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Ranger Power Master 3000 (PM3000) Power Quality Analyzer Operation Manual

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Dear User,

This manual has been written in detail to cater for a user with no prior knowledge of the way the PM3000, PM2000 or PM1000 works. The sophisticated user may wish to skip through many sections but some parts such as the Help section and discussion on maintenance are worth reading.

For a first time user we recommend you use PM Screen on your computer or the touch screen on the PM3000 and play with the menus. They will lead you logically and easily through the operations and you will soon become familiar with your Ranger Power Master's capabilities.

The PM3000, PM2000 and PM1000 have been rigorously designed and built with safety as an important aspect. Be extremely conscious of the hazardous nature of the environment into which the logger will be connecting and operating and take note of all the safety statements included.

The author would be grateful for any comments on this manual including any items you would like covered or added to. Please advise her if anything is difficult to understand or is unnecessary. Also we shall always be interested in application notes that we can add to the Appendix and pass on to other users. E-mail her at sales@outramresearch.co.uk or the Engineers at support@outramresearch.co.uk.

Enjoy your PM3000 and let us know how you get on.

With best wishes from all at Outram Research.

Graphic Symbols used on the PM3000 and in this manual are in accordance with table 1 of the Safety Standard that appears in Appendix F.

Safety Warnings

⚠ **Please read and feel comfortable with the safety warnings below.**

Warning

The Symbol ⚠ is about SAFETY and concerns YOU

Please read and take careful note of the following safety recommendations before using your PM3000 for the first time.

⚠ This symbol is displayed on the instrument to alert the user to the potential danger of using it. The symbol also appears from time to time in the manual. In some cases ⚠ draws attention to the fact that the parts or adjustments to which ⚠ refers are not serviceable by the user. In all cases the unit MUST be repaired or serviced by properly qualified personnel.

Please note that this includes changing internal fuses and batteries.

These following safety statements are particularly concerned with connecting your logger to the power source. To ensure your safety and avoid any damage to the PM7000 please take careful note.

⚠ Use extreme caution when connecting the signal input cables to the logger. Any voltage potential at the signal source will exist on the instrument's respective signal input cable. Consequently HAZARDOUS LIVE VOLTAGES may be exposed inside the instrument case and also may exist on the signal input terminals, which are floating with respect to the instrument chassis.

⚠ Because you will be attaching the PM3000 to a potentially hazardous live circuit, you must be suitably qualified. Before you make any such connection or disconnection you need to understand the dangers associated with doing this and how to eliminate those dangers and control the risks associated with CAT III (Category III) type high fault current electricity supplies.

You may safely connect the PM3000 input terminals to hazardous live circuits in normal operation provided that you take the following sensible precautions:

⚠ Never use damaged leads. Always check leads for wear and tear or damage before using them. Once you are satisfied with their soundness make sure that they are securely plugged into the logger before they make contact with any live power source. Connect sensor leads to the logger first to remove the risk of producing any hazardous live lead ends.

⚠ When using current transformers, current probes, or step-down voltage transformers other than the voltage probes and Rogowski Coils supplied with the logger, always consult the manufacturer's guide for connection information.

Voltage Measurement Leads

⚠ Use the GS38 approved test voltage leads supplied. These have fuses in the dolphin (or alligator or crocodile) clip end and safety connectors at the connection end. They are rated at CAT IV for 600 volts (CAT III for 1000 volts). Use these or equally GS38 compliant leads for your safety. We supply extension leads for your convenience for circumstances when GS38 compliance is not required. Be aware that this will separate the fuse from the probe head by the extension length.

⚠ Voltage leads must be treated with respect as they do an important job of carrying live voltage in a safe manner. Because they are flexible test leads they are strong and easy to coil and twist and will give good, safe, service when looked after carefully.

⚠ Always connect the voltage leads through the lower 4mm voltage ports, never through the upper BNC current ports.

Current Measurement Leads

⚠ Any current transformer (CT) used with this logger must be voltage output type. This equipment is NOT designed for use with current output, current transformers.

⚠ When installing voltage output current transformers, connect them to the adaptors and then the adaptors to the logger before you attach them round the source of power. Be careful not to touch any of the connection points.

⚠ Always make sure that your logger is positioned in a way that ensures it is mechanically stable. There must be no possibility of the test leads becoming disconnected from it while they remain attached to any external power source.

⚠ For your safety and to avoid damage to the logger do not connect your PM3000 to a live voltage source outside the specified range of 0-480 (+ 10%) Vac.

⚠ Under no circumstances should you remove the front panel of the logger while it is connected to a power source.

⚠ In line with safety requirements the PM3000 gives correct over range voltage readings. No danger will arise for an operator relying on any indicated values. However, this does not remove the possibility that a single fault in the unit could give misleading results, leading to a hazard for the operator.

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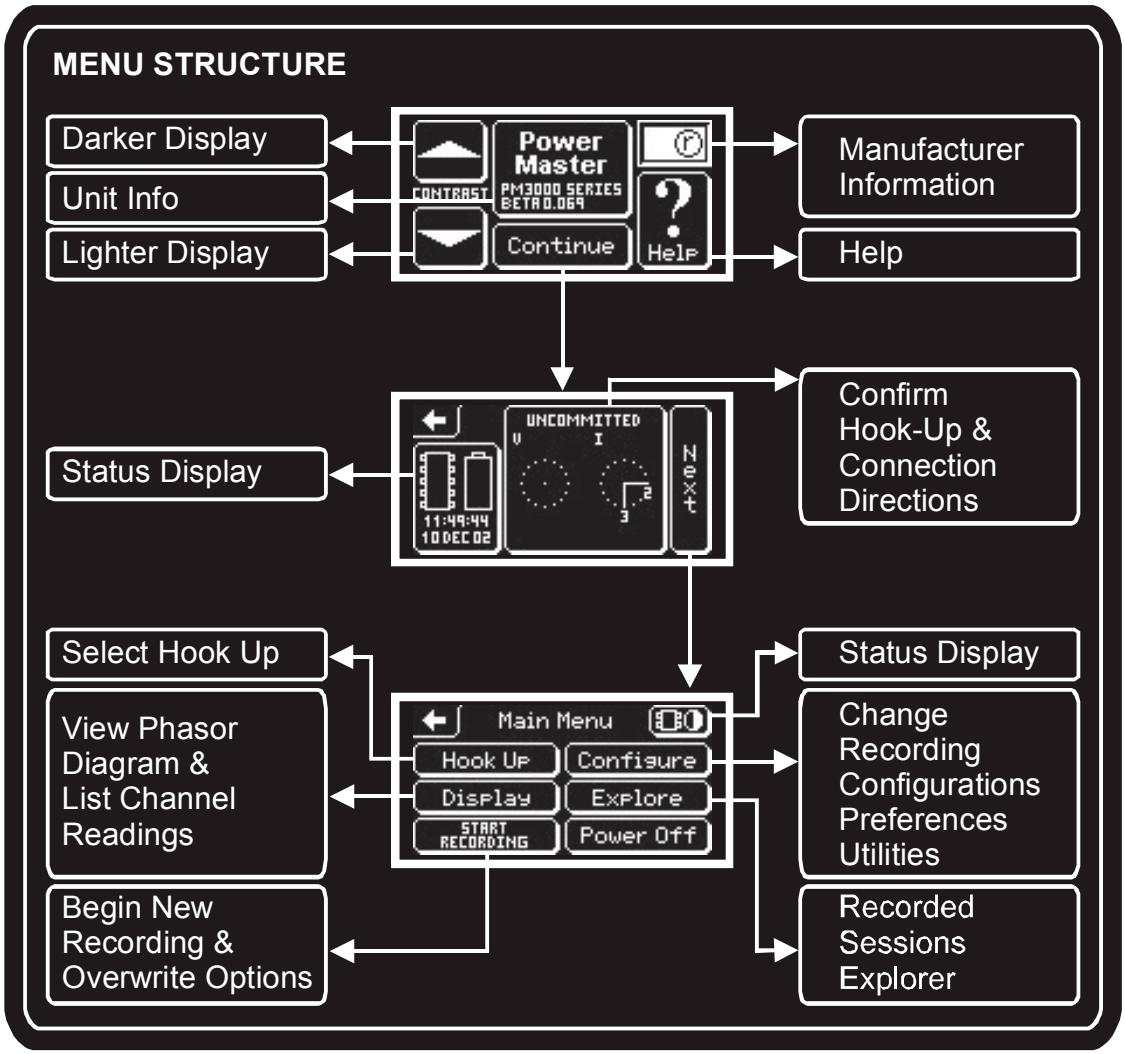
Top Menu Structure



Chapter 1: General Introduction

Welcome to the Ranger family and to our 3 phase, touch screen Power Master Analyzer, the PM3000.

PM3000

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General Introduction

Welcome to the ORL PM3000 Power Master data logger. You will find your logger with its accompanying software, Pronto for Windows, easy to understand and to use. Once you have plugged in your chosen leads all operation is either via the touch screen, a portable device or your PC. PMScreen, the user interface on the display, directs you logically, as you touch it, through a hierarchy of options. At all times a 'help' option runs alongside for you to call on.

Intended Use for the PM3000

The PM3000 is a voltage and current measuring and recording device. It is capable of monitoring a three phase supply and measures voltage by means of voltage probes and current by means of Rogowski Coils or current transformers. It records the results in memory for transfer to a computer for analysis. Monitoring the behaviour of the mains is the most likely use of your logger and the mains can power the logger as it is measured. However the logger can also be powered off a low voltage source such as a 12 volt car battery.

Your PM3000 will give you all the information you need to cover normal power quality situations and importantly, in addition, will flag up if there is a problem. The logger is able to measure the harmonic levels and total harmonic distortions of the currents and the voltages. It can therefore show up possibly unacceptable levels of harmonic activity in your power supply. You have in the PM3000 a good indicator instrument and if you do uncover a problem, its big brother, our PM7000, will go a long way towards solving it entirely.

Before you use your logger read this manual. Since this instrument can be attached to potentially hazardous live voltages, you will find safety 'warnings' written in bold throughout the manual. These warnings are prefaced by the symbol ⚠, and are necessary for our compliance with the safety standards. Please note them carefully as the reason for needing them is your safety and guidance.

How to use the manual

Chapter 1 gives a general introduction, describes what is in your kit and offers environmental precautions.

Chapter 2 covers a description of the logger itself including examples of its operations, and the specification.

Chapter 3 describes what you need to connect the logger to your power source and measurement inputs. There are seven different connections or 'hook-ups' to choose from and these are described along with typical applications to help you pick the right one for your purpose. Consult this section before applying any signals to the logger.

Chapters 4 to 8 go through the menus. You may find it helpful, as you read the manual, to get out your PM3000 and play along.

Chapter 4 tells you how to start to use the logger. It takes you through the first and second menus.

Chapter 5 begins to take you through the main menu and covers how to understand the status button and choose your hook-up before you start operating it.

Chapter 6 takes you through setting up the storage mode and recording time. It explains the difference between input signals going into the logger and the information coming from the recording channels and helps you select your appropriate input sensor.

Chapter 7 takes you through the process of setting up your recording channels and selecting the maths functions you want.

Chapter 8 shows you how to set up your PM3000 for

DC measurement.

Chapter 9 finishes going through the options on the main menu. These remaining are 'Explore', 'Display' and 'Start Recording'.

In **Chapter 10** we discuss maintenance, troubleshooting and replacement of batteries and fuses.

Appendix A describes all the maths formulae available along with the rules that apply for each, and their limitations.

Appendix B gives a detailed account of Single Cycle Adaptive Store™.

Appendix C gives further applications.

Appendix D lists replaceable parts

Appendix E consists of the Table of the Safety Standard IEC 61010 and shows the official significance of our 'safety warning' symbol ⚠ .

Appendix F is a list of the factory configured hook-ups.

Unpacking Instructions

Make sure nothing is missing or damaged. Report anything missing to your distributor / selling agent immediately and any damage to the carrier. Save the original packing material for storage or transport. You will notice that we have kept packaging to a minimum.

Chapter 10 has a troubleshooting table. Please refer to it if you experience any difficulty in using your Power Monitor.

⚠ **WARNING**
Do not use the instrument if the case or front panel overlay is damaged. You risk receiving an electric shock.

Your PM3000 Kit

Standard kit

Your standard PM3000 package will include the following: (These items differ in color between the USA/Canada, Europe and Asia).

- PM3000 Logger
- Serial Cable RS232
- Three Rogowski Coils,
  US & Canada: one red, one black and one blue.
  Europe: one brown, one black and one grey
  Asia: one red, one white and one blue
- Four voltage probes, fused with dolphin clips,
  US & Canada: one red, one black, one blue and one white.
  Europe: one brown, one black, one grey and one blue.
  Asia: one red, one white, one blue and one black.
- Three link leads
- Connect to power via:
  US & Canada: 12Vac wall cube adapter charger.
  Europe: Wall outlet connector and cables.
- Carrying bag
- Pronto and User Manual in CD form
- Sleeving
- Optional Bluetooth communications and portable device

See Figure 1-1 on next page.

Figure 1-1 Standard PM3000 kit

These items pack conveniently into your PM bag, carefully designed to help you in your work. The voltage probes fit into a roll that can be clipped onto the outside of the bag as you work in awkward environments.

Each Rogowski Coil has a pocket for storage to prevent the leads becoming tangled. The logger itself fits into a pocket and can be left running in the bag as long as the issues of over heating and loss of battery charge due to high temperatures are borne in mind.

Extension pack

You may wish to have additional longer leads for your logger. We offer further items to extend your pack. These are:

Two extra voltage probes with leads, black (white)
Nine 1 metre extensions
Three current probe adaptors: 4mm banana socket pairs to BNC plug*
U.S.B. serial adaptor
Bootlace Rogowski Coils
Low current CTs

*You can plug conventional current transformers with voltage outputs into these adaptors. If you wish to use a conventional current transformer rather than a Rogowski Coil, please take note of the following:

⚠ WARNING
Any current transformer used with the PM3000 must be voltage output type. This equipment is NOT designed for use with current output current transformers. Note also that it is essential that the current transformer output connectors be attached to the adaptor before the adaptor itself is attached to the PM3000.

The reason for this discipline is to prevent the possibility of voltage probes being fed into the adaptor and consequently applied to the current inputs. If in doubt seek qualified help.

Registration and Warranty

Your distributor or representative will keep a customer database so that he can contact you in the future. Our policy is to continue to improve the product and via the distributor we shall send you new information and upgrades.

Any logger or parts to be sent back for repair or replacement should be returned to your distributor. We give a one year guarantee against defects in manufacture.

Environmental Precautions

Storage

For prolonged storage it is good to keep your logger in a cool, dry place, on charge. If not on charge, the batteries' self discharge current and capacity loss will accelerate at higher temperatures.

We recommend that you keep your PM3000 on charge at all times, using a mains lead or a charger, so that it is always ready for use and to avoid draining the Time-of-Day clock battery. If this is not possible, ensure that the logger batteries are fully charged before storing for any extended time period of one month or more. For more information please see Appendix D for our Guide to Battery Management.

Performance

For optimum performance we advise you to take note of the following precautions:

- Your logger operates best in a cool environment. It will operate at a high temperature but as the temperature rises the ability of the batteries to retain their energy will gradually deteriorate. Avoid direct sunlight. Operating temperature must be within –10 to 60 °C.
- Maintain adequate air circulation paths to ensure proper cooling of the unit. The ambient operating temperature should not exceed 40 °C.
- Avoid sudden temperature swings of 10 °C or more.
- Avoid high humidity. Relative humidity is not to exceed 95% RH non condensing.
- Protect the instrument from rain, moisture and spillage of liquids because the PM3000 is not designed for unprotected use under those conditions.
- We claim no IP rating for the logger without an outer protective sleeve. When you use a waterproof sleeve the IP rating is IPx4.
- Avoid locations susceptible to vibration, shock, static, high magnetic, electro-magnetic, or radiation fields.

  The PM3000 is not designed to withstand damage from nearby or direct lightning strikes, circuit-breaking, or exceptionally high electromagnetic radiation greater than specified in IEC 61326 in close proximity
- Avoid extremely dusty, dirty or corrosive gas environments.

Computing equipment

If you are using a computer to download data from your PM3000, or you are using equipment more delicate than the PM3000. (It could be some other instrument.) You must take care to protect the more delicate equipment from the environment – in accordance with the directions from the manufacturer of the delicate equipment. Most computing devices conform to the requirements IEC 60950, whereas the PM3000 is designed to conform to IEC 61010-1.which requires more stringent testing for resistance to moisture and liquids.

Chapter 2: Introduction to the PM3000

PM3000 Specially Designed Carrying Bag

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What is a PM3000?

The PM3000 is an advanced, high performance, state of the art data logging instrument for measuring, displaying and storing AC power parameters for single and multi-phase systems. It measures voltage using voltage leads and current, indirectly as voltage, with Rogowski Coils that plug directly into the logger.

Graphic touch screen

The graphic touch screens will display your real time information. It is so easy to use. Lightly touch the button 'drawn' on the screen to cause it to respond. You will find the screen menu structure easy to follow and the comprehensive help feature a useful aid. There is a top level menu map on the lid of the logger for easy reference.

Status light emitting diode

An LED lying in the centre of the front panel above the screen gives an ongoing indication of the status of the instrument. Under normal conditions the LED will be 'off'. The occasions when it will be active are as follows.

When the firmware is going through an 'upgrade' procedure, it will be permanently 'on', (though the screen will be blank)

When the logger is recording, it will flash briefly once every four seconds.

When the batteries are charging just before the PM3000 wakes up, it will let you know by flashing more quickly.

Pronto application software

Downloading of accumulated historic information to your computer takes place via an RS232 serial cable. Our acclaimed Pronto application software provides all the tools necessary to transform your data into useful graphs and reports for analysis and review. This user friendly software with online help throughout makes it easy to understand and use.

Safety testing

Your PM3000 has undergone rigorous safety tests and is certified against Category III requirements of the European IEC 61010 Standard for a measuring instrument. Category IV is the most stringent and the PM3000 must not be used for such applications.

Voltage and current input signals

Direct inputs are fed into three voltage channels and three current channels in your PM3000.

The RATED maximum WORKING VOLTAGE for the three voltage terminals V1, V2 and V3 is 480 + 10% Vac.

The current measuring signals may be "rate-of-change -of-current" from Rogowski Coils or conventional signals from a voltage output clamp-on current transformer.

You can derive various parameters from these six direct input signals using the sixteen maths channels available for recording. Any parameter you want to record you must first assign to a maths channel. For more information on the available parameters please see Appendix A.

It is helpful to understand that the information coming into the logger through the sensors does not go directly to the recording channels. The logger takes from this data what it needs to satisfy the parameters you ask it to record, makes its calculations and allocates the results, your parameters, to each of the channels as appropriate. [Chapter 6 includes a discussion on the distinction between signals and channels.] Even if your parameter is a simple voltage measurement the logger takes lots of samples to calculate the RMS of the voltage waveform and then allocates this result to your chosen channel as the voltage reading.

The PM3000 calculates a true RMS result independently every cycle.

Recording Modes

The PM3000 has two different ways of storing your data to make best use of available memory. These are Adaptive Store and Point Store and which one you choose will depend on your application.

Adaptive Store

Adaptive Store is an Outram Research patented process. It is unique among data loggers and enables you to use the memory in the logger in the most effective way.

When the logger begins a recording it takes regular samples (64 samples per cycle), processes the data and makes this information available to the recording system each cycle. If the information you are monitoring is unchanging or predictable it will retrieve it but not store it unnecessarily. It does record a maximum / minimum envelope within which all your data falls. When the information begins to deviate from this predictable state the logger has (relative to alternative recording methods) plenty of memory to store the details and give you an accurate profile of the transient. Again as the information settles into a less changing, more predictable profile the logger no longer needs to store every record it takes. By being aware of the length of time you wish to record for, the logger makes maximum use of its memory.

This storage mode is particularly useful for obtaining accurate information over long periods. A fuller account of Adaptive Store is given in Appendix B.

Point Store

Point store is the conventional way of collecting your information. The logger stores every record it makes in memory. You can select the sample interval and recording time. The choice of sample interval ranges from 12 hours down to one cycle. Recording time varies between two years and 1 sec. Your logger advises you of the recording period that can be achieved for a given interval, memory available and number of channels to be recorded.

To understand the merit of Adaptive Store we invite you to make two identical recordings, one with your logger in Adaptive Store mode and the other with a logger in Point Store. Take note of the comparative resulting information produced for you by the two storage modes.

Please see Chapter 4 on 'setting up your logger' for further details of the recording modes.

We have five memory options for our PM3000: 1MB, 8MB, 16MB, 32MB or 64MB of internal memory.

Configuration

Physical communication with your logger is via the touch screen. Operating it is very straight forward as the screen graphics invite you to make your choices, in a logical, friendly way. Also, at all times, by pressing down for a second or so on an area of screen you can bring up a relevant help box. Our aim is to make learning to use your PM3000 an easy and pleasurable experience.

As we have mentioned already, examples of what you may wish to configure are recording mode, sample rate and recording length. Other parameters include scales, Current Transformer and Potential Transformer ratios, engineering units, alarm levels, maths functions and password. The password option allows you to protect your logger against unauthorised access.

Applications

Here are examples of some common measurement applications:

- Residential voltage monitoring. In the UK we typically measure 1 voltage, in the US we measure two voltages on a single split phase (called 2 phase in the PM3000).
- Residential load (current) monitoring
- Motor start-up
- Three phase power monitoring

- Stray voltage monitoring or the neutral to earth voltage. This can be quite important.

Further examples will be posted on either the Outram Research website (www.outramresearch.co.uk) or our distributor websites, from time to time.

System Technology

The PM3000 system is based on a 32 bit RISC (Reduced Instruction Set Computer) microprocessor which in layman's terms means there is plenty of horse power available for further development,. There is an FPGA (Field Programmable Gate Array) and the entire program and your long term configurations are stored in non-volatile Flash memory.

The benefits of this combination are that your unit is upgradeable out in the field via a PC: Changes can even be made to some aspects of the hardware and should faults or improvements be identified there is a good chance they can be rectified or incorporated respectively without you having to return the logger to the factory.

Data is stored in battery backed RAM (Random Access Memory). Without any powering of the unit the data will stay in memory for more than two months under normal circumstances. The analogue to digital converters (A to D's) or (ADC's) are Sigma/Delta type. These converters provide excellent noise rejection and well controlled input filtering. This eliminates phase distortion and we get the benefits of less hardware and lower costs.

The Rogowski Coil signal processing is carried out inside your unit so you need not be bothered with separate electronics and batteries. This option may be turned off in the software when you wish to use conventional voltage output Current Transformers (CT's).

Clock

The Time-of-Day clock will be maintained indefinitely (ten years plus) after loss of the power, by an internal lithium battery.

Replaceable Parts

All items in your kit can be replaced or added to. You can replace the fuses in the voltage probes. Otherwise there are no user serviceable parts. The internal fuses and batteries in the logger may need renewing. Your service department will be best qualified to take charge of replacing these. See maintenance in Chapter 10 and part details in Appendix D.

Communications

The RS232 serial cable links the logger to a PC. The RS232 output port is found on the front of your logger to the right of the touch screen and is fully isolated.

PM3000 Technical Specification

Input Voltage: 3 channels 0-480 Vac. Sensors: In-line shrouded 4mm banana plugs and fused dolphin clips

Input Currents: 3 channels. Sensors: Three 24" 3000 Amp Flexible Current Clamps supplied (Ranges 0-3000A, 0 - 400.0A, 0 - 50.00A) or can use with conventional 0 - 0.5 V ac voltage output current clamps.
DC measurement with suitable sensors optional

Channels: 16

Accuracy: Volts and wide range current < 0.25% True RMS +/-2 LSB's excluding sensors. Narrow range current < 1% True RMS excluding sensors. Zeroing function for DC

Resolution: Programmable to 0.1 V ac and 0.1 A ac, 0.01V and 0.01A high resolution mode

Maths Channels:
***AC 1 Phase*:** RMS, Stray Voltage RMS Hi Res < 35V, Real power W, Reactive Power VARS (fund), Apparent Power VA, Power Factor PF, Displacement Power Factor, Phase Angle, Frequency, Instantaneous Flicker Sensation, Short Term & Long Term Perceptibility, Flicker Flag
AC 2 Phase: Real Power, Reactive Power VARS (fund),Apparent Power, Power Factor
***AC 3 Phase*:** Real Power, Reactive Power VARS (fund), Apparent Power, Power Factor, Voltage Unbalance, (Conventional & Sequential Components) Current Unbalance
***Harmonics*:** Odds, Evens, Triplens, Individual Harmonics and Harmonic Direction to the 15th, K Factor, % Total Harmonic Distortion to the 25th, Harmonic Value
Other Maths Option: Channel X * Constant, Channel X / Channel Y, Filtered Channel X, Internal Temperature, On Charge, Battery Volts, DC optional

Sampling: Continuous sampling at 64 times per cycle

Recording: Single cycle True RMS response time; 16 bit simultaneously sampling all signals

Memory: 5 options available: 1MB, 8MB, 16MB, 32MB & 64MB RAM

Recording Mode and Rate:
Adaptive Store: *Unique* store management enables extended recording & single cycle resolution on significant signal changes
Point Store: Selectable from single cycle rate to once every 12 hours

Data Retention: Back-up battery provides 2 month's retention @ 25ºC (77ºF)

Power: Requires 50-480 Vac from Phase A voltage measurement or separate power supply

Battery: 4 AA NiMH battery pack & 1 Lithium battery

Safety & Standards: IEC 61010, 600v Cat. III, pollution level 2, CE, IEC 61326 (EMC),

IEC 61000-4-15

Internal fusing: PSU, Battery stack, fused voltage leads

Communications:
Serial Ports: RS232, (up to 230.4K baud); isolation >2.5 kV, Bluetooth (wireless), (optional)
Protocol: MODBUS ASCII touch-screen display 100 x 35 mm

Case: Pelican 1120 Guard Box: Dimensions. 210 x 165 x 90mm

Weight: 1.1 kg. without leads and clamps

Computer Requirements for Pronto Software:
Windows 9x, ME, N4T, XP, 2000, Pentium class processor or higher; 250MB hard drive: 32 MB RAM

Display: Backlit LCD graphic touchscreen display 2.5" x 1.35"

Operating Frequency: 45 to 64 Hz

Environmental
Operating & Storage Temp: 14ºF (-10ºC) to 140ºF (60ºC)

IP Rating: When used in conjunction with waterproof sleeve IP rating is IPx4. (Protected against water sprayed from all directions – limited ingress permitted).

Applicable Patents: 6424277, 0230712, 4910692

Features: Rogowski Coils included, Delayed Recording Start, Connection Phase Vector diagrams, Hook-up advice, Up to 125 Set-ups (Factory or User created) saved for easy reference, On-Screen context sensitive Help, Demand measurement

Chapter 3: Connecting Up Your PM3000

PM3000 Connection Points

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Power Requirements

The PM3000 operates on voltages ranging from 50 to 480 +10% Vac and 45-64 Hertz.(cycles per second) When the logger is powered up the batteries will automatically be charged.

Connecting To Your Logger

On the left side of the logger are three sets of three round sockets. Each set corresponds to one of the three measurement circuits. The lower left socket, the live (line) socket, is colored for convenience to correspond to the phase: A is brown, B is black and C is grey. Each set of sockets comprises two lower voltage inputs, + live and – live or neutral, and an upper current input. They are designated V1(+) brown, V1(-), I1, V2(+) black, V2(-), I2 and V3(+) grey,V3(-), I3. See Figures 3-1 and 3-2 and Table 3-1. This diagram appears on the PM3000 face to guide you to connect your voltage and current sensors to the logger correctly. See Figure 3-2 below.

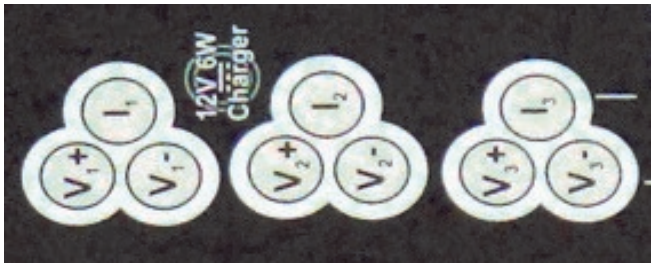


Figure 3-1 Diagram of the PM3000 Input Sockets

Figure 3-2 Side of Logger

The table below shows the relationship between the phases and the colors for Europe and the United States.

Phase	Color			
	Europe	US	Asia	(Old UK)
A	Brown	Red	Red	Red
B	Black	Black	White	Yellow
C	Grey	Blue	Blue	Blue
Neutral	Blue	White	Black	Black

Table 3-1 To Show the Relationship between the Phases and their Designated Colors

The logger is powered up through the V1 socket pair. Power will come generally from the mains. Should you want to monitor current only or you have no mains supply or voltages available, you may use an AC power adapter / battery charger or a 12V car battery. This plugs into the single round 2.1 mm standard jack socket close to I1.

⚠ This 12VDC PSU charger socket is only suitable for connection to products certified to IEC60950.

We do not supply an AC power adapter as standard kit in Europe but you may order one from your distributor.

⚠ Use extreme caution when wiring signal input connections. Hazardous potentials may exist on signal input terminals, which are floating with respect to instrument ground. These hazardous potentials may be exposed inside the instrument case and on the connectors of your instrument. Any voltage potential at the signal source will exist on the instrument's respective signal input cable.

Voltage measurement

A voltage connector is shown in Figure 3-3. It consists of a lead with a shrouded 4mm banana plug at one end and a fused dolphin clip at the other end. The banana plug plugs into the logger and the dolphin clip makes contact with the power cable.

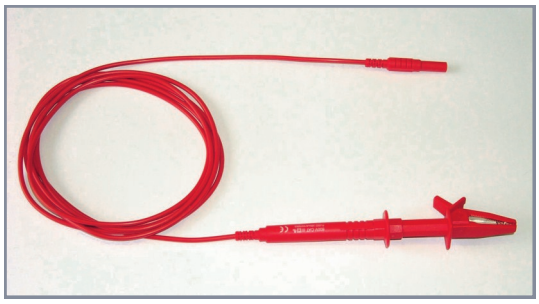


Figure 3-3 Voltage Lead

We supply you with three voltage leads colored to correspond to the phases. Refer back to Table 3-1. They nominally connect into the live (line) sockets of each phase. We supply also one white lead (US) / black lead (Europe) for connecting into the neutral sockets. As you will generally be measuring the same neutral with three phases of live, one white (US) / black lead (Europe) suffices, and the (neutral) sockets V- are joined up with the link leads supplied in your kit.

To make hook-ups as straight forward for you as possible the leads are colored to differentiate the phases. In practice there is no electrical difference between them and they can be used interchangeably.

For voltages above 480 V (+10%) you may use a step-down transformer whose outputs should be plugged into the live (line) V+ and V- sockets if required.

Current measurement

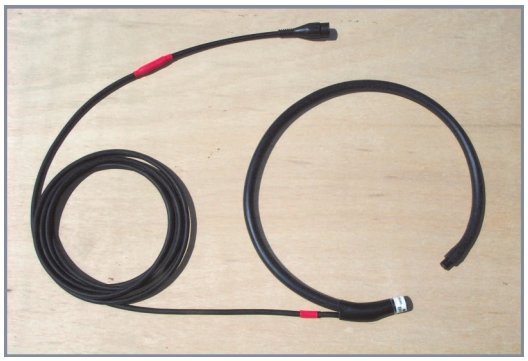


Figure 3-4 Rogowski Coil

The three Rogowski Coils in your pack measure the current, one for each phase. They are colored to match the phases and should be fitted into their corresponding I (current) connectors. See above Figures 3-1 and 3-2 and Table 3-1.

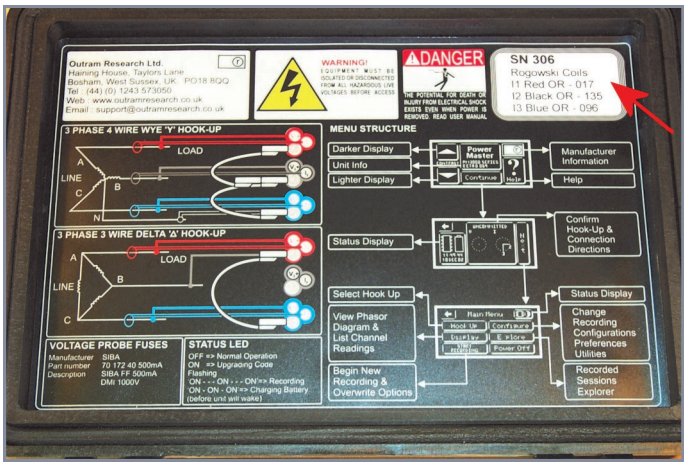


Figure 3-5 PM3000 Overlay on Lid to Show Serial Number Sticker

In the factory before despatch the systems are standardised so that each coil reads the same result as the others when in its matching slot. You will notice that on the lid of your logger there is a sticker. The red arrow in Figure 3-5 points it out.

This sticker gives the serial number of the logger and the numbers of the corresponding Rogowski Coils so there need be no confusion as to which coils go with which logger.

To take a current measurement the Rogowski Coil fits right round the selected conductor. Pull the ring of the coil to open it and push the ends together to close it. Make sure the ends are joined tightly.

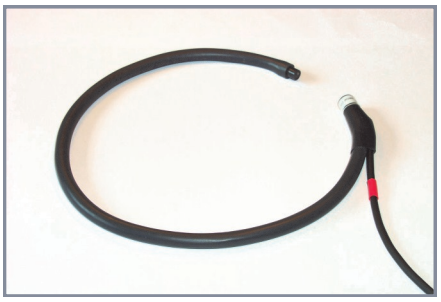


Figure 3-6 Open Rogowski Coil

Figure 3-7 Closed Rogowski Coil

Be careful at all times to orientate your Rogowski Coil (or any current transformer) round the wire to be measured so that the arrow on the Rogowski Coil is pointing in the notional current direction. This will ensure that the phases of the voltage and current will be measured correctly with respect to one another. This is very important for the correct calculation of the various power parameters.

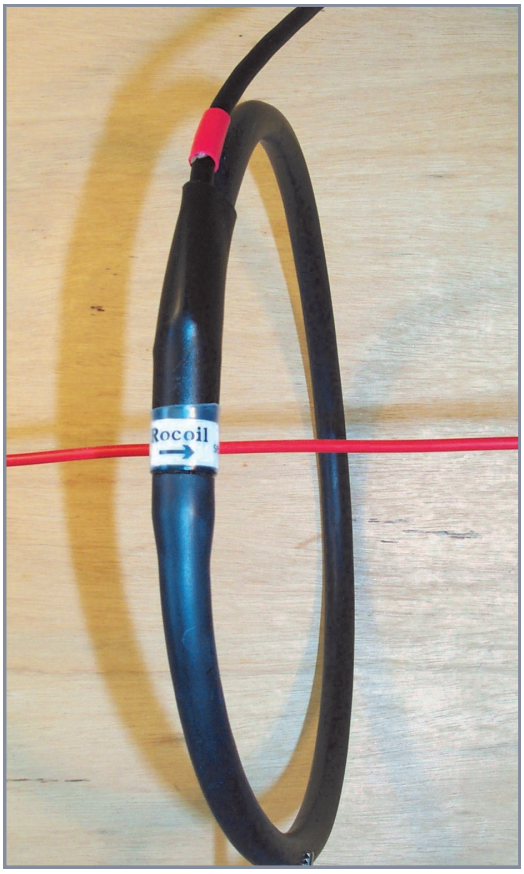


Figure 3-8 Rogowski Coil to Show Arrow

Note, you can verify current direction and other hook-up characteristics by reviewing the vector diagrams on the PM3000 screen either at the top level connection diagram or under the display / phasor diagram screen. See Chapter 6.

Each Rogowski Coil connects through one socket in your logger, In the past, a current measuring device will have consisted of two leads, one positive and the other negative. However, the connectors into the PM3000 are dual coaxial connectors: two, arranged one inside the other. The lead in the Rogowski Coil is also a dual coaxial arrangement. This simplifies connecting up and is safer.

The logger can be programmed so that each Rogowski Coil can be used for current inputs between two ranges: high range between 0 and 1,000 Amps

and low range between 0 and 50 Amps. Chapter 5 covers sensor configuration.

⚠ **Warning**

Before you come to connect your logger to the power source, to ensure your safety and avoid any damage to the PM3000 please take careful note of the following safety statements.

HAZARDOUS LIVE VOLTAGES – You may safely connect the PM3000 input terminals to hazardous live circuits in normal operation provided that you take the following sensible precautions:

⚠ **Use the GS38 approved test voltage leads supplied. These have fuses in the dolphin clip end and safety connectors at the connection end. Always use these or equally GS38 compliant leads for your safety.**

⚠ **Voltage leads must be treated with respect as they do an important job of carrying live voltage in a safe manner. Because they are flexible test leads they are strong and easy to coil and twist and will give good, safe service when looked after carefully.**

⚠ **Never use damaged leads. Always check leads for wear and tear or damage before using them. Once you are satisfied with their soundness make sure that they are securely plugged into the logger before they make contact with any live power source. Connect sensor leads to the logger first to remove the risk of producing any hazardous live lead ends.**

⚠ **Always connect the voltage leads through the lower 4mm voltage ports, never through the upper BNC current ports.**

⚠ **Any current transformer used with this logger must be voltage output type. This equipment is NOT designed for use with current output, current transformers.**

⚠ **When installing voltage output current transformers, connect them to the adaptors and then the adaptors to the logger before you attach them round the source of power. Be careful not to touch any of the connection points.**

⚠ **Always make sure that your logger is positioned in a way that ensures it is mechanically stable. There must be no possibility of the test leads becoming disconnected from it while they remain attached to any external power source.**

⚠ **For your safety and to avoid damage to the logger do not connect your PM3000 to a live voltage source outside the specified range of 0-480 (+ 10%) Vac.**

⚠ **Under no circumstances should you remove the front panel of the logger while it is connected to a power source.**

⚠ **In line with safety requirements the PM3000 gives correct over range voltage readings. No danger will arise for an operator relying on any indicated values. However, this does not remove the possibility that a single fault in the unit could give misleading results, leading to a hazard for the operator.**

Hook-ups

When you receive your data logger it is already factory configured for a number of frequently used ways to connect it up or 'hook it up' to the power source you wish to monitor. You will find these 'hook-ups', as we call them, in diagrammatic form in your PM3000. They are reproduced in the following pages both for information and to enable you to become familiar with what is in the logger.

