GridSense™

# PowerMonic

## MODEL–PM30/40

USER MANUAL
(North America)

# PowerMonic PM30/40 User Manual, Version 4.0

This product complies with IEC 61010



Printed in Australia

**AUSTRALIA / NEW ZEALAND**

N3207

This is a 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, it is limited to the repairing or replacing of any defective part and the instrument is returned freight paid to and from our Testing and Service office, Sydney.

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# 1. THE POWERMONIC PM30/40

**Congratulations!** You are a proud owner of a PowerMonic PM30/40 state of the art PQ analysers and data loggers for power supplies.

International Safety Symbols:

CAUTION Symbol: See explanation in manual

This manual covers the PM40. Other products in the PowerMonic suite are described in their relevant manual.

CHK places the highest emphasis on safety. Please see section **3. SAFE USE OF THE POWERMONIC** on page 17. Ensure that only qualified personnel use the PM40.

This manual describes the installation and operation of the PM30/40 three-phase power quality and disturbance analyser. The unit incorporates three-phase, three-channel voltage logging and three-phase, four-channel current logging of RMS volts, current, Power, harmonic voltages and currents, Interharmonic voltages and currents, flicker both Pst and Plt and power factor for each phase.

Additionally, the PowerMonic can record transient RMS events and actual waveform data.

## 2. POWERMONIC KIT OVERVIEW

The PowerMonic PM30/40 Kit and the items within the kit are listed below. Additional /accessories are also described.


*Figure 1Typical PM40PlusEV Kit*


*Figure 2Typical PM30PlusEv Kit*

| Item | Description |
|---|---|
| 1 | **AAPM30/40PlusEV-K2 (Kit)**<br>AAPM30 or 40 – PM30 or 40 Power Quality Analyser<br>AAVL6K-2 - Fused 6 wire voltage cable set (3P+ 3N), small clamps, banana plugs, and tinned ends (6 of each)<br>AAVL4-2 - Fused 4 wire voltage cable (3P+ N)<br>AAPC4-2 – 120/240v Single phase power cable<br>AAUSBCABLE – USB data cable<br>AAPMACHO-M – Protective rubber holster with back plate and strap<br>AACBP3 – PowerMonic and accessories carry Bag<br>AAPSLV4-1 – PowerView IV software CD |
| 2 | **Available Current Transformers (CT's)**<br>10amp switchboard CT's AACV10 (10A)<br>General purpose CT's AACV200 (200A) & AACV500 (500A)<br>3000 Amp Flexible CT's AACF3000-24, AACF3000-36, AACF3000-48 |

| | |
|---|---|
| 3 | **Available Accessories** |
| | AAVL4-2 4-way three phase, common neutral cable |
| | AAAC4CL Large clamp set (3P + 1N) |
| | AAAC4BC Banana plug with small clamp set (3P + 1N) |
| | AAAC4TE Tinned end terminations (3P + 1N) |
| | AAVL6-2 6-way 3 phase, 3 Neutral voltage cable |
| | AAAC6CL Large clamp set (3P + 3N) |
| | AAAC6BC Banana plug with small clamp set (3P + 3N) |
| | AAAC6TE Tinned end terminations (3P + 3N) |
| | AAPC4-2 240v single phase cable |
| | AAUSBCABLE USB Data Communications cable |
| | AACBP3 PowerMonic and Accessory carry bag |

For safety reasons, use only CHK GridSense Pty Ltd accessories specifically designed for use with this product. The use of any other manufacturer's equipment is NOT recommended.

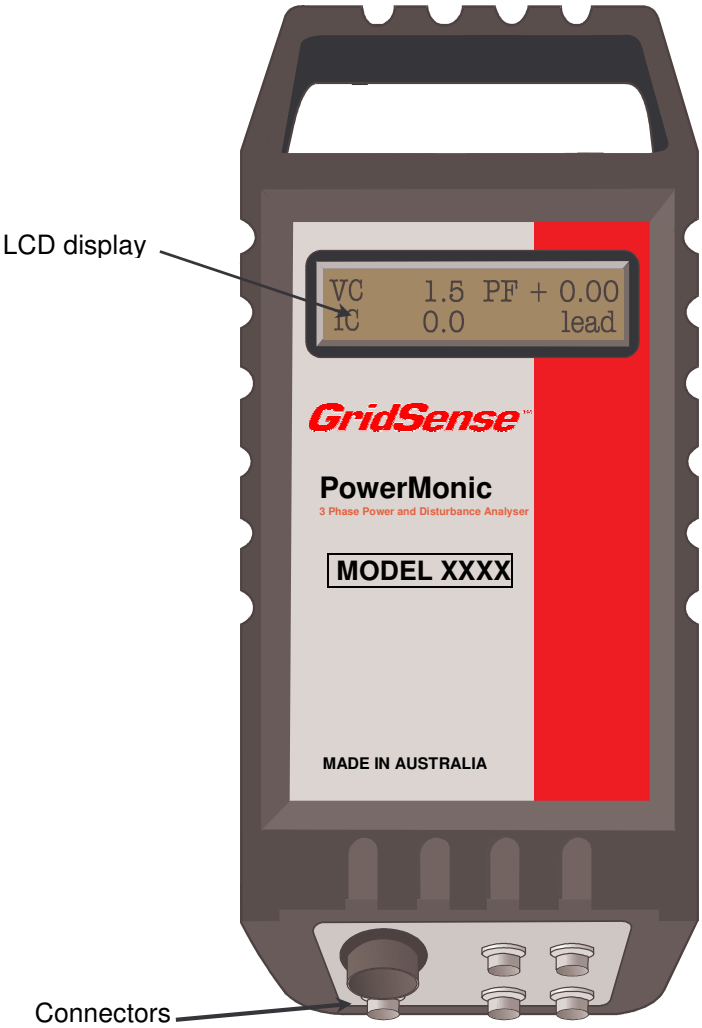



*Fig 3 – PowerMonic unit*

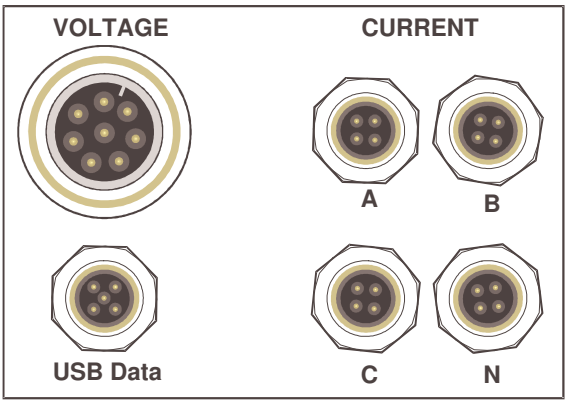



*Fig 4 – PowerMonic end connectors*

| Connector | Description |
|---|---|
| VOLTAGE | 3 Phase 6 wire plus earth<br>CAT III 440Volts |
| RS232 Data or USB 1.1 | Connection to PC or Laptop via USB 1.1(RS232 communication also available) |
| CURRENT “A” | Current Transformer (“A” Channel) |
| CURRENT “B” | Current Transformer (“B” Channel) |
| CURRENT “C” | Current Transformer (“C” Channel) |
| CURRENT “N” | Current Transformer (“N” Channel) |

## 2.1. Liquid crystal display (LCD)

The screens displayed on an operating PowerMonic PM40 can be selected using the PowerView IV software (refer to the PowerView IV User Manual for further details). These screens include the logging status, memory capacity / memory used, voltage/current values per phase, flicker, power and harmonic readings.

## 2.2. Voltage Cables

The voltage cables available to connect the PowerMonic to the voltage of the equipment under test are:

- PC4 single phase cable
- VL3 Three phase delta voltage cable
- VL4 Three phase Wye/Start and Split-phase voltage cable
- VL6 Delta, Three phase Wye/Star and Split phase voltage cable

### 2.2.1. Single Phase Cable (PC4-2)

The PC4-2 is supplied for use in the office or for single phase measurements. This cable has an internal earth connection.

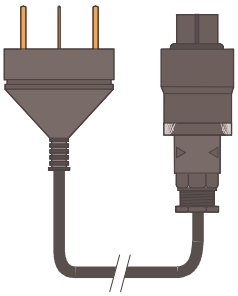


*Fig 3 – Single phase cable (PC4)*

### 2.2.2. Three phase 4-wire cable (VL4-2)

The VL4-2 is a fused four-wire cable with 3 active and 1 common neutral termination. The VL4-2 cable-set is used for measuring single phase or three-phase four-wire (Star or Wye configurations) and split-phase systems. This VL4-2 cable is shown in
Fig 4. When used to monitor single phase configuration the 3 actives should all be clamped to the A phase. Fig 5 shows the large clamps that are connected to the VL4-2. Each clamp hosts a fuse for safety. Fig 6 shows the Banana plug accessories with the small clamp attachments these also host fuses for safety.

| | |
|---|---|
| ⚠ | This cable does not include an earth connection. |

| | |
|---|---|
| ⚠ | Fuses should only be replaced by an authorised person. If in doubt, return the cables along with the full PowerMonic system to the supplier for repair. Replacement fuses must be rated to HRC 2A, 38 x 10.3mm, 500V 100kA. |

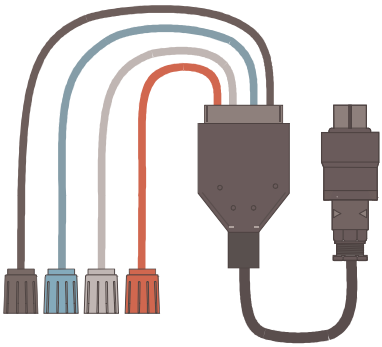


*Fig 4 - Three phase cable to fuse (VL4)*

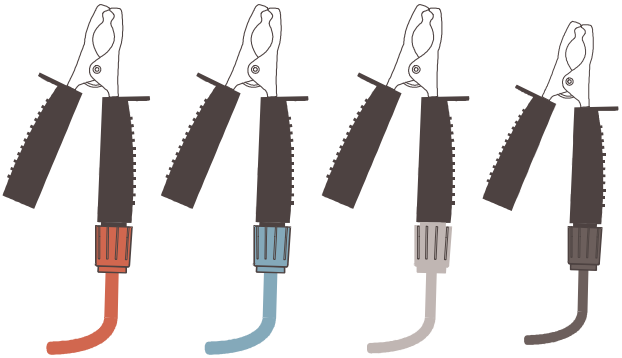


*Fig 5 - Large clamps (AC4CL)*

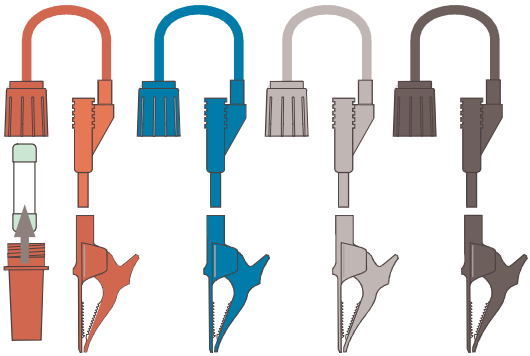


*Fig 6 - Banana plugs with small clamp (AC4BC)*

### 2.2.3. Three phase 6-wire cable (VL6-2)

The VL6-2s a six-way set (3 x active and 3 x neutral). This cable is used for measurement of three-phase three-wire systems (i.e. no neutral) such as Delta configurations as shown in Fig 10.

