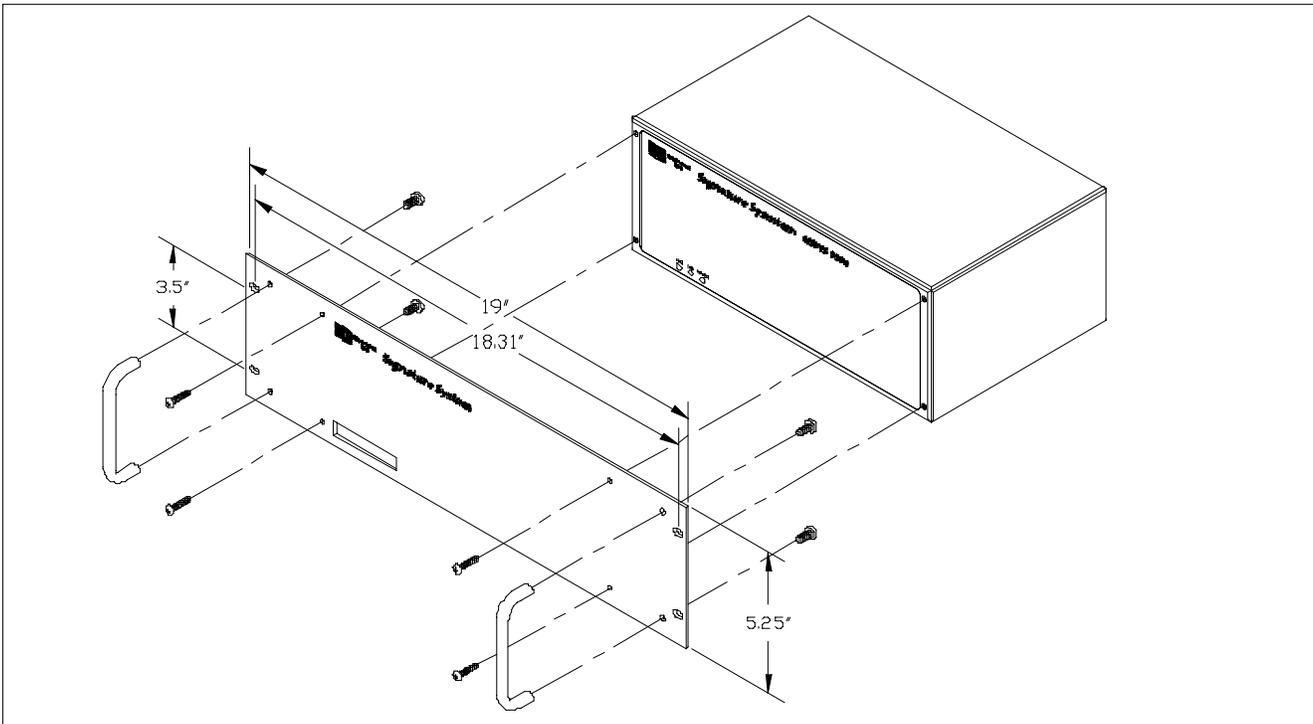
Voltage Probes

•AC Adapter with 4 Phase Adapter Cable:	RR/PS/4P
•Heavy Duty Cable Set:	116087-G1
•Fuse Voltage Adapter, for single phase connection:	FVA-1
•Fuse Voltage Adapter, for three phase connection:	FVA-4

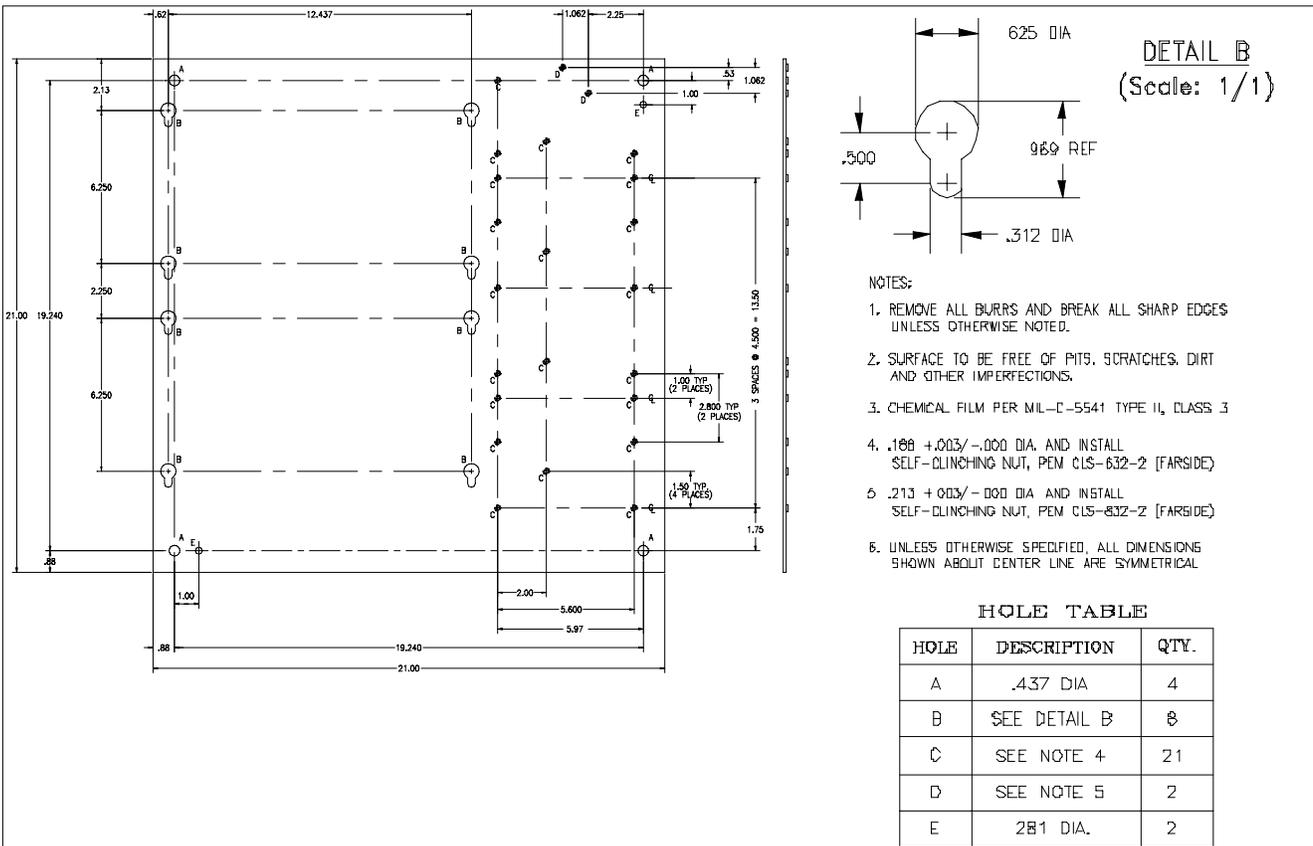
Optional Accessories



DataNode physical dimensions (applicable to Series 5500 DataNode)



Rack Mounting Panel (19"): 55RACK (applicable to 553x Series)

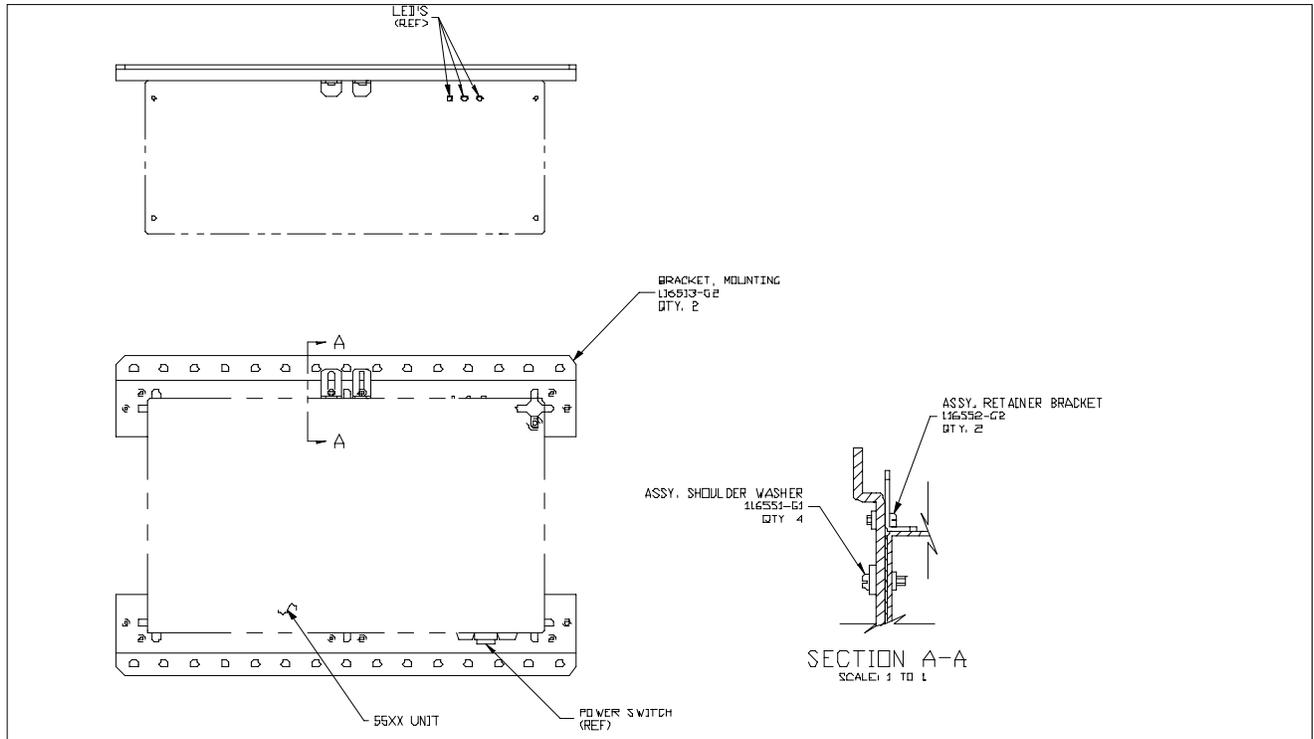


Pod enclosure plate showing distances (applicable to 553x Series)