As you will discover later in Chapter 5 you also have the option of setting up your own particular arrangement by which to introduce your signal to be measured to your PM3000, if you need something different.

⚠ Warning

When using current transformers, current probes, or step-down voltage transformers other than the voltage probes and Rogowski Coils supplied with the logger, always consult the manufacturer's guide for connection information.

A hook-up will be concerned with single phase, two phase (single phase split) and three phase wiring, the latter most commonly. The phases are designated A, B and C for convention and convenience and color coded as mentioned earlier: brown, black and grey (in Europe) or red, black and blue (in USA/Canada) or red, white, and blue (in Asia) respectively. To obtain all necessary information it is usual to measure both voltage and current. Where a neutral wire is present the voltage of each phase will normally be measured relative to it. Where there is no neutral present, as in three wire Delta, Phase A and Phase C may be measured relative to phase B to provide adequate information.

One pair of voltage leads and a current sensor are termed an Element. Also, the three phases A, B and C can be linked in either a Y (Wye) arrangement or a D (Delta) arrangement. The number of Phases, the number of Elements and the Y/D arrangement are included in the name of the hook-up.

Your PM3000 is powered up through the V1 pair of sockets. When you are measuring voltage and connected through V1, you will automatically power the logger.

The different hook-ups produced in the logger are described below. The American colors are shown in brackets. At the end of this section is a table of the hook-ups for easy reference

Single Phase 1-Element

This is the simplest hook-up. Connect the brown (red) voltage lead to V1+, and the black (white) voltage lead to V1-. The dolphin clips attach to the Live (Line) wire and Neutral wire respectively. Connect your brown (red) Rogowski Coil round the Live (Line) wire and plug its end into I1. See Figure 3-9. Actually any combination of colors can be used for this simple hook -up, as long as you configure the logger accordingly. However only V1 is able to power the logger.

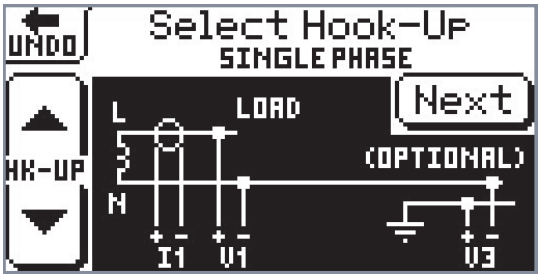


Figure 3-9 Single Phase, 1-Element Hook-up

There is in the logger an uncommitted hook-up configuration. You will use this option for this type of hook-up.

Figure 3-10 Uncommitted Hook-up

Link leads

Supplied with your kit are 3 white link leads similar to the one in Figure 3-11.

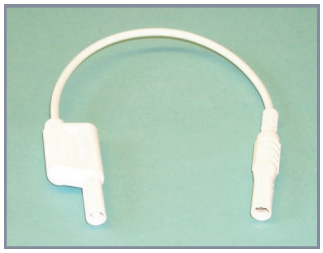


Figure 3-11 A Link Lead

These supplement the way you can use your 4 voltage probes. A number of hook-ups use them and Figures 3-15 and 3-17 diagrammatically show their use. In the first example one link lead joins V3- to V1- and enables one black (yellow) voltage probe with dolphin clip to attach to phase B, joining both V1- and V3- to phase B at the same time. This is obviously a tidy arrangement.

All the following hook-ups can be selected in the logger. How to do this is covered in Chapter 5.

Two Phase or Single Phase Split 2-Element Hook-up

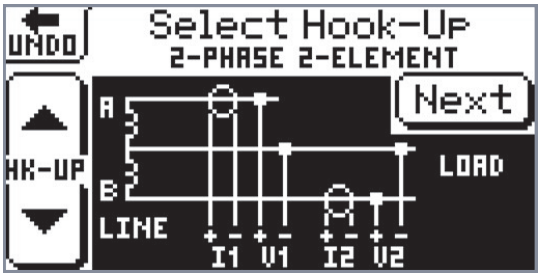


Figure 3-12 Two Phase, 2-Element

Here you have two live (line) wires and a neutral.

Connect the brown (red) voltage lead to V1+, the live (line) and the black (white) voltage lead to V1-, the neutral connector, and the dolphin clips to phase A. Then plug the corresponding brown (red) Rogowski Coil BNC connector into I1, the logger current connector and fit the coil round the Phase A line.

In a similar way, connect the black (white) voltage lead to V2+, the live (line) connector and with a white link lead connect V1- and V2- together and connect the black (white) dolphin clips to phase B. Then plug the corresponding black Rogowski Coil BNC connector into I2, the logger current connector, and fit the coil round the phase B wire. Remember to orientate the coil correctly.

Three Phase, 1-Element, Y (Wye) Hook-up

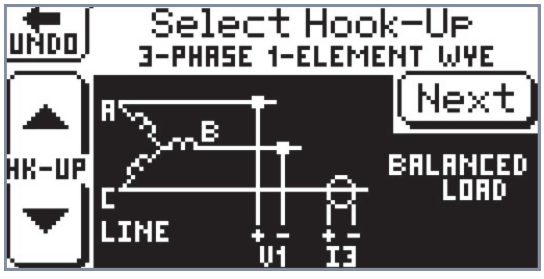


Figure 3-13 Three Phase, 1-Element, Wye

This simple hook-up, single element, is sometimes used if the load is perfectly balanced. It is not always adequate.

Here, as you can see from Figure 3-12, you connect your brown (red) voltage lead to V1+, and the brown (red) dolphin clip to the phase A wire, and the blue (white-US or black-Asia) voltage lead to V1-, and the dolphin clip to the phase B wire. Then plug the grey (blue) Rogowski Coil BNC connector into I3, the logger current connector, and fit the coil round the phase C wire. Remember to orientate the coil correctly. (Arrow pointing in the notional current direction.)

Three Phase, 2-Element (3-Wire), Y (Wye) Hook-up

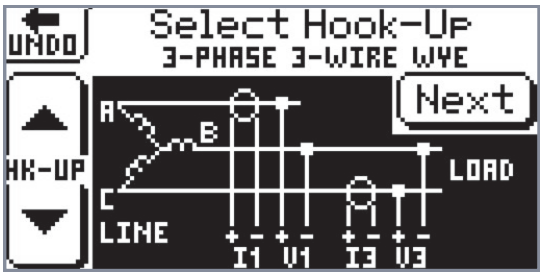


Figure 3-14 Three-Phase 3-Wire Wye

With a balanced load you only need two elements of measurement. Phase A and phase C voltages are measured with respect to phase B and the currents on phase A and phase C are also measured.

To do this, connect the brown (red) voltage lead to V1+ and its dolphin clip to Phase A. Connect the blue (white-US or black-Asia) voltage lead to V1-. and its dolphin clip to phase B. Also connect the grey (blue) voltage lead to V3+ and its dolphin clip to Phase C and in order to connect V3- to phase B use a link lead to connect V3- to V1-. Finally the brown (red) Rogowski Coil plugs into I1 and then joins round the Phase A conductor and the grey (blue) Rogowski Coil connects into I3 and then joins round the Phase C conductor. Figure 3-13 shows this hook-up. However, Figure 3-14 gives a clearer indication of how to use the link lead: the connections for the 3-wire Wye and Delta arrangements are the same. Remember to orientate the Rogowski Coils correctly.

Three Phase, 2-Element (3-Wire), D (Delta) Hook-up

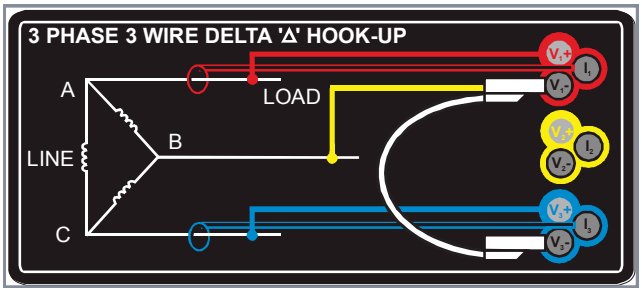


Figure 3-15 Three Phase, 3-Wire Delta (old UK colors)

The power in this example comes from a Delta type generator instead of a Y type but this hook-up arrangement is exactly the same as the one above. Please follow the above instructions. Note that this diagram shows the connections clearly and the link lead.

Three Phase, 2 ½ -Element (4-Wire), Y (Wye) Hook-up

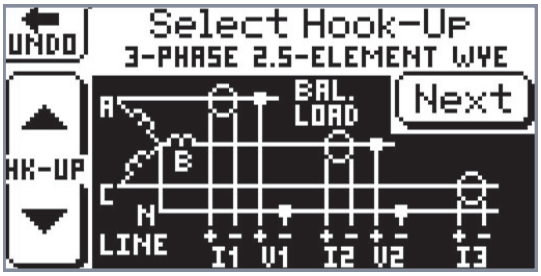


Figure 3-16 Three-Phase 4-Wire Wye (2 ½ Element)

In this hook-up there are four wires including a neutral. Phase A and B voltages are measured with respect to the Neutral and the currents on all three phases are measured. Where more than one neutral connection is required as in this case you use a link lead instead of another voltage lead. As other connections can build on the link leads they should be positioned first.

Therefore connect a link lead to the ports V2- and V1-. These are going to connect to the Neutral. Then connect the blue (white/black) voltage lead to the link lead at V1- (or V2-) and its dolphin clip to the Neutral. Now V2- is also joined to the Neutral. Connect the brown (red) voltage lead to V1+ and its brown (red) dolphin clip to Phase A. Connect the black (white) voltage lead to V2+ and its black (white) dolphin clip to Phase B. The brown (red) Rogowski Coil plugs into I1 and then joins round the Phase A wire, the black (white) Rogowski Coil plugs into I2 and then joins round the Phase B wire and the grey (blue) Rogowski Coil connects into I3 and then joins round the Phase C wire. Refer to Figure 3-14 and remember to orientate the Rogowski Coils correctly.

Three Phase, 3-Element (4-Wire), Y (Wye) Hook-up

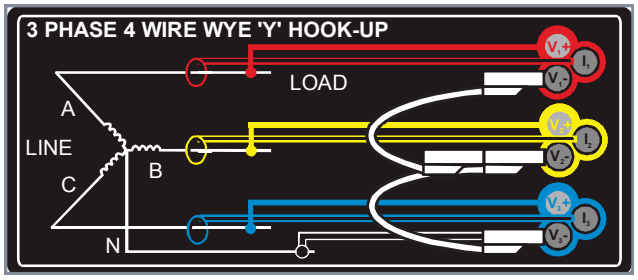


Figure 3-17 Three-Phase 4-Wire Wye (3-Element) (old UK colours)

This hook-up will enable you to measure the voltage on each Phase A, B and C relative to the Neutral and also the Current on each phase.

Your two link leads are required in this hook-up. Connect them first so that other leads can be connected to them. Therefore connect one link lead between the Neutral connections V2- and V1- and the other between V2- and V3-. Note that V2- has a double link lead connection. All the return ports are now linked and your blue (white/black) voltage probe connected to any link lead port will attach all three to the Neutral via the dolphin clip.

Now connect the brown (red) voltage lead to V1+ and its brown (red) dolphin clip to Phase A and the blue (white/black) voltage lead to the link lead at V1- and its dolphin clip to the Neutral. Now V2- and V3- are also joined to the Neutral. Connect the black (white) voltage lead to V2+ and its dolphin clip to Phase B. In addition take your remaining grey (blue) voltage lead and connect it to V3+ and the dolphin clip to Phase C. The brown (red) Rogowski Coil plugs into I1 and then joins round the Phase A wire, the black (white) Rogowski Coil plugs into I2 and then joins round the Phase B wire and the grey (blue) Rogowski Coil connects into I3 and then joins round the Phase C wire. Refer to Figure 3-16 and remember to orientate the Rogowski Coils correctly.

For your easy reference there is a table on the next page listing the hook-ups and their applications.

(This is found also in the Pronto applications software. Using the Pronto program it is possible to select your hook-up and configure it into your PM3000. A comprehensive 'Help' option will take you through the procedure.)

Table 3-2 A List of Hook-ups and their Applications

3 Phase 4 Wire Wye, use with a three phase star source
Voltage Input V1 is connected between phase A and neutral. Voltage Input V2 is connected between phase B and neutral. Voltage Input V3 is connected between phase C and neutral. Current Input I1 measures the current in phase A. Current Input I2 measures the current in phase B. Current Input I3 measures the current in phase C.
This hook up gives correct results regardless of any source or load mismatch.

3 Phase 3 Wire Delta, use with a three phase delta source.
Voltage Input V1 is connected between phase A and B. Voltage Input V2 is not used. Voltage Input V3 is connected between phase C and B. Current Input I1 measures the current in phase A. Current Input I2 is not used. Current Input I3 measures the current in phase C.
This hook up gives correct 3 phase results provided that the source is a true three phase delta, i.e. does not have a neutral.

3 Phase 3 Wire Wye, use with a three phase star source.
Voltage Input V1 is connected between phase A and B. Voltage Input V2 is not used. Voltage Input V3 is connected between phase C and B. Current Input I1 measures the current in phase A. Current Input I2 is not used. Current Input I3 measures the current in phase C.
This hook up gives correct 3 phase results ONLY when there is no current flowing in the neutral.

3 Phase 2.5 Element Wye, use with a three phase star source.
Voltage Input V1 is connected between phase A and neutral. Voltage Input V2 is connected between phase B and neutral. Voltage Input V3 is not used. Current Input I1 measures the current in phase A. Current Input I2 measures the current in phase B. Current Input I3 measures the current in phase C.
This hook up gives correct 3 phase results ONLY when there is no voltage present on the neutral.

Table 3-2 A List of Hook-ups and their Applications cont.

3 Phase 1 Element Wye, use with a three phase star source.
Voltage Input V1 is connected between phase A and B. Voltage Input V2 and V3 are not used. Current Input I1 and I2 are not used. Current Input I3 measures the current in phase C.
This hook up gives correct 3 phase results ONLY when there is no voltage present on the neutral AND the load on each phase is balanced.

2 Phase 2 Element Wye, use with a two phase, split phase source.
Voltage Input V1 is connected between phase A and neutral. Voltage Input V2 is connected between phase B and neutral. Voltage Input V3 is not used. Current Input I1 measures the current in phase A. Current Input I2 measures the current in phase B. Current Input I3 is not used.
This hook up gives correct 2 phase results regardless of any load or source mismatch between phases.

Uncommitted, use for non-standard hook ups.
No assumptions are made about the hook up. You must ensure measurement functions selected are appropriate for the connections made.
Harmonic Direction functions may not be available.

Communications Port Connection

RS232 serial cable

Figure 3-18 RS232 Serial Cable

On the top face of the logger to the right of the touch screen is a communications port for an RS232 serial cable. The cable is a straight through nine-way. The male end fits into the logger's nine-way female port. This RS232 socket is suitable only for connection to products certified to IEC60950. This connection conforms to the industry standard RS232.

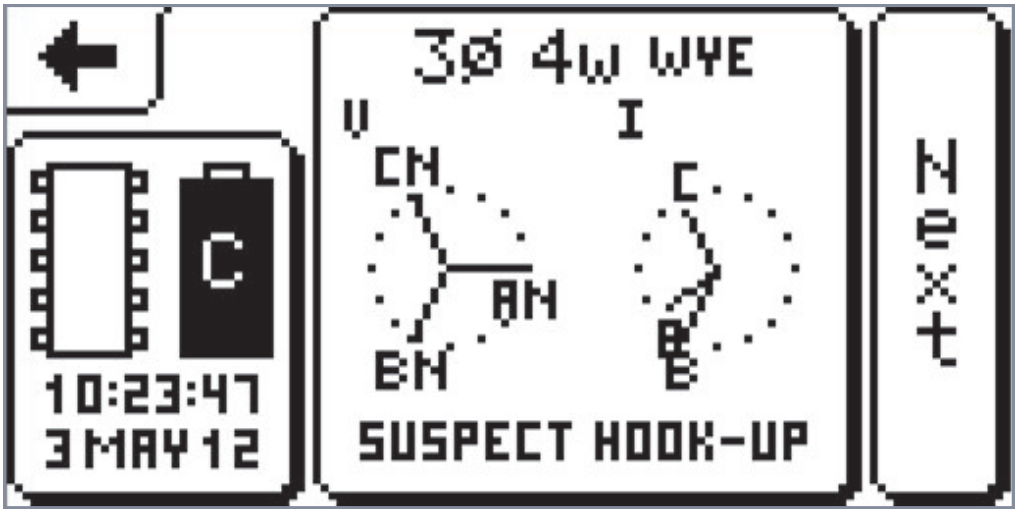
Figure 3-19 RS232 Serial Cable Connected to Logger

USB serial adaptor

Figure 3-20 Example of a USB Serial Adaptor

In the event that your computer does not have a serial port but instead has a USB (Universal Serial Bus) port we can offer you a USB serial adaptor. (See list of further accessories).

Chapter 4: Operation I
Screens 1 & 2: Help & Status



PM3000 Hook-up Screen

OUTRAM RESEARCH LTD
Haining House,
Taylors Lane, Bosham,
West Sussex, PO18 8QQ, UK
Tel: 0044 1243 573050
Email: support@outramresearch.co.uk

SYNERGY SYSTEMS INC
4101 Pierce Dr.
Shelby Twp., MI 48316
USA
Tel: 800-338-4505
Email: sales@synergy-mi.com

Contents

List of Illustrations

The Help Topics

(i) Accuracy
(ii) Auto recording restart
(iii) Battery charge
(iv) Battery – Deep discharge
(v) Calibration / Scale limitations
(vi) FIFO – Use of store with FIFO on
(vii) Flexible CTs
(viii) Gain or scale limitations (Same as calibration / Scale limitations)
(ix) Low signal
(x) Maintenance (preventative)
(xi) Noisy value suppression
(xii) NPS and PPS in functions
(xiii) Phase reversed
(xiv) Phase suspect
(xv) Resolution
(xvi) Recording modes
(xvii) Revision history
(xviii) Rogowski Coils
(xix) Rope clamps
(xx) Specs – Voltage and current
(xxi) Support (technical)
(xxii) Suspect hook-up
(xxiii) Symmetrical components. See NPS & PPS in functions
(xxiv) Temperature (operating)

Introduction to Operation 1

This chapter tells you how to use your logger now you know how to hook it up to the power to be monitored. (See Chapter 3.)

How To Turn On Your Logger

As mentioned earlier in Chapter 2, you give all your commands to the logger via the touch screen, and the display presents options to you in a way that makes it easy for you to interact with it.

Figure 4-1 Front Panel

There is also a help option that you can access easily as you proceed through the menus. It is present from the first screen you see to the final screen that completes your operation and is described in detail later in this chapter.

The next four Chapters, 4 to 8, will take you through all the possible operations that you can do with your logger. Get out your PM3000 and play along as you read. Turn to any relevant section if you have a particular job you need the logger to do for you and want immediate guidance.

The Initial Screen

When you touch your PM3000 screen the following 'Initial Screen' will appear.

Contrast adjustment

On the left of the screen are two contrast adjustments. Press the upper arrow for darker contrast and the lower arrow for lighter contrast.

Power Master button

Pressing 

will bring up the Serial Number of a logger and the date of last calibration.

Each logger can be identified by its serial number. This is present on the above screen. We would like to know which customer has which logger. This is particularly useful if you want to change or replace a Rogowski Coil.

We are pleased with the inherent accuracy of our Rogowski Coils. Their spread is typically less than +/- 1. Each Rogowski Coil is measured and calibrated in the factory and the information fed into its corresponding logger. This process enables the logger to use maths calculations to produce an end result that is independent of variations from coil to coil and enables us to take full advantage of the coils' accuracy.

In the event that a coil becomes lost or damaged, if the factory knows your logger serial number or the Rogowski Coil serial number it can replace the coil with one as near in characteristic as possible to the original.

Please quote the serial number in any communication.

We also provide the last calibration date. This refers to calibration of all the internal components that contribute to the accuracy of the instrument. Please contact your distributor if you wish your logger to be recalibrated.

This arrow in the top left hand corner will appear on many screens. Pressing it will take you back through the menu structure one screen at a time.

Go back to the Initial menu.

ORL Logo button

Outram Research Ltd is the electronic design company that has designed and developed your logger, its companion products and the Pronto software you use to analyse your data. You are reminded of this when you press ORL on the top right of the screen and produce the screen below.

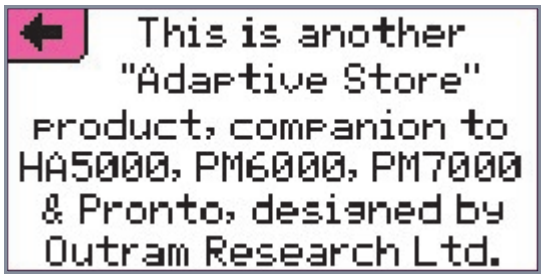


Figure 4-4 ORL Product Information Display

We are proud of our patented Adaptive Store data compression software algorithm that allows your logger to catch detailed information on your monitored power over longer periods than is generally the case. Chapter 2 and Appendix B describe how Adaptive Store works and its benefits. You will enjoy using our Pronto software to analyse your data. Do contact us if you have any comments about your logger and its use. Our address is inside the lid of your logger in the top left hand corner.

Go back to the initial screen using the arrow .

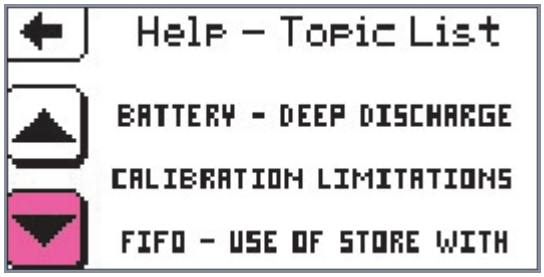
Help button

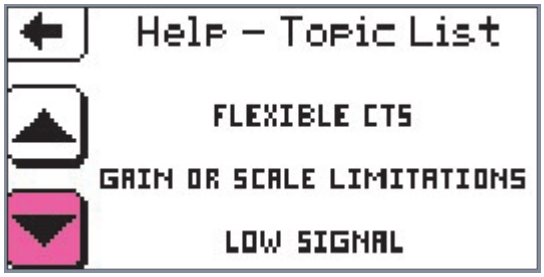
Help is available on the initial screen. Press the Help box on the bottom right of the screen.

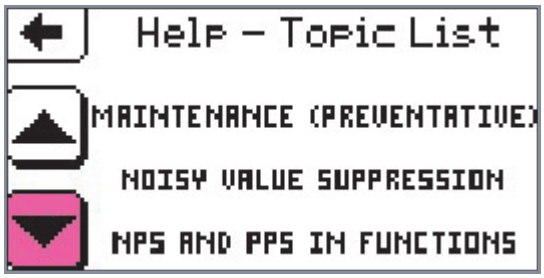
Topic help

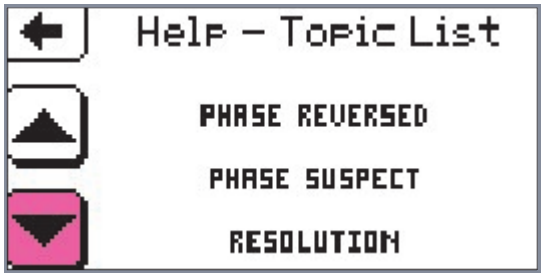
Press on Topics and a topic list will come into view. There are over twenty options as shown on the screens below. Use the arrows to scroll up and down through the list. Touching the arrow pointing down will take you to the next screen and down the list. Touching up will take you back up the list. Three

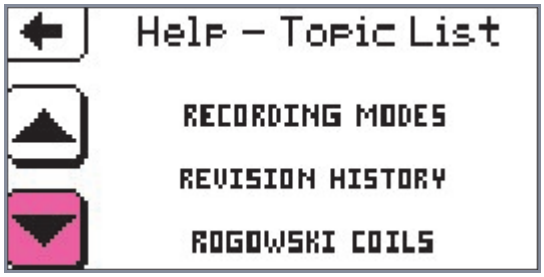
options will appear at any one time.

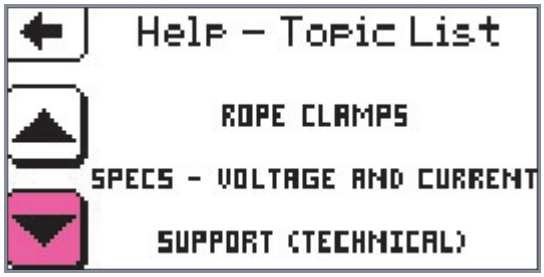


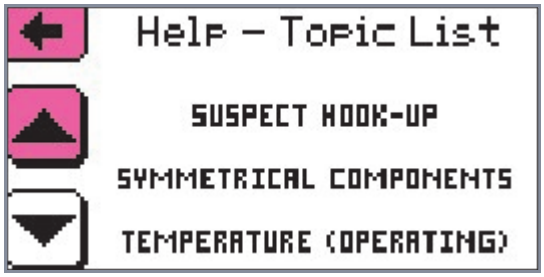












Here in the manual we can add to the help information. In this section we take you through the help topics in more detail than is possible on the screen.

The Help topics in detail

(i) Accuracy

The accuracy of the system depends on the functioning of two parts: the instrument itself and the sensors. Using a calibration instrument sensitive to 0.06 % we find that our logger initial setting does better than 0.1% accuracy. However the logger components do vary over temperature so we stipulate at 25 °C.

The Rogowski Coils are used over two ranges: 0-1000A or narrow range 0-50A. The voltage output current clamps or CT's can also be used over two ranges, 0-500mV or 0-25 mV.

Excluding the effect of these sensors:

For Volts and wide range current we are confident of an accuracy of up to 0.25% of the true RMS calculation.

For narrow range current we find we are accurate to up to 1% of the true RMS calculation.

Comments on accuracy
The Rogowski Coils can be set to achieve a similar accuracy result of 0.1%. A change in orientation of the coil round the wire, stray fields or other noise, or non uniformity of the windings can, however, affect results producing a general accuracy better than 1.0% for these sensors.

Rigid CT's can be more or less accurate than the Rogowski Coils but accuracy in sensors in general is difficult to measure and may fluctuate.

Inputs left open circuit may pick up noise and other spurious signals and must be correctly connected or terminated.

Accuracy is particularly important in the power metering field where customers are paying for their power.

(ii) Auto recording restart

If power is lost the logger will keep recording for 10 minutes. After that time it will stop. When power resumes it will automatically start recording again while the session still has time to run as set up. If the session end time has passed the logger will not restart. When in FIFO mode it will always restart.

(iii) Battery charge

- The logger battery charges off between 50 to 480 volts ac (+/- 10%) through the voltage 1 (red) input. Additionally you may charge it up using a 12V wall adapter or a 12V car battery.
- So long as the logger is receiving power as stipulated previously it will work even if the battery is discharged.
- After 12 hours the battery should have regained >50% of its charge from complete discharge.
- After the battery has recovered to 85% capacity the procedure will resort to trickle charging to achieve full charge.
- The menu will take you through a deep discharge process. This is explained more fully in the next topic.

The status of the battery voltage comes up on screen. It may appear to vary arbitrarily. This occurs as the instrument follows the charge level as it constantly adapts to the need for fast or slow charging. It may also change as the backlight display goes on and off.

(iv) Battery – Deep discharge

- We recommend you do this every three months.
- Follow the procedure in the menu: select 'configure', then 'utilities', then 'manage battery', then 'deliberate full discharge'. Do not leave any inputs connected while doing this.

(v) Calibration / Scale limitations

The Rogowski Coils in your kit are calibrated in the factory to work with your particular PM3000 and do not need to be calibrated by you. However, you have the ability to calibrate the Rogowski Coil sensors should you want to use alternative coils or renew your existing ones. You may also need to adjust the gain to make minor, non-permanent adjustments in some situations.

For example, if you loop your conductor through multiple turns you will increase the displayed current by the multiple of that number. This is a way of increasing the accuracy or resolution of your measurement. Using the scale facility you can then convert the result from the artificial current measurement to the correct one.

To use calibration:
- Enter the actual, known value of your reference current.
- Wait for the measured value to settle.
- Press OK.

Chapter 6 goes through the process in detail of setting up your logger to measure current and voltage accurately in different applications.

The internal arithmetic limitations of the calibration calculations require that the new number must be not more than twice the scale factor, disregarding the position of the decimal point. Thus a scale factor of 1.0000 may be converted to 0.2500 or 25.00 (2500 is less than 10000), but 1.0000 may *not* be converted to .25000 or 25.000 (25000 is now greater than twice 10000). So in this latter case using five significant figures has increased the gain too much. Any number with five significant figures up to 19999 would be OK, as would be any numbers with four significant figures or less.

(vi) FIFO – Use of store with FIFO on

In FIFO mode (First In First Out) the recording process aims to use up about one quarter of the total store available in the logger on the current recording. This is normally the case, although in units with 32MB or 64MB internal memory, the max. space made

available will be 4MB for each recording even if there is >16MB store remaining.

For example, if you choose to record for one day it will use up one quarter of the store for the first day. The logger will carry on recording the next day with a new session and use up another quarter of the store and so on for the third and fourth days. If you have not interrupted the process by now it will need to overwrite the first day on the fifth day. Whenever you retrieve your data you will collect the previous three and a bit days worth depending on when in the cycle you interrupt the process. This applies to any length of recording you set up. Adaptive FIFO storage allows you to record indefinitely, but you must retrieve your data soon after any significant event has occurred or the event may be overwritten. In units with 32MB or 64MB RAM, previous recordings will only be overwritten when the entire memory of the unit has been used up.

When setting up a recording in Point Store you will be invited on the screen to choose your desired record time and your sample rate. The screen will then show you the total time achievable using all the available store. This assessment by the logger will take into account the number of channels in use and the amount of store left. You may need to adjust either your preferred sample rate or record time or both if store is limited.

If the sample rate is set too fast for the desired record time and store available, the actual record time will necessarily be less than your desired time. If Point FIFO is activated, you can increase this actual record time indefinitely as storage space will be released as sessions are deleted. Note that each session time will be one quarter of the achievable record time.

(vii) Flexible CTs

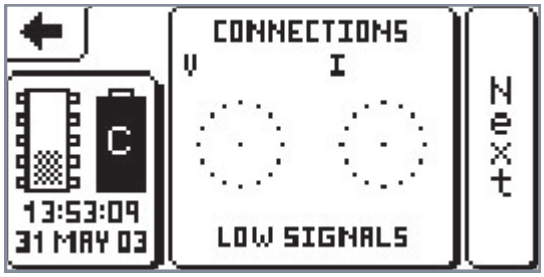
Flexible Current Transformers and rope clamps are another name for the Rogowski Coils we supply with your logger. See Rogowski Coils.

(viii) Gain or Scale limitations

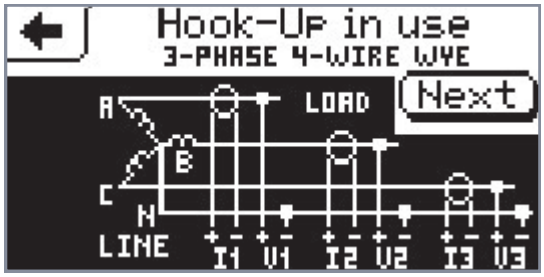
See (v) Calibration / Scale limitations

(ix) Low signal

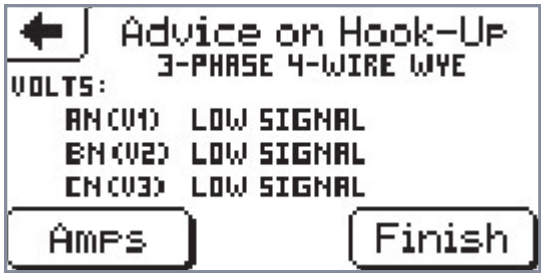
When this message comes up on the screen the input voltage or current is too low for the logger to detect all the signal characteristics (particularly phase) accurately.



Touch the 'Low Signals' button and the screen will change to 'Hook-Up in use' with a diagram of your current hook-up.



Click on Next for advice on the individual phases.



(x) Maintenance (preventative)

Checking and Servicing

Extend the operational life of your PM3000 by following these guidelines:

- Deep discharge the battery every three months. See Battery – deep discharge above.
- Change the batteries every two years. See the lid of your logger or the chapter on maintenance for details.
- You may wish to check the accuracy of the instrument on a regular basis, say every year, against a known reading If the logger, or more likely the sensors, are out of calibration do return it to your distributor or ORL for recalibration.
- Clean the display with a moist, non-abrasive, lint-free cloth when required. Do not use cleaning fluids as they may cause damage to the delicate surface.

- Regularly check all cables for cracks and look for holes in the insulation. Repair or replace as needed. See the chapter on maintenance for details.

(xi) Noisy value suppression

Calculations involving attributes such as phase angle, single phase power factor and % harmonic distortion depend on good phase or other measurements. These can become noisy when input signals are too small. To avoid misleading results this noise can be suppressed. There are two modes of suppression to choose from: 'Normal' for input signals less than 0.3% Full Scale and 'High' for signals between 1% and 0.3% Full Scale. To set up noise suppression go to 'configure' and then 'preferences' in the menu.

Note that for best results use the size of PT or CT best suited to the individual application. This way you will get full benefit from the logger's dynamic range. If the sensor range is too big the logger may not respond in as much detail as it potentially can, if the sensor range is too small some readings may drop off the top of the scale.

(xii) NPS and PPS in functions

Vectors (probably unbalanced) in a three phase system can be mathematically replaced by a combination of what are known as 'symmetrical components' or 'sequential components'. This is a new set of vector values comprising two balanced vector sets and a residual vector which are obtained from the original measurements of angle and magnitude for each phase. It can be used in calculations to give results more useful for describing unbalance; magnitude unbalance and the phase of the unbalance.

The first of the two sets is called the principal balanced set and is Positive Phase Sequence (PPS). This set of three vectors, though perfectly balanced, ie of equal length and separated by 120 degrees, typically looks close to the original measurement vectors. The second, secondary set (also balanced) is Negative Phase Sequence (NPS). The NPS and the residual vector (sometimes called the Zeroth Order Term) together equal the difference between the PPS and the original vector readings. Thus the PPS is the best BALANCED approximation to the original that can be found, and the NPS + Residual are WHAT IS WRONG with this approximation. Evaluating the PPS & NPS enables us to represent voltage unbalance in terms of phase dependence, something not always available in unbalance readings. Voltage unbalance is defined by the ratio of magnitude of the NPS/PPS. The phase of unbalance is given by the phase of NPS with respect to the voltage phase A. Please see Appendix C 'Further Application Notes' for comments on unbalance measurement.

NB (If the original set was itself a closed delta, the residual vector has zero magnitude).

(xiii) Phase reversed

There is a right and a wrong way to connect your CT's around the wire. The Rogowski Coils have an indicator arrow to help you orientate the coils so that they are correct with respect to the nominal flow of current in the enclosed conductors. Beware also that the voltage leads might be back to front.

This comment comes up on the logger screen, 'Advice on Hook-up' and is a useful warning. To reach that screen press Continue on the 'Initial Screen', then 'connections', then Next .

(xiv) Phase suspect

If this phrase appears in the display the logger is telling you that the phases do not correspond as might be expected. Check all your connections firstly for faulty contacts. Also check that the connections are not wrong, for example phase A mixed up with phase B. The other most likely explanation is a low signal.

This comment comes up the logger screen, 'Advice on Hook-up' and is a useful warning. To reach that screen press Continue on the 'Initial Screen', then 'connections', then Next .

(xv) Resolution

The defaults are 0.1V on the 480V range, 0.1A or 0.01A on the high and low current ranges respectively but you may change CT or PT ratios, or alter resolution in 'Edit Configuration / I/P Signals'. Note that the Factory multiphase power hook-ups use 1A resolution to avoid overflow in the Power calculations. [It is convenient to derive the power results to be recorded by multiplying the volts and current values and dividing by 1000. For Voltages resolved to 480.0V and currents to 1000.0, the (product / 1000) has too much significance to be very meaningful: two decimal places or a resolution of just 10 Watts in up to 480kW (or more in a three phase installation). By forcing the current resolution to be whole Amps, the overall resolution remains manageable at the same level as

that to which the Volts are specified, ie 480.0W, one decimal place, and the worst case maximum power will not overflow.] If the power results at an installation are expected to be small, you may always load a Factory configuration and edit the resolution to reinstate the decimal place.

(xvi) Recording modes

There are two recording modes, Adaptive store and Point store. You can find an account of these near the beginning of Chapter 2 and further information on Adaptive Store in Appendix B.

Because of the way Adaptive Store is effective in using memory, it will take measurements every cycle even if the length of time required to record is long. Point Store can be set to sample from every cycle to once in twelve hours. The rate of this mode will be limited by recording length.