VL6-2s also used to measure split-phase systems (i.e. 120v/120v/240v) and can be used for Wye/Star systems. When using the VL6-2 configuration, the three voltage channels are totally isolated from one another, so it may be used to monitor voltage sources that are floating with respect to each other.

| | |
|---|---|
| ⚠ | The working voltage between cables must not exceed 500 V RMS. |

The VL6-2 cable is available with the same accessories as is used with the VL4-2 but consist of three neutral's color coded to match their phase. These are shown in Fig11 and Fig 12. These accessories are joined to the VL6-2 in the same way as the VL4-2.

| | |
|---|---|
| ⚠ | This cable does not include an earth connection. |

| | |
|---|---|
| ⚠ | Fuses should only be replaced by an authorised person. If in doubt, return the cables along with the full PowerMonic system to the supplier for repair. Replacement fuses must be rated to HRC 2A, 38 x 10.3 mm, 500 V 100 kA. |

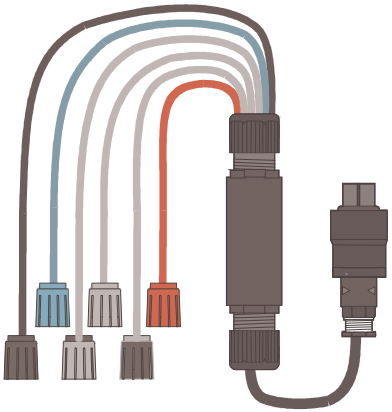


*Fig 10 - Three phase cable to fuse (VL6)*

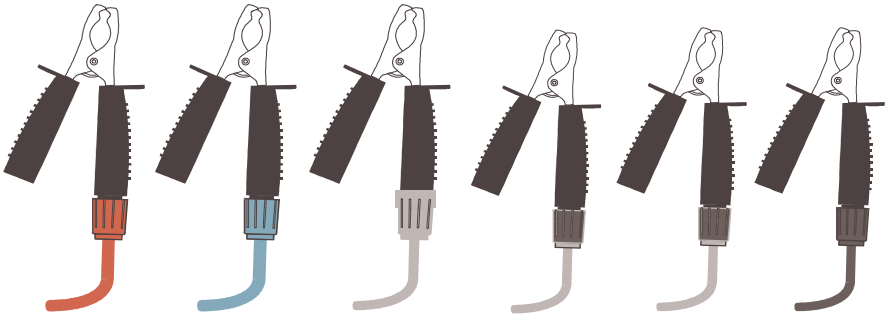


*Fig 11 - Large clamps (AC6CL)*

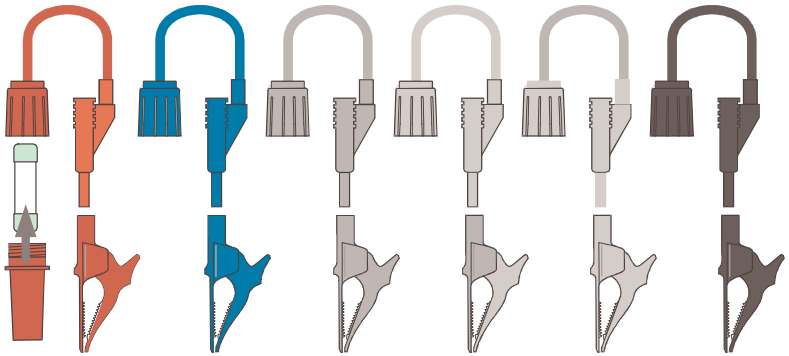


*Fig 12 - Banana plugs with small clamp (AC6BC)*

## 2.3. Current transformers (CT's)

The current transformer (CT) cables connect to the PM40 at the A,B,C and N input terminals. The PowerMonic continuously detects the current rating of the CTs and auto-scales and adjusts the LCD accordingly (i.e. configuring the PowerMonic for CT rating is not required).

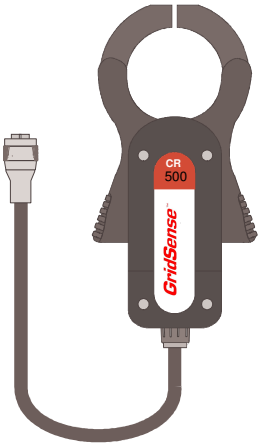



*Fig 13 - 500 A current transformer (AACV500)*

*Figure 14 Flexible CT, 3000 Amps*

## 2.4. Data cable – AAUSBCABLE

The data cable allows connection of the PowerMonic to a PC or Laptop for downloading data and configuring the PM40. This cable attaches to the USB 1.1 communications (COM) port of a PC/Laptop and allows data transfer at 1.1Mb per second.

## 2.5. Operating voltage range

The PowerMonic is capable of operating from 63-v520 ac and operating and measurement range is clearly labelled on the PowerMonic and listed within the product specification.

# 3. SAFE USE OF THE POWERMONIC

If you do not understand any instructions in this manual, ask someone to assist you.

The PowerMonic is intended to be used on low voltage energised lines or equipment (480 V RMS or less). 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 worksite. CHK GridSense offers no warranty or indemnity for accidents that may occur when following these instructions.

The PowerMonic is rated at IEC61010 CAT III 440 Volts

***Be careful*** when the PowerMonic is connected to a voltage source using a three phase cable (VL4 or VL6) - it is **not** grounded.

The PowerMonic and some types of voltage cables have internal HRC fuses. **Do not** attempt to replace these fuses in the field. Return the full PowerMonic system with the voltage cables to your supplier if you suspect a blown fuse.

## 3.1. Hazard assessment

Prior to using the PowerMonic, the operator must carry out a worksite, 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 the worksite.

This hazard assessment should:

- Identify possible hazards and risks.
- Identify the safety needs of the job.
- Identify the correct procedures, practices and equipment for the job.
- Eliminate unsafe conditions and actions from the worksite.
- Identify the need for personal protective clothing.
- Perform an ongoing risk assessment during the job.

### 3.1.1. Live low voltage work

Check your relevant regulatory body's rules for working with live equipment.

For the correct and safe use of this equipment, it is essential that all operating personnel follow these safety procedures. When using a PowerMonic on or near live low voltage conductors, the following basic safety principles should be observed. See Fig 1 for typical work sites.

Apart from the conductor that you are working on, you must be insulated from earth and any other conductor or maintain a distance of at least 500 mm (or other distance as required by relevant legislation or live working rules) from those points.

- Use insulated matting to cover bare busbars and exposed metalwork.
- Use ground mats.
- Wear protective safety eyewear and a hard hat.
- You should be trained in first aid procedures and have a portable first aid kit on hand.
- When working alone, ensure that a responsible person knows that you are working on live line equipment and will initiate emergency action if you do not call in within a specified period.

*Fig 15 – Use of insulating mats in switchboard application*

- When connecting the voltage cables or CT tongs to the conductors, do not assume that the insulation on the handle is adequate insulation. You must wear an insulating glove on each hand. Ensure that the exposed metal parts of the voltage cable clamps do not contact other conductors and cause a short circuit.

| | |
|---|---|
| ⚠ | Insulating Gloves must be worn on each hand when handling voltage cables or CT tongs. |

### *3.1.2. Equipment safety*

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

*INSPECTION BEFORE USE:*

Prior to using a PowerMonic, you should check the following:

- No outer sheath of any cable is damaged, and no inner insulation is showing.
- The sheaths of all cables are secured at the ends.
- Plugs and connectors, including fuse holders are properly connected and serviceable.
- The operating range, as indicated on the front of the PowerMonic, is suitable for the application.

*PERIODIC MAINTENANCE AND TESTING:*

The PowerMonic and cables should be inspected, tested and tagged on a regular basis (e.g. every 3-6 months).
Testing should include:

- Inspection (as above).
- Insulation test conducted at 500 V DC between each phase conductor with a minimum acceptable level of insulation resistance of 1 MΩ.
- A record of inspections should be kept that shows:
- Date of inspection, plant number or inspection number for the PowerMonic/accessory.
- Results of the tests and inspections and details of any repair work.
- Signature of an authorised inspector.

***EQUIPMENT FAULTS*:**

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

***CALIBRATION:***

It is recommended that the equipment should be calibrated every 12 months.

## ***CLEANING YOUR EQUIPMENT:***

All equipment should be cleaned with a soft, moist cloth using only a mild detergent.

## ***STANDBY BATTERY:***

The PowerMonic uses a sealed cable acid standby battery to power the unit when loss of AC supply occurs for two minutes to allow logging of waveforms etc. Like all Cable Acid batteries, the performance of the battery will degrade if it is exposed to long periods of high temperature and/or it is allowed to discharge excessively. The battery life of the PowerMonic can be extended by following a few simple precautions as outlined below:

- When the PowerMonic is not in use it should be stored at ambient temperatures below $30^{o}$ C
- When the PowerMonic is not in use it should be stored with a fully charged battery. This can be achieved by:
  - Charge the battery by energising the PowerMonic for 24 hours before storage
  - Recharge the battery after every three months of non use
  - Recharge the battery after each use of the PowerMonic

## 3.2. IEC 61010 Measurement Category

Under the IEC 61010 standard, the location of the measured point determines the transient over-voltage stresses that may be imposed on the measuring equipment. This voltage is independent of the nominal working voltage (e.g. 240 volts) of the system The four measurement categories (also known as over-voltage Categories) are:

| ***Measurement Category*** | ***Description*** | ***Examples*** |
|---|---|---|
| CAT I | Measurements of circuits ***not directly connected*** to Mains | Secondary's of low power transformers, Protected electronic equipment, |
| CAT II | Measurements performed on circuits directly connected to the low voltage installation | Household appliance, portable tools and similar equipment |
| CAT III | Measurements performed in the building installation | Distribution boards, circuit breakers, wiring, bus-bars, switches, socket outlets, industrial equipment such as stationary motors permanently connected to the fixed installation |
| CAT IV | Measurements performed at the source of the low voltage installation | Electricity Meters, overhead lines, primary overcurrent protection equipment, underground cables to remote equipment |

Under the IEC 61010 standard, Equipment is assigned a working voltage value (e.g. 300 Volts) and a measurement category which reflects the amount of over-voltage stress that the equipment can tolerate. This is expressed as a CAT number and associated working voltage value. The PowerMonic is rated at Measurement Category CAT III, 440 Volts.

## 4. CONFIGURING THE POWERMONIC BEFORE USE

### 1.1 Installing the PowerView 4 software

***Warning***

**The PowerView 4 software must be installed from the accompanying CD before connecting the PowerMonic PM40 to the computer's USB port.**

1. Place the accompanying CD in the CD drive of your PC
2. From the CD run ***PV4setup_4_1.EXE***
3. Follow the on-screen instructions
4. After the installation has finished, an icon named ***PowerView 4*** will be visible on the Desktop

*Notes*

- You may need System Administrator rights to install new software to your computer
- The default destination folder is:

  ***C:\Program Files\GridSense\PowerMonic\PowerView4***
- Alternatively the program can be executed selecting from the Windows XP ***Start*** menu:

  ***Start/All Programs/GridSense/PowerMonic/PowerView 4***

### 1.2 Connecting the PowerMonic PM40 to the computer's USB port for the first time

1. Power up the ***PowerMonic PM40***, using the proper voltage cable, before connecting to the computer's USB port
2. Connect the ***PowerMonic PM40*** to the computer's USB port using the supplied USB cable

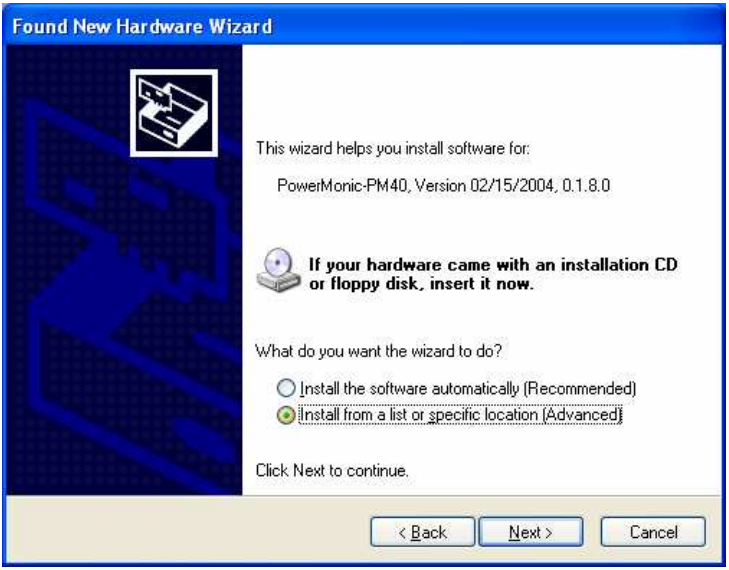
3. Windows XP will indicate that it has found a new hardware popping up the following message:

