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Outram

Ranger Power Master 1000 Mk2 (PM1000 Mk2) with Bluetooth Operation Manual

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Ranger

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 PMScreen on your computer or on your portable device (if your analyser is Bluetooth enabled) 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 analyser 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. 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 PM1000 and let us know how you get on.

With best wishes from all at Outram Research.

Graphic Symbols used on the PM1000 and in this manual are in accordance with table 1 of the Safety Standard that appears in Appendix D.

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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 PM1000 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 this product 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 analyser to the power source. To ensure your safety and avoid any damage to the PM1000 please take careful note.

⚠️ Because you will be attaching the PM1000 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.

⚠️ **LETHAL VOLTAGES MAY BE PRESENT if any conductors are exposed. IF IN DOUBT, SEEK ADVICE**.

Current Measurement Leads

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

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

⚠️ Always make sure that your analyser 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.

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Chapter 1: Brief Introduction to the PM1000 Mk2

A PM1000 with its hard, protective case

Ranger

Brief Introduction

The PM1000 is extremely simple to operate. It is possible that some units may be used throughout their lives to deliver all the data required without any user adjustments or configuration changes.

Recordings are made automatically by default. The current default configuration is 1ø Full PQ 7day, see Appendix C for precise details of the parameters recorded over the 7 day period. If you are recording at a new site for the best part of a week, and if these parameters are what you want to see, don't change anything! You may of course change the parameters to be recorded on your next recording, if later desired.

Our Pronto for Windows analysis software provides you with the essential means of data download, presentation and archiving. You will find the Pronto for Windows software on the Customer CD provided with your kit.

Pronto may also be used to configure the PM1000, and for those who want direct access to the instrument and to see it working in real time, we give you a Virtual Screen Interface program called "PMScreen". This program, which opens with a button from within the Pronto program, may be used to alter any of the PM1000 settings. Please see chapter 3 for more details.
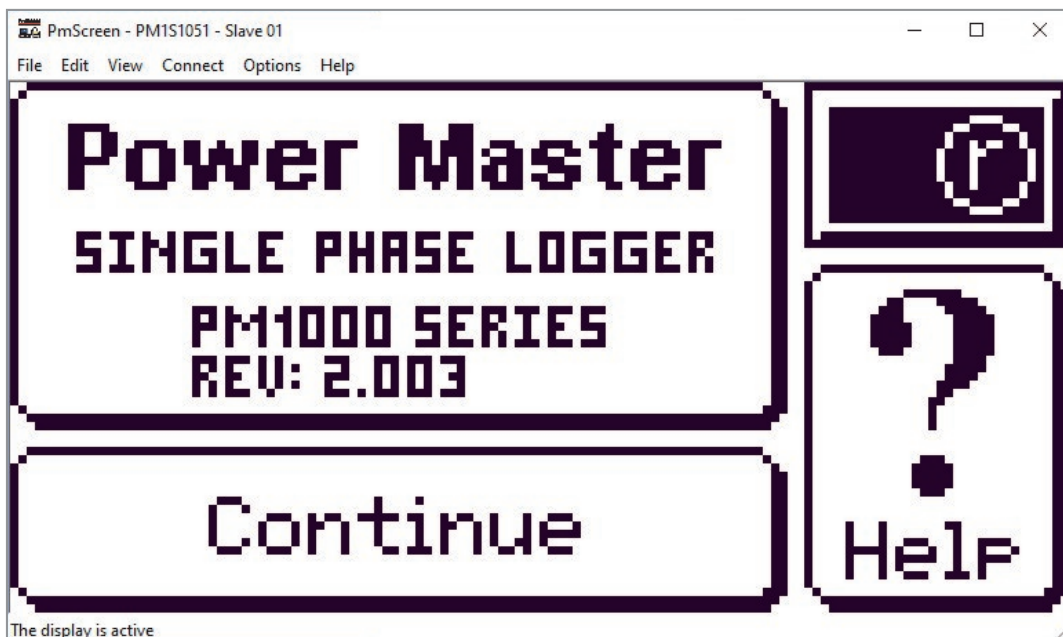
The physical interface between this PM1000 and a PC is via the USB-C to USB-A serial cable. It is also possible to connect over Bluetooth to a portable Bluetooth device such as an Android tablet or mobile phone. Do ask your distributor or Outram Research Ltd directly if you would be interested in purchasing one of these devices with both of our Apps; PMScreen and PMGateway pre-loaded.

Background

For users who know other Adaptive Store or Ranger Power Master products, this system will be very familiar. The Pronto interface, the Adaptive Store process, parameter selection and other set-up functions are the same (though restricted to the specific single phase application for which the PM1000 was designed) and even the virtual screens of the PM1000 are almost identical to those of the PM3000. The PM1000 is in fact based on the PM3000.

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Chapter 2: Quick details for users familiar with the PM3000

PM1000 PMScreen

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Ranger

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General Details

The Baud Rate for the USB-C to USB-A link is 115200Bd. When communicating between your PC and your PM1000, if using the Pronto Software, it is already set up for this. However, just for the first time using PMPortMonitor, our logger/PC connection utility, you will need to input this Baud Rate before it can initialise communications.

Recordings start 1 minute after power is applied to the voltage inputs.

If power is removed in the middle of a recording, recording will cease after 10 minutes, and resume when power is reapplied, provided the original recording time has not expired while the power was off. Note that if you move the unit from one site to another during a recording, recording will restart immediately when power is applied at the new site,

since the unit has no way of knowing that it is not still installed at the original site.

After the original recording time has elapsed, or the unit has been removed from site and is re-awoken to run from battery, recording will have stopped, and the data should be read by Pronto. Once data has been read, even if the memory is not erased, a flag is set in the unit to tell it that this data can be overwritten if necessary. The unit will then restart automatically when line power is reapplied. Thus recording and maintenance can be entirely automatic.

Note you may access the unit and down-load data without line power attached, however the unit will do its best to turn itself off if it is not being interrogated by the PC. (The PC can wake it up again, but there may be a few seconds delay in response. See below)

The PMScreen User Interface

PMScreen is a program which may stand alone or be run within Pronto. It is installed with Pronto Rev 5.33 or later with, in the latest versions, a "Connect with PMScreen..." button appearing on the Functions Panel to the right of your screen.

Pressing this button starts the application, which (if the USB cable is plugged in or the unit is connected over Bluetooth) should produce this screen on the analyser (see below left).
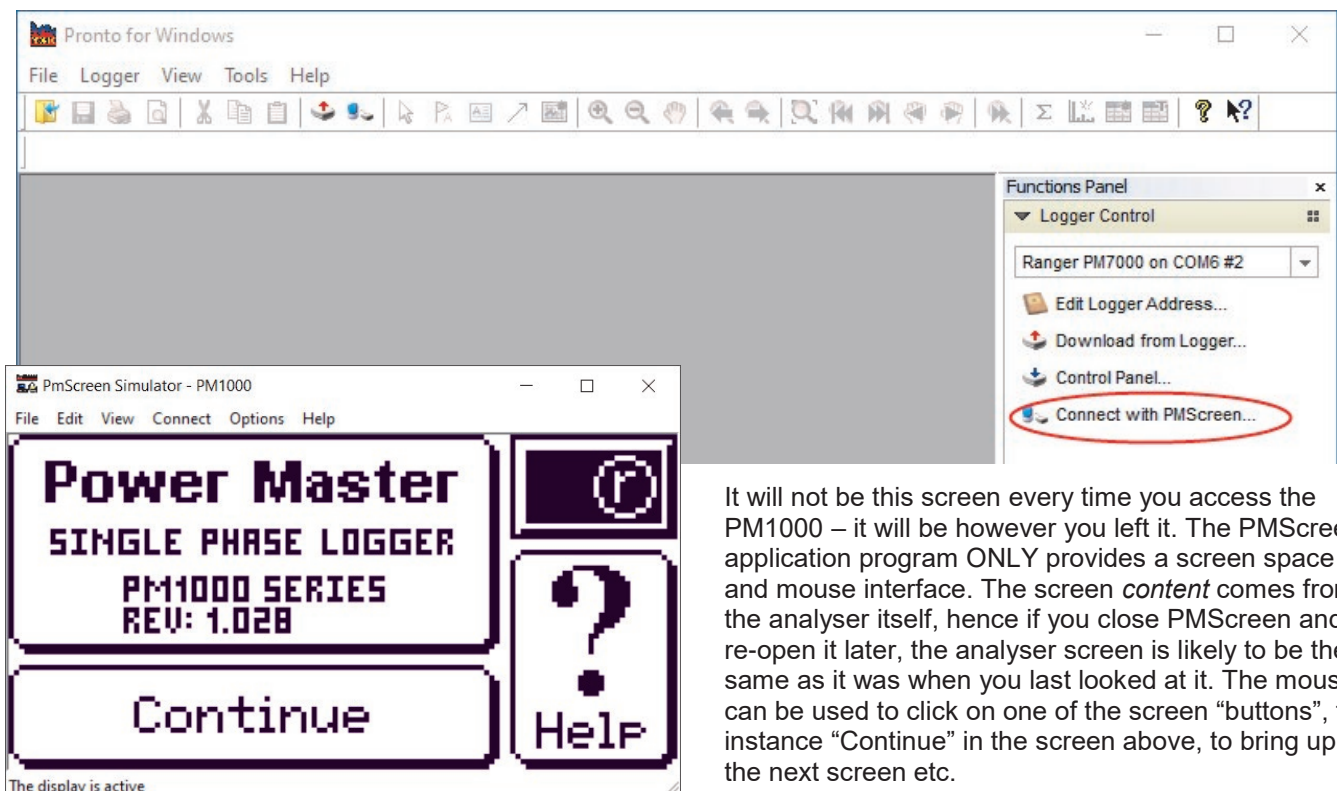
It will not be this screen every time you access the PM1000 – it will be however you left it. The PMScreen application program ONLY provides a screen space and mouse interface. The screen *content* comes from the analyser itself, hence if you close PMScreen and re-open it later, the analyser screen is likely to be the same as it was when you last looked at it. The mouse can be used to click on one of the screen "buttons", for instance "Continue" in the screen above, to bring up the next screen etc.

Power Drain On The PM1000

PMScreen has the ability to wake up a PM1000 (or a PM2000, PM3000 or PM7000) from a dormant condition, as has Pronto. Pronto however only talks to the instrument when the operator requests some kind of service, so if the operator downloads an analyser then examines the graph at length, the analyser itself may go to sleep if it is not powered even though Pronto remains open.

PMScreen is different. All the time you are using PMScreen, it interrogates the PM1000 to find out if its internal screen has changed, and if so, reads it to reproduce it on the PC screen. Consequently the analyser is never given a chance to go to sleep, and even if it did, PMScreen will deliberately send a wake-up code whenever a minute has elapsed since the last response. PMScreen can therefore drain the battery in the PM1000 (or PM3000 etc.) if it is not powered externally. So unless you anticipate only a short session without power (say a download over Bluetooth or a quick configuration amendment), it is best to use the line power or the USB lead when communicating with the PM1000.

User Interface Behaviour – Principal Differences From The PM3000

As mentioned above, the PM1000 interface and functionality are identical to those of the PM3000 except where the different applications demand differences. Specifically the areas of difference are:

- Serial Interface is via the USB-C to USB-A link instead of USB-B to USB-A.
- There is no display, though internal screens are prepared just as they are for the PM3000. These screens must be expressed on a PC or Bluetooth device using PMScreen rather than a built-in display.
- Without a Liquid Crystal Display, status information is made available through an LED interface visible on the PM1000 through its clear polycarbonate window.

In software, differences are:

- Automatic Start of Recording. This is the main difference. The automatic start process and the relatively well-known application of residential monitoring mean operation can be entirely automated if so desired.
- Hook-up – i.e. the name given to the particular arrangement by which you introduce your signals to be measured by the analyser. The PM1000 is for a prescribed Single Phase hook-up. Input signals are restricted in range so the Hook-up is fixed. There are choices for current sensors which may be Rogowski coil type (same type as on the PM3000) or VOLTAGE output current sensors.
- Choice of Maths functions – these are appropriate to the Single-Phase hook-up, so you will not find Two-Phase or Three-Phase options present.

See Chapter 5 for details on Automatic Recording and LED Behaviour. Please also see the Chapters 6 to 10 for an extensive discussion on the user interface.

Chapter 3: Introduction to the PM1000
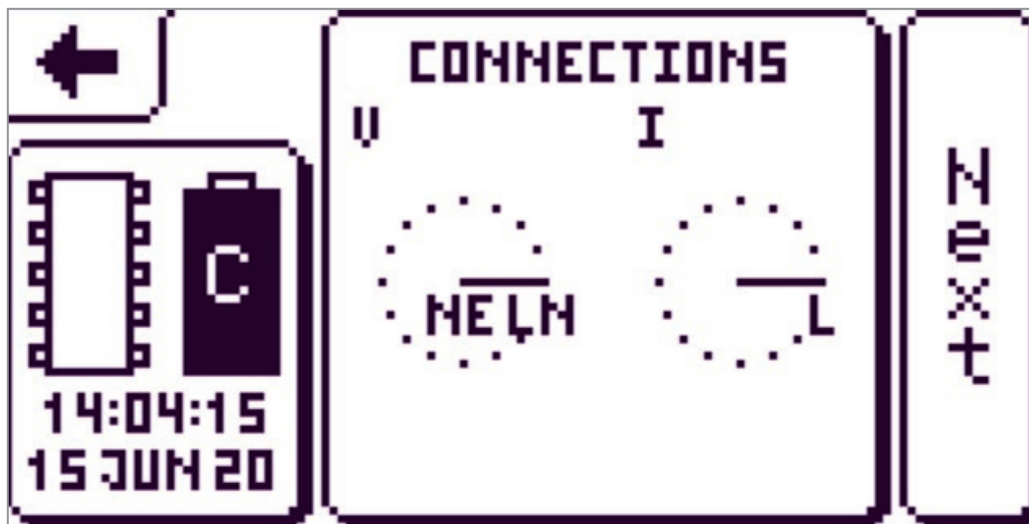
PM1000 PMScreen

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What is a PM1000?

The PM1000 is a state of the art data logging instrument for measuring, displaying and storing AC power parameters for single phase systems. It measures voltage using a mains lead and current, indirectly as voltage, with a Rogowski Coil that plugs directly into the analyser.

PMScreen

Communication with your PM1000 is through the virtual screen interface PMScreen. It provides a transparent way for the PM1000 to present its "screen" to the user via a PC, or portable device if using Bluetooth, as though it was a touch screen on a physical instrument. The PC Mouse acts as the user's finger or stylus, and a mouse click simulates touching the screen.

Pronto application software

Downloading of accumulated historic information to your computer takes place via a USB lead. 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 PM1000 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 PM1000 must not be used for such applications.**

Voltage and current input signals

The Live, Neutral and Earth voltage channels are fed into three 4mm connectors on your PM1000 and the single current channel is via a BNC connection.

⚠ **The RATED maximum WORKING VOLTAGE for the voltage terminals is 270 + 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 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 analyser through the sensors does not go directly to the recording channels. The analyser takes from this data what it needs to satisfy the parameters you ask it to record, makes its calculations and allocates the results, i.e. your parameters, to each of the channels as appropriate. [Chapter 8 includes a discussion on the distinction between signals and channels.] Even if your parameter is a simple voltage measurement the analyser 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 PM1000 calculates a true RMS result independently every cycle.

Recording Modes

The PM1000 has two different ways of storing your data to make best use of available memory. These are Single Cycle Adaptive Store™ and Point Store and which one you choose will depend on your application.

Single Cycle Adaptive Store™

Adaptive Store is an Outram Research patented

process. It is unique among Outram (Ranger) analysers and enables you to use the memory in the analyser in the most effective way.

When the analyser 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 analyser 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 analyser no longer needs to store every record it takes. By being aware of the length of time you wish to record for, the analyser makes maximum use of its memory.

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

Point Store

Point store is the conventional way of collecting your information. The analyser 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 analyser 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 analyser in Adaptive Store mode and the other with a analyser in Point Store. Take note of the comparative resulting information produced for you by the two storage modes.

Please see Chapter 8 on 'setting up your analyser' for further details of the recording modes.

Your PM1000 has either 8MB, 16MB or 32MB of internal memory. Retrospective upgrades are available.

Configuration

Physical communication with your analyser is via PMScreen. Operating it is very straight forward as the graphics invite you to make your choices, in a logical, friendly way. Also, at all times, by clicking 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 PM1000 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 and Current Transformer ratios, engineering units, alarm levels, maths functions and password. The password option allows you to protect your analyser against unauthorised access.

Applications

Here are examples of some common measurement applications:

- Residential voltage monitoring.
- Residential Flicker monitoring
- Residential load (current) monitoring
- Stray voltage monitoring or the neutral to earth voltage. This can be quite important.
- Long Term Monitoring

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 PM1000 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, your long term configurations and your recorded data 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 analyser to the factory.

Data is also stored in Flash Memory so even if the batteries on your PM1000 run flat, you will not lose your recorded data.

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 analyser may need renewing. Your service department will be best qualified to take charge of replacing these.

Communications

The USC-C to USB-A serial lead links the analyser to a PC.

The USB lead should be plugged into the USB port on your PC (earlier PM1000 models will have been supplied with an Infra-Red to USB or RS232 serial cable). This USB lead will also power your unit whilst you are interrogating it.

Bluetooth will work up to 10 metres including through cabinet doors.
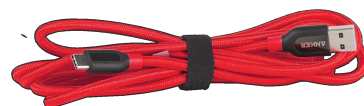
Example USB-C to USB-A Serial lead

(This lead may look slightly different from the one supplied with your kit)

PM1000 Mk2 Technical Specification

Input Voltage: 2 channels, 0-270 Vac, Live to Neutral and Neutral to Earth.

Input Current: 1 channel, ranges 0-1000 A RMS and 0-50 A RMS. Sensing using a flexible Rogowski Coil. Also works with standard, low current CT's.

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.

Resolution: Programmable to 0.1 Vac and 0.1 Aac or 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, Phase Angle, Frequency, Instantaneous Flicker Sensation, Short Term & Long Term Perceptibility, Flicker Flag.
Harmonics: Total Harmonic Value, % Total Harmonic Distortion.
Other Maths Option: Channel X * Constant, Channel X / Channel Y, Filtered Channel X, Internal Temperature, On Charge, Battery Volts.

Sampling: Continuous sampling at 64 samples per cycle.

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

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

Memory: 3 options available: 8MB, 16MB & 32MB RAM.

Data Retention: Recorded data stored in Flash Memory.

Power: Runs and charges via an input to 'Voltage Input Channel 1' of 100-270 Vac.

Battery: 4 AAA NiMH batteries & 1 Lithium button cell.

Battery ride through: 10 minutes at a time. Operation from fully charged battery with no ac mains power present > 5 hrs at 25ºC.

Safety & Standards: IEC 61010 (300V Cat III, Pollution level 2), CE, IEC 61326 (EMC), IEC 61000-4-15.

Internal fusing: PSU, Battery stack, fused voltage leads.

Communications:
User Interface: 3 status LEDs (Power on, Voltage in spec, Recording /Memory).
Serial Port: Serial USB-C port, (up to 115.2K baud); isolation >2.5 kV
Bluetooth (optional)*:* Wireless interface (isolated) reception up to 10m.
PMGateway App.: Enables Android mobile phone to act as a Gateway. Send data files to your inbox, start and stop recordings.
Protocol: MODBUS ASCII.
Computer Requirements for Pronto Software: Windows 2000, XP, Vista, 7, 8, 10; 250MB hard drive space.

Case: Multipurpose handheld enclosure with 4 soft grip corners.

Dimensions: 207 mm x 120 mm x 36 mm.

Weight: 800 gm.

Operating Temp: -10ºC (14ºF) to 60ºC (140ºF).

Ranger PM1000F Kit

- PM1000 Power Quality Analyser with Flicker
- USB-C to USB-A Download Cable and Bluetooth communication
- 24" 1000 Amp Flexible Rogowski Coil (max conductor size 8") Optional
- Mains Lead
- Customised Carrying Bag
- A Configuration Guide for the PM1000
- Pronto for Windows Analysis Software
- Customer CD with Operation Manual

Chapter 4: A Start Guide for the Ranger PM1000 with Bluetooth

PM1000 Kit

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PM1000 Start Guide

First Step: Check Your Kit

PM1000 with Bluetooth and kit

- *Ranger* **PM1000 power quality analyser with rugged case**
- One 24" 6000 Amp Flexible Current Clamp (Rogowski coil) (max conductor size 8")
- Mains lead
- A USB-C to USB-A Serial Cable - lead supplied may vary in colour
- Pronto for Windows Analysis Software
- Customer CD
- Configuration Guide for the PM1000
- Customised bag
- Android Tablet or Mobile Phone for Bluetooth communication (optional)

Second Step: Put Your PM1000 on Charge

Once you have taken delivery of your PM1000 we recommend you put it on charge. You can either plug it into the mains using the mains lead, or using the USB lead into any USB socket, just as you would a mobile phone, to charge the batteries ready for use. The USB socket is located on the end of your unit, behind the USB access panel, which should be slid back into place whenever the USB port is not in use.

Whenever your analyser is plugged in, either recording or not, the batteries will be charging automatically. We recommend that when not recording, the analyser is still plugged into a power source to keep the batteries

well charged and the unit always ready for action. This is good practice. However, the PM1000 can start up with batteries pretty flat and function once power is applied.

Once you have established your user interface via portable device or PC (after step 4 or 5) you will be able to check the current battery voltage by clicking the status button (see below).

If your unit does not have Bluetooth please go straight to the 'Fifth Step' of the Quick Start Guide.

Current battery voltage
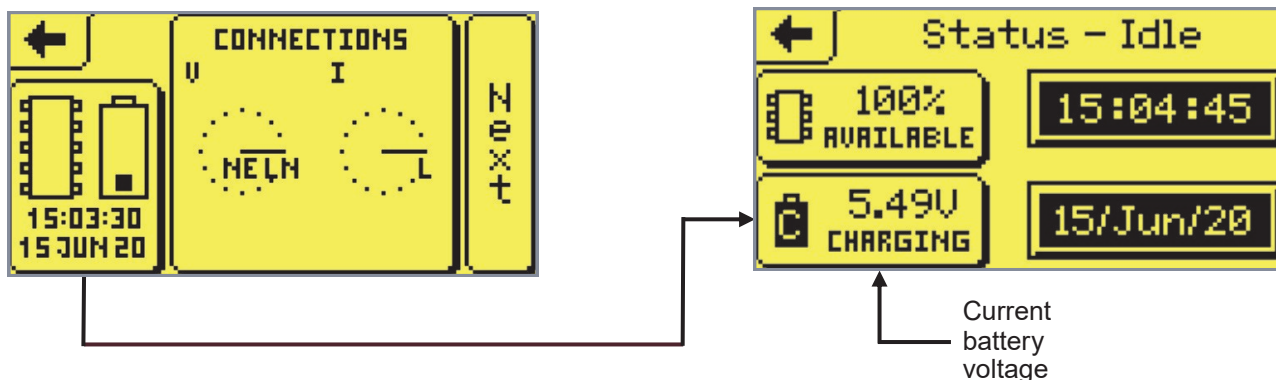
Third Step: Put Your Portable Device on Charge (If You Have One)

Take out your Android tablet or mobile phone provided with your unit and its relevant charging cable. Plug into your electricity supply to charge it up. Your device can be used whilst on charge, however if you use it off the cable we recommend you leave it on charge when not in use.