Adaptive Store can also provide you with 10, 15, or 30 minute demand monitoring because the information Adaptive Store collects can be organised by Pronto into accurate demand monitoring reports. The normal limitations: amount of store remaining, number of channels in use and length of time of recording, will determine the amount of data on which the reports will be based.

(xvii) Revision history

The firmware revision number for each logger is found on the first screen and in Topic Help. Also in the Topic Help is the revision history. The firmware in the logger will be upgraded as new developments are incorporated and this is described. At launch of the product the current revision will be number 1.000. The next rev. will be 1.001 and so on. If at any time you become aware that there is a more up-to-date revision with features you wish to have in your logger tell your sales contact who will be pleased to organise a logger upgrade.

(**xviii**) **Rogowski Coils**

They are also called Flexible Current Transformers or Rope Clamps. These coils are current sensing devises and three of them are supplied with your logger. They are sensitive to any alternating magnetic field they can loop round and are often much easier to install than rigid CT's. When using them make sure that the sensing loop makes a proper circle around the conductor and the ends fit tightly together.

In order to achieve the greatest accuracy this instrument has been calibrated for each of the coils supplied with it. You will find the coil serial numbers noted on the inside of the lid. Each Rogowski Coil is colored to match the phase that has been calibrated for it. For best accuracy use the right coils on the right phases.

For your information the output signal is proportional to rate-of-change of current and is typically extremely small. The mutual inductance of the supplied coils is approximately 0.3uH (MicroHenries) leading to a typical output of 110 uV / amp at 60Hz (American mains) or 92 uV / Amp at 50 Hz.

(xix) Rope clamps

This is another name for the Rogowski Coils, three of which are supplied with your logger. They are also called Flexible Current Transformers. See Rogowski Coils.

(xx) Specs – Voltage and current

There are three voltage input ports. The voltage leads measure between 0 and 480 VAC, +/- 10%. The V1 voltage pair feed the internal power supply, and are fused internally for your safety and to protect the instrument. All voltage leads (including the V1 pair) are also fused for your safety.

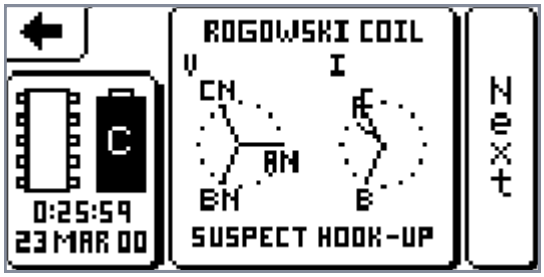
There are three current input ports and four ranges available. The Rogowski Coils cover the ranges 0-1000 Amps or 0-50 Amps. Voltage Output Current Transformers may have a range of 0-0.5 VAC or 0-0.25 VAC.

(xxi) Support (technical)

Call US: Synergy Systems on (248) 656 2727
UK: Redskye on (44) (0) 1633 450432
ORL on (44) (0) 1243 573050

(xxii) Suspect hook-up

If you have connected up your logger wrongly the notation 'Suspect Hook-Up' will come up on the following screen. This is alerting you to the likelihood of your sensors being wrongly attached.



Click on 'Suspect Hook-Up' and the screen will change to 'Hook-Up in use'. Now you can compare your connections with the diagram and correct them. Chapter 3 gives detailed information on hook-up connections and Chapter 5 covers setting up your hook ups.

Note that as well as 'Suspect Hook-Up', this screen offers 'Low Signal', 'Config OK', 'Wye Config OK' and 'Delta Config OK'. These phrases alternate depending on the situation.

(xxiii) Symmetrical components. See NPS & PPS in functions

Vectors (probably unbalanced) in a three phase system can be replaced by a combination of what are known as 'symmetrical components' or 'sequential components'. This is a new set of vector values comprising two balanced vector sets and a residual vector which are obtained from the original measurements of angle and magnitude for each phase. It can be used in calculations to give results more useful for describing unbalance; magnitude unbalance and the phase of the unbalance.

The first of the two sets is called the principal balanced set and is Positive Phase Sequence (PPS). This set of three vectors, though perfectly balanced, ie of equal length and separated by 120 degrees, typically looks close to the original measurement vectors. The second, secondary set (also balanced) is Negative Phase Sequence (NPS). The NPS and the residual vector (sometimes called the Zeroth Order Term) together equal the difference between the PPS and the original vector readings. Thus the PPS is the best approximation to the original that can be found, and the NPS + Residual are what is wrong with this approximation. Evaluating the PPS & NPS enables us to represent voltage unbalance in terms of phase dependence, something not always available in unbalance readings. Voltage unbalance is defined by the ratio of magnitude of the NPS/PPS. The phase of unbalance is given by the phase of NPS with respect to the voltage phase A. Please see Appendix F for further comments on unbalance measurement.

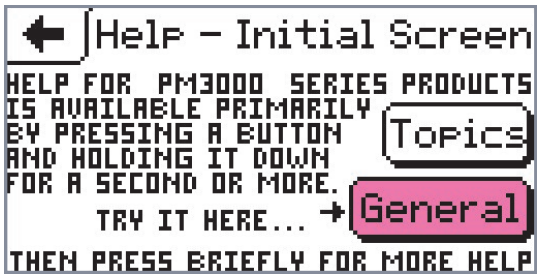
NB (If the original set was itself a closed delta, the residual vector has zero magnitude).

(xxiv) Temperature (operating)

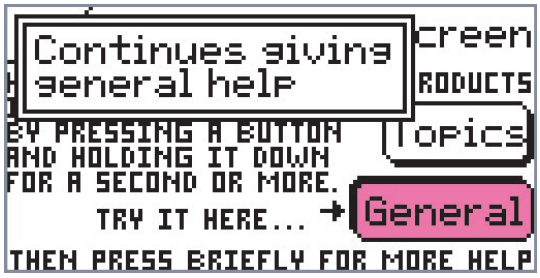
Your logger may be used between -10°C (Centigrade) and +60°C or between 14°F (Fahrenheit) and 140°F.

General help

There is a more general type of Help that is available to you throughout the menu structure. Wherever you are, by pressing and *holding down* on any area of the screen for which you need guidance, a help box will pop up explaining the situation or function.



As an example, if you press on General and hold your finger down for a few seconds this box will come up on the screen.

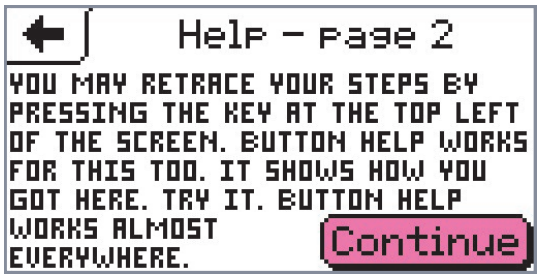


When you release your finger the box will go away.

Here is another example. If you want to know where you are in the menu structure press and hold on the top left arrow and a corresponding help box will come up.

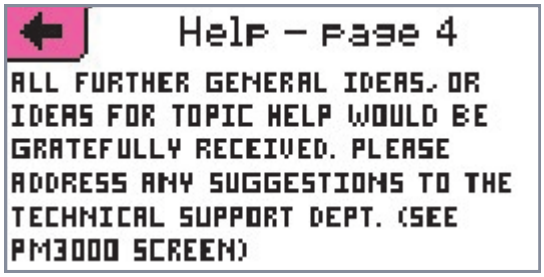
This type of help will work throughout the menus. Try it. To carry on down the menu and move to the next

screen press briefly on General



Press on Continue for a third help screen.

Press on Continue for a fourth help screen.

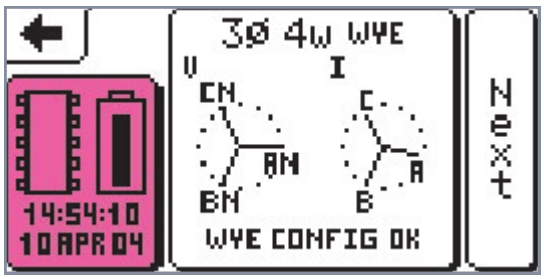


Now keep clicking on ← to travel back to the 'initial screen'

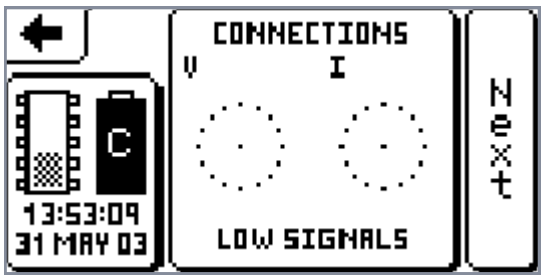
The Continue button

Press Continue . It brings us to the second screen.

The Second Screen



or



This screen gives us current status information and phase information.

Status button

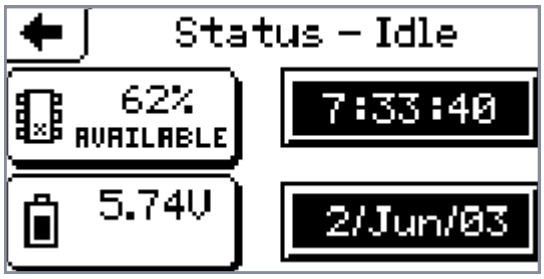
The status button  gives us immediate, up to date information on the status of the memory  , the battery  , and the time and date.

Memory Details

It is possible to see visually the amount of memory used  (less than half) but for a more

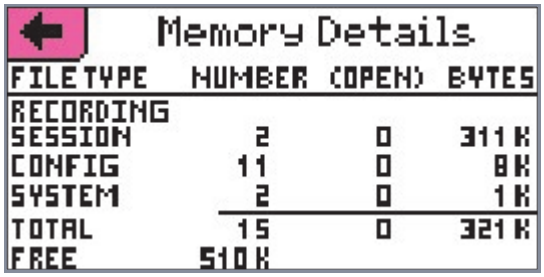
accurate percentage figure touch 

to bring up the next screen.



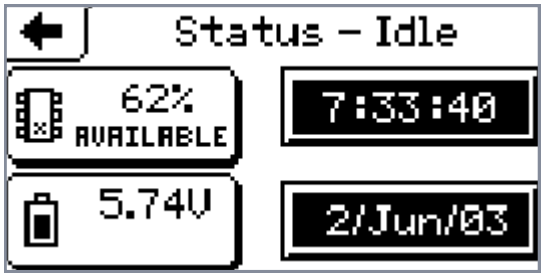
Further click on 

and more details about the amount of logger memory used come up.

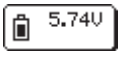


In this case, the logger has recorded two sessions, eleven configurations have been set up and there are two system files. No recording is taking place and there is plenty of memory left.

Touch  to go back to the 'Status Idle' screen.

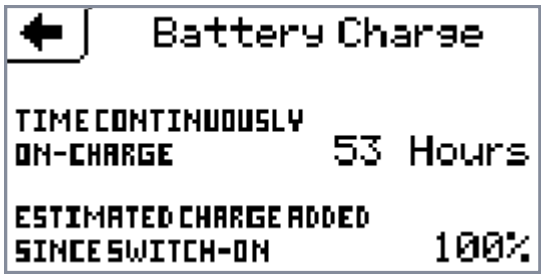


Battery details

To know more about the battery press on 

or 

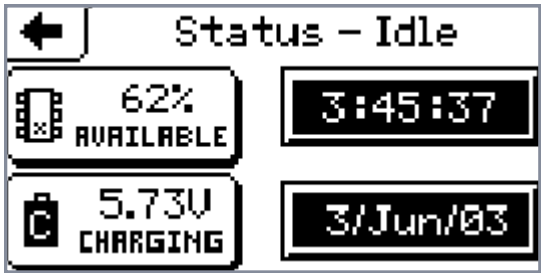
. (When your logger is plugged into the mains 'charging' will flash on and off to show that the battery is being charged.) A screen with information about Battery Charge will come up as shown below.



For further information on battery charging go to Topic Help in the previous section. Chapter 9 covers battery replacement.

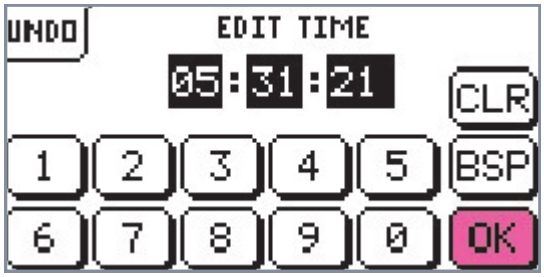
Change time

Go back two clicks to the Status screen



Touch the time button 

to come up with a keyboard through which you can change the time.



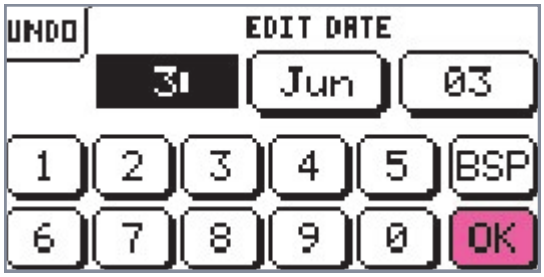
To alter the time, press clear, then use the keyboard to fill in the new time. Touch

to accept.

Change the date

Touch the date button 

to come up with a keyboard through which you can change the date.



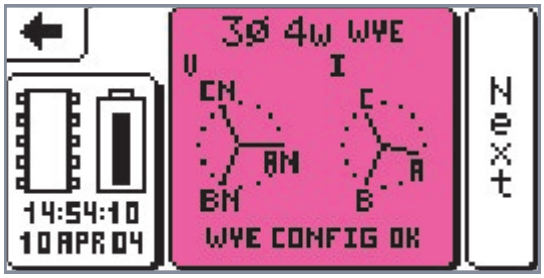
To change the date press Back Space [BSP] and starting with the day use the keyboard to select the number. Then press on the month and a keyboard of months will present itself. Choose the one you want and then press on the year button to return to the number keyboard. Select your two numbers. The year two thousand is assumed.

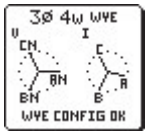
Chapter 9 also discusses edit time and date.

Touch [OK] to accept. Each time you will return to the 'Status Idle' screen. If you change your mind and want to keep the original setting, touch [UNDO] and you will return to the 'Status Idle' screen without anything changing.

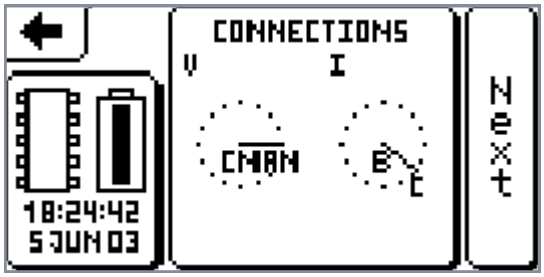
Go back up the menu tree touching [←] twice. You will return to the second logger screen.

Now we consider the 'Connection Button'.



Connection button 

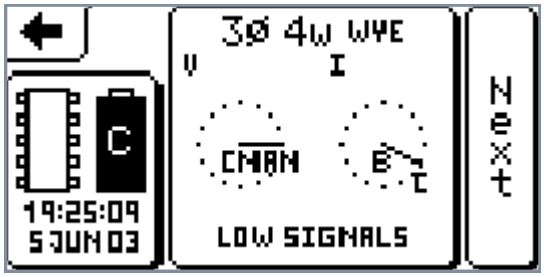
There are a number of possible examples of connection information. Here are a few screens indicating different types of fault.



In this example the logger is powered using a charger. There is no mains lead connected, and no volts or current are flowing through phase A, the red measuring circuit.

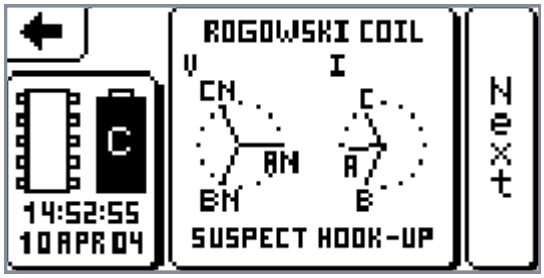
NB Always connect the mains to the red, left hand, pair of ports on the side of the logger.

This screen flashes between 'connections', and the current Hook Up ('3-phase 4w wye') and signal advice ('low signal'). See the screen below.

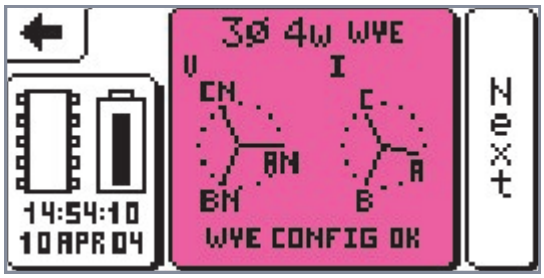


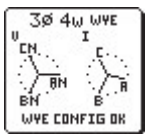
Here there is not enough signal for the logger to measure.

If you have hooked your power up wrongly the connections button will alert you to the situation as in the screen below.

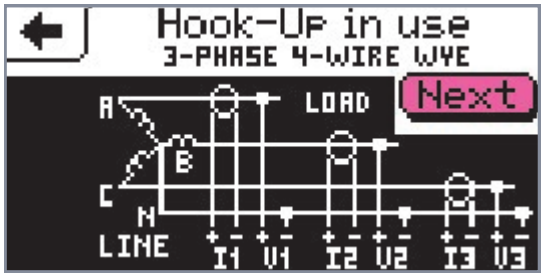


Finally, if the hook-up is correct you might get the following screen.

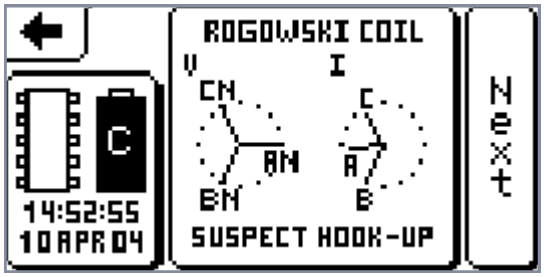


Whichever 'connections' screen the logger produces for you, touching  brings up the current

Hook-Up'.

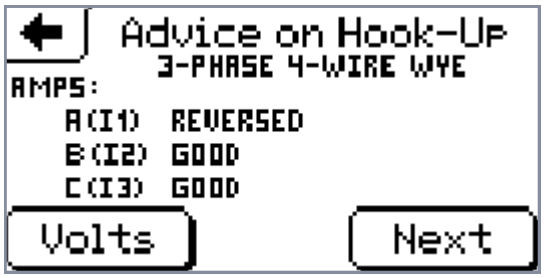


If your PM3000 has alerted you to the possibility of a wrong connection like -

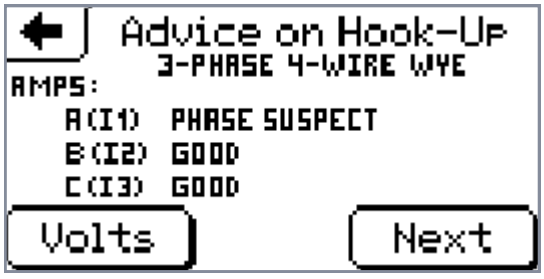


- the 'Hook Up in Use' screen is always available for reference.

Touch Next and the next screen will advise you further with a report on the status of the current.

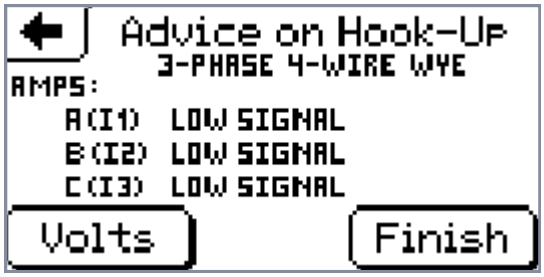


Check your hook-up. The Rogowski Coil may be fitted the wrong way round.

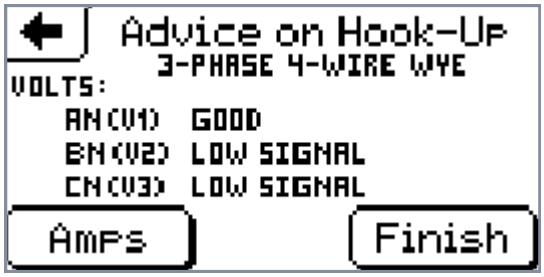


The wrong Rogowski Coil may be fitted round the wrong wire or the right coil may be round the wrong way.

.

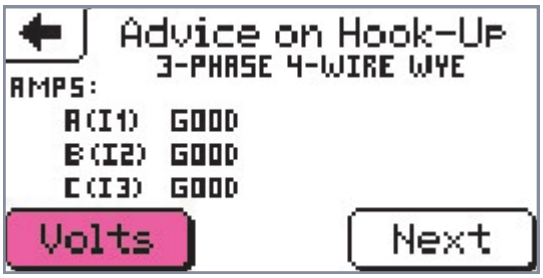


Check your connections. This screen reflects the situation of no sensor connected.



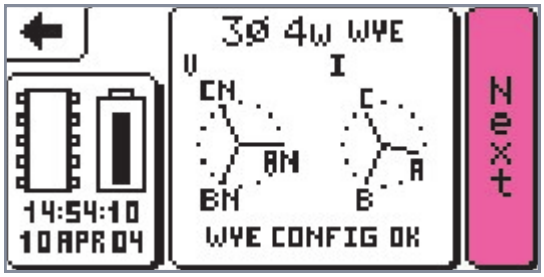
Here there are no sensors connected to V2 and V3.

Finally



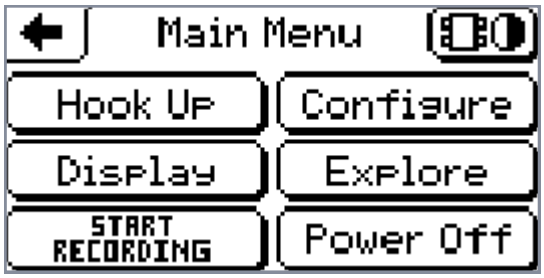
All is well. Touch Volts to get information on the status of the voltage.

The three connections V1, V2 and V3 are good. Touch Finish and jump back to the second screen.

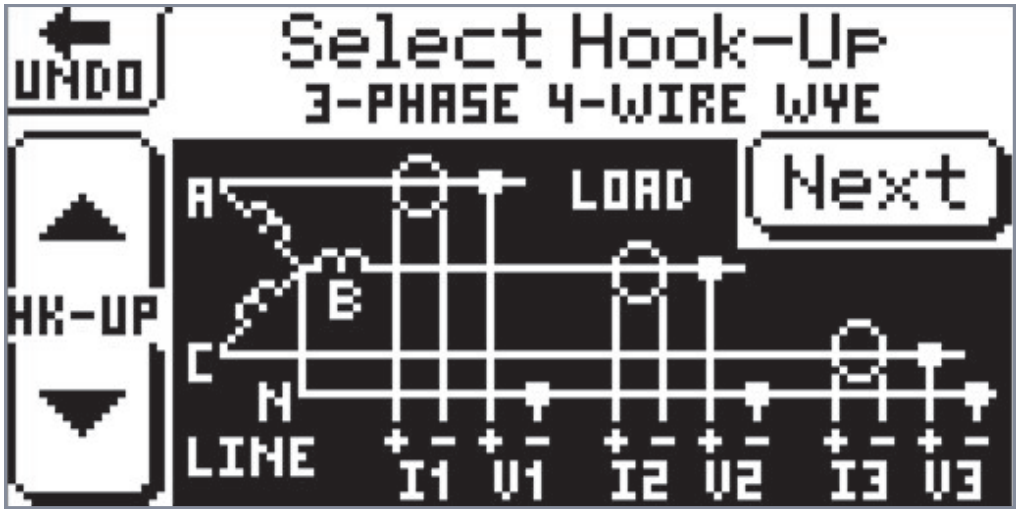


Touch 

to proceed to the third screen, the Main Menu. Chapters 5, 6, 7, 8 and 9 go through the main menu.



Chapter 5: Operation II
Main Screen 3: Hook-up Selection



A 3 phase 4 wire wye Hook Up Diagram

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Contents

List of Tables

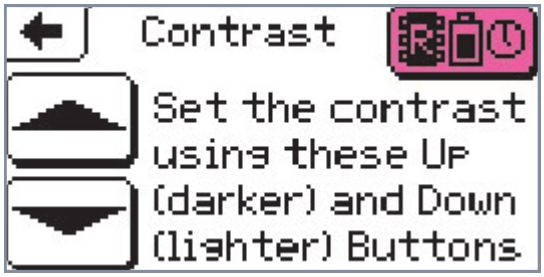
Main Menu

This chapter and the following three describe the operations that you will access from the main menu.

Status Button

This preliminary status button is available on many screens. It has the same function wherever it is used.

Touching will lead to the following screen.



This is another opportunity to adjust the contrast.

Status menu

Pressing on takes you into the status menu. This is already described in the previous chapter. Note that if the logger is recording as in the example, an 'R' will flash on the memory icon . If you have set up a delayed start 'T' will show up until the delayed start time is reached and the recording gets underway.

Using the will take you back up the menu structure, back to the main menu once more.

Hook Up Selection

The 'Hook Up' is the name given to the particular arrangement by which you introduce your signals to be measured to your PM3000. Which one you choose will depend on

- your power. Is it single phase, two (split) phase or three phase?
- the way it leaves the power source. Is it from a Delta or Wye generator?
- the parameters you want to record. What is your application?

You will find the Hook Up button on the third screen in the menu structure. This is the Main Menu from where you access all the functions of your power monitor.

Touching [Hook Up] leads you into the Hook Up set up menu. There are six different Hook Ups to choose from as well as an uncommitted option. These are all pictured on the logger screen to help you as you are connecting up the sensors. Each Hook Up is described in detail in Chapter 3. Here are some points to help you choose.

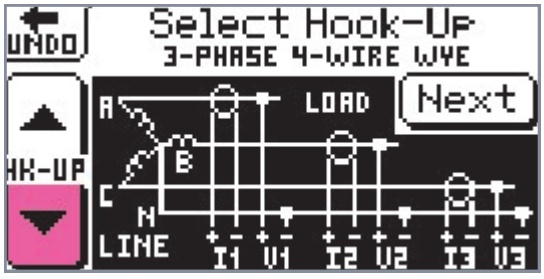
If your installation is 3-phase

- you must use a 3-phase hook up (nominal 120 degrees between the phases).
- if you have a neutral present and current may flow in it, you must use a 3-phase 4 wire Wye (Y) hook up.
- if there is no neutral or the neutral is a convenience only and no current flows in it, use 3-phase 3 wire Wye or 3-phase 3 wire Delta.

Scroll up and down the Hook Up options using the scroll button on the left.

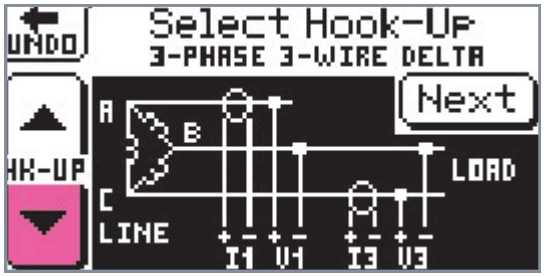
This first screen shows the logger uncommitted to any Hook Up. You have the flexibility to create any arrangement that suits your purpose.

Scroll down to the first and most popular of the committed hook ups.

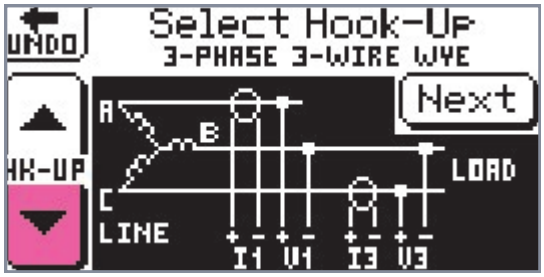


Note this hook up is a 3 element one. An element is the name we give to the use of a voltage probe and its corresponding current sensor. Here we require three sets of sensors. (3 voltage, 3 current).

Scroll down.



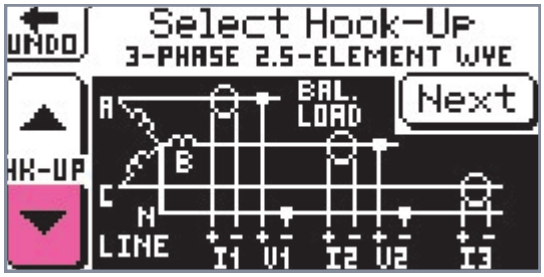
Note this hook up is a two element one. It requires two sets of sensors.



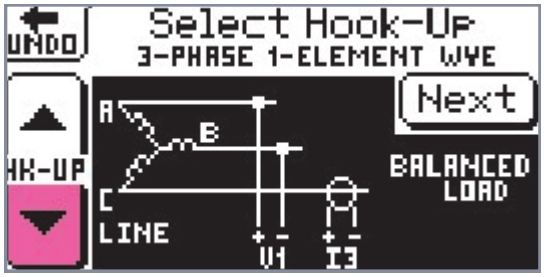
Note this hook up is a two element one also and the connections are the same as for the previous Delta configuration.

.

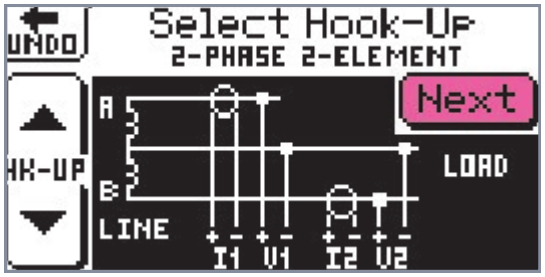
Scroll down.



Scroll down.



Scroll down.



And finally once again you scroll round to the uncommitted hook-up screen.

Should you select the uncommitted hook up, the logger can no longer give you feedback as to whether or not your hook up is correct and as you intended it to be. This feedback for committed Hook Ups is found on the 'Advice on Hook Up' screens described below. Also for an uncommitted Hook Up there is no guarantee that your hook up is appropriate and the results you get are meaningful. However we feel it is important to give you this flexibility.

(The reference on the screen to dependent functions being unavailable is not significant. It refers to two rarely used maths calculations to do with Real and Imaginary Impedance.)

Once you have chosen your preferred hook up, use the diagram to help you connect your sensors or go back to Chapter 3 for detailed information on connecting to the logger. (Remember that you have two link leads in your kit for use when two or three inputs are to be connected to the same conductor.)

Select Next on any Hook Up screen and the appropriate 'Advice on Hook Up' screen will follow.

Once you have connected the logger to your power to be monitored, this screen can confirm that you have made the connections correctly. The screen alternates (by pressing Volts and Amps) between Volts and Amps and gives a description of the resulting state of I1, I2, and I3 and V1, V2, andV3. The following table lists the notation on the screen and a comment on its interpretation.

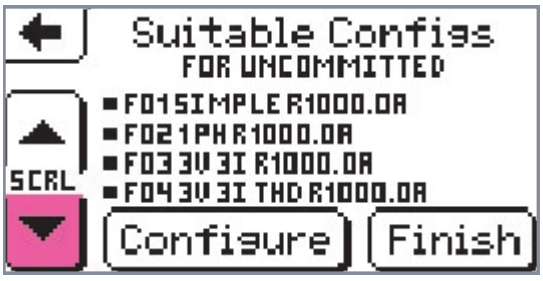
Notation	Comment
Good	The signal strength is adequate and the phase is consistent with the hook up selected.
Low signal	The signal is too low to measure. Perhaps the sensors are not properly connected.
Reversed	The reading is 180 degrees from expected. Perhaps the Rogowski Coil needs to be turned round or voltage pair swapped over.
Phase suspect	The phase is wrong. The phases could be swapped over. Nothing else is known.

Table 5-1 'Advice on Hook Up' Screen Interpretation

Press Next again and a 'Suitable Configs' screen will come up. This will show a list of all the set ups already programmed in the logger that you can use with the chosen hook up. The list will include both the appropriate factory set ups and any you have programmed in yourself.

Note factory configurations are amended from time to time so the screen shots below may not indicate the actual configurations in your logger. The principle, however, is the same.

The logger has available 'space' for up to 126 files for you to allocate to configurations or recording sessions.



Scroll down.

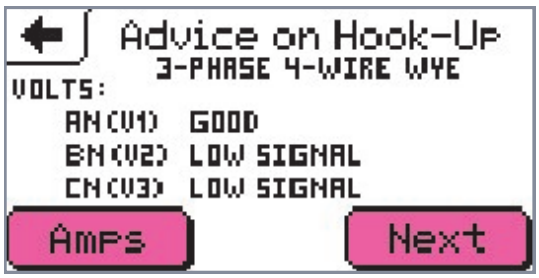
Scroll up or down to see in this example the six factory configurations you can use with an uncommitted Hook Up.

Consult Appendix G of this manual for a list and description of the factory configurations in your logger.

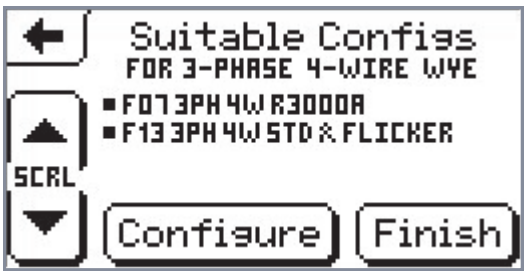
Further examples

Example 2: If you select a different hook-up, the advice and the suitable configurations will be different.

or



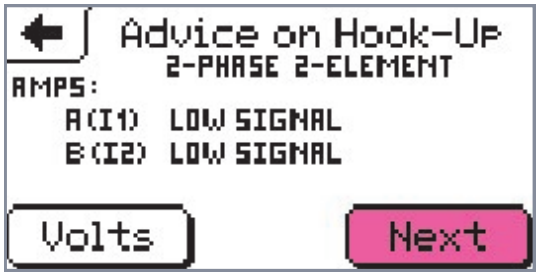
As described earlier under the Second Screen menu, touch on Amps to change the voltage information to current information and to change the button to Volts, and vice verse. Touch Next to bring up



Here we have two possible configurations to choose from, factory configuration 07 and whichever way the logger was configured before upgrade. The latter will come up only rarely, after a firmware upgrade.

Example 3

.



For the 2-phase 2-element (split phase) hook up the logger is offering you one possible factory configuration.

By this stage you are ready to select your hook up. The 'Hook Up' screens have allowed you to check that the connections are in order. You may wish to take note of a suitable factory configuration or decide if want something different.

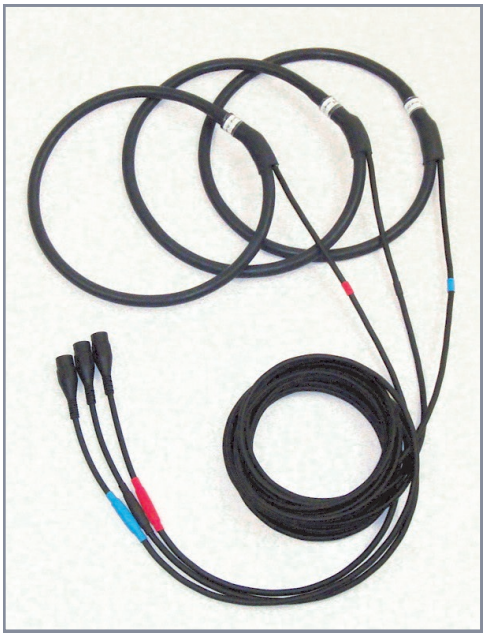
To enter the Hook Up, touch Configure or Finish. Now the logger will remember your hook up. This is important because the options the logger will now offer you if you go into 'configure' will reflect that choice.

Finish will return you to the main menu.

Be aware that at this point you have only selected the hook up part of your set up. Touching Configure will bring you directly into the Configure menu structure.

Now you can set up the other parameters necessary before you are ready to start monitoring your power. If you chose a factory configuration life is simple but you may wish to make use of, for example, a different storage mode, signal transformer or maths function. How to configure your logger is the subject of the next two chapters.

Chapter 6: Operation III
Main Screen 3: Configuration 1
Storage Modes & Input Sensors inc. Calibration Configuration



PM3000 Rogowski Coils (Old UK Colors)

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Contents

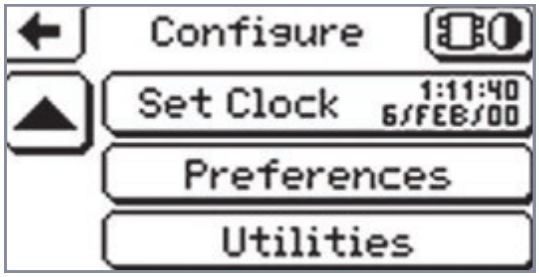
List of Illustrations

Configuration (Set Up)

Go to the Main Menu screen, unless you are already in the Hook Up Menu screen as described in the previous chapter.

Press Configure on either screen to produce this next one.

Now scroll down from this screen and come up with the six choices directly under Configure in the menu structure.



We shall cover each of these in turn in the following sections.

The 'Current Config' Button CURRENT CONFIG: F07 3PH 4W R1000A

The CURRENT CONFIG: F07 3PH 4W R1000A button will show you the configuration that is programmed in the logger at the present time. The one shown in this example is a previous Factory Configuration, F07. This was a configuration which included the Hook Up 3 phase 4 wire wye, a common hook up.

Full details as to the content of the factory configurations (including the default configuration) are listed in Appendix G. If you are happy with the default configuration you will not need to edit it.

CURRENT CONFIG: F07 3PH 4W R1000A is the button to touch if you wish to change any part of your configuration. The screen below will appear.