   ***Found new hardware PowerMonic-PM40***

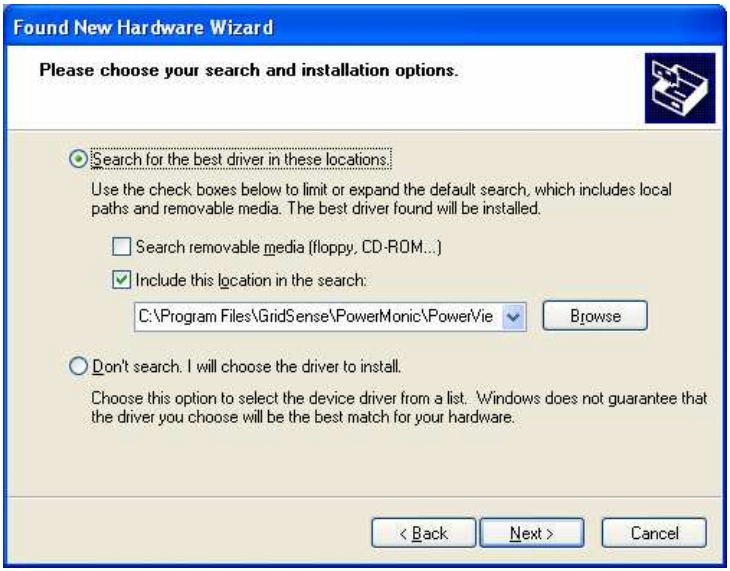
4. Then, the ***Found New Hardware Wizard*** will start

5. On the ***Welcome to the Found New Hardware Wizard*** screen select the option ***No, not at this time***, then click ***Next***


6. Now select the option ***Install from a list or specific location (Advanced)*** , then click ***Next***




7. On this screen select the option ***Search for the best driver in these locations***, and check the option ***Include this location in the search***:

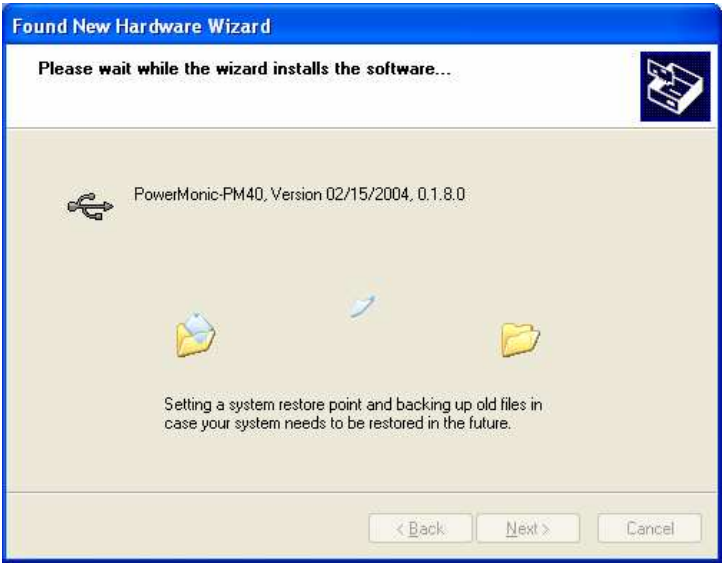


8. On this screen click on ***Browse*** and locate folder ***C:\Program Files\GridSense\PowerMonic\PowerView4***and then click OK


9. After selected the folder click ***OK***

10. The following warning screen will pop up. Click ***Continue Anyway***


11. Now the USB driver will be installed into your system. Please wait while the wizard installs the software




12. After the wizard had successfully completed the installation, click ***Finish***

13. The computer is now ready to communicate via USB interface with the ***PowerMonic PM40*** using the ***PowerView 4*** software. The PowerMonic is configured using a PC or Laptop running PowerView IV software on MS Windows™ 2000 or XP. To install this software, refer to the PowerView IV User Manual.

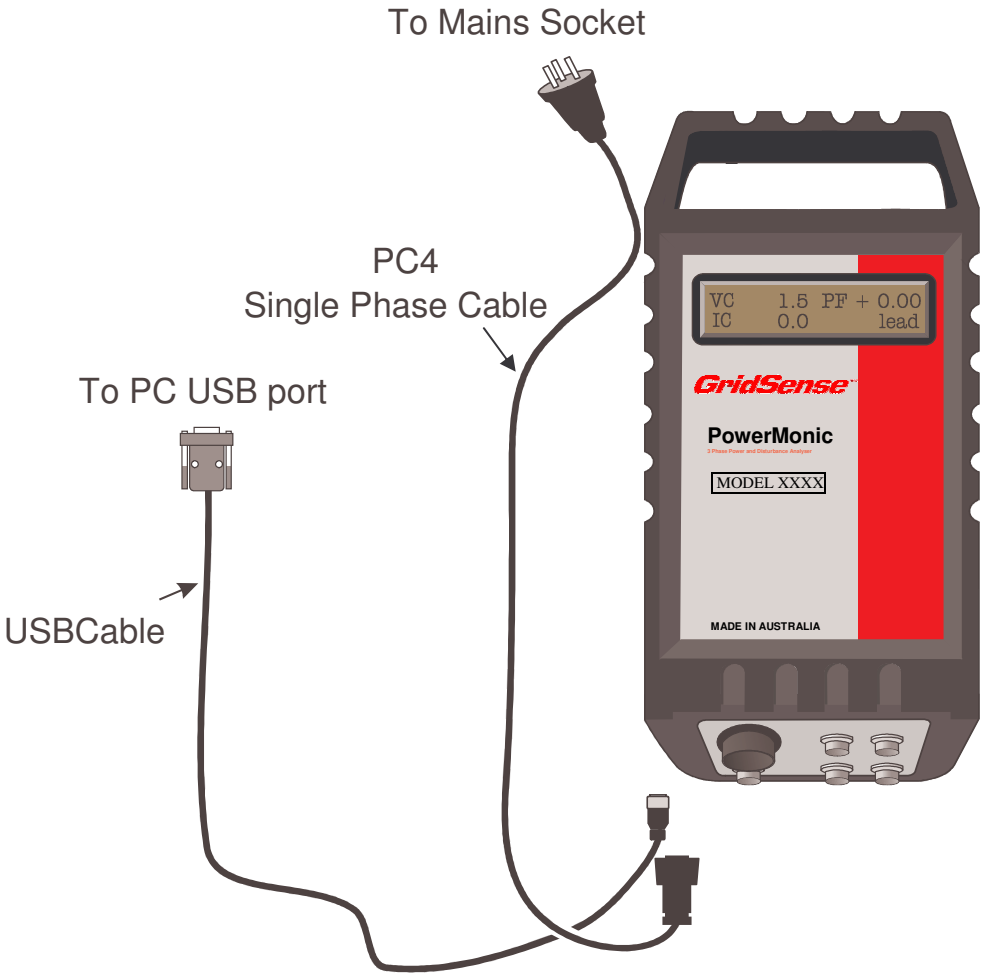



*Fig 16 – Connecting the PowerMonic to the PC*

# 5. INSTALLING YOUR POWERMONIC

The PowerMonic must be installed in accordance with the relevant legislation and workplace OH&S guidelines. Refer to section *3.* SAfe use of the PowerMonic for basic safety advice that should be followed if no other procedures apply.

When connecting current transformers (CTs) to the PowerMonic, ensure that each CT is matched to the appropriate voltage channel (refer to the diagrams with the installation instructions).

| Australia Phase ID | Voltage Cable Colour | Current Transformer Channel |
|---|---|---|
| A | Black | A |
| B | Red | B |
| C | Blue | C |
| Neutral | White | N (Neutral) |

The voltage cables are colour-coded red, white and blue (A, B, and C phase) and are to be attached to corresponding phases. The PowerMonic is powered from the A phase connection.
On VL4-2 type cables, the White cable is the neutral connection.

## 5.1. Pre-installation checks

- Verify that the nominal voltage to be tested is within the operating range of the PowerMonic as indicated on the front label.
- Identify and test the neutral and all phases.
- Ensure that voltage cables and CT cables are secured and not likely to move or dislodge.
- The PowerMonic is powered by A phase voltage. You must connect this phase for the PowerMonic to begin logging.

- Unused voltage cables should be connected to neutral or placed in an isolated container. (Do not leave the unit unattended with unconnected voltage clamps).
- The A phase must be able to provide 10 W to power the PowerMonic.

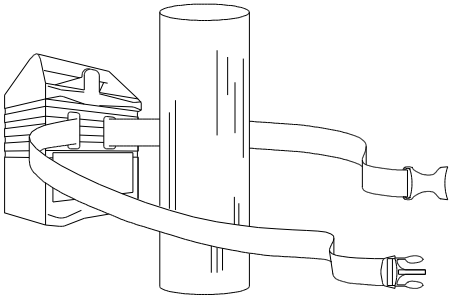
## 5.2. Warranty cards

When you first install your PowerMonic, you should complete your warranty card and mail it (postage paid) to CHK GridSense Pty Ltd.

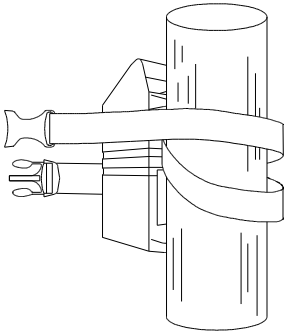
## 5.3. Securing the PowerMonic with the holster and strap

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

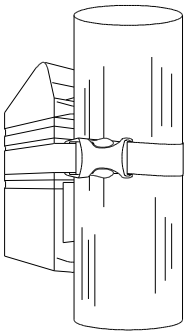
***Step 1.*** The strap is first fed through the holster slats and wrapped around the pole.



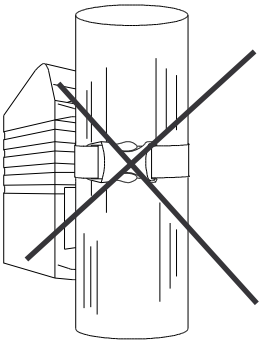
***Step 2.*** Bring the strap forward to embrace the PowerMonic.



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



***Note:*** *Do not* connect the PowerMonic PM40 to the pole without embracing the unit with the strap, as this may weaken the holster over time.



## 5.4. Connecting a PowerMonic to a 3-phase 4-wire system

| | |
|---|---|
| ⚠ | Ensure all safety procedures are followed. |

| | |
|---|---|
| ℹ | This procedure assumes the use of a VL4 voltage cable. |

1. Secure the PowerMonic to a safe position.
2. (Refer to
3. Fig ) Connect the CTs to the PowerMonic, observing correct phase connections.
4. Connect the CTs to the conductors. Ensure that the arrow is pointing in the direction of the load.
5. Connect all voltage cables to the neutral conductor or place in an isolated bag.
6. Connect the neutral (White) cable to the neutral conductor.
7. Connect the Black cable to the A phase conductor.
8. Connect the Red cable to the B phase conductor.
9. Connect the Blue cable to the C phase conductor.

| | |
|---|---|
| ℹ | Unused voltage cable clamps should be connected to the neutral conductor |

| | |
|---|---|
| ℹ | Clamps will short live conductors. |

10. Plug the free end of VL4 cable to PowerMonic.
11. Verify that PowerMonic starts up. Check the readings including the power factor to ensure correct connection of voltage cables and CTs.
12. If the power factor for any phase is displayed as a negative reading, carefully reverse the orientation of the CT for that phase.