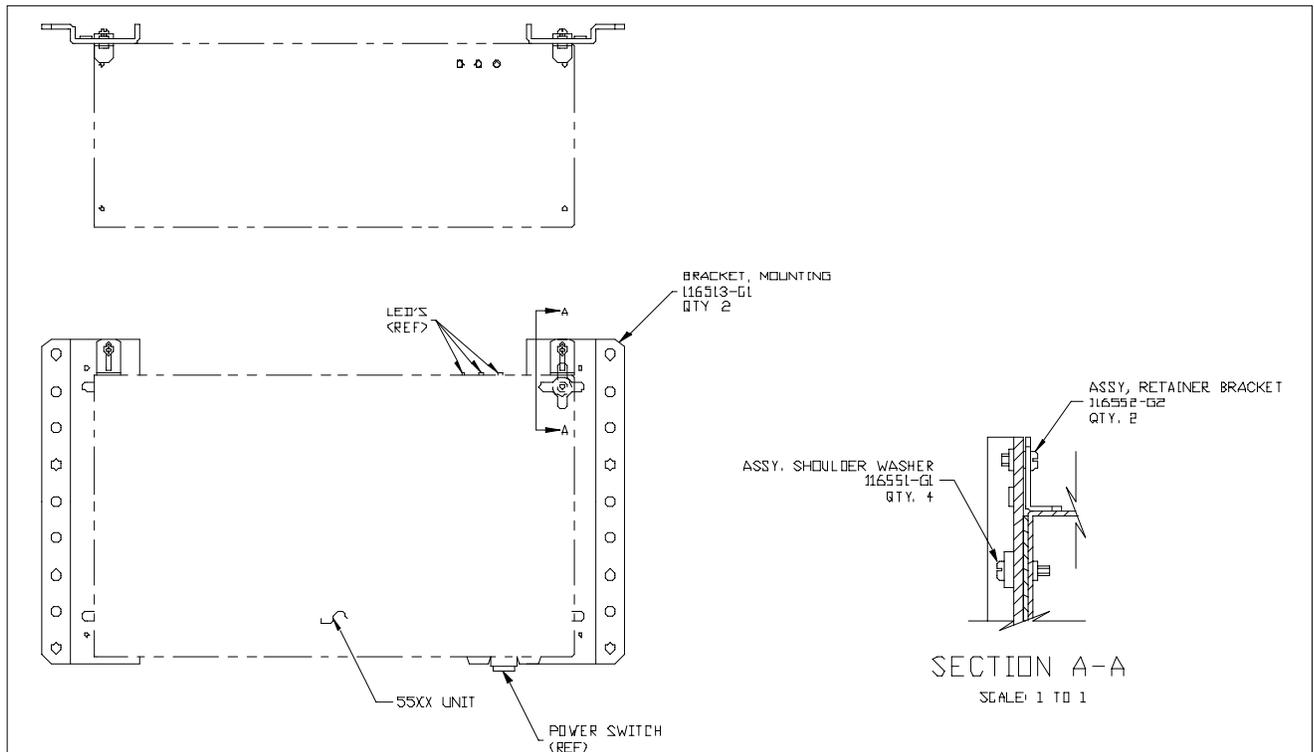
Optional Accessories

WARNING

Mounting to a vertical structure must be performed by qualified personnel who can verify that the anchoring surface is structurally sound and will support the accessory shown. These mounting brackets are only for use with the accessory shown and are not intended for any other use.



Pod mounting showing holes; Mounting Brackets: 550BRKTL



Pod mounting brackets (short style): 550BRKTS

DataNode Specifications

5530 / 5520 / 5513 / 5510

Inputs

Voltage

#V channels	4
V range (RMS)	5-600
V accuracy	±0.2% reading, ±0.2% full scale
Sample rate	Max 384 samples/cycle (128 s/c + dual peak detectors for 5510T, 5513T, 5520T, 5530T), phase locked
Input type	(for 5530) Single Ended, DC coupled with 5531 V Pod (for 5520 and 5536 V Pod) Differential, DC coupled
Input impedance	(for 5530) 2 Mohm to ground (for 5520 and 5536 V Pod) 8 Mohm to ground
CMMR	-80 dB
Connection Type	(for 5510/5530) External Module w/screw terminals (for 5520) Removable Screw Terminal Blocks (for 5513) Plug-in connection
RMS Update	1/2 cycle steps
RMS Compression	on long duration RMS events, 3 stages
#Waveforms	0-7 Pre-, 16-Before Post-

Current

#I channels	4
I range (RMS) nominal	5A
I range peak	5x with 5532 pod, 20x with 5533
I accuracy	±0.2% reading, ±0.2% full scale
RMS Sample rate	Max 384 samples/cycle (128 s/c + dual peak detectors for 5510T, 5513T, 5520T, 5530T), synchronous with corresponding voltage channel
CMMR	-80 dB
Connection Type	(for 5510/5530) External Module w/ 3/8" Toroid, #12 AWG wire (for 5520 and 5537 A Pod) Removable Screw Terminals, #10 Block (for 5513) Plug-in connection
RMS Update	1/2 cycle steps
#Waveforms	0-7 Pre-, 16-Before Post-
Phase shift V&I	0 degrees

Voltage Transients

PLL Synchronization	Yes
Zero crossing	
sample synchronization	Yes
V transient peak	± 50-1000Vpk
V transient min duration	1 µsec for less than -3db
Trigger techniques	Dual hi freq. peak detectors, waveshape, and instantaneous or crest peak
Update rate @60Hz	130 µsec

Current Transients

I transient	Yes
I transient peak	10-300% CT FS
I transient duration	1 µsec for less than -3db
Update rate @60Hz	130 µsec
Trigger techniques	Dual hi freq. peak detectors, instantaneous or crest peak

DataNode Specifications (continued)

5530 / 5520 / 5513 / 5510

Parameters

W (phases plus total)	Yes
VAR (phases plus total)	Yes
True PF (phases plus total)	Yes
VA (phases plus total)	Yes
Demand (total)	Yes
Projected Demand (total)	Yes
Energy (total)	Yes
Displacement PF (phases)	Yes
K factor	Yes
TIF	Yes
TDD	Yes
TID	Yes
TDF	Yes
V & I Imbalance	Yes (positive, negative and zero sequence)
Revenue Certified (ANSI C12.1)	Option
V Harmonics	50th
Update rate	200 msec windows, 5 seconds typ
I Harmonics	50th
Update rate	200 msec windows, 5 seconds typ
W Harmonics	50th, signed and unsigned total
Update rate	5 seconds typical
Interharmonic RMS	Yes
Frequency range	45-65 Hz
Frequency accuracy	±0.2%

Environmental

Power Supply Burden	20W
Power Supply DC	105-125Vdc ± 20%
Power Supply AC	90-250Vac
Operating Temperature	0 to 60°C
Storage Temperature	-20 to 70°C
Operating Humidity	0 to 90% RH, non-condensing, indoor use
Operating Altitude	2000m (6560 ft) max
UPS time	15 minutes typical, Full charge
Battery life expectancy	4 years with auto discharge feature

Clock

Clock accuracy	1 cycle
Clock sync	Network Time Protocol (NTP)
Event time resolution	10 msec
Event time accuracy	10 msec with NTP to InfoNode with GPS

DataNode Specifications (continued)

5530 / 5520 / 5513 / 5510

Trigger Conditions

RMS	V and I Selectable cycles to trip and restore
Waveshape faults	V and I Selectable duration and magnitude to trigger
Transients	Voltage and current, high frequency and crest peak
Harmonics	V and I Individual and THD
Phase Shift	Fundamental
Timed Readings	1-120 minutes
Cross Triggered	From other DataNodes on RMS or transient events

1159 Classification

Impulsive transient	Yes
Oscillatory transient	Yes
Interruption	up to 3KHz
Sag	Yes
Swell	Yes
Under/overvoltage	Yes
Sustained interrupt	Yes
DC	Yes
Harmonics	Yes
Interharmonics	Yes
Notching	Yes

Trending

Min/Max/Avg on parameters at user specified interval

Communication

Serial port type	RS232/RS485 (used for diagnostic and initial setup only)
Serial baud rate	9600 baud, 8 bit, 1 stop, no parity, no flow control
Ethernet	10BaseT using UCA-2 to InfoNode
Other	AUI for fiber optic, etc.

Other

Firmware Update	Remotely uploadable
Field Calibration Certification	Yes
Mounting	Rack, Panel, DeskTop, NEMA 4X

Installation Categories

Mains Supply	Installation Category II, Pollution Degree 2
Measurement Inputs	Installation Category III, Pollution Degree 2

Physical Characteristics

Dimensions	13"W x 8"D x 5"H (330.2mm x 203.2mm x 127.0mm)
Weight	6.3 lbs (2.9 kg)
Enclosure	Painted Aluminum

Theory of operation and detailed hardware description

Data Acquisition

Each input signal is processed by three separate paths. A straight through path goes through a low pass filter to the A/D and is used for RMS measurement. The other paths lead to positive and negative peak detectors for impulse capture. These are read and reset at the same rate as the RMS samples, 128 samples per cycle. Dual A/D converters convert voltage and current signals simultaneously to prevent any phase shift errors from being introduced in the power calculations.

Triggering

Voltage and current thresholds can be used to trigger 16 cycle pre/post/fault cycles of waveforms for every channel per event. This includes triggering on current transients, which may be the only way to detect voltage transients where surge-suppression devices are used on the circuit. VERY HI, HI, LO, VERY LO and Deadband (step or sensitivity changes) thresholds are settable on an individual phase or three phase basis, in absolute or percent of fixed or floating nominal. This versatility allows for maximum use of processing speed and memory, by collecting and analyzing only the data that is important to the equipment susceptibility or performance standards, instead of filling the memory with uneventful or meaningless data.

In addition to the sag, swell, interruption and transient capture, the user can select parameters for trending at

user-selected time intervals. This includes min/max/average values over each interval updated once per second. Certain power parameters, such as demand, also have statistical values computed over a day, week and month intervals. Harmonic and interharmonic calculations comply with the 6000-4-7 and other standard 200-millisecond windows, including fundamental phase angles and distortion levels. This information is also available for trending and statistical analysis.

Data and information from the EPQ DataNodes are sent to the InfoNode via a high-speed Ethernet link using the standard UCA-2 communication protocol. This protocol is also used from the InfoNode to the DataNodes for set-up, including time-syncing to GPS source in the InfoNode. The InfoNode provides the user interface for accessing the data and information from the DataNodes via a conventional web browser. Additional DataNodes can be easily added to the network. Operation of different types of DataNodes and the InfoNode are covered in their own separate user's guides.

EPQ Models

The 5530 EPQ DataNode consists of a measurement unit with external voltage and current pods. The voltage pods are rated for 600Vrms, while the current pods are 5A nominal, with 5X overcurrent capability. The pods are connected to the measuring unit with 3 foot cords, to allow the pods to be placed in line with existing wiring.

The 5520 EPQ DataNode has internal voltage and current transducers with the same operating ranges.

