

# **PowerMonic**

## **PM45**

### **USER'S MANUAL**

**Edition 1.3 – January 2009**

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**PowerMonic PM45 User Manual**


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This product complies with IEC 61010

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AUSTRALIA / NEW ZEALAND EMC NOTES	
	N3207
	This is a CISPR 22 Class A product. In a domestic environment this product may cause radio interference, which the user may need to take steps to prevent.

### **LIMITED WARRANTY**

The PowerMonic is guaranteed to be free of mechanical and electrical defects when dispatched from our store. Provided that the PowerMonic has been operated within its normal ratings as specified, it will be repaired or replaced free of charge if, within a period of twelve (12) months from date of our invoice to the original purchase, it is proven, upon examination by our engineers, to be defective in material or workmanship. This warranty is void if the unit has been tampered with, abused or if the defect is related to service not performed by CHK GridSense Pty Ltd.

**Responsibility of CHK GridSense Pty Ltd:** Under this guarantee, the responsibility of CHK GridSense Pty Ltd is limited to the repairing or replacing of any defective part provided the instrument is returned freight paid to and from our Testing and Service office in Sydney, NSW Australia.

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# 1. THE POWERMONIC PM45

The Powermonic PM45 is a robust power quality analyser and disturbance analyser. This manual describes the installation and operation of the PM45.




The PM45 is intended to log four channels of AC voltage and four channels of AC current in accordance with IEC 61000 standards. The PM45 measures and logs:

- phase to neutral and phase to phase voltages up to 600 V;
- ground (earth) to neutral voltages up to 60 V;
- phase and neutral currents;
- frequency and power factor;
- apparent power S, real power P and reactive power Q;
- voltage and current imbalance;
- short term and long term flicker;
- distortion, harmonic magnitude & angle and interharmonics;
- sag/swell events versus ITC curve;
- transient, waveform and RMS events.

This manual covers the PM45. Other products in the PowerMonic suite are described in other manuals.

Gridsense places the highest emphasis on safety. Ensure that only qualified personnel use the PM45.


This manual uses the following International Safety Symbols:

	CAUTION, risk of danger: documentation must be consulted in all cases where this symbol is marked.
	Equipment protected throughout by Double Insulation or Reinforced Insulation.
	Alternating current.

The manual also uses these definitions from IEC61010 Safety requirements for electrical equipment for measurement, control and laboratory use.

Double insulation	Insulation comprising both Basic Insulation and Supplementary Insulation
Basic Insulation	Insulation, the failure of which could cause a risk of electric shock.
Supplementary insulation	Independent insulation applied in addition to Basic Insulation in order to provide protection against electric shock in the event of a failure of Basic Insulation
Measurement category II	Measurements performed on circuits directly connected to the low voltage installation.
Measurement category III	Measurements performed in the building installation. Examples are measurements on distribution boards, circuit breakers, wiring, including cables, bus-bars junction boxes, switches, socket outlets in the fixed installation, and equipment for industrial use and some other equipment, for example, stationary motors with permanent connection in the fixed installation.
Measurement category IV	Measurements performed at the source of the low voltage installation. Examples are electricity meters, and measurements on primary over-current protection devices and ripple control units.
Hazardous Live	Capable of rendering an electric shock or electric burn in normal condition or single fault condition.
Responsible body	Individual or group responsible for the use and maintenance of equipment, and for ensuring that operators are adequately trained.



Where the  (CAUTION) symbol appears on the PM45 or accessories, the operator must consult the manual in order to determine the nature of the potential hazard and any actions which need to be taken.



The table below provides a cross reference to the sections in this manual where the symbol is used. Refer to the relevant sections of this manual for further information.

<b>Warning summary</b>	<b>Page Number</b>
Definition of symbol	6
Use of accessories	9
PC5 cable safety	12
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## **2. WHAT'S NEW WITH THE POWERMONIC PM45**

The PowerMonic PM45 includes the following enhancements over previous PowerMonic Power Quality Analysers:

- IEC 61010, CAT IV 600 V rating: (Mains transient voltage 8000 V peak);
- Rated phase to neutral input voltage 600 VRMS;
- Rated phase to phase input voltage 600 VRMS;
- Four voltage channels;
- Measures ground (earth) to neutral voltages (0 to 60 VRMS);
- USB data cable now allows configuration and data downloads without an external power supply;
- Up to 4 times faster data downloads;
- New configuration wizard in PowerView.
- 2 vertical cursor bars on graphs, with time difference display
- On-line monitor for backup and real time clock battery voltages
- Right click on any table to export that table in CSV format.



### 3. POWERMONIC PM45 KIT OVERVIEW

The PowerMonic PM45 is normally supplied in a kit which includes the following components:

Part No.	Description
PM45	PowerMonic PM45 power quality recorder and protective holster, mounting plate and nylon safety strap
PM45 Calibration Certificate	Calibration certificate
USBCABLE	Data and power supply cable
PC5	2 channel voltage lead - measures Phase A and Ground (earth) with respect to Neutral. Power cable for GPO connection. Suitable for CAT II 300V environments
VL5-C	4 channel voltage lead - measures A, B, C & Ground (earth) with respect to Neutral using 5 fused voltage clamps. Safety rating CAT IV 600 V
VL5-B	4 channel voltage lead - measures A, B, C, & Ground (earth) with respect to Neutral using 5 fused banana plugs. Safety rating CAT IV 600 V
PM45 User Manual	PM45 User Manual (this document)
PowerView	PowerView Software CD
CBP3	Black nylon carry bag

Note: Accessory part numbers have additional suffix “-2” for USA region.



- To maintain CAT IV 600V rating for the PM45, GridSense accessories with CAT IV 600 V safety rating should be used.
- The use of accessories with lower safety ratings will negate the CAT IV 600 V rating of the PowerMonic.
- The use of any other manufacturer's accessories with the PM45, will void the warranty and may cause safety hazards.

### 3.1 Liquid Crystal Display (LCD)

Figure 1 shows the PM45 front panel and liquid crystal display (LCD) location. The LCD is an 8 line by 20 character alphanumeric and graphical display.

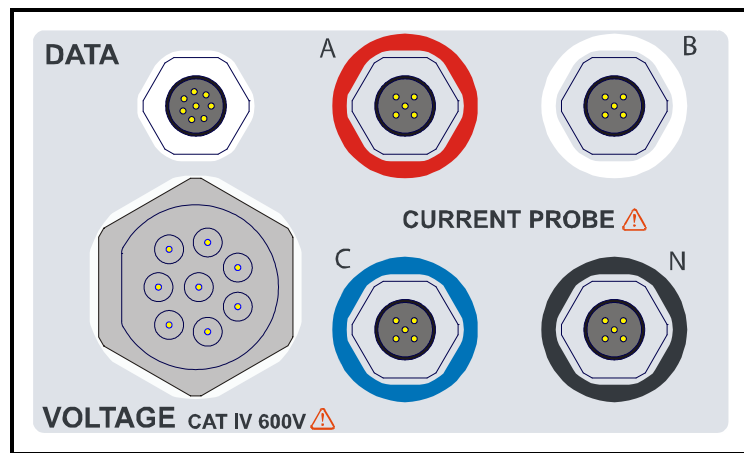


Figure 1: PowerMonic PM45 front panel

The screens displayed on an operating PM45 are selected using the PowerView software. Nine distinct displays are provided:

1. welcome screen
2. voltage and current values, voltage and current unbalance
3. true power factor, displacement power factor and frequency
4. kW, kVA, kVAR and total power
5. total harmonic distortion
6. phasor diagram
7. flicker
8. Current probe information
9. Log progress and status

### 3.2 Connectors



*Figure 2: PowerMonic connector receptacles (Australian colour coding shown)*

Figure 2 Shows the PM45 connector receptacle locations. The connector functions are listed below.

Connector	Description
Voltage	8 pin Voltage Probe connector
Data	8 pin data connector
Current "A"	5 pin Current Probe ("A" Channel) connector
Current "B"	5 pin Current Probe ("B" Channel) connector
Current "C"	5 pin Current Probe ("C" Channel) connector
Current "N"	5 pin Current Probe ("N" Channel) connector

### 3.3 Voltage leads

The voltage leads connect the PM45 to the equipment under test. Several lead types are available:

- PC5 2 channel (Phase A to Neutral & Ground to Neutral) 3 wire fused lead terminating in a standard general purpose outlet (GPO) plug.
- VL5-C 4 channel (Phase A to Neutral, Phase B to Neutral, Phase C to Neutral & Ground to Neutral) 5 wire lead terminating in fused CAT IV 600 V clamps.
- VL5-B 4 channel (Phase A to Neutral, Phase B to Neutral, Phase C to Neutral & Ground to Neutral) fused 5 wire lead terminating in fused CAT IV 600 V banana plugs.
- VL8-B 4 channel (Phase A to Neutral A, Phase B to Neutral B, Phase C to Neutral C, & Ground to Neutral) 8 wire lead terminating in fused CAT IV 600 V banana plugs. The VL8-B is an optional accessory.

### 3.4 PC5 Single phase power lead

The PC5 single phase lead is supplied for use in the office for single phase measurements.

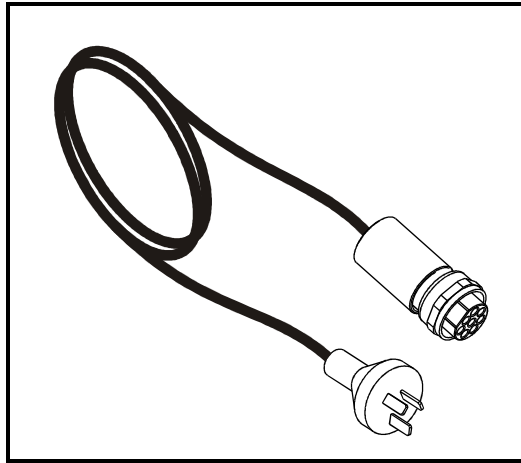


Figure 3: PC5 Single phase lead (Australia and New Zealand version shown)

The PC5 lead measures the Phase A to Neutral and Ground to Neutral voltages.

The PC5 lead measures the Phase A & Ground voltages with respect to a common neutral connection.

During measurements, the PM45 is powered directly from the Phase A to Neutral connection.



**The PC5 lead DOES NOT provide CAT IV 600 V protection.**

The PC5 lead is designed for indoor use only on CAT II 300 V circuits.

The PC5 lead connects via a standard general purpose outlet (GPO).

The PC5 lead contains internal 2A HRC (high rupture capacity) fuses. The fuses are not user replaceable.

The GND channel is intended for measurement of the voltage between the ground (earth) connection and the neutral phase.

### 3.5 VL5-C Three-phase 5-wire lead with voltage clamps

The VL5-C three-phase 5 wire lead connects to three-phase circuits using 5 fused clamps. The lead has a common neutral (N) shared by all phases.