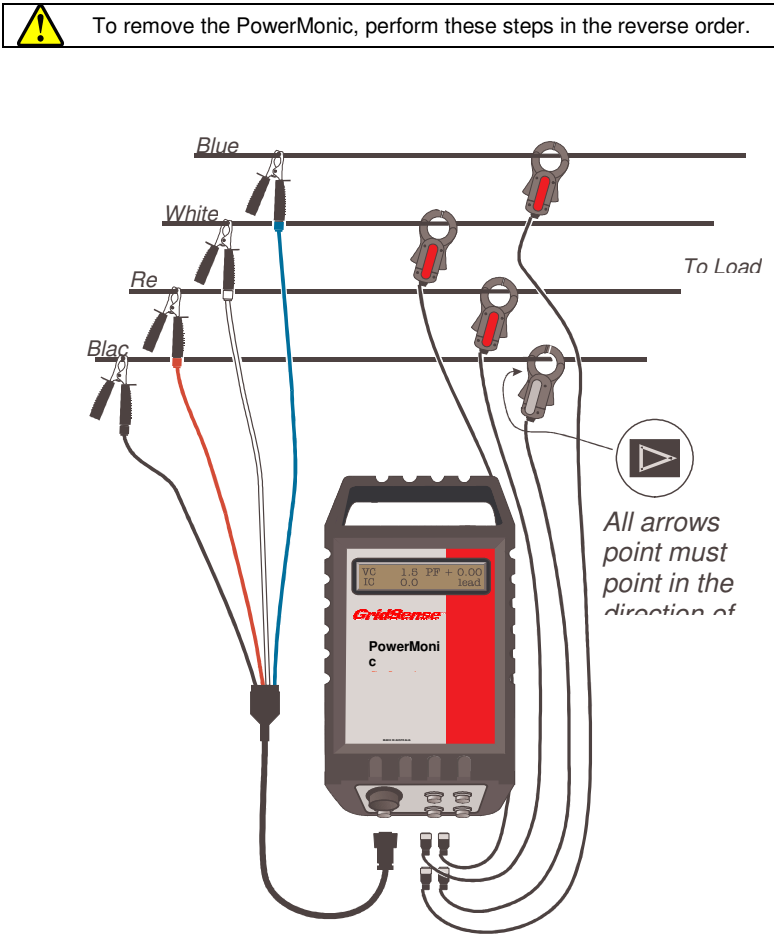



*Fig 17 - Connecting the PowerMonic to a 3-phase 4-wire system*

## 5.5. Connecting a PowerMonic to a 3-phase 3-wire system

| | |
|---|---|
| ⚠ | Ensure all safety procedures are followed. |

| | |
|---|---|
| ℹ | This procedure assumes the use of a VL6 voltage cable. |

1. Secure PowerMonic to a safe position.
2. (Refer to Fig 18) Connect the CTs to the PowerMonic, observing correct phase connections.
3. Connect the CTs to the conductors. Ensure that the arrow is pointing in the direction of the load.
4. Connect the VL6-2 cables as follows:

| Cable ID | VL6 Cable Colour | Fuseholder Colour | Conductor |
|---|---|---|---|
| A Phase Active | ***Black*** | ***Black*** | A |
| A Phase Reference | ***White/Black*** | ***White*** | B |
| B Phase Active | ***Red*** | ***Red*** | B |
| B Phase Reference | ***White/Red*** | ***White*** | C |
| C Phase Active | ***Blue*** | ***Blue*** | C |
| C Phase Reference | ***White/Blue*** | ***White*** | A |

5. Connect the A phase reference to the B phase conductor.
6. Connect the A phase active to the A phase conductor.
7. Connect the B phase reference to the C phase conductor.
8. Connect the B phase active to the B phase conductor.
9. Connect the C phase reference to the A phase conductor.
10. Connect the C phase active to the C phase conductor.

| | |
|---|---|
| ℹ | Unused voltage cable clamps should be connected to the neutral conductor |

11. Plug the free end of VL6 cable to PowerMonic.
12. Verify that PowerMonic starts up. Check the readings including the power factor to ensure correct connection of voltage cables and CTs (refer to section *Error! Reference source not found.*).
13. If the power factor for any phase is displayed as a negative reading, carefully reverse the orientation of the CT for that phase.

| | |
|---|---|
| ⚠ | To remove the PowerMonic, perform these steps in the reverse order. |

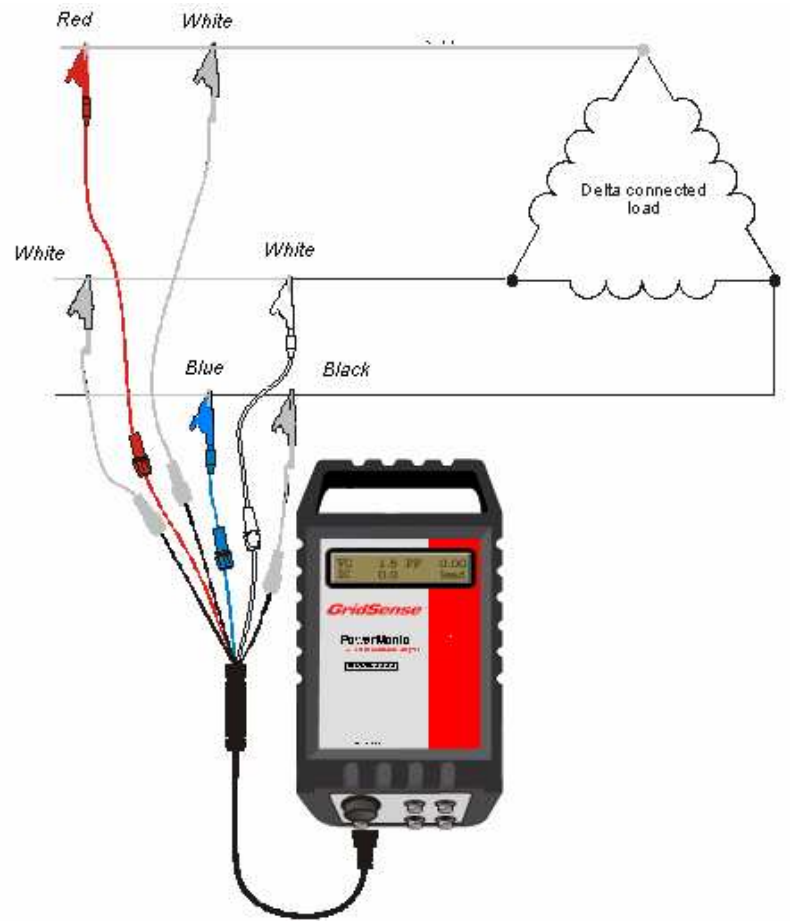



*Fig 18 - Connecting the PowerMonic to a 3-phase 3-wire system*

## 6. PowerMonic USA Circuit Connections

This section provides guidelines and recommendations for connections to typical North American low voltage circuits.

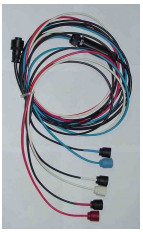
The PowerMonic voltage cables supplied to North America are manufactured to the USA National Electric Color Code scheme. The PowerMonic has four different types of main cables, these are:

1. **PC4-2**: Single Phase, a.c. wall plug cable used to power up the PowerMonic to configure, download and monitor household single phase voltages
2. **VL3-2**: A three-wire voltage cable used on Delta voltage connections
3. **VL4-2**: A four-wire voltage cable used on Wye and Split circuit (single-bushing transformer-multi-grounded primary circuits) voltage connections.
4. **VL6-2**: A six-wire voltage cable that can be used on Delta, Wye and Split circuit (single-bushing transformer-multi-grounded primary circuits) voltage connections.

1. PC4-2

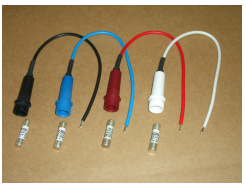
2. VL3-2

3. VL4-2



4. VL6-2 Wye/Delta

1. Banana Plug & Small Clamp



2. Tinned Ends

3. Large Clamp

The PowerMonic voltage cables are double insulated and UV stabilized and is suitable for indoor and outdoor installations. Each phase of the voltage cable is separately fused and there are various voltage cable attachments available to

suit different types of installations, these include, 4mm Banana Plug, Small Alligator Clamps, Tinned (bare wire) Ends and Large Clamps.

**North American PowerMonic Voltage Cables Color Coding**

The table below compares the phasing color codes for the North American and Australasian markets:

| Voltage | North America | Australasia |
|---|---|---|
| A-Phase | Black | Red |
| B-Phase | Red | Blue |
| C-Phase | Blue | White |
| Neutral | White | Black |

When configuring the PowerMonic there are three configuration settings that correspond to the circuit connection on voltage. These are highlighted in the above screen shot and summarized below.

a. Nominal Voltage = Circuit voltage measurement, Phase-Phase or Phase-Neutral
b. Nominal and Initial Line frequency = 50Hz Europe/Australasia, 60Hz North America
c. Voltage Cable Connection = State if the voltage connection is Wye (Star) or Delta

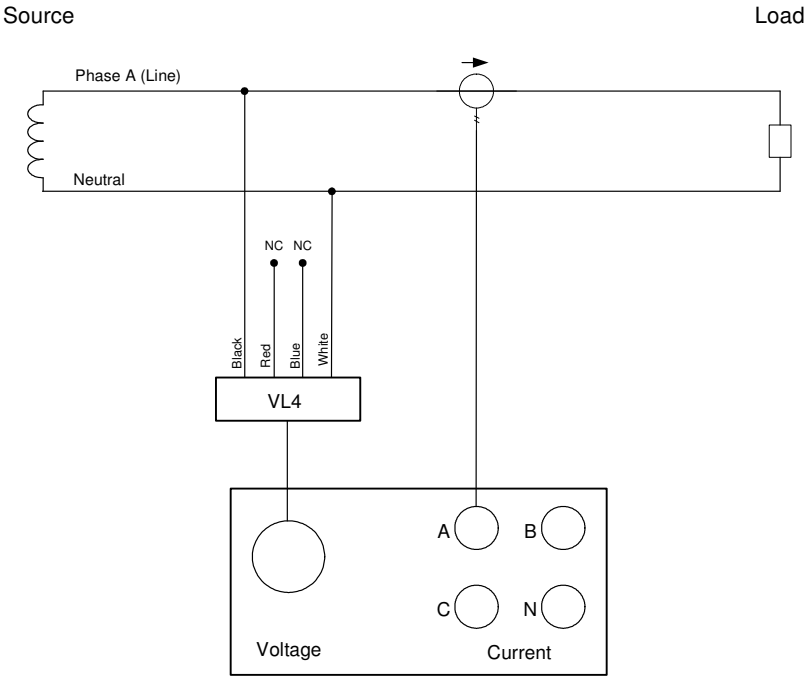
## Summary of PowerMonic Connections

The table below provides a summary of the various North American circuit connections that the PowerMonic can be installed on. The table highlights which voltage cable assembly can be used, the voltage connection type and nominal RMS settings to used in the PowerView configuration parameters. Detailed connection diagrams for each circuit can be found on the following pages.

| Ref. | Source Type | Load Type | Voltage Cable | Voltage Connection | Nominal RMS Voltage |
|---|---|---|---|---|---|
| 6.1 | Single Phase | Single Phase | PC4, VL4, VL6 | Star (Wye) | Phase-Neutral |
| 6.2 | Split Phase | 2 Single Phase | VL4, VL6 | Star (Wye) | Phase-Neutral |
| 6.3 | 3 Phase, 4 Wire (Wye) | Wye | VL4, VL6 | Star (Wye) | Phase-Neutral |
| 6.4 | 3 Phase, 3 Wire (Wye) | Delta | VL3, VL6 | Delta | Phase-Phase |
| 6.5 | 3 Phase, 3 Wire (Wye) | 3 Single Phase | VL3, VL6 | Star (Wye) | Phase-Phase |
| 6.6 | 3 Phase, 3 Wire (Delta) | Delta | VL3, VL6 | Delta | Phase-Phase |
| 6.7 | Delta Mid-Tap | 2 Single Phase | VL4, VL6 | Star (Wye) | Phase-Neutral |
| 6.8 | 3 Phase, 2 Watt (Delta) | Delta | VL6 | Delta | Phase-Phase |
| 6.9 | Generic | 3 Single Phase | VL6 | Star (Wye) | Phase-Neutral |

## 6.1 Single Phase

a. Connection Diagram using 4-Wire Voltage Cable (VL4-2)