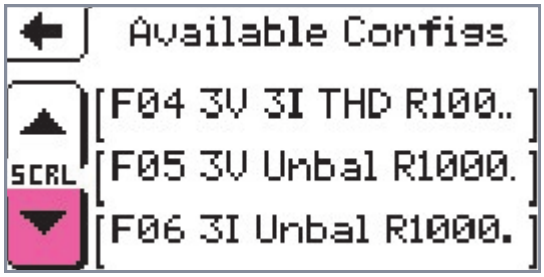
The words in the black rectangle remind you again of the set up currently programmed into the logger. Any set up you wish can be stored in the logger to retrieve when you want to use it.

We now supply you in the first instance with 23 stored set ups which we expect will cover many needs. The words (same as) indicate that the current programme in your logger is exactly the same as one of your stored configurations, either factory or your own. The configurations are stored under the AVAILABLE CONFIGS button and before we explain how to edit the current configuration (covered in the section 'How To Edit A Configuration' on p.60) we shall explore AVAILABLE CONFIGS and take a look at a list of old factory 'set ups' as they used to come up on the screen. The factory configurations have since changed so please see Appendix G for more details.

The ‘Available Configs’ Button [AVAILABLE CONFIGS]

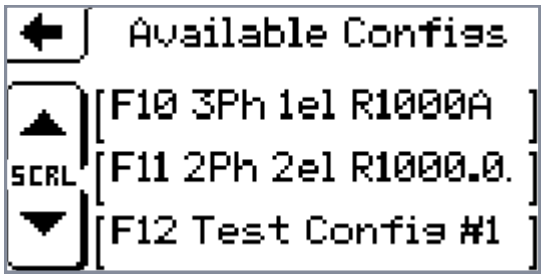
Touch [AVAILABLE CONFIGS] and bring up the screen with the current factory configurations. Since factory configs are subject to change, below are examples of what you might expect to see.

Scroll down.



Scroll down again.

Scroll finally to complete the options.



Choose any of the Factory Configurations from this list to configure the logger. To know which one to choose go to Appendix G for a complete list of what each Factory Configuration consists of. Or ‘review’ your set up. The [Review] button is found on the ‘Config actions’ screen and the topic is covered in detail in the section ‘How to Review your Configuration’ in Chapter 7.

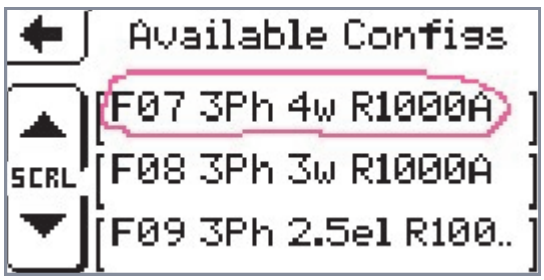
You can also add your own configurations to the list and then choose one of them. If you need something a little different edit the existing configuration on the list. You can treat configurations like documents on a word processor – edit the current one, or save it as something different and edit that, for example. Editing and saving new configurations is covered later in this chapter and also in the next one.

Note that you can overwrite your own file name but not that of a Factory Set Up. This means of course that you cannot ‘lose’ a factory set up.

The final two ‘Test configs’ are not set ups. They are files for testing the instrument in the factory and can be ignored.

How to load a factory configuration

Touch [AVAILABLE CONFIGS]. Scroll down the ‘Available Configs’ screens. For our example we shall take a previously used config. “F07 - 3Ph 4w R1000A”.



[The current default factory configuration loaded in your new logger is detailed in Appendix G.]

To select any configuration on the list touch it. Touch F07 to produce the next screen.

Press LOAD to place a copy of this configuration into the 'working' space. This is how you select your current working configuration (the Current Configuration). Now you can go back to the Main Menu and touch START RECORDING. Recording your data is covered in 9.

Note that when you pressed LOAD, the load button disappeared (obviously no longer necessary), and an Edit button has appeared which wasn't there before. So now you have the opportunity to edit or review your set up before 'recording' if you wish to.

Before you 'load' the Factory Configuration, its content is fixed. It cannot be changed. (It is "read-only"). So you don't get the choice to edit it. But when you LOAD a *copy* into the working space, now you can edit it (the copy). We will be doing this later. When the changes are to our satisfaction, the modified copy can be saved under another name.

At this stage, the copy is unchanged, so its name is as we selected it. (If we try and SAVE it under this name the "SAVE" will apparently succeed, that is there will not be an error message. This is because nothing has happened – the system knows that no changes have been made, and the file already exists, so the file is already saved – nothing further needs to be done.)

How to load a configured file

If you load one of your own files that you have 'saved' into AVAILABLE CONFIGS a slightly different screen comes up.

Because it is not a factory configured set up you can do any of the above actions at this point.

How to delete a file

Touch Delete and the file will immediately be deleted.

You are given a chance to change your mind by touching UNDO DEL and getting the following screen.

Press ← to go back to the 'configure' screen.

How to rename a file

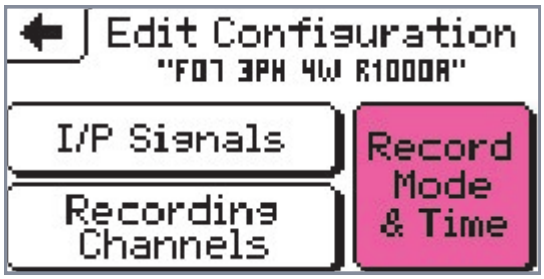
To rename File 9, touch Rename. A standard keyboard screen will come up. For help in using the keyboard go to 'Changing units' (Chapter 6) on page 66.

How To Edit A Configuration

If your current set up is F07, from the main menu touch [Configure], then [CURRENT CONFIG: F07 3PH 4W R1000A] to get to this following screen. Alternatively touch [Configure], then [AVAILABLE CONFIGS] and select F07 and come up with the next screen. F07 will be our example configuration.

We are now ready to change F07.

Touch [Edit] and get



Each button relates to an aspect of the information you want which you can change.

Input signals: You will often not need to change the input signals for long periods of time. If you are happy with the Rogowski Coils – and market research during the planning stage for this product suggested most people are – then you will not need to change the Input Signals.

Record Mode & Time: Occasionally you will make changes to the storage mode and time.

Recording Channels: The most common changes are to the Recording Channels' specification. This will be covered in the next chapter.

This 'Edit Configuration' screen is a very important screen. Once the Hook Ups are determined all the further settings up of the measurements take place under these three buttons.

Record mode & time

To change the storage mode and record time touch [Record Mode & Time] to bring up this set up screen.

These default configurations are put into the factory 'set ups'. They are Adaptive Store, a recording duration of 7 days (unless otherwise stated) and the FIFO, First In First Out, option in the off condition. We have found that using Adaptive Store over a seven day period is the most effective arrangement for many applications. For further information on Adaptive Store see 'Adaptive Store as the default storage mode' below, Chapter 2, 'Recording modes' and Appendix B.

How to change the record time set up

In the section below we go through example steps and change the time set up. Start by touching the [7 Days] button to bring up the following screen.

Touching [BSP] (Back Space), will eliminate the 7. Then press any number, say 5. Touch [Days] to highlight the time units. Select another time period, say hours, instead.

Touch OK and we have a new record time.

Press FIFO: Off to change it to FIFO: On .

Adaptive Store as the default storage mode

The default storage mode is our patented Single Cycle Adaptive Store™. You will make better use of your available memory using it. Regardless of the memory available Adaptive Store always samples every cycle so it 'catches' this amount of detail. If the data stays the same the logger does not record each reading. It gives you a maximum and minimum envelope within which all readings fall. When the data changes the logger gives you lots of detail until it once more feels the data behaviour is predictable. It then again reduces the amount of information it stores.

Over all, how much detail your PM3000 stores at any time will depend on the length of time you want to record for and the number of channels in use.

Because 'unnecessary', (i.e. predictable), information is not recorded, your memory lasts much longer than with the traditional Point Store Mode.

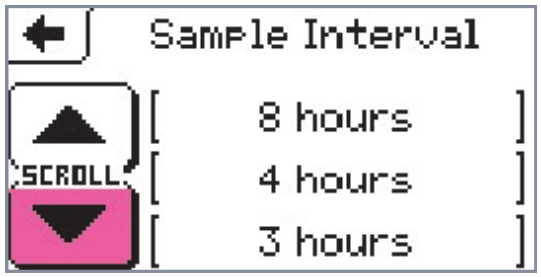
How to change the storage mode

Touch Storage Mode: Adaptive and you will change the screen to show point store.

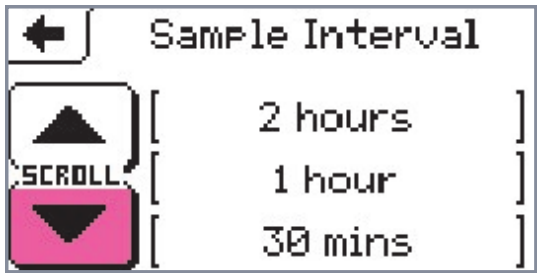
Notice that more information has suddenly appeared. Unlike Adaptive Store which samples once every cycle and stores sample information only if it does not fall within a predicted window, point store stores every sample it takes. This mode uses up memory more quickly. Because of this the logger lets you know how much time the recording will last before you run out of memory. In this case the achievable time span is 87 minutes.

Point Store gives you a choice of sample rates as indicated by the screens below. The appropriate screen appears when you touch the sample rate box with the corresponding value. Alternatively scroll up or down to reach your required interval.

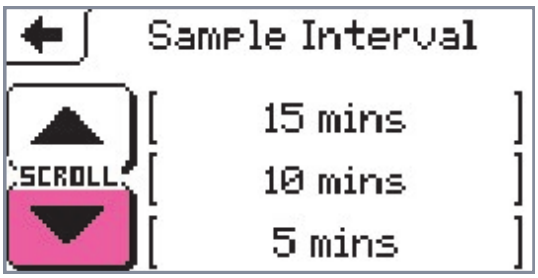
If you start with this screen, scroll down



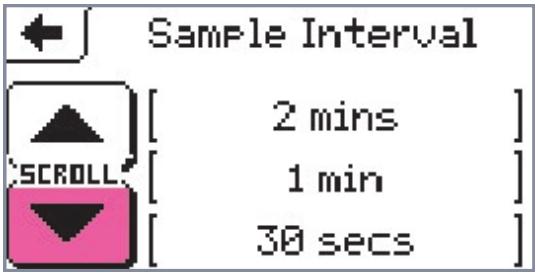
and down



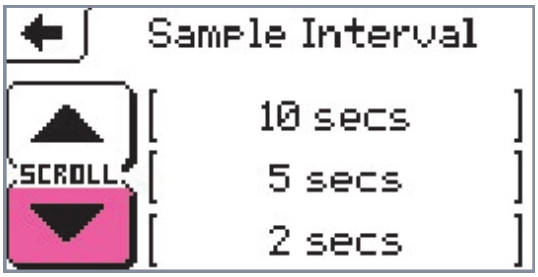
and down



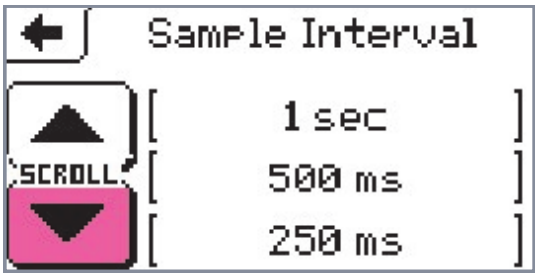
and down



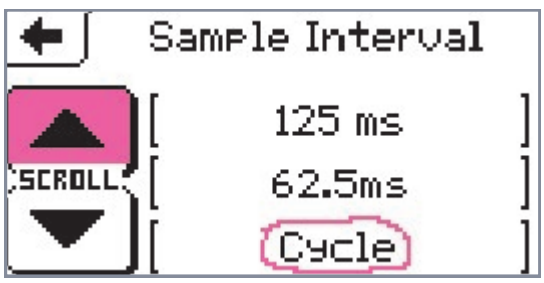
and down



and down



and get down to



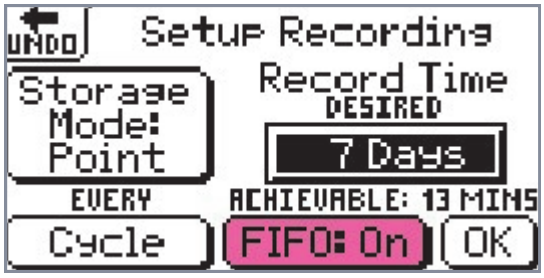
This last screen covers the fastest value sample rates, a single cycle being the fastest of all. The slowest rate, 12 hours, is not shown here.

Touching any sample interval puts that value in the sample interval box and returns you to the Setup recording screen. As an example we touch 'cycle' and get from our first screen repeated below

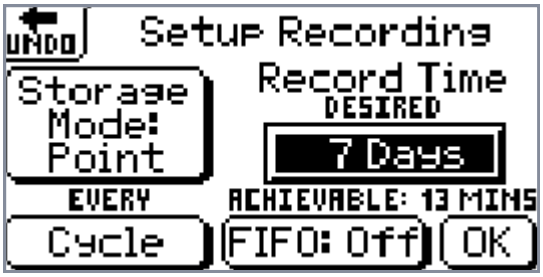
to this next screen

Notice how with a sampling rate of once every cycle the achievable time has fallen to 13 minutes.

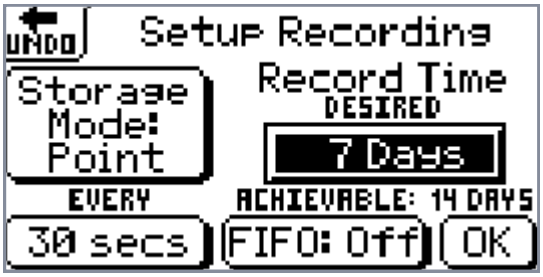
And if for example you were to ask for 7 days recording the time achievable would have to stay the same as all the memory is used up.



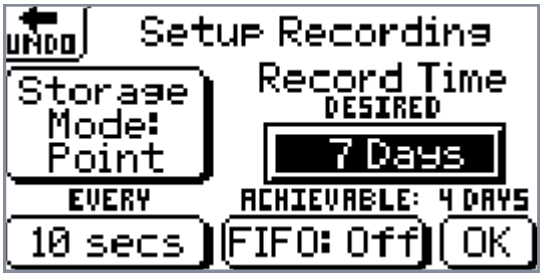
Decrease the sample rate and increase the recording time available



It becomes obvious that to achieve a recording duration of 7 days with point store the sampling rate must be less frequent than a single cycle. If you play around with the sampling values and compare the 'achievable times' you discover that 30 seconds sampling interval will give you 14 days recording



and 10 seconds will give you 4 days recording time.



Therefore if you wish to record in point store for 7 days the most frequent interval that you can use is 30 seconds.

Remember that if the number of channels to be recorded is reduced the recording time can increase on those remaining.

First In First Out

FIFO: On or off does not make any difference to the storage parameters. In practical terms, when FIFO is off readings will be recorded until the available store is used up. When FIFO is turned on the logger will start its recording, intending to use, for that recording, either one quarter of the remaining store in the unit or up to a max. of 4MB for those units with larger memory capabilities (32MB and 64MB). When the recording session is finished, the logger will start another session using the next quarter of store (or 4MB) and so on. Once all the store in the logger has been used up, i.e. just before the 5th recording is due to start for the smaller memory loggers, the oldest data will be discarded and over-written. This will continue to happen one recoding at a time until recording is stopped. Thus in the 'FIFO off' condition your earlier data is conserved while in the 'FIFO on' condition your later data is preferentially recorded.

Adaptive Store revisited

However for most applications, especially those with long time intervals and numerous channels to be recorded, we recommend Adaptive Store.

The logger will sample *every cycle* during any record time you need to specify and not miss anything important. It will give you a maximum and minimum value for your recorded data over the period. Wherever your data changes its behaviour, it will give you down to one cycle of recorded detail even over long recording periods.

Now you can press 'OK' to select your new storage mode configuration.

Input signals

Describing the difference between Signals and Channels

Historically, previous loggers designed by ORL have operated in a simple fashion. Each input signal was measured and that same unchanged information was recorded as a channel.

In the PM3000 there is no immediate connection between the SIGNALS being introduced to its measuring system and the information in the CHANNELS that will be recorded and displayed.

The reason for the distinction is that a single SIGNAL in an AC system, say input voltage V1, can be examined for a number of *attributes*, for instance RMS voltage, frequency, or Harmonic Content. The analysis process sub-divides the SIGNAL entering V1

into all its various attributes and briefly holds all this useful information as it does the calculations you have asked for. It then posts the results to the appropriate channels and the results are recorded. As you can see there is no fixed association between SIGNALS and CHANNELS. You define which attribute or *parameter* goes into which channel.
This independence of signals and channels has the advantage of allowing you, using the same selection method, to choose to record on the one hand as few attributes of a given signal as may be required, and on the other hand parameters derived from multiple signals. An attribute might be straightforward Volts or Amps, recorded onto a channel. Where three phase real power is measured, six input signals may all contribute to the parameter recorded on one channel. You have 16 channels to utilize.

This arrangement also allows the signal scale factors or treatments (see below) to be specified quite independently of the functions to be recorded.

It does mean, however, that you have to specify both these two distinct processes before your results are available to be displayed or recorded. These are, in more detail:

Input signal specification – which comprises where the signal is to be connected, any special treatment (distinguishes Rogowski Coil type sensors from Voltage output type current clamps), labelling and scale factor.

Display channel specification - the parameters to be extracted / developed which are intended to be displayed or recorded must be specified and the result applied to an allocated channel

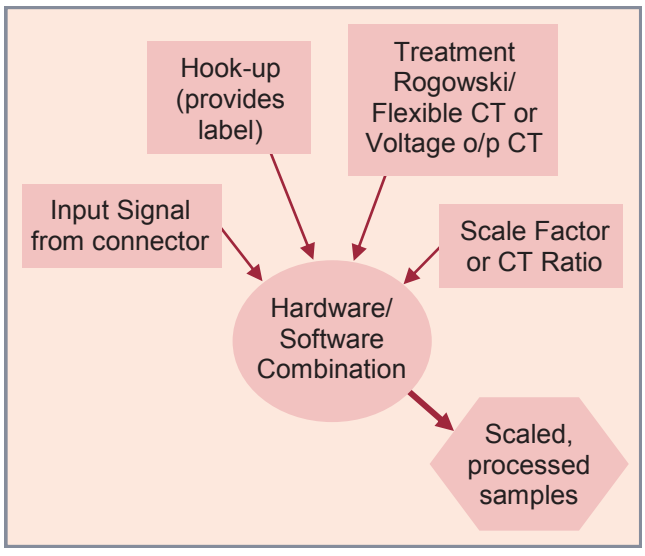


Figure 6-1 Input Signal Specification & Pre-Processing

The scaled samples (the result of pre-processing (see Figure 6-1) from each of the input signals are then themselves the inputs to the Maths Function calculation (see Figure 7-2, Chapter 7).
The next section covers the first process, the input signal specification. Chapter 7 takes you through the display channel specification.

Input signal specification

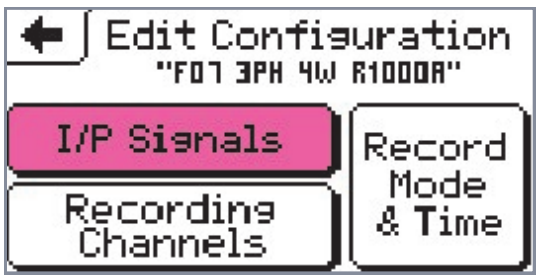
Selecting your current sensor

The programming in the logger enables you to use two different types of current sensor, Rogowski Coils and Voltage Output Current Transformers (CT's).

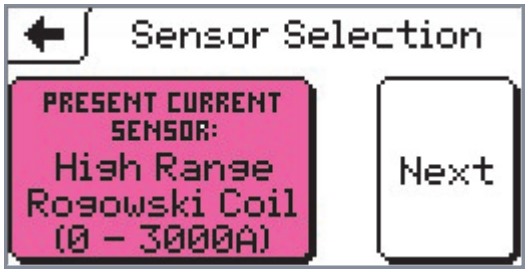
The Rogowski Coils are color coded to match the colored current port on the logger and are factory calibrated for greatest accuracy. Each coil may be used over two ranges, normal high range up to1000A with a resolution of 1 decimal place at best, or low range to 50A with a resolution of 2 decimal places. Chapter 3 gives more information on the Rogowski Coils themselves and how to use them.

Voltage Output type current sensors are catered for also in two ranges, from 0 to 0.5 Volts and 0 to 25 mVolts.

Before recording current you must tell the logger which type of sensor you will be using. To select a current sensor return to the 'Edit Configuration' screen.



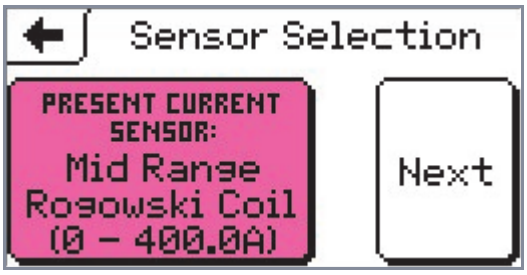
Touch I/P Signals to get the next screen.



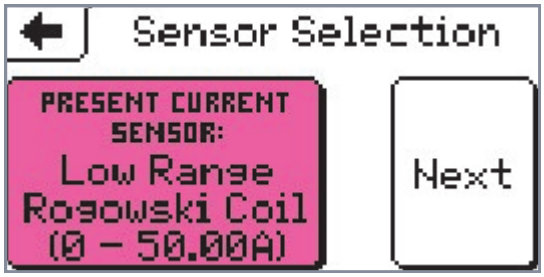
The new screen offers you the first of four current sensor choices, starting with the High Range Rogowski Coil.

For the other current sensor options touch 

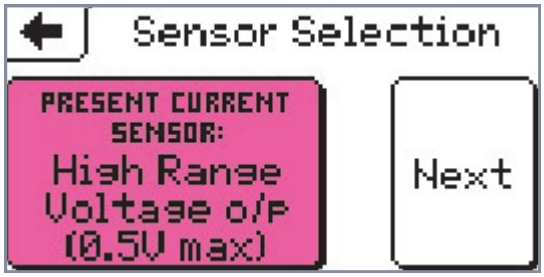
to get



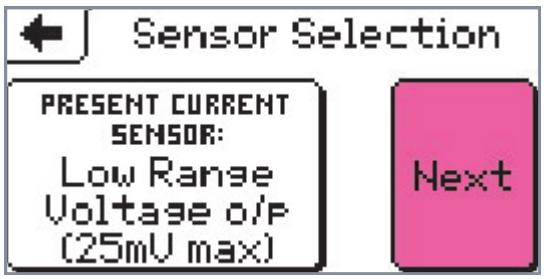
Touch again to get



Touch again to get



or again to get



(Touching one more time will return you to the original option.)

Choose one of the above four current sensor options. Whichever one is showing will automatically be selected. This arrangement of sensors will cover most applications. No further setting up is normally required when you use the Rogowski Coils provided with the logger. For the voltage output CT's and Rogowski Coils not calibrated you will need to tell the logger the gain or calibrate the sensor against a known current value.

For setting up the voltage sensor Full Scale and Input Ratios see section 'Selecting your voltage sensor' below.

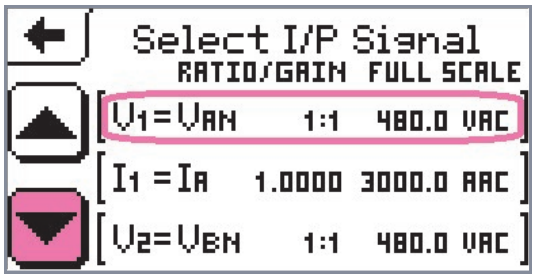
Selecting your voltage sensor

Different voltage inputs are less common. On most occasions the voltage probes do not need to be set up as the signal is under the top limit of 480 Volts. (Note that the logger can comfortably measure volts up to 480 + 10%.)

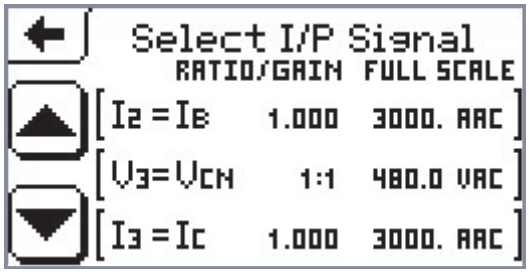
The following example describes the procedure for measuring volts beyond the logger's range.

Touch 

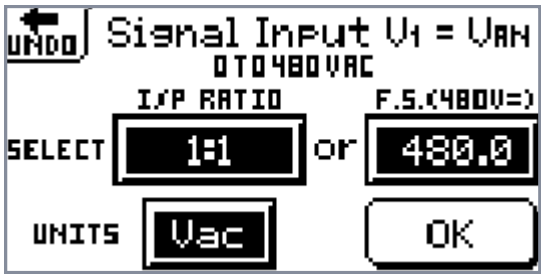
. The following 'Select I/P Signal' screen will come up.



This screen and the following one show you the effect of the sensors you have chosen. Scroll down to see all the choices.



Touch V1=VAN from the screen above. The following screen will appear. The next image shows the default condition.



If you wish to measure high voltages you will need to use some type of Potential Transformer (PT) so that the high voltage can be stepped down to a value the logger can deal with. (As we have already indicated this is below 480 Volts +10%.) It will be necessary to change the ratio/gain and full scale readings. If the PT ratio is known, that value can be keyed into the I/P ratio box. The logger will then automatically calculate the full scale.

Example 1: a requirement to measure a large voltage, up to 11,000V, through at 100:1 step down secondary transformer.

Each of the three boxes on the default screen (on the previous page) will need to change appropriately.

Changing the I/P ratio

To produce a ratio of 100:1 touch the box 

to bring up the 'Enter Ratio XX:YY' screen.

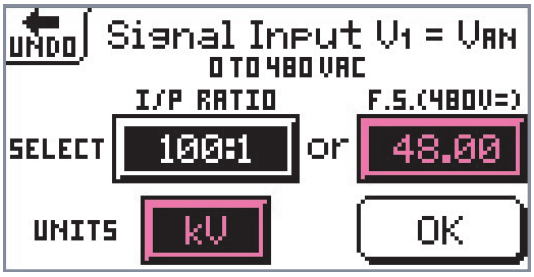
To clear the screen touch backspace 

three times to delete backwards one character at a time.

Enter the ratio you require, for this example it is 100:1.

When you are happy with your transformer ratio, touch 

and you will return back to the 'Signal Input' screen but now with the ratio changed to 100:1.



Now you can see that the Full Scale (F.S.) box and the Units box have automatically changed to 48.00kV, which is the maximum Voltage (+10%) to which the logger can now measure through the step down transformer. This full scale is more than enough to measure the required 11kV system.

Example 2: a requirement to measure a large voltage, up to 11,000V, with no prior knowledge of the PT ratio at the outset.

To produce a full scale of 0 to 11,000 Volts the Full Scale (F.S.) box needs to read at least 11,000. However the space in the box is limited to four digits and a decimal place. 11.00 kVolts will fit. Therefore the first task is to change the units from Volts to kVolts.

Changing units

Touch the units box 

. A keyboard, either upper or lower case, will come up.

To switch between the two cases touch

.

is

equivalent to the “Shift” button on a PC.

To enter the k we need lower case. Touch clear [CLR] and delete everything in the box in one go or backspace [BSP] to delete backwards one character at a time.

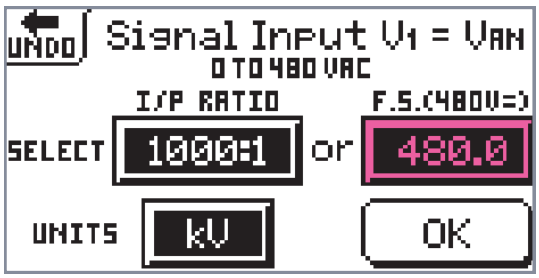
Now scroll down to find k on the next screen. Touch k to enter it in the units box.

Next find V by scrolling further and touching [↑] to change case. Touch V to bring it up beside k in the black units box.

The units box takes up to three letters.

There is another type of keyboard for entering units. It alternates with the above one when you press [KBD]. The whole alphabet comes up in one go and you may find this a quicker option, especially if you are using a stylus, or setting it up from a computer.

Finally, when you are satisfied with your units' set up, touch [OK]. The 'Signal Input' screen returns now with the new units information.



Note that you have changed the units but not yet the Full Scale. The logger now thinks your scale runs from 0 to 480 kV. It has changed the Input Ratio correspondingly to 1000:1 as every volt coming into the logger is now given a value of 1 kV or 1000 volts.

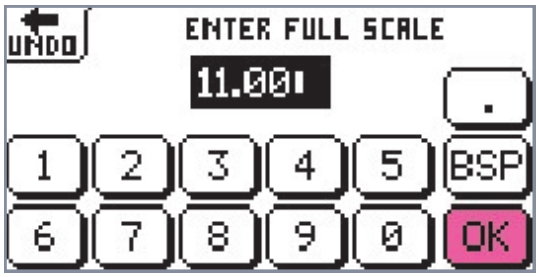
The next step is to select the full scale you want. In the case of our example this is 11,000 V or 11.00 kV.

Changing numbers

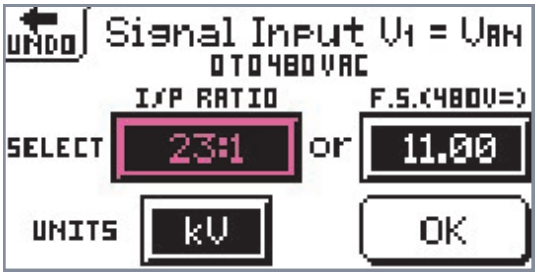
Touch 

and you will bring up the 'Enter Full Scale' screen.

Use the same procedure as with the selection of the units. Touch [BSP] five times to clear the box. Then touch the numbers and decimal point button and your value will appear in the number box.



Check that you have the correct number in the number box and touch OK to select it. Once more the 'Signal Input' screen returns with your new Full Scale value.

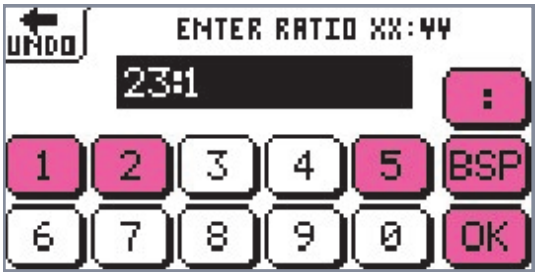


Note that the logger has again recalculated the Input Ratio in light of our further set up information. The value, 23:1, is what we might expect. The 11 kV or 11,000 V is very close to 23 times the default number of 480 V.

Using a potential transformer to step down the volts enables the instrument to safely process volts beyond its top limit (480 V). In our example the software will multiply the resultant incoming voltage value by 23 and we get back to the real answer.

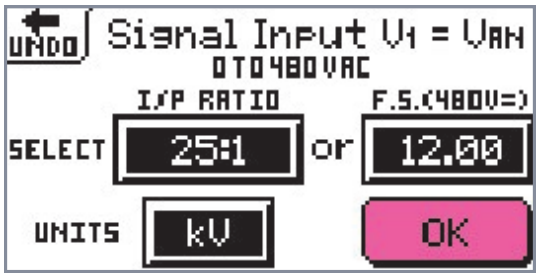
In practice however, it may be that 23:1 is not very meaningful. Industrial potential transformers have specific ratios. Suppose in our example kit we have a PT of ratio 25:1. The final step in our signal input set up will be to change our I/P ratio selection to 25:1.

Touch 23:1 and you bring up an 'Enter Ratio' screen.



In the same way as before clear the number box using BSP. Touch the relevant digits and the colon, and when 25:1 shows in the number box touch OK to select it.

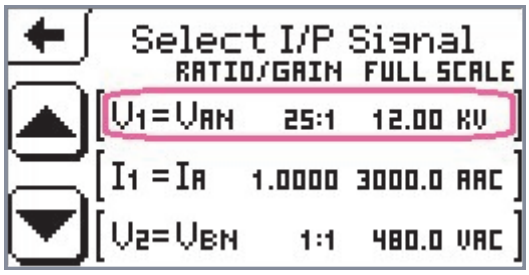
The 'signal input' screen displays the new and final information.



Again the logger recalculates. This time the Full Scale adjusts, to 12.00 kV to match the new input ratio set up. We now know that our full scale with a voltage transformer of 25:1 turns ratio is 0 to 12,000V. (480 default volts multiplied by 25 gives us 12,000 V or 12.00kV). This full scale covers our requirement for a top value of 11,000 V.

As before, the PM3000 realizes that the voltage input signal has been transformed down by 25 before entering the logger and must be multiplied by 25 to display the real value.

The final screen looks like this.

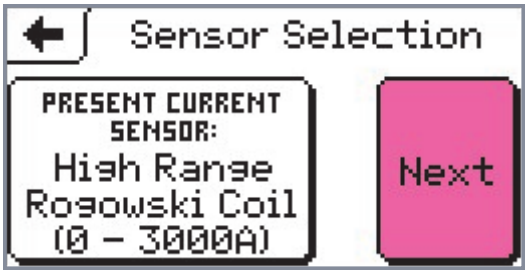


In our example we have successfully set up the logger to measure a large voltage through the first voltage input port V1. V2 and V3 can be set up in a similar fashion. Each voltage input must be set up individually.

Note that if you know the PT ratio you wish to use at the outset, the logger will do the Full Scale calculation for you.

Selecting the Current Input Signal

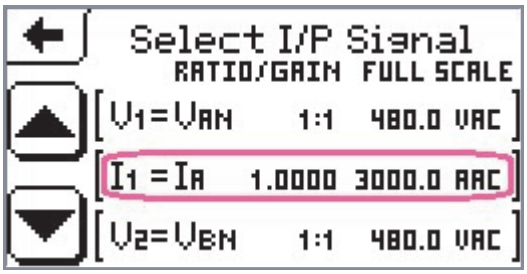
A previous section has described how to choose your current sensor from the Sensor Selection screen.



If you need to measure currents of higher value than 1000 Amps you may use an additional Current Transformer to step down the current. The Full Scale and Input Ratios are selected in the same way as described for the Voltage Transformers in the previous section.

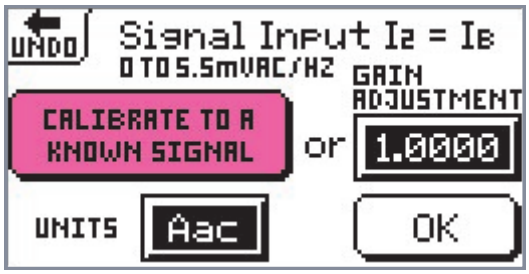
Touch 

and bring up the following screen.



This screen indicates that in the case of the high range Rogowski Coil the processed voltage equals the real value of the current. 1V = 1A. The gain is 1. It is written as 1.0000.

Touch I1 = IA for the next screen.



When you have selected the high range Rogowski Coil option this screen reminds you that the input signal should not exceed 5.5 mVAC/Hz. As long as you use the coils we supply you can ignore this prompt. It is there for guidance should you use a different type of coil. If you select a low range Rogowski Coil option, for example, which has a full scale of 0 to 50 AAC instead of 3000AAC, the screen will tell you that the signal input should not exceed a different figure, e.g. 100micro Volts (per Hz), if you use a different coil.

Your PM3000 kit comes with 3 Rogowski Coils, colored to correspond with the phases. Before they leave the factory these coils are calibrated to read the current accurately when connected to their correspondingly colored current input ports. **You do not need to calibrate your Rogowski Coils.**

How to Set Up the PM3000 to calibrate Your Current Transformer

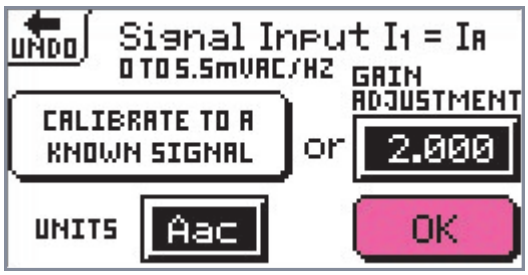
On the other hand the logger needs to be calibrated for any Current Transformers you use as they come in a range of ratios. If (as usually) these ratios are known it is a straightforward matter to adjust the gain on the above screen so that the logger will produce the correct answer.

If the CT ratio is not known the logger can be calibrated for your current sensor using a known current. Touch 

and get this screen.

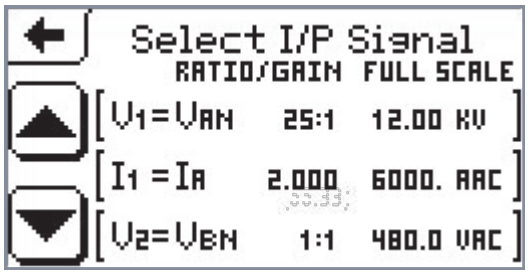
The 'present reading' is the value your sensor is producing. In the 'actual desired value' box you put the value of your known current. The logger will calculate the 'proposed (extra) adjustment' it needs to make, and bring up the number. Touch 

and you will return to the screen below. Now the 'gain adjustment' box has in it the new number.



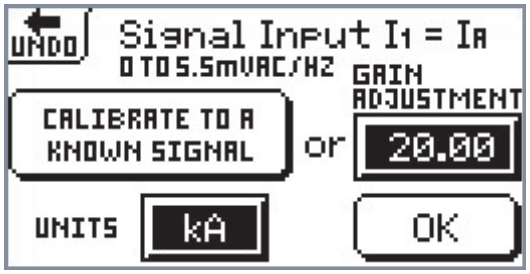
Touch 

and go back to the Select I/P signal screen once more. If you have more than one CT to calibrate, repeat the process using the alternative current inputs I2.and I3.