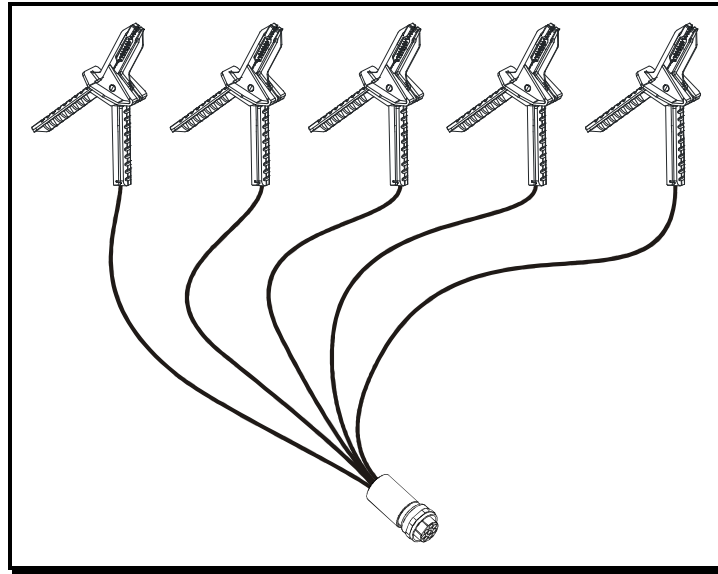


Figure 4: VL5-C Three-phase lead

The VL5-C lead measures the Phase A to Neutral, Phase B to Neutral, Phase C to Neutral & Ground to Neutral voltages, and is intended for use on three-phase star/bye connected power systems.

During measurements, the PM45 is powered directly from the Phase A to Neutral connection.

The five VL5-C leads are fused with 2A, high rupture capacity (HRC) fuses. These fuses are an integral part of the VL5-C lead and are not user replaceable.

The VL5-C lead measures the Phase A, Phase B, Phase C & Ground voltages with respect to a common neutral connection.

Note that the A, B and C channels can measure voltages up to 600 V, while the GND channel can only measure voltages up to 60 V.

The GND channel is intended for measurement of the voltage between the ground (earth) connection and the neutral phase.



- The VL5-C lead connects to live power systems using clamps. Connections should only be made by appropriately qualified operators. Appropriate personal protective equipment must be used when making live connections.
- The working voltage between any phase and Ground or between any two phases must not exceed 600 V RMS.
- If the clamps are wet or are installed or removed in rainy conditions, it is recommended that extra safety precautions are followed. As a minimum, this includes the use of appropriately rated insulated gloves.
- If the VL5-C shows any sign of damage or broken insulation, the VL5-C should not be used. Return it to GridSense or your supplier for repair or replacement.
- Never connect the A or N phases to ground (earth).

### 3.6 VL5-B Three-phase fused 5-wire lead with banana plugs

The VL5-B three-phase 5 wire lead connects to three-phase circuits using banana plugs. The lead has a common neutral (N) shared by all phases.

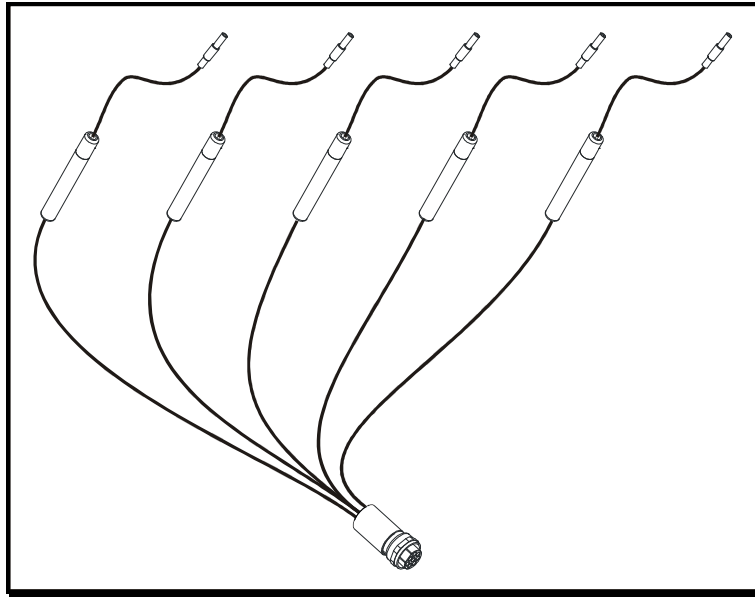


Figure 5: VL5-B Three-phase lead

The VL5-B lead measures the Phase A to Neutral, Phase B to Neutral, Phase C to Neutral & Ground to Neutral voltages, and is intended for use on three-phase star/wye connected power systems in indoor environments.

During measurements, the PM45 is powered directly from the Phase A to Neutral connection.

The five VL5-B leads are fused with 2A, high rupture capacity (HRC) fuses. These fuses are an integral part of the VL5-B lead and are not user replaceable.

The VL5-B lead measures the Phase A, Phase B, Phase C & Ground voltages with respect to a common neutral connection.

Note that the A, B and C channels can measure up to 600 V, while the GND channel can only measure up to 60 V.

The GND channel is intended for measurement of the voltage between the ground (earth) connection and the neutral phase.



- The VL5-B lead connects to live power systems using banana plugs and/or crocodile clips. Connections should only be made by appropriately qualified operators. Appropriate personal protective equipment must be used when making live connections.
- The working voltage between any phase and GND or between any two phases must not exceed 600 V RMS.
- The VL5-B lead is designed for indoor use only.
- If the VL5-B shows any sign of damage or broken insulation, the VL5-B should not be used. Return it to GridSense or your supplier for repair or replacement.
- Never connect the A or N phases to ground (earth).

### 3.7 VL8-B Three-phase 8-wire lead with voltage clamps (optional accessory)

The VL8-B three-phase 8 wire lead connects to three-phase circuits using 8 fused banana plugs.

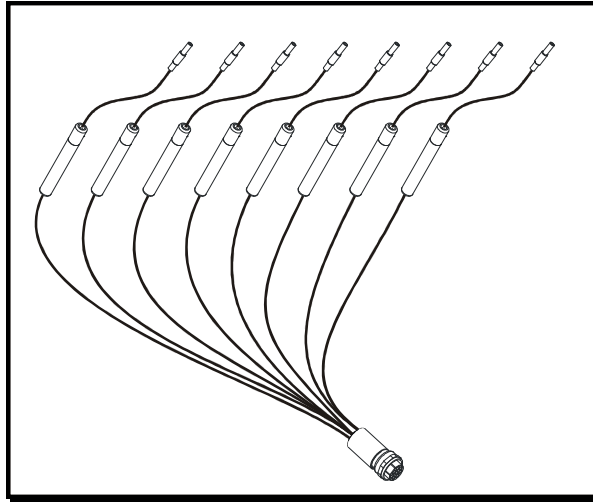


Figure 6: VL8-B Three-phase lead

The VL8-B lead measures the Phase A to Neutral A, Phase B to Neutral B, Phase C to Neutral C & Ground to Neutral voltages, and is intended as a general connection lead for use on all types of power systems.

During measurements, the PM45 is powered directly from the Phase A to Neutral A connection.

The eight VL8-B leads are fused with 2A, high rupture capacity (HRC) fuses. These fuses are an integral part of the VL5-C lead and are not user replaceable.

The four voltage channels provided by the VL8-B lead are totally isolated from one another, so this lead may be used to monitor voltage sources that are floating with respect to each other.

Note that the A, B and C channels can measure voltages up to 600 V, while the GND channel can only measure voltages up to 60 V.

The GND channel is intended for measurement of the voltage between the ground (earth) connection and the neutral phase.



- The VL8-B lead connects to live power systems using banana plugs and/or crocodile clips. Connections should only be made by appropriately qualified operators. Appropriate personal protective equipment must be used when making live connections.
- The working voltage between any phase and GND or between any two phases must not exceed 600 V RMS.
- If the VL8-B shows any sign of damage or broken insulation, the VL8-B should not be used. Return it to GridSense or your supplier for repair or replacement.
- The VL8-B is designed for indoor use only.
- Never connect the A or An phases to ground (earth).

### 3.8 F3000 Current Probes (optional accessory)

The current probe connections allow current probes to be connected to the PM45.

The PM45 continuously detects the current rating of the current probes while they are attached and scales the measured current accordingly.

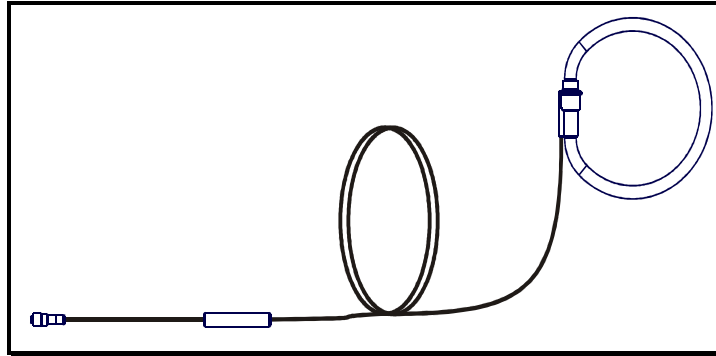


Figure 7: F3000 Flexible Current Probe



- Referring to IEC61010 2.32, the F3000 is a type B current sensor. This means it has protection against a short circuit between wires or busbars during clamping but it has no defined hand-held or hand-manipulated parts which provide protection against electronic shock from hazardous live conductors which cannot be de-energised during application or removal of the current sensor.
- When installing the F3000:
  1. Ensure conductors are de-energised and are not hazardous live, or
  2. If installing on hazardous live conductors, appropriate safe operating procedures and use of personal protective equipment is required. Refer to your employer or responsible body for safe procedures.
- If the inner contrasting colour of the insulation of the flexible cord is visible, or the lead is damaged, do not use the probe. Return it to GridSense or your supplier for repair or replacement.
- The current probe inputs should only be connected to GridSense current probes.
- To install the F3000 flexible probe, release the retaining clamps and open the probe, place it around the current conductor, and then close the retaining clamps. Current probe arrows should point to the load to ensure accurate power measurement.
- There are no user serviceable parts contained within the F3000 Flexible Current Probe.



### 3.9 Data Cable

The data cable allows connection of the PM45 to a PC USB port. PowerView software is used to configure the PM45 and to download recorded data.

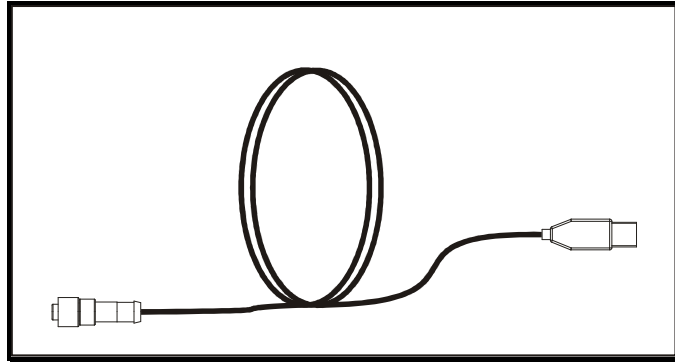


Figure 8: Data cable

The 5 V DC power provided by the USB port is also used to power up the PM45, avoiding the need to connect a voltage lead to configure and download data from the PM45. Note that the standby battery is not charged when the PM45 is powered from the USB port.