We also recommend a car charger to charge your portable device as a useful addition to your kit if you will be using the analyser at different geographical locations.

Fourth Step: Make the Communication between the Portable Device and the PM1000

Once the portable device is charged, make your connection with the analyser.

Prepare the PM1000

Plugging in the PM1000 will wake up the Bluetooth

communication. The Bluetooth LED on the front of the unit, on the bottom left hand corner, should flash twice every 4 seconds to show that the Bluetooth is awake. The Bluetooth will remain in this "Discovery Mode" for about 10 minutes after the unit has been plugged in.

PM1000 Power Quality Analyser Operating Notes

PM1000 Start Guide

Prepare the Bluetooth connection

The next step is to open "PMScreen", the application program that brings the live PM1000 screens onto your computer or portable device. If you have received your portable device from your distributor, PMScreen will have been preloaded into the principle functions of the device. Once you have turned it on, click on "START" and search for it, if the icon below is not immediately obvious.

Open "PMScreen".

The nominal range for Bluetooth communication is 10 meters (30 feet). It may be more in open line of site conditions or less if obstructions lie between the devices. If the portable device and analyser are within range of each other, and if the analyser is in discovery mode (the blue light to the bottom left on the front panel is flashing), the portable device should offer a list of any Bluetooth devices in range. The reference to the analyser will come in the form of PM1000SN**xxxx**. The Serial Number (SN) of your analyser can be found on the back of the unit.

Click on the Serial Number of the analyser you wish to talk to. The first time you connect you may be asked to input a passcode. This is 1234. Once you have entered it, click 'Done'. This will cause the portable device to connect to the analyser and the Bluetooth light on the analyser will go solid blue. Initially PMScreen may say the analyser is not responding (actually the analyser is waking up but can't talk properly yet). Then it may say "Busy - checking for Logger..." and then "Connecting…" and then "Found SN**xxxx**".

PMScreen will show one of the following:
- its initial screen (see below), if you have started a new session or
- the screen that was active when you disconnected from the previous session.

At this point you are now in contact with the analyser.

This is a typical PM1000 initial screen as seen on the portable device.

Now with your device in your hand you can play around and explore all the options that are available to you within your PM1000.

Note

Before you go any further, you may wish to explore the PM1000 menu interface in some detail without involving the analyser. You can do this via the PMScreen Simulator. See later in this Start Guide in the section "Sixth Step".

Starting to Record Data

At this point you can either load Pronto for Windows, our software, into your PC ("Fifth Step") or go straight to recording using your PM1000 ("Seventh Step") and come back to loading Pronto to the PC later.

PM1000 Power Quality Analyser Operating Notes

Fifth Step: Make the Communication Between the Computer and the PM1000

You can produce the same screens on your PC as you can on the portable device. To bring 'PMScreen' up on the computer, first insert the customer CD and follow the instructions to download the Software Pronto for Windows. Your Software Product Key can normally be found on the CD cover.

As part of this download, you will also install various necessary utilities used to improve your experience with your analyser. PMScreen, the PM1000 user interface we have already discussed, is one and PMPortMonitor is another. PMPortMonitor is a utility used for automatically recognising your logger (and any other Outram / *Ranger* Instrument) when it is plugged into your PC making connection with your PM1000 straightforward.

Connect to your PC by plugging in the USB lead to your PM1000. The USB-C socket is found by sliding back the USB access panel on the end of your unit. This panel is to provide a weatherproof barrier when the USB cable is not in use. Connect your logger to the USB port on your PC.

Using PMPortMonitor

PMPortMonitor should automatically appear. If you cannot see it, check behind other programs if you have them open. Otherwise PMPortMonitor.exe can be found and launched from the recently downloaded Pronto4w directory (recommended to be saved onto your C: drive).


As you can see, the utility has automatically found the FTDI USB serial port on COM 4. This COM number will depend on where on your PC you have plugged

the USB cable into. If you connect the unit over Bluetooth by 'adding a Bluetooth device' to your PC (if it is Bluetooth enabled), a different communication port will be found. When searching for your unit in the list of Bluetooth devices available, the name of the unit will be in the format PM1000snXXXX. Pair with the device by giving the code 1234 and go back to PMPortMonitor.

Now you may have 3 designated COM ports. The computer has recognised the Bluetooth connection as both incoming and outgoing. You are only interested in the outgoing connection (which includes the serial number of your unit). You can ignore the other.

N.b. We would, in normal practice, not recommend making the connection via both the Bluetooth and the USB at the same time, as it might slow your communication down.

The other downloaded Applications available to you are listed on PMPortMonitor.

PMFiles allows you to manage the configuration files and recorded data within your logger:

PMMeter allows you to view all the live measurement data at the same time on your PC, without necessarily carrying out a recording. This example is a unit measuring 10 out of 16 channels with no external sensors connected, just the USB lead.

PMMeter is also available through the PMScreen App which can be used on most Android Tablets or Mobile phones.

Selecting the Baud Rate

The one thing you must do, before trying to make your connection this first time, is to select the correct Baud Rate (the speed at which traffic flows between the analyser and the computer). . For the PM1000 this is 115200 Baud (4th on the list on the right hand side).
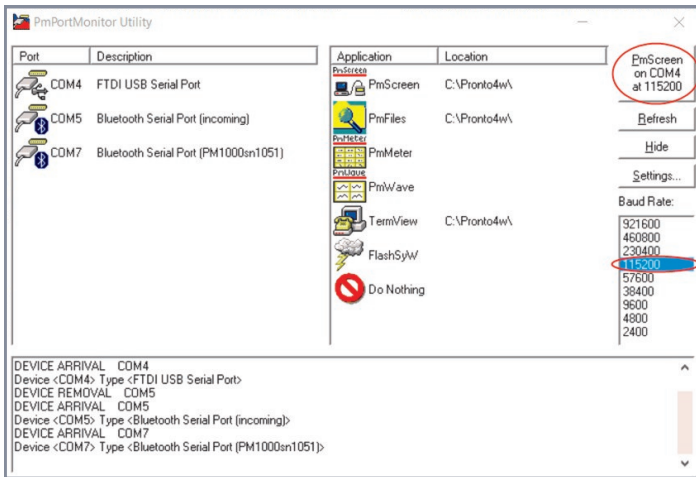

Then select which utility you want to use, in this case PMScreen and the COM port you want to communicate via. In this case we choose the wired USB port which will be faster than Bluetooth. Then click on the button on the top right to launch PMScreen on your PC.

If you happen to choose a different port on your PC next time you come to use it, a different port will be listed by PMPortMonitor, however the correct Baud rate for this unit will have been remembered so there is no need to select it again.

The other option you have for making a connection to a new analyser is through the Pronto Software itself. If you would like to choose this method, launch Pronto. For now close the Tutorial page that appears and follow the "Start Up Assistant" to connect to your PM1000. The first time you make a new connection there are four steps.

Startup Assistant

In Step 1 the default selection is "Control and/or Playback data from a analyser". You do not yet have any data and files to browse for.
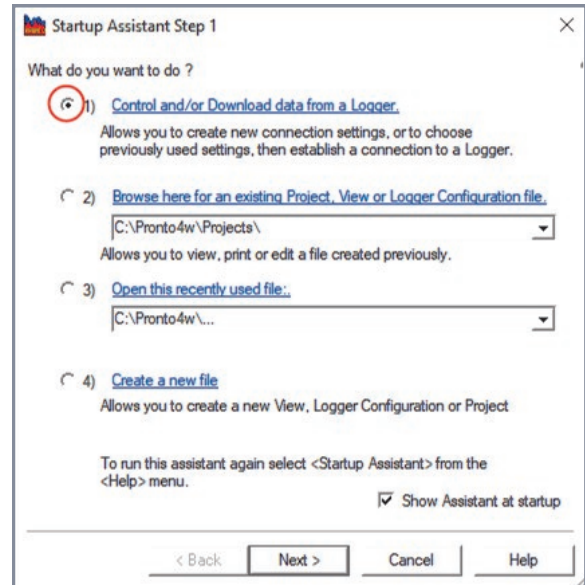
Click on 'Next'.

In the following Step 2 for this first connection select 'Create new connection settings'.
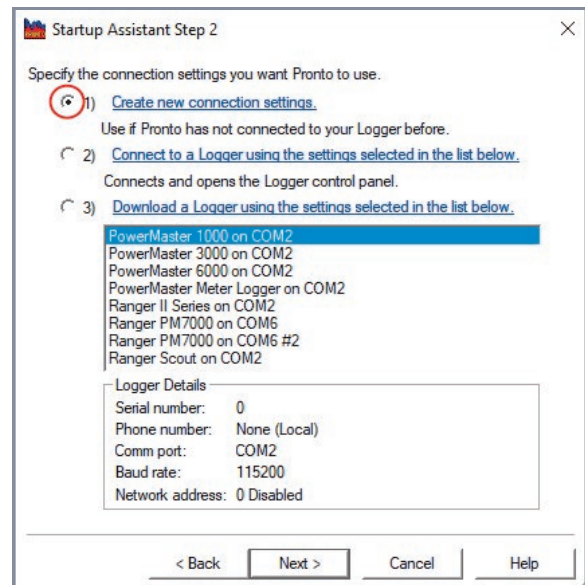
Click on 'Next' to bring up Startup Assistant Step 3. This will give you the list of Ranger products supported by Pronto.

The PM1000 Mk2 is bottom right on the list. Scroll down and click on it, then click on 'Next'.
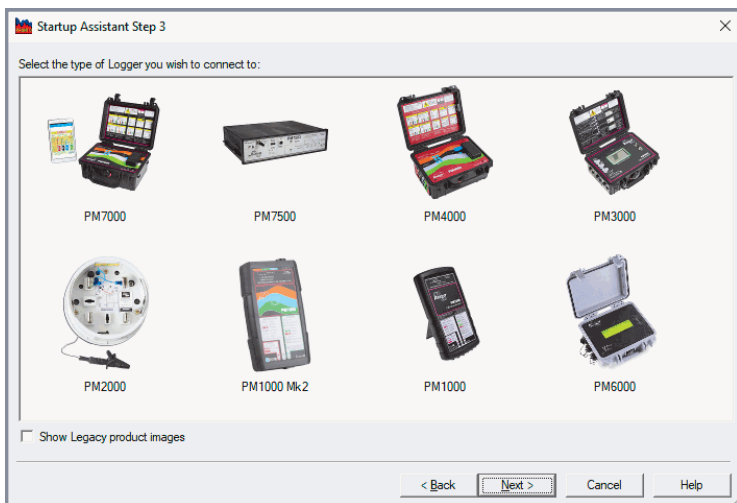
Once selected, click 'Next' to bring up the final 'Startup Assistant Step 4' screen. If the FTDI USB Serial Port has not already been found we can now search for it.
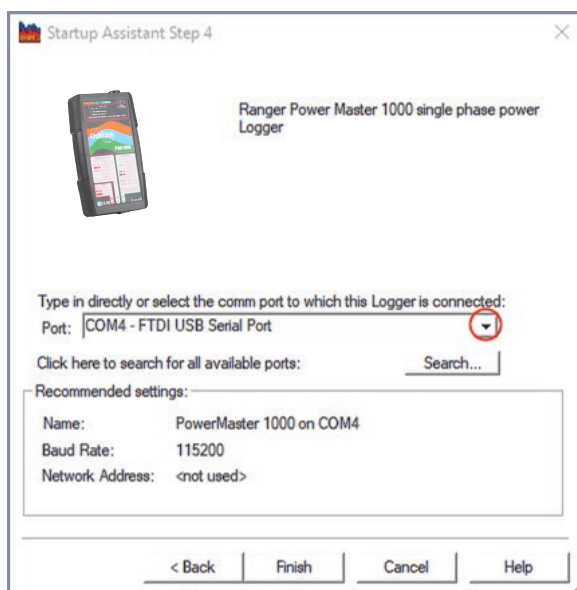
Click on the Port box. A dropdown menu will reveal the other COM port options. Select the one you need, or 'search' for the relevant one, in this case COM 4.

Each time you connect your USB lead to the same port on your computer the port number will be the same i.e. 4.

Remember that the Baud rate for the PM1000 it is 115200 and Pronto will choose this value for you when you select PM1000. (Different Ranger models may have different baud rates). Click 'Finish'.

The following 'Select Instrument for Playback' window may come up confirming the right instrument is connected to the right port.
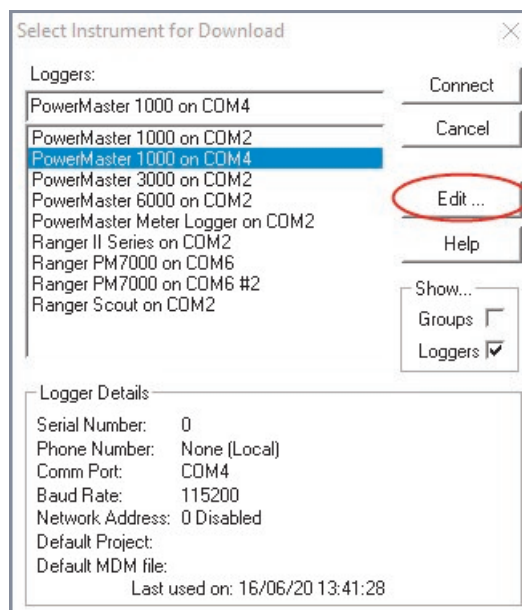
Here is the opportunity to change the name, add comments or alter the baud rate if you ever need to do so.

Click on 'Edit' and bring up an 'Edit an Existing Logger Address' screen.
Clicking on 'recommended rates…' will bring up Pronto Help and advice on the correct baud rate. In this instance, the correct baud rate for the PM1000 is automatically chosen by Pronto.
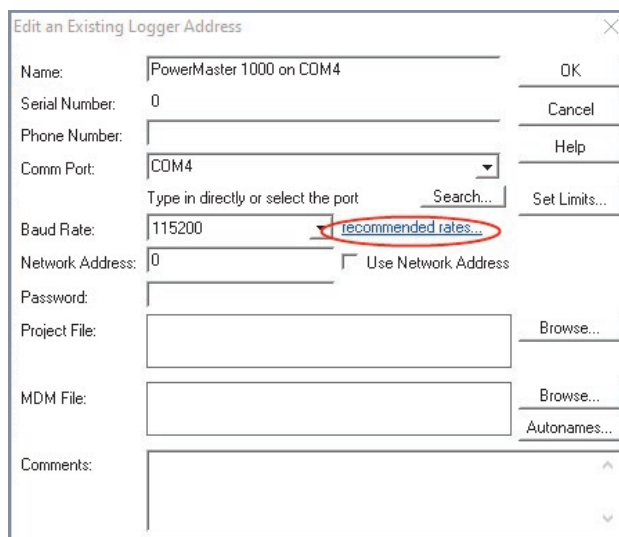
Click OK to return to the 'Select Instrument for Playback' window.

Finally click on 'Connect'….

...and you'll see on the screen 'Pronto is connecting to the instrument'.
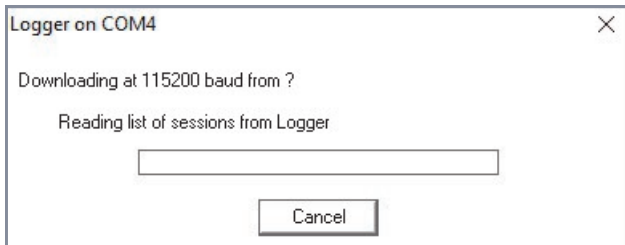
Then once connected, if there are not recorded sessions present in the logger you will be asked if you want to start the Logger recording now?
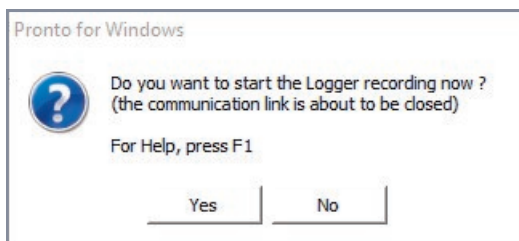
Since we just want to connect with PMScreen, click 'No'. You will be given a warning that there are no recording sessions are in the Logger. Click 'Ok' and up comes the main Pronto screen.
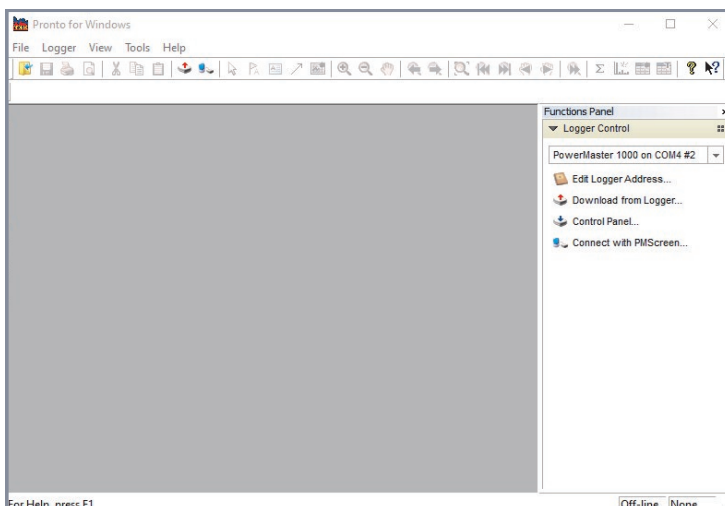
To bring up your PM1000 display click on 'Connect with PMScreen...' on the Functions Panel on the right hand side..

This is how you talk to and configure your analyser via the computer. The screen to come up will be whichever you used the last time you talked to your PM1000. For the first time you will see the initial screen of your PM1000 on the computer in front of you. This is the default screen with 'Power Master Single Phase Logger' that we saw previously on the portable device.

You can enlarge or contract the PMScreen area by clicking "View", Zoom in" or Zoom out". This screen is intended to give you an immediate indication of system status, and especially the connections you have made (the "Hook up").

Subsequent connection to your computer

Please note that NEXT time you open Pronto it will remember the previous connection information and four steps will become only two steps, by choosing to 'Control and / or Download data from a Logger' then choosing to download a Logger using the settings listed in the box under choice 3) below.
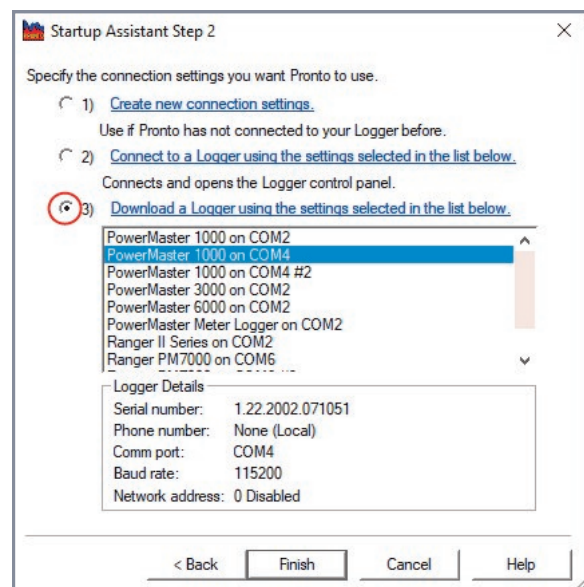
If, however, you use a different port subsequently, Pronto will ask you to go through a similar selection process, and then it will remember that connection also.

In fact, with PMPortMonitor opening automatically when you connect your PM1000 to your PC, you may find that it is easier to use that process rather than the start up assistant.

PM1000 Power Quality Analyser Operating Notes

Sixth Step (Optional): Using the Simulator

Use the simulator for learning about PMScreen

Before you do your first recording (or after) you may wish to play with the PM1000 Simulator. We suggest that as you read through the rest of this manual you have the simulator open on the computer and follow the steps in parallel with the simulator.
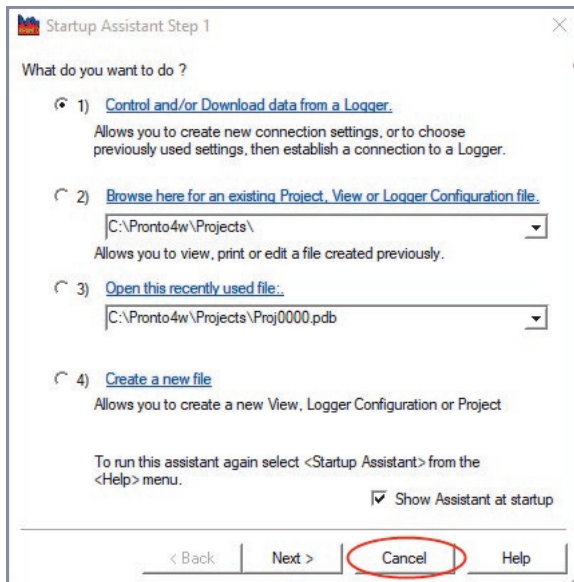
If you wish to have the instructions and the simulator open at the same time 'Resize' the material by clicking on the middle box, top right of the screen…

 becomes
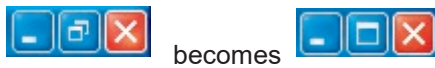
… and make room for both programs on the computer screen.

To bring up the simulator

Insert the customer CD into your computer. Launch 'Pronto.exe'. Cancel the "Start up Assistant" as it isn't needed for this activity.

The main Pronto window will come up.
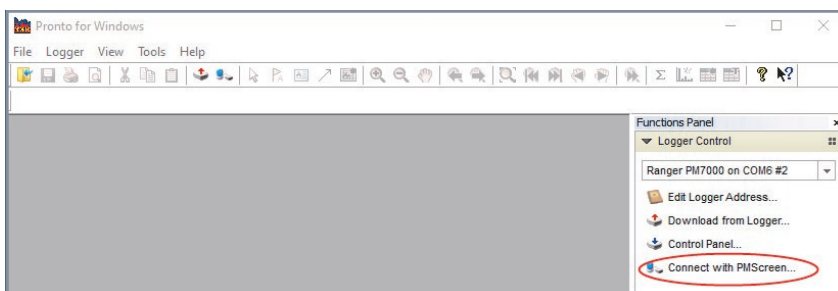
Click on 'PMScreen' on the Functions Panel to the right.

If you have an analyser connected and are communicating with it, clicking on 'PMScreen' will bring up PMScreen on the computer screen. Select the Simulator by clicking on 'connect' on the top tool bar of PMScreen. Follow the path from 'Launch Simulator' to 'PM1000' after which the simulator screen will arrive. See below.