Maintenance and Service

In normal use, only the internal backup battery pack requires periodic replacement. Contact Dranetz-BMI Technical Support in case of trouble. See specifications page for replacement interval.

Cleaning

Cleaning should only be performed with power to the unit set to the OFF position and no external voltage or current connections to the unit. The external surfaces of the unit may be cleaned by wiping with a clean, soft, dry cloth. Do not use any cleaning fluids or solvents as the plastic and rubber surfaces may be damaged.

Battery Pack Safety Precautions

• **WARNING: DO NOT intentionally short circuit the battery pack. The batteries are capable of providing hazardous output currents if short circuited. Do not attempt to charge the batteries with an external charger.**

• **ADVERTENCIA: NO ponga intencionalmente la batería en cortocircuito. Las baterías son capaces de proporcionar corrientes de salida peligrosas si están en cortocircuito. No intente cargar las baterías con un cargador externo.**

• **AVERTISSEMENT: NE PAS court-circuiter délibérément le bloc-batterie. Lors d'un court-circuit, les batteries risquent d'émettre des courants effectifs dangereux. Ne pas tenter de charger les batteries au moyen d'un chargeur externe.**

• **WARNUNG: Die Batterien dürfen NICHT kurzgeschlossen werden. Im Falle eines Kurzschlusses können die Batterien lebensgefährliche Ausgangsströme leiten. Die Verwendung eines externen Ladegeräts kann zu einer Explosion der Batterien führen.**

Battery Safety Precautions

The following safety precautions must be adhered to.

- Keep batteries away from children. Never permit a child to play with a battery as an ornament or toy.
- Do not disassemble battery or battery pack.
- Do not dispose of battery in fire.

- Dispose of a used battery promptly in accordance with local Environmental Protection Agency (EPA) regulations.
- Visually inspect the battery pack for corrosion.

Medidas de seguridad de la batería

Deberán observarse las medidas de seguridad siguientes:

- No deberá mantenerse las baterías al alcance de los niños. No deberá permitirse que un niño juegue con una batería.
- No deberá desensamblarse ninguna batería ni el compartimiento de la misma.
- No deberá prenderse fuego a una batería.
- Toda batería agotada deberá desecharse de manera rápida según las normas locales de la Agencia de protección del medio ambiente (EPA).
- Deberá verificarse que el compartimiento de las baterías no esté corroído.

Mesures de sécurité relatives aux batteries

Il est très important de suivre les mesures de sécurité suivantes.

- Ne pas laisser les batteries à la portée des enfants. Ne jamais laisser un enfant jouer avec une batterie.
- Ne pas démonter de batterie ou de bloc-batterie.
- Ne pas jeter de batterie dans le feu.
- Se débarrasser rapidement des batteries usagées en se conformant aux règlements de l'EPA (Agence américaine pour la protection de l'environnement).
- Inspecter le bloc-batterie à l'oeil nu pour rechercher les signes de corrosion.

Batterie-Sicherheitsvorkehrungen

Die folgenden Sicherheitsvorkehrungen müssen beachtet werden.

- Halten Sie Batterien von Kindern fern. Erlauben Sie einem Kind unter keinen Umständen, eine Batterie als Verzierung oder Spielzeug zu benutzen.
- Nehmen Sie Batterien oder Batteriepackungen nicht auseinander.
- Entsorgen Sie Batterien nicht durch Verbrennen.
- Entsorgen Sie verbrauchte Batterien umgehend nach den gesetzlichen Umweltschutzbestimmungen.
- Prüfen Sie die Batteriepackung optisch auf Korrosion.

Battery pack replacement

The internal backup battery pack has a life expectancy of four years under normal use. To replace the battery pack:

1. Press the DataNode power switch to the OFF position. Verify that the power indicator lamp is off. Disconnect all power to the unit. Disconnect all external communications cables from the rear panel.
2. Open the cabinet by removing the seven screws that retain the cover to the chassis. Facing the rear panel, carefully swing the cover upwards and back.
3. The battery pack is located on the Input Filter Board. Observe the mounting orientation of the battery pack. Remove the battery pack hold-down strap by loosening its two retaining screws.

• **WARNING: Replace with Dranetz-BMI battery pack 116455-G1 only.**

• **ADVERTENCIA: Reemplace con batería Dranetz-BMI 116455-G1 solamente.**

• **AVERTISSEMENT: Remplacer par la batterie Dranetz-BMI 116455-G1 exclusivement.**

• **WARNUNG: Nur mit Dranetz-BMI 116455-G1 Batteriesatz auswechseln.**

4. Disconnect the polarized battery pack connector from the circuit board. Remove the old battery pack and replace only with Dranetz-BMI Battery Pack, P/N 116455-G1. Observe correct mounting orientation.
5. Connect the polarized battery pack connector to the circuit board. Replace the battery pack hold-down strap and tighten the two screws securely.
6. Install the cover on the chassis and tighten the seven screws securely.

Typical initial setup via serial port

Dranetz-BMI Signature System DataNode 5520/30
Boot ROM
Copyright (C) 1997-2000 Dranetz-BMI - All Rights Reserved
Created: Apr 24 2000, 14:50:20

System Booting....

MAC Address: 00:01:32:74:d5:c1

Reading configuration Done

Press any key to stop auto-boot...

4

System will reboot in 60 seconds if no response to login prompts.

Login: admin

Password: password

Dranetz-BMI 5530 DataNode Boot Configuration

Press the appropriate number key to select option.
Press the [ESC] key to exit setup and start the DataNode.

Main Menu

- 1) Communications Setup
- 2) Administrator Functions

Dranetz-BMI 5530 DataNode Boot Configuration

Press the appropriate number key to select option.
Press the [ESC] key or any arrow key to go back to the previous menu.

Communications Setup Menu

- 1) Set TCP/IP Parameters
- 2) Set DataNode OSI Parameters
- 3) Set InfoNode OSI Parameters
- 4) Set all TCP/IP and OSI to Defaults
- 5) Set Terminal Baud Rate
- 6) Set Modem Setup String
- 7) Set InfoNode Connection Mode
- 8) Display All Communication Parameters

Set TCP/IP Parameters

Press Enter to keep the existing value in a field

InfoNode IP Address = 0.0.0.0

Enter new InfoNode IP Address (xxx.xxx.xxx.xxx):

DataNode IP Address = 198.69.18.11

Enter new DataNode IP Address (xxx.xxx.xxx.xxx):

Subnet mask = 255.255.255.0

Enter new Subnet Mask (xxx.xxx.xxx.xxx):

Gateway I.P. Address = 198.69.18.1

Enter a . to set a NULL gateway

Enter new Gateway I.P. Address (xxx.xxx.xxx.xxx):

Firmware Download Host I.P. Address = 198.69.18.12

Enter a . to set to same as InfoNode Address

Enter new Download Host I.P. Address

(xxx.xxx.xxx.xxx):

Time Synchronization Host I.P. Address = 0.0.0.0

Enter a . to set to same as InfoNode Address

Enter new Time Synchronization Host I.P. Address

(xxx.xxx.xxx.xxx):

Press any key to return to menu.

Dranetz-BMI 5530 DataNode Boot Configuration

Press the appropriate number key to select option.
Press the [ESC] key or any arrow key to go back to the previous menu.

Communications Setup Menu

- 1) Set TCP/IP Parameters
- 2) Set DataNode OSI Parameters
- 3) Set InfoNode OSI Parameters
- 4) Set all TCP/IP and OSI to Defaults
- 5) Set Terminal Baud Rate
- 6) Set Modem Setup String
- 7) Set InfoNode Connection Mode
- 8) Display All Communication Parameters

A Appendix

Dranetz-BMI 5530 DataNode Boot Configuration

Press the appropriate number key to select option.
Press the [ESC] key to exit setup and start the DataNode.

Main Menu

- 1) Communications Setup
 - 2) Administrator Functions
-

Dranetz-BMI 5530 DataNode Boot Configuration

Press the appropriate number key to select option.
Press the [ESC] key or any arrow key to go back to the previous menu.

Administrator Functions Menu

- 1) Download IOP Firmware
- 2) Set ACP firmware download flag
- 3) Change passwords
- 4) Set passwords to default values
- 5) Display startup and download statistics
- 6) Network statistics menu

About to erase memory and download new firmware.
Hit the [ESC] key within 5 seconds to abort download.
Hit any other key to start now.

1
Erasing IOP program memory Done

Verifying erase OK
Downloading firmware via FTP from Host =
198.69.18.12

Processing FTP data blocks for file.
Number shown represents the time to download each 4K block.
The time is reported in ticks where 1 tick = 1/60 second.

154 5 6 114 6 5 6 6 13 5 5 6 5 6 55 12

Downloaded 914875 bytes. Validating program. Please wait...

Good IOP program file checksum.
IOP program download Successful.

About to execute downloaded program.
Hit the [ESC] key within 5 seconds to abort.
Hit any other key to start now.
Transferring execution to main IOP program

Dranetz-BMI Signature System DataNode 5520/30
IOP Program Firmware
Copyright (C) 1997-2000 Dranetz-BMI - All Rights Reserved
Created: Jun 23 2000, 09:59:35

IOP starting....

(a series of bootup diagnostics will appear on the screen.
reboot the system and login.
select Administration mode then select download ACP firmware)

Dranetz-BMI Signature System DataNode 5520/30
Boot ROM
Copyright (C) 1997-2000 Dranetz-BMI - All Rights Reserved
Created: Apr 24 2000, 14:50:20

System Booting....

MAC Address: 00:01:32:74:d5:c1

Reading configuration Done

Press any key to stop auto-boot...
4
System will reboot in 60 seconds if no response to login prompts.

Login: admin
Password: password

Dranetz-BMI 5530 DataNode Boot Configuration

Press the appropriate number key to select option.
Press the [ESC] key to exit setup and start the DataNode.

Main Menu

- 1) Communications Setup
 - 2) Administrator Functions
-

Dranetz-BMI 5530 DataNode Boot Configuration

Press the appropriate number key to select option.
Press the [ESC] key or any arrow key to go back to the previous menu.

Administrator Functions Menu

-
- 1) Download IOP Firmware
 - 2) Set ACP firmware download flag
 - 3) Change passwords
 - 4) Set passwords to default values
 - 5) Display startup and download statistics
 - 6) Network statistics menu

About to set a flag that will cause the ACP to initiate
Hit the [ESC] key to abort.
Hit any other key to set the flag now.
ACP firmware download flag set. Press any key to return to menu.

(at this point press any key)

Dranetz-BMI 5530 DataNode Boot Configuration

Press the appropriate number key to select option.
Press the [ESC] key or any arrow key to go back to the previous menu.