The data cable is intended to connect to a standard PC data port. The cable should only be connected to non hazardous live circuits (insulated from hazardous live circuits by reinforced or double insulation or equivalent)

### 3.10 Standby Battery:

The PM45 uses a sealed lead acid standby battery to power the unit for two minutes when loss of AC supply occurs. This allows normal and event logging to continue.

The performance of the standby battery will degrade if it is exposed to long periods of high temperature and/or it is allowed to discharge excessively. As a safety measure, the PM45 battery is protected by a thermal switch that operates when the temperature of the battery exceeds 50°C. If the thermal switch disconnects the battery, battery powered operation and battery charging will not be possible. Other circuitry in the PM45 will continue to operate normally. When the battery temperature falls to 35°C, the thermal switch will reconnect the battery.

The battery life of the PM45 can be extended by following a few simple precautions as outlined below:

- When the PM45 is not in use it should be stored at ambient temperatures below 30°C.
- When the PM45 is not in use it should be stored with a fully charged battery. This can be achieved by energising the PM45 for 24 hours before storage.
- Recharge the battery after every three months of non use. The battery is recharged when the PM45 is powered from the any of the voltage leads. It is NOT recharged when the PM45 is powered from the USB cable
- The battery is not user serviceable. If you suspect the battery is faulty, return the PM45 to GridSense or your supplier.

## **4. EQUIPMENT RATING**

The PM45 is meant to operate under the following conditions. A full set of specifications is provided in Section 12 of this manual.

### **4.1 Operating voltage range**

- Minimum input voltage on channel A for correct operation is 60 VRMS.
- The maximum voltage which can be applied between any 2 voltage leads is 600 VRMS.
- The maximum phase to neutral voltage is 600 VRMS.
- The maximum phase to phase voltage is 600 VRMS.
- The maximum voltage on Channel GND is 600 VRMS. Note that only voltages up to 60 VRMS can be measured on Channel GND.

### **4.2 Operating frequency**

- 50 or 60 Hz

### **4.3 Operating power**

- 12 VA maximum

### **4.4 Environmental**

- IP66 environmental protection rating, in accordance with AS 6059-2004: Degrees of protection provided by enclosures (IP Code). No ingress of dust; complete protection against contact. Water projected in powerful jets against the enclosure from any direction shall have no harmful effects
- Operating temperature -20°C to +60°C. Standby battery -20°C to +50°C

## **5. EQUIPMENT MAINTENANCE**

The PM45 equipment should be regularly tested and maintained to make sure the equipment and leads are in good order.

### **5.1 Periodic maintenance and testing**

The PM45 and accessories should be inspected, tested and tagged as per the normal procedures of your employer or responsible body.

### **5.2 Equipment faults**

If the equipment is found to be faulty in any way, including suspected blown fuses, it should be returned to your supplier for service.

### **5.3 Calibration**

The PM45 and current probes should be calibrated every 12 months. CHK GridSense offers this service.

### **5.4 Cleaning**

The PM45, voltage leads, and current probes should be cleaned with a soft, moist cloth using only a mild detergent.



After cleaning, ensure that all equipment is thoroughly dry before use.  
Double check that all connectors and connector receptacles are completely dry.

### **5.5 Warranty cards**

When you first receive your PM45, you should complete your warranty card and mail it (postage paid) to GridSense.

GridSense also suggest that you register on the GridSense web site:

<http://www.gridsense.net/service>

Registered owners will receive emails advising them of the release of firmware and software upgrades.

## 6. SAFE USE OF THE PM45

If you do not understand any instructions in this manual, please contact GridSense.

The PM45 is intended to be used on energised lines or equipment. Personnel using equipment on energised lines must be authorised by the relevant regulatory bodies to carry out such work and must have appropriate training.

The information given in this document is given as a guide only. It is the user's responsibility to ensure that correct and safe procedures are followed at the actual work site. GridSense offers no warranty or indemnity for accidents that may occur when following these instructions.

Prior to using a PM45, you should note the following:



- The voltage leads have internal HRC fuses which are not field replaceable. Refer to Section 10.1 on troubleshooting if you suspect a blown fuse. Return the full PM45 system with the voltage leads to your supplier if you determine a fuse has been blown
- If the PM45 and accessories are used in a manner not specified in this manual, the protection provided by the equipment may be impaired.
- To maintain a CAT IV 600V rating, only use current probes rated at CAT IV 600V.
- The PM45 unit should not be immersed in water or other fluids. The unit should not be used in explosive atmospheres.
- When any voltage clamp/plug is connected to a hazardous live conductor, the other voltage clamp/plugs should also be treated as live, due to the internal measurement impedance of the PM45.
- Connectors should be properly connected to their receptacles, using their screw or push fastener.
- The outer sheath of all leads should be free from damage, with no inner insulation showing. There should be no breakages or cracks in the PM45 enclosure, the voltage clamps, banana plugs or connectors.
- The PM45 is suitable for outdoor measurements only when used with the VL5-C voltage lead. When other voltage leads are used, the unit is suitable for indoor measurements.
- When used outdoors with the VL5-C voltage lead, the unit will withstand exposure to rain and fog.
- All voltage leads and current probes should be connected to the PM45 before connection to mains conductors.
- If any equipment showing signs of damage should not be used. Return it to GridSense or your supplier.

## 7. INSTALLING YOUR PM45

### 7.1 Pre-installation check

- Verify that the nominal voltage to be tested is within the operating range of the PM45 as indicated on the front label.
- The A phase supplies power to the PM45 (12 VA maximum).
- Identify the ground (earth), neutral and all phases.
- Ensure the unit will be physically secured against movement;
- Ensure that leads will not be damaged when shutting enclosure doors;
- Internal mounting locations should be chosen so that the temperature limits are not exceeded.
- External mountings should be such that there can be no access by the public.

### 7.2 Hazard assessment

Prior to using the PM45, the operator must carry out a work site, pre-job hazard assessment to identify the safety and environmental needs. This must be done prior to commencing work and prior to recommencing work after leaving and returning to the work site. Refer to the safety procedures provided by your employer or responsible body.

### 7.3 Live low voltage work

For the correct and safe use of this equipment, it is essential that all operating personnel follow appropriate safety procedures.

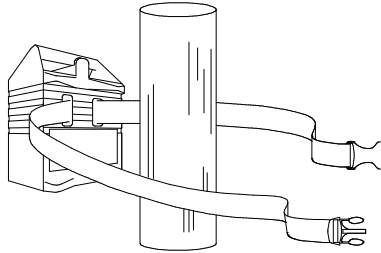


Check your relevant employer or responsible body's rules for working with live equipment.

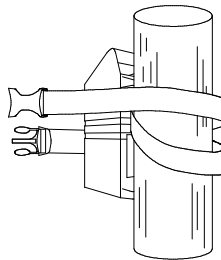
## 7.4 Pole Mounting

When installing a PM45 on a pole, hang the instrument in a suitable location and ensure that it is safely secured using the holster and strap provided.

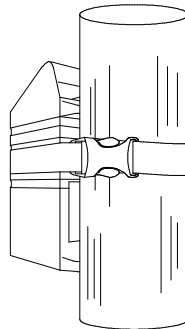
**Step 1.** The strap is first fed through the holster slats and wrapped around the pole.



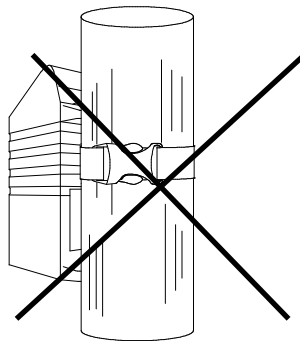
**Step 2.** Bring the strap forward to embrace the PM45.



**Step 3.** Wrap the strap around the post and secure the PM45 with the quick release clip at the rear.



**Do not connect the PM45 to the pole without embracing the unit with the strap, as this may weaken the holster over time.**



## 7.5 Connecting the PM45

Connect the appropriate voltage lead to the PM45. The voltage connector is keyed. Screw up the locking ring to ensure the connector does not inadvertently become disconnected.

Connect the appropriate current probes to the PM45. These connectors are keyed. Push on the locking rings to ensure that the connectors do not become inadvertently disconnected.



- When any voltage clamp/plug is connected to a hazardous live conductor, the other voltage clamp/plugs should also be treated as live, due to the internal measurement impedance of the PM45.
- When attaching the connectors to the PM45, ensure the connectors and receptacles on the PM45 are completely dry.

To ensure accurate power measurements, it is important that the current probes are connected to the same phases as the voltage leads. For example, the A phase voltage must be measured by the A phase voltage clamp and the A phase current probe must measure the A phase current. Current probe arrows should point to the load to ensure accurate power measurement.

Connect the current probes first, making sure that:

- They are connected to the appropriate phase
- The arrow markings point towards the load

Connect the voltage clamps in the following order:

PC5	Insert the plug in the GPO and switch it on
VL5-C and VL5-B:	Ground, Neutral, Phase C, Phase B, Phase A
VL8-B:	Ground, Neutral, Neutral C, Phase C, Neutral B, Phase B, Neutral A, Phase A.

The PM45 is powered from the Phase A to Neutral connection, and will commence logging once the A phase connection is made. It will draw power (12 VA maximum) from the A phase.

A full set of connection diagrams is provided in section 14.

## 7.6 Post-installation checks

- Ensure that voltage clamps and current probes are secure and not likely to move or dislodge.
- Check that all leads are secure and will not be damaged when equipment doors are closed.
- The PM45 is powered by the A phase voltage. You must connect this phase for the PM45 to begin logging.
- Unused voltage clamps should be connected to neutral. (Do not leave the unit unattended with unconnected voltage clamps).
- Before leaving the installation site, check that the voltages and currents displayed on the LCD are reasonable.
- Check that the PM45 is logging data by checking that an asterisk is shown on the bottom right hand corner of the LCD.
- If the bottom right hand corner of the display is blank, the PM45 is NOT logging data.

## 7.7 Disconnecting the PM45



When any voltage clamp/plug is connected to a hazardous live conductor, the other voltage clamp/plugs should also be treated as live, due to the internal measurement impedance of the PM45

Disconnect the voltage leads in the following order:

- |                  |  |
|------------------|--|
| PC5              | Switch off the GPO and remove the plug   |
| VL5-C and VL5-B: | Phase A, Phase B, Phase C, Neutral, Ground   |
| VL8-B:           | Phase A, Neutral A,<br>Phase B, Neutral B,<br>Phase C, Neutral C,<br>Neutral, Ground |

Disconnect the current probes.



## 8. CONFIGURING THE PM45 BEFORE USE

### 8.1 Introduction

The PM45 is configured using a PC running PowerView software for Microsoft Windows™. To install this software, insert the CD supplied with the PM45 into a CD drive.

If the installer does not start automatically, browse to the PowerView directory on the CD and run the PVSetup program.

Note that you must install the USB driver when the PM45 is first connected to your computer. The USB driver must be installed for each USB port that you will use.

### 8.2 Connecting the PM45 to the PC

- Connect the USB data cable to the PM45.
- Connect the USB cable to one of the USB ports on the computer.
- This will power up the PM45. The operating system will then detect the PM45.
- If you have not connected the PM45 to that USB port before, you will need to install the USB driver.