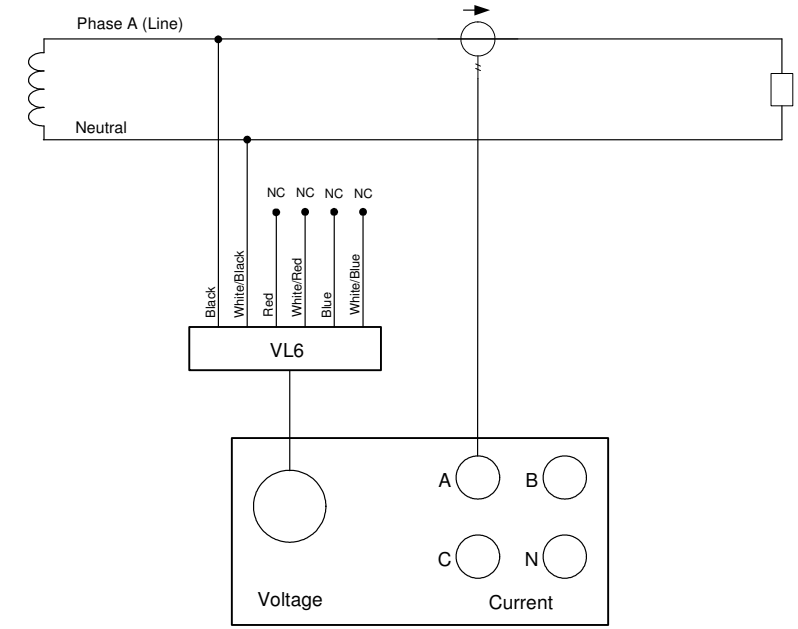



**2.**

NC = Not Connected

| **Circuit Summary Table** | |
|---|---|
| Source | Single Phase |
| Load | Single Phase |
| Connection | Wye |
| Nominal RMS | Phase-Neutral |
| **Voltage Cable Connection** | |
| A-Phase | Black |
| B-Phase | Red |
| C-Phase | Blue |
| Neutral | White |

b. Connection Diagram using optional 6-Wire Voltage Cable (VL6-2)




NC = Not Connected

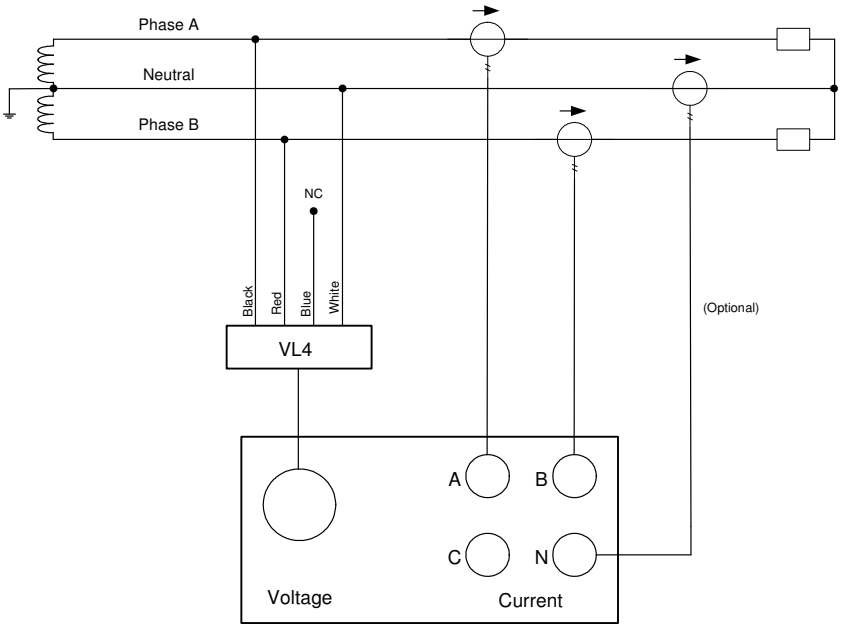
Phasor Diagram


| **Circuit Summary Table** | |
|---|---|
| Source | Single Phase |
| Load | Single Phase |
| Connection | Wye |
| Nominal RMS | Phase-Neutral |
| **Voltage Cable Connection** | |
| A-Phase | Black |
| B-Phase | Red |
| C-Phase | Blue |
| Neutral-A | White/Black |
| Neutral-B | White/Red |
| Neutral-C | White/Blue |

## 6.2 Split Phase with 2 Single Phase Loads

a. Connection Diagram using 4-Wire Voltage Cable (VL4-2)

Source Load

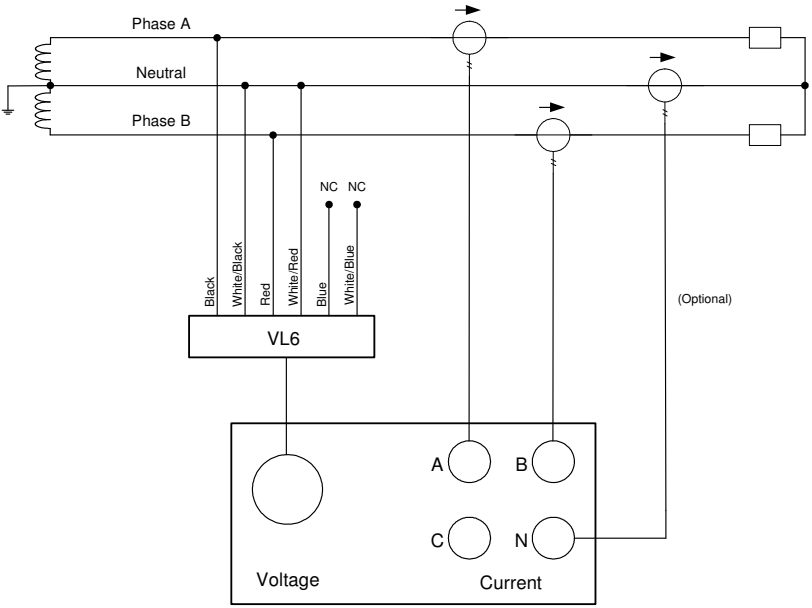



NC = Not Connected

| **Circuit Summary Table** | |
|---|---|
| Source | Split Phase |
| Load | 2 Single Phase |
| Connection | Wye |
| Nominal RMS | Phase-Neutral |
| **Voltage Cable Connection** | |
| A-Phase | Black |
| B-Phase | Red |
| C-Phase | Blue |
| Neutral | White |

b. Connection Diagram using 6-Wire Voltage Cable (VL6-2)

Source Load



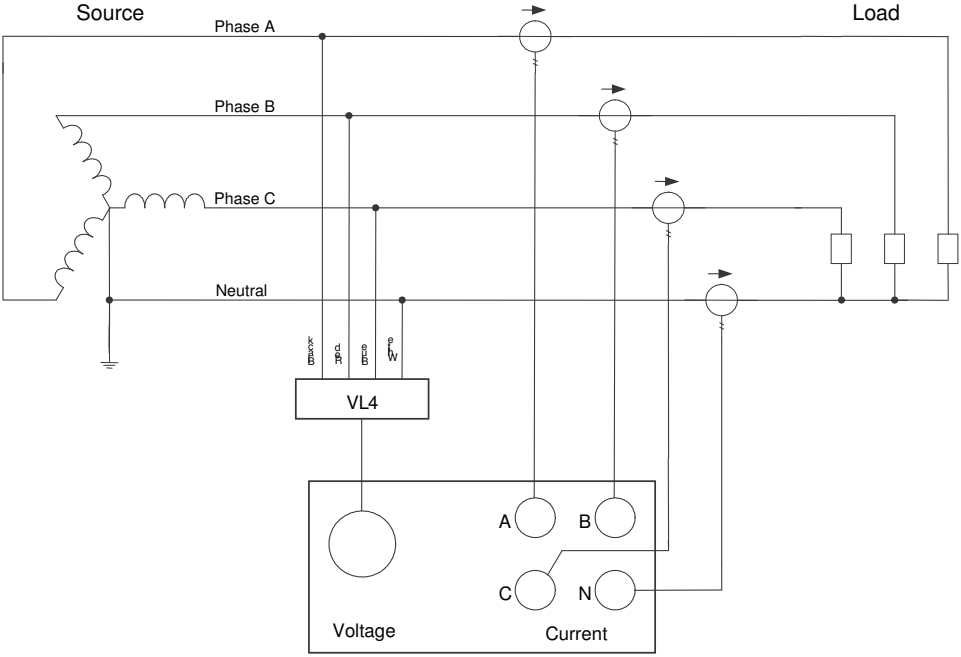

NC = Not Connected

| Circuit Summary Table | |
|---|---|
| Source | Split Phase |
| Load | 2 Single Phase |
| Connection | Wye |
| Nominal RMS | Phase-Neutral |
| **Voltage Cable Connection** | |
| A-Phase | Black |
| B-Phase | Red |
| C-Phase | Blue |
| Neutral-A | White/Black |
| Neutral-B | White/Red |
| Neutral-C | White/Blue |

Phasor Diagram

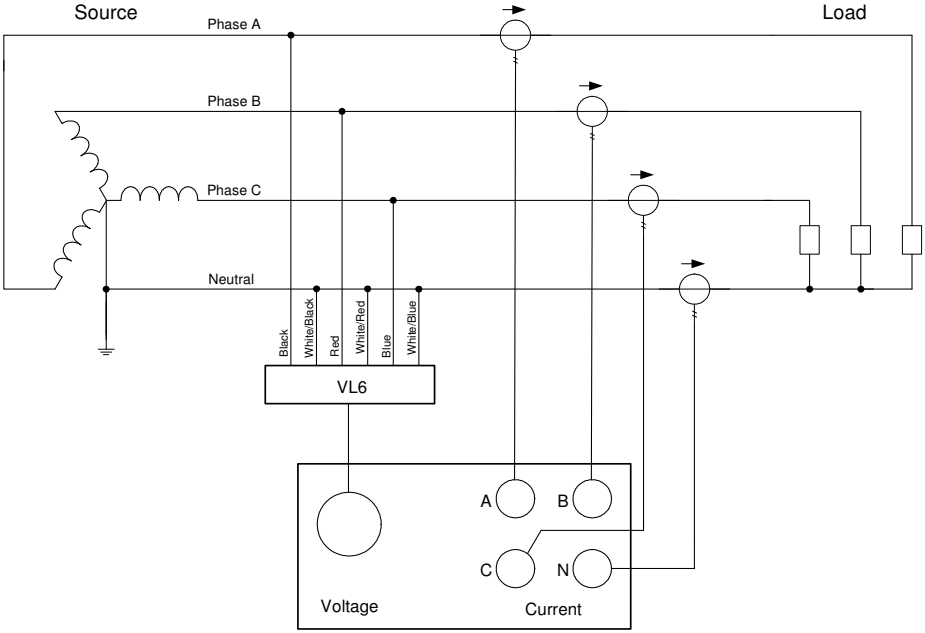
## 6.3 Three-Phase 4-Wire Wye Source with Wye Load

a. Connection Diagram using 4-Wire Voltage Cable (VL4-2)



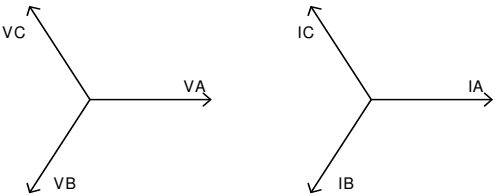

| Circuit Summary Table | |
|---|---|
| Source | 3-Phase Wye |
| Load | Wye |
| Connection | Wye |
| Nominal RMS | Phase-Neutral |
| **Voltage Cable Connection** | |
| A-Phase | Black |
| B-Phase | Red |
| C-Phase | Blue |
| Neutral | White |

b. Connection Diagram using 6-Wire Voltage Cable (VL6-2)



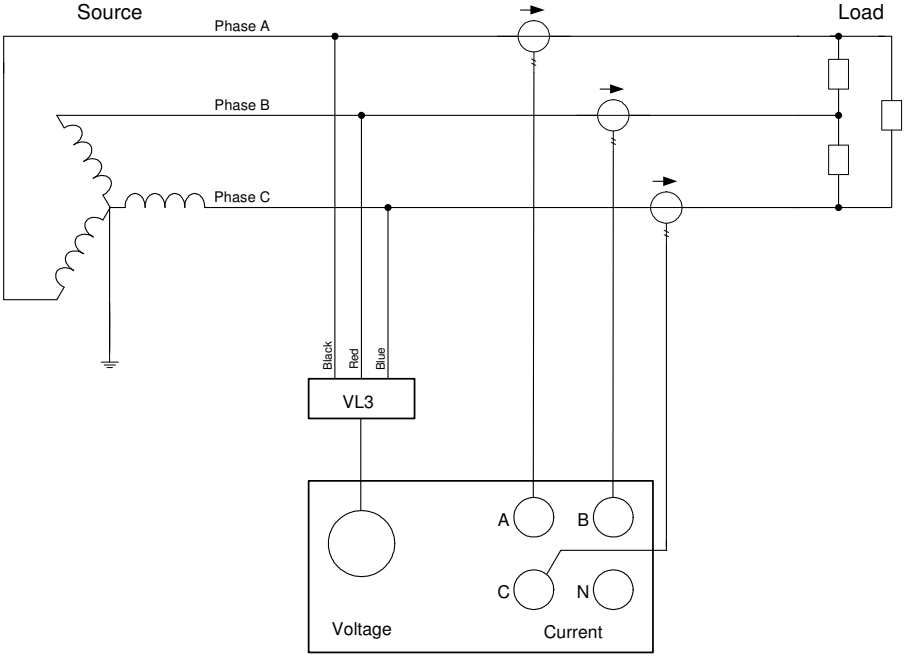

| Circuit Summary Table | |
|---|---|
| Source | 3-Phase Wye |
| Load | Wye |
| Connection | Wye |
| Nominal RMS | Phase-Neutral |
| **Voltage Cable Connection** | |
| A-Phase | Black |
| B-Phase | Red |
| C-Phase | Blue |
| Neutral-A | White/Black |
| Neutral-B | White/Red |
| Neutral-C | White/Blue |