If no analyser is connected, when you open Pronto, after a while of 'Busy - Checking for Logger' the following advice window will come up:
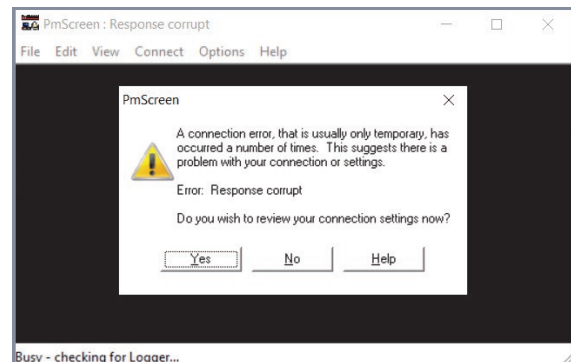
For the simulator we don't require a communication route so click 'No'.
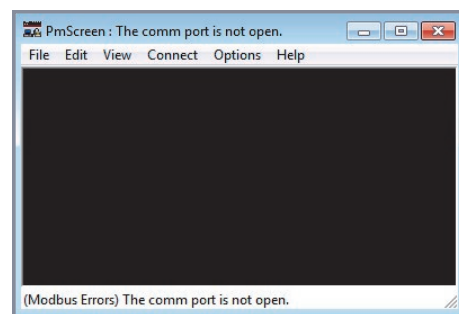
In this example there is no analyser connected and therefore no live PMScreen.

Click on "Connect" on the 'PMScreen' tool bar, then "Launch Simulator" and select "PM1000". The simulator will arrive.

Yet another way into the simulator is to click on PMStart on the customer CD and follow the steps indicated.

Now you have the initial simulator screen in front of you.

The simulator will give you a comprehensive set of artificial readings. Use this facility to investigate the capability of your new PM1000.
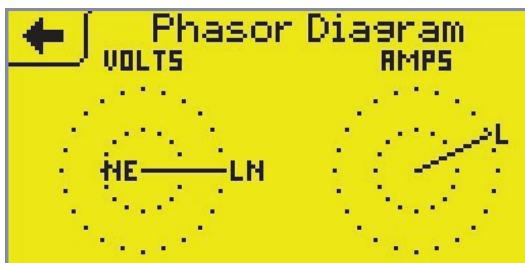

Here is an example screen, the 'Configure' screen, showing the options available to set up.

Further example screens

Explore what is available to you as you use your PM1000.

When you close the simulator the following window will appear. It is asking you to close down the executable program running PMScreen. Click 'yes' and the program will close down.

Button help

If you hold down a button on PMScreen for a few seconds, most of the time you will stimulate the popping up of a help message. This message will explain the function of the button you are pressing. We hope you find it useful.

Seventh Step: Make a First Recording with the PM1000 by Measuring the Live Mains (or Using the Simulator)

Below we go through some basic steps to show you how to start a recording. These will be the same whether you are practicing on the Simulator or doing it for real on the analyser itself.

Simply plug in the PM1000 to the mains. Let us measure this voltage.

In fact, the PM1000 is programmed to start recording automatically after a delay of 1 minute once it has been plugged in. Power must be available consistently for the whole minute, so if the unit is removed and reconnected, e.g. repositioned, the minute delay restarts. The new recording will begin provided that there is no data on the analyser that has still to be downloaded, in which case the new recording does not start.

So if you are confident that the analyser is configured to record the information you require, then you can install the unit, wait one minute, check the status LEDs, and leave.

To check and amend the analyser configurations follow the instructions below.

From the opening screen on PMScreen click on **Continue** to produce the following 'Connections' screen.
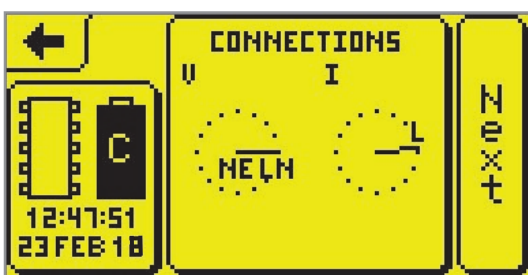
This screen gives you the option of clicking on 'Connections' to look more closely at the single phase hook up, preconfigured into the analyser, or at the battery status as previously mentioned.

If you click on it will bring up the 'Main Menu'.

This Main Menu screen gives you the opportunity to select **Explore** to explore your stored data, **Configure** to configure your different set ups, **START RECORDING** to start a recording, **Display**, to either display historical data or in some cases it may be live, or **Hook Up** to look at that Single Phase hook up again.

As we are interested in doing a simple "start" we shall ignore these buttons for the time being and click on **Configure** to bring up the next screen.

For the moment we want to review our initial set up as configured by the factory. For this example, this is the configuration named F Full PQ Test. Please note that this default configuration name does change, please see the next section for more details).

Click on **CURRENT CONFIG: F FULL PQ TEST** to show

Then on **Review** to get a general understanding of this configuration.

In this case the recording mode is Adaptive Store, FIFO ('First In, First Out' memory management) is off and the recording will last 7 days. It also gives you the LED status. LED status is discussed in a later section, 'Automatic Recording and Status LED behaviour'.

Click on ← to return to the previous page and press **Edit** to look at the configuration in detail and amend if necessary. You can then save your new configuration under a new name for future use.

Default factory configuration

For the purpose of a 'quick' start, all of the recorded parameters of the current default configuration are listed below (June 2020) . The other factory configurations are included in the Appendices of the full PM1000 Manual.

Signal/ Maths Channel	1ø Full PQ 7day
V1	V line - neutral 0-300Vac
I1	I line 0-1000Aac
V2	V neutral - earth 0-300Vac
1	RMS of Signal Vln
2	RMS of Signal Il
3	% THD Traditional of Signal Vln
4	Value all Harmonics of Signal Il
5	Flicker sensation on Vln
6	Flicker flag on Vln
7	Flicker short term Vln 10 mins
8	Flicker long term Vln 2 hours
9	RMS of Signal Vne (High resolution)
10	AC Frequency

If this configuration looks like it will capture all of the detail you require then you can start recording. Press ← to get back to the 'Main Menu' screen.

Now we select **START RECORDING** and bring up the 'Start Recording' screen.

If you want to give this first session a different name

Click on the box **Session 1** on the above screen and bring up the Keyboard.

Use the keyboard to 'clear' the box by pressing **CLR** and type in another name (press **KBD** to get the whole alphabet) and press **OK**.

Now we can start recording. Click on **Start Now** and the analyser will start recording. The screen will revert to the 'Main Menu':

Note the recording button has changed to give you the

option to but the

 button is greyed out so that you cannot inadvertently turn the power off while the analyser is recording.

The PM1000 is now set to record for 1 week. If the recording analyser is interrupted by a power outage, the unit will continue to record for 10 minutes, then stop. Once power is resumed it will automatically restart in the same session for all the time the restart is within that pre-set recording period, in this example 1

week. If the set period is has passed, your logger will not start again unless it is in FIFO mode.

At the end of the set period the recording will stop automatically but it is perfectly OK to stop the recording at any time to see the results, or download, and then 'start recording' again.

Your PM1000 can be configured and a recording started using either the portable device with its Bluetooth communication method or the computer with its Infra-Red communication.

Display

If you wish to view the current recording press

. This will allow you to either view

the or to view the numerical results of the current recording.

# Eighth Step: To Download the PM1000 and Plot Results

To take the data out of the PM1000 requires a computer and the USB lead supplied. The recording will either have stopped because it reached the end of the recording period, because it was stopped manually, or the analyser will still be recording. In the latter case Pronto will invite you to stop the recording prior to the download as part of the download process.

To download we will use the USB communication to the computer.

Connect the analyser to your PC using the USB-C serial lead and open 'Pronto for Windows'.

First of all, tutorials relevant to the latest Pronto release will appear. There are many of these tutorials available on our website to help you to familiarise yourself with our software and to make the most of Pronto for Windows. Once you have seen enough, close this window.

Behind these tutorials the Pronto 'Startup Assistant' has appeared.
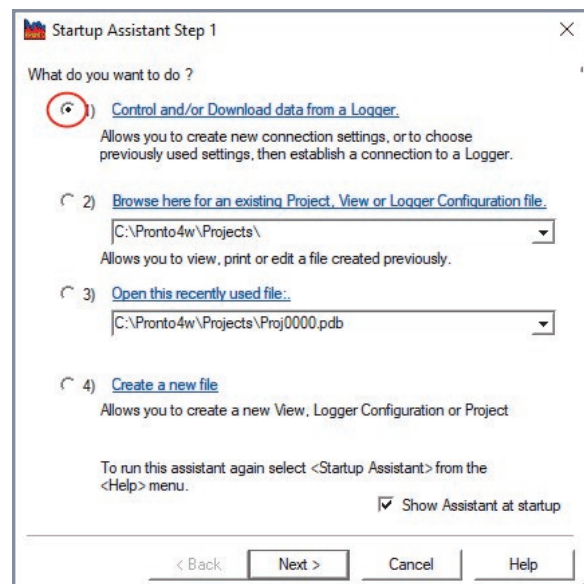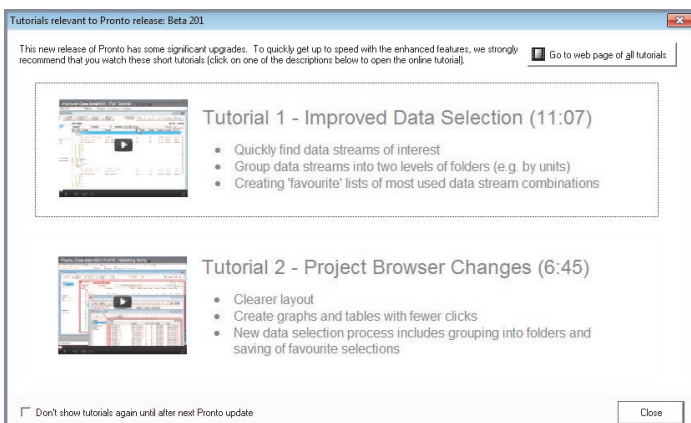
The default is 'Control and/or Download data from a logger' which is what we want so click on 'Next'.

Use the list to select PM1000 if you have connected it to your computer previously. If not, please see the Fifth Step of this Start Guide which will show you how to connect your logger to your PC.
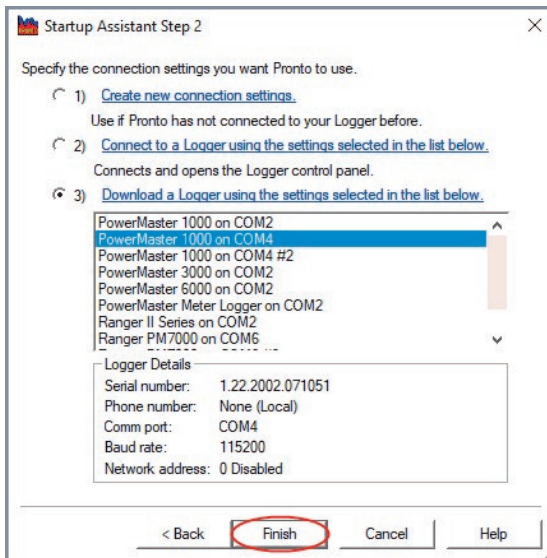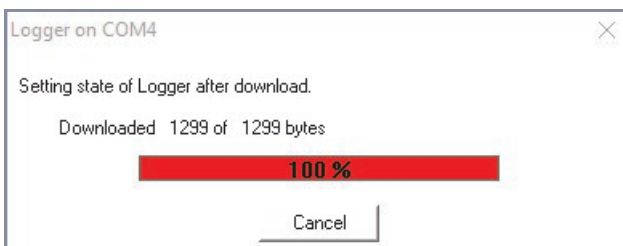

 The next screen may be the 'Select Instrument for Download'. If so, click Connect.
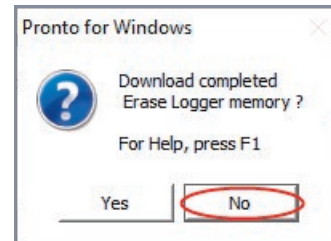
The next screen to come up invites us to stop the recording if we have not already done so.
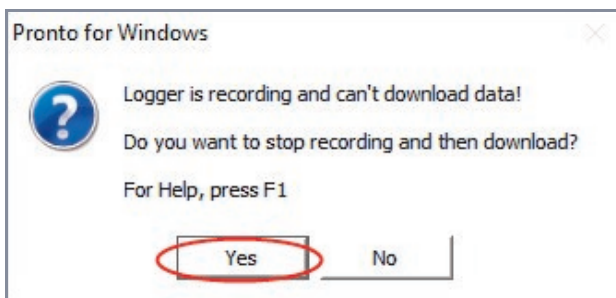
Click on 'yes'. Now you see the playback.

Next you will be invited to 'Erase logger memory?'

Normally we would recommend you to click 'No'.

Then you are asked if you wish to 'Set logger clock to computer time?'
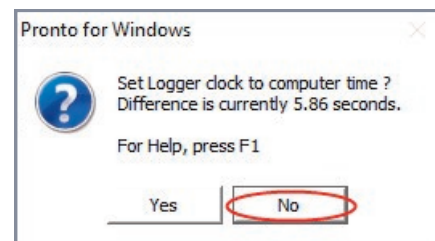
Many computers these days have clocks updated automatically from reference clocks on the internet. If yours is one of these you may wish to click 'yes'. However, the Ranger analysers have good clocks that keep their time better than the average PC. So generally speaking, click on 'No'.
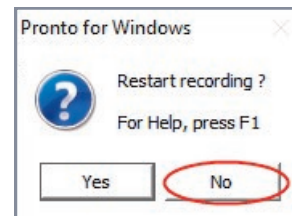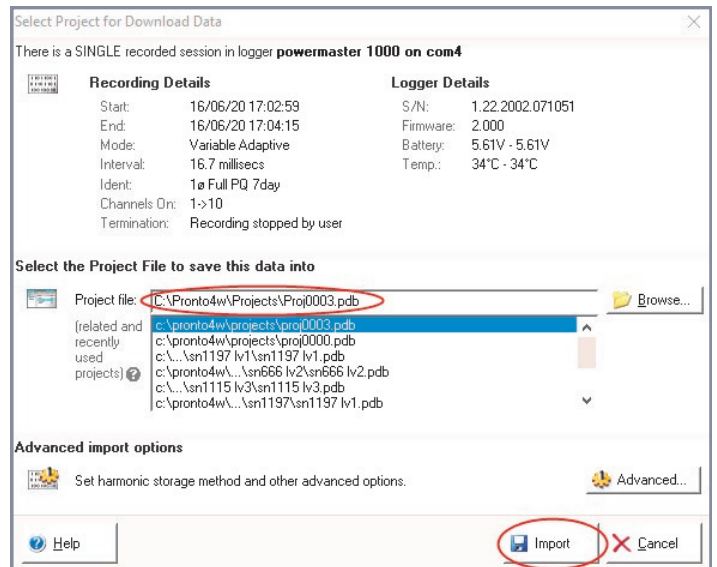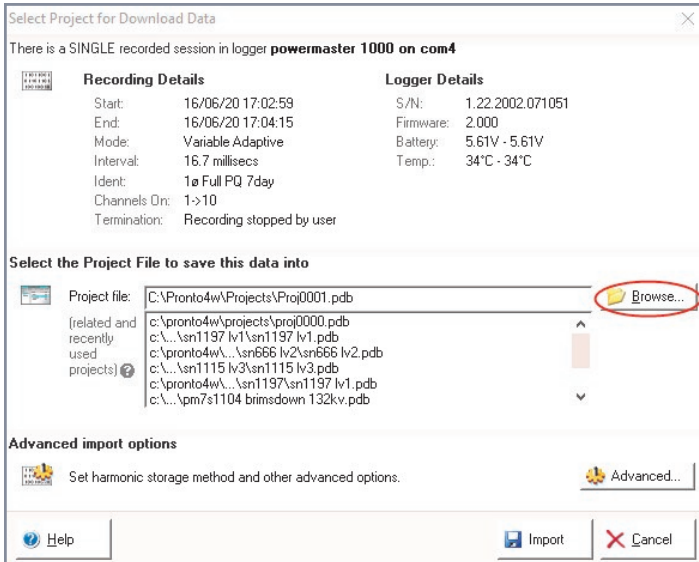

Unless you want a further recording click 'No'.
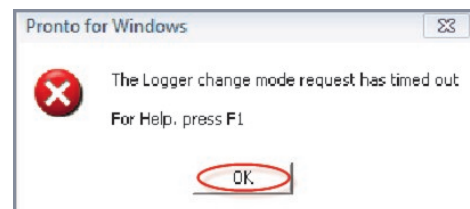
If you have taken a long time or gone off to get a cup of coffee this screen may come up. Click 'OK'.
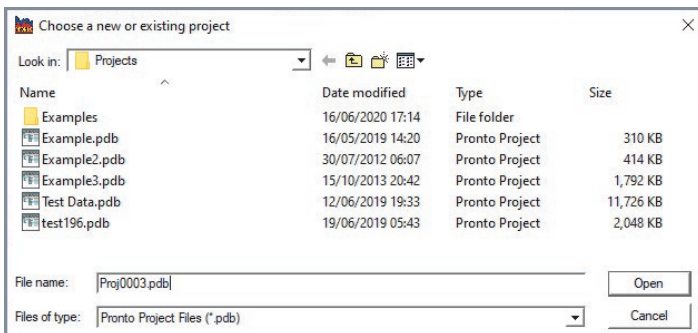
The next screen offers us a place to save our recording. Pronto already has a default folder called 'Projects'. Click on 'Browse' to find an appropriate place to save your new project.

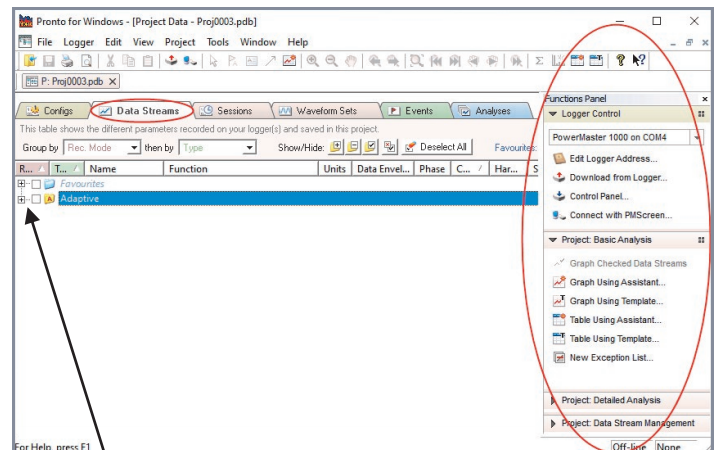The following screen will allow you to create a new folder or search for the one you want.

In this example we select the default folder, 'Projects'. The example here is called 'Proj0003test'. Type it into the box 'File name:' (We can discard it later.) New recordings may go in a new or an existing project.

Note: If you have multiple recordings (we call them sessions) from the same site, one after the other, save them into the same project. This way they can be viewed altogether in Pronto as if they were a single recording.

Your recording will go in the Projects folder. Click 'Open'.

Now we have a name and a location for our data.

This next screen comes up, where we can double check our choices.

When you're happy with your choice, click 'Import'.

NB If you have multiple sessions in your analyser, you will be offered the choice of 'Import all sessions'. This will save all of them to the same project.

Pronto For Windows main browser

Once your data has been imported, Pronto's main browser is opened up for you.

In order to view all the parameters you have measured, in this case in Adaptive Store, you can expand the folders by clicking on the '+' boxes next to the headings. Or you can expand or contract all the folders at once using the buttons in the middle of the tab section (see below). If you hover over each button, an explanation is given to explain what each one does.
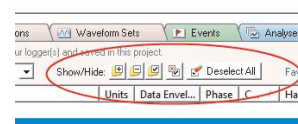
Once you can see your measured parameters you can select which ones you would like to graph.
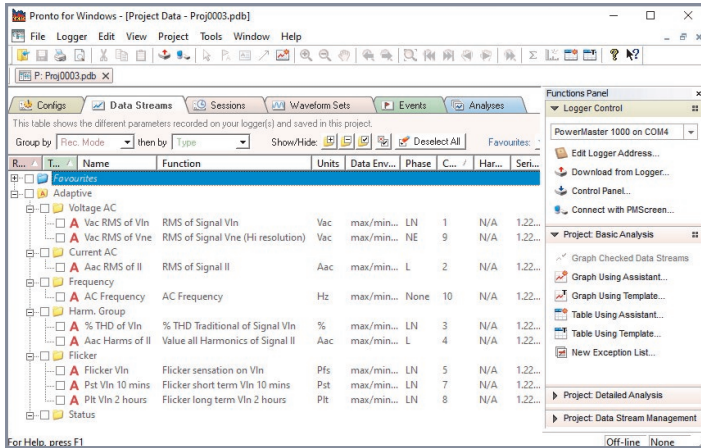
In fact, you have three options. You can either: a) choose to select the parameters here, creating a graph using default settings, b) use the graph assistant or c) create a graph from a pre-loaded template, all options which are available on the context sensitive Functions Panel on the right hand side of the screen. You will note that 'Graph Checked Data Streams' (the quickest way to create a graph) will remain greyed out until the boxes are 'checked' adjacent to one or more of the measurement parameters.

As an example we will use the Graph Assistant.

It has four steps. Click on 'Graph Using Assistant…' In the first step you have the opportunity to select the data streams you want to graph by checking the boxes next to the data stream. Red 'A's stand for the recording mode, which is Adaptive Store, i.e. the more detailed recordings.

The other three steps enable you to format the graphs in different ways, selecting time period etc. You will want to familiarise yourself with the choices at a later stage.

Go straight to 'Finish' for a 'quick' graph. From then on there are tabs on the project browser to help with your graph selections. Each different graph is called a 'view'.
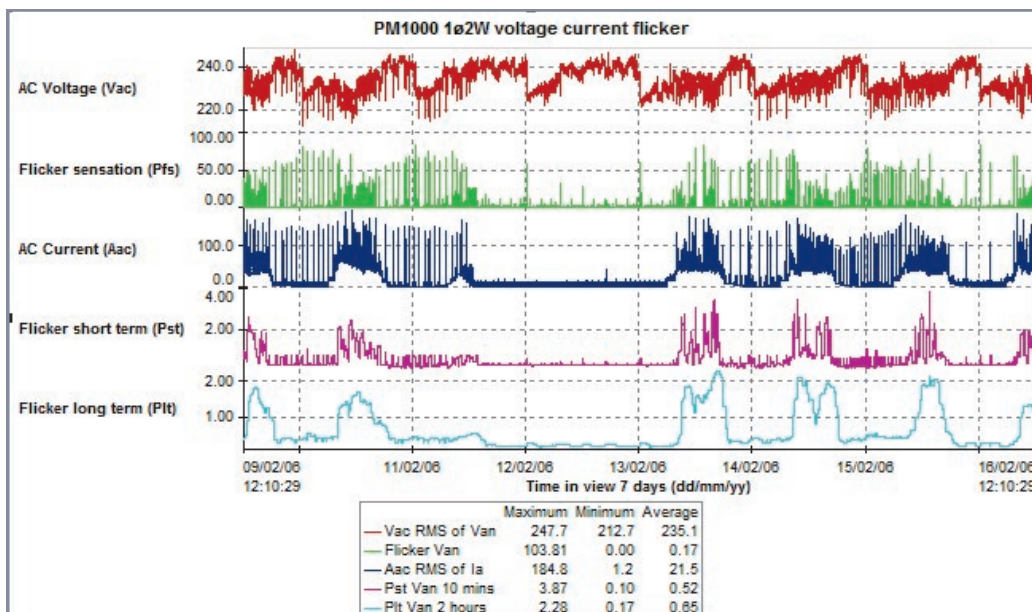
Below is an example of a graph you might produce.