### 8.3 PM45 Status

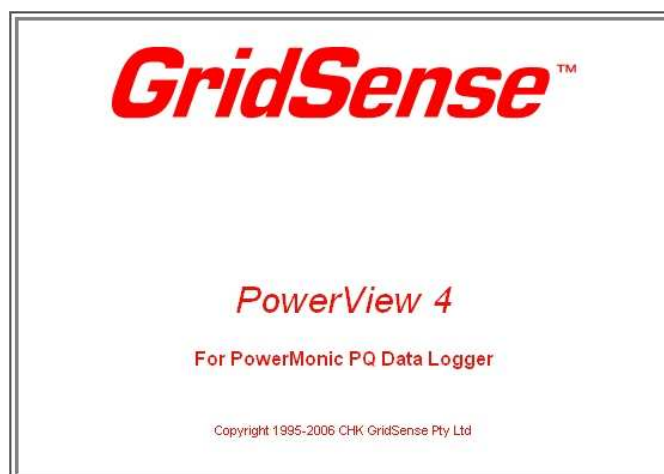
PM45 status is indicated in the bottom right hand corner of the display.

The three main modes of operation are shown as follows:

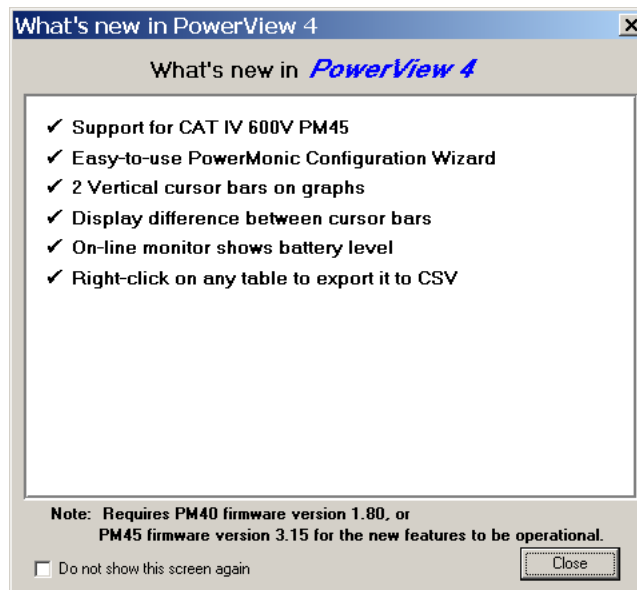
- \* (asterisk) indicates that the PM45 is logging data.
- If the bottom right hand corner of the screen is blank, the PM45 is not logging data.
- P indicates that the PM45 is in power down mode. This means that no power is applied to the A channel voltage input, and the PM45 is running from the internal battery. The PM45 will shut down within 2 minutes.

### 8.4 Starting PowerView

Start PowerView by clicking on the desktop icon. The splash screen will appear for 5 seconds.

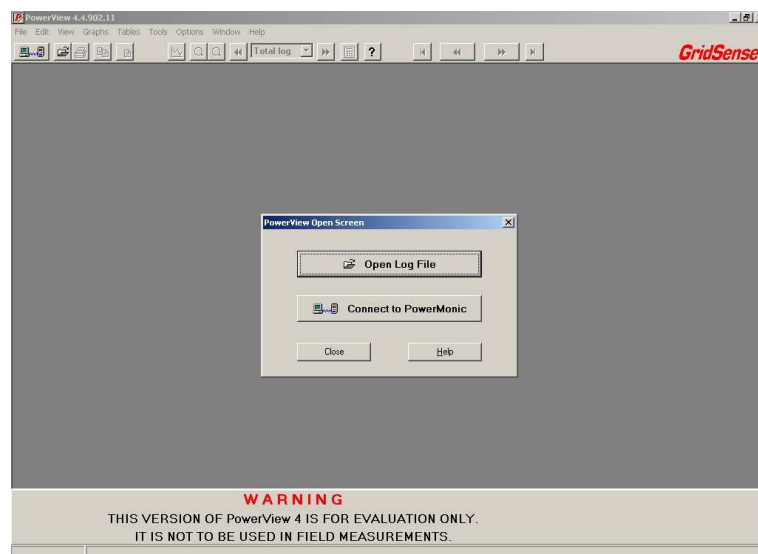


You can exit this early by clicking on the GridSense logo. If not disabled, the What's New screen will appear next.



To prevent this screen from appearing again, tick the box in the the bottom left hand corner. The What's New screen can be accessed at any time from the File menu.

The next screen to appear is the PowerView Open screen.

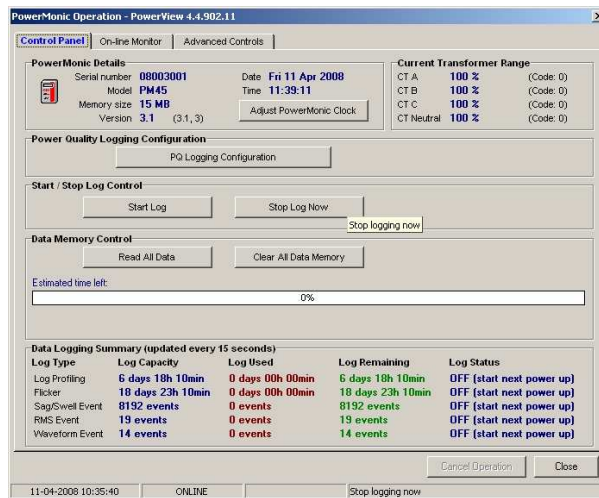


Connect to the PM45 and the Connections Mode screen will appear.

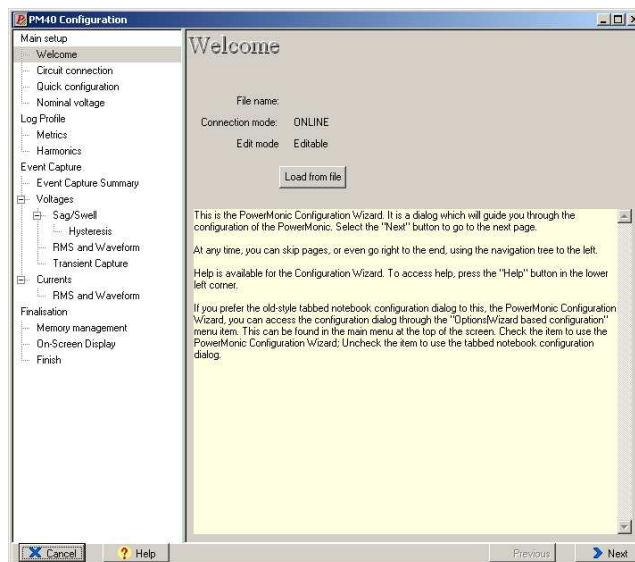


## 8.5 Configuring the PM45 using the Configuration Wizard

Select “PM40 Series” and the Operation screen Control Panel will appear.



Now select “PQ Logging Configuration” and the Configuration Welcome screen will appear. Note: You may be asked to update the PM45 clock, stop logging and clear the PM45 memory before you are able to configure the PM45.



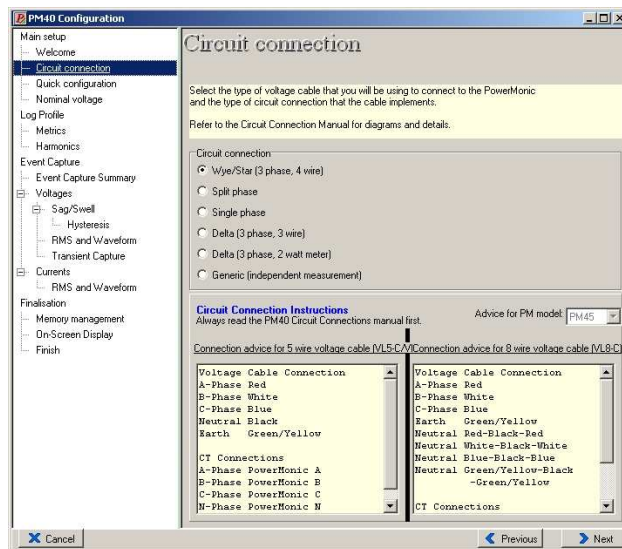
This is the first screen of the Configuration Wizard, and is divided into two panes.

The left hand pane shows the stages of the configuration process, with the current stage highlighted. This pane will change as options are selected.

Configuration options are entered into the right hand pane. At the conclusion of each option, click on the “Next” button in the bottom right hand corner. The “Previous” button allows you to return to the previous screen. The “Help” button displays context sensitive help. The “Cancel” button allows you to exit the Configuration Wizard.

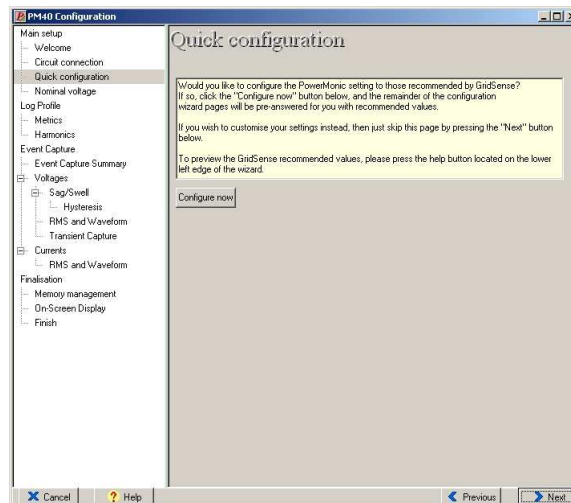
The Configuration Welcome screen allows an existing configuration file to be loaded.

Clicking on the “Next” button brings up the Circuit Connection screen.



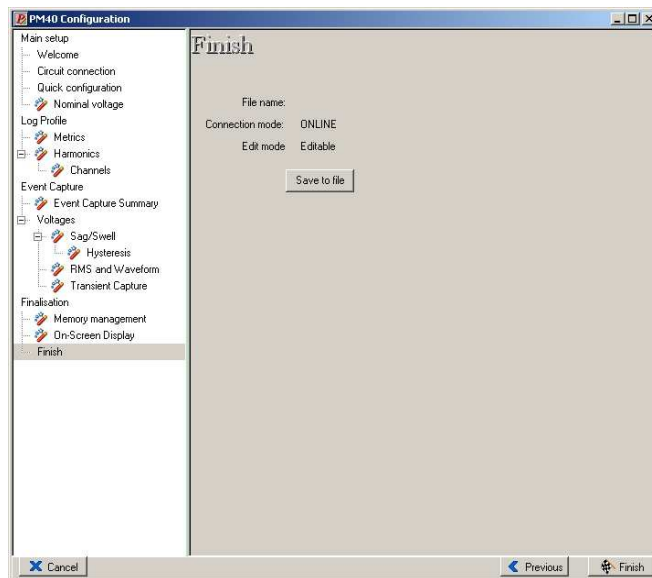
This window shows the available connection types, with details of the logged parameters for specific voltage connection leads shown in the two scrolling sub-panels.