Administrator Functions Menu

-
- 1) Download IOP Firmware
 - 2) Set ACP firmware download flag
 - 3) Change passwords
 - 4) Set passwords to default values
 - 5) Display startup and download statistics
 - 6) Network statistics menu

(now press escape to get to the main menu)

Dranetz-BMI 5530 DataNode Boot Configuration

Press the appropriate number key to select option.
Press the [ESC] key to exit setup and start the DataNode.

Main Menu

-
- 1) Communications Setup
 - 2) Administrator Functions

(now press escape to begin the boot process)

Escaping from the main menu will start DataNode.
Press r to reboot the DataNode (to allow you to login again).
Press any other to remain in this menu.
3

(at this point the datanode will reboot and download the new ACP code)

Please wait ... Checking program checksum
Program code passes checksum. Jumping to entry point.
Transferring execution to main IOP program

Dranetz-BMI Signature System DataNode 5520/30
IOP Program Firmware
Copyright (C) 1997-2000 Dranetz-BMI - All Rights Reserved
Created: Jun 23 2000, 09:59:35

IOP starting....

Reading configuration Done
Attaching network interface mbc0... done.
Attaching network interface lo0... done.
IOP:
***** Host Needs Program File !!!
IOP:
Waiting for Host Program Download to Complete.IOP:
Downloading file name: 332fmr.bin via FTP from Host = 198.69.18.12
IOP: User = admin Password = password
IOP: Reading header
IOP: Program file size is: 524320 bytes
.....
.....
.....
.....
.....
.....
.....
.....IOP: Good 332 Flash Program file Checksum.

A Appendix

IOP: 332 Download Successful.
IOP:
Total number of 332 file bytes read: 524320.

Hello from the 332

DataNode SW:116690-G1 (c) 1999 Dranetz-BMI, Inc.
Edison, N.J.
Compiled on Jun 23 2000 at 13:11:32, Version E1.0
Host Initialization Complete!

Test DSP Sh RAM: OK
DSP Self Test: Load OK start OK results OK
DSP Appl Ext OK Int Load OK start OK
IOP: IB: Getting persisted setups from NVRAM
IOP: sizeof(ACP_NVR): 8178
IOP: Read setup with CRC of: DF56
IOP: Successfully initialized bricks setup from
NVRAMIOP: About to send change setup message
IOP:
cfg.GLOB: 0xC
IOP: cfg.MSQI: 0x1
IOP: cfg.MDMD: 0x5
IOP: cfg.MVAR: 0x5
IOP: cfg.MTRN: 0x5
TaskStart

Init PLL
Waiting for setups isr_startup_msg:22
isr_startup_msg:20 isr_startup_msg:16
MDMD CF WPTI CF MMS PhsCon:5 Prif:1, Secf:1
Prif:1, Secf:1 Prif:1, Secf:1 P
rif:1, Secf:1 Prif:1, Secf:1 Prif:1, Secf:1 Prif:1, Secf:1
Prif:1, Secf:1 P
rif:1, Secf:1 RATO CF
Check Z-Cross, def = 60.000Hz
Inp:0 = 59.993 sync: OK at 59.993Hz
basic_acp
full_acp
DAB EEROM: OK set_user_thresholds done

set mdmd:
mask:0 mask:0 mask:0 mask:0 mask:0 mask:0

(diagnostic message displayed)

Illustration of DataNode Tabs & Additional Explanatory Notes

LEGEND (please note the following conventions used in the screen displays):

Items in *italics* are not programmable, but included for information purpose to the user.

Items in **bold** are examples of what can be entered.

Selections available in drop down menu are enclosed in brackets { xxxx }.

A WORD OF CAUTION: Dranetz-BMI has already set default values for the various parameters in each DataNode.

The default values have been tested to result in optimal system performance. Users are advised not to change the default value settings unless they operate advanced setups which make the default values inapplicable.

General tab

Properties	Values
Identification Information	
Name	DataNode 1
Description	Service Entrance
Serial Number	<i>53000001</i>
Version	<i>2.0.798</i>
Status Information	
Active	<input checked="" type="checkbox"/>
Get settings from DataNode on activation	<input type="checkbox"/>
Last contact at	<i>7/25/01 4:38</i>
Health	<i>System health is normal</i>

B Appendix

Basic tab

Properties	Values
Power System	
Wiring configuration	Wye {Single Phase, Wye, Delta, Split Single Phase}
Base Voltage (Vrms)	120
Base Current (Irms)	5
Phase rotation	Normal (counter clockwise) {Normal, Reverse}
Display	
Display voltage limits in	Percent {Volts, Per Unit, Percent}
Steady State Trending	
Time between periodic samples (min)	1
Demand Interval (min)	15
Demand Sub Interval (min)	5
Basic Metering (Metering, MMXU0)	<input checked="" type="checkbox"/>
Basic Revenue Metering (Revenue, MMTR0)	<input type="checkbox"/>
Demand (Demand, MDMD0)	<input type="checkbox"/>
Advanced Energy (Adv. Energy, MFLO0)	<input type="checkbox"/>
Advanced Metering (Adv. Metering, MADV0)	<input type="checkbox"/>
Imbalance and Sequence Components (Sequence, MSQI0)	<input type="checkbox"/>
Harmonics (Harmonics, MHAIO)	<input type="checkbox"/>
Advanced Harmonics (Individual, MHAIO)	<input type="checkbox"/>
Communications	
DataNode address	10.0.2.32
Password	*****

RMS Variations tab

Properties	Values
Limit Methods	
Voltage trigger method	Manual (% of fixed base) {Manual (Engineering units)} {Manual (% of fixed base)}
Current trigger method	Automatic (% of base current) {Manual (Engineering units)} {Manual (% of base current)}
Limits	
A-N Voltage {Bank selection enables programming limits below}	
B-N Voltage	
C-N Voltage	
N-G Voltage	
A-B Voltage	
B-C Voltage	
C-A Voltage	
A Current	
B Current	
C Current	
N Current	
Limit enabled	<input type="checkbox"/>
High limit	108.0
Low limit	90.0
Pre- and Post- Event Captures	
Pre-event start RMS samples (cycles)	10
Post-event start RMS samples (cycles)	238
Pre-event start waveform samples (cycles)	1
Post-event start waveform samples (cycles)	15
Post-event end RMS samples (cycles)	15
Pre-event end waveform samples (cycles)	10
Post-event end waveform samples (cycles)	5
Cycles in range to end event	1
RMS Variations Sampling Intervals	
Number of Rates to Use	3
Intervals	
Reduced sampling rate #1	
Reduced sampling rate #2	
Reduced sampling rate #3	
Sample min/max/avg every N cycles	6
Number of seconds to use this rate	8

B Appendix

Additional Notes on RMS Variations

Kinds of RMS Variations

RMS variations are classified as short duration or long duration, depending on whether the excursion lasts beyond one minute.

Short Duration Variations

Short duration variations are further classified as instantaneous (duration $\frac{1}{2}$ - 30 cycles), momentary (duration 30 cycles - 3 seconds), and temporary (duration 3 seconds - 1 minute). Short duration RMS voltage decreases, called sags, are most frequently caused by faults or changes in load current. Voltage sags are often more significant than power interruptions because more customers are affected, as illustrated in Figure B.1 below. When a protective device clears a fault, only customers located downline of the device are interrupted. However, until the fault is cleared, customers on adjacent feeders are subjected to a voltage sag. Protective devices with automatic reclosing can subject customers to as much as four sags in succession, each lasting 2 - 10 cycles or longer.

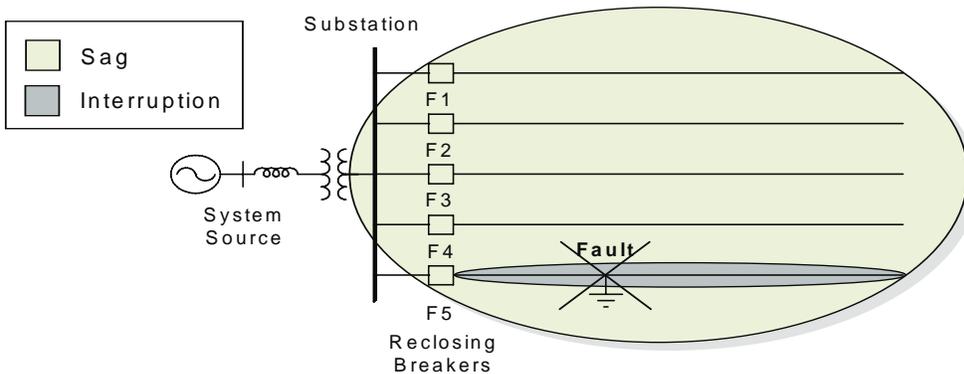


Figure B.1 Area of Vulnerability due to Fault-Induced Sags

The severity of a sag in customer service voltage due to a fault on the distribution system increases with the proximity of the fault to the distribution substation. Remote faults produce milder sags, but sag duration may increase due to increased protective device operating times.

While most instantaneous sags are related to faults, motor starting is the chief cause of longer sags. An induction motor draws 6 - 10 times full load current when starting, which - depending on the motor construction, mechanical load, and the size of the motor relative to the system - may induce a sag of a few cycles to several seconds in duration.

Single-line-to-ground faults are among the dominant cause of swells - short duration RMS voltage increases. Until the fault is cleared, the unfaulted phases will be subjected to a swell whose magnitude depends on the system grounding (X_0/X_1) ratio. The swell can be as high as 1.73 pu for an ungrounded system. Swells can also occur until the automatic tap changer can react when loads are suddenly de-energized.

Long Duration Variations

Long duration RMS variations are deviations outside the normal tolerance in the ac voltage for a period exceeding one minute. Overvoltage and undervoltage are the standard terms employed for a long duration voltage increase and decrease, respectively.

Long duration voltage variations result from addition or removal of system load or reactive compensation, and can be controlled by improving the voltage regulation characteristics of the system.

Transients tab

Properties	Values
Limit Methods	
Voltage trigger method	Manual (% of fixed base) {Manual (Engineering units)} {Manual (% of fixed base)}
Current trigger method	Automatic (% of base current) {Manual (Engineering units)} {Manual (% of base current)}
Cycle Counts	
Number of pre-trigger cycles	2
Number of post-trigger cycles	2
Individual Channel Parameters	
A-N Voltage	
B-N Voltage	
C-N Voltage	
N-G Voltage	
A Current	
B Current	
C Current	
N Current	
Instantaneous limit enabled	<input type="checkbox"/>
Instantaneous limit	25.0
Waveform change limit enabled	<input type="checkbox"/>
Waveform change magnitude limit	10.0
Waveform change duration limit (% of cycle)	10.0

Additional Notes on Transients

Kinds of Transient

Impulses

An impulsive transient is a short duration disturbance characterized by a very rapid change in the magnitude of the measured quantity. Lightning strokes, the most common cause of this type of disturbance, produce current impulses typically lasting from 30 - 200 microsec, with 1 - 10 microsec rise times (Figure B.2 next page). Due to the high frequencies involved (5 kHz or greater), these types of transients are damped quickly by the resistive components of the system. Thus, they tend to be unidirectional, at least close to the source of the transient.