As just mentioned you can play around with the different ways of formatting your graph and adding text. 'How to zoom in' and other facilities are covered in the Pronto video tutorials and help pages.

There is also a help guide available: 14 Things You Didn't Know You Could Do With Pronto For Windows. Please ask your distributor for a copy.

Enjoy your PM1000. For further help see other sections in the PM1000 Manual or the Pronto for Windows Help on your customer CD.

You can also contact your distributor for support or Outram Research Ltd on tel: +44 (0)1243 573050, email: support@outramresearch.co.uk or via our website: www.outramresearch.co.uk.

	Maximum	Minimum	Average
Vac RMS of Van	247.7	212.7	235.1
Flicker Van	103.81	0.00	0.17
Aac RMS of Ia	184.8	1.2	21.5
Pst Van 10 mins	3.87	0.10	0.52
Plt Van 2 hours	2.28	0.17	0.65

Outram

Chapter 5: Connecting up your PM1000 for Measurement

PM1000 Voltage and Current Lead Connections

Ranger

Contents

Introduction

This is very much simpler than for other products since there is only one possible Hook-up, Single Phase!

Simply plug in the mains lead matching the 4mm connectors on the lead to the corresponding colours on the unit and if required, connect up the current sensor.

On the Main Menu screen of PMScreen click on 'Continue' to bring up a connection phasor diagram. This way you can make sure that the current sensor is the right way round.
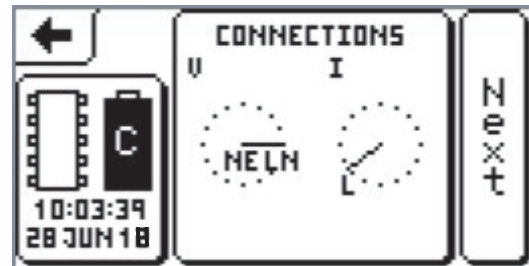
Operation From A PC Using USB Interface Or Bluetooth

The PM1000 Power Quality Analyser is configured, and downloaded from a PC via the USB-C Serial lead or using Bluetooth communication. Separate software drivers are not necessary in the PC, since the operating programs contain the necessary protocol and control functions.

The programs to be used with the PM1000 are:

- Pronto for Windows, Beta 121 or Rev 5.31 or later
- PMScreen, the user interface which can be launched from within Pronto.
- PMPortMonitor, used to simplify communication between your PC and your PM1000.
- PMMeter which allows the user a clear view of live measurements
- PMFiles which enables easy file management of the configurations and data files stored in your PM1000.
- PMGateway, our Remote Communications App available for install on most Android Mobile phones or tablets to facilitate remote data download from site.

Pronto for Windows works with the PM1000 Single Phase Analyser as with other Outram Research products, providing download, data presentation, and many analyser control functions.

Bluetooth is woken up as the unit is connected and is immediately available for connection using either a PC

with Bluetooth or with a portable device, e.g. Android tablet or mobile phone, that may have been supplied with your PM1000 kit. PMScreen will have already been pre-installed on your portable device so it is ready to use immediately out of the box.

For those who want the direct screen interface and control over all analyser functions, PMScreen provides a virtual screen to the PM1000.

The PM1000 is the active partner when used with PMScreen. The PMScreen program is both passive and unintelligent, providing only a means of display for the screen information which is prepared and controlled WITHIN the PM1000 instrument itself (it also passes mouse clicks to the instrument to simulate a touch screen). Of particular interest to someone demonstrating the PM1000 may be the STATUS screens, which show the decision making process prior to recording. Please see Chapters 7, 8, 9 and 10 for details on how to configure your PM1000 using PMScreen.

Both Pronto and PMScreen are able to wake up the PM1000 directly. They are also both "network aware". Normally this "network awareness" is not used, but if desirable can be invoked to control or interrogate more than one unit at once.

Connecting Up Your PM1000

Voltage Measurement

On the top end of the PM1000, next to the current sensor socket are 3, coloured, 4mm sockets into which connect the mains cable supplied with your PM1000 kit. Blue is Neutral, Green is Earth and Orange (Brown) is Live. This is how the unit takes its voltage measurements. It is worth noting that when the logger is powered up the batteries will automatically be charged.

Current Measurement

The Rogowski Coil in your kit measures current. You will notice that on the back of your analyser, there is a sticker that gives the serial number of the analyser and the number of the corresponding Rogowski Coil. With multiple analysers there need be no confusion as to which coil goes with which analyser. It is worth keeping a coil with its original unit, to maintain maximum accuracy, as they will have been calibrated together.

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.

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 phase 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.

Note, you can verify current direction and other hook-up characteristics by reviewing the vector diagrams on the PM1000 screen either at the top level connection diagram or under the display / phasor diagram screen. See Chapter 10.

The Rogowski Coil connects through the input socket in the top of your analyser. In the past, a current measuring device will have consisted of two leads, one positive and the other negative. However, the connectors into the PM1000 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 analyser 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 8 covers sensor configuration.

The Rocoil Rogowski Coils supplied with Outram Analysers do not need external power or batteries, making them convenient and easy to use.

PM1000 Power Quality Analyser Operating Notes

Automatic Recording

The PM1000 analyser does not have a touch screen, nor any direct user controls. It therefore needs to work automatically and indicate its status somehow so that the user may have confidence in what it is doing. When a PC is present the PM1000 can be operated through the PMScreen program or Pronto For Windows, and this is the way to change its operating characteristics. However an operator may take the PM1000 to site, install it and leave it in complete confidence that house voltages are in specification and it is recording correctly. This is achieved by a combination of Automatic Behaviour, and an LED array showing status.

The PM1000 uses several conditions to control behaviour:

- AC voltage is present
- Memory is empty
- Memory contains recording(s), which may or may not have been downloaded
- Whether the unit has been switched off since the last recording was completed

The default condition for the PM1000 is to TRY to record (if not already recording). (The recording period to be used and number of channels to be recorded are whatever has been set by the user (using PMScreen or Pronto)).

Typically the unit WILL record if given a chance, provided it has NOT got UNREAD data from a previous recording. It may still contain data from a previous recording, but so long as it has been downloaded at least once, this will not prevent a new recording being started.

Recording starts (or can be started) by:

- Direct user action through PMScreen or Pronto

Or automatically

- after AC has been detected consistently for 1 minute.

The automatic recordings erase any previously recorded data before they start (unless that data has not been read/downloaded, in which case the new recording does NOT start). The operator can choose to keep previously recorded (and downloaded) data but in order to do this, a recording must be started manually through PMScreen or Pronto. If the saved recording was 4MB (the default single recording memory allocation), then the subsequent recording will use either 4MB (depending on the memory size purchased with the PM1000 - 8MB, 16MB or 32MB) or the remaining memory left in the unit, whatever that

may be.

The normal situation for an operator is to install the unit, wait 1 minute, and leave. By this time the unit should have begun recording and will be indicating voltage quality and recording status, as discussed below.

The 1 minute delay after power is applied is added to give the operator a chance to remove or re-position the unit before starting the recording. Power must be available consistently for the whole minute, so if the unit is removed and reconnected, the minute delay restarts. This condition is intended to give the operator the freedom to test the installation voltage, and make satisfactory physical arrangements before recording starts.

Once recording is complete (or has been stopped by the user) the data remains in the unit, and since this is a normal benign condition, the unit knows it should not attempt a new recording. It knows this because although conditions may be right for recording, the unit has not been switched off since the recording ended, so in all probability, it is still installed on the same meter base.

Once the unit has been turned off (or turned itself off), that "continuation" information is lost. When power is reapplied it could well be on a new meter base, so this time it will try to start a recording when power conditions are right. As discussed above, the only thing preventing a recording is the UNREAD recording still in memory. Once the recording has been read, that restriction has been removed, and recording can start when power conditions are again right.

[Note that while a recording is incomplete, the unit will continue to record after power up even though data has NOT been read. The distinction is that when a user starts a (say) seven day recording, power interruptions occurring WITHIN the seven days are assumed to be just that – interruptions – which are either ridden through (if less than 10 minutes in duration), or which cause shut down after the 10 minute ride-through and immediate restart when power is restored. Only after the seven days recording time (or whatever was selected) or the recording stopped by the user, is further automatic recording prevented until the data has been read.]

Status LEDs

There are 4 LEDs recessed in the end of the unit. Looking from end on, these are:

Bluetooth

Power   Line Voltage   Memory/Recording
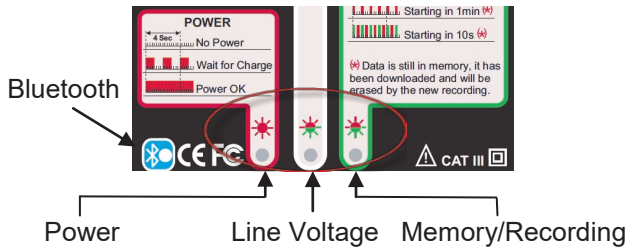
The 3 central Status LEDs are in a line, as shown above. To the far left is a blue LED, to indicate Bluetooth availability and connectivity.

To enable quick interpretation of the LED signals and therefore the logger status, the front panel of the PM1000 has been designed as a easy reference tool.
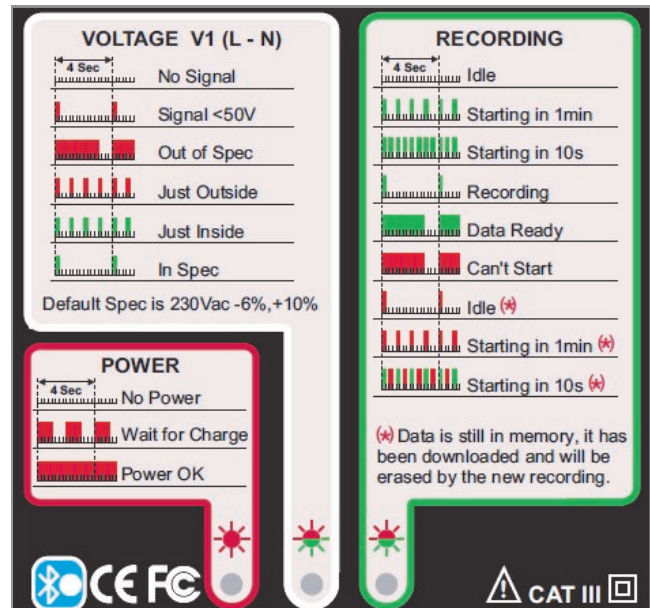
LED Interpretation

Power LED

This is **red** and only comes on when input mains is present and > ~100V. (Normally this is 230V, so 100V is way below the level it should ever see.)

The Power LED is on all the time the unit is powered, even if it has been switched off, EXCEPT when power has been newly applied, and the batteries have too little charge to support operation. Then it will flash every 2 secs to indicate that it is in the process of waking up. In this case, please be patient for up to 64 secs. It is not driven by the processor, and has only this simple function.

Power LED	Meaning
Off	There is no external power on the unit.
Flashing Red	External power has been applied, but the internal charge accumulator wants up to a minute (64 secs) of full charge before switching the processor on. Be patient, it will come on soon!
Red all the time	Power is present. The unit might be either on or off.

Voltage LED

This is bi-colour **red** and **green**. It shows the condition of the line voltage, ranging from Off (< 50V) to badly out of tolerance, just out of tolerance, just in tolerance, and comfortably inside tolerance. Simply, if it is **red**, its **out of tolerance**, if **green**, it is **in tolerance**. Note that if it is not being measured AND evaluated (i.e. for which no tolerancing is available), the LED stays off permanently.

Voltage tolerance levels and setting

The tolerance levels are set in the factory, though they may be altered in the field if necessary. Contact the factory for details if required .

All Factory Configurations specify line voltage in channel 1. The thresholds are set at –6% and +10% around a nominal of 230V, as shown below:

Channel	Function	Low (Alarm) Threshold (V)	High (Alarm) Threshold (V)
1	RMS Line Voltage	216.2	253.0

The LED now reflects the state of voltage evaluation.

Voltage LED	Meaning
Off	This signal is not being evaluated against tolerance.
Quiet flashing red (short pulse every four secs.)	Input signal is < 50V. This is typical when the unit is operated from the charger on the bench at playback time. Its just showing that the signal IS being evaluated, but it is clearly not plugged to an AC voltage source, so its nothing to be concerned about.
Angry red (on all the time except for short gap every four secs.)	Signal is a volt or more out of tolerance. For tolerance level 216.2 to 253.0V, this signifies signal is 50 to 215.2V OR ≥ 254V.
Alert red (short pulse every sec.)	Signal is just OUT of tolerance, by up to a volt. For tolerance level 216.2 to 253.0V, this signifies signal is 215.3 to 216.2V OR 253.0 to 253.9V.
Alert green (short pulse every sec.)	Signal is just IN tolerance, by up to a volt. For tolerance level 216.2 to 253.0V, this signifies signal is 216.3 to 217.2V OR 252.0 to 252.9V.
Quiet green (short pulse every four secs.)	Signal is IN tolerance, by better than a volt. For tolerance level 216.2 to 253.0V, this signifies signal is 217.3 to 251.9V.

Note that the "All is well" sequence is quiet green, a short pulse every four seconds. This is the same pattern used in the PM3000 to indicate recording is under way, and it applies in the PM1000 Single Phase Analyser too, as discussed next. So if all the LEDs (except the power one) flash in a quiet green way, it means the voltage is comfortably in spec and the unit is recording.

Memory / Recording LED

This too is bi-colour, and again the ANGRY RED flashing condition is to be avoided. This LED gives more information than the voltage LED, as it shows when data is in memory, whether it has been downloaded, and whether the unit would like to start recording automatically! It indicates that recording is under way, and when it has finished, that new data is in memory which has not been downloaded.

In addition to showing whether data is in memory, this LED operates rather like the "Timed Exposure" function on a camera – it flashes at one rate to show it is switched on, and at a more urgent rate to show that recording start is imminent. When recording has started, the flash rate backs off to the "quiet" regime exactly in synchronism with the "comfortably in tolerance" rate on the voltage LED. So if all LEDs (except power) are doing the same thing, slowly and quietly, and are GREEN, then all is well, the meterman can tiptoe away so as not to disturb it, and go to the next site.

Memory/ Recording LED	Meaning
Off	No power present, therefore it cannot start recording automatically. Or there IS power present, but there is no data in memory BECAUSE its just been downloaded and erased. It's the normal state after playback and erasure.
Alert green, (short pulse every sec.)	Power is present. Memory is empty. If nothing else happens, recording will start in 1 minute. This is the condition after the PM1000 is plugged in for the first time after downloading and erasure.
Urgent green, (short pulse every $\frac{1}{2}$ sec.)	Recording start is imminent. Memory is empty. Recording will start automatically in the next 10 secs.
Quiet green, (short pulse every 4 secs.)	Recording is under way. Once started, the ride-through function will allow recording to continue for ten minutes after power loss, so this does not depend on power being present, though it will not start automatically without power. If power is off for more than ten minutes, recording will stop and the unit will shut off. When power is restored, the unit will start recording again within a few seconds.

Memory/ Recording LED continued	Meaning continued
Angry green, (on all the time except for short **gap every 4 secs.**)	Recording has stopped, data is in memory, it hasn't been downloaded, so THAT'S THE PRIORITY! This also applies if the unit is woken up without power.
IF the unit is turned off or allowed to turn itself off, without downloading (normal condition when the unit is removed from a house installation), then EITHER the unit will be woken without AC power, in which case the Angry Green LED applies, OR the operator forgets to download, goes to another installation and plugs it in...	
Angry red, (on all the time except for short **gap every 4 secs.)**	Now AC power IS present, there is data in memory, AND it hasn't been downloaded. Yet the operator has reinstated the unit ready to record again. IN THIS CASE, the unit WILL NOT RECORD. **Angry red** is a warning that something must be done to empty this unit, or at least to download it.
Quiet flashing red (short pulse **every** 4 secs.)	If it is downloaded but not erased – a common condition – the LED will flash quiet red to indicate that data is present, it has been downloaded so situation is not critical, and recording could start if the conditions are right (though while flashing quiet **red**, something is not yet ready).
Alert red, (short pulse every sec..)	AC Power is present, data is still in memory though it has been downloaded. This is the condition arising when the unit has been downloaded but not erased, then the unit is installed at another installation. Recording will start in 1 minute on the basis that AC voltage is present, and the data WILL BE ERASED just before the recording starts.
Urgent red/green, (short alternating pulse every $^1/_2$ sec.)	AC Power is present, data is still in memory though it has been downloaded. Recording will start. This is the condition arising when the unit has been downloaded but not erased, then the unit is powered at another installation. Recording will start in the next 10 seconds and the data WILL BE ERASED just before the recording starts.

Normal sequence examples

Installation on site
If previously downloaded and now empty:
- Sitting on the bench or in a car: OFF
- Arrive on site, and install. ALERT **GREEN** (voltage now present, recording starts in 1 minute if nothing else is done)
- URGENT **GREEN** (recording to start in next 10 seconds)
- Recording starts, QUIET **GREEN**
- Recording Ends (automatically at the end of the recording period or by user operation) ANGRY **GREEN**. (The unit detects that it has not lost power since the recording was completed so it does not need to try starting another)
Unit removed from site. Turns itself off.

Data recovery
Arrival in car, or back at office.
- When unit is woken (either on battery or by connection to line power), ANGRY **RED** shows that data is present and not downloaded. The unit may be downloaded without power if necessary. If so, Pronto is used to wake it up and perform the

download. After download, QUIET **RED** applies to show data is still present, though it has been downloaded. If memory is erased too, LED goes off altogether.

Alternative Installation on site
If previously downloaded but NOT erased:
- Sitting on the bench or in a car: OFF
- Arrive on site, and install. ALERT **RED** (recording starts in 1 minute if nothing else is done)
- URGENT **RED**/**GREEN** (recording starts in 10 seconds)
- Recording starts, QUIET **GREEN**. Note previous data is erased when recording starts.
As for a) above

Second Alternative Installation on site
Recording present but NOT DOWNLOADED
- Sitting on the bench or in a car: OFF
- Arrive on site, and install. ANGRY **RED.** RECORDING IS DISABLED until data is downloaded.

Note that when a recording is interrupted by loss of power (ie without use of Pronto or PMScreen) then

recording will restart automatically all the time the original recording period still has time to run. Thus if recording is set for 7 days, and begins at site A on Monday, the unit can be removed from site A and reinstalled at site B on Thursday, and recording will restart automatically and continue until the following Monday. If the user uses Pronto or PMScreen to stop the recording, it is assumed that the *User is in control*, so recording does not start automatically.

In simple terms, if the unit is plugged in without computer intervention, the UNIT is in control, and will try to record. If the computer is used to control the unit, it is assumed the USER is in control, so it will not try to record.

If power is removed, and the unit allowed to go to sleep (> 30 secs) , then the next time power is applied, the UNIT takes control again.

Chapter 6: PMScreen Operation 1
Screens 1 & 2: Help & Status

PM1000 Help Button

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Help & Status

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Introduction to PMScreen Operation I

This chapter tells you how to use your analyser now you know how to hook it up to the power to be monitored (See Chapter 5).

How To Turn On Your Analyser

Please see the fourth and fifth steps of the PM1000 Start Guide to find out how to connect your PM1000 to you PC or your portable device. As mentioned previously, once connected, you give all your commands to the analyser via PMScreen, and the display presents options to you in a way that makes it easy for you to interact with it.

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, 7 to 10, will take you through all the possible operations that you can do with your analyser. Get out your PM1000 or use the PMScreen simulator and play along as you read. Turn to any relevant section if you have a particular job you need the analyser to do for you and want immediate guidance.

The Initial Screen

When you connect to your PM1000 and start up PMScreen the following 'Initial Screen' will appear.

Power Master button

Selecting [Power Master] will bring up the serial number of a analyser and the date of last calibration.
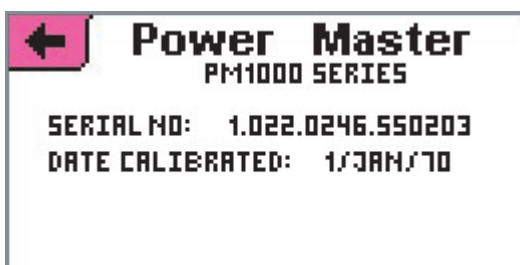
Each analyser can be identified by its serial number. This is particularly useful if you want to change or replace a Rogowski Coil.

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 analyser. This process enables the analyser 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 analyser 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 analyser to be recalibrated.

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

To have a look at the next button go back to the Initial menu.

ORL Logo button

🔲⒭ Or **Outram** (Outram Research Ltd) is the electronic design company that has designed and developed your analyser, its companion products and the Pronto software you use to analyse your data. You are reminded of this when you click on ORL on the top right of the screen and produce the screen below.
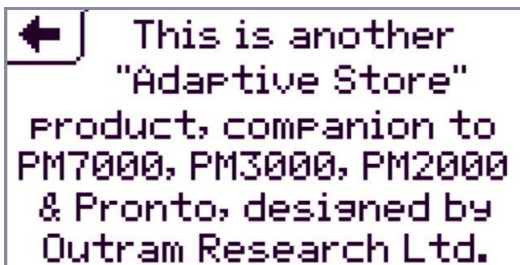
We are proud of our patented Adaptive Store data compression software algorithm that allows your analyser to catch detailed information on your monitored power over longer periods than is generally the case. Chapter 3 and Appendix B describe how Adaptive Store works and its benefits. You will enjoy using our Pronto software to analyse your data. Do contact us if you have any comments about your analyser and its use. Our address is on the front page of this manual.