How to measure a very high current

A high current may need to be stepped down before it can be fed into your PM3000 sensor. It must be below 3000 Amps. Operators may use an external Current Transformer with a large transforming ratio followed by the Rogowski Coil. Set up your ratio in the logger in the same way as described earlier, remembering to multiply the two ratios together to work out the total effect.



How to measure a very low current

Should the current you are measuring be very low, its value can be increased for measuring purposes by adding a number of turns of the wire. If your current is below 5 Amps, loop the conductor through the Rogowski Coil. It can be done many times.

The logger will be able to register the increased current which will be the real current multiplied by the number of turns. Calibrate the logger as shown above so that it gives a reading that is the measured current *divided* by the number of turns. The gain value will be less than 1 if the 'gain' is a reduction in current.

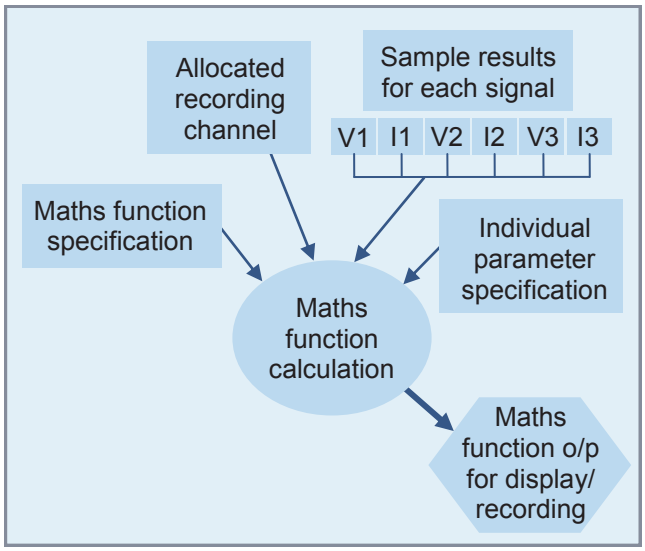
Example. If the number of turns necessary to produce a large enough current for the logger to monitor is five then the gain factor will be 0.2. The value measured by the logger is multiplied by 0.2 to produce the real value. This is the same as dividing that measured number by 5.

Now you have sorted out your hook up, set up your storage mode and selected the type of voltage and current input.

The next activity is to set up the channels to record the information you need.

See 'display channel specification' on page 64. Setting up the channels to record is covered in Chapter 7.

Chapter 7: Operation IV
Main Screen 3: Configuration 2
Setting Up To Record Maths Functions



PM3000 Maths Functions

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Introduction

In the previous chapter we described the difference between signals and channels and covered all you need to do to configure the logger to appropriately process your signals.

Figure 6-1 is repeated here to remind you of the processes in your logger which go on to produce the samples of information the channels will act on.

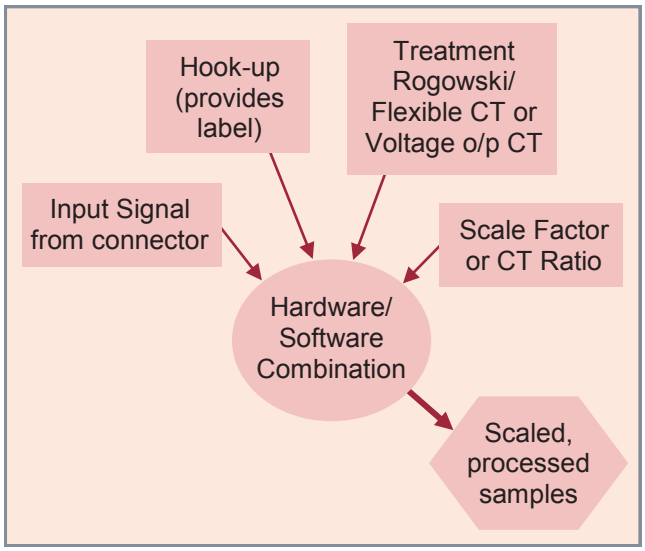


Figure 7-1 Input Signal Specification & Pre-processing

This processed input information is 'used by' appropriate Maths Functions to produce your required recorded and displayed information on selected channels. Chapter 7 covers this final step starting with a description of the Maths Functions.

Under most circumstances you, the operator, will probably need to do only this second step of setting up these Maths channels because:

- The sensors we supply will suit your purposes and not require specifying
- You may wish to use the default parameters Adaptive Store and 7 days
- One of our factory Hook Ups may work well for you.

Maths Functions

The PM3000 provides various functions for one, two (split) and three phase power measurements, plus single phase measurements of, for example, RMS (voltage or current) or harmonic level, together with filtering, scaling, and one or two other mathematical operations.

The outputs of these maths functions are the parameters that you choose to be displayed or recorded. To make them available for display or recording, the maths function output is allocated to one of the 16 *channels*. The *signals* on which the maths function operates are specified as part of the maths formula.

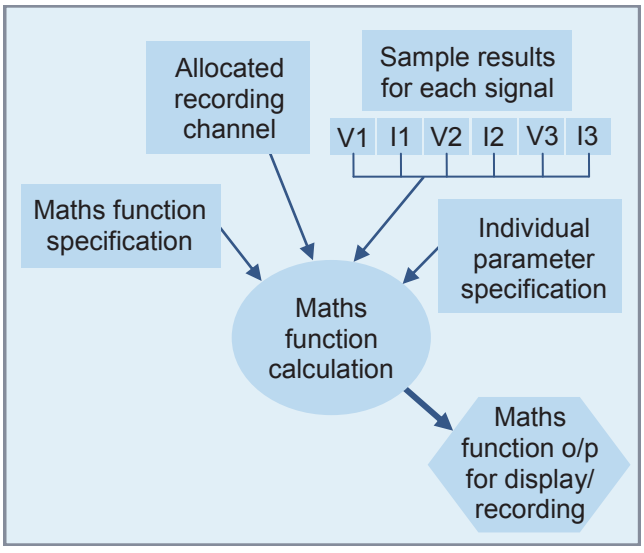


Figure 7-2 Display/Recording Channel Specification

As has been discussed in the section on hook-ups, the system tailors the maths functions available to the choice of hook-up. By choosing a hook-up and making the appropriate connections, a number of the available functions will not be relevant. Consequently all functions inappropriate to the chosen hook-up are suppressed in the menu options.

We are now ready to select our channels and Maths Functions.

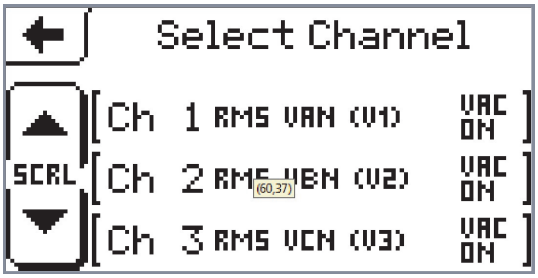
To reach the channel allocation and maths function specification, press [Configure] from the main menu. This gives you the following screen.

Touch either [CURRENT CONFIG: F07 3PH 4W R1000A] or [AVAILABLE CONFIGS], (see Chapter 6, 'The Available Configs Button') to bring up this screen as before.

Touch [Edit] and get

Recording Set Up

Now, to allocate channels and specify maths functions, Touch [Recording Channels] and bring up the next screen.



Our example configuration has 10 of the 16 Recording Channels already specified, as shown in the table below.

NAME	F07 – 3p4w R1000A
Hook-up	3 Phase 4 Wire Wye
Current Sensors	Rogowski Coil High Range
Signal	Name & Full Scale
V1	Van 480.0V
I1	Ia 3000A
V2	Van 480.0V
I2	Ib 3000A
V3	Vcn 480.0V
I3	Ic 3000A
Channel	
1	RMS Van
2	RMS Vbn
3	RMS Vcn
4	RMS Ia
5	RMS Ib
6	RMS Ic
7	3 Ph 4 w Real Power
8	3 ph 4 w VARs
9	3 ph 4 w Power Factor
10	3 ph 4 w Apparent Pwr
11	
12	
13	
14	
15	
16	

Table 7-1 Configuration Details for an Example Application

The maths functions that have been factory configured into the logger (please see Appendix G for a list of Factory Configurations), are those we feel to be most usefull. The following example will demonstrate how to set up more functions.

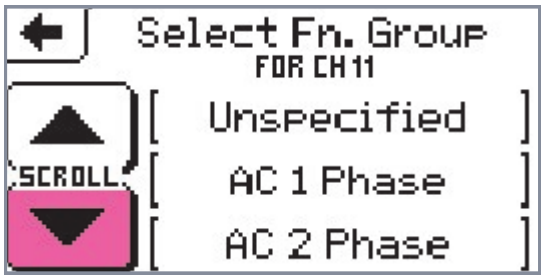
Example: We shall add THD measurements on the three voltage signals to Channels 11, 12 and 13. To do this we assign the THD of the signals Van, Vbn and Vcn to Channels 11, 12 and 13 respectively.

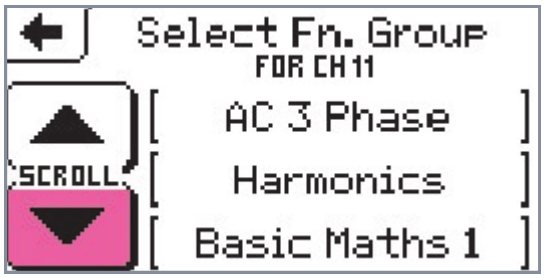
Example: Changing channel 11 so that it is assigned to evaluate the THD of Van

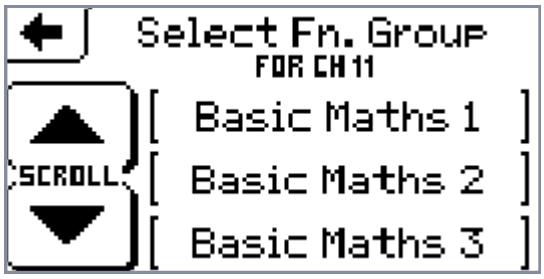
Scroll down the 'Select Channel' screen, through the channels, until Channel 11 shows up, or a different channel that is currently unspecified. Select it.

This produces the following screen with the single selection button. UNSPECIFIED is not a group but is included here to make de-selection of a channel easy. No maths function has been allocated to the channel

Press on UNSPECIFIED to bring up the 'Select Function Group' screen. You can choose from various maths functions available to you. They are organised into seven groups. Scrolling up and down through the 'Select Function Group' screens shows the groups.







The maths functions are organised under these group headings and the choices come up as you press any of the group descriptions. Remember that the hook up we are using in these examples is F07: 3 Phase 4 wire Y. The screens above show the maths functions appropriate and therefore available for F07.
To know all the functions in your PM3000 go to Appendix A where you will find a complete list of every option.

"AC Phase" groups

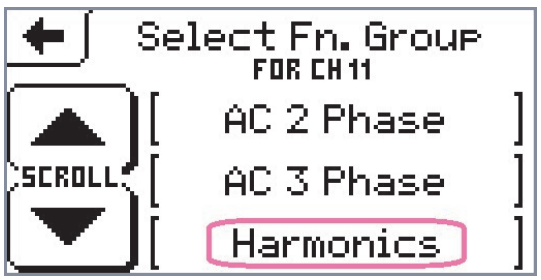
The group "AC 1 PHASE" contains all the options for 'simple', single phase operations. For example: you can measure RMS which requires specification of a single signal, or measure 1 Phase Real Power and specify 1 voltage and 1 current signal, or measure FREQUENCY, which requires no further parameter.

Though this group is described as a single phase operation use it also, of course, for monitoring the individual phases within your 2 and 3 phase installations.

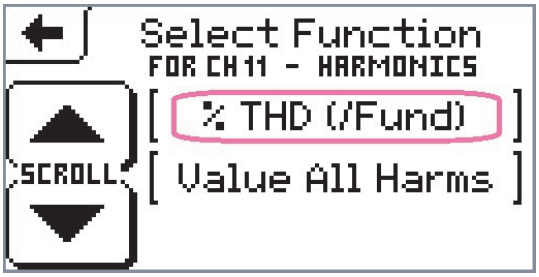
"AC 2 PHASE" and "AC 3 PHASE" allow you to specify two (split phase) and three phase power functions. However, remember that *functions available do depend on the hook-up*. If in our example you try to select the group "AC 2 PHASE", you will find it empty. This is because the hook-up selection we have configured is "3 Phase 4 Wire", thus 2 phase functions are inappropriate, and therefore suppressed.

The lists of Factory hook-ups in Appendix G show the hook-up associated with each factory set up. For advice on setting up hook-ups go to Chapter 5.

Carrying on with our example to set up channel 11, scroll down until HARMONICS appears on the screen.



Touch Harmonics. This presents a screen with the two options within the Harmonics Group.

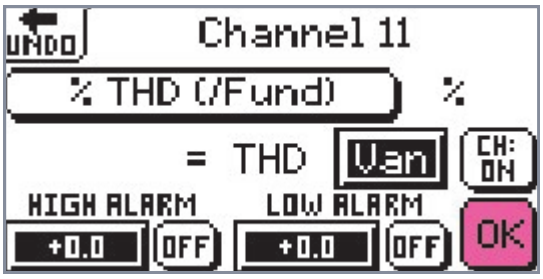


Both options on the new screen measure the harmonic content of a chosen signal. The % THD option divides the total harmonic component of the signal by its fundamental component to give the conventional Total Harmonic Distortion expressed as a percentage of the fundamental. The VALUE ALL HARMONICS is just the total harmonic component, expressed in the same units as the RMS for the chosen signal.

Further discussion on THD and value all Harmonics

Typically the THD is used to represent harmonic distortion of Voltage signals, since Voltages tend to be (nominally) fixed, and the proportions of distortion are of interest up and down the voltage transmission path. For Current, with its arbitrary load dependent variation, VALUE ALL HARMONICS is more useful. However either can be applied to both Voltage and Current signals.

In our example we shall select % THD (/Fund) and bring up the signal selection screen shown below.

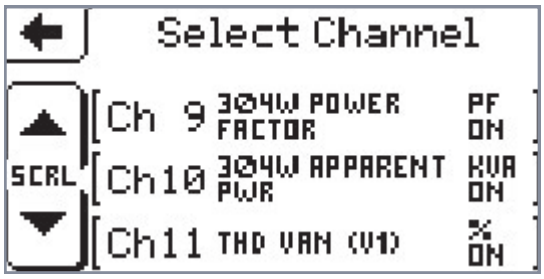


This screen shows the values of these settings as they are set up at the moment for this selection. It shows that the FUNCTION for Channel 11 is % THD (/Fund). Its UNITS will be %. The SIGNAL for which the THD is to be calculated is Van, and the Channel is automatically switched ON.

The High and Low Alarm settings (which can have an effect on recorded detail in Adaptive Store as well as providing visual indications of out-of-limit conditions in

the display screen) are not in use. Both alarms are switched off.

This screen shows the settings that are actually required for Channel 11 to be assigned to THD of Van, so you have no changes to make. Touch OK to accept this arrangement. This returns us to the "Select Channel" screen.



Now it shows the Channel 11 assignment, together with the units applicable and the indication that this channel is ON, that is, it will be recorded.

Turning a channel off

Looking at the above screen, note that you may turn a channel OFF for recording purposes by touching the 'Ch on' button when that channel is selected. The channel will still be evaluated and its results made available for other Maths Functions if required.

When you "List Channels" under the display menu (See Chapter 9), should a recording session be under way, channels which are ON, i.e. being recorded, will be shown with a flashing "R" beside them. Those NOT being recorded will not have a flashing "R".

Remember 'Help'

Remember that if you need to know how you got to a particular screen, you can always press AND HOLD the "back arrow" in the top left corner. This will list the steps taken to your present position. Perhaps it might be useful to make a note of them.

Assigning THD of Vbn and Vcn to channels 12 and 13

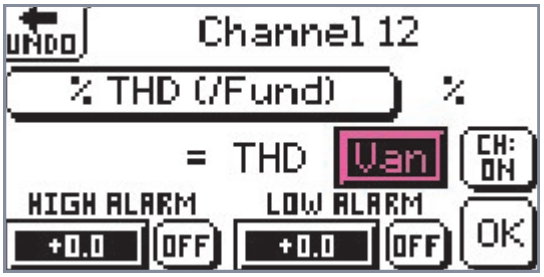
This process is the same as for channel 11 above, except that we must change the signal whose THD is to be measured.

From the "Select Channel" screen, scroll down to Channel 12, which shows "Unspecified". As before, touch it to access that channel.

Press on the UNSPECIFIED button to access the Function Group selection.

Scroll down to HARMONICS, and select it.

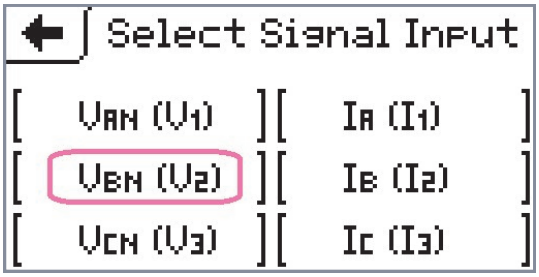
Finally choose % THD (/Fund) to produce this screen.



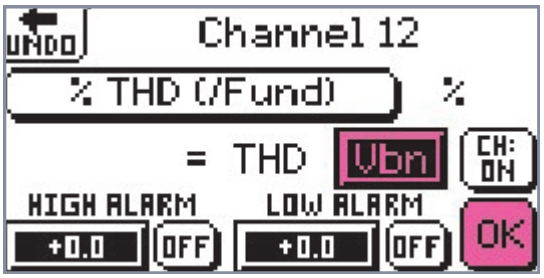
The reverse video Text Box is presently showing "Van".

[Note that this text box will show the last signal assigned to this Channel, so it will not always be "Van".]

Now touch "Van" and bring up the screen that allows you to select your voltage or current input for this new channel 12. In our example we want Vbn.



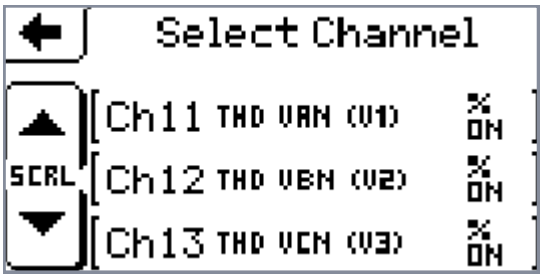
Touch "Vbn" to select Vbn to appear in the text box of the next screen.



Finally touch "OK" to accept the configuration.

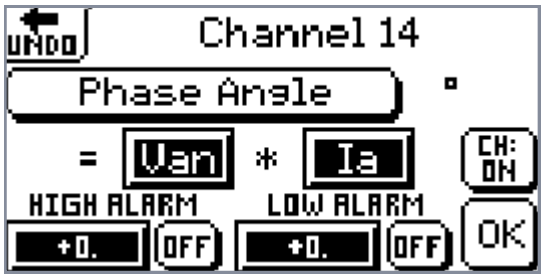
Repeat the process to assign THD of Vcn to Channel 13.

Go once back up the menu tree to the 'Select Channel' screen and your changes will appear on the screen.

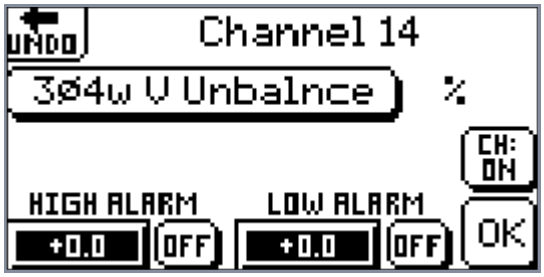


All the channel selections are made in a similar way. However, some like Phase Angle or Real Power in the 1 phase function group require two signals to be set up, as the next screen shows.

Example screen



On the other hand some functions don't need any signals to be specified. Examples are "Frequency", 3 Phase Voltage Unbalance or 3 Phase Real Power.

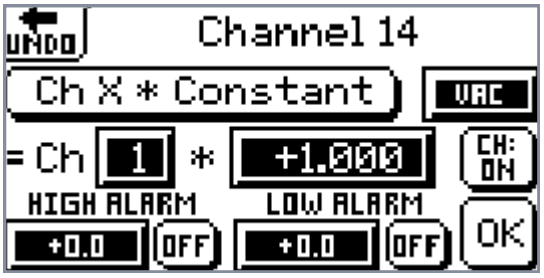


In fact, for all 2 and 3 phase power selections, which have the most complicated calculations, we have already programmed the signals into the logger and don't need you to set them up. This is because when you choose a Hook Up you are selecting a particular way of measuring the signals and we use this knowledge.

See the example screen below.

Remember that if you have a hook up need we do not provide for, use the 'Uncommitted' option.

Finally, here is an example of the basic maths selection screen.

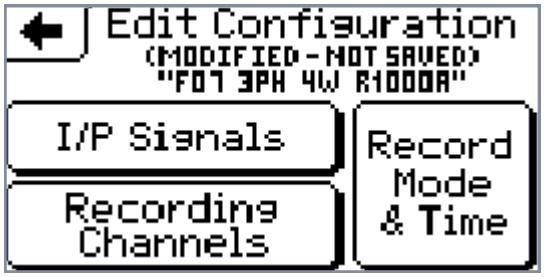


Note that it requires number values to be keyed in using the screen keyboards. Use of these has already been covered in detail in the previous chapter. Refer to the section 'Changing Numbers' in Chapter 6 if you need any reminder on how to change numbers.

How to Give your Configuration a Name [Save (as)]

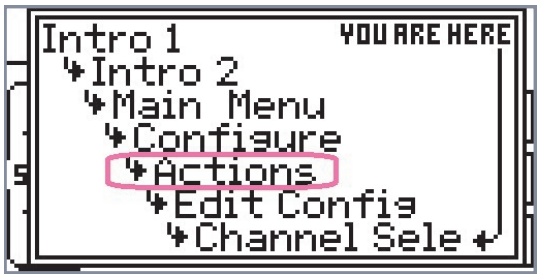
We have now covered all aspects of 'Editing your Configuration`. Now that your logger is set up for your application, you may wish to give the new set up a name.

If you alter your configuration in any way, when you return up the menu tree the screen below will remind you that you have modified your current configuration but not saved it or given it a new name.



Let us assume you want to make your modification permanent. Touch [←] to carry on up the menu tree to the 'Config Actions' screen.

Remember that if you touch [←] for a second or two you will activate button help and see your current position on the menu tree. The outlined screen is where you want to go to next. See below.



You have touched [←] twice to go back up the menu tree from 'Channel Selection' to the 'Config Actions' screen.

Touch [Save (as)] and a keyboard will appear.

Now you have the opportunity to rename your new configuration. Touching [CLR] will empty the black name box. Touching backspace [BSP] will delete a letter at a time from the right. Clear the black box then touch in your new name. For a reminder on using the keyboard go back to the 'Changing units' section in Chapter 6.

Touch [KBD] if you prefer to produce an alternative keyboard.

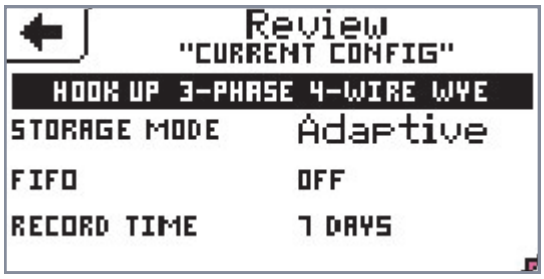
When you have entered your new name touch [OK] and you will return to the 'Config Actions' screen.

(Same as) reassures you that the configuration now in use is File 9 and it has not been modified in any way. File 9 is now entered in the list of set ups ready for selection under the [AVAILABLE CONFIGS] button.

How to Review your Configuration Review

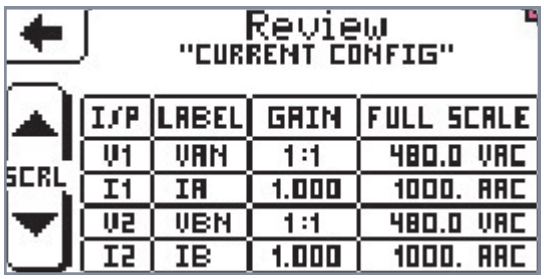
On the 'Config Actions' screen above touch Review. The following screen will come up. It is the first of three linked screens showing set up information.

Screen 1 gives you information on hook-up and storage mode and time.



The small flashing symbol on the bottom or top right of the screen tells you there is another linked screen – it's a page turning symbol. Press anywhere to go to the next screen.

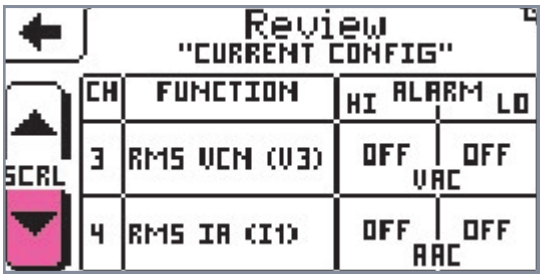
Screen 2 gives you information on the input sensors.



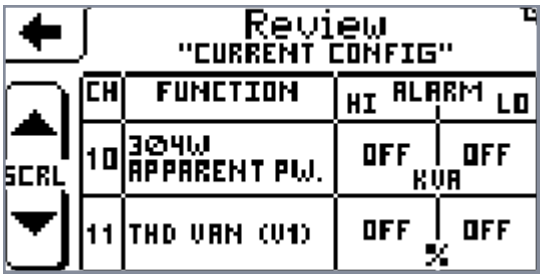
Scroll down for information on V3 and I3. Turn the page again.

Screen 3 gives information on the Maths Channels.

Scroll (up or) down to view all the channels.



Scroll down through information on channels 5-10 and arrive at channels 11, 12 and 13. Review your newly configured channels.

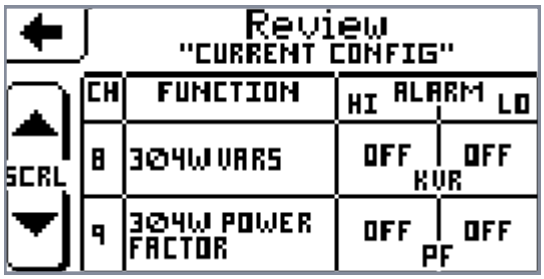


Press anywhere on screen 3 (except the scroll bar and) and you return to screen 1.

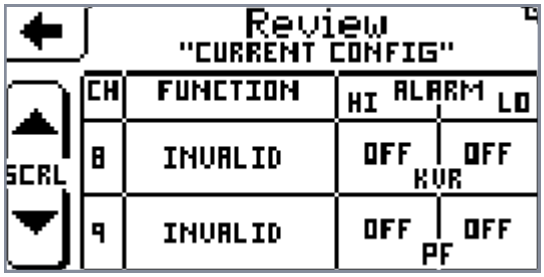
Note that non-configured, that is unspecified, channels will not appear.

Invalid channels

If you change your hook-up and do not adjust the maths functions you have specified, some channels may now be inappropriately configured for the hook-up. The logger will communicate this situation to you in 'Review' by flashing 'invalid' onto the screen as shown below.



With hook-up 3 phase 4 wire wye, channels 8 and 9 were set up for appropriate maths functions. In this example we changed the hook-up to 2 phase 2 element. Now there is not enough information to calculate these maths functions. 'Invalid' flashes onto the screen to warn you and remind you that these channels are no longer active.

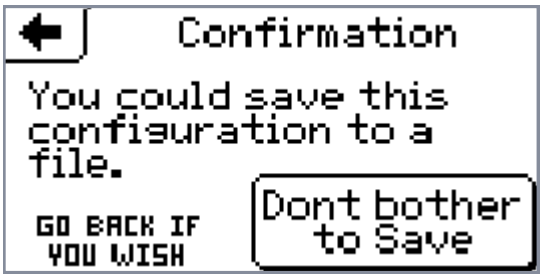


Review gives you all the information you need to check on and confirm your set up.

To return to the 'Config Actions' screen once more touch ↵.

Touch the back arrow ↵ again to return to the main menu.

[If, however, you have changed your set up and have not saved it the following screen will appear to remind you and give you a chance to do so.



Select ↵ if you wish to go back and save this modification so that it becomes another set up on the list. Otherwise press Dont bother to Save to take you back to the main menu.]

How to load a new configuration

If nothing changes, every time you use your logger File 9 will be the configuration in place. To change to an alternative set up from the list of saved configurations go to the Main Menu, touch Configure and AVAILABLE CONFIGS and select a new configuration. This topic is covered in detail in the section 'The 'Available Config.s' Button' in Chapter 6.

How to Copy your Configuration into Flash Memory

Press Configure once more.

Touch COPY TO FLASH MEMORY and the logger will do just that over the next few seconds. A box will come up on the screen indicating 'writing configurations…'. After about a 12 seconds pause the logger will have completed the activity and will return to the main menu.

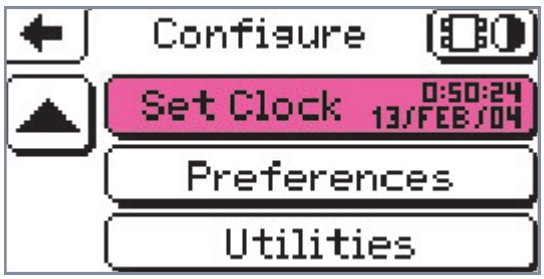
You may wish to copy your configurations to Flash Memory if you are planning to store the logger for an indefinite period. In Flash Memory, set ups will be saved permanently. The 'save as' option, that we have already covered in the section 'How to Give your Configuration a Name' in Chapter 7, stores the set ups in Random Access Memory and requires the batteries to be operating. The batteries will hold the set ups in memory from full charge when the logger is not being powered for at least two months.

For further information turn back to the PM3000 Technical Specification: Data Retention in Chapter 2.

We expect you to use the Flash Memory option only under exceptional circumstances as this type of memory eventually wears out.

How to Set the Clock Set Clock 1:11:40 6/FEB/00

Starting from the Main Menu touch Configure then scroll down to reach this screen.

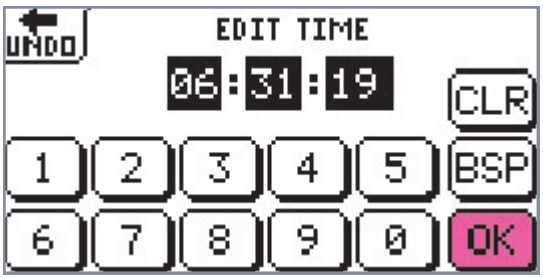


To change the time in the logger touch Set Clock 0:50:24 13/FEB/04 to bring up a screen like the following.

Now you may change the time and/or date.

How to edit time

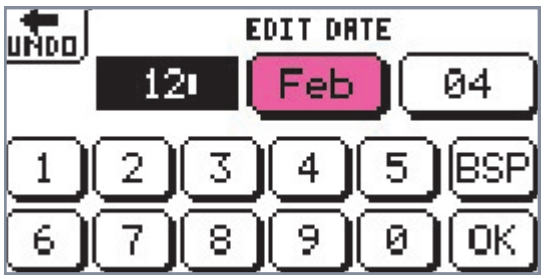
Press 18:07:25 to bring up the next screen.



Touch CLR to empty the time number boxes completely or BSP to clear the digits one at a time from the right. Press a number and it will enter to the left of the cursor. Touch OK when your editing is complete to go back to the 'Set Clock' menu.

How to edit the date

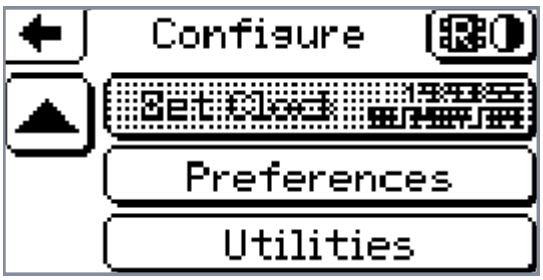
Go to the Set Clock menu and press [12/Feb/04]
Change the number and year using the date keyboard.



To change the month a new screen will come up after you touch Feb.

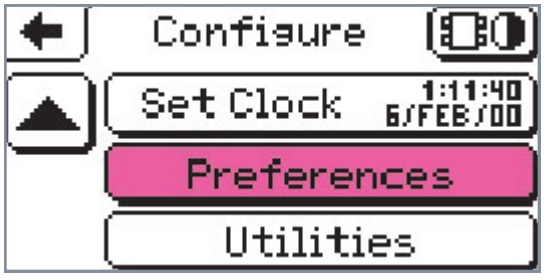
Press any month button and the new month will come up in the black box. Press [OK] to select. You will return to the 'Set Clock' screen. Touch [←] to return to the [Configure] menu.

If the logger is recording a session you are not allowed to change the clock. The screen below will come up and indicate this. A flashing R in the status box (top right) indicates recording in progress.

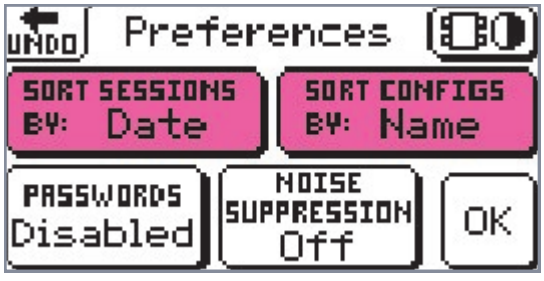


Two further options under Configure remain to be covered.

Preferences



Using the [Preferences] button gives you the opportunity to select further options as you can see clearly from the screen below.



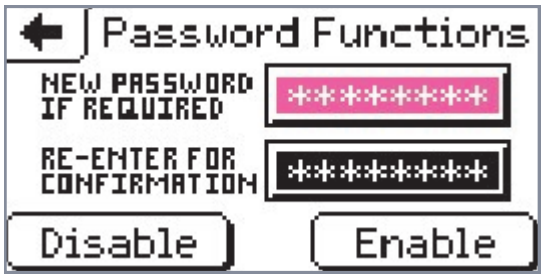
Sort lists by date or name

If you touch [SORT SESSIONS BY: Date] the alternative state [SORT SESSIONS BY: Name] will come up, similarly with [SORT CONFIGS BY: Name], touching this button will produce the alternative, sort by date, as shown next. These refer to how you organise your data lists.

.

Password Functions

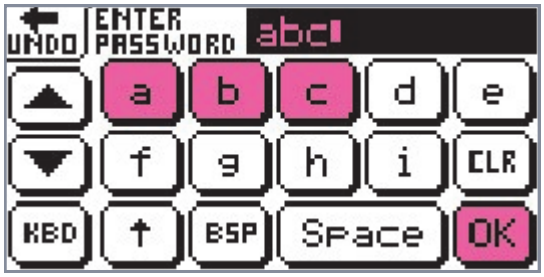
Press PASSWORDS Disabled to produce the next screen.



Now you can enter a password.

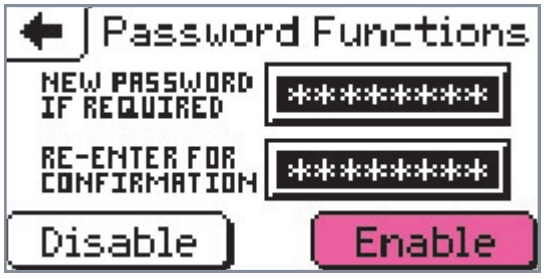
How to specify a new password

Touch 'new password' ******** to bring up a keyboard. Key in your new password by touching the letters or numbers you want. (Refer to 'Changing units' section in Chapter 6 for further help).



After entering your password touch OK to select it.

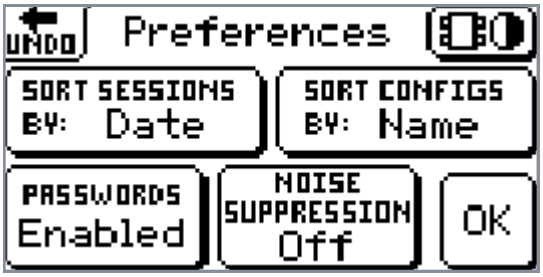
(Touching UNDO will take you back without selecting the new password.) You will return to the password functions screen again. Now you must re-enter it in the lower box



Now you have a password, you choose to enable it or disable it. Enable your password by touching Enable.

IT IS MOST IMPORTANT THAT YOU DO NOT FORGET YOUR PASSWORD. Write it down and put it in a safe place.

The password is now 'enabled'. The logger will return you to the next screen.



Check your preferences and touch OK to get back to the Main Menu.

When you again touch Configure a different screen will come up.

Without entering the correct password your options will be limited to loading and reviewing.

Press this button to get the following screen.

Press again to get the 'Config Actions' screen. Here, in a 'password enabled' condition, you may only 'review' your set ups.

Alternatively,

Touch [AVAILABLE CONFIGS] and bring up your list of available configurations. (Chapter 6). Select one to bring up the next screen.

Without a password you have the option to 'load' and 'review' any of your listed configurations but you may not change them.

How to Enter your Password

Go back to the second screen,

Touch [Enter Password] and bring up this keyboard.

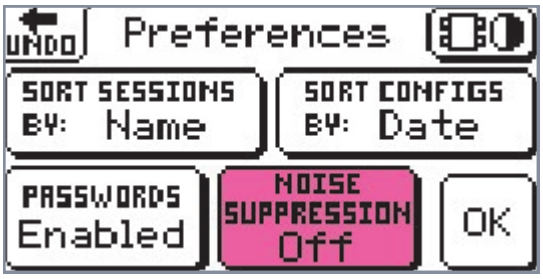
Touch your appropriate letters and numbers and get

When you have entered the correct password press [OK]. Now the logger will permit you to have access to all options and you can proceed as normal.