The voltage transient that results from a lightning-induced current impulse is a function of utility pole grounding and the surge or high frequency impedance of the line. The magnitude of the voltage impulse is limited by arrester operation or insulation flashover. Oscillations are produced when the resulting traveling wave is reflected at line ends and other circuit discontinuities.

B Appendix

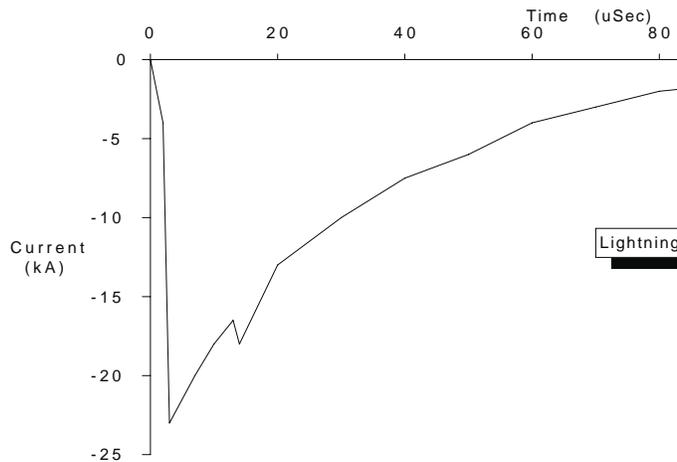


Figure B.2 Lightning Stroke Current versus Time

The "low side surge" phenomenon

One important transient concern is the coupling of lightning impulses originating on the distribution system into customer low voltage systems. Except for close-in direct strokes, arresters placed at distribution transformer high voltage terminals prevent destructive impulses from being coupled through the transformer windings. However, transformers with grounded secondaries introduce a path for primary-side arrester discharge current to flow into the secondary system. The most common example is the residential service transformer, which provides dual voltage service through a grounded center tap, as illustrated in Figure B.3. In addition to introducing potentially destructive transients into customer circuits, this phenomenon is one of the main causes of distribution transformer failures.

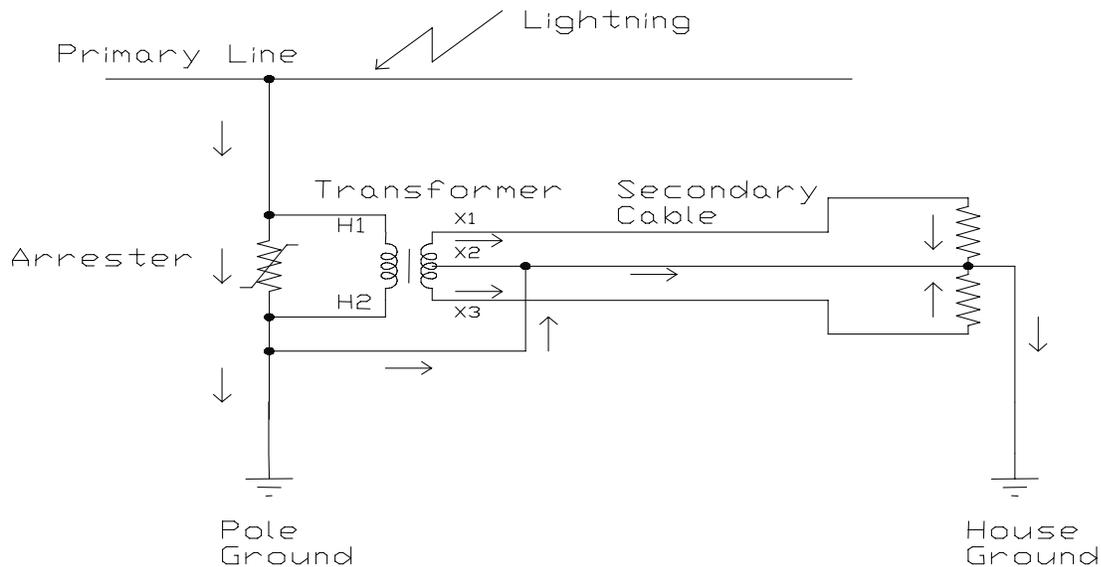


Figure B.3 Impulse Coupled Through Distribution Transformer Ground Connections

Oscillatory Transients

An oscillatory transient is a temporary rapid fluctuation in the measured quantity. Oscillation frequency and initial direction (negative or positive transient) are the most important characteristics in terms of identifying the cause of this type of disturbance. Thus, oscillatory transients are further classified as high, medium, or low frequency. The transient decay period, while useful for characterizing the disturbance, is not a defining criterion.

Low Frequency

Oscillatory transients on the distribution system are predominantly low frequency - 5 kHz or less. Capacitor switching is the primary cause for low frequency transients. Energizing a capacitor can in theory, produce a 200% peak voltage, but peaks of 130 - 150% are more typical following the initial negative transient. The transient voltage oscillates at 300 to 1400 Hz, and decays after ½ to 3 cycles, depending on system damping characteristics.

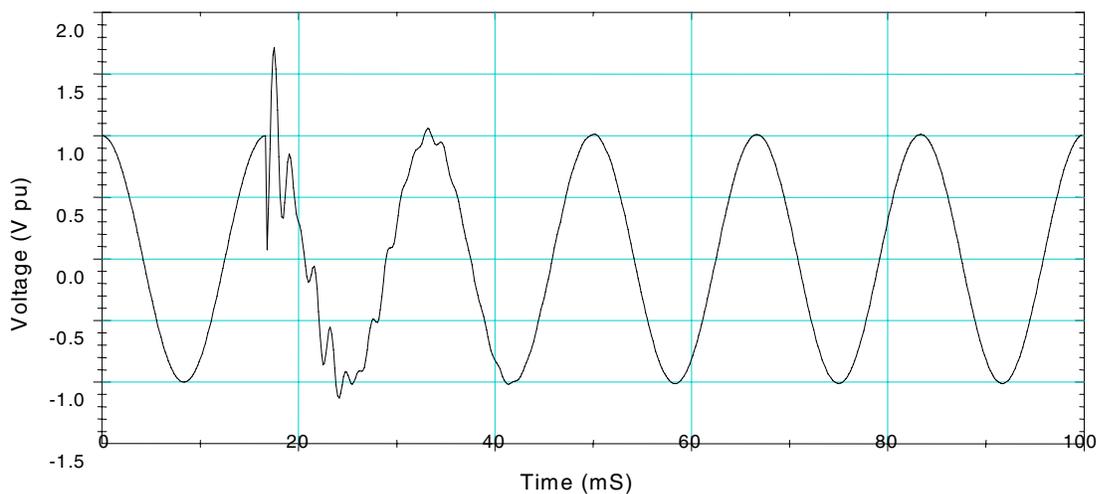


Figure B.4 Capacitor Energizing Transient

Capacitor switching on the utility system can lead to equipment failure or process interruption in customer systems. Nuisance tripping of adjustable speed drives that employ a capacitor in the DC link is the most common symptom. However, the presence of customer power factor correction capacitors is a special cause for concern. Potentially destructive voltage magnification at the customer capacitor can occur when the oscillation frequency of the switching transient excites the parallel resonant circuit formed by the customer capacitor and the equivalent source reactance of the system at the capacitor. The voltage magnification phenomenon is illustrated in Figure B.5 next page. Distribution system transients oscillating at less than 300 Hz are mainly due to transformer energization or ferroresonance.

The application of distribution system capacitor banks has long been accepted as a necessary step in the design of distribution feeders. Design considerations often include traditional factors such as voltage support, power factor, and released capacity. However, as customer systems evolve through the use of power electronics, the distribution system design of the future should include power quality as a consideration.

The frequent switching of distribution capacitor banks coupled with the increasing application of sensitive customer equipment has led to a heightened awareness of some important events:

- Magnification of capacitor switching transients
- Nuisance tripping of adjustable-speed drives

These concerns have become particularly important as utilities institute higher power factor penalties, thereby encouraging customers to install power factor correction capacitors.