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. Clicking on the arrow pointing down will take you to the next screen and down the list. Clicking on the up arrow will take you back up the list. Three options will appear at any one time.

```
┌──────────────────────────────┐
│ ← │  Help - Topic List        │
│ ▲ │     LOW SIGNAL            │
│   │ MAINTENANCE (PREVENTATIVE)│
│ ▼ │ NOISY VALUE SUPPRESSION   │
└──────────────────────────────┘
```

```
┌──────────────────────────────┐
│ ← │  Help - Topic List        │
│ ▲ │    PHASE SUSPECT          │
│   │     RESOLUTION            │
│ ▼ │   RECORDING MODES         │
└──────────────────────────────┘
```

```
┌──────────────────────────────┐
│ ← │  Help - Topic List        │
│ ▲ │   RESET TO DEFAULTS       │
│   │   REVISION HISTORY        │
│ ▼ │ SPECS - VOLTAGE AND CURRENT│
└──────────────────────────────┘
```

```
┌──────────────────────────────┐
│ ← │  Help - Topic List        │
│ ▲ │   SUPPORT (TECHNICAL)     │
│   │   SUSPECT HOOK-UP         │
│ ▼ │ TEMPERATURE (OPERATING)   │
└──────────────────────────────┘
```
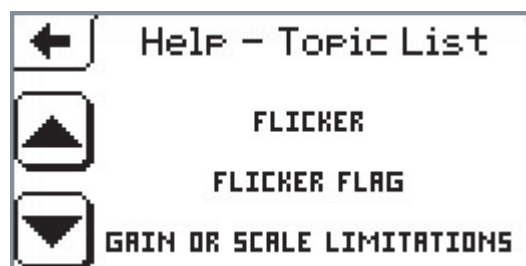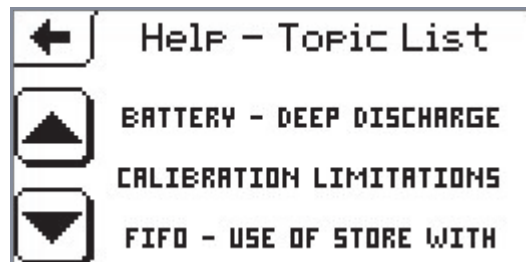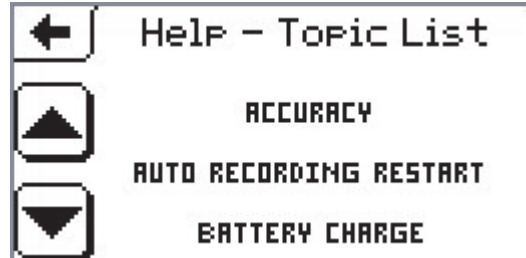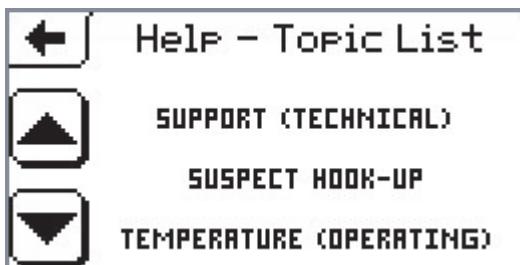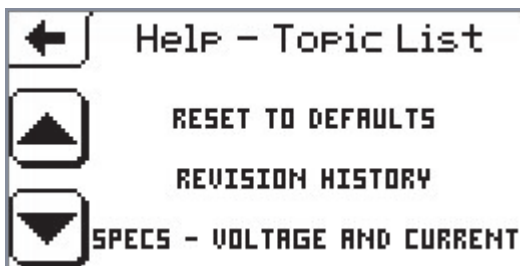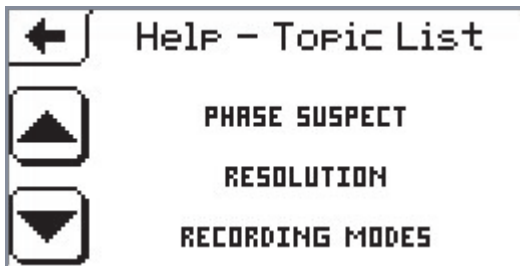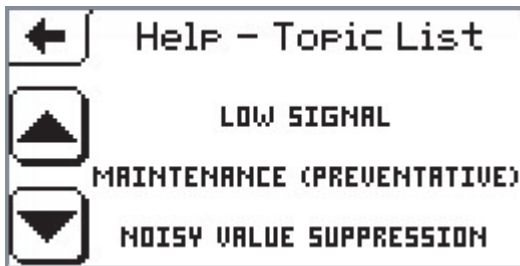
Here in the manual we can add to the help information. In this section we take you through the help topics in more detail than is possible on the screen.

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 analyser initial setting does better than 0.1% accuracy. However the analyser components do vary over temperature so we stipulate at 25 °C.

The Rogowski Coil is 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 Coil 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.

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 analyser 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 analyser will not restart. When in FIFO mode it will always restart.

(iii) Battery charge

- The analyser battery charges off between 50 to 270 volts ac (+/- 10%) through the voltage input. Additionally you may charge it up using a 12V DC wall charger or a 12V car battery.
- So long as the analyser 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.

(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 Coil in your kit is calibrated in the factory to work with your particular PM1000 and does not need to be calibrated by you. However, you have the ability to calibrate the Rogowski Coil sensor should you want to use an alternative coil or renew your existing one. 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 8 goes through the process in detail of setting up your analyser 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 one quarter of the total store available in the analyser on the current recording, up to a maximum of 4MB.

For example, if you choose to record for one day it will use up one quarter of the store for the first day (or max. 4MB). The analyser 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 day. 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 (or more for the 32MB model) 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 (how soon depends on the recording length you have set) or the event may be overwritten.

A way around this is to connect up your PM1000 to an Android mobile phone over Bluetooth to take advantage of our PMGateway App. It allows you to send and receive data remotely, direct to your inbox or a Dropbox account. Please ask your distributor, contact us at Outram or look on our website for more information.

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 analyser 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) Flicker

There are three flicker measurement functions in the PM1000 and a validity flag. The available measurements are:
- Instantaneous Flicker Sensation, which shows how humans perceive flicker as it happens. The units are Pfs. 1.00 represents borderline perceptibility.

- Short Term Flicker (Pst), measured over a few minutes, represents the likely levels of irritation.
- Long Term Flicker (Plt) is the same thing measured over a few hours, taking into account major but infrequent events.

All three functions require substantial processing, consequently recording channels may be restricted when flicker functions are selected.

(viii) Flicker Flag

This is an indication of the validity of the flicker measurements based on the input voltage level.

Excessive input changes, of > 20% e.g. dips, brown-outs etc. are excluded from the Pst (and hence Plt) processing. The flicker flag is held high (1.00) to show normal (valid) inputs. The flag falls (0.00) when inputs to Pst are suspended due to > 20% signal excursion.

(ix) Gain or Scale limitations

See (v) Calibration / Scale limitations

(x) Low signal

When this message comes up on the screen the input voltage or current is too low for the analyser to detect all the signal characteristics accurately.
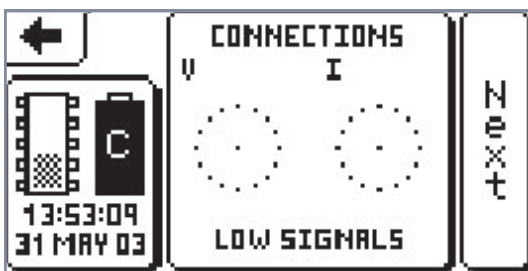
Click on the 'Low Signals' button and the screen will change to 'Hook-Up in use' showing a diagram of the single phase hook-up used with the PM1000.
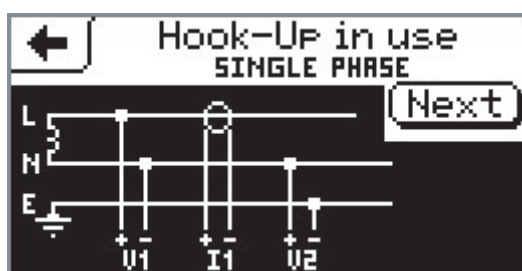
Click on [Next] for advice on the individual phases.
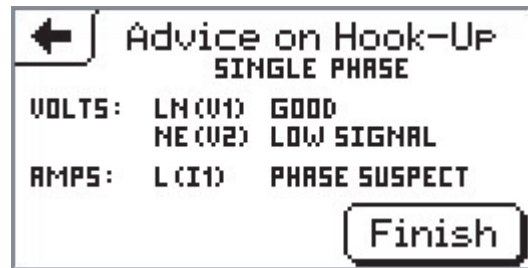
(xi) Maintenance (preventative)

Checking and Servicing

Extend the operational life of your PM1000 by following these guidelines:

- Deep discharge the battery every three months. See 'Battery – deep discharge' above.
- Change the batteries every two years. Contact the your distributor or ORL 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 analyser, or more likely the sensors, are out of calibration do return it to your distributor or ORL for recalibration.
- Regularly check all cables for cracks and look for holes in the insulation. Repair or replace as needed.

(xii) 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 analyser's dynamic range. If the sensor range is too big the analyser may not respond in as much detail as it potentially can, and if the sensor range is too small some readings may drop off the top of the scale.

(xiii) Phase suspect

This point is more relevant to our multiphase analysers. If this phrase appears in the display the

analyser is telling you that the phase does not correspond as might be expected. Check all your connections firstly for faulty contacts. Also check that the connections are not wrong e.g. the Rogowski Coil is not the wrong way round. The other most likely explanation is a low signal.

This comment comes up the analyser 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) Resolution

The defaults are 0.1V on the 300V range, 0.1A or 0.01A on the 200A current range, but you may change CT or PT ratios, or alter resolution in 'Edit Configuration / I/P Signals'.

(xv) Recording modes

There are two recording modes, Adaptive store and Point store. You can find an account of these near the beginning of Chapter 3 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.

(xvi) Reset to defaults

This is done by loading one of the factory configurations under menu option ;Available configs'. '1ø V only 7day' is simplest, measuring simply voltage from the mains lead.

(xvii) Revision history

The firmware revision number for each analyser is found on the first screen and in Topic Help. Also in the Topic Help is the revision history. The firmware in the analyser 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 analyser tell your sales contact who will be pleased to organise an analyser upgrade.

(xviii) Specs – Voltage and current

There is one voltage input port. The mains cable, which is used to measure both the voltage and to feed the internal power supply, measures between 0 and 300 Vac.

There is one current input port and four ranges available. The Rogowski Coil covers the ranges 0-1000 Amps or 0-50 Amps. Voltage Output Current Transformers may have a range of 0-500 mVac or 0-25 mVac.

(xix) Support (technical)

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

(xx) Suspect hook-up

If you have connected up your analyser in the wrong way 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.

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

((xxi) Temperature (operating)

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

PM1000 Power Quality Analyser Operating Notes

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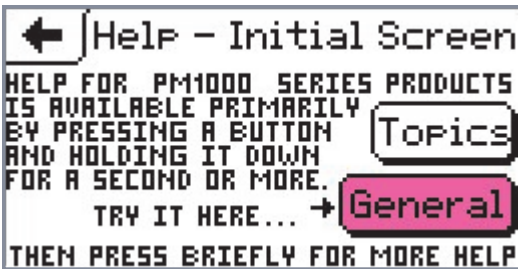
As an example, if you press on [General] and hold your finger down for a few seconds this box will come up on the screen.
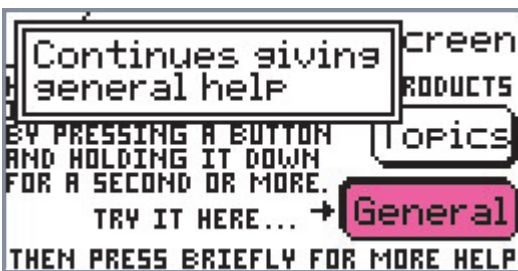
When you release your finger the box will go away.

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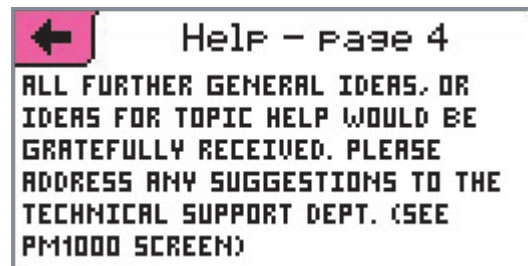
Now keep clicking on to travel back to the 'initial screen'

The Continue button

Press [Continue] . It brings us to the second screen.

The Second Screen
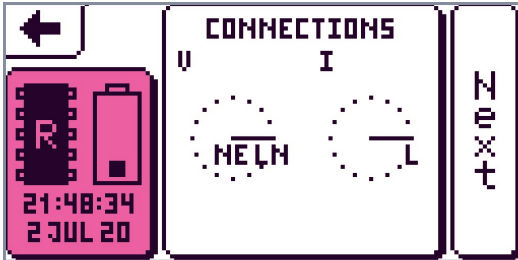
or
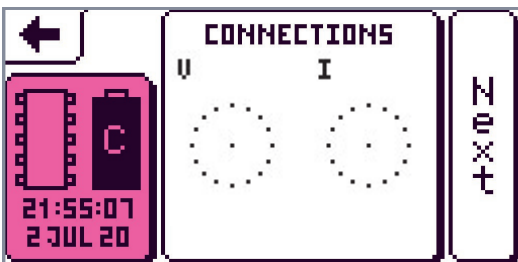
This screen gives us current status information and signal information.

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 (in this case, less than half) but for a more accurate percentage figure select to bring up the next screen. In this case only 1% has been used.
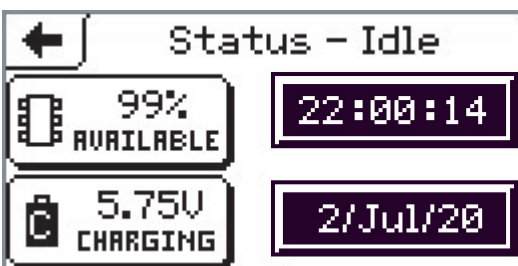
Further click on and more details about the amount of analyser memory used come up.

In this case, the analyser has recorded no sessions, twelve configurations have been set up and there is one system file. No recording is taking place and there is plenty of memory left.

Click on to go back to the 'Status Idle' screen.
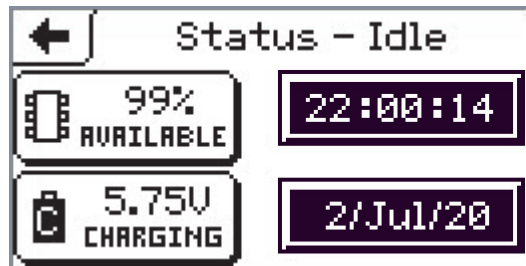
Battery details

To know more about the battery press on or . (When your analyser 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.
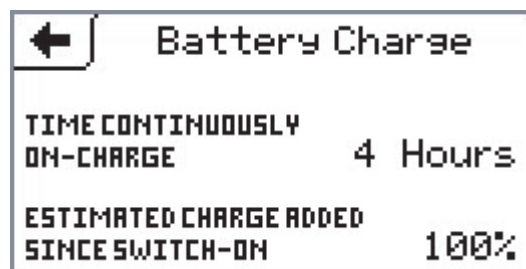
For further information on battery charging go to Topic Help in the previous section.

Change time

Go back two clicks to the Status screen
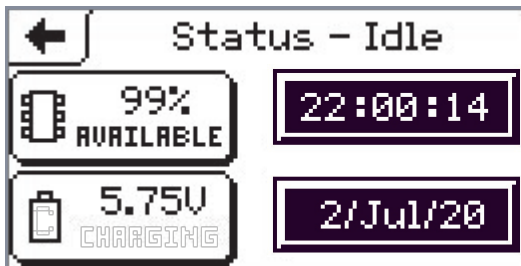
Click on the time button [22:00:14] to come up with a keyboard through which you can change the time.

To alter the time, click on clear, then use the keyboard to fill in the new time. Select [OK] to accept.

Change the date

Click on the date button [2/Jul/20] to come up with a keyboard through which you can change the date.
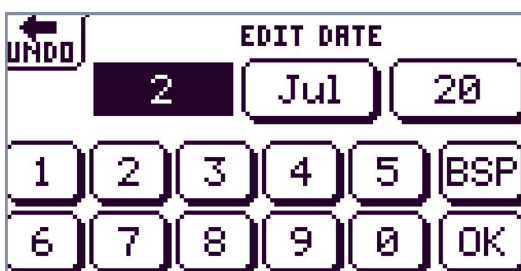
To change the date click on Back Space [BSP] and starting with the day use the keyboard to select the number. Then click on the month and a keyboard of months will present itself. Choose the one you want and then click on the year button to return to the number keyboard. Select your two numbers. The year two thousand is assumed.

Chapter 9 also discusses edit time and date.

Click on [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, click on [UNDO] and you will return to the 'Status Idle' screen without anything changing.

Go back up the menu tree clicking on [←] twice. You will return to the second analyser screen.

Now we consider the 'Connection Button'.
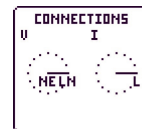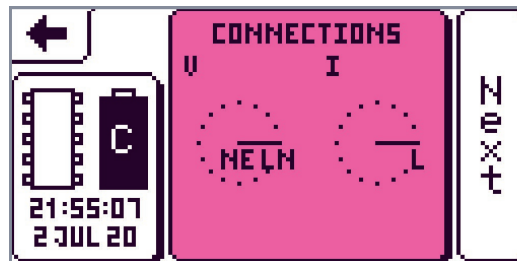
Connection button

There are a number of possible examples of connection information. Here are a few screens indicating different types of fault.
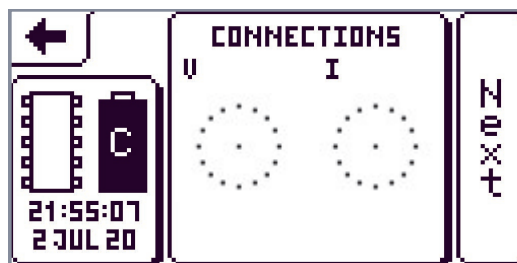
In this example the analyser is communicating via the USB lead, to give you PMScreen, but the mains lead is not plugged in. No volts or current are flowing through the unit. There is no (or not enough) signal for the analyser to measure.

If you have hooked your power up in the wrong way 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.
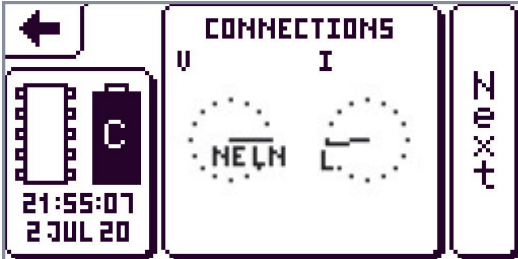
Whichever 'connections' screen the analyser produces
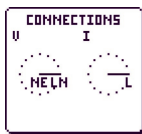
for you, selecting brings up an image of the 'Single Phase Hook-Up'.
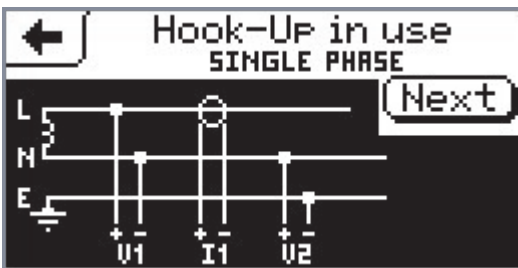
If your PM1000 has alerted you to the possibility of a wrong connection this 'Hook Up in Use' screen is always available for reference.

Click on and the next screen will advise you further with a report on the status of the signals.
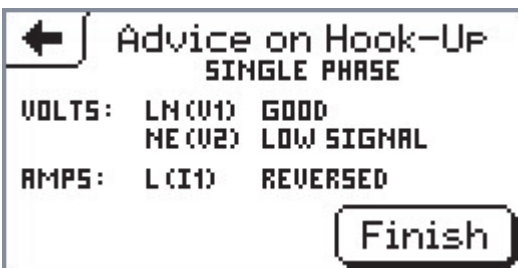
or
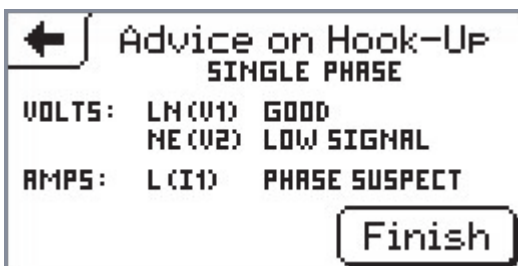
Check your hook-up. The Rogowski Coil may be fitted the wrong way round.

Finally
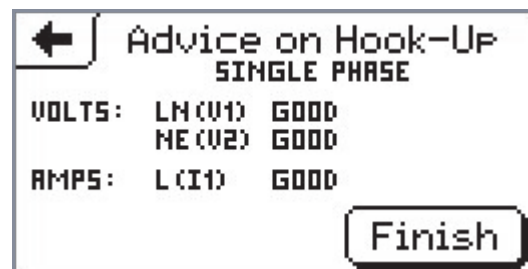
Click on Finish and jump back to the second screen.
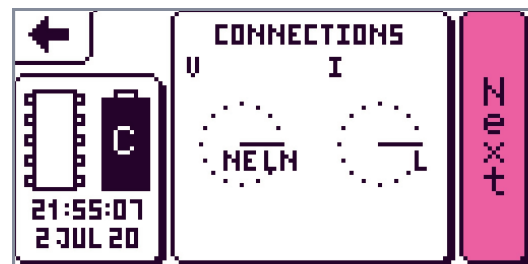
Touch to proceed to the third screen, the Main Menu. Chapters 7, 8, 9 and 10 go through the main menu.

Chapter 7: PMScreen Operation II
Main Screen 3: Hook-up Selection

A Single Phase 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.

Status menu

Touching 📷 will lead to the status menu. This is already described in the previous chapter. Note that if the analyser is recording an 'R' will flash on the

memory icon 📷. If your PM1000 has just been switched on and is waiting for the automatic delayed start 'T' will show up until the delayed start time is reached (60 secs) and the recording gets underway.
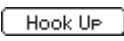
Using the ⬅ will take you back up the menu structure, back to the main menu once more.

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 PM1000.

Since the PM1000 measures only one phase of voltage and current there is only one hook-up option, Single Phase.

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] will show you the image of the Single Phase Hook-up in use.
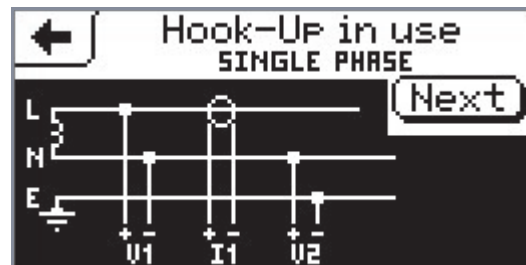
This diagram is to show you how the connections are made, although, in the case of the PM1000, if you plug in the mains lead, these voltage connections are made for you automatically.

Select [Next] and the 'Advice on Hook Up' screen will follow as seen in the previous chapter.

Once you have connected the analyser to your power to be monitored, this screen can confirm that you have made the connections correctly. 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.
Phase suspect	The phase is wrong. The Rogowski Coil may be the wrong way round. Nothing else is known.

Table 7-1 '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 analyser that you can use with the chosen hook up i.e. Single Phase. The list will include both the 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 analyser. The principle, however, is the same.

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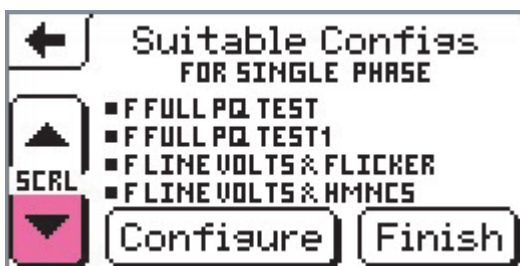
Scroll down.

Consult Appendix C of this manual or the PM1000 Configuration Guide included in your kit for a list and description of the factory configurations in your analyser.

Please note that if your distributor has asked for specific configurations to be loaded into your PM1000 the configurations in Appendix C will not match those in your analyser, nor will a Configuration Guide have been included in your kit for this same reason.

[Finish] will return you to the main menu.

Clicking on [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 analyser is the subject of the next two chapters.