Phasor Diagram



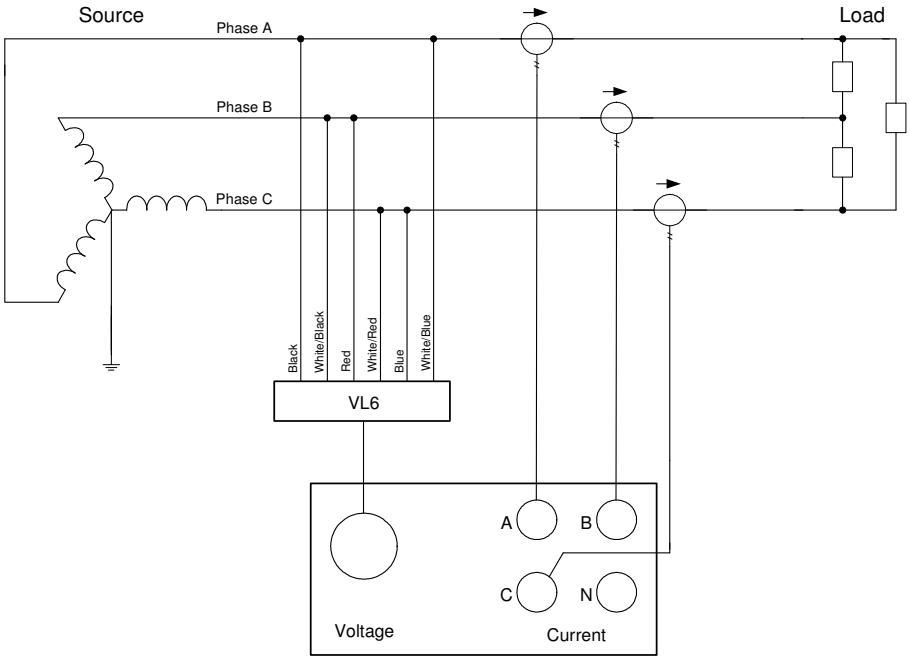
## 6.4 Three-Phase 4-Wire Wye Source with Delta Load

a. Connection Diagram using 3-Wire Voltage Cable (VL3-2)



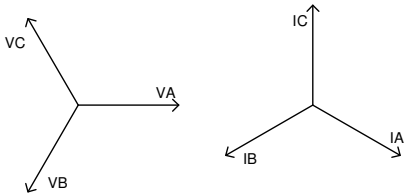

| Circuit Summary Table | |
|---|---|
| Source | 3-Phase Wye |
| Load | Delta |
| Connection | Delta |
| Nominal RMS | Phase-Phase |
| **Voltage Cable Connection** | |
| A-Phase | Black |
| B-Phase | Red |
| C-Phase | Blue |

b. Connection Diagram using 6-Wire Voltage Cable (VL6-2)



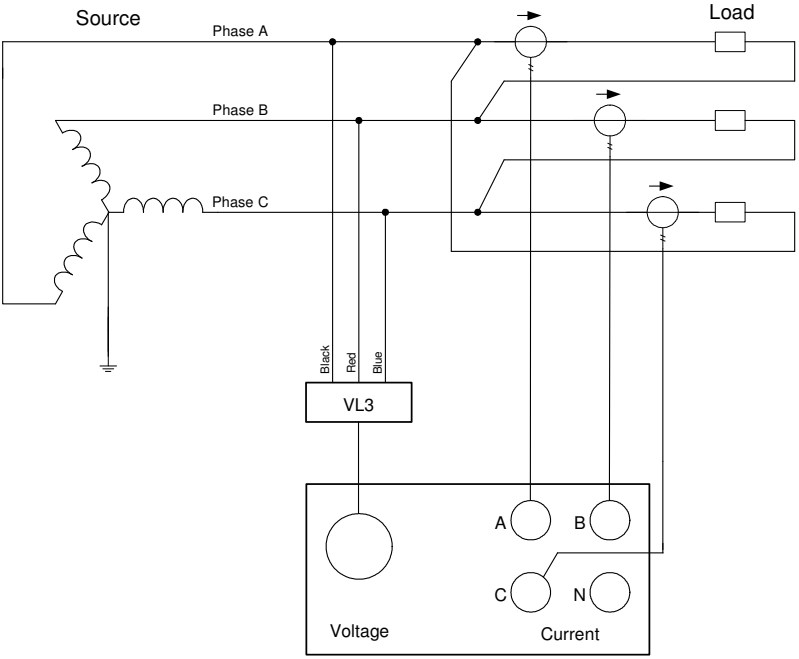

| Circuit Summary Table | |
|---|---|
| Source | 3-Phase Wye |
| Load | Delta |
| Connection | Delta |
| Nominal RMS | Phase-Phase |
| **Voltage Cable Connection** | |
| A-Phase | Black |
| B-Phase | Red |
| C-Phase | Blue |
| Neutral-A | White/Black |
| Neutral-B | White/Red |
| Neutral-C | White/Blue |

Phasor diagram



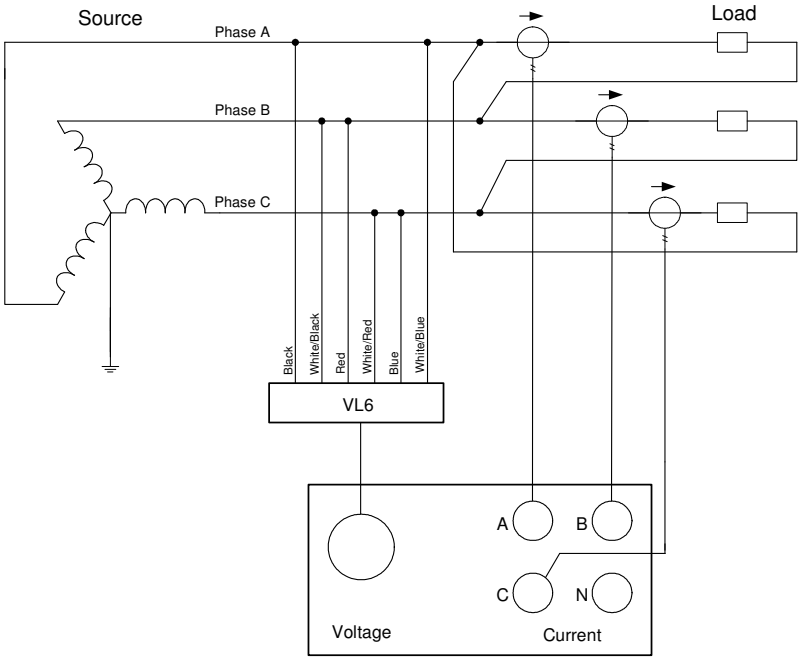
## 6.5 Three-Phase 4-Wire Wye Source with 3 Single Phase Loads

a. Connection Diagram using 3-Wire Voltage Cable (VL3-2)



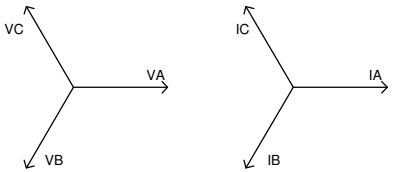

| Circuit Summary Table | |
|---|---|
| Source | 3-Phase Wye |
| Load | 3 Single Phases |
| Connection | Star |
| Nominal RMS | Phase-Phase |
| **Voltage Cable Connection** | |
| A-Phase | Black |
| B-Phase | Red |
| C-Phase | Blue |

b. Connection Diagram using 6-Wire Voltage Cable (VL6-2)



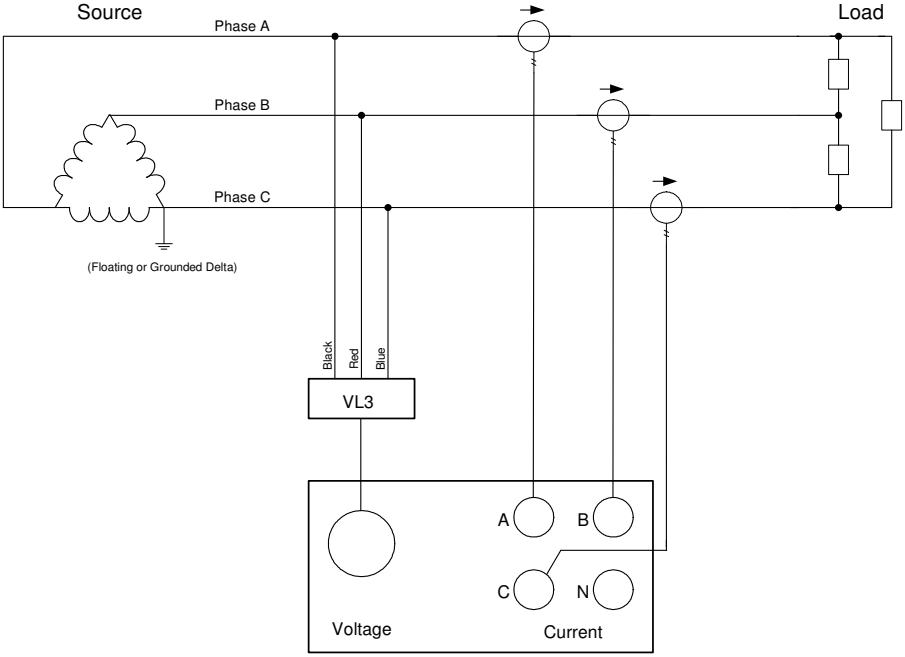

| Circuit Summary Table | |
|---|---|
| Source | 3-Phase Wye |
| Load | 3 Single Phases |
| Connection | Star |
| Nominal RMS | Phase-Phase |
| **Voltage Cable Connection** | |
| A-Phase | Black |
| B-Phase | Red |
| C-Phase | Blue |
| Neutral-A | White/Black |
| Neutral-B | White/Red |
| Neutral-C | White/Blue |

Phasor Diagram



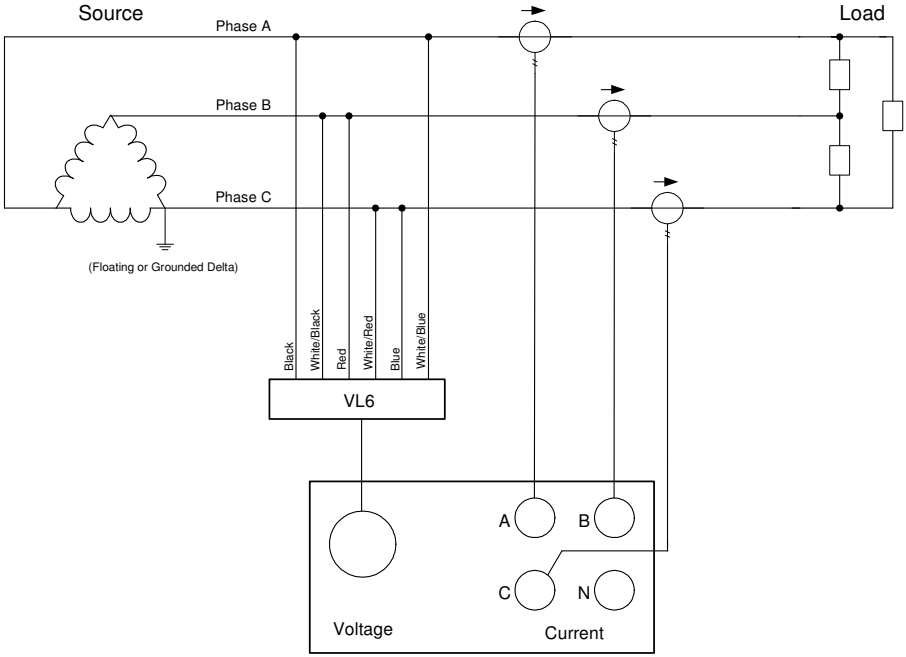
## 6.6 Three-Phase 3-Wire Delta Source with Delta Load

a. Connection Diagram using 3-Wire Voltage Cable (VL3-2)