B Appendix

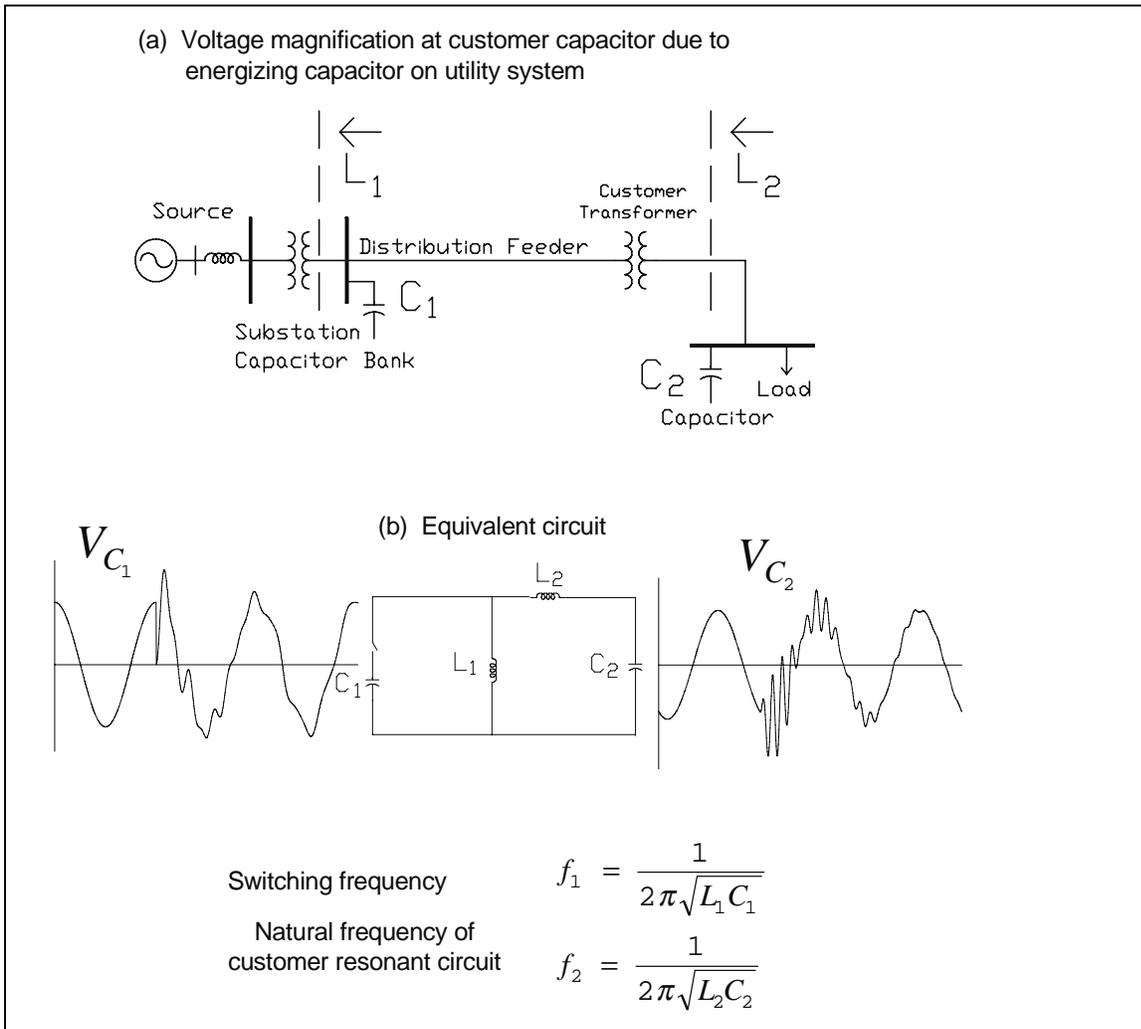


Figure B.5 Magnification at Customer Capacity due to Utility Capacitor Switching

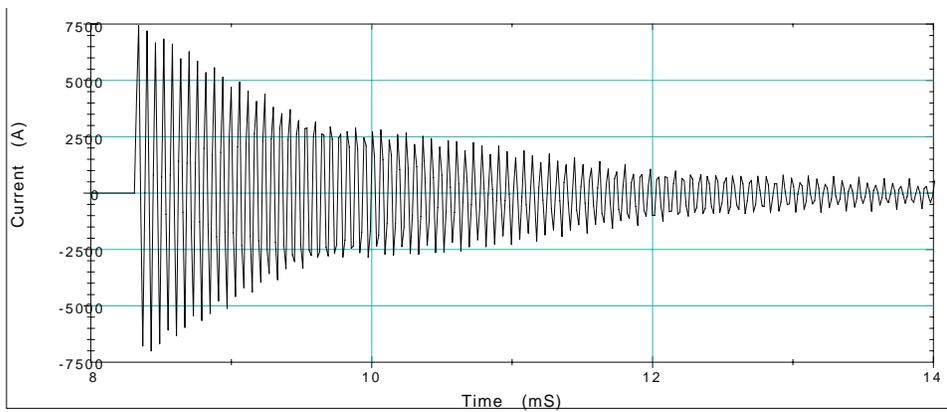


Figure B.6 Back-to-Back Capacitor Switching

Medium Frequency

A medium frequency oscillatory transient is characterized by a principal frequency of 5 to 500 kHz. The principal causes of medium frequency transients on the distribution system are cable switching and back-to-back capacitor energization (Figure B.6 previous page). Both typically produce oscillations in the tens of kilohertz.

Power electronic devices produce switching oscillations in the high kilohertz range. These transients occur several times per fundamental frequency cycle and decay after one or two oscillations. Medium frequency oscillatory transients within customer facilities are often the result of the low voltage system being excited by impulsive transients coupled from the utility distribution system.

Medium frequency oscillations tend to be very localized. Conductor and load resistances provide damping, which limits the portion of the circuit exposed to these types of transients.

Medium frequency oscillations that are coupled into a customer system usually result in a much larger transient voltage than the turns ratio of the customer service entrance transformer would indicate. This is because the transformer response in this frequency range is dominated by winding capacitance, rather than inductance. Capacitive coupling ratios are usually much larger than turns ratios.

High Frequency

High frequency transients are those that oscillate at 500 kHz or greater. On distribution systems, perturbations in this frequency range are quickly damped out. Most common in low voltage systems, high frequency transients are chiefly caused by switching, local ferroresonance, and lightning-induced ringing.

B Appendix

Transducers tab

Properties	Values
Transducer Ratios	
Phase A-N VT	
Phase B-N VT	
Phase C-N VT	
Neutral VT	
Phase A CT	
Phase B CT	
Phase C CT	
Neutral CT	
Phase A-B VT	
Phase B-C VT	
Phase C-A VT	
Transducer Primary	1.00
Transducer Secondary	1.00
Magnitude correction	0.00
Phase correction	0.0
DC offset	0.00

Additional Notes on Transducers

Installation Considerations

Monitoring on the distribution primary requires both voltage transducer (VT) and current transducer (CT). Selection of the best combination of these transducers depends on a number of factors. i.e. monitoring location (substation, overhead, underground, etc.), space limitations, and ability to interrupt circuit for transducer installation.

Substation Transducers

Usually, existing substation CTs and VTs can be used for power quality monitoring.

Overhead Line Locations

For monitoring on distribution primary circuits, it would be desirable to use a transducer that could be installed without taking the circuit out of service. Recently, transducers for monitoring both voltage and current have been developed that can be installed on a live line.

These devices incorporate a resistive divider type VT and window type CT in a single unit. The resistive divider is connected from phase to ground, and the output is taken from the lower resistor. There is some problem with heat dissipation in the divider. Due to the high voltage levels to be measured, and the need for an output signal of 120 V rms, the upper resistor in the divider will dissipate up to 10 Watts. Therefore, it is necessary for the resistors in the divider to meet military specifications and for the temperature coefficient to be low.

A split core choke is clamped around the phase conductor, and is used to shunt the line current through the CT in the insulator. This method allows the device to be installed on the cross-arm in place of the original insulator. By using the split core choke, the phase conductor does not have to be broken, and thus, the transducers can be installed on a live line. The CT must be field calibrated to adjust for the leakage current that flows in the phase conductor. This is due to the fact that the choke can not shunt all the line current around through the jumper and through the CT.

Initial tests indicated adequate frequency response for these transducers, assuming careful installation and no corrosion between contacts on the split core choke. However, field experience with these units has shown that the frequency

response, even at 60 Hz, may be dependent on current magnitude, temperature, and secondary cable length. This makes this device very difficult to use for accurate power quality monitoring.

In general, all primary sites should be monitored with metering class VTs and CTs to obtain accurate results over the required frequency spectrum. Installation will require a circuit outage but convenient designs can be developed for pole top installations.

Another option for monitoring primary sites involves monitoring at the secondary of an unloaded distribution transformer. This will give accurate results up to at least 3 kHz. This option does not help with the current transducers, but it is possible to get by without the currents at some circuit locations (e.g. end of the feeder). This option may be particularly attractive for underground circuits where the monitor can be installed on the secondary of a pad-mounted transformer. Primary wound CTs are available from a variety of CT manufacturers.

Secondary Sites

Transducer requirements at secondary sites are much simpler. Direct connection for the voltage is possible for 120/208 Volt RMS or 277/480 Volt RMS systems. This permits full utilization of the instrument's frequency response capability. Currents can be monitored with either metering CTs (at the service entrance, for example), or with clamp-on CTs (at locations within the facility). Clamp-on CTs are available in a wide range of turns ratios.

Table 1 VT and CT Options describe the different power quality and the proper transducers to measure the type of power quality problem.

Monitoring Location	Voltage Transducer	Current Transducer
Substation	Metering VTs Special purpose capacitive or resistive dividers Calibrated bushing taps	Metering CTs Relaying CTs
Overhead lines	Metering VTs	Metering CTs
Underground locations	Metering VTs Pad mounted transformer Special purpose dividers	Metering CTs
Secondary Sites Service Entrance	Direct connection	Metering CTs Clamp-on CTs
In Facility	Direct connection	Clamp-on CTs

Table 1 VT and CT Options

B Appendix

Advanced tab

Properties	Values
Broadcast Group ID	1234
Enable sending rms trigger	<input type="checkbox"/>
Enable responding to received rms trigger	<input type="checkbox"/>
Enable sending transient trigger	<input type="checkbox"/>
Enable responding to received transient trigger	<input type="checkbox"/>
Broadcast address - if empty, uses local	
Communications	
When configurations differ use the DataNode setup {use the DataNode setup} {use the InfoNode setup}
Passwords	
User Account Password	*****
Admin Account Password	*****
InfoNode Access User ID	admin
InfoNode Access Password	*****
Firmware Access User ID	admin
Firmware Access Password	*****
One Time Operations	
Reset 302 Default Setup	<input type="checkbox"/>
Clear 332 Database and reboot	<input type="checkbox"/>
Do both of the above	<input type="checkbox"/>
Don't save data from next download	<input type="checkbox"/>
Clear last journal ID	<input type="checkbox"/>
Channel Mapping	
Phase A voltage	
Phase A current	
Phase B voltage	
Phase B current	
Phase C voltage	
Phase C current	
Neutral voltage	
Neutral current	
Signal is connected to	<i>Channel 1</i>
Channel is inverted	<input type="checkbox"/>
One Time Firmware Operations	
CAUTION: These operations will copy new firmware to the DataNode	
Load IOP (302) firmware	<input type="checkbox"/>
Load ACP (332) firmware	<input type="checkbox"/>
Load both IOP (302) and ACP (332) firmware	<input type="checkbox"/>
Load both to all DataNodes	<input type="checkbox"/>

Accumulator Resets tab

Properties	Values
Demand Resets	
Reset Real Power, DMD, total (Never reset)	<input type="checkbox"/>
Reset Reactive Power, DMD, total (Never reset)	<input type="checkbox"/>
Reset Apparent Power, DMD, total (Never reset)	<input type="checkbox"/>
Reset Peak Current Demand (A) (Never reset)	<input type="checkbox"/>
Reset Peak Current Demand (B) (Never reset)	<input type="checkbox"/>
Reset Peak Current Demand (C) (Never reset)	<input type="checkbox"/>
Reset Peak Current Demand (N) (Never reset)	<input type="checkbox"/>
Reset Average Peak Current Demand (Never reset)	<input type="checkbox"/>
Reset All Values	<input type="checkbox"/>
Energy Accumulators	
Reset Phase Energy (Never reset)	<input type="checkbox"/>
Reset Total Energy (Never reset)	<input type="checkbox"/>
Reset Integrated Reactive Power (Never reset)	<input type="checkbox"/>
Reset Total integrated Reactive Power (Never reset)	<input type="checkbox"/>
Reset Forward fund. freq. WHrs (Never reset)	<input type="checkbox"/>
Reset Reverse fund. freq. WHrs (Never reset)	<input type="checkbox"/>
Reset Forward tot. fund. freq. WHrs (Never reset)	<input type="checkbox"/>
Reset Reverse tot. fund. freq. WHrs (Never reset)	<input type="checkbox"/>
Reset Forward fund. freq. VarHrs (Never reset)	<input type="checkbox"/>
Reset Reverse fund. freq. VarHrs (Never reset)	<input type="checkbox"/>
Reset Forward tot. fund. freq. VarHrs (Never reset)	<input type="checkbox"/>
Reset Reverse tot. fund. freq. VarHrs (Never reset)	<input type="checkbox"/>
Reset Fundamental freq. V A Hours (Never reset)	<input type="checkbox"/>
Reset Total Fund. freq. VA Hours (Never reset)	<input type="checkbox"/>