Chapter 8: PMScreen Operation III
Main Screen 3: Configuration 1
Storage Modes & Input Sensors inc.
Calibration Configuration
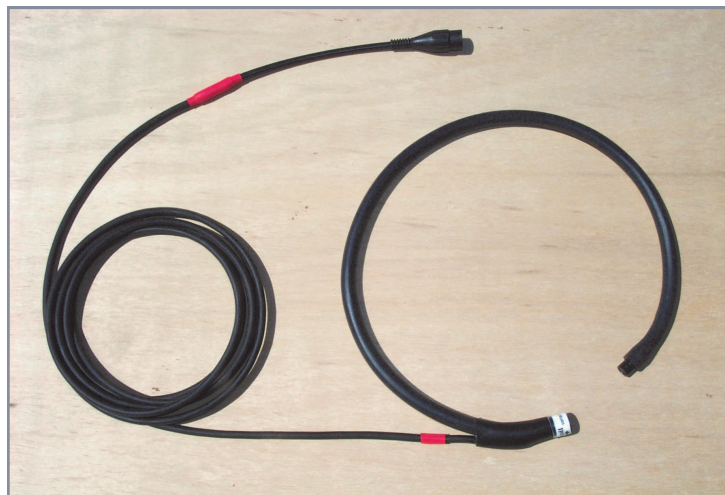
Rogowski Coil

Configuration 1

Contents

Configuration (Set Up)
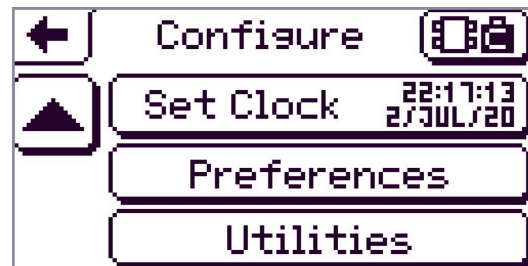
Go to the Main Menu screen.

Press `Configure` 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: 1Ø FULL PQ 7DAY`

The `CURRENT CONFIG: 1Ø FULL PQ 7DAY` button will show you the configuration that is programmed in the analyser at the present time. The one shown in this example is 1ø Full PQ 7Day.

Full details as to the content of the factory configurations (including the default configuration) are listed in Appendix C and the Configuration Guide included in your kit. If you are happy with the default configuration you will not need to edit it and you can proceed directly to 'Start Recording'. If 'T' (T stands for Time delay) is still flashing in the status box in the corner of your screen, let your PM1000 start recording automatically within the next 60 secs.

`CURRENT CONFIG: 1Ø FULL PQ 7DAY` 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 analyser. Any set up you wish can be stored in the analyser to retrieve when you want to use it.

We now supply you in the first instance (unless your distributor has requested otherwise) with 13 stored set ups which we expect will cover many needs. The words (same as) indicate that the current program in your analyser 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.64) we shall explore `AVAILABLE CONFIGS` and take a look at the factory 'set ups'. The factory configurations in your unit may have since changed so please see Appendix C for more details.

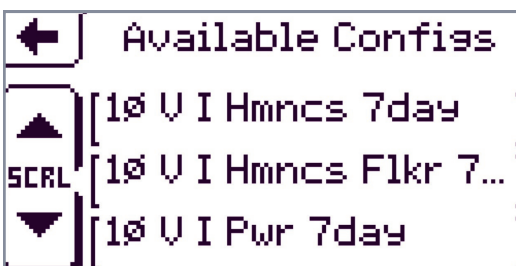# The 'Available Configs' Button   [AVAILABLE CONFIGS]

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.
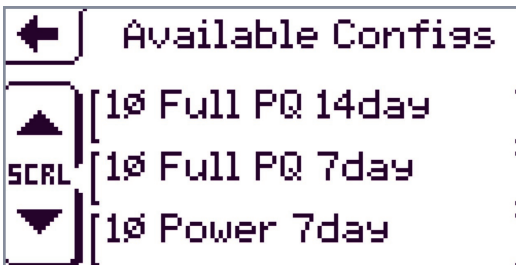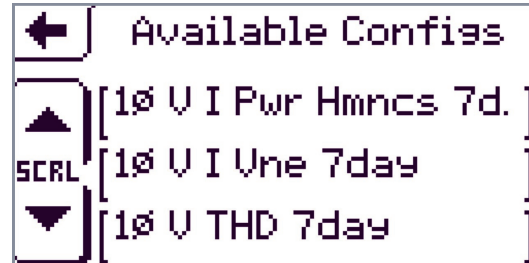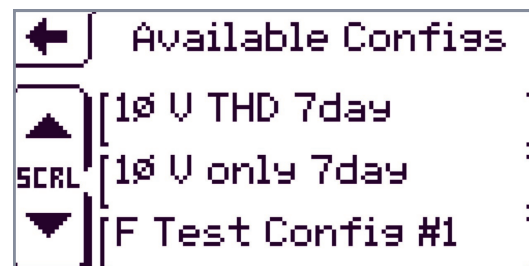

Scroll down.

Scroll down again.

Scroll down again.

Scroll finally to complete the options.

Choose any of the factory configurations from this list to configure the analyser. To know which one to choose go to Appendix C 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 9.

You can also add your own configurations to the list and then choose one of them. If you need something only a little different then you can edit an 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 'Test config' is not a set up. It is a file for testing the instrument in the factory and can be ignored.

How to load a factory configuration

Click on [AVAILABLE CONFIGS] . Scroll down the 'Available Configs' screens. For our example we shall take the config. "1ø Full PQ 7Day".

[The current default factory configuration loaded in your new analyser is detailed in Appendix C.]
To select any configuration on the list click on it. Click on '1ø Full PQ 7Day' to produce the next screen.

Click on '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 Chapter 10.

Note that when you clicked on '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 your 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.
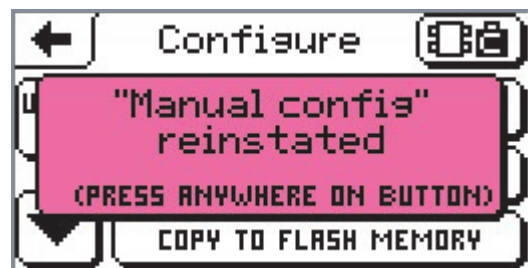

Because it is not a factory configured set up you can do any of the above actions at this point.

How to delete a file

Click on [Delete] and the file will immediately be deleted.

You are given a chance to change your mind by Clicking on [UNDO DEL] and getting the following screen.

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

How to rename a file

To rename the config, touch [Rename]. A standard keyboard screen will come up. For help in using the keyboard go to 'Changing text' in Chapter 9.

How To Edit A Configuration

If your current set up is 'F Full PQ Test', from the main menu click on [Configure], then [CURRENT CONFIG: 1Ø FULL PQ 7DAY] to get to this following screen. Alternatively click on [Configure], then [AVAILABLE CONFIGS] and select '1ø Full PQ 7Day' and come up with the next screen. This will be our example configuration.

We are now ready to change '1ø Full PQ 7Day'.

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 Coil – 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. All the settings up of the measurements take place under these three buttons.

Record mode & time

To change the storage mode and record time click on [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 3 '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 clicking on 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^{TM}. 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 analyser does not record each reading. It gives you a maximum and minimum envelope within which all readings fall. When the data changes the analyser 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 PM1000 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

 Click on 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 analyser lets you know how much time the recording will last before you run out of memory. In this case the achievable time span is 91 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.
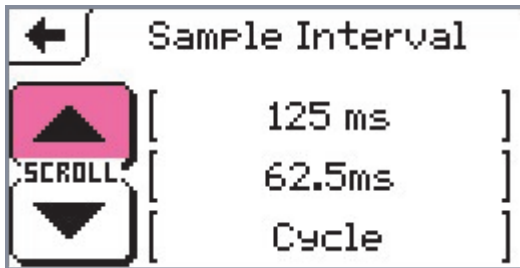
If you start with this screen, scroll down
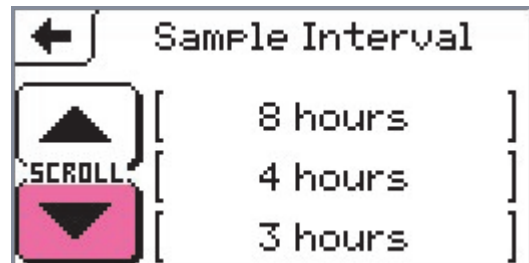
and down
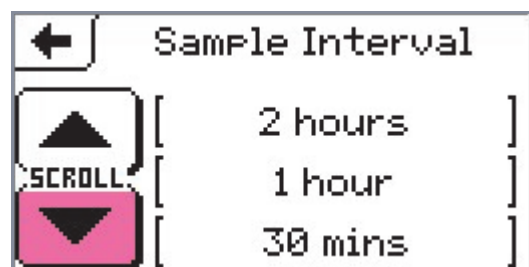
and down and down …. until you get the following screen.

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 14 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 16 days recording

and 10 seconds will give you 5 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 have an impact on the storage parameters. In practical terms, when FIFO is off, 4MB of the available 8MB, 16MB or 32MB will be used up per recording. When FIFO is turned on the analyser will start its recording, intending to use, for that recording, one quarter of the remaining store in the unit, up to a maximum of 4MB. When the recording session is finished, the analyser will start another session using the next quarter of store and so on.

Once all the store in the analyser has been used up, i.e. just before the 5th recording is due to start (depending on the memory capacity of your PM1000), the oldest data will be discarded and over-written. This will continue to happen one recording 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 analyser will sample *every cycle* during any record time you specify and will not miss anything important. It will also 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 analysers 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 PM1000 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 Vln, can be examined for a number of *attributes*, for instance RMS voltage, frequency, or Harmonic Content. The analysis process sub-divides the SIGNAL entering Vln 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. 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
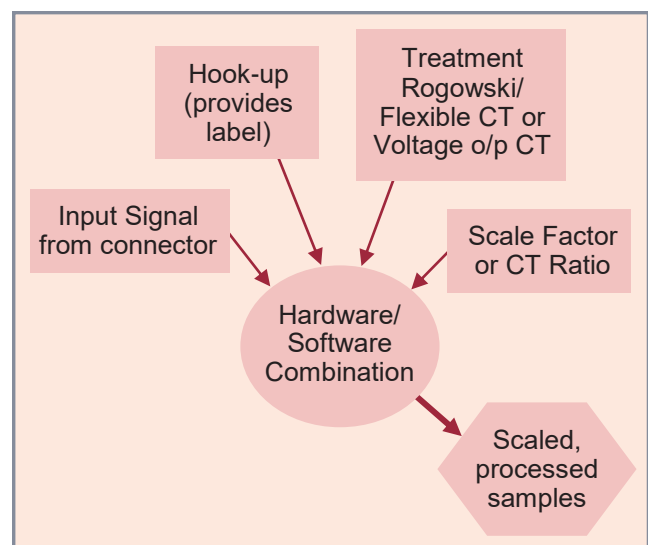

Figure 8-1   Input Signal Specification & Pre-Processing

The scaled samples (the result of pre-processing - see

Figure 8-1) from each of the input signals are then themselves the inputs to the Maths Function Calculation (see Figure 9-2, Chapter 9). The next section covers the first process, the input signal specification. Chapter 9 takes you through the display channel specification.

Input signal specification

Selecting your current sensor

The programming in the analyser enables you to use two different types of current sensor, a Rogowski Coil and a Voltage Output Current Transformer (CT).

The Rogowski Coil is factory calibrated for greatest accuracy. The 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 5 gives more information on the Rogowski Coil itself and how to use it.

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.

Select I/P Signals to get the next screen.
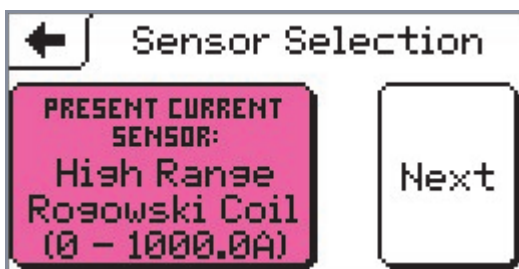
The new screen offers you the first of four current sensor choices, starting with the High Range Rogowski Coil.

For the other current sensor options click on
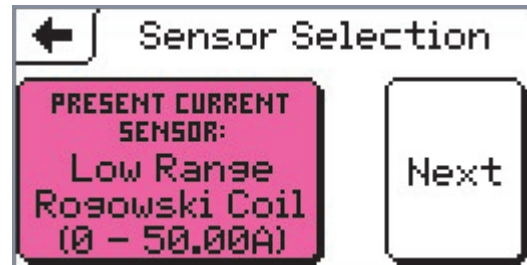
to get
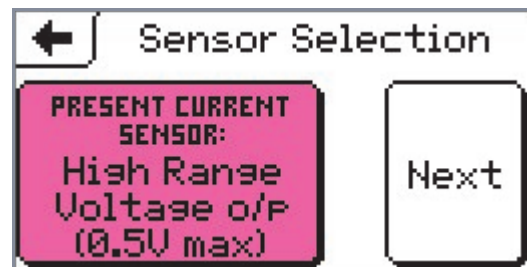
Click again to get

or again to get
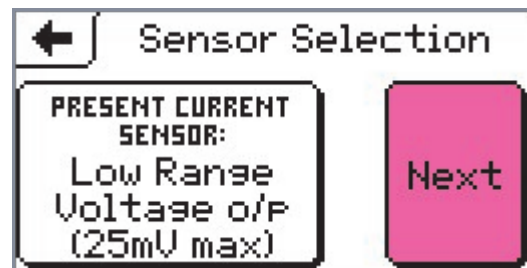
(Clicking one more time will return you to the original option.)

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 Coil 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.
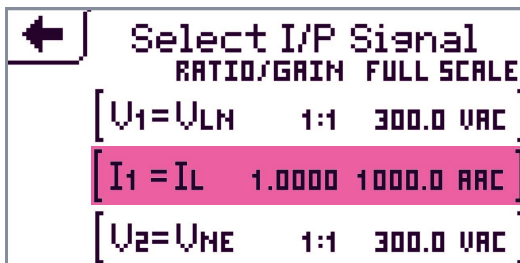
Selecting the Current Input Signal

The previous section has described how to choose your current sensor from the Sensor Selection screen.
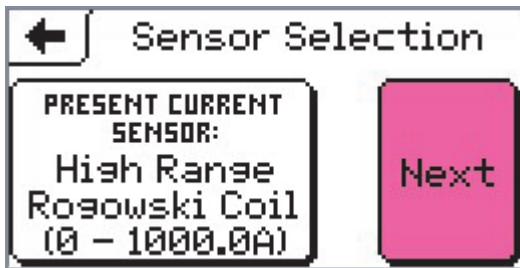
If you need to measure currents of higher value than 1000 Amps you may use an additional Current Transformer to step down the current.
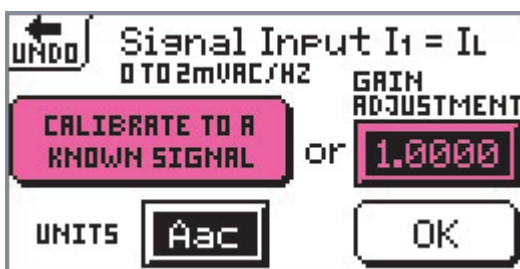

Touch and bring up the following screen.

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

Click on I1 = IL for the next screen. Here it shows the default condition.

When you have selected the high range Rogowski Coil option this screen reminds you that the input signal should not exceed 2 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 the low range Rogowski Coil option which has a full scale of 0 to 50 Aac instead of 1000Aac, the screen will tell you that the signal input should not exceed 100microVolts (per Hz) if you use a different coil.

Your PM1000 kit comes with 1 Rogowski Coil. Before it leaves the factory this coil is calibrated to read the current accurately when connected to its current input port. **You do not need to calibrate your Rogowski Coil.**

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 'Signal Input' screen so that the logger will produce the correct answer.
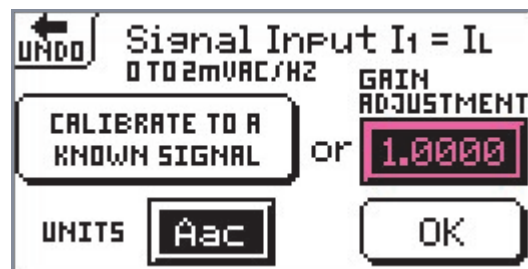
Changing numbers

Touch and you will bring up the 'Enter Gain Figure' screen.

Click on BSP six times to clear the box. The gain is the number of times the PM1000 will have to multiply its result by, driven by the ratio on the Current Transformer that you are using, in order to give the correct current reading.

For example, if your CT is a 10:1 transformer, then since the CT reduces the incoming signal by 10 times so it can be received by the analyser, the gain on the logger must also be 10 to get the result recorded by the analyser back to the original current value. Click on 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 Gain Adjustment value.
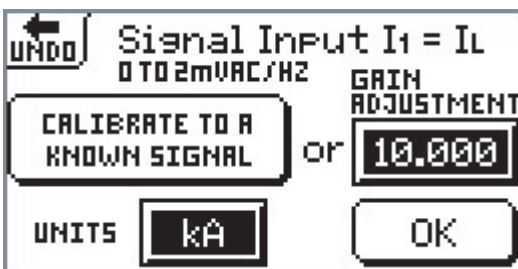
The Gain Adjustment figure should read 10000.0, i.e. 1000 * 10, however the space in the box is limited to five digits and a decimal place. Note that the Units have now changed to kA, since 10.000 kAmps will fit.

With a gain of 10 (CT ratio 10:1), the Full Scale that the analyser can measure is now 10 kA (10,000 A).
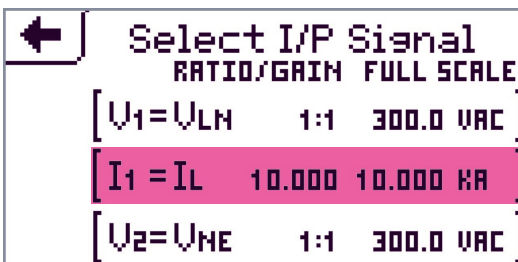
How to Set Up the PM1000 to calibrate Your Current Transformer

If the CT ratio is not known the logger can be calibrated for your current sensor using a known current. Touch [CALIBRATE TO A KNOWN SIGNAL] on the 'Signal Input' screen and get the next 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. Click on [OK] and you will return to the screen below. Now the 'gain adjustment' box has in it the new number.
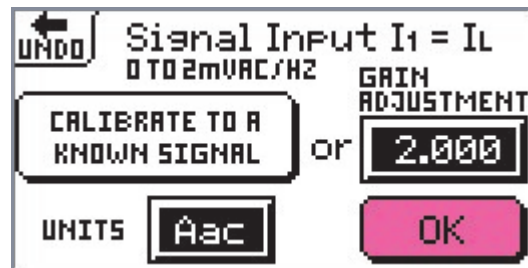
Touch [OK] and go back to the Select I/P signal screen once more.

How to measure a very high current

A high current may need to be stepped down before it can be fed into your PM1000 sensor. It must be below 1000 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 (if taking 2 transformations into account) to work out the total effect.
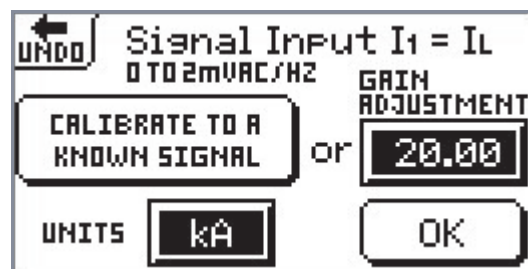
How to measure a very low current

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 analyser will be able to register the increased current which will be the real current multiplied by the number of turns. Calibrate the analyser 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 set up your storage mode and selected the type of current input.

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

Chapter 9: PMScreen Operation IV
Main Screen 3: Configuration 2
Setting Up To Record Maths Functions
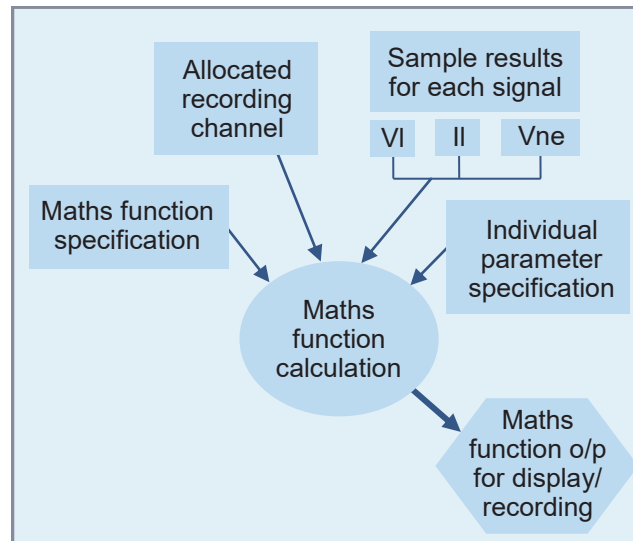
PM1000 Maths Functions

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List of Illustrations

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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 8-1 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.
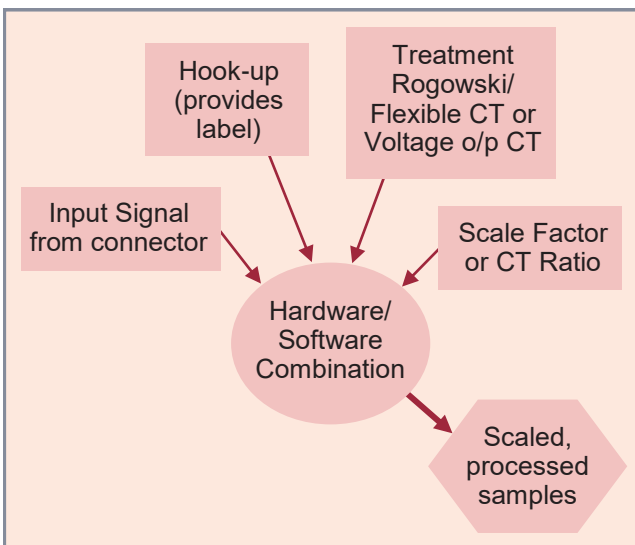
This processed input information is 'used by' appropriate Maths Functions to produce your required recorded and displayed information on selected channels. Chapter 9 covers this final step starting with a description of the Maths Functions.

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 configurations may work well for you. Please see Appendix C for more details on factory configurations.

Figure 9-1   Input Signal Specification & Pre-processing

Maths Functions

The PM1000 provides various functions for single 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 9-2   Display/Recording Channel Specification
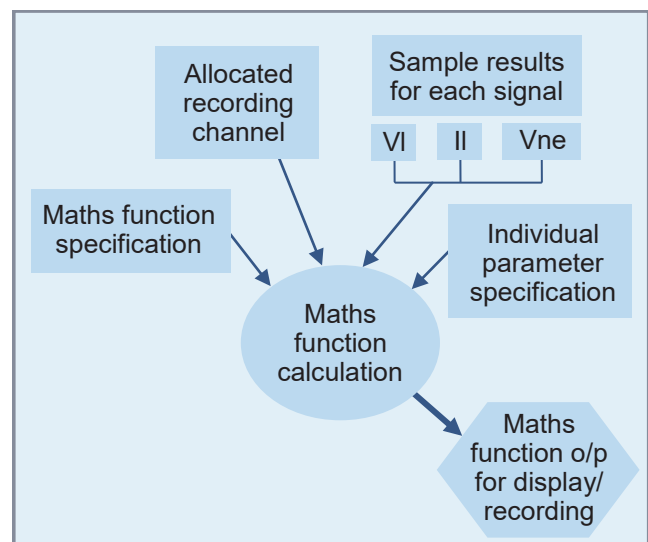
We are now ready to select our channels and Maths Functions.

To reach the channel allocation and maths function specification, click on `Configure` from the main menu. This gives you the following screen.

Touch either [CURRENT CONFIG: 1Ø FULL PQ 7DAY] or [AVAILABLE CONFIGS], (see Chapter 8, '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, Click on `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 opposite.