Clicking on the “Next” button brings up the Quick Configuration screen.



This screen allows you to quickly configure the PM45 with GridSense recommended settings.

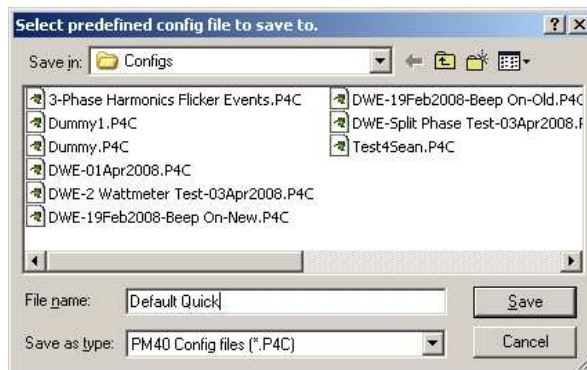
Click on the “Configure Now” button to accept this configuration. The next screen to appear will be the Configuration Finish screen.



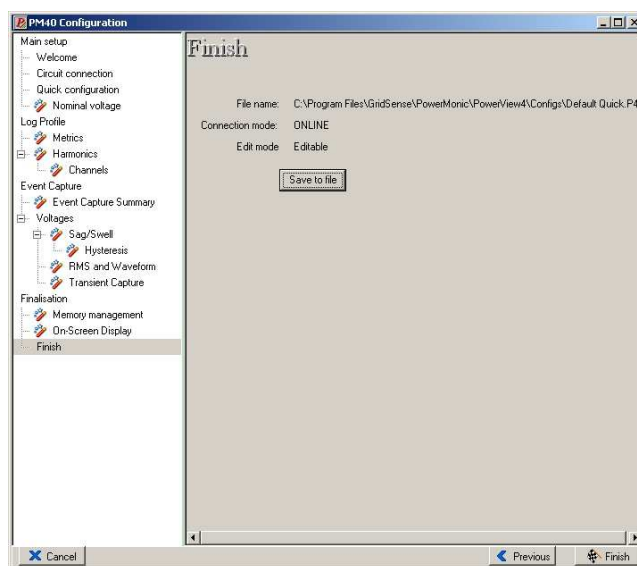
The configuration can now be saved using the “Save to File” button.

The default configuration file extension is .P4C.

A default location to save configuration files is assumed. Type a suitable name into the dialog box.

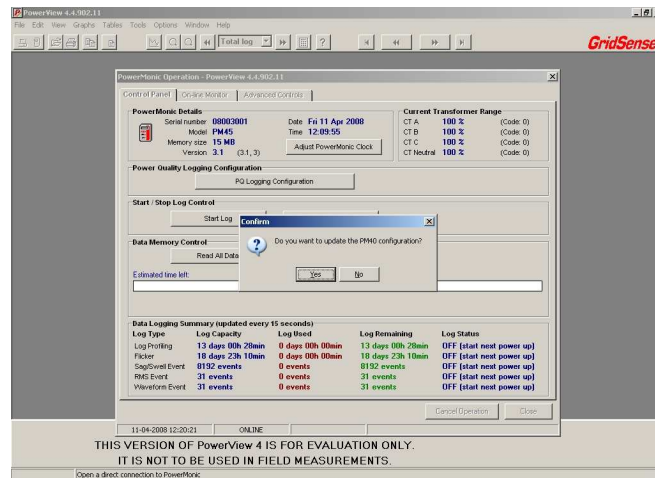


Then click on the “Save” button to save this configuration.



The complete path and file name will be shown.

Then click on “Finish” to exit the Configuration Wizard. This will return you to the Control Panel and bring up a dialog box asking if you want to apply this configuration to the PM45.



Click on the “Yes” button, and a confirmation screen will appear.



Click on OK to continue. Then click on the “Start Log Options” button, and select the appropriate option.

Three options are available:

- Start logging immediately
  - If this option is selected, the PM45 will commence logging immediately.
  - This option is most useful if the configuration is being changed while the PM45 is installed and sufficient power is present at the A phase voltage input.
  - This option is unavailable (greyed out) if the PM45 is not powered up - i.e. the USB cable is connected but power is not available at the A phase voltage input.
- Start logging at the next power up
  - If this option is selected, the PM45 will commence logging at the next power up.
  - This option is most useful if the PM45 is being configured in an office situation for later field installation.
- Start logging at a specified date and time
  - If this option is selected, the PM45 will commence logging at the specified date and time provided sufficient power is available at the A phase voltage input.

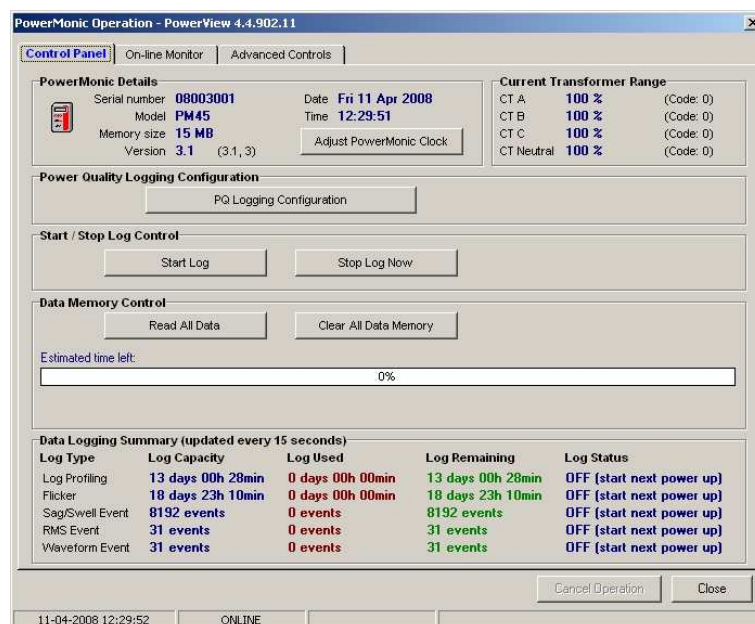
- If there is insufficient power at the specified date and time, the PM45 will commence logging when sufficient power is first available at the A phase voltage input after the specified date and time.



Select the “Start Log at Next Power Up” option, and click on OK. A confirmation screen will appear.



Click on “Yes” to confirm this. You will then be returned to the Control Panel Operations screen, which indicates that logging will commence on the next power up.



Click on “Close” to disconnect from the PM45.

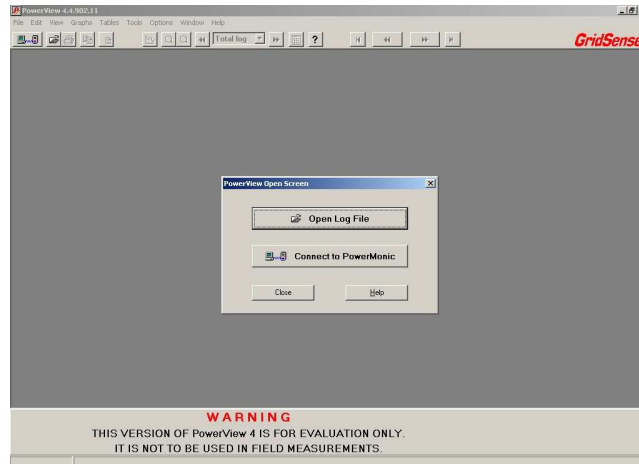
Remove the data cable from the PM45.



## 9. DOWNLOADING AND VIEWING DATA

PowerView is used to download and view logged power quality data.

Run PowerView to allow communications between the PC and the PM45, via the USB data cable. Select “Connect to PowerMonic” as shown below.



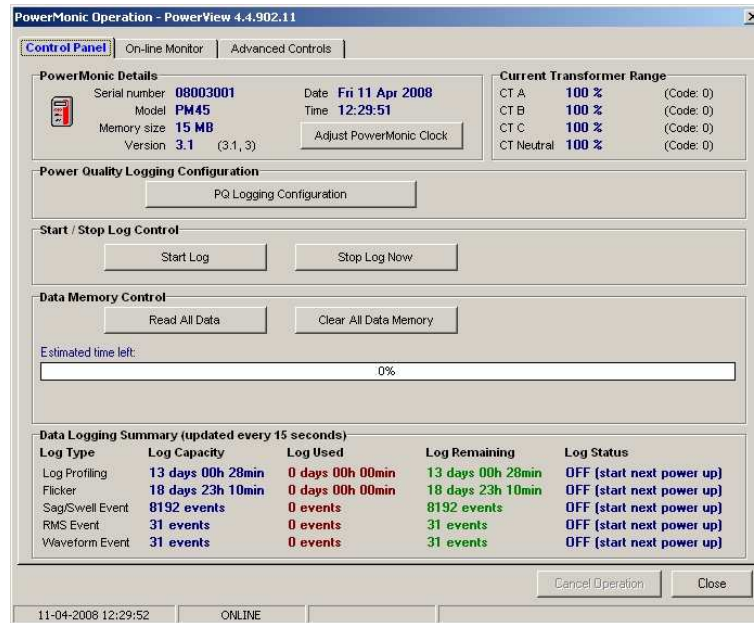
You will then see this screen:



Select PM40 Series, then click on direct connection. You will see the following screen. To save the log data, click on “Read All Data”. You can then save the log data to a .PM4 file.

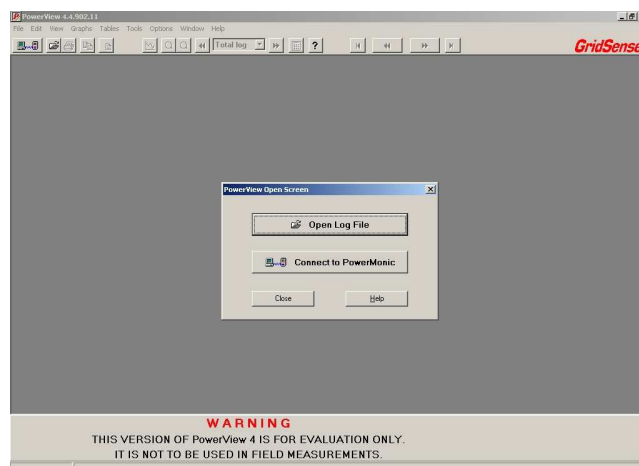
You will then be asked if you want to view the log data. GridSense recommend that the data is viewed immediately in order to verify the download integrity. If the data does not appear as expected, down load the data again, and save it with a different file name.





To view the log data you have two options:

Option 1: Run PowerView and select “Open Log File” from the following screen.



Option 2: Double click the .PM4 filename you have saved previously.

Data can be examined in both tabular and graphical form.

The configuration information of the PM45 which was used to record the data is also stored in the data file.

Tabular data can be exported in Comma Separated Variable (CSV) format, and can then be analysed in spreadsheets and other software.

## **10. TROUBLESHOOTING**

### **10.1 The PM45 does not start up after applying power**

When powered up, the PM45 LCD should show the instrument date/time and the log status. If the LCD remains off, check that the voltage lead is connected to the voltage connector and that the voltage lead is connected to a suitable power source.