Note that should you wish to change your hook-up you will be asked to enter the password. Without it you can only review the current one.

Noise suppression

Go back up the menu tree to the 'Preferences' screen.



To complete preferences, touch noise suppression and alternate between 'off', 'normal' and 'high'. Here we choose normal.

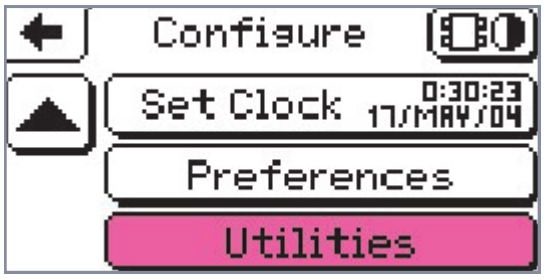
Select by touching [OK] after checking all your preferences. You will go back to the Main Menu.

Utilities

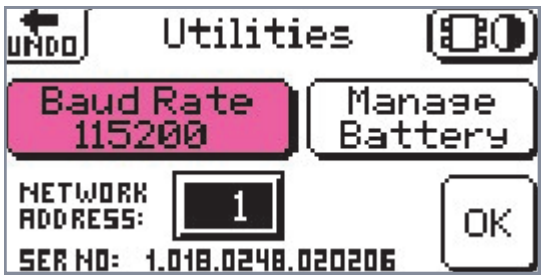
From the main menu

touch [Configure].

Scroll down.

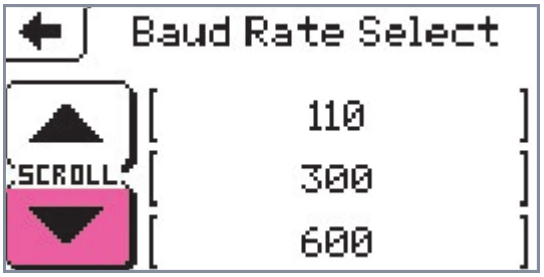


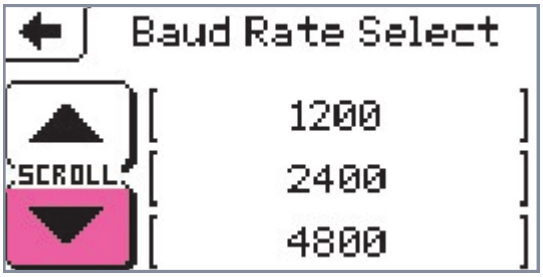
Touch [Utilities] to produce a screen showing the utility options available.

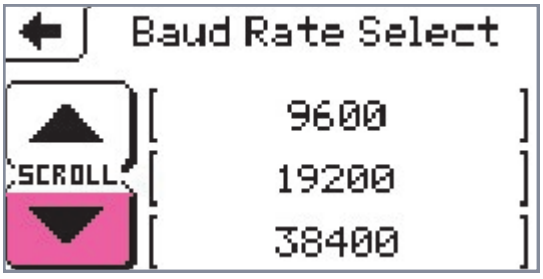


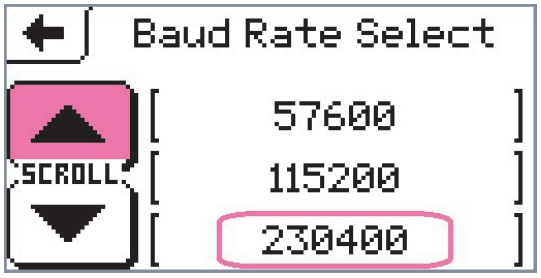
How to change the baud rate

The default baud rate set up in the logger when you receive it is 115200. To change this rate touch [Baud Rate 115200]. A 'Baud Rate Select' screen will come up. Scroll up and down to pick out your required baud rate. All the choices are shown below.

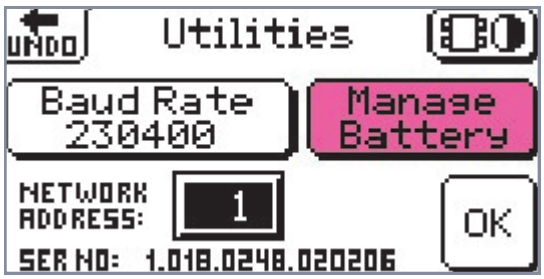








Touching the selected rate, (an example is shown highlighted in the last screen), will return you to the utilities screen. The logger will have renewed the 'Baud Rate' value.



Note that most PC's do not support 230400, though USB ports / serial connections may.

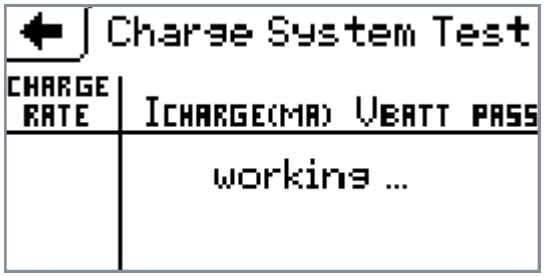
How to manage the battery

Touch Manage Battery to get the following screen.

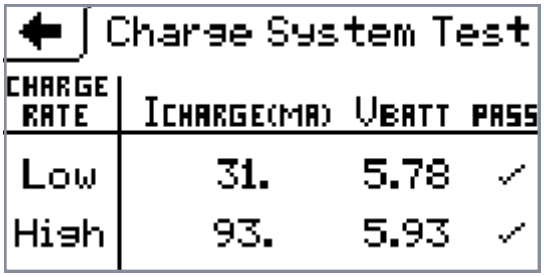
Battery charger test

To help you in a troubleshooting situation where you want to know that your logger battery is charging correctly we have included a test function.

To carry out the test touch the 'Test Charge Circuit' button. The following screen will come up.



While this screen is showing your logger is doing some tests on the battery charger circuit. When the tests are finished you will see this screen.

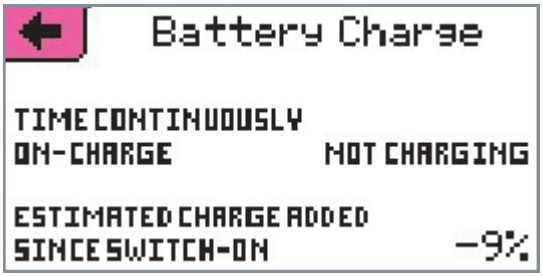


This battery has passed.

(Note that if the logger is recording you will not be allowed to test the circuit). Return via ← to the 'Battery Management' screen.

Battery charge button

Touch 8.17V CHARGING. A 'Battery Charge' screen comes up.

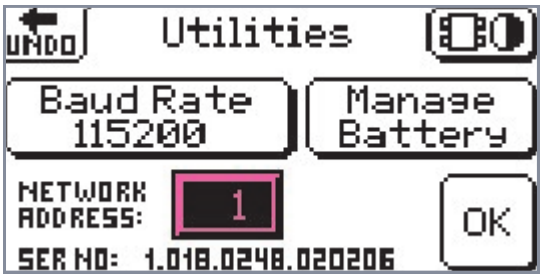


This screen tells you how long the batteries have been charging and the percentage of charge added. This topic is also covered in the section 'Battery Details' in Chapter 4, under the 'Status Button'. The batteries have a capacity of 1 Ampere hours. Return via ← to the 'Battery Management' screen.

How to fully discharge the batteries

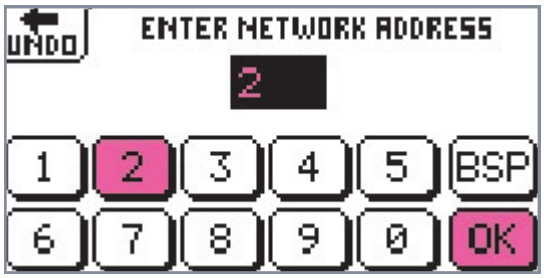
If you touch DELIBERATE FULL DISCHARGE your logger will undertake the task of fully discharging the batteries. Before you do this remove all input connections. We recommend you do this every 3 months or so to keep the batteries in optimal health.

How to change the network address



The default Network Address in your logger is 1. You will not need to use this facility unless you have a number of loggers you wish to network together through the same computer serial port. To do this you will need an RS 485 converter for each logger and to give each logger a uniquely identifying network address.

Touch 1 and bring up a network address keyboard.



Clear the current number using BSP and touch the new number(s). Press OK .

You are now able to set up every possible option in your logger that comes under the Configure button.

After Chapter 8, on DC measurement, Chapter 9 will take you through the final buttons in the Main Menu as highlighted below.

Chapter 8: Operation VI
DC Current Measurement in the PM3000 (Optional)

PM3000

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Contents

Before You Start

You should be using Firmware Rev 2.1xx. As of 27 April 2012, the latest version is 2.126.

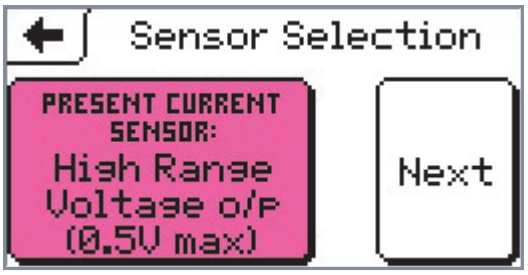
The DC functions are available as Maths Functions under Basic Maths 1. They may be used at the same time as normal AC measurement from the same probe.

To use this with the Fluke i310S Hall Effect current probes, turn current probes on to the 300A range, and connect up, observing the phase identification on the probe labels, and current direction (for the normal AC operation).

To Configure The Analyzer To Measure DC

Set logger configuration for the appropriate AC hook-up as normal, e.g. 3 phase 4 wire Wye.

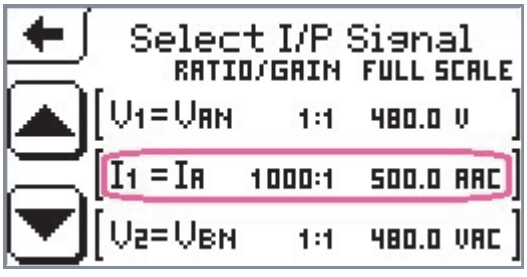
Go to 'Configure', 'Current Config', 'Edit', 'Input Signals' and for the Present Current Sensor, choose High Range Voltage o/p (0.5V max).

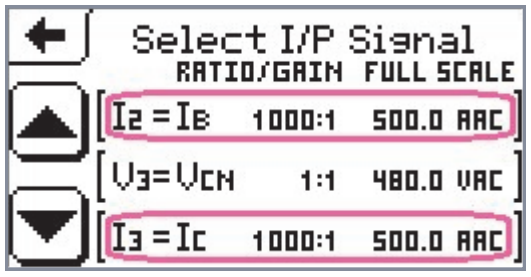


Touch 'Next'.

On the 'Select I/P Signal' screen, touch on I1 = IA. If not already set, set I/P ratio to 1000:1. Repeat for I2 and I3. All three currents should read

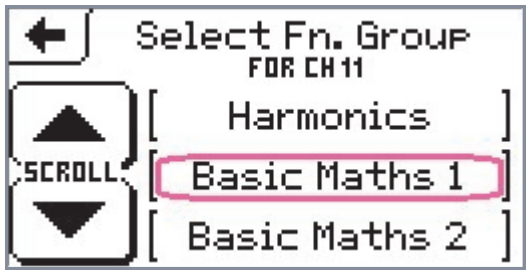
Gain = 1000:1, Full Scale = 500.0 Aac.





Press back ( ) to the 'Edit Configuration' screen. Touch on 'Recording Channels'. Scroll down to an "unspecified" channel, and press on it.

Scroll down and touch on 'Unspecified' and select the 'Basic Maths 1' Function Group.



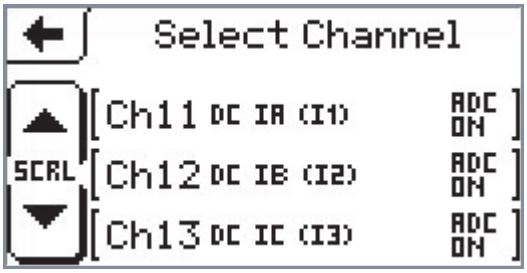
You will see two DC options.

The "DC" by itself measures the DC from each cycle with no carry-over or filtering from previous cycles. The "DC Filtered" takes each cycle's result and passes it

into a simple filter with a 4-cycle Time Constant. In practice the results are not noisy so there is little benefit in using the filter unless you wish to attenuate upwards of 5Hz components.

Choose “DC” and on the channel specification screen, choose the desired input signal (e.g. Ia), and click OK.

Choose two more unspecified channels and make them DC for the current on the other two phases.



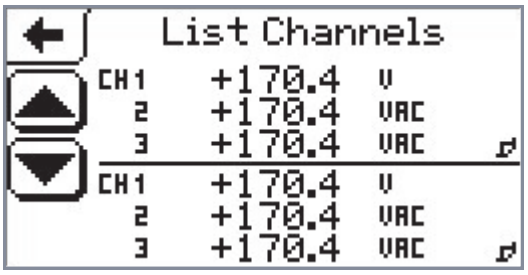
Return to the ‘Main Menu as normal.

This is all that is required. However a “Zero” function is available to eliminate starting condition offset error from all causes.

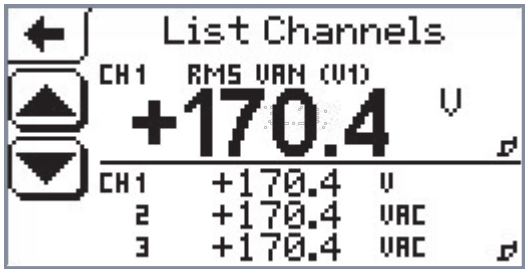
To Zero The DC Terms

This function is NOT available during recording. It may only be used in Display mode while NOT recording. Offset data is stored in non-volatile memory and is held across power outages. Each channel must be zeroed individually.

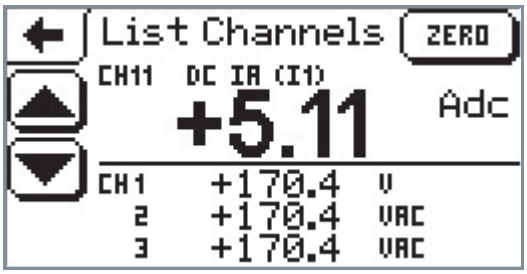
With NO DC passing through the jaws of the probes, from the Main Menu, select ‘Display’, then ‘List Channels’.



Press anywhere in the top half of the screen to change the three line small display to single line large display.

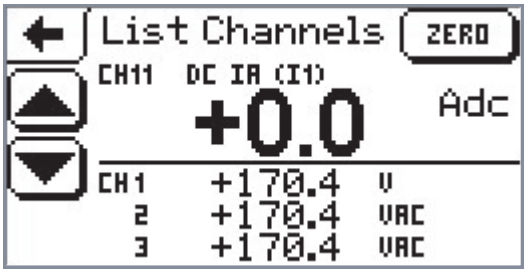


Scroll down to the relevant DC channel.



When you get there you will see that a button appears in the top right of the screen labelled “Zero”. This button ONLY appears when the top half of the screen is in Single Line Large mode, and the channel being displayed is a DC type. The button is not present for AC channels, i.e. it is unambiguously available for the displayed DC channel only.

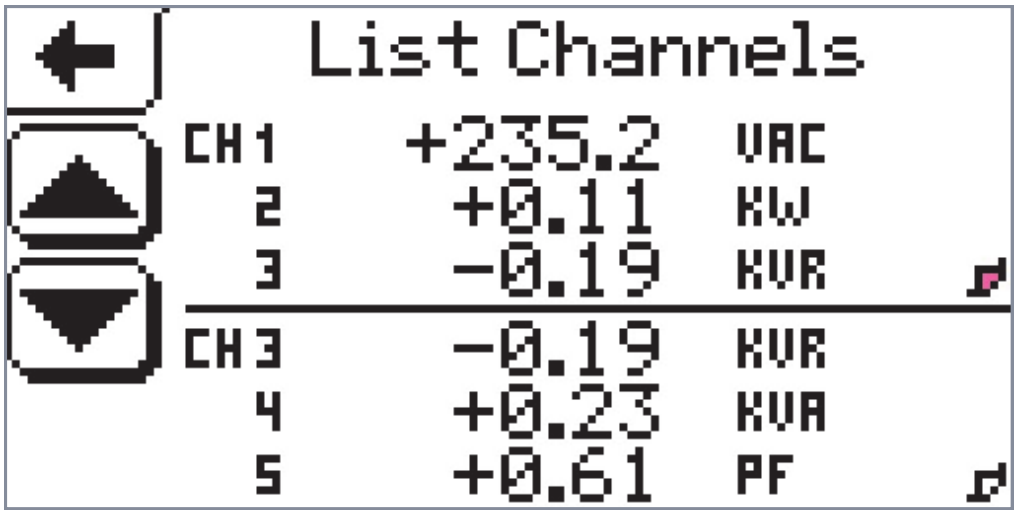
Touch on ‘Zero’. The unit will write the offset information into non-volatile storage. When complete, the display screen should return with the offset corrected as shown on the next screen.



Use the scroll button to go to the next DC channel and zero that. Repeat for the third channel.

Recordings may now be undertaken as normal. Pronto Version 5.67 and later knows about the DC channel option and will display the channel data with the appropriate label.

Chapter 9: Operation VI
Main Screen 3: Start Recording, Display Results & Explore Sessions



PM3000 Results

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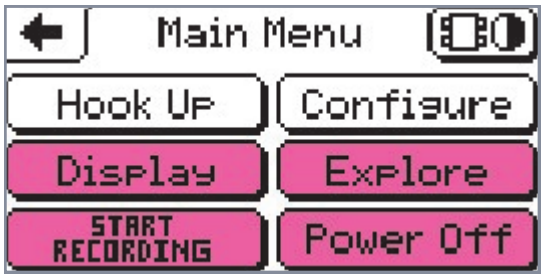
Contents

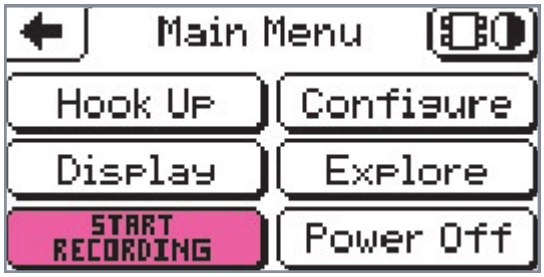
Introduction

Your PM3000 is set up to produce the best, recorded data for your particular power monitoring requirement. Now you want to 'make it happen' and see results.

In this chapter we look at the four remaining buttons on the Main Menu: Display, Explore, Start Recording and Power Off.



Recording Your Data



Here is a reminder: Use button Help to develop your knowledge of the PM3000 menu and screen structure. In this case we shall use it to describe the function of the START RECORDING button.

Hold your finger or pointer on START RECORDING and wait for button help to appear

The message gives you an indication of the options available under START RECORDING. You can start a new recording session immediately or set up a Delayed Start. Touch START RECORDING again briefly to bring up a 'Start Recording' screen. Now the button changes to STOP RECORDING. All the time there is a recording taking place in the logger STOP RECORDING will appear in the 'Main Menu' so as to give you the opportunity to stop the recording at any time.

This next screen gives you four options. These will be dealt with in turn.

Rename your session

You may rename your session as follows. Touching Session 11 brings up a keyboard.

Use BSP to clear letters in the 'New Name' box starting from the right.

Oops, cleared too much. We need a keyboard with n in it. Use the scroll arrow to move on to this next keyboard.

Enter n and a space and then scroll back to the first keyboard to finish setting up the new name.

By scrolling you will discover that there are four keyboard screens.

To finish touch OK and you will return to the 'Start Recording' screen.

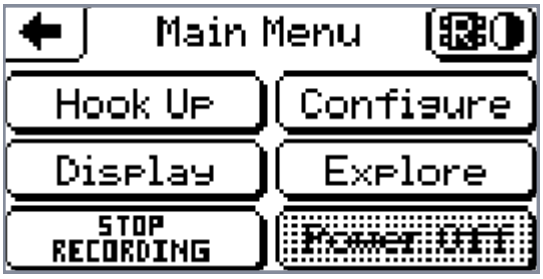
Use of the keyboard is described in further detail in Chapter 6, under 'Changing Units'.

Start recording (erase old files)

Press down on Start (ERASE OLD SESSIONS) for the 'help' message to come up and explain the outcome of selecting this button.

Touching Start (ERASE OLD SESSIONS) briefly starts recording a new file. All previous ones are erased.

Your logger is now in recording mode and it immediately returns you to the Main Menu.



Now START RECORDING has been replaced by STOP RECORDING. Your PM3000 will continue to record until either the specified set up time has expired or you touch STOP RECORDING.

There is always an 'R' flashing in the status button at the top right when the logger is recording.

Note that you are not able to enter the START RECORDING menu without stopping the recording.

Note also that the Power Off button is shaded in to indicate that you cannot turn the logger off and inadvertently interrupt the recording.

Start recording (keep old files)

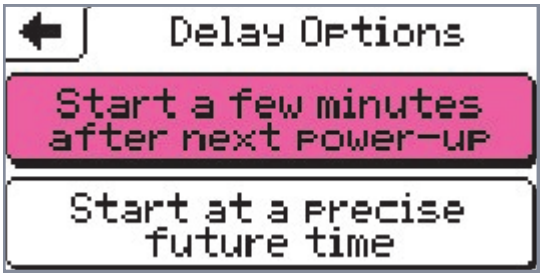
Go back to the first 'Start Recording' screen.

Touch Start (KEEP OLD SESSIONS) and the logger will immediately start recording. All previous files will remain. The PM3000 will take you straight back to the Main Menu and show STOP RECORDING and Power Off.

Delayed start

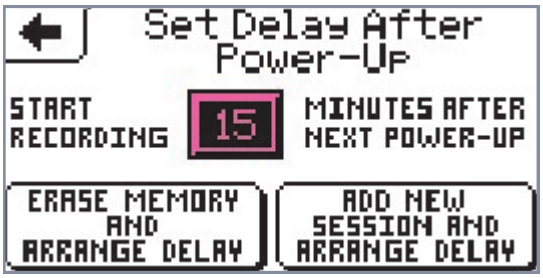
Go to the Main Menu and touch START RECORDING. From the 'Start Recording' screen touch DELAYED Start and if you want 'help' to remind you of the option detail hold the pressure for a few seconds to get the screen below.

Touch DELAYED Start again and the Delay Options screen will come up. It contains the two options mentioned in the 'Help': you can either set a start time for some short period after the next power-up or to take effect at some time in the future.



Set a delay time after the next power-up

Touch Start a few minutes after next power-up and bring up the screen below.



Choose the time delay you want after the next Power-Up. The default time in the logger is 15 minutes. Example: to make the delay time 14 minutes. Touch the number box 15 to produce the next screen.

Touch BSP once to remove the 5 then touch 4 to change 15 minutes to 14 minutes. Touch OK to select your new delay time. You will return to the 'Set Delay after Power-Up' screen and it will show your new delay time….

Erase memory and arrange a delay

Touch [ERASE MEMORY AND ARRANGE DELAY] and get

This gives you confirmation of the timing of your delayed start. With this option you have chosen also to erase all your existing files. Press anywhere to select your delayed start. Immediately the logger will return to the Main Menu.

Note the change in the status button [T] which now has a flashing 'T' to denote that the Delayed Start on a Timer is activated.

Note also that the [START RECORDING] button now reads 'cancel delayed start' [CANCEL DEL START]. The delayed start option is active and you are given the option of cancelling your delayed start set up at any time.

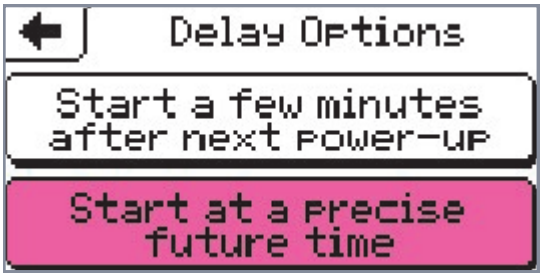
Add a new session and arrange a delay

To complete the Set Delay section we return to the 'Set Delay after Power-Up' screen

Touch [ADD NEW SESSION AND ARRANGE DELAY] and the same screen will come up as before.

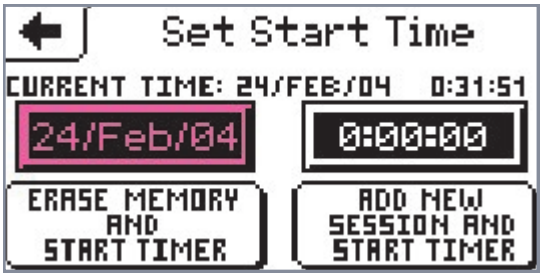
This time the session is added to the list of previous sessions. Press anywhere and the logger will take you back to the Main Menu. Again you will be offered the option of cancelling your 'delayed start' set up.

Start recording at a precise future time

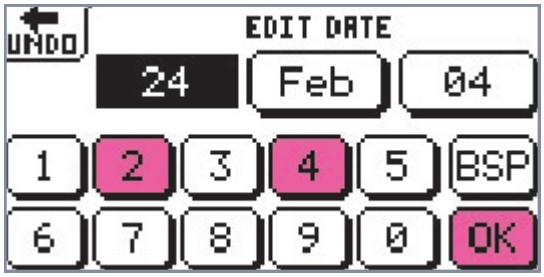


Touch [Start at a precise future time] and a 'Set Start Time' screen will come up.

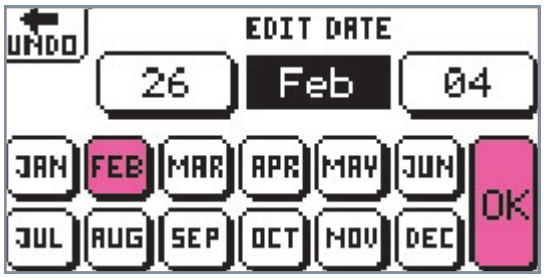
Edit date



Touch [24/Feb/04] and an 'Edit Date' keyboard will come up. The 'number of days' box will be highlighted, that is come up in black, for you to select the *day* of the month you want. Touch the correct number buttons. If you are happy with the complete date selection, touch [OK].

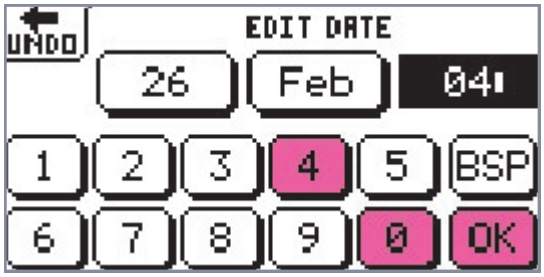


If you wish to change the *month* selection touch the month box. The logger will bring up a month selection screen.



The month selection box will now show as black. Touch the month you want and it will appear in the box. If your date is completed, touch [OK].

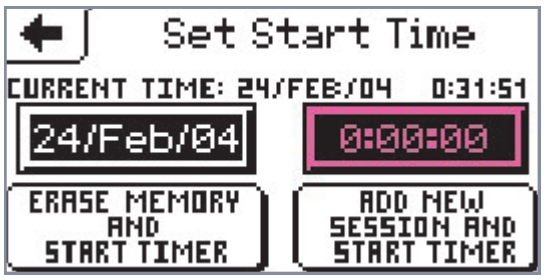
Touch the year box to carry on further and change the year.



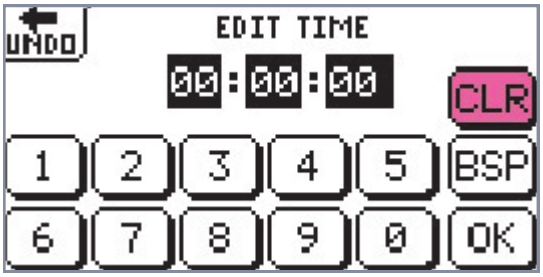
At any time press [OK] and you will return to the 'Set Start Time' screen.

Edit time

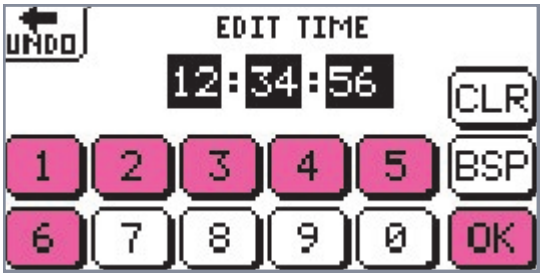
Now select the time box [0:00:00]. The default will be as highlighted on the screen below.



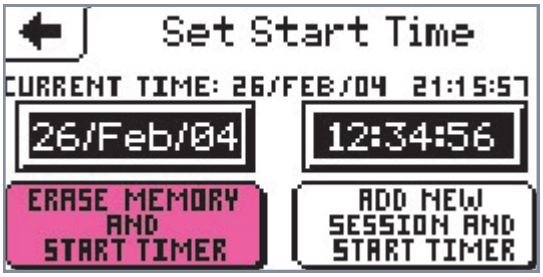
Touch the time box [0:00:00] and the 'Edit Time' screen will appear.



Touch clear [CLR] to remove all the noughts in the black boxes or backspace [BSP] to remove one at a time from the right.



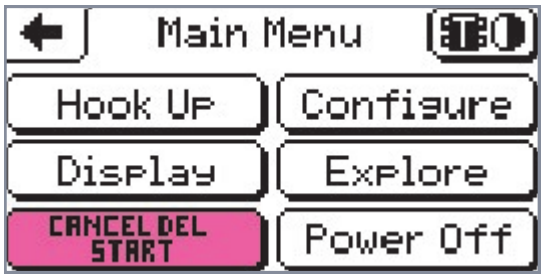
Touch the appropriate numbers and press [OK] to select the time you wish your delayed recording to start. Go back to 'Set Start Time' once more.



Erase memory and start timer

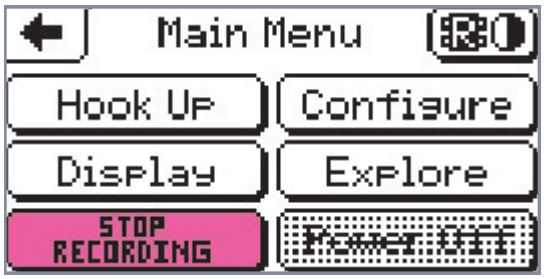
Touch [ERASE MEMORY AND START TIMER] and bring up the following screen.

Check your date and time set up and press anywhere on this screen to select your delayed start. *You will erase all your previous sessions*. The logger will return to the Main Menu. While you have set up a delayed start and the start time has not yet been reached the following Main Menu will appear.



The presence of CANCEL DEL START, the 'cancel delayed start' button and the flashing 'T' on the status button shows that the logger is timed to start at a future date.

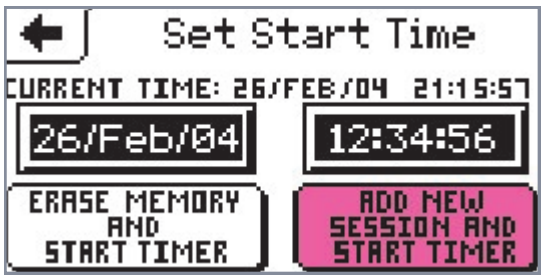
When the recording date has arrived the logger will automatically start recording. The button will change to STOP RECORDING.



The menu now shows the STOP RECORDING button. The logger will remain recording until the recording duration set up is passed or until you press STOP RECORDING. The moment you touch STOP RECORDING your PM3000 will stop recording and the button will revert again to START RECORDING. Again note that you cannot turn the power off if a recording is in progress.

Add new session and start timer

Go to the 'Set Start Time' screen.



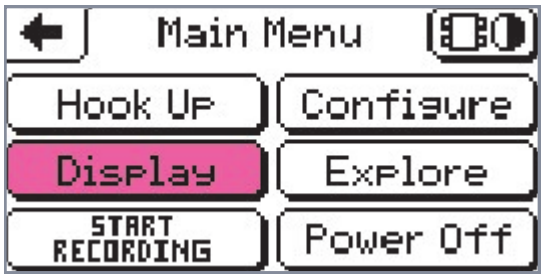
Touch ADD NEW SESSION AND START TIMER. The following screen will come up, the same as if you touched ERASE MEMORY AND START TIMER.

This time the session is added to the list of previous sessions. Press anywhere and the logger will take you back to the Main Menu. Again you will be offered the option of cancelling your 'delayed start' set up. Note the 'T'.

Display Results

Before or while the logger is recording see on display an example of the current performance of your signal. The session being recorded is not affected.

Go to the Main Menu.

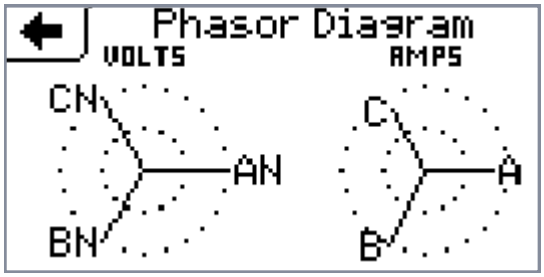


Touch Display. Up will come the Display Menu.

You have two options. Choose to see a Phasor Diagram or get information on all your files.

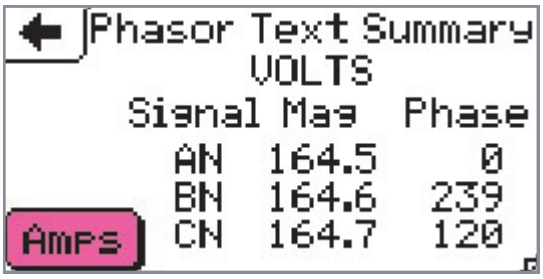
Display a phasor diagram

Touch Phasor Diagram to produce the Phasor Diagram screen.

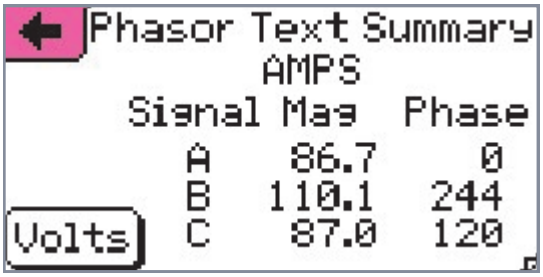


This screen shows how well balanced are the phases of your signal. On the example screen A, B and C, the phases of the voltage and current, are perfectly balanced at 120 degrees apart. This is generally true for voltage but the phases of the current can become unbalanced.

In the right hand bottom corner of this screen is a 'page turn' symbol. This indicates that there are further linked screens. If you touch the screen anywhere, a new screen will come up.



This screen shows what is happening to the voltage on the three phases. Touch Amps and the equivalent screen with current information will come up.



This screen shows typical readings for current where the phases are balanced.

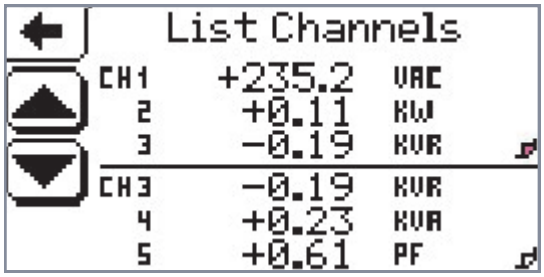
As indicated by the 'page turn' symbol, by touching anywhere on the screens you can toggle between a Phasor Text Summary and the Phasor Diagram. When you have finished viewing these screens, touch ← to return to the Display Menu.

Display a list of all the channels

Go to the Main Menu and touch Display. Up will come the Display Menu.

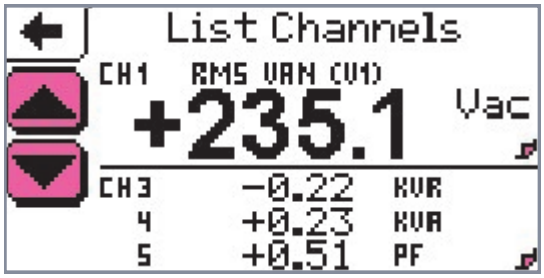
Touch 

and bring up the List Channels screen.

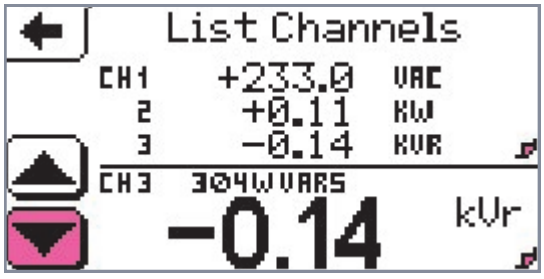


In this example there are five channels in action, that is, specified. The screen is divided into two halves to make comparison of results possible. Again the page turning symbol is present to indicate that a further screen is linked with this one. In this case there are two symbols, one for each half of the screen

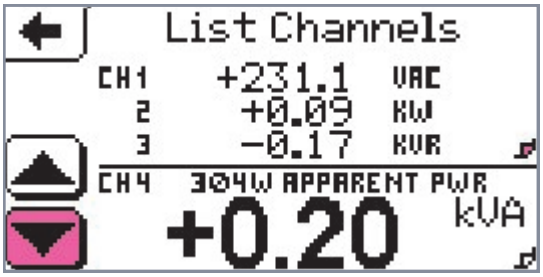
Press anywhere on the top half screen to 'turn the page'.