Table 9-1 Configuration Details for an Example Application

NAME	1ø Full PQ 7Day
Hook-up	Single Phase
Current Sensors	Rogowski Coil High Range
Signal	Name & Full Scale
Vln	Vln 300.0V
Il	Il 1000A
Vne	Vne 300.0V
Channel	
1	RMS of Vln (Vac)
2	RMS of Il (Aac)
3	% THD of Vln (%)
4	Value all Harmonics of Il (Aac)
5	Flicker sensation on Vln (Pfs)
6	Flicker flag on Vln (Flg)
7	Flicker Pst Vln 10 mins
8	Flicker Plt Vln 2 hours
9	RMS of Vne (Hi res) (Vac)
10	10 AC Frequency (Hz)
11 - 16	Unspecified

The maths functions that have been factory configured into the analyser (please see Appendix C 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 measurement. To do this we assign the THD of the signal Vln to Channel 11.

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

Scroll down the 'Select Channel' screen, through the channels, until Channel 11 shows up, or a different channel that is currently unspecified.   Select it.
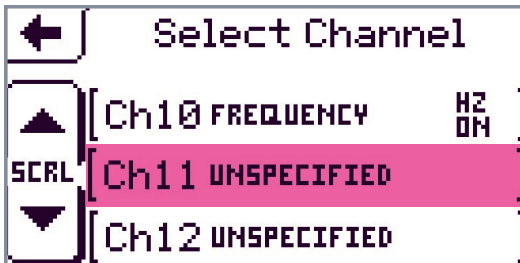
This produces the following screen with the single selection button. UNSPECIFIED is not a group but is included here to make de-selection of a channel easy. No maths function has been allocated to the channel.

Click on UNSPECIFIED to bring up the 'Select Function Group' screen. You can choose from various maths functions available to you. They are organised into five groups. Scrolling up and down through the 'Select Function Group' screens shows the groups.
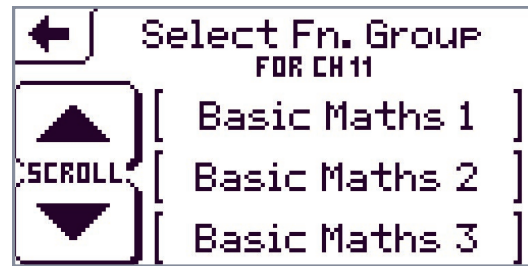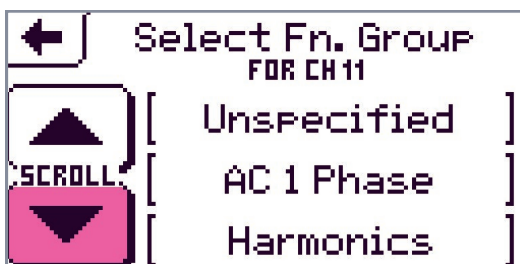
The maths functions are organised under these group headings and the choices come up as you press any of the group descriptions. To know all the functions in your PM1000 go to Appendix A where you will find a complete list of every option.

"AC 1 Phase"

The group "AC 1 Phase" contains all the options for your single phase operations. For example, you can measure RMS which requires specification of a single signal, Vln, Il or Vne, or measure Real Power and/or measure Frequency.

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

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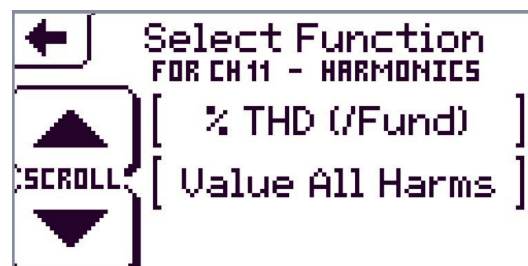

Both options on the new screen measure the harmonic content of a chosen signal. The % THD option divides the total harmonic component of the signal by its fundamental component to give the conventional Total Harmonic Distortion expressed as a percentage of the fundamental. The VALUE ALL HARMONICS is 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.
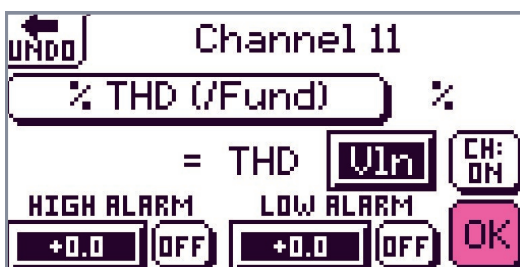
This screen shows the values of these settings as they are set up at the moment for this selection. It shows that the FUNCTION for Channel 11 is % THD (/Fund). Its UNITS will be %. The SIGNAL for which the THD is to be calculated is Vln, and the Channel is automatically switched ON.

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. Click on OK to accept this arrangement. This returns us to the "Select Channel" screen.
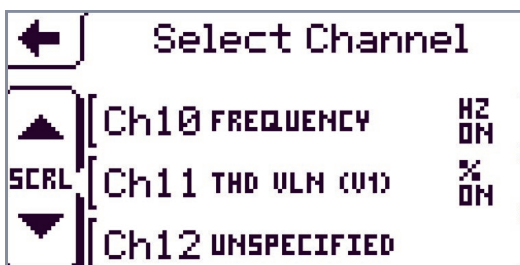
Now it shows the Channel 11 assignment, together with the units applicable and the indication that this channel is ON, that is, it will be recorded.

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 10), 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 click 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 Vne to channel 12

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, click on it to access that channel.

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

Scroll down to HARMONICS, and select it.

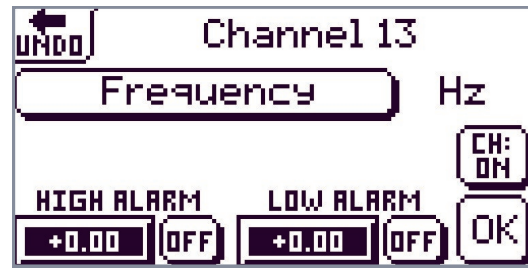Finally choose % THD (/Fund) to produce this screen .

The text box is presently showing "Vln".

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

Now click on "Vln" 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 Vne.
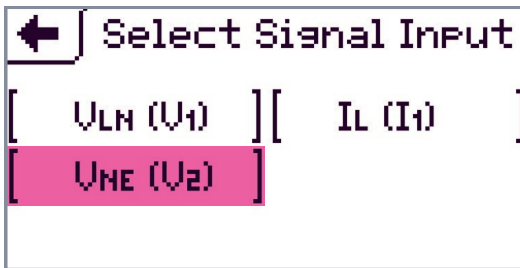
Click on "Vne" to select Vne to appear in the text box of the next screen.
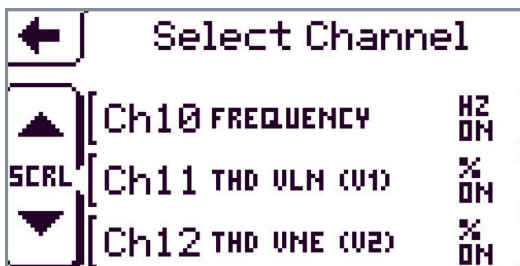
Finally click on "OK" to accept the configuration.

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 e.g. "Frequency".

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 the previous chapter. Refer to the section 'Changing numbers' in Chapter 8 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.
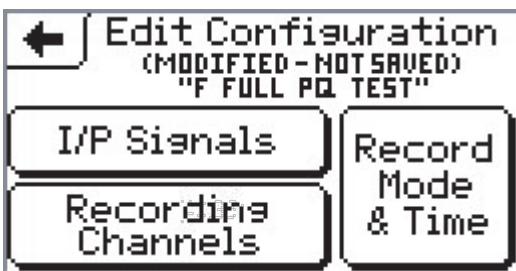
Let us assume you want to make your modification permanent. Click on ← to carry on up the menu tree to the 'Config Actions' screen.

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

You have clicked on ← twice to go back up the menu tree from 'Channel Selection' to the 'Config Actions' screen.

Touch [Save (as)] and a keyboard will appear.
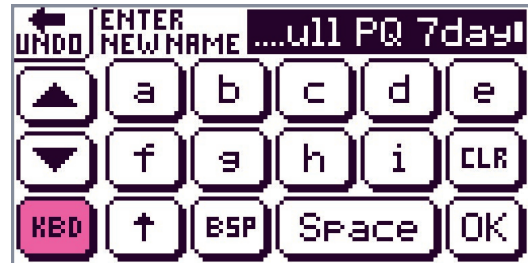
Now you have the opportunity to rename your new configuration.

Changing text

Clicking on [CLR] will empty the black name box. Touching backspace [BSP] will delete a letter at a time from the right.

To switch between the two cases touch [↑]. [↑] is equivalent to the "Shift" button on a PC.

Clear the black box then select your new name.

To do this either scroll down to find the letters you want or click on [KBD] if you prefer to produce an alternative keyboard.

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

(Same as) reassures you that the configuration now in use is 'Test 1' and it has not been modified in any way. 'Test 1' 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 select ⌈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 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 in the bottom
half of the screen to go to the next screen.

Screen 2 gives you information on the input sensors.

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 and 12. Review your newly
configured channels.

Press anywhere on the bottom half of screen 3 (except
the scroll bar and ⌐←⌐) and you return to screen 1.

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

⌈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 click on [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 analyser 'Test 1' will be the configuration in place. This will be the set-up that will start recording automatically when you next plug in your PM1000 (after the 60 second time delay). To change to an alternative set up from the list of saved configurations go to the Main Menu, click on [Configure] and [AVAILABLE CONFIGS] and select a new configuration. This topic is covered in detail in the section 'The 'Available Configs' Button' in Chapter 8.

How To Copy Your Configuration Into Flash Memory

Select [Configure] once more.

Click on [COPY TO FLASH MEMORY] and the analyser 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.
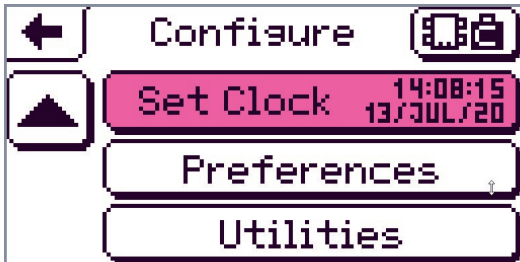
You may wish to copy your configurations to Flash Memory if you are planning to store the analyser for an indefinite period. In Flash Memory, set ups will be saved permanently.

Improved upon from previous models of PM1000, the PM1000 Mk2 now automatically stores all configurations and recorded data in Flash Memory. This means that both configurations and data are saved, even if your unit is left off charge for so long that the batteries go flat.

If you have a PM1000 with an serial number lower than SN1051 then your configuration will have been saved in Random Access Memory which requires the batteries to be operating. In these older PM1000's, the batteries will hold the set ups in memory from full charge when the analyser is not being powered for at least two months. In this case, it is worth saving your configuration into Flash memory as previously described.

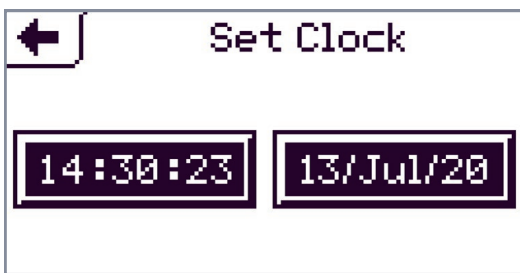## How To Set The Clock `Set Clock 14:08:15 13/JUL/20`

Starting from the Main Menu click on `Configure` then scroll down to reach this screen.

To change the time in the logger select `Set Clock 14:08:15 13/JUL/20` to bring up a screen like the following.

Now you may change the time and/or date.

How to edit time

Press `14:30:23` 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 `13/Jul/20` .

Change the number and year using the date keyboard.

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

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.
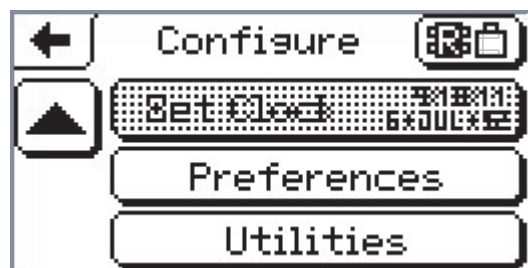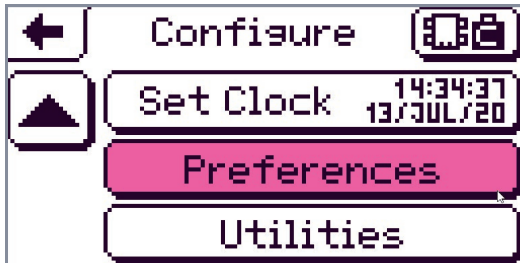

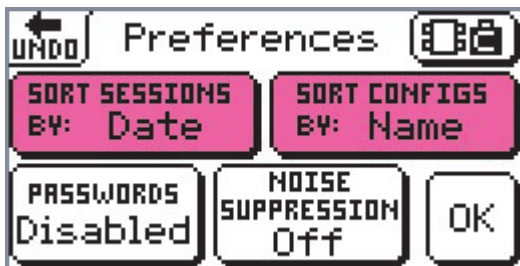Two further options under Configure remain to be covered.

Preferences

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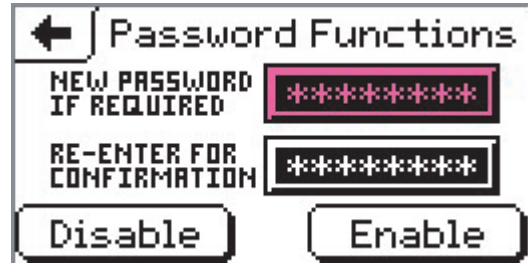

Sort lists by date or name

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

Password Functions

Click on [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 text' section in Chapter 9 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.
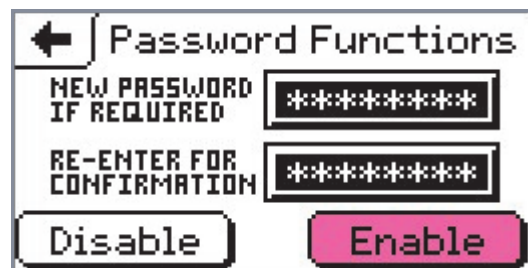
Now you have a password, you choose to enable it or disable it. Enable your password by

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.

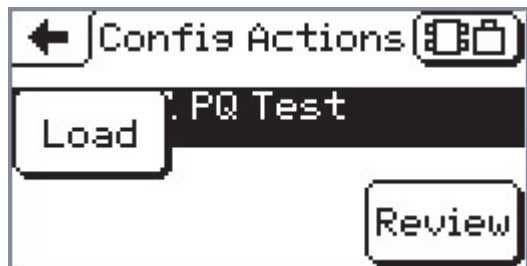Press this button to get the following screen.

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 8). 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,

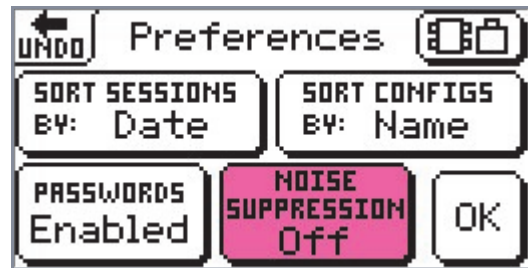Touch Enter Password and bring up this keyboard.

Touch your appropriate letters and numbers.

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.

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
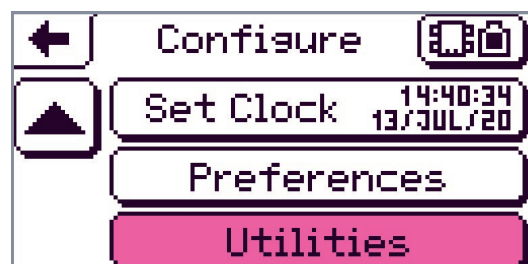preferences. You will go back to the Main Menu.

Utilities

From the main menu


Click on [Configure] .

Scroll down.

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

How to change the baud rate

The default baud rate set up in the analyser when you receive it is 115200. To change this rate click on

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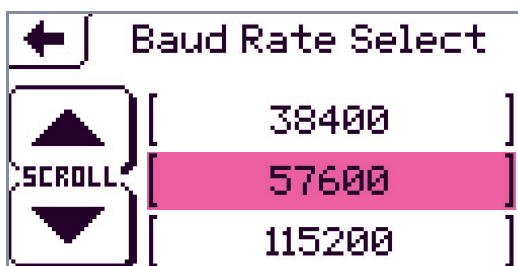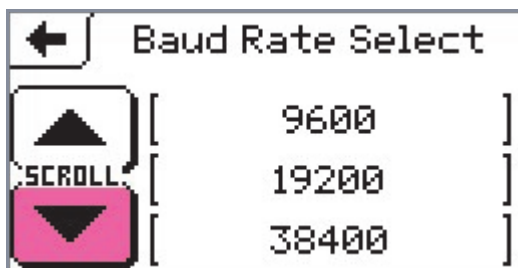
Clicking on the selected rate, (an example is shown highlighted in the last screen), will return you to the utilities screen. The logger will have renewed the 'Baud Rate' value.

Note, always go for the highest baud rate you can (i.e.

115200) for the highest download speed, except under special circumstances. So, if not using the simulator, do not forget to put it back to how it was.

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 analyser battery is charging correctly we have included a test function.

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

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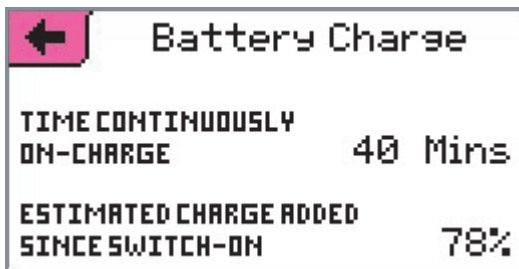

This battery has passed.

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

Battery charge button

Touch [🔋 5.75V 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 6, 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 select [DELIBERATE FULL DISCHARGE] your analyser 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
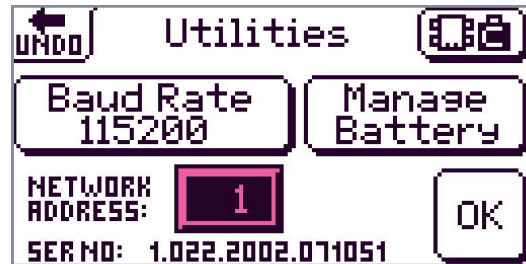
The default Network Address in your analyser is 1. You will not need to use this facility unless you have a number of analysers you wish to network together through the same computer serial port. To do this you will need to give each logger a uniquely identifying network address.

Touch [1] and bring up a network address keyboard.
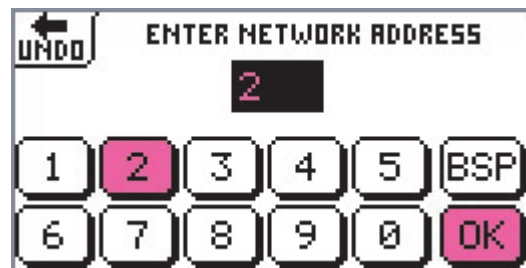
Clear the current number using [BSP] and touch the new number(s). Press [OK].

You are now able to set up every possible option in your analyser that comes under the [Configure] button. Chapter 10 will take you through the final buttons in the Main Menu as highlighted below.

Chapter 10: PMScreen Operation V Main Screen 3: Start Recording, Display Results & Explore Sessions

PM1000 Results

Contents

Introduction

Your PM1000 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 PM1000 menu and screen structure. In this case we shall use it to describe the function of the ⟦START RECORDING⟧ button.

Click and hold 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. Click on ⟦START RECORDING⟧ again briefly to bring up a 'Start Recording' screen. Now this button seen on the 'Main Menu' screen changes to ⟦STOP RECORDING⟧. All the time there is a recording taking place in the analyser ⟦STOP RECORDING⟧ will appear so as to give you the opportunity to stop the recording at any time.

When pressed for the first time, the following screen will appear.

If you have made previous recordings the following screen will replace it. This next screen gives you three options. These will be dealt with in turn.

Rename your session

You may rename your session as follows. Selecting Session 2 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 click on OK and you will return to the 'Start Recording' screen.

Use of the keyboard is described in further detail in Chapter 9, under 'Changing text'.

Start recording (erase old files)

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

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

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

Now [START RECORDING] has been replaced by [STOP RECORDING] . Your PM1000 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 analyser 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.

Click on [Start (KEEP OLD SESSIONS)] and the analyser will immediately start recording. All previous files will remain. The PM1000 will take you straight back to the Main Menu and show [STOP RECORDING] and [Power Off].
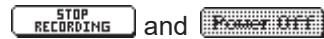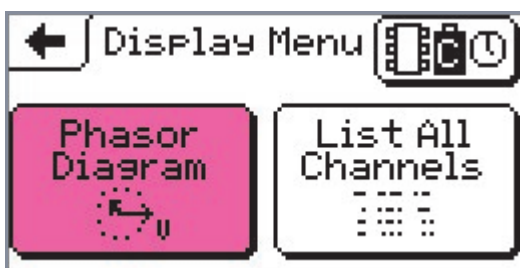
Display Results

Before or while the analyser 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.

Select [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

Select [Phasor Diagram] to produce the Phasor Diagram screen.
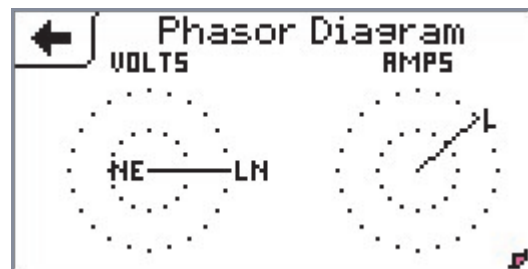
In this case the current is seriously lagging the voltage. Perhaps power factor correction has been applied and the motor that is being corrected is not in operation.

In the right hand bottom corner of this screen is a 'page turn' symbol. This indicates that there are

further linked screens. If you click on the screen anywhere, a new screen will come up.

This screen shows what is happening to the voltage and current.

As indicated by the 'page turn' symbol ⟳ , by clicking 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 select Display . The Display Menu will come up.

Click on and bring up the List Channels screen.

In this example there are nine 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. Click anywhere again and the large numbers for channel 1 revert back to the list of channels. Now click on the lower half of the screen. You might expect that channel 7 would enlarge but the first result is a movement of the scroll arrows into the lower screen. A second click produces an enlarged Channel 7 reading as seen below.

Scrolling down selects the next channel, Channel 8.

Scrolling down again selects Channel 9.

Clicking anywhere on the upper screen returns the scroll arrows to the top screen. See the screen below. Clicking 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.
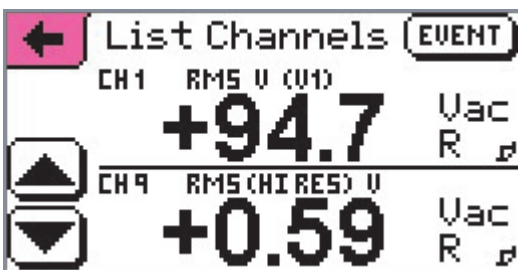
Note the R's. This analyser is in Recording Mode. The 'help' message below indicates that by clicking on EVENT you can add an event marker to your recording at that precise moment. It will appear in Pronto on every channel if you choose to display it.