Check the fuses on the voltage leads. Remove the voltage lead from all mains power and then disconnect the voltage lead connector from the PM45. Check the fuses using a continuity tester, referring to the voltage lead wiring diagrams provided in Section 15.

Note that the PM45 is powered from the A phase. At least 60 V is required for start-up.

### **10.2 The PM45 does not display voltage and/or current values**

If the values of voltages and/or currents do not display, you must configure the PM45 to do so using the PowerView software. If this is not configured, the PM45 displays only the date/time and log status.

Log status is shown in the bottom right hand corner of the display. \* means logging is in progress, P indicates power down mode, and a blank indicates that logging is not in progress.

### **10.3 The PM45 displays incorrect voltage/current values**

Ensure that the voltage clamps and current probes are connected to the correct inputs and phases.

Check the connectors on the voltage lead and current probes for broken, loose, or dislodged pins. If damage is found, do not use the unit. Return the faulty unit to GridSense or your supplier.

Check the fuses on the voltage leads. Remove the voltage lead from all mains power and then disconnect the voltage lead connector from the PM45. Check the fuses using a continuity tester, referring to the voltage lead wiring diagrams provided in Section 15.

Check that the current probe pole faces are free of dirt or rust. Poorly-maintained current probes may cause measurement errors.

Check for faulty signal inputs on the PM45 by swapping the voltage or current inputs and checking the displayed value.

Check for faulty current probes by swapping the current inputs and checking the displayed value.

The PM45 may need recalibrating. GridSense recommends that PM45 units should be recalibrated every 12 months.

### **10.4 The PM45 LCD shuts down immediately after removing power**

When the power is removed from the PM45, the LCD should remain active for two minutes.

The PM45 has an internal battery that maintains power during this power-off period. This battery normally discharges gradually over time.

To recharge the internal battery, connect the PM45 to power for 24 hours. If the problem persists, the battery may need replacing and you should return the PM45 to your supplier for service.

## 10.5 The PM45 does not communicate with the PC using PowerView software

Check if the data cable is connected to the PM45 data connector and to the PC USB port. Check that no pins on the PM45 data cable are broken, loose, or dislodged.

Check that the PM45 is powered on and functioning. If the USB data cable is connected but the PM45 is not powered up, connect the PC5 power lead.

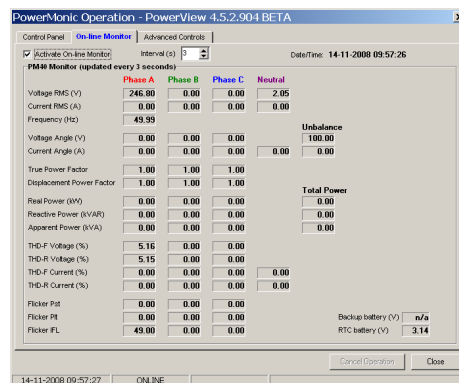
Check that you have installed the USB driver for the USB port you are using.

## 10.6 The PM45 date and time are not correct

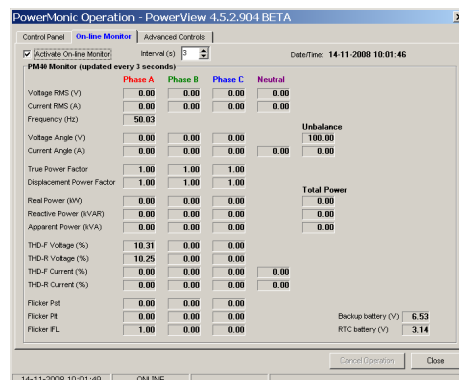
The PM45 clock can be set using the PowerView software. The internal clock is maintained during power-off periods by an internal battery. If this is not functioning properly, return the unit to your supplier for repair.

## 10.7 Verifying internal battery voltages

With the PM45 powered up, the Real Time Clock (RTC) battery voltage is displayed in the bottom left of the On-line Monitor screen, as shown below.



To display the Backup battery voltage, remove the AC power from the PM45. The Backup battery voltage will be displayed during the 2 minute power down period, as shown below:



## 11. CHK GRIDSENSE SUPPORT SERVICES

### 11.1 Operational problems

If you have any questions about the operation of the PM45 or the PowerView software, first look in the User Manual or consult the on-line help file included with PowerView software.

### 11.2 Firmware and software upgrades

The PM45 is a complex instrument which utilises embedded firmware and PC based software (PowerView).

GridSense occasionally releases firmware upgrades for the PM45 and new versions of PowerView, and recommend that these should be installed.

Users who have electronically registered with GridSense will be notified of firmware upgrades and new versions of PowerView.

Updated firmware and software can be downloaded from the GridSense web site after registering: <http://www.gridsense.net/support>

### 11.3 Technical sales and assistance

The PM45 is manufactured by CHK GridSense Pty Ltd, Unit 3 Ground Floor, 20-36 Nancarrow Avenue, Meadowbank, NSW 2114. If you are experiencing any technical problems, or require any assistance with the proper use or application of this instrument, please call our technical hotline:

NORTH AMERICA	OTHER COUNTRIES
Phone: +1 916 372 4945	Phone: +61 2 8878 7700
Fax: +1 916 372 4948	Fax: +61 2 8878 7788
Email: <a href="mailto:support_na@gripsense.net">support_na@gripsense.net</a>	Email: <a href="mailto:support@gripsense.net">support@gripsense.net</a>
Web: <a href="http://www.gridsense.net/service">http://www.gridsense.net/service</a>	Web: <a href="http://www.gridsense.net/service">http://www.gridsense.net/service</a>

### 11.4 Calibration

To guarantee that your instrument complies with factory specifications, we recommend that the PM45 be submitted for recalibration to our factory service center at a minimum of one-year intervals.

Return the PM45, including all accessories (current probes and voltage leads etc) to:

NORTH AMERICA	OTHER COUNTRIES
GridSense Inc	CHK GridSense Pty Ltd
2568 Industrial Blvd	Unit 3 Ground Floor
Suite 100	20-36 Nancarrow Avenue
West Sacramento CA 95691	Meadowbank NSW 2114
USA	AUSTRALIA

## 12. POWERMONIC PM45 SPECIFICATIONS

	Voltage	Current
Input Channels	4 (isolated)	4
Measuring Range (RMS)	A, B & C channels: 0-600 VAC GND channel: 0 - 60 VAC	0-3000 Amp
Frequency Range	50Hz nominal (42.5Hz - 57.5Hz) 60Hz nominal (51.0Hz – 69.0Hz)	50Hz nominal (42.5Hz - 57.5Hz) 60Hz nominal (51.0Hz – 69.0Hz)
Instrument Accuracy	A, B & C channels: $\pm 0.4\%$ reading $\pm 1$ lsd GND channel: $\pm 1\%$ reading $\pm 1$ lsd	$\pm 0.4\%$ reading $\pm 1$ lsd
System Accuracy	$\pm 0.4\%$ reading $\pm 1$ lsd	1% reading $\pm 1$ lsd (0.5M Current probes)
Resolution Logged Data	A, B, C & GND channels: 0.01 Volt	0.01 Amp
Resolution Display	0.1 Volt	0.1 Amp
Instrument Type	Class B (IEC 61000-4-30)	
Samples / Cycle	204 @ 50Hz, 170 @ 60Hz	
Samples rate	PLL synchronised	
Logged Parameters	IEC61000-4-30 V, A, Min/Max, Freq, TPF, DPF, kW, KVA, kVAR	
Frequency	IEC61000-4-30 (+/- 0.02Hz)	
Total Harmonic Distortion	IEC61000-4-7 (THD-F & THD-R)	
Harmonics	IEC61000-4-7 (Up to 48 <sup>th</sup> , Magnitudes & Angles)	
Interharmonics	IEC61000-4-7 (Up to 48 <sup>th</sup> )	
Flicker (Pst & Plt)	IEC61000-4-15 (10min Pst, 2hr Plt, logged every 10min)	
Voltage & Current Unbalance	IEC61000-4-30	
Waveform Capture	Duration: 400ms Triggers: Half Cycle RMS, dV/dt	
RMS Capture	Half Cycle RMS 50Hz - 5s to 30s configurable 60Hz - 5s to 25s configurable	
Sag / Swell Capture	Half Cycle RMS	
Circuit Connections	Star/Wye, Delta, Delta, Split Phase, Single Phase, Generic Independent Measurement.	

### MECHANICAL & POWER

Display	Graphic LCD 128 x 64bits
Memory	15MB FLASH
Communications	USB1.1 for Local operation, RS232 for Remote operation
Power Consumption	Maximum 12 VA (10 W typical) from Phase A
Power Source Main	Phase A to Neutral 60 – 600 Volts AC 50 or 60 Hz
Power Source Backup	6 V 0.5 Ah Rechargeable Sealed Lead Acid (not user replaceable)
RTC Battery	3 V 950 mAh Li-Manganese Dioxide / Organic Electrolyte (not user replaceable)
Dimensions	230 mm (l) x 120 mm (w) x 90 mm (d) or 9.1" (l) x 4.72" (w) x 3.6" (d)
Weight	3 kg (7 lbs) instrument only, 7kg (16 lbs) typical with accessories in carry case

### ENVIRONMENTAL & SAFETY

Ambient Temperature	-20°C to +60°C (-4°F to +130°F). Note: standby battery is disabled when ambient temperature exceeds +45°C (113°F)
Protection Class	AS 60529-2004 - IP66
Safety rating	IEC 61010-1 2001 Pollution Degree 3 Measurement Category IV 600 Volts (Double Insulation or Reinforced Insulation, Altitude up to 2000 m)

### ABSOLUTE MAXIMUM RATINGS

Nominal AC Phase to Phase Voltage	600 Volts
Nominal AC Phase to Neutral Voltage	600 Volts
Nominal AC Phase to Ground (earth)	600 Volts

Note: voltage specifications allow for a mains voltage tolerance of  $\pm 10\%$  of nominal.

## 13. ACCESSORY SPECIFICATIONS

### 13.1 Voltage leads

Cat. No.	PC5	VL5-C	VL5-B	VL8-B (optional accessory)
Termination	3 pin Australian GPO plug	Fused clamps	Fused banana plugs	Fused banana plugs
No of channels	2 (A & GND)	4 (A, B, C & GND)	4 (A, B, C & GND)	4 (A, B, C & GND)
No of wires	1	5 (Phase A, Phase B, Phase C, Ground & Neutral)	5 (Phase A, Phase B, Phase C, Ground & Neutral)	8 (Phase A, Neutral A, Phase B, Neutral B, Phase C, Neutral C, Ground & Neutral)
Length from connector	2 m	2 m	2 m	2 m
Maximum span	1.5 m	1.5 m	1.5 m	1.5 m
Safety	Suitable for CAT II 300 V	CAT IV 600 V	CAT IV 600 V	CAT IV 600 V
Current rating	0.2A ~	0.2A ~	0.2A ~	0.2A ~
Fuses (not user replaceable)	2A High rupture capacity (HRC)	2A High rupture capacity (HRC)	2A High rupture capacity (HRC)	2A High rupture capacity (HRC)

### 13.2 Current Probes

Cat. No.	F3000 (optional accessory)
Input Range	0-3000A
Output Range	100 uV per A at 50 Hz 120 uV per A at 60 Hz
Accuracy Class	2M
Window size	100 mm x 128 mm
Encapsulation	Plastic, fully insulating
Safety	Cat III 1000 V (equivalent to CAT IV 600V)

Note: Accessory part numbers have additional suffix “-2” for USA region.