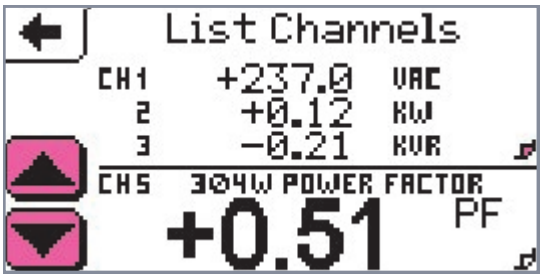
The channel 1 value has become emphasised. Touch anywhere again and the large numbers for channel 1 revert back to the list of channels. Now touch the lower half of the screen. You might expect that channel 3 would enlarge but the first result is a movement of the scroll arrows into the lower screen. A second touch produces an enlarged Channel 3 reading as seen below



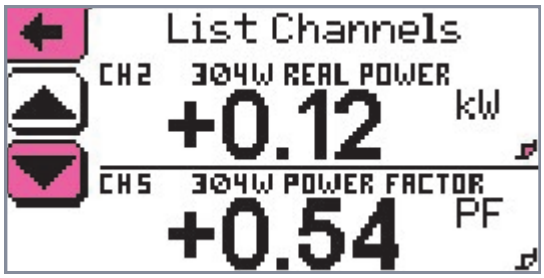
Scrolling down selects the next channel, channel 4.



Scrolling down again selects Channel 5.

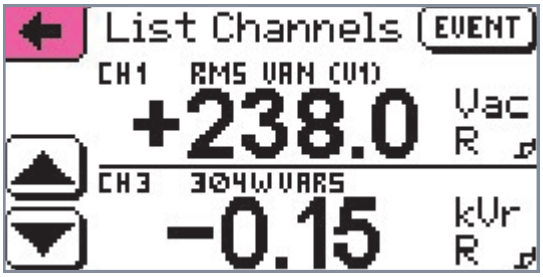


Touching anywhere on the upper screen returns the scroll arrows to the top screen. See the screen below. Touching anywhere again produces an enlarged Channel 1, as it is top of the list on the upper screen. Scrolling down produces an enlarged Channel 2.

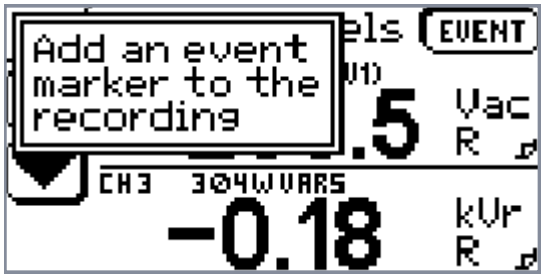


You may find it useful to use this option of highlighting specific channels for comparing results.

The screen below shows a different set up.



Note the R's. This logger is in Recording Mode. The 'help' message below indicates that by pressing EVENT you can add an event marker to your recording at that precise moment. It will appear in Pronto on every channel if you choose to display it.

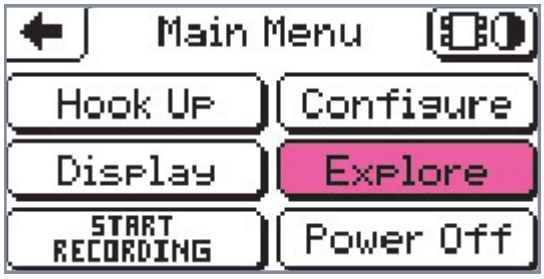


Press ← once and you return to the 'Display' menu, press once more and you return to the Main Menu.

Explore Results

Your recordings are completed. You wish to check the information that exists in your logger's memory. You want to explore your results.

Go to the Main Menu.



Touch Explore . The following screen will come up.

Sessions Explorer lists your recorded sessions in reverse chronological order. The most recent file, in this case Session 9, is at the top. Use the scroll arrows (highlighted) to scroll up and down your list.

You are invited to Select All the sessions. Press Select All .

This screen confirms that all your files have been selected and reminds you of the number of sessions currently retained in the logger's memory. You have two options here. You may Delete them all or Review them all.

Delete all your stored files

Touch Delete . The logger will take you back to the previous screen.

Now touch any part of the screen, except UNDO DEL which is flashing at you, and all your files will be erased. So use explorer to delete old redundant files.

In case you didn't really mean to delete all your files you are given an opportunity to reconsider. If you

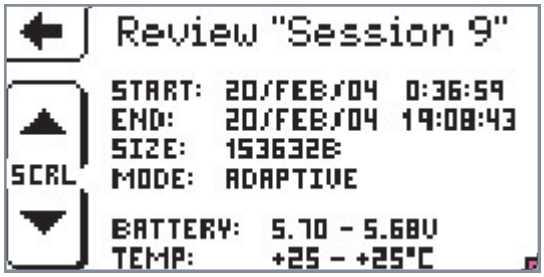
have second thoughts press [UNDO DEL] and the next screen will come up.

Phew, that was a close shave. Press anywhere on the button and you will be taken back to the first 'Sessions Explorer' screen .

Review all your files

Touch [Select All] .

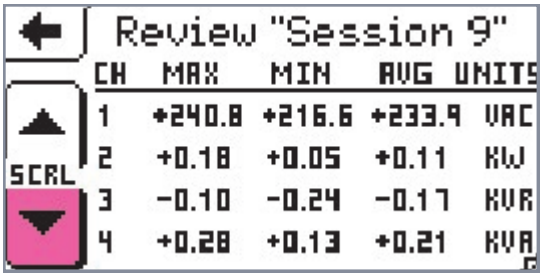
Touch [Review] to bring up a 'Review Session' screen.



The first session to be reviewed is always the most recent. Note the information produced by the first 'Review' screen.

The scroll arrows are not used yet on this screen.

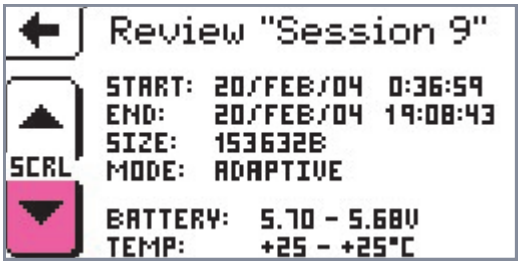
'Turn the page' by touching to bring up one other 'Review' screen.



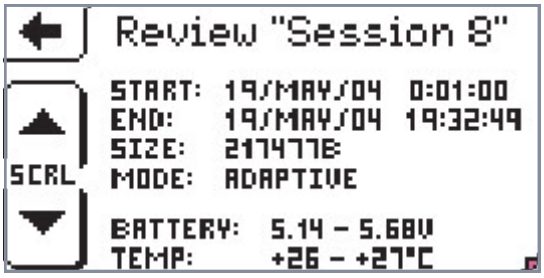
This 'Review' screen in Sessions Explorer gives you the maximum, minimum and average information for each of your sessions. You can see at a glance if your input signal has stayed within limits and make a decision on whether or not to look at your data in detail.

Use the scroll arrow to scroll down through your specified channels.

Touch anywhere on the screen to return to the first 'Review' screen.

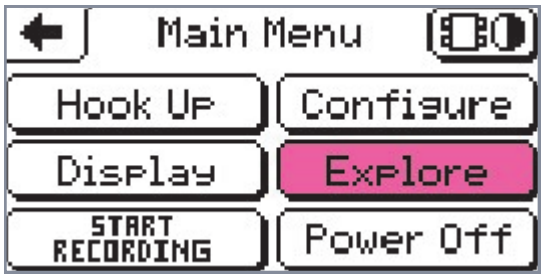


Touch the scroll down arrow and you will find you have selected 'Review "Session 8"'



Turn the page ( ) by pressing anywhere and again a second review screen will come up.

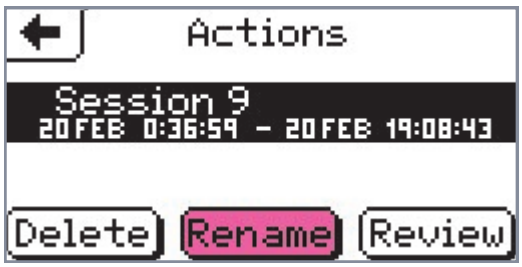
When you have reviewed all your files touch ← to return to the 'Actions' screen and on this screen touch ← to get back to the Main Menu once more.



Delete and review a single file

Again touch Explore and return to the first 'Sessions Explorer' screen.

Touch Session 9 to select the individual session. You will bring up another 'Actions' screen.



This time the 'Actions' screen gives you three options.

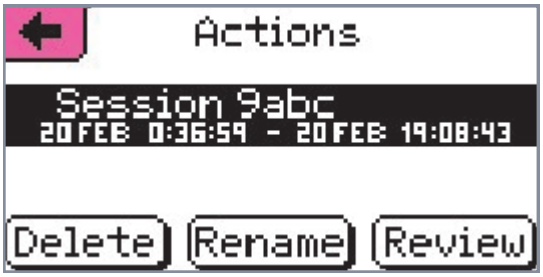
Delete and Review have already been covered in the sections above. The procedure is the same. The third option, Rename, is described now.

Rename a single file

To rename your selected file press Rename. You will bring up a 'Rename' keyboard. How to use the keyboard has been covered in the section 'Rename Your Session' above and in detail in Chapter 6, in the section 'Changing Units'.

Example: Session 9 will be renamed Session 9abc. Touch the appropriate letters and watch them appear immediately in the black name box.

Press OK to select your new name and return to the 'Actions' screen.

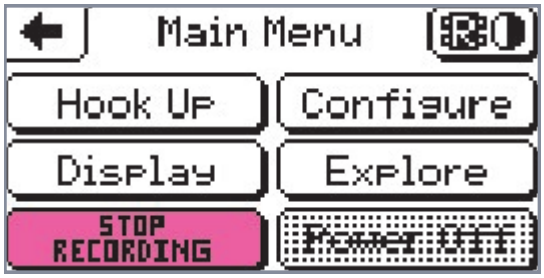


Press OK once more to go back to the Main Menu.

The Power Off Button

Power Off on the Main Menu turns off the power to your logger when you touch it. This also happens automatically when a time interval of four minutes elapses since your last touch of the screen.

However, if your PM3000 is recording you will not be allowed to turn off the power. See below how the screen will look if the PM3000 is recording. The Power Off button is shaded and unresponsive.

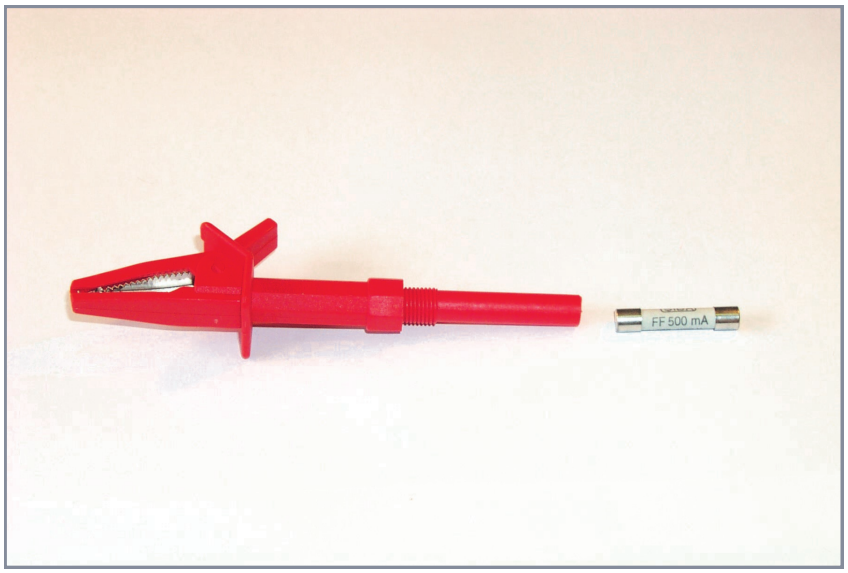


Touch STOP RECORDING to stop recording. The flashing 'R' disappears and Power Off becomes active.

Touch Power Off. Your logger will close down. It enters a state akin to suspended animation. The display shuts off. The internal batteries will keep your data and set ups intact for at least two months depending on their charge at the time of shut down and the number of channels in use.

The next chapter is the final chapter of this manual. It explains how the internal batteries work and contains a troubleshooting table. It also advises you on logger maintenance and replacement of the batteries and fuses.

Chapter 10: Batteries, Maintenance and Troubleshooting Guide



PM3000 Voltage Lead

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List of Illustrations

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Introduction

This chapter covers the general maintenance of your logger. It includes a section on the internal batteries and gives help on troubleshooting. At the end is a section on how to change the internal batteries and fuses.

Please note that there are no user serviceable parts in this product. Should the internal batteries or internal fuses need replacing, this operation must be carried out by your service department.

Internal Batteries

The most important maintenance requirement of the user is to look after (but not change) the internal batteries. It seems a good idea, therefore, to explain how they work in the logger.

The purpose of the internal batteries

The role of the four internal batteries is to conserve your data in the event that the power goes down.

The life of the batteries

When the logger is running off the mains the internal batteries will be charged automatically. It will take nominally 16 hours to full charge, 12 hours to 85% after which it is trickle charged. Once the batteries are fully charged they will drive an un powered logger for over 15 hours at 25 °C. (Because of the different factors affecting the discharge rate: temperature, initial charge state and backlight, for example, we choose to define their life as less than this in the Specification at the end of Chapter 1.)

How the batteries could lose their charge

If the logger becomes unplugged it will carry on its operations supported by the batteries for 4 minutes (or 10 minutes if recording). At this point the logger will shut down in order to be sure of keeping enough battery charge to conserve your data. Touching the screen will reawaken the logger and it will carry on its operations for a further 4 or 10 minutes. You can keep on reawakening the logger but gradually you will use up the batteries' charge. Similarly, if you are using your computer remotely to talk to the logger the 'ten minute' safety mechanism is overridden here. The computer is continually waking up the logger and will use up the charge. Also batteries in a stored logger will gradually self-discharge.

If the batteries lose their charge this is what you do

In the unlikely event that the batteries do lose their charge, connect the logger to a supply of power and it will immediately start the charging process. This is the first priority of the logger. It will do so for sixty four seconds and during this time the logger will apparently not respond to turning on. Wait and once the batteries have satisfied your logger that there is now enough charge to protect your data in the event of another power cut immediately, the logger will come to life and behave normally. Recording can begin after 64 seconds but if the power fails soon after starting the recording you run the risk of losing some of the ten minute ride through benefit. The batteries are charged independently of the logger so they will carry on taking charge all the time the logger is powered. The longer the logger has been connected to power the more charge the depleted batteries will have received.

When you use your PM3000 and the battery charge is low, what may happen?

Here is a worse case example of what could happen if your logger starts a recording when the batteries' charge is very low:

- Your batteries have no charge.
- You connect the logger to the mains for 15 minutes. *This will supply the batteries with 20*

minutes of operation time.

- The power goes off and the batteries run the logger for ten minutes ride through. *Now the batteries are again low in charge.*
- You try to turn the logger back on. It does not respond *because the charge in the batteries is too low.*
- What is going to happen to your data? *You will be left with approximately 32 hours in which to retrieve your data or power up the logger.*
- The logger will only restart if connected to a power source.

General Maintenance

Battery maintenance

For best practice maintenance and peace of mind we recommend the following:

1. **Keep your internal batteries charged even when the logger is not in use.**
   Regularly check battery charge status in the menu. If the charge is low, recharge the batteries by plugging the logger into a power source and leave for up to 16 hours.

   When the logger is stored, if it is not possible to keep it permanently on charge, then plug it into your mains supply for at least a day every two months.

2. **Deep discharge your batteries periodically**
   To keep the batteries healthy we advise you to discharge them every three months. Follow the procedure in the menu: Select 'configure', then 'utilities', then 'manage battery', then 'deliberate full discharge'. For further information, turn back to the section 'How to Manage the Battery' in Chapter 7.

⚠ Do not leave any inputs connected while doing this.

Further maintenance

3. **Keep the logger clean**
   Wipe the overlay gently so as to retain its insulating properties and any warning markings. Use a damp, soft cloth and a mild soap or mild, nonabrasive detergent. Be careful not to scratch the touch screen.

4. **Keep your logger and kit in the bag**
   We have designed the bag with the welfare of your logger, sensors and cables in mind! Put your Rogowski Coils in their compartments and the voltage leads in the pouches in the roll, and tangled and lost leads will become a thing of the past. Check regularly for kinks in the leads.

5. **Operating environment**
   Be aware of the environmental considerations as outlined at the end of Chapter 1.
   NB Don't leave your logger in a hot car in the sun. High temperatures are the enemy of batteries. Batteries self discharge fast at 70 °C!

Troubleshooting

Below is a troubleshooting chart. We hope you will find it useful should you have any difficulty getting your PM3000 to perform in the way you would wish and expect.

Start your checking by removing the power from the logger and looking it over carefully.

- Check that all the cable connections are seated properly.
- Check the Wiring Connections to ensure that all connections are secure
- Ensure that the input voltage is applied to the Phase A Power Inputs V1+ and V1-.or via a transformer correctly connected. See Chapter 3.

Table 9-1 Troubleshooting Chart

Problem	Checkpoint	Yes/ No	Explanation & Solution
Display remains blank when screen is touched. (No change from when power is off).	Is the little green LED flashing	Yes	Low battery charge. Wait till after 64 seconds when the unit will power up. Then leave it on charge for 24 hours. You can still use the unit.
	Is the little green LED flashing Are the voltage input connections at V1+ and V1- well plugged in to the power source or is your charger properly plugged in to the wall socket	No No	 Connect them up properly. See Chapter 3.
Your logger display wakes up for a few seconds and then shuts down.	Has your logger been left on the shelf?	Yes	The battery has discharged completely. Leave the power plugged in for a few minutes while the batteries take in charge, then remove the power and switch on again. You will need to wait 64 seconds then the logger will power up as normal. Replace the power to continue charging the logger
The display still remains blank	The Supply Power is connected properly. The batteries appear to be charged.	Yes Yes	Contact your distributor or representative.
The display appears dim or black	Is the contrast setting correct?	No	Adjust the contrast level setting via the status button. See Chapter 4.
	Is the contrast setting correct? Are the temperature and humidity within the appropriate ranges?	Yes No	Remember that the logger works best at temperatures between -10 and 60 °C and below humidity of 95% non-condensing.
	Is the contrast setting correct? Are the temperature and humidity within the appropriate ranges?	Yes Yes	Contact your distributor or representative.
Your logger measures the voltage present but does not charge the batteries. (There is no flashing C). It shuts down after a few minutes.	Will it run happily on the charger?	Yes No	One of the fuses has gone. Check the fuses on the bottom board. Change if required. See Chapter 10. Contact your distributor or representative.
	The bottom board fuses are intact	Yes	Contact your distributor or representative.
The phases are back to front	Is your logger hooked up to the power correctly?	No Yes	Make sure that the Rogowski Coils and the voltage probes are connected to the right wires and that they are orientated correctly. See Chapter 3 on Connecting to your Power. Unlikely situation. Refer to your distributor or representative.
The screen is not displaying correct data.	Is the neutral properly connected?	No Yes	Check your hook-up. See Chapters 3 & 5. Check your Set Ups particularly Maths Functions. See Chapters 6 & 7.
	Set ups OK?	Yes	Refer to your distributor or representative.

Parts Replacement

Before sending your instrument back, in the first instance we ask you to contact your distributor or representative. Tell him/her your problem in case he/she can help you.

If you are advised to return the logger, please remember the following:

- Give a description of the problem
- Include all the kit (In case an accessory is broken)
- Remember to include your name and address.

Should it be difficult to contact your distributor or representative you can contact your main distributor. These contact details are at the front of the manual and in the logger menu under 'topic help', technical support.

All items of your logger kit can be replaced if they are lost or damaged.

The only components that might need replacing are the fuses in the voltage leads and the batteries and fuses inside the logger.

Replacement of the voltage lead fuses

The voltage leads for the logger are internally fused for your safety. Unscrew the head of the probe and shake out the fuse. Replace with a 500 mA fuse that has a 50,000 Amp rupture current (threshold for arcing).

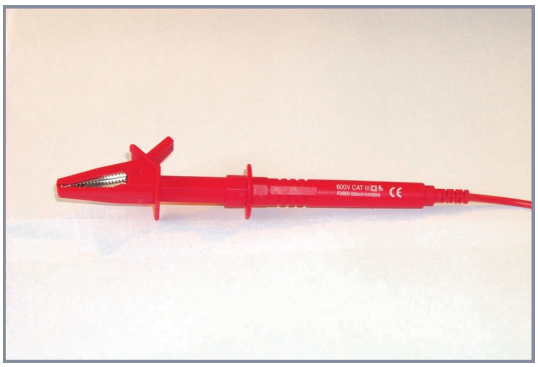
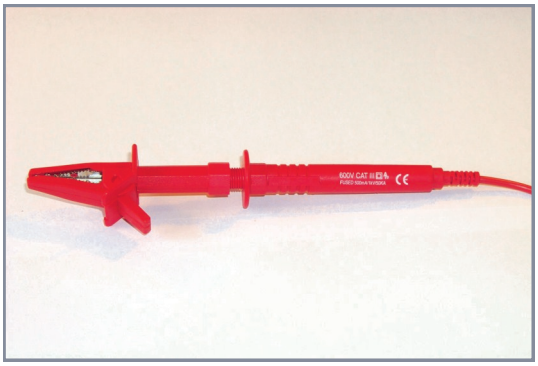
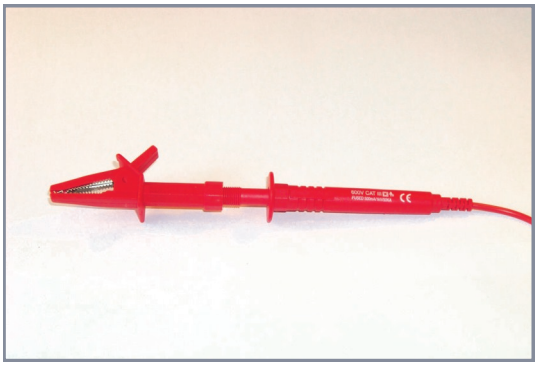
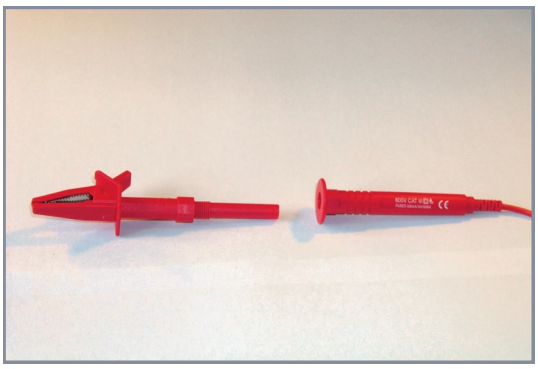


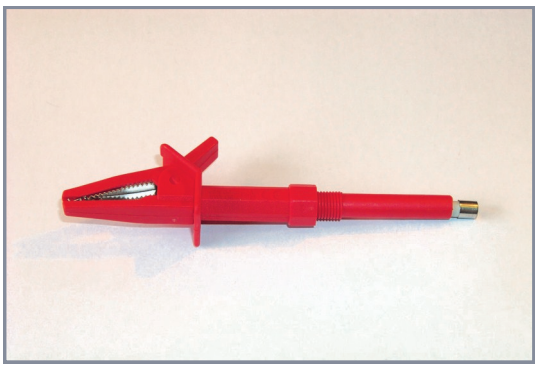
Figure 9-1 Voltage lead showing clip end

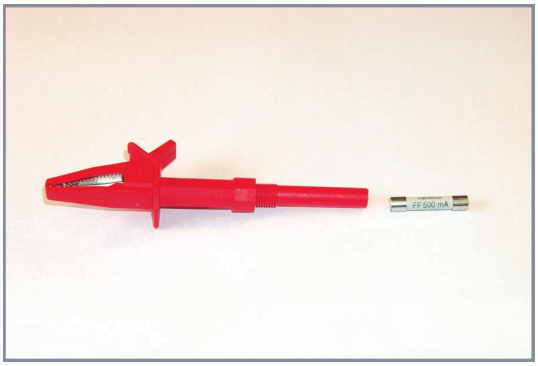
Figures 9-2/6 Below is a sequence of pictures to show unscrewing of a voltage lead clip and replacement of fuse











Figures 9-2/6 Sequence of pictures to show unscrewing of voltage lead clip and replacement of fuse

Replacement of internal batteries and fuses

⚠ **To be replaced by service personnel only**

There are four batteries and two fuses inside the box on the underside of the unit. Refer to Appendix D for detailed information on their specification. For your safety ask your service department to do these replacements. The logger unit is made up of three interconnecting circuit boards. The batteries and fuses are located on the underside of the lowest board. To change them it is necessary to take the logger out of the box.

⚠ **Before changing the batteries please take note; battery replacement is easy and safe provided that the following simple precautions are taken:**

It is important that the four batteries be replaced altogether as a unit, as batteries with differing charge capacities will rapidly degrade.

The batteries must be orientated correctly in their clips for the logger to work.

Make sure that you use the correct type of *chargeable* battery. Never use non rechargeable batteries.

Use of incorrect or wrongly orientated batteries may result in the liberation of gases and/or heat.

Removal of the logger from the box

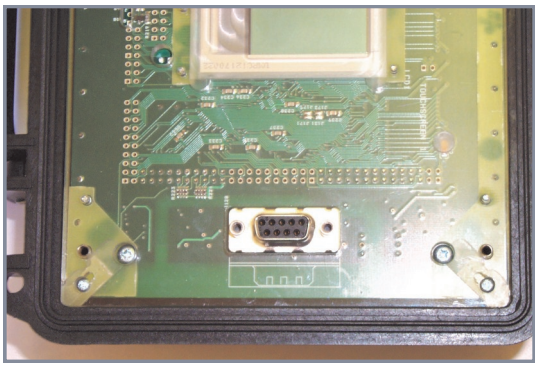
Disconnect the logger from any power source and make sure no Rogowski Coils or voltage probes are attached. Disconnect the RS232 cable if attached but keep it nearby. It is part of the procedure!

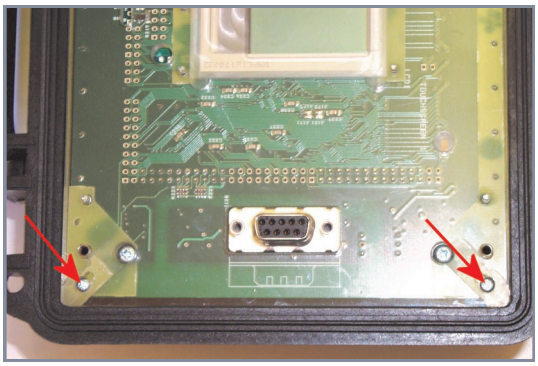
You will need a small 'Posidrive' screwdriver. Unscrew the overlay (four screws, one at each corner). Place it carefully to one side. Now you are looking at the front panel.

In the top right and bottom right corners are two locking tongues. Remove their screws. With a sharp pointed implement release the locking tongues from the edge of the box.

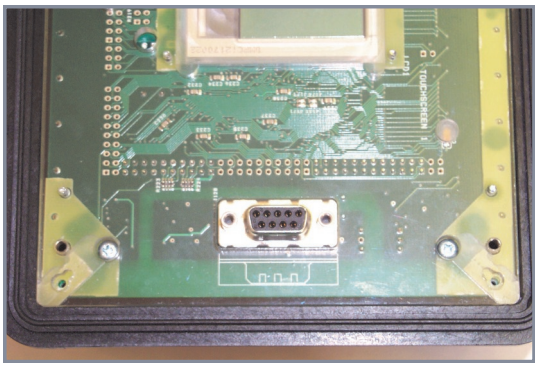
Now screw your RS232 connector onto its socket in the logger face and use it as a handle to pull the logger out of the box or turn the box over and gently tap one corner to loosen the logger inside.

Figures 9-7/13 The following pictures show the sequence of steps to go through to lift the boards out of the box.

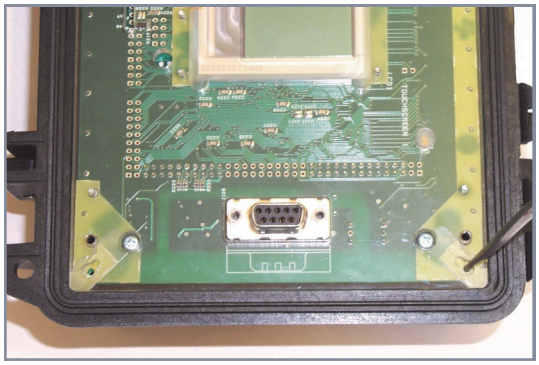




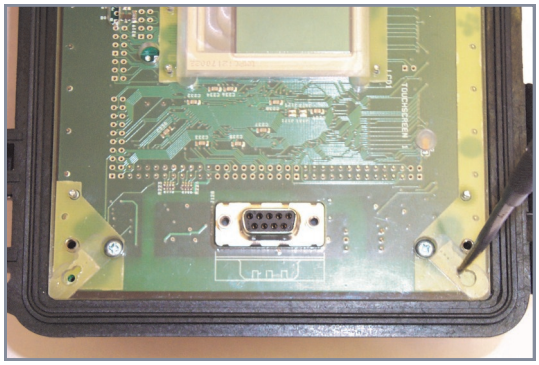
You have removed the overlay and revealed the front panel. Note the two locking tongues and their screws.



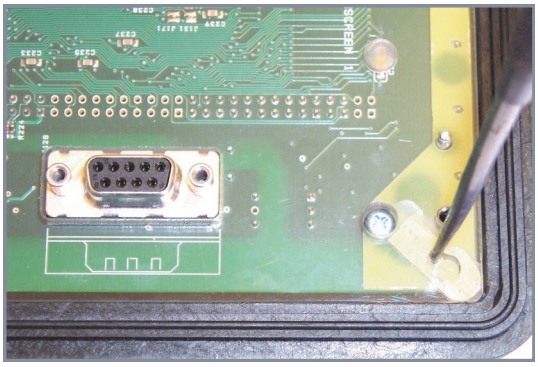
The screws are now removed.



Take your pointed implement and locate it in the top of the locking tongue screw hole, catching the locking tongue,



Slide the hole as far as the tongue groove will let you. The locking tongues may be a little stiff the first time they are moved.

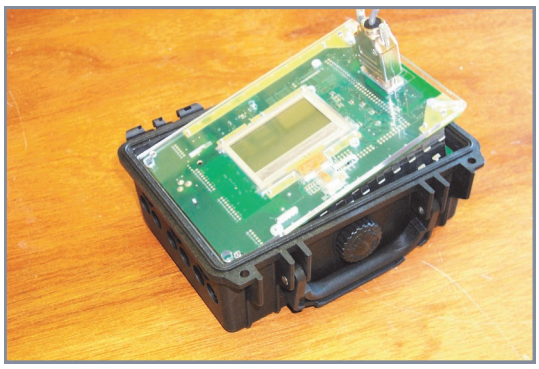


When both locking tongues have been released, attach the RS232 cable to its socket.

Use it as a handle to lift the unit out of the box *after* reading the following precaution!

⚠ **Although the battery voltage is low, each battery is capable of storing a large amount of energy. This is not dangerous unless a battery is inadvertently short-circuited. When any such battery is short-circuited a great deal of heat may be generated, especially at the contacts where the short circuit is made and in the conductors where the short circuit current flows. In extreme cases this could result in melting of the insulation or even fire.**

To avoid this hazard, after taking the unit out of the box put it down on a dry flat insulating surface that is free from any conducting debris. Take care not to allow the battery contacts to become damaged or to touch any other conductors. Keep the logger well away from any metal objects like scissors, knives or screwdrivers!



Lift the unit out of the box using the RS232 connector or turn the unit upside down and gently tap the corner of the box to nudge the logger out.

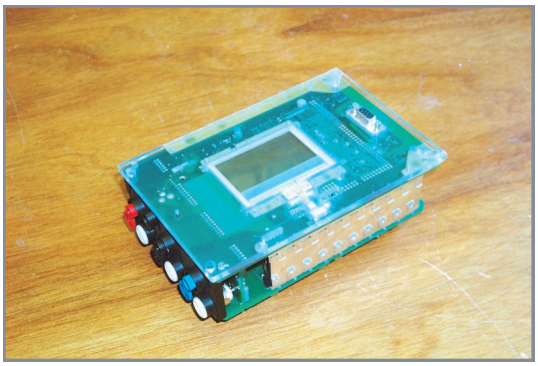


Figure 9-14 PM3000 boards out of the box

Now turn the unit upside down to reveal the batteries and fuses.

Fuse Replacement

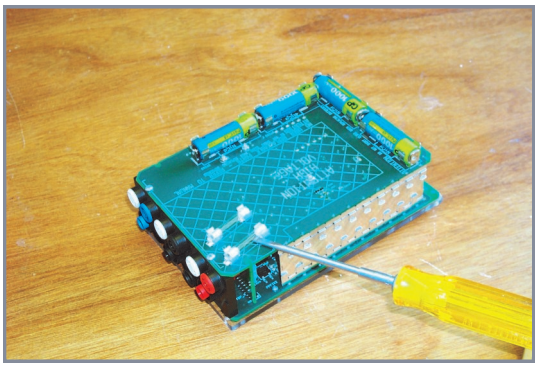


Figure 9-15 Underside of PM3000 boards to show position of fuses

Lift the fuses out of their clips and replace.

Battery Replacement

Battery replacement is easy and safe provided that the simple precautions in the manual are followed. Note also that:

It is important that the four batteries be replaced altogether as a unit, as batteries with differing charge capacities will rapidly degrade.

The batteries must be orientated correctly in their clips for the logger to work.

Make sure that you use the correct type of *chargeable* battery. Never use non rechargeable batteries. See Appendix D for part information

Use of incorrect or wrongly orientated batteries may result in the liberation of gases and/or heat.

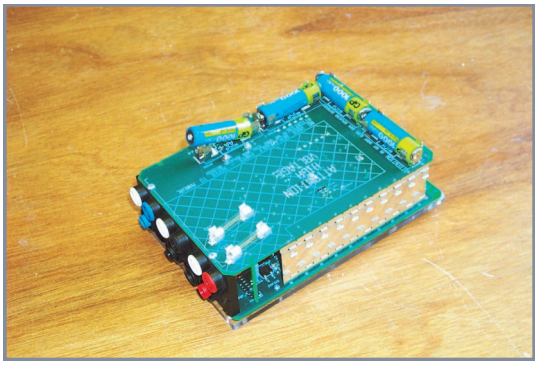


Figure 9-16 Underside of PM3000 boards to show position of batteries

Lift the batteries out of their clips and replace. Follow the markings on the circuit board to guide you to **fit them the right way round**. See Figure 9-17 below.

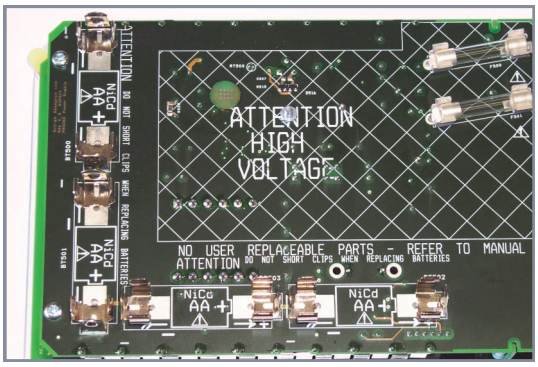


Figure 9-17 Picture of the underside of the boards with batteries removed

Note the position of the +'s to denote the orientation of the batteries.

Reassembly of the logger

Before you reassemble the unit you must verify that the correct batteries have been fitted in the correct orientation

When reassembling the unit take care that at no time is there any possibility of the battery contacts touching any other conductor.

Take the logger and offer the end with the connectors into the box first. Then gently push down on the other end and the logger will slide into position inside the box. Take your pointed implement and push the two locking tongues back into position. Secure them with their screws. Screw the overlay back on.

Take great care when reintroducing power to the logger.

Further Precautions for Service Personnel

Please be aware that users or service departments should not do any fault finding on their PM3000. If, having consulted the troubleshooting table, the logger fails to work, please return it to your sales person as explained in Appendix D.

Making changes other than replacing the internal fuses and batteries will invalidate the guarantee.

For your safety when handling the PM3000 please be aware of these further cautions:

- Exercise CAUTION when connecting and measuring off-line voltages.
- The PM3000 must not be connected to any external supplies when the unit is disassembled.
- The PM3000 is designed to operate with high voltages. Dangerous voltages are present inside the unit especially on the high voltage side of the isolation barrier. When the unit is disassembled, service engineers must be careful to follow safety procedures appropriate for working with high-voltage electrical equipment.
- Take care not to introduce any short circuits - under severe fault or failure conditions, the PM3000 offline power supply may dissipate large amounts of power, which could result in the mechanical ejection of a component or of component debris at high velocity. Operate with care to avoid possible personal injury.
- Voltage at the primary side may be as high as 700V peak.
- Wear protective eye gear at all times.
- Do not touch any part of the circuit with bare hands or conductive materials.
- Make sure all high-voltage capacitors are fully discharged before handling.
- Make connections to the voltage channels in pairs only. (I.e. connect V1+ and V1- at the same time, if possible).

List of Battery Cautions

Lithium

Caution: Danger of explosion if battery is incorrectly replaced.

Caution: Replace battery with Duracel DL1616 3V Lithium Button Cell. Use of another battery may present a risk of fire or explosion.

Caution: Burn Hazard if mistreated. Do not disassemble. Handle damaged or leaking battery with extreme care. If the battery is damaged, electrolyte may leak from the cells and may cause personal injury.

Caution: These batteries may be safely disposed of in normal household waste. Contact your local government for disposal or recycling practices in your area.

Caution: Do not expose to high temperatures (> 60°C/140°F).

Caution: Dispose of used battery promptly.

Caution: Keep away from children.

Caution: Battery may present a fire or chemical burn hazard if mistreated.

Do not heat above 60°C/140°F or incinerate.

Caution: Duracell packaging recommendations. "Connect correctly. Do not recharge. Keep away from children. Do not swallow."