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 analyser'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 chronological order. The most recent file, in this case Session 3, is at the bottom. Use the scroll arrows (highlighted) to scroll up and down your list.

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

This screen confirms that all your files have been selected and reminds you of the number of sessions currently retained in the analyser's memory. You have

two options here. You may Delete them all or Review them all.

Delete all your stored files

Click on Delete. The analyser will take you back to the previous screen.

Now click any part of the screen, except UNDODEL 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

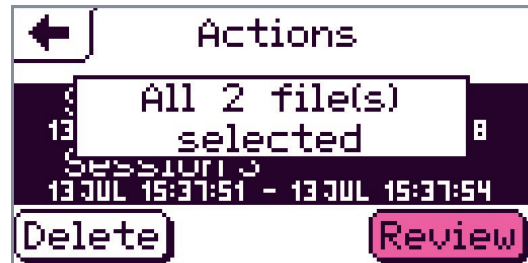have second thoughts click on UNDODEL and the next screen will come up.

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

Review all your files
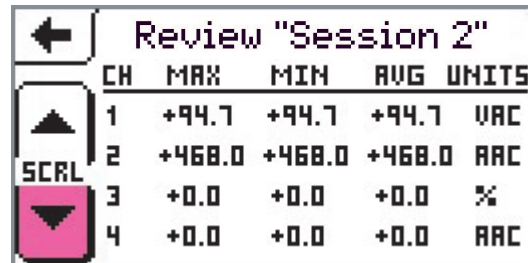
Click on Select All .

Touch Review to bring up a 'Review Session' screen.
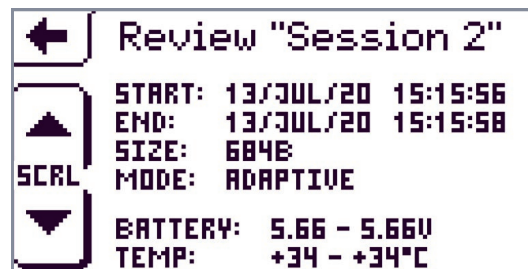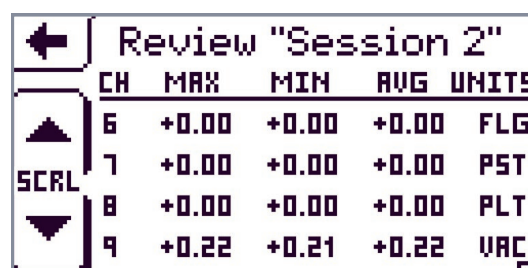
Scroll up or down to find the session you would like to review. Then 'turn the page' by clicking on ♫ to bring up one other 'Review' screen.

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 3"'
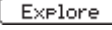
Turn the page (↵) by pressing anywhere and again a second review screen will come up.
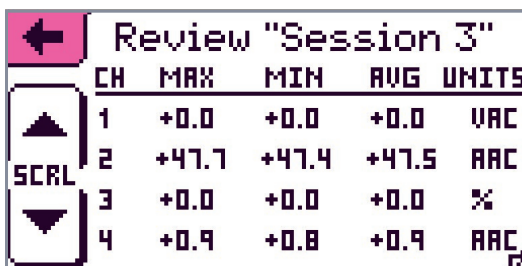
When you have reviewed all your files click on ◀┘ to return to the 'Actions' screen and on this screen click on ◀┘ to get back to the Main Menu once more.

Delete and review a single file

Again click on ⌷Explore⌷ and return to the first 'Sessions Explorer' screen.

Touch 'Session 2' 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 select ⌷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 9, in the section 'Changing text'.

Example: 'Session 2 will be renamed 'Session abc'. Click on ⌷BSP⌷, then 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 analyser when you select it. This also happens automatically when a time interval of four minutes elapses since your last selection on the screen.

However, if your PM1000 is recording you will not be allowed to turn off the power. See below how the screen will look if the PM1000 is recording. The Power Off button is shaded and unresponsive.

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

Click on ⌷Power Off⌷. Your analyser will close down. It enters a state akin to suspended animation. The display shuts off. The internal batteries will keep you're your unit responsive for at least two months depending on their charge at the time of shut down and the

number of channels in use. Your data and configurations will still be saved even if the batteries do go flat.

Outram

Chapter 11: Troubleshooting
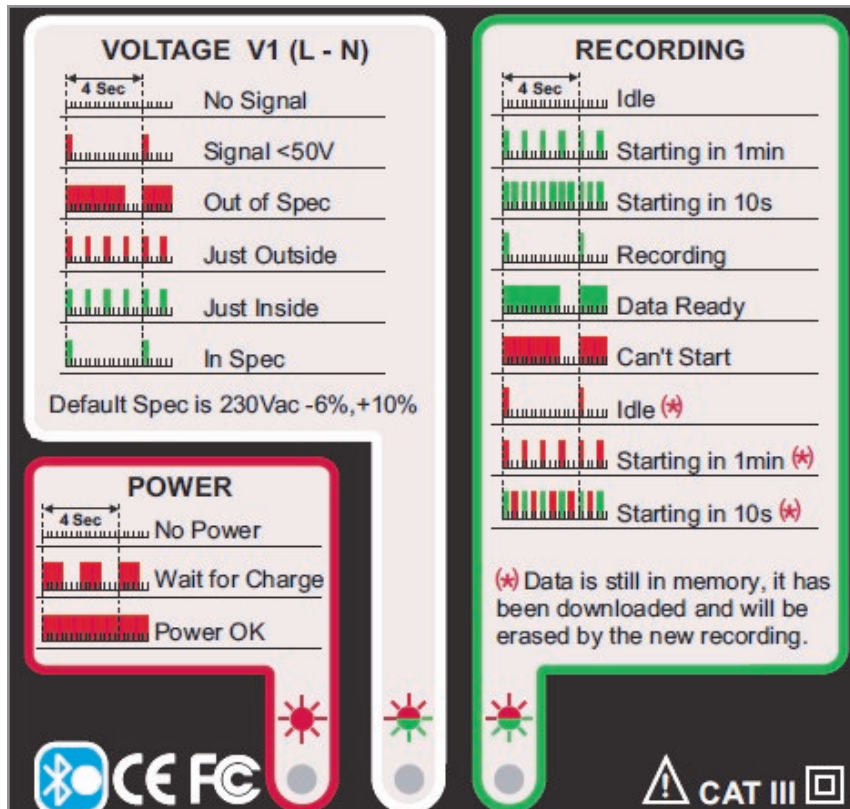
Status LEDs on the PM1000

Ranger

Contents

Introduction

Below are troubleshooting charts. We hope you will find these useful should you have any difficulty getting your PM1000 to perform in the way you would wish and expect.

Lack Of Communication

This may be because the unit has not woken up, or there may be a communications block. We deal with failure to wake up first:

Failure to wake up

Symptom	Checkpoint	Yes/No	Explanation / Remedy
No response to computer when Pronto or PMScreen running	Is power applied?		
If yes	Is the little red power LED flashing (extreme left viewed from underneath)	Yes	Low battery charge. It hasn't yet woken up properly. 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.
		No, it is off	Power is not being received. Check mains connections.
		No, it is on	Power is being received. See Communications problems below.
If no	Is there any LED activity?	Yes	Unit is awake. See Communications problems below.
		No	Battery charge level may be too low to permit waking up, or see Communications problems below.

Communications problems

This is probably the easiest and most likely source of frustration. Many things under the *User's* control have to be right to ensure proper operation. Here is a list of things to consider.

Note that the serial interface is not switched on all the time, as when recording in a meter cabinet etc., its not necessary. Therefore there is a preliminary "wake-up serial interface" process which must precede normal communications. Both Pronto and PMScreen

automatically invoke this process so the user is normally unaware that it occurs. However it is not sent continuously once normal communications are established, so if communications are *interrupted*, there may be a delay of up to one minute before the retry processes try again.

Assuming the unit has adequate power and could, if physical arrangements and set up were all correct, talk to the computer, reasons for failure are:

Communications problems continued

Reason	Remedy
No cable, or cable not connected at PC or PM1000 end	Connect sound cable
Wrong Baud Rate	Choose 115.2KBd at the PC and leave the PM1000 baud rate set to 115.2kBd Pronto: Under Logger/Playback/Edit set Baud rate and de-select "Use Network Address". PMScreen: Under Connect/Configure/ set Baud rate PMPortMonitor: Select 115200 in the Baud Rate options
Wrong .COM port on the PC	Select correct .COM port Pronto: Under Logger/Playback/Edit set COM port. PMScreen: Under Connect/Configure/ set COM port. If the option is "greyed out", close the port first (Connect/Close) PMPortMonitor: Select the available COM port option found by the utility
Wrong PM1000 slave address	The PM1000 is MODBUS compatible, and hence "network" aware. It is not normally necessary to change network addresses, since this is done automatically by the PC. If you close and restart Pronto and/or PMScreen, either will use a "Discovery" procedure to find new units to talk to.

Will Not Record

Symptom (Will not record)	Checkpoint		
The Record/Memory LED flashes anything EXCEPT one short green flash every four seconds (which would indicate recording).	If LEDs are on (or flashing), and this still applies after 1 minute, it means there is a specific reason for NOT recording. Has 'Delayed Start' recording been cancelled through Pronto or PMScreen?	Yes	Start recording in either Pronto or PMScreen, or remove power completely, and power up again. (The act of re-powering re-sets the default "I will try to record", so when voltage is consistently present, it will start after 1 minute.
	Is power present?	No	Recording won't start unless told to through Pronto or PMScreen.
		Yes	Recording SHOULD start as described above in no more than 1 min, BUT
	Has previously recorded data been downloaded?	No	This is the one condition which prevents automatic recording. Previously recorded data MUST be either read or deleted from the PM1000 in order to release it to start recording automatically. However, if there is enough memory in your PM1000 Mk2, you can start the recording again manually without either downloading or deleting the data.
		Yes	It is likely that either the input voltage is not consistent, or the "User is in control". Start recording in either Pronto or PMScreen, or remove power completely, and power up again.

Flashing angry red LEDs

"Flashing Angry" is used to describe the state of the
LEDs when they are on for 3 seconds out of 4. Only
when they are Angry **RED** is there a real problem.

If it's the Voltage LED flashing –the middle one – it
means the voltage is more than 1 volt outside the
threshold.
If it's the Recording/Memory LED, this indicates that
the unit is TRYING to record, but previously recorded
data is present and has not been downloaded. Data
must be downloaded or deleted.

Miscellaneous

Symptom (Miscellaneous)	Checkpoint		Explanation /Remedy
Your logger measures the voltage present but does not charge the batteries. (There is no flashing C). It shuts down after a few minutes.			One of the fuses has gone. Check the mains input fuse.
	The fuse is intact	Yes	Contact your distributor or representative.
The screen is not displaying correct data.			Check connections Check your Set Ups, particularly Maths Functions.

Appendices

Interval Store:
3 sec. avg. recordings obtained by other top of the range analysers adhering to the most rigorous standard IEC61000-4-30.

PM7000 Adaptive Store:
Consistently gives much greater visibility, even without setting thresholds, enabling quick resolution of the problem.

	Maximum	Minimum	Average
Vac RMS of Van	123.7	120.4	122.5
Average of Vac RMS of Van	123.5	121.8	122.5

Graph Depicting Benefits of Single Cycle Adaptive Store^{TM}

Contents

Appendix A: Maths Functions

The functions available in the PM1000 are arranged in groups. There are five groups and an "Unspecified" assignment. These are listed below:

Groups

- Unspecified
- AC 1 Phase
- Harmonics
- Basic Maths 1
- Basic Maths 2
- Basic Maths 3

The "Unspecified" category is 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
- RMS High Resolution
- Real Power
- Volts Amps Reactive (VAR)
- Apparent Power
- Displacement Power Factor
- Real Power Factor
- Phase Angle
- Frequency
- Real Impedance
- Reactive Impedance

Harmonics

- Total Harmonic Distortion (with reference to the Fundamental)
- Total Harmonic Value

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^{TM} 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.

Adaptive Store example -Single Cycle detail when something interesting occurs
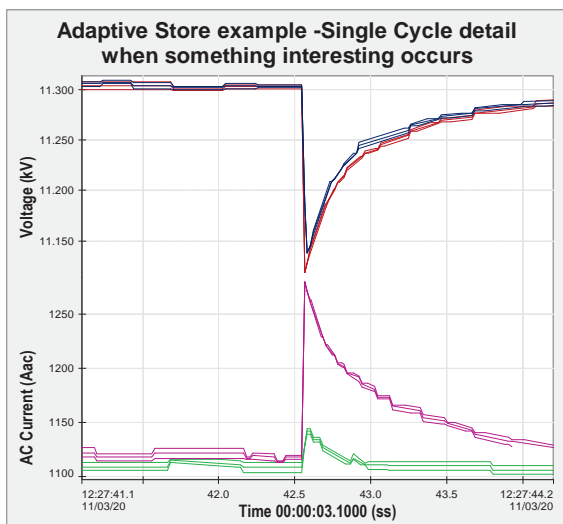
Introduction

The patented Single Cycle Adaptive Storage used in the PM1000 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 PM1000, there is a way of improving on the regular sample and store process, "Single Cycle Adaptive Store^{TM}".

Single Cycle Adaptive Store^{TM}

Single Cycle Adaptive Store^{TM} 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 PM1000 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 ⎤ Basic statistics
- Amount of store available ⎦

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 PM1000 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.
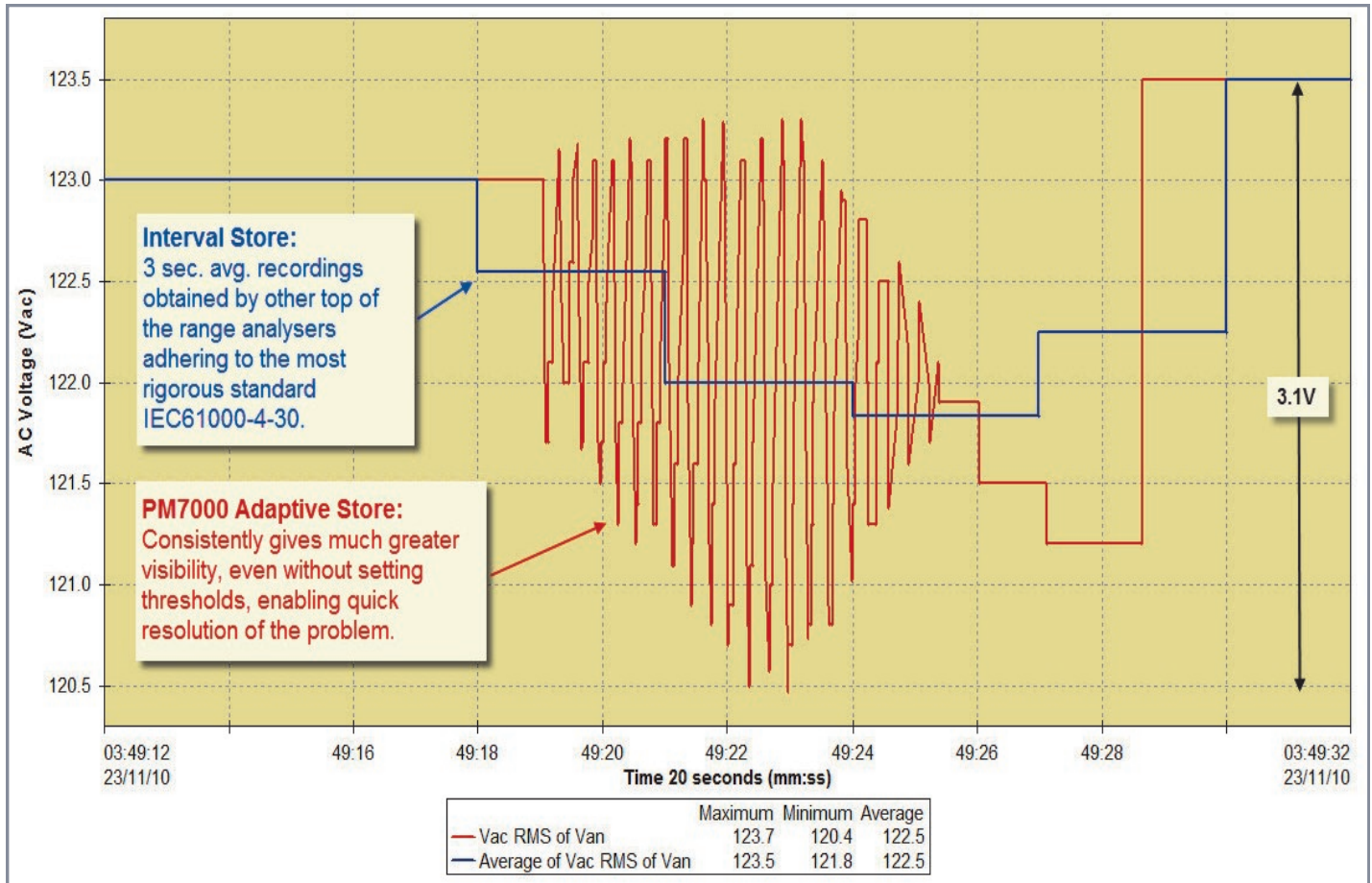
The PM1000 caters for the UNPREDICTABILITY of future signal activity by employing multiple predictive mechanisms, against which all samples are tested as they are received. Though they are all loosely based on past history, some of those predictions are worse than others, and the poor ones are discarded.

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

The graph on the next page compares actual results of Adaptive and Point Store.

An Example of Adaptive Store vs Point (Interval) Store

Interval Store:
3 sec. avg. recordings obtained by other top of the range analysers adhering to the most rigorous standard IEC61000-4-30.

PM7000 Adaptive Store:
Consistently gives much greater visibility, even without setting thresholds, enabling quick resolution of the problem.

	Maximum	Minimum	Average
Vac RMS of Van	123.7	120.4	122.5
Average of Vac RMS of Van	123.5	121.8	122.5

You can see that the adaptive process is much better at catching anomalies by comparing the two lines on the graph.

The oscillations seen here are on the RMS voltage, they are not waveforms. The spread is over around 2.7V, so would very unlikely be caught by inputting a particular threshold on a standard analyser.

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: Factory Configurations

Configurations 1 - 13 are for recordings in Adaptive store with FIFO Off. Length of recording is specified. From June 2020 these are the configurations found pre-configured in your PM1000 Mk2 unless specified otherwise by your distributor.

NAME	1ø Full PQ 14day	1ø Full PQ 7day (Default)	1ø Power 7day	1ø V Flicker 7day
Signal (Name and Full Scale)				
Vln	Vln 300.0V	Vln 300.0V	Vln 300.0V	Vln 300.0V
Il	Il 1000.0A	Il 1000.0A	Il 1000.0A	Il 1000.0A
Vne	Vne 300.0V	Vne 300.0V	Vne 300.0V	Vne 300.0V
Time Scale	14 days	7 days	7 days	7 days
Channel				
1	RMS Vln	RMS Vln	RMS Vln	RMS Vln
2	RMS Il	RMS Il	RMS Il	FLKR sensation Vln
3	THD Vln (Harmonics %)	THD Vln (Harmonics %)	Real Power	FLKR flag Vln
4	HMNCS Il (Harmonics Value)	HMNCS Il (Harmonics Value)	Reactive Power	FLKR st Vln (10 mins)
5	FLKR sensation Vln	FLKR sensation Vln	Apparent Power	FLKR lt Vln (2 hrs)
6	FLKR flag Vln	FLKR flag Vln	Displacement power Factor	
7	FLKR st Vln (10 mins)	FLKR st Vln (10 mins)	Real Power Factor	
8	FLKR lt Vln (2 hrs)	FLKR lt Vln (2 hrs)		
9	RMS Vne (Hi resolution)	RMS Vne (Hi resolution)		
10	AC Frequency	AC Frequency		
11-16				

Factory Configurations cont.

Configurations 1 - 13 are for recordings in Adaptive store with FIFO Off. Length of recording is specified.

NAME	1ø V I 7day	1ø V I Flicker 7day	1ø V I Hmncs 7day	1ø V I Hmncs Flkr 7day
Signal (Name and Full Scale)				
Vln	Vln 300.0V	Vln 300.0V	Vln 300.0V	Vln 300.0V
Il	Il 1000.0A	Il 1000.0A	Il 1000.0A	Il 1000.0A
Vne	Vne 300.0V	Vne 300.0V	Vne 300.0V	Vne 300.0V
Time Scale	14 days	7 days	7 days	7 days
Channel				
1	RMS Vln	RMS Vln	RMS Vln	RMS Vln
2	RMS Il	RMS Il	RMS Il	RMS Il
3		FLKR sensation Vln	THD Vln (Harmonics %)	THD Vln (Harmonics %)
4		FLKR flag Vln	HMNCS Il (Harmonics Value)	HMNCS Il (Harmonics Value)
5		FLKR st Vln (10 mins)		FLKR sensation Vln
6		FLKR lt Vln (2 hrs)		FLKR flag Vln
7				FLKR st Vln (10 mins)
8				FLKR lt Vln (2 hrs)
9-16				

Factory Configurations cont.

Configurations 1 - 13 are for recordings in Adaptive store with FIFO Off. Length of recording is specified.

NAME	1ø V I Pwr 7day	1ø V I Pwr Hmncs 7day	1ø V I Vne 7day	1ø V only 7day
Signal (Name and Full Scale)				
Vln	Vln 300.0V	Vln 300.0V	Vln 300.0V	Vln 300.0V
Il	Il 1000.0A	Il 1000.0A	Il 1000.0A	Il 1000.0A
Vne	Vne 300.0V	Vne 300.0V	Vne 300.0V	Vne 300.0V
Time Scale	14 days	7 days	7 days	7 days
Channel				
1	RMS Vln	RMS Vln	RMS Vln	RMS Vln
2	RMS Il	RMS Il	RMS Il	
3	Real Power	Real Power	RMS Vne	
4	Reactive Power	Reactive Power		
5	Apparent Power	Apparent Power		
6	Real Power Factor	Real Power Factor		
7		THD Vln (Harmonics %)		
8		HMNCS Il (Harmonics Value)		
9-16				

Factory Configurations cont.

Configurations 1 - 13 are for recordings in Adaptive store with FIFO Off. Length of recording is specified.

Special configuration for Test purposes. Recording in Adaptive Store for 3 days, FIFO Off.

NAME	1ø V THD 7day
Signal (Name and Full Scale)	
Vln	Vln 300.0V
Il	Il 1000.0A
Vne	Vne 300.0V
Time Scale	7 days
Channel	
1	RMS Vln
2	THD Vln (Harmonics %)
3	
4	
5	
6	
7	
8	
9-16	

NAME	F Test config #1
Signal (Name and Full Scale)	
Vln	Vln 300.0V
Il	Il 1000.0A
Vne	Vne 300.0V
Time Scale	7 days
Channel	
1	RMS Vln
2	RMS Il
3	RMS Vne
4	THD Vln (Harmonics %)
5	HMNCS Il (Harmonics Value)
6	THD Vne (Harmonics %)
7	AC Frequency
8	Internal Temperature
9	On Charge
10	Battery Volts
11-16	

Appendix D: The Safety Graphics Symbols

Graphic Symbols used on the PM1000 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	3∿		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