B Appendix

Metering tab

Properties	Values
Select the journal entry/entries to change	
Line-Neutral Voltage (A-N)	Apparent Power (A)
Line-Neutral Voltage (B-N)	Apparent power (B)
Line-Neutral Voltage (C-N)	Apparent Power (C)
Neutral-Ground Voltage	Total Apparent Power
Line-Line Voltage (A-B)	Power Factor (A)
Line-Line Voltage (B-C)	Power Factor (B)
Line-Line Voltage (C-A)	Power Factor (C)
Line Current (A)	Average Power Factor
Line Current (B)	Angle Between Phases (A)
Line Current (C)	Angle Between Phases (B)
Line Current (N)	Angle Between Phases (C)
Active Power (A)	Frequency
Active Power (B)	
Active Power (C)	
Total Active Power	
Enable Periodic Sampling	<input type="checkbox"/>
High-High limit enabled	<input type="checkbox"/>
High-High limit	135.0
High limit enabled	<input type="checkbox"/>
High limit	125.0
Low limit enabled	<input type="checkbox"/>
Low limit	105.0
Low-Low limit enabled	<input type="checkbox"/>
Low-Low limit	90.0
Deadband enabled	<input type="checkbox"/>
Deadband	3.0

Revenue tab

Properties	Values
Select the journal entry/entries to change	
Phase Energy (A)	
Phase Energy (B)	
Phase Energy (C)	
Total Energy	
Integrated Reactive Power (A)	
Integrated Reactive Power (B)	
Integrated Reactive Power (C)	
Total Integrated Reactive Power	
Enable periodic sampling	<input type="checkbox"/>
High-High limit enabled	<input type="checkbox"/>
High-High limit	135.0
High limit enabled	<input type="checkbox"/>
High limit	125.0
Low limit enabled	<input type="checkbox"/>
Low limit	105.0
Low-Low limit enabled	<input type="checkbox"/>
Low-Low limit	90.0
Deadband enabled	<input type="checkbox"/>
Deadband	3.0

B Appendix

Demand tab

Properties	Values
Select the journal entry/entries to change	
Real Power, Dmd, Total	
Reactive Power, Dmd, Total	
Apparent Power Dmd, Total	
Average PF Over Last Interval	
Peak Real Power Dmd Total	
Var Dmd Coincident w/Pk W Dmd	
VA Dmd Coincident w/Pk W Dmd	
Avg PF Coincident w/Pk W Dmd	
Peak Reactive Power Dmd, Total	
W Dmd Coincident w/Pk Var Dmd	
VA Dmd Coincident w/Pk Var Dmd	
Avg PF Coincident w/Pk Var DMd	
Peak Apparent Power Dmd, Total	
W Dmd Coincident w/Pk W Dmd	
Var Dmd Coincident w/Pk VA Dmd	
Avg PF Coincident w/Pk VA Dmd	
Predicted Real Power Dmd, Total	
Predicted Reactive Power Dmd, Total	
Predicted Apparent Power Dmd, Total	
Current Demand (A)	
Current Demand (B)	
Current Demand (C)	
Average Current Demand	
Peak Current Demand (A)	
Peak Current Demand (B)	
Peak Current Demand (C)	
Average Peak Current Demand	
Enable periodic sampling	<input type="checkbox"/>
High-High limit enabled	<input type="checkbox"/>
High-High limit	135.0
High limit enable	<input type="checkbox"/>
High limit	125.0
Low limit enabled	<input type="checkbox"/>
Low limit	105.0
Low-Low limit enabled	<input type="checkbox"/>
Low-Low limit	90.0
Deadband enabled	<input type="checkbox"/>
Deadband	3.0

Advanced Energy tab

Properties	Values
Select the journal entry/entries to change	
Forward fund. freq. WHrs (A)	
Forward fund. freq. WHrs (B)	
Forward fund. freq. WHrs (C)	
Reverse fund. freq. WHrs (A)	
Reverse fund. freq. WHrs (B)	
Reverse fund. freq. WHrs (C)	
Forward tot. fund. freq. WHrs	
Reverse tot. fund. freq. WHrs	
Forward fund. freq. VarHrs (A)	
Forward fund. freq. VarHrs (B)	
Forward fund. freq. VarHrs (C)	
Reverse fund. freq. VarHrs (A)	
Reverse fund. freq. VarHrs (B)	
Reverse fund. freq. VarHrs (C)	
Forward tot. fund. freq. VarHrs	
Reverse tot. fund. freq. VarHrs	
Fundamental freq. VA hours (A)	
Fundamental freq. VA hours (B)	
Fundamental freq. VA hours (C)	
Total fundamental freq. VA hours	
Enable periodic sampling	<input type="checkbox"/>
High-High limit enabled	<input type="checkbox"/>
High-High limit	135.0
High limit enabled	<input type="checkbox"/>
High limit	125.0
Low limit enabled	<input type="checkbox"/>
Low limit	105.0
Low-Low limit enabled	<input type="checkbox"/>
Low-Low limit	90.0
Deadband enabled	<input type="checkbox"/>
Deadband	3.0

B Appendix

Advanced Metering tab

Properties	Values
Select the journal entry/entries to change	
Total VA - Arith. Method	
Total VA - Vect. Method	
Total Fund. VA - Arith. Method	
Total Fund. VA - Vect. Method	
Worst True Power Factor	
Total Arithmetic True PF	
Total Vector True Power Factor	
Displacement Power Factor (A)	
Displacement Power Factor (B)	
Displacement Power Factor (C)	
Worst Displacement Power Factor	
Average Displacement PF	
Total Arithmetic Disp. PF	
Total Vector Disp. Power Factor	
Residual Current	
Net Current	
Enable periodic sampling	<input type="checkbox"/>
High-High limit enabled	<input type="checkbox"/>
High-High limit	135.0
High limit enabled	<input type="checkbox"/>
High limit	125.0
Low limit enabled	<input type="checkbox"/>
Low limit	105.0
Low-Low limit enabled	<input type="checkbox"/>
Low-Low limit	90.0
Deadband enabled	<input type="checkbox"/>
Deadband	3.0

Imbalance tab

Properties	Values
Select the journal entry/entries to change	
Sequence Voltage (Pos)	
Sequence Voltage (Neg)	
Sequence Voltage (Zero)	
Sequence Current (Pos)	
Sequence Current (Neg)	
Sequence Current (Zero)	
V Imbalance: L-N dev. from avg (A-N)	
V Imbalance: L-N dev. from avg (B-N)	
V Imbalance: L-N dev. from avg (C-N)	
V Imbalance: L-L dev. from avg (A-B)	
V Imbalance: L-L dev. from avg (B-C)	
V Imbalance: L-L dev. from avg (C-A)	
V Imbalance: L-N Max from avg	
V Imbalance: L-L Max from avg	
V Imbalance: Neg. Seq. Method	
V Imbalance: Zero Seq. Method	
I Imbalance: dev. from avg (A)	
I Imbalance: dev. from avg (B)	
I Imbalance: dev. from avg (C)	
I Imbalance: Max dev. from avg	
I Imbalance: Neg. Seq. Method	
I Imbalance: Zero Seq. Method	
Enabled	<input type="checkbox"/>
High-High threshold enabled	<input type="checkbox"/>
High-High threshold	135.0
High threshold enabled	<input type="checkbox"/>
High threshold	125.0
Low threshold enabled	<input type="checkbox"/>
Low threshold	105.0
Low-Low threshold enabled	<input type="checkbox"/>
Low-Low threshold	90.0
Deadband enabled	<input type="checkbox"/>
Deadband	3.0

B Appendix

Harmonics Tab

Properties	Values
Percent Eddy Current Loss	8.000
Maximum Demand Load Current	100.000
Select the journal entry/entries to change	
Voltage THD - Fund. Normalized (A-N)	Current TID - Fund. Normalized (A)
Voltage THD - Fund. Normalized (B-N)	Current TID - Fund. Normalized (B)
Voltage THD - Fund. Normalized (C-N)	Current TID - Fund. Normalized (C)
Voltage THD - Fund. Normalized (N-G)	Current TID - Fund. Normalized (N)
Voltage THD - RMS Normalized (A-N)	Current TID - RMS Normalized (A)
Voltage THD - RMS Normalized (B-N)	Current TID - RMS Normalized (B)
Voltage THD - RMS Normalized (C-N)	Current TID - RMS Normalized (C)
Voltage THD - RMS Normalized (N-G)	Current TID - RMS Normalized (N)
Voltage TID - Fund. Normalized (A-N)	Current Harmonic RMS (A)
Voltage TID - Fund. Normalized (B-N)	Current Harmonic RMS (B)
Voltage TID - Fund. Normalized (C-N)	Current Harmonic RMS (C)
Voltage TID - Fund. Normalized (N-G)	Current Harmonic RMS (N)
Voltage TID - RMS Normalized (A-N)	Current Interharmonic RMS (A)
Voltage TID - RMS Normalized (B-N)	Current Interharmonic RMS (B)
Voltage TID - RMS Normalized (C-N)	Current Interharmonic RMS (C)
Voltage TID - RMS Normalized (N-G)	Current Interharmonic RMS (N)
Voltage Harmonic RMS (A-N)	IT Product (A)
Voltage Harmonic RMS (B-N)	IT Product (B)
Voltage Harmonic RMS (C-N)	IT Product (C)
Voltage Harmonic RMS (N-G)	IT Product (N)
Voltage Interharmonic RMS (A-N)	Current Crest Factor (A)
Voltage Interharmonic RMS (B-N)	Current Crest Factor (B)
Voltage Interharmonic RMS (C-N)	Current Crest Factor (C)
Voltage Interharmonic RMS (N-G)	Current Crest Factor (N)
Voltage TIF - Fund. Normalized (A-N)	Current Total Demand Distortion (A)
Voltage TIF - Fund. Normalized (B-N)	Current Total Demand Distortion (B)
Voltage TIF - Fund. Normalized (C-N)	Current Total Demand Distortion (C)
Voltage TIF - Fund. Normalized (N-G)	K Factor (A)
Voltage TIF - RMS Normalized (A-N)	K Factor (B)
Voltage TIF - RMS Normalized (B-N)	K Factor (C)
Voltage TIF - RMS Normalized (C-N)	K Factor (A)
Voltage TIF - RMS Normalized (N-G)	Transformer Derating Factor (A)
Voltage Crest Factor (A-N)	Transformer Derating Factor (B)
Voltage Crest Factor (B-N)	Transformer Derating Factor (C)
Voltage Crest Factor (C-N)	Total Phase Harmonic Power (A-N)
Voltage Crest Factor (N-G)	Total Phase Harmonic Power (B-N)
Current THD - Fund. Normalized (A)	Total Phase Harmonic Power (C-N)
Current THD - Fund. Normalized (B)	Signed Phase Harmonic Power (A-N)
Current THD - Fund. Normalized (C)	Signed Phase Harmonic Power (B-N)
Current THD - Fund. Normalized (N)	Signed Phase Harmonic Power (C-N)
Current THD - RMS Normalized (A)	
Current THD - RMS Normalized (B)	
Current THD - RMS Normalized (C)	
Current THD - RMS Normalized (N)	
Enable periodic sampling	<input type="checkbox"/>
High-High limit enabled	<input type="checkbox"/>
High-High limit	135.0
High limit enabled	<input type="checkbox"/>
High limit	125.0
Low limit enabled	<input type="checkbox"/>
Low limit	105.0
Low-Low limit enabled	<input type="checkbox"/>
Low-Low limit	90.0
Deadband enabled	<input type="checkbox"/>
Deadband	3.0