## 14. CIRCUIT CONNECTIONS

The table below provides a summary of the circuit connections suitable for use with the PM45.

The table highlights which voltage lead assembly can be used, the voltage connection type and Nominal RMS Voltage settings used in the PM45 configuration parameters.

Detailed connection diagrams for each circuit are found on the following pages.

Ref.	Source Type	Load Type	Voltage Cable	Voltage Connection	Nominal Voltage
14.1	3 Phase, 4 Wire (Wye)	Star (Wye)	VL5, VL8	Star (Wye)	Phase-Neutral
14.2	3 Phase, 3 Wire, 3 WattMeter (Delta)	Delta	VL8	Delta	Phase-Phase
14.3	3 Phase, 3 Wire, 2 WattMeter (Delta)	Delta	VL8	Delta	Phase-Phase
14.4	Split Phase	2 Single Phase	VL5, VL8	Star (Wye)	Phase-Neutral
14.5	Single Phase	Single Phase	PC5, VL5, VL8	Star (Wye)	Phase-Neutral
14.6	Generic	3 Single Phase	VL8	Star (Wye)	Phase-Neutral
14.7	3 Phase, 3 Wire (Wye)	Delta	VL8	Delta	Phase-Phase
14.8	3 Phase, 3 Wire (Wye)	3 Single Phase	VL8	Delta	Phase-Phase
14.9	Delta Mid-Tap	2 Single Phase	VL5, VL8	Star (Wye)	Phase-Neutral

The circuit connections fall into two categories:

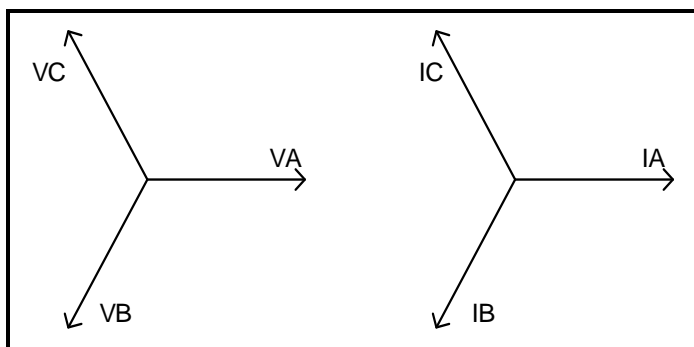
- **Neutral line connection.** This includes connections 14.1, 14.4, 14.5, 14.6 and 14.9. The phase-neutral voltages and line currents are measured.
- **Non-neutral line connection.** This includes connections 14.2, 14.3, 14.7 and 14.8. The phase-phase voltages and line currents are measured. The phase-phase voltages are converted to phase-neutral voltages and processed so that the centre of the phase-phase voltage triangle becomes the neutral point. This conversion is done point by point in the time domain so there is no assumption that the three-phase system is balanced.



### Voltage Lead Connection for

**VL5 or VL5-2**

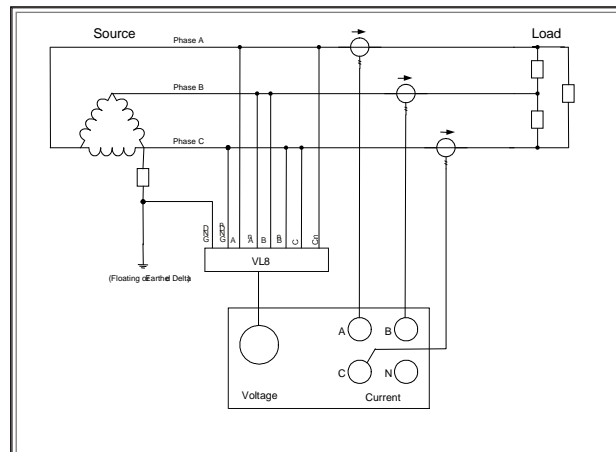
Wire Label	Connection Point
Ground	Ground (earth)
Neutral	Neutral
Phase A	Phase A
Neutral A	Neutral
Phase B	Phase B
Neutral B	Neutral
Phase C	Phase C
Neutral C	Neutral



- This connection should be configured as Star/Wye (3-phase, 4-wire) in PowerView.
- Current probe arrows should point to the load to ensure accurate power measurement.



## 14.2 Three-Phase 3-Wire Delta Source with Delta Load



Connection Diagram using 8-Wire Voltage Cable (VL8 or VL8-2)

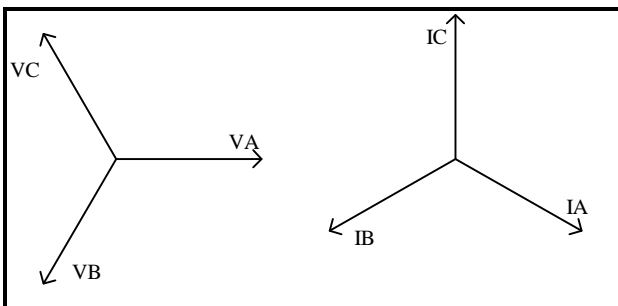
**Circuit Summary Table**

Source	3-Phase Delta
Load	Delta
Connection	Delta
Nominal RMS Voltage	Phase-Phase

**Voltage Lead Connection for VL8 or VL8-2**

Wire Label	Connection Point
Ground	Ground (earth)
Neutral	Phase C
Phase A	Phase A
Neutral A	Phase B
Phase B	Phase B
Neutral B	Phase C
Phase C	Phase C
Neutral C	Phase A

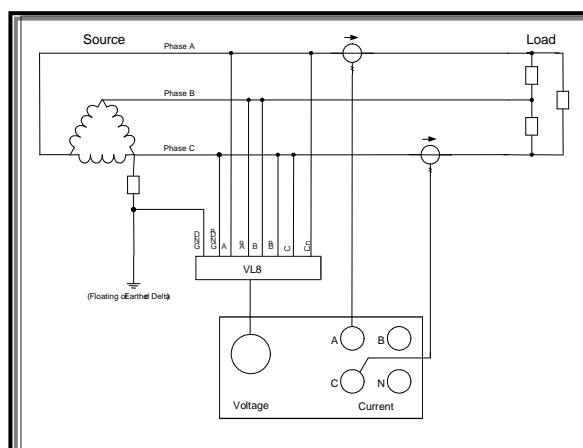
Phasor Diagram



**Notes:**

- This connection should be configured as Delta (3-phase, 3-wire) in PowerView.
- Current probe arrows should point to the load to ensure accurate power measurement.

### 14.3 Three-Phase 2-WattMeter Delta Source with Delta Load – Standard



Connection Diagram using 8-Wire Voltage Cable (VL8 or VL8-2)

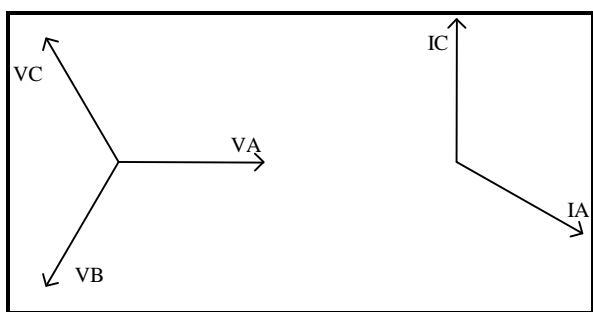
**Circuit Summary Table**

Source	3-Phase Delta
Load	Delta
Connection	Delta
Nominal RMS Voltage	Phase-Phase

**Voltage Lead Connection for VL8 or VL8-2**

Wire Label	Connection Point
Ground	Ground (earth)
Neutral	Phase C
Phase A	Phase A
Neutral A	Phase B
Phase B	Phase B
Neutral B	Phase C
Phase C	Phase C
Neutral C	Phase A

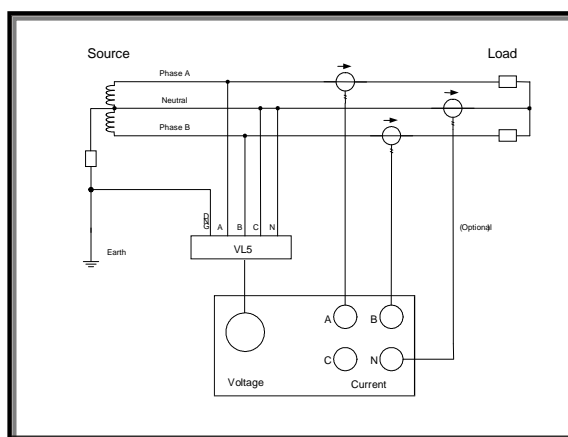
**Phasor Diagram**



**Notes:**

- This connection should be configured as Delta (3-phase, 2-wattmeter) in PowerView.
- The same type of Current probes should be used for Phase A and Phase C.
- For a system with only two loads connected, configure the PM45 as Delta (3-phase, 2-wattmeter) in PowerView.
- Current probe arrows should point to the load to ensure accurate power measurement.

## 14.4 Split Phase with 2 Single Phase Loads



Connection Diagram using 5-Wire Voltage Cable (VL5 or VL5-2)

**Circuit Summary Table**

Source	Split Phase
Load	2 Single Phases
Connection	Star/Wye
Nominal RMS Voltage	Phase-Neutral

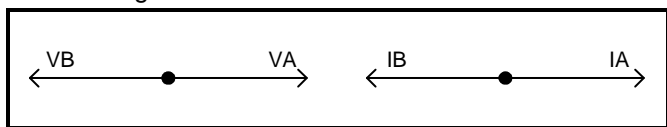
**Voltage Lead Connection for VL5 or VL5-2**

Wire Label	Connection Point
Ground	Ground (earth)
Phase A	Phase A
Phase B	Phase B
Phase C	Neutral
Neutral	Neutral

**Voltage Lead Connection for VL8 or VL8-2**

Wire Label	Connection Point
Ground	Ground (earth)
Neutral	Neutral
Phase A	Phase A
Neutral A	Neutral
Phase B	Phase B
Neutral B	Neutral
Phase C	Neutral
Neutral C	Neutral

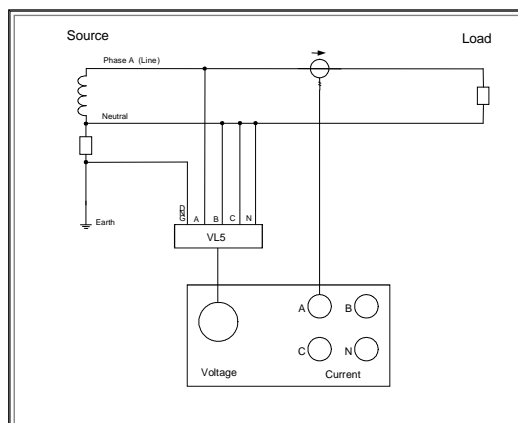
**Phasor Diagram**



**Notes:**

- This connection should be configured as Split Phase in PowerView.
- Current probe arrows should point to the load to ensure accurate power measurement.