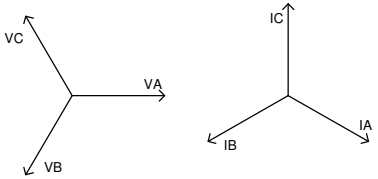



| Circuit Summary Table | |
|---|---|
| Source | 3-Phase Delta |
| Load | Delta |
| Connection | Delta |
| Nominal RMS | Phase-Phase |
| **Voltage Cable Connection** | |
| A-Phase | Black |
| B-Phase | Red |
| C-Phase | Blue |

b. Connection Diagram using 6-Wire Voltage Cable (VL6-2)



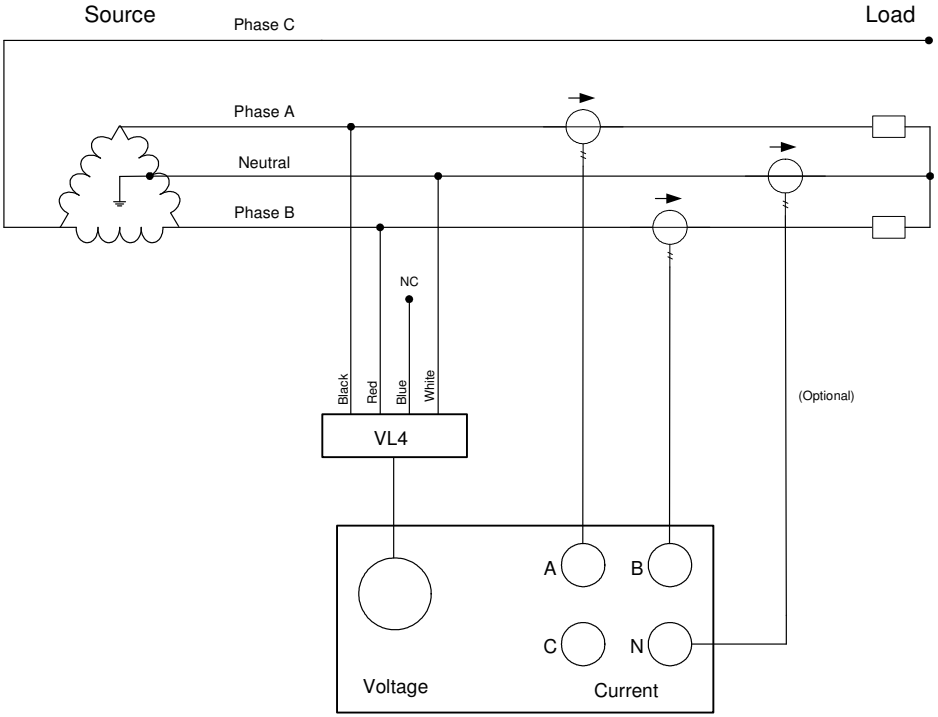

Phasor Diagram




| **Circuit Summary Table** | |
|---|---|
| Source | 3-Phase Delta |
| Load | Delta |
| Connection | Delta |
| Nominal RMS | Phase-Phase |
| **Voltage Cable Connection** | |
| A-Phase | Black |
| B-Phase | Red |
| C-Phase | Blue |
| Neutral-A | White/Black |
| Neutral-B | White/Red |
| Neutral-C | White/Blue |

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

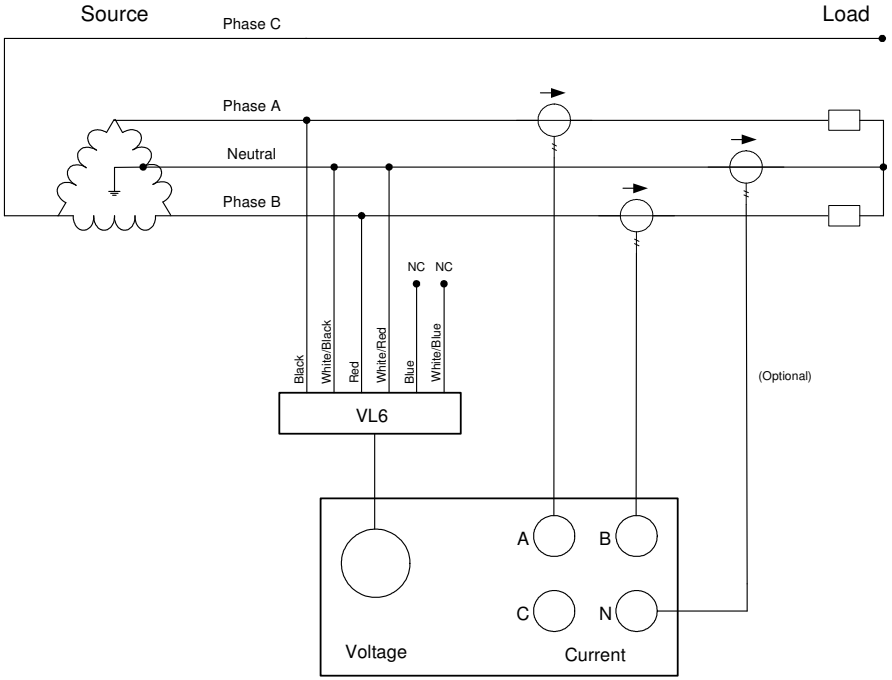
a. Connection Diagram using 4-Wire Voltage Cable (VL4-2)




NC = Not Connected

| **Circuit Summary Table** | |
|---|---|
| Source | Delta Mid Tap |
| Load | 2-Single Phases |
| Connection | Wye |
| Nominal RMS | Phase-Neutral |
| **Voltage Cable Connection** | |
| A-Phase | Black |
| B-Phase | Red |
| C-Phase | Blue |
| Neutral | White |

b. Connection Diagram using 6-Wire Voltage Cable (VL6-2)



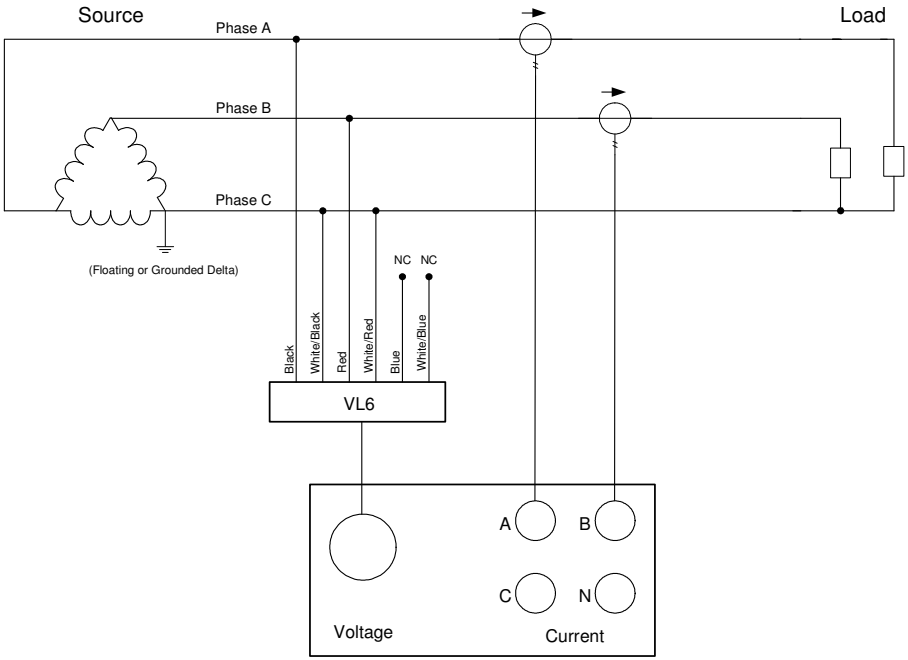

NC = Not Connected

| Circuit Summary Table | |
|---|---|
| Source | Delta Mid Tap |
| Load | 2-Single Phases |
| Connection | Wye |
| Nominal RMS | Phase-Neutral |
| **Voltage Cable Connection** | |
| A-Phase | Black |
| B-Phase | Red |
| C-Phase | Blue |
| Neutral-A | White/Black |
| Neutral-B | White/Red |
| Neutral-C | White/Blue |

Phasor Diagram

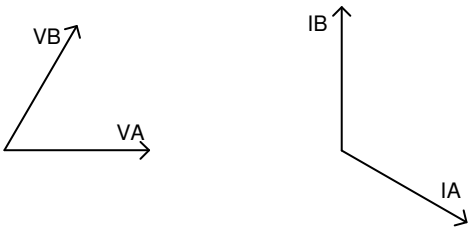
## 6.8 Three-Phase 2-Watt Delta Source with Delta Load

Connection Diagram using 6-Wire Voltage Cable (VL6-2)




NC = Not Connected

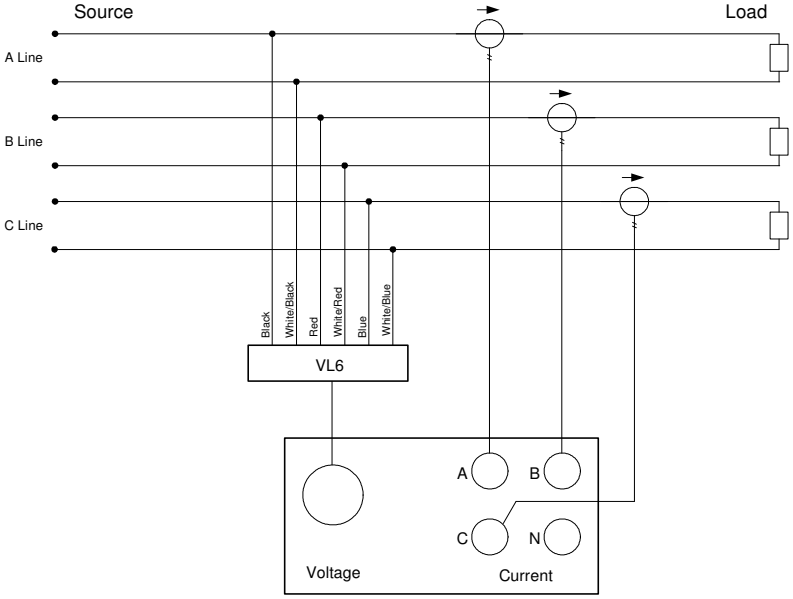
Phasor Diagram




| Circuit Summary Table | |
|---|---|
| Source | 3-Phase Delta |
| Load | Delta |
| Connection | |
| Nominal RMS | Phase-Phase |
| **Voltage Cable Connection** | |
| A-Phase | Black |
| B-Phase | Red |
| C-Phase | Blue |
| Neutral-A | White/Black |
| Neutral-B | White/Red |
| Neutral-C | White/Blue |

## 5.9 Generic, 3 independent circuits

Connection Diagram using 6-Wire Voltage Cable (VL6-2)




Phasor Diagram


| **Circuit Summary Table** | |
|---|---|
| Source | Generic |
| Load | 3-Single Phases |
| Connection | Wye |
| Nominal RMS | Phase-Neutral |
| Pf Correction | None |
| **Voltage Cable Connection** | |
| A-Phase | Black |
| B-Phase | Red |
| C-Phase | Blue |
| Neutral-A | White/Black |
| Neutral-B | White/Red |
| Neutral-C | White/Blue |