NiMH

Caution: Danger of explosion if battery is incorrectly replaced.

Caution: Replace battery with GP Batteries Rechargeable Nickel Metal Hydride Cylindrical Cell (GP130AAHC). Use of another battery may present a risk of fire or explosion.

Caution: Burn Hazard if mistreated. Do not disassemble. Handle damaged or leaking battery with extreme care. If the battery is damaged, electrolyte may leak from the cells and may cause personal injury.

Caution: Return to GP Batteries for disposal. (Summerfield Avenue, Chilton Business Park, Wellington, Somerset, TA21 9JF.

Caution: Do not expose to high temperatures (> 60°C/140°F).

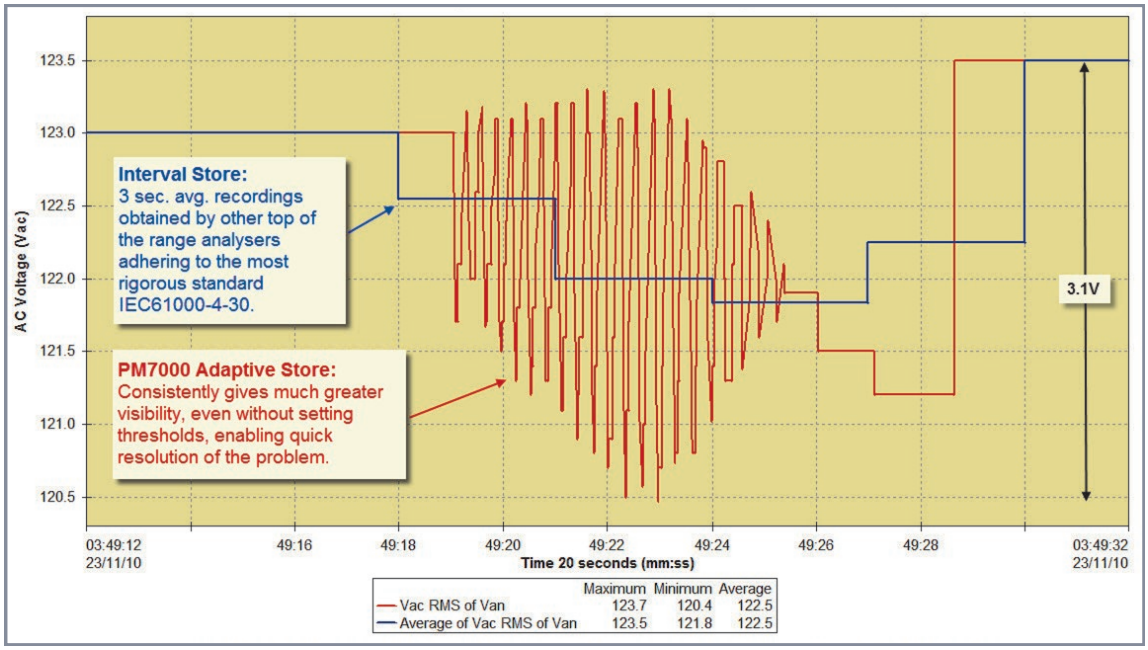
Caution: Dispose of used battery promptly.

Caution: Keep away from children.

Caution: GP warnings

Do not incinerate or dismantle batteries. Cell components are corrosive and may be harmful to skin and eyes. Never short-circuit or reverse polarity in application. Do not use different types of batteries in the same battery assembly.

Appendices



Adaptive Store
vs Point Store

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Taylors Lane, Bosham,
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Tel: 0044 1243 573050
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Contents

Appendix A
Maths Functions and Groups in the PM3000 and PM3000HF

Groups

The maths functions available in the PM3000 models are arranged in seven groups. These are listed below. Those found only in the PM3000HF are in blue:

AC 1 Phase
AC 2 Phase
AC 3 Phase
Harmonics
Basic Maths 1
Basic Maths 2
Basic Maths 3

Unspecified

There is also an “Unspecified” category used to “deselect” a Channel. When a Channel is “Unspecified”, it does not appear in the Display functions, and it is not recorded. In fact it is not processed at all.

AC 1 Phase Group

Options available in the 1 phase group are:
RMS voltage and current
RMS High Resolution up to 35V
Single phase Real Power
Single phase Volts Amps Reactive (VAR)
Single phase Apparent Power
Single phase Displacement Power Factor
Single phase Real Power Factor
Flicker Sensation
Flicker Flag
Flicker Pst
Flicker Plt
Phase Angle
Frequency
Single phase Z-Real Impedance
Single phase Z-Reactive (imaginary) Impedance

AC 2 Phase Group

Options available in the 2 phase group are:
2 phase 2 element
2 phase Real Power
2 phase Volts Amps Reactive (VAR)
2 phase Apparent Power
2 phase Power Factor

AC 3 Phase Group

The 3 phase functions given to you depend upon the hook-up.

3 phase 4 wire Wye Hook up
3 phase 4 wire Real Power
3 phase 4 wire Volts Amps Reactive (VAR)
3 phase 4 wire Apparent Power
3 phase 4 wire Power Factor
3 phase 3V Voltage Amplitude Unbalance (conventional)
3 phase 3I Current Amplitude Unbalance
Voltage Amplitude Unbalance (using Sequential Components)
Voltage Phase Unbalance (using Sequential Components)
3 phase NPS Volts Unbalance
3 phase NPS Phase

3 Phase 4 wire Delta Hook up
3 phase 4 wire Real Power
3 phase 4 wire Volts Amps Reactive (VAR)
3 phase 4 wire Apparent Power
3 phase 4 wire Power Factor
3 phase 3 current Unbalance
3 phase NPS Volts Unbalance
3 phase NPS Phase

3 Phase 3 wire 3P-P Hook up
3 phase 3 wire Real Power
3 phase 3 wire Volts Amps Reactive (VAR)
3 phase 3 wire Apparent Power
3 phase 3 wire Power Factor
3 phase 1 element Real Power
3 phase 1 element Volts Amps Reactive (VAR)
3 phase 1 element Power Factor
3 phase 3 Volts Unbalance
3 phase 3 current Unbalance
3 phase NPS Volts Unbalance
3 phase NPS Phase

3 Phase 3 wire Wye and Delta Hook ups
3 phase 3 wire Real Power
3 phase 3 wire Volts Amps Reactive (VAR)
3 phase 3 wire Apparent Power
3 phase 3 wire Power Factor
3 phase 1 element Real Power
3 phase 1 element Volts Amps Reactive (VAR)
3 phase 1 element Power Factor
3 phase NPS Volts Unbalance
3 phase NPS Phase

3 Phase 2 ½ element Wye (2 voltage, 3 current)
3 phase $2^1/_2$ element Real Power
3 phase $2^1/_2$ element Volts Amps Reactive (VAR)
3 phase $2^1/_2$ element Power Factor
3 phase 3 current Unbalance

3 Phase 1 element Wye (1 voltage, 1 current)
3 phase 1 element Real Power
3 phase 1 element Volts Amps Reactive (VAR)
3 phase 1 element Power Factor

Harmonics

%THD Total Harmonic Distortion (w.r.t Fundamental)
Total Harmonic Value
% Odd Harmonics (with regard to the Fundamental)
Value of Odd Harmonics
% Even Harmonics (with regard to the Fundamental)
Value of Even Harmonics
% Triplens (with regard to the Fundamental)
Value of the Triplens
% of One Harmonic
Value of One Harmonic
+/- % One Harmonic
+/- Value of One Harmonic
K-Factor

Basic Maths 1

Channel X * Constant

Basic Maths 2

Channel X / Channel Y

Basic Maths 3

Filtered version of Channel X
Internal Temperature
On Charge Indication
Internal Battery Voltage

Appendix B
Single Cycle Adaptive Store™ Technique for the PM Family

The patented Single Cycle Adaptive Storage technique has proven to be an exceptionally good performer in the field. The main attributes of this technique is its ability to accurately reproduce trend data and at the same time sample at a fast enough rate over long periods of time to faithfully reproduce anomalies and deviations from the trend. The ability to do this is not present in any other storage technique. This is a very rigorous requirement for conventional recording techniques and becomes more and more rigorous as the length of the recording time increases. The following discussion explains the functionality of the adaptive storage technique.

Introduction

The patented Single Cycle Adaptive Storage used in the PM3000 is designed to make the best use of the store available, in reconciling two conflicting requirements:

- Provide long term trend data, observing worst extremes of maximum and minimum values seen, and
- Provide detail where new activity occurs, i.e. detect and capture "transients".

If "transients" are slow moving, and the "long term" is relatively short, then the above requirements can both be met with a conventional Data Logger operating a sample and store process at a fixed sample rate. In technical terms, if the sample rate chosen can give a long enough recording period given the number of channels in use and the amount of store available, AND if the maximum frequency of the input signal can be defined to be less than half the sample rate, then a regular sample and store process does provide an adequate record of the input signal, from which the actual input signal can be reconstructed.

If the above conditions cannot be met at the same time, something else must be done.

In the PM3000, there is a way of improving on the regular sample and store process, "Single Cycle Adaptive Store™".

Single Cycle Adaptive Store™

Single Cycle Adaptive Store™ does not require any prior knowledge of signal conditions. The only parameter it takes is the total time of the record.

It then applies a storage rate of 1 cycle for the whole recording period. The PM3000 samples 64 times per cycle and calculates the true RMS value over the time period of each cycle for the adaptive store process.

This sample rate is applied regardless of the number of channels. Thus for 4 channels, recording for 1 week, a total of 60*86400*7*4 = 145.152 million samples are taken. At two bytes per sample, a store requirement of nearly 300 MBytes would be required in the classical sample and store method.

The PM's adaptive store process reduces this number by reducing the number of times it records anything. If a value can be predicted from past history, the new value is not recorded. All the time a set of values CAN be predicted, it is sufficient to define them on the basis of the past history, how the past history is being used, the length of time for which the prediction is valid, and the prediction tolerance (or better still, the worst case deviations from the prediction). In PM language, we call such a combination of Data a "record".

Clearly there are a number of factors to be considered:

- Recording time requested
- Number of channels in use
- Amount of store available

} Basic statistics

These items set the frequency with which recording of some sort can occur. That also depends on how much store is used each time a "record" is placed in memory.

If some kind of prediction tolerance is to be applied in order to distinguish "more useful" values from "less useful" ones, then we also have to include in our list of factors:

- Typical noise on the signal
- Dynamics of any apparent trends

} Data Dynamics

Clearly the process has to be able to perform equally well with large signals and large signal activity, and small signals, etc. It should be able to distinguish transients whether they are simple steps from an otherwise static signal, or on top of some trend already covered in noise.

The PM3000 operates by initially:

1. Assessing the Basic Statistics to give the typical

worst case "record" time.
2. Dividing the total available store into 2, and allocating one part to "transients"

During recording, the Logger assesses the "normal signal activity" within a "worst case record time", and attempts to define a prediction tolerance based on that activity. To begin with, the tolerance is set tight, so that predictions fail frequently. When the signal can no longer be predicted within the "tolerance", a "record" is taken, and the statistics revised.

The Control Loop is designed to set the tolerance at the level which will NOT cause normal activity to fail, yet will respond the moment a signal fails outside the "normal activity" envelope. Thus when the system has established the right tolerance, and that tolerance is confirmed after each record, a departure from prediction of the normal activity envelope will be sufficient to be recognized as a transient.

When a transient is seen, loop parameters are modified again taking into account

- whether this is a new transient, and
- its size.

If this is not a new transient, the system desensitizes itself by increasing the tolerance level. If it is a new one, it actually INCREASES sensitivity to allow detail on this transient to be captured.

Over and Under Detection of Transients

If signal activity continues to increase over a long period of time, an excess of transients may be detected and stored. In this case the system becomes insensitive to rapid pulse type signals (though the worst case envelope still reflects them), while remaining responsive to step type excursions. At the other extreme, for the situation of so much "normal signal activity" that small step changes are undetectable, the store allocated to transients remain unused. If the unused store builds up, it is reallocated to normal recording.

Worst Case Envelope and Multiple Predictions

At all times, the extremes of the signal seen by the sampling process are included in the "worst case envelope". This envelope comprises the maximum and minimum deviations from the best prediction that the PM Logger has been able to use to describe the signal activity in the relevant record. Thus the max/min plot from the Pronto software shows the extremes of signal excursion, and all samples taken lie within that envelope. (i.e. all > 30 million samples over the whole week in the example mentioned on page 2.

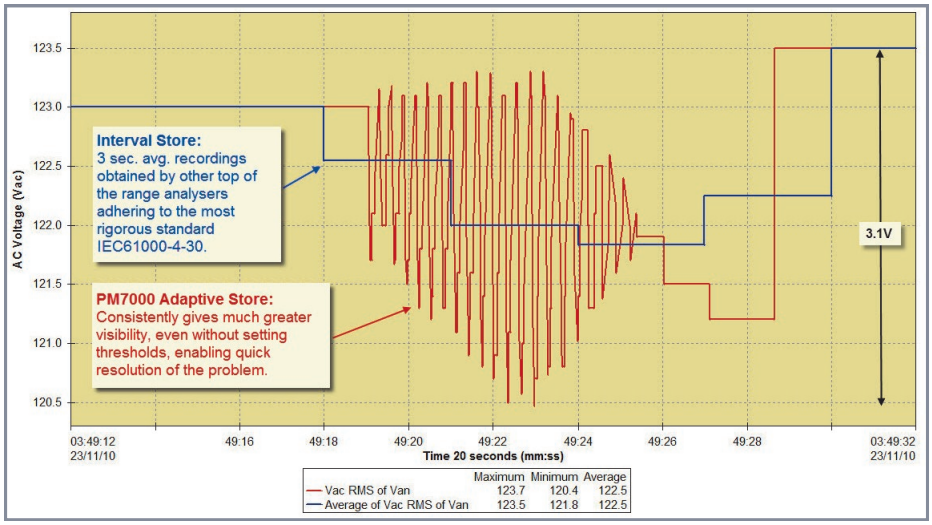
The uncertainty as to actual signal value at any one time depends upon the difference between the maximum and minimum lines, i.e. the height of the envelope. For a given length of time allocated to each record (which is the ultimate constraint imposed by finite store), the height of the envelope is controlled by the quality of the prediction.

The PM3000 caters for the UNPREDICTABILITY of future signal activity by employing multiple predictive mechanisms, against which all samples are tested as they are received. Though they are all loosely based on past history, some of those predictions are worse than others, and the poor ones are discarded.

This method of ANTICIPATING the possible signal path and testing each sample for conformity:

- Spreads the computational load out uniformly over time
- Allows for immediate reaction to transients
- Works with extremely long recording periods

Figures Ia and Ib show actual results of Adaptive and point store



You can see that the adaptive process is much better at catching anomalies by comparing the two graphs.

The PM Adaptive Store System has shown itself to be the most powerful automatic data compression system seen in any of today's Data Loggers.

Appendix C
Further Application Notes

About Symmetrical Components

Hi Frank, Another good reason to use both PM6000 & PM3000 is that they have the facility to calculate voltage unbalance using the "Symmetrical Components" or "Sequential Components" method (Two names for the same thing).

The "Good Reason" is "Phase sensitive Voltage Unbalance is available using "Sequential Components" method."

This is great for helping find the cause of motor heating etc. As the "Good Reason" states, its a method of obtaining a measure of Voltage Unbalance which is sensitive to phase, which the conventional Unbalance method is not, and it has been requested over here because water pumping stations sometimes wear much faster than they are expected to, and the reason is often phase unbalance. You can imagine that if the windings on a three phase motor are 120 degrees apart, and input 3-phase voltage is correctly balanced, the torque generated by each phase is equal and smooth. If one of the phases is wrong, the torque generated would not be even, which leads to overheating and accelerated wear.

However the phase being wrong does not produce an unbalance result in the conventional calculation (provided the voltages are equal), but it does using Sequential components, which is sensitive to both phase and voltage.

I have asked PQ experts in US companies if they are familiar with it as a method and they are, but I understand its not used a great deal in the US because its derivation is not as easy to understand as the simplistic amplitude-only method, and provided there is a Function "Voltage Unbalance" that they can access, the operators are not critical of the quality of the result. As an example of the performance of the two methods, consider three vectors of equal amplitude, but phase 10, -120, 120 degrees instead of 0,-120, 120. This is clearly seriously wrong but the conventional method does not show any error. Sequential components method shows 5.8% unbalance.

If you want to understand this further I have a basic un -adorned spreadsheet (ie engineering, not super beautiful) which shows results with the two methods for different input conditions.

Appendix D
Replacement Parts

All items in the kit can be obtained from your distributor. Also field replaceable are the fuses in the voltage probes. The internal batteries and fuses must be replaced by service personnel. With the exception of the NiMH internal batteries, under normal usage no components should require replacement for several years.

Part No	Description
PM3000 kit	Power Analyzer System. Comprises Monitoring system. (IEC 61010 rating 480V Cat III pollution level 2), 3 Rogowski Coil flexible current sensors, 4 fused voltage probes (IEC rating 600V Cat III), 3 link cables (IEC rating 1000V Cat III), serial cable, Manual and Pronto Graphics software on CD
PM3000	Power Analyzer System Unit
PM0145	Fused Voltage probe and 2.5m Cable (specify color) (IEC 61010 Rating 1000V Cat III)
PM0146	1m Voltage extension cable (specify color) (IEC 61010 Rating 1000V Cat III) 123680/CS/OF/1M
PM0147	Link lead 15cm 4mm shrouded plug to stackable 4mm shrouded plug (IEC61010 rating 1000V Cat III)
PM0150	15cm Flexible Voltage Dolphin Clip extension, comprising Socket Adaptor, 0.15 Short extension cable, Push-on Dolphin clip. (IEC 61010 rating 600V Cat III) (specify color)
PM0155	Rogowski Coil flexible current sensors, 60cm sensor loop, 2.5m to BNC safety connector
PM0160	1m Current Extension cable, Safety BNC socket to safety BNC Plug (specify color)
PM0165	Current probe adaptor (2 shrouded 4mm sockets to safety BNC Plug)
PM0170	Serial Cable RS232 1.5m
PM0300	Wall outlet connector and cable US
PM0310	Wall outlet connector and cable UK
PM0400	Carrying Bag
PM0600	Pronto and User Manual CD
PM0650	USB Serial Adaptor
PM0320	12 Vdc wall cube adapter battery charger US
PM0330	12 Vdc wall cube adapter battery charger UK
PM0500	Fuse (for voltage probe) 1000V/500mA fusing current/50kA rupture current Mfr Part.No 116048
PM0501	Fuse (internal) 1000V/100mA
PM0521	NiMH Batteries, 1.2V 1300mAHr, set of 4. GP130AAHG
PM0531	Lithium Cell Battery, CR1616 3.0V 50mAHr

Appendix E
Guide to Battery Management

Here are some points which we hope will be helpful with regard to the behaviour of the PM3000 and its battery management.

- The PM3000 is not primarily a battery operated instrument.
- It is designed to be on charge all the time even when stored on the shelf, using the mains lead or a charger.
- The purpose of the batteries is to give a ten minute ride through should the power go down and to preserve the data for a realistic period when the power is removed and the unit is off.
- The unit is normally powered off the voltage being measured. If only current is to be measured you must use a 12 volt charger plugged into the mains (or other form of power e.g. car battery) to charge the system.
- The main charge rate for the PM3000 is slow, 30 mA. This is the maximum rate we can use to meet the safety standards. It is the maximum rate which can be sustained indefinitely.
- So to charge the PM3000 fully from a flat state will take several days.
- To see if it is charging correctly go to 'Configure', 'Utilities', 'Manage Battery', ‘Test charge circuit’ and wait for it to give you a charging value for the Low and High rates. A fully charged unit will read about 5.6 Volts.
- The fact that the batteries are completely flat (we consider flat to be < 4.8 V) is not catastrophic for the unit but will increase the drain on the clock battery, which will eventually need replacing, and data will be lost.
- However the batteries should from full charge hold the data for about two months at room temperature.
- When the batteries are nearly flat the operation of a charge accumulator will force the screen to shut down to stop any more drain on the batteries and leave enough charge to hold up the data. Once the unit is plugged in and the battery has reached a reasonable level of charge, the screen will once more light up. This means that after the screen has ‘closed down to save batteries’, it will not necessarily come alive immediately it is plugged in.

Appendix F
Table: The Safety Graphics Symbols

Graphic Symbols used on the PM3000 and in this manual are used in accordance with this table

Number	Symbol	Reference	Description
1		IEC 60417 – 5031	Direct current
2		IEC 60417 – 5032	Alternating current
3		IEC 60417 – 5033	Both direct and alternating current
4			Three-phase alternating current
5		IEC 60417 – 5017	Earth (ground) TERMINAL
6		IEC 60417 – 5019	PROTECTIVE CONDUCTOR TERMINAL
7		IEC 60417 – 5020	Frame or chassis TERMINAL
8		IEC 60417 – 5021	Equipotentiality
9		IEC 60417 – 5007	On (Supply)
10		IEC 60417 – 5008	Off (Supply)
11		IEC 60417 – 5172	Equipment protected throughout by DOUBLE INSULATION or REINFORCED INSULATION
12			Caution, risk of electric shock
13		IEC 60417 – 5041	Caution, hot surface
14		ISO 7000 – 0434	Caution, risk of danger (See note.)
15		IEC 60417 – 5268	In position of a bi-stable push control
16		IEC 60417 – 5269	Out position of a bi-stable push control

Table 1 of the Safety Standard IEC61010-1 part 1

Appendix G
List of Factory Configurations

All configurations are for recordings in Adaptive Store for 7 days (unless otherwise specified), FIFO Off.

NAME	1ø 1V 7day	1ø Full PQ Flkr 7day	1ø Full PQ Pwr 7day	2ø 2el Y Pwr 7day
Hook-up	Single Phase	Single Phase	Single Phase	2-Phase 2-Element Wye
Current Sensors	Rogowski Coil High Range	Rogowski Coil Low Range	Rogowski Coil High Range	Rogowski Coil High Range
Signal (Name & Full Scale)				
V1	V1 480.0V	V1 480.0V	V1 480.0V	V1 480.0V
I1	I1 3000.0A	I1 400.0A	I1 3000.0A	I1 3000.0A
V2	V2 480.0V	V2 480.0V	V2 480.0V	V2 480.0V
I2	I2 3000.0A	I2 400.0A	I2 3000.0A	I2 3000.0A
V3	V3 480.0V	V3 480.0V	V3 480.0V	V3 480.0V
I3	I3 3000.0A	I3 400.0A	I3 3000.0A	I3 3000.0A
Channel				
1	RMS Vln (V1)	RMS Van (V1)	RMS Van (V1)	RMS Van (V1)
2		RMS Ia (I2)	RMS Ia (I1)	RMS Vbn (V2)
3		THD Van (Harmonics %)	THD Van (Harmonics %)	
4		HMNCS Ia (Harmonics Value)	HMNCS Ia (Harmonics Value)	RMS Ia (I1)
5		FLKR sensation Van	Real Power	RMS Ib (I2)
6		FLKR flag Van	Reactive Power	
7		FLKR st Van (10 mins)	Displacement Power Factor	2 ph 3 w Real Power
8		FLKR lt Van (2 hrs)	Apparent Power	2 ph 3 w Reactive Power
9		RMS Vne (Hi resolution)		2 ph 3 w Power Factor
10				2 ph 3 w Apparent Power
11				
12				
13				
14				
15				
16		AC Frequency		

Factory Configurations cont.

All configurations are for recordings in Adaptive Store for 7 days (unless otherwise specified), FIFO Off.

NAME	3ø 1el Y Pwr 7day	3ø 2.5el Y Pwr 7day	3ø 3el 11kV Flkr 7day	3ø 3el 11kV THD Flkr 7day
Hook-up	3-Phase 1-Element Wye	3-Phase 2.5-Element Wye	3-Phase 3-Wire Delta 3el	3-Phase 3-Wire Delta 3el
Current Sensors	Rogowski Coil High Range	Rogowski Coil High Range	Voltage Output CT (1000A=1V) High Range	Voltage Output CT (1000A=1V) High Range
Signal (Name & Full Scale)				
V1	V1 480.0V	V1 480.0V	V1 480.0V	V1 480.0V
I1	I1 3000.0A	I1 3000.0A	I1 500.0A	I1 500.0A
V2	V2 480.0V	V2 480.0V	V2 480.0V	V2 480.0V
I2	I2 3000.0A	I2 3000.0A	I2 500.0A	I2 500.0A
V3	V3 480.0V	V3 480.0V	V3 480.0V	V3 480.0V
I3	I3 3000.0A	I3 3000.0A	I3 500.0A	I3 500.0A
Channel				
1	RMS Vab (V1)	RMS Van (V1)	RMS Vab (V1)	RMS Vab (V1)
2		RMS Vbn (V2)	RMS Vbc (V2)	RMS Vbc (V2)
3			RMS Vca (V3)	RMS Vca (V3)
4		RMS Ia (I1)	RMS Ia (I1)	RMS Ia (I1)
5		RMS Ib (I2)	RMS Ib (I2)	RMS Ib (I2)
6	RMS Ic (I3)	RMS Ic (I3)	RMS Ic (I3)	RMS Ic (I3)
7	3 ph 1 e Real Power	3 ph 2.5 e Real Power	FLKR sensation Vab	THD Vab (Harmonics %)
8	3 ph 1 e Reactive Power	3 ph 2.5 e Reactive Power	FLKR sensation Vbc	THD Vbc (Harmonics %)
9	3 ph 1 e Power Factor	3 ph 2.5 e Power Factor	FLKR sensation Vca	THD Vca (Harmonics %)
10			FLKR st Vab (10 mins)	FLKR st Vab (10 mins)
11			FLKR st Vbc (10 mins)	FLKR st Vbc (10 mins)
12			FLKR st Vca (10 mins)	FLKR st Vca (10 mins)
13			FLKR lt Vab (2 hrs)	FLKR lt Vab (2 hrs)
14			FLKR lt Vbc (2 hrs)	FLKR lt Vbc (2 hrs)
15			FLKR lt Vca (2 hrs)	FLKR lt Vca (2 hrs)
16			AC Frequency	AC Frequency

Factory Configurations cont.

All configurations are for recordings in Adaptive Store for 7 days (unless otherwise specified), FIFO Off.

NAME	3ø 3el 33kV Flkr 7day	3ø 3el 33kV THD Flkr 7day	3ø 3w D Pwr 7day	3ø 4w Y 3V 3I 7day
Hook-up	3-Phase 3-Wire Delta 3el	3-Phase 3-Wire Delta 3el	3-Phase 3-Wire Delta	3 Phase 4 Wire Wye
Current Sensors	Voltage Output CT (1000A=1V) High Range	Voltage Output CT (1000A=1V) High Range	Rogowski Coil High Range	Rogowski Coil High Range
Signal (Name & Full Scale)				
V1	V1 480.0V	V1 480.0V	V1 480.0V	V1 480.0V
I1	I1 500.0A	I1 500.0A	I1 3000.0A	I1 3000.0A
V2	V2 480.0V	V2 480.0V	V2 480.0V	V2 480.0V
I2	I2 500.0A	I2 500.0A	I2 3000.0A	I2 3000.0A
V3	V3 480.0V	V3 480.0V	V3 480.0V	V3 480.0V
I3	I3 500.0A	I3 500.0A	I3 3000.0A	I3 3000.0A
Channel				
1	RMS Vab (V1)	RMS Vab (V1)	RMS Vab (V1)	RMS Van (V1)
2	RMS Vbc (V2)	RMS Vbc (V2)		RMS Vbn (V2)
3	RMS Vca (V3)	RMS Vca (V3)	RMS Vcb (V3)	RMS Vcn (V3)
4	RMS Ia (I1)	RMS Ia (I1)	RMS Ia (I1)	RMS Ia (I1)
5	RMS Ib (I2)	RMS Ib (I2)		RMS Ib (I2)
6	RMS Ic (I3)	RMS Ic (I3)	RMS Ic (I3)	RMS Ic (I3)
7	FLKR sensation Vab	THD Vab (Harmonics %)	3 ph 3 w YD Real Power	
8	FLKR sensation Vbc	THD Vbc (Harmonics %)	3 ph 3 w YD Reactive Power	
9	FLKR sensation Vca	THD Vca (Harmonics %)	3 ph 3 w YD Power Factor	
10	FLKR st Vab (10 mins)	FLKR st Vab (10 mins)	3 ph 3 w YD Apparent Power	
11	FLKR st Vbc (10 mins)	FLKR st Vbc (10 mins)		
12	FLKR st Vca (10 mins)	FLKR st Vca (10 mins)		
13	FLKR lt Vab (2 hrs)	FLKR lt Vab (2 hrs)		
14	FLKR lt Vbc (2 hrs)	FLKR lt Vbc (2 hrs)		
15	FLKR lt Vca (2 hrs)	FLKR lt Vca (2 hrs)		
16	AC Frequency	AC Frequency		

Factory Configurations cont.

All configurations are for recordings in Adaptive Store for 7 days (unless otherwise specified), FIFO Off.

NAME	3ø 4w Y 3V 3I 14day	3ø 4w Y 3V only 7day	3ø 4w Y Flkr 7day	3ø 4w Y Flkr THD 7day
Hook-up	3 Phase 4 Wire Wye	3 Phase 4 Wire Wye	3 Phase 4 Wire Wye	3 Phase 4 Wire Wye
Current Sensors	Rogowski Coil High Range	Rogowski Coil High Range	Rogowski Coil High Range	Rogowski Coil High Range
Length of Time	14 days	7 days	7days	7days
Signal (Name & Full Scale)				
V1	V1 480.0V	V1 480.0V	V1 480.0V	V1 480.0V
I1	I1 3000.0A	I1 3000.0A	I1 3000.0A	I1 3000.0A
V2	V2 480.0V	V2 480.0V	V2 480.0V	V2 480.0V
I2	I2 3000.0A	I2 3000.0A	I2 3000.0A	I2 3000.0A
V3	V3 480.0V	V3 480.0V	V3 480.0V	V3 480.0V
I3	I3 3000.0A	I3 3000.0A	I3 3000.0A	I3 3000.0A
Channel				
1	RMS Van (V1)	RMS Van (V1)	RMS Van (V1)	RMS Van (V1)
2	RMS Vbn (V2)	RMS Vbn (V2)	RMS Vbn (V2)	RMS Vbn (V2)
3	RMS Vcn (V3)	RMS Vcn (V3)	RMS Vcn (V3)	RMS Vcn (V3)
4	RMS Ia (I1)		RMS Ia (I1)	RMS Ia (I1)
5	RMS Ib (I2)		RMS Ib (I2)	RMS Ib (I2)
6	RMS Ic (I3)		RMS Ic (I3)	RMS Ic (I3)
7			FLKR sensation Van	THD Van (Harmonics %)
8			FLKR sensation Vbn	THD Vbn (Harmonics %)
9			FLKR sensation Vcn	THD Vcn (Harmonics %)
10			FLKR st Van (10 mins)	FLKR st Van (10 mins)
11			FLKR st Vbn (10 mins)	FLKR st Vbn (10 mins)
12			FLKR st Vcn (10 mins)	FLKR st Vcn (10 mins)
13			FLKR lt Van (2 hrs)	FLKR lt Van (2 hrs)
14			FLKR lt Vbn (2 hrs)	FLKR lt Vbn (2 hrs)
15			FLKR lt Vcn (2 hrs)	FLKR lt Vcn (2 hrs)
16			AC Frequency	AC Frequency

Factory Configurations cont.

All configurations are for recordings in Adaptive Store for 7 days (unless otherwise specified), FIFO Off.

NAME	3ø 4w Y Hmnc 7day	3ø 4w Y Pwr 7day	3ø 4w Y Pwr Flkr 7day	3ø 4w Y Unbal 7day
Hook-up	3 Phase 4 Wire Wye	3 Phase 4 Wire Wye	3 Phase 4 Wire Wye	3 Phase 4 Wire Wye
Current Sensors	Rogowski Coil High Range	Rogowski Coil High Range	Rogowski Coil High Range	Rogowski Coil High Range
Signal (Name & Full Scale)				
V1	V1 480.0V	V1 480.0V	V1 480.0V	V1 480.0V
I1	I1 3000.0A	I1 3000.0A	I1 3000.0A	I1 3000.0A
V2	V2 480.0V	V2 480.0V	V2 480.0V	V2 480.0V
I2	I2 3000.0A	I2 3000.0A	I2 3000.0A	I2 3000.0A
V3	V3 480.0V	V3 480.0V	V3 480.0V	V3 480.0V
I3	I3 3000.0A	I3 3000.0A	I3 3000.0A	I3 3000.0A
Channel				
1	RMS Van (V1)	RMS Van (V1)	RMS Van (V1)	RMS Van (V1)
2	RMS Vbn (V2)	RMS Vbn (V2)	RMS Vbn (V2)	RMS Vbn (V2)
3	RMS Vcn (V3)	RMS Vcn (V3)	RMS Vcn (V3)	RMS Vcn (V3)
4	RMS Ia (I1)	RMS Ia (I1)	RMS Ia (I1)	RMS Ia (I1)
5	RMS Ib (I2)	RMS Ib (I2)	RMS Ib (I2)	RMS Ib (I2)
6	RMS Ic (I3)	RMS Ic (I3)	RMS Ic (I3)	RMS Ic (I3)
7	THD Van (Harmonics %)	Displacement Power Factor Van, Ia	3 ph 4 w Real Power	Real Power Factor Van, Ia
8	THD Vbn (Harmonics %)	Displacement Power Factor Vbn, Ib	3 ph 4 w Reactive Power	Real Power Factor Vbn, Ib
9	THD Vcn (Harmonics %)	Displacement Power Factor Vcn, Ic	3 ph 4 w Apparent Power	Real Power Factor Vcn, Ic
10	HMNCS Ia (Harmonics Value)	Real Power Factor Van, Ia	3 ph 4 w Power Factor	3 ph 4 w Real Power
11	HMNCS Ib (Harmonics Value)	Real Power Factor Vbn, Ib	FLKR st Van (10 mins)	3 ph 4 w Reactive Power
12	HMNCS Ic (Harmonics Value)	Real Power Factor Vcn, Ic	FLKR st Vbn (10 mins)	3 ph 4 w Apparent Power
13		3 ph 4 w Real Power	FLKR st Vcn (10 mins)	3 ph 4 w Power Factor
14		3 ph 4 w Reactive Power	FLKR lt Van (2 hrs)	3 ph I Unbalance
15		3 ph 4 w Apparent Power	FLKR lt Vbn (2 hrs)	3 ph NPS/PPS V Unbalance
16		3 ph 4 w Power Factor	FLKR lt Vcn (2 hrs)	3 ph NPS V Phase Angle

Factory Configurations cont.

All configurations are for recordings in Adaptive Store for 7 days (unless otherwise specified), FIFO Off.

NAME	U 3V 3I 7day	U 3V 3I Flkr Flag 7day	U 3V Unbal 7day
Hook-up	Uncommitted	Uncommitted	Uncommitted
Current Sensors	Rogowski Coil High Range	Rogowski Coil High Range	Rogowski Coil High Range
Signal (Name & Full Scale)			
V1	V1 480.0V	V1 480.0V	V1 480.0V
I1	I1 3000.0A	I1 3000.0A	I1 3000.0A
V2	V2 480.0V	V2 480.0V	V2 480.0V
I2	I2 3000.0A	I2 3000.0A	I2 3000.0A
V3	V3 480.0V	V3 480.0V	V3 480.0V
I3	I3 3000.0A	I3 3000.0A	I3 3000.0A
Channel			
1	RMS V1	RMS V1	RMS V1
2	RMS V2	RMS V2	RMS V2
3	RMS V3	RMS V3	RMS V3
4	RMS I1	RMS I1	
5	RMS I2	RMS I2	
6	RMS I3	RMS I3	
7		FLKR sensation V1	3 ph NPS/PPS V Unbalance
8		FLKR sensation V2	3 ph NPS V Phase Angle
9		FLKR sensation V3	
10		FLKR st V1 (10 mins)	
11		FLKR st V2 (10 mins)	
12		FLKR st V3 (10 mins)	
13		FLKR flag V1	
14		FLKR flag V2	
15		FLKR flag V3	
16			

Factory Configurations cont.

All configurations are for recordings in Adaptive Store for 7 days (unless otherwise specified), FIFO Off.

NAME	3p Test Config #1	3p Test Config #2
Hook-up	Uncommitted	Single Phase
Current Sensors	Rogowski Coil High Range	Voltage Output CT (1000A=1V) High Range
Length of Time	3 days	3 hours
Signal (Name & Full Scale)		
V1	V1 480.0V	V1 480.0V
I1	I1 3000.0A	I1 500.0A
V2	V2 480.0V	V2 480.0V
I2	I2 3000.0A	I2 500.0A
V3	V3 480.0V	V3 480.0V
I3	I3 3000.0A	I3 500.0A
Channel		
1	RMS V1	RMS Vln (V1)
2	RMS V2	RMS Il (I1)
3	RMS V3	Real Power
4	RMS I1	Reactive Power
5	RMS I2	Apparent Power
6	RMS I3	THD Van (Harmonics %)
7	AC Frequency	Harmonics Ia (Harmonics Value)
8	Harmonics V1 (Harmonics Value)	FLKR sensation Vln
9	Harmonics V2 (Harmonics Value)	Ch 1 * 0.
10	Harmonics V3 (Harmonics Value)	
11	Harmonics I1 (Harmonics Value)	
12	Harmonics I2 (Harmonics Value)	
13	Harmonics I3 (Harmonics Value)	
14	Internal Temperature	
15	On Charge	
16	Battery Volts	