## 14.5 Single Phase



Connection Diagram using 5-Wire Voltage Cable (VL5 or VL5-2)

**Circuit Summary Table**

Source	Single Phase
Load	Single Phase
Connection	Star/Wye
Nominal RMS Voltage	Phase-Neutral

**Voltage Lead Connection for VL5 or VL5-2**

Wire Label	Connection Point
Ground	Ground (earth)
Phase A	Phase A
Phase B	Neutral
Phase C	Neutral
Neutral	Neutral

**Voltage Lead Connection for VL8 or VL8-2**

Wire Label	Connection Point
Ground	Ground (earth)
Neutral	Neutral
Phase A	Phase A
Neutral A	Neutral
Phase B	Neutral
Neutral B	Neutral
Phase C	Neutral
Neutral C	Neutral

Note: The PC5 may also be used to log A phase and ground (earth) voltages.

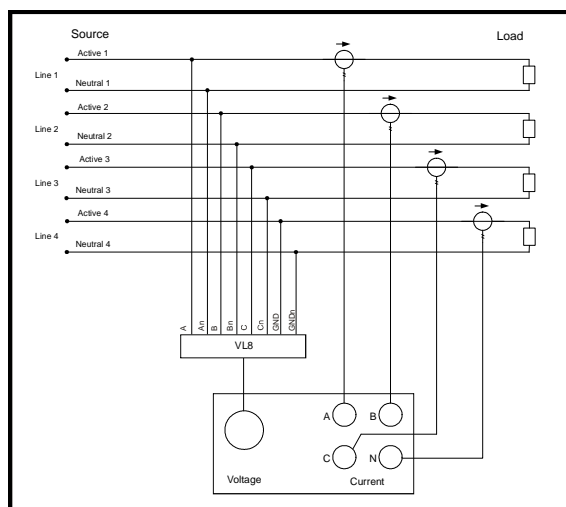
**Phasor Diagram**



**Notes:**

- this connection should be configured as Single Phase in PowerView.
- The return current on the neutral is the same as the Phase A current.
- Current probe arrows should point to the load to ensure accurate power measurement.

## 14.6 Generic, 4 Independent Circuits



Connection Diagram using 8-Wire Voltage Cable (VL8)

**Circuit Summary Table**

Source	Generic
Load	4-Single Phases
Connection	Star/Wye
Nominal RMS Voltage	Phase-Neutral

**Voltage Lead Connection for VL8 or VL8-2**

Wire Label	Connection Point
Phase A	Active 1
Neutral A	Neutral 1
Phase B	Active 2
Neutral B	Neutral 2
Phase C	Active 3
Neutral C	Neutral 3
Ground	Active 4
Neutral	Neutral 4

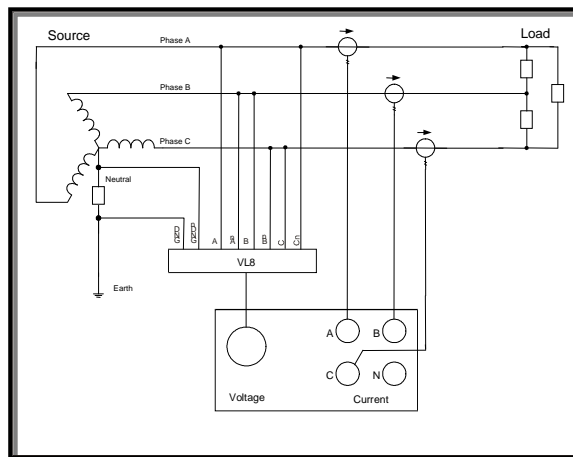
Phasor diagram



### Notes

- This connection should be configured as Generic (independent measurement) in PowerView.
- The 4<sup>th</sup> voltage channel (GND) can only measure limited parameters such as voltage RMS, max/min voltage RMS during logging interval.
- The 4<sup>th</sup> voltage channel (GND) can only measure the voltage up to 60VAC.
- Current probe arrows should point to the load to ensure accurate power measurement.

## 14.7 Three-Phase 4-Wire Wye Source with Delta Load



Connection Diagram using 8-Wire Voltage Cable (VL8)

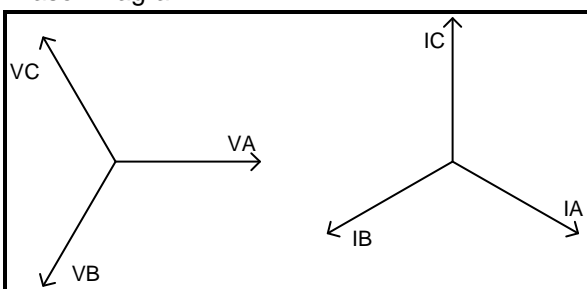
**Circuit Summary Table**

Source	3-Phase Star/Wye
Load	Delta
Connection	Delta
Nominal RMS Voltage	Phase-Phase

**Voltage Lead Connection VL8 or VL8-2**

Wire Label	Connection Point
Ground	Ground (earth)
Neutral	Neutral if available, Ground(earth) otherwise
Phase A	Phase A
Neutral A	Phase B
Phase B	Phase B
Neutral B	Phase C
Phase C	Phase C
Neutral C	Phase A

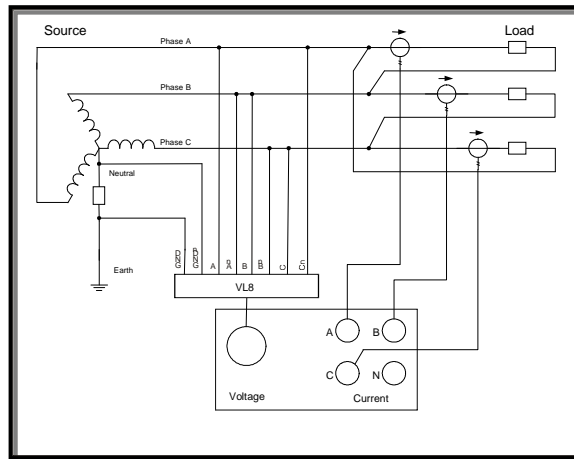
Phasor Diagram



Notes:

- This connection should be configured as Delta (3-phase, 3-wire) in PowerView.
- Current probe arrows should point to the load to ensure accurate power measurement.

## 14.8 Three-Phase 4-Wire Wye Source with 3 Single Phase Loads



Connection Diagram using 8-Wire Voltage Cable (VL8)

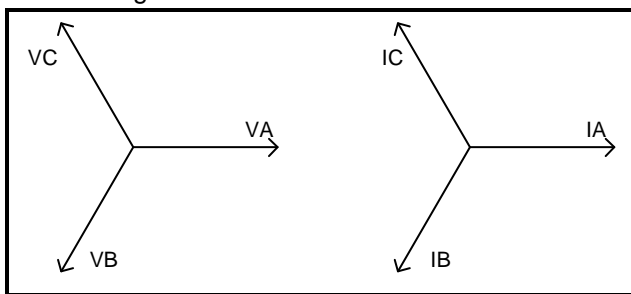
**Circuit Summary Table**

Source	3-Phase Star/Wye
Load	3 Single Phases
Connection	Star/Wye
Nominal RMS Voltage	Phase-Phase

**Voltage Lead Connection VL8 or VL8-2**

Wire Label	Connection Point
Ground	Ground (earth)
Neutral	Neutral if available, Ground(earth) otherwise
Phase A	Phase A
Neutral A	Phase B
Phase B	Phase B
Neutral B	Phase C
Phase C	Phase C
Neutral C	Phase A

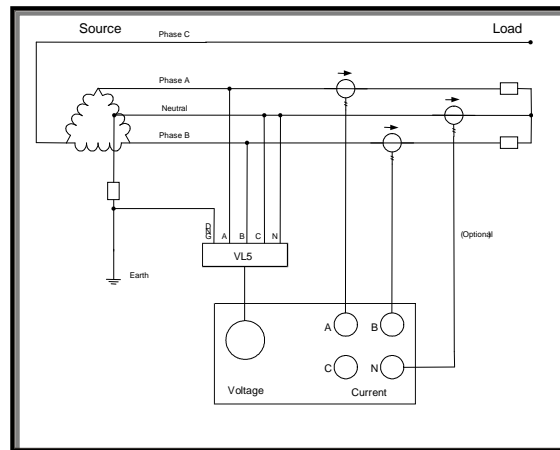
Phasor Diagram



Notes:

- This connection should be configured as Generic (independent measurement) in PowerView.
- Current probe arrows should point to the load to ensure accurate power measurement.

## 14.9 Delta Mid-Tap Source with 2 Single Phase Loads



Connection Diagram using 5-Wire Voltage Cable (VL5)

**Circuit Summary Table**

Source	Delta Mid Tap
Load	2 Single Phases
Connection	Star/Wye
Nominal RMS Voltage	Phase-Neutral

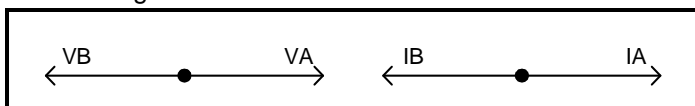
**Voltage Lead Connection for VL5 or VL5-2**

Wire Label	Connection Point
Ground	Ground (earth)
Phase A	Phase A
Phase B	Phase B
Phase C	Neutral
Neutral	Neutral

**Voltage Lead Connection for VL8 or VL8-2**

Wire Label	Connection Point
Ground	Ground (earth)
Neutral	Neutral
Phase A	Phase A
Neutral A	Neutral
Phase B	Phase B
Neutral B	Neutral
Phase C	Neutral
Neutral C	Neutral

**Phasor Diagram**



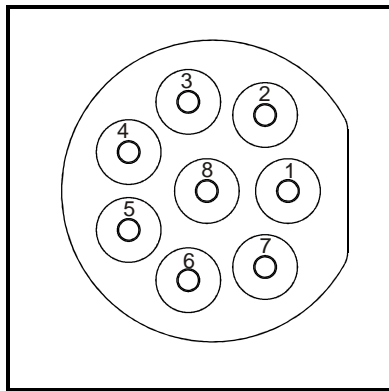
**Notes:**

- This connection should be configured as Split Phase in PowerView.
- Channel N can be used for neutral current.
- Current probe arrows should point to the load to ensure accurate power measurement.



## 15. VOLTAGE LEAD PINOUTS

The voltage leads use an 8 way connector with pin numbers shown below:



The connection tables are given below:

VL5-C, VL5-B

Phase	Pin number
Phase A	1
Phase B	3
Phase C	5
Ground	7
Neutral	2,4,6,8

VL8-B

Phase	Pin number
Phase A	1
Neutral A	2
Phase B	3
Neutral B	4
Phase C	5
Neutral C	6
Ground	7
Neutral	8

PC5

Phase	Pin number	Australasia GPO pins
Phase A	1	Active
Neutral A	2, 8	Neutral
Ground	7	Earth

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