# 7. POWERMONIC PM40 SPECIFICATIONS

## *MEASUREMENT*

| | Voltage | Current |
|---|---|---|
| **Input Channels** | 3 (isolated) | 4 |
| **Measuring Range (RMS)** | 63 -520 VAC | 0-3000 Amp |
| **Isolation Voltage between** | 600 V RMS | (not isolated between CT |
| **Frequency Range** | 50Hz nominal (42.5Hz - 57.5Hz)<br>60Hz nominal (51.0Hz – 69.0Hz) | 50Hz nominal (42.5Hz - 57.5Hz)<br>60Hz nominal (51.0Hz – 69.0Hz) |
| **Instrument Accuracy** | 0.4% reading ± 1 lsd | 0.4% reading ± 1 lsd |
| **System Accuracy** | 0.4% reading ± 1 lsd | 1% reading ±1lsd (0.5M |
| **Resolution Logged Data** | 0.001 Volt | 0.001 Amp |
| **Resolution Display** | 0.1 Volt | 0.1 Amp |
| **Instrument Input** | 63 -520 VAC | 0-440mV @10K Ohms |
| **CT Burden** | n/a | 2.2 Ohm +/-1% (if applicable) |
| **Instrument Type** | Class B (IEC 61000-4-30) | |
| **Samples / Cycle** | 204 @ 50Hz, 170 @60Hz | |
| **Samples rate** | PLL synchronised, Standard IEC61000-4-7 | |
| **Logged Parameters** | V, A, Min/Max, Freq, TPF, DPF, kW, KVA, kVAR, | |
| **Frequency** | IEC61000-4-30 (+/- 0.02Hz) | |
| **Total Harmonic Distortion** | IEC61000-4-7 | |
| **Harmonics** | IEC61000-4-7 (Up to 48$^{th}$, Magnitudes & Angles) | |
| **Interharmonics** | IEC61000-4-7 (up to 48$^{th}$) | |
| **Flicker (Pst & Plt)** | IEC61000-4-15 (10min Pst, 2hr Plt, logged every 10min) | |
| **Voltage & Current Unbalance** | IEC61000-4-30 | |
| **Waveform Capture** | Duration: 400ms<br>Triggers: RMS, dV/dt, dI/dt | |
| **RMS Capture** | Half Cycle RMS<br>50Hz - 5s to 30s configurable<br>60Hz - 5s to 25s configurable | |
| **Sag / Swell Capture** | Half Cycle RMS | |
| **Circuit Connections** | Star/Wye (3P4W), Delta (3P3W3M), Delta (3P3W2M), Split Phase (1P3W), Single Phase (1P2W), Generic Independent Measurement. | |

## *MECHANICAL & POWER*

| | |
|---|---|
| **Display** | Graphic LCD 128 x 64 bits, 7 rows x 20 characters Information shown (configurable): date, time, status, voltages and currents, PF, frequency, Harmonics, Interharmonics, V & I unbalance, Flicker (Pst/Plt), V & I vectors of Cable/Lag |
| **Memory** | 15MB FLASH |
| **Communications** | USB1.1, RS232 for Remote operation |
| **Power** | 10W typical (from Phase A) |
| **Power Source Main** | Phase A to Neutral 63V – 520V AC |
| **Power Source** | 6V 0.5Ah Rechargeable Sealed Cable Acid |
| **Battery RTC** | 3V 950mAh Li-Manganese Dioxide / Organic Electrolyte |
| **Dimensions** | 230mm (l) x 120mm (w) x 90mm (d) or 9.1" (l) x 4.72" (w) x |
| **Weight** | 3kg (7lbs) instrument only, 7kg (16lbs) typical with accessories in |

## *ENVIRONMENTAL & SAFETY*

| | |
|---|---|
| **Temperature** | -20℃ to +60℃ (-4℉ to +130℉) |
| **Humidity** | 20% to 99% RH |
| **Protection Class** | IP65 |
| **Protection Levels** | IEC 61010-1 2001<br>Pollution Degree 2<br>Installation Category III<br>Material Group III, 600V<br>Measurement Category III 440Volts<br>(double Insulation or Reinforced Insulation) |

## *ABSOLUTE MAXIMUM RATINGS*

| | |
|---|---|
| **Phase to Phase Voltage** | 520VAC |
| **Phase to Ground** | 440VAC |

## 7.2 POWERMONIC PM30 SPECIFICATIONS

| | Voltage | Current |
|---|---|---|
| **Input Channels** | 3 (isolated) | 4 |
| **Measuring Range (RMS)** | 125-440 V<br>63-260 V available on request | 0-3000 A (max with clip-on CTs, others no limit) |
| **Isolation Voltage between Channels** | 600 V RMS | (not isolated between CT inputs) |
| **Power System Frequency** | 40-70 Hz (50-60 Hz nominal) | 40-70 Hz (50-60 Hz nominal) |
| **Instrument Accuracy** | 0.4% reading ± 1 lsd | 0.4% reading ± 1 lsd |
| **System Accuracy** | 0.4% reading ± 1 lsd | 1% reading ± 1 lsd<br>(0.5M CTs) |
| **Resolution** | 0.1 V | 0.1 A (0-500 A)<br>1 A (1000-3000 A) |
| **Instrument Input** | | 0-200 mA (Aust) 0-3v (USA) |
| **CT Burden** | | 2.2 Ω ± 1% |
| **Protection Levels** | IEC 61010-1 2001<br>Pollution Degree 2<br>Installation Category III<br>Material Group III, 600 V<br>Measurement Category III 440 Volts<br>(Double Insulation or Reinforced Insulation) | |

| Connectors | |
|---|---|
| **Voltage & Power** | 8 pin 30mm dia |
| **Current** | 4 pin circular |
| **Data** | 5 pin circular |

| Environmental | |
|---|---|
| **Temperature** | -10°C to + 60°C |
| **Humidity** | 20% to 99% RH |
| **Sealing** | IP65 |

| | |
|---|---|
| **Power Factor** | +1 to -1, Accuracy ± 0.01 ± 1 lsd |
| **Power (Real)** | Accuracy approx. 2% when used with class 0.5 M CTs |
| **Harmonics** | Logging from 1st to 48th, both even and odd |
| **Total Harmonic Distortion** | Accuracy ± 2% |
| **Sample Rate** | 11,413 samples per second (>228 / cycle at 50 Hz, >190 / cycle at 60 Hz) |
| **Logging Rate** | Normal RMS: 30 seconds to 4 hours (user selectable) |
| **Real Time Clock** | ± 50 ppm (2 min/month approx) |
| **Event Recording** (see table below) | RMS recording of 13.6 sec at 10 ms intervals<br>RMS recordings of 13.6 sec at 10ms intervals<br>Waveform recordings 120 ms @ 11,413 samples/s |
| **Power Source** | When Logging - A phase to Neutral, 63 – 520V<br>Rechargeable 6 V 0.5 Ah sealed lead acid battery backup for power outages<br>Clock – ½ AA, 3 V Lithium |
| **Power Consumption** | 10 W typical (from A phase) |
| **Memory** | 4 Mb of non-volatile FLASH memory |
| **Communication** | RS-232 serial interface, software selectable to 115,200 baud |
| **Display** | 2 line x 16 character, scrolling selected screens every 2 seconds<br>Information shown: date, time, 3 voltages and 4 currents, PF, frequency, log status, errors |
| **Analysis Software** | POWERview IV Microsoft Windows™-based |
| **Dimensions** | 230mm(l) x 120mm(w) x 90mm(d) |
| **Weight** | 3 kg (instrument), 7 kg typical with accessories in carry case |

## *ABSOLUTE MAXIMUM RATINGS*

| | |
|---|---|
| **Phase to Phase Voltage** | 520VAC |
| **Phase to Ground** | 440VAC |

## 7.1. CT ACCESSORIES

| Cat. No. | CV10 | CV200 | CV500 | CF3000-24 Flexi CT | CF3000-48 Flexi CT |
|---|---|---|---|---|---|
| **Range** | 0-10A | 20-200A | 50-500A | 30-3000A | 30-3000A |
| **Accuracy Class**[1] | 1M | 1M | 0.5M | 2M | 2M |
| **Window (mm)** | 50 (diameter) | | | L24"/165mm | L48"/260mm |
| **Weight (kg)** | 0.78 | | | 0.1 | 0.15 |
| **Encapsulation** | Plastic, fully insulating | | | | |
| **Burden** | 2.2 Ω | | | | |

[1] app 0.5% for 0.5M, 1% for 1M and 2% for 2M of reading accuracy from 0.1 to 1.25 full scale.

# 8. TROUBLESHOOTING

*8.1. The PowerMonic does not start up after applying power:*

When powered up, the PowerMonic LCD should show the instrument date/time and the log status. If the LCD remains off, check that the voltage cable is connected to the voltage connector and that the voltage cable is connected to the power point.

Note that the PowerMonic is powered from the Black (A) phase. A minimum voltage is required for start-up. Refer to ***PowerMonic PM40 Specification***.

If the LCD shows only a dark bar on the first line, the PowerMonic is not functioning due an internal hardware fault or it may have lost the firmware from the non-volatile memory. Return the unit to your supplier for repair.

*8.2. The PowerMonic does not display the Voltage/current values:*

If the values of voltages/currents do not display, you must configure the PowerMonic to do so using the PowerView software. The PowerMonic PM40 displays only the screens selected during configuration.

*8.3. The PowerMonic displays the voltage/current values as zero:*

- Check the connections of the voltage cables and CTs.
- Check the pins on the connectors on the PowerMonic,voltage cables and CTs for broken, loose, or dislodged pins.
- Check the fuses on the voltage cables.
- Check for faulty signal inputs on the PowerMonic by swapping the voltage or current inputs and checking the displayed value.
- Check for faulty current transformers by swapping the current inputs and checking the displayed value.

*8.4. The PowerMonic displays incorrect voltage/current values:*

- Check that the voltage cables and CTs are connected to the right inputs and phases.
- Check the pins on the connectors on the PowerMonic, voltage cable and CTs are not broken, loose, or has dislodged pins.
- Check the fuses on the voltage cables.

- Check that the CTs' pole faces are free of dirt or rust. Poorly-maintained CTs may cause measurement errors.

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

*8.5. The PowerMonic LCD shuts down immediately after removing power:*

When the power is removed from the PowerMonic , the LCD should remain active for at least 10 seconds. Typically the display remains active for a period of up to 2 minutes after the power is removed.

The PowerMonic 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 PowerMonic to power for 24 hours. If the problem persists, the battery may need replacing and you should return the PowerMonic to your supplier for service.

*8.6. The PowerMonic does not communicate with the PC using the PowerView software:*

- Check if the data cable (USBCABLE) is connected to the PowerMonic's data connector and to the PC's USB port.
- Ensure the initial set/up procedure detailed on pages 24-28 has been followed.
- Check that no pins on the PowerMonic's data cable (USBCABLE) or the PowerMonic COM port are broken, loose, or dislodged.
- Check that the PowerMonic is powered on and functioning.

*8.7. The PowerMonic date and time are not correct:*

The PowerMonic clock can be set using the PowerView software. The internal clock is maintained during power-off periods by an internal battery. The clock can be synchronised with your PC or Laptop using the PowerView softwarre. If the problem persists, return the unit to your supplier for repair.

# 9. USER NOTES

## 10. CHK GRIDSENSE SUPPORT SERVICES

If you have any questions about the operation of the PowerMonic or the PowerView software, first look in the accompanying PowerMonic Users Guide, the PowerView User Manual, or consult the on-line help file that comes with the PowerView software.

## REPAIR AND CALIBRATION

To guarantee that your instrument complies with factory specifications, we recommend that the PowerMonic be submitted to our factory service center at one-year intervals for recalibration, or as required by other standards.

**For instrument repair and calibration:**

**GridSense Inc.**
**5757 W Century Blvd Suite 815**
**Mail-box 91, Los Angeles**
**CA 90045, United States**

### TECHNICAL SALES AND ASSISTANCE

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:

**GridSense Inc.**
**5757 W Century Blvd Suite 815**
**Mail-box 91, Los Angeles**
**CA 90045, United States**

**Tel: +1 (310) 645-0755** **Fax: +1 (310) 645-0923**
**Email:** support@gridsense.net **Web:** www.gridsense.net

## 11. INDEX