Additional Notes on Harmonics

Harmonics, Interharmonics, and DC Offset

Many nonlinear devices, such as those listed in Table 2, inject currents at harmonic (integer multiples of the fundamental) frequencies into the system. Harmonic currents, and the voltage distortion they create as they flow through system impedances, can reduce equipment operating reliability and service life.

<p>Electronic Power Converters</p> <ul style="list-style-type: none"> • Adjustable speed motor drives • Switching power supplies (computers & other office equipment) • Fluorescent lighting with electronic ballasts • Battery chargers <p>Arcing devices</p> <ul style="list-style-type: none"> • Arc furnaces • Fluorescent lighting with magnetic ballasts • Sodium vapor & mercury vapor lighting <p>Ferromagnetic devices</p> <ul style="list-style-type: none"> • Transformers • Motors & generators

Table 2 Harmonic Producing Devices

Harmonics are particularly troublesome where capacitors are applied on the distribution system or in customer facilities. As illustrated in Figure B.7 below, capacitors may force the system into resonance at a harmonic frequency, leading to high harmonic voltages and currents throughout the system.

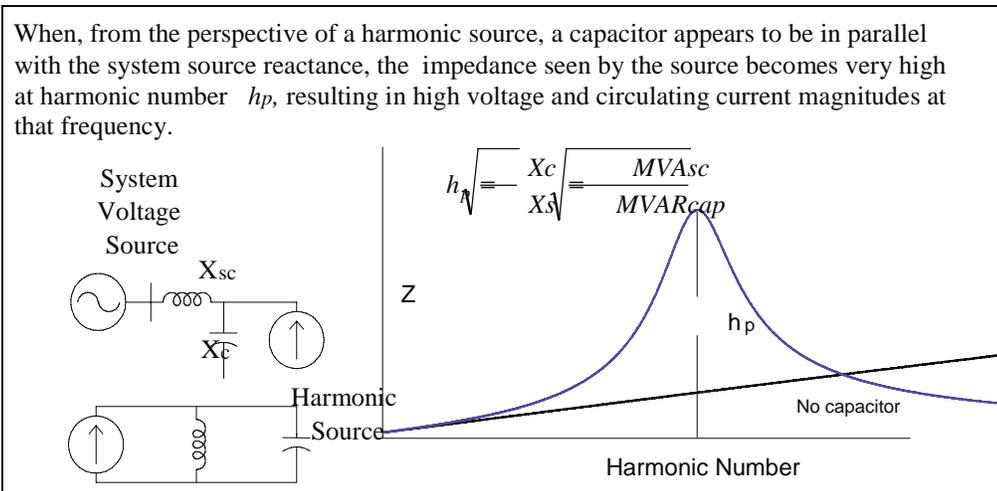


Figure B.7 Parallel Resonance

B Appendix

The term interharmonics refers to high frequency voltage or current components which are not integer multiples of the fundamental frequency. Interharmonics result from any nonlinear load whose current waveform is not periodic at 60 Hz; cycloconverters and arc furnaces are examples.

A dc offset in alternating current can be introduced by geomagnetic disturbances, or by the normal operation of single-phase electronic power supplies using half-wave rectifiers. Direct currents in the system can cause increased transformer saturation, added insulation stress, and misoperation of electronic equipment.

Notching

Notching is a periodic voltage disturbance caused by the normal operation of three-phase power converters. Several times per cycle of ac voltage, current is commutated (switched) from one phase to another. A momentary phase-to-phase short circuit exists during commutation, which results in a repetitive negative transient due to the excessive currents and the corresponding voltage drop in the source impedance. The severity of the notch at any point in the system is determined by the inductance between that point and the converter, in relation to the source inductance at that point.

Voltage notching is a special case that falls between transients and harmonic distortion. Since the notching is periodic, it can be characterized as a harmonic spectrum. However, the frequency components may be too high to measure with conventional harmonic monitors.

Noise

Noise is defined as: "unwanted electrical signals with broadband spectral content lower than 200 kHz superimposed upon the power system voltage or current in phase conductors, or found on neutral conductors or signal lines." Improper grounding and the normal operation of power electronic equipment are the chief causes of noise in power systems. While noise may be of great concern in customer facilities, distribution systems are effectively isolated from noise producing devices by the facility service entrance transformer and cables.

Voltage Fluctuations

Loads which exhibit continuous, rapid variations in the load current, particularly the reactive component, can cause voltage variations often referred to as flicker. The fluctuation is caused by modulation of the fundamental frequency voltage by signal whose frequency is typically less than 25 Hz. Modulating signal magnitudes as low as 0.5% of the fundamental can result in perceptible lighting flicker for frequencies between 1 - 5 Hz. Arc furnaces are the most common cause of voltage fluctuations in distribution systems.

Advanced Harmonics Tab

Properties	Values
Harmonics to Trend	
Phase Voltages	1, 3, 5, 7
Neutral Voltages	
Phase Currents	
Neutral Current	

Glossary

Angle between Phases

The phase angle between the Phase Fundamental Voltage and Current at power line Frequency.

Apparent Phase Power

RMS voltage * RMS current on per phase basis.

Average DPF

Arithmetic average of individual phase displacement power factors (DPF).

Deadband or Sensitivity

An value programmed as an incremental/decremental threshold from the last deadband value that would be recorded as an event, making it the new value to be compared with.

Demand Interval

Time interval used for the power demand values to be calculated. The values are updated every subinterval.

Demand Subinterval

An interval less than the demand interval, equal to the demand interval divided by an integer value. Demand calculations are made every subinterval, on the values that occurred during the most recent Demand Interval. Values become valid after the first Demand Interval has expired.

Fixed Base

A fixed nominal value that is used with the limits in percent.

Floating Base

The nominal value is the average value over the specified update interval.

Hi Limit

Set point or threshold above the normal range.

Hi-Hi or Very High Limit

Set point or threshold above the high limit.

Instantaneous or Crest Transient

The largest magnitude value in a cycle.

Line-to-Line values for wye circuits

$V_{ab} = V_{an} - V_{bn}$; $V_{bc} = V_{bn} - V_{cn}$; $V_{ca} = V_{cn} - V_{an}$

Low Limit

Set point or threshold below the normal range.

Lo-Lo or Very Low Limit

Set point or threshold below the low limit.

Negative Sequence

The three phase vectors that would make a motor rotate in the reverse direction. $U_{2a} = 1/3 (U_a + a^{2*}U_b + a^*U_c)$, where a^* is the 120 degree vector operator, a^{2*} is the 240 degree vector operator.

Net Current

Vector sum of all phase currents, including neutral

Peak Detected Transient

High frequency deviation from low frequency or normal sine wave value in either the positive or negative direction that exceeds programmed limits.

Periodic Reading Interval

Time interval used to periodically record the parameter for trending or time plots.

Positive Sequence

The three phase vectors that would make a motor rotate in the positive direction. $U_{1a} = 1/3 (U_a + a^*U_b + a^{2*}U_c)$, where a^* is the 120 degree vector operator, a^{2*} is the 240 degree vector operator.

Power Factor - (true PF)

Watts divided by Volt-amperes on per phase basis (except delta) and total values.

Reactive Phase Power

Volt ampere reactive power for individual phases.

Residual Current

Vector sum of phase currents (not including neutral)

RMS Variation

A change in square root of the sum of samples squared divided by number of samples (128) that crosses limit

Sequence Imbalance

Negative sequence component divided by positive sequence.

Total

The phases used in computing the totals depend on the wiring configuration and parameter. Typically, wye and delta configurations use the three individual phases, except for power related, which use the IEEE 1459 equivalent wye method.

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Total Power

Arithmetic sum of phase Watts.

Total Reactive Power

Arithmetic sum of phase VARs.

Total Apparent Power

Square root of (total WATTS squared + total VARs squared)

Total Arithmetic VA

Arithmetic sum of individual phase volt-ampere values.

Total Vector VA

Square root of (total WATTS squared + total VARs squared)

Total Fundamental Arithmetic VA

Arithmetic sum of the volt amperes of the fundamental frequency components of each phase.

Total Fundamental Vector VA

Square root of (fundamental frequency component of WATTS squared + fundamental VARs squared)

True Phase Power or Real Power

Measured in watts, of each phase, calculated over 1 second from cycle-by-cycle power values (voltage sample * current sample). Not valid for delta configurations.

True PF

Total Real Power divided by Total VA

Worst PF

True PF of the individual phase with largest deviation from 1

Total Arithmetic True PF

Total Real Power divided by Total Arithmetic Volt-Amperes

Total Vector PF**Displacement PF**

Cosine of angle between fundamental frequency voltage and current on a per phase basis.

Worst Displacement PF

Displacement PF of phase with largest deviation from 1.

Zero Sequence

$U_{0a} = 1/3 (U_a + U_b + U_c)$